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Green Building Guidelines

Through the Building Lifecycle and Value Chain

Kyrgyzstan

2022

Acknowledgement

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BREEAM	Building Research Establishment Environmental Assessment Method
BRP	Building Renovation Passport
CdTe	Cadmium Telluride
CDW	Construction and Demolition Waste
CIGS	Copper Indium Gallium Diselenide
c-Si	Crystaline Silicate
CEM	Cement
CO_2	Carbon Dioxide
CPR	Construction Product Regulation
COP	Coefficient of Performance
DALI	Digital Addressable Lighting Interface
DCF	Discounted Cash Flow
DBL	Digital Building Logbook
EBRD	European Bank for Reconstruction and Development
EDGE	Excellence in Design for Greater Efficiencies
EE	Energy Efficiency
EEEF	European Energy Efficiency Fund
EEFIG	Energy Efficiency Financial Institutions Group
EN	European Norms
EPBD	Energy Performance of Building
EPD	Environmental Product Declaration
ESA	Energy Service Agreement
ESCO	Energy Service Company
ESG	Environmental, social and governance
EU	European Union
EVC	European Voluntary Certification
GBC	Green Building Council
GBG	Green Building Guidelines, Through the Building Lifecycle and Value Chain [this publication]
GHG	Greenhouse Gas
GIFA	Gros Internal Floor Area
GPP	Green Public Procurement
hEN	Harmonised European Standards
HLPF	High-level Political Forum

HVAC	Heating Ventilation and Air-Conditioning
IAQ	Indoor Air Quality
ICN	Interstate Construction Norms
IEA	International Energy Agency
IFC	International Financial Corporation
IPCC	Intergovernmental Panel for Climate Change
KyrSEFF	Kyrgyz Sustainable Energy Financing Facility
kWp	Kilo Watt Peak Power Capacity
kWth	Kilo Watt Thermal Capacity
LCA	Lifecycle Assessment
LCC	Lifecycle Cost
LED	Lighting Emitting Diodes
LEED	Leadership for Energy and Environmental Design
LEPB	Law on Energy Performance of Buildings
m^2	square metre
MDF	Medium Density Fibreboard
NGO	Non-governmental Organisation
NFRD	Non-Financial Reporting Directive
NZEB	Nearly Zero Energy Buildings
OSB	Oriented Strand Board
PCR	Product Category Rule
PEF	Product Environmental Footprint
PV	Photovoltaics
RE: FIT	UK National Energy Performance Contracting Framework
SCIESU	State Committee on Industry, Energy and Subsoil Use under the Government of the Kyrgyz Republic
SCP	Sustainable Consumption and Production
SDGs	Sustainable Development Goals
SFDR	Sustainability-related Disclosures in the Financial Services Regulation
SME	Small and Medium Enterprises
SNiP	Building standards and technical rules
SPF	Seasonal Performance Factor
SWOT	Strengths Weaknesses Opportunities and Threads analyses
TCO	Total Cost of Ownership
TEG	Technical Expert Group
TF-Si	Thin Film Silicate
UK	United Kingdom

UN	United Nations
USA	United States of America
VAT	Value Added Tax
VNR	Voluntary National Review
VOC	Volatile Organic Compound
WBCSD	World Council for Sustainable Development
WGBC	World Green Building Council
WLC	Whole Life-cycle
µm	micrometre

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Foreword

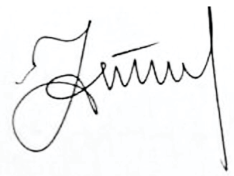
The concept 'Kyrgyzstan is a Green Economy Country', adopted by the Parliament of the Kyrgyz Republic on 28 June 2018 (No. 2532-VI)[1], provided the basis for the development of the Green Economy Development Programme for the period 2019–2023. Seven priorities within the Programme were identified: green energy, green agriculture, low carbon transport, green industry, sustainable tourism, green cities, and waste management. This unique opportunity to integrate Sustainable Consumption and Production (SCP) principles and Circular Economy approaches into national policies and sectoral plans supports the implementation of the seven priorities and achievement of the Sustainable Development Goals (SDGs) in Kyrgyzstan.

Kyrgyzstan has been actively participating in the global sustainable development process and developed its first Voluntary National Review (VNR) for the 2020 High-level Political Forum (HLPF) in July 2020. The Government has introduced various policies to promote green economy principles in the Kyrgyz Republic, aimed at accomplishing the SDGs by implementing SCP policies for the medium- and long-term.

Integrating SCP and Circular Economy approaches, in particular in the building sector by delivering on the Green Economy policy, is considered a priority for which the European Union (EU) SWITCH-Asia Programme is providing valuable support. The objective is to promote SCP implementation in Kyrgyzstan by enhancing the SCP and Circular Economy approaches in the building sector with a focus on energy efficiency. The intensive use of natural resources for buildings and construction in Kyrgyzstan makes a significant contribution to economic growth in the short term, yet it is important to understand that in the long term it will lead to significant negative consequences if sustainable business models are not adopted across the value chain in time.

The Green Building Guidelines (the 'Guidelines' or the 'GBG') developed by this publication will facilitate introducing building sustainability concepts along the value chain and addressing all the actors (e.g. developers; architects and designers; manufacturers of building materials, components and systems; asset managers; etc.) involved in the lifecycle of a building – from development stage through construction and operation, and up to the end of life with demolition of the buildings and remediation of the building site. The GBG provides practical recommendations illustrated by examples for introducing SCP, the decarbonisation of buildings, and circular economy concepts in the value chain of buildings and construction industry. These Guidelines were prepared with the support of the Sustainable Consumption and Production Facility (SCP Facility) of the SWITCH-Asia Programme. The report analyses policies along with the legal and regulatory documents related to SCP in the building and construction sector, and includes international best practices as well. Kyrgyzstan does not yet have a stand-alone national action plan or a roadmap on SCP. The Guidelines could serve as the basis for SCP roadmap preparation and including the action and capacity development plan on the importance of the building sector and construction.

On behalf of the Ministry of the Economy and Commerce of the Kyrgyz Republic, I would like to express my deep gratitude to the SCP Facility team of the SWITCH-Asia Programme and to all those who have helped in the preparation of these **Green Building Guidelines**.



Mr. Choro Seitov
First Deputy Minister, Ministry of Economy and Commerce

1 http://cbd.minjust.gov.kg/act/view/ru-ru/83126

Executive Summary

SWITCH-Asia is the largest Sustainable Consumption and Production (SCP) technical assistance programme supported by the European Union, involving 24 countries in Southeast Asia, South Asia, Central Asia, Mongolia and China. In line with the priorities of the European Green Deal, the programme aims to promote sustainable and inclusive growth in Asia, decoupling it from environmental degradation and supporting Asian countries in their transition towards a low-carbon, resource-efficient and a more circular economy while contributing to poverty reduction. The programme promotes mainstreaming SCP in relevant national policies, and supports the transition towards a green economy, poverty reduction and climate mitigation.

The objectives of these Guidelines are to address the gaps in capacity and knowledge among Kyrgyz market players and policy makers with respect to green buildings and building sustainability. These Guidelines will help raise both the awareness and the capacities of the targeted audience by providing practical advice for introducing building sustainability concepts throughout the lifecycle of a building – from the concept and development stage through construction and operation, terminating with end of life with demolition of the buildings and remediation of the building site.

The built environment sector has a vital role to play in responding to the climate emergency. For buildings currently responsible for about half[2] of the global final energy consumption, decarbonisation of the sector is one of the most cost-effective ways to mitigate the worst effects of climate breakdown. In addition, more than half of global raw materials are used for buildings and broader construction. Over one third (35%) of total generated waste comes from the construction and demolition of built structures, and over one-third of drinking water is consumed by building occupants and building services. Buildings thus leave a major environmental footprint and generate about 39% of global carbon emissions, including 28% of CO_2 emissions during the operation stage, and another 11% of embodied carbon arising from the energy used to produce materials and during the construction stage.

The expert community recognises that decarbonising buildings is one of the most cost-effective ways to mitigate the worst effects of the impending climate breakdown. According to the UN IPPC report mentioned below (see Chapter 1)[3], the world needs to dramatically reduce the carbon emissions associated with building construction, use and deconstruction some 80%–90% by 2050 in order to limit global warming to no more than 1.5 °C. At the same time, the worldwide building stock is expected to double by 2050, and given that buildings will be expected to deliver more in terms of indoor comfort, conveniences and entertainment, carbon emissions are set to increase exponentially if little or nothing is done to reduce them.[4]

In light of these considerations, this set of Guidelines presents the following:

- A review of good international practices demonstrating energy efficiency integration, sustainability and circular economy considerations in building codes, outlining the most relevant policy, regulatory and market improvements that can be implemented in the local context

- A review of existing policies, energy efficiency regulations, institutional arrangements on the national level related to energy and resource efficiency, sustainability and improved environmental

2 This includes the energy consumption of building services during operation stage of a building (at about 40%) and over 10% of energy consumption for upfront energy use (embodied energy in building materials, transportation and the construction process), as well as the energy required for demolition at the end of a building's lifecycle. World Green Building Council, Advancing Net Zero, 2019.
3 United Nations Intergovernmental Panel on Climate Change (IPCC 2018 report), *Global Warming of 1.5 ºC*.
4 World Green Building Council, Bringing Embodied Carbon Upfront, 2019.

performance of buildings, and identifying options for improvement including minimum energy requirements, green technologies and standards

- Identification of amendments in technical standards and regulations, and some practical recommendations on the improvement of energy and resource efficiency, circular economy practices in existing policy and the regulatory framework while taking into account the review of both gaps in and barriers to national frameworks as well as applicable lessons learnt from international best practice

- Practical suggestions for adapting international good practice for Kyrgyzstan's own particular context, and to encourage environmental sustainability and circular economy concepts in buildings at the local level

- Development of a comprehensive definition of the 'green building' via credible international references to take into account the local context of climate conditions and the building typology in Kyrgyzstan

- Publication of these ***Green Building Guidelines (GBG)***, which introduce technical building sustainability concepts throughout the lifecycle of a building and provide practical recommendations illustrated by examples for introducing SCP, decarbonization of buildings and circular economy concepts in the value chain of buildings and the construction industry. The Guidelines explain the benefits of green buildings from the business point of view as well as from a broader social perspective. They also provide an overview of green building opportunities through the value chain of buildings: from planning and design, through construction and operation until end of life of buildings

- New legislation has allowed the Kyrgyz Republic to become a pioneer and the first country in the post-Soviet region (with exception of the three Baltic states) to implement energy efficiency legislation for buildings, based on best practices from the European Union (EU).

The *Green Building Guidelines* may be found in Section 7 of this publication.

Background

Many countries in Asia are undergoing rapid industrial transformation which in turn is significantly deteriorating the environment. Activities of the industrial sector, such as the burning of fossil fuels, contribute to increases in greenhouse gas emissions and waste, affecting climate change and provoking natural disasters. Changing production and consumption patterns, along with decoupling economic growth from environmental degradation and natural resource depletion are urgent challenges. For this reason, the European Commission (EC) launched the SWITCH-Asia – Promoting Sustainable Consumption and Production (SCP) programme in 2007 to support the transition towards a low-carbon, resource-efficient and circular economy.

SWITCH-Asia is the largest SCP programme supported by the European Union, involving 24 countries in Southeast Asia, South Asia, Central Asia, Mongolia and China. In line with the priorities of the European Green Deal, the programme aims to promote sustainable and inclusive growth in Asia, decoupling it from environmental degradation and supporting Asian countries in their transition towards a low-carbon, resource-efficient and more circular economy, and contributing to poverty reduction at the same time. The programme promotes mainstreaming sustainable consumption and production in relevant national policies and supports the transition towards a green economy, poverty reduction and climate-change mitigation.

The second phase of SWITCH-Asia was launched in 2018, and in July 2019, the programme was extended to five Central Asian countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. The last call for proposals was launched in 2019, and 23 new grant projects were awarded, out of which seven, focused on the tourism, agri-food and textile sectors, were awarded to the Central Asian region.

Through a combination of grant-funded projects and networking, the programme is expected to achieve the following goals:

1. A higher use of environmentally friendly technologies and practices
2. Changes in consumer behaviour to less damaging consumption patterns
3. Improved policy dialogue on SCP at national and regional levels in Asia, eventually with a common platform to promote SCP
4. Initiating active and continuous dialogue on SCP priorities and needs at national, regional and international levels through sharing and learning
5. The development of effective economic instruments that will enhance SCP

In 2017 the EC established the SWITCH-Asia SCP Facility in Bangkok, Thailand, to better facilitate coordination and implementation of the programme, and to function as a backbone for the SWITCH-Asia Programme, thus providing a single platform for all SWITCH-Asia projects to maximise their results, further promote SCP policies and principles, and support the delivery of the United Nations Sustainable Development Goals (SDGs). The Regional Central Asia office is located in Almaty, Kazakhstan, providing liaison between the Central Asia Region and the Head Office in Bangkok. Activities at the regional level are focused on supporting the countries covered under the SWITCH-Asia Programme through the following actions:

- Mainstreaming SCP into national policies to promote the implementation of green economy strategies and concepts
- Raising awareness among all stakeholders via outreach efforts

- Promoting best practices to ensure future sustained improvements in SCP patterns
- Building capacity of government officials and other key stakeholders
- Enhancing dialogue on local and regional SCP priorities
- Enabling the adoption of cleaner technologies and practices – particularly by micro-, small- and medium-sized enterprises (MSMEs)

Intensive use of natural resources in Kyrgyzstan certainly makes a significant contribution to economic growth in the short term, yet it is important to understand that in the long term such use will lead to significant negative consequences including widespread poverty and poor health caused by polluted air, poor quality drinking water, and shortages of food and energy.

Kyrgyzstan has participated in global sustainable development processes and has developed its first Voluntary National Review (VNR) for the 2020 High-level Political Forum (HLPF).[5] The government has introduced various policies to promote green economy principles in the Kyrgyz Republic, aimed at realising SDGs through implementation of the SCP approach for medium- and long-term policy.

The green economy is defined as an economy that results in improved human well-being and social equity, while significantly reducing environmental risks, preserving and increasing natural capital, effectively using resources and stimulating the conservation of the country's natural ecosystems.[6] Under a green economy, growth in income and employment is driven by public and private investment to reduce carbon emissions and pollution, create green jobs, and improve the efficiency of energy use, resources and ecosystem services.

The concept of 'Kyrgyzstan is a Green Economy Country' was adopted by the Parliament of the Kyrgyz Republic on 28 June 2018 (No 2532-VI) and it led to the development of the Green Economy Development Programme for the implementation of Green Economy for the period 2019–2023. [7]Seven priorities were identified within this programme: green energy, green agriculture, low carbon transport, green industry, sustainable tourism, green cities, waste management.

Integrating SCP and Circular Economy approaches into the delivery of the Green Economy policy, in particular in the building sector, is considered a priority for which European Union (EU) SWITCH-Asia is providing support. The objective here is to promote SCP implementation in Kyrgyzstan by enhancing SCP and a circular Economy approach in the building sector with a focus on energy efficiency.

Originally, SCP was defined in 1994 by the Oslo Symposium 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 not to jeopardise the needs of future generations'.[8]

More recently, with the development of a policy framework focused on sustainability and environmental protection, this definition has broadened and evolved. While SCP may be open to interpretation, certain overarching concepts weave together broad areas of consensus to establish a holistic approach that transcends regions and sectors of activity. 'Sustainable consumption and production' means systemic change, and it proposes decoupling economic growth from environmental degradation and applying a life-cycle thinking approach, taking into account all phases of resource use to do more and better with less. Only by paying attention to both sides of the equation – consumption and production – will the type of transformative change that is needed become possible. This is the

5 https://sustainabledevelopment.un.org/memberstates/kyrgyzstan
6 UN Environment Programme: https://www.unep.org/pt-br/node/23750
7 Mineconom.gov.kg
8 Oslo Symposium 1994: https://sustainabledevelopment.un.org/topics/sustainableconsumptionandproduction

concept of SCP embedded in the EU Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy.[9]

Thus a green building accommodating SCP principle is a building that, in its design, construction or operation, reduces or eliminates negative repercussions, and that can create positive effects on climate and the natural environment. Green buildings preserve precious natural resources and improve the quality of people's lives. There are a number of features that can make a building 'green' or 'sustainable'. These include:

- Efficient use of energy, water and other resources
- Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling
- Good indoor environmental air quality
- Use of materials that are non-toxic, and ethically and sustainably sourced
- Consideration of the environment in design, construction and operation
- Consideration of the quality of life of occupants in design, construction and operation
- Design that enables adaptation to a changing environment

Any building can be a green building, whether it's a home, an office, a school, a hospital, a community centre, or any other type of structure, provided it includes features from those listed above. However, it is worth noting that not all green buildings are – or need to be – the same. Different countries and regions have a variety of characteristics such as distinctive climatic conditions, unique cultures and traditions, diverse building types of different ages, or wide-ranging environmental, economic and social priorities – all of which shape their approach to green/sustainable building.

This Report and the Green building Guidelines attached define criteria for 'green buildings' in the market context of Kyrgyzstan, while taking into account the international research that has already been done on the subject.

9 EU Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy COM(2008) 397 final

1. INTRODUCTION AND NATIONAL CONTEXT

Kyrgyzstan is considered one of the most vulnerable countries to climate change in Eastern Europe and Central Asia. Kyrgyzstan's land area is 90% mountainous, and more than 60% of the population live in rural areas. Poverty is major issue in Kyrgyzstan, with more than 30% of the population living below the poverty line. Climate change affects the most vulnerable communities in the country, making the situation even more challenging.[10]

As is the case with most countries, historically the development of the Kyrgyz Republic was aimed at achieving economic growth, mainly through the intensive and irrational use of natural resources. This depletion of natural capital through active exploitation has been exacerbated by poor management that prevents ecosystems from recovering. In recent years, it has become clear that the methods of economic growth such as those in Kyrgyzstan, without due consideration for environmental and social factors, pose a serious threat to both current and future generations.

The landmark 2018 special report from the United Nations Intergovernmental Panel on Climate Change (IPCC 2018 report), *Global Warming of 1.5ºC*, presented a stark picture of the dramatically different world we will inhabit if global average temperatures rise by 2 °C compared to a 1.5 °C scenario. The catastrophic breakdown of climate associated with the difference between these two scenarios is likely to result in entire eco-systems being destroyed. And the global negative impact of additional heating and cooling demand on the economy is expected to increase fourfold by the end of the century. The consequences will be long-lasting, and in some cases irreversible. This emergency calls for urgent action now to radically transform current unsustainable models of consumption, particularly in the building sector due to its high demand on resources throughout the entire life-cycle of buildings and the increasing demand and complexity buildings represent.

According to the UN IPPC report mentioned above, we will need to dramatically reduce carbon emissions associated with building construction, use and deconstruction by 80–90% by 2050 in order to put the world on a path to limit global warming to less than 1.5 °C. At the same time, the global building stock is expected to double by 2050. Given that buildings are expected to deliver more and better in terms of indoor comfort, convenience and entertainment, emissions will increase exponentially if little or nothing is done to reduce their carbon intensity. The expert community recognises that decarbonising buildings is one of the most cost-effective ways to mitigate the worst effects of the impending climate breakdown.

