Sustainable housing – Addressing SCP in the housing sector

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Acknowledgement

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List of abbreviations

BEE	Bureau of Energy Efficiency
BIM	Building Information Modelling
BREEAM	Building Research Establishment Environmental Assessment Methodology
C&D	Construction and demolition
CDW	Construction and demolition waste
COP	Conference of the Parties
EBRD	European Bank for Reconstruction and Development
EE	Energy efficiency
EnEV	Energy saving ordinance
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracting
ESCO	Energy Service Company
GBI	Green Building Index Malaysia
GDP	Gross domestic product
GHG	Greenhouse gas emissions
Global ABC	Global Alliance for Buildings and Construction
IBS	Industrialised Building Systems
IEA	International Energy Agency
KyrSEFF+	Kyrgyzstan Sustainable Energy Efficiency Financing Facility
LEED	Leadership in Energy and Environmental Design
MDGs	Millennium Development Goals
MEPS	Minimum Energy Performance Standards
MSMEs	Micros, small and medium-sized enterprises
NDCs	Nationally Determined Contributions
NUA	New Urban Agenda
RE	Renewable Energy
SCP	Sustainable consumption and production
SCPF	Switch-Asia Sustainable Consumption and Production Facility
SDGs	Sustainable Development Goals
TREES	Thai's Rating of Energy and Environmental Sustainability
UNEP	United Nations Environnent Programme
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization

1 Context

1.1 Objective of the study

The EU-funded SWITCH-Asia programme was launched in 2007 to support sustainable consumption and production (SCP) and to promote inclusive sustainable growth while contributing to the economic prosperity and poverty reduction in Asia and Central Asia and supporting the development of a green economy and the transition towards a low-carbon, resource-efficient and circular economy. Since its inception, seven calls for proposals were successfully implemented from 2007 to 2017 (in total around EUR 280 million). More than 100 projects were financed, and support was provided to over 400 Asian and European non-for-profit partners, approximately 100 private sector associates and benefiting up to 70,000 Asian micros, small and medium-sized enterprises (MSMEs). The second phase of SWITCH Asia was launched in 2018 and the programme was extended to Central Asia, thus now covering 24 countries (i.e. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka, Cambodia, China, DPR Korea, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, Vietnam, Mongolia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan).

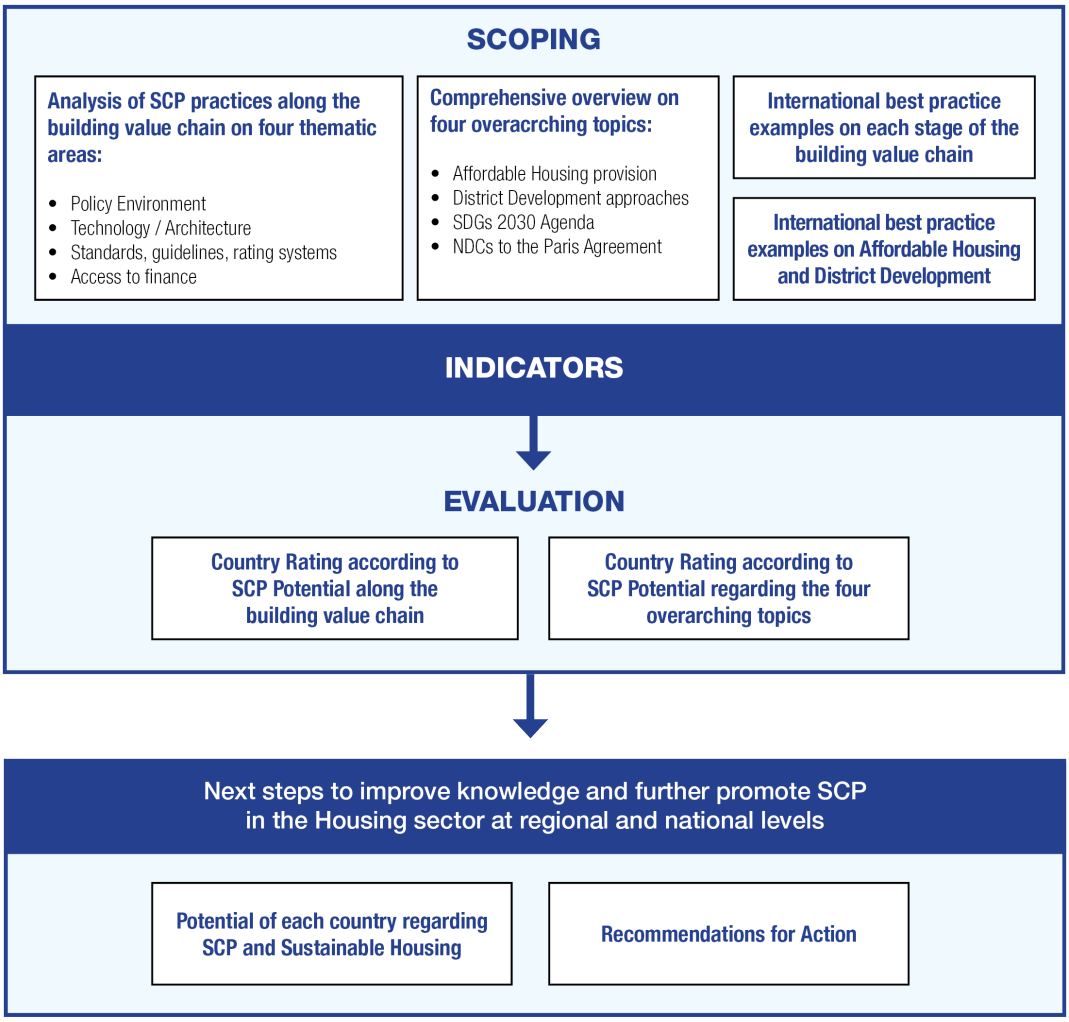
In this context, the SWITCH-Asia Sustainable Consumption and Production Facility (SCPF) aims at providing a platform to promote SCP policies and principles in Asia and enhance the awareness and dialogue of local stakeholders on the theme. To achieve these goals, the SCPF fosters dynamic and evolving exchange through platforms with the aim to connect key experts, entities and stakeholders, both online and offline, who share the interest for impactful actions to further enable sustainable housing, a top priority for Asia and Asian countries, through relevant responsible consumption and production patterns. Such a platform should enable participants to discuss ideas and lessons learned and consequently, to identify and develop joint actions.

This scoping study aims to provide a solid basis and to identify the thematic scope for the identification of top priorities and related actions in support to Sustainable Housing. For this purpose, the study first examines the different stages of the building value chain and critical issues, trends and gaps on the development of sustainable housing in the context of SCP in the focal countries of China, India, Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka and Thailand. Based on an initial in-depth assessment conducted by the SCPF on country sector focus and priorities, these ten countries have been selected. By going through the stages of material production, design and manufacturing, construction, usage and recycling, this study provides a holistic overview of SCP in sustainable housing in Asian countries, followed by an assessment of overarching topics underpinning the theme, i.e. affordable housing, district development and the countries' building and sustainable housing objectives within the Nationally Determined Contributions (NDCs) to the Paris Agreement and the UN Sustainable Development 2030 Agenda. In addition to the ten focal countries that are addressed in the in-depth analysis, the scoping study also includes research on other SWITCH-Asia countries, namely Afghanistan, Bangladesh, Bhutan, Cambodia, Indonesia, Laos, Maldives, Myanmar, Philippines, Tajikistan, Turkmenistan, Uzbekistan and Vietnam. The results are presented in the form of country briefs that summarise the main aspects of sustainable housing in the context of SCP in each country. Last within the scoping part of the study, a selection of international best practices suitable for replication in the Asian context is provided.

Based on the information collected in the scoping phase, the SCP potential of the focal countries is analysed using a set of indicators in the second part of this study (see figure 1 for a schematic overview). The indicators take into consideration the different stages of the building value chain as well as the overarching topics. As SCP has not received much attention in the field of housing, this evaluation offers crucial insights regarding the differences and similarities of SCP approaches pursued in the Asian context.

With the help of the comprehensive analysis performed in the scoping and evaluation part of this study, interesting conclusions on the current situation as well as recommendations for critical issues that require joint action to encourage sustainable development can be drawn. The findings from the study will be used both as a basis for future discussion and actions for promoting SCP for sustainable housing and as knowledge products for the general public.

Figure 1: Structure of the scoping study – Schematic overview



1.2 Definition of sustainable housing

In order to be able to discuss sustainability in the context of housing, first, the term "sustainable development" is defined. Today's widely used definition for sustainable development dates back to the Brundtland report from 1987 and is described as follows:

> *"**Sustainable development** is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987, p. 41)*

In 2018, 4.2 billion people, i.e. 55% of the world's population, lived in cities. By 2050, this number is expected to rise up to 6.5 billion people, with 90% of the urban expansion taking place in the developing world (UNDP 2019a). The rapid growth of cities and the range of economic, environmental and social challenges associated with it demonstrate the importance of rethinking and transforming the way urban spaces are built and managed in order to achieve sustainable development. Sustainable (urban) development can be understood as a multidimensional process harmonising environmental, economic, social and cultural dimensions (UN-Habitat 2012). Hence, by fostering sustainable urban development, cities enable conditions for job creation, economic growth, social inclusion, poverty reduction, protection of local and regional ecosystems, climate change mitigation, etc.

In this context, housing and housing policies play a very important role, as they shape cities worldwide and, in many cases, produce fragmentation, inequalities, and environmental impacts. The future of urbanisation will therefore depend on how countries and cities position housing as a priority in the public debate around sustainable development (Kacyira 2016). Different facets come into play when discussing "sustainable housing":

> *"Housing as an essential component of the built environment, a constituent of social development, an important economic sector and an entity that uses natural resources (including labour power) and produces energy and waste, its development certainly affects the **ecological, economic, social and cultural sustainability** of a place." (Chiu 2003, p. 224)*

Until now, the debate on sustainable housing mainly centred on the ecological and economic component. UN-Habitat stresses the importance to also consider the social and cultural sustainability of housing:

> *"Housing is where successive generations find shelter to keep healthy, develop, socialise, be educated and prepare for fulfilling adult lives. In this sense, **housing speaks to every dimension of personal human development**, hopefully generating a double sense of identity and social belonging. Both are essential to sustainable cities and their participatory governance. If the "emerging futures" of our cities are to become sustainable, then the housing conditions of one billion slum residents must become sustainable, too." (UN-Habitat 2016, p. 52)*

To address key challenges related to urbanisation, climate change, affordable housing, clean energy and poverty reduction, sustainable housing shall combine all four sustainability dimensions (i.e. environmental, social, cultural and economic) and thus, pursue a more holistic approach:

> *"Along with the solutions for the **built environment** (resource and energy efficiency, environmental, ecological and health safety, resilience to natural disasters), sustainable housing policies should deal with the **affordability, social justice, cultural and economic impacts of housing**, and contribute to making **healthy residential neighbourhoods and sustainable cities**." (UN-Habitat 2012, p. 1)*

1.3 Relevance of sustainable housing

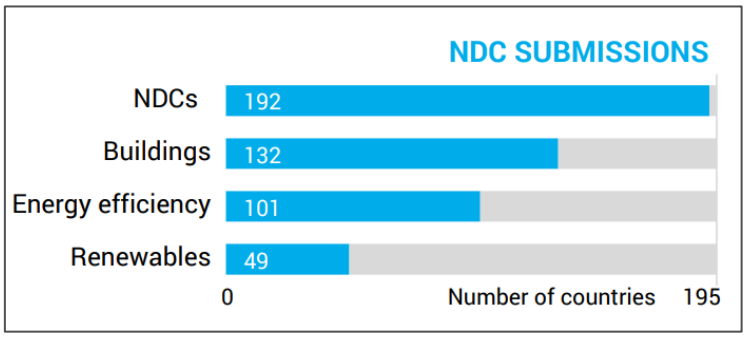
1.3.1 Sustainable housing in the context of the global agenda setting processes

Subsequent to the Agenda 21 and the Millennium Development Goals (MDGs) of the United Nations, key international policies, i.e. the **Sustainable Development Goals (SDGs), the Paris Agreement and the New Urban Agenda (NUA)** have been recently introduced to encourage sustainable development in different priority areas.

Adopted on 25 September 2015, the 2030 Agenda for Sustainable Development specifies 17 SDGs that shall be achieved during the next 15 years. Goal 11 "Sustainable cities and communities" focuses on urban systems and aims to *"make cities and human settlements inclusive, safe, resilient and sustainable"* (UNDP 2018a). A sub-target specifically addresses housing, namely its safety, affordability and provision of basic services for all as well as slum upgrades by 2030 (UNDP 2018b). Besides Goal 11, other SDGs such as Goal 6 "Clean water", Goal 7 "Affordable and clean energy" or Goal 12 "Sustainable consumption and production patterns" are also relevant for sustainable housing.

Following the SDGs, the Paris Agreement was agreed at the 21st Conference of the Parties (COP) in December 2015, aiming to combat climate change and limit the increase of the global average temperature. In order to implement the agreement and achieve its objectives, each country is requested to prepare the NDCs (UNFCCC 2019). The building sector plays a key role due to its significant but largely unrealised potential (see section 1.3.2). As depicted in figure 2, out of 192 countries that have submitted NDCs, 132 have explicitly mentioned the building sector. Nevertheless, concrete policy actions, targets, and measures to reach these ambitions are lacking in most submissions. Several key areas including space cooling, building design, and vertical integration are particularly under-addressed. Energy building codes which are a crucial measure for the transition towards green buildings are only mentioned in 40 NDCs. Consequently, solely 13% of global CO_2 emissions stemming from the building sector are covered in the NDCs (UNEP and IEA 2017).

Figure 2: Overview of NDC submissions related to sustainable housing (UNEP and IEA 2017)

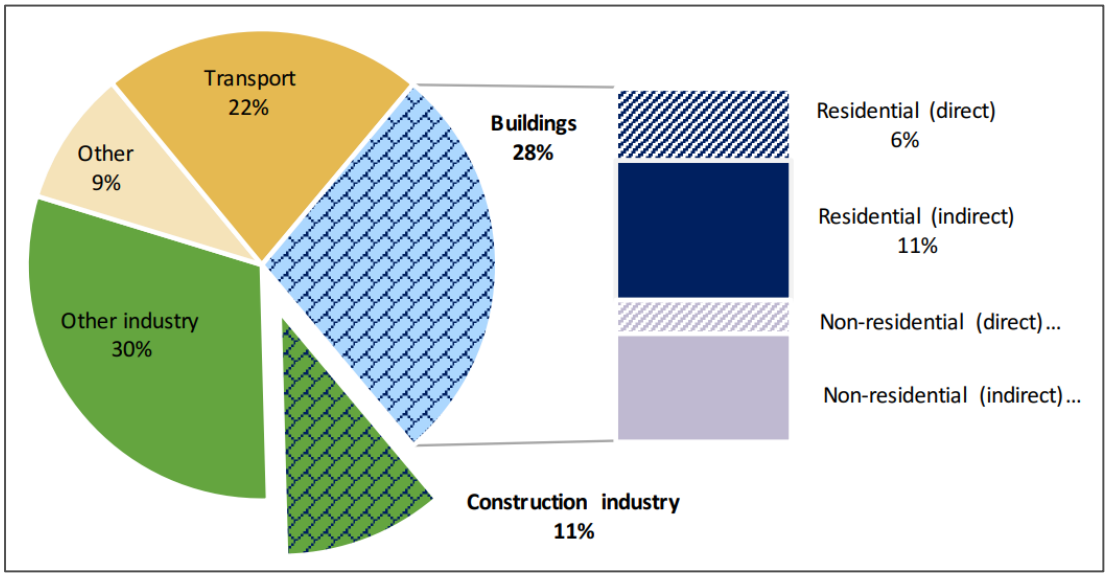


In October 2016, the NUA was adopted in the course of HABITAT III, in order to provide a sustainable urbanisation strategy and action plan for the next 20 years. As housing was not considered as a priority in the urban development policy of many countries in the past, UN-Habitat aimed to place "housing at the centre of the New Urban Agenda" (UN-Habitat 2015). Goal 11, as well as other SDGs related to housing, have been translated into commitments and actions for key stakeholders. Nevertheless, as in the case of the SDGs and Paris Agreement, the NUA is not legally binding and a concrete roadmap for achieving the goals is missing (Amann & Jurasszovich 2017).

1.3.2 Potential of the housing sector to achieve greenhouse gas (GHG) and energy savings

Globally, the buildings sector is responsible for 30% of final energy consumption. It is the second largest consumer after the industrial sector which consumes 40% energy. The residential sector plays a key role as it consumes the major share of final energy with 22%. Together with the buildings construction, final energy use of the global buildings sector exceeds more than 35% and continues to rise at almost three per cent per year. Better access to energy in developing and emerging economies increased ownership and usage of appliances as well as immense floor area additions contribute to this trend (OECD & IEA 2018). Moreover, buildings and their construction generate almost 40% of total direct (from fossil fuel combustion) and indirect CO_2 emissions, as depicted in Figure 3. From 2010 until 2016, CO_2 emissions from buildings have continuously grown by one per cent annually (UN Environment & IEA 2017).

Figure 3: Global energy-related CO_2 emissions by sector, 2015 (IEA 2017)



This development is expected to continue, especially in Non-OECD Asia with a projected growth in building energy demand of over 50% by 2050 (OECD & IEA 2015). The building sector, particularly the residential sector has not only the pressing need but also the immense potential to lower energy consumption and GHG emissions, thereby developing more sustainably. In order to tap this potential and shape the fast-growing building sector sustainably, adequate financing schemes and policies as well as efficient technologies have to be deployed urgently (UNEP & IEA 2017).

1.3.3 Sustainable housing in the context of SCP

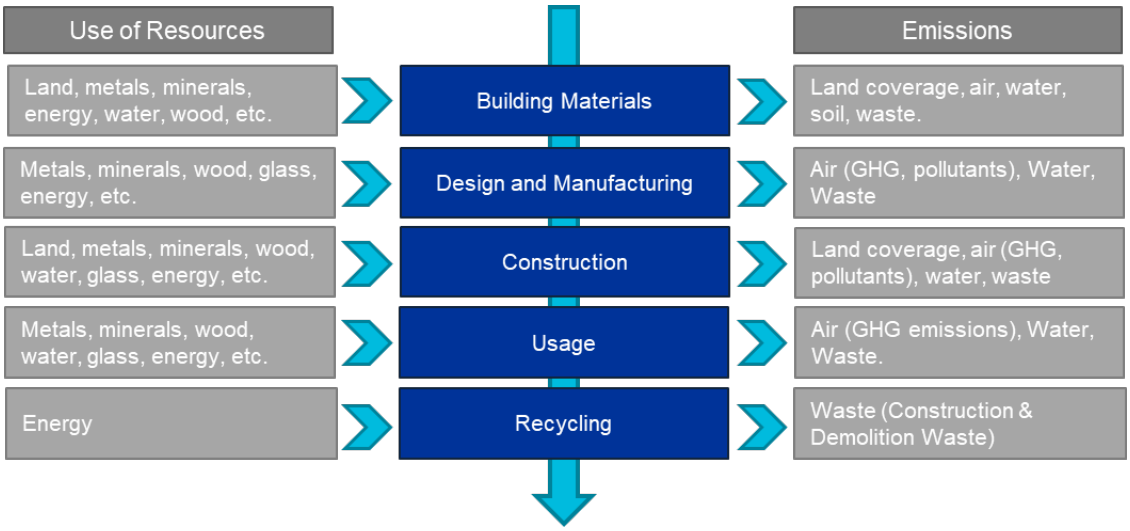
The importance of SCP was first recognised internationally at the 1992 United Nations Conference of Environment and Development in Rio de Janeiro (UNCED 1992). The concept of SCP was later defined by the Oslo Symposium in 1994 as “the use of services and related products, which respond to basic needs and bring a better quality of life while minimising the use of natural resources and toxic materials, as well as the emissions of waste and pollutants over the life cycle of the service or product so as to not jeopardise the needs of further generations.” (ISSD 1994)

Later, at the World Summit on Sustainable Development (WSSD 2002), world leaders signed the Johannesburg Plan of Implementation, in which SCP has been identified as one of the three overarching

objectives of sustainable development, together with poverty eradication and the management of natural resources to advance social and economic development. The Johannesburg Declaration also called for the development of a 10-Year Framework of Programmes (10YFP) to accelerate the shift towards SCP practices and promote social and economic development decoupled from environmental degradation. To implement the commitment of the 10YFP, which was adopted at Rio+20, the One Planet network (previously the 10YFP Secretariat) has been formed as a multi-stakeholder partnership for sustainable development and an implementation mechanism for SDG 12 on Responsible Consumption and Production (One Planet 2019a). The 10YFP consists of six programmes: Sustainable Public Procurement; Consumer Information for SCP; Sustainable Tourism; Sustainable Lifestyles and Education; Sustainable Buildings and Construction; and Sustainable Food Systems (UN Environment 2019). The Sustainable Buildings and Construction Programme (SBC) aims at improving the knowledge on sustainable construction and supporting and mainstreaming sustainable building solutions, allowing for all major activities in the field to be brought together under network's umbrella. The goals of the programme are operationalised through five concrete work areas: (i) Fostering of enabling frameworks to implement policies on sustainable construction; (ii) Promotion of sustainable housing, including in the field of affordable and sustainable housing; (iii) Enhancement of sustainability in the Building Supply Chain; (iv) Reduction of climate impacts and strengthening of climate resilience in the building sector; and (v) Promotion of knowledge sharing, outreach and awareness raising (One Planet 2019b).

Research on consumption patterns and life cycle analysis detected three key areas where consumption has the highest impact on the environment, i.e. food, housing and transport (UNEP 2015). In these sectors, the consumption of water and energy, the generation of waste and the GHG emissions of these activities affect and are affected by almost every lifestyle domain. Within the context of SCP, housing thus plays a critical role as part of a production system that represents considerable use of resources and major environmental consequences. How people live, where they live and how their living spaces are built all have social and environmental effects, beginning at mining, with the extraction of raw materials for the production of building materials, and ending with the demolition of the building at the final life cycle stage. Along this life cycle, different processes are responsible for emitting GHGs and pollutants into the atmosphere. Figure 4 presents important impacts of housing on the environment in terms of use of resources and emissions in the different stages of the building life cycle. The left column in the figure presents the different resources required for housing, such as raw materials, energy, land and water, and the column on the right shows the emissions resulting from the different stages of the building life cycle. The different processes involved in these stages cause different kinds of emissions, such as the pollution of air, water or soil; the alterations on land coverage and the generation of waste.

Figure 4: Housing and its impacts on the environment (adapted from UNEP 2015)

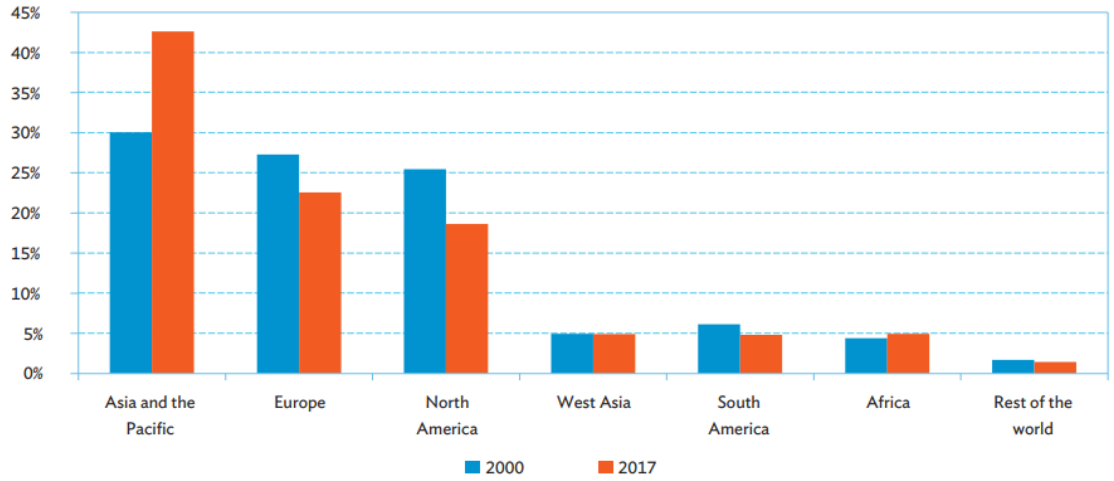


2 Current state and trends of sustainable housing in the context of SCP in Asia

2.1 Relevance of sustainable housing in Asia

Over the last decades, Asia has been through a process of robust economic growth, driven especially by countries such as China, India, Japan and South Korea. In 2017, the Asia and Pacific region accounted for 42.6% of the global gross domestic product (GDP), compared to a share of 30.1% in 2000 (see figure 5). During this period, the gross capital formation as a share of GDP has increased in 25 of the 37 regional economies (Asian Development Bank 2018).

Figure 5: Distribution of gross domestic product at purchasing power parity, Asia and Pacific region in the world economy (Asian Development Bank 2018)



Apart from the financial crisis in 1998, Asia has been the fastest growing economic region in the world for several decades: a process that has been underpinned by rapid and large scale urbanisation. Additionally, between 1950-1975 and 1975-2000, Asia's urban population more than doubled. In 2015, 2.38 billion people lived in urban areas, representing 60.1% of the world's urban population. This trend is continuing as the current quarter century (2000-2025) will lead to an estimated addition of 1.1 billion people to Asia's urban areas (UN-Habitat, UN ESCAP 2015). Figure 6 presents the growth of Asia's urban population from 1950 to 2050 compared to other regions.

This remarkable rate of urbanisation is one of the major driving forces influencing consumption and production patterns in Asia. Conservation of resources becomes a key topic, as lifestyles change and consumption patterns become more unsustainable and environmentally-damaging. The regions' material consumption has increased strongly in the last four decades, accounting for more than half of the global consumption in 2015 (UNEP 2016). Figure 7 demonstrates the increase in domestic material consumption until 2015, when consumption per person reached 2.9 tonnes (UNEP 2016).

Figure 6: Urban population at mid-year, 1950-2050, thousands (UN-Habitat, UN ESCAP 2015)

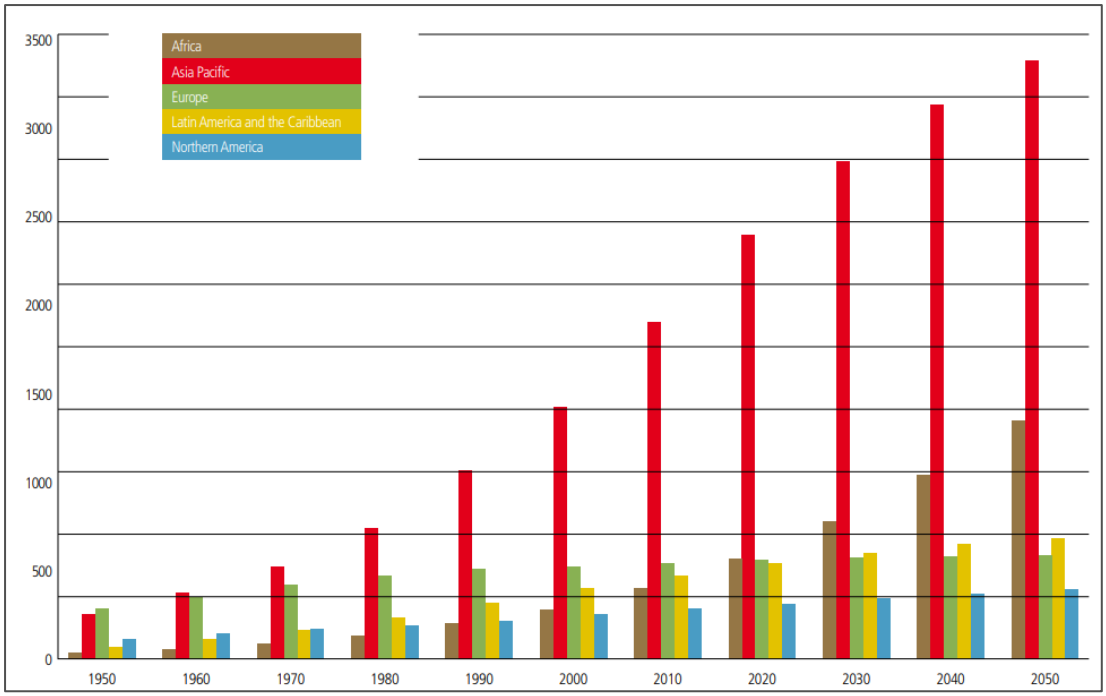
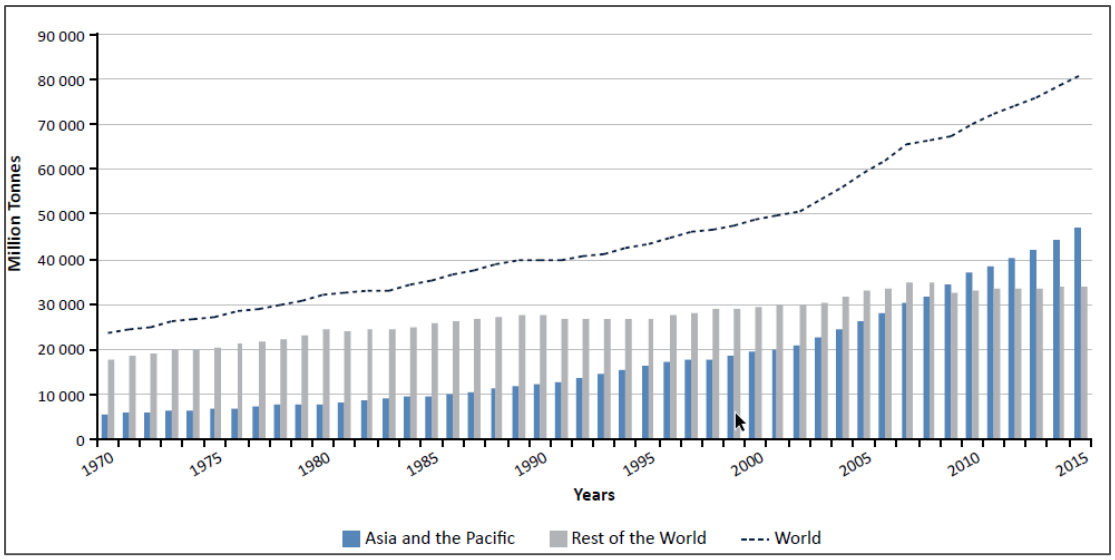


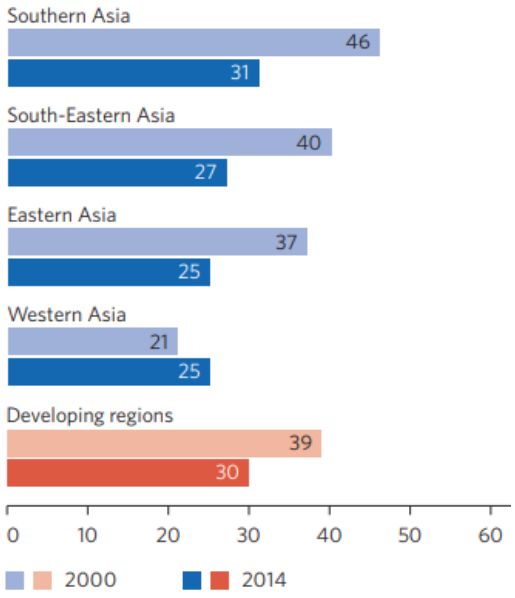
Figure 7: Domestic material consumption of Asia and the Pacific compared to the global consumption, 1970-2015, million tonnes (UNEP 2016)



Despite the many and varied reasons for rapid urban growth, most of the Asian cities face similar challenges to quickly adapt to the rising urban population and to develop adequate solutions for housing, transportation and basic services. According to UN-Habitat, the construction of affordable housing has not matched the urban growth in Asian cities, except for Singapore and Hong Kong (UN-Habitat 2011). What is more, an average of 28% of the urban population resides in informal settlements (UN-Habitat 2015). Although the proportion of urban population living in slums has fallen in most Asian regions in the past decades as depicted in figure 8, informal housing is still prevalent and many challenges remain for the provision of adequate housing. As further economic expansion, population growth, and corresponding

changes in living standards and lifestyles are expected to occur over the upcoming decades, it is crucial to consider the environmental, social, cultural and economic component of housing to ensure sustainable development.

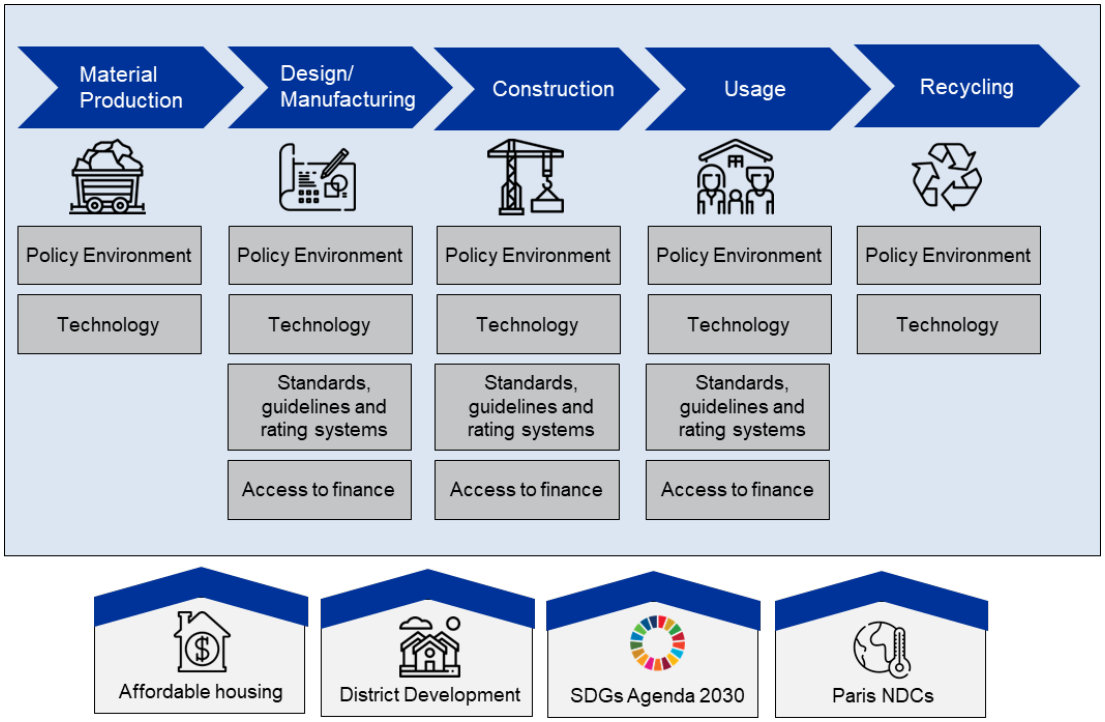
Figure 8: Proportion of the population living in slums, % (adapted from UN 2015)



2.2 Methodological approach of assessment

Due to the high relevance of sustainable housing in the context of SCP in Asia, this study aims to assess the current state and trends in this field. The in-depth assessment in the following chapters has been conducted for China, India, Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka and Thailand. The study focuses on the **analysis of the building life cycle**, identifying trends and priority issues for each stage of the building value chain with a particular focus on: i) Policy environment, ii) Technology and architecture, iii) Standards, guidelines & rating systems and iv) Access to finance. The second part of the study addresses overarching topics that guide and impact the situation of the selected countries on sustainable housing. These topics concern the countries' targets within the scope of the **NDCs and SDGs for the building sector, the national policies for affordable housing and the concepts for district development**. Figure 9 provides a schematic overview of the assessment structure and linkages. Further insights from other SWITCH-Asia countries, i.e. Afghanistan, Bangladesh, Bhutan, Cambodia, Indonesia, Laos, Maldives, Myanmar, Philippines, Tajikistan, Turkmenistan, Uzbekistan and Vietnam on SCP in sustainable housing can be found in section 2.5 as **country briefs**. Finally, **international and local best practices** are presented to provide additional perspectives on the subject area. Together, the findings of these analyses highlight potential thematic key areas, gaps and trends for further promoting SCP in support to Sustainable Housing.

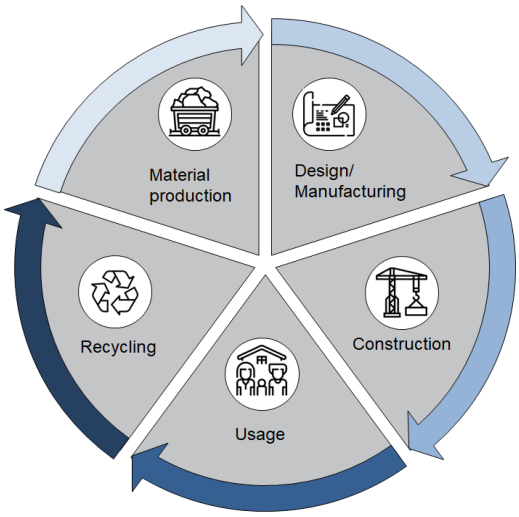
Figure 9: Overview of the methodological approach for the assessment



2.3 Analysis of sustainable housing along the life cycle of buildings in selected countries

This part of the scoping study provides a comprehensive overview of priority issues and emerging topics of sustainable housing in the context of SCP, with a particular focus on China, India, Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka, and Thailand[1]. Key trends of the selected countries are presented within this section. Detailed information for each focal country can be found in the Annex.

Figure 10: Building life cycle stages as considered in the assessment



The structure of this section follows the different life cycle phases/stages of buildings, i.e. **material production, design and manufacturing, construction, usage and recycling**. Each of these topics is evaluated along previously defined focal areas: national policy environment; technology and architecture; standards, guidelines & rating systems; and access to finance. Within the focal area **policy environment**, research has been conducted on each country's specific laws and regulations on the different stages of the building's value chain, allowing for a better understanding of the legal situation on SCP in sustainable housing. The area

[1] The study's focus on China, India, Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka, and Thailand is a result of the initial in-depth assessment conducted by the SWITCH Asia SCP Facility on country sector focus and priorities.

technology and architecture comprises information regarding the application of upcoming technologies and architectural innovations. The third focal area, **standards, guidelines and rating systems**, concentrates on energy building codes, green building rating systems, standards and labelling schemes and further requirements of each country for the building sector. Finally, the focal area access to finance contemplates the possibilities of financial support for the implementation of measures within the value chain.

2.3.1 Material production

Within the life cycle of buildings, the first stage to be considered is the production process of building materials required for the building construction. This stage involves the extraction of raw materials, such as iron, ore and timber and their transformation into construction materials. In addition, this stage also considers the transportation of the finalised materials to the construction site. The environmental impacts generated during these processes comprise the depletion of natural resources, the consumption of large quantities of water and energy, the emission of GHGs and other pollutants in the atmosphere, the release of chemical pollutants in the soil, erosion, loss of biodiversity in the mining area as well as deforestation (Aigbavboa & Ngwepe 2015).

When dealing with the issues related to the production of building materials in Asia, one of the most pressing topics regards the extraction of sand for cement production. Sand mining in Asia is responsible for various negative environmental impacts, and has become a critical issue for many national governments. This is due to the fact that demand of sand for cement production continues to rise to keep up with the rapid urbanisation process of many Asian cities. In that sense, the production of cement also deserves attention within the stage of the manufacturing of building materials. This is particularly crucial for China, which has become the world leader in cement production and construction.

Within the stage of material production, this scoping study focuses on the policies and regulations coordinating the extraction of raw materials in the construction industry and the technologies and trends on the sector. Prevalent issues and trends within the focal countries are highlighted.

POLICY ENVIRONMENT

The efforts of Asian countries to develop their economies in a more sustainable manner have led many of them to implement stricter policies on the regulation of heavy industries, in order to improve their efficiency and reduce GHG emissions and environmental impacts associated with their activities. Among the industries affected by such policies is the cement industry, responsible for major emissions and environmental problems in Asia. This section looks at some of the developments of the policy environment addressing building material production in the selected countries, focusing especially on the giant cement industry in China and on the issues related to the extraction of sand that affect many Asian countries.

The problem of sand extraction in Asia

Globally, 50 billion tons of sand and gravel are consumed every year, mostly for the production of concrete, which is the most widely used building material in the world (UN Environment 2019). Although being more extensively mined than any other material, sand and gravel still receive very limited attention from policy makers and the problems related to their extraction are mostly unknown to the general public (UNEP 2016). This large material extraction has significant impacts on the environment, such as inland and coastal erosion, changes in river water flows, flood regulations and marine currents, lowering of water table and pollution of water (UNEP 2016).

In Asia, especially in South Asia and in China, uncontrolled and mostly illegal extraction of sand and gravel from riverbeds is responsible for many adverse environmental impacts, especially for river deltas and lakes where exploitation takes place. With rapid urbanisation and economic growth, China has increased its

cement demand by 437.5% in the last 20 years which is expected to further rise due to the demand for new infrastructure and buildings in urban areas (UNEP 2016). Today, China leads the world in cement production, with 2,360 million metric tons produced in 2015, accounting for 57% of the world's total (Hasanbeigi et al. 2017). The industry is one of the major contributors to air pollution and GHG emissions in the country, not only due to the size of the market but also to the fact that its high energy intensity is supplied primarily through fossil fuels (Trucost and ICCS 2015).

The effects of the intense sand exploitation are aggravated by the weak regulations on mining and dredging in Asian developing countries, as well as by the lack of enforcement and the illegality that characterises the sector. Different solutions arise for the issue in terms of policy implications, but very few regulative efforts are in place to coordinate sand and gravel extraction. Some state governments in India and national governments in other South Asian countries have, for instance, implemented policies on permitting and licensing of sand and gravel extraction from predetermined stretches of rivers (The Third Pole 2017). Laws and regulations to incentivise the use of alternative or recycled building materials could be applied to promote the reduction of sand consumption. Although increasingly scarce, sand has had a stable price over the decades, thus making it a very cheap and accessible material, rendering other alternative options less viable (UNEP 2016).

Cement industry in China

Cement production in China exploded in the 1970's to fuel the country's urbanisation and continued to expand in the following decades. The Chinese government has taken advantage of investments in infrastructure, real state and industrial capacity to stimulate the economy and promote growth. Today, China leads the world in cement production, with 2,360 million metric tons produced in 2015, accounting for 57% of the world's total (Hasanbeigi et al. 2017).

The production of cement involves the consumption of large amounts of raw materials, energy and heat, and results in significant amounts of waste generation and emissions. The industry is one of the major contributors to air pollution and GHG emissions in the country, not only due to the size of the market but also to the fact that its high energy intensity is supplied primarily through fossil fuels (Trucost & ICCS 2015). Given the environmental impacts of the industry, different measures have been implemented by the Chinese government in the last years to mitigate such impacts. For instance, the 11th Five-Year Plan has defined ambitious goals for energy efficiency for its most energy-intensive industries, including cement. With this regulation, China was able to change the face of its cement industry previously dominated by polluting and energy intensive shaft kilns, towards the use of precalciner kilns, which are the most advanced rotary cement kilns. Under the 11th FYP, the amount of energy required to produce a metric ton of cement fell by 41% through cleaner modes of cement productions. These efficiency measures reduce fuel and electricity use, in the process cutting air pollutants and greenhouse gases released by cement production (Trucost & ICCS 2015). Furthermore, in 2013, the Chinese Government published the "National Air Pollution Action Plan" setting targets and deadlines to improve air quality in cities and provinces and requiring some of the highest polluting industrial regions to achieve reductions in their coal consumption.

Fly ash brick industry in India

The Indian brick industry is predominated by resource depleting and highly polluting technologies. In Bihar in East India, fired clay bricks consume around 4.8 million tons of coal per year, emitting 16 million tonnes of CO_2 (DA 2019). About 6.000 acres of land are destroyed every year in the city due to red brick kilns, compromising the agricultural land in the region and depleting groundwater sources. 2017 data indicates that the over 6,000 registered brick kilns units in Bihar produced 19,000 million units of red brick and consumed 53 million tons of soil (Singh 2019). By cutting the top soil of land, the layer of hummus is lost, resulting in massive loss of fertility. Besides, due to evaporation of the underlying water, even the water table in these areas starts to decade (Singh 2019). In response to the issue, the Bihar State Pollution Control has mandated the adoption of fly ash brick by all traditional brick kilns.

Fly ash is a fine powder that is a by-product of burning coal in electric generation power plants. Fly ash contains aluminous and siliceous materials that form cement in the presence of water and thus, can be applied as a suitable prime material in blended cement and other building materials (Rodriguez 2019). In many markets, fly ash can be a cost-effective substitute for Portland cement with the advantage of being more environmentally friendly, given it is a by-product and has low embodied energy. Moreover, the production of fly ash requires less water in comparison to that of Portland cement and includes other benefits such as better resistance at cold weathers, great workability, reduction of cracking and permeability programmes, and CO_2 emission reduction (Rodriguez 2019). The technology does not consume any top soil for the production of brick and presents an opportunity for Bihar to shift to a technology that promotes circularity through the employment of by-products in the production and reduces the use of natural resources.

In order to promote utilisation of fly ash, the Ministry of Environment, Forest and Climate Change (MoEF&CC) of the Government of India has issued a notification under E.P. Act 1986 dated 14th September 1999 stating that the manufacturing of clay brick, tiles or blocks for construction within a radius of 300 kilometres from coal or lignite based thermal power plants should contain a mix of at least 25% of ash (i.e. fly ash, bottom ash or pond ash) (DA 2019). Besides, every construction agency located within the same radius should use only fly-ash based products for construction, such as cement or concrete, fly ash bricks or tiles, or clay fly ash bricks (DA 2019). Moreover, in the 2019 budget, the Indian government has reduced GST from 18% to 5% on products like fly ash, fly ash aggregate with 90% or more fly ash content.

TECHNOLOGY AND ARCHITECTURE

The development of new methods for raw materials extraction and technologies for their conversion into building materials can contribute to mitigate the negative environmental effects of mining and of processes carried out by heavy industries. Besides, sustainable mining and material production practices contribute to improve health and safety conditions for employees along the production process (ASEAN 2017).

To introduce new technologies and share the knowledge on innovations, international partnerships play a crucial role in the Asian context. In Malaysia, for instance, the Ireland-based company CDE works together with Batu Tiga Quarry in developing and promoting manufactured sand which is produced in the company's quarries (Eco-business 2018). The technology of manufactured sand is not only a more environmentally friendly alternative, allowing for the reduction of river-sand projects, but also improves production efficiency by enhancing the quality of the sand and reducing the consumption of cement. The development of the production method in Asia can contribute to mitigating the sand crisis in the region and meet the demand of cement for further urban expansion.

Technological developments in mining and building materials manufacturing are also taking place in the production of limestone for the cement industry. In Thailand, the cement manufacturer Siam Cement Kaeng Khoi is the first to implement the semi open cut mining method in its limestone quarry in Saraburi. This method leaves forest area as a buffer zone along the quarry boundaries, thus reducing environmental impacts, noise and dust pollution caused by the extraction process. It also allows for the rehabilitation of the biodiversity in the area to be undertaken at the same time as the limestone production (ASEAN 2017). Similarly, in Kazakhstan, intelligent mining has started to shape the future of the industry. The first digital plant has become operational in the city of Aktogay; boosting an artificial intelligence platform that uses real time insights to predict loads, key minerals and potential recovery in order to maximise value and reduce stoppages during processing (IntelliSense.io 2019). Another six existing mines have been scheduled for digitalisation by the Government of Kazakhstan (International Mining 2019). Although these mines are leading the way to a more streamlined manufacturing process through innovative technologies, policies that support a more widespread implementation of digitalisation in the mining sector are still lacking.

Another problematic sector of Asia's building material industry that has received attention in the recent years is the production of brick, which contributes significantly to global warming and is a threat to people's health. In many Asian countries, the operation of the brick sector is vastly unregulated and the traditional methods and technologies applied are highly contaminating, increasing air pollution and GHG emissions. In Pakistan, the Environmental Protection Department of Punjab, the most populated province of Pakistan, and the National Energy Efficiency Conversation Authority (NEECA) are working together with the All Brick Kiln Owners Association of Pakistan and the International Centre for Integrated Mountain Development (ICIMOD) to develop environmentally friendly brick kiln technologies in the sector (CCAC 2018). The work consists on training and awareness raising initiatives to inform brick entrepreneurs about new cost effective and scalable kiln techniques and sustainable improvements in the production process. It aims at informing and persuading industry stakeholders on adopting these practices and promoting a shift in the country's industry to more sustainable practices.

2.3.2 Design/Manufacturing

The stage of design and manufacturing refers to the composition process of a building, which is one of the most important stages of the value chain. The decisions of architecture and design have major impacts on all other building life cycle stages: it determines which materials will be employed, how the building will be constructed and operated, and if the materials will be recycled eventually.

The subsequent section on the policy environment draws attention to policies that encourage Building Information Modelling (BIM) in the analysed countries, followed by a presentation of vernacular architecture practices in Asia and how they can provide insights for contemporary housing design. Further on, the section on standards, guidelines and rating systems provides an overview of the coverage and design requirements established by energy building codes and green building rating systems in the selected countries. Last, the section on access to finance covers existing incentive mechanisms to promote green building and sustainable design.

POLICY ENVIRONMENT

The integration of different project dimensions during the design stage of a building has been enhanced in the last decade with the introduction of BIM. This practice refers to an intelligent 3D model-based process that provides professionals involved in a project with insights and tools to integrate and simulate data on architectural design, structural system, installations, energy performance, costs, etc. At present, BIM is widely applied in the construction industry in industrialised countries, but still faces implementation challenges in Asian economies.

China has been very proactive in the last few years in implementing policies to foster the use of BIM in its construction industry, while other countries have experienced a more discrete policy development in this direction. In China's building industry, BIM technology has been applied since 2003, but its use is still limited to post-design stages, such as construction (Jin, Tang and Fang 2015). To strengthen BIM practices in the construction industry, the Chinese government introduced different BIM related policies and standards as part of the 12th Five-Year Plan. In January 2012, the publishing of the 2012 Engineering and Construction Standards was announced, marking the official launch of the Chinese BIM Standards (Jin, Tang and Fang 2015). Policies on BIM have also been developed at regional level in China, with metropolitan areas like Beijing, Shanghai, Shenzhen and Guangzhou publishing their own policies on BIM application (Jin, Tang and Fang 2015).

Beyond the application of BIM in design and construction, the policy environment is an important asset in fostering the use of new technologies and methods. In India, a Technology Sub-Mission was developed within the Pradhan Mantri Awas Yojana (PMAY) housing programme, launched with the aim to provide housing at affordable prices to the weaker sections of society. The main objective of the Sub-Mission is to

enable States and Unit Territories in India to adopt modern, innovative and green technologies and building materials in their mass housing schemes, accelerating construction times and improving housing quality. The implementation of the Sub-Mission was undertaken through the setup of a scheme to identify sustainable technological solutions for faster and cost effective construction of houses (Ministry of Housing and Urban Poverty Alleviation 2015).

TECHNOLOGY AND ARCHITECTURE

A common issue for developing countries in Asia is the dependence on materials, layouts and methods of western construction that are often outdated, energy inefficient and inadequate for local climatic conditions. In addition, many business and trade models are expensive or inappropriate in the local contexts, highlighting the importance of learning from traditional vernacular architecture practices in order to develop more sustainable practices in construction.

"Vernacular architecture comprises the dwellings and all other buildings of the people. Related to their environmental contexts and available resources, they are customarily owner- or community-built, utilising traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies and ways of living of the cultures that produce them" (Oliver 2006, p.30). The definition of vernacular architecture proposed by Oliver describes some of the elements that determine the sustainability of vernacular design and construction solutions: the consideration of environmental context (geography, topography, site, climate, local building materials, labour experience and building techniques), the use of resources available on site and traditional technologies and the involvement of the community. The cultural identity is an important aspect of vernacular architecture, that has developed through time and modified itself through trial and error in order to fulfil society's needs (Salman 2018).

Vernacular architecture can provide valuable contributions to present practices of sustainable construction, allowing for establishing a regional identity independent from imported values and applying design elements and construction materials in contemporary buildings that are adequate to the local conditions and available resources. The traditional Malay house in Malaysia, for instance, provides insights on features that can be incorporated in the contemporary design of sustainable housing. Developed to adapt to the local equatorial climate that is characterised by high temperatures, high humidity and copious rain, the Malay house is built with floor raised above the ground, in order to avoid dampness and flush flood during the heavy rains. Moreover, it features many openings such as windows, panels and grilles, which allow for the ventilation to cool its inner areas and reduce humidity. The materials utilised in the Malay house, such as rumbia leaves, bamboo, palm and cengal wood, are widely available locally and present low thermal capacity, contributing to the thermal comfort of the rooms (Ramli et al. 2012).

In Mongolia, The Ger is part of the country's centuries-old tradition of nomadic life and thus, is built with lightweight and flexible structure. It is made out of wood, felt and canvas, with pieces tied up together by knots that can be easily undone and redone again (Buechner 2018). This housing unit is large enough to shelter a family, yet it was never intended to serve as a permanent urban dwelling. Nevertheless, Ger areas have become a substantial part of the city of Ulaanbaatar and accommodate more than 60% of its inhabitants (Master Planning Agency of the Capital City 2014). To promote the integration of this traditional Mongolian dwelling to the city and allow it to respond to needs of its inhabitants in an urban environment, initiatives have been developed for adapting the Ger structure. Developed by the Rural Urban Framework, the Ger Plug-In is specifically designed for adaptation and possible future growth, and works as an infrastructural wall which the Ger plugs in to receive basic urban infrastructure features, such as water and septic tanks and heating systems (Rural Urban Framework 2017). Another corresponding initiative is the Ger Innovation Challenge Project, which focuses on the re-design of Ger parts (such as doors, floors and openings) in order to enhance the performance in terms of energy efficiency and heat loss (GerHub 2018). Similar to the Malay house and Ger, the Yurt is a traditional style of portable tent-like housing unit in Central

Asian countries, such as Kazakhstan and Kyrgyzstan. It is typically made from a collapsible wooden frame, i.e. willow or hazel, covered in natural fabrics such as felts made from sheep's wool, with no internal support structures (German Embassy of Kazakhstan 2016).

STANDARDS, GUIDELINES AND RATING SYSTEMS

To better understand the framework for the housing design in the ten focal countries of this study, this section focuses on energy building codes and green building rating systems. The development and implementation status varies across the focal countries: while some already have very mature standards in place, others are still at an incipient stage.

Energy building codes

Energy building codes set the minimum efficiency requirements for new and renovated buildings in order to guarantee a reduction in energy consumption and GHG emissions along the buildings' life cycle. By ensuring that information on energy consumption is taken into account during the stage of design of a building, energy codes represent a significant opportunity for savings during the buildings operation.

The development and implementation of energy building codes in different Asian countries is taking place at a different pace. From the selected countries assessed in this study, Mongolia has not established its own energy code yet. In China, in turn, the codes have been through many revisions and address different kinds of buildings for different climatic zones. In countries such as Thailand and India only some parts of the buildings are covered by a building code.

The compliance and enforcement mechanisms vary across the selected countries, with codes being mandatory for all urban residential and public buildings in China whereas in Thailand and Malaysia restrictions are established depending on the type of buildings or area. Table 1 presents information on energy building codes in the selected countries.

Table 1: Comparison of energy building codes in selected countries

	China	Thailand	Malaysia	Mongolia
Energy code	Design Standard for Energy Efficiency of Residential Buildings (1986)	Green Building Energy Code (2009)	MS 1525 – Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-residential Buildings	Mongolia has not yet implemented an energy building code
	Design Standard for Energy Efficiency of Public Buildings (1993)			
	Design Standard for Energy Efficiency of Rural Residential Buildings (2013)			

Compliance	Mandatory for urban residential buildings and for public buildings, voluntary for rural residential buildings	Mandatory for government buildings and voluntary for private buildings	Mandatory for new and renovated non-residential buildings with air-conditioned area over 4,000 m^2	
Building types	- New and existing urban residential buildings - New and existing commercial buildings - Rural residential buildings	New commercial and institutional buildings	New and renovated non-residential buildings	
Measures covered	- Building envelope - Air Conditioning - Lighting System - Renewable Energy - Domestic hot water - Maintenance	- Building envelope - Air Conditioning - Lighting System - Renewable Energy - Whole building energy	- Building envelope - Air conditioning - Lighting System	

Green building rating systems

Green building certification systems are tools applied for assessing and recognising buildings that achieve certain green requirements and standards. Rating and certification systems may vary in their approach and are designed to meet the local demands. These systems can be applied to different stages of the building value chain, as well as to different building types, with a specific set of tools being employed in the evaluation of each type of construction. Rating systems offer different levels of certification that can be reached by a project, which signify how many prerequisites and requirements it fulfils. The highest levels of certification require incorporating new and innovative technologies to the project, encouraging developers to invest in these features and stimulating the market for green buildings.

Many green building programmes and rating systems have been developed in Asia in the last decade. From the selected countries assessed in this study, Mongolia is the only one that does not have a scheme aimed at green buildings and promoting more sustainable construction practices. In general, the green building rating systems developed in Asia use the American Leadership in Energy and Environmental Design (LEED) certification as a reference, adapting the requirements and priority issues to country-specific conditions. The Thai Rating of Energy and Environmental Sustainability (TREES) and the Green Building Index (GBI) Malaysia, for instance, award the same certification levels as in LEED, i.e. certified, silver, gold and platinum.

The categories used for certification are similar across the different rating systems, including areas such as energy and water consumption, location and outside environment as well as materials applied in the construction process (see table 2).

Table 2: Green building rating systems in selected countries

	"Three Star" China	TREES Thailand	GBI Malaysia
Year of introduction	2006	2009	2009
Responsible institution	Ministry of Housing and Urban-Rural Development (MOHURD)	Thai Green Building Foundation (TGBI)	Green Building Index (GBI) Malaysia Green Building Confederation (MGBC)
Building types	- Residential buildings - Public buildings (including office buildings, malls and hotels)	Suitably for various building types, with certification possible for: - New Construction - Pre-New Construction - Core and Shell - Existing Buildings	- Non-residential - Residential - Industrial - Townships - Interiors (New construction and existing buildings)
Certification levels	One, two or three stars, depending on the number of options achieved within each category	Platinum, gold, silver and certified	Platinum, gold, silver and certified
Categories of evaluation	1. Land saving and outdoor environment 2. Energy saving and utilisation 3. Water saving and utilisation 4. Materials saving and utilisation, 5. Indoor environmental quality 6. Operation and management	1. Building Management 2. Site and Landscape 3. Water Conservation 4. Energy and Atmosphere 5. Materials and Resources 6. Indoor Environmental Quality 7. Environmental Protection 8. Green Innovations	1. Energy Efficiency 2. Indoor 3. Environmental Quality 4. Sustainable Site Planning and Management 5. Material and Resources 6. Water Efficiency and Innovation

ACCESS TO FINANCE

Financing green building design and energy efficiency measures in construction still represents a major challenge in Asia. Different concerns revolving around high initial costs of the investment, perceived risk exposure, high discount rate, long payback time and lack of awareness from the financier side still exist. To address these barriers, it is crucial to stimulate the market for sustainable housing in Asia. This section looks at schemes that have been successful in fostering energy efficiency and sustainable housing in the respective countries.

Thailand's Energy Efficiency Revolving Fund (EERF)

The EERF was established in 2003 as part of the Energy Conservation Programme to address the barriers of Thailand's financial sector to stimulate energy conservation and energy efficiency projects in the country. As a financing mechanism, the EERF provides banks with low-interest loans, which on-lend the funds to energy efficiency projects (Frankfurt School – UNEP 2012). The revenue generated when clients return the payment for the loans is used to issue new loans, ensuring a consistent inflow and outflow of capital (Frankfurt School – UNEP 2012). Eligible borrowers for the loan can be buildings, factories, energy service companies and project developers working on medium-sized energy conservation or energy saving projects (Frankfurt School – UNEP, 2012). For buildings, the eligibility criteria comprise energy conservation measures defined by the Thai Energy Conservation Act and include, for instance, the reduction of heat from insulation, and the use of efficient air-conditioning, construction materials, lighting systems machinery. The agency responsible for the EERF in Thailand is the Department of Alternative Energy Development and Efficiency (DEDE), which allocates the budget of the fund for the participating banks.

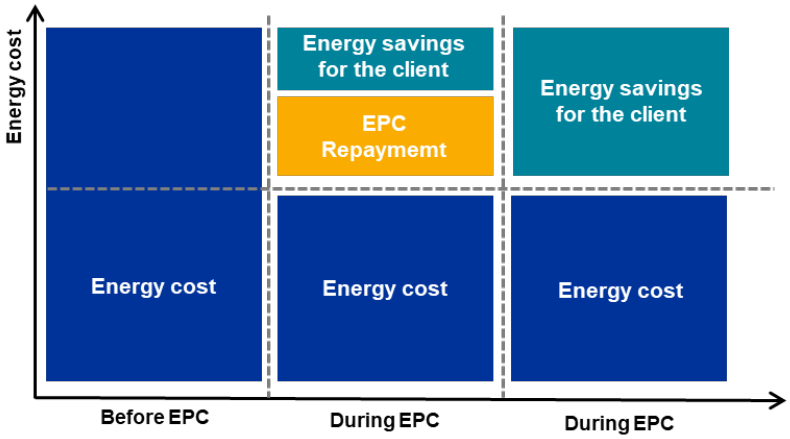
Kyrgyzstan Sustainable Energy Financing Facility (KyrSEFF)

KyrSEFF+ is an extension of the KyrSEFF programme, which begun in 2012 and continues to provide financing through the European Bank for Reconstruction and Development (EBRD) and European Investment Facility for Central Asia (EU IFCA). The programme supports both water and energy efficiency in homes through the provision of loans and grants of up to 35%, as well as technical assistance. Private households and homeowners are able to invest in energy and water saving technologies ranging from wall insulation to solar energy and rainwater harvesting, allowing comfort of homes to be increased at a reduced cost. For the private sector, funds are available for machinery, wastewater treatment systems, energy saving devices or agricultural machines, to name a few. A team of engineers is also available to support and provide advice to commercial and private investors in order to help find the best solutions for their energy and water resource efficiency needs. There is also funding available for suppliers, vendors and installers of energy efficient and resource-saving technologies so that they may increase their stock or expand their operating base. In 2018, the programme expanded to offer awards at a ceremony in Bishkek, recognising outstanding projects in the field of energy and water efficiency and contribution to conservation of the environment in order to raise awareness and publicly promote these areas (KyrSEFF+ 2017).

Energy Performance Contracting (EPC) in Malaysia

An energy performance contract is as an agreement between an energy service company (ESCO) and a client who plans to develop an energy efficiency project. The ESCO provides the client with knowledge and expertise on the identification and assessment of the energy saving potential and on the development and implementation of energy saving measures in the project (BSEEP 2017). Thus, the ESCO undertakes the risks associated with achieving the proposed savings for the project and is paid, during the contract period, with a portion of the energy cost savings achieved. When this period is over, the ESCO ceases to provide the services and the energy cost savings belong to the client. Figure 11 presents a schematic overview of how the energy cost savings are distributed when using EPC.

Figure 11: Energy cost savings distribution along EPC (Adapted from BSEEP 2017)



In 2016, the Malaysia Association of Energy Companies (MAESCO) had 61 energy service companies as members, of which 35 were engaged in the provision of EPC services (BSEEP 2017). The goal is to overcome the implementation barriers of energy efficiency facilities in Malaysia, which are mainly related to the lack of technical expertise and constraints on capital investments. The contracting can be applied to any facility using energy, including all types of buildings, and contributes to the client's management of the energy efficiency project, avoiding the need to deal with many different contractors working on very specialised fields.

2.3.3 Construction

Within a building's value chain, the construction phase accounts for all the activities developed from the beginning of the construction works until the completion of the building. From a life cycle perspective, this stage plays a very important role, accounting for major environmental impacts of buildings, such as large releases of waste and emissions, and high energy and water consumption.

Looking at the policy environment, this section presents the most important laws and policies regulating the construction industry in the selected countries in the areas of water and sanitation, mechanical systems, lighting, structural systems, etc. Moreover, the section on technology and architecture deals with the trends and developments in terms of building materials and construction methods, covering not only technological advancements that may contribute to more sustainability in the construction phase, but also alternative building materials and their application. The third part of this section, standards, guidelines and rating systems, covers the issue of certification of green building materials in the selected countries, presenting some of the programmes that have been developed to address them. Last, the section access to finance deals with the financial schemes that support greener and energy efficient construction works, as well as incentives that encourage the use of sustainable building materials.

POLICY ENVIRONMENT

The institutional framework and policy environment regulating the construction sector in China, Malaysia, Mongolia and Thailand present many aspects that are specific to each country's context as well as different levels of development. China, for instance, has a more deep-rooted and well-established framework regulating the construction sector, covering different dimensions, including recommendations and standards for indoor air quality, lighting appliances, fire security and structural project. In Mongolia, on the other hand, the system of building norms, regulations and standards is still based on the former Soviet Union system from the 60s and 70s, requiring revisions and adaptation. The Law of Construction of

Mongolia was last revised in 2008, incorporating current concerns and aspects of the Mongolian Green Development Policy related to Green Building.

Table 3 comprises information on the policy environment of the construction industry in the selected countries regarding the following dimensions of construction: water and sanitation, mechanical systems, lighting systems, fire safety, structural components and land use planning and zoning.

Table 3: Policy environment of the construction industry in selected countries

	China	Malaysia	Mongolia	Thailand
Water and sanitation	Several codes on the design and installation of water and sanitation systems, covering, for instance, the design of pipes, installations for potable water and storm water and rainwater systems.	- The legal framework for water and sanitation differs between peninsular Malaysia and Eastern Malaysia. - The Ministry of Energy, Green Technology and Water is responsible for policy setting. - Sewage Act 1994 - Water Services Industry Act (WSIA) 2006 - National Water Services Commission Act - Water Forum: to give voice to sub-represented stakeholders.	- National Water Programme: approved in 2010 to protect water resources in Mongolia and create conditions for Mongolian people to live in a safe and healthy environment - Ulaanbaatar Master Plan 2030: one of the objectives is the improvement of the provision of water and sanitation services - Law on Water - Law on the Utilisation of Urban Settlements Water Supply and Sewage.	- Master Plan on Water Resource Management - Water Act Metropolitan Waterworks Authority and Provincial Waterworks Authority supply piped water in urban and suburban areas. Sanitation Programme included in the National Economic and Social Development Plans
Mechanical systems	Codes on design and installation of heating and hygiene engineering, HVAC, fan, compressors and boiler systems. Codes also for quality and inspection control of installations.	Malaysian Standards establish requirements for mechanical systems, such as tele-communication equipment and household electrical appliances (MS IEC 60335).	No information available	Ministerial regulations on mechanical design established under the Building Control Act.

	China	Malaysia	Mongolia	Thailand
Indoor air quality	Norms on IAQ issued by the Ministry of Health. - Hygienic Norm of IAQ - Code for Indoor Environmental Pollution Control of Civil Building Engineering	Code of Practice on Indoor Air Quality, introduced in 2010 by the Department of Occupational Health and Safety, replacing the code launched in 2005.	- Law on Occupational Health and Safety (2008) - Law on Hygiene (1998) MNS Standards related to Occupational Health and Safety	Mandatory Requirements for IAQ included in the Building Energy Code.
Lighting	Requirements for lighting energy use and lighting installation are part of the energy and building codes and mandatory standards. Standard for Lighting Design of Buildings: mandatory, as it has been incorporated into many codes.	Malaysian Standards establish the requirements for different applications of lighting	No information available	Mandatory requirements for lighting included in the Building Energy Code
Fire	Several fire codes and mandatory standards on the design of different areas of buildings in regard to fire protection and prevention. Building codes also include fire protection requirements.	MS 1183 – 2015: Fire safety in design, management and use of buildings – Code of Practice Malaysian Standards establish requirements for fire dampers, safety signs, fire resistance doors, components of fire detection systems, etc.	Fire Safety Law (1999): fire safety requirements to be met in the design of buildings.	Fire requirements included in the Building Control Act and Ministerial Regulations. - Fire Safety Regulation for High-rise Buildings and Special Large Buildings - Regulation on Fire Prevention for general buildings - Regulation on fire-resistant construction
Structural	Mandatory structural codes and standards, covering: loading, concrete, steel, brick and masonry, timber, rolled steel, seismic foundation, precast structures, reinforced concrete, etc.	Several Malaysian Standards establish the requirements for structural systems. Use of steel, foundations, use of timber, use of precast concrete, etc.	Law on Construction (2008): regulates relation concerning building design, manufacturing of building materials, executing construction works	- Building Control Act - Ministerial Regulation on Structural Design - Engineering Institute of Thailand Standards

	China	Malaysia	Mongolia	Thailand
			and technical supervising. - MNS Standards related to Construction and Construction Materials - Mongolian Construction Standards and Rules.	
Planning/ zoning	*National level:* Five-Year Plan for National Economic and Social Development: distribution of significant construction projects and production capacity; targets and directions of national development. *Regional Level:* National Spatial Plan, on overall land use plan, under control of Ministry of Land and Resources *Urban planning:* Urban System Plans, based on the Urban and Rural Planning Law, under control of MOHURD	Economic Planning Unit: main government agency responsible for planning and policy change in the country. National Physical Plan (revised in 2010): national strategic spatial planning policies and measures, drafted by the Federal Department of Town and Country Planning. Metropolitan planning system: Kuala Lumpur Structure Plan, developed by the Kuala Lumpur City Hall	- Law on Land (2002): allocation of land ownership to Mongolian citizens, cadastral survey and land cadastre, land fee. - Urban development law (2008): Legal status of capital city; Construction; Housing, Utilisation of urban water supply and sanitation, Roads, Energy, Tele-communications. - Ulaanbaatar 2020 Master Plan and Development Approaches for 2030	*National Level:* National Economic and Social Development Plan, on policy; National Spatial Development Plan, on spatial planning. *Regional Level:* Regional Spatial Development Plan, for six regions. *Plans on sub-regional, provincial and town areas.* Plans on land use and zoning under the authority of the Department of Public Works and Town & Country Planning.