Decarbonising buildings applies equally to residential, public and commercial non-residential buildings. For instance, the International Tourism Partnership's *Hotel Global Decarbonisation Report*[11] concludes that 'to keep pace, the global hotel industry will need to reduce its greenhouse gas (GHG) emissions per room per year by 66% from 2010 levels by 2030, and 90% by 2050.' The International Energy Agency's (IEA) Energy Technology Perspective 2017 also provides information on the overall building sector.

To draw a quick comparison with the EU, which is probably the world's most-advanced market with regards to building sustainability and decarbonisation, over two-thirds (65%) of the European building stock was built before 1980, and about 97% of the EU's buildings must be upgraded to

10 The National Statistic Committee of the Kyrgyz Republic, Kyrgyzstan in Digits, www.stat.kg

11 International Tourism Partnership: Hotel Global Decarbonisation Report, 2017, https://buildingtransparency-live-87c7ea3ad4714-809eeaa.divio-media.com/filer_public/c4/9c/c49c0756-d91b-43b6-9819-6f4a2215052b/wc_am-hoteldecarbonizationreportpdf.pdf

achieve the 2050 decarbonisation goal, but only 0.4–1.2% are being renovated each year. 'Deep renovation' as used in the EU is a term for renovations maximising the full energy efficiency potential of improvements – in particular the building shell – for existing buildings, leading to a very high-energy performance. The energy reductions for renovated buildings can reach 75% or more compared to the status of the building before deep renovation.[12] Accelerating the rate of deep renovations to a minimum of 5% (from the present <1.2%) and transitioning to new construction at Nearly Zero Energy Building (NEZB) requirements will obviously require upscaling both financing as well as the supply of technologies. Research on the latter points out that the supply of basic technologies related to improving the carbon performance of buildings will require increasing supply by a factor of 2–3 compared to the present situation. For some other technologies (e.g. waste heat recovery ventilation, renewable energy applications, building automation and control, etc.), which will become mandatory to achieve the NZEB requirements, but have a lower market penetration at present, the rate of increase of supply will need to multiply by a factor of 8–10 compared with the current market supply.

The European energy and resource efficiency regulation on energy performance of buildings is probably the most complex and comprehensive set of building regulations currently in use, and has therefore been used as a model for designing the current legislation on energy efficiency for buildings in Kyrgyzstan. It is thus important to follow any further development of the European legislation and broaden the scope from energy efficiency to wider environmental and sustainability considerations, including for integration of SCP practices and circular economy requirements in buildings.

These *Green Building Guidelines, Through the Building Lifecycle and Value Chain* (GBG) are expected to review the current situation of the building sector in Kyrgyzstan, draw on applicable lessons learnt from international best practice experiences, and suggest recommendations applicable for market development of building sector in Kyrgyzstan. They provide some analysis on improving and strengthening market conditions for supporting the introduction of SCP and Circular Economy concepts in buildings. They focus on understanding the landscape of existing policies, energy efficiency regulations, and institutional arrangements on the national level related to SCP and Green Economy in the Kyrgyz Republic. They provide a general overview of SCP practices and opportunities for improvement in both construction materials industries as well as the operation of buildings through their life-cycle, and reflect the market specifics in the Kyrgyz Republic. The most relevant improvements that can be implemented in the local context are identified and elaborated in detail. This publication also identifies gaps and barriers in the current legal framework on energy efficiency in public buildings, based on international best SCP practices, and it provides recommendations on measures for improving the capacity of SMEs in energy efficiency.

From perspective of the national context a focus on energy efficiency, SCP and overall sustainability of the building sector is particularly relevant for Kyrgyz Republic where nearly 85% of the housing stock, 77% of the administrative buildings and over 60% of public buildings such as schools and hospitals were built before 1991 (*Green Economy Development Program for 2019–2023*, 2019). These buildings were built according to building code requirements developed during the Soviet period with almost no considerations for energy efficiency or other sustainability considerations, and are no longer in line with today's energy efficiency performance benchmarks and technological advances. As a result, the country's buildings are subject to high heating losses (70%), which in turn puts heavy pressure on the national energy demand.

The energy sector accounts for the largest share (61.1%) of total greenhouse gas (GHG) emissions in the Kyrgyz Republic (*USAID, 2017*). The building sector in particular constitutes over 70% of total electricity consumption and contributes to 35% of the country's GHG emissions (World Bank, 2019).

12 Shnapp, S., Sitjà, R., Laustsen, J., What is a Deep Renovation? Technical Report, Global Buildings Performance Network, 2013, p. 19. https://www.gbpn.org/report/what-deep-renovation-definition-3/

The reason for such high carbon intensity is that most of the country's existing building stock was constructed 35 to 50 years ago, during the Soviet era. Lack of maintenance and the absence of timely retrofit have brought these buildings to a condition of obsolescence, resulting in significant high heat losses. Such losses multiply the energy demand per m^2 up to 3–5 times more than in countries with comparable climate conditions and building typologies in the EU (*UNDP, 2008*). In addition, new building stock is growing at a rapid pace.

Domestic migration from rural to urban areas coupled with a population growth of 14% between 2009 and 2017 increased urban housing demand by 27% during the same time period (*Green Economy Development Program for 2019–2023*, 2019). As a result, from 2006–2015 the electricity demand in the country rose by 52%. Public and residential buildings accounted for nearly 70% of this increase (*International Energy Charter, 2018*). Combined with low energy efficiency in the building stock, this increase made the country's electricity consumption grow faster than its capacity to generate electricity, over 90% of which is generated through hydropower. Since 35% of urban heating comes from electricity, demand triples during the winter months, from November to March (*World Bank, 2015*). This leads to a 20–25% gap in heating supply in public and residential buildings and to a low comfort level in many buildings, while at the same time creating a dependency on energy imports. Due to seasonal winter domestic shortage in electricity generation, heavily dependent on hydropower plants, 40% of the fuel for electricity generation is imported from neighbouring countries to meet the country's electricity needs (*UNECE, 2018*). The *Updated Nationally Determined Contribution 2021 of Kyrgyz Republic* estimates that the country's energy sector generated 66% of the CO_2 in Kyrgyzstan, and that improvements could reduce the country's CO_2 contribution some 40% by 2030. In particular, the potential for energy savings in public and residential buildings through energy efficiency measures and energy saving technologies would amount to nearly 40%, according to the World Bank (2019). *The Green Economy Development Program* hence identifies energy efficiency in buildings as one of its seven priority focuses.

2. DEFINITIONS OF ‘GREEN BUILDINGS‘

This publication, *Green Building Guidelines*, is part of the broader cycle of SCP Switch-Asia initiatives for Kyrgyzstan, continuing the work published in 2021 in the analytical report titled *Enhancing Sustainable Consumption and Production Tools and a Circular Economy in Kyrgyzstan: Approach in the Building sector with a Focus on Energy Efficiency*. Both these publications were produced by the Unison Group in partnership with the Ministry of Economy and Commerce of the Kyrgyz Republic. Their goal is to increase knowledge and improve awareness of the issues involved in ‘green buildings’ for Kyrgyz government officials and relevant stakeholders so as to encourage them to adopt recognised good practices and utilise the tools already in use in the building sector in the EU.

The World Green Building Council (WGBC), which represents a significant part of the global professional construction community, has provided a clear definition for the term ‘green building’: ‘A green or sustainable building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and that can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life.

There are a number of features that can make a building ‘green’ or ‘sustainable’. These include:

- Efficient use of energy, water and other resources
- Use of renewable energy, such as solar energy, biomass, and others
- Pollution- and waste-reduction measures, and re-use and recycling practices
- Good indoor-environment quality
- Use of materials that are non-toxic, ethical and sustainable
- Consideration of the environment in design, construction and operation
- Consideration of the quality of life of occupants in design, construction and operation
- Design that enables adaptation to a changing environment’[13]

Specific areas of environmental impacts, with practical objectives and measurable indicators are explained further.

Energy and carbon performance toward decarbonisation

In order to reduce the carbon footprint of buildings, issues such as the energy efficiency of building services, renewable energy, good thermal protection, lower-carbon and/or more sustainable construction materials effectively, among others, must be addressed.

The objective here is to reduce total greenhouse gas emissions (GHG) along the entire life cycle of a building, focusing on energy-related emissions first at the building stage, and then in the usage phase of that building. The GHG emissions resulting from the building materials used, and those resulting from the entire building’s life cycle, must be assessed from the outset of a building project.

This objective includes actions to be taken with a focus on:

13 World Green Building Council: https://www.worldgbc.org/what-green-building

1. Energy performance during the use phase, including the contribution of cost effective and low/zero emissions energy technologies and infrastructure,

2. Reduction of embodied greenhouse gas emissions along the building life cycle, including those associated with the manufacturing of construction materials. There could be potential trade-offs between the production stage and the use stage, so as to enable minimisation of total GHG emissions along the life cycle.

Carbon emissions during operational stage are dependent on energy used in the building and its services. We distinguish between *final energy*, which can be measured and for which end-use customers are paying according to energy tariffs; and *primary energy*, which is calculated on the basis of primary energy inputs and system efficiency at all stages of energy generation, transportation and use. *Primary energy* is defined by the EU Building Directive as 'the energy that has not undergone any conversion in the transformation process, calculated by energy carrier using a primary energy factor'. It is the energy that is required to generate the electricity, heating and cooling used by the end-use customer in a building. It could be broken-down into renewable, non-renewable and exported energy. This is so that the benefits of generating low carbon or renewable energy can be taken into account. *Delivered* and *final energy* are the energy forms delivered to the building as electricity, heat and fuel. It is the energy per '*carrier*' supplied to the building, to satisfy uses within the building (heating, cooling, ventilation, domestic hot water, lighting, appliances, etc.). Delivered energy is generally the one metered by the utilities.

Use stage energy demand is responsible for the majority of life-cycle energy used in the case of buildings constructed before the year 2000 in Europe and before introduction of stricter energy efficiency criteria by the LEPB in Kyrgyzstan. Reporting on primary and final energy demand might be required for the purpose of building permits, while the LEPB requires an Energy Performance Certificate (EPC) to be issued when a building is commissioned or sold. The EPC includes the energy performance of a building (primary energy demand) and reference values such as minimum energy performance requirements, or additional information such as the annual energy consumption for non-residential buildings and the percentage of energy from renewable sources in the total energy consumption.

For new buildings constructed after adoption of the LEPB, carbon emissions during the usage stage might be responsible for a smaller share at about 30–40% from the overall life cycle energy use, depending on the building type, form and specification. The remaining share (60–70%) of the whole-life carbon footprint is associated with the up-front emissions including mostly in embodied energy and carbon of construction materials used and to lesser extent in emissions associated with the construction and deconstruction process.

Indicator of lifecycle carbon emissions is the Global Warming Potential (GWP)

This indicator explains the contribution of a building to global warming along its life cycle. This is sometimes also referred to as a carbon footprint assessment, or whole-life carbon measurement. It includes the assessment of the overall lifecycle CO_2 emissions – those that are result of processes to produce, construct, use, repair, maintain, renovate and eventually deconstruct a building.

The strategies to reduce the whole-life cycle carbon footprint should proceed along the following steps:

1. Design the site for the building, its size, shape and connectivity in a way to reduce future energy and resource demands and by minimising the need for any external delivered energy in future (i.e. apply passive energy solutions using energy from the ambient environment).

2. Apply advanced energy efficiency techniques following the *energy efficiency first principle* in design. That means applying the best practice thermal protection of building fabric (thermal insulation of building envelope, roof, floors, energy efficient windows and doors), reducing the rate of uncontrolled air infiltration by making the building airtight in order to reduce as much as possible the energy needs in synergy with passive systems. Thereafter apply efficient building services: space heating and domestic hot water, mechanical ventilation with waste heat recovery, efficient air-conditioning if and where needed, efficient lighting, and any other electrical services (e.g. for vertical and horizontal transportation) and for any electrical infrastructure equipment (transformers, switchgear, etc.), as well as advanced systems for building management and automation (e.g. building energy and management systems). Applying the energy efficiency first principle makes it possible to reduce the need for any delivered energy from utilities to a minimum, and to minimise the size and capacity of mechanical and electrical building services. Once advanced measures to reduce energy demand are incorporated, make sure to use any delivered energy as needed as efficiently as possible and potentially cover as much of it by deployment of renewable energy.
3. Installation of on-site renewable energy: solar thermal or biomass (for space heating and domestic hot water), or solar PV or micro-wind generation for electricity. Renewable energy is also the ambient energy (from air, water or ground) which could be used by heat pumps. The electricity needed by the compressor and pumps for heating can be supplied by an on-site PV system with battery storage or with invertors for selling peak electricity to the grid.

The overall objectives inf adopting the process listed above is to achieve a zero-energy or zero-carbon building. The professional community distinguishes among several categories of low-carbon buildings, each with very distinct definition:

- **Energy efficient buildings** can be defined as buildings adopting energy efficiency techniques, defined by UNIDO[14] as the extent to which the energy consumption per m^2 of floor area of the building measures up to established energy consumption benchmarks for that particular type of building under defined climatic conditions. Building energy consumption benchmarks are representative values for common building types against which a building's actual performance can be compared. The benchmarks are derived by analysing data on different building types within a given country. The typical benchmark is the median level of performance of all the buildings in a given category and good practice represents the top quartile performance. Comparisons with simple benchmarks of annual energy use per m^2 of floor area or treated floor area (kWh/m^2/annum) allow the standard of energy efficiency to be assessed and priority areas for action to be identified. Benchmarks are applied mainly to heating, cooling, air-conditioning, ventilation, lighting, fans, pumps and controls, office or other electrical equipment, and electricity consumption for external lighting. The benchmarks used vary with the country and type of building.
- **The energy performance of a building** defined by the EU Building Directive means '*the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting*'.
- **Nearly-Zero Energy Building** (NZEB), as defined by the European Building Directive (EPBD) is '*a building that has a very high energy performance… [ ]. The nearly zero or very low amount of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby*'. The EPBD states that Member States shall detail NZEB definitions at national level by reflecting national, regional or local conditions, and including a numerical indicator of primary energy use expressed in kWh/m^2 per year. Primary

14 UNIDO. Energy efficiency in buildings, Module 18,

energy factors used for the determination of the primary energy use may be based on national or regional yearly average values taking into account relevant EN European standards.

- **Passive house building** (PHB) is a highly energy efficient building compliant with the principles developed by the Passivehouse Institute.[15] A **Passive House** is defined 'as a building, for which thermal comfort (ISO 7730) can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air'. The Passive House is not an energy standard but rather an integrated concept assuring the highest level of comfort. The above is a purely functional definition which does not contain any numerical values and is valid for all climates. This heating concept automatically implies extremely low energy consumption. Using fresh ventilation air for heating without an additional heating system can work only in buildings with very low net heat losses. This requires an excellent insulation of the building envelope – especially in cold climates to keep the desired warmth inside the building, but also in hot climates to keep undesirable heat out. The calculation of the energy balance will help determine the level of insulation that will be required in a given building and climate.
- A **Zero Energy Building** (ZEB), also known as a **Net Zero Energy** (NZE) building, or a **Zero Net Energy** (ZNE) building, is a building with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site[16] or in other definitions by renewable energy sources off-site, using technology such as heat pumps, high efficiency windows and insulation, and solar panels, to name just a few technologies.
- **Zero-carbon-ready building**, is defined by the IEA[17] as 'highly energy efficient and either uses renewable energy directly, or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heat, This means that a zero-carbon-ready building will become a zero-carbon building by 2050, without any further changes to the building or its equipment.'
- **Net zero whole life carbon building** (new or renovated) is a highly energy efficient, with upfront carbon reduced to the greatest extent possible and all remaining carbon reduced or, as a last resort, offset in order to achieve net zero across the entire remaining lifecycle.

All of the above definitions (with exception of the Net zero whole-life carbon building) were used to explain the energy and carbon footprint during use stage of the building. In the next section we discuss how to improve the up-front emissions, which encompass embodied energy and carbon in construction materials and the emissions due to use of energy in the process of construction.

Resource efficiency and circularity

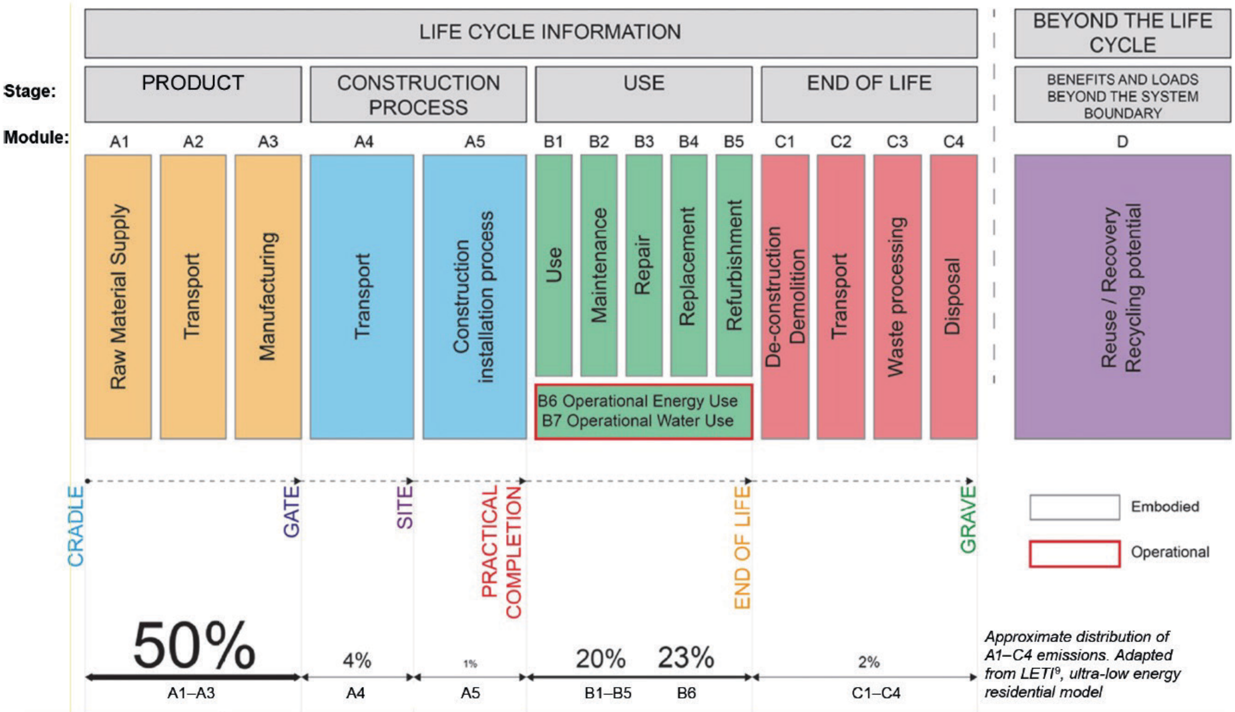
This objective of better material and resource efficiency, and adoption of circularity feeds into reducing the whole-life cycle carbon footprint beyond operational emissions, was elaborated in the previous section. It encompasses actions targeting reduction of upfront and embodied carbon footprint as well as in relation to emissions at deconstruction stage. that can be taken at building level with a focus on material efficiency and circular utility. It covers actions along the life cycle relating to construction product manufacturing, building design, structural engineering and construction management, and addressing replacement cycles, adaptability and deconstruction. The overall objective shall be to reduce waste, optimise material use and reduce the life cycle environmental impacts of designs and material choices. This can be done using metrics to measure specified building elements or waste, but also by looking at potential performance over use-stage of the building.

15 Passivehouse Institute: https://passivehouse.com/
16 US Department of Energy. September 2015. A common definition of Zero Energy Buildings, 2016
17 IEA, Net Xero by 2050, 2021: https://www.iea.org/reports/net-zero-by-2050

The definitions used below are adopted from the WGBC *Bringing Embodied Carbon Upfront* (2019). They make reference to the lifecycle modules set out in European standard *EN15978: Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method*. It is noted that this standard is being reviewed at present by CEN Technical Committee 350 – Working Group 1 - Environmental performance of buildings. These definitions may be amended son to ensure they remain aligned with a future update of the European standards.

The standard distinguishes among the following stages of lifecycle as illustrated in Fig. 1.

Fig. 1. Life cycle stages.



Source: The Institute of Structural Engineers: How to calculate embodied carbon, 2020

Figure 1 provides a break-down of carbon emissions from Modules A1–C4 shown at the bottom, using example data across all building elements for a medium-scale residential building in Europe. Operational carbon modules are outlined in red. For a highly energy efficient building, using common practice brick and concrete for structural elements the share of upfront emissions (modules A1 to A5) would be higher and we estimate at around 65–70%. This is because of a) higher carbon content of common practice building materials as used in Kyrgyzstan, and b) the low carbon intensity of Kyrgyz grid electricity. For buildings compliant with the current provisions of the LEPB, the share between upfront and operation carbon would be in the magnitude of 35–40% to 60–65% for upfront and operational carbon, respectively. Below are a few basic definitions of the terminology used:

Carbon emissions: Refers to all emissions of greenhouse gases (GHG). Their global warming potential (GWP) is quantified in units of carbon dioxide equivalence.[18] A kilogram of carbon dioxide therefore has a GWP of 1 kgCO_2-e.

Whole life carbon: Emissions throughout the lifecycle of a built asset as defined in European standards (particularly EN15978 and EN15804). The lifecycle as defined within these standards

18 Because different greenhouse gases can remain in the atmosphere for different lengths of time, their GWP will change if a shorter or longer time period is used. It is best practice to report the time period used alongside results and divergence from the widely used GWP100 [years] should be explained

(modules A-C) encompasses both embodied and operational carbon. The standards also describe module D, which contains important information concerning benefits and impacts from product reuse, material recycling and exported energy/energy recovery that has not been accounted for in modules A-C. Module D should always be reported, but should be shown separately in the assessment for transparency to ensure consistent accounting if these same reused products, recycled materials, or exported energy/energy recovery are assessed again as part of their subsequent use in the following system or next building life cycle, to ensure double accounting of loads and benefits can be avoided. There may be scope to count benefits beyond the system boundary towards a net zero carbon balance.

Embodied carbon: Because different GHG can remain in the atmosphere for different lengths of time, their GWP will change if a shorter or longer time period is used. It is best practice to report the time period used alongside results and divergence from the widely used GWP100 [years] should be explained. Carbon emissions associated with materials and construction processes throughout the whole lifecycle of a building or infrastructure. Embodied carbon therefore includes: material extraction and upstream production (module A1)3 , transport to manufacturer/factory (A2), manufacturing (A3), transport to site (A4), construction and installation processes (A5), use phase (B1), maintenance (B2), repair (B3), replacement of building components (B4), refurbishment (B5), deconstruction (C1), transport to end of life facilities (C2), processing for reuse, recovery or recycling (C3), disposal of waste (C4). Benefits and loads from product reuse, material recycling and exported energy/energy recovery beyond the system boundary (D) should be reported separately to modules A-C according to EN 15978 and associated standards.

Upfront carbon: The emissions from the materials production and construction phases (Module A in Fig. 1) of the lifecycle before the building or infrastructure begins to be used. In contrast to other categories of emissions listed here, these emissions have already been released into the atmosphere before the building is occupied or the infrastructure begins operation.

Use stage embodied carbon: Emissions associated with materials and processes needed to maintain the building or infrastructure during use such as for refurbishments. These are additional to operational carbon emitted due to heating, cooling and power, etc.

Operational carbon: The emissions associated with energy used (module B6 under EN 15978) to operate the building or in the operation of infrastructure.

The basic strategy for improving material efficiency or reducing upfront carbon footprint and emissions during the end-of-life stage (deconstruction and disposal of construction and demolition stage) encompasses four main strategies:

- Adopt design maximising resource efficiency, particularly of carbon intensive materials – concrete, reinforced concrete, aluminium and steel. Over-specification of these carbon intensive materials should be avoided as well. There are structural solutions which could considerably reduce the extent of material use by use of clever engineering and more accurate modelling.
- Give preference to lower-carbon materials, preferably of local origin and of higher lifespan. These could be natural materials with embodied energy or carbon-like earth structures, natural stone, straw bales, mud bricks or combination of the above. Alternatively these could be manufactured materials with a lower carbon footprint (as documented by EPDs or PEFs) like low-carbon concrete, aerated blocks instead of classical bricks, etc. Use of reclaimed material or those made of recycled resources (steel) could also provide a good advantage.
- Consider design concepts that take into account future deconstruction of the building and possible reuse, recycling of individual building components at the stage of deconstruction.

- Use responsible construction techniques at the stage of construction or renovation. Applying prefabrication as much as possible will not only save time, efforts and resources at construction, but this will reduce the amount of construction waste generated on-site and improve material efficiency as prefabricated components are likely to be produced by the manufacturer at a higher grade of material efficiency in their manufacturing facilities.

Efficient use of water

While using buildings we drink, cook, use toilets, water our gardens, wash ourselves, our clothes and the building floors. Even during construction or renovations, builders use considerable amounts of water comparable with the amount of water used by manufacturers for production of construction materials. Offices and some categories of public and commercial buildings consume vast quantities of water for large scale catering, swimming pools, and other processes.

The water we receive and use in our buildings has undergone complex and energy-intensive processing to collect, clean at the required quality, and be pumped from water reservoirs to reach users in the buildings. That is why it is important to use water in the most efficient way, and particularly in regions exposed to water stress. Actions to minimise water use at the building level should take place in all areas, with a particular focus on water efficiency and reuse in buildings located in areas of continuous or seasonal water stress. Such actions could combine efficiency measures with supply-side measures such as grey water reuse and rainwater harvesting –e.g. for specific water uses like irrigation of landscaping areas, or for flushing toilets.

Planning authorities can set specific minimum water-efficiency requirements for sanitary fittings and devices or irrigation requirements at city level (e.g. Osh, or Talas), at regional level (e.g. oblasts of Osh) or as national building regulations. In regions where currently installed potable water and/or wastewater treatment plants are near maximum capacity, the water utility may act as expert counsel at the planning stage. The design team and the client would ultimately decide how ambitious the design should be in terms of water efficiency, based on knowledge of the water efficiencies of the sanitary devices and fittings, as well as water-consuming appliances currently on the market. It will be the job of the building contractors to then correctly source and install these fittings, devices and appliances to avoid leakage or any sub-optimal performance caused by poor installation. Asset managers should quantify water consumption, estimate the impact on operating costs and identify cost-effective savings where possible. Expert counsel together with assumed usage factors would thus make an estimation of the per capita water consumption possible even before the building is occupied. However, actual water consumption will ultimately be determined by occupant behaviour and occupancy rates, which can be accurately monitored via periodic meter readings. The most likely source of variations between estimated and actual per capita water consumption is an inaccurate estimate of occupancy rates, especially in buildings with a significant number of visitors. If greywater and/or rainwater harvesting systems are installed, a means of monitoring the total water passing out of storage tanks into water-consuming devices and fittings will be necessary.

Adaptability, resilience to climate change, and impact on biodiversity

Adaptability means building in such a way that buildings are capable of adapting to future changes in the climate, in order to protect health and comfort of those using the building, and to minimise risks to property values.

Buildings typically have a longer life-span than the timeframe of a single human generation. For most buildings this means that it is impossible to know at the design stage all the various potential activities and uses of a building over its entire life. The building may experience many changing functions over its operational life, and even if it is continuously used for the same purpose, for example as an office, the nature of office work might change over time. COVID-19 and provisions for restricted access to previous work places have demonstrated how this is possible. Therefore a building should be designed so as to accommodate a variety of different activities over its life-span, meaning it must be designed in a way that allows easy adaptation to changing activity patterns (e.g. new ways of working in offices), or to accommodate completely different activities (e.g. residential, retail, etc). Buildings and spaces that cannot accommodate these demands will frustrate occupants and hamper their business objectives and will lose value for their owners as well. Adaptable interiors are essential for business sectors likely to face uncertainty and following shifting markets.

In order to achieve better building adaptability it is important that designers consider how buildings will perform and change over time from the moment the building concept is created. Non-adaptable buildings will be condemned to rapidly becoming lost, obsolete resources. On the other hand, buildings which allow their systems or component parts to change will weigh more lightly on future uses of natural resources, and will provide better value for future generations. There are several simple concepts which can help to make a building a more adaptable:[19]

- Minimise the number of internal structural components (columns and load-bearing walls) and optimise the structural grid to allow for future uses. A simple structural grid is a better one.
- Allow some redundancy so that additions and future changes can be accommodated. Ensure that floor loads used in design reflect future foreseeable changes in occupancy patterns.
- Separate structure from cladding where possible in order to allow independent alterations and replacements.
- Allow for good vertical connectivity with spacious staircases, lifts and service routing.
- Separate services into clear, accessible locations to allow easy changes or upgrades. Raised floors can also permit easier upgrades of building services.
- Design with a building depth allowing as much daylight as possible.
- Integrate finishes so they can be easily upgraded and replaced without making access to other components difficult.
- Provide a 'loose-fit' to allow some redundancy to accommodate future additions and changes.
- Keep the design simple to facilitate future changes. Strong interdependence reduces the need for change.
- Provide sufficient space for machinery in order to allow easy dismantling, renovations or additions.
- Avoid any complex composite materials that would be difficult to separate in the future.
- Incorporate each component so that it can easily be replaced and recycled when obsolete.
- Consider drainage carefully as this can be a limitation factor in building modifications.

In addition to adaptability for future uses, it is important that the building be adapted to climate change. The less dependent the building is on external sources of energy, water or other utilities, as one example, the better. Utilities may become scarce in the future and excessive internal demand would become difficult or costly to meet. The design should also account for future climate risks: floods from increased precipitation, wildfires in case of heat waves and dry spells, cooling systems adapted to possible higher summer temperatures, structural components exposed to stronger winds, thus façades and roofs must be anchored appropriately for resistance.

Making the building future-proof will reduce exposure to future regulatory changes and preserve its functionality and value.

19 RIBA. The green building bible, Volume 1, Fourth Edition, 2009

Health and well-being in buildings

Indoor environment quality is an important aspect of the green building concept. People typically spend about 90% of their life in buildings, and the quality of the indoor environment directly affects their health. There are many sources of indoor pollution, including combustibles such as oil, gas, coal, wood, and tobacco products; building materials and furnishings (paints, sidings, surface preservatives), asbestos or volatile fibre-containing insulation, wet or damp carpets, and cabinetry or furniture made of certain pressed wood products; products for household cleaning and maintenance, personal care, or hobbies; cooling systems and humidification devices; some outdoor sources such as radon, pesticides; and outdoor air pollution. In addition we are exposed to electro-magnetic pollution, noise and even visual pollution.

The relative importance of any single source of pollution depends on how much of a given pollutant is emitted and how hazardous the emissions are. In some cases, factors like age and whether the source of the pollutant is properly maintained are significant. For example, an improperly adjusted gas stove can emit significantly more carbon monoxide than one that is properly adjusted.

Some sources, such as building materials, furnishings, and household products like air fresheners, release pollutants more or less continuously. Other sources, related to activities carried out in the home, release pollutants intermittently. These include smoking; the use of unvented or malfunctioning stoves, furnaces, or space heaters; the use of solvents in cleaning and hobby activities; the use of paint strippers in redecorating activities; and the use of cleaning products and pesticides in housekeeping. High pollutant concentrations can remain in the air for long periods after some activities.

The following is a classification of indoor pollution by type and source of pollution with recommendations for pollution-reduction strategies.

- **Outdoor pollution:** This is pollution coming from the outdoor environment into the building through air infiltration. This could be pollution by natural agents or from human activities. Pollution from outdoor natural agents is dust and pollens, or from the ground like radioactive radon penetrating through building foundations. The most common source of indoor radon is uranium in the soil or the rock on which homes are built. As uranium naturally breaks down, it releases radon gas which is a colourless, odourless, radioactive gas. Radon gas enters homes through dirt floors, cracks in concrete walls and floors, floor drains, and sumps. When radon becomes trapped in buildings and concentrations build up indoors, exposure to radon becomes a problem. The man-made sources of outdoor pollution are particles or gasses, or odours from industrial processes, such as agricultural spray drift. A special category of man-made pollution is electromagnetic pollution from pylons or high-voltage infrastructure near the building. Clearly there is a limit to what can be done to reduce pollution from these sources in the building itself, but there are a few steps that can be taken to reduce pollution from the outside:
    - sensitive site-sitting of the building at design stage in order to use prevailing winds or air-pressure regimes for diverting outdoor pollution beyond the building, or avoiding locations with high exposure to ground radon emissions or close to any high-voltage installations
    - making the building airtight and installing effective filtration in the mechanical ventilation system in order to secure the necessary quantity of fresh, clean air
    - designing a buffer-space filled with plants and water to filter incoming air

- **Indoor pollution from building materials and home decorations.** These include chemical contamination, combustion products, biological contamination and other indoor contaminants.
    - **Chemical contamination:** Most indoor air pollution comes from sources inside the building. For example, adhesives, carpeting, upholstery, manufactured wood products, copy machines, pesticides, and cleaning agents may emit volatile organic compounds (VOCs), including formaldehyde. Environmental tobacco smoke contributes high levels of VOCs, other toxic compounds, and respirable particulate matter. Research shows that some VOCs can cause chronic and acute health problems at high concentrations, and some are known carcinogens. Pressed wood products made for indoor use include: particleboard (used as subflooring and shelving, and in cabinetry and furniture); hardwood plywood panelling (used for decorative wall covering and in cabinets and furniture); and medium density fibreboard (used for drawer fronts, cabinets, and furniture tops). Although formaldehyde is present in both types of resins, pressed woods that contain PF (phenol formaldehyde) resin generally emit formaldehyde at considerably lower rates than those containing UF (urea formaldehyde) resin.
    - **Combustion products** such as carbon monoxide, nitrogen dioxide, as well as respirable particles, can come from unvented kerosene and gas space heaters, woodstoves, fireplaces and gas stoves. These are the most lethal indoor contaminants when combustion processes in indoor boilers and stoves are incomplete; fumes leak from old chimneys where masonry has deteriorated, or from flues as the result of backdraft in adverse wind conditions. In order to prevent such contamination, it is recommended to strictly follow all service and maintenance procedures recommended by the manufacturer, including those specifying how frequently to change filters in combustion appliances. If the manufacturer's instructions are not readily available, change filters once every month or two during periods of use. Proper maintenance is important even for new furnaces because they can also corrode and leak combustion gases including carbon monoxide.
    - **Biological contamination** includes bacteria, moulds, fungi, viruses, pet hair and saliva, house dust mites, cockroaches, and pollen. There are many sources of these pollutants. Pollens originate from plants; viruses are transmitted by people and animals; bacteria are carried by people, animals, and soil and plant debris; and household pets are sources of saliva and animal hair. The protein in urine from rats and mice is a potent allergen. When it dries, it can become airborne. Contaminated central air filtering systems or damp condensation on colder surfaces can become a breeding ground for mould, mildew, and other sources of biological contaminants which are then distributed throughout the house.
- **Noise pollution:** Excessive noise is obviously to be avoided; however, constant low levels of background noise, often associated with machinery or from sources that cannot be controlled, are considered as high-stress sources that can result in health problems. Many but not all noises can be attenuated, e.g. fresh air supplied by mechanical ventilation, or indoor temperature by air-conditioning. Noise pollution can be reduced by using nature-friendly passive solutions and avoiding the use of noisy machinery.
- **Light pollution:** The inappropriate or excessive use of artificial light – known as light pollution – can have serious environmental consequences for humans, wildlife, and our climate. Components of light pollution include: glare, excessive brightness that causes visual discomfort; skyglow, brightening of the night sky over inhabited areas; light trespass, light falling where it is not intended or needed; clutter, bright, confusing and excessive groupings of light sources. Too much light pollution creates problems: it washes out starlight in the night sky, disrupts ecosystems, has adverse health effects and wastes energy. Light pollution has significant adverse health effects, as many species and especially humans are dependent on natural body cycles called circadian rhythms and the production of melatonin, which are regulated by light and dark (e.g. day and night). The levels of light pollution can be eliminated to shading the building from excessive outdoor artificial light and by sensitive and human-centric design of indoor lighting installations.

It is important to choose properly coloured, dimmable lighting fixtures at the right intensity, that are adapted to normal activities indoors. It is also important that people use the artificial light only when needed and only at the intensity recommended for the given activity.

- **Other indoor contaminants:** We have included here all other contaminants like lead, asbestos or other fibre-volatile materials, excessive humidity, etc. **Asbestos** is a mineral fibre that has been used commonly in a variety of building construction materials for insulation and as a fire-retardant. European regulations have banned asbestos-containing products for construction. Manufacturers have also voluntarily limited uses of asbestos. Today, asbestos is most commonly found in older homes, in pipe and furnace insulation materials, shingles, millboard, textured paints and other coating materials, and floor tiles. Elevated concentrations of airborne asbestos can occur after asbestos-containing materials are disturbed by cutting, sanding or other renovation activities. Improper attempts to remove these materials can release asbestos fibres into the air in homes, increasing asbestos levels and endangering people. That is why asbestos should be removed during renovation works by specialised companies, who follow strict procedures in order to eliminate any contamination of the building or the surrounding neighbourhood. Similar to asbestos, but with fewer lethal consequences is the use of **thermal insulation materials with volatile fibres**, which can be emitted to the ambient environment. These are for instance old types of **fibre-glass insulation**. These materials should be covered by siding or plasterworks in order to prevent fibre leakage to the ambient environment. **Lead** has long been recognised as a harmful environmental pollutant. In late 1991, the US Secretary of the Department of Health and Human Services called lead the 'number one environmental threat to the health of children in the United States.' **Excessive humidity** is also counted among indoor pollutants. A comfort level of indoor humidity lies in the range of 40%–65%, which encourages only low concentrations of biological contamination (bacteria, viruses, moulds and fungi). Higher levels of relative humidity stimulate the growth of biological contamination, while very low levels expose the human body to the negative effects of chemical contamination and can also stimulate the growth of particular viruses.

Strategies to reduce indoor pollution for each of the sources of pollution encompass a combination of design strategy and occupants’ behaviour in using the building and its systems. The first step in adopting design strategies to prevent indoor pollution is to include a selection of building materials and in particular decoration and finishing elements with low levels of harmful contaminants. The second step is to encourage passive, non-energy consuming systems (natural ventilation, access to natural daylight, etc.) wherever possible. A third step is to design mechanical and electrical systems (mechanical ventilation, lighting, cooling, etc.) at maximum efficiency levels for human comfort, taking into account health and well-being factors as well.