TECHNOLOGY AND ARCHITECTURE

In the construction phase, choices made during the design process in terms of material specification, suppliers and construction methods might lead to serious environmental impacts, as well as represent significant financial losses for the project. Within the value chain, the design stage should thus also take into the consideration practical aspects of the construction work, prioritising the specification of materials and construction methods that allow for cleaner, faster and less resource-consuming on-site processes.

In that sense, the use of local abundant materials presents an opportunity for the construction industry in Asia to go beyond conventional materials such as brick and cement, taking advantage of traditional construction methods that are often overlooked by contemporary architecture practices. Moreover, this

section describes construction systems that are still nascent in the Asian context, but could contribute to greener and more efficient practices.

Use of bamboo in Asia

Bamboo has been historically used as building material for traditional construction in different regions of South- and South-East Asia, given its abundance in the region and adaptation to withstand the heat and humidity of the climate (Rashid and Rahat Ara 2015). The advantages of building with bamboo have brought attention to the material and its application in contemporary architecture as an alternative sustainable building material. Bamboo forests present an incredibly rapid growth cycle, so that their regeneration takes place much quicker than any other wood plants, making the material a very sustainable choice. Additionally, bamboo is a light material, easy to transport and store, as well as to be cut and handled without the need for any sophisticated equipment. These characteristics also allow for very simple maintenance procedures, in which bamboo pieces can be easily repaired and repositioned. Due to its multipurpose character as a building material. bamboo can be applied in floors, wall panels, water pipes and furniture, and its structures can contribute to ventilation and natural lighting in constructions.

Straw bale as construction material for sustainable houses in China

In June 2000, the province of Heilongjian in northeast China, joined with the international NGO Adventist Development and Relief Agency (ADRA) in an effort to promote energy efficient housing in the rural local communities of the region (China Daily 2005). As the region is one of China's grain production bases, especially of wheat, ADRA has elected straw bales as the insulation material to be employed in the construction of the houses. In comparison to conventional construction with bricks and rocks, straw bale housing is more efficient in insulation, reducing fuel consumption in the house (IGES 2010). The material also improves housing resistance to earthquakes, given its enhanced elasticity in comparison to traditional building materials, and allows for constructions with much lower costs(IGES 2010).As of 2009, more than 600 buildings had been built within the project, which, in 2005, won the United Nations World Habitat Award (World-Habitat 2017). One of the key elements is the cooperation with the local communities and the local government to empower and build capacity, involving them in the housing design, material acquisition and village education (World-Habitat 2017).

Use of rammed earth in Asia

Rammed earth is an ancient construction technique based on compacting loose soil inside a formwork in successive layers to make a homogeneous wall. The technique requires a mixture of sand, silt and clay soil, which can be found in different locations. It has been developed independently in different regions of the world, with variations according to a number of factors, such as the availability of materials and the capacity of the workforce. Rammed earth has been applied as a vernacular practice in Asian countries like Bhutan, China, India and Nepal, and provides many advantages in terms of sustainability compared to traditional construction methods (Jaquin 2011). The soil for the construction can be sourced on-site, at zero or almost zero costs, providing a solution for housing in remote areas and avoiding the consumption of energy in transportation. Besides, rammed earth structures are durable and do not require any painting or wall treatment, contributing to an easy and low cost maintenance.

Promotion of ecological, innovative and cost-effective construction materials in Kyrgyzstan

In 2017, the United Nations Industrial Development Organization (UNIDO) set up and financially equipped a "SMART BUILD" technology centre in Bishkek, Kyrgyzstan, aiming to raise awareness of and provide technical support for environmentally-friendly and cost-effective construction materials (such as insulation made from natural materials or mud-stabilised bricks). The Smart Build centre is located at the Kyrgyz-Russian Slavic University and acts as a demonstration space for knowledge sharing. The centre also utilises an online information based platform, intended to widely disseminate and replicate knowledge and information about advanced technologies in construction and alternative building materials by bringing

together academia, industry and business (UNIDO 2017). Already, samples of mud-stabilised blocks have been developed, along with a technical handbook on how they can be produced. The programme also aims to promote the establishment of community-level jobs through trainings of future professionals (UNIDO 2017).

Industrialised Building Systems (IBS) in Malaysia

IBS are construction methods characterised by the mass production of structural components in a factory or at site (Chan et al. 2014). The use of IBS in construction allows for a higher quality control of the structural components, less labour on site, reduced construction time and cost savings. Additionally, IBS is a more sustainable construction method compared to conventional systems, generating less waste due to the controlled production and faster and less energy- and water-consuming construction works.

Since the early 1960s the Malaysian government has made efforts to establish and successfully implement this practice in the country (Fathi et al. 2012). In the 1990s, the IBS became more popular with the construction of many infrastructure and mega projects, such as the Kuala Lumpur Convention Centre and the Kuala Lumpur International Airport. In 1999, the Construction Industry Development Board (CIDB) formed the IBS Steering Committee to promote a greater use of IBS in the Malaysian construction industry, leading to the development of different strategic plans and roadmaps for IBS in the country (Fathi et al. 2012). However, many of the efforts did not result in significant progress. Therefore, Malaysia's Construction Industry Transformation Programme 2016-2020 emphasises the importance of accelerating the adoption of IBS in the country's construction industry (CIDB Malaysia 2015).

STANDARDS, GUIDELINES AND RATING SYSTEMS

The construction materials utilised in a building have a great impact on its performance in terms of energy efficiency and indoor environmental quality. Certification systems for green building materials provide guidance for architects and developers to comply with building's performance and energy efficiency requirements by providing them with information on the tested properties of each product (Pacific Northwest National Laboratory 2017). The certification schemes also contribute to increasing the market share of sustainable materials, incentivise green procurement by construction companies and allow for a larger supply of quality products in the market.

Certification of green building materials in China

Over the last decades, China has put great emphasis on energy efficiency in the building sector with building materials being one of the key areas to control emissions and achieve energy conservation and improvement. The 13th Five Year Plan targets the integration of green building materials in 40% of newly constructed buildings by 2020 and provides guidelines for the establishment and improvement of standardisation, certification and identification systems for green products and services (Pacific Northwest National Laboratory 2017).

All certification systems in China are managed and supervised by government ministries, with the central government playing a prominent role in the creation and management of certification programmes and standards (Pacific Northwest National Laboratory 2017). The implementation of green building materials is spread across different certification schemes (see table below).

Table 4: Green building materials certification programmes in China (Adapted from Pacific Northwest National Laboratory 2017)

	Details	Compliance	Building materials
China Compulsory Certification (CCC)	Products listed under the CCC cannot be used for any commercial purposes without the certification	Mandatory	Architectural safety glass, solvent furniture paint, concrete anti-freezer and porcelain tile.
Resource Conservation Programmes	Organisations of certification have the autonomy to carry out their own programmes. The most influential certification programs regard energy and water conservation.	Voluntary	Doors and windows, hollow glass, aluminium, architectural profile, inorganic thermal insulation profiles. Energy Conservation Programme: electric appliances, office equipment, lighting products, etc.
Environmental Products Certification	Comprises the China Certification for Environmental Products and the China Environmental Labelling programmes.	Voluntary	Paints, artificial boards, wallpapers, binders, ceramic tiles, carpet, concrete mixture, wooden doors.
Low-Carbon Product Certification	Developed to speed up the improvement and popularisation of energy-saving and low-carbon techniques	Voluntary	Portland cement, sheet glass, aluminium alloy proximate matter for buildings, ceramic tile or board.
Green Building Material Assessment Label	Certification of building materials according to five dimensions: energy conservation, emission reduction, safety, convenience and recycling.	Voluntary	Seven categories of products including premixed concrete, energy-saving glass, ceramic tiles, sanitary wares, etc.
Fenestration Energy Efficiency Performance Labelling	Informational label to ensure energy efficient performance of windows and apertures	Voluntary	Provides information on U-values, shading coefficients, air permeability and energy performance metrics for fenestration.

The MyHIJAU Programme in Malaysia

Launched in 2009, Malaysia's National Green Technology Policy established the milestones for the country's pursuit of green economic development and determined green technology as a driver to accelerate the national economy and promote sustainable development. Within this framework, the MyHIJAU Mark & Directory Programme was approved in 2012 as Malaysia's official green recognition

endorsed by the government to bring together certified green products and services under one single label that comply with local and international standards (Malaysian Green Technology Corporation 2017).

To be eligible with the MyHIJAU Mark, products or services must be able to meet the following criteria: (i) mitigate environmental degradation or reduce GHG emissions; (ii) promote health and/or environmental improvement; (iii) promote the conservation of natural resources (energy, water, etc.) or the use of renewable energy or recyclable materials (GreenTech Malaysia 2015). Green products and services registered under the MyHIJAU Mark are listed in the MyHIJAU Directory, an online platform that makes information about these products available to the general public, working as a reference for green procurement, green incentives and different green technology initiatives (Malaysian Green Technology Corporation 2017).

The MyHIJAU Mark comprises different categories of labelling such as the ISO 14024 Type I Eco-label and the ISO 14025 Type III Eco-label (Carbon Footprint Eco Labelling Scheme), as well as other Type I voluntary schemes including Energy Efficiency Rating & Labelling, Water Efficient Products Labelling and Timber Certification Schemes. In 2015, there were 3,400 registered manufacturers in green manufacturing in Malaysia. According to the National Green Technology Policy, this number should raise up to 10,200 manufacturers in 2025 and 17,000 in 2030 (Ministry of Energy, Green Technology and Water Malaysia 2017). The products listed under MyHIJAU Directory are divided by their correspondent sector, namely building, energy, transport, waste and water. In 2018, the directory on the building sector comprised of 497 products and 78 services, such as bricks, concrete blocks, roof tiles, pavers, coatings and paints, decoration panels and flooring products (Malaysian Green Technology Corporation 2018)

ACCESS TO FINANCE

The shift towards more sustainable construction practices in Asia faces a number of roadblocks and challenges. Developers still give preference to build in a fast and cheap manner and limited attention is drawn to the life cycle benefits of green buildings and the specification of sustainable building materials and green technology. Among the financial barriers that hinder the penetration of energy efficiency and green practices in the building sector are the higher upfront costs for more efficient equipment and the costs and risks associated with potential non-compatibilities and uncertainty about performance (ESCAP & KOICA 2012). To overcome these barriers, many countries in Asia have put in place financial incentives to foster the green building industry and incentivise the application of green construction practices and green technologies. This section comprises examples of incentives applied in Malaysia, India and China for different purposes within the building and housing sector and how they contribute to promote and raise awareness on sustainability and resource efficiency in buildings.

Green investment tax incentives in Malaysia

The Green Technology Tax Incentives aim to encourage investments in green technology in the country, motivate companies to acquire green certified products and enhance the number of providers for green services (Malaysian Green Technology Corporation 2016). There are three categories of activities: the Green Investment Tax Allowance (GITA) for assets; the Green Investment Tax Allowance (GITA) for projects and the Green Income Tax Exemption (GITE) for services.

The GITA for assets is applicable for companies that purchase assets registered under the MyHIJAU Mark and are listed under the MyHIJAU Directory. This category features a GITA of 100% of qualifying capital expenditure incurred on approved green technology assets listed in the categories of energy efficiency, building and transport (Malaysian Green Technology Corporation 2016). The GITA for projects applies for companies that undertake qualified green technology projects on the areas of renewable energy, energy efficiency, green building, green data centre, and waste management (Malaysian Green Technology Corporation 2016). Lastly, the Green Income Tax Exemption is applicable for companies that provide green technology services verified by GreenTech Malaysia and listed under the MyHIJAU Directory. The

rate of incentive is 100% of statutory income from 2013 until 2020, with a five years maximum period. To qualify, companies must not only obtain the certification by GreenTech, but also comply with certain requirements, such as having at least one qualified personnel specifically for green technology services, featuring enterprise policy related to sustainability and having their income originating 100% from green technology services (Malaysian Green Technology Corporation 2016).

Financing green construction and affordable housing in India

In order to achieve the Government's objective of providing affordable housing for its low-income population, the Confederation of Real Estate Developers (CREDAI) and the State Bank of India (SBI) partnered in 2017 to strengthen development of the green housing sector in the country (CREDAI 2017). The CREDAI is the highest body in India for real estate builders and developers, working as a partner with government representatives, policy makers, investors, finance companies and consumers in organising the construction industry in the country. The SBI, one of the largest banks and mortgage lenders in India, signed a three-year Memorandum of Understanding with CREDAI to support its members with construction finance for eligible affordable housing(CREDAI 2017). The partnership between the two entities also supports green construction projects through concessional interest rates.

Financing of retrofit programmes in China, the Tonghua County Programme

Green building efforts in China have been heavily dependent on governmental subsidies, especially for large-scale retrofit programmes. During 2011-2015 (11th Five-Year Plan), 700 million square meters of existing residential buildings were retrofitted in the north of China to improve energy efficiency (Mo 2016). More than 80% of the costs were covered by the local and central governments, highlighting the need to establish market mechanisms to allow for efforts in this area (Mo 2016).

Some cities have managed meaningful experiences in implementing large-scale building retrofit programmes. One interesting example is the retrofitting programme developed in the county of Tonghua in northern China, where heating accounts for 40% of the county's total energy consumption by buildings (Mo 2016). Prior to the programme, the area accounted for 1.3 million square meters of residential and 1.1 million square meters of public inefficient buildings, with a central coal-fired heating system utilised for the entire urban area (Mo 2016). During 2009-2011, the county was able to complete the retrofit of 1.64 million square meters of existing buildings as well as to install heating meters. This led to an increase of 40% in total energy savings each year (Mo 2016). The project was funded through an inclusive financing method that matched funds from the central and local government, funds raised by district heating utility companies and residents who benefited from the project. The design of the metering and billing system for district heating was developed in a manner that would generate considerable profits for the district heating companies, thus incentivising the participation of these companies in the programme. Overall, the government was responsible for approximately 70% of the total investment, but the project has achieved significant improvements and offers valuable lessons in terms of its large-scale implementation and use of a wide array of financing sources, having been able to evoke the participation of both heating companies and residents (Mo 2016).

2.3.4 Usage

After construction is completed, the stage of usage of a building refers to its daily operation and maintenance processes, which involves energy and water consumption as well as generation of waste. As for the maintenance processes such as repairing or replacing building assemblies, life cycle assessment should also take into consideration new materials that need to be deployed. The stage of usage is usually the longest phase along the value chain and many major urban environmental challenges are related to it, for instance, the lowering of groundwater table as well as pollution of the soil and water bodies.

In order to present the most relevant aspects of sustainability during the use and operation phase of a building, this section focuses on the issues of water resource management and solid waste management,

both critical in most Asian cities dealing with an intense and rapid urbanisation process. The first part of this section presents examples of policies and regulations related to these two sectors in the selected countries, as well as some of the challenges for implementation and compliance. This is followed by trends and innovative projects in resource conservation, focusing on initiatives that relate directly to the users' consumption behaviour. The third part of this section presents systems and standards for energy performance of appliances and how they have been developed and implemented in the selected countries. Finally, financial support mechanisms aimed at encouraging environmentally friendly behaviour in the use and operation of buildings are discussed.

POLICY ENVIRONMENT

As mentioned above, many environmental problems faced by Asian cities are related to the operation of buildings. Various cities in Asia are facing water crises, resulting mainly from inequalities in the distribution and deficient water management, characterised by low efficient systems, excessive pumping of groundwater, pollution of water bodies etc. In terms of solid waste management, urbanisation has also impacted the generation of waste in Asian cities. With increasing volumes of municipal solid waste, which is also becoming more complex due to non-biodegradable and toxic elements, open dumping is still the most common method of final disposal, resulting in water and soil contamination.

This section presents examples of how policies and management plans for water and waste have been implemented in Asia, highlighting the importance of fostering practices related to the use of storm water and reuse of grey water, as well as to the application of the 3R principle in terms of waste management.

Water efficiency in China, the case of Beijing

Water management is still one of the constraining factors for sustainable development and the building of a wealthy society in China. Although rich in water resources, ranking sixth in the world in terms of volume, the available water per capita is less than one quarter of the world average (Global Water Partnership 2015).

The megacity of Beijing has undergone a water crisis in the last decades, both in terms of quantity and quality of water. Over the past 30 years, water demand has always exceeded the available water resources in the city, leading to the overexploitation of groundwater (Global Water Partnership 2015). In 1957, the Preliminary Master Plan for Beijing's Urban Development was formulated, comprising strategies to deal with the water scarcity and various projects implemented. At that time, the focus of water management was on providing water for the growing population and the economy, rather than on measures for water conservation (Global Water Partnership 2015).

Since the 1980s, water conservation has been promoted across all sectors in Beijing, with the issuance of the Interim Regulation on Groundwater Management, requiring all new projects to include water conservation facilities. The regulation also promoted the use of water-saving devices, which reached a coverage of almost 100% in public institutions and 95% in households in 2014 (Global Water Partnership 2015). Another instrument contributing to water conservation is water pricing. Water fees were introduced in Beijing in 1960, but did not go through any change until 1983 (Global Water Partnership 2015). At present, tariffs are readjusted more frequently, helping to encourage water conservation.

Mechanisms to capture and use storm water have also been developed in Beijing. The Provisions on water conservation in Beijing were published in 2000 and comprise requirements for all public utilities to build storm water collection and use facilities (Global Water Partnership 2015). Other regulations and standards for storm water use have also been implemented, promoting, for instance, the use of permeable brick pavements for storm water harvesting.

The national waste management master plan in Thailand

Dealing with serious challenges regarding waste management and disposal, Thailand has developed and implemented a National Agenda for Municipal Solid Waste Management in the past few years. The responsible authority is the Pollution Control Department which prepares recommendations for standards of environmental qualities, emissions and effluents, monitors environmental quality and develops proposals for waste management systems, methods and technologies. Table 5 presents the four main policies of the Thai National Agenda on Waste Management and their contents (Pollution Control Department 2017).

Despite the efforts of the Thai government in developing policies and regulations for the management of municipal solid waste, obstacles still remain. In 2017, appropriate management systems were used only in 12% of the overall waste disposal sites. The remaining sites are characterised by dumpsite methods, improper incineration systems and outdoor burning. Most of these sites, i.e. 1,730 out of the 2,474 improper facilities, are dumpsites (Pollution Control Department 2018).

Table 5: Main policies on waste management in Thailand (Adapted from Pollution Control Department 2018)

Policy	Year	Details
National Solid Waste Management Master Plan (2016-2021)	2016	- Encourage waste reduction at the source by following the 3R principle. - Establish proper disposal methods in the municipalities, with focus on waste utilisation and waste-to-energy methods. - Involve all relevant sectors in waste management.
Action Plan "Thailand Zero Waste" (2016-2017)	2016	- Minimise waste by promoting separation at source. - Establish a database for waste management. - Establish methods to handle improper disposal wastes and hazardous wastes. - Targets for reduction of waste generation, collection centres in communities and correct disposition of infectious waste.
Action Plan "Clean Province"	2017	
20-Year Pollution Management Strategy and Pollution Management Plan	2018	Three strategies: 1. Preventing waste and reducing at source 2. Increasing efficiency in waste treatment 3. Developing a waste management system

TECHNOLOGY AND ARCHITECTURE

Installation of Smart Collection Points in Ulaanbaatar, Mongolia

During the last decades, the development of infrastructure has not been able to accompany the rapid urbanisation in Ulaanbaatar, Mongolia. The city's Ger areas lack public amenities such as infrastructure communal spaces and services. To deal with these issues, the Asia Foundation in partnership with the municipality of Ulaanbaatar have commissioned the design group Rural Urban Framework to develop community centres for Ger area residents (Archdaily 2016). Smart Collection Points have been designed, aiming to provide basic services for the disposal of waste to the community. At the collection points, trash can be sorted and appropriately disposed, avoiding its dumping on the streets (Archdaily 2016). The building of the collection point shall also serve as local landmark in the neighbourhoods, for instance as bus stops or information points on waste disposal.

Generation of electricity and fertiliser from organic household waste in Thailand

Rayong city is the capital of the province of Rayong in Thailand, where the increasing amounts of municipal solid waste, resulting from the rapid economic development and growing population, became a challenge for the local authorities (IGES 2010). With the city's old landfill lacking in capacity to receive more waste, the city government decided to address the problem by adopting an integrated plan for a community-based waste management scheme (IGES 2010). The scheme included not only the production of organic fertilisers from the organic household waste, but also biogas to generate electricity.

The project in Rayong city was developed within the context of the Ninth Economic and Social Development Plan of Thailand (2002-2006) that established the national strategy on community-based management of natural resources and environmental problems (IGES 2010). The government initiated a comprehensive campaign to promote waste separation at source, in order to incentivise the population on household waste recycling. As part of the campaign, citizens were provided with plastic bins to segregate organic wastes, which were then sent to the biogas facility. A comprehensive understanding of the characteristics of the household waste in the city was also an important output of the project, making it possible to assess the availability and characteristics of its components and identify the feasibility of waste-to-energy approaches (Jutidamrongphan 2018).

STANDARDS, GUIDELINES AND RATING SYSTEMS

Minimum energy performance standards (MEPS) and energy performance labelling for appliances and equipment are the two most widely utilised programmes to stimulate market transformation towards more efficient products. By establishing a regulatory framework, MEPS eliminate inefficient products from the market and compel consumers to purchase those that reach a minimal level of efficiency. The labelling of products provides consumers with adequate information and allows for better informed decisions that take into account a comparison in terms of energy efficiency. Minimum standards and labelling programmes are widespread in Asian countries, and are currently focusing on their upgrade and expansion to other types of appliances and equipment.

Energy Performance Standards and Labelling in Thailand

The MEPS were implemented in Thailand by the Department of Alternative Energy Development and Efficiency (DEDE) and the Thailand Industrial Standard Institute (TISI) to prevent the production and import of equipment that does not comply with energy standards. The MEPS comprise mandatory and voluntary certification schemes for different classes of products, with mandatory certification being required for air conditioners and refrigerators (APERC 2017). Other products covered by voluntary certification include appliances such as microwaves, electric ovens and electric kettles, as well as different types of lamps and water pumps.

Thailand also established a voluntary energy efficiency certification programme, the High Energy Performance Standards and Labelling (HEPS), known as Energy Efficiency Labelling No. 5 Programme. The voluntary scheme aims at informing consumers about highly efficient products that can contribute to reducing their electricity bills and raising awareness on the subject (APERC 2017). It also aims at enhancing the competition among manufacturers to further develop their products in terms of energy efficiency, so that low-efficient equipment is gradually replaced by energy efficient products.

Malaysian Standards and Minimum Energy Performance Standards

In 2014, the Ministry of Energy, Green Technology and Water in Malaysia issued an amendment to the Electricity Regulations of 1994, incorporating the standards and requirements for the implementation and enforcement of MEPS in the country (Energy Commission Malaysia 2016). The MEPS specify the minimum level of energy performance that appliances, lighting and electrical equipment must meet. The standards apply to five categories of electrical domestic equipment, namely refrigerators, air-conditioners, television,

domestic fans and lighting, and make it mandatory for this equipment to be affixed with an energy rating label (Energy Commission Malaysia 2016). The Malaysian Standards (MS) were developed for each of these categories of equipment, with efficiency rating levels represented by the number of stars on the label.

Minimum Energy Performance Standards and Energy Efficiency Endorsement Labelling in China

China introduced its first set of minimum energy efficiency standards in 1989, comprising requirements for eight types of products, i.e. refrigerators, air conditioners, washing machines, electric irons, rice cookers, television, radio receivers and electric fans (Lin et al. 2002). Since the introduction of MEPS, a variety of improvements and additions has been made with the policy now covering a wide range of industrial, commercial and residential appliances, divided into several categories, which are frequently-updated (IEA 2017).

In addition to the minimum standards, China also initiated a voluntary certification scheme, the Voluntary Energy Efficiency Endorsement Labelling to promote highly efficient products and allow for additional energy savings (Lin et al. 2002). The programme requires manufacturers to submit audits, undertake tests of the product in certified laboratories and comply with ISO 9000 standards. It also applies to a series of equipment, including domestic appliances, electronics, lighting and office equipment (Zhou 2008).

What is more, China launched its Mandatory Energy Efficiency Label in 2005, which includes five categories of energy efficiency for products (Zhou 2008). For any of the products covered by the mandate, manufacturers have to submit the product's energy performance information to the China Energy Label Centre (CELC) which is required to put the products on the market (IEA 2017).

ACCESS TO FINANCE

Government incentives for Ger areas in Mongolia

In 2000, the Government of Mongolia launched the National 100,000 Solar Ger Electrification Programme, aiming at providing communities of nomadic herders with access to modern forms of electricity through the adoption of portable solar home systems (Jayawardena et al. 2012). Even during winter months, Mongolia has a high number of sunny days, making solar energy a useful and sustainable way of providing electricity. The portable equipment meets the needs of the nomadic lifestyle of the population, allowing the preservation of their culture of frequent relocation by being easily dismantled and re-installed. In 2006, the World Bank started to assist the Government of Mongolia through the Renewable Energy and Rural Electricity Project (REAP), combining experience with other successful rural electrification initiatives and redesigning some key aspects of the programme (Jayawardena et al. 2012).

Air pollution is one of the most critical environmental problems in Ulaanbaatar, where raw coal is the main fuel source powering cooking and heating stoves in Ger area households. The lack of alternatives for heating and cooking prevents a shift in the use of fuel, and the intensive burning of coal makes Ulaanbaatar one of the cities with highest levels of air pollution in the world, especially during winter (UN-Habitat 2010). To reduce air pollution during this period, the Government of Mongolia approved a regulation in 2016, to cut the electricity tariff for district households to zero and offer Ger district residents free electricity during night (PAGE 2018). Moreover, the Government of Mongolia has also issued loans through the Green Fund Credit to the Ger residents for the purchase of electric heating units (PAGE 2018). The measures aim at allowing households to purchase and use electric heating devices at affordable prices and thus, avoid the need to burn coal. Still, the Mongolian government faces various implementation challenges regarding the capacity of Ulaanbaatar's power plants and the affordability of the electric heating devices (Bayarbat 2019).

Renewable Energy Subsidy in Nepal

Nepal is endowed with good renewable energy potential from hydropower, wind energy and biogas. However, still approximately 85% of the total energy consumption of the country is met by traditional biomass energy and around 28% of households do not have access to electricity (Government of Nepal 2016). As the extension of the national grid to reach these areas is not foreseen in the next years due to the high costs the project would imply and the complex topography of the region, clean and sustainable energy from renewable sources need to be developed in Nepal as both immediate and long-term solutions. The Renewable Energy Policy of Nepal was revised in 2016, with the aim of developing the renewable energy sector in the country and encouraging low-income households to use renewables by providing subsidy for the deployment of these technologies. The policy focuses mainly on off-grid applications and provides subsidies that vary according to the technology and the region for applications such as mini/micro hydropower, improved water mill, solar energy (mini-systems, mini-grids, grid-connected), biogas, biomass energy, wind energy and wind-solar hybrids (IEA 2017).

The subsidy is expected to cover 40% of the total costs of investing in these technologies, with approximately 30% coming from credit and investments of the private sector and/or contributions of communities or households (Government of Nepal 2016). The subsidy is also provided for the installation of solar PV systems in grid connect areas with irregular electricity supply, including applications such as street lighting in urban and rural areas, public educational institutions, public health facilities and religious places, as well as households. A subsidy deliver mechanism is yet to be prepared by the Alternative Energy Promotion Centre and implemented after ministerial approval (IEA 2017).

Subsidies for energy efficient appliances in Kazakhstan

In the Kazakh cities of Nur-Sultan and Almaty, residents had the opportunity to exchange their outdated household appliances at a proper recycling point and in return receive a 10% discount voucher for the purchase of new, energy efficient refrigerators. The campaign, supported by the government, UNDP and appliance companies, handed out over 2000 discount coupons, which led to increased sales of A++ refrigerators and the recycling of almost 300 large-sized domestic appliances. As the goal of the programme was not only to provide discounts on energy efficient products, consumers' attention was also directed towards the benefits of energy efficient appliances and how to read energy labels properly, resulting in raised awareness about eco-friendly lifestyles. Similar programmes are expected to be developed in the future for a wider range of products (UNDP 2019b).

2.3.5 Recycling

Recycling refers to the final stage of a building's life cycle, when its structure is dismantled or demolished to give place to new construction. During deconstruction, workers are able to manually remove a significant part of the building elements that can be re-used or recycled. This is followed by demolition where heavy equipment is employed to complete the dismantling of the building and additional recyclable materials can be sorted out from the generated rubble. The materials collected during deconstruction and demolition can be either directly reused, as in the case of windows, doors, carpets, cabinets, etc., or recycled onsite or at a processing facility (such as in the case of concrete, metal, asphalt and pavement).

The re-use and recycling of construction and demolition waste has many benefits: it diminishes emissions of GHG and other pollutants by reducing the need of extracting and manufacturing new materials, thus contributing to saving energy and reducing the environmental impacts along the buildings value chain. Besides, it contributes to conserving landfill spaces in urban areas and promotes the creation of new employment opportunities in the sector. For the developer, recycling and re-using materials means also reducing costs with waste transportation and disposal, as well as with new materials in case of reutilisation (EPA 2008).

This section focuses on the reuse and recycling of construction and demolition waste in Asia, presenting the incipient policy environment and the technology trends that are currently evolving in the region.

POLICY ENVIRONMENT

The construction and demolition (C&D) of buildings are responsible for about 40% of the global solid waste generation (UN Environment 2017). During the last decades, intense urbanisation has posed many C&D challenges especially for cities, contributing to approximately 25%-35% of the municipal solid waste in Asia (UN Environment 2017). Still, the sector has not received much attention in Asian countries and the policy environment for C&D management is very incipient. In countries like Malaysia and Thailand, for instance, most of the illegal dumping originates from the construction sector, with C&D being discarded at undesignated places as a way of saving costs.

Construction and Demolition Waste in China

With the intense urbanisation and reconstruction of old towns in the last years, China's amount of C&D waste (CDW) increased rapidly, with the major part not being recycled or disposed correctly. The average treatment rate of construction waste in most cities in China is between 3% and 10% (Wu and Shen 2012). The first CDW management related policy, i.e. City Appearance and Environmental Sanitation Management Regulations was issued in 1995, followed by several other national and regional policies which are summarised in table 6.

Despite the existing policies regulating CDW in China, waste management in China has not yet improved substantially. According to Jiao and Sun (2013), approximately 75% of the Chinese cities are facing "CDW surrounding", with the large quantities of urban CDW being disposed inappropriately in rural areas. Some of the challenges faced to achieve sustainability in CDW management revolve around short-sighted urban planning processes, lack of guidance for effective CDW collection and sorting, lack of standards, an underdeveloped market for reused CDW, ineffective management systems for CDW treatment and immature recycling technology.

Table 6: Key construction and demolition waste management laws and regulations in China (adapted from Huang et al. 2018)

Year	Regulation	Policy details
2003	Urban construction waste and engineering sediment management regulation	City Appearance and Environmental Sanitation Administrative Department is in charge of the management of CDW
2005	Provisions on the Administration of Urban Construction Garbage	Producers of CDW should bear the responsibility to treat and dispose waste
2008	Financial subsidies for energy saving building materials	Financial subsidies for CDW recycling
2009	Technical specifications for construction waste disposal	Guidance for construction waste design and management
2011	Bulk solid waste comprehensive utilisation plan	Development of demonstration projects for utilisation of CDW
2014	Implementation plan of predominant resource recycling project	Suggestion of technologies for building demolition, CDW classification and treatment of recycled aggregate

Construction Waste Management in Malaysia

CDW accounts for approximately 41% of the total solid waste generation in Malaysia, reaching an estimate of 161,19t per day in 2009 and increasing up to 299,69t per day in 2015 (Mah et al. 2016). With the country undergoing a rapid process of urbanisation and population growth, these numbers are projected to increase even more in the next years, challenging the authorities in the promotion of appropriate methods for CDW management, disposal and recycling. Table 7 displays the main legislative and administrative requirements regarding CDW in Malaysia.

Despite the number of acts and pieces of legislation governing waste management in Malaysia, CDW still attracts limited attention. Produced and managed mainly by the private sector, CDW management practices are often guided by economic reasons, with developers frequently opting for environmentally damaging and illegal practices, landfill dumping and open burning (Mah et al. 2016). Besides that, appropriate CDW management and recycling faces many challenges in Malaysia, with the legislation being weakly enforced and the lack of awareness and specific knowledge on the field among construction industry professionals.

Table 7: Key construction and demolition waste management laws and regulations in Malaysia

Regulation	Description	Details
Environmental Quality Act 127, 1974	On the prevention, abatement and control of pollution and enhancement of the environment.	- Restrictions on atmosphere pollution. - Restrictions on soil pollution: penalties for deposition of any matter on soil and for the establishment of dumps, disposal sites, etc. - Restrictions on the pollution of water - Prohibition on open burning - Prohibition on placing, depositing, etc. of scheduled solid waste.
Solid Waste and Public Cleansing Management Act 2007 (Act 627)	Regulates the management of controlled solid waste and public cleansing.	- Prohibition and penalties for unauthorised deposing, treatment, etc., of controlled solid waste. - Prohibition against unauthorised escape of controlled solid waste.
Street, Drainage and Building Act 133, 1974	Amends and consolidates the laws related to street, drainage and building in local authority areas in West Malaysia.	- Penalties for deposition of materials without permission. - Penalties for deposition of dirt on the streets during construction, alteration or demolition of a building.
Uniform Buildings By-laws, 1984 (By-law 21)	By-laws came made in exercise by Section 133 of the Street, Drainage and Building Act	- Prohibition of unauthorised deposition of building materials in any street.

TECHNOLOGY AND ARCHITECTURE

Along with the strengthening of the policy environment for disposal, recycling and reuse of CDW, technological developments can also contribute to provide solutions for ongoing problems and challenges. In recent years, the use of alternative building materials produced from different types of recycled waste has gained more prominence. These developments are of particular importance for Asia, where the rapid urbanisation process has led to the generation of excessive quantities of CDW, aggravated by natural disasters and reconstruction programmes taking place in the region (Jayasinghe et al. 2016). In this context, opportunities for the re-utilisation of CDW, as well as other types of waste, arise especially within the concrete and brick industry. This section looks at some of the technological developments in recycling construction materials, highlighting experiences and practices that have already been developed in the focal countries.

Recycled Aggregate Concrete (RAC)

As the single most widely used construction material in the world, concrete provides a very important opportunity regarding the recycling and re-utilisation of construction and demolition waste. Concrete is composed basically of water, a cement-like binder, and aggregates, most commonly sand and gravel (Gragan and Arora 2015). The natural aggregates utilised in concrete production are usually non-renewable and scarce resources, obtained by mining, that cause many negative environmental impacts along the extraction and production process. The use of recycled concrete aggregate represents thus a great opportunity for CDW management.

With increasing awareness on sustainability and environmental protection, the Chinese government has engaged in studying RAC technologies since the 1990s. In 1997, the Ministry of Housing and Urban-Rural Development (MOHURD) has included “Building waste comprehensive utilisation” in key projects for scientific and technological achievements. Nevertheless, the application of recycled aggregate is still nascent and a systematic basic research is lacking in the country. Furthermore, guidelines, codes and standards on the topic are scarce to guide engineering, given that the ordinary regulations on concrete cannot be applied to the design of RAC structures.

Composite materials from waste

Due to its large volume of final products and intensive consumption of raw materials, the brick industry is one of the prominent sectors to absorb the waste generated in C&D in Asian cities (Andreola et al. 2005). In recent years, many attempts have been made to incorporate waste materials in brick production, utilising, for instance, natural fibres, granite sawing waste, structural glass waste, fly ash, sugar cane bagasse ash, PC and TV waste, sewage sludge, etc. (Shakir et al. 2013). The bricks manufactured from waste have proved to have their physical and mechanical properties positively influenced by the addition of the waste material, and present a great opportunity for resource conservation and environmental protection in Asia.

In countries like Thailand, where agriculture plays an important role, the utilisation of waste generated by harvest and post-harvest operations from agriculture as ingredients for composite materials can be used as alternatives. Besides avoiding the further extraction of minerals and raw materials, composite materials from agricultural waste are well suited for thermal insulation. With low thermal conductivity, materials like rice hulls, sugarcane stalk, coconut husk and corn cob allow for the construction of buildings with better indoor environmental quality, more adapted to the local climatic conditions of Asian countries (Panyakew and Fotios 2008). Furthermore, many studies have been developed on the alternative use of plastic in the production of building materials. Plastic has in recent years become a major environmental problem in Asia, especially with the ban on plastic exports to China leading countries like Malaysia and Vietnam to experience significant increases in waste exports (Thompson 2019). The application of recycled plastics in the building sector can contribute to the issue of plastic waste management and offers different options

for industry, being used, for instance, for road construction and pavement to improve strength and durability and as insulator or conduit in building construction.

Reuse of local resources in Putrajaya, Malaysia

The reuse of local resources has played an important role during the initial stages of the development of Putrajaya as the administrative centre of the Malaysian government. To reduce waste generation resulting from site clearing and construction, the developer Putrajaya Holdings Sdn. Bhd. has carried out different initiatives in reutilising local resources, as, for instance, the use of aggregate rocks as material for road paving and for the construction of a dam, thus reducing the costs of construction (Putrajaya Corporation 2012).

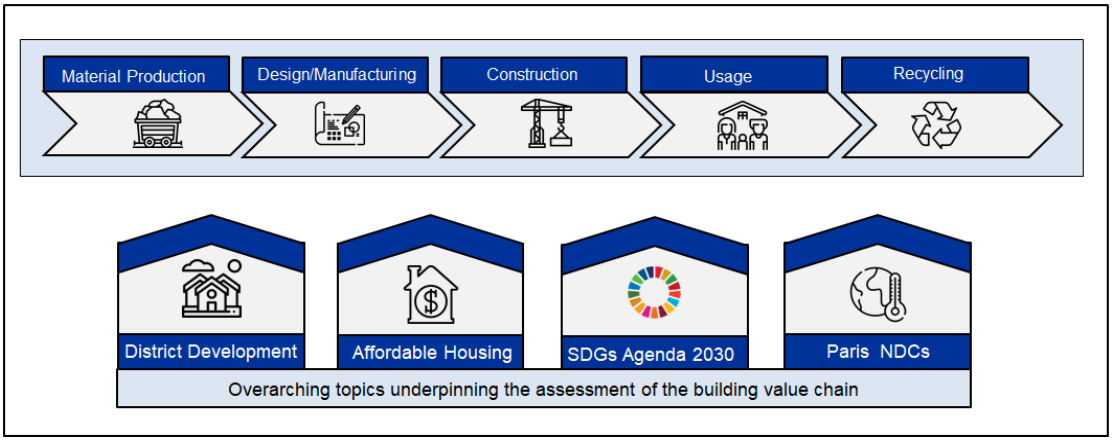
Station for recycling of construction waste in Lahore, Pakistan

Due to its rapid urbanisation in the past years, the city of Lahore, i.e. the capital of the province Punjab in Pakistan, has experienced a rapid growth of construction activities, along with the demolition of a large number of properties due to infrastructure projects. In this context, the correct disposal and recycling of CDW has become an important issue for the city, where its generation reaches 200-250 ton per day (Raza 2016). To tackle the problem, the Lahore Waste Management Company (LWMC) is working on establishing a Solid Waste Transfer Station, where not only municipal solid waste, but also CDW can be collected and recycled. The project shall contribute to decreasing the pressure on the main landfill site of the city of Lahore, as well as to the creation of new economic dimensions for the reutilisation of CDW, with the installation of a crusher plant to allow for the reuse of recyclable concrete building materials (Raza 2016).

2.4 Analysis of social and environmental aspects of sustainable housing in selected countries

Apart from the building life cycle covered in the previous section, additional overarching themes are fundamental when assessing sustainable housing in the context of SCP. They should complement the life cycle assessment and allow for a broader reflection on the subject matter, going beyond SCP and covering further facets of sustainable housing such as housing affordability, district development, and the role of housing in the international agenda on climate-action and sustainable development. Therefore, the first part of this section focuses on the building sector targets of the SDGs and NDCs set by the focal countries, followed by an analysis of the policy environment and initiatives regarding affordable housing and district development (Figure 12).

Figure 12: Overarching topics relevant for sustainable housing



2.4.1 SDGs and NDCs addressing sustainable housing of selected countries

United Nations SDGs & sustainable housing

The United Nations SDGs comprise 17 different goals with 169 targets aimed at addressing complex global challenges and encompassing a vision of global sustainable development. The SDGs present many linkages and synergies among each other, helping to integrate programmes in different sectors and developing coherent cross-sectoral policies to explore the existing synergies (Mainali et al. 2018). Regarding the building sector and more specifically sustainable housing, the most relevant goals are SDG 11 on sustainable cities and human settlements and SDG 12 on SCP.

Goal 11 – *Make cities and human settlements inclusive, safe, resilient and sustainable* - specifically deals with the issue of affordable housing. The first target of Goal 11 establishes that, by 2030, access to adequate, safe and affordable housing and basic services should be ensured to all (UN 2019). The targets of Goal 11 comprise measures focusing also on the enhancement of sustainable urbanisation and capacity for participatory planning processes, as well as on the mitigation of the adverse environmental impacts of cities, mainly related to air pollution and waste disposal. Regarding SDG 11, different levels of commitment can be identified among the selected countries. In its *National Plan on Implementation of the 2030 Agenda of Sustainable Development,* China stresses the need to advance the development of public housing in the country and establishes the general completion of the rebuilding of rundown areas, villages and dilapidated houses by 2020 (Government of People's Republic of China 2016). Mongolia, on the other hand, on its *Sustainable Development Vision 2030* does not mention housing programmes as part of its priority actions, and does not include the indicator on urban population living in slums, correspondent to target 11.1, among those used to assess the country's implementation performance (Secretariat of the State Great Hural Mongolia 2016). Nevertheless, within SDG 11, Mongolia does establish the intention to provide greater independence to urban areas and settlements and creates a healthy and comfortable environment for its citizens by improving green features and sustainable standards for urban planning (Secretariat of the State Great Rural Mongolia 2016). Regarding SDG target 11.6, Kazakhstan focuses on air quality improvement and waste management/collection services, which have grown to almost 90% coverage in urban areas in recent years. (UNECE 2019).

Furthermore, **Goal 12** of the SDGs describes the targets that should be achieved in order to *ensure SCP patterns*, including important aspects related to sustainable housing, especially regarding resource consumption, waste generation and sustainable businesses. The first target of Goal 12 establishes the implementation of framework programmes on SCP, which is already taking place in many Asian countries. Thailand, for instance, reports on its Voluntary National Review on the Implementation of the 2030 Sustainable Development Agenda the formulation of work plans to direct the implementation of Goal 12, as the 20-Year SCP Roadmap (2017-2036) and the 5-Year Action Plan on SCP (Ministry of Foreign Affairs of the Kingdom of Thailand 2018). The SDG 12 comprises targets aimed at the sustainable and efficient use of natural resources and promotion of circular economy, conservation-oriented consumption patterns and recycling practices based on waste prevention, reduction and reutilisation (UN 2019).

Other important aspects related to SCP are addressed in the targets 12.6 and 12.7, i.e. sustainable business practices and green procurement, respectively. On its implementation plan, China states the intention to support enterprises in strengthening the development of green products and in incorporating information on sustainability on corporate reports (Government of People's Republic of China 2016). The Malaysia SDGs Voluntary Review 2017, although not prioritising Goal 12, presents the measures and initiatives implemented in Malaysia to foster SCP. Among them, the Government Green Procurement (GGP) is a measure to create demand for green products and services in the domestic industry, which has received much attention in the country in the last years. The guidelines on GGP have been adopted in stages in Malaysia since 2014, and were made mandatory at the federal level in 2017 (Economic Planning Unit Prime Minister's Department Malaysia 2017). In Kazakhstan, education on sustainable development

is now integrated as early as preschool through to secondary education thus contributing towards target 12.8 (UNECE 2019).

Apart from Goals 11 and 12, other SDGs include synergies related to sustainable housing. **Goal 1**, on ending poverty, highlights the need to ensure access to basic services, ownership and control over land and other forms of property (UN 2019). This is an important issue in the Asian context, where affordability of land and housing in urban areas is one of the biggest challenges. Malaysia's Voluntary Review addresses the higher cost of living and income vulnerability by monitoring prices, and improving the access to affordable housing, transportation and health system (Economic Planning Unit Prime Minister's Department Malaysia 2017). **Goal 7**, on the access of affordable and clean energy, also has implications on sustainable housing as it determines the need to increase the application of renewable energies and enhance energy efficiency. As part of its implementation plan, China, for instance, defines within this goal the advancement to low-carbon and green urbanisation models by promoting "the building of energy management system, measurement system and online energy consumption monitoring system to review, assess and increase energy efficiency".

Sustainable Housing and the NDCs for the Paris Agreement

The NDCs are at the heart of the Paris Agreement, embodying the efforts by each country to achieve its long-term goals in terms of emissions reduction and adaptation to climate change (UNFCCC 2019). All signatory parties are requested to submit NDCs every five years to the UNFCCC Secretariat, projecting their highest possible ambition and represent a progression compared to the previous NDC submitted (UNFCCC 2019). Given the significance of the construction sector and the building environment for the long-term temperature goals established by the Paris Agreement, the NDCs of most countries include provisions on enhancing efficiency and controlling emissions from buildings. Nevertheless, concrete policy actions, targets, and measures to reach these ambitions are lacking in most submissions. Table 8 presents insights from the NDCs of the ten focal countries examined in this study in order to better understand their priorities and overarching objectives. For each country, the general contributions and main actions covered by the NDCs are illustrated, as well as the specific measures for the building sector.

Table 8: NDCs from selected countries and their specific targets on the building sector

Country	Submission year	NDCs – Main objectives and specific actions in the building sector
China[2]	2015	Main Actions • To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early; • To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level; • To increase the share of non-fossil fuels in primary energy consumption to around 20%. Building Sector • To enhance low-carbonised urbanisation, improving energy efficiency of buildings and the quality of building construction, extending buildings' life spans, intensifying energy conservation transformation for existing buildings, building energy-saving and low-carbon infrastructures, promoting the reutilisation of building wastes and intensifying the recovery and utilisation of methane from landfills; • To promote the share of green buildings in newly built buildings of cities and towns reaching 50% by 2020.

[2] Government of People's Republic of China 2015

India[3] 	2015	**Main Actions** • To reduce emissions intensity of GDP by 33%-35% from 2005 levels by 2030; • To achieve about 40% cumulative electric power installed capacity from non-fossil fuel based energy sources by 2030; • To enhance investments in development programmes in sectors vulnerable to climate change to promote better adaptation efforts. **Building Sector** • Promoting energy efficiency in the economy, with focus on the industry, transportation, buildings and appliances sectors; • Development of climate resilient infrastructure.
Kazakhstan[4] 	2016	**Main Actions** • To reduce GHG emissions by 15%-25% by 2030 compared to 1990; • To become one of the 30 most developed countries in the world by 2050, following a path of low-carbon economic growth; • To contribute to international efforts to combat climate change. **Building Sector** • Modernisation of housing and communal services; • Modernisation of production technologies based on energy efficient technologies.
Kyrgyzstan[5] 	2015	**Main Actions** • To reduce GHG emissions in the range of 11.49% – 13.75% below BAU in 2030; • To limit the per capita GHG emissions to 1.58 tCO_2 in 2050 in line with the 2°C objective; • To prevent climate change related damages and losses in the country. **Building Sector** • To update sectoral adaptation programmes and action plans for energy, industrial processes, land use and waste.
Malaysia[6] 	2016	**Main Actions** • To reduce GHG emissions intensity of GDP by 45% by 2030, relative to the emissions intensity of GDP in 2005. This consists of 35% on an unconditional basis and a further 10% is condition upon receipt of climate finance, technology transfer and capacity building; • Importance of adaptation efforts in the country's context. **Building Sector** • Specific actions in the building sector or in the field of sustainable housing are not foreseen.

[3] Government of India 2015

[4] Government of the Republic of Kazakhstan 2016

[5] Government of the Kyrgyz Republic 2015

[6] Government of Malaysia 2015

Mongolia[7] 	2015	**Main Actions** • To reduce 14% in total national GHG emissions compared to BAU by 2030; • To increase renewable energy capacity from 7.62% in 2014 to 20% by 2020 and to 30% by 2030 as a share of total electricity generation. **Building Sector** • To reduce building heat loss by 20% by 2020 and by 40% by 2030 compared to 2014 levels; • To reduce emissions in the cement industry through upgrading the processing technology; • To reduce the consumption of fossil fuels by improving stove efficiency at household level.
Nepal[8] 	2016	**Main Actions** • Nepal is one of the most vulnerable countries to climate change, water-induced disaster and hydro-meteorological extreme events. The country places climate change adaptation at the centre of its development plans and policies. • To achieve 80% electrification through renewable energy sources by 2050; • To reduce dependency on fossil fuels by 50% by 2050. **Building Sector** • To promote greener, smarter and better homes in the post-earthquake situation with the implementation of the Nepal Building Code; • To formulate the Low Carbon Economic Development Strategy to promote economic development through low carbon emission on certain sectors, including energy and human settlements.
Pakistan[9] 	2016	**Main Actions** • To reduce up to 20% of its 2030 projected GHG emissions subject to availability of international grants to meet the total abatement costs; • National Adaptation Plan creates a framework for action to guide implementing agencies on mainstreaming climate change efforts into policies, strategies and programmes. **Building Sector** • Mitigation options in energy demand sector include the replacement of incandescent bulbs with LED; the utilisation of efficient stoves, water heaters, refrigerators, space heaters and air conditioners; • Low priority mitigation options include the improvement of roof insulation for energy efficiency.

[7] Government of Mongolia 2015

[8] Government of Nepal 2016

[9] Government of Pakistan 2016

Sri Lanka[10] 	2016	Main Actions • To reduce GHG emissions against BAU scenario by 20% in energy sector and 10% in other sectors (transport, industry, forest and waste) by 2030. Building Sector • To mainstream climate resilience in building design and promote alternative materials for construction; • To enhance the resilience of human settlements and infrastructure to extreme weather events; • To achieve housing for all by 2025 through the implementation of low income housing.
Thailand[11] 		Main Actions • To reduce emissions in 20%-25% compared to BAU by 2030; • To achieve 20% of power generation by renewable energy by 2036; • Priority sectors: energy, transport, waste management, industrial sectors and product use sectors; • Priority given to adaptation efforts, as the country is one of the most affected by climate-related impacts. Building Sector • Specific actions in the building sector or in the field of sustainable housing are not foreseen.

2.4.2 Affordable Housing

With the fastest urbanisation rate in the world, Asian cities grew by approximately one billion people from 1980 to 2010, and are expected to add another billion by 2040, according to projections from the United Nations (UN-Habitat and UN ESCAP 2015). In this context, the provision of affordable housing at scale, especially for low-income groups, remains a key challenge to most countries. A significant proportion of households in Asian cities still live in slums or informal settlements (UN-Habitat 2011), despite the different housing programmes and policies that have been carried out in the past decades.

The approaches used to deal with the rapid urbanisation and the growing demand for affordable housing varied between the focal countries of this study. While some have focused on the direct provision of housing by the government such as Mongolia, where the real estate market has started booming only at the beginning of the 2000s; others have supported the private sector to build adequate housing structures. For example, the housing sector in China has shifted to a market-oriented approach over the last 30 years by developing and regulating the real estate market and increasing commodity housing supply. In most countries though, such efforts of adhering to a market orientation and supporting the private sector in the production of housing have not been enough to provide for the ever-growing demand in urban areas. Thus, affordability of housing has become primarily a public concern in many Asian countries: In Malaysia, high prices for housing have also affected middle-income groups of the country, which were not eligible for participation in the government housing programmes. In the implementation of such schemes, Asian governments experienced a range of obstacles. This is due to the fact that the programmes often did not suit the needs of their target groups in terms of location or type of housing. Moreover, the economic growth

[10] Ministry of Mahaweli Development and Environment Sri Lanka 2016

[11] Office of Natural Resources and Environmental Policy and Planning Thailand 2015

of the region also led to increasing costs for land and construction materials. Without adequate options for housing finance, high initial costs and/or high rents are a barrier for low-income groups to access housing.

Nevertheless, a variety of successful housing programmes and policies that improved the living conditions of the lower income population and enhanced affordability of housing has been initiated in the countries assessed in this study. Besides adding to the formal housing stock, many governments in Asia have focused on slum upgrading programmes. Below, a selection of these housing programmes is presented:

"My First Home" Scheme in Malaysia

Aiming at including low-income groups in the housing provision, the Malaysian government launched the My First Home Scheme in 2011, which provides 100% financing from banks for households with a maximal income of RM5,000 per month to purchase their first home (Hadi et al. 2014). Moreover, it allows them to avoid the 10% down payment when buying a house. The programme focuses on young adults with the age of 35 years or younger, who are employed in the private sector.

The "7-20-25" initiative in Kazakhstan

There have been several affordable housing programmes adopted by the government of Kazakhstan, mainly focused on cost reduction. The most recent is called "New Housing Opportunities for Each Family" or "7-20-25 initiative," and was adopted in March 2018. Through the National Bank, housing loans with interest payments at a rate of 7% per annum and a payback period of 25 years are provided. The application process is kept simple, requiring only a proven income (there is no minimum income required), no outstanding debts on mortgages or home loans and lack of current homeownership (National Bank of Kazakhstan 2018). The programme is open to all citizens for an unlimited amount of time, with no preferential treatment (Shalbolova et al. 2019).

The "Cheap Rental Housing" Programme in China

Cheap Rental Housing is a scheme of the Chinese government targeting low-income households, as well as other disadvantaged groups such as seniors and people with disabilities. The programme faced various challenges during its implementation and rental housing for low-income groups still needs to scale up. During the 11th Five-Year Plan (2006-2010), the Cheap Rental Housing programme regained attention and millions of units of public housing were built in combination with other forms of low-rent housing.

The "100,000 Homes Project" in Mongolia

Implemented in 2010, the 100,000 Homes Project aimed at building 75,000 housing units in Ulaanbaatar and 25,000 in rural areas in Mongolia (Otgonjargal 2015). The goal of the project was not only to reduce rural-urban migration, but also to provide urban residents with adequate living and avoid the environmental effects of the growing Ger areas in the capital. However, due to the lack of planning of funding sources, the programme was unable to deliver the promised results.

The Baan Mankong Programme in Thailand

This scheme was launched in 2003 to address the housing problems of the urban poor in the country. The plan to guide improvements in housing, environment, basic services and tenure security was prepared by the communities themselves. Based on these city-wide plans, the Community Organisations Development Institute (CODI), a public organisation responsible for the implementation of the programme, channels the government funds in the form of infrastructure subsidies as well as soft housing and land loans directly in the communities (CODI 2019). The example of the Baan Mankong Programme demonstrates how slum-upgrading schemes can provide significant improvements for social, economic and environmental conditions in informal settlements and shows the importance of engaging a wide range of stakeholders.

2.4.3 District Development

The rapid urbanisation process draws the attention to the importance of cities for future developments in Asian countries in terms of prosperity, social development and environmental protection. Over the last 50 years, urbanisation has allowed for better living conditions, increased access to housing, water, sanitation and waste collection services. Such positive developments have not taken place without consequences for the environment though: the growing urban population and the changes in people's lifestyle provoked by the economic growth of the region have led to higher consumption rates of energy and water, higher levels of GHG emissions and air pollution, increasing pollution of water bodies and large amounts of waste.

As environmental considerations gain space in more integrated and holistic urban planning approaches, the concept of eco-cities has grown in Asian countries as a way for the region to develop urban areas that are gentler to the natural environment and provide their inhabitants with better health and life quality. The concept of eco-cities has proven to be very broad and comprise different initiatives of green urban development, e.g. "low-carbon cities" or "garden cities", thus making it difficult to define rigorously the aspects that characterise an eco-city. In general, the concept is used in Asia to describe the developments in which an ecological approach to urban planning is applied, allowing for better results in terms of energy efficiency, GHG emissions, water resource efficiency, waste generation, collection and reutilisation. Different approaches to eco-cities/district development have been developed in Asia in the last decade, especially in China, where a strong eco-city development agenda has been put in place (Asia Dialogue 2017).

Eco-villages in China

In order to deal with the challenges arising from the rapid economic growth and urbanisation in the country, the Chinese government has put in place various efforts to address sustainable development. Among these efforts, the 12th Five-Year Plan presents the eco-city development agenda as an important tool for sustainability. Eco-cities have been envisioned by China as a "pioneering" programme that can help the country solving its environmental issues. The 12th Five-Year Plan for Green Building and Green Eco-City Development has selected 100 new urban areas with an area of minimum 15 square kilometres where the eco-city concept should be demonstrated with financial support from the central government (Asia Dialogue 2017).

One of the most important examples of eco-city development in China is the case of the Sino-Singapore Tianjin Eco-city (SSTEC), envisioned in a partnership with Singapore as an ecological alternative to urban planning and urban design that would allow both economies to grow together and learn from another in the transition towards a more environmentally friendly development (Ghiglione and Larbi 2015). Some examples of the ecological features of SSTEC are the urban design, which revolves around the scheme of "live-work-play", comprising walkable districts permeated by housing structures and green and blue spaces; as well as the adoption of renewable energy solutions, such as solar and geothermal systems (Ghiglione and Larbi 2015).

Many hurdles have been experienced by China in the implementation of the eco-city development agenda. One of the issues often pointed out by specialists is the lack of a system of indicators and parameters to define what an eco-city should achieve in terms of sustainability. The term eco-city ends up referring to different efforts and comprising, for instance, projects on garden-cities or low-carbon-cities (Luchino 2017). In addition, the construction of eco-cities has often been abandoned by developers, due to lack of investment. The design and urban form of these cities often does not meet the needs of the users, with housing projects that do not accommodate their lifestyle and an urban design characterised by the replication of buildings (Luchino 2017).

Model Village Programme in Sri Lanka

To address the challenge of providing permanent housing for families living in informal settlements in Sri Lanka, the National Housing Development Authority has established the "Model Village Programme" in

2017, aimed at increasing the affordable housing stock in the country and promoting development at village level (Ministry of Housing, Construction and Culture Affairs 2019). Under the programme, beneficiary families receive the title of a state owned land, in which a new house should be built, financed by a government's loan. To ensure that the beneficiaries are capable of completing the construction of the house, a loan of Rs. 400,000 at five per cent annual interest rate is provided to the beneficiaries whose monthly salary income is Rs.25, 000 or less, taking into consideration their preferences and capacities to proceed with the repayment within a 5 to 10 years' time (Ministry of Housing, Construction & Culture Affairs 2019). The implementation of the programme takes place at a village level in the sense that the adjacent construction of the new houses configures the new "Model Village". Investments have also been made on the development of essential infrastructure facilities in these areas with the assistance of the relevant Ministries and external parties, including government institutes and partner countries. In December 2018, Sri Lanka has signed two Memoranda of Understanding (MoU) with India, agreeing on the construction of 1,200 houses in 50 model villages supported by an Indian grant assistance of Rs. 600 million (Daily FT 2018). The 146th model village, "Hirikiranagama" in Anuradhapura district was inaugurated on 30th December 2018, with 25 new housing units, water and electricity supply facilities, internal roads and an access road (Ministry of Housing, Construction & Culture Affairs 2019).

One Bangkok in Thailand

Developed by the Thai TCC Assets and the multinational company Frasers Property, One Bangkok should be an integrated city district within Bangkok, composed of office buildings, hotels, residential condominiums, cultural spaces and eight hectares of green and open areas. The vision behind the development involves the design from ground up of a complete liveable district, based on people-centric principles, environmental sustainability and smart-city living (One Bangkok 2019). The project is the largest private real estate development in Thailand and should be completed in 2025 to become a new urban centre within the city. It is designed in a way to meet international and local building standards and adhere to the LEED Neighbourhood Development Platinum certification. Within the concept of "Smart City Living", One Bangkok is projected to have a centralised infrastructure system that contributes to district cooling and energy management (One Bangkok 2019).

Putrajaya Green City in Malaysia

In 2010, the Malaysia Prime Minister announced "the development of Putrajaya as a Pioneer Township in Green Technology as a showcase for the development of other townships" (Putrajaya Corporation 2013). Since then, a collaborative feasibility study has been developed in partnership between the Putrajaya Corporation, the University Technology of Malaysia, the Kyoto University, the Okayama University, the National Institute of Environmental Studies, and the Malaysia Green Technology Corporation (Othman and Wee 2011). Called "Putrajaya Green City 2025" (PGC2025), the study has estimated the GHG emissions for the city for seven different sectors and established 12 implementation actions for the development of the three environmental targets proposed in the plan:

1. Putrajaya as a low-carbon city: the plan establishes the target of 60% reduction in GHG emissions related to energy use in comparison to the 2025 BAU projection level.
2. Cooler Putrajaya: a target of reducing the peak of temperature by 2°C.
3. 3R Putrajaya: reduction of 50% in the final disposal of solid waste to landfill as well as of GHG emissions in comparison to the 2025 BAU projection level (Putrajaya Corporation 2013).

Putrajaya was designed to accommodate the government ministries from Kuala Lumpur and become the new Federal Government Administrative Centre reflecting the values of an integrated, environmentally friendly city (Putrajaya Corporation 2013). Among the features included in the green development plan is the emphasis on green building design and certification, the land use planning for green and open spaces, the programme of energy efficient retrofitting for buildings and infrastructure and the promotion of solar energy applications (Putrajaya Corporation 2013).

As one of the targets focuses on 3R practices and waste management, implementation actions have been established in this field, with the provision of 3R facilities for solid waste treatment, recycling programmes and innovative reuse of waste by the local community (Putrajaya Corporation 2013). Another important feature of the city's development is the greywater management system, which works through the operation of the manmade lakes that function as large water retention structures (Putrajaya Corporation 2013).

Green Quarter in Nur-Sultan, Kazakhstan

Within the framework of EXPO-2017, an international exposition with the theme of 'Future's Energy' and the goal of creating dialogue around ensuring sustainable access to energy while reducing emissions, the green quarter of Kazakhstan's capital was conceptualised. Intended for reuse after the expo, many large-scale, futuristic, and LEED certified buildings were built on the site, including residential areas and services. The district is also home to the International Centre of Green Technologies and Investments, which seeks to support the country's transition to a green economy, minimise the carbon footprint of the energy sector, and track regional green projects in a single database (Edge KZ 2019). Although the district is still under development, the following features are planned to promote the latest energy-saving technologies: green-roofs, energy efficient elevators, solar power, energy-saving window glazing, reuse of rain water as well as parking and charging stations for electric vehicles, to name a few (Strategy2050.kz Information Agency 2015).

2.5 Additional insights on SCP through country briefs

In addition to the in-depth analysis performed for the focal countries in the previous sections, this section offers further insights regarding the situation of SCP in the context of sustainable housing in other SWITCH-Asia countries in Central, South and South-East Asia, i.e. Afghanistan, Bangladesh, Bhutan, Cambodia, Indonesia, Laos, Maldives, Myanmar, Philippines, Tajikistan, Turkmenistan, Uzbekistan and Vietnam.

The country briefs comprise key facts for each country in terms of: (1) the situation of urbanisation and informal settlements; (2) the building sector targets determined in the country's NDCs; (3) the status on the development of energy building codes, rating systems and financial mechanisms; (4) the most important polices on affordable housing; (5) the trends of SCP along the stages of building lifecycle; and (6) the main challenges for the development of sustainable housing in each country.

AFGHANISTAN

Background (1)

Population (2017)	35,530,081
Urban Population (2017)	25.25%
Urban Population Living in Informal Settlements (2014)	63%

NDCs on the Building Sector

- For 2030 mitigation, the contributing sectors include: i) Energy efficiency in households, services, transport etc. ii) Solid waste management, segregation and composting of biodegradable waste.
- Develop an assessment for vulnerability and adaptation to climate change. (2)

Green Building

Energy Building Code

Afghanistan Energy Efficiency Codes for Building (AEEC) have been announced as part of the Energy Efficiency policy of 2016. Legal and institutional frameworks for the code are still to be established (3). By 2009, eight green building pilot projects have been demonstrated by the Groupe Energies, Renouvables, Environnement et Solidarités (GERES). (4)

Green Building Rating System

There is no national green building rating system in place in Afghanistan. The country also does not have any projects that are LEED or BREEAM certified.

Access to Finance

- Housing Microfinance (HMF) and Community-Based Savings Organisations (CSBOs) provide non-collateralised loans for incremental housing construction and home improvements only.
- Shortage of banks and financial institutions that provide long-term mortgage loans/housing finance. (5)

Affordable housing

- Afghanistan National Development Strategy objectives: +50% housing units (affordable shelter) and +30% serviced land on the market, coupled with access to affordable finance.
- The Urban National Priority Programme, National Urban Policy and the National Housing Programme are under development.
- Mega projects: New Kabul city, Khwajah Rawash, Khushal Khan, Qasaba project. (6)

SCP Trend

Material Production (7)	Limited capacity for building material production, mostly imported. Use of local building materials is being promoted.
Design/ Architecture (8)	Vernacular architecture with typical courtyard housing; irregular detached dwellings on single plots.
Construction (9)	Mud houses are the norm, only 7 per cent of houses are built with concrete or bricks.
Usage (10)	Informal Settlements Upgrading Policy (2013); more than 60% population lives in temporary structures.
Recycling (11)	No proper waste management/ collection or recycling policy in place: informal sector.

Challenges

- ✖ The gap between housing need and supply is very large with a rapid urbanisation partly due to returning refugees and rural-urban migrants
- ✖ Lack of capacity and coordination among urban sector institutions
- ✖ Lack of accurate data on which to base critical policy decisions
- ✖ Lack of available financial funds due to limited interest of donors in the urban sector

(1) World Bank 2017
(2) Islamic Republic of Afghanistan 2015
(3) IRA MoEW 2016
(4) GERES 2010
(5) UN-Habitat 2017
(6) IRA ANDS 2008
(7) UN-Habitat 2017
(8) UN-Habitat 2017
(9) UN-Habitat 2017
(10) UN-Habitat 2017
(11) A. W. Azad 2015

BANGLADESH

Background (1)

Population (2017, thousand)	164,669
Urban Population (2017)	35.7 %
Urban Population Living in Informal Settlements (2014)	55.1%

NDCs on the Building Sector

Bangladesh is committed to developing its economy on a low carbon pathway. The country committed to reduce GHG emissions in the power, industry and transport sectors by 5% below 'business-as-usual' scenario by 2030. Bangladesh aims to develop a 10-year sustainable consumption and production framework by 2020.

Green Building

Energy Building Code

The Bangladesh National Building Code provides regulation and minimum requirements of building type, size, structure strength, indoor condition, construction material, etc. There is a proposal to add energy efficiency requirements for buildings on heat insulation/ ventilation, HVAC, water efficiency and sanitation. (3)

Green Building Rating System

There is no national green building rating system but there is high demand from developers for USGBC LEED certification, with over 300 LEED certified buildings. The Housing and Building Research Institute developed recommendations for a green building code in 2012.(4) There are no BREEAM certified buildings in the country.

Access to Finance

- Bangladesh Bank is promoting energy efficiency in buildings with soft loan facilities.
- Limited access to basic financial services and formal financial institutions. (5)
- Absence of a functional mortgage market.
- House Building Finance Corporation (HBGC) is part of the housing delivery system. (6)

Affordable Housing

- National Housing Policy 2017; Improvisation of tenure security and quality of life of people living in urban poverty.
- Three main housing programmes: i. The *Grameen* bank housing programme, ii. Housing for the urban poor-BRAC initiative, iii. Reimagining slums: innovative solutions to urban housing.
- BRAC affordable housing initiative-scale up. (6)

SCP Trends

Material Production (7)	Products include bricks made up of a compressed composite of river mud and cement. They are light in weight which makes it easier to transport.
Design/ Architecture (8)	Multiple community-led, sustainable low-income urban housing projects have been piloted.
Construction (9)	Extensive use of compressed earth blocks, treated bamboo, jute composite tin corrugated iron sheets in construction.
Usage (10)	Every building or portion is classified according to its use or the character of occupancy as a building occupancy.
Recycling (11)	Plastic recycling is performed in urban areas of the country.

Challenges

- ✖ The infrastructure is unable to keep pace with the economic growth. The government meets only 7% of the annual housing demand and relies on the private sector to fill the gap.
- ✖ Corruption is widespread; the housing delivery system is uncoordinated.
- ✖ Complicated allotment and registration procedure.