3. REVIEW OF THE BEST INTERNATIONAL PRACTICES

A key challenge for reducing embodied carbon and effectively using construction demolition waste (CDW) in the construction sector relates to value-chain fragmentation and a high dependency on subcontracting, which in turn leads to cost-driven sub-optimisation between parties for each transaction and not properly taking environmental impact into consideration. Additionally, less developed markets in the Central Asian countries (including Kyrgyzstan) are currently lacking the skills and experience involved in working with embodied carbon and materials efficiency. To successfully improve environmental performance, the investor/developer must set targets along with optimisation and enforcement mechanisms early in the conceptualisation of a project. The opportunities for the sector are enormous: material efficiency reduces capital costs, life-cycle design reduces lifecycle costs and the solutions required for embodied carbon reduction are available today. A number of initiatives already working at national or regional level both in the European Union (EU) and a few other regions, and demonstrating the best international practices for addressing the various sustainability aspects within the value chain and the life-cycle stages of buildings, are provided in this section.

Particularly important are the EU-sector specific directives and regulations (e.g. the **EU Building Directive** and the **EU Construction Product Regulation**) and the **Level(s) initiative**, which is the European framework for sustainable buildings and introduction of circular economy concepts.

Several voluntary initiatives to reduce embodied carbon exist. The ***Advancing Net Zero*** project by the World Green Building Council federates efforts from national green building councils, which are active in the post-Soviet region as well. For the EU as well as for countries beyond the EU, the ***Level(s) initiative*** from European Commission, or rather the standards underlying it, provide the methodology and template for reporting life-cycle repercussions. The ***Carbon Heroes Benchmark Program*** is a benchmarking program focused on material efficiency and reducing embodied carbon and energy, which could be applicable in Central Asian countries as well. Some examples of international best practice, which could be useful in the context of Central Asia and in Kyrgyzstan in particular, are also provided.

1. The EU's Level(s) framework

The **Level(s) initiative** is an assessment and reporting framework that provides a common language for sustainability performance in a building. Level(s) promotes lifecycle thinking for buildings and provides a robust approach to measuring and supporting improvement from initial concept and design to the building's end of life, for both residential housing and offices. Level(s) uses core sustainability indicators, already tested by the building sector, to measure carbon, materials, water, health and comfort, and climate-change impact. It takes into account lifecycle costs and value assessments.

Level(s) is open-source and freely available to all market stakeholders. The challenges of cost control and environmental gain are met both by reductions in energy, materials, and water use, and by future-proofing buildings. Whether the stakeholders are commissioning, designing, or occupying buildings, Level(s) helps them ensure that their high quality, fit-for-purpose buildings meet their cost and environmental objectives.

Level(s) is divided into three areas, each with its own subject matter and desired outcomes

- Resource use and environmental performance during a building's lifecycle
- Health and comfort
- Cost, value, and risk

Each of the three areas has its own set of indicators dealing with a building's environmental, social, and economic long-term sustainability (see Table 1.

Table 1. Thematic areas and indicators of the EU Level(s) assessment method

Thematic areas	Macro objectives	Indicators
Resource use and environmental performance	1. Greenhouse gas emissions along the life-cycle of a building	1.1 Use stage energy performance (kWh/m²/yr) 1.2 Life cycle Global Warming Potential (CO_2-eq/ m²/yr)
	2. Resource efficient and circular material life-cycles	2.1 Bill of quantities, materials and lifespans 2.2 Construction and demolition waste 2.3 Design for adaptability and renovation 2.4 Design for deconstruction
	3. Efficient use of water resources	3.1 Use stage water consumption (m³/occupant/yr)
Health and comfort	4. Healthy and comfortable spaces	4.1 Indoor air quality 4.2 Time spent out of thermal comfort range 4.3 Lighting 4.4 Acoustics
Cost, value and risk	5. Adaptation and resilience to climate change	5.1 Life-cycle tools: scenarios for projected future climate conditions 5.2 Increased risk of extreme weather 5.3 Increased risk of flooding
	6. Optimised life-cycle cost and value	6.1 Life-cycle costs (€/m²/yr) 6.2 Value creation and risk factors

Level(s) enables building professionals and their clients to use fewer resources, and thus improving the environmental performance of their buildings. Level(s) can be used as an entry-level tool and at each stage in a building project to provide a complete picture throughout the full life cycle, offering a framework to measure performance in key areas at each stage (Fig. 2):

Fig. 2. Level(s) framework

Some studies from more advanced economies have shown that embodied carbon can be made a standard practice in construction projects. The Netherlands has required all new offices and residential projects to meet a threshold level for a building materials environmental assessment since 2018, and had a mandatory declaration in vigour since 2013. Currently, France and Finland are also preparing to launch regulatory limit values, with Sweden planning a mandatory declaration. Most construction markets worldwide apply voluntary mechanisms, such as green building certifications, to reduce embodied carbon. While such measures are useful and necessary for building up initial success, skills and best practises, they are not sufficient to achieve industry-wide decarbonisation.

2. EPBD

The **Energy Performance of Buildings Directive (EPBD)**[20] is the cornerstone of the EU policy and regulations in the building sector, and it offers a broad range of instruments aimed at helping national governments in Europe boost the energy performance of their buildings and improve the existing building stock. Such policies include:

- Renovation strategies: EU countries must establish strong long-term renovation strategies, aimed at decarbonising their national building stocks by 2050. The strategies should contribute to achieving national energy and climate plan (NECP) energy efficiency targets.
- Performance requirements: EU countries must set cost-optimal minimum energy performance requirements for new buildings and for existing buildings undergoing major renovation.
- Nearly zero-energy buildings (NZEB) : after 31 December 2020, all new buildings must be nearly zero-energy buildings (NZEB).
- Energy Performance Certificates: these must be issued when a building is sold or rented, and inspection schemes for heating and air-conditioning systems must be established.

In addition to the EPBD, the Commission has also published a series of recommendations on building renovation – (EU)2019/786 and building modernisation (EU)2019/1019.

The updated EPBD was published on December 15, 2021 to ensure it meets the additional requirements set out in the EU *Green Deal* and the *EU Renovation Wave* programme.

20 Energy performance of buildings directive (EPBD): https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-building/energy-performance-buildings-directive_en

3. CPR

The **EU Construction Products Regulation (CPR)**[21] lays down harmonised rules for marketing construction products in the EU. The Regulation provides a common technical language to assess the performance of construction products. However, the current regulation does not directly set minimum requirements for environmental information or performance, only allowing for the possibility of these data to be established through harmonised European Standards (hEN). The aim of the current regulation is to ensure that reliable information is available to professionals, public authorities and consumers, to facilitate assessment and comparison of the essential characteristics of products from different manufacturers in different countries. The CPR is under review, and a consultation process was concluded in December 2020, with the results available online (https://ec.europa.eu/docsroom/documents/45224).

3.1 Best-practice examples from specific countries

Best practise for product environmental data: France

The French decree of 9 July 2014 for construction product environmental information requires that any manufacturer who markets construction products as environmentally sustainable must produce an Environmental Product Declaration (EPD) in conformity with EN 15804 standards, have it third-party verified and publish it in the French INIES system. This regulation makes allowances for specific claims, such as 'compostable', 'reusable' and so forth, but any other environmental claims require an EPD. This regulation was implemented because of rampant greenwashing[22], a problem it has effectively addressed. In addition, the regulation has led to an increase in the environmental performance information concerning products, so buyers can compare different products. Smaller manufacturers have addressed these requirements often by working together with their respective industry associations to develop a set of generic data. However, this particular regulation also imposes a technical barrier to trade, as foreign manufacturers also need to deposit their EPDs in the French INIES system to be able to market environmental advantages. This requires reworking and reprocessing the data and imposes additional costs, in particular for manufacturers with large product ranges.

Considering that the road construction sector is a very large buyer of aggregates, it is often easier to find large-volume applications for recycled materials in roads. For example, France had a current goal to achieve a 50% share of reused or recycled building waste materials in road construction materials bought by national and local authorities in 2017, rising to 60% by 2020. Setting up goals of this kind can help ensure having a market for most of the recycled aggregates processed from CDW.[23]

Best practise for building environmental performance: the Netherlands

Since 2013, the 2012 Dutch Building Act (*Bouwbesluit*) has required all new offices and residential buildings to report the lifecycle assessment (LCA) of building materials using a national methodology

21 Construction product regulation (CPR): https://ec.europa.eu/growth/sectors/construction/product-regulation_en
22 There are many definitions of "greenwashing" and we have picked the one given by Investopedia, which in our opinion is among the most accurate: https://www.investopedia.com/terms/g/greenwashing.asp
23 Note from the SWITCH-Asia SCP Facility – the practice of adding construction waste materials (secondary material) into road materials has to be done with consideration of secondary material composition avoiding dangerous components that could leakor leech into the environment

known as MPG, *Milieuprestatie Gebouwen*. The regulation introduced a mandatory ceiling for the environmental impact of materials from January 1, 2018. National methodology compliance is verified by an independent institute, *Stichting Bouwkwaliteit*, which maintains the environmental database used for the national methodology. This approach has successfully propelled the market in terms of skills and use of LCA for building design. Clearly, the best practise here consists of a determined roll-out of the requirements in stages to ensure building up the required skills prior implementation.

However, the technical implementation of this national methodology is a mixed success. For instance a weakness is that the methodology uses a weighted score based on the basket-of-indicators approach for environmental impact assessment, where the effect on carbon reduction is indirect accounting for everything except pure material reduction. The methodology is also highly sophisticated in its approach to calculation, but it has not led to innovative solutions such as the automation of assessments. Possible improvements for this methodology would be to extend its scope beyond the office and residential buildings currently covered, to set targets for building performance based on carbon as opposed to a basket of indicators, and reducing the complexity in using the system. To speed up adoption, the Dutch government has also introduced tax policy measures, including faster depreciation of environmental investments (up to 75% in the first year), and a further tax rebate for purchasing high-performance assets using the Environmental List, a collection of pre-validated measures that render projects eligible to seek tax rebates. The budget for the tax rebate was set at €114 million for 2019.

Best practise for construction and demolition waste: Finland

The 2011 Finnish Waste Act has been revised, with the revisions having taken effect in 2019. The Waste Act sets a recycling target of 70% for recycling construction and demolition waste (CDW) into reuse as building materials (although excluding their use for energy). This Act is enforced by the municipalities. The policy goal is to prohibit dumping CDW into public landfills. One important measure is the requirement for on-site sorting and separation of waste streams for concrete, brick, mineral slab and ceramics waste, gypsum-based waste, untreated wood waste, metal waste, glass waste, insulation wools, plastic waste, paper and cardboard waste, and earth and rock mass waste. The Finnish landfill tax has been increased in several steps from 23 €/ton in 2003, to 30 €/ton in 2005, to 40 €/ton in 2011, and 70 €/ton since 2016. The industry was kept informed about the increases in the tax, which made preparatory investments and actions possible so that businesses could adapt. A further improvement to this Act would be streamlining the use of secondary materials, and collaborative pilot programs to improve this end are under way.

Concrete use reduction and recycled content in Singapore

The Singapore Building and Construction Authority operates a green building rating scheme known as BCA Green Mark, which provides additional construction rights for builders obtaining a good rating score, a valuable incentive in a country where land is scarce. BCA Green Mark[24] awards points for using concrete more efficiently, and for incorporating specified alternative binders to replace Portland cement. The best-in-class concrete target is to use less than 840 kg/m^2 concrete, and points may be earned using no more than double that amount. Alternative binder points start at 5% of ordinary Portland Cement substitution with either Ground Granulated Blast-furnace Slag, fly ash or silica fume, and 20% substitution obtains maximum points. The same or stronger effects can be achieved by specifying cements using alternative binders. Most cement (CEM) II types achieve at

24 The Singapore Building and Construction Authority BCA Green Mark Certification programme: https://www1.bca.gov.sg/buildsg/sustainability/green-mark-certification-scheme

least comparable environmental benefits, except CEM II Portland-limestone cements. Clearly higher environmental gains are achieved when using CEM III (Blast-furnace cement), CEM IV (Pozzolanic cement), or CEM V (Composite cement). The above refers to a small part of the scope of the The Singapore Building and Construction Authority BCA Green Mark Certification programme, dedicated to adoption of material efficiency and circular economy concepts.

Incentives for choosing lower-carbon products in Norway

The Norwegian government construction organisation Statsbygg applies a requirement for using only products with Environmental Product Declarations (EPDs) for concrete, steel, insulation materials, gypsum boards, natural stone, wood-based boards, floorings, ceilings and roofing membranes. Of these, concrete, steel, gypsum and insulation have maximum emission limits. For pilot projects, limits are also set for other material types. EPDs are additionally used as a product specification tool by the European Green Public Procurement (GPP) criteria for offices. It is worth noting that such incentives do not improve material efficiency but reduce material carbon intensity.

Incentives from green building certifications in the US and UK

Commercial green building certification systems, such as the United States Green Building Council (USGBC) ***Leadership in Energy and Environmental Design*** (LEED) and the United-Kingdom-based ***Building Research Establishment's Environmental Assessment Method*** (BREEAM), include sustainable materials design and selection measures. LEED distributes credits in Building Life-Cycle Impact Reduction and Environmental Product Declarations, and BREEAM International using Life-Cycle Assessment credits.[25] These systems award points for projects that demonstrate savings via life-cycle assessments, and that use products with third-party verified Environmental Product Declarations (EPDs). LEED is also introducing with its pilot version 4.1 a mechanism for additional points for using products demonstrating lower-than-average negative effects. The current version of the specification does, however, suffers from some technical deficiencies. In the view of the authors of these Guidelines, the use and application of mainstream green building certification systems and their associated credits improves materials transparency and documentation but does not guarantee a specific level for materials or embodied carbon savings.

Other relevant EU and global initiatives

A comprehensive recent survey of the voluntary and regulatory green building systems used globally can be found in The Embodied Carbon Review[26], which identified 156 green building systems targeting environmental performance in construction works, and found that 105 of those provided direct measures for reporting or reducing embodied carbon. General material efficiency policies in Europe are reviewed in the ***More from less — material resource efficiency in Europe*** report.[27] According to this report, national action plans or national strategies for construction materials were reported by two countries, Estonia and Liechtenstein. A life-cycle based approach for construction materials was adopted by Flanders (Belgium). In our opinion, the following broader initiatives are also of interest since they may be applicable in the Central Asian context. Numerous other initiatives exist; however, not all of them connect as directly with the industry and practice. For clarity, this listing considers only those initiatives with specific goals and measures, and not those related to general networks or concepts.

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25 Credit are the scores which BREEAM methodology uses to recognise advanced practices with positive impact beyond minimum regulation requirements
26 The Embodied Carbon Review (2018) – www.embodiedcarbonreview.com
27 European Environmental Agency (2016): More from less — material resource efficiency in Europe report

Advancing Net Zero by the World Green Building Council: The World Green Building Council is promoting a net zero energy concept, by 40% by 2030. The initiative works on the one hand by signing up commitments to deploy this practice from stakeholders, and on the other hand by having national GBCs develop specific methodologies for implementing and accounting for these metrics nationally. This initiative is in place, with numerous national GBCs and businesses having joined.

EMAS and Sectoral Reference Document for the Construction Sector by the European Commission: Environmental Management and Audit Scheme (EMAS) is a voluntary, third-party audited environmental management scheme offered by the European Commission. It has a sectoral reference for construction. The sectoral reference has a best practice for waste prevention and management on the construction site, with as its target that less than 5% of reusable or recyclable material is sent to landfill or incineration without energy recovery. It also requires tracking for waste generation.

Green Public Procurement (GPP) for office buildings by the European Commission: The GPP template is a flexible procurement scheme that incorporates different levels of technical ambition and complexity. For materials, it has different types of categories of demands, including use of recycled content in concrete and masonry (from 15%–30% in main building elements) and carbon impacts of building materials with different options, as well as reuse of demolition waste (from 55%–80%) and limits to the amount of construction site waste generated (from 110 to 70 kg per m^2 GIFA).The criteria for materials emissions are, in decreasing order of ambition and complexity: 1) use LCA for main building elements, 2) collect EPDs for main building elements, 3) require recycled and re-used content, and 4) require reducing transportation impacts of heavy materials.

EDGE Buildings by the International Finance Corporation: EDGE is a green building system for emerging markets. It is focused on a range of simple, efficient measures to save energy and water, with clear payback times. EDGE is implemented with software, and projects can undergo a third-party certification. The EDGE toolkit does include a measure for embodied energy. However, this is not a particular strength of the system, which is excellent at communicating and promoting energy savings. The added value of EDGE is the most significant in areas with loose building codes.

Carbon Heroes Benchmark Program: This is a program for creating embodied carbon awareness and benchmarks performance levels with the initial focus on Europe and targeting 1000 buildings. The program is operated via national green building councils which promote embodied carbon and with the support of the One Click LCA platform which is used to collect and calculate the data and benchmarks. The project's initial scope is being expanded as new national GBCs join. Eastern European participants, which to some extent are facing similar market challenges, are the Romanian and Hungarian GBCs.

#BuildingLife Project: #BuildingLife is an EU-supported regional project initiated and implemented by the World Green Building Council (World GBC) and ten national green building councils across Europe. The World GBC is the world's largest global network driving action to deliver the ambitions of the Paris Agreement and UN Global Goals for Sustainable Development in the building and construction industry. #BuildingLife brings together a coalition of Green Building Councils across Europe – in Croatia, Finland, France, Germany, Ireland, Italy, the Netherlands, Poland and Spain, and the UK – to drive decarbonisation of the building sector through private sector action and public sector policy. Running until the end of 2022, the project aims to support the ambitions of the EU Green Deal by outlining how the EU and national building policy can move beyond a focus on operational emissions from buildings and start to consider both operational and embodied (whole life carbon) in an integrated manner. #BuildingLife follows World GBC's systemic approach to driving impact, with activities taking place across six main work streams: Collaborate, Advocate, Communicate, Educate, Rate and Invest. To drive collaboration as part of the project, a European Leadership Forum with diverse leaders across the built environment value chain has come together to build consensus and steer the direction of an EU Policy Whole Life Carbon Roadmap. In addition to the Leadership Forum, an 'EU Whole Life Carbon Roadmap Technical Working Group' has been established to provide technical input and analysis into the EU WLC roadmap.

EU Construction and Demolition Waste Management Protocol: This is a voluntary protocol for identifying recycled materials and managing their separation, collection and logistics to improve their commercial usability, and clarify their properties within the associated waste streams to support risk management.

A summary of national targets and commitments with regards to green buildings in selected EU advanced markets is summarised in Table 2.

Table 2. National building decarbonisation commitments and supporting policies and methodologies

Country	Targets	Initiatives
Belgium	Carbon neutrality by 2050	• Mandatory National LCA requirement for state government buildings • Net zero 2050 initiative
	Supporting policies: regulatory instruments for the building envelope, heating fuel switch, appliance efficiency, renewable electricity, and materials including LCS reporting	
Croatia	Reduce CO_2 emissions by 80% in the building construction sector by 2050	Integrated Energy and Climate Plan (IECP) for the period 2021–2030
	IECP introduces measurable indicators of energy renovation of buildings to convert the existing stock into NZEBs, which are climate neutral. It promotes the nearly-zero energy standard in building construction and refurbishment	
Denmark	Reduce 70% of emissions by 2030 and achieve carbon neutrality by 2050 (all sectors)	National Strategy for Sustainable Construction
	• The strategy introduces a number of initiatives to promote sustainable buildings, including CO_2 limit values for new buildings from 2023 • Mandatory national life-cycle carbon limits on new buildings. It will be introduced in 2023	
Finland	Carbon neutrality by 2035	Lifecycle (optimisation) approach and assessment
	• The Ministry of the Environment has developed an assessment method and will develop a generic emission database for products and materials, sources of energy, modes of transportation as well as other major processes such as site operations and waste management • Mandatory national life-cycle carbon limits for new buildings starting in 2025	
France	Carbon neutrality by 2050	2050 carbon-neutral law - National Low Carbon Strategy
	• Strategies: make energy production fully carbon-free by 2050; halve energy consumption through energy efficiency; increase and safeguard carbon sinks such as soils and forests; and promote carbon capture and storage (CCS) technologies and products from the bio-economy • Additionally, there will be mandatory national life-cycle carbon limits on new buildings starting in 2022	

<table>
<tr><th>Country</th><th>Targets</th><th>Initiatives</th></tr>
<tr><td rowspan="2">Germany</td><td>Reduce 70% of building emissions by 2030 and achieve carbon neutrality by 2050</td><td>• Climate action law
• Climate Action Plan 2050
• Ökobaudat: LCA platform for buildings
• Voluntary national LCA requirement for federal government buildings</td></tr>
<tr><td colspan="2">• The Climate Action Plan contains a road map for an almost climate-neutral building stock. It promotes the Passive House Standard, SECAPs, more stringent regulations to improve energy efficiency, as well as linking funding to heating systems based on renewable energy sources
• Since July 2021: Public funding for sustainability measures require meeting life cycle GHG emissions and primary energy limit values</td></tr>
<tr><td rowspan="2">Hungary</td><td>Carbon neutrality by 2050</td><td>• National Energy and Climate Plan of Hungary
• Draft: 2050 decarbonisation strategy, so-called: Clean Growth Strategy</td></tr>
<tr><td colspan="2">Draft proposal: Increasing the budget of energy efficiency programmes for energy management in buildings and improving the effectiveness of their distribution of funds</td></tr>
<tr><td rowspan="2">Ireland</td><td>Carbon neutrality by 2050.
- 7% annual average reduction in greenhouse gas emissions between 2021 and 2030</td><td>National Energy & Climate Plan 2021–2030</td></tr>
<tr><td colspan="2">Proposals: setting stricter requirements for new buildings and substantial refurbishments; public sector buildings to have a B Building Energy Rating (BER) by 2030: one-third of commercial (including mixed use) buildings to have a B BER (or carbon equivalent gains) by 2030; 600,000 heat pumps to be installed over the period 2021–2030</td></tr>
<tr><td rowspan="2">Netherlands</td><td>Reduce 50% emissions by 2030 and achieve carbon neutrality by 2050</td><td>• Mandatory National life-cycle impact limits on new buildings
• Amsterdam aims to be fully circular in 2023 (new buildings and products. Renovations by 2025)</td></tr>
<tr><td colspan="2">• Environmental performance for new houses more stringent after 2021
• Upcoming uniform assessment method for circular measures
• Performance requirements will become more stringent-step-by step to finally attain one-half by 2030.</td></tr>
<tr><td rowspan="2">Spain</td><td>• Carbon neutrality and circular economy by 2050
• Reduction of 23% of emissions by 2030</td><td>Climate law under review</td></tr>
<tr><td colspan="2">• Plan to make Spain’s electricity system 100% renewable by 2050; ban all new coal, oil and gas extraction projects
• Upcoming regulation with efficiency measures to reduce energy consumption by at least 35%, through the renovation of buildings and homes
• Upcoming regulation under review for carbon neutral new buildings</td></tr>
</table>

Country	Targets	Initiatives
Sweden	Carbon neutrality by 2045	• Upcoming regulation: Climate declaration of buildings including all LCA stages • Increase the requirements for EPDs (no specific % yet) • Sweden's long-term strategy for reducing greenhouse gas emissions
	• Upcoming regulation of embodied carbon (preliminary limit values of 12 kg CO_2-e/m^2 from 2023) • Upcoming energy and carbon taxes for various sectors including homes and commercial buildings • National carbon reporting for new buildings, carbon caps by 2027	
UK	Reduction of 78% of emissions by 2035	• Net Zero Whole Life Carbon Roadmap from the UKGB • Mandatory Greater London Authority requirement for new projects • Industrial Decarbonisation Strategy
	Strategies include resource and energy efficiency to reduce demand for energy across the economy; societal choices leading to a lower demand for carbon-intensive activities	

Source: World GBC: BuildingLife Roadmap Consultation, 2021

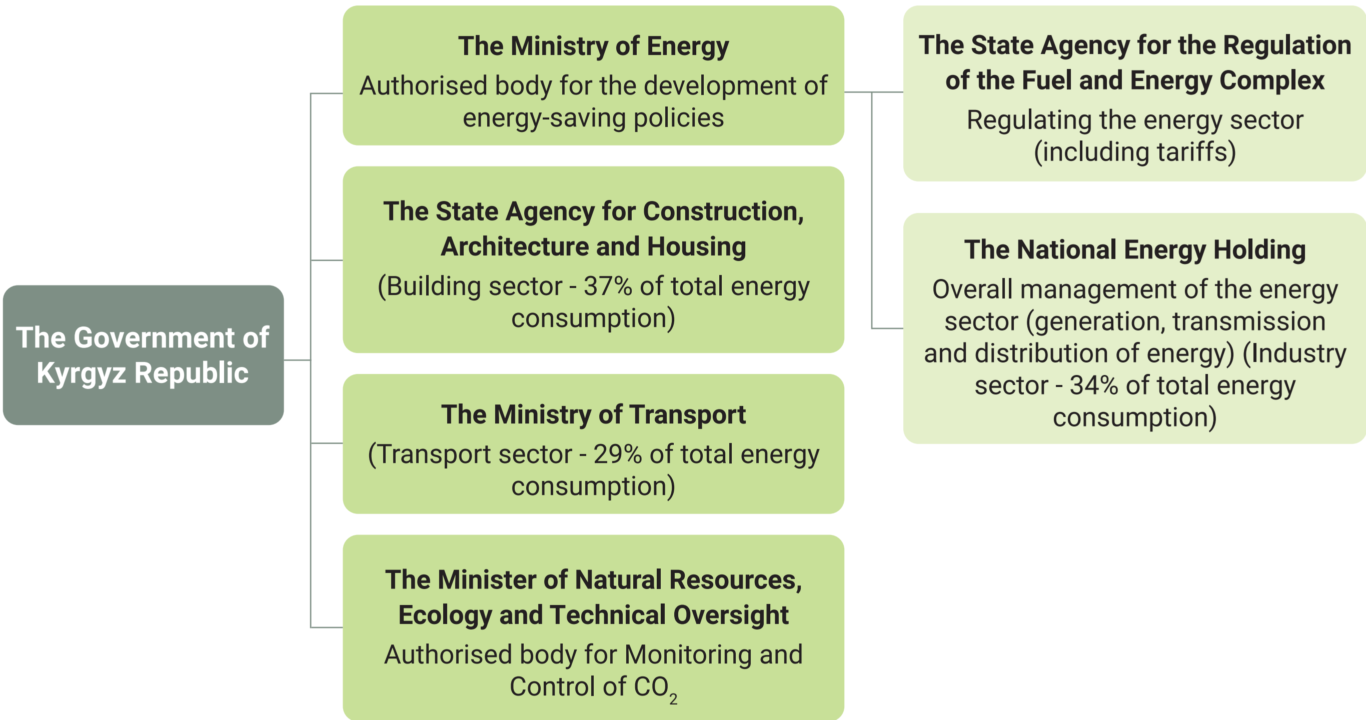
4. NATIONAL POLICIES, REGULATORY AND INSTITUTIONAL FRAMEWORK

4.1 National institutional structure

Over the past 10 years, the structure of energy sector management has changed significantly with the liquidation of the Ministry of Energy and public control structures, the creation of the Joint Stock Company 'National Energy Holding', the separation of a regulatory body into a separate institution, etc. But energy issues are still mainly focused on issues of energy generation, transmission and distribution with the central aim being to provide the country with energy. The issues of effective energy use by end users – buildings and industry – are considered as secondary.

From 2016 to the present, the main state body for energy efficiency policy in the Kyrgyz Republic is the Ministry of Energy under the Cabinet of Ministries of the Kyrgyz Republic. According to the institutional structure of the government, other issues related to the promotion of energy efficiency and the regulation of energy saving in other sectors are coordinated by the departments of other state bodies. They are schematically reflected in Fig. 3. The figure also highlights ministries responsible for the sectors with the highest sectoral energy consumption: the building sector (37%), industry (34%), and transport (29%).[28]

Fig. 3. Organisational chart on energy and energy efficiency in Kyrgyzstan



28 National Report on the Development of EE and RES in KG, UN Economic Commission for Europe, 2015.

The Ministry of Energy of the Kyrgyz Republic is an authorised state body responsible for energy-efficiency governance[29], along with energy-saving and the development of alternative energy. The issues of energy efficiency are managed by a dedicated Department of Renewable Energy and Energy Saving[30], with 4 full-time employees; they are subordinate to the Deputy Chairman of State Committee on Industry, Energy and Subsoil Use (SCIESU) on energy. Their capacity for the implementation of tasks set for the development of energy efficiency and energy-saving in the country is insufficient, both quantitatively and institutionally: the department is involved in other routine tasks, including the development of small hydropower stations, and does not have the resources to address the issues of energy-saving. Other structures involved in energy efficiency issues are also under the authority of the SCIESU:

- **The Research Centre for Energy and Economics** was appointed to manage energy audits/ inspections. The research centre has its share of the state budget allocated for these purposes (KGS 4 million for 2015 and 2016), however, there is a lack of experts, methodological background and the capacity of human resources to cover all buildings.

- **The Coordination Council for Energy Efficiency** was established in 2018 in response to the demand of parties interested in developing energy efficiency in Kyrgyzstan – international development banks, suppliers and producers of energy-saving technologies and materials. The Council is expected to organise effective and constructive coordination among all stakeholders involved in energy efficiency and energy saving, so as to improve the effectiveness of the actions undertaken and the efficiency of allocated international support and financial resources, to share knowledge and best practices, and to prevent inconsistency and the duplication of efforts.

The State Agency for Architecture, Construction, Housing, and Communal Services under the Government of the Kyrgyz Republic (Gosstroy) and its expanded structure of departments and structural units[31] involved in the implementation, is responsible for implementing energy-saving and energy-efficient policies in the construction and building sectors. Institutionally, agencies are structurally separated entities coordinated by the general management, including:

- **The State Department for the Examination of Design Estimates**, which monitors the compliance of design estimates with current standards and regulations (including energy efficiency requirements)
- **The Republic Center of Certification in Construction**, which monitors the compliance of the technical characteristics of construction and energy-efficient materials with the requirements of the safety standards in use and other standardised parameters
- **A training school within the Republic Center of Certification in Construction** is responsible for educating specialists in the construction sector and certifying their qualification in the future
- Laboratory equipment (see Table 3):
    - A testing laboratory to check conformity of construction materials, products and structures with the requirements of technical regulations at the Republican Certification Center in Construction under the Gosstroy[32];

29 http://cbd.minjust.gov.kg/act/view/ru-ru/99446 - The Regulation on SCIESU approved by the GKR from July 15, 2016 No. 401
30 http://www.gkpen.kg/index.php/komitet/control - Scheme of management of GKPEN, departmental structure. A number of advisory groups working on the improvement of the policy in the fuel and energy sector presented recommendations on the creation of an institutionally separate state body (for example, in the form of an agency) that would focus solely on the issues of energy saving and energy efficiency and would work in all sectors of the economy. The recommendation has not yet been implemented, because the establishment of a separate state agency is fraught with difficulties in budget allocation and a number of bureaucratic procedures, and there is a lack of understanding of the feasibility of energy saving in the residential sector as well as in public buildings.
31 http://gosstroy.gov.kg/ru/?page_id=1168 – the structure of departments and units of Gosstroy
32 http://gosstroy.gov.kg/ru/kyrgyzskijj-nauchno-issledovatelskijj/

- A light-bulb testing laboratory (spectrometers, gonio photometers, luxmeters and accessories) of the Center for Standardization and Metrology under the Ministry of Economy of the Kyrgyz Republic (KyrgyzStandart)[33].

Table 3. Overview of building components and systems subjected to laboratory tests

Energy efficiency technologies	Lab-tested characteristics	Characteristics required for testing (no labs in Kyrgyzstan)
Thermal insulation	Mechanical performance	Thermal conductivity
Windows	Mechanical performance	Thermal conductivity
Heating systems	Technical safety	Efficiency of fuel combustion (energy efficiency)
Lighting	Energy performance	-

One of serious challenges for market access of more efficient and more sustainable technologies is a lack of laboratories for testing energy efficiency of materials and technologies: locally produced boilers can obtain a certificate of safety design, but cannot pass the tests for fuel quality and energy-conversion efficiency of combustion. Similarly, with thermal insulation materials, the National Center for Standardization and Certification can provide a certificate of compliance with design characteristics in accordance with GOST, but cannot test its thermal conductivity.

At the same time, it is important to note that there are gaps in the exchange of information and adaptation of sub-institutional work schemes to modern requirements (bureaucratic inertia), which is the reason why the introduction of energy efficiency, despite the general policy of Gosstroy for its development, is not being implemented in practice.

4.2. National policy and regulatory framework

There are several national strategies defining sustainability vectors for development in all sectors of economy including for buildings and constructions. The most relevant are enlisted below.

The National Development Strategy of the Kyrgyz Republic for 2018–2040 is a national document with the intent to create ‘a politically stable, economically strong and socially responsible state’.[34] Under the main section of the ‘Economic well-being and quality of environment for development,’ priority 3.2 contains the ‘Formation of Sustainable Environment for Development’. A specific area relates to the environment, climate change adaptation and disaster risk reduction.[35] In the current situation, there two sectoral strategy plans have been prepared on the Construction and Industry sectors.

Development Program of the Kyrgyz Republic for 2018–2022 ‘Unity, Trust, Creation’ is another comprehensive national document guiding the Kyrgyz Republic towards creating sustainable development programs and solutions up through the end of 2022. This development program prioritises the environment to be integrated into Programme areas. Priority 6 focuses on cross-cutting

33 http://www.nism.gov.kg/
34 http://donors.kg/en/strategy/5174-national-development-strategy-of-the-kyrgyz-republic-for-2018-2040
35 National Development Strategy of KR, 2018- 2014

development directions, and 6.2 is specifically dedicated to the Ecological aspect of development indicating that 'the principles and requirements of the green economy will be introduced at all stages: planning, decision-making, implementation and monitoring'.[36 37]

In 2019, with a corresponding action plan, the Kyrgyz government implemented the Green Economy Growth Policy for 2019-2023. Seven focus areas were identified by this program: **renewable energy; green agriculture, green industry; low carbon and environmentally friendly transport; sustainable tourism; waste management; and green cities**. The Government is currently concentrating on the implementation of the goals for this program.[38]

The energy efficiency (EE) legislation of the Kyrgyz Republic is based on two primary laws – the Law on Energy Saving (1998) and the Law on Energy Performance of Buildings (2011) – and on related secondary legislation, such as government decrees, technical norms and regulations. However, it should be noted that as a cross-cutting issue, energy efficiency is affected by several other laws, many of which are outdated or lack effective implementation. The key cornerstone laws in this context are:

- The Law on Energy (1998)
- The Law on Electricity (1996)
- The Law on Renewable Energy (2008)
- The Law on Oil and Gas (2004)
- The Law of Energy Performance of Buildings (2011)

The Government of Kyrgyzstan has started recognising the importance of EE improvements and has initiated a number of important steps to help improve the EE framework. In recent years, some progress has been made with regards to the Kyrgyz EE agenda and related sector reforms, including:

- Amendments to the Law of Renewable Energy, July 24, 2019, #99
- Amendments to the Law on Energy Efficiency of Buildings, June 20, 2019, #74
- Action Plan/Roadmap for creating conditions for practical implementation of legislation in the sphere of energy efficiency of buildings of the Kyrgyz Republic, Gosstroy order 26.10.2016
- Regulation on the Modalities for the Energy Certification of Buildings, the Procedure for Periodic Monitoring of Energy Efficiency of Boilers, Heating and Hot Water Supply Systems, Government Decree № 531, August 2, 2012
- Regulation on rules and procedures for qualification certification of specialists in energy certification of buildings and periodic monitoring of energy efficiency of boilers, heating systems and hot water supply of buildings, Government Decree № 13, January 17, 2020
- Regulation on the State Register of Energy Certificates of Buildings, Reports on Periodic Monitoring of Energy Efficiency of Boilers, Heating and Hot Water Supply Systems of Buildings and Certified Specialists, Government Decree № 131, January 17, 2020
- SNiP 23-01:2013 'Building Heat Engineering (Thermal Protection of Buildings)', Gosstroy order 26.05.2013
- SP 23-101-2013 'Design of Thermal Protection of Buildings', Gosstroy order 26.05.2013
- Methodology for Calculating the Energy Efficiency of Buildings and Determining Energy Efficiency Class for Energy Certification of Buildings, Gosstroy order 26.05.2013

36 Development Program of the Kyrgyz Republic for 2018-2022; 'Unity, Trust, Creation'
37 https://www.gov.kg/ru/programs/6
38 https://www.kg.undp.org/content/kyrgyzstan/en/home/projects/partnership-for-action-on-green-economy.html

- Methodical instructions for conducting periodic monitoring of energy efficiency of boilers, heating systems of buildings and hot water supply of buildings, Gosstroy order 26.05.2013
- Guide to the settlement application for energy certification of buildings (based on Microsoft Excel), Gosstroy order 26.05.2013

Despite recent progress, the implementation of EE improvements is still hindered by multiple barriers. While the potential for EE improvements in economic sectors is significant, a number of technical, economic, institutional, legal, regulatory and financial impediments are preventing comprehensive EE investments from being undertaken. Key recommendations to address these barriers and taking into account the lessons learnt from implementation of EU legislation and from other more developed markets are specified further.

The main legal documents defining the scope and level of ambition of sustainability objectives in the building sector are the ***Law on Energy Efficiency of Buildings (LEPB)*** and associated secondary legislation represented by a set of government decrees and technical standards defining technical requirements and other practical provisions important for implementation by market stakeholders. The LEPB provides provisions for the buildings sector in the context of the more general Law on Energy Savings. The latter was adopted in 1998 and amended 2019 with assistance from the European Bank for Reconstruction and Development (EBRD). The main objective of this law is to increase energy efficiency at each stage of the generation, transmission, distribution and consumption of energy in all sectors of economy. In particular, Article 15 mandates establishing energy consumption norms in buildings and updating them at least every three years. This article has yet to be implemented.

Law on Energy Performance of Buildings (LEPB)

The Law on Energy Performance of Buildings[39] was developed in 2011 within the framework of technical support provided by the European Bank for Reconstruction and Development. The LEPB, defining legal responsibilities of building owners and instruments to promote energy efficiency in buildings, was adopted as Law No. 137 by the Parliament and has been in force since 6 February 2012. The LEPB addresses all stakeholders of the building sector, including private homeowners, commercial premise owners, and public buildings. The new legislation on energy performance of buildings in Kyrgyzstan is in almost full compliance with the EU Energy Performance of Buildings Directive 2010/31/EU (the EPBD or the 'Building Directive') and introduces a new concept of legislation for the Kyrgyz authorities. The new legislation allowed the Kyrgyz Republic to become a pioneer and the first country in the post-Soviet region (with exception of the three Baltic states) to implement energy efficiency legislation for buildings, based on best practices from the European Union (EU).