(1) World Bank 2017 (2) Climate CoLab 2014 (3) SREDA 2018 (4) GBIG 2019
(5) Shrin 2016 (6) Haque 2008 (7) Hossain 2017 (8) Rakib et al. 2018
(9) Fawaz 2014 (10) SREDA 2015 (11) Chowdhury et al. 2016

BHUTAN

Background (1)

Population (2017)	807,601
Urban Population (2017)	40.16%
Urban Population Living in Informal Settlements (1990)	70%

NDCs on the Building Sector

- Integration of low emission strategies in urban and rural settlements through green buildings, sustainable construction methods and climate smart cities.
- Energy demand management by promoting energy efficiency in appliances, buildings and industrial processes and technologies. (2)

Green Building

Energy Building Code
Provides minimum requirements for energy-efficient design and construction of buildings and their systems. Relevant for new constructions, new portions of buildings and major renovations. Building envelope, HVAC, lighting, electric power and water heating. (3)

Green Building Rating System
Non-mandatory guidelines provide practical information on how to integrate and apply principles and practices of sustainable green design and construction in buildings. Formulation of the rating system is to be done by the Ministry of Works and Housing Settlement. (4)

Access to Finance

The governmental National Pension and Provident Fund provides housing loans but only to its members - civil servants and armed forces.
House rent is one of the major expenses for the majority of the population. (5)

Affordable Housing

In 1985, around 2500 employees in Thimphu were entitled with built housing by the National Housing Development Corporation. It benefitted only a small group of civil servants. Later, the policy was discarded; instead rental subsidy was consolidated in monthly salaries of civil servants. Since then, no major housing policy has been proposed in Bhutan, resulting in housing shortages (6).

SCP Trends

Material Production (7)	Bhutan is self-sufficient, set-up of industrial unit clusters for material production.
Design/ Architecture	BIM and data driven design have helped streamline the process and lower material use, but it is not commonly used.
Construction (9)	45% of the households have walls made of stone with mud or lime/cement roofs made of metal sheets (95.2%).
Usage (10)	The majority (47%) of citizens in urban areas live in rented private houses.
Recycling (11)	Short-term target to separate storage space for C&D waste and use. Waste plastic replacing bitumen in roads.

Challenges

- ✖ Growth rate in urban centres is exponential, with rural urban migration.
- ✖ Forest cover needs to be maintained according to NDC commitment, lack of urban planning and future land use allotment.
- ✖ Under-developed roadways form limitations for the transport of construction material.

(1) World Bank 2017 (2) Kingdom of Bhutan 2015 (3) Department of Renewable Energy 2015 (4) Department of Engineering Services 2013
(5) NPPF 2018 (6) Kuensel 2017 (7) IDRG 2009 (9) MWHS 2016
(10) MWHS 2016 (11) Royal Government of Bhutan 2014

CAMBODIA

Background (1)

Population (2017, thousand)	16,005
Urban Population (2017)	22.98%
Urban Population Living in Informal Settlements (2014)	55.1%

NDCs on the Building Sector

- Promotion of energy efficiency of buildings and the use of more efficient cook stoves.
- Low emitter, highly vulnerable to the effects of climate change.
- Mitigation contributions conditional upon availability of international financial support. (2)

Green Building

Energy Building Code

There is no energy building code in place. Currently, the Draft National Energy Efficiency Policy and Strategy from 2013 is revised with the aim to establish an energy building code and foster energy efficiency. Moreover, the country's green growth strategy (2013 – 2030) establishes the goal to develop green construction and to promote green technology in the sector. (3)

Green Building Rating System

There is no national green building rating system in place in Cambodia. The country also does not have any projects that are BREEAM certified. Only 15 buildings in the country are LEED certified. (4)

Access to Finance

Green funding programmes exist for certain sectors, with support schemes mainly targeting rural electrification as well as energy efficiency and renewable energy adoption in the industrial sector. So far, green credit is not a priority for Cambodian banks. Existing initiatives are led or supported by international organisations. (5)

Affordable Housing

- The National Housing Policy was developed in 2014, with the goal to identify housing options for low- and medium-income households and to determine the quantity and quality of required housing units.
- Developments in the housing sector cannot be considered affordable for the low-income population, since the prices verge into the same category as average priced condominiums. (6)

SCP Trends

Material Production (7)	Brick manufacturing industry is booming; many factories are changing to more efficient rotary designs.
Design/ Architecture (8)	The New Khmer vernacular architecture combines modern architecture with elements of traditional Khmer culture.
Construction (9)	Buildings are mostly constructed with imported steel, glass and cement. Domestic production of these materials is still incipient.
Usage (10)	Intense reform of the municipal water scheme in Phnom Pen led to reduction of water loss and increase in coverage rate.
Recycling (10)	Construction and demolition waste management practices are evolving, especially in Phnom Pen.

Challenges

- ✖ Urbanisation is taking place in a largely unplanned and unregulated manner.
- ✖ High prices of land and property combined with an inefficient banking system make housing not affordable for low income groups.
- ✖ Lack of specific construction law.
- ✖ Lack of regulations for energy efficiency and green buildings.

(1) World Bank 2017
(2) Kingdom of Cambodia 2015
(3) Kingdom of Cambodia 2017
(4) Kossov 2015
(5) Asean Bankers Association 2014
(6) Kingdom of Cambodia 2016
(7) KE, 2018
(8) Bodach & Waibel 2017
(9) Bodach & Waibel 2017
(10) IGES and UNEP 2018
(11) SWITCH-Asia & adelphi 2016

INDONESIA

Background (1)

Population (2017, thousand)	263,991.38
Urban Population (2017)	54.66%
Urban Population Living in Informal Settlements (2014)	21.80%

NDCs on the Building Sector

- No specific targets for the building sector.
- Priority mitigation areas: land use change, energy conservation, renewable energies and waste management.
- Adaptation is an important component of Indonesia's strategy. (2)

Green Building

Energy Building Code

- Government Regulation 36/2005 mandates new residential and commercial buildings to implement energy conservation measures, according to their area.
- Energy Efficiency & Conservation Standards: cover building envelope, air conditioning system, lighting system and energy auditing. (3)

Green Building Rating System

National green certification scheme called GREENSHIP: Introduced by the Green Building Council of Indonesia (GBCI) in 2011, considers five types of certification: new buildings, existing buildings, interior space, homes and neighbourhoods. (4)

Access to Finance

- MoF Regulation No. 21/2010: establishes fiscal incentives for renewable energy in the form of import duty exemption on machinery and income tax reduction for investors in renewable energy development (5)
- National Energy Efficiency Awards (PEEN) for energy efficient buildings, energy management in industry and energy saving in government institutions. (6)

Affordable Housing

- National Affordable Housing Programme: improved access to affordable housing through a mix of demand and supply side interventions.
- Different programmes on self-help housing and slum upgrading (7)
- Million Homes Programme: launched in 2014, aiming at building one million housing units per year. The programme reached its target for the first time in 2018 with 1,132,621 units. (8)

SCP Trends

Material Production (9)	PROPER: programme for rating and public disclosure of environmental performance of industries.
Design/ Architecture (10)	Practices of climatic vernacular architecture and use of bamboo as building material.
Construction (11)	GBCI Membership Catalogue lists green building products from member companies as guidance for green construction.
Usage (12)	Programme in Surabaya to reduce waste generation through the promotion of composting practices.
Recycling (13)	Construction and demolition waste management and recycling is not largely practised in Indonesia yet.

Challenges

- ✖ Lack of technical knowledge regarding green and energy efficient building practices, which are still uncommon for experts and communities.
- ✖ General perception of high costs to build green and lack of consumer demand for green buildings.
- ✖ Limited possibilities of accessing financial schemes that support green buildings.

(1) World Bank 2017
(2) Government of Indonesia 2015
(3) ACE & GIZ 2018
(4) ACE & GIZ 2018
(5) KEI 2018
(6) ECCJ & ACE 2017
(7) World Bank 2019
(8) GCR 2019
(9) Kanungo & Torres 2003
(10) Amaller et al. 2015
(11) GBCI 2019
(12) GIZ 2018
(13) Sembiring 2018

LAOS

Background (1)

Population (2017, thousand)	6,858,160
Urban Population (2014)	34.37%
Urban Population Living in Informal Settlements (2017)	31.40%

NDCs on the Building Sector

- No specific targets for the building sector.
- Laos is highly climate-vulnerable and must urgently take steps to build resilience by enhancing adaptation efforts.
- Floods are a major risk with adverse impacts on housing, causing damages to property and infrastructure. (2)

Green Building

Energy Building Code

There is no energy building code in place in Laos.
The National Energy Efficiency Policy from 2016 targets the reduction of total final energy consumption by around one per cent per year, compared to BAU. (3)

Green Building Rating System

There is no national green building rating system in place. The only LEED certified building in the country is the Embassy of the United States. (4). The country also does not have any projects that are BREEAM certified.

Access to Finance

The Investment Law (2004) includes some provisions to incentivise energy efficiency, such as exemptions from import/export duties, but no targets have been defined yet on energy efficiency and conservation in buildings. (5)

Affordable Housing

- The majority of the population lives in rural areas.
- National Shelter Strategy (1991): did not result in specific actions, regulations or budgets for housing. Recommendations concern mostly land use and accessibility, infrastructure and building materials.
- No formal mortgage market for private or commercial housing finance. (6)

SCP Trends

Material Production (7)	Timber extraction linked to development projects is a booming industry, causing intense deforestation.
Design/ Architecture (8)	Diverse typologies of vernacular architecture consider climatic aspects and passive design and make use of local materials.
Construction (9)	Generally, houses are self-built and owner occupied. Materials like bamboo and wood are intensively utilised.
Usage (10)	Improved Cook Stove Project: to design new, energy efficient cook stoves for households.
Recycling (11)	No system in place for proper segregation and recycling of construction and demolition waste.

Challenges

- ✖ Country is highly vulnerable to climate hazards, in particular floods and droughts.
- ✖ Lack of legislation and policy environment for housing development and energy efficient/green buildings.
- ✖ Laos is a net importer of construction materials.
- ✖ Limited governmental budget and lack of capacities regarding sustainable housing.

(1) World Bank 2017
(2) Lao PDR 2015
(3) ACE & GIZ 2018
(4) ACE & GIZ 2018
(5) ACE & GIZ 2018
(6) Vangkeomany 1999
(7) Koch 2016
(8) Facts and details 2014
(9) UNDP & MEM Lao PDR 2017
(10) Phonsavath 2017
(11) Global Green Growth Institute 2018

MALDIVES

Background

Population (2019) (1)	451,738
Urban Population (2017) (2)	41.7%
Urban Population Living in Informal Settlements (2014) (3)	Nil

NDCs on the Building Sector

- Energy efficiency in domestic consumption, processes and product use
- National Building Code to increase resilience and climate proofing in buildings
- Development of sewage treatment on islands, solid waste management. (4)

Green Building

Energy Building Code

Under the National Building Code for design of buildings, provisions for efficient use of energy have been listed:
- Thermal resistance to heat loss
- Heat Gains through building envelope
- Air tightness
- Control systems for cooling and ventilation (5)

Green Building Rating System

There is no national green building rating system in place in Maldives. The country also does not have any projects that are LEED or BREEAM certified.

Access to Finance

- Mutual Fund Scheme: to assist in the wider distribution of resource use benefits and wider participation of communities (6)
- The Housing Development Finance Corporation (HDFC) was established in 2004 as a wholly owned government institution to provide long-term housing finance in the country. (7)

Affordable Housing

"Affordable housing for All" scheme: Affordable housing loan is provided to the low income group. Banks and financial institutions involved in the scheme are mandated by the central bank to allocate at least 10% of income to low-interest housing loans. The tenure of the loan is 20 years. (8)

SCP Trends

Material Production (9)	- Traditional houses made of corals are built on silts. - Male has modern architecture of stones, bricks and concrete.
Design/ Architecture (10)	Houses made of crushed corals; porites are common.
Construction (11)	Regulation on coral mining, construction materials are not locally available, except for corals.
Usage (5)	- Appliance energy labelling, building codes, energy Audits - Water & sewerage policy
Recycling (5)	Solid waste: Provision within the building for temporary storage of solid waste, installation of rubbish chutes.

Challenges

- ✖ Poor domestic waste management, limited land and water scarcity issues.
- ✖ Overpopulation and overcrowding in cities.
- ✖ Limited island economies, physical isolation and social exclusion.
- ✖ Biodiversity faces threat from habitat destruction and overexploitation.

(1) World Population Review 2019
(2) Worldmeters 2019
(3) OHCHR 2014
(4) UNFCCC 2015
(5) Ministry of Construction and Public Infrastructure 2008
(6) UNCTAD 2001
(7) Asian Development Bank 2008
(8) Maldives Independent 2017
(9) Cruising Maldives 2016
(10) Safari the globe 2012

MYANMAR

Background

Population (2017, thousand)	53,370,309
Urban Population (2014)	30.32%
Urban Population Living in Informal Settlements (2017)	41%

NDCs on the Building Sector

- No specific targets on the building sector.
- Mitigation actions include increasing access to clean sources of electricity and the number of efficiency cook stoves.
- Urban planning regulation is also being drafted to support sustainable development. (2)

Green Building

Energy Building Code

National Energy Efficiency and Conservation Policy, Strategy and Roadmap (2015): sets strategic objectives for each sector. The building sector is aimed to reduce electricity consumption by 12% from 2012 baseline by 2020.

A new National Building Code is still under development. It shall provide requirements for some key energy efficiency items, like lighting, HVAC, building envelope, etc. (3)

Green Building Rating System

There is no national green building rating system in place in Myanmar. The country also does not have any projects that are LEED or BREEAM certified (4) (5)

Access to Finance

Incentives for investors in renewable energy projects are provided under the 2016 Investment Law. The law permits foreign investment in the energy sector for the development of renewable sources and of energy efficiency, and includes incentives like tax reliefs, reduction in research and development expenses and exemptions or relief of custom duties for imports. (6)

Affordable Housing

- The Department of Housing and Urban Development (DUHD) provides social housing with a long-term mortgage system. Low-income families can purchase housing by opening an account at the Construction and Housing Development Banks, in which they have to save a certain percentage of the housing price to be eligible for the scheme.
- A National Housing Development Law is being drafted by DUHD. (7)

SCP Trends

Material Production (8)	Building materials are primarily imported. However, investors are boosting local cement and concrete production.
Design/ Architecture (9)	Wide use of local materials for the construction of houses, such as wood, bamboo and leaves and grasses for roofing.
Construction (10)	Residential sector is responsible for a large part of construction activities. Still lacks proper legislation and enforcement.
Usage (11)	Due to the lack of standards for energy performance of appliances, imported inefficient products are able to enter the market and commonly used.
Recycling (12)	Solid waste is in general not properly treated or recycled. The Draft National Waste Management Strategy was established in 2018.

Challenges

✖ Limited capabilities and no previous experience of the government in developing and implementing policies on urban planning, energy efficiency and conservation and building standards.

✖ Construction sector lacks legislation and is not formally organised.

✖ Most building materials are not locally produced.

(1) World Bank 2017
(2) Republic of Myanmar 2015
(3) ACE & GIZ 2018
(4) ACE & GIZ 2018
(5) USGBC 2019
(6) ACE & GIZ 2018
(7) Nwal & Panuwatwanich 2018
(8) Oxford Business Group 2015
(9) Oo et al. 2003
(10) Oxford Business Group 2015
(11) United for Efficiency 2017
(12) Ministry of Natural Resources 2018

PHILIPPINES

Background (1)

Population (2017, thousand)	104,918.09
Urban Population (2014)	46.68%
Urban Population Living in Informal Settlements (2017)	38.30%

NDCs on the Building Sector

- No specific targets on the building sector.
- Pursuit of mitigation measures is conditioned to financing resources, technology development and capacity building.
- Public financing will prioritise adaptation to reduce vulnerability. (2)

Green Building

Energy Building Code
Department of Energy Guidelines for Energy Conservation of Buildings: key document regarding building energy efficiency. The guidelines cover lighting appliances, electric power and distribution, building envelope, ventilation and air conditioning, among others. (3)

Green Building Rating System
Building for Ecological Responsive Design Excellence (BERDE) (2013): developed as a voluntary rating system and a referral code in the National Building Code. It is applied as a tool to verify and monitor building performance, based on the country existing regulations and standards. (4)

Access to Finance

Quezon City, the largest in Metro Manila, awards land developers and planners with tax credits and tax discounts for compliance with green standards on design and construction. Both new buildings and those undergoing retrofit can qualify for the tax credit, which can be 15%, 20% or 25% of the total property tax due to the year, depending on the implemented measures. (5) (6)

Affordable Housing

- Urban Development and Housing Act (UDHA) (1992): national vision and guiding principles for housing and urban development sectors.
- Balanced Housing Provision: UDHA requires developers to allocate 20% of project area or project costs for socialised housing.
- National Informal Settlements Upgrading Strategy 2025 (NISUS) (2014): to provide at least one million households living in informal settlements with housing by 2025. (7)

SCP Trends

Material Production (8)	Adoption of more sustainable practices in the cement industry, like the use of alternative fuels, recycled aggregates and manufactured sand.
Design/ Architecture (9)	Traditional houses are designed for the tropical climate and built with low-cost readily available indigenous materials.
Construction (10)	Innovative building materials are produced from locally available products, such as rice husks, and recycled materials, such as plastic bottles and bags.
Usage (11)	Philippine National Standard specifies energy efficiency standards and labelling requirements for air conditioners and refrigerators.
Recycling (12)	The Philippines has a strong law addressing solid waste management, but has failed in meeting its targets and guaranteeing compliance.

Challenges

- ✖ Complex institutional coordination for planning, implementation and operation of infrastructure and services.
- ✖ Deficient housing development programme and inadequate technical, financial and managerial capacities.
- ✖ Lack of expertise and capacity in the field of green building.

(1) World Bank 2017
(2) Republic of the Philippines 2015
(3) ACE& GIZ 2018
(4) ACE& GIZ 2018
(5) Business Mirror 2017
(6) Business World Online 2011
(7) Habitat III Philippines 2016
(8) Manila Times 2018
(9) Caruncho 2012
(10) Petit 2017
(11) DOE Philippines 2019
(12) Sarmiento 2018

TAJIKISTAN

Background (1)

Population (2018)	9,100,837
Urban Population (2017)	27.13%
Urban Population Living in Informal Settlements (2014)	n/a

NDCs on the Building Sector

- Extreme vulnerability to climate change.
- Construction sector is among the basic spheres of economic activity included in the NDCs.
- Development of green infrastructure in the housing sector is subject to international funding and technology transfer. (2)

Green Building

Energy Building Code

The Law on Energy Savings and Energy Efficiency (2013) addresses the most relevant issues regarding energy efficiency. However, it has not been properly implemented and enforced.
The construction standard "Thermal protection of buildings" (2009) establishes increased requirements for thermal performance of buildings. (3)

Green Building Rating System

There is no national green building rating system in place in Tajikistan. The country also does not have any projects that are certified by an international scheme such as LEED or BREEAM. (4)

Access to Finance

There is a lack of public and private financing schemes to encourage energy efficiency activities and projects in Tajikistan. The UNDP prepared a set of documents to address the energy sector challenges in the country and proposes the establishment of a National Fund to finance RE and EE measures. (5)

Affordable Housing

- There are no mechanisms in place to foster the construction of affordable urban rental and social housing aimed at low-income groups.
- Financial mechanisms for new housing construction are geared only to high- and medium-income households.
- There is no governmental body in the country in charge of developing and implementing housing policy. (6)

SCP Trends

Material Production (7)	Extraction of raw materials, such as sand, gravel and limestone and national production of cement, concrete and bricks.
Design/ Architecture (8)	Traditional vernacular architecture characterised by earth houses employing cob technique or adobe blocks.
Construction (9)	Self-build housing makes up to 87% of the total housing output. Stones and bricks are used as building material.
Usage (9)	74% of the population uses individual ovens for heating. The use of firewood for both cooking and heating increases deforestation in the country.
Recycling (10)	Waste separation is still incipient in Tajikistan. The country generally lacks recycling infrastructure.

Challenges

- ✖ High proportion of self-build housing, lacking access to water, basic sanitation and electricity.
- ✖ 93% of the country is occupied by mountains and the entire territory is located on a zone of high seismic activity.
- ✖ Extremely low per capita floor space.
- ✖ Housing stock characterised by high degree of depreciation of basic structures of buildings and utilities.

(1) World Bank 2018
(2) Republic of Tajikistan 2017
(3) UNDP 2011
(4) USGBC 2019
(5) Laldjebaev et al 2018
(6) UNECE 2017a
(7) Dermastia et al 2017
(8) Norges Naturverforbund 2009
(9) UNECE 2017
(10) Norges Naturverforbund 2009
(11) Boboeva 2015

TURKMENISTAN

Background

Population (2018)	5,850,908
Urban Population (2018)	51.6 %
Urban Population Living in Informal Settlements	n/a

NDCs on the Building Sector

- Turkmenistan has adopted a National Strategy on climate change.
- Energy efficiency, energy conservation and use of alternative sources is among the main priorities of the country.
- Housing and communal services are among the key sectors for GHG emissions reduction. (2)

Green Building

Energy Building Code

Mandatory Energy Building Codes cover new construction and existing buildings with requirements for thermal insulation, heating and hot water, air conditioning, ventilation, design and orientation, thermal bridging, etc. The project *"Improving Energy Efficiency in the Residential Sector in Turkmenistan"*, developed by the UNDP and funded by GEF, has revised the existing energy building codes and developed corresponding guidance materials. (3)

Green Building Rating System

There is no national green building rating system in place in Turkmenistan. The country also does not have any projects that are certified by an international scheme such as LEED or BREEAM. (4)

Access to Finance

Subsidised mortgage loans are available for citizens to buy apartments in buildings with improved interior. The loans are granted on a long-term basis with a maturity of up to 30 years, annual interest of 1% and a five-year repayment period. (5) There are no incentives in place to encourage compliance with energy building codes. (6)

Affordable Housing

In the past decade, the government has promoted a number of policies to encourage housing construction and to increase private sector investment, including the introduction of credit lines and mortgages for housing. Nevertheless, the promotion of affordable housing is not a priority. Moreover, the urban renewal and beautification attempts of the capital, Ashgabat, are accompanied by expropriation, eviction and demolition of many houses. (7)

SCP Trends

Material Production (8)	Building materials industry (cement, metal structures and coatings) needs to be further developed to meet the urbanisation demand.
Design/ Architecture (9)	High-rise, multi-unit apartment buildings with white marble facade represent the vast majority of new construction in the capital.
Construction (10)	Process of construction continues to be highly centralised. The government commissions, regulates and oversees housing production.
Usage (11)	Comparatively high water usage in the country, mainly due to large-scale urban greening projects that are sustained by irrigation.
Recycling (12)	Low levels of recycling and poor controlled waste disposal sites. Open dumping is still a common practice and most municipal waste goes to landfills.

Challenges

- ✖ Very early stage of transition to a sustainable market economy, with private sector activity severely limited.
- ✖ Heavy state presence dominates economic decision making.
- ✖ Energy production is dominated by natural gas and oil.
- ✖ Resource governance characterised by lack of transparency.

(1) World Bank 2018
(2) Turkmenistan 2016
(3) UNECE 2018
(4) USGBC 2019
(5) Turkmenistan 2019
(6) UNECE 2018
(7) UNDP 2011
(8) BT Business Turkmenistan 2019
(9) UNDP 2011
(9) UNDP 2011
(10) EPRS 2018
(12) UN Environment 2017

UZBEKISTAN

Background

Population (2018) (1)	32,955,400
Urban Population (2018) (1)	50%
Urban Population Living in slum conditions (2004) (2)	50.7

NDCs on the Building Sector

- Very vulnerable to climate change.
- Adaptation is a priority in the country's activities.
- Long-term strategy for low carbon development establishes measures to reduce emissions from key sectors, including housing, thermal energy and utilities. (3)

Green Building

Energy Building Code

Energy efficiency building standards were first introduced in 1997, but compliance and enforcement remain a challenge mainly due to the decentralised construction market and the lack of awareness. The energy code is mandatory for residential and non-residential existing and new construction and comprises measures on heating, cooling, hot water, lighting and ventilation (4)

Green Building Rating System

There is no national green building rating system in place in Uzbekistan. The country has one LEED certified building and no BREEAM certified buildings. (5)

Access to Finance

Government financial framework for the housing sector is primarily intended to encourage model-housing construction in rural areas. The project "Market Transformation for Sustainable Rural Housing" was launched in 2017 with the aim of designing and scaling-up a green mortgage market mechanism to boost the demand for rural low-carbon housing. (6)

Affordable Housing

- The provision of affordable housing does not satisfy the demand in large cities and the contribution of the public sector to the supply remains very low. Almost all investments in housing are undertaken through private funds.
- The government prioritises rural development and rural housing provision as a long-term strategy, aiming at increasing quality of life in rural areas and decreasing rural-urban migration.
- High rates of home ownership. (7)

SCP Trends

Material Production (8)	Cement production accounts for 76% of the total materials production sector. The energy-intensive wet method dominates the industry.
Design/ Architecture (9)	Detached single-family houses dominate the current practices. The enforcement of building standards in design and construction is problematic.
Construction (10)	Apartment buildings are built from reinforced concrete and brick. Regulations restrict the height of buildings due to the high seismicity in the country.
Usage (11)	The residential sector is the largest end user of energy and natural gas. Widespread use of low efficiency gas boilers in individual households.
Recycling (12)	Landfills receive solid waste, industrial and construction waste, among others. A high proportion of landfills do not meet regulatory standards.

Challenges

- ✖ Housing market is constrained by insufficient financing and lack of government incentives.
- ✖ Affordable housing provision remains a challenge due to the increasing urbanisation process.
- ✖ Lack of supply of energy efficient products, materials and technologies.
- ✖ Lack of data on housing prevents the government from developing targeted policies.

(1) World Bank 2018
(2) UN-Habitat 2004
(3) Republic of Uzbekistan 2017
(4) UNECE 2018
(5) GBIG 2019
(6) Green Climate Fund 2017
(7) Ministry of Economy of Uzbekistan 2014
(8) Kholikov 2019
(9) World Bank Group 2011
(10) UNECE 2015
(11) World Bank Group 2016
(12) UNECE 2015

VIETNAM

Background (1)

Population (2017, thousand)	95,540.80
Urban Population (2014)	35.21%
Urban Population Living in Informal Settlements (2017)	27.20%

NDCs on the Building Sector

- Energy efficiency and renewable energy applications in the residential building sector are among the mitigation actions.
- Mitigation measures involve also awareness raising, the development of eco-cities, green housing and improvement of energy efficiency. (2)

Green Building

Energy Building Code
Vietnam Energy Efficiency Building Code: introduced in 2013, the code provides mandatory technical standards for design, new construction and retrofit of civil buildings (commercial, residential and service buildings) with a minimum size of 2,5000m², with requirements for building envelope, ventilation, air conditioning, lighting, etc. (3)

Green Building Rating System
LOTUS certification: introduced in 2010 as a voluntary rating tool by the Vietnam Green Building Council is based on various international systems. Standards apply for residential and non-residential buildings, as well as for buildings in operation. (4)

Access to Finance

The Vietnam Development Bank provides low interest rate loans for listed projects that focus on saving energy and applying renewable energy. Fund clients include projects investing in energy-saving technology in residential areas or for commercial purposes, such as solar water heater, high voltage AC, lighting, etc. (5)

Affordable Housing

- 2011: National Housing Development Strategy up to 2020: sets the construction of 100 million m² of floor area annually until 2020.
- 2015 Housing Policy: the state resumed its role as a supplier of housing. The law introduces public social housing and government incentives for social housing development, such as land use fee exemptions and taxes reductions and exemptions. (6)

SCP Trends

Material Production (7)	National policies to enhance production and consumption of green non-fired bricks which are more environmentally friendly.
Design/ Architecture (8)	Lessons from vernacular architecture are used for building orientation, ventilation and water conservation.
Construction (9)	The Vietnam Green Building Council provides a resource directory for green building products and services, the Vietnam Green Database.
Usage (10)	Mandatory labelling for household appliances and endorsement labelling for high performance lighting products.
Recycling (11)	High amounts of construction and demolition waste, mostly indiscriminately dumped. Recycling practices are not fully developed.

Challenges

- ✖ Large number of actors involved in governance of the housing sector and lack of coordination among them.
- ✖ Lack of technical skills, research and knowledge among stakeholders in the sector.
- ✖ Low level of market penetration of green building materials.

(1) World Bank 2017
(2) Socialist Republic of Viet Nam 2016
(3) ACE & GIZ 2018
(4) ACE & GIZ 2018
(5) UNIDO 2018
(6) Habitat III Viet Nam 2016
(7) The Voice of Vietnam 2018
(8) Truong 2014
(9) VGBC 2016
(10) Ministry of Industry and Trade 2012
(11) Van Tuan et al. 2018

2.6 International Best Practices

In the last decades, there have been considerable developments in the fields of green and resource efficient building and sustainable urban planning around the globe. This section aims at providing examples of best practices from the international context, highlighting the lessons and opportunities these projects can offer to the development of sustainable housing in Asia. Following the methodology applied for the assessment of the selected countries throughout this scoping study, the examples described in this section are organised according to the different stages of the building's value chain – material production, design and manufacturing, construction, usage and recycling – and presented as one-pager briefs.

The section on material production discusses the advancements by the cement industry in the European Union towards more resource and energy efficient production methods and the utilisation of "co-processing" technologies. This is followed by the design and manufacturing stage that comprises two case studies covering the implementation of building standards in two different contexts, namely in Germany and in Singapore. The German example demonstrates the successful experience of developing and implementing standards for energy efficient building design combined with funding schemes based on the EU Energy Performance of Buildings Directive (EPBD). The case study on Singapore presents the characteristics of the country's green building rating system and the implementation success factors which contribute to its forerunner position in Asia's green building industry. The section on construction also illustrates two best practice cases: The first example presents a guide on the environmental impacts of building materials published in the UK, while the second discusses the capacity building efforts for safer construction in Nepal. On the stage of usage, the case of the ENERGY STAR and EnergyGuide Programmes in the United States is illustrated as best practice example for an implementation of energy labelling programs for household appliances. Last on the value chain, the stage of recycling introduces the concept of Superuse architecture, developed by the Dutch architecture practice Superuse Studios, and the Harvest Map, an open-source online platform for materials reutilisation.

In order to provide a comprehensive overview, this section also deals with best practice examples for the overarching topics of this scoping study – affordable housing and district development. The section on affordable housing discusses the project of the Star Apartments in Downtown Los Angeles, developed by the architecture firm Michael Maltzan to tackle the challenges related to homelessness in the neighbourhood of Skid Row. Furthermore, the Swedish Hammarby Sjöstad project is presented as a model of sustainability and integrated design in urban planning.

MATERIAL PRODUCTION

Cement production in the EU

Cement is a key construction material for global housing and infrastructure needs, being applied as a binder in the production of concrete, one of the most used materials in the world. As an energy-intense industry - with energy accounting for 30%-40% of production costs - the cement industry plays a major role in resource conservation and environmental protection, with growing challenges regarding energy efficiency and the reduction of CO_2 emissions (Chatziaras et al. 2014). To tackle these challenges, the European Union has invested in spreading the practice of "co-processing" for cement production, which uses municipal solid waste for both generating energy and replacing raw materials in the composition of cement.

The European Union produces around 2.5 billion tons of waste annually, with a considerable part stemming from cement manufacturing (CEMBUREAU 2018a). The method of co-processing makes use of the waste from municipalities and industries to heat the cement kiln to high temperatures that create the clinker, which is then mixed with mineral components to produce cement. The high temperatures of the kiln allow for the production to leave no residual materials, and to destroy harmful substances and emissions (CEMBUREAU 2018a). The share of specific thermal energy consumption coming from alternative fuels derived from waste and biomass in grey clinker production in the EU reached 41% in 2014, and has the potential to increase even more (CEMBUREAU 2013). CEMBUREAU - the European Cement Association - targets a reduction of the industry's emissions by 80% by 2050, and anticipates the technical availability of a co-processing rate of 60% in the medium-term (CEMBUREAU 2013). Such a scenario of co-processing would result in 26 Mtones of CO_2 emissions to be avoided and 15.7 Mtones of waste to be processed in all EU member states (CEMBUREAU 2013).

Besides energy generation, co-processing in the cement industry allows for the recycling of the mineral part of the waste, which is utilised in substitution to other raw materials present in the composition of cement. This avoids the further extraction of materials for that purpose. To enable the utilisation of waste as an alternative fuel for the production of cement, the availability of high quality waste fuels plays an important role, and therefore, also the appropriate separation and collection of waste.

Opportunities for Asia

The **implementation of "co-processing" technologies** would provide an opportunity for Asian countries to not only reduce the environmental impacts, but to allow the cement industry to become part of a circular economy by improving waste management and reducing the volume of waste landfilled. Important drivers for the development of co-processing methods that have been identified in the EU include: (a) waste management policies that **incentivise practices alternative to landfilling**; (b) low levels of bureaucracy regarding the processes of permitting waste utilisation; and (c) a cement industry that is open towards new methods.

DESIGN / MANUFACTURING

The German Energy-Efficiency Housing Standard

The German approach to ensure good energy performance of buildings is an innovative combination of funding schemes provided by the state-owned development bank KfW, aligned with adjustable legislative building codes. This twofold-instrument provides an incentive to build new housing that is more energy efficient than requested by the legislative minimal standards.

The increase of energy efficiency in the sectors with high energy demand, such as the housing sector, is an important pillar of the German energy transition and a policy priority of the government. Energy standards for new buildings have already been in place in Germany since the late 1970s. The so-called energy saving ordinance (EnEV), established in 2002, is the current legislative framework for the energy performance of buildings, implementing the EU Energy Performance of Buildings Directive (EPBD) on the national level.

The legal requirements for a building's energy performance in Germany are not expressed as fixed values, but in relation to the standards of a reference building, which are periodically updated. The compliance baseline refers thus to the primary energy demand of the building as a whole, so that it is possible to compensate, for example, for poor thermal insulation by applying renewable energies in the project. Besides the legal obligations, the KfW development bank defines its own "efficiency house" standards for the bank's financing programmes. These standards are determined by the energy consumption required by a real building in relation to a reference building that complies with all legal requirements, and displayed in the form of a percentage. The numbers of the different KfW efficiency houses KfW 40, KfW 55, KfW 70) stand thus for the percentage of energy consumed by this house in comparison to a reference house. EE related programmes from KfW are provided in the form of low-interest loans and grants (KfW 2018a). The amount of subsidy depends on the energy savings achieved by the respective building. In 2017, more than half of all new dwellings were built with the efficiency house standard 55, therefore significantly exceeding legal requirements for energy efficient construction (KfW 2018b).

Opportunities for Asia

The German approach of combining energy efficiency related funding schemes with adjustable legislative building codes can provide valuable lessons for Asian countries. An interesting opportunity lies in the implementation of **flexible building codes,** i.e. the legal requirements for the energy performance are not expressed in fixed values but by a periodically-updated reference building with certain standards. Another interesting feature of the German system that can be replicated in the Asian context is the **establishment of different thresholds** for receiving funding. This allows for buildings that over-achieve the legislative standards to be rewarded by their efforts, stimulating more developers to invest in measures that exceed the minimum requirements.

DESIGN / MANUFACTURING

Singapore BCA Green Mark

In the white paper "The Top 10 Global Cities for Green Buildings" developed by the management consultancy firm Solidiance, Singapore is one of the top-rated cities in the world together with Paris, London, Sydney and Tokyo in terms of its efforts in sustainable design and energy conservation in the building environment (Solidiance 2016). In the category "Green Building Codes and Targets", Singapore emerges in the report as the standout leader and forerunner in the industry by putting in place a comprehensive set of policies, regulations and incentives. Moreover, with the launch of the City's Sustainability Blueprint, a target to green 80% of its building stock by 2030 has been set (Asia Green Buildings 2016).

To encourage stakeholders to start building and living green and to promote practices of sustainable design, construction and operation of buildings, the Building and Construction Authority (BCA) of Singapore launched the BCA Green Mark in 2005. Through this green building rating system the environmental impact and performance of buildings can be assessed. Unlike the US Green Building Council's LEED certification, the Green Mark has not been developed by an industry association, but rather directly by the government, with focus on achieving specific policy targets of energy and water resource conservation in the building stock (Baker 2019). The rating system is now more widely applied in Asian countries than the LEED standard, given the fact that it is particularly well-designed for the tropical and sub-tropical climates of the region. BCA Green Mark provides a comprehensive framework for assessing the performance of new and existing buildings in five categories, i.e. energy efficiency, water efficiency, environmental protection, indoor environmental quality and other green/innovative features (BCA 2019). Under the assessment system, buildings can be awarded with Platinum, Gold Plus, Gold or Certified rating depending on the number of points they score within the scheme.

The policies and regulations set out by the government in Singapore represent big drivers of the growth of the green building industry in the country. By setting effective policy frameworks in place, local and regional governments can improve the level of commitment in the sector towards the established targets. Moreover, the BCA Green Mark provides different financial incentives for stakeholders investing in the certification. The most impactful incentive in driving new and existing developments to undertake measures of energy efficiency has been the Green Mark Gross Floor Area Incentive Scheme, which grants additional floor area for projects attaining the Green Mark Platinum or Gold ratings (Solidiance 2016).

Opportunities for other Asian countries

The **integration of green building targets and regulations into Singapore's policy environment** is key success factor of the BCA Green Mark that can be replicated in other contexts in order to foster green building practices. Other relevant factors for the implementation of the scheme are the **introduction of financial incentives** associated to the rating system and the **integration of standards for green building products** in the certification, allowing developers to score more points in the rating by applying listed products. The implementation strategies can be adapted according to the country's context and provide opportunities to tackle some of the main challenges faced by Asian countries in endorsing a green building rating system.

CONSTRUCTION

Capacity building for safer construction in Nepal

In 2015, Nepal experienced a disastrous earthquake of magnitude 7.8 (M_w) with an epicentre at Barpak, Gorkha district, followed by a strong aftershock. Estimates indicate that around eight million people in the country were affected by the earthquake, with impacts in 31 out of 75 districts and more than 700,000 buildings collapsing or experiencing severe damage (Karmacharya et al. 2018). An assessment of 200,000 buildings conducted by the National Society for Earthquake Technology (NSET) – Nepal shows that more than 95% of the people killed during the earthquake were inside buildings, highlighting the importance of building code implementation to regulate safer construction in hazard-vulnerable regions (Guragain et al. 2018).

Nepal developed its National Building Code (NBC) in 1993, with assistance of the United Nations Development Programme (UNDP) and the UN-Habitat to provide basic provisions for seismic design (Karmacharya et al. 2018). However, although compliance with the building code has been made mandatory in 1998, the majority of the buildings continued to be constructed in violation to the requirements of the code. To scale up the good initiatives developed in some municipalities in the period between 1998 and 2011, the NSET developed a programme, aimed at supporting selected municipalities in implementing the NBC, thus encouraging effective compliance and enforcement.

A survey conducted by the NSET to understand the existing situation in the municipalities indicated three core issues hindering proper building code implementation: (1) lack of awareness on safer resilient construction; (2) lack of capacity building on seismic building design; and (3) inadequate institutional set up (Guragain et al. 2018). Based on the results of the survey, the NSET developed a strategy considering these three issues at its core. To promote awareness raising on the topic, activities were developed for social leaders, community groups, and house owners, aimed at changing risk perception among the population and informing about earthquake resilient construction. Bottom-up activities to increase awareness on the code included school education programmes, on-the-job training for masons and contractors, home owner orientations, mobile earthquake safety clinics as well as demonstrations and advertisement on the radio and television.

Opportunities for other Asian countries

Although much remains to be done to widespread building code implementation in Nepal and improve resilience of the country's building stock, the experience of the Building Code Implementation Programme in Municipalities of Nepal (BCIPN) provides interesting insights for other countries in Asia in implementing building regulations. Effectively implementing building codes is one of the most important ways to decrease potential risks from earthquakes and the experience of Nepal provides a valuable lesson on the necessity of awareness raising and education in developing countries to create demand for construction safety. To supply this demand, capacity building programmes are fundamental to provide training for different stakeholders in the construction industry.

CONSTRUCTION

The Green Guide to Specification, United Kingdom

The Life Cycle Assessment of building materials is an important tool for the environmental evaluation of buildings, providing a systematic analysis of a product over its entire lifespan, taking into consideration each and every aspect of it, from the extraction of raw materials for production until the recycling alternatives at the end of its lifecycle. To provide architects and developers with guidance on making environmentally friendly choices on construction materials and components, the Green Guide to Specification was first published in the UK in 1996 explaining the environmental impacts of building materials (BRE Centre for Sustainable Products 2015).

The Green Guide to Specification has had various editions since its first publication and is periodically revised and updated by BRE to reflect the changes in the construction industry. The current version of the guide contains more than 1,200 specifications of products to be applied in six generic categories of buildings: commercial, educational, healthcare, retail, residential and industrial (BRE 2009). For each of the products, a Life Cycle Assessment is conducted to examine a broad range of environmental impacts over a period of 60 years for the stages of manufacture, installation, use and final disposition and demolition. BRE's Impact Categories of analysis include, for instance, climate change, water extraction, mineral resource extraction, waste disposal and fossil fuel depletion, among others (BRE Centre for Sustainable Products 2015). To facilitate the comparison, materials are grouped into elemental categories covering the main building elements, e.g. walls, roofs and windows.

The information obtained through the Life Cycle Assessment of the products is translated into a single rating, scaled from A+ to E that measures the environmental performance of materials and allows for them to be easily compared. Even though the specifications are generic in nature to keep the rating simple, the guide is a valuable tool for professionals in the construction industry to take into consideration a lifecycle perspective on the choice of materials for a project without necessarily having any prior expertise on such kind of assessment. Besides, over the years, the Green Guide on Specification has become part of the Building Research Establishment Environmental Assessment Methodology (BREEAM) certification, which awards credits for projects using the guide to select high performance specifications for key building components. Furthermore, it has also become part of the UK's Code for Sustainable Homes, launched in 2006, to provide standards for the design and construction of new homes in England. Within the Code, developers can also be awarded with credits for applying materials with low environmental impact according to the Green Guide (BRE Centre for Sustainable Products 2015).

Opportunities for Asia

Guidance and information on the environmental performance of building materials can contribute to **raise awareness** on the impacts they cause along their lifecycle and **building capacity** in the construction industry. This helps practitioners to make better informed choices for more sustainable materials. Associating this guidance to green building certification schemes highlights the importance of this type of assessment and rating scheme and **incentivises the adoption** of the guide early in the design process.

USAGE

U.S. ENERGY STAR and EnergyGuide Programmes

Energy labelling programmes can have very positive impacts on energy conservation and efficiency during the stage of use and operation of a building. Since its introduction in 1992, the ENERGY STAR labelling has allowed for the saving of four trillion kilowatt-hours of electricity in the U.S. and achieved over 40 million metric tons of GHG reductions (Energy Star 2018). As some of the longest existing and most successful international experiences, the U.S. Energy Star and Energy Guide Programmes can provide valuable lessons for the development of energy labelling programmes in Asia.

U.S. EnergyGuide labelling programme

The EnergyGuide Programme was established in the United States in 1980 by the Federal Trade Commission (FTC) in response to the 1975 Energy Policy and Conservation Act that mandated the development of a **mandatory energy labelling programme**. The label provides consumers with information about the energy consumption, efficiency and operating costs of different appliances, including boilers, central air conditioners, clothes washers, dishwashers, freezers, furnaces, heat pumps, pool heaters, refrigerators, televisions, water heaters and window air conditioners.

ENERGY STAR

The ENERGY STAR **endorsement labelling programme** was introduced in the U.S. in 1992 on a joint effort of the U.S. Environmental Protection Agency (EPA) and the Department of Energy (DOE). The voluntary program aims at promoting products that are more efficient than the legal minimum standards and providing customers with credible and unbiased information on the energy performance of different appliances. The label covers at present different categories of products, such as appliances, building products, commercial food service equipment, heating and cooling equipment, lighting, office equipment and water heaters.

Opportunities for Asia

As most of the assessed Asian countries still do not use MEPS or comprehensive labelling programmes, the U.S. EnergyGuide and ENERGY STAR provide interesting examples of best practices in the development and implementation of energy requirements for products:

a) Strong legal background: Both labelling programmes in the U.S. present a **strong legal basis in the national law**, as well as a clear definition of the agencies regulating implementation and enforcement of the programme and their responsibilities.
b) **Flexible and quick revision process**: The revisions of the ENERGY STAR occur in an independent manner from the revisions of the mandatory minimum standards. This allows the process to be quicker in adapting to market changes and increasing the penetration of more efficient product models.
c) Rigorous certification requirements: The requirements for ENERGY STAR include testing in EPA accredited laboratories and certification of testing results by approved certification bodies.
d) Evaluation and Monitoring Process: The ENERGY STAR programme is subject to **consistent evaluations and monitoring** over time. Surveys are conducted on annual basis to assess awareness and influence of the programme, providing continuous feedback and opportunities for improvement (Zou and Zeng Khanna 2017).

RECYCLING

Superuse and the Harvest Map, Netherlands

Developed by the Dutch architecture practice Superuse Studios, the concept of "Superuse" revolves around the idea of creating architecture by shortcutting the flow of new construction products through a design process that starts by identifying waste material components available in the area adjacent to the project site. The approach aims at promoting circular economy within architecture and design and involves not only the reuse of materials, elements and components of former buildings, but the application of other different products and parts to functionalities they were not meant to perform. To support this approach and allow for the access of the public to waste materials, Superuse Studios have developed the Harvest Map, an online platform and market place for redundant and second hand materials of all kinds.

The Harvest Map was first developed in 2012 as an innovative approach for mapping local waste streams that may serve designers and architects in their work. The Web GIS tool displays all objects available for reutilisation, as well as factories and industries and the kind of waste they produce in a continuous flow an area map around the project site. Associated with the concept of Superuse, the idea behind the Harvest Map is to provide a platform to be employed as a tool to anticipate the selection of materials for projects in the very early design stages, fostering creative solutions to make use of the waste or redundant materials available in the area. The platform includes construction materials coming from demolitions, as well as products that have reached their end-of-life, unsold inventory and stock and leftovers from industrial manufacturing (Mezzi 2018). By mapping and researching the surrounding area of the project, the Harvest Map allows identifying potential material resources that can guide design choices and enable original solutions. The platform is running in the Netherlands, Austria, France, Belgium and Spain, as well as China (Mezzi 2018). The adaptation and implementation of the platform in the different contexts is undertaken through partnerships with local entrepreneurs (BBM Sustainable Design 2017).
Superuse Studios have applied the concept of Superuse in different architecture, interior and furniture design projects. The Villa Welpeloo, for instance, is a residential project in Roombeek, in the Netherlands, mainly constructed out of demolition materials and manufacturing residues, such as steel profiles that previously constituted a textile machine and wooden slats from redundant cable-reels, collected from a local cable factory (Archello 2019).

Opportunities for Asia

- Mapping of materials that can be "harvested" for reuse has the potential to **incentivise the emergence of sustainable building projects and social enterprises**, focused on the utilisation of locally available resources.
- Such a platform can contribute to **waste management**, avoiding waste from municipalities and industries to be landfilled or incorrectly disposed.
- The facilitation of access to waste fosters creative **and innovative design approaches** to re-utilising them.

DISTRICT DEVELOPMENT

The Hammarby Sjöstad Project in Sweden

A number of European cities have been internationally recognised for their efforts in achieving sustainable urban development. Sweden's capital, Stockholm, is on the front line of such efforts and has for decades now been investing in measures on sustainable mobility, emissions reduction, energy conservation and efficiency, waste management and sustainable water resource management. The Hammarby Sjöstad is one of Stockholm's biggest urban development projects, acknowledged worldwide as a model of sustainability in its re-development of a declining industrial district into a mixed-use area comprising housing, commercial areas and recreational spaces.

The roots of the Hammarby Sjöstad project lie in Stockholm's bid to host the 2004 Olympic Games, where the project was meant to be developed as part of an ecological Olympic Village. Although the city did not win the bid, local authorities decided to move forward with the plan of re-developing the former industrial brownfield into a sustainable model neighbourhood close to the city centre. From the beginning, ambitious goals for sustainability were integrated into the design of the project through the development of a comprehensive master plan for the area, including new public transport lines, district heating and cooling infrastructure, solutions for water treatment and an underground waste collection system (The World Energy Foundation 2016). One of the main goals of the development was to keep the environmental impacts of the district 50% lower than they would be with the technology level applied in the 1990s. Besides, the development was designed to employ 100% of energy from renewable sources, whereas 80% of it should be produced from waste collected in the area (Modarres-Sadegui Konstari 2015).

The strategic master plan was divided into 12 sub-neighbourhoods to be developed in phases along the construction works (Foletta 2011). The strong and interdisciplinary environmental goals that shaped the plan contributed for its conception as a "closed-loop" urban metabolism. Known as "Hammarby Model", the methodology applied allowed for creating a unique eco-cycle for the district that describes environmental solutions for energy, waste, water and sewage in an integrated manner (Modarres-Sadegui Konstari 2015). Energy is produced from sources like biogas products and purified waste heat. The district heating system is also based on the reutilisation of waste, which is collected through a large scale vacuum transport system that comprises 12,000 apartments in the district, as well as other facilities. Stormwater, rainwater and snowmelt are treated locally and reutilised in multiple ways in the district (Foletta 2011).

Opportunities for Asia

- Collaboration of the city authority departments with the private sector: The involvement of many architecture firms and building contractors promoted competition and stimulated the employment of higher standards and innovative technologies.
- Application of an efficient methodology based on interdisciplinary work and citizen involvement in the development of the master plan for the area.
- Definition of a comprehensive vision and establishment of main goals and targets on the early stages of the development.
- Planning of the district development as an extension of the city, rather than a separated new suburb.
- Integration of sustainable practices in managing water, energy and waste.
- Life-cycle cost analysis allowed for justifying higher initial costs.

AFFORDABLE HOUSING

Star Apartments – Social Housing in Los Angeles

Skid Row is an area in downtown Los Angeles, which has been associated with poverty and a transient migrant population for decades. California has, by far, more homeless people than any other state in the United States, many of which live on the streets of Skid Row and in the suburbs surrounding downtown Los Angeles (U.S. Interagency Council on Homelessness 2018). The neighbourhood has developed quickly around the train station, attracting and absorbing various waves of migrant workers since the 1870s. Over the century, the area has become more separated from the rest of downtown, with a high concentration of homeless people determining the strong presence of problems related to public health, criminality and substance abuse.

In 1989, in response to the increasingly critical situation in the area, the Skid Row Housing Trust was created, aimed at providing permanently supportive housing for homeless individuals and re-characterising the occupation of the area. During the 1990s, the Trust developed a new model of supportive-housing, focused not only on housing provision, but on creating architectural structures that would offer safety, support, permanence, independence and a sense of community to formerly homeless individuals (Kilston 2014). To do so, it partnered with small, creative architectural firms to develop a building model combining single rooms, communal facilities and services such as mental health treatment and substance abuse recovery (Mclaughlin 2013). The architecture firm Michael Maltzan Architecture was responsible for the design of some of the buildings developed by the Trust in the Skid Row neighbourhood over the last years, with the **Star Apartments** project deserving special highlight in the context of sustainable and affordable housing. The project was completed in 2014, transforming an existing one-storey commercial building into a mixed-used complex with 102 residential units organised around a large area dedicated to communal use (Michael Maltzan Architecture 2019). The complex comprises a public health zone at street level and a community and wellness centre at the second level, with community garden, kitchen, dining room, therapy room, library and physical exercise facilities. The Star Apartments was certified under the LEED for Homes Platinum and awarded with many different prizes since its construction for not only providing conditions to mitigate the effects of homeless, but also employing innovative design approaches and construction methods that guarantee the sustainability of the project.

Opportunities for Asia

- **Participative approach in the design process**, with "design engagement sessions" being carried out to discuss resident's needs and ideas in the early design stages.
- Incorporation of communal spaces and public services within a building's programme, contributing to the recovery and improvement of life quality of formerly homeless individuals.
- **Good quality architecture** that provides **representation** and legitimises the presence of this population in the area.
- Design solutions focused on the user, rather than on budget-driven utilitarian conceptions.

3 Assessment and comparison of SCP progress in sustainable housing in selected Asian countries

Based on the information collected on the current state and trends of SCP in sustainable housing across Asian countries in the previous part of this study, this chapter draws the attention to the respective SCP progress. Through a set of indicators, the SCP potential of the focal countries (i.e. China, India, Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka and Thailand) in the field of sustainable housing is assessed and contrasted. As SCP in combination with sustainable housing offers a relatively new perspective on the housing sector, this evaluation provides crucial insights regarding the differences and similarities of SCP approaches pursued in Asia. This assessment also helps to identify key topic areas for further promoting SCP for Sustainable Housing.

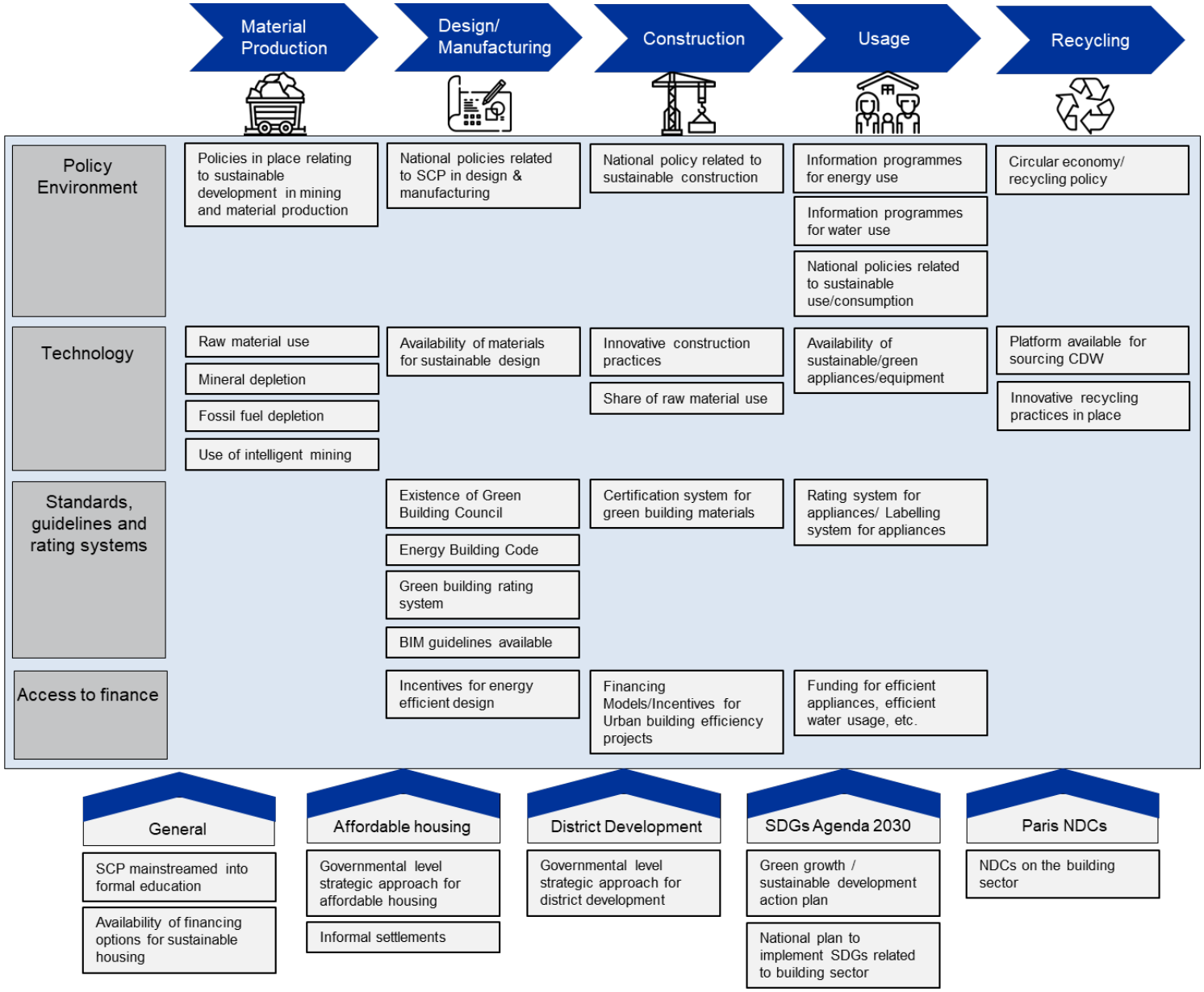
3.1 Methodology to evaluate SCP progress

In order to identify and compare SCP progress across the focal countries, a set of indicators has been defined. As depicted in Figure 13, the indicators take into consideration the different stages of the building value chain from material production to recycling, the focal areas (i.e. policy environment, technology and architecture, standards, guidelines and rating systems and access to finance) as well as the overarching topics (i.e. affordable housing, district development, building sector objectives in SDGs and NDCs).

Based on their relevance for the sustainable housing context, both qualitative and quantitative indicators have been selected and applied to the focal countries. Each indicator is ranked on a scale from 1 to 3, with 1 representing low potential and 3 representing high potential. The scale has been specified for all indicators individually. For instance, the indicator pertaining to NDCs provides a score of 1 if an NDC exists for the country but the building sector is not addressed, 2 points if the NDC outlines qualitative goals for the building sector and 3 points if the NDC sets out ambitious quantitative goals for the building sector. The detailed specifications for all indicators can be found in the Annex.

The country data for the evaluation is based on the information collected in the scoping part of this study. The complete data set is presented in the form of individual country matrices in the Annex.

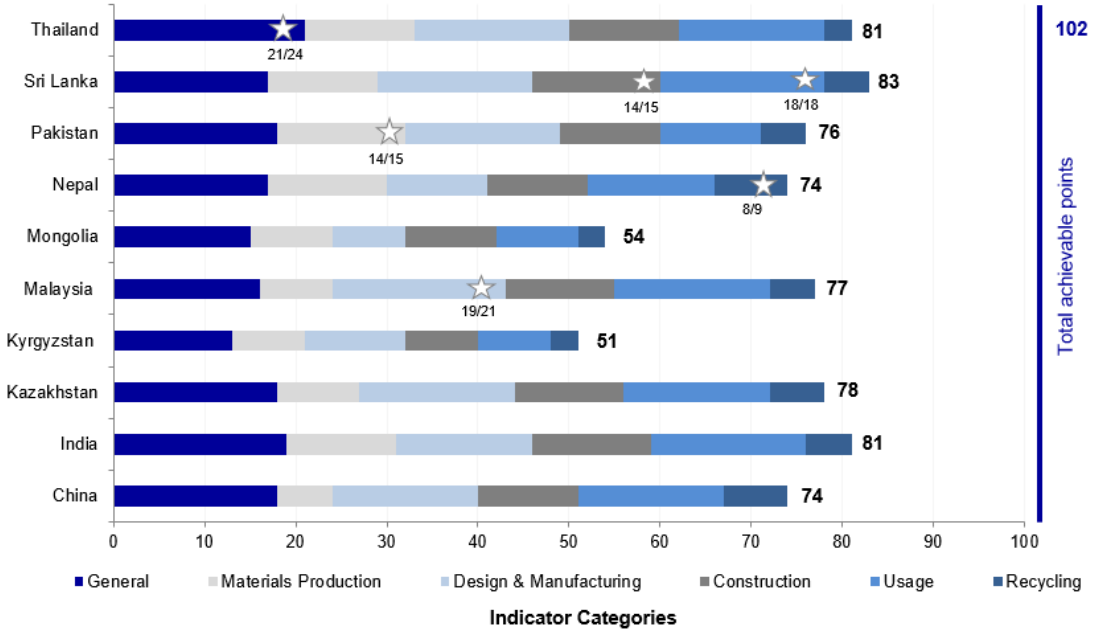
Figure 13: Indicators to evaluate SCP progress in sustainable housing



3.2 Findings on SCP progress in selected countries

With the help of the indicators presented in the previous section, the SCP progress of the focal countries has been identified. Both the overall country results as well as the scores achieved per SCP category are visualised in Figure 14. Sri Lanka reaches the highest score of the ten countries under assessment, followed by Thailand and India. Kyrgyzstan and Mongolia obtain the lowest scores with a considerable 20 points difference to the next to last countries, i.e. Nepal and China. The highest ratings within the six SCP categories are distributed across the countries of Thailand, Sri Lanka, Pakistan, Nepal and Malaysia (see stars in Figure 14). More details on the results can be found in Figure 15 with an overview of the individual scores as well as in the Annex with explanations for the individual scoring. In the following, the overall and categorical rankings of the focal countries are analysed, specifically outlining the SCP status and possible areas for improvements or best practices to be adopted.

Figure 14: Total ranking of focal countries by SCP category



Of the focal countries, **Sri Lanka** not only has the highest overall ranking, but also reaches the best score in two of the individual SCP categories – construction and usage. By putting the reduction of negative environmental impacts and strengthening of sustainable development at the forefront of their National Construction Policy (*Indicator #C.1, see Figure 15*), Sri Lanka sets an example in the construction sector. Through the use of innovative technologies and the Ceylon Institute of Builders (CIOB) Green Building Product (CGBP) certification scheme (*C.4*), which assesses building products and equipment regarding their environmental impact and performance, these activities can serve as best practice examples to lead the way for other SWITCH-Asia countries in achieving better SCP practices in the construction industry. When it comes to usage, Sri Lanka scores the total points available in

Figure 15: Summary of SCP ranking

			SWITCH-ASIA COI ON SUSTAINABLE HOUSING - FOCAL COUNTRIES									
	Indicator #		China	India	Kazakhstan	Kyrgyzstan	Malaysia	Mongolia	Nepal	Pakistan	Sri Lanka	Thailand
		General										
	G.1	Green growth / sustainable development action plan	3	2	3	2	3	3	2	3	3	3
	G.2	NDCs on the building sector	3	2	2	1	1	2	2	2	2	1
	G.3	National plan to implement SDGs related to building sector	2	3	2	2	1	1	3	3	3	3
	G.4	SCP mainstreamed into formal education	1	3	3	1	2	1	1	1	2	3
	G.5	Availability of financing options for sustainable housing	2	2	2	2	3	2	2	2	2	3
	G.6	Governmental level strategic approach for affordable housing	2	3	3	2	2	2	3	3	1	3
	G.7	Informal settlements	2	2	1	1	2	1	1	1	2	2
	G.8	Governmental level strategic approach for district development	3	2	2	2	2	3	3	3	2	3
		CATEGORY TOTAL (out of 24)	*18*	*19*	*18*	*13*	*16*	*15*	*17*	*18*	*17*	*21*
		Materials Production										
	MP.1	Policies in place relating to mining and materials production	1	2	3	2	1	2	3	3	2	3
	MP.2	Raw Material Use	1	3	1	2	1	2	3	3	3	2
	MP.3	Mineral Depletion	1	3	2	2	2	1	3	3	3	3
	MP.4	Fossil Fuel Depletion	1	3	1	1	1	2	3	3	3	1
I	MP.5	Use of intelligent mining	2	1	2	1	3	2	1	2	1	3
N		*CATEGORY TOTAL (out of 15)*	*6*	*12*	*9*	*8*	*8*	*9*	*13*	*14*	*12*	*12*
D		**Design & Manufacturing**										
I	DM.1	National policies related to SCP in design & manufacturing	1	2	3	2	3	1	1	3	3	3
C	DM.2	Availability of materials for sustainable design	2	2	2	2	2	1	2	1	2	2
A	DM.3	Existence of Green Building Council	3	3	2	1	3	1	1	3	3	1
T	DM.4	Energy Building Code	3	2	3	1	2	1	1	2	2	2
O	DM.5	Green Building Rating system	3	3	2	1	3	1	1	3	3	3
R	DM.6	BIM guidelines available	2	1	2	1	3	2	2	3	1	3
S	DM.7	Incentives for energy efficient design	2	2	3	3	3	1	3	2	3	3
		CATEGORY TOTAL (out of 21)	*16*	*15*	*17*	*11*	*19*	*8*	*11*	*17*	*17*	*17*
		Construction										
	C.1	National policy related to sustainable construction	2	2	3	2	2	3	2	3	3	3
	C.2	Innovative construction practices	3	2	2	1	2	2	3	1	2	3
	C.3	Share of raw material use	1	3	2	3	2	2	3	3	3	2
	C.4	Certification system for green building materials	3	3	2	1	3	1	1	2	3	1
	C.5	Financing Models/Incentives for Urban Building Efficiency Projects	2	3	3	1	3	2	2	2	3	3
		CATEGORY TOTAL (out of 15)	*11*	*13*	*12*	*8*	*12*	*10*	*11*	*11*	*14*	*12*
		Usage										
	U.1	Information programmes for energy use	3	3	3	2	3	2	3	2	3	3
	U.2	Information programmes for water use	1	3	3	1	3	1	3	1	3	2
	U.3	National policies related to sustainable use/consumption	3	2	3	1	2	2	3	3	3	3
	U.4	Availability of sustainable/green appliances/equipment	3	3	3	1	3	1	2	1	3	3
	U.5	Rating system for appliances/ Labelling system for appliances	3	3	2	2	3	1	2	2	3	2
	U.6	Funding for efficient appliances, efficient water usage, etc.	3	3	2	1	3	2	1	2	3	3
		CATEGORY TOTAL (outo f 18)	*16*	*17*	*16*	*8*	*17*	*9*	*14*	*11*	*18*	*16*
		Recycling										
	R.1	Circular economy/recycling policy	3	2	3	1	2	1	2	2	2	1
	R.2	Platform available for sourcing CDW	2	1	1	1	1	1	3	1	1	1
	R.3	Innovative recycling practices in place	2	2	2	1	2	1	3	2	2	1
		CATEGORY TOTAL (out of 9)	*7*	*5*	*6*	*3*	*5*	*3*	*8*	*5*	*5*	*3*
		TOTAL RATING (OUT OF 102)	74	81	78	51	77	54	74	76	83	81

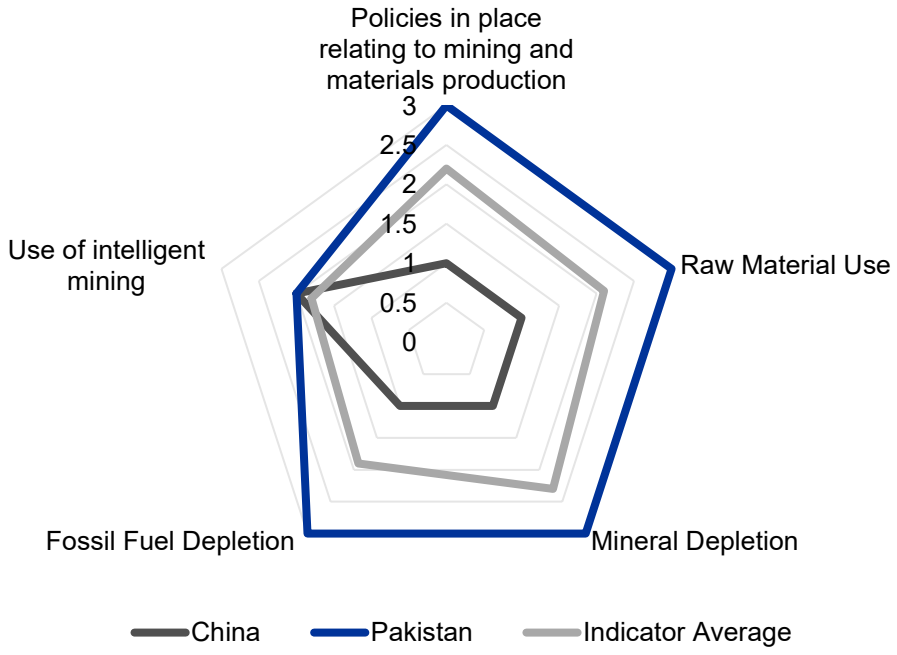
this category. The country ranks highly on the grounds of a number of progressive instruments: for example, a Presidential task force specifically designed to encourage visibility of energy efficiency in the residential building sector has been set up to manage the demand side of energy use (*U.1*). Additionally, the country promotes water conservation through television and radio advertisements, school programmes and print media (*U.2*). Efficient appliances are readily available (*U.4*) and made more affordable through government grants and discounts (*U.6*). Nevertheless, the country's SCP practices, especially in the field of recycling and overarching SCP policies still offer possibilities for further progress. In these categories, Sri Lanka scores some of its lowest points for the indicators pertaining to government level strategic approaches to affordable housing (*G.6*), policies for a circular economy (*R.1*) and strategies for dealing with CDW (*R.2, R.3*). Further efforts could be made with regards to the use of more modern technologies such as fostering intelligent mining (*MP.5*) or providing guidelines and standards for the use of BIM (*DM.6*). Sri Lanka could improve their current policies, for example, by promoting the manufacturing of and guidelines for selecting regionally sustainable materials (*DM.2, C.4*), and by providing a framework to facilitate the process of recycling or reuse of construction materials (*R.1, R.3*).

Following Sri Lanka in the overall ranking are the countries of **India and Thailand**. While India does not obtain the highest score in any single category, it does have a good and consistent ranking across all SCP aspects with its lowest performance in the field of recycling. Similar to Sri Lanka, India's highest score is reached in the category of usage with the help of extensive information programmes on the conservation of energy and water (*U.1, U.2*), a corresponding national SCP policy under development (*U.3*) and an existing labelling scheme for appliances (*U.5*) from the Bureau of Energy Efficiency (BEE). India's SCP progress in the construction industry is also considerable due to the availability of a green materials directory (*C.4*) and the comparatively low share of raw material use (*C.3*). Moreover, India will soon have a national SCP policy in place that specifically targets the construction sector (*C.1*) as well as a building code specifically designed for residential buildings (*DM.4*). As in the case of Sri Lanka and India, Thailand's efforts in recycling are comparatively low, confirming that SCP practices can be strengthened in this field. This could be achieved through the set up of online platforms to recycle CDW (*R.2*) that are already used in China and Nepal or through the development of SCP policies in the waste and recycling sector (*R.1*). China, for instance, has a Circular Economy Promotion Law in place, which specifically adresses the construction sector. In turn, Thailand ranks first in the general category, where overarching policies such as the National Sufficiency Economy Policy towards the SDGs (*G.3*), and National Economic and Social Plans (*G.1*) with specific measures to strengthen building codes and support GHG mitigation have been introduced. Further to these policies, Thailand also has a number of UN and government funded programmes to support affordable urban and green housing (*G.8*), and offers university level education specifically on the topic of SCP (*G.4*) – all of these measures put Thailand in a position to act as a forerunner in this category.