Following the LEPB entry into force, Government Decree No. 531 was approved, which introduces implementation procedures for energy performance certifications (EPC) of buildings and regular inspections of boilers and heating systems. EPC and regular inspections of boilers and heating systems are to be conducted by independent accredited professionals on a commercial basis. Decree No. 531 also introduces minimum energy performance (MEP) requirements for all types of buildings under construction, major refurbishment and those for sale, and an energy assessment methodology in compliance with ISO EN 13790/2008.

Government Decree No. 531 requires the introduction of minimum energy efficiency requirements for buildings. New buildings and buildings undergoing energy renovation should:

- have a thermal conductivity of the enclosing structures that is lower than the set values, and
- consume less energy than the set values per unit area, in accordance with the functional purpose of the building and the climatic zone of the building's location.

39 http://cbd.minjust.gov.kg/act/view/ru-ru/203377/20?mode=tekst

The sphere of implementation of the legislation includes residential, public, administrative, and multifunctional non-industrial buildings, with the exception of:

- buildings intended for religious rites, rituals, and ceremonies;
- buildings that, in accordance with the legislation of the Kyrgyz Republic, are considered as cultural heritage sites (historical and cultural monuments), if the fulfilment of energy efficiency requirements is impossible due to a change in its appearance and enclosing structures;
- individual residential buildings, the total area of which does not exceed 150 m^2 (facilitated by the ranking of the Tax Code of the Kyrgyz Republic);
- temporary objects of non-capital construction, country houses, and buildings and structures of auxiliary use (auxiliary farming facilities).

The legislation presupposes the existence of an institute of independent specialists conducting Energy Certification of Buildings and Periodic Monitoring of the energy efficiency of heating and hot water supply systems in buildings - procedures similar to those applied in the European Union.

Further, the technical standards and rules were updated (SNiP 23-01:2013 'Building Heat Engineering (Thermal Protection of Buildings)'), with the adaptation of the requirements[40] for the section 'Energy Passport' in the design and estimate documentation. In 2013, with the updating of technical documents, the obligation for having an Energy Passport was eliminated, and amendments were made to mandatory verification of compliance of the thermal protection of new buildings with the minimum requirements established by the LEPB.

Although not all of the mechanisms have been implemented at the planned scale up to now, energy efficiency issues are gaining momentum, and the harmonisation and strengthening of requirements for energy efficiency in other areas such as household appliances and public procurement can be observed.

Technical standards and rules in the building sector

There are about 6,000 technical documents and standards that regulate the construction sector in the Kyrgyz Republic, which can be divided up as follows:

- 130 construction norms and rules (SNiPs), regulating norms of designing buildings
- 4,500 standards (GOSTs), regulating the requirements for construction materials, products, structures and the methods for testing them
- 1,500 normative documents from related departments, such as instructions and regulations from the Ministry of Emergency Situations, the Ministry of Health, the Ministry of Labour, State Mining and Technical Supervision, Fire Fighting Service, Kyrgyzstandard, etc.

Of the 130 SNiPs currently in force, 20 documents have been developed by the Interstate Scientific and Technical Commission on Standardization, Technical Rating and Conformity Assessment in Construction as interstate construction norms (ICN), 35 documents have been developed (some of them have been revised two or three times) by the State Construction Institute itself as national construction norms (SNiP KR). Thus, 55 construction norms have been updated[41], or 42% of the total number of SNiPs, while the rest of SNiPs are Soviet-era documents that have not yet been revised.

40 The introduction of this section was in 2009, with the updating of the standard according to Russian standards, as part of the UNDP project 'Improving the Energy Efficiency of Buildings'. The passport suggested a 5-class energy scale system. 5 years of experience in its implementation showed that the implementation of this standard is hampered by the lack of harmonisation of the procedures for preparing project documentation.
41 https://www.faufcc.ru/upload/iblock/257/raisova.pdf

For example, there are no technical rules or design instructions for built-in photovoltaic panels, pre-insulated heat pipes or other modern technologies.

The State Committee for Industry, Energy and Underground Resources of the Kyrgyz Republic has approved the registering of priority documents which require development, but has not yet revised them. Finally, there are a number of developed documents already approved by the SCIEN Scientific and Technical Council, but the process of issuing these documents as ‘official technical documents’ has been delayed.

5. RECOMMENDATIONS FOR AMENDMENTS OF NATIONAL POLICY AND REGULATORY FRAMEWORK

Taking into account the national context as described in Section 1 (Introduction and National Context) as well as Section 4 (National Policies, Regulatory and Institutional Framework), it is critically important that the Government set up the right set of policies and regulations stimulating the adoption of sustainability practices both for new construction as well as for the deep and energy-efficient renovation of existing building stock. Over 90% of the existing building stock does not meet either the requirements for low-carbon buildings or the current national energy performance requirements. At the same time the age of these buildings (at least 35 years old) makes them suitable for different degrees of renovation because some of their components (engineering systems, windows, doors, roof, insulation, façade elements) are approaching the end of their physical life and will require replacement.

The sections below explain some specific recommendations broken down into 1) general provisions, 2) energy performance of buildings, and 3) broader sustainability considerations including whole-life cycle carbon footprint, resource efficiency and circular economy concepts applicable for buildings. These recommendations are being suggested in order to address different types of broader market barriers.

5.1 General policy recommendations on sustainability in buildings

In order to identify appropriate recommendations it is important to understand the gaps and barriers for energy efficiency and general sustainability and SCP in the building sector. Based on understanding of the gaps and barriers and upon critical reflection of lessons learnt from more developed markets worldwide adapted to the local market context in Kyrgyzstan, a set of actions and recommendations have been suggested.

A good summary and deeper plunge into complex set of gaps and barriers is provided in the report ***Enhancing Sustainable Consumption and Production Tools and a Circular Economy in Kyrgyzstan: Approach in the Building Sector with a Focus on Energy Efficiency***.[42]

There is a significant market potential for energy-efficiency renovations in Kyrgyzstan. Rapid demographic growth, urbanisation and increasing internal mobility, the development of the service sector and higher requirements for building comfort and conditions is driving high construction rates and investments in building as the main investment opportunity in Kyrgyzstan.

A prompt adoption of supportive policies will have wider and more positive socio- and macro-economic ramifications as briefly outlined here:

42 SWITCH-Asia SCP Facility: Enhancing Sustainable Consumption and Production Tools and a Circular Economy in Kyrgyzstan: Approach in the Building Sector with a Focus on Energy Efficiency, 2022.

- **Micro-economic benefits.** The adoption of energy- and resource-efficient techniques will reduce utility bills for building occupants, allowing them to use the savings for other purposes, including for a better quality of life. This is particularly relevant for residents living in single family buildings or for the owners of commercial buildings. Even with the current low energy tariffs the savings for a standard family could represent savings equivalent to 1.5–2 times the amount of average monthly income.[43]
- **Job opportunities.** Construction of new buildings and particularly of smaller ones, along with the renovation of existing buildings, is labour intensive. Data from advanced markets[44] adjusted for the Kyrgyz market suggest that each EUR 1 million invested in energy efficiency renovation of existing buildings or implementation of sustainability techniques in new construction generates from 20–24 full-time jobs. Taking into account the current data on new building construction statistics (pre-COVID 2019) and the anticipated rate of renovation to reach decarbonisation of the existing stock by 2050, the resulting number of job opportunities ranges from 29,000–35,000 new full-time jobs in the construction industry, a very substantial figure for a small country like Kyrgyzstan with moreover a high rate of unemployment among youth. The number above does not account for the additional benefits of introducing circular economy concepts and whole-life cycle approaches in building sustainability, as these will give a natural advantage to products manufactured locally or that are more environmentally friendly local resources (e.g. straw-mud blocks, which are so popular in rural areas at present).
- **Macro-economic benefits.** The current energy system in Kyrgyzstan is overloaded, operating beyond the limits of its current capacity for safe and reliable operation. Frequent interruptions in energy supply and technical failures affect business and local communities, particularly during summer and winter peaks. Buildings including residential, commercial and public are the main final-end energy consumers who are responsible for over 55% of national final energy consumption.[45] Clearly with a fast demographic growth and high rates of construction, the national energy system will no longer be able to cope with growing demand. Major reconstructions of the entire grid and new generation capacities are unlikely due to the scale of foreign investments needed, which is not likely under the current vulnerable political situation. This means that the most cost-efficient solution would be rapid, determined action to improve energy efficiency in the end-use sectors – and where buildings play a key role. Unlike investments in the energy sector, where large and international investors are necessary, investments in energy and resource efficiency in buildings require no international capital and can easily leverage and use the private capital of local market stakeholders including among the population.
- **Positive effects on the national energy balance.** Taking into account the high share of imported fossil fuels in buildings (over 90% of gas imports)[46], rapid decarbonisation of buildings will have a substantial and positive effect on both security of energy supply, reduction of energy dependency on imports and positive influence on the national energy balance. The recommendations suggested in the Green Building Guidelines follow the ‘energy efficiency first’ principle, which anticipates a radical reduction of energy demands, while the residual part can be easily covered by renewable sources with a minimum of on-site energy from fossil fuels.
- **Better competitiveness for local businesses.** The vulnerability of current energy supplies, high dependency on delivered energy on-site, the volatility of energy markets all negatively affect the local business community in terms of competitivity. Services and production facilities need to interrupt their operation when there are power black-outs, retailers lose stock due to refrigeration interruptions, services where indoor comfort conditions are requirement for receiving clients lose customers. Taken together these conditions result in both profit loss and lowered

43 Unison, 2020.
44 Frits Meijer, Henk Visscher, Nico Nieboer, Robert Kroese: Jobs Creation Through Energy Renovation of The Housing Stock, 2021
45 World Bank, 2019.
46 Kyrgyz National Statistic, 2019.

competitiveness. With the reduction of energy demand due to energy and resource efficiency, and a higher use of independent renewable energy, businesses will be able to carry on their operations independently of the volatility of the national grid infrastructure.

- **Positive social results including health, well-being and security.** Energy efficiency measures can support good physical and mental health primarily by creating healthy indoor living environments via healthful air temperatures, humidity levels, noise levels and improved air quality. The potential benefits of energy efficiency measures include improved physical health through reduced symptoms of respiratory and cardiovascular diseases, less rheumatism, arthritis and allergies, and fewer injuries. In cold climates, energy efficiency improvements can lower rates of excess winter mortality, and in hot climates they can help reduce the risk of dehydration and negative effects. The health benefits of energy-efficient buildings can be seen in both homes and the workplace. A Singaporean study found that people working in energy efficient buildings are less likely to suffer from fatigue, headaches or skin irritations. Improving the health of workers could in turn have significant implications for workplace productivity.[47] The measures for improving energy efficiency should be taken; however, they must be of good quality and maintain the rates of fresh-air ventilation for the indoor environment. That means energy efficiency retrofit should be conducted not as single stand-alone measures implemented in isolation, but as a well-thought and well-engineered retrofit package of measures respecting all the provisions elaborated in the Green Building Guidelines. Greening local communities and introducing advanced control, monitoring and automation technologies (management and monitoring systems) will positively affect community security through better visibility via lighting levels, the presence of surveillance cameras, better waste management.
- **Improved market value chains and investment climate.** Setting up green and sustainability supportive legislation will create market opportunities for modern technologies. By increasing the demand for these, the higher supplies will positively affect the prices of these technologies on the Kyrgyz market due to better competition among suppliers and vendors as well as availability of wider product range. At the same time making building regulations compliant by spirit and objectives compliant with the business practice of advanced markets will make it easier for international investors with high standards of their Environmental, Social Governance (ESG) policies to undertake larger investment projects and will prevent from facing unfair price competition with other investors not applying the same set of investment requirements.
- **Improved credit-worthiness of local businesses.** Investments in one's own building assets, and making them future-proof from the regulatory perspective, better adapted to future needs, more energy efficient, less vulnerable to volatility of energy infrastructure and tariffs fluctuations, makes them more valuable too. Evidence from international green building certifications schemes (LEED, BREEAM) indicates the high asset values of greener buildings in the range of 12%–16% of asset value.[48] A direct correlation between decrease in energy consumption and higher building value was also assessed in this study, which concluded that a 10% decrease in energy consumption will have a 1% increase in rent or value premium for a labelled building.

A larger scale of renovation across Kyrgyzstan will require designing and introducing additional financing instruments, making it possible to internalise longer term and wider benefits from energy renovations while reducing higher up-front costs, which currently make renovation unaffordable for the vast majority of Kyrgyz households. Wider renovation programs need to consider an extension of existing supply chains and the involvement of wider spectrum of suppliers upon stricter control for market access. Otherwise scaling-up investments in renovation will result in shortages of materials and technologies, or respectively higher prices and lower cost efficiency in building renovation programs. Any further amendments of policy and regulatory frameworks will need to keep in mind

47 IEA, Multiple Benefits of Energy Efficiency: From Hidden Fuel to First Fuel, 2019
48 C. Ciora, G. Maier, I. Anghel. s the higher value of green buildings reflected in current valuation practices? 2016

the market transition to decarbonisation across the entire value chain.

But energy efficiency retrofit is still focused on reducing energy consumption, and to a lesser extent on the decarbonisation, and not at all on issues associated with the overall carbon footprint of buildings, and more specifically on carbon emissions including embodied carbon. These are all areas for further dialogue on policy and regulatory development. National legislation needs to be amended taking into account the lessons learnt from practical implementation in more developed markets (i.e. the EU). Collaboration at the international level and within the entire value chain is thus essential for reflecting on the lessons learnt, and adopting the most effective and useful models and instruments.

Policy and regulations will need to address a complex set of market barriers in the building sector, listed below.

- **Address gaps in current policy and regulatory framework:** as discussed in Section 4.
- **Institutional barriers:** these are related to misalignment in the roles and responsibilities assigned to different ministries as well as through sector-specific legislation. To address the life-cycle sustainability of buildings, coordinated interventions are necessary across the value chain and in the legislation of sectors not directly related to building design or operation during building-usage stage: for example, manufacturing industries, waste management and disposal, public procurement, energy sector regulations. Kyrgyzstan faces exactly the same challenges as any other country when a particular Ministry designs policies strictly within their institutional remit, without taking into account cross-cutting linkages that are nonetheless related to broader issues of environmental sustainability, which is considered the domain of responsibility by the designated environmental agency only.
- **Market fragmentation:** Building is an extremely fragmented sector in terms of physical and geographical implantation, and ownership and institutional structure, all of which significantly complicates the development of supportive policies or financing instruments, because there are specific constraints for each of the market stakeholder groups. The different sizes and scales of investments needed, the different ranges of technology options, different motivations, capacities for understanding and awareness among various residential, commercial and public stakeholders responsible for their building assets contribute to fragmenting the market.
- **Affordability constraints:** Budget considerations directly affect the market stakeholders, who can benefit from implementation of green building techniques in their building assets, but do not have the capital resources for their implementation, particularly for the residential segment of the market and for lower-income families with respect to ownership of residential assets (typically single-family houses in smaller towns or rural areas). Another category of market stakeholders with affordability constraints are small business people who own small commercial assets and public authorities with larger portfolio of public buildings. This affordability constraint can be addressed through well-designed financial instruments that unlock investment opportunities, and by using as collateral the increasing asset value of the building upon renovation. Other possibilities could be measures for energy performance contracting or blended finance combining commercial finance with grant support (incentives) linked to specific environmental results to encourage broader benefits for the entire society.
- **Split incentives:** Split incentives refer to any situation where the benefits of a transaction do not accrue to the actor who pays for the transaction. In the context of energy efficiency in buildings, split incentives are linked with cost recovery issues related to energy efficiency upgrade investments due to the failure of distributing effectively financial obligations and rewards of these investments between concerned actors. This can ultimately result in inaction from either actor’s side, despite the fact that many of these upgrades are of positive net present values.

- **Availability of technologies:** Availability of advanced green technologies on the local market, their high prices, and sub-standard conditions for maintenance and service are typically triggered by low supply of these technologies by limited numbers of suppliers. This is typically result of a low demand by end-use customers. This barrier can be addressed by set of actions aiming at both removing gaps in regulatory framework and stimulating market players to adopt advanced green solutions. Supply typically follows the demand by the market. In parallel additional activities could be conducted addressing both capacity and understanding of the professional community as well as the awareness of general public. Awareness raising activities targeting general public and possible end-use customers will advise about wider benefits of applying greener solutions.
- **Implementation capacity constraints:** The construction industry and the broader professional community (architects, designers, energy and environmental assessors, energy auditors, valuators, etc) lack the quality and the capacity of implementing more sophisticated sustainability concepts in buildings. In addition professional services related to building sustainability are in their very infancy of these and largely not available on the market.
- **Information asymmetries:** related to limited awareness of various and very diverse categories of market stakeholders over wider benefits from better EE and broader SCP

The barriers identified have been assessed in a number of reference studies (e.g. including in materials produced by the EU EEFIG[49] Working Groups) and there is a general consensus among professional community on the reasons for market failures of wider and market base renovations. These encompass barriers related to insufficient policy and regulatory framework, structure of the market, affordability, lack of capacities and information asymmetries. The set of barriers is common for all of Central Asia or in general for post-Soviet countries with different degrees of magnitude in different countries.

The barriers specified above can be further complemented with additional considerations, which hamper implementation of energy efficiency techniques as well as any further SCP in buildings in Kyrgyzstan:

- low energy tariffs and standard benchmark-based billing for district heating. Tariff policies fall under insufficient policy and regulatory. However, tariffs set up in the wrong way (without taking into account environmental externalities or wider society benefits) do also impact affordability and economic incentives for implementing EE and SCP practices;
- restricted public-sector budgets and lack of access to commercial financing by public entities, including for energy efficient retrofits. Like to energy tariffs above, public procurement rules fall under insufficient policies and regulatory. It is however up to the financing sector to offer financing products allowing to capture the value added of better EE and/or broader SCP, moreover if some of financial institutions are interested to scale-up their portfolio of greener and environmental investments;
- public budgeting regulations do not allow to retain any energy cost savings. Similar this specific gap falls under policy and regulatory barriers;
- lack of local market capacity and experience (e.g. energy auditors, design institutes, construction companies, etc.) in preparing and implementing high quality EE projects;
- lack of credible data, awareness and behavioural inertia, which hamper the demand for investments in EE products and services. These gaps fall under both under lack of sufficient implementation capacity (for EE and broader SCP practices) as well as is a function of information asymmetries;
- institutional and regulatory barriers, such as incomplete legislation and weak enforcement of building codes.

49 EEFIG: https://eefig.ec.europa.eu/index_en

These are the key conclusions out of the market overview as presented above.

- Current construction practice at present does not incorporate resource efficiency or circular economy concepts. The only positive practice is a wider use of mud-bricks, typically used in rural areas for construction of family houses
- No attempts are being made for reuse or recycling of construction and demolition waste
- The current supplies of technologies and materials is not sufficient to cover any broader building renovation efforts.
- Existing supply chains have limited capacity and limited number of suppliers
- There is no quality control of imports of materials and technologies, which potentially creates the risk of importing sub-standard and low-performing technologies
- Wider renovation programs need to consider extending the existing supply chains and involving a broader spectrum of suppliers upon stricter control for market access. Otherwise scaling-up investments in renovation will result in shortage of materials and technologies or respectively higher prices and lower cost efficiency of building renovation programs.

Table 4 presents the gaps and barriers presented in this section, along with recommendations to address them.

Table 4. Links between gaps and barriers and policy recommendations

Gaps and barriers	Recommendations	Comments
Gaps in the current legislation on energy performance of buildings, waste management, and other environmental legislation (fluorinated gas substances)	Amend the set of minimum requirements and introduce NZEB for new construction and cost-optimal level of requirements for renovation of existing buildings. Existing waste management regulations can be amended in order to reflect and follow the EU Waste Hierarchy as well as support waste processing, minimisation, value recovery and recycling. It could be relatively easier to adopt regulations supporting the introduction of more energy- and resource-efficient equipment, appliances and technologies falling under the provisions of the EU EcoDesign Directive and relevant regulations. The latter might require support for national certification and testing laboratories, which are instrumental for the implementation of these regulations.	These recommendations can be implemented through amendment and extension of the existing regulatory framework.

Gaps and barriers	Recommendations	Comments
Absence of policy and legislation supporting a circular economy	Adoption of a new set of policies and legislation addressing circular economy considerations across all sectors of the economy. Sector specific sub-laws or regulations can introduce circular economy concepts in buildings and construction.	Prior to adopting suggested a new set of policies and legislation, some further work including policy dialogue, monitoring and assessing lessons learnt from implementation of similar concepts in more developed markets is necessary. This could be combined with capacity-building activities, implementation of pilot and demonstration projects as well as further analytical work on the wider benefits of circular economy concepts in the market context of Kyrgyzstan
Absence of provisions supporting an integrated approach to SCP in building and construction	Adoption of a new set of policies and legislation addressing SCP considerations across all sectors of economy. Sector specific sub-laws or regulations can support the introduction of SCP in buildings and construction.	
Energy and utility tariff policy	Amending tariff regulations and associated methodologies with internalising of environmental impacts	Amending tariff policies is theoretically possible within existing regulations in the case of strong political will. However such political will is completely lacking at present due to recent political instability and the risk of negative public opinion. In addition to any further work on amending tariff regulations we recommend undertaking and supporting broader actions addressing increased public awareness on climate and environmental challenges. This will enhance public acceptance on the need to internalise climate and environmental externalities.

Gaps and barriers	Recommendations	Comments
Low level of policy enforcement	Capacity-building and awareness raising activities targeting: (i) local designated authorities in charge of legal enforcement of regulations related to the energy efficiency of buildings, and ii) the broader professional community (developers, building managers, architects, designers and construction companies) on the benefits from compliance with the new legislation on energy efficiency in buildings.	Although the Kyrgyz legislators have adopted legislation on energy performance of buildings, implementation is hampered by the lack of legal enforcement, mainly because of the lack of capacity among designated authorities and their limited understanding of the benefits and functionalities of the legislation as well as an absence of practical tools supporting legal compliance.
Lack of practical provisions for integration of distributed renewable energy generation	Development and adoption of secondary legislation (Government Regulation or Decree) providing clear conditions for grid connections of smaller-size renewable energy projects (wind, solar energy and photovoltaics (PV)).	Although Kyrgyzstan adopted a law supporting renewable energy generation, smaller-sized renewable energy distribution projects are discouraged because of the absence of clear and practical regulations defining the conditions for grid connection. One of the arguments frequently used by power utilities against connection of larger numbers of smaller-size renewable energy projects is that grid could be stability influenced by fluctuating wind and solar power generation. In order to address these concerns, we recommend conducting a grid stability assessment study, which could provide factual and objective analytical evidence on the basis of modelling the impact of renewable distributed power generation on grid stability. This study could precede development of a grid connection regulation as it would provide scientific, fact-based evidence on the anticipated impact as well as suggest measures to mitigate a possible negative impact at larger scale deployment of renewable energy power generation capacities.

Gaps and barriers	Recommendations	Comments
Lack of green procurement rules and sustainability-related procurement criteria	Adoption of green public procurement rules, similar to the EU GPP	This action is recommended in coordination with and following some analytical works related to the identification and assessment of circular economy and SCP concepts applicable for the building sector within the market context in Kyrgyzstan.
Budgetary regulations for public entities in relation to energy performance contracting. These tend to use lowest acquisition upfront costs as the decisive criteria without incorporating life-cycle costs and benefits	Amendment of existing budgetary regulations for public entities to allow energy performance contracting and retaining revenues from energy or resource efficiency investments.	This is important for introducing off-balance financing instruments in the public sector (including for energy-efficient retrofit in public buildings) such as energy performance contracting, and/or for stimulation of energy performance services.
Absence of legal obligation for environmental, social and governance (ESG) disclosure for corporations and financial institutions	Introduction of legal obligations of financial institutions and larger corporations for public disclosure for SCP activities (or their financing)	As soon as higher-level policies targeting climate, environmental or sustainability objectives are introduced, an obligation for larger corporations and financial institutions to disclose their activities supporting these policy objectives will stimulate interest and engagement in SCP, climate change and the environment. However, it would be practical to apply this only after corresponding SCP-related legislation is adopted (bullet points above) and reflects the lessons learnt from implementation of the SFDR and NFRD directives in the EU.

6. PRACTICAL MEASURES FOR THE IMPLEMENTATION OF GREEN BUILDING VALUE CHAIN CONCEPTS

Better material efficiency and the introduction of circular economy concepts to reduce the embodied carbon footprint in buildings and in the construction industry in general are still in their infancy in Kyrgyzstan. There are no policy or regulatory frameworks at present to address these challenges, or to stimulate the market for voluntary practices aimed at either environmental benefits or value creation from better material efficiency or reuse/recycling of construction and demolition waste (CDW).

The key messages with regards to policy dialogue opportunities as well as for other practical measures which can help to address gaps and barriers listed in Section 5 take into account the links between gaps and barriers, and policy recommendations.

Policy and regulatory actions

Taking into account that the EU policy and regulatory framework is still under development, we recommend the following activities in the short term (2021–2023):

- Monitor any further developments and understand the lessons learnt and the positive experiences of the EU and global best practices related to material efficiency and circular economy concepts in buildings
- Test the application of the methodology developed under the Level(s) programme for pilot projects in Kyrgyzstan
- Pilot Life-cycle Assessment (LCA) for certain building products and materials, and suggest a prototype Environmental Performance Declarations (EPDs) mirroring the EU approach
- Support capacity-building for market-based solutions in the field of circular economy of buildings in Kyrgyzstan (development and adoption of relevant methodologies, training and awareness-raising activities)

Reflecting on the outcome of these as well as taking into account any positive experiences and lessons learnt from implementing the policies on the energy performance in buildings as is currently being done in the EU, we recommend further development of similar regulatory frameworks, adapted to the context of the Kyrgyz construction market in the medium- or longer-term perspective:

- Adopt policy and regulations aiming at net zero carbon performance of new buildings and renovation of existing buildings at cost-optimal levels in compliance with the level of ambition and carbon reduction targets as defined by the national climate policies and for meeting the targets specified in the National Determined Contributions and associated sector-specific low-carbon pathways.
- The above should be harmonised and coordinated with introduction of circular economy considerations and by reflecting on lessons learnt and positive experience from implementation in the EU and other countries (e.g. USA).

Table 5. Timeframe for implementation of policy and regulatory recommendations (summary)

<table>
<tr><th>Policy and regulatory recommendations</th><th>Short-term perspective 2021–2022</th><th>Medium-term perspective 2023–2025</th><th>Longer-term perspective (after 2025)</th></tr>
<tr><td>Existing legislation on energy performance of buildings</td><td>• Ensure enforcement and wider application of existing legislation
• Support capacity-building for legal enforcement by the designated authorities responsible for implementation of existing legislation
• Support building up capacities for implementation of provisions of existing legislation among local professional community
• Continue with harmonisation of technical standards with existing primary and secondary legislation</td><td>Amend existing legislation with introduction of these measures:
• Cost-optimal level of requirements as per methodology introduced by EPBD in addition to existing minimum technical requirements on energy efficiency
• NZEB requirements applicable for new construction of buildings</td><td>Monitor any further up-dates of the EU legislation in buildings and more specifically with respect to EPBD, and incorporate any new provisions supporting decarbonising of buildings in the national legislation within local market conditions in Kyrgyzstan</td></tr>
<tr><td>Introduction of material efficiency standards and circular economy concepts</td><td colspan="2">• Monitor any further development and understand lessons learnt and positive experiences of EU-wide initiatives related to material efficiency and circular economy concepts in buildings
• Test application of methodology developed under Level(s) for pilot projects in Kyrgyzstan
• Pilot Life-cycle Assessment (LCA) of certain building products and materials and suggest a prototype Environmental Performance Declarations (EPDs) mirroring the EU approach
• Support capacity-building for market-based solutions in the field of circular economy of buildings in Kyrgyzstan (development and adoption of relevant methodologies, trainings and awareness-raising activities)</td><td>Adopt policy and regulations aiming at net zero carbon performance of buildings and by introducing of circular economy considerations by reflecting on lessons learnt and positive experience from implementation of EU legislation</td></tr>
</table>

Policy and regulatory recommendations	Short-term perspective 2021–2022	Medium-term perspective 2023–2025	Longer-term perspective (after 2025)
Other areas of legislation	• Develop a concept for introducing the EU Waste Hierarchy with regards to construction materials and construction and demolition waste (CDW) • Adopt provisions reflecting the ban of substances with high Global Warming Potential (GWP) and more specifically containing fluorinated gases in line with the EU F-Gas Regulation • Adoption of regulations on products consuming energy and mirroring the EU Regulations implementing the EU EcoDesign Directive • Adopt grid connection regulations for smaller-size distributed renewable energy power generation	• Adopt policies and regulations aiming to support better waste management, reuse and recycle of construction materials and CDW by reflecting on lessons learnt and positive experience from implementation of EU legislation • Adopt stricter criteria for market access to energy- consuming products in line with provisions of the EcoDesign Regulations and as amended by the EU • Adopt legislation introducing climate disclosure and reporting provisions • Adopt legislation regulating the Do No Significant Harm for all economic activities including buildings and construction in compliance with provisions of the EU Taxonomy for sustainable activities • Adopt green public procurement rules in coordination with works on circular economy and SCP • Adopt regulations and requirements for ESG disclosure of corporates and financial institutions with provisions similar to the EU Regulation 2019/2088 on sustainability-related disclosures in the financial services sector (known as the Disclosure Regulation, ESG Regulation or SFDR) and to – also called the Non-financial Reporting Directive (NFRD) 2014/95/EU	

The introduction of efficient and supportive policies should be backed by provisions for financing resources made available on market principles by financing institutions.

In addition to policy dialogue aiming for up-grades in policies and regulatory frameworks, it is important to conduct further analytical work and activities targeting the enhancement capacity of relevant market counterparts and broader public awareness.

Further **analytical work** is important especially in the following areas:

- Assess the broader benefits from introduction of SCP and circular economy concepts in buildings and construction
- Develop analytical evidence behind possible definitions of NZEB requirements for new constructions along with cost-efficient requirements for existing buildings

- Develop analytical justification for the impact of larger-scale introduction of smaller distributed renewable energy power generation on grid stability
- Conduct Life-cycle assessment for key construction materials, manufactured and widely used in Kyrgyzstan in the form of Environmental Product Declarations
- Identify and assess cost-effective nature-based solutions, applicable for construction practices in Kyrgyzstan

At the same time we recommend a spectrum of **capacity-building and awareness raising** activities complementing on-going and future policy dialogue opportunities, for example:

- Training the authorities responsible for implementing legislation on energy performance of buildings
- Training key market players (developers, building facility managers, architects, designers, construction companies) on the wider benefits from adopting advanced SCP and energy efficiency in particular, and on key provisions of the new legislation
- Conduct awareness raising activities and capacity-building events on topics related to overall environmental footprint assessment of buildings, green building materials, use of cost-effective SCP techniques, etc.

The above should be complemented with reporting on the outcomes of **pilot and demonstration** projects (Zero Carbon Buildings), buildings integrating nature-based solutions, and so on.

Special attention should be given paid to working with financial institutions on the development and introduction of dedicated financing instruments supporting introducing SCP in building and construction. These should be also complemented with capacity-building activities with financial institutions in order for them to understand the benefits from financing projects with higher environmental and sustainability credentials.

In addition to policy and regulatory actions, we have identified a number of market development, economic, institutional and financial actions, which could support decarbonisation market transition in line with the new supportive policies.

Market actions

- Improvement of and further reinforcement of legislation on energy performance of buildings and more specifically on building certification and minimum performance standards applied in building upgrades, sales or rentals in order to help build a vibrant and comparable market for building energy efficiency investments
- Improvement of information flows by developing an open-source energy and cost database for buildings and effective systems for sharing information and technical experience among sectors
- Facilitate innovation such as development of Government-led initiatives aimed at introducing innovative market-driven schemes using on-bill repayment and energy performance contracting, factoring and others by creating pilots to help grow energy efficiency investments in public buildings
- Develop a project rating system to provide a transparent assessment of the technical and financial risks of building energy renovation projects and their contracting structure

Economic actions

- Streamlining, blending and optimising the use of any donor or national support funding for energy efficiency investments through ensuring their better linkage to national climate strategies together and with the energy market reforms
- Increase the use of targeted fiscal instruments to motivate municipalities to prioritise energy efficiency during the natural replacement cycle of building assets and associated technologies;
- Review public and private accounting management of Energy Performance Contracts
- Further expert examination of the discount rates used in energy modelling, policy-making and investment decision-making, to adequately balance the benefits and risks of energy efficiency

Financial actions

- Work with the Financial Regulator and with the National Bank on developing a common set of procedures and standards for energy efficiency and building renovation, underwriting for both debt and equity investments and taking into account experience from more developed markets and in particular from the EU
- Adjust financial regulatory frameworks to better support innovation, and ensure that risk assessment and related capital requirements for long-term energy efficiency investments correctly reflect the risks and develop market potential for green bonds, factoring funds for Energy Performance Contracts and other more innovative sources of financing for energy efficiency
- Address barriers to expanding the green mortgage market, including by examining how to include energy costs and energy efficiency potential in mortgage affordability calculations
- Ensure that new regulatory frameworks for financial institutions (Solvency II and Basel III) do not prejudice energy efficiency investments
- Ensure that public technical assistance and project development assistance facilities are compatible and can be easily combined with market-based and concessional funding by qualified and experienced financial institutions
- Ensure that any public refinancing facilities, confirm eligibility for financial instruments accounting for energy efficiency

Institutional actions

- Ensure that better law enforcement of existing legislation and regulatory frameworks on energy performance of buildings, based on best international experience and lessons learnt from practical application of the legislation, is reflected in further refinement of the legal and regulatory framework (see recommendations suggested in section 4).
- Increase the capacity to facilitate ongoing project development assistance for all relevant actors, and provide technical assistance to relevant public sector bodies and entities for development and aggregation of energy efficiency investments in public and residential buildings
- Review of the public authority procurement rules to better evaluate lower operational costs as a part of tender assessment processes (e.g. through development of Green Public Procurement Rules applicable for any public tenders) in order to set up at least minimum requirements for products/materials in public projects to be reused/reusable and recycled/recyclable, require minimum requirements on new building design and large renovations to promote adaptability, flexibility and reversibility, and adopt criteria to award contracts based on Life-Cycle Cost (LCC) or Total Cost of Ownership (TCO) instead of the conventional upfront price. In addition, all public

tenders should require third-party verified environmental data of key materials to start building databases and enable setting of benchmarks

- Develop institutional capacity to implement national climate strategies and/or building renovation programmes that enable long-term planning and supply chain scale-up to deliver and finance ambitious buildings renovation programmes
- Increase the focus on regulatory frameworks that support strong corporate energy efficiency investment choices at key points in their investment cycle (connecting with energy audits)
- Review current rules for donor and national support in order not to unnecessarily burden accelerated energy efficiency investing and the up-scaling of public-private financial instruments
- Last but definitely not least, action is needed to support the Kyrgyz professional community in setting up a national Green Building Council, ideally as a member of the World GBC. This will greatly accelerate knowledge transfer and help to build sufficient expert capacities for applying lessons learnt from markets with much greater experience on application of building sustainability to Kyrgyzstan.

7. GREEN BUILDING GUIDELINES – THROUGH THE BUILDING LIFECYCLE AND VALUE CHAIN

The World Green Building Council, which represents the global professional network, provides definition of the term 'green building': 'A green or sustainable building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and that can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life. There are a number of features which can make a building 'green' or 'sustainable'.

The Guidelines provides further on an overview of green building opportunities through the value chain of buildings and the as per criteria and definitions stated below:

- Planning and design stage - take into account the following considerations: site selection, sitting on site, infrastructure and connectivity, energy efficiency, water efficiency, choice of materials and material base, pollution reduction, future health and well-being of building occupants, adaptability, impact on biodiversity, overall life-cycle assessment and environmental footprint;
- Construction: management and organisation of construction, energy, water and resource efficiency of construction process, pollution protection, waste management, health and safety
- Operation and management: energy, water and resource efficiency during operation, building up-grade and retrofit, choice of materials, furniture and redecoration of buildings, solid waste management
- End of life: end of life demolition of building, remediation of site, waste management, recycling and reuse of construction and demolition waste and waste by-products;

The value chain encompasses all different counterparts participating and responsible for lifecycle stages of a building: from building owners, developers, designers and architects, construction companies, manufacturers of construction materials and building components and systems, through facility managers and down to waste management and disposal companies.

7.1. Planning and design stage

(applicable for building developers, and conducted by building designers, architects and urban planners, material specification applicable for manufacturers and suppliers)

Site-sitting and conceptual considerations

Buildings which we are building today are likely to stay even beyond 2080. When designing buildings, it is increasingly useful to test how robust the building design will perform in future predicted climate and design future-proof buildings which are taking into account the change of climate and climate hazards expected for the given location and the needs for future adaptability.

Future-proof design does not mean to spent more money right now. Many useful concepts can be easily implemented simply by planning ahead and thinking differently about the site and building design. Further on we introduce a number of basic and simple recommendations, which should be considered by architects and designers, while deciding about site-sitting of the building and about the basic concepts of design:

- **Climate adaptation:** Main climate hazards driven by climate change and which could expose buildings to risks are: extreme weather events (heat or cold spells, extreme winds), floods due to increased rain precipitation or availability of resources out of public infrastructure due to changing weather patterns. Few basic recommendations with regards to specific climate hazards:

    - ***Flood protection:*** A good mitigation measure is to conduct a flood risk assessment upfront and prior to choosing the site location. Flood risk assessment should take into account future exposure and rain precipitation as well as how the site fits into broader district development. Obviously a single-site cannot be fully protected to a wider-area flood risk if not integrated into city flood defences. However even measures at the level of single building can prevent from extensive flood damage. For instance, develop a raised ground floor, with a water retention option in the basement. Where development takes place close to water basins exposed to raising level, the building could be built at higher ground and/or on stilts. The stilts need a protection against breakwaters to avoid damage from flood debris. Alternatively, the ground floor can be designed to raise up with the water level by using EPS polystyrene slabs with concrete screed over to achieve floating ground floor base. Pipeworks and building engineering systems can be encased in flexible pipeworks to allow vertical movement of the building. Connection to a floating pier or mooring posts is required. Another technique is a 'wet-proof' building design with minimum damage of the property in case of a flood. Such design encompasses use of water-resistant and easy to clean materials for floors, sidings or wall cover and the siting of electrical controls and cables above the predicted level of flood.
    - ***Extreme weather events:*** heat and cold spells. These are short term hazards of extreme intensity exceeding the maximum of standard weather events for which building has been designed. A good mitigation strategy is to adopt excellent thermal protection quality as per recommendations described further in the section of thermal protection. That will reduce to minimum building vulnerability. In addition, a thermal mass storage, good heating accumulation capacities will help to overcome shorter term exposure to heat and cold spells.
    - ***Extreme weather events – extreme winds***. Extreme winds can damage structural elements like roofs or façade elements. In order to mitigate possible risks, the roof should be well anchored in building fabric at level exceeding standard design recommendation. It should be also designed in a way preventing from the wind damaging any of peripheral elements and getting in the loft, which could make the roof exposed to simultaneous back pressure from beneath and overpressure from above. Façade elements should be also anchored with sufficient strength. The building sitting should allow external protection from the side of prevailing winds and avoid creating wind tunnels.
    - ***Access to urban infrastructure:*** Urban infrastructure might be exposed to climate risks and become vulnerable during climate events or might reduce its capacity in time. That is why designing the building as autonomous as possible will help to reduce the risk of infrastructure vulnerability. Applying the net zero carbon principles with high level of thermal protection and airtight will reduce heating demand in buildings. On the other side a good solar shading, use of green vegetation buffers, using wind to advantage for good air ventilation and using passive cooling techniques and thermal mass storage will reduce demand for cooling and air-conditioning in summer. If we combine this with rain water harvesting, use of water efficient fixtures and where possible waterless (e.g. urinals) will reduce demand of cold water too. Such a building supplied with power and heat from renewables will be less vulnerable to any external supply of electricity, heat, fuels or water, which potentially can be exposed to climate risks in future.