Although **Kazakhstan, Malaysia and Pakistan** fall in the middle of the ranking, many lessons can be learned when taking a closer look. For example, Malaysia performs the highest in the category of design & manufacturing, showing a very different landscape for SCP compared to the lowest and average ranked countries thanks to its well-developed Green Building Council (*DM.3*) and Index (*DM.5*), an online government-supported portal for BIM guidelines (*DM.6*) and green material product directories (*DM.2, C.4*). The country has also recently adopted a "mysmartcity" framework, providing guidance to state and local authorities to implement measures to encourage smart city development (*G.1, G.2, U.1, U.2*). Additionally, the government offers exemptions from tax and stamp duty on properties which are certified under the Green Building Index (*DM.5*). Malaysia's National SCP Blueprint for 2016-2030 was also announced in the Eleventh Malaysia Plan and mentions the importance of sustainability in the design and manufacturing process (*DM.1*). Adoption of similar SCP blueprints for design and manufacturing by the other focal countries could have a vast impact on practices in this category. Similarly, SCP activities in material production can be learned from Pakistan. As seen in Figure 16, Pakistan excels in this category, scoring nearly all points and thus, ranks highest of all focal countries. With a National Mineral Policy which outlines the importance of environmental, social and economic sustainability and impacts (*MP.1*) and comparatively

low raw materials use (*MP.2*), mineral depletion (*MP.3*) and fossil fuel depletion (*MP.4*), other countries can learn from Pakistan's practices in this sector. There is room for improvement in intelligent mining (*MP.5*), especially considering the high number of mining tragedies which took place in Pakistan over the year 2018, which could have been minimised through the use of better technology and enforcement of existing laws. Pakistan could further improve SCP along the life cycle in the categories of usage and recycling where it earns the lowest percentage of available points, particularly due to the lack of water conservation programmes (*U.2*), poor availability of energy efficient appliances (*U.4*) and lack of specific recycling policies and practices (*R.1, R.3*). Kazakhstan performs well in most categories as many of its policies are generally guided by a plethora of constantly-updated policy frameworks and strategies which incorporate SCP as an underlying theme; often providing specific objectives for the housing sector. For example, along with China, it is the only focal country to have a circular economy/recycling policy (*R.1*) in place. Likewise, Kazakhstan and China are also the only two countries to obtain the highest ranking for their energy building codes (*DM.4*). Kazakhstan's building code - the Law "on energy saving and energy efficiency" (2012) - outlines mandatory use of energy saving materials, metering of energy and water resources, use of efficient bulbs and specific targets for renewables. Its relatively new national policy for mining (*MP.*1) also sets a good example for SCP activity due to its comprehensive, streamlined and transparent character.

Figure 16: Comparison of the material production category in focal countries with the highest (Pakistan), lowest (China) and average ranking by indicator

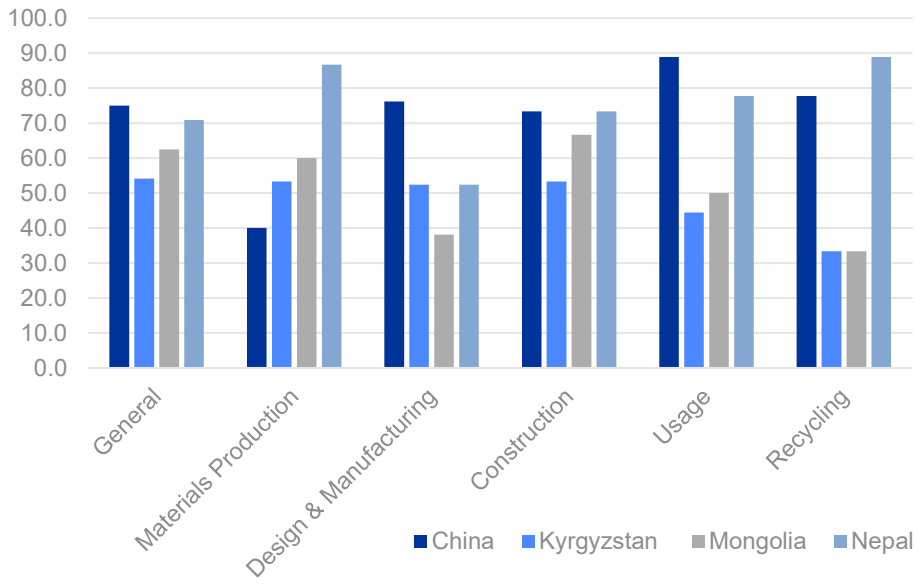


Nepal and China share the score for third-lowest ranking of the focal countries. Interestingly, Nepal reaches the highest points of all countries in the recycling category – a sector where even the highest ranked countries have low scores. Nepal performs well in this category due to bottom-up and grassroots efforts to reduce the amount of plastic waste in the mountainous region where specialised recycling and upcycling programmes have been developed. Furthermore, Nepal has circular economy policies currently under development (*R.1*), a dedicated website for sourcing CDW (*R.2*) and a UNFCCC funded programme which installs biogas plants in villages in order for citizens to recycle used cooking oils (*R.3*). While there are many indicators where China performs well, especially when it comes to the legislative environment,

such as with the above mentioned Circular Economy Promotion Law or ambitious strategies for district development (*G.8*), green growth policy (*G.1*) and goals for the building sector outlined in its NDC (*G.2*), the country has significant progress to make in other SCP fields. For instance, China ranks the lowest in materials production due to its high per capita consumption of raw materials (*MP.2*), fossil fuels (*MP.4*) and minerals (*MP.3*) as well as its lack of effective policies in the mining and production sector (*MP.1*). In turn, China also scores quite well compared to the other focal countries in the recycling category, showing that all focal countries can learn from one another despite overall rankings.

Kyrgyzstan and Mongolia rank the lowest overall, falling about 20 points behind Nepal and China. Kyrgyzstan scores the lowest of all countries in four out of the six SCP categories and received 55% or less of the achievable points in all categories. Figure 17 shows that Kyrgyzstan and Mongolia consistently fall behind the second lowest ranked countries, except for the category material production. Thus, SCP practices could be strengthened across the whole value chain. In the recycling stage both Kyrgyzstan and Mongolia score the lowest points across all indicators. Kyrgyzstan achieves a high score for some indicators in design/manufacturing based on the national SCP policies (*DM.1*) and incentives for energy efficient design (*DM.7*). In turn, without a Green Building Council (*DM.3*), green building rating systems (*DM.5*), readily available materials for sustainable design (*DM.2*) or national policies related to SCP for design and manufacturing (*DM.1*) or energy use in buildings (*D.4*), one can see why there is much room for improvement for Mongolia, who scores the minimum points for all indidcators except BIM guidelines (*DM.6*). Finally, Kyrgyzstan ranks low in the usage category due to a lack of conservation programmes for water (*U.2*), national policies related to sustainable consumption of energy or water (*U.3*), availability of sustainable or energy efficient appliances (*U.4*), and funding mechanisms to encourage the purchase of efficient appliances (*U.6*).

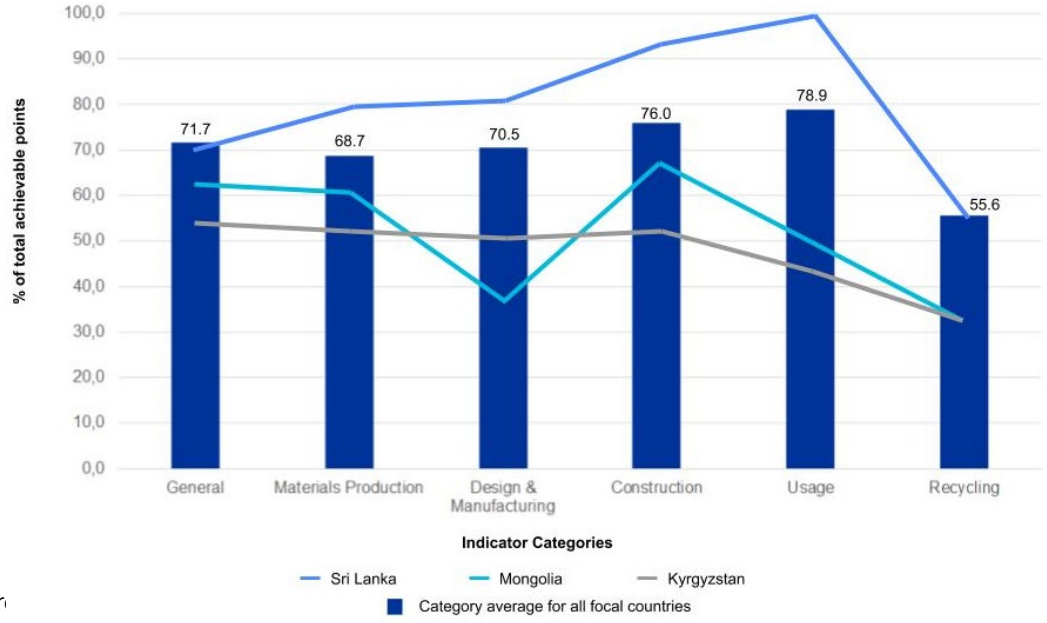
Figure 17: Comparison of two lowest (Kyrgyzstan & Mongolia) and second lowest (China & Nepal) ranked countries by category as % of total achievable points



An overview of the SCP performances by category is visualised in Figure 18. The average ranking indicates in which categories further actions and efforts are required, and where the focal countries are generally performing well. Overall, the highest rating is reached in the category of usage, followed by construction, which also corresponds to the scores achieved by Sri Lanka, i.e. the country with the highest total rank. Since all countries have strengths and weaknesses in the field of SCP, taking a closer look at the

performances in the individual categories and indicators reveals valuable insights on the overall SCP progress in sustainable housing.

Figure 18: Comparison of average rating of all focal countries by category as % of total achievable points



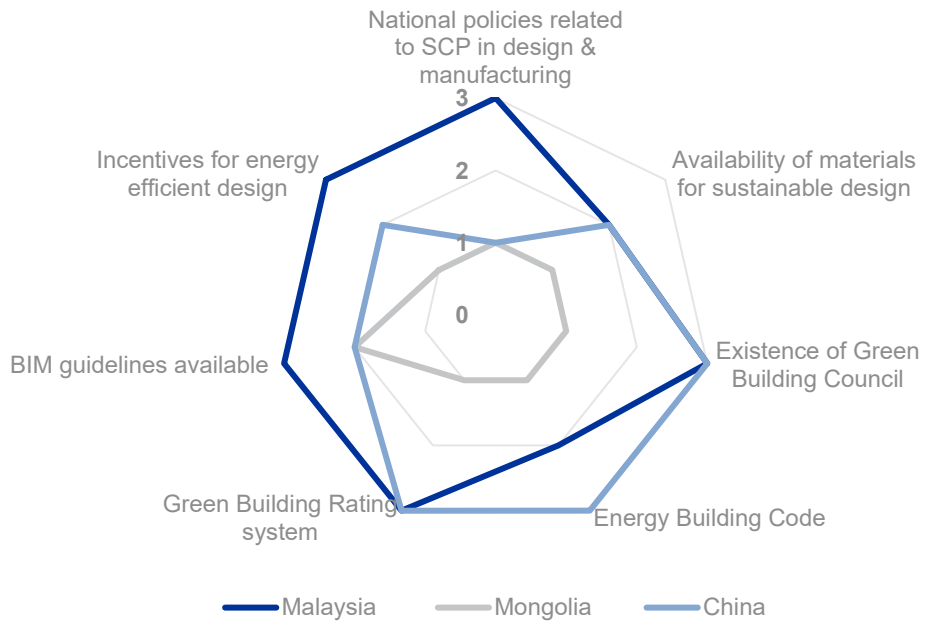
In r the green gr ries have at least set out a framework for green growth which specifically relates to the building sector. Moreover, many countries have a governmental strategic approach for district development (*G.8*) and affordable housing (*G.6*) in place. With almost all countries scoring a medium or high ranking for both of these indicators, it shows that the idea of affordable, green and eco-cities are gaining attention in the Asian context. Although high scores are reached in this category, there is still room for improvement, especially regarding NDCs (*G.2*) since very few of the focal countries set out specific goals for the building sector. It also appears that it is uncommon for SCP to be mainstreamed into formal education (*G.4*) and all of the focal countries still have a rather high number of citizens living in informal settlement situations (*G.7*). China sets a good example for Asia in regards to their NDC, as it outlines specific quantitative targets for reducing emissions in the buiding and housing sector. Similarly, lessons can be learned from India, Kazakhstan and Thailand in regards to integrating SCP into formal education, as all three countries have progressive university level education centred around the concept of SCP.

Material production falls into the bottom half of category performance. With especially low scores across the board for the use of intelligent mining (*MP.5*) and only two countries, i.e. Malaysia and Thailand receiving a high ranking for this indicator, more work needs to be done to overcome the barriers preventing a more widespread uptake of smart mining practices. Kazakhstan, however, seems to be catching up as they plan to implement digitalisation in seven key mines over the next years. Differences exist regarding policies in place addressing sustainable mining and materials production (*MP.1*) and quantitative indicators pertaining to use and depletion of raw materials (*MP.2, MP.3, MP.4*): While Nepal and Pakistan have an existing legislative framework and consume a compartively low amount of resources, China ranks last for these indicators.

Design and manufacturing is another category which lands in the bottom half when overall performance across all focal countries is considered. There is, however, a considerable variance between performance of the individual countries ranging from 38.1% to 90.5%, a gap larger than in any other category. This divergence is visualised through the highest, average and lowest rankings in Figure 19,

where Malaysia pursues almost all SCP activities across the indicators in contrast to China or Mongolia. Whereas materials for sustainable design (*DM.2*) are generally not widespread yet, Green Building Councils (*DM.3*) and rating systems (*DM.5*) have already been implemented in most of the countries. China, for instance, due to its comprehensive energy building code, incorporating acompliance inspection at different stages of the building life cycle.

Figure 19: Comparison of design & manufacturing category with highest (Malaysia), lowest (Mongolia) and average (China) ranking by indicator



In the **construction** category, the focal countries generally perform well with the total achievable points reaching more than 75%. The highest performing indicators relate to national SCP policy specifically for the construction sector (*C.1*) and financing for urban building efficiency (*C.5*). While innovative construction practices are being used or developed (*C.2*), several focal countries still lack a certification system for green building materials (*C.4*).

When comparing performance of the categories, **usage** comes out on top. Not only does this category have the highest average score, it is also the only category in which any country achieved the total points (i.e. Sri Lanka). The majority of the countries already have information programmes for energy use (*U.1*) and national policies for sustainable use/consumption of energy and water (*U.3*) in place. At the same time, awareness raising could still be strengthened regarding water conservation (*U.2*). Malaysia and India are few countries that already have extensive water conservation programmes in place. Availability of and rating systems for energy efficient appliances could also be improved in many of the focal countries.

Lastly, **recycling** performs the weakest overall, with an average rating of 55.6%. Although recycling is perceived to be a known practice, total points achieved by all countries in this category was almost 15% lower than any of the other categories. Progress could be made across the board for this category, especially regarding the availability of sites and platforms for recycling CDW (*R.2*), where nearly all countries scored the lowest ranking.

To sum up, the overall performance based on the selected indicators, shows that the focal countries of this study already have a range of SCP practices in place. Many of the countries perform well in areas such as accessibility to affordable housing, government level approaches to district development or financing incentives for urban building energy efficiency or efficient appliances. However, there is still need for further progress, especially in the areas of materials production,design & manufacturing and recycling. The implementation of the current and potential new instruments should be further monitored and evaluated to ensure continuous SCP progress in sustainable housing in the SWITCH-Asia countries. Learning from one another by discussing best practice examples from within and beyond this region creates a high potential for improvement across all SCP categories.

3.3 Limitations

Although a comparison can be made between the focal countries, there are limitations with the data upon which the assessment has been made - such as differentiation in sources of comparable data, lack of available data, quality of data, etc. Furthermore, the presence of a policy does not necessarily mean that compliance is high, or that the policy is enforced. For example, in the case of Pakistan there are many policies and instruments in place, however, proper implementation and uptake is lacking. The opposite can also be said, such as in the case of Nepal where government leadership in SCP policy is lacking, yet many grassroots organisations work towards improvements in the field of SCP, especially in the housing sector. Additionally, many of the indicators had a high rating when international donor organisations have stepped in to provide funding and programmes where governmental support is lacking. These factors should all be taken into consideration with regard to the ratings of the countries. Overall, it should be considered that the indicators are only able to capture a certain portion of the SCP activities by the focal countries. Thus, the rating is not meant to provide an absolute picture but an indication for improvement as well as replication potential.

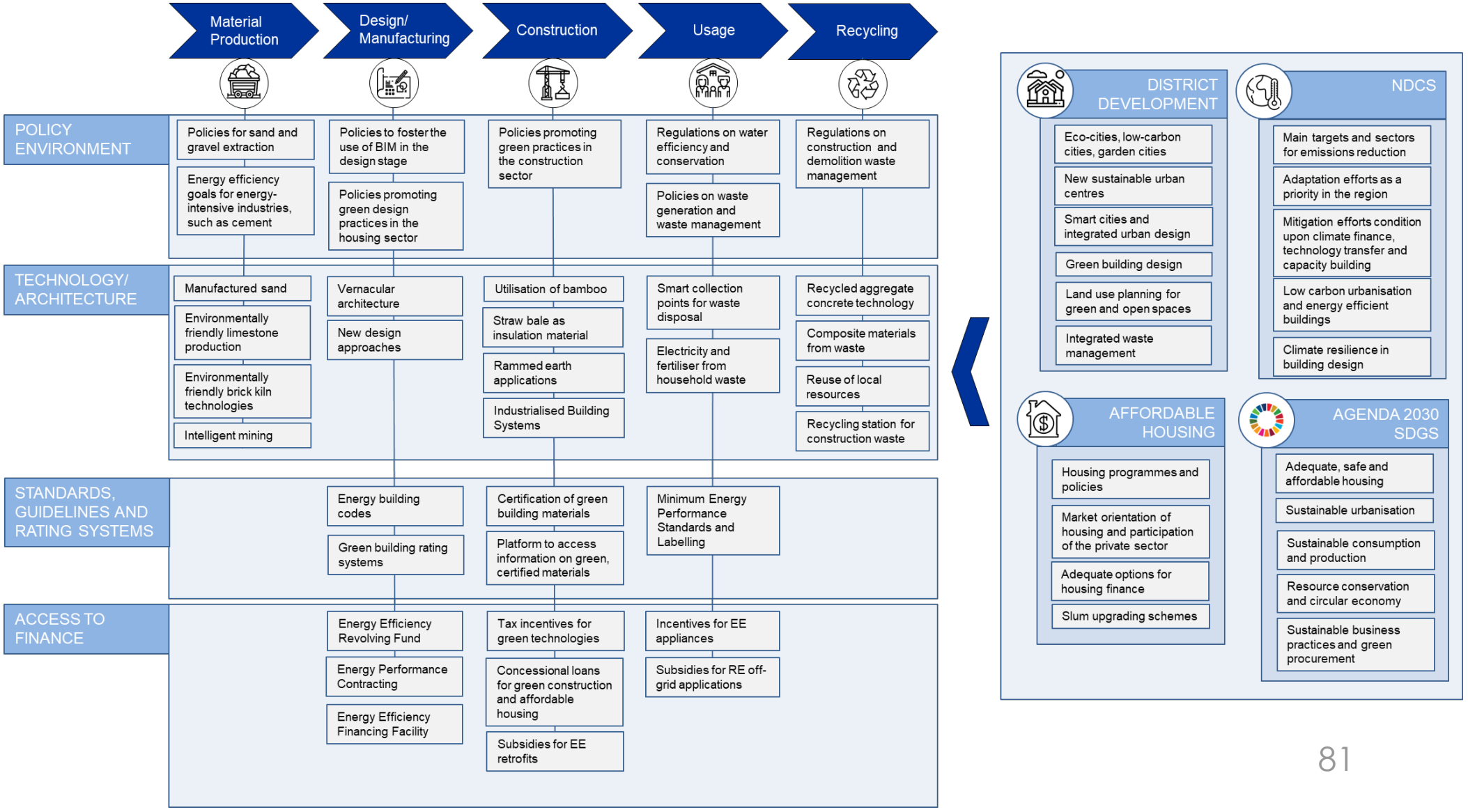
4 Conclusion

This study was developed with the objective to provide a solid basis and to identify the thematic scope for further enabling most relevant SCP patterns for the development and delivery of Sustainable Housing. The findings and outcomes of this scoping study will guide further exchanges between experts to collectively discuss and promote holistic and systemic approaches and strategies that respond to the critical issues identified in the scoping study and trigger the scale-up of sustainable housing across Asia as well as at national level in support to relevant national SCP policies and action plans. This shall bring together experts from different countries and within countries to share their experiences and good practices in order to foster SCP progress in sustainable housing; In order to define key topic areas at the heart of the current discussion revolving around SCP in sustainable housing in the Asian context, the study has been structured along two main chapters, i.e. a scoping and an evaluation phase.

First, the different stages of the building value chain have been assessed, i.e. material production, design and manufacturing, construction, usage and recycling, to identify current trends and challenges of sustainable housing in the context of SCP in Asian countries. A particular focus has been placed on the national policy environment, technology & architecture, standards, guidelines & rating systems and access to finance. Besides the stages of the value chain, four overarching topics relevant to sustainable housing have been addressed, namely building and housing sector objectives within NDCs and SDGs; affordable housing programmes and efforts in district development. These analyses have been performed for ten focal countries, i.e. China, India, Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka and Thailand that have been previously selected by the SCPF. Nevertheless, insights on SCP practices in other SWITCH-Asia countries have also been provided in the form of country briefs. Furthermore, a selection of best practices from European, U.S. and Asian experiences depicted potential areas for adoption in the SWITCH-Asia countries. Based on the comprehensive information gathered in the first part of the study, the SCP progress of the focal countries has been evaluated and contrasted in the second chapter. A set of indicators considering the building life cycle stages as well as the overarching topics has been developed and applied for the evaluation.

Overall, this study shows that a considerable amount of SCP activities in sustainable housing already exist across Asian countries and efforts for further progress in this field are pursued. Figure 20 comprises an overview of the key topics arising from the assessment of the building value chain and overarching issues of the scoping phase in this study. Measures to limit environmental effects are taken along the whole building's life cycle, starting at material production: Governments in the focal countries have made progress in implementing stricter policies and regulations for raw material extraction and building materials production. However, the increasing demand for building materials due to rising urbanisation, in particular for cement, requires further legislative advances in the region to foster more efficient and environmentally friendly practices. Besides, different technological applications showcase new opportunities for mining and material production that are not only more sustainable, but also contribute to improved health and safety conditions for workers. Within the design and manufacturing stage, the importance of energy building codes and green building rating systems in encouraging green building practices is highlighted. Developments in this regard vary between the selected countries, with China having established a mandatory code for all building types whereas countries such as Kyrgyzstan or Mongolia do not have any standards in place. Vernacular architecture represents another trend where the use of available resources on site and traditional architectural approaches are re-discovered, allowing to apply design elements and materials that are suited for the local conditions. In the construction industry, alternative and innovative applications are tried out, such as IBS which result in reduced construction time, costs and waste generation. Certification programmes and

Figure 20: Overview of key topics of the scoping part of the study



corresponding guides/directories, such as the MyHIJAU in Malaysia, enable developers and architects to compare and apply materials according to environmental criteria, lifecycle assessment, etc. To stimulate the market for sustainable construction in Asia, different financial schemes have been initiated in recent years such as Thailand's Energy Efficiency Revolving Fund. In the life cycle stage of usage, a considerable amount of practices are already in place, such as policies, labelling schemes, subsidies and awareness raising programmes to encourage energy and water conservation. For instance, through the installation of Smart Collection Points in the municipality of Ulaanbaatar in Mongolia, the population of Ger areas is able to access basic services of waste disposal. Recycling refers to the final stage of a building's lifecycle, when its structure is dismantled or demolished to give place to new construction.The intense urbanisation during the last decades has posed many challenges in Asia regarding the management of CFW, which accounts for approximately 25%-35% of the Municipal Solid Waste in the region. Still, the sector has not received much attention in Asian countries and the policy environment for C&D management is still very incipient. Nevertheless, first efforts have been made to regulate the collection and correct disposal of CDW and to foster technological developments for its recycling and reutilisation.

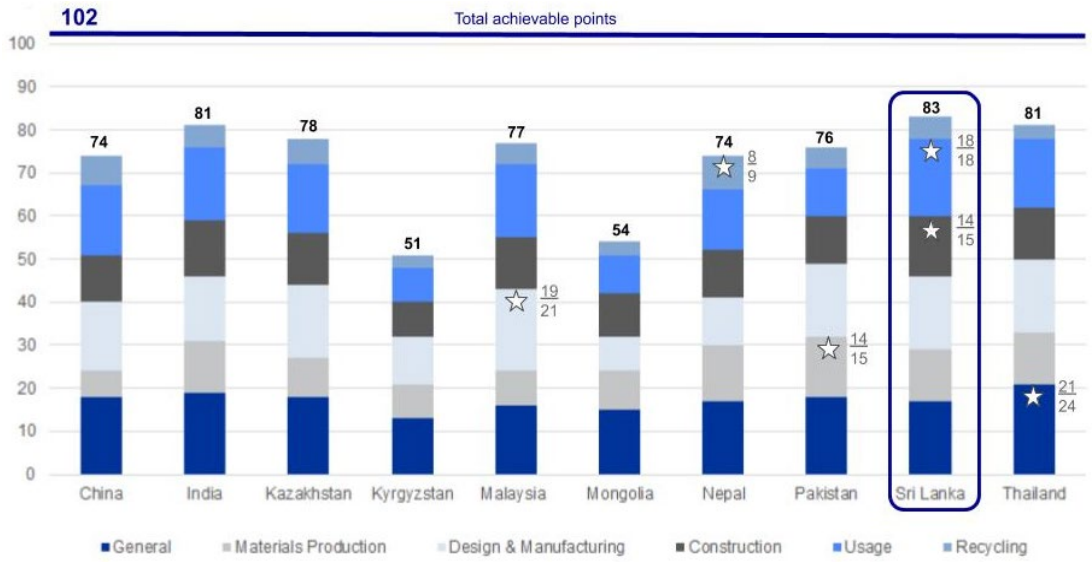
The analysis of the four overarching topics underpinning this study provides insights on additional aspects of sustainable housing in the ten focal countries. As the region is one of the most vulnerable to climate change, adaptation efforts are highlighted in most of the NDCs as a priority for sustainable development. China and India are among the highest emitters in the region, thus having established ambitious targets for emissions reduction with a particular focus on energy efficiency measures in the building sector. Regarding the UN SDGs, this study looked at the progress of the focal countries regarding Goals 11 (sustainable cities and human settlements) and 12 (sustainable consumption and production). Within each country's strategy to achieve the SDGs, the housing sector is addressed in different manners. While Kazakhstan, for instance, aims to improve the access to affordable housing, Mongolia does not address housing or SCP programmes as part of its priority actions. By taking a closer look at affordable housing developments, a variety of successful programmes and policies to enhance living conditions of the low-income population across the region have been detected, such as the Baan Mankong Programme in Thailand aimed at slum upgrading. However, housing affordability remains a challenge in urbanised Asia, where options for housing finance are still limited and housing programmes often fail to identify and provide for the needs of their target groups. In turn, as environmental considerations gain space in urban planning practices in the region, Asia has experienced the development of various eco-city projects, with different levels of application of integrated planning methods and environmental concerns, such as the green quarter of Nur-Sultan in Kazakhstan.

Adding to the in-depth assessment, country briefs of other SWITCH-Asia countries allowed further insights on the current state of SCP in sustainable housing and confirmed the general view captured in the analysis of the focal countries. International best practices provided additional inputs on general SCP trends with replication potential for the Asian context. While some of these practices require higher political commitment and investments in technological development (such as standards), others can be more simply undertaken by industry stakeholders (such as online platforms for second hand materials).

On the basis of the scoping phase in this study, the SCP progress of the focal countries has been assessed and contrasted using a set of indicators. Each category consists of a set of indictors which have been applied to the focal countries using a rating from 1 (low potential) to 3 (high potential). As depicted in figure 21, Sri Lanka achieves both the highest overall rating and highest category rating for construction and usage, while Thailand, Kazakhstan and India follow closely behind. Sri Lanka ranks highly on the grounds of a number of progressive instruments: for example, a National Construction Policy which puts the strengthening of sustainable development and the reduction of negative environmental impacts at the forefront, a Presidential task force specifically designed to encourage visibility of energy efficiency in the residential building sector as well as the promotion of water conservation through television and radio advertisements, school programmes and print media. In contrast, Kyrgyzstan and Mongolia rank last with a 20 points difference to the next lowest ranked countries, i.e. Nepal and China. Except for the categories

of material production (China) and design/manufacturing (Mongolia), Kyrgyzstan has the lowest scores across all categories. Without a Green Building Council, green building rating system, readily available materials for sustainable design or national policies related to SCP for design and manufacturing and energy use in buildings, there is much room for further progress.

Figure 21: Overview of country ranking



The evaluation results demonstrate that considerable efforts in the field of SCP in sustainable housing have already been made in most focal countries, ranging from affordable housing programmes, government level approaches to eco-city development and incentives for urban building energy efficiency or energy efficient appliances to awareness raising campaigns for energy and water conservation. However, challenges remain, especially in the areas of material production and recycling, i.e. at the beginning and at the end of the building lifecycle. This is due to a lack of policies for energy intensive industries such as cement, low uptake of smart mining practices as well as a lack of reuse of C&D waste. Moreover, existing standards are often not enforced or complied with and financing options are rare, especially for lower-income groups.

The variance in performance between indicators and categories insinuates that all focal countries offer lessons to learn from one another. Through facilitated exchanges at regional and national levels, relevant stakeholders from the different countries can share their experiences and knowledge in order to foster SCP progress in support to sustainable housing. The comprehensive analysis performed on the current state and trends of SCP in sustainable housing in the course of this study shall support regional and national experts in identifying critical issues in the current SCP debate which shall be jointly further developed while establishing and implementing national SCP Action Plans.

5 Recommendations

Through the comprehensive analysis performed in this study, several challenges related to housing became apparent, with urbanisation being the most prevalent one, especially in the Asian context. Due to the continuing trend of rapid urban growth, Asian cities are not able to meet the immense demand for housing, resulting in an average of 28% of the urban population still residing in informal settlements (UN-Habitat 2015). When looking closer at the focal areas of the study, i.e. legislative environment, technology & architecture, standards, guidelines & rating system and access to finance, further obstacles such as the lack of policies for energy intensive industries, low uptake of smart mining practices, lack of commercial viability of sustainable construction materials, lack of reuse of CDW, low enforcement and compliance levels with standards and lack of financing options for the lower-income group become apparent.

Based on this assessment, priority topics in the current SCP debate related to sustainable housing have been identified which have not received much attention so far but are critical to foster sustainable development along the whole building value chain. Thus, the following topics areas are recommendations on the basis of the assessment with the need for further action. Overarching topics related to affordable housing, district development as well as connecting housing with SDGs and NDCs shall be addressed across all topic areas. Joint efforts are required to collectively discuss and promote (holistic) approaches and strategies that respond to these critical issues and trigger the scale-up of sustainable housing across Asia.

In order to address these challenges and encourage progress of SCP in sustainable housing, it is suggested to give due consideration to four thematic topic areas that correspond to the focal areas of this study. The following sub-topics are recommendations that have been identified in the course of this study, but each thematic topic area could bring up, through national relevant consultations, additional subject matters that might be considered as sub-topics worth in-depth consideration depending on local and national context.

Table 9: Recommended priority topics for further promoting SCP in the Housing sector

Focal areas	Identified critical issues
Policy environment	• **Policies for energy-intensive industries such as cement,** including specific objectives, particularly for the extraction of sand and gravel; • **Policies promoting sustainable practices in the design and construction stage,** such as application of BIM, mandatory requirements for building components; • **Policies on water efficiency and conservation & waste generation and management,** such as requirements for storm water collection and regulations on C&D waste.
Technology & architecture	• **Environmentally friendly materials and technologies for material production and construction,** such as fly ash, manufactured sand and semi open cut mining method for limestone production; • **Vernacular architecture**: use of local resources (such as bamboo, sheep wool and straw bale) and traditional ways of construction (such as Malay house, Yurt and Ger areas); • **New design/construction approaches,** such as intelligent mining, modular design, BIM and industrialised building systems;

	• **Waste and recycling concepts,** such as digital platforms to reuse waste materials of all kinds, smart collection points/recycling stations for construction and household waste, waste-to-energy approaches.
Standards, guidelines & rating systems	• **Energy building codes, green building rating systems and green building materials certification** to upscale sustainability practices in the housing sector; particularly addressing effective measures for implementation, compliance and enforcement; • **MEPS and labelling for appliances;** • **Guides/directories for architects and developers** to compare products using lifecycle assessment, environmental criteria, etc.
Access to finance	• **Concessional finance mechanisms,** such as soft loans, grants, revolving funds, energy performance contracting for green construction; combination of financial incentives with building standards; • **Community-based savings and loans schemes**, such as funds for settlement upgrading; • **Regulatory and fiscal incentives,** such as subsidies for green construction and retrofits, upgrading to EE appliances; RE off-grid applications; tax/import duty reduction/exemption for green building materials.

Affordable Housing	District Development
• Slum upgrading programmes • Housing programmes targeting minorities • Bottom-up approaches led by the communities • Financing schemes	• Integrated urban planning approaches: solutions for energy, waste, water, sewage, mobility, health, etc. • Community-centred approaches
Connecting housing with SDGs and NDCs	
• Country objectives and actions on housing in the scope of the global agenda setting process.	

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7 Annex

7.1 SCP Rating System Indicator Descriptions

General				
Theme	Indicator	Rating Level	Requirements for Achieving Rating Level	Points Earned
Policy environment & connection to SDGs and NDCs	Green growth / sustainable development action plan (G.1)	LOW	None	1
		MEDIUM	Exists	2
		HIGH	Addresses sustainable/green housing	3
	NDCs on the building sector (G.2)	LOW	Building sector is not addressed	1
		MEDIUM	Qualitative goals for the building sector	2
		HIGH	Ambitious quantitative goals for the building sector	3
	National plan to implement SDGs related to building sector (G.3)	LOW	No national plan	1
		MEDIUM	Under development/ national plan in place without SDGs addressing building sector	2
		HIGH	National plan with SDGs related to building sector in place	3

Standards, guidelines & rating systems	SCP mainstreamed into formal education (G.4)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Access to finance	Availability of financing options for sustainable housing (G.5)	LOW	Not available	1
		MEDIUM	Under development	2
		HIGH	Financial incentives well developed by government	3
Affordability & social component	Governmental level strategic approach for affordable housing (G.6)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
	Informal settlements (proportion of urban population living in informal settlements [2014]) (G.7)	LOW	Higher than average for SWITCH focal countries	1
		MEDIUM	Average for SWITCH focal countries	2
		HIGH	Lower than average for SWITCH focal countries	3
District development & community	Governmental level strategic approach for district development (G.8)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3

Materials Production				
Theme	Indicator	Rating Level	Requirements for Achieving Rating Level	Points Earned
Policy environment & connection to SDGs and NDCs	Policies in place relating to sustainable development in mining and materials production (MP.1)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Technology & architecture	Raw material use (consumption footprint in tonnes per capita [2015]) (MP.2)	LOW	Higher than average for SWITCH focal countries	1
		MEDIUM	Average for SWITCH focal countries	2
		HIGH	Lower than average for SWITCH focal countries	3
	Mineral depletion (consumption footprint in Million tonnes Cu. Eq. Per capita [2015]) (MP.3)	LOW	Higher than average for SWITCH focal countries	1
		MEDIUM	Average for SWITCH focal countries	2
		HIGH	Lower than average for SWITCH focal countries	3
	Fossil fuel depletion (consumption footprint in Million tonnes oil Eq. Per capita [2015]) (MP.4)	LOW	Higher than average for SWITCH focal countries	1
		MEDIUM	Average for SWITCH focal countries	2
		HIGH	Lower than average for SWITCH focal countries	3
	Use of intelligent mining (MP.5)	LOW	Not used	1

		MEDIUM	Somewhat used	2
		HIGH	Widely used	3
Design & Manufacturing				
Theme	**Indicator**	**Rating Level**	**Requirements for Achieving Rating Level**	**Points Earned**
Policy environment & connection to SDGs and NDCs	National policies related to SCP in design & manufacturing (DM.1)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Technology & architecture	Availability of materials for sustainable design (DM.2)	LOW	Few	1
		MEDIUM	Available	2
		HIGH	Widely used	3
Standards, guidelines & rating systems	Existence of Green Building Council (DM.3)	LOW	No GBC exists in this country	1
		MEDIUM	GBC under development	2
		HIGH	GBC is active in this country	3
	Energy Building Code (DM.4)	LOW	No code in place	1

		MEDIUM	Code is currently developed or addresses only part of the buildings (e.g. only envelope)	2
		HIGH	Energy Building Code in place	3
	Green Building Rating system (DM.5)	LOW	Does not exist	1
		MEDIUM	Exists, basic	2
		HIGH	Exists, well developed	3
	BIM guidelines available (DM.6)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Access to finance	Incentives for energy efficient design (DM.7)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Construction				
Theme	**Indicator**	**Rating Level**	**Requirements for Achieving Rating Level**	**Points Earned**

Policy environment & connection to SDGs and NDCs	National policy related to sustainable construction (C.1)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Technology & architecture	Innovative construction practices (C.2)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
	Share of raw material use (2015 consumption footprint per capita) (C.3)	LOW	Higher than average for SWITCH focal countries	1
		MEDIUM	Average for SWITCH focal countries	2
		HIGH	Lower than average for SWITCH focal countries	3
Standards, guidelines & rating systems	Certification system for green building materials (C.4)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Access to finance	Financing models/incentives for urban building efficiency projects (C.5)	LOW	No	1
		MEDIUM	Under development	2

		HIGH	Yes	3
Usage				
Theme	**Indicator**	**Rating Level**	**Requirements for Achieving Rating Level**	**Points Earned**
Policy environment & connection to SDGs and NDCs	Information programs for energy use (U.1)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
	Information programs for water use (U.2)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
	National policies related to SCP (U.3)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Technology & architecture	Availability of sustainable/green appliances/equipment (U.4)	LOW	No	1
		MEDIUM	Under development	2

		HIGH	Yes	3
Standards, guidelines & rating systems	Rating system for appliances/ Labelling system for appliances (U.5)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Access to finance	Funding for efficient appliances, etc. (U.6)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Recycling				
Theme	**Indicator**	**Rating Level**	**Requirements for Achieving Rating Level**	**Points Earned**
Policy environment & connection to SDGs and NDCs	Circular economy/recycling policy (R.1)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3
Technology & architecture	Platform available for sourcing CDW (R.2)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3

	Innovative recycling practices in place (R.3)	LOW	No	1
		MEDIUM	Under development	2
		HIGH	Yes	3

7.2 Detailed findings of SCP ratings with reasoning

China

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) National Strategy for Climate Adaptation mentions EE renovations and the use of EE methods in all new buildings in cities and towns. The Ministry also issued the Special Blueprint of Conserving Energy in the Construction Sector during the 12th Five-Year Plan Period. By the end of 2012, the country had completed heat metering and energy efficiency renovations on 590 million square meters of existing residential buildings in northern China, saving energy equivalent to 4 million tons of standard coal and reducing about 10 million tons of CO2 emissions. All new buildings in cities and towns, or a total of 6.9 billion square meters of floor space, have reached the new energy saving standard, saving energy equivalent to 65 million tons of standard coal, or 150 million tons of CO2 emissions. (http://en.ndrc.gov.cn/newsrelease/201311/P020131108611533042884.pdf)
NDCs on the building sector (G.2)	(3) Mostly generic information about increasing EE of buildings, but does mention the promotion of the share of green buildings in newly built buildings of cities and towns reaching 50% by 2020. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/China%20First/China's%20First%20NDC%20Submission.pdf)
National plan to implement SDGs related to building sector (G.3)	(2) China became one of the first 22 countries to present a voluntary national review of efforts to implement the 2030 Agenda. The SDG plan does touch on the importance of creating resilient infrastructure, but not specifically about sustainable housing or buildings. (https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/W020161014332600482185.pdf)

SCP mainstreamed into formal education (G.4)	(1) SCP is not formally taught in China.
Availability of financing options for sustainable housing (G.5)	(2) Financial incentives are provided by both central government and some provincial governments. However, they are not well-used and require further development.
Governmental level strategic approach for affordable housing (G.6)	(2) Existing, but constantly undergoing amendment. Unstable. Many affordable housing programmes are developed under sub-national governments. (https://www.adb.org/sites/default/files/publication/190060/adbi-housing-challenge-emerging-asia-options-solutions.pdf)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(2) 25,2% (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=CN&view=chart)
Governmental level strategic approach for district development (G.8)	(3) China's 12th Five-Year Plan for Green Building and Green Eco-City Development has selected 100 new urban areas with a minimum size of 15 square kilometres, to demonstrate this eco-city concept. Financial support has been provided for these projects from the Chinese central government. (https://cbi.typepad.com/files/full-translation-5-yr-plan-2011-2015.doc)
Materials Production	
Policies in place relating to mining and materials production (MP.1)	(1) Although EIA exists and has improved occurred over the last decade, China still allows dangerous mining practices. Policies in place, but not very stringent and do not mention sustainable development of the sector. (https://www.researchgate.net/publication/328840830_Building_Material_Use_and_Associated_Environmental_Impacts_in_China_2000-2015)
Raw Material Use (MP.2)	(1) 22,54 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(1) 37,32 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)

Fossil Fuel Depletion (MP.4)	(1) 1,44 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(2) Somewhat used, advances are being made. (https://www.sciencedirect.com/science/article/pii/S2095809917306021)
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(1) No policies currently exist directly relating to sustainable design and manufacturing, especially not for housing. However, dialogue is opening up for new policies to address this issue. (https://eeas.europa.eu/delegations/china/61624/national-high-level-policy-dialogue-sustainable-consumption-policy-makers-and-stakeholders_en)
Availability of materials for sustainable design (DM.2)	(2) Many guides and manuals exist on the availability and selection of sustainable building materials, but in practice use is still limited.
Existence of Green Building Council (DM.3)	(3) China's Green Building Council is well established.
Energy Building Code (DM.4)	(3) Design Standard for Energy Efficiency of Residential Buildings has 4 different versions for specific climate zones.
Green Building Rating system (DM.5)	(3) China's 3-star rating system is well developed. (https://www.researchgate.net/publication/254458145_An_Overview_of_Chinese_Green_Building_Standards)
BIM guidelines available (DM.6)	(2) Plan to move forward the BIM implementation through the establishment of standards, to achieve digitalization within construction firms during the 12th Five-Year-Plan.
Incentives for energy efficient design (DM.7)	(2) Difficult to apply to; require capacity building required for building sector professionals.
Construction	

National policy related to sustainable construction (C.1)	(2) Sustainable construction policies are still under development in China, however In 2014, the State Council Green Building Action Plan mandated that public buildings such as affordable housing must meet the green building standards of China's 3-Star Rating System GBEL. (https://www.export.gov/article?id=China-Construction-and-Green-Building)
Innovative construction practices (C.2)	(3) 3D printed houses, some of the most sustainable buildings in the world exist in China. (https://www.spireresearch.com/spire-journal/yr2011/q1/2011-q1-china-construction-industry/)
Share of raw material use (C.3)	(1) 16,67 tonnes per capita
Certification system for green building materials (C.4)	(3) Products listed in the compulsory certification category cannot be marketed, sold, imported or used for any commercial purposes without acquiring a certificate issued by accredited certification authorities. Building materials products in the product catalogue for compulsory certification include, for example, architectural safety glass, solvent furniture paint, concrete anti-freezer and porcelain tile. China Environmental Label was initiated by SEPA in 1993. It provides environmental standards for construction materials, textiles, vehicles, cosmetics, electronics, packaging, and more. (http://www.ecolabelindex.com/ecolabels/?search=construction+material&as_values_056=)
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(2) Urban EE projects are currently mainly funded by financial subsidies or incentive funds from each level of government, plus a smattering of policy-based loans disbursed by foreign governments or intergovernmental banks, exposing the death of choice and lack of innovation in financing tools.
Usage	

Information programmes for energy use (U.1)	(3) Energy conservation campaigns have been carried out in families, communities, enterprises, organizations and schools in cities across China. Education activities with the theme of “Low-carbon, A healthy home life” were held in 15 cities including Nanjing, Shenzhen and Jinan, and 300,000 free publicity brochures have been distributed, to advocating a scientific concept of energy conservation and promote a low-carbon lifestyle. (http://www.china.org.cn/government/whitepaper/2013-11/10/content_30555366.htm)
Information programmes for water use (U.2)	(1) Only grassroots organisations promote household waste reduction in China.
National policies related to sustainable use/consumption (U.3)	(3) Energy Conservation Law puts end-use energy efficiency and standards and labelling programmes at the centre of China's new energy conservation strategy. No. 1 Policy Document on Water Resources Reform and Development: sets out a ten-year programme of reform and investment in water resources and flood protection infrastructure as well as a water pricing and institutional reforms. 12th Five-Year Plan: for the first time, the plan includes a specific section on water, placing particular focus on addressing the current challenges to the water sector. (https://aceee.org/files/proceedings/2002/data/papers/SS02_Panel9_Paper21.pdf)
Availability of sustainable/green appliances/equipment (U.4)	(3) Many policies in place promoting the availability and use of energy efficient appliances. (https://www.iea.org/policiesandmeasures/energyefficiency/?country=China)
Rating system for appliances/ Labelling system for appliances (U.5)	(3) China implements mandatory energy efficiency labelling system under national law.
Funding for efficient appliances, efficient water usage, etc. (U.6)	(3) China launched the largest ($4.26 billion) energy-efficient appliances subsidy programme (Promoting Energy-Efficient Products for the Benefit of the People Program) in June 2012. (https://www.sciencedirect.com/science/article/pii/S0306261914007612)

Recycling	
Circular economy/recycling policy (R.1)	(3) China has well developed circular economy and recycling policies. (http://www.eria.org/RPR_FY2014_No.44_Chapter_7.pdf)
Platform available for sourcing CDW (R.2)	(2) Dutch website for sourcing CDW waste SuperUse has recently expanded to China.
Innovative recycling practices in place (R.3)	(2) The application of RAC and RA technologies in China is still at early demonstration phase. Basic research is still lacking and guidelines, codes and standards are scarce to guide engineering. (https://books.google.de/books?id=gq4-DwAAQBAJ&printsec=frontcover&hl=de#v=onepage&q&f=true)

India

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(2) India's National Action Plan on Climate Change outlines the importance of green growth and sustainable development at both a national and state level. However, not within the building sector specificially. The Ministry of Environment, Forests, and Climate Change recognizes green growth and poverty eradication to contribute to the vision of sustainable development. (https://www.teriin.org/projects/green/pdf/National_SPM.pdf)
NDCs on the building sector (G.2)	(2) India's NDC mentions the mandatory use of fly ash for buildings to reduce pollution and the promotion of energy efficient buildings but does not specifically address sustainable housing. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf)
National plan to implement SDGs related to building sector (G.3)	(3) India has a strong commitment to the SDGs and much of India’s development agenda is mirrored in the Sustainable Development Goals. The plan specifically outlines incentives for buildings which obtain green ratings. (https://niti.gov.in/content/pm%E2%80%99s-statement-un-summit-adoption-post-2015-development-agenda)
SCP mainstreamed into formal education (G.4)	(3) In order to contribute to increased capacities and the integration of SCP into learning curricula, as well as ensure behavioural change and the creation of SCP policy champions in India, the SWITCH-Asia Programme entered into a partnership with TERI University as the lead national policy school for SCP and a co-host of the South Asia Regional Hub of the United Nations Sustainable Development Solutions Network (SDSN). Together they developed and delivered the first MA course on SCP taught in a developing country. The collaboration between SWITCH-Asia and TERI University has further led to the development of a new series of activities in which more than 900 secondary-level students from the lowest-income public schools in Delhi and Hyderabad learned about how sustainability could be applied to their local context. (https://www.switch-asia.eu/news/education-for-all-on-sustainable-consumption-and-production-sdg-12-in-india/) The Centre for Environmental Education (CEE), India seeks to improve public awareness and understanding of the environment with a view to promoting the conservation and sustainable use of nature and natural resources through

	innovative programmes, educational material and capacity-building in the field of ESD. (http://www.unep.fr/shared/publications/pdf/DTIx1235xPA-MainstreamingSCPintoDevPlanning.pdf)
Availability of financing options for sustainable housing (G.5)	(2) The ECBC-R is still under development, but plans to provide heaper loans, lower registration fee for green homes. (http://timesofindia.indiatimes.com/articleshow/59210313.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst) Sustainable Housing Leadership Consortium (SHLC) on Tuesday announced they will make 100% of their new housing portfolio green, thereby contributing 110 million square feet of green housing by 2020. This would entail an investment of around $1 trillion.
Governmental level strategic approach for affordable housing (G.6)	(3) India's Ministry of Housing and Urban Poverty Alleviation has a number of guidelines and criteria for affordable housing. (https://reader.elsevier.com/reader/sd/pii/S0970389615000336?token=79A9E9913476C4670CD1E9519CA9327F4C54464E007A9708EF5EC6BB12E629F5377E206FFBA80B85DB611E2C02B1973B)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(2) 24% (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart)
Governmental level strategic approach for district development (G.8)	(2) Under the RAY, in land pooling/town planning scheme, the owner or developer undertaking the development shall reserve and earmark the land in the proportions of 5% for the economically weaker sections (EWS) and 5% of land for low income group persons for housing purpose. In case of vertical development, 20% of built up space shall be earmarked for EWS and low income groups. Once implemented, in the long term, availability of affordable land /housing will discourage squatting by poor on public lands and create slum free cities. It will also sustainably reduce urban poverty levels by providing legal access to better services and economic opportunities. (http://pib.nic.in/newsite/PrintRelease.aspx?relid=188069)
Materials Production	

Policies in place relating to mining and materials production (MP.1)	(2) India's Mineral Policy for 2019 has only a few vague sentences on the sustainable development in the mining industry. (https://mines.gov.in/writereaddata/Content/NMP12032019.pdf)
Raw Material Use (MP.2)	(3) 4,76 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(3) 0,60 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(3) 0,23 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(1) India lags behind in research and development in the space of AI and ML in the mining industry. (https://www.analyticsindiamag.com/ai-digs-deep-into-the-mining-industry-revolutionizes-one-of-the-worlds-most-profitable-sectors/)
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(2) SCP policy relating to design and manufacturing under development. India has been an active participant in discussions engaging countries with emerging economies, including the convening of national roundtables on SCP in China, India, Brazil and South Africa.
Availability of materials for sustainable design (DM.2)	(2) A Technology Sub-mission under the PMAY has been set up to facilitate the adoption of modern, innovative and green technologies and building material for faster and quality construction of houses. Under this sub-mission the Building Materials and Technology Promotion Council (BMTPC) has set up a Performance Accreditation Certificate Scheme (PACS) that has identified 16 sustainable technological solutions for faster and cost effective construction of houses. (http://www.ijesd.org/vol7/784-R0004.pdf)
Existence of Green Building Council (DM.3)	(3) India's Green Building Council is well established.
Energy Building Code (DM.4)	(2) India's ECBC-R code for energy efficient residential buildings is currently under development.

Green Building Rating system (DM.5)	(3) There are three primary Rating systems in India, GRIHA, IGBC and BEE. All of them have specific sets of criteria for housing. (https://greencleanguide.com/three-primary-rating-systems-for-green-buildings-in-india/)
BIM guidelines available (DM.6)	(1) BIM is being promoted in India but currently does not have any related guidelines, policies or regulations in place.
Incentives for energy efficient design (DM.7)	(2) National Housing Bank (NHB) along with French Development Agency (AFD) and European Union (EU) have launched the SUNREF (Sustainable Use of Natural Resources and Energy Finance) Housing India Programme that will focus on (The Hindu: Business Line, 2017): 1. Promoting the existing local green labels for housing (GRIHA and IGBC) 2. Making green housing more affordable to low-income households 3. Demonstrating the market potential and the relevance of green housing 4. Encouraging the adoption of rules favouring green housing in public policies The Sustainable Housing Leadership Consortium launches #greenhomes campaign for 20% of India's new homes to become green by 2022.
Construction	
National policy related to sustainable construction (C.1)	(2) Under development. (http://apps.unep.org/redirect.php?file=/publications/pmtdocuments/-State%20of%20Play%20for%20Sustainable%20Buildings%20in%20India-2010994.pdf)
Innovative construction practices (C.2)	(2) Some innovative construction techniques are used. Innovative construction techniques are still under development in India. (https://scroll.in/bulletins/29/how-innovation-in-construction-is-changing-the-way-indians-live)
Share of raw material use (C.3)	(3) 2,34 tonnes per capita
Certification system for green building materials (C.4)	(3) Directory available for sourcing of green building materials. (http://site.igbc.in/site/igbcdir/index.jsp)

Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(3) Model State Affordable Housing Policy for Urban Areas (MSAHPUA), 2014: MSAHPUA is intended as a step towards implementing the NUHHP 2007. The policy empowers individual states to achieve housing policy objectives as listed under NUHHP 2007 by inclusion of legal and regulatory reforms, fiscal concessions, financial sector reforms and innovations. The Policy aims to provide "affordable housing for all" with special emphasis on EWS and LIG and other vulnerable sections of society such as Scheduled castes/Scheduled Tribes, Backward Classes, Minorities and senior citizens, physically challenged persons in the State and to ensure that no individual is left homeless. The policy further aims to promote Public Private People Participation (PPPP) for addressing the shortage of adequate and affordable housing.
Usage	
Information programmes for energy use (U.1)	(3) School education, HR training, Energy conservation contests and awards, etc. (https://powermin.nic.in/en/content/energy-efficiency)
Information programmes for water use (U.2)	(3) Extensive information and communication programme. (http://mowr.gov.in/schemes-projects-programmes/schemes/hrd-capacity-building)
National policies related to sustainable use/consumption (U.3)	(2) Under development. (http://unpan1.un.org/intradoc/groups/public/documents/ungc/unpan038638.pdf)
Availability of sustainable/green appliances/equipment (U.4)	(3) EE appliances are readily available and have a high impact on EE in India. (http://www.ecoideaz.com/expert-corner/are-indian-consumers-aware-of-energy-efficient-appliances)
Rating system for appliances/ Labelling system for appliances (U.5)	(3) BEE implements an energy label for 4 types of appliances. (https://eneken.ieej.or.jp/data/3694.pdf)
Funding for efficient appliances, efficient water usage, etc. (U.6)	(3) 2016 there was a $95USD project to provide EE appliances in India. (https://economictimes.indiatimes.com/industry/energy/power/india-and-us-launch-95-million-clean-energy-projects/articleshow/55421849.cms) Funding is also available through BEE's Energy Efficiency Financing Platform. (https://www.beeindia.gov.in/content/eefp)

Recycling	
Circular economy/recycling policy (R.1)	(2) Under development with assistance from EU. (https://eeas.europa.eu/regions/asia/50296/eu-and-india-closetheloop-circular-economy-better-tomorrow_en)
Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(2) Small projects under development with centres for waste pickers to create products from waste to sell.

Kazakhstan

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) The Concept for Transition to a Green Economy clearly outlines many targets for the building sector. Kazakhstan became adherent to the OECD Declaration on Green Growth in November 2015. The Kazak Green Growth Action Platform aims to support high-level Cross-Ministerial policy dialogues on priority issues and political action identified by various initiatives on green economy, low-carbon, climate-resilient development and environmental law reform in Kazakhstan. The concept of the transition of the Republic of Kazakhstan to the ""green"" economy, approved by the Decree of the President of the Republic of Kazakhstan from May 30, 2013 № 577 is one of the most important public policy documents aimed at sustainable development (http://habitat3.org/wp-content/uploads/NATIONAL-REPORT-OF-THE-REPUBLIC-OF-KAZAKHSTAN-Habitat-%D0%86%D0%86%D0%86.pdf). "
NDCs on the building sector (G.2)	(2) NDC mentions briefly the modernisation of housing to support the implementation of the concept of transition to a green economy. (https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Kazakhstan/1/INDC%20Kz_eng.pdf)
National plan to implement SDGs related to building sector (G.3)	(2) National Architecture on SDGs has been established. The UNCT supported the Committee on Statistics in the process of nationalizing SDG indicators. As a result, a draft system of 257 indicators was developed to monitor the SDGs, and the SDG Statistical Office was established within the Committee on Statistics. The national architecture seems to address directly the need for EE in housing, but provides no specific targets.
SCP mainstreamed into formal education (G.4)	(3) "With UNDP/GEF financing, KazGASA faculty members developed three undergraduate- and graduate-level syllabuses along with how-to-teach guides that include design and construction of energy efficient buildings, construction materials and frames, and modern energy efficient technologies and architectural design for three study programs “Architecture”, “Construction”, and “Production of construction materials, products and constructions”. The three syllabuses/courses were endorsed by the Republican Education - Methodology Council of the Ministry of Education of RK in May 2012 for a nation-wide use."

	Six Russian and Kazak universities have agreed to collaborate with schools in Finland, Denmark and Spain to develop programs for waste management and SCP.
Availability of financing options for sustainable housing (G.5)	(2) EC initiative to increase financing for lending in sustainable energy through the Kazakhstan Sustainable Energy Financing Facility, which promotes EE in housing and all sorts of lending for sustainable housing for individuals or (https://ec.europa.eu/europeaid/blending/kazakhstan-sustainable-energy-financing-facility_en)
Governmental level strategic approach for affordable housing (G.6)	(3) “Affordable Housing-2020” programme which provided such measures as state support for the construction of affordable housing. "Nurly Zhol" Infrastructure(Regional) Development Programme for 2015-2019 intends to increase affordability of housing for citizens, among other targets. (https://www.government.kz/en/gosprogrammy/nurlyzhol) "Nurly Zher" Housing Construction Programme promotes construction of housing, increases mortgage lending and provides more rental housing through private lending. (https://www.government.kz/en/gosprogrammy/nurlyzher) " "During independence of Kazakhstan, housing construction has become one of the priority directions of strategy of development of the country and is one of the most important national tasks. The main focus of housing policy is to ensure sustainable growth of affordable housing for the General population by reducing its cost, increase in terms of housing credits, lower down payment and crediting rates. 97% home ownership - privatization of social housing.
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(1) Access to data on informal settlements is scarce. (https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/Literature_Review_on_Informal_Settlements.pdf) Informal settlements are argued to be fairly recent, having first appeared after the beginning of transition in the 1990s, but which have since become the significant part of urban growth (e.g. Kazakhstan, Kyrgyzstan). (https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/Literature_Review_on_Informal_Settlements.pdf)
Governmental level strategic approach for district development (G.8)	(2) Development of macro-regions is key for the development of the country, governed by complex schemes of urban planning. (http://habitat3.org/wp-content/uploads/NATIONAL-REPORT-OF-THE-REPUBLIC-OF-KAZAKHSTAN-Habitat-%D0%86%D0%86%D0%86.pdf)
Materials Production	

Policies in place relating to mining and materials production (MP.1)	(3) Mining regulation in Kazakhstan one of the most streamlined, progressive and transparent in the world.
Raw Material Use (MP.2)	(1) 20,41 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(2) 3,84 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(1) 3,44 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(2) Kazakhstan has been using intelligent mining since the early 2010's. The development has resulted in fully operational smart mine, but there is still progress to be made, especially with its integration into policy. Green Smart Mine innovation programme developed to reduce energy waste and improve flow balance / production yields without additional equipment.
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(3) Law on energy saving and energy efficiency 2012 includes new regulations for design methods according to established indicators of efficiency including compliance with design values of normalized indicators (energy passports), methods for determination of air permeability of the frame structures in the natural environment; method of determination of specific consumption of thermal energy for heating; introduction of rationing of energy consumption of the building as a whole; development of calculation methods of determining the level of thermal performance of buildings for energy indicators; introduction a system of classification of buildings for energy efficiency. Green Growth Strategy outlines: Energy Efficiency (EE) in manufacturing: additional investments in energy-saving technologies in key manufacturing sectors (including metals, chemicals, minerals, food, paper and pulp, construction and machinery). (https://diw-econ.de/en/wp-content/uploads/sites/2/2015/03/2014-03-13-Green-Growth-Kazakhstan-policy-oriented-summary-v2.0.pdf)

Availability of materials for sustainable design (DM.2)	(2) Mandatory use of nrg saving materials (Law on energy saving and energy efficiency, 2012) However, locals say that the materials are not as easy to get. "Domestic materials suppliers Alina Holdings, producers of dry mixes, paints and other construction materials, was the recipient of a €10 million loan from the EBRD in December 2015. The purpose of this funding is to establish an energy and resource-saving programme at Alina Holding's key production facilities – an initiative that is likely to be match by other organisations over the next few years." (http://www.buildingshows.com/market-insights/kazakhstan/the-future-of-building-looks-green-in-kazakhstan/801816831) Reports indicate that use of materials should be given priortiy as a focus area for improvement. (https://www.mdpi.com/2071-1050/10/12/4383/htm)
Existence of Green Building Council (DM.3)	(2) Kazakhstan's Green Building Council is still considered emerging.
Energy Building Code (DM.4)	(3) Law "On energy saving and energy efficiency" 2012 established mandatory use of nrg saving material, installation of metering devices of energy and water resources automated heat systems for construction, switching to nrg efficient bulbs, etc.The law also outlines targets for renewables until (http://habitat3.org/wp-content/uploads/NATIONAL-REPORT-OF-THE-REPUBLIC-OF-KAZAKHSTAN-Habitat-%D0%86%D0%86%D0%86.pdf) Other energy efficiency policies include: Strategy of Transition of the Republic of Kazakhstan to a "Green" Economy", Strategy-2050, and programmes such as Nurly Zhol, 100 Steps of the Nation, Energy Saving-2020, and more.
Green Building Rating system (DM.5)	(2) LEED and BREEAM are used. National standard is under devleopment. (http://habitat3.org/wp-content/uploads/NATIONAL-REPORT-OF-THE-REPUBLIC-OF-KAZAKHSTAN-Habitat-%D0%86%D0%86%D0%86.pdf)
BIM guidelines available (DM.6)	(2) Still emerging. Concept of implementation fo BIM in the industrial and civil construction of Kazakhstan approved in 2018.

	Uptake is slow, but under development. (https://www.researchgate.net/publication/321273984_Current_State_of_Building_Information_Modeling_BIM_and_Total_Building_Commissioning_and_study_of_their_applicability_in_Kazakhstan)
Incentives for energy efficient design (DM.7)	(3) Energy Saving 2020 programme in effect since 2013 has provided: lease financing of nrg saving technology; subsidies for nrg audits; upgrading of urban heating systems; construction of RES and intro of RES into smartgrid and storage and others (https://www.iea.org/policiesandmeasures/pams/kazakhstan/name-158202-en.php) Grants for nrg efficient lighting (https://www.thegef.org/sites/default/files/project_documents/4166%2520FINAL_TE_REPORT_EEL_2.pdf)
Construction	
National policy related to sustainable construction (C.1)	(3) The following legislation mention the built environment or sustainable development of the built environment in some way: Law on “Energy saving and energy efficiency” - Law “On supporting the use of renewable energy” - Strategy “Kazakhstan 2050” - Concept: “Transition to Green Economy - Programme “Energy Efficiency 2020” - ST RK ISO 37120 Sustainable development for the communities. Indicators for city services and quality of life - SC RK ISO “Sustainable development of administrative and territorial devices. Management systems. General principles and requirements - Nur-Sultan city development programme - ST RK 2725-2015 “Sustainable Community Development. Indicators of urban services and quality of life - ST RK BSI PD 8100-2016 “Overview of smart cities. Management”
Innovative construction practices (C.2)	(2) Nur-Sultan's Green Quarter features high-tech energy saving measures and modern environmental features, and highly efficient technology. (http://www.asiagreenbuildings.com/8915/kazakhstan-green-housing-construction-begins-astana/) Model of 'open innovation' is used in Kazakhstan and is often applied in the construction sector. It allows the country to step up innovation activities of small and medium sized businesses (https://dergipark.org.tr/tr/download/article-file/367234).

	AstanaBuild is a leading exhibition in construction technology and innovation, exposing new building materials, tools / equipment in the construction market. (https://astanabuild.kz/en/press-center/press-releases/344-17-05-2016astbuild-pr)
Share of raw material use (C.3)	(2) 6,44 tonnes per capita
Certification system for green building materials (C.4)	(2) Under development. Technical standards and labels with regard to energy performance is required for most construction materials.
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(3) Regional DH Metering Programme developed by EDRB loans support efficient energy use by financing the installation of heat meters in residential buildings, the programme plans to extend to a pilot phase or installation of individual heat substations (IHS) and wholesale electricity meters. (https://www.unece.org/fileadmin/DAM/hlm/prgm/urbandevt/2017_Smart_Sustainable_Cities_Astana/3_session_presentations/05_SRadchenko.pdf) Other grants exist to cover Investment costs funded by a donor or national government to municipality. (https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/FINAL_MGN1-Municipal%20Financing_KS18-14_web.pdf) GEF/UNDP projects financed together with the Government of Kazakhstan are significantly contributing in the development sustainable housing/urbanization of Kazakhstan. Among the projects: "Removing Barriers to Improving the Energy Efficiency of Public Heat Supply", "Integrated Energy Efficient Solutions in Small Cities", "Energy Efficient Design and Construction of Residential Buildings" and "Promotion of Energy-Efficient Lighting", Sustainable Cities for Low-Carbon Development. The OECD supports Kazakhstan in developing more energy efficiency financing options for urban residential buildings. (https://www.oecd.org/env/outreach/KAZ%20report_programme%20design_ENG_web%20version.pdf)
Usage	
Information programmes for energy use (U.1)	(3) Various print materials, flyers and banners have been distributed to promote and increase public awareness on energy conservation. 17 demonstration projects have been implemented in apartment buildings in different cities of Kazakhstan, $6.6 million of public and private investment attracted to modernise residential homes in 4 cities, large-scale energy audits

	of buildings has been conducted, the country's first energy service company was created. Promotion of nrg efficient and LED lamps. (https://waset.org/publications/10000514/towards-achieving-energy-efficiency-in-kazakhstan)
Information programmes for water use (U.2)	(3) Many awareness raising activities for both water use in households and conservation of watersheds. (https://www.cigionline.org/sites/default/files/documents/Kazakhstan%20Conference%20Pinto%203rd%20Price.pdf) Additional UNDP developed and supported activities pertaining to education, public awareness on water saving. (https://www.gwp.org/globalassets/global/toolbox/about/iwrm/asia/kazakhstan-iwrm-action-plan.pdf)
National policies related to sustainable use/consumption (U.3)	(3) In Kazakhstan, some elements of SCP are included in the Strategy on Sustainable Development for 2007–2024. The objectives of the strategy include, among other things, achieving balanced levels of natural resources extraction, introducing sustainable production and consumption initiatives (including a cleaner production strategy), developing sustainable transport; establishing sustainable development targets for large industrial and energy facilities, setting up requirements and deadlines for transition to best available technologies; and developing alternative energy sources. (https://www.eea.europa.eu/publications/eea_report_2007_3/03_Policies_supporting_SCP.pdf/at_download/file)
Availability of sustainable/green appliances/equipment (U.4)	(3) New measures within the Energy Efficiency 2020 Programme include energy efficiency classes for buildings and household appliances. (https://www.enerdata.net/publications/daily-energy-news/kazakhstan-adopts-energy-efficiency-2020-programme-and-feed-tariffs.html) Appliances appear to be readily available.
Rating system for appliances/ Labelling system for appliances (U.5)	(2) Under development. It is planned to apply this standards and labelling to the following long-term use goods: • electric cooling devices; • washing and combined washing-drying household electric machines (250W, 50Hz); • household dishwashing machines (250W, 50Hz); • electric cabinet ovens (i.e., household electric ovens);

	• household air conditioners; • household electric lamps. (https://www.researchgate.net/profile/Almaz_Akhmetov/publication/303669393_Energy_efficiency_assessment_of_household_electrical_appliances_in_Central_Asia_and_policies_for_energy_performance_standards_and_labeling/links/574c386f08aed8df7c54d66d/Energy-efficiency-assessment-of-household-electrical-appliances-in-Central-Asia-and-policies-for-energy-performance-standards-and-labeling.pdf?_sg%5B0%5D=vxexi5-S9SaMr3IbPfS-IFdUov0ya-uegDwS9Tx6Ud-ywwao_rivcWy2UTDhRGhS0WPNEqmpVs0g8GS7N9FTGw.k18VFTKsbohm0P6s9126thRofA0bkmp9gekgoAUWkaNBN4ryDsW3KfiZYBoijnF4HAdB_5LXiPvLz6CMxMkCsQ&_sg%5B1%5D=HDoZJYBznupPj_Z2g6zHiucLGdnNPWQI1qj_gUTTiM-rCYIjOTtZIiSXIgnArNL37ICRqydHweWcnzr6LIRb_JarnqxdTJ--BCR4IPle-OVg.k18VFTKsbohm0P6s9126thRofA0bkmp9gekgoAUWkaNBN4ryDsW3KfiZYBoijnF4HAdB_5LXiPvLz6CMxMkCsQ&_iepl=)
Funding for efficient appliances, efficient water usage, etc. (U.6)	(2) "Residents of Astana (now Nur-Sultan) and Almaty the opportunity to recycle their old household appliances free of charge and get a 10 percent discount on a new energy-efficient refrigerator." (https://astanatimes.com/2018/10/new-household-appliance-recycling-discount-programme-launched-to-promote-energy-efficiency/) The campaign, spread 2,000 discount coupons, which led to 100 percent sale of A++ refrigerators and the recycling of 279 large-sized domestic appliances. Similar programs are expected to be developed in the future for a wider range of products.
Recycling	
Circular economy/recycling policy (R.1)	(3) Comprehensive legislation includes long-term targets, roadmaps, guidelines and adequate enforcement. In 2019 Kazakhstan finally prohibits waste entering landfills without prior processing. Separate collection began in 2019. (http://www.eu-recycling.com/flips/gr22018/files/assets/common/downloads/publication.pdf)

Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(2) Kazakhstan is the only country in Central Asia having introduced extended producer responsibility. Many cities are planning waste-to-energy plants. (https://issuu.com/zoienvironment/docs/ca-waste-eng) A joint project of the Kazakh Ministry of Energy and the UN Development Programme (UNDP), with financial support from Samsung Electronics in Kazakhstan and Central Asia, is helping to improve the efficiency of services for collection, transportation, use, and disposal of this type of waste. Advocacy campaigns through leaflets and media announcements are helping to educate young and old about the need to recycle personal e-waste and how they can do it. (https://www.undp.org/content/undp/en/home/ourwork/ourstories/kazakhstan-tackles-its-electronic-waste-problem.html)

Kyrgyzstan

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(2) Inclusive Green Economy Programme for 2019-2023 was developed with assistance from UN's PAGE.
NDCs on the building sector (G.2)	(1) INDC exists but does not mention housing, building or construction. The INDC outlines the need for financing in order to reach climate change mitigation targets. (https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Kyrgyzstan/1/Kyrgyzstan%20INDC%20_ENG_%20final.pdf)
National plan to implement SDGs related to building sector (G.3)	(2) National Strategy of Sustainable Development up to 2017 states "Increasing costs of energy resources is a sustainable trend that will continue, this is why it will be necessary to: (i) improve the system of state regulation and the encouragement of energy conservation; (ii) to strengthen the role of state and local authorities and NGOs in the matters of energy conservation and energy efficiency of buildings; (iii) create an environment that encourages application of energy efficient technologies for buildings and structures; (iv) promote the use of renewable energy sources. Energy conservation policy must become an integral part of all development strategies: of the nation as a whole, of the Oblasts and of local authorities. Each household should aim for energy efficiency. It is necessary to introduce a system of norms and economic preferences that encourage greater energy efficiency in the economy." (http://donors.kg/en/strategy) The latest version mentions buildings and housing, but to a lesser extent and without direct indicators or targets.
SCP mainstreamed into formal education (G.4)	(1) SCP is not formally taught in Kyrgyzstan.

Availability of financing options for sustainable housing (G.5)	(2) As of June 2019 development of sustainable housing financing is being established in coordination with UNDP and anout half a dozen other partners. (https://www.unece.org/index.php?id=51837.
Governmental level strategic approach for affordable housing (G.6)	(2) The Development Program of the Kyrgyz Republic for the period 2018-2022 as well as the Decree "on the announcement of 2018 as the year of regional development." Under these, strategies are developed for affordable housing, modern communication and energy services. The program stipulates state subsidy issuing for dwelling purchasing, but there is no mechanism for its effective implementation in place. Provision of social housing for low-income citizens, as well as for vulnerable groups of the population, including graduates of children's boarding schools, including through the implementation of the Government's affordable housing program (https://www.un-page.org/files/public/the_development_program_of_the_kyrgyz_republic_for_the_period_2018-2022.pdf)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(1) Kyrgyzstan has passed a law on the legalisation of informal settlements as it has been a growing problem since its fairly recent independence. According to the World Bank (WB), 2.8% of households lived in extreme poverty, and 37% of the population lived below the poverty line in 2013 (GEF, 2014).
Governmental level strategic approach for district development (G.8)	(2) The Development Program of the Kyrgyz Republic for the period 2018-2022 as well as the Decree "on the announcement of 2018 as the year of regional development," outline strategies for development of regions. Under these, strategies are developed for affordable housing, modern communication and energy services, local governments, and smart-city frameworks. (https://www.un-page.org/files/public/the_development_program_of_the_kyrgyz_republic_for_the_period_2018-2022.pdf)
Materials Production	

Policies in place relating to mining and materials production (MP.1)	(2) Insufficient mining policy exists as monitoring compliance is lacking and practices such as mercury mining still exist. Certain industrial facilities (large mining facilities, thermal power stations, the water authority) are required to report on their environmental activities in a format approved by the National Statistical Committee. (https://www.eea.europa.eu/publications/eea_report_2007_3/03_Policies_supporting_SCP.pdf/at_download/file).
Raw Material Use (MP.2)	(2) 8,31 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/=)
Mineral Depletion (MP.3)	(2) 5,46 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(1) 1,22 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(1) Within Kyrgyzstan's massive mining industry there are few to no signs of the use of intelligent mining.
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(2) In summer of 2019 the UNDP has made suggestions and recommendations for the development of policies pertaining to SCP in industrial and manufacturing sectors. (https://www.unece.org/fileadmin/DAM/ceci/publications/I4SD_Kyrgyzstan/ECI_CECI_25_ENG.pdf)
Availability of materials for sustainable design (DM.2)	(2) Programs are under development for the manufacturing of sustainable materials. (https://www.unido.org/our-focus-advancing-economic-competitiveness-upgrading-businesses-and-industrial-infrastructure/promoting-community-level-job-creation-and-income-generating-activities-through-development-cost-effective-building-materials-production-kyrgyzstan)

	(https://www.unido.org/sites/default/files/2014-10/IUMP_KYRGYZ_REPUBLIC_0.pdf)
Existence of Green Building Council (DM.3)	(1) Kyrgyzstan does not have representation with the World Green Building Council
Energy Building Code (DM.4)	(1) No energy building code related to residential buildings.
Green Building Rating system (DM.5)	(1) Kyrgyzstan is yet to develop a national green building certification system. Only one LEED building exists in country (US Embassy Bishkek).
BIM guidelines available (DM.6)	(1) BIM is rarely used in Kyrgyzstan and work is typically insourced from countries with more experience in BIM.
Incentives for energy efficient design (DM.7)	(3) Through KyrSEFF, "New buildings and buildings under construction can also qualify for KyrSEFF+ loans up to US$ 1 mil (or higher with special permission from EBRD) and grants up to 35%, where the grant is only payable upon official commissioning and/or when the permit of use is in place. The key criteria for new buildings to qualify I that the investment should result in a higher building energy efficiency standard (e.g. for windows, insulation, boilers and heating system, air conditioning, etc) than demanded by the local building regulation."
Construction	
National policy related to sustainable construction (C.1)	(2) Program of transition to SD (2013-2017) mentions energy efficient construction briefly. (https://sustainabledevelopment.un.org/content/documents/3911Kyrgyzstan.pdf)
Innovative construction practices (C.2)	(1) No notable innovations in construction have been realised in Kyrgyzstan

Share of raw material use (C.3)	(3) 1,70 tonnes per capita
Certification system for green building materials (C.4)	(1) Does not exist, recommended for development.
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(1) General lack of financing for EE in the building sector, especially for sustainable housing. (http://documents.worldbank.org/curated/en/555021468011161504/pdf/97409-WP-P133058-Box391503B-PUBLIC-Heating-Assessment-for-Kyrgyz-P133058-Final.pdf)
Usage	
Information programmes for energy use (U.1)	(2) First energy awareness campaign developed in 2019. (http://www.kg.undp.org/content/kyrgyzstan/en/home/presscenter/pressreleases/2019/08/kyrgyzstan-hosts-the-first-childrens-camp-on-energy-saving--burn.html)
Information programmes for water use (U.2)	(1) Infrequent programs typically conducted by UNDP or similar entities.
National policies related to sustainable use/consumption (U.3)	(1) Kyrgyzstan's water consumption policy relates only to water use in agriculture.
Availability of sustainable/green appliances/equipment (U.4)	(1) EE appliances are not readily available.
Rating system for appliances/ Labelling system for appliances (U.5)	(2) Under development. The regulatory framework has been set up. However it is reported that there is an "absence of: • Operating economic mechanisms that stimulate development of energy saving and efficiency, including energy-performance certification and labeling of equipment; • Energy-consumption categories and a range of energy-consuming

	equipment regulated by corresponding energy-efficiency standards and regulations; • Economic sanctions and legal liabilities for violating energy-consumption standards."
Funding for efficient appliances, efficient water usage, etc. (U.6)	(1) Funding does not currently exist.
Recycling	
Circular economy/recycling policy (R.1)	(1) Outdated legislation, no targets or plans to develop strategies. (https://issuu.com/zoienvironment/docs/ca-waste-eng)
Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(1) Basic recycling programs have only recently been introduced in Kyrgyzstan.

Malaysia

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) Together with Indonesia and Thailand, Malaysia implements the Green City Action Plans that aim to take into account existing green city examples, frameworks, development master plans and planned anchor projects to identify potential actions and projects that will support the community to become models of urban sustainability. (http://imtgt.org/green-city-action-plan/)
NDCs on the building sector (G.2)	(1) NDC exists for Malaysia, but does not include any information specific to EE in buildings or housing. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Malaysia%20First/INDC%20Malaysia%20Final%2027%20November%202015%20Revised%20Final%20UNFCCC.pdf)
National plan to implement SDGs related to building sector (G.3)	(1) Malaysia has a National SDG Roadmap to guide implementation of Agenda 2030 and the SDGs, but does not directly address the building sector. (https://sustainabledevelopment.un.org/memberstates/malaysia)
SCP mainstreamed into formal education (G.4)	(2) Currently under development as the CEPA component of the SCP Blueprint addresses the importance of SCP in school education. The virtual Malaysian SCP academy will serve as a lifelong learning platform for the twenty-first century. (http://www.switch-asia.eu/fileadmin/user_upload/PSCs/SCP-BP_Final_Draft_Jan2016.pdf)
Availability of financing options for sustainable housing (G.5)	(3) Malaysian banks offer preferential rates for homeowners financing a green home under specific conditions (must be GBI, LEED, etc. certified).

Governmental level strategic approach for affordable housing (G.6)	(2) The history of housing provision in Malaysia can be divided into four phases, namely 'Housing the Poor (1971–1985)', 'Market Reform (1986–1997)', 'Slums Clearance (1998–2011)', and 'State Affordable Housing (2012–present). Despite efforts, affordable housing is still a pending topic in Malaysia. (https://kyotoreview.org/yav/affordable-housing-imalaysia/)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(2) Despite the 5th Malaysia Plan's 'Zero Squatter 2005' policy, the number of squatters in Malaysia remained large. (http://www.planningmalaysia.org/index.php/pmj/article/download/263/236)
Governmental level strategic approach for district development (G.8)	(2) Under development: The construction of Putrajaya takes into account the environmental effects of building materials and design, construction methods, building operations and maintenance to substantially reduce or minimize impacts on the environment. Latest technologies and systems have been used to avoid environmental degradation, improve comfort and enhance productivity of building occupants. At the early planning and design stage, systems concerning energy consumption, low energy and efficient design buildings and supply have always been considered. A framework for Smart Cities has been launched in Sept 2019 serving as a guide for local governments. Five cities will serve as pilot projects to deploy solutions for upgrading to smart cities (Kulim, Kuala Lumpur, Johor Baru, Kota Kinabalu and Kuching). The framework is yet to be implemented. (https://www.thesundaily.my/local/ministry-launches-malaysia-smart-city-framework-BN1395377)
Materials Production	
Policies in place relating to mining and materials production (MP.1)	(1) The two main legal instruments that govern activities relating to mining are the Mineral Development Act (MDA) 1994 and the various State Mineral Enactments. Each State has its own legislation governing mining activities. No national policy directly relates to sustainable mining.
Raw Material Use (MP.2)	(1) 19,37 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(2) 10,08 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(1) 2,85 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)

Use of intelligent mining (MP.5)	(3) Much research and development of intelligent mining has occurred in Malaysia. (https://ieeexplore.ieee.org/document/5383486)
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(3) The NATIONAL SCP BLUEPRINT 2016-2030 was announced in the Eleventh Malaysia Plan and mentions the importance of designing and manufacturing for sustainability. (https://www.oneplanetnetwork.org/resource/national-scp-blueprint-2016-2030-announced-eleventh-malaysia-plan) Malaysia is an early adopter of Industry 4.0, which introduces the idea of a 'smart factory' where real time data is used to make decisions in a decentralised way. AI and the IoT will converge to lead to further innovation, automation and management of manufacturing processes. (https://www.equipment-news.com/malaysia-an-early-adapter-of-industry-4-0/).
Availability of materials for sustainable design (DM.2)	(2) Green material product directories are available. (https://www.greentechmalaysia.my/download/gtmp.pdf)
Existence of Green Building Council (DM.3)	(3) Malaysia's Green Building Council is well established.
Energy Building Code (DM.4)	(2) No energy building code relates directly to residential buildings:, however, a number of policies mention EE in buildings: -Malaysian Standard Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings -UNDP Malaysia Building Sector Energy Efficiency Project -National Energy Efficiency Policy
Green Building Rating system (DM.5)	(3) Malaysia's Green Building Index is well developed. (https://new.greenbuildingindex.org/)
BIM guidelines available (DM.6)	(3) Online portal provides learning materials and guidelines for students and professionals. The network is supported by the Government of Malaysia. (https://www.mybimcentre.com.my/)

Incentives for energy efficient design (DM.7)	(3) Exemption from tax and stamp duty for Green Building Index (GBI) certified building. Government lead by example.
Construction	
National policy related to sustainable construction (C.1)	(2) Institutional framework to improve adoption rate of Industrialised Building Systems (i.e. Construction Industry Transformation Programme, green building rating tools, and formal public-private collaboration) . It is planned for continuous implementation of the CITP, improving the financial viability of IBS through tax incentives, developing competencies via CoE. (https://www.greentechmalaysia.my/download/gtmp.pdf)
Innovative construction practices (C.2)	(2) Economic issues are the first priorities among stakeholders in any decision-makings for building projects and cost becomes one of the major reasons for the slow progress in implementing sustainable practices in building projects. Socially, there is still a wide gap of knowledge and awareness on sustainability issues among stakeholders, explaining the lack of commitment in achieving sustainability. However, industrialised building systems (IBS) are used in the construction sector. (https://emeraldinsight.com/doi/abs/10.1108/CI-12-2012-0064?journalCode=ci)
Share of raw material use (C.3)	(2) 4,91 tonnes per capita
Certification system for green building materials (C.4)	(3) Green product directories exist and it is planned to have a policy framework to be agile to enable recycling of C&D materials. (https://www.greentechmalaysia.my/download/gtmp.pdf)
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(3) Energy Performance Contracting (EPC) Fund for energy retrofit projects. Green Sukuk schemes: first green Islamic bond.

Usage	
Information programmes for energy use (U.1)	(3) National scale programmes to increase awareness of households, commercial and industrial sectors through EE campaigns in mass media, newspapers, etc. (http://author.uthm.edu.my/uthm/www/content/lessons/2693/ENERGY%20EFFCIENCY%20PROGRAMS%20IN%20MALAYSIA.pdf)
Information programmes for water use (U.2)	(3) A number of agencies work to educate the public about water conservation. (http://www.gec.org.my/index.cfm?&menuid=358&parentid=92)
National policies related to sustainable use/consumption (U.3)	(2) Under development. (https://www.switch-asia.eu/fileadmin/user_upload/SCP_Malaysa_-_Baseline_Study__pdf_of_printed_version_.pdf)
Availability of sustainable/green appliances/equipment (U.4)	(3) EE appliances are readily available in Malaysia. (http://bseep.gov.my/App_ClientFile/df08bc24-99fb-47a3-937f-dc25df9d3997/Assets/EE%20FEATURES/TEEAMBSEEP.pdf)
Rating system for appliances/ Labelling system for appliances (U.5)	(3) Minimum Energy Performance Standards (MEPS) for Electrical Appliances.
Funding for efficient appliances, efficient water usage, etc. (U.6)	(3) Sustainability Achieved via Energy Efficiency Programme or SAVE was a programme designed under the Economic Transformation Program (ETP) of the Malaysian National Energy Efficiency Action Plan Ministry of Energy, Green Technology and Water, 2015 13 Government in July 2011. The program was aimed to provide cash rebates for the purchase of energy-efficient refrigerators, air-conditioners and chillers. A total of RM 45 million was allocated under the program for the rebates and its promotional campaign activities throughout the country. The budget had covered the purchases of as many as 100,000 units of refrigerators, 65,000 units of air conditioners and 72,000RT capacity of energy efficient chillers for eligible

	domestic consumers and private companies. SAVE has helped to create a market for energy-efficient appliances and market penetration of those products. (https://www.mestecc.gov.my/web/wp-content/uploads/2019/04/13.-National-Energy-Efficiency-Action-Plan-english-only.pdf)
Recycling	
Circular economy/recycling policy (R.1)	(2) Under development. Policy framework to be agile to enable recycling of C&D materials. Until 2022, the CIDB will collaborate with key stakeholders to facilitate equipment procurement for construction and demolition (C&D) waste recycling in priority areas and work to amend policies that will allow the usage of recycled materials in construction. (https://www.greentechmalaysia.my/download/gtmp.pdf)
Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(2) Green building index (GBI) is influencing the likelihood of C&DW material being recovered. In GBI, it gives additional points for on-site C&DW separation and recycling and since there are more construction projects in Malaysia are in involves in reusing and recycling C&DW materials. (http://ousar.lib.okayama-u.ac.jp/files/public/5/55545/20171207090109368178/K0005620_fulltext.pdf)

Mongolia

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) Mongolia's Green Development Policy (2014) outlines a framework for green growth, incorporating information about buildings and housing. (http://www.switch-asia.eu/fileadmin/user_upload/RPSC/event/23-25May16-Mongolia/23May/2.3_GGI_Mongolia_v.2_eng.pdf)
NDCs on the building sector (G.2)	(2) Mongolia's NDC outlines the need to reduce heat loss in buildings, reduce emissions in the cement industry, and reduce fuel use in households by increasing stove efficiency and increase insulation for existing housing. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mongolia%20First/150924_INDCs%20of%20Mongolia.pdf)
National plan to implement SDGs related to building sector (G.3)	(1) Mongolia's Sustainable Development Vision 2030 outlines greater independence to urban areas and settlements, healthy, safe and comfortable living environment for citizens, and improvement of urban planning in line with world-class green development model, but outlines no further information about sustainable buildings or housing. (http://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/MONGOLIA%29%20Mongolia%20Sustainable%20Development%20Vision%202030.pdf)
SCP mainstreamed into formal education (G.4)	(1) SCP is not formally taught in Mongolia.
Availability of financing options for sustainable housing (G.5)	(2) Mongolian banks have voluntarily committed to introduce and operationalize sustainable banking practices since 2013 in cooperation with the International Finance Corporation (IFC) and the Dutch Development Bank (FMO). Through the implementation of the Mongolian Sustainable Finance (TOC) Principles, banks have started to conduct environmental and

	social due diligence as part of the regular loan processing procedures. For instance, if a business applying for a loan from a bank is assessed and determined that its operation is likely to cause major environmental and social risks, the bank will require the client to eliminate or mitigate the negative impacts, or even deny the loan request if the environmental and social risks are identified as irreversible.
Governmental level strategic approach for affordable housing (G.6)	(2) Housing for 100,000 Households: A government programme that plans 75,000 units for the capital and 25,000 for the Mongolian countryside (apartments for at least 1,000 households per province in the countryside offering five percent mortgages) and the Ulaanbaatar city government's Ger Area Land Re-adjustment plan, which is reforming ger areas around city. The mayor's office is also receiving technical support and possible financing from the Asian Development Bank (ADB) for affordable housing. (https://www.export.gov/article?id=Mongolia-Construction)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(1) 43% (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart)
Governmental level strategic approach for district development (G.8)	(3) The Master Plan 2030 for Mongolia's capital city of Ulaanbaatar divides the city in 47 khoroolols (neighbourhoods) as administrative planning units. The 47 khoroolols include 22 residential apartment neighbourhoods, 10 public service neighbourhoods, 10 redeveloped ger areas and 5 industrial neighbourhoods. 32 khoroolol are to be built as apartment complexes in Ulaanbaatar. Each of them will have planned social infrastructure such as schools, and hospitals, as well as parks and grocery stores. Over recent decades the informal settlements on the fringe of the city have become the ger areas and a substantial part of the city accommodating more than 60% of the city's residents. The fast and unplanned growth of the ger areas has resulted in many issues including inadequate public services and infrastructure, poor quality construction, air pollution and a range of environmental issues. The redevelopment of the ger areas aims to address these issues by increasing densities in the inner area and controlling further expansion in the outer areas of the city.
Materials Production	

Policies in place relating to mining and materials production (MP.1)	(2) EIA includes mining. The 2014 amendment of the Mineral Law conclude agreements on issues of environmental protection, mine exploitation, infrastructure development in relation to the mine-site development and job creation.
Raw Material Use (MP.2)	(2) 9,19 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(1) 45,93 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(2) 0,51 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(2) Intelligent mining practices are starting to be developed. In 2017, virtual reality training has been introduced at Oyu Tolgoi. The virtual reality scenarios were developed both in Mongolian and English, and cover topics ranging from identification of correct PPE to refuge chamber access and procedures. The training has proved to bring improvements as an increase in understanding of tagging procedures, in knowledge retention and recall and in confidence of successfully initiating an emergency response.
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(1) No national policy specifically relates to SCP in design & manufacturing.
Availability of materials for sustainable design (DM.2)	(1) Commercial availability of high quality energy efficient materials and systems in Mongolia is mostly through imports but they too are limited. This is more evident with regards to the advanced triple/quadruple glazed, low-e, argon filled and insulated frame windows that are actually needed in Mongolia's extreme winter climate for BCNS EE code compliance for highly glazed/curtain wall buildings. There are some local manufactures who are capable of producing some of these advanced insulation materials, but the market demand is still low that manufacturing cannot reach the economy of scale, putting the cost of these materials at considerable prices.
Existence of Green Building Council (DM.3)	(1) Mongolia does not have representation with the World Green Building Council.

Energy Building Code (DM.4)	(1) The sustainable development vision has reflected to reduce a heat loss of buildings by 20 percent by 2020 and by 40 percent in 2030, but no building code has been developed. (https://montsame.mn/en/read/132428)
Green Building Rating system (DM.5)	(1) Mongolia is yet to develop a national green building certification system.
BIM guidelines available (DM.6)	(2) BIM project in cooperation with a Czech university, but no fully developed guidelines.
Incentives for energy efficient design (DM.7)	(1) Suitable and effective financial mechanisms and fiscal products to support EE buildings designs and investments are hardly available.
Construction	
National policy related to sustainable construction (C.1)	(3) Article 11.1.7 of the revised Law of Construction has a provision stating: "To implement GB Policy and green construction requirements in construction activities: introduction of advanced technology, and effective planning to use of electricity, steam and water resources"
Innovative construction practices (C.2)	(2) Use of supplementary Cementous materials. (https://unfccc.int/files/cooperation_support/nama/application/pdf/mongolia1062015.pdf)
Share of raw material use (C.3)	(2) 3,81 tonnes per capita
Certification system for green building materials (C.4)	(1) Recommended for development, none to date.
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(2) Mongolian banks have voluntarily committed to introduce and operationalize sustainable banking practices since 2013 in cooperation with the International Finance Corporation (IFC) and the Dutch Development Bank (FMO). Through the implementation of the Mongolian Sustainable Finance (TOC) Principles, banks have started to conduct environmental and social due diligence as part of the regular loan processing procedures.

	(https://www.ifc.org/wps/wcm/connect/0ff46c80476d9de285c4f5299ede9589/MBA_Construction-Sector-Guideline_Final.pdf?MOD=AJPERES)
Usage	
Information programmes for energy use (U.1)	(2) Programmes under development to increase awareness of public and industries. (https://www.smart-energy.com/regional-news/asia/energy-conservation-mongolia-ggci-erc/)
Information programmes for water use (U.2)	(1) No majour water efficiency campaigns to increase public awareness.
National policies related to sustainable use/consumption (U.3)	(2) One of the principles of the Green Development Policy is efficient, effective and rational use of resources.
Availability of sustainable/green appliances/equipment (U.4)	(1) Efficient appliances are not readily available.
Rating system for appliances/ Labelling system for appliances (U.5)	(1) There is no rating or labelling system for appliances in Mongolia.
Funding for efficient appliances, efficient water usage, etc. (U.6)	(2) In 2000, the Government of Mongolia began the National 100,000 Solar Ger Electrification Programme, an ambitious initiative to improve the lifes of about half a million herders by provinding modern electricity systems. The program provided photovoltaic solar home systems adaptable to the nomadic lifestyle of herders and complementing their traditional way of life. (http://www.worldbank.org/content/dam/Worldbank/document/mn_REAP.pdf)
Recycling	
Circular economy/recycling policy (R.1)	(1) Mongolia has no specific policy addressing a circular economy. Recycling policies are limited and most recycling is informal.

Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(1) Recycling in Mongolia is rather informal, there are no innovative processes in place.

Nepal

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(2) The GGGI helped Nepal to produce a national planning framework up to 2020, however, it does not mention sustainable housing or buildings. (http://gggi.org/site/assets/uploads/2018/07/GGGI_Nepal_Country-Plannig-Framework-2017-2021_Web-optimized_low.pdf)
NDCs on the building sector (G.2)	(2) Nepal's NDC outlines the promotion of greener, smarter and better homes. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nepal%20First/Nepal%20First%20NDC.pdf)
National plan to implement SDGs related to building sector (G.3)	(3) Nepal's SDG strategy outlines that a proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings utilizing local materials. (https://www.npc.gov.np/images/category/1__SDG_Report_final_version.pdf)
SCP mainstreamed into formal education (G.4)	(1) SCP is not formally taught in Nepal.
Availability of financing options for sustainable housing (G.5)	(2) Financing strategies for sustainable housing in Nepal are currently under development. (https://www.unescap.org/sites/default/files/National%20Study%20-%20Final%20-%2020170303.pdf)
Governmental level strategic approach for affordable housing (G.6)	(3) Especially since the last earthquake to hit Nepal in 2015, a number of approaches have been developed for affordable housing and reconstruction.

Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(1) 54% (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart)
Governmental level strategic approach for district development (G.8)	(3) A number of programmes are set up for district development in Nepal, including some from Habitat for Humanity and government plans.
Materials Production	
Policies in place relating to mining and materials production (MP.1)	(3) “National Policy Framework” has been developed specifically for the brick sector with the aim to make the industry more energy-efficient, environment-friendly and socially responsive, thereby contributing to achieve reductions in black carbon and CO2 emissions along with promoting their related co-benefits on development and health.”
Raw Material Use (MP.2)	(3) 2,58 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(3) 0,47 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(3) 0,04 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(1) Intelligent mining practices are not yet mainstream in Nepal.
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(1) No national policy specifically relates to SCP in design and manufacturing.
Availability of materials for sustainable design (DM.2)	(2) Guides are available for building material selection and use.

Existence of Green Building Council (DM.3)	(1) Nepal does not have representation with the World Green Building Council.
Energy Building Code (DM.4)	(1) National building codes in Nepal focus on structural safety due to past earthquake disasters. No policies currently outline energy use in buildings.
Green Building Rating system (DM.5)	(1) Nepal's SBR is under development.
BIM guidelines available (DM.6)	(2) No current guidelines for BIM in Nepal, however, a number of companies are working towards standardizing BIM.
Incentives for energy efficient design (DM.7)	(3) Green Homes, a project developed by the EU and UN Habitat worked closely with Nepalese stakeholders to increase demand for green housing as well as to bring down the cost of materials. (http://unhabitat.org.np/project/greenhomes/about-us/) Government of Nepal Approves Increase in Grants Subsidy to NPR 300,000. The Steering Committee of the National Reconstruction Authority (NRA) recently approved the increase of the housing reconstruction grants to Rs.300,000 (about USD 3,000). Reconstructed homes are intended to be built to higher environmental standards. Subsidies are also available for the development of renewables since 2013.
Construction	
National policy related to sustainable construction (C.1)	(2) Nepal's National Land Policy outlines regulations for ownership, use and overall management of the land. Policies directly relating to construction stipulate measures for mitigating seismic activity, but do not outwardly mention sustainability in construction.
Innovative construction practices (C.2)	(3) With assistance from the UNDP houses which mitigate the impacts of seismic activity have been developed for the region and are available for as low as $4000 (USD). Nepalis wishing to build new structures can now officially apply and

	receive their building permits online. Launched at the Kathmandu Metropolitan City (KTM) Office and planned to be expanded at many other municipalities, the electronic building permit system or e-BPS, is an online application system that makes obtaining a permit easier and will improve compliance to building codes. (http://www.np.undp.org/content/nepal/en/home/presscenter/articles/2016/04/19/e-building-permit-system-easing-reconstruction-promoting-code-compliance-.html)
Share of raw material use (C.3)	(3) 0,64 tonnes per capita
Certification system for green building materials (C.4)	(1) Green building materials are not readily available or cost efficient according to experts in Nepal. There is currently no system specific to the rating of building materials available. (http://conference.ioe.edu.np/ioegc2015/papers/IOEGC-2015-029.pdf)
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(2) The Asian Development Bank funds urban development projects such as wind power grids and others, but there are no specific financing models which directly fund these projects. (https://www.adb.org/results/darkness-gone-wind-nepal)
Usage	
Information programmes for energy use (U.1)	(3) The Alternative Energy Promotion Centre attempts to mainstream a renewable energy supply in Nepal by raising awareness and capacity building for the public. (https://sustainabledevelopment.un.org/content/documents/4873govind.pdf) Clean Energy Nepal works with the public, including school aged children about the importance of clean energy. The Nepal Energy Efficiency Programme (NEEP) has been promoting energy efficiency in Nepal since 2010. NEEP is implemented by the Ministry of Energy, Water Resource and Irrigation (MoEWRI), the Government of Nepal with technical assistance provided by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). (http://www.energyefficiency.gov.np/article-about)
Information programmes for water use (U.2)	(3) USAID has multiple programmes promoting water efficiency in Nepal. (https://www.usaid.gov/global-waters/september-2013/in-focus)

National policies related to sustainable use/consumption (U.3)	(3) The government has formulated many policies and enacted laws and regulations related to environment and climate change. These include the Soil and Water Conservation Act 1982, Water Resources Act 1992, Industrial Enterprises Act 1992, Vehicle and Transport Management Act 1992 and Regulations 1997 (First Amendment in 2004), Forest Act 1993 and Regulations 1995, Local Self Governance Act 1999 and Local Self Governance Regulations 1999, and Ozone Depleting Substance Consumption Regulations 2001. These instruments are being implemented for promoting sustainable consumption and production. (https://sustainabledevelopment.un.org/content/documents/1018nepalnationalreport.pdf)
Availability of sustainable/green appliances/equipment (U.4)	(2) EE appliances and equipment appear to be readily available in Nepal. (https://www.grin.com/document/368409)
Rating system for appliances/ Labelling system for appliances (U.5)	(2) Although Nepal does not have their own energy labelling system, they promote the use of a variety of related labels such as from India's BEE, the Thai EE label, the EU EE label and Energy Star. Public information programmes (by NEEP) promote these labels. (http://energyefficiency.gov.np/downloadthis/leaflet_energy_efficiency___(2013,_english).pdf)
Funding for efficient appliances, efficient water usage, etc. (U.6)	(1) The government has adopted several subsidy schemes to promote energy efficiency in all sectors of the economy. No specific information states if this is available for EE appliances during housing construction or for public to apply for grants.
Recycling	
Circular economy/recycling policy (R.1)	(2) Improved circular economy and recycling policies are currently under development in Nepal.
Platform available for sourcing CDW (R.2)	(3) CDW materials have their own section on a popular sharing community in Nepal. (https://www.merosecondhand.com/for-sale/construction-materials)
Innovative recycling practices in place (R.3)	(3) Over 330.000 biogas plants have been installed for households in Nepal to recycle cooking oils, etc. (https://unfccc.int/sites/default/files/resource/tpMitigation.pdf) Nepal has many programmes for recycling and upcycling plastic, especially in sensitive landscapes. (https://psdnepal.org/plastics)

Pakistan

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) Pakistan's Pakistan National Action Plan on SDG 12 Sustainable Consumption and Production speaks to the importance of green buildings and housing and outlines a framework to develop new green building codes. (https://www.pbc.org.pk/wp-content/uploads/final_nap_report_aug_2017_pakistan.pdf)
NDCs on the building sector (G.2)	(2) No specific information to do with housing, the potential for EE in buildings is mentioned. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Pakistan%20First/Pak-INDC.pdf)
National plan to implement SDGs related to building sector (G.3)	(3) Pakistan's National Strategy for SDG #12 (SCP) outlines specific information about the importance of sustainable buildings and green housing. (http://www.oneplanetnetwork.org/sites/default/files/final_nap_report_aug_2017.pdf)
SCP mainstreamed into formal education (G.4)	(1) SCP is not formally taught in Pakistan.
Availability of financing options for sustainable housing (G.5)	(2) Financing mechanisms are under development to promote sustainable housing in Pakistan, especially in banking and lending frameworks have been set up to identify applicants who are investing in EE. (http://www.sbp.org.pk/departments/ihfd/pub.pdf)
Governmental level strategic approach for affordable housing (G.6)	(3) There are both public and public-private partnership programmes which support low income affordable housing, for example the National Housing Policy and government initiated housing schemes. (http://siteresources.worldbank.org/EXTFINANCIALSECTOR/Resources/282884-1239831335682/6028531-1239831365859/Rizvi_LowIncomeHousingPakistan_overviewpaper.pdf) The World Bank and the Climate Fund also both support affordable sustainable housing.

Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(1) 46% (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart)
Governmental level strategic approach for district development (G.8)	(3) District development in Pakistan includes the development of smart cities, productivity villages and participatory rural appraisal which seek participation from citizens to identify problem and expedite solutions.
Materials Production	
Policies in place relating to mining and materials production (MP.1)	(3) Measures under the National Mineral Policy relate directly to environmental, social and economic sustainability and impacts.
Raw Material Use (MP.2)	(3) 3,21 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(3) 0,35 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(3) 0,17 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(2) Intelligent mining strategies are being developed in Pakistan, especially after a number of mining tragedies in 2018. (https://link.springer.com/book/10.1007/978-981-13-6052-7)
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(3) Pakistan's National Action Plan on SCP mentions integrating SCP principles into the design and manufacturing processes. (https://www.pbc.org.pk/wp-content/uploads/final_nap_report_aug_2017_pakistan.pdf)
Availability of materials for sustainable design (DM.2)	(1) Despite improvements, Pakistan still lags in sustainable design of buildings although materials are somewhat available, their use is not as commonplace. (http://cesb.cz/cesb10/papers/7_policy/103.pdf)

Existence of Green Building Council (DM.3)	(3) Pakistan's Green Building Council is well established.
Energy Building Code (DM.4)	(2) The Building Energy Code of Pakistan outlines minimum standards for EE, but not for residential buildings. (https://www.iea.org/beep/pakistan/codes/building-energy-code-of-pakistan-1990.html) (https://www.globalabc.org/uploads/media/default/0001/01/0bf694744862cf96252d4a402e1255fb6b79225e.pdf)
Green Building Rating system (DM.5)	(3) Pakistan's Green Building Guidelines BD+C are well developed. SEED is also commonly used as the GB standard. (https://pakistangbc.org/index.php#)
BIM guidelines available (DM.6)	(3) Pakistan's BIM Council provides guidelines and training on the use of BIM technology in construction.
Incentives for energy efficient design (DM.7)	(2) Pakistan has introduced financial incentives for energy efficiency and green energy., including wind energy and solar. EE in buildings or housing is not specifically mentioned. (http://news.trust.org/item/20130625141050-sw1nq)
Construction	
National policy related to sustainable construction (C.1)	(3) Pakistan's National SCP policy has provisions directly relating to construction. (https://www.pbc.org.pk/wp-content/uploads/final_nap_report_aug_2017_pakistan.pdf)
Innovative construction practices (C.2)	(1) No majour innovations in construction have been realised in Pakistan.
Share of raw material use (C.3)	(3) 0,77 tonnes per capita
Certification system for green building materials (C.4)	(2) Many guidelines available, but no official rating system for green building materials. (https://www.researchgate.net/publication/267364466_Sustainability_of_Different_Pakistani_Building_Systems)
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(2) PPP projects for urban EE projects have been initiated in Pakistan for sustainable urban infrastructure, but not necessarily related to housing. (http://www.oecd.org/cfe/regional-policy/WP_Financing_Green_Urban_Infrastructure.pdf)

Usage	
Information programmes for energy use (U.1)	(2) Most major campaigns for the promotion of energy conservation are developed by private energy companies. (https://www.ke.com.pk/sustainability/energy-conservation/)
Information programmes for water use (U.2)	(1) Despite issues with water scarcity, no majour campaigns relating to increasing public awareness of water efficiency.
National policies related to sustainable use/consumption (U.3)	(3) National Energy Efficiency and Conservation Act 2016: The National Energy Efficiency and Conservation Board is an inter-ministerial body, including among its members for example Federal Secretaries of Ministry of Finance, Ministry of Planning and Development, Ministry of Housing and others. The Board is responsible for the supervision, management of the affairs, and policy direction of the NEECA. Its main functions include promotion of energy conservation and efficient development of energy efficient technologies, certification of energy efficient products and projects. The Act further defines “Powers and functions of the Federal Government to facilitate and enforce efficient use of energy and its conservation” (Article 10-13), including powers to prescribe energy conservation building codes, issue energy saving certificates, prescribe the value of energy and establish an Energy Conservation Fund for the purposes of promotion of efficient use of energy and its conservation within its territory. (http://www.lse.ac.uk/GranthamInstitute/law/national-energy-efficiency-and-conservation-act-2016/)
Availability of sustainable/green appliances/equipment (U.4)	(1) Energy efficient appliances are not commonplace in Pakistan. The need for improvement has been pointed out since the early 2010's, yet little progress has been made. "Even if the world’s most energy efficient brands like Bosch, Siemens, Electrolux and Daikin are available, they are overpriced, taking into account the energy savings." (https://www.dawn.com/news/1055880)
Rating system for appliances/ Labelling system for appliances (U.5)	(2) Pakistan has an energy efficiency rating system for fans, but not for other appliances.

Funding for efficient appliances, efficient water usage, etc. (U.6)	(2) Available through Asian Development Bank. (https://www.adb.org/sites/default/files/project-document/64091/42051-014-pak-fam.pdf)
Recycling	
Circular economy/recycling policy (R.1)	(2) C&D disposal Guidelines - Using construction waste and sand as top layer at urban disposal sites - Strengthen enforcement laws and regulations on SWM(including construction waste) (http://www.environment.gov.pk/images/provincialsepasguidelines/SWMGLinesDraft.pdf)
Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(2) UN-Habitat and the UNESCAP have launched a solid waste management pilot project in the cities of Karachi, Rawalpindi, Islamabad and Mardan, Pakistan. (https://waste-management-world.com/a/pilot-recycling-composting-projects-in-pakistani-cities)

Sri Lanka

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) Sri Lanka National Action Plan for Haritha (Green) Lanka Programme mainstreams green growth and sustainable development. The program is launched to create 10,000 eco-friendly "Haritha Suhuru" (Green Smart villages throughout the island by the year 2021 under the concept "Neela Haritha Lassana Lanka" (Green Environmental Beautiful Sri Lanka) covering all nine provinces. (https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/presentation/wcms_150736.pdf)
NDCs on the building sector (G.2)	(2) Sri Lanka's NDC mentions the promotion of climate resilient building design and the importance of alternative building materials. It mentions that design should be based on GB guidelines. Housing is not specifically mentioned. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Sri%20Lanka%20First/NDCs%20of%20Sri%20Lanka.pdf)
National plan to implement SDGs related to building sector (G.3)	(3) Sri Lanka's national SDG strategy outlines the importance for green buildings and eco villages. (https://www.researchgate.net/profile/Mohan_Munasinghe/publication/327221768_Sustainable_Sri_Lanka_2030_Vision_and_Strategic_Path/links/5cd26cc892851c4eab89919c/Sustainable-Sri-Lanka-2030-Vision-and-Strategic-Path.pdf?_sg%5B0%5D=QAmK2bfDBn3MIlDVyloy_8e3A_qTqgjW_Aet9dRuPxeX_Xf15IFGgJHvcAoxin0DwN5zIKPtnkmkImwaxGnVoA.fCCX6c-aCBxp7er03Ox-ThZXnCqVq6CHiVggpUQdq8lbqHVhnpfsWn65tPQXwMcBssGL6vFAXg2ReD4ZAlbsIQ&_sg%5B1%5D=Exy3tqDrHLCKmstVVlhuwBSFDA_EUqAHwKCYpA5n0YybpkR0HJNkthMGwe0Yw6ZPU4-1WL9Fv4GBeLG75UEPSwzNZUQzhmySlfKRaYoSK3-l.fCCX6c-aCBxp7er03Ox-ThZXnCqVq6CHiVggpUQdq8lbqHVhnpfsWn65tPQXwMcBssGL6vFAXg2ReD4ZAlbsIQ&_iepl=)

SCP mainstreamed into formal education (G.4)	(2) Since 2015, a 4-year programme was launched for a scholarship programme for Sri Lankan students to study the SCP programme at AIT. (https://eeas.europa.eu/sites/eeas/files/notice_for_certificate_programme_0.pdf)
Availability of financing options for sustainable housing (G.5)	(3) Banking sector has made progress towards innovative loan/saving products for energy efficiency, green building, green urban infrastructure, water saving and efficiency, and climate-smart agriculture through project loans, corporate loans, green mortgage loans, etc. (https://www.cbsl.gov.lk/sites/default/files/Sri%20Lanka%20Sustainable%20Finance%20Roadmap%20FINAL%2008.04.19.pdf)
Governmental level strategic approach for affordable housing (G.6)	(1) Some developers are creating affordable developments, but Sri Lanka is still lacking in a strategic approach to affordable housing for all citizens (https://echelon.lk/landmark-revolutionizes-affordable-living-in-sri-lanka/)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(2) 25% in 1990 (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart)
Governmental level strategic approach for district development (G.8)	(2) The Model Village Programme is government funded and offers financing for low income families to live in districts created with necessary infrastructure, however sustainability measures are not at the forefront of this programme. Districts are being developed sustainably with support from UN Habitat. Smaller, individual cities used as pilot projects. http://www.fukuoka.unhabitat.org/programmes/scp/sri_lanka/detail01_en.html
Materials Production	
Policies in place relating to mining and materials production (MP.1)	(2) National Env Poli mentions sustainable use of resources, but no sustainable mining policy specifically exists. National Policy on Sand as a Resource for the Construction Industry – 2006: Sand is a mineral as defined in the Mines and Minerals Act No. 33 of (1992), and is the property of the state. Estimated annual national demand for sand for the construction industry is appx. 7 million cubic metres. Its objective is to develop a dual approach to the wise management of sand resources, (a) though an effective system of policing within a strong regulatory framework; and (b) through the granting of incentives including skills training and alternate employment, for the dev. of sustainable alternatives.

Raw Material Use (MP.2)	(3) 4,05 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(3) 0,84 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Fossil Fuel Depletion (MP.4)	(3) 0,15 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(1) Sri Lanka is hesitant about going beyond traditional construction boundaries, and the situation has critically deterred the progress of all sectors including financial management, technology and project management.
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(3) National Policy and Strategy for Cleaner Production for Sri Lanka-2004 : The policy pronounces that cleaner production principles should be applied to improve the efficiency of natural resource use while maintaining and improving environmental quality. The objective of this policy is to incorporate the cleaner production concept and practices into all development sectors of the country. To implement the policy sectoral policies were developed for health and tourism in collaboration with the Ministry of Health and Ministry of Tourism.
Availability of materials for sustainable design (DM.2)	(2) Sustainable materials are available, but require market stimulation for more widespread use. (https://www.researchgate.net/publication/323336715_Sustainable_construction_practices_of_Sri_Lankan_contractors)
Existence of Green Building Council (DM.3)	(3) Sri Lanka's Green Building Council is well established.

Energy Building Code (DM.4)	(2) Guidelines for EE specifically in Residential Buildings is under development and other tools for implementation in construction sector are under development. National Energy Policy of Sri Lanka spells out the implementing strategies, specific targets and milestones through which the Government of Sri Lanka and its people would endeavour to develop and manage the energy sector in the coming years in order to facilitate achieving its millennium development goals. It includes promotion of energy efficiency and conservation as one of its elements under which Supply side and end-use energy efficiency will be encouraged through financial and other incentives/disincentives in respect of energy end-use mandatory measures such as appliance energy labelling, building codes and energy audits. However, the residential sector is not yet fully covered under this building code-. (https://noulanka.lk/Green%20Building%20Guidelines%20-%20English.pdf) (https://www.globalabc.org/uploads/media/default/0001/01/0bf694744862cf96252d4a402e1255fb6b79225e.pdf)
Green Building Rating system (DM.5)	(3) Green mark is well developed in Sri Lanka. (http://greenbuild.lk/)
BIM guidelines available (DM.6)	(1) BIM is becoming popular and likely to become industry standard for construction project design in future. However, BIM is not yet practiced in Sri Lankan construction industry and not many in the industry know about it.
Incentives for energy efficient design (DM.7)	(3) Green Banking (Government policy measures for private sector involvement): Under Green Banking funds are being provided essentially to private sector Non- Conventional Renewable Energy (NCRE) projects. Based on which consumer demand has been created by Government policy initiatives which includes- Encouragement of private sector investment in grid connected Wind/Solar/Waste to Energy Power generation • Tenders for 60, 1 MW solar plants • Net Metering/Net Accounting/Net Plus Schemes with attractive feed in tariffs • “Surya Bala Sangramaya” (Battle of Solar) initiative for 1 million solar roof tops • “Rivi Bala Saviya” interest subsidy scheme • Differential duties for Electric/Hybrid vehicles To be fully implemented: • Developing technical standards, Energy labelling, Electric Vehicle charging standards, Green building codes • Licensing Service providers • Hiring of roof-tops for Solar power generators
Construction	

National policy related to sustainable construction (C.1)	(3) A guiding principle of the National Construction Policy is to ensure minimizing negative environmental impacts and achieving sustainable development and enhancing the competitiveness and transparency in the procurement process as well as to create the social and economic environment that will facilitate private sector Investments and entrepreneurship. (https://drive.google.com/file/d/0B-H067SvwMyeVEx2VVJ6eEE1YjQ/view)
Innovative construction practices (C.2)	(2) Traditional construction techniques are often updated with modern technology. However, a larger number of SLLSE firms being in the typically less innovation-intensive or less skills-intensive retail and wholesale trade, hotels and restaurants, and construction service sectors. (https://www.innovationpolicyplatform.org/sites/default/files/rdf_imported_documents/productivity,%20innoation%20and%20growth.pdf)
Share of raw material use (C.3)	(3) 2,83 tonnes per capita
Certification system for green building materials (C.4)	(3) The CIOB Green Building Product (CGBP) certification scheme is a dedicated building product labelling scheme that evaluates building products and equipment for their environmental impact and performance. (http://greenbuild.lk/)
Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(3) The Ministry of Power and Renewable Energy has begun a community based project called Soorya Bala Sangramaya (Battle for Solar Energy) which promotes small solar installations on rooftops of houses (or businesses) where they can sell excess electricity through net metering, net accounting or as a micro solar producer. (http://www.energy.gov.lk/Solar/)
Usage	
Information programmes for energy use (U.1)	(3) A Presidential task force promotes energy efficiency, with specific programming directed at residential EE. Program includes a national arts competition to increase visibility of EE issues within the younger generation. Presidential task force on energy demand side management was set up to speed up the energy demand side activities in the country which would

	curb the addition of 500 MW power plants to the national grid in five years' time. This is an inter-ministerial task force headed by Minister of power and renewable energy, convened by the Secretary of Ministry of Power and Renewable energy. (http://www.energy.gov.lk/ODSM/index.html) (http://www.energy.gov.lk/energy_efi.php)
Information programmes for water use (U.2)	(3) School programmes TV advertisements, print media and posters available which promote water conservation. (http://www.waterboard.lk/web/index.php?option=com_content&view=article&id=31&Itemid=189&lang=en#water-conservation)
National policies related to sustainable use/consumption (U.3)	(3) SRI LANKA SUSTAINABLE ENERGY AUTHORITY ACT, outlines a number of tools to support sustainable use of energy. (http://www.energy.gov.lk/document/SLSEA%20Act-E.pdf) (http://www.energy.gov.lk/ODSM/download/Circulars/circular-presidential-secretariat-eng.pdf)
Availability of sustainable/green appliances/equipment (U.4)	(3) High quality EE appliances are readily available and promoted in Sri Lanka. (https://www.iiec.org/2015-11-12-07-37-38/energy-efficiency-and-demand-side-management/678-sri-lanka/446-appliance-energy-testing-and-labeling-sri-lanka)
Rating system for appliances/ Labelling system for appliances (U.5)	(3) Standards and regulations available for most major appliances. (http://www.energy.gov.lk/ODSM/Standards-and-Regulations.html)
Funding for efficient appliances, efficient water usage, etc. (U.6)	(3) Adequate financial incentives for the households to adopt the energy-conserving technology, including discounts on energy saving appliances. (https://www.econstor.eu/bitstream/10419/109331/1/ewp-131.pdf)
Recycling	
Circular economy/recycling policy (R.1)	(2) Principles of circular economy have been included in policies since the 2000's. However, no enforced standards on national level, some local authorities control sorting and collection. Open dumping still a problem. National policies for circular economy are being developed. (https://roar.media/english/life/reports/does-sri-lanka-recycle-garbage-or-recycle-promises/)

Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(2) Under development with IUCN. (https://www.iucn.org/news/asia/201801/innovative-and-collaborative-future-plastic-waste-management-sri-lanka)

Thailand

General

Indicator	Ranking & Reasoning
Green growth / sustainable development action plan (G.1)	(3) The Twelfth National Economic and Social Plan for Thailand outlines the improvement of building codes and prescribes measures and mechanisms to support greenhouse gas reduction in all sectors. (http://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/THAILAND%29%20The%20Twelfth%20National%20Economic%20and%20Social%20Development%20Plan%20%282017-2021%29.pdf)
NDCs on the building sector (G.2)	(1) NDC exists for Thailand, but does not include any information specific to EE in buildings or housing. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Thailand%20First/Thailand_INDC.pdf)
National plan to implement SDGs related to building sector (G.3)	(3) The national Sufficiency Economy Philosophy is Thailand's Path towards Sustainable Development Goals. It outlines the importance of green buildings and green certification to move forward in sustainable development. (https://data.opendevelopmentmekong.net/dataset/ae9eb825-d327-4953-ab65-10060cd96ffc/resource/adacab88-fcf3-4cf0-8751-7363ba26afee/download/sep_thailands_path_towards_sdgs_2.pdf)
SCP mainstreamed into formal education (G.4)	(3) The Asian Institute of Technology (AIT), Thailand offers a 5-month post-secondary certificate programme for SCP. (https://eeas.europa.eu/sites/eeas/files/notice_for_certificate_programme_0.pdf)
Availability of financing options for sustainable housing (G.5)	(3) UN Environment's technical assistance and stakeholder engagement were instrumental in helping the country work out how to promote sustainable, energy-efficient buildings to reduce greenhouse gas emissions while ensuring affordable housing for its citizens. (https://www.unenvironment.org/news-and-stories/story/building-green-growth-thailand)
Governmental level strategic approach for affordable housing (G.6)	(3) Baan Mankong Collective Housing Programme was launched by the Thai government in January 2003, as part of its efforts to address the housing problems of the country's poorest urban citizens. The program channels government funds,

	in the form of infrastructure subsidies and soft housing and land loans, directly to poor communities, which plan and carry out improvements to their housing, environment, basic services and tenure security and manage the budget themselves. (http://www.codi.or.th/housing/aboutBaanmankong.html)
Informal settlements (Proportion of urban population living in informal settlements [2014]) (G.7)	(2) 25% (https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?view=chart)
Governmental level strategic approach for district development (G.8)	(3) National Housing Authority (NHA) Thailand has been actively involved with design and construction of eco-villages. [http://solutions.ait.ac.th/wp-content/uploads/2015/12/Technology-Magazine-December-2015-low.pdf] Example: One Bangkok: smart city, certified green buildings [https://custom.forbes.com/2018/10/30/thailand-a-vision-for-the-future/] Thailand has successfully developed a Community Development Model, known as a "Sufficiency Economy Village", based on the application of the Sufficiency Economy Philosophy (SEP). [http://www.tica.thaigov.net/main/contents/files/articles-20160630-151027-942140.pdf]
Materials Production	
Policies in place relating to mining and materials production (MP.1)	(3) Thai government has also launched the policy on "Green Mining" in 2009 aimed to encourage mining entrepreneurs to go green, developing new environmental performance evaluation tools for the mining industry to more understand about the negative impacts of their production processes. There are a number of different tools used for investigating the environmental performance of the mining operations, such as Environmental Impact Assessment, Ecological Risk Assessment, Ecological Footprint, GHGs Footprint, Material Flow Analysis, and Life Cycle Assessment (LCA) (https://www.degruyter.com/downloadpdf/j/rtuect.2017.20.issue-1/rtuect-2017-0011/rtuect-2017-0011.pdf)
Raw Material Use (MP.2)	(2) 11,91 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Mineral Depletion (MP.3)	(3) 6,08 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)

Fossil Fuel Depletion (MP.4)	(1) 1,46 (http://scp-hat.lifecycleinitiative.org/module-1-country-profile/)
Use of intelligent mining (MP.5)	(3) Thailand Green and Smart Mining Awards, organized by the Ministry of Natural Resources and Environment, is awarded to enterprises which operate their mining business in accordance with good governance, therefore promoting intelligent mining.
Design & Manufacturing	
National policies related to SCP in design & manufacturing (DM.1)	(3) The twelfth National Economic and Social Development Plan (2017-2021), Thailand outlines a "sufficiency economy" principle which is built on the same principles as SCP. For decades, the Thai government has used SCP principles under the sufficiency economy. Highlighted in the plan are the importance of innovation in design and manufacturing. (https://www.oneplanetnetwork.org/resource/twelfth-national-economic-and-social-development-plan-2017-2021-thailand)
Availability of materials for sustainable design (DM.2)	(2) Constant flow of new building materials and products entering the market, prices deter builders from widespread use. (http://www.asiagreenbuildings.com/9029/thailand-building-materials-used-sustainable-homes-phuket/)
Existence of Green Building Council (DM.3)	(1) Thailand does not have representation with the World Green Building Council.
Energy Building Code (DM.4)	(2) New BEC for large-scale buildings in 2018 (area greater than 10,000 square metres), followed by 5,000 m^2 in 2019 and 2,000 m^2 in 2020 In July 2017, the Department of Alternative Energy Development and Efficiency ("DEDE") has launched Thailand's first compulsory building energy consumption standards, namely the Green Building Energy Code ("GBEC"). The GBEC established certain standards and specifications related to the building envelope, electrical lighting system, air conditioning

	system, water heating, overall energy consumption, and renewable energy outfitting within the building, which all of the large buildings' design and construction must follow. It is estimated that 74 million units of electricity would be reduced if stricter standards were applied to energy consumption in larger buildings in Thailand. (https://www.mdpi.com/2071-1050/10/10/3585)
Green Building Rating system (DM.5)	(3) While LEED is still used, the TREES certification is based on LEED and specific to Thailand's needs. (https://www.dmg-thailand.com/leed-trees-certification/)
BIM guidelines available (DM.6)	(3) Detailed guidelines available. (http://download.asa.or.th/03media/isa/bim/20150427-tbgv01.pdf)
Incentives for energy efficient design (DM.7)	(3) Incentives available through ENCON fund, revolving EE fund, and success with major banks to become more confident in investing in EE projects. (http://thai-german-cooperation.info/userfiles/Presentation%20-%20Lesson%20Learnt%20and%20Roadmap.pdf)
Construction	
National policy related to sustainable construction (C.1)	(3) The Thai building code has favoured greener buildings since the 1990s, but widespread adoption of green building practices will require steeper requirements and improved enforcement. Thailand's Energy Conservation Promotion (ENCON) Act, revised in 1995, mandates that buildings larger than 2000 sq. metres or with peak demand above 1000 megawatts (MW) meet standards for six green criteria: building envelope, lighting, heating, air conditioning, renewable energy and overall performance. (https://oxfordbusinessgroup.com/news/thailand-setting-standard-green-building-incentives)
Innovative construction practices (C.2)	(3) Thailand has been a leader in construction innovation for years, leading in design and materials. (http://www.asiagreenbuildings.com/8540/thailand-new-buildings-design-focus-green-concept/)
Share of raw material use (C.3)	(2) 5,47 tonnes per capita
Certification system for green building materials (C.4)	(1) No rating system for materials.

Financing Models/Incentives for Urban Building Efficiency Projects (C.5)	(3) Incentives available through ENCON fund, revolving EE fund, and success with major banks to become more confident in investing in EE projects. (https://www.unece.org/fileadmin/DAM/energy/se/pp/eneff/IEEForumDushanbeSept2011/1.4.2_Achavangkool.pdf)
Usage	
Information programmes for energy use (U.1)	(3) Well developed programmes to promote energy conservation to the private sector and the public. (http://www.thaieei.com/thaiess/doc/ESS/1-Policy&Plan%20on%20EE.pdf)
Information programmes for water use (U.2)	(2) Programmes targeted at tourists or agriculture sector to reduce water consumption. (http://www.scp-thailand.info/)
National policies related to sustainable use/consumption (U.3)	(3) Energy Conservation Promotion Act since 1992.
Availability of sustainable/green appliances/equipment (U.4)	(3) High quality EE appliances are available in Thailand. Gov has launched several campaigns to promote EE appliances. (https://www.mendeley.com/catalogue/influence-changing-behavior-high-efficient-appliances-household-energy-consumption-thailand/)
Rating system for appliances/ Labelling system for appliances (U.5)	(2) Voluntary comparative label.
Funding for efficient appliances, efficient water usage, etc. (U.6)	(3) Voluntary programme for energy-efficient air conditioners was first implemented by the Electricity Generating Authority (EGAT) of Thailand in 1996. (https://united4efficiency.org/wp-content/uploads/2017/06/U4E-ACGuide-201705-Final.pdf)
Recycling	
Circular economy/recycling policy (R.1)	(1) 1. There are no clear rules and operational guidelines in the C&D waste management including waste minimization at source, waste segregation, reuse, recycle, transportation and disposal, 2. Lack of operational staff who has skill and competent in effective and proper waste minimization at source, waste

	segregation, reuse, recycle, transportation and disposal, 3. Recycling of C&D waste is limited only as fill material without awareness of contamination of hazardous and potentially hazardous materials, 4. The existing laws do not cover C&D waste management effectively, and 5. Lack of corporation among concerning parties, e.g. public sectors, private sectors and professional organizations to participate in development of appropriate C&D waste management. (https://ac.els-cdn.com/S1876610217351299/1-s2.0-S1876610217351299-main.pdf?_tid=55d64419-932d-4f7c-be6e-fcd26bd2a776&acdnat=1544804895_42f47390916e12d826f57168b3f8ca7a)
Platform available for sourcing CDW (R.2)	(1) No platform established.
Innovative recycling practices in place (R.3)	(1) No innovative recycling practices. Waste is still a major issue in Thailand.

7.3 SCP Sustainable Housing in China

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	In general, four materials – cement, steel, concrete, and brick – are the key contributors to the environmental impacts of building materials. **Cement** Since the 1950s, all 31 provinces in China have developed their own cement enterprises to decrease transportation and distribution costs, and keep profits local. Cement production exploded in the 1970s to fuel the country's urbanisation, and continued to expand even as urban construction started to slow in the past few years. Even as the national government raises concerns over cement	**National BIM digitalisation policies in China** **2011-2015 Development Guidelines for the construction industry digitalisation (2011):** plan to move forward the BIM implementation through the establishment of standards, to achieve digitalisation within construction firms. **2012 Engineering and Construction Standards (2012):** was the official launch of the Chinese BIM standards. **Request for proposal on BIM application in the construction industry (2013):** by 2016, government-invested projects over 20,000 square meters and "green	**Construction Law of China (1997)** Outlines the building and construction regulatory system, which is administered by the Ministries of Construction and of Housing and Urban-Rural Development. The administration of various laws, regulations, codes and standards lies with the central government and various state and provincial governments. The permit to start a project must be obtained from a state council, and that permit is tied to other permits granted by other	**Energy Conservation Law (1997):** end-use energy efficiency and standards and labelling at the centre of China's energy conservation strategy. Since then, China has developed comprehensive standards and labelling programs, including minimum energy efficiency standards (MEES), a voluntary energy efficiency endorsement label, and a forthcoming mandatory energy efficiency information label. Several independent agencies and organisations support China's energy efficiency	**Circular Economy Promotion Law (2009):** to promote circular economy, improve resources using efficiency, promote and improve environment and realise sustainable development. 2004: Law on the Prevention and Control of Environmental Pollution by Solid Waste 2005: Strategy of realising a resources saving society. 2013: Development Strategies and Short-Term Action Plans for Circular Economy

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	overcapacity, local governments—especially in China's Rust Belt—fear social unrest and political risks of job losses in the cement sector and often find loopholes to continue subsidising the industry. The 11th Five-Year Plan mandated aggressive energy-efficiency goals for the country's top 1,000 most energy-intensive industries. China's cement industry was previously dominated by polluting and energy-intensive vertical shaft kilns. The campaign reduced the share of these kilns to only 20 percent by 2010, and prompted existing plants to become more energy-efficient, but overall emissions from the sector remain high. Small firms struggle to comply with new regulations, due	buildings" in the provincial level should adopt BIM in both design and construction stages. By 2020, the industry guidelines for BIM application and government policy systems should be well-established **Proposals on enhancing the development and improvement in the construction industry (2014):** to enhance the implementation of BIM in project design, construction and operation and maintenance; to improve the overall project outcome through BIM usage; and to actively investigate the feasibility of replacing traditional hardcopy drawings with digital files.	authorities (e.g., city planning, land use, demolition). The individual state or province engages a building control department to administer and enforce the regulatory system. Laws, regulations, codes and standards are uniform throughout China. The Construction Law requires uniformity in the building control regulatory system; however, the state councils are tasked to include, administer, and enforce additional regulations and codes pertaining construction quality, safety and supervision. Permit and inspection methods are similar even though there	standards and labelling programs, and all have important responsibilities for different aspects of China's overall strategy. **Water Consumption 2011 - No. 1 Policy Document on Water Resources Reform and Development**: sets out a ten-year programme of reform and investment in water resources and flood protection infrastructure as well as a water pricing and institutional reforms. **12th Five-Year Plan:** includes a specific section on water, placing particular focus on addressing the current challenges to the water sector. Targets include:	**Construction and Demolition Waste Management** Since 2013, 14 provinces and 25 cities in China have implemented a series of policies and regulations to manage CDW production, transportation and disposal. Although the existing regulations require CDW to be centrally deposed and treated, most of the CDW in China is disposed directly into landfill or dumped randomly. Large quantities of CDW that are produced from infrastructure have been transferred from urban to rural areas: "CDW surrounding".

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	to the high costs of retrofitting and long returns on investment. And the 13th Five-Year Plan mandated a 25 percent cut in the number of cement enterprises by 2020. In early June 2018, the ministry deployed 18,000 inspectors to impose new regulations on the cement industry.		are some differences in regulations and codes.	- 95% of people connected to water supply in urban areas; - Control national water use to within 93km^3; - 85% of the total wastewater generated in urban areas should be treated and 20% of the treated wastewater should be reused.	The average treatment rate of construction waste in China is between 3% and 10%. In the case of Beijing, about 40 million tons of CDW was generated in 2014, of which less than 3% was treated and recycled.

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	**Steel** The promotion and application of energy-saving technologies has become an important step for increasing energy efficiency and reducing energy consumption of steel enterprises, especially during the 11th FYP and the 12th FYP. During this time, energy efficiency technologies adopted in China's steel industry included: Coke-Drying Quenching, Top-pressure Recovery Turbine, recycling converted gas, continuous casting, slab hot charring and hot delivery, Coal Moisture Control and recycling waste from sintering. The penetration level of energy efficiency technologies in the steel industry has improved greatly in China, improving	**Digitalisation – BIM** Although BIM technology has been applied in China's building industry since 2003, and is moving towards being the mainstream technology in the architectural, engineering and construction industries, the current usage of BIM is still limited to design firms. Presently, the BIM development is facing challenges such as the lack of well-developed standards and legislation, lack of interoperability among project team members and difficulties of implementing BIM in the whole building lifecycle, etc.	**Smart construction** Influence of smarter global construction processes and methods, including new materials (self-healing concrete, bioplastics, new forms of solar panelling), new technology (3D Printing) and new methods of construction. **Pre cast** China is still largely dependent on on-site casting. Cheap unskilled labour, cost pressure and less stringent quality requirements have hindered the development of the precast technology in the construction industry. **Steel structures** Data shows that steel structures make up less	**Shared living** Co-living is a form of housing in which a group of people share the common living spare areas, such as kitchens, dining areas, lounge areas, etc. Drivers of this growing segment in China include high residential property prices and rentals facing residents, particularly in Tier 1-cities.	**Recycled Aggregate Concrete** Sustainable method for resolving the issue of natural resources shortage (natural aggregates, like sand and stone), environment pollution and waste concrete. In 2016, China reached 1590 million tonnes of C and D wastes (construction waste), of which nearly 500 million tonnes are waste concrete. The application of RAC and RA technologies in China is still at early demonstration phase. Basic research is still lacking and guidelines, codes and standards are scarce to guide engineering. **Water Recycling**

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	its energy efficiency and emissions reduction. **Cement** Two types of kilns - vertical shaft kilns and rotary kilns - are used in China to produce clinker, which is the key ingredient in cement. Vertical shaft kilns are outdated technologies that use significant more energy to produce a ton of clinker that rotary kilns do. At the end of the 1990s, China began to restrict the construction of new shaft kilns and instead promote precalciner kilns, which are the most advanced rotary cement kilns. Consequently, production from precalciner kilns increased rapidly and by 2013 it accounted for more than 90% of cement production in China.		than 5% of China's total housing at present. This figure is over 40% in developed countries. Steel structures can meet the new demands for energy-saving and environmental protection. **LED Lighting** LED is expected to be accepted by the Chinese market as readily as they were in Europe. Forecast for large growth in the sector. **Wood construction** China has been building with wood for thousands of years. Although concrete and steel are more common construction materials, the government is looking at wood building as part of its		**- Centralised schemes:** effluent from major wastewater treatment works undergoes tertiary treatment and disinfection and is then piped through a separate pipe network to be used purposes tolerant of lower quality water. Currently only practical in very dense large cities, such as Beijing. **- Decentralised treatment and reuse:** more promising approach. Wastewater is collected and treated locally at building- or community-level. Ideally coupled with rainwater collection and harvesting, as well as storage system. Most effective when integrated into new

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	Despite considerable progress, China's cement firms remain less energy efficient than their Western counterparts and cause more stress on the local environment. The sector lags behind the rest of the world on its implementation of sustainable production techniques, including the use of renewable energy, energy efficiency techniques and the substitution of clinker for carbon efficient alternatives, such as fly ash.		sustainability strategy. Wood has low thermal resistance; it is strong, light, and easy to handle and to transport. Besides, it can be renovated in a fast and flexible manner, and it is naturally renewable.		development such as eco-cities from the start. "Government policy and regulation to increase recycling will encourage people to consider constructing decentralised wastewater reuse schemes, but they will only be sustainable when there is a clear economic incentive for the owners to invest and maintain them"

China

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		**Building Energy Code** China has mandatory building energy codes for urban residential and commercial buildings and a voluntary energy code for rural residential buildings. **"Code for Acceptance of Energy Efficient Building Construction" (2007):** code for implementation and enforcement of the energy code. Includes construction quality and acceptance requirements for building envelope, water heating, HVAC systems, lighting, monitoring and controls; it applies to new construction and existing building additions and retrofits. **Green Building Evaluation Standard (2006):** "Three Star Standard". It considers all the stages of the building's life cycle and covers both	**China Compulsory Certification (CCC):** legal compulsory certification system. Products listed in the compulsory certification category cannot be marketed, sold, imported or used for any commercial purposes without acquiring a certificate issued by accredited certification authorities. Building materials products in the product catalogue for compulsory certification include, for example, architectural safety glass, solvent furniture paint, concrete anti-freezer and porcelain tile. **Resource Conservation**: voluntary, certification organisations have the	**Minimum Energy Performance Standards (MEPS):** created in 1989, and since then there has been a variety of improvements and additions to the regulations as technology improves. Now the policy covers a wide range of selected industrial, commercial and residential appliances. It divides regulations into several categories with a frequently-updated list of products within each category: household appliances, lighting products, commercial equipment, and industrial equipment.	

China					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		residential and public buildings. The aim is to reduce total resource, water, energy and land use and address the following six aspects: (1) land saving and outdoor environment; (2) energy saving and utilisation; (3) water saving and utilisation; (4) material saving and utilisation; (5) indoor environment; (6) operation and management. The national standard is a voluntary standard. Developers need to submit their application to the appropriate governmental agency if they seek to receive an official certification.	autonomy to carry out their own programs. **Energy Conservation and Water Conservation Certification Programs:** building materials covered by this certification include, for example, doors and windows, hollow glass, aluminium architectural profile, and inorganic thermal insulation projects. **Environmental Products Certification:** voluntary, to promote the production and usage of environmentally friendly products. Building materials covered by this certification include, for example, paints, artificial boards, wallpapers, binders, ceramic tiles,	**Voluntary Energy Efficiency Endorsement Labelling:** voluntary energy efficiency labelling program introduced, in addition to minimum standards, China to allow for additional energy savings. The endorsement label was developed to be awarded to products that met both quality assurance and energy performance specifications. **China Energy Label (CEL):** categorical mandatory energy information label, adapted from the EU categorical energy label. Includes five categories of efficiency, from 100% (meeting the minimum standard) to 55% of the minimum standard.	

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems			concrete admixture, and wooden doors. **Green Building Material Assessment Label:** accredits building materials according to five dimensions: energy conservation, emission reduction, safety, convenience, and recycling throughout the whole lifecycle. The label has a three tier system based on performance (one to three stars from low to high rank). **China's State Council Green Building Action Plan** mandates that public buildings like schools and hospitals meet sustainable building standards of the country's three-star rating system, the Green	Initially covering only two products, today the mandatory label covers appliances such as air-conditioners, refrigerators, washing machines, lamps, gas water greater, motors, etc. Labels must be present at the point of sale of any product covered by the mandate.	

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems			Building Evaluation Label. This system takes six categories into consideration including land, energy, water, resource efficiency, indoor environment quality, and operational management. The US's Leadership in Energy and Environmental Design (LEED) system also has a strong presence in China. In 2015, LEED-certified Grade A office buildings in 10 of China's major cities were 28 percent of the total market. Real estate companies are also using the market to pressure cement industries to green their production. In 2016, the Chinese Foundation Society of Entrepreneur and Ecology (SEE) joined		

China					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems			forces with major Chinese real estate companies and associations to create **China's first-ever green supply chain certification system targeting building materials**. Many of China's top developers have signed onto the program and by 2020, SEE estimates that green-sourced building materials will reduce the building sector's annual CO2 emissions by 50 million.		

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		**Subsidies for energy-efficient products** The strong political commitment to reducing energy consumption and carbon emissions in China led to a series of policy initiatives in which the so called "Jienenhhuimin" project (a project to promote energy-efficient products for the benefit of the people) is a key subsidy program during the 12th Five-Year-Plan period to stimulate demand for products and drive market transformations towards higher energy efficiency. Together with lighting products, air conditioners and cars were included into this program. The subsidies are given to manufactures by the central government. The participating manufactures must register to the program according to implementing	**Subsidies** **Interim Measures on the Management of the Special Funds for Renewable Energy Applications in Buildings (2006):** MOF and MHUD determined the subsidies values for different kinds of renewable energy applications in projects. Subsidies are also provided to support research and development of key technologies. **Notice on the Organisation and Implementation of the Demonstration of Photovoltaic Applications in Buildings (2006):** 50% of the bid price for the key components of photovoltaic applications		

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		rules for a specific product category. Additional cost between an energy-efficient model and an inefficient one is determined and taken as the subsidised amount to remove the purchase barriers for expensive products. The market share of energy efficient products has been highly increased, e.g. the market shares of energy efficient air conditioners increased from 5% to 70%.	will be paid directly by the local finance department to the suppliers. **Awards** **Opinions on Accelerating Green Building Development (2012):** this document indicates that the central government will establish a monetary award system for high-rated green buildings (Two or Three Stars). Some local governments also offer awards to green building developments. For instance, in Shandong province, even One Star buildings can receive an award.		

China	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			**Existing Financing Models for Urban Building Efficiency Projects** China's present shortage of financing channels and tools to support large-scale building efficiency projects in its cities - a symptom of the absence of a mature investment and financing marketplace - has become the largest roadblock for cities looking to make the low-carbon transition. At present, green building and retrofit projects are chiefly funded by financial subsidies or incentive funds from each level of government, plus a smattering of policy-based loans disbursed by foreign governments or intergovernmental		

China					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			banks, exposing the lack of innovation in financing tools.		

Affordable Housing in China

Housing Provident Fund (since 1991)

It is essentially a housing savings scheme to promote home-ownership. Employers and employees contribute to a certain percentage to an HPF account. Employees can get their funds for home purchase, or improvement, or self-construction at low interest rates. As it is salary based, workers who get paid more, get larger employer contributions. Those on low incomes cannot get a large loan, a challenge for low-income households. HPF loans are typically around half of the value of the property, so purchasers have to fund nearly half the purchase themselves, which is a challenge for many households. There are large differences between regions and cities in employer contribution percentages and membership rates.

Economic and Comfortable Housing (since 1995)

The program aims to help lower- and middle-income households to secure housing when they cannot afford private housing. Housing is mostly built by private developers for profit and sold through market transactions. All units are developed for sale, not rent. House prices are lower because local governments provide land for free or at low-cost and reduce or waive development fees. Furthermore, they regulate the sale price and keep profits at 3%. House prices are around 50-60% of market prices (per square meter). A large proportion of the population is eligible. Since 1998 onwards ECH housing has been positioned to be accessible to 70 to 80 percent of the population.

Cheap Rental Housing (1999-2014)

Government subsidised rental housing programme for those with disabilities, low-incomes, disadvantaged groups and seniors. The funding comes from local governments through several mechanisms such as capital gains from the HPF, annual budgetary allocations and other housing funds. In 2006 a new law specified that local governments must spend 5% of their net gain from land conveyance fees on CRH, although this had limited practical success due to the lack of enforcement.

70-90 Policy (since 2006)

The 70-90 Policy, or the Adequate Housing Development Scheme, refers to the policy regulation that at least 70% of newly built flats since 2006 must be under 90 square meters. It aims to reduce the average living space to lowers increasing housing prices, but has failed almost from the beginning. The proportion of newly built flats under 90 square meters was below 35% of the total value, since its implementation. Property developers devised new forms of housing construction to meet the requirements of building flats under 90m^2 but selling flats above 90m^2.

Restrictive Purchase (since 2010)

The Restrictive Purchase policy was issued to cool down the overheated property market. Restrictive purchase limits on the number of flats saleable to buyers. Targeted on middle- and high-income households, the objective of the policy was to curb speculations and limit owners with more than two properties, to bring down vacancy rates, strengthen monitoring of housing bubbles and tackle the problems of 70-90 policy.

District Development in China

"Reportedly, one of the most important sustainability decisions taken by China, in recent times, was to embed at the very core of its Twelfth Five Year Plan an entire section that sets guidelines for sustainable development. Among the tools suggested by the Plan is the eco-city development agenda. Indeed, the eco-city, and its green spaces, resilient architecture, small-scale urban development agenda, and ecological approach to urbanism is envisioned by China as a "pioneering" enterprise that may help the country solve its environmental issues". To date, more than 230 projects have been initiated and strive to create cleaner and greener cities that respond to the exigencies of the 11th and 12th FYP, and to the quantitative and qualitative national standards set by the Ministry of Environmental Protection and the Ministry of Housing and Urban-Rural Development (MoHURD).

Example: Sino-Singapore Tianjin Eco-City

- SSTEC was envisioned as an ecological alternative to urban planning and urban design that would help China's transition from an industrial to a more eco-friendly nation, fuel the drive for more eco-friendly alternatives in China by setting an example for others to replicate, and allow for both Singapore and China's economies to grow together and learn from one another.

- The project adopts a basic eco-structure expressed in a hierarchy of "live-work-play" spaces, eco-cells, walkable districts, high and tight housing structures and neighbourhood’s green and blue spaces and embedded transportation networks. On the energy issue, SSTEC envisions a city where "clean energy sources will be used in addition to traditional energy supply and practical energy solutions such as solar heaters and geothermal operating systems will be adopted"

Problems with eco-cities development in China

- Lack of coordination between the various ministries and authorities appointed to establish a system of indicators to evaluate the eco-city interventions, and therefore information and data relating to eco-cities are often fragmented and not consistent. Depending on the prevailing parameters used and the body that issued them, each eco-city could refer to several systems of indicators and be described with non-harmonised nomenclatures - eco-city, garden-city or low-carbon city.

- Eco-city construction is often abandoned due to the loss of investment or of the investor's interest, or sometimes is only partially arrested due to temporary economic crises. Interventions benefit of a sort of advertising connected with the ecological label. However, once the building permit is obtained, the private parties build the more profitable areas first (residential and commercial), sometimes even leaving an incomplete development.

- Housing does not meet needs of the user. For example in Huanbayu, ecological housing was built with car-parking spaces while none of future residents - mainly farmers - owned a car- At the same time small courtyards belonging to the houses did not allow users to accommodate their cattle.

- Poor design and urban form. China has become a lab for futuristic projects, but on the other hand, the rapidity of construction is characterised by replication. Those contradictions are clear comparing iconic images of public buildings, designed by well-known architects, to those of identical towers building spreading to shape residential beehives.

China's Nationally Determined Contributions (NDCs)

Based on its national circumstances, development stage, sustainable development strategy and international responsibility, China has nationally determined its actions by 2030 as follows:

- To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early;

- To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level;

- To increase the share of non-fossil fuels in primary energy consumption to around 20%; and

- To increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level.

Policies and Measures to implement enhanced action:

Controlling Emissions from Building and Transportation Sectors

• To embark on a new pattern of urbanisation, optimising the urban system and space layout, integrating the low-carbon development concept in the entire process of urban planning, construction and management and promoting the urban form that integrates industries into cities;

• To enhance low-carbonised urbanisation, improving energy efficiency of building and the quality of building construction, extending buildings' life spans, intensifying energy conservation transformation for existing buildings, building energy-saving and low-carbon infrastructures, promoting the reutilisation of building wastes and intensifying the recovery and utilisation of methane from landfills;

• To accelerate the construction of low-carbon communities in both urban and rural areas, promoting the construction of green buildings and the application of renewable energy in buildings, improving low-carbon supporting facilities for equipping communities and exploring modes of low-carbon community operation and management;

• To promote the share of green buildings in newly built buildings of cities and towns reaching 50% by 2020;

Promoting the Low-Carbon Way of Life

• To enhance education for all citizens on low-carbon way of life and consumption, to advocate green, low-carbon, healthy and civilised way of life and consumption patterns and to promote low-carbon consumption throughout society;

• To improve waste separation and recycling system.

China and the UN Sustainable Development Goals

China's Action National Plan to Implement Sustainable Development Goals:

Goal 3 - Ensure healthy lives and promote well-being for all at all ages

3.9 - Intensify prevention and treatment of pollution from hazardous chemicals and promote the recycling or safe disposal of industrial, agricultural, and household wastes. Reform current environmental governance and establish an emission permit system covering all fixed pollution sources. By 2020, endeavour to establish a national, centralised and real-time environment monitoring system and improve the environmental information disclosure system. Conduct environmental inspection and strengthen environmental law enforcement

Goal 11 - Make cities and human settlements inclusive, safe, resilient and sustainable

11.1 - Advance the development of public rental housing. By 2020, generally complete the rebuilding of rundown areas, villages in cities and dilapidated houses. In rural areas, intensify efforts to revamp dilapidated houses and subsidize the maintenance, consolidation and revamping of dilapidated houses of poor farmers.

11.6 - Proactively promote greening construction in urban and rural areas by continually increasing per capita green park space. Comprehensively elevate the management level of urban household waste and improve rural household waste treatment. Formulate urban air quality standards to reduce the days of heavy air pollution by 25 percent in prefecture-level cities and above by 2020.

11.b - Improve the housing system, vigorously advance revamping of rundown areas and dilapidated houses. Raise the energy-saving standards for buildings and promote super low and zero energy consumption buildings. Improve the energy-saving capacity for existing buildings and promote green construction materials and prefabrication. Strengthen natural disaster monitoring and early warning systems, as well as disaster-resistance capability of engineering projects. Improve the social mobilisation for disaster prevention and reduction and build channel for social participation in disaster prevention.

Goal 12 - Ensure sustainable consumption and production patterns

12.1 - Preserve the fine Chinese tradition of frugality and advocate sustainable consumption culture. Advance legislation on sustainable consumption and green standards setting. Encourage and guide consumers to make sustainable consumption through pricing, taxation, fees and other means. Vigorously promote sustainable production by adjusting economic structure and transforming development mode.

12.2 - Control the total volume of energy and resource consumption, optimize the structure of utilisation, and substantially increase secondary utilisation of energy and resources. Accelerate the establishment of a natural resources property rights system and an assessment and compensation system for ecological damages. Substantially improve energy and resource efficiency. Fully implement the strictest water resource control system to keep the total volume of national water consumption below 700 billion cubic meters by 2030.

12.5 - Vigorously promote cyclic economy. Encourage and promote a conservation-oriented consumption pattern. Control the production and release of industrial

7.4 SCP Sustainable Housing in India

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**The 1957 Mines and Minerals (Development and Regulation) Act** is an Act of the Parliament of India enacted to regulate the mining sector in India. It was amended in 2015 and 2016. It classifies sand as a minor mineral if used for construction purposes and its management comes under the purview of state governments. Sand used to make concrete must adhere to the specifications for fine aggregates set out in Indian Standard 383:1970, while sand used for masonry mortar must adhere to Indian Standard 2116:1980. Both the standards suggest use of 'natural sand deposited by streams' (river sand).	**The Energy Conservation Building Code (ECBC) 2007** was launched by Ministry of Power, for promoting energy efficiency in the building sector. The ECBC provides design norms for: Building envelope, including thermal performance requirements for walls, roofs, and windows; Lighting system, including daylighting, and lamps and luminaire performance requirements; HVAC system, including energy performance of chillers and air distribution systems; Electrical system; and Water heating and pumping systems, including requirements for solar hot-water systems.	**The National Building Code of India (NBC),** a comprehensive building Code, is a national instrument providing guidelines for regulating the building construction activities across the country. It serves as a Model Code for adoption by all agencies involved in building construction works be they Public Works Departments, other government construction departments, local bodies or private construction agencies. In 2013, a new Part 11 was added to the NBC entitled 'Approach to Sustainability' with a view 'to create buildings and built environment in such a way [as to make]	**Draft National Energy Policy 2017:** the NEP proposes to set out the national energy objectives and the strategy to meet them, with four main goals: Access at affordable prices, Improved security and Independence, Greater Sustainability and Economic Growth. The first of seven intervention areas is Energy Consumption by businesses, households, transportation and agriculture. Here the aim is to improve Energy Efficiency of all electrical appliances and apply ECBC to all Building; Enhancing availability of better insulation and	**National Policy on Solid Waste Management** The main objectives of the policy are (a) to ensure environmental accountability and social responsibility of all waste generators, waste managers and service providers (b) to actively involve individuals and all institutions in integrated and environmentally sound solid waste management practices (c) to maximize resource recovery with a view to minimize the amount of waste for disposal and (d) to minimise adverse environmental impacts

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	Mining of river sand for heavily consumed materials such as concrete and mortar has tremendously deleterious impacts on river ecology and leads to downstream erosion, causing changes in channel bed and habitat type, as well as deepening rivers and estuaries, and enlarging river estuaries. The annual turnover from illegal mining in India is estimated to be INR 10 billion (Centre for Science and Environment, 2012). The extent of illegal mining has forced certain state governments to impose a ban on sand mining. This has led to a gap between demand and supply. This gap will be further aggravated by the increase in demand to 1,430 million tonnes by 2020.	**Sustainable Habitat Mission under the National Action Plan on Climate Change** was launched on June 30, 2008. It encompasses a broad and extensive range of measures, and focuses on eight missions, which will be pursued as key components of the strategy for sustainable development. These include missions on solar energy, enhanced energy efficiency, sustainable habitat, conserving water, sustaining the Himalayan ecosystem, creating a "Green India," sustainable agriculture and, finally, establishing a strategic knowledge platform for climate change. For the habitat mission, the strategies proposed aim at promoting efficiency in residential and commercial	sustainability a way of life and necessary tool for all buildings [coming up]' The code involves guidelines on fire and life safety, building services such as Lighting, natural ventilation, indoor air quality, electric installations, waste management, water supply, drainage, sanitation, solid waste management, structural requirements, site planning and zoning rules which are mandatory in nature. **Real Estate (Regulation and Development) Act, 2016:** The Real Estate (Regulation and Development) Act, 2016 which came into force in March 2016 has laid down a regulatory framework which will change the way	construction materials.; and increase investment in buildings and domestic appliances with higher energy. **The Energy Conservation Act** has been enacted to encourage efficient use of energy and its conservation. Nation Water Policy (2012) states the importance of prioritising access to safe water to households. Urban and rural domestic water supply should preferably be from surface water in conjunction with groundwater and rainwater. Where alternate supplies are available, a source with better reliability and quality needs to be assigned to domestic	due to waste disposal to ensure health and wellbeing of the people and on ecosystems. **The Construction and Demolition Waste Management Rules** apply to every waste generating construction, re-modelling, repair and demolition of any civil structure of individual or organisation or authority. The Construction and Demolition (C&D) waste management and utilisation strategy is intended to help facilitate the implementation of the C&D Waste Rules 2016 to ensure that ULBs across the country are able to adopt proper

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	The Ministry of Environment, Forests and Climate Change (MoEF&CC), has also notified the 2015, **Sustainable Sand Mining Management Guidelines:** The guidelines encourage the use of recyclable materials such as quarry dust, incinerator ash and manufacturer sand (M-sand) as sand substitutes. Environmental Protection Act: The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment. They relate to the protection and improvement of the human environment and the prevention of hazards to human beings, other living creatures, plants and property. The Act is an "umbrella" legislation	sector through various measures such as, change in building bye laws, capacity building, research and development in new technologies, education and awareness, etc., management of municipal solid wastes, and promotion of urban public transport. **National Mission for Enhanced Energy Efficiency (NMEEE):** 1. Perform, Achieve and Trade Scheme (PAT), a regulatory instrument to reduce specific energy consumption in energy intensive industries; 2. Market Transformation for Energy Efficiency (MTEE), for accelerating the shift to energy efficient appliances; 3. Energy Efficiency Financing Platform (EEFP), for creation of mechanisms that would help finance	the real estate sector operates in India. It aims to enhance transparency, bring greater accountability in the realty sector and set disclosure norms to protect the interest of all stakeholders. Speedy execution of property disputes will also be ensured in due course.	water supply. Exchange of sources between uses, giving preference to domestic water supply should be possible. Also, reuse of urban water effluents from kitchens and bathrooms, after primary treatment, in flush toilets should be encouraged, ensuring no human contact. Urban domestic water systems need to collect and publish water accounts and water audit reports indicating leakages and pilferages, which should be reduced taking into due consideration social issues. **National Policy on Solid Waste Management** The main objectives of the policy are (a) to ensure environmental accountability and social	C&D waste management and recycled products find appropriate and adequate utilisation. The C&D Waste Rules 2016 laid out detailed duties and responsibilities of different stakeholders ranging from waste generators to ULBs to state and central government Ministries and agencies. It also provided templates for documents needed for each management step to ease implementation. However, implementation of these Rules has not been to the full extent, despite guidelines and advisories in support of

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	designed to provide a framework for central government coordination of the activities of various central and state authorities established under previous laws, such as the Water Act and the Air Act. **National Mineral Policy (2019):** The 2019 Policy proposes to grant status of industry to mining activity to boost financing of mining for private sector and for acquisitions of mineral assets in other countries by private sector., encouraging the private sector to take up exploration, It also mentions that Long term import export policy for mineral will help private sector in better planning and stability in business	demand side management programmes in all sectors by capturing future energy savings; 4. Framework for Energy Efficient Economic Development (FEEED), for development of fiscal instruments to promote energy efficiency. 5. Building sector not mentioned despite potential for reductions in energy consumption		responsibility of all waste generators, waste managers and service providers (b) to actively involve individuals and all institutions in integrated and environmentally sound solid waste management practices (c) to maximise resource recovery with a view to minimise the amount of waste for disposal and (d) to minimise adverse environmental impacts due to waste disposal to ensure health and wellbeing of the people and on ecosystems.	the Rules being issued by different agencies such as CPWD, BMTPC, MoHUA, etc. Delhi and Ahmedabad have pioneered C&D waste management in Indiawith adoption of Public Private Partnership (PPP), which is regarded as sustainable. **Niti Ayog:** Resource Efficiency and Circular economy; Strategy on Resource Efficiency in the steel sector, Aluminium sector. The focus is to recommend a broad strategy for enhancing resource-use efficiency in Indian economy and industry.

India

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Niti Ayog:** Resource Efficiency and Circular economy; Strategy on Resource Efficiency in the steel sector and Aluminium sector.				These documents exclusively deal with the need of resource efficiency in the above mentioned sectors, adoption of which shall help in improving performance in the field of energy, environment and efficiency in the sector besides making industry globally competitive.
Technology/ Architecture	**The Indian steel industry** has adopted best practices and reduced its specific energy consumption from 8–9 Gcal/tcs (tonnes of crude steel) in 2004 to 6–7 Gcal/tcs in 2015. Other materials such as paints and chemicals, plumbing and electrical fixtures, etc. are not used in large quantities in a building, but	Urban construction is increasingly moving away from masonry load-bearing structures in favour of RCC (reinforced cement concrete) framed structures, which form a substantial part of a building, thus increasing the amount of cement and steel used.	Material use in the construction sector in India has been on the rise since 2011-12 with a slight dip in 2012-13 for iron and steel and in 2013-14 for cement, brick and tiles. Further, material intensity (for total construction), represented by the ratio of total input value (i.e., material use) to the GVA	Of the **total electrical energy consumption** in the country during the year 2013–2014, 22.5 % was consumed by the residential sector and 8.7 % by the commercial sector, taking total consumption by building-related uses to approximately 31 %. The energy use in the	In the recent years, with the issue of **safe disposal of industrial/mining waste**, environmental scientists and industry experts have been conducting research as well as developing building materials, using these waste materials. These include, Red-mud, coal

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	have a higher cumulative cost as compared to bulk materials such as bricks, cement, etc. Resources such as soil and sand that are used in large quantities to make the bricks, concrete and mortar used in construction, are also the most critical resources in India. This is primarily due to their scarcity, the conflict of uses especially in the case of soil and the legal restrictions and massive ecological impact on rivers associated with extraction of sand. Introduction of new resource efficient materials and technologies in the market: Fly Ash brick promotion, prefabricated concrete, bamboo composites. **The National Mission Bamboo Application**	A **Technology Sub-mission** under the PMAY has been set up to facilitate the adoption of modern, innovative and green technologies and building material for faster and quality construction of houses. Under this sub-mission the Building Materials and Technology Promotion Council (BMTPC) has set up a Performance Accreditation Certificate Scheme (PACS) that has identified 16 sustainable technological solutions for faster and cost effective construction of houses. Under the guidance of Technology Sub Mission and Mission Directorate of Pradhan Mantri Awas Yojana, BMTPC has brought out Compendium of Prospective Emerging Technologies for Mass Housing. This Compendium	has been increasing with a slight dip in 2013-14 indicating an increase in the intensity of the material use. Urban construction is increasingly moving away from masonry load-bearing structures in favour of RCC (reinforced cement concrete) framed structures, which form a substantial part of a building, thus increasing the amount of cement and steel used. The Ministry of Housing and Urban Affairs in 2018 launched the **Global Housing Construction Technology Challenge** as part of the technology sub-mission of PMAY (Urban). The challenge has sought to invite ideas from cross the globe for alternate	buildings sector in India is projected to increase over the coming decades due to population growth, the rate of urbanisation, growth in access to modern energy and ownership of appliances as income levels rise. Urbanisation has improved access to energy, but lack of planning has resulted in inefficient patterns of energy use. It is estimated that a growth rate of about 6 % in total energy use from all sources is needed to sustain a growth rate of eight % in GDP. In residential buildings, lighting, ceiling fans and appliances such as television, refrigerators, air conditioners and water heaters and cooking make the	ash, slag, and fly ash, which are by-products generated from large-scale mining, industries and thermal power plants. These waste products can be utilised for the manufacture of bricks, substitute for fine aggregates in concrete, partial replacement of cement in concrete, lime-pozzolana cements and others. Other construction techniques like stabilised mud blocks and rammed earth walls are also low-energy techniques which can reduce total embodied energy by up to 50% and will contribute to the reduction in the operational energy due to their insulation properties.

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	(NMBA) under the Department of Science and Technology has developed and commercialised technology and applications in the segments of developing bamboo based wood substitutes, development of pre-fabricated bamboo based housing structures and other technological applications of bamboo. According to recent estimates, 2800 fly ash units are present in India which produce close to 6.65 billion bricks annually. The increase in the use of these fly ash bricks has been significant, however, disproportionate across the country. In this regard, the Central and State government have played a vital role in the formulation and implementation of policies and schemes to	containing technology details of emerging technologies expected to be a useful resource for State Governments and related Housing Agencies for construction of mass housing.	technologies that go beyond the brick-and-mortar building model used widely in Indian construction. Vernacular construction techniques in most parts of India have been resource efficient and circular in principle. Designing with locally available material and passive techniques for climatic adaptation are often being revisited for new constructions. Traditional Indian architecture materials like rammed earth are sustainable substitute for concrete. It is non-combustible, thermally massive, strong, durable, easy to construct, and has a low life cycle impact. Harvested from earth, it can be disposed of without damaging the	greatest contribution to energy consumption. Although cooking accounts for the major share of energy consumption in the residential sector, the chief fuel used for cooking is either liquefied petroleum gas (LPG) in urban areas and to some extent biomass and kerosene in rural areas. The energy consumed during the operational phase accounts for 80–90 % of total primary energy use by air-conditioned buildings and decreases to about 40–50 % in the case of non-air conditioned buildings.	Efforts are being made to ensure **maximum use of waste materials** as well as recycling of materials. For instance, the cement industry has already shifted toward fly ash based Portland Pozzolona Cement (PPC). PPC utilises about 30% less limestone than ordinary Portland cement. PPC's share in total cement production in India is estimated to be 67% Steel is used as bars and rods in the construction sector and is 100 % recycled in the secondary market after buildings have been demolished. **Annual metal scrap consumption** in India has been estimated to be about 20 million tonnes by the Metal

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	promote fly ash brick technology.		environment. Rubble masonry – another common traditional wall construction material – has been used to build walls and standing structures in India since ancient times. It is naturally available, long lasting and with good cooling properties that can be used to construct large structures. The thermal capacity of brick and rammed earth are the least, which makes them suitable for wall construction and rammed earth are the least, which makes them suitable for wall construction.		Recycling Association of India (MRAI). However, the recycling industry is dominated by the informal sector which limits its effectiveness. As a result, scrap imports are increasingly important to the industry, which currently imports about 1/3 of its scrap demand, with steel scrap imports alone amounting to 5 million tonnes in 2013-14
Standards, guidelines and Rating Systems		**The Energy Conservation Building Code (ECBC) 2007** was launched by Ministry of Power, for promoting energy efficiency in the building sector. The	**Green Building Council of Sri Lanka (GBCSL)**: created Sri Lanka's indigenous rating system, which is better suited to the country's tropical climate.	**Bureau of Energy Efficiency (BEE):** BEE developed its own rating system for the buildings based on a 1 to 5-star scale. The star rating is a measure of energy	

India					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		ECBC provides design norms for: - Building envelope, including thermal performance requirements for walls, roofs, and windows; - Lighting system, including daylighting, and lamps and luminaire performance requirements; - HVAC system, including energy performance of chillers and air distribution systems; - Electrical system; and Water heating and pumping systems, including requirements for solar hot-water systems. The code provides three options for compliance: 1) Prescriptive: Compliance with the performance		efficiency of an appliance, it is a five points scale where higher the rating lower is the energy consumption and hence better savings. BEE has developed the Energy Performance Index (EPI). The unit of Kilo watt hours per square meter per year is considered for rating the building and especially targets air conditioned and non-air conditioned office buildings. The BEE Star Rating scheme was launched in 2006 and is currently applicable for appliances like Room Air Conditioner (Inverter AC, Split AC , Windows AC), Ceiling Fan, Colour Television, Computer, Direct Cool Refrigerator, Distribution Transformer, Diesel Engine Driven Mono set pumps For	

India					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		requirements for each subsystem and system; 2)Trade off: Compliance with the performance requirements of each system, but with trade-offs between subsystems; and 3) Whole Building Performance: Building-level performance compliance. Irrespective of whether one opts for Whole Building Performance (WBP) method or Prescriptive method, the code compliance requires the building to fulfil a set of mandatory provisions. These are given in the ECBC manual. Currently, the ECBC is voluntary, but the government plans to mandate it for commercial buildings. A new set of codes have been developed for Residential Buildings in 2018 which are currently		Agricultural Purposes, Frost Free Refrigerator, General Purpose Industrial Motor, Monoset Pump, Openwell Submersible Pump Set, Stationary Type Water Heater, Submersible Pump Set, Tfl, Room Air Conditioner (Variable Speed), Chillers, Washing Machine, Ballast, Solid State Inverter, Printer,Diesel Generator Set, Led Lamps, Domestic Gas Stove, Office Automation Products, Agricultural Pumpset etc.	

India					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		available for assessing the building envelope. **Green Rating for Integrated Habitat Assessment (GRIHA)** is India's own rating system jointly developed by TERI and the Ministry of New and Renewable Energy, Government of India. It is a green building design evaluation system where buildings are rated in a three-tier process. All buildings, which are in the design stage and have built up area more than 2,500 m2, are eligible for certification under GRIHA. Building types include, but are not limited to offices, retail spaces, institutional buildings, hotels, hospital buildings, healthcare facilities, residences, and multi-family high-rise buildings. GRIHA is a			

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
		performance-oriented system where points are earned for meeting the design and performance intent of the criteria. It is a 100-point system consisting of some core points, which are mandatory, while the rest are optional. Different levels of certification (one star to five stars) are awarded based on the number of points earned. The minimum points required for certification are 25.			
Access to Finance		Aimed at scaling up of sustainable housing projects in India the National Housing Bank (NHB) along with French Development Agency (AFD) and European Union (EU) have launched the **SUNREF (Sustainable Use of Natural Resources and Energy Finance)**	Taking forward the Government of India's goal of Housing for All, **The State Bank of India and Confederation of Real Estate Developers' Association of India (CREDAI)** have signed a Memorandum of Understanding to collaborate and work	**Interest subsidy for first-time homebuyers:** To stimulate housing demand from first- time home buyers, the Union Budget 2016-17 also proposed deduction of additional interest of Rs 50,000 per annum for first-time home buyers for loans of up to Rs 35	

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		**Housing India Program** that will focus on: 1. Promoting the existing local green labels for housing (GRIHA and IGBC) 2. Making green housing more affordable to low-income households 3. Demonstrating the market potential and the relevance of green housing 4. Encouraging the adoption of rules favouring green housing in public policies	towards the development of the real estate sector, with specific emphasis on affordable and green housing projects. CREDAI has launched 373 affordable housing projects through its member developers across the country for providing 230,300 housing units. SBI being the largest bank and mortgage lender will support CREDAI as their national banking partner. CREDAI has also partnered with International Finance Corporation (IFC), to promote green building in the country through EDGE certification. Bank of Maharashtra and ING Vysya Bank have initiated a **green mortgage scheme for eco-housing certified projects**, which allows up to 0.5%	lakh sanctioned during the next financial year for houses with a value not exceeding Rs 50 lakh. This move should positively influence home sales in non-metros in the long term where residential product prices are not as high as those in metros. The residential construction (housing) sector in India is the fourth largest employment generator in India and accounts for: § 1.24% of the total output of the economy (total construction sector at 11.39%); § 1.00% of GDP (total construction sector at 8.2%); § 6.86% of employment (total construction sector at 11.52%).	

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			discount on interest rates. NOIDA Development Authority allows an **FSI increase** of 5% above the maximum to projects with plot size above 5,000 m2 that achieve a minimum IGBC gold rating. The Hyderabad Metropolitan Development Authority's (HMDA) 'green channel' initiative provides faster clearances for IGBC compliant residential, commercial and industrial buildings, and a 50% reduction of the approval fee. One of India's largest HFCs, **IIFL Home Finance Limited** recently created **'KUTUMB'**, a platform to promote benefits of green architecture in the affordable housing segment in India. The platform is created in partnership with National		

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			Housing Bank (NHB), Green Business Certification Inc. (GBCI), CDC UK, and Ashok B Lall Architects. The aim of KUTUMB is to promote sustainable and energy efficient real estate development in the country aligned with the vision of Pradhan Mantri Awas Yojana – Housing for All by 2022." **100% deduction in profits for affordable housing construction:** To promote affordable housing, the finance minister proposed 100% deduction in profits to an undertaking from a housing project for flats of up to 30 sq metre in four metro cities and 60 sq metre in other cities. These projects have to be approved during June 2016 to March 2019.		

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			Another condition was that the project should be completed within three years of grant of approval. **Service tax exemption on construction of affordable housing:** Exemption of service tax on construction of affordable houses of up to 60 square metre under any scheme of the Central or state government including public private participation or PPP schemes will propel construction in affordable segment across India and encourage greater collaboration between the public and private sector as well as participation in affordable home construction. of the Central or state government including public private participation or PPP schemes will		

India	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
			propel construction in affordable segment across India and encourage greater collaboration between the public and private sector as well as participation in affordable home construction.		

Affordable Housing in India

Pradhan Mantri Awaas Yojna (PMAY): The scheme is aimed for meeting the housing needs of the urban areas through a) Slum rehabilitation of slum dwellers with participation of private developers using land as a resource b) Promotion of affordable housing for weaker section through credit linked subsidy c) Affordable housing in partnership with Public & Private sectors c) Subsidy for beneficiary-led individual house construction or enhancement. Under the union budget of 2018-19, a dedicated fund for affordable housing under the National Housing Bank has been set up to be funded by priority sector lending shortfall and fully serviced government authorised bonds.

National Urban Housing and Habitat Policy (NUHHP), 2007: The foremost objective of NUHHP is to promote and ensure sustainable development in the country with a focus on urban human settlements, duly served by ensuring equitable supply of land, shelter and services at affordable prices. NUHHP has critically analysed the ways and means of providing 'Affordable Housing to All' with special emphasis on EWS and LIG sectors so that they are fully integrated into the mainstream of ecologically well-balanced urban development. The NUHHP aims at urban planning, affordable housing by fostering fund generation, better management information system (MIS), employment generation, public private partnership (PPP), special incentives scheme (increase in FAR).

Model State Affordable Housing Policy for Urban Areas (MSAHPUA), 2014: MSAHPUA is intended as a step towards implementing the NUHHP 2007. The policy empowers individual states to achieve housing policy objectives as listed under NUHHP 2007 by inclusion of legal and regulatory reforms, fiscal concessions, financial sector reforms and innovations. The Policy aims to provide "affordable housing for all" with special emphasis on EWS and LIG and other vulnerable sections of society such as Scheduled castes/Scheduled Tribes, Backward Classes, Minorities and senior citizens, physically challenged persons in the State and to ensure that no individual is left homeless. The policy further aims to promote Public Private People Participation (PPPP) for addressing the shortage of adequate and affordable housing.

National Mission on Sustainable Habitat (NMSH), 2010:

1. Promotes understanding of climate change, its adaptation and mitigation, energy efficiency and natural resource conservation;
2. On adaptation, climate change impacts on human settlements and infrastructure 'addressed' in relation to water, sanitation, energy, transportation, health-care, fire services and other forms of emergency measures;
3. On mitigation, covers extension of Energy Conservation Building Code (ECBC) into commercial and residential sector, better urban planning, modal shift towards public transport, recycling of materials, and urban waste management with focus on Waste-to-Energy;

District Development in India

The **Smart Cities Mission** is an urban renewal and retrofitting program by the Government of India with the mission to develop 100 cities across the country making them citizen friendly and sustainable. The Union Ministry of Urban Development is responsible for implementing the mission in collaboration with the state governments of the respective cities.

Under the RAY, Inland pooling/town planning scheme, the owner or developer undertaking the development shall reserve and earmark the land in the proportions of 5% for the economically weaker sections (EWS) and 5% of land for low income group persons for housing purpose. In case of vertical development, 20% of built up space shall be earmarked for EWS and low income groups. Once implemented, in the long term, availability of affordable land /housing will discourage squatting by poor on public lands and create slum free cities. It will also sustainably reduce urban poverty levels by providing legal access to better services and economic opportunities.

Atal Mission for Rejuvenation and Urban Transformation (AMRUT), 2015-2035:

- Focus on providing basic infrastructure, but also development of green spaces, parks and recreation centres, capacity building and reform implementation;

- 500 cities to be covered (capital cities/towns, heritage cities as per HRIDAY Scheme, hill states/islands/tourist destinations and all cities/towns with populations of over one lakh with notified municipalities);

- Fund investment over twenty years estimated at 59.1 lakh crores (US$870.5bn), to be invested under different components in addition to Operation & Maintenance (O&M);

India’s Nationally Determined Contribution (NDC)

India's pledge and target for the Paris Agreement is:

1) To reduce the emissions intensity of GDP by 33%–35% by 2030 below 2005 levels by 2030;

2) To increase total cumulative electricity generation from fossil free energy sources to 40% by 2030;

3) To create additional carbon sink of 2.5 to 3 billion tons through additional forest and tree cover.

The long term climate goal remains to never have the per capita emissions exceed those of the developed world.

Targets towards the Building sector

India's NDCs partially focuses on reducing vulnerability towards climate change for sectors such as water supply and disaster management. Secondly, the focus is on sustainable lifestyles and cleaner economic development, which addresses sustainability in both the bottom and top end of the building value chain among other sectors

ACTION PLAN:

- Reduction of energy intensity through enhancing energy efficiency: National Mission for Enhanced Energy Efficiency (NMEEE)
- Developing climate resilient urban centres: Government of India in recent times has launched a number of schemes for transformation and rejuvenation of urban areas including Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and National Heritage City Development and Augmentation Yojana (HRIDAY).
- Abatement of pollution: Fly Ash Utilisation Policy

India and the UN Sustainable Development Goals

SDG 1: India is tackling the issues of homelessness under target 1.4, along with access to basic services, ownership of land or property and appropriate finance. The 2030 target is to achieve 0% homelessness. The government of India has put in place multiple programs and schemes to work towards these targets, such as the Pradhan Mantri Awas Yojana (PMAY) which promises housing for all and aims at promotion of affordable housing through credit linked subsidy or through partnership with public and private sectors. Programmes such as Swachh Bharat Mission, Pradhan Mantri Ujjawala Yojana, Pradhan Mantri Jan Dhan Yojana (PMJDY) etc. aim at ensuring access to basic services to the vulnerable sections of the population.

SDG 7: India has taken the Goal of ensuring access to affordable, reliable, sustainable and modern energy for all as a prerequisite for its socio-economic development. In April 2018, India achieved the milestone of providing electricity to all the Census villages and aims to achieve universal electrification at the household level by 2019. Among the indicators for measurement of progress for goal 7 is the number of households using clean fuel for cooking and the number of households electrified. To achieve 100 percent electrification in India, the Pradhan Mantri Sahaj Bijli Har Ghar Yojana- Saubhagya (Prime Minister's Programme for Easy Electricity for Each House- hold) was launched to provide electricity connections to all households in rural and urban areas. By the end of October 2018, nearly 95 percent of households were electrified. Six States along with the UT of Puducherry have achieved universal access to electricity.

SDG 11: Houses completed under Pradhan Mantri Awas Yojana (PMAY) as a percentage of net demand assessment for houses acts as a progress indicator for Target 11.1. The aim is to have 0% urban households living in slums by 2030. Unfortunately, only 3.2% of houses under the PMAY scheme have been completed as of now. Various government schemes and strategies have been formulated for achieving targets enlisted under SDG11. The Smart Cities Mission is a step in the direction of achieving the vision of improving the ease of living, particularly for the poor, women, elderly and disabled people. The strategic components of area-based development in the Smart Cities Mission are city improvement (retrofitting), city renewal (redevelopment) and city extension, as well as applying of smart solutions covering larger parts of the city.

SDG 12: The Indian Government has enacted laws to regulate many kinds of waste generated in the country. The wide range of wastes include household/ municipal waste, biomedical waste, e-waste, waste electronic and electrical equipment, waste from construction and demolition activities, waste from end of life cars, mining waste, waste from power plants, hazardous waste, waste from agriculture/forestry etc. The Environment Protection Act (EPA), 1986 is the umbrella Act that pertains to management of solid waste in the country. The National Environment Policy (NEP), 2006 of the Government of India emphasises the need for recovery and reuse of any material thereby reducing the waste destined for final disposal.

7.5 SCP Sustainable Housing in Kazakhstan

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Law of the Republic of Kazakhstan "on subsoil and subsoil use" (2017)** High level of state control over mining activities and companies. Code was amended in December of 2017 to include social relations in the sphere of subsoil, aimed at protecting the interests of the country and utilisation of mineral resources. It gives the government a stronger hand in dealing with investors and regulation of extractive industries; provides different regulations for mining / petroleum; new rules on awarding of grants and subsoil use rights; auctioning of subsoil permits; new power allocation between state	Kazakhstan's **Green Economy Concept and Kazakhstan 2050** provide an overall policy concept. The **law 'on energy-saving and increasing energy efficiency' (2012)** specifically targets decreases in industrial and municipal energy consumption, but majour investment is needed to refurbish and modernise current manufacturing plants as well as to fund programmes to encourage the use of green technologies (https://publications.waset.org/10000514/pdf). **National legislation on energy performance of buildings**, based on EU EPBD experience **(Law of the Kyrgyz Republic "On energy**	The **2001 Law on Construction** is the main piece of legislation which regulates construction activities. Throughout the construction process, many stages of approvals are required by the Agency for Construction, Housing and Utilities. The **2007 law, Decree No. 555** outlines the construction activities requiring a licence, which are typically obtained from regional local executive bodies. Hence, municipalities have a great deal of say in applying the regulations. Other **construction codes** include:	The state **policy on waste management** is defined in the **Concept on Transition towards Green Economy until 2050** and aims to introduce separate waste collection and develop a waste recycling sector through public-private partnerships. The concept was developed by the former **Kazakh Ministry of Environmental Protection and the United Nations Development Programme** to address environmental concerns by increasing resource use efficiency and modernising existing infrastructure. Kazakhstan will **prioritise**	**Environment Management Framework** outlines that during any renovation all usable materials should be collected and sold or turned over to authorized agencies for proper recycling. **Development Strategy 2030** is an overarching framework. Comprehensive **legislation includes long-term targets, roadmaps, guidelines and adequate enforcement.** In **2019 Kazakhstan finally prohibits waste entering landfills without prior processing**. Separate

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	authorities; includes monitoring compliance; mining rights are granted on basis of a license to simplify procedures; authorities retain the right to designate state-owned companies as shareholders where deposits are considered "major and unique"; contracts will be extended contingent on meeting additional government conditions. (https://www.bakermckenzie.com/en/insight/publications/2018/01/kazakhstan-adopts; https://www.whitecase.com/publications/alert/brief-overview-code-republic-kazakhstan-subsoil-and-subsoil-use) Environmental code outlines **EIA, SEA and TEA** for mining, including in situ leach mining projects.	**performance of buildings"** in force since February 2012, and package of sub laws, technical standards and norms) "**Action plan for 2013-2020** adopted by the **Decree of the №750** dated July 31, 2013 was developed to implement the Concept [29]. According to the Action plan, **energy conservation and improvement of energy efficiency in residential and commercial buildings** should be reached through measures including review of heat tariffs, introduction of tax breaks, financial support, facilitating local production of construction materials, conducting energy audit of all buildings every 5 years, thermomodernisation of buildings, and **improving normative documentation for design construction**,"	SNiP RK 2.04-01-2010 Building climatology. SNiP RK 2.03-30-2006 Construction in seismic areas. SNiP RK 4.02-42-2006 Heating, ventilation and air conditioning. SNiP RK 5.04-18-2002 Metallic constructions. Work execution and acceptance rules. SNiP RK 1.03-05-2001 Occupational health and safety in construction. SNiP RK 3.02-04-2009 Office and amenity buildings. SNiP RK 5.01-03-2002 Pile foundation. SNiP RK РК А.2.2-1-96 Regulations for design documentation SNiP RK РК А.2.2-1-96 Regulations for developing, concurrence, approval and make up of design documentation	**optimising resource use**, increasing the efficiency of environmental protection activity and establishing green infrastructure until 2020, after which it will begin transforming the national economy, implementing renewable energy technology and developing rational water use until 2030. In 2030-2050, the country will transition to using natural resources according to renewability and sustainability. (https://astanatimes.com/2019/07/kazakhstan-to-develop-state-programme-to-better-manage-municipal-solid-waste/) "The cross-sectoral **programme Ak Bulak 2011–2020** targets	collection began in 2019. (http://www.eu-recycling.com/flips/gr22018/files/assets/common/downloads/publication.pdf) "There is an environmental code (**Art. 301, item 18 in Environmental Code of the Republic of Kazakhstan**) that restricts the landfill disposal of certain construction materials but it is not followed by construction companies," (https://www.researchgate.net/publication/331801203_A_Comprehensive_Construction_and_Demolition_Waste_Management_Model_using_PESTEL_and_3R_for_Construction_Companies_Ope

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	(https://www.unece.org/info/media/presscurrent-press-h/environment/2018/kazakhstan-presents-draft-legislation-aligned-with-unece-environmental-impact-assessment-and-strategic-environmental-assessment-legal-instruments/doc.html; https://www-pub.iaea.org/MTCD/publications/PDF/TE_1428_web.pdf) **Policies regulating production of building materials** include: The **Civil Code of the Republic of Kazakhstan** as well as the **Law on Architectural, Town Planning and Construction Activities in the Republic of Kazakhstan** both outline proper quality of construction and	(https://publications.waset.org/10000514/pdf). **State programme "Energy Efficiency 2020"** was adopted on August 29, 2013 by the **Decree № 904** [30]. The objective of the Programme is to reduce consumption by 10% every year until 2015 and decrease energy intensity of GDP by 40% in 2020 comparing to the level of 2008. There are nine main streams for the Programme implementation: EE industry, EE innovative energy, **EE housing and utilities, EE construction**, EE transport, **EE lighting, EE society**, EE budget sector, and economic payment (https://publications.waset.org/10000514/pdf). The **Promotion of Energy Efficient Lighting in Kazakhstan** includes updating	for constructing production units, buildings and structures SNiP RK 5.04-23-2002 Steel structures. Design standards. SNiP RK 5.03-37-2005 Supporting and enclosing structures. SNiP RK 3.05-01-2010 Trunk pipelines **Prescriptive requirements in the building energy code** include: thermal insulation (inc. u-values), specified thermal comfort levels for summer and winter, air-tightness, ventilation or air quality, requirements for daylight, thermal bridges. Does not cover water and sanitation, mechanical systems, fire, planning or zoning.	water supply quality and systematic improvements in **water legislation** to ensure water use efficiency and savings" (https://pubs.iied.org/pdfs/16559IIED.pdf) After adoption of the new **law "On Energy Saving and Increasing Energy Efficiency"** in 2012, a number of bylaws regulating the mechanisms and relationships in the field of **energy saving and increasing energy efficiency** were enacted. They particularly stipulated: • phased banning of incandescent lamps; • introduction of energy consumption standards for all types of	rating_in_Central_Asia)

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	construction products and should be distributed to all types of dimensional, plate and line capital structures (constructions, building and their complexes, services), including technological and engineering equipment, relating to them, as well as to all types of works (services) on their designing, construction, manufacturing (production) of construction materials, products and constructions, depending on purpose of construction products. Building materials must adhere to the technical regulations and requirements of building codes. Regulatory and technical documents exist for building materials, products and structures. Independent laboratories are involved in testing of structures and building	relevant mandatory and recommended sections of the national building code on lighting, life-cycle cost criteria and establishment of collection, recycling and storage of mercury-containing lamps (https://publications.waset.org/10000514/pdf). Improved **enforcement and implementation of mandatory building energy codes and rating system** is under development (https://info.undp.org/docs/pdc/Documents/KAZ/MTE%20report%20EE%20buildings%20FINAL%2074950.docx). Introduction of BIM in Kazakhstan began with the development of the **"Concept for the implementation of information modelling technology in the industrial and civil construction of the**	Development of **EIA and SEA** began in 2017 as a tool for greening not only the economy, especially in sectors such as energy, industry, land use, regional development, and waste & water management. (https://www.unece.org/info/media/presscurrent-press-h/environment/2017/towards-a-green-economy-kazakhstan-has-started-the-second-practical-phase-to-establish-a-strategic-environmental-assessment-national-framework/doc.html)	manufactured goods and services. (https://carececo.org/upload/medialibrary/2ac/Energy%20Efficiency%20Assessment%20of%20Household%20Electrical%20Appliances%20(2).pdf) **Regional legislation on energy efficiency of electric appliances, developed by Eurasian Economical Union (EAEU), applicable for Kyrgyzstan and Kazakhstan** (in Central Asia). In Kazakhstan requirements are in force and fixed by local legislation, in Kyrgyzstan there is still process of its approval.	

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	materials to check compliance with standards. (http://adilet.zan.kz/eng/docs/Z010000242_)	Republic of Kazakhstan", which was entrusted with "KazSRICA" JSC. By that time, the Institute's staff have carried out a great work (with the participation of the design academy "KAZGOR") in investigating the world experience of using BIM (the report on the conduct the scientific research project was registered in "National Centre of Science and Technology Evaluation" JSC under the Ministry of Education and Science of the Republic of Kazakhstan) on their own initiative and funds, and also have gained some experience from pilot projects in the field of the use of information modelling to industrial and civil construction facilities (http://isicad.net/articles.php?article_num=19700).			

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	"**Locally produced materials** include cement, bricks, wooden doors, windows, steel doors, and soft and iron roofs. A fairly high portion of locally produced materials and products are not considered to be up to international standards. Most other materials are imported, mainly from Turkey, China, Germany and Russia." ... "strong demand for high quality imported products and materials used in the finishing and renovation process, which include: wall & floor coverings, ceiling products, doors and windows, kitchen and bath equipment, plumbing and electrical equipment, hardware, and DIY products." (https://2016.export.gov/kazakhstan/doingbusinessink	**THE REPUBLIC OF KAZAKHSTAN CONSTRUCTION INDUSTRY AND CONSTRUCTION MATERIALS PRODUCTION DEVELOPMENT PROGRAM FOR 2010-2014** outlines strategies for development of digitalisation in the construction industry (http://miid.gov.kz/en/pages/republic-kazakhstan-construction-industry-and-construction-materials-production-development). Kazakhstan also the acronym TIMCF (Technology of Information Modeling of Construction Facilities) for the term BIM. The **concept for implementation of information modeling technology in the industrial and civil construction of the Republic of Kazakhstan** seeks to create conditions for	**Industry growth until 2025** shows efforts to enhance transport and residential infrastructure. Renewable energy sources are expected to play a large role as well as modernization. Strong demand for high quality imported products and materials used in the finishing and renovation process, which include: wall & floor coverings, ceiling products, doors and windows, kitchen and bath equipment, plumbing and electrical equipment, hardware, and DIY products. **Vernacular architecture** - Kazakhstan's early inhabitants were nomadic and lived in	67% of households in rural areas still use coal as a primary heating source. (https://www.thepmr.org/system/files/documents/Additional%20Funding%20Proposal_KAZAKHSTAN_DRAFT_FINAL.pdf) Generally, the residential housing stock uses about **3x more nrg per unit of area than other countries in Northern Europe** and exceed the rate of most developed countries. Furthermore, **most of the houses use central heating based on boiler houses or CHPP. 80% + of the central heating facilities in Kazakhstan run on coal.** It is important to note that average temperatures are much lower in Kazakhstan	Many cities are planning **waste-to-energy plants**. (https://issuu.com/zoienvironment/docs/ca-waste-eng)

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	azakhstan/leadingsectorsinkazakhstan/constructionandbuildingmaterials/index.asp) The Institute of Science and Technology for Building Materials is involved in **state programs for technology transfer and technological consulting**, alongside many partners from public and private sector involved in preparation of financing the project, financing of investment, disbursement of funds, post-investment financing. (https://www.unece.org/fileadmin/DAM/SPECA/documents/kdb/2019/Presentations/18_S6_E_Dauren_Presentation_QTV_Techconsult_%D0%B0%D0%BD%D0%B3.pdf). **Technology parks** often	a domestic construction industry by transferring new technologies on BIM and construction facilities. It develops approaches to improve cooperation among participants of investment and construction sectors and increases transparency of the processes of decision-making and pricing in construction while defining stages, developing approaches to update digital documentation for constructino facilities and creates an accumulation of knowledge and operational experience in the form of big data to develop optimal design solutions. The tool reduces risks for public investment and increases transparency for all stakeholders in the construction and real estate processes (http://isicad.net/articles.php?article_num=19700).	yurts, of which some still exist today, mostly for cultural and tourism purposes. Nowadays, traditional wood materials used for the structure of yurts is composed in metal. (https://www.edgekz.com/kazakh-yurt-classics-or-modern-housing/) "The Kazakh yurt is easy to assemble and disassemble. It retains heat well and protects from the wind, as well as from the excessive heat in the summer. When it is hot, felt flooring is removed to make the inside cooler. For the winter, the yurts were insulated with double covers, surrounded with snow, hedged with sheaves of reeds, and dug round with soil." (https://weproject.media/	therefore much more heating is required. (https://energycharter.org/fileadmin/DocumentsMedia/Thematic/EE-Kazakhstan_2014_en.pdf#page=38) "For heat and hot water supply, most urban residential and public buildings in Kazakhstan **depend on the centralized heating system in both urban and district zones**. However, these systems – a network of heating units and co-generation stations – are **outdated and inefficient**. If **electricity and heating stations do not get modernized through budget investments, then the heating units in buildings (which belong to residents) are not**	

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	focus on machinery for building materials, production of new building materials. These areas focus on cultivation of small innovative companies working on improving building materials (http://www.sesric.org/files/article/497.pdf; https://books.google.de/books?id=TemWBQAAQBAJ&pg=PA339&lpg=PA339&dq=technology+for+building+materials+in+kazakhstan&source=bl&ots=W6VWadAD24&sig=ACfU3U0AVdlHgLEEGCxdsdZa2xav1HjFXg&hl=en&sa=X&ved=2ahUKEwigk_yJtdfkAhXJ0aQKHb4BB1UQ6AEwGXoECAoQAQ#v=onepage&q=technology%20for%20building%20materials%20in%20kazakhstan&f=false). Alternative materials and production methods	BIM is still considered an emerging technology in Kazakhstan. Its practice is becoming more widespread and is expected to gradually increase and align with applications of BIM developments in other countries. A number of forums and knowledge sharing events and conferences are taking place in Kazakhstan (https://www.researchgate.net/publication/321273984_Current_State_of_Building_Information_Modeling_BIM_and_Total_Building_Commissioning_and_study_of_their_applicability_in_Kazakhstan). A local green building certification tool called “OMIR” was developed by KazGBC members, 4 pilot certifications are completed – 1 residential building, 2 office buildings, 1 retail building.	en/articles/detail/kazakh-yurts-importance-in-nomadic-lifestyle-history-and-structure/)	updated either. " (https://www.thegef.org/news/kazakhstan-consuming-less-energy-raises-comfort-urban-residents)	

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	include Scientists in the Department of Technology of Building Materials, Products and Designs at the M.AUEZOV SOUTH KAZAKHSTAN STATE UNIVERSITY working on improving technology and efficient design of concrete, investigation of local raw materials and industrial waste for development of new production technology of finishing and wall building materials (http://sm.ukgu.kz/en/content/technology-building-materials-products-and-designs). Use of 3D-printing technologies for titanium scrap recycling is one of the most promising solutions developed in Kazakhstan to reduce costs of titanium production. (https://www.researchgate.net/publication/327498792				

Kazakhstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	_TITANIUM_STATE_AND_ PERSPECTIVES_OF_PRO DUCTION_DEVELOPMENT _IN_KAZAKHSTAN)				
Standards, guidelines and Rating Systems		The main regulatory documents pertaining to **building energy codes** are the The **Law of the Republic of Kazakhstan № 541-IV "On energy saving and energy efficiency"**, January 13, 2012; SN 2.04-21-2004 " **Thermal protection and energy consumption of civil buildings**"; and SN RK-2.04-04-2011 " **Thermal protection of buildings**" last amended in 2006 and 2012 which outlines national standards take into	**Rating/certification of building materials:** Yes, however directory and availability of such materials is hard to find. **Harmonization with other technical standards:** International technical standards (ISO) **Requirements to test building materials and products by certified test laboratories**: Yes,	**Minimum energy performance standards** will be defined in the new unified **technical regulations, ""On Informing Consumers on Power Efficiency of Electric Power Consuming Devices",** which are currently being reviewed for approval and would be applied to long term use goods such as: electric cooling devices; • washing and	

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		account different climatic conditions of the Republic. These cover apartment blocks, commercial buildings, public buildings, new non-residential buidlings, new residential buildings, existing residential buildings (after refurb.) and existing non-residential buildings (after refurb). **National classification of buildings in the building code of 2012**: A++; A+; A; B+; B; C+; C; C-; D; E. However, labelling is not mandatory. The building code itself is **mandatory.** **Requirements for the assessment of energy efficiency and energy consumption**: Existing buildings (for example, after major repairs) There are requirements, but they are not really implemented.	Committee for Technical Regulation and Metrology (https://www.unece.org/fileadmin/DAM/hlm/Meetings/2018/05_14/Documents/Annex_II._Countries_information__sheets-FINAL.pdf).	combined washing-drying household electric machines (250W, 50Hz); • household dishwashing machines (250W, 50Hz); • electric cabinet ovens (i.e., household electric ovens); • household air conditioners;• household electric lamps. These technical regulations will **establish EE classes** and characteristics re: energy saving and notifying consumers **on energy performance**. (https://carececo.org/upload/medialibrary/2ac/Energy%20Efficiency%20Assessment%20of%20Household%20Electrical%20Appliances%20(2).pdf) New measures within the **Energy Efficiency 2020 Programme** include	

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		**Energy use for**: heating, ventilation. (https://www.unece.org/fileadmin/DAM/hlm/Meetings/2018/05_14/Documents/Annex_II._Countries_information__sheets-FINAL.pdf). **Green building rating system** does not exist specifically for Kazakhstan. Currently, LEED and BREEAM are used and Kazakhstan is expected to develop their own rating system specific to the region in the future.		**energy efficiency classes for buildings and household appliances**. (https://www.enerdata.net/publications/daily-energy-news/kazakhstan-adopts-energy-efficiency-2020-programme-and-feed-tariffs.html)	
Access to Finance		Kazakh banks are slow to lend for energy efficiency related projects as there are risk concerns. An EU grant has stepped in to provide funds to ensure co-lending of credit lines and reduce the risk factor for financial intermediaries to allow local SMEs to access financing	Some funding from the GEF has gone towards **funding the Kazakhstan Green Building Council** (https://www.oecd.org/environment/outreach/Kazakhstan_Financing_Climate_Action.Nov2016.pdf).	"Residents of Astana (now Nur-Sultan) and Almaty the opportunity to **recycle their old household appliances free of charge and get a 10 percent discount** on a new energy-efficient refrigerator." (https://astanatimes.com	

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		resources more easily for investment in EE related operations through the **Kazakhstan Sustainable Energy Financing Facility**. (https://ec.europa.eu/europeaid/blending/kazakhstan-sustainable-energy-financing-facility_en) The **Kazakhstan Energy Efficiency Project** seeks to use World Bank funds to develop a legal, institutional and regulatory framework for EE financing mechanisms. (http://documents.worldbank.org/curated/en/890181554818140679/pdf/Disclosable-Version-of-the-ISR-Kazakhstan-Energy-Efficiency-Project-P130013-Sequence-No-10.pdf) UNDP project **Energy-Efficient Design and Construction of Residential Buildings** provided funding		/2018/10/new-household-appliance-recycling-discount-programme-launched-to-promote-energy-efficiency/) The campaign, spread 2,000 discount coupons, which led to 100 percent sale of A++ refrigerators and the recycling of 279 large-sized domestic appliances. Similar programs are expected to be developed in the future for a wider range of products.	

Kazakhstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		which improved enforcement and implementation of mandatory building codes, standards and rating systems. Education and outreach are a part of the program to promote EE design and applying best practices (http://www.kz.undp.org/content/kazakhstan/en/home/operations/projects/environment_and_energy/energy-efficient-design-and-construction-of-residential-building.html). Other development financing can be found, however, the **government does not provide any financial incentives** for green building or energy efficiency.			

Affordable Housing in Kazakhstan

During independence of Kazakhstan, housing construction has become one of the priority directions of strategy of development of the country and is one of the most important national tasks. The main focus of housing policy is to ensure sustainable growth of affordable housing for the General population by reducing its cost, increase in terms of housing credits, lower down payment and crediting rates. 97% home ownership - privatization of social housing." There have been several affordable housing programs adopted by the government of Kazakhstan, mainly focused on cost reduction.

"Affordable Housing-2020"

This program is especially targeted at young families and provides such measures as state support for the construction of affordable housing. However, the program is criticised for its point-system applicant selection and for generally being unaffordable for most who do qualify.

"Nurly Zhol" Infrastructure (Regional) Development Program for 2015-2019

Intended to increase affordability of housing for citizens, among other targets. (https://www.government.kz/en/gosprogrammy/nurlyzhol)

"Nurly Zher" Housing Construction Program

During the period of 2017 to 2021, this program seeks to increase housing affordability in Kazakhstan through the promotion of housing construction and increases in mortgage lending. Provision of more rental housing through private lending is also planned, along with a shift in "emphasis from direct budget financing of housing construction to extra-budgetary financing." The program has 7 main objectives: 1) To increase the affordability of mortgage lending; 2) To encourage the construction of housing by private developers; 3) To construct affordable housing for the members of the housing construction savings system; 4) To establish a rental housing stock for the socially vulnerable population stratum; 5) To develop individual housing construction; 6) To provide citizens with rental and commercial housing; and 7) To support shared housing construction. (https://www.government.kz/en/gosprogrammy/nurlyzher)

"New Housing Opportunities for Each Family," or, "7-20-25 initiative," and was adopted in March of 2018. The fundamental difference between this and previous mortgage programmes is that 7-20-25 is not state funded. Through the National Bank, interest payments are offered on housing loans at a rate of 7% per annum, with an initial payment of the buyer is 20%, and a payback period of 25 years. The loans can be easily applied to, requiring only a proven income (there is no minimum income required), no outstanding debts on mortgages or home loans, and lack of current homeownership (National Bank of Kazakhstan 2018). The programme is open to all citizens for an unlimited amount of time, with no preferential treatment. This affordable housing programme is not, however, focused on green construction (Shalbolova et al 2019).

District Development in Kazakhstan

Development of macro-regions is key for the development of the country, governed by complex schemes of urban planning. (http://habitat3.org/wp-content/uploads/NATIONAL-REPORT-OF-THE-REPUBLIC-OF-KAZAKHSTAN-Habitat-%D0%86%D0%86%D0%86.pdf)

UNDP has had a presence in Kazakhstan since 2010. During this time, the organisation cooperated with the **Committee for Construction, Housing and Utilities of the Regional Development of the Republic of Kazakhstan, the Ministry of Industry and Trade and the Ministry of Environmental Protection**. The goal of this collaborative effort is to develop improved frameworks and practices related to the large-scale adoption of green building. (http://www.buildingshows.com/market-insights/Kazakhstan/The-future-of-building-looks-green-in-Kazakhstan/801816831)

Nur-Sultan Green Quarter

Although Nur-Sultan's Green Quarter district was developed originally for EXPO 2017, it now serves as a best practice example for the country. The district features a central area with a surrounding network, including the following features:

- waste to energy plants
- gas system cogeneration for district heating
- grey water recycling
- intelligent management centre
- bioclimactic city features
- south exposure
- mixed use complexes
- rainwater storage
- design diversity
- wind energy production
- solar generation for heat and electric energy
- stormwater reuse system
- grid to cloud connection (cloud tech)
- central green park
- landscape design
- BIPV glass facades
- residential quarters
- arboretum and bio dome

Kazakhstan's Nationally Determined Contribution (NDC)

Kazakhstan's pledge and commitment to the Paris Agreement outlines that the country intends to achieve an **economy-wide target of 15%- 25% reduction in greenhouse gas emissions by 2030 compared to 1990**. The higher estimate of a 25% reduction target is conditional on additional international investments, access to low carbon technologies transfer mechanism, green climate funds and flexible mechanism for country with economy in transition.

Main actions:

- To reduce GHG emissions by 15-25% by 2030 compared to 1990;
- To become one of the 30 most developed countries in the world by 2050 following a path of low-carbon economic growth;
- To contribute to international efforts to combat climate change.

Actions specifically targeting the building sector:

- Modernisation of housing and communal services;
- Modernisation of production technologies based on energy efficient technologies

"Kazakhstan's long term objectives is to become one of the 30 most developed countries in the world by 2050. Following a path of low carbon economy growth Kazakhstan adopted the law "On energy saving and energy efficiency", "On supporting the Use of Renewable Energy Sources" aiming at greater use of renewable energy sources. In order to emphasize its commitment to low carbon growth, Kazakhstan has adopted a Concept on transition to a «Green» Economy. For the implementation of the Concept, an action is developed, under which government programs on waste management, modernisation of housing and communal services, development of sustainable transport, conservation of ecosystems and enhancement of forest cover were adopted. The laws on extended responsibility of entrepreneurs and greening of vehicles are being formulated. The implementation of the «Green» Economy Concept, and adoption of related legislative acts, should lead to modernisation of key infrastructure and production technologies based on energy-efficient technologies, and will make a significant contribution to reducing the emissions of greenhouse gases."

(https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Kazakhstan/1/INDC%20Kz_eng.pdf)

Kazakhstan and the UN Sustainable Development Goals

In Kazakhstan, the SDGs are implemented through national instruments, such as the **National Architecture on SDGs** (a framework where the UNCT supported the Committee on Statistics in the process of nationalizing SDG indicators. As a result, a draft system of 257 indicators was developed to monitor the SDGs, and the **SDG Statistical Office was established** within the Committee on Statistics) and almost 80% of the SDG objectives are integrated (http://kz.one.un.org/content/unct/kazakhstan/en/home/presscenter/national-architecture-on-sdgs-established-in-kazakhstan.html). Although implementation of the SDGs is currently funded by the state, it is proposed that private financing should play a larger role in the future (https://www.kz.undp.org/content/kazakhstan/en/home/presscenter/pressreleases/2019/undp-and-the-government-discuss-financing-sustainable-developmen.html). Another challenge for Kazakhstan for achieving SDG targets is the disparity between regions in terms of capability and resources (http://www.un-expo.org/wp-content/uploads/2017/08/NHDR-2016.pdf).

The following **national strategic documents** are related to the achievement of the SDGs in Kazakhstan:

- "Strategy-Kazakhstan 2050": new political course of the established state"
- The concept of Kazakhstan's joining top 30 developed countries
- Five institutional reforms – «100 concrete steps»
- State program «Nurly Zhol», the Plan on transition to «Green economy» and other strategic documents and the plans on the development of state bodies

SDG 11: Sustainable cities is an area where Kazakhstan could lead the world through a flagship initiative that promote cities such as Nur-Sultan and Almaty as model SDG cities.

For **further implementation of the SDGs**, it is planned:

- To coordinate with the Government of the Republic of Kazakhstan - the national system of indicators for monitoring the SDGs;
- To develop a medium-term Action Plan based on the UNECE Road Map on SDG Statistics (until 2020);
- To play a supportive role in the preparation of the first Voluntary National Report 2019 (NAD);
- By the end of this year, to work out the development of a separate Concept for the implementation of the SDGs in Kazakhstan until 2030.

7.6 SCP Sustainable Housing in Kyrgyzstan

Kyrgyzstan	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	The mining sector is **governed by** the Ministry of Economy, the State Agency on Geology and Mineral Resources, the State Inspectorate for environmental and technical safety, the State Agency for Environmental Protection. (http://www.geoportal-kg.org/index.php/investor-s-guide/for-investors/regulatory-authorities). **Mining codes and standards** are revised and updated to best practices, key laws are regularly updated. However, mining companies are concerned by frequent amendments. Technical instructions are outdated as they are based	Through following the framwork for the global **Agenda for Sustainable Development until 2030** and promoting the principles of a **green economy**, the Kyrgyz Republic expresses ist committment to sustainable development. However, there is **currently no legislative or regulatory principles, organisational or economic mechanisms, research or institutional prerequisites set up in order to support the adoption or development of any environmental certification** (https://www.undp.org/content/dam/kyrgyzstan/Publications/biofin/Study%20on%20ecocertification%20in%20Kyrgyzstan_eng.pdf). The **National policy and legal**	The codes which define health, building quality, environmental practices and safety for the construction industry include: i. **GOST National Standards (RUSSIAN) (ГОСТ – Государственный стандарт)** – standards and technical specifications cover energy, oil and gas, environmental protection, construction, transportation, telecommunications, mining, food processing, and other industries; ii. **SNiP Building Code (СНИП – Строительные нормы и правила)**– cover the Construction	There are three main documents that establish the strategic framework for the development of the energy sector of the country: 1. The **National Energy Programme of the Kyrgyz Republic for 2008–2010 and Fuel and Energy Complex Development Strategy until 2025**, approved by Government Resolution #47, dated 13 February 200850; 2. The **Mid-Term Power Sector Development Strategy for 2012–2017**, approved by Government Resolution #330, dated 28 May 2012; 3. The **National Sustainable**	**No specific policy for CDW waste**. However, Kyrgyzstan has strengthened environmental and technical safety controls over industrial and municipal waste. (https://zoinet.org/wp-content/uploads/2018/02/CA-waste-eng.pdf) Mining waste is left in open landfills with no treatment (https://zoinet.org/wp-content/uploads/2018/02/CA-waste-eng.pdf) The country seeks to improve, however **does not have the financial stability to set up required facilities** (https://zoinet.org/wp-

Kyrgyzstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	on Soviet-era standards and guidelines. Tax regime for mining is unpredictable and tax rates have prolonged increases. **EIA and SEA for mining are largely misunderstood**. Legislation can be confusing for companies due to perceived contradictions in legislature and the variability of the application of the mining standards. Mine closure is not addressed within current legislation. (https://www.iisd.org/sites/default/files/publications/kyrgyzstan-mining-policy-framework-assessment-en.pdf) The **Kumtor gold mine** is supported by the European Bank for Reconstruction and Development, although it has several accidents per year and ongoing	**framework for disaster risk reduction** includes enforcement of building codes (https://www.preventionweb.net/files/43352_KGZ_NationalHFAprogress_2013-15.pdf). The **Third National Communication of the KR for UNFCCC** outlines that the improvement of building codes is priority (https://unfccc.int/files/national_reports/non-annex_i_natcom/application/pdf/nc3_kyrgyzstan_english_24jan2017.pdf). There are currently **no policies which support or incentivise the use of BIM** in Kyrgyzstan. The Ministry of Energy and Industry has prepared a **draft program of energy saving and energy efficiency**	Norms and Rules; iii. **ЕН – EN – European Standards (Европейский стандарт)** – are an adoption of European construction standards; iv. **KNS – КГС (Классификатор государственных стандартов)**– Classifier of State Standards; v. **ISO 9000/ 9001, which can include GOST ISO 9001 (the Russian/ Eurasian adaption of ISO 9000/9001)**. – international quality management standards for manufacturing and services. (http://www.ibc.kg/en/download/858). **Perscriptive requirements in the building energy code** include: thermal	**Development Strategy for 2013–2017**, approved by President Decree #11, dated 21 January 2013. In relation to the latter two documents, the Government of Kyrgyzstan is in the process of updating the strategies for 2018–2022. (https://energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-KyrgyzstanEN2018.pdf) **Regional legislation on energy efficiency of electric appliances, developed by Eurasian Economical Union (EAEU)**, applicable for Kyrgyzstan and Kazahkstan (in Central Asia). In Kazahkstan requirements are in force and fixed by local	content/uploads/2018/02/CA-waste-eng.pdf)

Kyrgyzstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	environmental damages from mining operations. It attracts critisism from local residents and has been the site of many massive conflicts, even into August of 2019. (https://bankwatch.org/project/kumtor-gold-mine-kyrgyzstan) The government has worked diligently to improve transparency in the mining sector, but still has a long way to go. (https://www.export.gov/article?id=Kyrgyz-Republic-Mining-Industry-Equipment). Practices used in gold mining are environmentally harmful and the government has been accused of not keeping foreign companies accountable for practicing environmental methods of	planning until 2017 and in the future until 2025.	insulation, ventilation or air quality, daylighting requirements, boiler/ac systems, specified thermal comfort levels for summer and winter, solar gains and artificial lighting systems and lighting density. Does not cover water and sanitation, fire, planning or zoning. Road Map on improving legislation on energy performance of buildings, for the State Agency for Architecture, Construction and Housing under the Government of the Kyrgyz Republic, October, 2016 Regulation “On energy certification of buildings” with minimal requirements to energy performance of new	legislation, in Kyrgyzstan there is still process of its approval. "Article 16 of the Law requires mandatory certification of energy-consuming goods of any purpose, and energy resources. Compliance of household equipment to requirements established by state standards is confirmed by mandatory labeling; information on a correlation between energy efficiency of a device and energyefficiency standards should be marked either on the device or in its technical documentation." (https://carececo.org/upload/medialibrary/2ac/Energy%20Efficiency%20Assessment%20of%20Ho	

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	mining within the Kyrgyz law (https://www.minexforum.com/en/chinese-mining-company-in-kyrgyzstan-suspected-of-playing-havoc-with-ecology). The **Ministry of Industry, Energy and Fuel Resources** is responsible for introducting regulations for use of locally produced building materials throughout the country and for the reuse of discarded industrial material for construction as well as the use of effective technology for construction. They should also care for modernising construction materials with respect to cost and promote the use of local substitutes. Development of domestic building materials is a priority as well as		**constructed and energy renovated public, residential, administrative and non-industrial buildings** (http://cbd.minjust.gov.kg/act/view/ru-ru/93706)	usehold%20Electrical%20Appliances%20(2).pdf) **Energy Efficiency Policy of the Kyrgyz Republic** governs energy use in buildings. **Water use** is only governed in the agricultural sector. **Waste management** is not strongly governed in Kyrgyzstan. Over 80% and 90% of waste disposed goes to semi-controlled sites operating with minimal environmental standards (https://www.researchgate.net/publication/258200465_Waste_management_and_recycling_in_the_former_Soviet_Union_The_City_of_Bishkek_Kyrgyz_Republic_Kyrgyzstan).	

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	standardisation of prefabricated materials. (https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/cp.kyrgyzstan.e.pdf)				
Technology/ Architecture	The **development of new technologies** should favour those which enable more effective energy consumption in all sectors to enhance sustainable development. There is an expected shift from raw materials to innovation and technology based industries for buildling materials and a focus on the development of new materials. (http://hdr.undp.org/sites/default/files/kazakhstan_hdr_2006_0.pdf) Long term goal to **diversify mining to explore new**	**There are no major developments in digitalisation of the construction industry or BIM in Kyrgyzstan.** **BIM is rarely applied** in Kyrgyzstan and projects using BIM are typically outsourced to countries with more experience. In the capital of Bishkek, the **SMART BUILD centre** is a **demonstration and information based platform** at the Kyrgyz-Russian Slavic University which intends to widely disseminate and replicate knowledge and	Kyrgyzstan is not a trendsetter by way of construction materials or methods. Priorities for housing focus on providing minimum requirements. A **new technology centre for smart buildings** seeks to change that (https://www.unido.org/news/smart-build-technology-centre-opens-kyrgyz-republic). **Energy saving materials and equipment** are only rarely imported or produced due to lack of	**Little to no advocacy for saving fuel and energy in production or everyday use**. Places of higher education and vocational studies do not include programs to specialise in energy saving. There are no training programs (https://www.unece.org/fileadmin/DAM/energy/se/pdfs/gee21/projects/Database_e.pdf).	The **vernacular architecture** of Kyrgyzstan unknowingly creates a demand for recycled construction materials. The Novostroiki are a group of people who situate on land formerly used for agriculture in semi-formal settlements. They mainly **build houses using discarded building materials.** These constructions can include more traditional brick dwellings, or huts which often use coal ovens for heat in the winter and plastic bags

Kyrgyzstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	**reserves and new raw materials** to further implement international best practices, including SEA and EIA. Specifically, for **construction materials** the goal is to increase production by introducing modern technologies and promoting internal demand for construction materials through implementing programs for construction of new housing and social infrastructure. (https://www.unido.org/sites/default/files/files/2018-12/Background_document_to_the_Industrial_Development_Strategy_Kyrgyzstan_EN.pdf).	information about **advanced technologies in construction and alternative building materials** (https://www.unido.org/news/smart-build-technology-centre-opens-kyrgyz-republic).	appropriate information. "In the Kyrgyz Republic, construction industry **remains energy intensive**, as the support for the budget for the development and implementation of **energy-efficient technologies and related innovations remain low**. Construction companies **refrain from using new technologies because of consumer distrust of innovations in construction**. The **lack of environmental certification of construction and repair materials aggravates the situation**," (https://un-page.org/files/public/kyrgyz_republic_stocktaking_report_eng.pdf)		over windows as insulation. There is no access to basic services or utilities, including medical services. (https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/cp.kyrgyzstan.e.pdf)

Kyrgyzstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture			The **vernacular architecture of Kyrgyzstan** unknowlingly creates a demand for recycled construction materials. The Novostroiki are a group of people who situate on land formerly used for agriculture in semi-formal settlements. They mainly build **houses using discarded building materials**. These constructions can include more traditional brick dwellings, or huts which often use coal ovens for heat in the winter and plastic bags over windows as insulation. There is no access to basic services or utilities, including medical services. (https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/cp.ky		

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
			rgyzstan.e.pdf) Specifically for construction materials the goal is to increase production by introducing modern technologies and promoting internal demand for construction materials through implementing programs for construction of new housing and social infrastructure. (https://www.unido.org/sites/default/files/files/2018-12/Background_document_to_the_Industrial_Development_Strategy_Kyrgyzstan_EN.pdf).		
Standards, guidelines and Rating Systems		The main regulatory document related to **building energy codes** is the **Law of the Kyrgyz Republic (KR) "On Energy Efficiency of Buildings" of 26.07.2011,**	There is no data and no indication of **Building Materials and Products or Rating/certification of building materials** in the near future.	Per capita energy consumption is high considering the average income. **Minimum energy**	

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
		No. 137, as amended by Law No. 194 of 18 October 2013. It is a mandatory regulation which covers Buildings: residential, public, administrative and multifunctional: • new residential • new non-residential • existing residential • existing non-residential. However, the minimum energy efficiency requirements for buildings do not apply to: • Individual residential buildings, the total area of which does not exceed 150 square meters; • buildings designed for religious rites, rituals and ceremonies; • buildings that, in accordance with legislation, are assigned to cultural heritage sites • Temporary objects of non-capital construction;	Harmonization with other technical standards: No data Requirements to test building materials and products by certified test laboratories: No data	performance standards are under development for energy-consuming equipment which are set to be regulated by energy efficiency standards and regulations. Also under developmen t are the legal liabilities for violating energy consumptions standards. Current technologies, legal and financial frameworks are inefficient for use of fuel and energy. No incentives for energy producers or consumers to reduce expenditure on energy. Energy saving materials and equipment are only rarely imported or produced due to lack of appropriate information. There is no market for energy saving	

Kyrgyzstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		• holiday homes; • Buildings and structures of auxiliary **Energy passports** are mandatory for single family houses, apartment blocks, commercial buildings, public buildings, new res, new non-res, exist res and existing non-res. (https://www.unece.org/fileadmin/DAM/hlm/Meetings/2018/05_14/Documents/Annex_II._Countries_information__sheets-FINAL.pdf).		technologies and equipment, producers and consumers have no funding for them and it is difficult to access loans for innovative projects. Government provides no financial support for development of energy saving technologies (https://www.unece.org/fileadmin/DAM/energy/se/pdfs/gee21/projects/Database_e.pdf)	

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		Financing for green building is **not available through the government**. However, it is available through global financing and development projects such as the EBRD, green climate fund, the **Kyrgyzstan Sustainable Energy Efficiency Financing Facility (KyrSEFF)**, and other international development finanancing. "Launched in November 2016, **KyrSEFF+ is a USD 35 million financing programme, developed by the European Bank for reconstruction and Development (EBRD)**. KyrSSEFF loans are supported by grants incentives of up to 35% as well as technical assistance, provided by the EU-IFCA fund. KyrSEFF+ loans are disbursed through local Partner Banks.	On the sectoral level, green economy priorities within Kyrgyz Republic's **participation in PAGE include development of low-carbon energy and energy efficiency, 'green' construction, development of technologies to minimize environmental pollution,** climate change adaptation, protection of natural ecosystems, increased safety of social objects and education for sustainable development. (https://un-page.org/files/public/kyrgyz_republic_stocktaking_report_eng.pdf) **No government funding** for sustainable construction materials, methods, machinery, etc.	There is currently **no funding** for purchase of EE appliances or equipment.	

Kyrgyzstan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		KyrSEFF+ builds on the successes of KyrSEFF, which has supported more than 630 households and 60 businesses with loans and grants in their efforts to become energy efficient. **KyrSEFF+ does not only support energy efficiency, but also water efficiency in private households and commercial businesses.** KyrSEFF+ is available to: **Private households**, owners of houses and apartments and residential buildings for investments in energy and water saving technologies. Investments may range from wall insulation through to innovative solar energy and rainwater harvesting solutions, allowing families to save money and increase the comfort of their homes. **Private enterprises in**			

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		**industry, agribusiness and service sectors for investments that result in energy, water and other resource savings.** These investments may include new efficient machinery for production companies, compact waste-water treatment systems and energy saving devices for hotels, drip irrigation and machinery for agricultural companies and much more. **Suppliers, vendors and installers of energy and resource efficient technologies to ensure these are readily available in Kyrgyzstan.** Investments may include an expansion of stock holding, the operating base, etc. Please note that supplier loans are exempt from grant incentives. Commercial and private investors can seek support and advice from the			

Kyrgyzstan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
		KyrSEFF+ team of engineers to find the most appropriate solution for their energy and water resource efficiency investment." (https://www.kyrseff.kg/?lang=en)			

Affordable Housing in Kyrgyzstan

Development Program of the Kyrgyz Republic for the period 2018-2022 & **the Decree "on the announcement of 2018 as the year of regional development"**

Under these, strategies are developed for affordable housing, modern communication and energy services. The program stipulates state subsidy issuing for dwelling purchasing, but there is no mechanism for its effective implementation in place.

"Affordable housing 2015-2020" (http://gik.kg/ru/borrowers/government-program/)

The Governmental Program is claimed to be unaffordable, even for state employees. It dictates, "Provision of social housing for low-income citizens, as well as for vulnerable groups of the population, including graduates of children's boarding schools, including through the implementation of the Government's affordable housing program." (https://www.un-page.org/files/public/the_development_program_of_the_kyrgyz_republic_for_the_period_2018-2022.pdf) However, many sources discredit the program, saying it has resulted in more harm than good, calling it "poorly implemented," and "overpriced."

Kyrgyzstan has passed a law on **the legalisation of informal settlements** as it has been a growing problem since its fairly recent independence.

District Development in Kyrgyzstan

The Development Program of the Kyrgyz Republic for the period 2018-2022 & the Decree "on the announcement of 2018 as the year of regional development"

These strategies outline development of regions as larger unbites. Under these, strategies are developed for smart-city frameworks (https://www.un-page.org/files/public/the_development_program_of_the_kyrgyz_republic_for_the_period_2018-2022.pdf).

Kyrgyzstan withdrew from the Smart Cities initiative due to lack of ability to fulfil obligations for investments.

Kyrgyzstan's Nationally Determined Contribution (NDC)

INDC exists but does not mention housing, building or construction. The INDC outlines the need for financing in order to reach climate change mitigation targets. (https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Kyrgyzstan/1/Kyrgyzstan%20INDC%20_ENG_%20final.pdf)

Main Actions

- To reduce GHG emissions in the range of 11.49 – 13.75% below BAU in 2030;
- To limit the per capita GHG emissions to 1.58 tCO_2 in 2050 in line with the 2℃ objective;
- To prevent climate change related damages and losses in the country.

Building Sector

- To update sectoral adaptation programs and action plans for energy, industrial processes, land use and waste.

"At present the Kyrgyz Republic's technical, institutional and financial capacities to address the impacts of climate change are scarce. Adaptation investments will need to be increased to reduce climate vulnerabilities. Currently, domestic financing is insufficient and cannot support such efforts," (https://www.globalsupportprogramme.org/sites/default/files/resources/kyrgyz_nap_in_focus_online_final.pdf).

Kyrgyzstan and the UN Sustainable Development Goals

National Strategy of Sustainable Development up to 2017 states "Increasing costs of energy resources is a sustainable trend that will continue, this is why it will be necessary to:

(i) improve the system of state regulation and the encouragement of energy conservation;
(ii) to strengthen the role of state and local authorities and NGOs in the matters of energy conservation and energy efficiency of buildings;
(iii) create an environment that encourages application of energy efficient technologies for buildings and structures;
(iv) promote the use of renewable energy sources.

Energy conservation policy must become an integral part of all development strategies: of the nation as a whole, of the Oblasts and of local authorities. Each household should aim for energy efficiency. It is necessary to introduce a system of norms and economic preferences that encourage greater energy efficiency in the economy." (http://donors.kg/en/strategy) NOTE: an updated version of the National Stategy of Sustainable development is not yet available. However, the latest version is set to mention **buildings and housing**, but to a lesser extent and without direct indicators or targets.

Kyrgyzstan will participate in the 2020 high level forum on SDGs.

It is strongly recommended that national SDG indicators should be included into the **National Development Strategy of the Kyrgyz Republic for 2018-2040** and the **National Development Programme for 2018-2022, "Unity, Trust, Creation"**. This would allow for a continuous process of monitoring and evaluation of the development planning cycle. Further development of the SDGs into sub-national (regional) development plans should also be considered.

7.7 SCP Sustainable Housing in Malaysia

Malaysia	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Mining Legislation** The two main legal instruments that govern activities relating to mining are the Mineral Development Act (MDA) 1994 and the various State Mineral Enactments. Each State has ist own legislation governing mining activities. **Mineral Development Act** (1994, came into force in 1998): defines the powers of the Federal Government on matters pertaining to the inspection and regulation of mineral exploration, mining and other related issues. **State Mineral Enactment:** empower the States the rights to issue mineral	**BIM in Malaysia** - Introduced in Malaysia in 2009, but the technology adoption rate has been slow in comparison to other countries. - Companies know the technology, but lack on guidance, government support and well-trained personnel for proper implementation. - **Construction Industry Transformation Programme 2016-2020 >** development of BIM implementation in the country to transform the construction industry to be more productive, sustainable and competitive.	**Malaysia's Building Regulations** Malaysia's building regulations are based on the Street, Drainage and Building Act (1974), the Uniform Building By-Laws (1984) and the Building (Federal Territory of Kuala Lumpur) By-Laws (1985). These legal instruments stipulate the guidelines for approval of building plans and prescribe requirements for fire safety. **Uniform Building By-Law (UBBL):** prescribes plan submission procedures, space provisions, and design methods, provisions of	**Water Policy in Malaysia Water resources National Water Resources Policy:** was officially launched in 2012, asserting that security and sustainability of water resources shall be made a national priority to ensure adequate and safe water for all, through sustainable use, conservation and effective management of water resources. - Four key areas, including Water Resources Sustainability and Water Resources Security.	**Construction and demolition waste management in Malaysia** CDW accounts for approximately 41% of total solid waste generation. Malaysian CDW is estimated at 161.19t per day in 2009, increasing to 299,69t per day in 2015, and is projected to reach 368.31t per day by 2023. **Environmental Quality Act 127, 1974:** on the prevention, abatement and control of pollution and enhancement of the environment. Restrictions and fines for

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	prospecting and exploration licences and mining leases. The administration of legislation is undertaken by the office of the State Director of Land and Mines (SDLM). The SME is currently at various stages of implementation in the respective States. The SME provides an attractive, efficient, harmonious and stable mineral regulatory framework that is conducive to the development of the industry. It was enacted replacing existing laws to cover conditions allowing not only for small scale and labour intensive mining, but also for large scale exploration and capital intensive modern mining that the country anticipates in the future.	- **2011: Construction Industry Development Board** of Malaysia has been given the mandate to lead BIM uptake in Malaysia. CIDB has ever since developed various initiatives and projects to enhance implementation and build capacity.	temporary work, structural requirements, construction requirements, fire requirements, alarm, detection, extinguishment, and access, and others. **Building By-Laws 1985:** specifies the enforcement and regulation for the territory of Kuala Lumpur only. The federal government is the local authority for the Territory. **Street, Drainage and Building Act:** provisions on street design and maintenance, plants management, drainage design and maintenance, back lanes provision, design and maintenance, and other administration procedures.	**2018:** Malaysian government is drafting a new national water policy to address the weaknesses in the existing mechanism. Focus on reducing the demand for water supply though various measures, such as mandatory use of water efficient products, exploring alternative water sources and audit on efficiency of water consumption. **Waste management in Malaysia** **1998 - Action Plan for a Beautiful and Clean Malaysia**: formulated to produce a national uniform municipal solid waste system that was productive, environmentally sound	pollution of atmosphere, soil and water. Penalties for open burning. **Solid Waste and Public Cleansing Management Act 2007 (Act 672):** provides for and regulates the management of controlled solid waste and public cleansing to maintain proper sanitation. Categorisation of solid waste. **Street, Drainage and Building Act 133, 1974:** to amend and consolidate the laws relating to street, drainage and building in local authority areas of West Malaysia. Provisions on the deposition of materials.

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment			The Department of Local Government under Ministry of Housing and Local Government develop and administer building laws and/or regulations but are enforced by the respective local councils our municipals at the state level. Laws apply only to commercial, institutional and industrial buildings. They do not govern housing and low-cost development. There are mandatory laws for federally owned buildings, and it is up to the state or territory to determine if the laws apply to them.	and socially acceptable. The policy was not officially endorsed by the National Council for Local Government as well as implemented completely. **2005 - National Strategic Plan for Solid Waste Management in Malaysia:** provides the basis for SWM policies and measures in Peninsular Malaysia until 2020. The plan proposes six strategies to guide solid waste legislative, institutional and infrastructural planning and management. The NSP established a target of 22% for reduction and recovery and a target of 100% for urban source separation by 2020.	**Uniform Building By-laws 1984:** provisions on the deposition of building materials during construction.

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment				**2006 - Master Plan on National Waste Minimisation:** launched with the objective to provide vision, strategies and roles of stakeholders to minimise the amount of solid wastes disposed in Malaysia. The MWM outlined waste minimisation strategies, action plans for the Federal Government, action plans for local authorities and pilot projects including the preparation of guidelines on waste minimisation. **2006 - National Solid Waste Management Policy:** forms the basis for SWM in Malaysia in terms of objectives and key thrusts. Aims at establishing an integrated SWM system that is comprehensive,	

Malaysia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment				cost effective, sustainable and accepted by the public. The SWM Policy has provisions for 3R with emphasis on waste reduction through 3R activities, intermediate treatment and final disposal. **2007 - Solid Waste and Public Cleansing Management Act:** regulates the management of solid waste and public cleansing to ensure the maintenance of proper sanitation. **2009-2013 Corporation Strategic Plan:** identified seven focus areas, which include public awareness programme, monitoring of SWM services, environmentally	

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment				sustainable SWM, human resource sustainability, strong financial management and requirements to meet customer needs. **2010-2015 - Tenth Malaysian Plan:** similar to its predecessors, has provisions for 3R as part of the Malaysian government's strategy for sustainable waste management.	
Technology/ Architecture	**Manufactured Sand** - CDE Asia is working together with Batu Tiga Quarry Sdn Bhd, YTL Corporation Berhard's quarry division on the development and promotion of manufactured sand in Malaysia.	**Vernacular Architecture** - Overall house construction that allows **ventilation** for cooling and reducing humidity and use **building materials with low thermal capacity** so that little heat is transmitted into the house. - Thatch roof designed with lightweight materials.	**Industrialised Building System (IBS):** a construction method in which structural components of a structure are mass produced either in factory or at site under strict quality control and minimal on site activities. Reportedly, IBS		

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	- Production of manufactured sand: controlled crushing of hard rocks into smaller fractions, followed by advanced wet processing techniques that allow the consistent grading of sand. - Sand is free of adulterations and impurities: technology enhances the quality of the sand and reduces the consumption of cement. - "Collaboration with CDE to bring high-quality manufactured sand to Asia has the potential to change the game and divert sourcing from the region's riverbeds." - "Packaging CDE's technology into its mobile plants enables to run on less energy. The power needed to fuel	- Gable ends designed with carved wood that act as screen to allow **natural lighting and natural ventilation** into the house. - Built with the **floor raised** on the posts above the ground as an ideal solution to avoid the dampness and flush flood while heavy rain. - **Open spaces, high ceiling or roof** to provided good ventilation and airy the space. - **Many windows** in the wall provide good ventilation and views as well as creating a comfortable and cool atmosphere. - Use of local materials, such as rumbia, thatch roof, bamboo wall or mengkuang weabing and cengal wood can decrease the temperature of the Malay house interior space.	produces higher quality structural components through careful selection of materials, use of advanced technology and strict quality assurance control. The use of IBS in construction also reduces the need for labour on site, which is very relevant on the Malaysian contexts, since the construction industry in the country relies heavily on foreign workers, allowing for cost savings. - **1990s:** IBS became popular in Malaysia with the construction of various infrastructure and mega projects using the method. Example: Kuala Lumpur International Airport.		

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	CDE's mobile plants is kept to less than 1kW per tonne of material. The system also recycles 95% of the water used"		- **1999:** CIDB formed the IBS Steering Committee, to promote the use of IBS in the Malaysian construction industry. Development of strategic plans and roadmaps for implementation. **-Malaysia's Construction Industry Transformation Programme 2016-2020:** emphasis on the importance of accelerating the adoption of IBS in the construction industry.		
Standards, guidelines and Rating Systems		**Building Energy Code** **MS 1525 Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings** - Code is mandatory for new and renovated non-residential buildings with	**MyHIJAU Mark** **MyHIJAU Mark & Directory** is a Government initiative to promote the sourcing and purchasing of green products and services in Malaysia. This programme was	**Malasyan Standards (MS)** Most reference standards are Malaysian Standards. Besides MS, the laws also referred to other standards such as the British Standards, ASHRAE, AS/NZS, etc.	

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		air-conditioned area over 4,000m². - First standard for commercial buildings was launched in Malaysia in1989 as a voluntary guideline, which was later revised and incorporated into the Malaysian Standards. - 2012: MS 1525 was made mandatory for new and renovated non-residential buildings with air-conditioning area over 4,000m². - Code covers: Building envelope. Lighting Systems, Air conditioning **Green Building Rating System** **Green Building Index (GBI):** launched in 2009, GBI is a comprehensive rating system for evaluating the environment design and performance of buildings based on the	approved by the Green Technology & Climate Change Council (MTHPI) on 23 October 2012. MyHIJAU Mark is Malaysia's official green recognition endorsed by the Government of Malaysia, bringing together certified green products and services that meet local and international environmental standards under one single mark. Registered green products and services will be listed in the MyHIJAU Directory which works as a reference for green procurement (including Government Green Procurement; GGP and Green Private Purchasing; GPP), green incentives (including Green Investment Tax	The Malaysian Standard (MS) is a consensus document developed by the Standards Development Committee (SDCs) within the Malaysian Standards Development System and approved by the Minister of Science, Technology and Innovation in accordance with the Standards of Malasya Act 1996 (Act 549). A MS is a technical document that specifies the minimum requirements of quality and safety for volutary use by the public. A standard becomes mandatory when a regulatory agency enforces its use through the relevant acts and regulations.	

Malaysia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		following six criteria: energy efficiency, indoor environmental quality, sustainable site planning and management, material and resources, water efficiency and innovation. - Malaysia does not have a mandatory standard or code for green building standard. - The Green Building Index is very similar to USGBC LEED with certification at four levels: certified, silver, gold and platinum. Buildings and townships can apply for certification in non-residential, residential, industrial and township categories. - The evaluation of the projects is based on performance on six main criteria: - Energy Efficiency - Indoor Environmental Quality	Allowance; GITA and Green Income Tax Exemption; GITE) and related green technology initiatives. **Eco labelling** In 1996 Standards and Industrial Research Institute of Malaysia (SIRIM) launched the national eco-labelling program verifying products according to environmental criterial such as Environmentally Degradable, Non-toxic Plastic Packaging Material, Hazardous Metal-Free Electrical and Electronic Equipment, Biodegradable Cleaning Agents and Recycled Paper.	**Categories of Malaysian Standards:** Specification/Requirements, Method, Codes of practice, Terminology/ Glossary/ Vocabulary/ Nomenclature, Guide. **Minimum Energy Performance Standards (MEPS)** specify the minimum level of energy performance that appliances, lighting and electrical equipment (products) must meet or exceed before they can be offered for sale or used for commercial purposes. MS 2595: 2014 - MEPS for Refrigerator MS 2597: 2014 - MEPS for Air Conditioners MS 2576: 2014 - MEPS for Television	

Malaysia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
		- Sustainable Site Planning and Management - Material and Resources - Water Efficiency - Innovation		MS 2574: 2014 - MEPS for Domestic Fan MS 2598: 2014 - MEPS for Lamps	
Access to Finance		**Energy Performance Contracting in Malaysia** - **EPC:** works as an agreement between the Energy Service Company (ESCO) and a client who plans to develop an energy efficiency project in his facility. The ESCO compromises to provide the client with knowledge and expertise on the identification and assessment of energy saving potential and on the development and implementation of energy saving measures in the project. - During the contract, ESCO undertakes risks	**Green Technology Tax Incentive in Malaysia** - Introduced in 2014, when GreenTech Malaysia has been mandated to commence and verify on the incentives that would be offered. - **Goals:** to encourage investments in green technology on project basis, to motivate companies in acquiring green technology assets, to enhance the number of green technology service and system providers.	**Green Technology Financing Scheme (GTFS):** all green products, equipment and systems that satisfy stipulated criteria such as minimisation degradation of environment, promotion the use of renewable sources, zero or low emission of greenhouse gases (GHGs) are eligible to apply for the financing scheme **KeTTHA, SEDA - Energy Audit Conditional Grant (EACG)** open to any existing commercial and	

Malaysia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		associated with achieving energy savings and is paid back with a portion of the energy costs savings achieved. - Goal: to overcome the barriers to implementation of energy efficiency facilities in Malaysia by providing technical expertise and capital investments. - EPC can be applied to any facility using energy.	3 categories of incentives: **1. Green Investment Tax Allowance for Projects (GITA-Project):** applicable for companies that undertake qualified green technology projects for business purposes. **2. Green Investment Tax Allowance for Assets (GITA-Assets):** applicable for companies that purchase assets listed under the MyHIJAU Directory, that qualify as capital assets. **3. Green Income Tax Exemption (GITE):** applicable for Green Technology Service Companies listed in the MyHIJAU Directory. The Malaysia Investment Development Authority is responsible for the applications for GITA-	industrial building with electrical energy consumption of more than or equal to 100,000 kWh per month; Provide a fund for industries to conduct energy audits to establish their baseline consumption patterns and to identify opportunities for efficiency	

Malaysia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
			Project and GITE, while Malaysian Green Technology Corporation is responsible for the GITA-Asset category.		

Affordable Housing in Malaysia

National Housing Policy (2011): commitment of the Malaysian Government to provide adequate, comfortable, quality and affordable housing with the ultimate aim to enhance sustainability and wellbeing of Malaysian.

Public housing programmes for poor and low-income households in urban areas were implemented through programmes like:

- Home Assistance Program (PBR) - for households below poverty line income
- People's Housing Program (PPPR) - for households with income 2,500RM or below
- Rumah Mesrah Rakyar 1 Malaysia (RMR1M) (SPNB) - different incomes
- 1 Malaysia Civil Servants Housing (PPA1M) - for households with monthly income between 2,000RM and 10,000RM
- Federal Territory Homes: for households with monthly income of 6,000RM or below

Government effort to provide adequate and quality affordable housing to poor, low- and middle-income households also become the focus area in 11th MP 2016-2020. Aimed to improve the wellbeing of all groups of households, this Plan outlines a target of 653,000 units of affordable housing to be built during the Plan period with the average of 130,000 houses built a year. In detailed, 606,000 houses to be developed for low- and middle-income households, while 47,000 houses to be constructed/repaired for the poor.

Housing Programmes and Schemes for Low- and Middle-Income Households

Private Affordable Housing Scheme (MyHome) was launched in April 2014 to help the low-income households to own a house at affordable prices. The Government provides a subsidy of up to RM30,000 (USD7,357) per unit to private developers to enable first-time buyers with a monthly household income of between RM3,000 (USD736) to RM6,000 (USD1,471) to own a house.

First Home Deposit Scheme (MyDeposit) is a special product that was introduced by the Government to help the middle class to own their dream home. The government has announced the allocation of RM200 million (USD49M) as a contribution to the deposit for the purchase of a first home by one household.

Housing Loan Scheme (Skim Pinjaman Perumahan - SPP) is a financial scheme that aims to help the lower income group, that is for household income between RM750 – RM2,500 (USD182 – USD613) per month, with maximum loan amount of RM45,000 (USD 11,035), to build a house on their own land. With this scheme, those people who are unable to secure a bank loan would be able to get financial assistance through government to build a house in their land.

Indirect Financial Assistance to Strengthen Publics' Housing Finance: The housing projects that are abandoned by housing developer due to several reasons are given new life by the government by providing assistance to new housing developers to complete the projects. With this initiative, many house buyers who have been victims to bogus or failed developer were able to own their dream houses with the help of Government.

District Development in Malaysia

The construction of Putrajaya takes into account the environmental effects of building materials and design, construction methods, building operations and maintenance to substantially reduce or minimize impacts on the environment. Latest technologies and systems have been used to avoid environmental degradation, improve comfort and enhance productivity of building occupants. At the early planning and design stage, systems concerning energy consumption, low energy and efficient design buildings and supply have always been considered.

Putrajaya is the new Federal Government Administrative Centre of Malaysia. Its development strategy was originally based on two underlying concepts: "Putrajaya as a garden city" and "Putrajaya as an intelligent city", based on which a master plan was drawn and approved for implementation in 1995. The plan includes an integrated land use plan supported by various guidelines and subject plans covering sectors such as transportation, environment, utilities, landscape, urban design, etc.

Main features of Putrajaya Master Plan:

- Almost 40% of the city are designated as open space

- 400 hectares of man-made lake and 200 hectares of wetlands

- Road and transportation network planned based on a policy of modal split of 70:30 between public transport and private transport usage.

- City divided in 20 precincts, with main employment and commercial precincts located in the "core island"

- Residential precincts at the peripheral are planned on a neighbourhood planning concept.

In tabling the 2010 Malaysian Budget, the Prime Minister announced to "develop Putrajaya and Cyberhaya as pioneer townships in green technology to showcase the development of other townships"

Three main components and qualitative environmental targets in PCG2025:

- reduce GHG emission intensity by 60%

- reduce peak temperature by 2 degree Celsius

- reduce final disposal of solid waste and GHG emission per waste generation by 50%

Malaysia's Nationally Determined Contributions (NDCs)

Malaysia has taken early action:

Since the **Ninth Malaysia Plan (2006-2010),** the country has started initiatives to increase the share of use on non-fossil fuel energy.

- National Biofuel Policy 2006: development and use of biofuels

- National Biofuel Industry Act 2007: to regulate the biofuel industry and promote th mandatory use of the B5 domestic blend (5% palm biodiesel, 95% fossil fuel diesel)

The Tenth Malaysia Plan (2011-2015) focused on sustainable growth and introducing mitigation strategies to reduce GHG emissions

- Feedin-tariff mechanism (FiT) in conjunction to the Renewable Energy Policy Action Plan (2010): to help finance renewable energy investment, providing fiscal incentives and funding for green technology investment and promoting projects eligible for carbon credits.

Malaysia's INDC: Malaysia intends to reduce greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. This consists of 35% on an unconditional basis and a further 10% is condition upon receipt of climate finance, technology transfer and capacity building.

In 2009, Malaysia set a voluntary target of reducing greenhouse gas emission intensity of its GDP by up to 40% compared to 2005 levels. By the end of 2013, Malaysia had achieved a 33% reduction. The energy sector, which is a major contribution to greenhouse gas emissions, has taken steps to increase the use of clean and environmentally friendly sources of energy.

Malaysia and the UN Sustainable Development Goals

Malaysia Sustainable Development Goals Voluntary National Review

In 2009, Malaysia formulated the **New Economic Model (NEM)** which further cemented its commitment to pursue sustainable development based on three goals, namely, high income, inclusivity and sustainability. These mirror the three elements of the 2030 Agenda for Sustainable Development (the 2030 Agenda), encompassing economic, social and environmental elements. The NEM provides the basis for Malaysia's development plans until 2020. The current plan, the **Eleventh Malaysia Plan 2016–2020 (11MP),** is thus premised on the three goals of NEM. The 11MP theme is "Anchoring Growth on People," where people are the centrepiece of all development efforts, complemented by ensuring that no section of society is left behind in participating and benefiting from the nation's development.

Policies and Plans to achieve the SDGs in Malaysia

Goal 7 – Ensure access to affordable, reliable, sustainable and modern energy for all

- 11MP Strategic Thrusts 4 and 5
- National Renewable Energy Policy and Action Plan 2009
- National Green Technology Policy 2009
- National Energy Efficiency Action Plan 2015

Goal 11 – Make cities and human settlements inclusive, sage, resilient and sustainable

- 11MP Strategic Thrusts 1, 2, 4 and 5 and Game Changer "Investing in competitive cities"
- National Physical Plan 3 (NPP3)
- National Urbanisation Policy 2 (NUP2)
- Competitive Cities Master Plans
- National Environmental Health Action Plan
- National Housing Policy (DRN) 2013–2017 and DNR 2.0 2018–2022
- Road Safety Plan of Malaysia 2014–2020
- National Solid Waste Management Policy

Malaysia and the UN Sustainable Development Goals

Goal 12 – Ensure sustainable consumption and production patterns

- 11MP Strategic Thrusts 4 and 6 and Game Changer "Embarking on Green Growth"
- National Ecotourism Plan 2016–2025
- National Policy for Biological Diversity 2016–2025
- National Environmental Health Action Plan (NEHAP)
- National Solid Waste Management Policy 2006
- Solid Waste and Public Cleansing Management Corporation Strategic Plan 2014–2020
- Department of National Solid Waste Management Strategic Plan 2016–2020
- Construction Industry Transformation Programme (CITP) 2016–2020

Goal 13 – Take urgent action to combat climate change and its impact

- 11MP Strategic Thrusts 2, 4 and 5
- National Policy on Climate Change 2009
- National Urbanisation Policy 2006–2020
- National Physical Plan 3
- National Green Technology Policy 2009

7.8 SCP Sustainable Housing in Mongolia

Mongolia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	Mongolia produces about 60 percent of its construction materials domestically and imports the remaining 40 percent, and seeks to domestically produce as much of these materials as possible. To this end, the Ministry of Construction and Urban Development has stated that the government will waive import and value-added taxes on construction equipment and related technologies that can be used to create a Mongolia-based construction sector **The Minerals Law (2006, amendments 2014)**	**Green Development Policy of Mongolia** The policy and has become the pillar of green development in Mongolia. The policy defines green development goals, objectives and their implementation policy and strategy divided in medium and long term targets up to 2030. The Goal of the GDPolicy is to allow Mongolia to evolve as a developed nation having built conditions for environmental sustainability to be inherited by future generations and with opportunity of gaining benefits from it in the long run through participatory and inclusive economic growth based on a green development concept.	**Key Legislations in the Construction Sector** **Law on Construction (2008):** to regulate relations concerning the development of construction design, manufacturing of construction materials, executing construction works and technical supervising. The revised version of the Law on Construction sets out the implementation of the Green Development Policy and green construction requirements: introduction of advanced technology, efficient	The sustainable development vision has reflected to reduce a heat loss of buildings by 20 percent by 2020 and by 40 percent in 2030 [https://montsame.mn/en/read/132428] **Government policy on energy (2015) -** Priorities of the government: - Ensure reliable energy supply and safety - Increase efficiency and effectiveness - Ensure environmental sustainability and green development **Water National Programme**	**Key Legislations related to Waste Management:** - Law on Waste (2012) - Law on Air (2012) - Law on Hygiene (2016) - Law on Environmental Protection (1995) - Green development Policy (2014) **Solid Waste Management** Mongolia has adopted the Law on Waste on May 2017, and various 3R programmes are introduced such as Green Development Strategic Action Plan, National Program for

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	The Minerals Law regulates the mining industry in Mongolia and states that the Government is owner of all "mineral resources naturally occurring on the surface and in the subsoil within the State territory". Companies will have to request a license for prospect, exploration, mining and processing minerals. It is illegal to carry out any mining activities within 5km from the border of a city and village tenure land. **Environmental Impact Assessment Law:** enforce conservation obligations for various projects, including mining. **General Law on Environmental Protection:** sets duties of a current owner, lease or user to	**Criteria/Indicators:** 1- Share of renewable energy in total installed capacity of energy production 2 - Share of reduction of building heat loss 3- Waste recycling share 4- Share of expenditure in green development in total GDP 5- Share of expenditures for science and technology research in total GDP 6- Share of green procurement in total government procurement 7- Share of protected areas 8- Increased investment in environmental protection and restoration 9- Share of forest area in total territory 10- Percentage of population with access to qualified drinking water	planning of electricity, steam and water sources. **Green construction issues were included in the Law on Construction:** Article 11.1.7 of the revised Law of Construction has a provision stating: "To implement GDPolicy and green construction requirements in construction activities: introduction of advanced technology, and effective planning to use of electricity, steam and water resources" **Law on Urban Development (2008):** to regulate relations of the state, economic entities, institutions and citizens, within the framework of the urban development	First adopted in 2010, the programme should be implemented in two phases, with the first phase covering 2010-2015, and the second phase covering 2016-2021. The strategic objectives of the programme include: - To ensure storage of water resources for supplying the population with qualified drinking water meeting hygienic standards, improving industrial and agricultural water supply and ensuring sustainable development; - To introduce advanced technology designed to ensure the appropriate use of water, to reuse treated waste water, and to take comprehensive	Reducing Air and Environmental Pollution and Sustainable Development Concept of Mongolia. However, for an effective implementation of 3R policies and programme, Mongolia faces various challenges such as a lack of financial resources, lack of specific 3R policies and legislation, lack of awareness and knowledge among stakeholders and the significant role played by the informal sector. Recycling in Mongolia is mainly operated by the informal sector and recyclables are usually exported.

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	protect the environment and conditions of their lands and resources, regulates the process of EIA in Mongolia. **The Industry Policy in Mongolia** **Top Priorities** Heavy Industry: Steel production and Cement Industry Light Industry: Wood production Small and medium enterprises: construction material production Principles of Policy - Manage health, sage and environment friendly manufacturing - Support manufacturing of the export-oriented, import-substitutive and competitive products that assured national and international standards	11- Percentage of population with access to improved sanitation facilities 12- Poverty level 13- Percentage of green facilities in Ulaanbaatar city and other urban areas 14- Share of agriculture and manufacturing in total GDP	policy of Mongolia, concerning issues such as population localisation, settlement, and the creation of an appropriate development structure of comparatively independent development regions, and development of cities and dwellings according to the city development plan. **Law on Housing (1997):** to regulate the relations concerning issues such as the definition of the mandate organisations, planning of housing, financing of activities for the development of housing, changing the purpose of public areas and operational issues.	measures to prevent flood danger, and to render all necessary support to these activities, and initiatives within the legal framework; - To improve water resource and utilisation management and to improve the legal environment, management, and organisational structure to regulate multi-sided relations and capacity building;	

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	- Develop economic efficiency manufacturing based on the advanced techniques, high technology and innovation - Be based on effective state, science and business collaboration - Provide equality and fair competition to stakeholders of industrial sectors				
Technology/ Architecture	**Building Materials in Mongolia** Only a handful of domestic companies produce building supplies in Mongolia - primarily cement, concrete, bricks and a small number of iron products. The bulk - approximately 70% - of the materials in the country is imported, and the largest suppliers are in China,		**Traditional Mongolian Gers** Today's Gers are lightweight and flexible, and typically constructed out of wood, felt and canvas, with pieces tied together by knots that can be undone. Large enough to shelter a large family yet easy to pack and move, they are part of a centuries-old	**Installation of meters for water** Households living in apartments without meters consume 220 litters of water daily, while those living with meters consume 160 litters daily. Out of 153 entities reviewed in 2014, only 69 had meters installed, and groundwater consumption of those	**Construction and Demolition Waste** Up to 25% of the total solid waste is from construction sector, which is the biggest polluter in Mongolia. Caritas Czech NGO is implementing a project under the EU's development cooperation in Asia (SWITCH Asia) with the

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	Russia, South Korea and Germany. Given Mongolia's remote location and low-quality national transport network, shipping materials to Ulaanbaatar - where most of the building is taking place - is a logistical challenge. Depending on the importing country, materials are moved to Mongolia via road or rail. The country's construction industry is highly seasonal, with almost the entire work taking place during the short, warm summers, which generally begin in May and end in early September. For most of the rest of the year it is simply too cold to build. Materials prices reflect this seasonality. Generally, in the first three to five months of the year, prices for all construction material		tradition of life within herding and other nomadic cultures across Central Asia. The ger was never intended to serve as a permanent urban dwelling. Ger Plug-In The Ger Plug-In is conceived as being in-between a ger and a house. It is designed as a thickened infrastructural wall containing water and septic tanks and heating systems that the ger plugs into. By hybridising the ger with essential infrastructure, it provides a new form of urbanism. Rather than accepting generic forms of brick houses, so typical in developing regions, the project creates a new typology of affordable housing. It is an	households was 21 times more than surface water consumption.	contribution of the Czech Development Agency and in collaboration with other partners. The four year project will especially support small and medium construction entities operating in the three largest cities of Mongolia - Ulaanbaatar, Erdenet and Darkhan, for introduction of eco-friendly technologies through more efficient use of natural resources and recycling of construction waste. In Ulaanbaatar, municipality plans to demolish a large number of old buildings, but there are no certified companies running demolition and in addition deal with the resulting rubble and general waste. Caritas

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	rise steadily, as local firms begin the preparation for the building season. Stabilising the price and supply of building materials has been a key focus of the government in recent years. In 2012-2013 the Bank of Mongolia, the central bank, channelled substantial new financing into various constructions materials-related segments to smooth out market volatility. (https://oxfordbusinessgroup.com/analysis/prices-building-inputs-rise-mongolias-construction-sector-driven-fast-growing-demand-materials) **Avoiding Seasonal Impact on Construction** - Introduction of systems which combine both cast-in-place and pre-fabricated construction methods.		emergent form: located in tradition yet positioned strategically for the future. Over time, the unique Mongolian ger is not lost, but becomes the active agent of Ulaanbaatar's evolution into a city of nomads. **Ger Innovation Challenge Project** To address the heat loss in gers which leads to energy inefficiency, increased use of fuel and air pollution, GerHub jointly with UNICEF Mongolia and UNICEF Innovation took a human centered design approach to solve the pressing challenge facing the residents of Ulaanbaatar. Together with international partners like the Stanford University and the		project will target to build their capacity, enabling to solve these problems. **Smart Collection Point, Ulaanbaatar** For rural nomads, waste, in the form of plastic bottles, glass and cans is an unfamiliar urban phenomenon and without clear systems of collection, garbage accumulates in gulleys, roadside verges and streams. The Asia Foundation identified the worst areas for rubbish build up alongside certain neighbourhoods of Khoroos and The Rural Urban Framework designed and constructed two "Smart Collection Points", where trash can be sorted and

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	- Increasing the production of prefabricated reinforced concrete and metal structural elements - Establishing building material whole sale centre. Uninterrupted operation of building material manufactures will be ensured by way of purchasing and storing domestically supplied common materials. construction materials		University of Pennsylvania, as well as outside gear manufactures and architecture firm KieranTimberlake, the project seeks to improve the design of ger parts (door, floor and toono). Designs that can be open-source, sustainable, affordable and can be locally produced and adopted by Mongolian communities. 1) Toono (Oculus) Insulation: let light into the ger and allows the chimney to pass through. 2) Door insulation 3) Insulated Floor: three distinct prototypes		consolidated. Constructed of concrete and built up to fit the topography of the landscape, the structured also acto as local landmarks, serving as bus stops and even displaying maps of local facilities that had been previously unmapped.

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		**Cooperation with the International Financial Corporation on green building evaluation** The Ministry of Construction and Urban Development, Ministry of Environment and Tourism, Energy Regulatory Commission signed a memorandum of cooperation with the International Financial Corporation on green building evaluation system implementation in Mongolia on April 2018. The cooperation between the Ministry of Construction and Urban Development and the IFC started in 2017 and the memorandum launches the second phase of its operation. As a result of the cooperation, it will be possible to evaluate green building in Mongolia using the IFC's EDGE software for green building evaluation system based on the principle	**Limited availability of high-performing, advanced energy efficient building materials** Commercial availability of high quality energy efficient materials and systems in Mongolia is mostly through imports but they too are limited. This is more evident with regards to the advanced triple/quadruple glazed, low-e, argon filled and insulated frame windows that are actually needed in Mongolia's extreme winter climate for BCNS EE code compliance for highly glazed/curtain wall buildings. There are some local manufactures who are capable of producing some of these advanced insulation materials, but the market	**Standards and Labelling in Mongolia** To support the realisation of energy efficiency's potential to reduce the need for future power plants, bring energy savings to consumers and reduce GHG and other emissions, Mongolia may consider a more formalised framework for building energy efficiency, such as national energy conservation law. As part of such law, Mongolia could develop: - Appliance efficiency standards to ensure that appliances and other electronics, use of which is rapidly expanding in Mongolia, meet stringent standards. Policy templates and assistance is available from a	

Mongolia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		of improving the efficiency of new housing and public buildings and resource-savings. The "Green building" certificate for buildings will make a significant improvement in the development of resource efficient construction. **Building Energy Efficiency Project** The project was implemented during 2011-2014 by the Ministry of Construction and Urban Development in cooperation with the UNDP. - Development of new construction norms, regulations and standards to ensure more effective energy consumption in old buildings with poor insulation, as well as in new buildings and facilities - Implementation of measures to introduce the new system, technology and financing mechanisms for saving energy	demand is still low that manufacturing cannot reach the economy of scale, putting the cost of these materials at considerable prices.	number of international organisations, including the Collaborative Labelling & Appliance Standards Program (CLASP) and the Super-efficient Equipment and Appliance Deployment (SEAD) Initiative; (http://gbpp.org/wp-content/uploads/2015/10/Mongolia-Energy-Report_FINAL-web-version.pdf) **Partnership of Global Green Growth Institute with ERC to promote energy efficiency in Mongolia** February 2018: Workshop to present recommendations for the establishment of a Mongolian energy standards & labelling program (S&L). The study concluded that	

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		in houses and public buildings that are to be built up and for the construction of energy efficient buildings and facilities. - Measures were undertaken to put additional insulation into buildings with greater heat loss. - New standards were developed and approved in relation to ISO building heat protection and standards in the area of energy consumption and insulation materials, heating and cooling systems. - To make protection norms clear, "Green House" labels were issued to energy efficient buildings.		S&L can save over 1,000GWh of electricity annually by 2040. This is the equivalent of nearly half the annual output of one of Ulaanbaatar's coal-fired plants. http://gggi.org/gggi-and-mongolias-energy-regulatory-commission-host-a-cross-ministerial-working-group-meeting-to-present-mongolias-first-energy-standards-labeling-program/	
Access to Finance		**Absence of Financing Models for Energy Efficiency Investments**	**Mongolian Sustainable Finance (TOC) - Sustainable Finance in the Construction Sector**	**Water usage** - Government Resolution #326 of 2013 sets out that the reuse of treated	

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		A lack of financial ability to target end-users and limited financial capabilities of construction companies has been restraining the propagation of EE technology. Financing is still expensive and/or difficult to access for developers and owners who are prepared to spend more capital upfront for energy efficient buildings. Suitable and effective financial mechanisms and fiscal products to support EE buildings designs and investments are hardly available. In general, commercial banks have stringent requirements for mortgage; a loan term is very short (typically less than 5 years) and the interest rate is very high. The high cost of capital as a result of the lofty interest rates and concomitant risk perception by financial institutions have been	Mongolian banks have voluntarily committed to introduce and operationalise sustainable banking practices since 2013 in cooperation with the International Finance Corporation (IFC) and the Dutch Development Bank (FMO). Through the implementation of the Mongolian Sustainable Finance (TOC) Principles, banks have started to conduct environmental and social due diligence as part of the regular loan processing procedures. For instance, if a business applying for a loan from a bank is assessed and determined that its operation is likely to cause major environmental and social risks, the bank will	waste water shall be fully exempted from the water use fee. - The Annex to Resolution #303 sets out exemptions from income tax on the sale of equipment designed for the efficient use of natural resources, like equipment for waste water treatment. **Subsidized heat and electricity tariffs** Subsidized energy tariff remains a persistent barrier which provides significant disincentive to property developers and owners to look for more energy efficient solutions, as EE in buildings inevitably involves higher upfront capital costs that must be balanced by lower operational energy costs. Heat tariff is a	

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		consistently identified as one of the key financial barriers to implement energy efficiency in the residential and commercial sectors. The government 8% interest housing program does not necessarily support energy efficiency housing market as it is not a requirement for the loan program.	require the client to eliminate or mitigate the negative impacts, or even deny the loan request if the environmental and social risks are identified as irreversible. **Operational Health and Safety - Fiberglass:** due to the cold climate in Mongolia, insulation is one of the most important qualities of buildings and residential complexes and fiberglass is the most used material in buildings, although globally forbidden due to its harm to human health. Banks in Mongolia have started requiring construction projects applying for loans to refrain from using fiberglass. If the construction company	cross-subsidy of electricity and coal prices are subsidised for power plants to keep the heat tariff low. Consumers, therefore, have low interest in energy savings which lead to low demand in energy efficient homes. **Loans to be granted for the purchase of electric heating devices** In 2016, the Government issued a resolution on providing ger district residents in Ulaanbaatar with free electricity for night time. Following the resolution, more decisions are being approved and adhered. Now the Government works to provide citizens in the ger district with possibility to purchase electric heating with	

Mongolia

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			insists on using the material, banks will not issue any loan. **Other assessments on construction companies:** - Development of safe and green environment in residence complexes: The Law of Urban Development requires that 20% of the total site area has to be allotted for green area, but the law is rarely implemented. However, the Mongolian Sustainable Finance Initiative is bringing together banks and companies to prioritise developing public space and greenery for the benefit of residents and customers. - Increased accessibility for the physically	loans financed from Green Credit Fund. **Providing Portable Solar Power to Nomadic Herders** In 2000, the Government of Mongolia began the National 100,000 Solar Ger Electrification Program, ab ambitious initiative to improve the lives of about half a million herders by providing modern electricity systems. The program provided photovoltaic solar home systems adaptable to the nomadic lifestyle of herders and complementing their traditional way of life.	

Mongolia					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance			challenged: another assessment on construction companies ensures whether the construction project has provided appropriate roads, ramps and further comprehensive accessibility for the physically challenged people and wheel-chair users. - Waste management: when assessing the environmental and social risks of a project, banks also look into whether the project has a waste management plan, how the waste is separated and disposed, and if they have a contracted partner to transport the waste.		

Affordable Housing in Mongolia

1990-2002

A dramatic economic and political transformation began in the 1990s have resulted in the removal of Soviet subsidies. During this transition period, radical economic changes were introduced which included the privatisation of state property and other assets, scaling back and removal of many state subsidies and the introduction of the free market for many goods. After the 1997 Asian financial crises, the Mongolian government made great effort in stimulating housing and promote marketisation of housing, focusing on shifting its role away from directed providers of land and housing towards enabling a wider range of market actors to produced housing. The law on allocation of land to Mongolian citizens adopted in 2002 markets the beginning of great rural-urban migration trend.

2003-2008

Even though the law on housing privatisation was launched in 2001, it was not until 2006 that the real estate sector started booming in Mongolia. During this time, systematic, technical and funding support from international organisations was still going on shaping and forming the foundation for a market-based housing system in Mongolia.

By 2005, the Ulaanbaatar population almost doubled from 1995. This has stressed the government to take more vigorous actions towards housing. In 2008, the government approved its New Development medium-term target program, which marks the start of many housing policies including "40,000 Homes" and "100,000 Homes" projects.

Since 2008

Despite the actions taken by the government to support the mortgage system in the country, many low-income households lacked to access opportunities to purchase housing. Mining industry boom resulted in increased housing demand while the increased price of imported construction materials both resulted to double or triple the housing price becoming more unaffordable for low-income households. By the end of 2015, the population of Ulaanbaatar reached 1,350,00o- almost tripled since 1995. However, this outward growth has not been followed by the basic services and did not meet the urban standards common on the traditional part of the city, thus creating a different kind of settlement that became known as GER.

State Policy on Housing

Midterm Targeted Programme "New Developments": The Programme plans to build 100,000 homes with engineering and other social infrastructure facilities. Of these 100,000 new homes, 75,000 households are planned in Ulaanbaatar, and the remaining 25,000 in rural areas.

Housing 8% interest rate loan: This is a procedure to provide concessional loan at an annual rate of 8% for 20 years to citizens who sent their application to buy a new flat of not more than 80m², or to buy a flat in an old building where they have paid 10-30% of the total housing price. The loan is provided through commercial banks.

District Development in Mongolia

Ulaanbaatar 2020 Master Plan and Development Approaches for 2030

The population of Ulaanbaatar Capital Region has growth substantially in recent years as a result of the migration of people from other aimags within Mongolia, significantly increasing the proportion of the Mongolian population residing in Ulaanbaatar. The trend is projected to continue; by 2030 the capital region population will reach 1,763,000 and form 50.3% of the projected Mongolian population.

Priorities:

1) Safe, healthy, and green city that is resilient to climate change
2) Provide a liveable environment for its residents through appropriate land use planning, infrastructure, and housing.
3) Good governance and developed legal environment that serves the general public and private sectors
4) Encourage the development of settlements, towns and satellite cities outside the city centre.
5) Ulaanbaatar will be one of Asia's tourist destination cities
6) Have an internationally competitive business centre and be developed as a world-standard capital city.

General strategies:

- Mitigate the centralised settlements by administrative units restructuring
- Improve the City's administration of the planning system by introducing land-use zoning codes.
- Improve and extend the road and public transport network
- Improve the existing condition of the socio-economic infrastructure
- Improve the basic infrastructure such as utilities and telecommunications
- Establish sustainable environmental management

Housing

The Master Plan 2030 divides the city in 47 khoroolols (neighbourhoods) as administrative planning units. The 47 khoroolols include 22 residential apartment neighbourhoods, 10 public service neighbourhoods, 10 redeveloped ger areas and 5 industrial neighbourhoods. 32 khoroolol are to be built as apartment complexes in Ulaanbaatar. Each of them will have planned social infrastructure such as schools, and hospitals, as well as parks and grocery stores.

Over recent decades the informal settlements on the fringe of the city have become the ger areas and a substantial part of the city accommodating more than 60% of the city's residents. The fast and unplanned growth of the ger areas has resulted in many issues including inadequate public services and infrastructure, poor quality construction, air pollution and a range of environmental issues. The redevelopment of the ger areas aims to address these issues by increasing densities in the inner area and controlling further expansion in the outer areas of the city.

Mongolia’s Nationally Determined Contributions (NDCs)

- Mongolia's INDC has its conceptual roots in the Green Development Policy of Mongolia, approved by the Parliament in 2014, to which key sectorial action plans at the national level, including energy sector, are being adjusted.

- In its INDC, Mongolia has outlined a series of policies and measures that the country commits to implement up to 2030, in the energy, industry, agriculture and waste sectors. The expected mitigation impact of these policies and measures will be a 14% reduction in total national GHG emissions excluding land use change and forestry by 2030, compared to the projected emissions under a business as usual scenario.

Policies and Measures for implementation up to 2030:

- Increase renewable energy capacity from 7.62% in 2014 to 20% by 2020 and to 30% by 2030 as a share of total electricity generation capacity.

- Reduce building heat loss by 20% by 2020 and by 40% by 2030, compared to 2014 levels.

- Reduce emissions in the cement industry through upgrading the processing technology from wet- to dry- processing and through the construction of a new cement plant with dry processing up to 2030.

To reduce building heat loss by 40% by 2030: Improved insulation for existing panel apartment buildings of 18,184 households in Ulaanbaatar. Investment needs = 90 million USD

Mongolia and the UN Sustainable Development Goals

4 priorities, 44 targets: Sustainable Economic Development, Sustainable Social Development, Sustainable Governance, Sustainable Environmental Development.

- Meet 100% of national energy demand from domestic supply until 2030 and become an energy exporting country

- Increase the share of renewable energy in consumption of total energy to 30% until 2030

- 2016-2020: Develop the "General Plan for Mongolian Population settlement, residential development" and implement amends to the "General Development Plan of Ulaanbaatar City 2020"

- 2021-2025: Determine the leading regions of industrial development, develop and enforce general urban development plans and partial general plans of cities and settlements, create infrastructure for national geo-location information systems and develop and implement master plans for land usage at state, province, capital city and district levels.

- Reduce heat loss in buildings by 20 percent until 2020, 25% until 2025 and 40% until 2030.

- Development and enforcement of the green development standards for urban development.

- Develop and implement strategies to cope with climate change and strengthen the system to prevent from meteorological hazard and natural disaster risks

. Adopt environment friendly advanced technologies and reduce the emissions of carbon dioxide from production and consumption.

7.9 SCP Sustainable Housing in Nepal

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	A “National Policy Framework” has been developed specifically for the brick sector with the aim to make the industry more energy-efficient, environment-friendly and socially responsive, thereby contributing to achieve reductions in black carbon and CO_2 emissions along with promoting their related co-benefits on development and health. The brick kiln initiative is aimed at achieving substantial reductions of black carbon and other emissions from brick kilns through employing a range of technologies and policy approaches.	**Nepal National Building Code(NBC) 206:2015** Government has formulated and implemented new fundamental regulations for planning and construction of houses, the Urban Planning & Development Act, Building Code for Nepal, 2072. The building buy laws Nepal 2072 has paid special attention to reconstruction after the earthquake and required open space. For proposals concerned with residential construction planning, the area in such planning shouldn't be less than specified in Land Rules, 2021. Similarly, adjacent houses can only be constructed if at least three houses of same height are there. Similarly, while applying	**Nepal building code** Building Code Development Project was launched in 1992. Its objective included the development of regulations and design documents for use by the planners and engineers in order to improve the seismic safety aspects of the existing buildings and to suggest safer building design and construction practices to be introduced/enforced gradually in Nepal. Under the Ministry of Physical Planning and Works (MPPW), the Department of Urban Development and Building Construction	**Water and Energy Commission (WEC)** 1- WEC was established in 1976 to work as a central planning and coordinating agency. 2- Planning and policy advisory (not regulatory) agency 3-Formulates and assists in developing policies and strategies 4- Renders advice and recommendation on bilateral and multilateral issues 5- Establishes coordination among national and sectoral policies and plan 6- Identifies viable power projects	**Solid Waste Management In Nepal-Current Status And Policy Recommendations** The Government of Nepal enacted the Solid Waste Management Act of 2011 effective from 15 June 2011. The objectives of the act include maintaining a clean and healthy environment by minimising the adverse effects of solid waste on public health and the environment. The local bodies, such as municipalities, have been made responsible for the construction, operation, and management of

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	The strategic policy actions will provide the basis for decision-makers, national governments and subnational entities to make informed and evidence-based policy decisions to improve the operation of the brick sector. **Mines and Minerals Rules, 2056 (1999)** "Specified Minerals" means any minerals for which the Department has issued a license to carryout mining operations having concluded a contact or any minerals as specified by Government of Nepal to carry out any mining operations by the Department or any other governmental agency only as specified by the Department.	for the Building Construction Permit in case of constructing adjacent buildings, the responsibilities to be borne by owners of such houses while repairing such houses, should be submitted together.	(DUDBC) developed the Nepal National Building Code (NBC) in 1993. The United Nations Development Programme (UNDP), the United Nations Centre for Human Settlement (UNCHS) and few domestic as well as foreign subcontractors' teams provided their technical assistance in developing the NBC. The NBC implementation went into effect after the authorisation provided by the Building Construction System Improvement Committee (established by the Building Act 1998). Following a government notice in the Nepal Gazette in 2006, the NBC implementation became mandatory in all the municipalities in Nepal.	The above mentioned policies includes some Necessary Legal Aspects as mentioned below- 1- National Electricity Regulatory Commission Act, 2009 (submitted to Parliament) 2- Electricity Bill, 2009 (submitted to parliament) 3- Formulate Renewable Energy Act 4-Enact separate law for competitive market of petroleum products 5- Formulate law on reducing deforestation, indoor air pollution and reducing GHG emission	infrastructure for collection, treatment, and final disposal of MSW. The act mandates local bodies to take the necessary steps to promote reduce, reuse, and recycle (3R), including segregation of MSW at source. It also provides for the involvement of the private sector, community-based organisations (CBOs), and nongovernment organisations (NGOs) in SWM through competitive bidding. **Solid Waste Management Rules, 2070 (2013)** The survey and other assessment undertaken under the technical assistance identified eight key policy

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment			Water and Sanitation Nepal has had an approved national sanitation policy since 1994. A recent process to review the policy has resulted in the development of National Guidelines for Sanitation and Hygiene Promotion, 2005. The National Guidelines for Hygiene and Sanitation Promotion, 2005 reflect Nepal's overall commitment to decentralisation. While this aspect of policy is widely recognised by stakeholders, there are concerns about the lack of capacity in local government bodies to implement sanitation programmes.		recommendations for solid waste management (SWM) in Nepal: 1-an appropriate policy and strategic framework needs to be developed, together with technical guidelines on key issues such as organic composting and landfill operations, to properly guide local bodies in effective SWM; 2-reduce, reuse, and recycle (3R) should be promoted. The survey identified great potential for resource recovery in Nepal, which could be realised with better public awareness and initiatives by local bodies and communities; 3-strengthening the capacity of local bodies is essential, as they are

Nepal					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment					mandated to provide SWM services to the citizens; 4-enhancement of public participation and consultation would be effective in advancing SWM practices; Costs for SWM need to be recovered, albeit partially at first, to provide better services. The public is generally willing to pay for services if the level of services is improved; 5-current poor management practices such as open dumping and open burning should be stopped immediately to allow for more integrated SWM; 6-public-private partnership offers opportunities for operational efficiency and cost effectiveness.

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment					The role of the private sector will be more important for complex tasks such as the operation of landfill sites, as municipalities are less experienced in these areas; and the management, updating, and dissemination of basic data will play an important role in improving planning by the local bodies and monitoring progress.
Technology/ Architecture	**Switch Asia Project "Vertical Shaft Brick Kilns (VSBK) And Sustainable Construction Practice In Nepal"** Main achievements 1-VSBK has become a challenge for the "establishment" and is being opposed by the" business as usual"	**Sustainable Building Rating (SBR) System for Nepal – A Case of Kathmandu Valley:** Building construction sector is one of the largest end users of environmental resources and it consumes approximately 40% of the world's primary energy use. Nowadays, people are aware of about Green / Sustainable building that is why rating	**Material Labelling System In Nepal** As per the Nepal Standards (Certification Mark) Act, 1980, the Nepal Council for Standards (NCS) is the governing body for Quality and Standards related activities in Nepal. Currently, 59 standards exist for the building and		**Citizen-led reuse and reconstruction from earthquake debris** In the 2015 earthquake, Nepal's Kathmandu valley generated approximately 3.94 million tons of debris; "An equivalent of nearly 11 years of waste" was generated in one day. In the absence of a

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	2-Problems regarding sustainability in the construction has been realised by the government of Nepal. 3-This project has proven sustainable construction options, application and skills are available. Background 1-This project aims at reducing energy consumption and black carbon, carbon dioxide from the building material production sector. 2-Increasing the demand for and supply of sustainable construction practises. 1. Promoting innovative building materials to green Nepal's construction sector The project reduced energy consumption by 30%, black carbon emissions by 99% and created 1 500	systems have been developed to measure the sustainability level of green buildings in many developed countries. This helps to certify the different aspects of sustainable development during the planning and construction stages and to incorporate best-practice experience for achieving higher certification level. The limitation of this research is based from the case study; Qualitative Analysis, Questionnaires and Interview were done with 40 expertises to fulfil the major objective which is "To develop Sustainable Building Rating (SBR) system for residential buildings of Kathmandu valley ". To get the criteria for the SBR system, different case study were done regarding different rating system of the world and case study on rated and nonrated building of	construction industry. Nepal uses ISO standards and Nepal Standards (NS) Mark and the Indian Standards (ISI) mark for all products including construction materials. No labelling methodology or body exists for "green labelling" of materials as of 2019.		government plan and pushed by economic necessity, people in the city, and across Nepal, have taken it upon themselves to sort the debris and begin the reusing, recycling, and rebuilding process. Across Kathmandu city, bricks and wood are being separated and piled up for reuse. Building contractors too, have been buying up reusable bricks and wood. Since the earthquake, the demand for bricks has risen and so has the price. The Nepalese government plans to pull down all the severely damaged buildings, sort out concrete and bricks that cannot be reused, crush these materials and create recycled bricks or

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	jobs by triggering private investment worth EUR 2.5 million. 2. The construction sector, including conventional brick production, is a key source of black carbon and CO_2 emissions and consumes 30-40% of the total energy. 3. By applying energy-efficient and earthquake resilient Vertical Shaft Brick Kiln (VSBK) production technology, Nepal could realise a reduction of CO_2 emissions of over 370 000 tonnes annually, if all were to use VSBK to make bricks.	Nepal. Objective was achieved by using Simple Weighted Sum method and AHP, MCDA tool and also the other specific objectives were fulfilled. After the analysis done from these tools a new SBR system was developed. To verify the research few buildings were done pilot test in the SBR system developed from the analysis, where the result were found to be positive, data can be found in the annex. This study may be useful to all the stakeholders involved in the evaluation of green building			filling material for roads and other structures. Debris that is contaminated by lead infused paint or contains asbestos, pesticides, and acids is to be appropriately processed before being reused or cast away. Recycling of waste The potential for recycling the waste generated in Nepalese municipalities is high because most of the waste is recyclable and technologies for recycling most of the waste is readily available in the country. Furthermore, there is a market for most recyclable materials because of the demand created by the formal and informal private

Nepal					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
					sector involved in this sector. On average, about 70% of the household waste generated in Nepalese municipalities consists of organic matter, while about 20% consist of recyclable inorganic materials 10% is inert materials.
Standards, guidelines and Rating Systems		**Green Building Rating System In Nepal** A green building rating system in Nepal has not been formulated yet, still in action. The major problems and challenges in the context of Nepal is lack of proper toolkit to design the energy efficient building and measure of level of energy and environment efficiency. In Nepal, residential sector has highest energy consumption (89.1%) than any other sectors.		**DEVELOPMENT OF GREEN LABELING SYSTEM IN NEPAL** This study is a continuation work of proposed Green Building Guidelines initiated by UN-Habitat in collaboration with FNCCI and other institutions. The purpose of the Green Building Guidelines is to introduce simple practical green building design and construction	

Nepal					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		**Green Building Guidelines** This study is a continuation work of proposed Green Building Guidelines initiated by UN-Habitat in collaboration with FNCCI and other institutions. The purpose of the Green Building Guidelines is to introduce simple practical green building design and construction philosophy that can be easily and efficiently applied in Nepal. There is an urgent need of more specific policies and detail guidelines related to sustainable housing as a whole. It requires a provision for eco-friendly housing in National Building Codes. In order to promote sustainable housing the style of municipality plans and implementation processes need to adapt the measures of green building principles at the municipality level. The Guidelines is based on six guiding principles		philosophy that can be easily and efficiently applied in Nepal. There is an urgent need of more specific policies and detail guidelines related to sustainable housing as a whole. It requires a provision for eco-friendly housing in National Building Codes. In order to promote sustainable housing the style of municipality plans and implementation processes need to adapt the measures of green building principles at the municipality level. The Guidelines are based on six guiding principles (components) and this study has considered these components for further developing Green Labelling system and Green Building Rating system.	

Nepal					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		(components) and this study has considered these components for further developing Green Labelling system and Green Building Rating system. **Energy Building Code In Nepal** An Energy Building Code in Nepal has not been formulated yet, still in action			
Access to Finance		**Green Buildings Market Intelligence Nepal Country Profile:** The largest sources of real estate development will come from institutional/assembly, education, and multi-unit residential as urban areas are reconstructed.		**Renewable Energy Subsidy Policy of Nepal:** The Policy aims to develop the renewable energy sector and encourage very poor households to use renewables by providing subsidy for deployment.	

Nepal	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		TOURISM AND HOUSING ARE KEY DRIVERS OF GROWTH: push for green buildings is being pursued across sectors, with the tourism and hospitality sector leading the way with a $6 million investment by IFC and FMO, the Netherlands-based development bank, in a sustainable, green business hotel in Kathmandu. This model will be replicated across the country-Climate Investment Opportunities in South Asia IFC 2017 The United Nations Development Program created and promoted 'Green Homes' under its Switch Asia program. Green Homes utilize compressed stabilised earth blocks, which are more efficient as conventional mud bricks without being more expensive.		It revises the subsidy determined in the Renewable Energy Subsidy Policy – 2012 and Urban Solar System Subsidy and Credit Mobilisation Guidelines. The subsidy amount is expected to cover 40% of the total costs; with around 30% coming from credit and around 30% from private sector investment and/or community or households contribution (cash or in kind). The policy primarily focusses on off-grid applications and provides subsidies for mini/micro hydropower, improved water mill, solar energy (home systems, mini-grids, grid connected), biogas, biomass energy, wind	

Nepal					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		The National Reconstruction Authority is leading standards and guidelines for green construction.		energy and wind-solar hybrids. Selected examples are: 1-Solar PV mini-grid 2-Mini/micro hydropower 3-Solar-Wind Hybrid Energy Systems 4-Wind Energy. For technologies producing electricity output, the subsidy is not only given for equipment and civil work but also, where applicable, for development of distribution infrastructure. Subsidy will also be provided for installation of solar PV systems in grid connected areas with irregular supply. This includes subsidies for solar street lighting in urban and rural areas and for solar PV systems in households, public	

Nepal					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance				educational institutions, public health facilities and religious places. A subsidy delivery mechanism will be prepared by the Alternative Energy Promotion Centre (AEPC) and implemented after approval from the Ministry.	

Affordable Housing in Nepal

- Under the leadership of the Government, Nepal is taking steps in the right direction to carry out a successful housing recovery process and to build back better. The Nepal's Earthquake Housing Reconstruction Program is moving forward at steady pace and has reached important milestones.
- A Post-Disaster Needs Assessment (PDNA) and subsequent donor conference were both successfully completed within two months of the earthquake events, with pledges of reconstruction assistance totalling $4.1 billion. Of the amounts pledged at the conference, the Government has signed over 12 agreements with different development partners.
- The National Reconstruction Authority (NRA) was established on December 22, 2015, and the CEO was appointed on December 25th. Since its inception, important progress has been achieved in terms of policies, staffing, legal procedures and direction.
- The NRA has gradually expanded its presence in the 14 districts most affected in the earthquakes and it has also established seven regional offices to augment program monitoring and to better address issues on the local level.
- A Program Operations Manual and an Earthquake-Safer Housing Design catalogue were produced by the NRA and are being used for all housing reconstruction efforts.
- In May 2016, the NRA established a standard agreement with banking associations throughout the country and has since signed more than 50 agreements with commercial banks to disburse subsidies to beneficiaries throughout the country.
- The NRA established a Grievance Redness Mechanism (GRM) to receive and file grievance cases and promote accountability.
- A new Management Information System (MIS) was designed and launched to increase transparency and accountability
- Nepal suffered 2 major earthquakes and subsequent aftershocks in April & May 2015. 8,700 people were killed and 25,000 suffered injuries. The international community has been working together to assist Government of Nepal with relief, recovery and reconstruction.

District Development in Nepal

Habitat for Humanity in Nepal, established in 1997, has served over 70,000 households and built a network of valued local partners through which it implements its housing programs. Since 2015, reconstruction has been the primary focus of Habitat Nepal, directing funding and technical support to the earthquake-affected central region, followed by shelter initiatives in the flood-devastated lowlands of the East and West. In line with its new strategic plan, Habitat Nepal will develop programs, build institutional capacity and raise funds with tithing Habitat affiliates in the U.S. to make the transition from a primarily disaster-reconstruction operation to a portfolio of projects that address Nepal's shelter needs more comprehensively and sustainably.

- Researching and developing market-based housing solutions.
- Advocating with local and federal government entities to direct resources to address the shelter needs of highly vulnerable groups.
- Mobilising international volunteers and local youth to raise awareness and support for housing needs in Nepal.
- Promoting safe shelter designs and technologies

Infrastructure Financing

Nepal has been able to expedite its infrastructure development in the last two decade. This has made it possible that all the district headquarters would be road linked within next two years. Infrastructure including road transport, education, health and hydropower are seen as a vital tool towards poverty reduction. People have shown their keen interest towards infrastructure development in their areas. Development partners and multilateral agencies support towards infrastructure development is increasing over the last few decades which have been instrumental to shape the road network of Nepal to its present status.

Realising the inadequate investment in infrastructures like power, airports, roads, bridges, and communication facilities is impeding the economic growth, the Nepali government is partnering with the private sector. The recently concluded Nepal Infrastructure Summit-2014 is the best example of this partnership, which was organised by Confederation of Nepalese Industries (CNI), Government of Nepal and Young Community for Nepalese Contractors (YCNC) with an aim of accelerating investment in the infrastructure sector.

No concrete information is there on "eco-cities development, or eco-districts and neighbourhoods in Nepal.

Nepal and the UN Sustainable Development Goals

The Government of Nepal prepared its first SDG country report, detailing and taking stock of its current development context, the starting line for the SDGs. This report is expected to guide the work plan and implementation of the SDGs in the coming years as Nepal aligns its periodic plans along with the 17 Goals and their targets. This made Nepal the first country in the world to publish its SDG country report and symbolises Nepal's commitment and readiness to execute the SDGs

Sustainable development continues to be in-built in Nepal's socio-economic development. Nepal's efforts for the successful implementation of the MDGs have also opened new avenues for the implementation of SDGs planned for 2016-2030.

SDGs Implementation Strategy

- Mainstream SDGs into national, provincial and local level budgeting and planning systems
- Regular/annual audits of the program and budget from SDGs perspective
- Strong collaboration between federal, provincial and local governments for SDGs implementation
- Partnership between public, private, Cooperative, NGOs sector and development partners in policy formulation and M&E

Step Ahead

- Evidence Based Policy- Country Specific Measures
- Policy Coherence
- Ambition of Double Digit growth with Human face- Prosperous Nepal and Happy Nepali
- Institutional Strengthening and Capacity Development at provincial and local level
- SDGs based Planning at all tire of government
- Collaboration and partnership-National, Provincial and Local level
- Periodic Review and HLPF Voluntary Presentation
- Monitoring of implementation of IPOA SDGs.

Meeting the SDGs would require Nepal to have a stable political environment with predictable policies that can usher in developmental reforms. The induction of educated and skilled planners, researchers and policy experts into the system of governance would be essential in realising this objective. More importantly, the policy makers and administrators of Nepal should be able to establish various institutional structures and processes to facilitate the work.

Nepal's Nationally Determined Contribution (NDC)

As a least developed country highly vulnerable to climate change, Nepal has focused its climate action on adaptation. Nevertheless, Nepal's Nationally Determined Contribution (NDC) still includes plans to increase renewable energy production, which shows its intent to move to a low-carbon development pathway. Despite the lack of GHG reduction targets, the NDC contains ambitious sectoral targets, expected to result in emissions reductions compared to the current policy projections, which lie in the "1.5°C Paris Agreement compatible" range.

Nepal's current policies do not require other countries to make comparably deeper reductions or greater effort. As of 2010, Nepal's own emissions make up less than 0.1% of global emissions. With its current policies, Nepal's GHG emissions are expected to increase to between 54–58 MtCO2e by 2030 (an increase of 54–66% compared to 2010 levels). Nepal's GHG emissions per capita are amongst the lowest in the world and even with this increase, the country's per capita emissions would only grow from 1.3 tCO2e/cap as of 2010 to 1.6–1.8 tCO2e/cap by 2030, still far below the world average required per capita emissions of 3.6 tCO2e/cap by 2030 according to a 1.5°C scenario.

Nepal's Enhanced Actions To Address Climate Change:

Nepal has initiated several activities to reduce climate hazards and build resiliency, help climate vulnerable communities to cope with climate change impacts, and reduce impacts of climate change on its people, property and natural resources.

1) Nepal's Climate Change Policy (2011): The Policy has objectives of, inter alia, reducing GHG emissions by promoting the use of clean energy; enhancing the climate adaptation and resilience capacity of local communities for optimum utilisation of natural resources and their efficient management; and adopting a low-carbon development path by pursuing climate- resilient socio-economic development.

2) Energy Policy: Nepal has a policy for maximum utilisation of hydropower potential to meet its domestic demand of electricity by mitigating adverse environmental impacts. It also has a policy to accelerate renewable energy services, and increase access to the RE technologies with subsidy provisions.

3) National Adaptation Programme of Action: The effective implementation of NAPA priorities would provide multiple opportunities to help climate vulnerable communities and ecosystems to cope with the adverse impacts of climate change, and improve livelihoods by addressing most urgent and immediate adaptation needs.

7.10 SCP Sustainable Housing in Pakistan

Pakistan	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Mining is Pakistan is governed by legal instrument of National Mineral Policy 2013 National Mineral Policy 2013** Out of the many broad goals of the National Mineral Policy 2013, few of them are listed below: Mitigation of adverse environmental effects of mineral development, Generation of mass-scale employment and socio-economic uplift through enhanced skills, sustainable mineral development, technology transfer and regional infrastructure development, Generation of geological data,	**National Energy Conservation Policy** In 2005, the National Energy Conservation Centre (ENERCON) and the Ministry of Environment, Islamabad published a report called "National Energy Conservation Policy 2005".This report has broad guidelines for energy conservation in all sectors. For Buildings, few of the guidelines stated are: 1.Facilitate energy audits in commercial and community buildings 2. Use of energy efficient equipment, fixtures and appliances in buildings. 3. Promote use of energy efficient HVAC and lighting in buildings.	**Building Code of Pakistan (2007) – Seismic Provisions** The objective of the provisions described in this code is to prescribe the minimum requirements for the earthquake design and construction of buildings and building-like structures and/or their components subjected to earthquake ground motions. These Seismic Provisions in the Pakistan Building Code are founded on broad-based principles that make the use of new materials and new construction systems possible for seismic strengthening.	**National Energy Efficiency and Conservation Act 2016** The National Energy Efficiency and Conservation Board is an inter-ministerial body, including among its members for example Federal Secretaries of Ministry of Finance, Ministry of Planning and Development, Ministry of Housing and others. The Board is responsible for the supervision, management of the affairs, and policy direction of the NEECA. Its main functions include promotion of energy conservation and efficient development of energy efficient technologies,	**Policy on Solid waste management in Pakistan** Although SWM policies do exist, the levels at which they are implemented and enforced lack as a result of the governmental institutions lacking resources and equipment. **Solid waste disposal guidelines** 2.2.1 Specifications for land filling 2.2.2 Pollution prevention 2.2.3 Water Quality Monitoring 2.2.4 Ambient Air Quality Monitoring

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	development of a national and provincial cadastre and provision of online accessibility to such data and ensuring safe mining operations and safety and security of investors. Measures under National Mineral Policy to ensure less Environmental Impact: Companies will be expected to ensure that their mining operations are carried out in an environmentally acceptable and safe manner and that such operations are properly monitored. This can be achieved through: i. Implementation of the regulatory environmental management measures including Environmental Impact Assessment, as well as environmental management system, plan and audit;	4. Evaluate Building and Insulation materials for energy efficient characteristics. 5. Develop/update a Building Energy Code for the country and institute measures for its compliance. 6.Promote energy efficient building design and ensure compliance with Building Energy Code		certification of energy efficient products and projects. The Act further defines “Powers and functions of the Federal Government to facilitate and enforce efficient use of energy and its conservation” (Article 10-13), including powers to prescribe energy conservation building codes, issue energy saving certificates, prescribe the value of energy and establish an Energy Conservation Fund for the purposes of promotion of efficient use of energy and its conservation within its territory.	2.2.5 Standards for Composting, Leachates and Incineration 2.2.6 Incineration Guidelines 2.2.7 Emission standards and monitoring 2.2.8 Air Pollution Control Device 2.2.9 Emission limits 2.2.10 Emission of grit and dust C&D disposal Guidelines - Using construction waste and sand as top layer at urban disposal sites - Strengthen enforcement laws and regulations on SWM(including construction waste)

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	ii. Compliance with the national environmental protection law and other appropriate national and international standards, codes, guidelines and policies; iii. Ensuring effective implementation of progressive post-mining rehabilitation; iv. Promoting the recovery, recycling and reuse of minerals, metals and mineral-based products; v. Ensuring the implementation of effective mine waste management measures; and vi. Promoting and disseminating information on the use of best mining practices, public disclosure and corporate social responsibility (CSR). Major institutions involved in regulation of mining are:			National Power Policy 2013 The process of policy and strategy formulation is informed by the following organising principles :(i) efficiency, (ii) competition, (iii) sustainability. The principle of sustainability is grounded on three pillars: low cost energy, fair and level playing field, and demand management. Altering the fuel mix towards less expensive fuels will lead to low cost energy. Investments required for the low-cost fuel mix will necessitate rationalisation of the electricity tariff. Fairness will be ensured by protecting the poor and cross-subsidising their consumption from the affluent. A level playing	

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	• Provincial Mineral Investment Facilitation Authority – MIFA(P) • Federal Mineral Investment Facilitation Authority – MIFA(F) • Ministry of Petroleum and Natural Resources • Provincial Directorates General of Mines & Minerals			field will be created by providing power at comparable prices to all industrial users. Demand management will be introduced through novel policy, pricing and regulatory instruments. **National Sanitation Policy of 2006** The grassroots concept of community-led total sanitation (CLTS) in communities with less than 1,000 inhabitants. In larger communities, the NSP promotes a "component sharing model", under which sewage and wastewater treatment facilities are provided by the communities in case that local government-developed disposal is not available. The objective is the safe disposal of	

Pakistan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment				excreta through the use of latrines, the creation of an "open defecation free environment", safe disposal of liquid and solid waste and the promotion of health and hygiene practices. The National Drinking Water Policy (2009) aims at providing safe drinking water to the entire Pakistani population by 2025, including the poor and vulnerable, at an affordable cost. A main objective is a clearer separation between the functions of service provision and regulation. The right to water for drinking precedes all other uses, like industrial or agricultural water use. Women are recognised as main actors of	

Pakistan	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment				domestic water supply, and their active participation in the sector is sought. In accordance with the LGO, the document highlights the responsibility of local governments to provide drinking water. The policy is expected to be reviewed and updated every five years to examine its implementation and efficacy and to adapt it to the changing situation	
Technology/ Architecture	**Environmentally friendly and cost-effective brick kilns in Pakistan** [The Environment Protection Department, Punjab (EPD, Punjab) and	**BIM in Pakistan** Pakistan construction industry is lagging in BIM Implementation. A survey showed that only 27% of AEC organisations are using BIM	**Pakistan's vernacular architecture** 1. Thar, Sindh – These huts are called "Chaunras" – one hut	**Existing Solid Waste Management System in Pakistan** Local and municipal governments are responsible for collecting	**Lahore - Waste Management** A dedicated service for the collection of construction and demolition (C&D) waste

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	National Energy Efficient Conversation Authority (NEECA) is working closely with the All Bricks Kiln Owners Association of Pakistan to introduce environmentally friendly and cost-effective brick kiln technology. This is being facilitated by the International Centre for Integrated Mountain Development (ICIMOD). Pakistan is working with the Climate and Clean Air Coalition (CCAC) and ICIMOD to train brick entrepreneurs and raise awareness of new increasingly cost effective and scalable kiln technologies and improvements in the brick production process. Much of the training is based on the experiences and knowledge gained from Nepal's experience of	technology, whereas 73% organisations are neither using BIM nor involved in BIM adoption process in any capacity. Pakistan BIM Council: Pakistan BIM Council is a Standard Organisation for BIM and Corporate Training Providers to Individuals and to Industry based on worldwide best practices and Standards.	rooms with roofs that are thatched and the rest of the building is made out of mud. 2. Gilgit, Baltistan – Traditional stone wood houses 3. Kalash Valley, Chitral- Wood , glass and stone structures 4. Jammu and Kashmir – Houses with wood border, thatched roofs and cottages 5. Rural Punjab , rural Balochistan– Blocked mud houses with wooden entrances 6. Swat Valley – Wood carved houses to sustain cold weather 7. Quetta, Balochistan - Blocks of houses jumbled together to form societies; some houses are built on mountains	waste throughout most of Pakistan's major cities. About 60-70 percent of solid waste in the cities is collected. Karachi, Pakistan's largest city, utilises three sanitary landfill sites, while Lahore, the country's second-largest city, has two. Other major cities plan to build proper landfill sites. In many areas, solid waste is simply dumped outside the city limits. Solid waste management capabilities and systems vary by province. In Pakistan, much of the waste generated is recovered for recycling, mostly by scavengers, before it ever reaches disposal points.	has been introduced in Lahore. The collected waste may be sold for the filling / leveling of low lying areas and /or for the construction of roads etc. Undergoing the present practices of construction it is estimated that C & D waste generated from these activities would be approximately 350 – 400 tons / day. Further option to recycle C&D will also be explored. C&D waste is collected and transported on full cost recovery basis. SWM Projects: According to the United Nations Environment Program, there are six current activities and plans taking place towards an efficient Waste Management

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	rebuilding its brick industry after the 2015 earthquake. The All Bricks Kiln Owners Association of Pakistan have adopted the cleaner technology and Pakistan's Environment Protection Agency (Pak-EPA) and National Energy Efficiency Conservation Authority (NEECA), are looking at how internal resources can be mobilised to support the brick association in promoting adoption of cleaner technology kilns. **Cement Industry in Pakistan** At present, there are 24 manufacturing units operating in the country with a total installed annual capacity of 49.4 million tons. Cement industry is expected to expand by 50% over the next few.		**Lessons from Vernacular Architecture** The fact that traditional cities have survived for centuries against natural and human elements is a strong indicator of lessons embodied in them that can be implemented for a better architectural future. One of the lessons to be learned from traditional architecture is the people's ability to create comfortable spaces harnessing natural elements in response to the regional climate. - How to harness natural phenomena of heat, light, wind, and humidity, and use these specifications in conjunction with cultural and technical values. -Design of open space		System. These current activities are as follows: Solid Waste Management Guidelines (draft) prepared with the support of Japan International Cooperation Agency (JICA), Japan. Converting waste agricultural biomass into energy/ material source – project by UNEP, IETC Japan. North Sindh Urban Services Corporation Limited (NSUSC) – Assisting the district government in design and treatment of water supply, sanitation and solid waste management The URBAN UNIT, Urban Sector Policy & Management Unit P & D Department, Punjab. Conducting different

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	CPEC related Construction, construction due to housing deficits and mega power and water sector projects are the reasons behind increase in demand of cement. In Pakistan most of the cement industries are constructed in remote areas without any proper environmental impact assessment. Air pollution caused by cement industries is harmful to the human's health, spoils and erodes building surface, corrodes metals, weakens textiles, deteriorates atmospheric visibility, affects plant life and leads to ecological imbalances.		- The exterior walls in traditional homes range from 18 inches to 2 feet and sometimes are shared between adjacent lots.86 Because they are buffered by each other, it reduces their exposure to sun, protecting them from direct solar gain **Latest technology being used in construction sector in Pakistan:** 1. Building Information Modelling (BIM) 2. Energy efficient buildings – Technology transfer from China - Solar and geothermal energy in building structures will be used that maintains comfortable temperatures. 3. Prefabricated construction		seminars on awareness of waste water, sanitation & solid waste management etc. Lahore Compost (Pvt.) Ltd. only dealing with the organic waste with the cooperation of city district government Lahore, Pakistan. The company is registered as a CDM project with UNFCCC. Different NGOs are involved at small scale for solid waste collection, and recycling.

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture			a. Construction ground granulated blast furnace slag as partial replacement of cement b. Construction using load bearing hollow concrete blocks c. Construction using soil cement stabilised blocks for masonry walls and pre-fabricated roof with slag cement **Design for Seismic Provisions** After the earthquake of 2005 in Pakistan, the design standards in relation with Seismic Provisions have been outlined for following components: 1. Soil and Foundation 2. Design for Loads(Dead load, Live load, Earthquake load)		

Pakistan	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture			3. Frames and Walls constructed using Precast Concrete 4. Structural steel buildings 5. Reinforced concrete buildings		
Standards, guidelines and Rating Systems		**Green Building Guidelines and rating** [Pakistan Green building council is playing a vital part to create awareness and eagerness to understand the importance of Green buildings and sustainability concept. It provides access to the Green building guidelines manual to improve their chances of getting Green Certification. **SEED - Green Building certification System by Pakistan Green Building Council** A new green building certification system has been	Standards , Guidelines and ratings for Green building materials are not in place in Pakistan. However certification for energy/water efficiency in green buildings is provided in Pakistan, named SEED SEED - Green Building certification System by Pakistan Green Building Council A new green building certification system has been launched in Pakistan by Pakistan Green Building Council in partnership with around	**Pakistan Minimum Energy Performance and Standards** (Implemented by ENERCON- National Energy Conservation Centre) 1. MEPS and Labelling For Window Type & Split Air conditioners (With Cooling Capacity under: 14000 W, i.e., 12000 – 48000 BTU/hr) 2. MEPS and Labelling For Self- Ballasted Fluorescent Lamps(CFLs) 3. MEPS and Labelling For AC Induction Motors (0.37kW – 7.5 kW	

Pakistan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		launched in Pakistan by Pakistan Green Building Council in partnership with around 70 organisation including academia, government agencies, private organisations and local rollout partners; professional Associations/ institutes of Pakistan SEED, which stands for "Sustainability in Energy and Environmental Development" seeks for market transformation in building and construction sector of Pakistan in order to minimize their carbon footprint. It aim is to reduce energy and water consumption .Through SEED certification up to 40% energy and water efficiency can be achieved depending upon nature of project. The categories of certification depends upon points obtained in any particular	70 organisation including academia, government agencies, private organisations and local rollout partners; professional Associations/ institutes of Pakistan SEED, which stands for "Sustainability in Energy and Environmental Development" seeks for market transformation in building and construction sector of Pakistan in order to minimize their carbon footprint. It aim is to reduce energy and water consumption .Through SEED certification up to 40% energy and water efficiency can be achieved depending upon nature of project. The categories of certification depends upon points obtained in	(Single/Three Phase 50Hz)) **Pakistan Energy Labelling Scheme for Fans** The NEECA is awarding certificates to local manufacturers of electrical fans that would be followed for implementing efficiency standards in the other electrical appliances like light bulbs, electric motors, washing machines and ovens	

Pakistan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		project, there are four categories of certification: -Silver, 40-49 points -Gold, 50-59 points -Platinum, 60-69 points -Titanium, 70 points and above **Green Buildings** At present, there are about 18 to 20 buildings in Pakistan which are LEED Certified and registered with the US Green Building Council. These include British Council Library in Lahore, NCC, Mega Corporate Office and Karachi Citiplan in Karachi. Coco Cola Pakistan Icecek Plant in Multan and the World Bank Country office in Islamabad. Pakistan Green Building Council (PGBC) is responsible for developing design guidelines for green buildings in Pakistan.	any particular project, there are four categories of certification: -Silver, 40-49 points -Gold, 50-59 points -Platinum, 60-69 points -Titanium, 70 points and above		

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		**The building code of Pakistan (Energy provisions - 2011)** Pakistan Engineering Council (PEC) is responsible for the development and implementation of the building codes and ENERCON as national coordinator for energy conservation measures and policies jointly worked to finalise the Energy Provisions-2011 to be included in Building Code of Pakistan. The BCP (EP-2011) stresses on the compliance and enforcement of the code. It states that the review and approval of the plans and specification by respective sanctioning from the development authorities or municipalities shall be in accordance with the EP-2011.			

Pakistan

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		**Building and Construction Improvement Programme** • Funding for the programme has been provided by the Canadian International Development Agency (CIDA), USAID, the UNDP GEF Small Grants Programme and the Pakistan Poverty Alleviation Fund. Total BACIP investment from all donors over the last eight years has amounted to approximately US$1.5 million. • Micro-credit loans have been arranged with local financial institutions to assist in the creation of sustainable livelihoods in the region.	**Incentives for Sustainable construction** The lack of incentives from government to implement green building practices is ranked as the second most significant barrier, as the survey respondents see insufficient support from government in the development of green building practices in Pakistan	**USAID** USAID has funded Smart Meters at all feeders in Pakistan. USAID has focused its program over the last year on five areas essential to Pakistan's stability and long-term development and reflective of Pakistani priorities: energy, economic growth, stabilisation, education and health. Incentives under **National Sanitation Policy 2006** The federal government provides incentives for the implementation of the NSP in the form of rewards for open defecation-free tehsils/towns, 100% sanitation coverage tehsils/towns, the cleanest tehsils/towns	

Pakistan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance				and the cleanest industrial estates or clusters Asian Development Bank [Source: https://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_Pakistan#Financial_aspects] • The ADB also financed the Punjab Community Water Supply and Sanitation Sector Project with US$50 million, which was active in rural areas in all districts of the Punjab province from 2003 until the end of 2007. • In Sindh, the Asian Development Bank's (ADB) Infrastructure and Service Delivery Reform Program has provided $400 million to the Sindh Cities Improvement Investment Program (SCIP), which aims to	

Pakistan					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance				improve solid waste management services in 20 secondary cities, and has issued tenders for a wide range of waste management projects	

Affordable Housing in Pakistan

Land Acquisition Act, 1894

The law entrusts the Pakistani state with the power of eminent domain to appropriate land for “any public purpose”, upon provision of a “just” compensation. However, the law does not provide for a resettlement and a rehabilitation plan. In the absence of the resettlement policy, the resettlement plans for infrastructure development projects in Pakistan are made on an ad hoc basis. Due to the lack of pre-approved standards in the shape of legal frameworks to abide by, these ad hoc plans go unchallenged.

National Housing Policy 2001

The objective of this policy is to create affordability, specially, for the middle- and low-income groups. One of the corner stones of the Policy is to ensure development of housing for the poor and needy and housing for the majority rural population through the use of different instruments like free land, cross-subsidy and concessionary finance, etc. The major emphasis of the policy is on resource mobilisation, land availability, incentives for homeownership, incentives to developers and constructors and promotion of research and development activities to make construction cost effective. The policy also initiated the regulation of katchi abadis(slums), and includes provisions to formulate new master plans; streamline regulation and administrative processes; regularise taxes and develop new towns (Ministry of Housing and Works, 2001)

Government Initiated Housing Schemes

Several low cost housing schemes have been initiated at national and provincial levels. The 2013 federal Apna Ghar scheme intended to provide 500,000 low cost housing units across the country. The project never got off the ground and in 2017 it was reported that it had been shelved (Haq, 2017). The Government of Punjab initiated the Ashiana Housing Scheme and the Government of Sindh initiated the Benazir Housing Program and Shaheed Benazir Bhutto Town Scheme (Ministry of Climate Change, 2015). While these projects might ameliorate the housing shortage to some extent, they are reactionary policies that aim to mitigate the problem after it occurs rather than focusing on institutional and administrative change.

National Policy on Katchi Abadis, Urban Renewal and Slum Upgradation, 2001

This policy makes provisions for the regularisation, development and resettlement of katchi abadis.

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District Development in Pakistan

Smart Cities in Pakistan

Sindh: Government of Sindh has signed a memorandum of understanding with three investors from the USA, China, UAE to turn Karachi into a smart city, equipping it with solar streetlights, closed-circuit cameras and free Wi-Fi connectivity

KP: Government of KP has initiated the Safe City- Smart Peshawar Project in collaboration with Motorola.

Punjab: In Punjab holistic city wide smart city smart city project have not been initiated but sector wise work on various aspects of city services have been improved and made smart using the ICT platform.

Productivity Village

The concept of Productivity Village aims to improve literacy rate in the rural areas; imparting technical and vocational skills, in order to enable the people earn better wages and hence improve the standard of living. It encompasses involving the people of the community to work for their own betterment through mutual cooperation and a collaborative approach. The concept is graved towards the achievement of a number of specific and measurable outputs in the following areas:

1) Primary and Secondary School Education;

2) Technical and Vocational Education;

3) Professional and Skill Development in Agricultural farm and non-farm activities;

4) Community health and hygiene; and

5) Establishment of Women Skill Development Centre (WSDC).

Participatory Rural Appraisal

PRA is a way of learning from and with community members to investigate, analyse and evaluate constraints and opportunities, and make informed and timely decisions regarding development projects. Participatory Rural Appraisal (PRA) is one of the most appropriate approaches for the identification of community problems and for understanding the socio-economic and cultural aspects of the community.

Pakistan's Nationally Determined Contributions (NDCs)

Pak-INDC (Pakistan's Intended Nationally Determined Contribution) is rooted in the country's strategic plan 'Vision 2025'. Vision 2025 is based on the following 7 pillars:

Pillar I: Putting People First - Developing Human And Social Capital: This requires capitalising upon and strengthening existing social capital, improving the human skill base of the population, and providing access to opportunities for advancement

Pillar II: Achieving Sustained, Indigenous And Inclusive Growth: The objective is to provide better living standards to every Pakistani irrespective of caste, creed, or domicile, or religious or political affiliation.

Pillar III: Governance, Institutional Reform and Modernisation of the Public Sector: The Vision seeks an efficient and transparent government, which operates under the rule of law and provides security of life and property to its people.

Pillar IV: Energy, Water and Food Security: To commit major new resources through public and private sector collaboration in these areas and ensure required production and storage capacities. At the same time, efforts will be made towards conservation, efficient distribution and usage of resources, and preventing contamination and environmental degradation.

Pillar V: Private Sector & Entrepreneurship Led Growth: Vision 2025 aims to make Pakistan a highly attractive destination for private sector investment, with conditions that allow private investors to successfully participate in its development. This will require a concerted focus on the areas that inhibit the private sector, including the energy deficit, lack of security, 10 Ministry of Planning, Development & Reform, Government of Pakistan labour skills, slow and costly judicial procedures (contract enforcement), macroeconomic instability and ad hoc regulations

Pillar VI: Developing a Competitive Knowledge Economy through Value Addition

Pillar VII: Modernising Transportation Infrastructure and Greater Regional Connectivity: Key related targets are reduction in transportation costs, safety in mobility, effective connectivity between rural areas and markets/urban centres, inter-provincial high-speed connectivity, integrated road/rail networks between economic hubs (including air, sea and dry ports), high-capacity transportation corridors connecting major regional partners and exponential growth in exports.

Pakistan and the UN Sustainable Development Goals

Goal 1: No Poverty

Since the government has signed up to SDG 1, they can be asked to adopt the equivalent of US$1.25 per person a day as an official poverty line. The SDGs can also be used to push for a quick consensus on ways of measuring “poverty in all its dimensions according to national definitions”.

Goal 7: Affordable and Clean Energy

For affordable clean energy, Pakistan requires more transmission lines, cost-effective production, and better-regulated renewable energy markets. Germanwatch’s latest Global Climate Risk Index, which measures how nations are affected by weather-related disasters, ranks Pakistan as the world’s 8th most impacted nation. Experts have estimated that about a quarter of the country’s land area and half its population is vulnerable to climate change-related disasters. With its dry climate, extreme weather events, and natural resource shortages, the country’s climate vulnerabilities can’t be overstated

Goal 11: Sustainable cities and Communities

Goal 11 – sustainable, green and resilient cities – forms the defining constructs of an emerging urban planning paradigm that is fast gaining global traction. Here, strategic plans are replacing master plans. Gated communities and urban sprawl, supported by private automobile-friendly transportation infrastructure, are being discouraged to promote mixed, integrated neighbourhoods with walking and bicycling supportive streets. With more than half of the world’s population presently residing in urban centres, these designs serve as the frontlines in the battle against climate change.- Implementing the National Master Plan on Waste Management 2016-2021, which includes an objective to create an integrated waste management plan. Some of the key concepts under the Master Plan are the reduction of wastes at the source, the centralisation of waste disposal system and engagement and shared responsibilities in all sectors.

7.11 SCP Sustainable Housing in Sri Lanka

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Mining in Sri Lanka** Sri Lanka is endowed with a variety of mineral resources, such as feldspar, clays (including ball clay and kaolin), dolomite, graphite, limestone, mica, mineral sands (including Ilmenite, rutile, and zircon), phosphate rock, quartzite, and salt. Sri Lanka is known for its unique type of graphite, which is called vein graphite. The mineral processing industry produced cement, lead (secondary), iron and steel, and semi manufactures.	**National Building Research Organisation** The NBRO has introduced guidelines for hazard mitigation and codes and standards for design and construction of disaster resilient structures. **Disaster Risk Reduction (DRR)** DRR profiles have been prepared for several districts as well as selected urban areas with funding from UN-Habitat. Incorporating disaster mitigation provisions is an essential part in the planning procedures of all major planning agencies. It has also been incorporated into local authority legislations, national health policy and	**National Policy on Construction (2014)** This policy initiative includes: i. Support for human resource development. ii. Targeting of the construction sector for employment generation, poverty alleviation and social uplifting. iii. Ensuring the availability of materials, plant and equipment through the growth of the local materials and related industries, and through liberalised trade. iv. Creating an enabling regulatory framework v. Enabling fair competition for Government contracts through the establishment	**National Policy on Protection and Conservation of water sources, their catchments and reservations in Sri Lanka** Three main components related to conservation and Protection of water sources in Sri Lanka have been taken into account when formulating this Policy depending on its importance. (a) Micro catchments which include rivers and streams, their reservations and their spouts and flood plains of the rivers. (b) Natural or manmade tanks and reservoirs and	**National Policy on Solid Waste Management** The main objectives of the policy are (a) to ensure environmental accountability and social responsibility of all waste generators, waste managers and service providers (b) to actively involve individuals and all institutions in integrated and environmentally sound solid waste management practices (c) to maximize resource recovery with a view to minimize the amount of waste for disposal and (d) to minimize adverse environmental impacts due to waste disposal to

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Major Institutions involved in the Regulation of Mining in Sri Lanka:** - Sri Lanka Exports Development Board - Ministry of Environmental Protection (MEP) - Ministry of Industry and Information Technology (MIIT) - Ministry of State Resources and Enterprise Development - Ministry of Science, Technology and Research - Ministry of Land and Resources (MLR) **Key Documents Related to Regulating the Environmental Impacts of Mining in Sri Lanka** **Mines and Mineral Act, No. 33 of 1992.** An act to provide for the establishment of the geological survey and	national housing policy documents, as well as into the national planning process of the Ministry of Finance. **National Energy policy and strategies in Sri Lanka:** National Energy Policy of Sri Lanka spells out the implementing strategies, specific targets and milestones through which the Government of Sri Lanka and its people would endeavour to develop and manage the energy sector in the coming years in order to facilitate achieving its millennium development goals. It includes promotion of energy efficiency and conservation as one of its elements under which Supply side and end-use energy efficiency will be encouraged through financial and other incentives	of clear procurement guidelines and regulations vi. Establishing National Registers for Stakeholders by Construction Industry Development Authority (CIDA). vii. Creating an attractive investment climate for infrastructure development including private capital and foreign direct investment. **Code of practice for energy efficient buildings:** It sets forth the requirements for design and/or retrofit of commercial buildings and industrial installations. This code of practice covers the following building elements: a) Building envelope b) Ventilation & Air conditioning c) Lighting	shallow lakes (villu), their reservations and "immediate catchments" of those tanks and irrigation canals and their reservations. (c) Existing underground or aquifers or surface springs or spouts or such sources which are potentially available for common use and necessary land extent to ensure their existence and protection. **National Energy policy and strategies in Sri Lanka:** The National Energy Policy of Sri Lanka, spells out the implementing strategies, specific targets and milestones through which the Government of Sri Lanka and its people would endeavour to	ensure health and well-being of the people and on ecosystems. **Deposit refund policy and tax on plastics:** The International Union of Conservation of Nature (IUCN) Sri Lanka proposed the polluter pays, by way of Extended Producer Responsibility (EPR) principle. For this approach, the plastic producer is fully responsible for the product it creates and bears the burden of properly recovering and recycling the product after disposal. . **National Policy on Sustainable Consumption and Production (2018):** Minimising the natural

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	mines kitreau to regulate amp; the exploration for, mining, transportation, processing, trading in or export of, minerals for the transfer to such bureau of the functions of the department of geological survey for the repeal of the salt ordinance (chapter 211) the radioactive minerals act, no. 46 of 1968, and the mines and minerals law, no. 4 of 1973; and to provide for matters connected therewith or incidental thereto. National Environment Policy (2003) The policy aims to promote the sound management of Sri Lanka's environment balancing the needs for social and economic development and environment integrity.	and disincentives in respect of energy end-use mandatory measures such as appliance energy labelling, building codes and energy audits.	d) Electrical power and distribution e) Service Water Heating. All commercial buildings, industrial facilities and large scale housing developments having one or more of the following features a) Four or more stories b) Floor area of 500 m2 or more c) Electrical power demand of 100 kVA or more d) Air-conditioning cooling capacity of 350 kW (output) or more are subject to the regulations of this code. Reform in dealing with construction permits- Sri Lanka made dealing with construction permits easier by launching a single window, increasing transparency by providing	develop and manage the energy sector in the coming years in order to facilitate achieving its millennium development goals. It includes promotion of energy efficiency and conservation as one of its elements under which Supply side and end-use energy efficiency will be encouraged through financial and other incentives/disincentives in respect of energy end-use mandatory measures such as appliance energy labelling, building codes and energy audits.	resources and toxic materials used, and the waste and pollutants generated throughout the entire production and consumption process in all economic sectors. In Building and Construction specifically: 1. Review, strengthen and empower existing legal instruments, such as Environmental Impact Assessment (EIA) 2. Promote disaster and climate resilient buildings and constructions 3. Local Authority regulations amended to ensure that all state sector buildings constructed in the future comply with Green Building Certification

Sri Lanka

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	It also aims to manage the environment by linking together the activities, interests and perspectives of stakeholders and to assure environmental accountability. **National Policy on Sand as a Resource for the Construction Industry (2006)** Sand is a mineral as defined in the Mines and Minerals Act No. 33 of (1992), and is the property of the state. The estimated annual national demand for sand for the construction industry is approximately 7 million cubic metres. Its objective is to develop a dual approach to the wise management of sand resources, (a) though an effective system of policing within a strong regulatory framework; and (b) through		online access to building regulations and reducing the processing times to issue several building certificates.		4. Western province to have a model SMART CITY by 2025 5. Habitable built environment for all established by 2030 **Construction and Demolition waste:** C& D waste is mentioned in the National Policy on Solid Waste Management but no policies available specifically on the C&D waste management. In the current scenario Central Environmental Authority, Waste Management Authority and National Solid Waste Management Support Centre are involved in C&D waste management indirectly.

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	the granting of incentives including skills training and alternate employment, for the development of sustainable alternatives. Encouragement will be given for major construction projects to optimize the use of sand and use alternate aggregates such as quarry dust wherever possible, bearing in mind the need to also mitigate the environmental impacts of quarrying.				
Technology/ Architecture	**Cement Industry** Sri Lanka is estimated to be consuming 7.8 million ton of cement per annum (Economic and social statistics of Sri Lanka, 2017). Sri Lanka imports 66% of its required cement from India, Vietnam, Pakistan, Malaysia,	Building Information Modelling (BIM) is becoming popular and likely to become industry standard for construction project design in future. BIM is not yet practiced in Sri Lankan construction industry and not many in the industry know about it.	**Trends in Construction industry** The country is home to over 2500 registered local construction firms. The Construction Industry Development Authority (CIDA) has categorized these construction companies in Sri Lanka on		**Construction Waste management (COWAM) Project** Sri Lanka suffered enormously from the Indian Ocean tsunami of 2004. The City of Galle located on the south coast was severely affected by this event

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
	Indonesia and Thailand. And nearly 40% of Sri Lanka's cement demand is met through local clinker grinding. Local cement manufacturers have taken range of environmental initiatives to reduce GHGs emission. Brick Industry It is estimated that annually over 800 million bricks are being produced in Sri Lanka. Most of the industries are restricted to small scale operations. The demand for clay bricks products do not meet the specifications as mandated for in the national standards for building bricks and which resulted in various brick sizes produced among different manufacturers. Clay extraction and bricks firing was identified as the sub		a scale of 1 to 10 while taking into account the company's financial assets, technical capabilities, and field-specific experience. The newest technology that the majority of apartments and buildings construction companies use today is the precast concrete or pre-fabricated construction, laser scanning for digital reproduction of the dimensions and positions of the objects.		destroying over 15000 houses. The Construction Waste Management project, funded by the European Union from 2005-2009, looked at the most sustainable ways of dealing with Construction & Demolition (C&D) waste after a disaster and devised a pilot C&D recycling plant (COWAM Centre) in Galle. Galle Municipal Council has successfully up cycled debris waste and incorporated them in their constructions for more than 10 years.

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	process with considerable impact to the environment. Sri Lankan bricks industry still use considerable greener energy sources like agricultural wastes and efficient energy techniques with traditional knowledge. **Sand** Due to high demand of sand in the construction industry of Sri Lanka, finding high quality sand is a challenge in Sri Lanka. After considering the environmental impacts, government has imposed artic laws on mining of sand. Due to this reason, certain individuals have focused on mining inland dunes. However, sand excavated from inland dunes contains higher percentage of cohesive sediment (mud) which exceeds the recommended				

Sri Lanka	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Technology/ Architecture	limits, posing difficulty in controlling cracks and ruptures that may appear in structures made of such concrete. Currently the Sri Lanka Land Reclamation and Development Corporation has taken the initiative to pump sand from the deep sea and can be delivered after controlling salt levels as an alternative. New Technologies Sri Lanka is hesitant about going beyond traditional construction boundaries, and the situation has critically deterred the progress of all sectors including financial management, technology and project management.				

Sri Lanka					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		**Code of practice for energy efficient buildings** It sets forth the requirements for design and/or retrofit of commercial buildings and industrial installations. This code of practice covers the following building elements: a) Building envelop b) Ventilation & Air conditioning c) Lighting d) Electrical power and distribution e) Service Water Heating. All commercial buildings, industrial facilities and large scale housing developments having one or more of the following features: a) Four or more stories b) Floor area of 500 m2 or more c) Electrical power demand of 100 kVA or more	**Green Building Council of Sri Lanka (GBCSL)**: created Sri Lanka's indigenous rating system, which is better suited to the country's tropical climate. **Green Labelling System**: established to certify products and promote the use of green products in construction The GLS encompasses multiple environmentally acceptable criteria across a product life cycle of sustainable materials/ products, hence to grant the certification. In the process of establishing environmentally preferable criterion for the product standards, the relevant international standards were drawn and benchmarked with well-developed green labels to	**Minimum Energy Performance Standards (MEPS) and Energy Labelling for appliances** The Sri Lanka Standards Institution (SLSI), the national standards body of Sri Lanka operates the Energy Efficiency Labelling Scheme based on the relevant Sri Lanka Standards for energy efficiency rating of appliances. SLSI offers this scheme for following products- Compact Fluorescent Lamps (CFLs), Magnetic / Electronic Ballasts, Electric Ceiling Fans, Double Capped Tubular Fluorescent Lamps, Light Emitting Diode Lamps (LEDs). MEPS on appliances was proposed and implemented in 2016.	

Sri Lanka					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		d) Air-conditioning cooling capacity of 350 kW (output) or more are subject to the regulations of this code. **Green Rating System for Built Environment** A Green Environment Rating System applicable to Sri Lanka has been formulated as a 'home- grown system' with all norms acceptable to leading rating systems. Green Building Council has four categories for rating building: ● Platinum (70 points or above) ● Gold (60 - 69 points) ● Silver (50 - 59 points) ● Certified (40 - 49 points) The procedure for Green rating is: (i) Green rating tool (ii) Eight categories (iii) Prerequisites (iv) Requirements, credits, points (iv) Rating achieved	ensure the creditability. The Green Labels focus on certain environmental aspects such as energy consumption, water use, timber source and ecological well-being etc. Green Building Council Sri Lanka (GBCSL) offers the valuable opportunity to the environmentally responsible product manufactures to brand their product under the GBCSL umbrella, which will give them a competitive advantage among traditional products.		

Sri Lanka					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Standards, guidelines and Rating Systems		(v) Certifies - Silver, Gold or Platinum. **Key aspects of 'GREEN' rating system**: Sustainable sites, Management, Social and Cultural Awareness, Innovation and Design process, Indoor environmental quality, Materials and Resources, Energy and atmosphere and Water Efficiency. Till now 7 building have been accredited 'Green' including Hotels, Banks and Office buildings.			

Sri Lanka					
	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Access to Finance		**National Energy policy and strategies in Sri Lanka** The policy includes promotion of energy efficiency and conservation as one of its elements under which Supply side and end-use energy efficiency will be encouraged through financial and other incentives/disincentives in respect of energy end-use mandatory measures such as appliance energy labelling, building codes and energy audits.	**Construction Industry Development Act (CIDA)** CIDA has formulated programmes to raise the skill levels of workers and also give them the dignity of earning a diploma. The effects of the efforts of the government to upgrade the status of the construction industry employment are yet to bear fruit.		

Affordable Housing in Sri Lanka

National Housing Development Authority (NHDA): NHDA is the only state institution granting housing loans mainly to the disadvantaged groups in Sri Lanka. There are three main Housing Programmes implemented by the NHDA for the low income earners across the country namely:

(i) Model Villages Programme
(ii) Reawakening Villages Programme
(iii) Scattered Loans Programme

The housing sector in Sri Lanka is financed by both Public sector as well as the private sector. The two state commercial banks, the Bank of Ceylon (BOC) and the Peoples Bank (PB) together with the State Mortgage and Investment Bank (SMIB), National Savings Bank (NSB) and the Housing Development Finance Corporation (HDFC) provide the bulk of the financing requirements of housing at present. The SMIB established in 1931 is considered the leader in this sphere with a housing loan portfolio in National Policy on Mineral Resources.

Million Houses Programme (1978-1983): Between 1978 and 1983, the Government of Sri Lanka implemented the Hundred Thousand Houses Programme which aimed at the provision of houses for low-income households through direct construction as well as aided self-help. A task-force which had reviewed the results of the Hundred Thousand Houses Programme had noted that during the period 1977-1982, when the Government constructed some 115,000 housing units at a substantial cost, the people themselves had built many more houses without any governmental assistance. They had done so at a much lower cost and at a far greater satisfaction with the end-product. The Government of Sri Lanka came to realise that housing is an activity of the people and that the role of the government is not to do what people have been doing for centuries, i.e., building their own houses and settlements, but to strengthen this process by providing support where it is needed. Therefore, the answer was a support-community based housing programme where the State is participating in the house-building activities of the people rather than the people are participating in house-building by the State. The support by the Government should not dominate the process, but facilitate it by assisting the actors involved to take.
House Plastering Programme: The programme was launched in 2015 to bring un-plastered houses to finish level, 28,673 houses of low income families were renovated. The Treasury allocated Rs. 637.50 million to renovate another 75,000 houses. It is launched to prevent residents who suffer from bacterial infections in addition to being plagued by fleas, ticks and other insects due to unfinished houses.

Scattered Housing Programme: This housing development programme will be implemented with the aim of completing the partially built houses. The families who are unable to complete the construction activities of their new house built amidst various difficulties were selected as the beneficiaries of this programme. A loan of Rs. 100.000 is granted to the beneficiary for the completion of the ongoing construction of the house whose monthly salary is Rs.25,000 or less than that 5% annual interest rate.

District Development in Sri Lanka

Model Village Programme

The model village programme is put into effect covering the entire districts island and it is supposed to construct 1000 model villages island wide under this. The development of essential infrastructure facilities is carried through coincide with the construction of houses in the model villages thus being constructed with the assistance of the relevant line Ministries and external parties including government institutes and a fully-fledged village with the basic infrastructure facilities will be entrusted to the public. Families who have no land and house of their own, this model village programme will be implemented. Under this, the beneficiary family will receive the title of a state owned land and a new house should be built in that land using the loan granted by the Government. Thus, the model village is created by joining several constructed houses adjacent. A loan of Rs. 400,000 at 5% annual interest rate is granted to the beneficiaries whose monthly salary income is Rs.25, 000 and government/semi government officers whose monthly salary is Rs.45,000 or less than that.

Sri Lanka's Nationally Determined Contributions (NDCs)

Sri Lanka is a country highly vulnerable to adverse effects of climate change and very low greenhouse gas emitter, hence Sri Lanka presents the NDCs to strengthen the global efforts of both mitigation and adaptation as an overall objective. It has four main areas:

1. Mitigation - Reducing the GHG emissions against the Business-As-Usual (BAU) scenarios in the sectors of energy (electricity generation), transportation, industry, waste and forestry. The key contributors to GHG are Carbon Dioxide (CO2), Methane (CH4) and Nitrous Oxide (N2O).

2. Adaptation - Building resilience in most vulnerable communities, sectors and areas to adverse effects of climate change. Adaptation will focus on human health, food security (agriculture, livestock and fisheries), water and irrigation, coastal and marine, biodiversity, urban infrastructure and human settlement, tourism and recreation. Adaptation initiatives that derive mitigation co-benefits will be prioritised.

3. Loss and Damage - In order to address issues related to losses and damages resulting from extreme weather events, a local mechanism will be developed in accordance with the Warsaw International Mechanism for Loss and Damage.

4. Means of Implementation- External support for Finance, Technology Development and Transfer, and Capacity Building for the above sectors are considered in the implementation process of the NDCs of Sri Lanka.

In the building sector it seeks to promote climate resilient building designing and alternative materials for construction through:

- Design based on green building guidelines

- Incorporate disaster prevention guidelines

- Incorporate low cost environment friendly materials

Sri Lanka and the UN Sustainable Development Goals

The current policy framework of the country further reflects the country's commitment to sustainable development. Sri Lanka's strategic development framework, reflected through its long-term development plan, Vision 2025, its medium-term plan, the Public Investment Programme 2017-2020, and the 'Blue Green' Budget of 2018 align significantly with the SDGs. Given the rising environmental challenges faced by the country, especially due to climate induced disasters in recent years, the focal SDGs of HLPF 2018, the SDGs 6, 7, 11, 12, and 15 bear a special significance to Sri Lanka.

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all: encouraging the use of energy saving technologies.

Goal 6: Ensure availability and sustainable management of water and sanitation for all: includes proper household waste disposal for to prevent contamination of ground water.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable: Considering the housing demand, The Urban Development Authority (UDA) has launched a project to provide 50,000 housing units to low and middle income groups within five years starting from 2016 to cater to the growing demand for housing in urban areas.

Goal 12: Ensure sustainable consumption and production patterns - A Green Reporting System is being implemented by the MMDE. The green reporting system deals with 50 indicators which consist of six economic indicators, 20 social indicators and 24 environmental indicators. A green public procurement policy is being drafted in Sri Lanka, and this indicates that green public procurement is a nationally important aspect in Sri Lanka.

In the National Action Plan for Haritha Lanka Programme, under its Mission 9 on Greening the Industries, two action items have been listed relevant to public procurement. The two items are:

(a) Develop guidelines to facilitate industries to select and procure environmentally friendly raw materials, and
(b) Promote green purchasing: Implementing the National Master Plan on Waste Management 2016-2021, which includes an objective to create an integrated waste management plan. Some of the key concepts under the Master Plan are the reduction of wastes at the source, the centralisation of waste disposal system and engagement and shared responsibilities in all sectors.

7.12 SCP Sustainable Housing in Thailand

Thailand	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**2009 – Policy on "Green Mining":** to encourage mining entrepreneurs to go 'green' by the following principles: - Environmental and social responsibility; - Pollution prevention and reduction of the environmental impacts; - Keeping all stakeholders safe and healthy during mineral and mining operations; - Operating mining areas are clean and green; - Transparency and accountability; - Enhancing efficient of mineral resources with the aim of achieving sustainable development in the mining and mineral industry	**1992 – Energy Conservation Promotion Act** It is a mandatory energy efficiency cod and includes three ministerial regulations. The first one prescribes the standards, criteria and procedures for designated buildings. The second one prescribes forms and schedules for submitting data on energy consumption, energy conservation, criteria and procedures for recording energy consumption data, and installation or retrofitting of machinery or equipment that affect energy consumption and conservation. The third one prescribes criteria, procedures, and schedules for owners of designated buildings to establish energy	The **Building Control Bureau of Thailand** enforces the laws related to building regulations Ministerial regulations related to the building control are also developed under the Building Control Act **Mandatory building codes in Thailand:** - The Building Control Act (1975, amended 2006) - Building Inspection Regulation - Fire Safety Regulation for High-rise Buildings and Special Large Buildings - Regulation on Fire Prevention for general buildings	**Energy Conservation Thailand Energy Conservation Promotion Act (ENCON Act):** stipulates the duties of owners of designated factories/buildings with regard to energy conservation in their facilities and promotes the use of energy-efficient machinery/equipment as well as materials contributing to energy conservation. **Water management Thailand's Water Resource Management Strategy (2015-2026):** The Thai government has worked out a 12-year water resource	**Waste Management** - 2014: Road Map on Waste and Hazardous Waste Management - 2016: National Solid Waste Management Master Plan (2016-2021) - 2016: Action Plan "Thailand Zero Waste" (2016-2021) **National Waste Management Master Plan** 1. Encourage population, including children and the private sector to reduce waste at source by following the 3Rs concept.

Thailand

	Material Production	Design/ Manufacturing	Construction	Usage	Recycling
Policy Environment	**Thailand Energy Conservation Promotion Act (ENCON Act):** in place since 1992, it is a comprehensive piece of legislation, laying out the general scope, requirements and responsibilities for key energy consuming sectors The Energy Conservation Programme as part of the ENCON Act put mandates on so-called designated facilities and building to take energy-related measures. **Mandatory tasks for the designated facilities are:** - Assignment of energy managers; - Prepare and submit energy efficiency target and plan;	conservation targets and plans in designated buildings as well as to assess and monitor the implementation of the plan. Part of the Act includes the Building Energy Code. The code only applies to commercial and government buildings in the Bangkok Metropolitan Area and districts under the Thailand Provisional Authority. **Coordinating Centre of Energy Conservation Building Design** - To provide information to any government sectors, state enterprises, or project stakeholders regarding the evaluation procedures of building plans for energy conservation as required by the Ministerial Regulation - To create collaborative networks between the government and private	- Regulation on Building Drainage Equipment - Regulation on improvement of building in inappropriate safety condition - Regulation on fire-resistant construction - Regulation on seismic building design - Energy Conservation Promotion Act and Building Energy Code (administered by the Department of Energy) Mandatory codes are applicable only in Bangkok Metropolitan Municipality, districts under the Town Planning Act, and for buildings larger than 1000 square meters or with more than 500 occupants. Provinces are required to adopt the regulations	management strategy, to be implemented from 2015 to 2016. It is also in the process of drafting a Water Act, which will provide a framework for handling all dimensions of water resource management. - Water source management: emphasis on rehabilitating deteriorated forests and watershed areas and preventing soil erosion - Water consumption: reduce unequal access to water, ensure water security for the agricultural and industrial sectors, encourage the community to play a greater role in managing water consumption. - Waste water management: reducing waste water from its original sources, increase	2. Establish proper disposal methods for municipal solid waste and household hazardous waste by using centralised facilities for clusters municipalities emphasising waste utilisation and waste to energy methods. 3. All relevant sectors participate in the management of solid and hazardous waste Goals: - By 2021 more than 75% of municipal solid waste is disposed properly. - By 2019, all accumulated waste are disposed properly - By 2021, more than 30% of household

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Policy Environment	- Six-monthly reporting of energy use. Plants have to also report their production; - Conduct the energy audit funded by the Energy Conservation Program.	sectors in order to lay the foundation of energy conservation building design	and may introduce additional rules.	the efficiency of waste water treatment systems and prevent seawater from pushing inland.	hazardous waste are collected and disposed properly - By 2021, more than 50% of local governments have systems for separation at the source
Technology/ Architecture	**Siam Cement Kaeng Khoi (SKK) - Limestone Quarrying in Saraburi Province, Thailand** **- Semi-open cut mining design**: a method of quarrying that combines Open Cut Mining and Open Pit Mining by leaving some forest (about 40% of the permission area) as a buffer zone along the quarry boundary line. SKK's semi-cut open cut quarry is the first in Thailand and in ASEAN to implement this	**Digitalisation** CAT Telecom in cooperation with Actility's ThingPark wireless LPWA connectivity platform to power a national IoT communication network roll-out, kicking off with a smart city solution for Phuket and soon to be followed by Bangkok. The smart services offered will include smart metering, smart buildings, smart lighting, smart parking, smart farming, smart logistics and smart tourism.	**Vernacular architecture** - Application of traditional Thai architecture to new building - Modern architecture can accommodate certain elements of traditional Thai architecture like extended eaves, which can do a good job in sun and rain protection - Modern buildings should be developed from making appropriate		

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Technology/ Architecture	method. The technique reduces environmental impact, noise and dust pollution. It also preserves significant forest cover, minimises damage to the mountain ecosystem, and maintains better scenery compared to an Open Cut system. **- Innovations leading to higher efficiency:** Zero-Waste Quarry, Resistivity Method to search for caves, Improvements in Blasting, Dust Control System, Machine Innovation.	**Building Information Modelling (BIM)** BIM is a computer technology for design and management of buildings and facilities, which is adopted for implementing design projects in many countries. Thailand is one of those countries, which has adopted the changing design technology of BIM to use in Thai architectural and engineering design industry. However, the **lack of professional architects and engineers who have appropriate knowledge** and understanding is found to be the current barrier to BIM implementation in Thailand.	adjustments of some familiar architectural elements - The most important element in Thai architecture lies in the way it **responds to the topography and the climate** like sunlight, wind, rain and humidity: **Use of bamboo** - A bamboo forest can be harvested after just three years of plantation. - Well-managed bamboo farms trap a relatively high quantity of CO2 per hectare of managed forest area. - The challenges in replacing traditional tree woods with bamboo involve chemical treatment against mould, pests, and discoloration as well as joining.		

Thailand

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Standards, guidelines and Rating Systems		**Building Energy Code (BEC) 2018** - New BEC for large-scale buildings (area greater than 10,000 square metres), followed by 5,000 m² in 2019 and 2,000 m² in 2020 In July 2017, the Department of Alternative Energy Development and Efficiency ("DEDE") has launched Thailand's first compulsory building energy consumption standards, namely the **Green** **Building Energy Code ("GBEC")**. The GBEC established certain standards and specifications related to the building envelope, electrical lighting system, air conditioning system, water heating, overall energy consumption, and renewable energy outfitting within the	**Green building materials** "Few building material producers in Thailand communicate to consumers that their products are green, while some other green materials still have to be imported. Regarding building materials like cement, concrete, timber, and ceramic tiles, EIC found that only SCG has communicated to customers that their products are green. Among decorative paint businesses, only TOA clearly states that their paints have low VOCs. With regard to glass materials, local manufacturers can produce insulated low-e glass. However, some	**Minimum Energy Performance Standards and Labelling (MEPS)** MEPS were implemented to prevent the production and import of substandard equipment. Moreover, equipment that meets a high standard is eligible for certification marks. The certification schemes include mandatory and voluntary certification options for different product classes. Mandatory certification is required for air conditioners and refrigerators, while voluntary certification is optional for the following types of equipment: Double-capped	

Thailand					
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Standards, guidelines and Rating Systems		building, which all of the large buildings' design and construction must follow. **TREES - Thailand's Rating of Energy and Environmental Sustainability** - New Construction, Pre-New Construction, Core and Shell, Existing Buildings Operations and Maintenance - Topics can be separated to prerequisite and credit topics. For each type of building there are a certain number of prerequisite topics that must be achieved for the building to pass the certification. - 4 award levels: platinum, gold, silver and certified. - Design Submittals and Construction Submittals in 8 different sections: Building Management, Site and Landscape, Water Conservation, Energy and Atmosphere, Indoor	green building projects in Thailand prefer to import the material." **SCG Eco Value** SCG Cement-Building Materials (SCG Portland Composite Cement: reduces greenhouse gas emission during production for at least 70 kilograms per ton of cement)	fluorescent lamps, Self-ballasted lamps, Single-capped, LPG cooking stoves, Three-phase motors, Fiberglass insulation, Diesel engines, Microwaves, Rice cookers, Electric ovens, Motorcycles fluorescent lamps, Electric kettles, Irons, Magnetic ballasts, Electronic ballasts, Diesel engines, Water pumps. **High Energy Performance Standards and Labelling (HEPS)** Thailand established HEPS, known as the Energy Efficiency Labelling No. 5 Program, on a voluntary basis with the purpose of informing consumers that No. 5 labelled appliances and equipment are highly energy efficiency and	

Thailand

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Standards, guidelines and Rating Systems		Environmental Quality, Environmental Protection and Green innovations.		that they will help reduce their electricity bills. This will also enhance competition among manufacturers to further improve the energy efficiency of their products. This program, in operation since 1993, applies to the industrial, commercial and residential sectors.	

Thailand

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Access to Finance		**Thai Energy Efficiency Revolving Fund:** - To support clients for investment in machinery and equipment in relation to Energy Efficiency and Renewable Energy projects, through providing low-interest loans to banks, which then finance EE projects through loans with favourable interest rates. - Eligible borrowers: buildings, factories, energy service companies and project developers, for projects on energy conservation or energy saving.			

Affordable Housing in Thailand

Currently there are two major public agencies that are responsible for Thailand's low-income housing, the NHA and the CODI. The NHA is the state enterprise specifically established to be responsible for the construction of public formal housing. In addition the CODI is another institution operated in the form of the public organisation taking the role in the sum upgrading programmes.

The **National Housing Authority (NHA)** is a state enterprise attached to the Ministry of Social Development and Human Security. The objectives are to provide housing for low and middle income earners, to provide financial assistance to those who need to have their own housing, to deal with the business of building construction and land acquisition in order to assist people in achieving better living, social and economic conditions.

Baan Eua-Arthorn Project

In 2003, the government began an ambitious housing program, Baan Eua-Arthorn, assigning the construction of 600,000 units to the National Housing Authority (NHA). These units targeted low income, junior civil servants and government official households. This housing development program aimed at enhancing the targeted group to hire-purchase their own residential quarters at prices that they can afford.

- Strategies: utilising a Public-Private Partnership, supervision of design and construction by NHA, utilising industrialised systems to minimise cost and reduce construction time.
- Conditions: from 2003-2005 for households with monthly income until 15,000 Bath. After 2005: for households with income until 40,000 Baht.

Baan Mankang Collective Housing Programme set up by Community Organisations Development Institute (CODI)

The objective of the Baan Mankong is to develop living conditions of slum dwellers by upgrading housing conditions based on self-help and community development bases as an alternative to low-income housing. The program channels government funds, in the form of infrastructure subsidies and soft housing and land loans, directly to poor communities, which plan and carry out improvements to their housing, environment, basic services and tenure security and manage budget themselves. Instead of delivering housing units to individual poor families, the program puts Thailand slum communities at the centre of a process of developing long-term, comprehensive solutions to problems of land and housing in Thai cities.

District Development in Thailand

Eco-villages

Recently, the National Housing Authority (NHA) Thailand has been actively involved with design and construction of eco-villages. For eco-village, the inhabitants are the mains constituents, and should be more actively involved with the direction and operation of their own community. One of the major achievements envisioned by the NHA is the creation of a sustainable, environmentally friendly housing project. The created community's growth should be attained through the adoption of 'self-sufficiency' as a main course of development.

One Bangkok

TCC Assets (Thailand) and multinational company Frasers Property have joined forces to create an integrated city district within Bangkok. A key masterplan principle of the project is to design from the ground up, creating a complete liveable city that is green, sustainable, comfortable, healthy and smart, for everyone who works, resides and plays at the district. The development includes office towers, hotels, residential towers, a large retail loop comprising shopping precincts, art and cultural spaces, and eight hectares of green and open space. One Bangkok is designed to meet international and local standards, including adhering to the LEED Neighbourhood Development International Certification standards. One Bangkok is designed to be a smart city. Enabled by a comprehensive digital infrastructure connected by high-speed communication networks, the project aims at revolutionising ways to make complex operations, including energy efficient energy consumption and predictive maintenance with automated processes.

Thailand’s Nationally Determined Contributions (NDCs)

Thailand intends to reduce its greenhouse gas emissions by 20 percent from the projected business-as-usual (BAU) level by 2030. The level of contribution could increase up to 25 percent, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support

The revised Energy Efficiency Plan (EEP), ratified by the National Energy Policy Council (NEPC) in 2015, states an energy intensity reduction target of 30% by 2036 (compared with 2010) from an estimated final demand reduction of 56 Mtoe (compared to business-as-usual (BAU)). Additionally, Thailand adopted the goal to reduce its energy intensity by at least 45% by 2035 and expressed its intention to reduce greenhouse gas emissions from energy by 7%–20% in accordance with the Thailand Climate Change Master Plan enacted by the Office of Natural Resources and Environmental Policy and Planning (ONEP).

Nationally Appropriate Mitigation Actions (NAMAs) to the UN Framework Convention on Climate Change: greening Thailand's low- and middle-income housing, and greening the country’s government buildings:

By commissioning nationally built low- and middle-income housing, retrofitting government buildings, and instilling national green building specifications, Thailand will push the country’s housing and construction markets to move towards greener standards.

Thailand and the UN Sustainable Development Goals

Implementation of the 2030 Sustainable Development Agenda

Goal 6 - Ensure availability and sustainable management of water and sanitation
- Thailand aims to reduce waste water from its original sources and increase the efficiency of waste water treatment systems, as well as improve community's wastewater treatment.

Goal 7 - Ensure access to affordable, reliable, sustainable and modern energy for all
- Thai Integrated Energy Blueprint: a 20-year long-term energy plan aimed at achieving energy security, economic prosperity, and social sustainability.
- Thailand has been strictly implementing the EEP2015, which aims at decreasing energy intensity at least 30 per cent by 2036 compared to 2010 by promoting energy saving products, campaigning on energy saving, and regulating service providers to use energy efficiently covering all four economic sectors.

Goal 11 - Make cities and human settlements inclusive, safe, resilient and sustainable
- Integrated and resilient urban planning
- 10-Year Strategic Plan for Housing Development (2016-2026): focus on two groups of low income population, tasks the NHA to develop housing for the low income and the CODI to develop housing for homeless and low income particularly in slums, informal settlements, trespassed land and rural areas. Additionally, the Government Housing Bank is providing concessional housing loan for low and medium income population.
- Public Private Partnership: City development companies have been established in many provinces with the aims of raising capital for infrastructure development and to promote the transition towards smart city. Such approach is structured through the collaboration between private sector, people, and the government.

Goal 12 - Ensure sustainable consumption and production patterns
- Product labels to promote environmentally-friendly products
- Implementation of a range of projects on environmentally sustainable cities and green cities, such as the Smart Cities - Clean Energy Project and the Green Procurement Project
- Implementing the National Master Plan on Waste Management 2016-2021, which includes an objective to create an integrated waste management plan. Some of the key concepts under the Master Plan are the reduction of wastes at the source, the centralisation of waste disposal system and engagement and shared responsibilities in all sectors.

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