- **Urban density and access to urban infrastructure:** Maximum densities of around 80 dwellings per hectare are optimal for access to public transport and supports close walking to community services and facilities. For car-free developments the density could increase to 200-250 dw/ha, while maximum sustainable densities are considered below 400-450 dw/ha. Such high densities should be limited to parts of urban developments only. Further recommendations:

    - Ensure easy access to open spaces and communal facilities (shops, healthcare, public transport, etc)
    - Ideally 30 to 50% of open space area, minimum at 15%
    - Access to public transport, walking and cycling pathways. Typically, people are prepared to walk some 15 minutes (about 1.3 km distance) to local amenities. For zero carbon green buildings the energy use to access buildings by car can exceed the energy used in buildings by app. 30%. While site-sitting buildings and considering foot-walk or cycling pathways avoid long and straight design in order to prevent from unpleasant wind tunnels. Consider introduction of wind breaks or buffers as needed. Courtyard width should equal height of buildings if enclosed on all sides. This will provide wind buffering and allow sufficient ventilation and winter solar gains. Tall buildings with lower spacing could be exposed to little wind penetration. This could be a problem for dispersal of air-pollution. Spacing of 1.5 to 2 times the building height is recommended for good natural ventilation, daylighting and solar gains.
    - Trees and shelterbelts should be better placed to the north-east and skewed by 30º from the main wind direction in order to protect buildings from the colder winter winds.
    - City-scale networks should interlink open spaces, ideally located within 350-450 m distance (6–10 minutes' walk from each other) to form continuous green corridors with minimum road-crossings from the city centres to the edges.
    - Avoid tall free-standing buildings as they catch wind and direct it downwards. Working with the wind is important to ensure successful urban environment. The closer the buildings are to each other, the more they protect each other, but also the more they reduce solar gains to each other. Buildings too close together will luck summer ventilation and street pollution might not disperse effectively. It is recommended that buildings are skewed by 30º to the direction of yearly or summer winds.
    - Buildings higher than four storeys should be considered for connection to district heating and cooling plants
    - Consider the space needed for renewable energy use: there is a conflict between maximising the use of renewables and the optimal levels of urban density. For a development or building to rely on on-site renewables the urban density should drop to about 35-40 dw/ha. For higher density developments an offset by off-site renewables might be considered. Around 50 dw/ha are likely to meet zero carbon requirements by some partial renewables offset.

- Taking advantage of sunshine: Taking advantage of passive solar gains reduces considerably the building's energy consumption. Low buildings and open spaces which are oriented to the sun create a positive microclimate in winter. This extends the 'outdoor season' and reduces heat demand in buildings. Few basic concepts to be remembered for the passive use of solar energy:

    - Determine sun path and existing shelter on obstructions on site
    - Design with solar access during February-October in mind
    - The façade should face directly south, ideally no more than 30° of the east-west axis. Where solar gain is undesirable apply solar shading with horizontal or vertical elements of the façade

    - Apply urban 'breaks' between buildings to allow better sun access. Locate taller buildings to the north-east of the site as this protects from the winds without overshadowing. Lower buildings should be on the south with flat or low-pitched roofs. Height difference is ideally one or two storeys, but less than twice the average surrounding building heights to avoid wind turbulence at higher levels. The width of the urban 'breaks' should be about 3 to 5 meters minimum to avoid wind funnelling and to allow good solar access between buildings and beyond the breaks.
    - Ideally, each building should have two orientational directions. These should maximise the solar gain and allow cross-flow ventilation. If however the site specific allow for a single direction of functional building units (dwellings, offices or other), then a number of simple recommendations can be considered: (i) single-direction buildings should better face south or south-west; (ii) depth of plan should not exceed 6 m in order to provide a level of insolation and daylight; (iii) increase windows and always apply solar shading unless facing north.
    - Plan to allow a view of the sky and aim to achieve a balance between access to solar gains, wind protection and other considerations. Further provisions related to active use of solar energy is described in section Use of Renewable Energy below. Considerations related to the shape of building and its components are described in section *Thermal Protection of Building Fabric*.
- Biodiversity: Urban environment is typically by 3-4º warmer than the country side due to energy emitted by buildings. While this is an advantage in winter, can lead to overheating in summer. Passive cooling by green belts, green roofs and green vertical structures can reduce the risk of summer overheating. The vegetation should be placed at least 400mm from vertical building walls to avoid a rain shadow. Evergreens like ivy are suitable for buffering north-facing facades. The shelterbelt of green around buildings should be 2 to 5 meters high at lower storey developments with leaves cover of app 50%. Careful selection of vegetation is essential. On average deciduous trees provide around 80% reduction in summer solar gains, but decrease durable solar gains in winter by only 30%. In any case the design and use of vegetation should not compromise of the need for solar, good air ventilation and access to daylight. Vegetation also helps to screen noise from buildings, but is not a sufficient barrier on its own. Noise reduction out of dense evergreen vegetation can reach about 6-10 dB near the source of noise. Alongside wind, solar and noise-buffering considerations it is important to consider protection of trees from building works and the other way around protection of building structures from tree roots. The avoid stunting trees' growth a soil volume of 8 m^3 for small trees, 15 m^3 for medium ones or about 25 m^3 for large trees should be considered. Trees and vegetation have a positive impact on local biodiversity. Greenery offers shelter for birds and bats, while these keep control over invasive insects. With transition to airtight buildings, the birds and bats nesting in small gaps and niches in building will disappear. Keeping green belts and vegetation will offer sheltering opportunities for them. To avoid diseases and pests and to protect biodiversity select local species. A key action before development decisions are adopted is to appoint an ecology consultant who will assess the impacts on biodiversity and advise about appropriate set of mitigation measures.

Choice of materials

There are a few basic principles by which the footprint of embodied energy and carbon in materials can be reduced:

- Use natural and local materials: compressed earth structures, clay or mud blocks, mixed with straw, straw bales, plasters and finishes made of clay, natural stones, sustainable wood.
- Choose durable materials, ideally with a lifespan comparable to that of the building itself in order to avoid extra maintenance or replacement, because replacing specific components or materials

during the lifetime of the building adds to its overall environmental footprint (for example, surfaces using polished visual concrete or masonry do not require painting or plastering).

- Use materials from renewable sources, which are materials that will grow or regenerate at rates exceeding the extraction rate of non-renewable resources.
- Use recycled, reclaimed materials. These could be bricks, ceramic roof tiles, timber, but also concrete blocks or even steel structures which have been carefully dismantled.
- Use materials from ethical manufacturers with ambitions to reduce environmental footprint of their products. The environmental footprint can be tracked by review of EPDs or PEFs where available. In general manufacturers in developed countries already offer low-carbon concrete, or steel made with high recycled content. Concrete due to its carbon intensive process and extensive use is probably the material with high carbon impact in Kyrgyz construction practice. Examples of how to reduce the carbon footprint of concrete structures are numerous: (i) use of recycled aggregate, including of crushed concrete, or ground granulated blast-furnace slag; (ii) partial replacement of Portland cement as a binder with fly ash, silica fume or limestone fines; (iii) use of admixtures, which could extend certain qualities of even design life.
- Avoid toxic components or finishes. Toxic elements are included in pains and finishes. Whenever possible we recommend to use natural pains. These are mineral based and used for renders and plasters with great durability. Breathable wood-stains, based on natural oils and waxes can be used if unfinished timber cannot be accommodated. These however will require regular maintenance once applied.
- Avoid any hazardous materials such as lead, asbestos or are sources of high emissions of VOCs, particularly for use in interiors. Such materials are most of synthetic carpets, vinyl flooring and wall covering materials using adhesives and sealants. Some harmful solvents are also used for timber preservation. Many wood-based boards like chipboards, melamine, plywood and MDF (medium-density Fibreboard) contain formaldehydes. OSB (Oriented Strand Boards) have the lowest content of harmful substances.
- Apply resources efficient design solutions: (i) do not overdesign or overspecify load-bearing structures and particularly concrete and steel structures, (ii) apply more efficient design solutions with resource efficiency impact: use of prefabricated units wherever possible, use of flat slabs, post-tension slabs, voided slabs, ribbed and waffle slabs, etc.
- Embodied energy and carbon benchmarks in the region indicate about following material use for different categories of buildings:

Type of buildings	Residential	Public	Commercial
Material use, kg/ m^2 of GBA	1,600-1,700	2,000-2,500	1,700-2,000
Use of concrete	1,300	1,700-2,000	1,400
Use of steel	80-120	110-120	100-120
Use of bricks, gypsum, plaster and cementitious materials	50-120	80-90	50-100
Use of timber	8-9	1-2	3-7
Use of glass	10	6-7	8-15

- The chart below compares the carbon intensity of materials available on the market with best-practice materials, showing their significant potential to reduced the embodied carbon footprint:

Materials	Common practice, $kgCO_2$/tonne	Best practice materials, $kgCO_2$/tonne
Concrete	160-170	110
Steel	2,300	600-1,200
Aluminium	9,000-15,000	2,000-4,000
Bricks, gypsum, plaster and other cementitious materials	350	20 (mud bricks) -280 (aerate blocks)

Thermal protection of building fabric

In order to develop the building at low carbon performance it is important that ambitious design standards are applied. The 'passive house' approach is considered by m any to be the world's leading design concept in energy efficient construction. Passive house design relies on airtightness and superior thermal insulation of building fabric, coupled with a balanced mechanical ventilation with efficient heat recovery. This combination offers a controllable environment with maximum use of internal heat gains and minimum capacity of any additional heating system.

Designing compact building forms is an important consideration in the Passivehouse concept.

The level of thermal protection suggested by the Passive house and applicable for climatic conditions in Kyrgyzstan are the following:

- U-wall ≤ 0.16 W/m^2.K or application of at least of 200mm of certified compact external thermal insulation composite system (ETICS) to a load-bearing envelope wall typically used in Kyrgyzstan. The quality of the thermal insulation apply should ensure functional qualities as required for CE certified insulation systems and with thermal conductivity ≤ 0.044 W/m.K;
- U-roof ≤ 0.12 W/m^2.K or application of at least of 300mm of certified roof- insulation system to a standard horizontal load-bearing structure as typically used n Kyrgyzstan. The quality of the thermal insulation apply should ensure functional qualities as required for CE certified insulation systems and with thermal conductivity ≤ 0.040 W/m.K;
- U-floor (lower occupied floor) ≤ 0.12 W/m^2.K calculated according to provisions of the SO 13370:2017 Thermal performance of buildings — Heat transfer via the ground — Calculation methods;
- U-windows and U-entrance doors ≤ 0.65 W/m^2.K or application of triple glazing windows or transparent façade elements, with inert gas filling between the glass panes, and frames made of composite wood and/or certified plastic frames (7-chamers or more) or certified aluminium frames with Uf≤ 1.1 W/m^2.K; It is highly recommended that the windows and/or transparent façade element encompasses low-emissive glazing with the resulting Solar heat gain coefficient (SHGC) at about 0.45 to 0.55 and glass emissivity coefficient at 0.040. The overall energy rating of such windows should be not lower than A++ as per EU energy rating for windows prior to 2021, or at class A as per new energy rating regulation[50] applicable from 1st September 2021.

50 https://ec.europa.eu/commission/presscorner/detail/en/IP_21_818

- The resulting airtightness of the building fabric should not exceed 0.6ach-1 at 50 Pa pressure difference.
- Important consideration as part of thermal protection of the building is the decision on its shape. A compact building has fewer or smaller surfaces exposed to external environment. That means lower heat losses and lower energy demand from external sources. Building compactness is expressed as the ratio of externally exposed surface (A) to the internal building volume (V) or = A/V. An optimal ratio is considered at ≤0.7 m^2/m^3. Complex buildings with higher ratios will have more thermal bridges, which means increasing heat losses. Fabric standard needs to be better by 30 to 50% of thermal protection if to offset such a negative impact. The 'passive house' refers to a different definition of the form factor as the ratio of externally exposed surface areas (A) to the internal treated (conditioned) floor area (TFA). The optimal A/TFA form factor A/TFA is ≤3. For line type of buildings or for terraced houses as these are called in UK, the form factor is <2 or 4< for one-storey residential detached houses so frequently built in rural areas. Building form should be carefully weighed against other benefits (daylight, aesthetics, etc) prior to offsetting its energy use and apply additional insultation. A very general rule of thumb is that surfaces exposed to south or south-west could be larger and with bigger share of windows, while those facing north or north-east should be smaller with less of transparent structures. Another consideration is that areas highly exposed to sun should have a higher heat accumulation capacity in order to accumulate as much as possible of solar gains, which could be gradually released and substitute part of delivered heat energy and/or can provide from overheating in summer months.

Engineering systems (mechanical and electrical installations

Engineering systems or building services encompass mechanical and electrical services, which ensure that the building provides a good enabling environment to its occupants.

We would suggest a number of recommendations and concepts to consider at design stage for engineering systems in order to enhance building's green qualities:

- **Space heating**: By adopting design concept as suggested by Passive house principles, the heat demand will be reduced to very minimum, what offers flexibility on the source of heat and the requirements for space heating system. If to adopt a net zero carbon concept, any fossil fuels-based heating source should be avoided. Depending on the land-plot specification several non-fossil fuel options would be available:
  - **Heat pumps*:*** Heat pumps can use low-grade heat sources from ambient environment and convert it into low-temperature space heating by using electricity driven compressors and pumps. Depending on the source of heat we distinguish air , ground-water or ground-source heat pumps. Air heat pumps takes the heat from outdoor air. Ground-water heat pumps extract the heat from adjacent water sources if any located nearby or from underground water wells if water table is close enough to the ground surface. Ground source are using the heat of underground of the land plot. There are several limitations, pros and cons for each of the heat sources:
    - ***Air-sourced*** heat pumps: This is the cheapest and least-space requiring option as it extracts heat from ambient outdoor air. Recommended efficiency levels are around 3 COP (coefficient of performance), or Seasonal Performance Factor (SPF) at about 2.45–2.5. Disadvantages are related to drop of efficiency of conversion(heat output to electricity consumed) down to app 1.0 at outdoor temperatures of about 0 to –5 °C. For the best performing models, lower temperatures are possible at about -10 °C. In any case an air-sourced heat pump might not be sufficient during winter peaks. It needs to be combined with another heating source, which could be a biomass boiler or solar thermal booster,

or any conventional high-efficiency gas boiler used only during extremely low outdoor temperatures. Another disadvantage is the lower lifespan of about 20 years. There are several recommendations, which could increase efficiency of an air heat pump: (i) use air from a passively solar heated area (conservatories, etc), (ii) place bushes around the external unit for protection from cold winds; (iii) place external unit away from activity triggered security lights; (iv) consider the noise and visual impact of placing the external units;

- *Water-sourced*: Water source heat pumps are often more efficient than ground and air source devices. This is because heat transfers better in water, while water temperatures are generally more stable throughout the year (between 7 and 12 degrees on average), which is higher than the average air and ground temperature in winter. Efficiencies for good quality systems can be as much as COP 5, whereas the standard COP for heat pumps is in the range of 3.0 to 4.3.
- *Ground-sourced*: The source of heat in this case is the ground beneath a plot of land. A pipe collector is installed at a depth of about 1.5 to 5-6 m (below the winter frost level), and a circulating liquid medium (typically brine) delivers the heat to the heat pump unit. The soil temperature at that depth is generally stable at 8-10 °C. The pipework can be inserted horizontally or vertically, or by using 'slinky coils' which increase the levels of efficiency from COP 3–4, and up to 4.5. The deeper the pipework in the ground, the higher the efficiency will be, due to the stability of the heating source. Efficiency is higher than for air-heat pumps, but somewhat lower than for water-based pumps. A few practical recommendations:
    1. Locate the pipework in ground exposed to sunlight
    2. Dark surfaces like playgrounds or parking areas are ideal for such installations
    3. Trenches with pipework should be 3–5 meters apart
    4. Approximately 35 m of vertical pipework corresponds to 1kW of installed capacity, 10 meters of slinky coils piping per kW installed capacity, and 50 m of horizontal piping for 1 kW installed capacity
- *A few general provisions applicable for all types of heat pumps*:
    - Combine with PV installation which could drive the the electrically operated components. A very low energy single house will have a peak heating demand in the magnitude of 2 to 3kW installed capacity and that means a surface of solar PV panels about 22 to 25 m^2.
    - Heat pump should be used only for low-temperature space heating systems that will require a heat input of 35 to 40ºC.
    - Weather compensation control allowing to adjust the required output by factoring the variations in outdoor temperatures

- **Solar thermal**: elaborated above in the Renewable section
- **Biomass**: Biomass is not widely available in Kyrgyzstan, but certain areas might have access to agricultural biomass in future and after supply chain is established and biomass pelleting or briquetting facilities are established. Important is that that storage facilities are well protected from fire hazards and fire regulations are diligently followed. For larger size buildings boilers with automatic feeding and levels of automation and control are used. For smaller size buildings like family houses or smaller public building facilities, manual feeding of biomass boilers or in combination with chimneys and stoves is possible. In any case the biomass boilers or stoves with pellet burner with integrated back boiler for central heating & hot water. Should an underfloor heating be used, then a low-temperature heating loop is

needed with adding an accumulation tank and mixing regulation valve to ensure double loop operation – higher temperature for radiator heating and hot water, and a low-temperature one for the underfloor heating. For use of biomass boilers it is important to respect local air-pollution limits and apply boilers with high efficiency and low emission of particles. The level of efficiency depends on the quality of fuel which should be dry, and on availability of oxygen for efficient combustion process. There are back boilers with separate supply of fresh air with preheating of the latter. Pyrolytic boilers are among best products on the market and they offer good level of control of heating output. Manufacturers often state the combustion efficiency of their boilers for these different fuels, and that can range from about 94% (for pellets), down to about 80% (for wet chips). A good level of efficiency is considered above 84%.

- **Least carbon intensive fossil-fuel source**: In the case of site limitations making impossible or difficult the use of renewable energy sources, like spatial limitation (for use of water or ground-heat pumps), overshadowing by taller buildings or terrain (limiting the use of solar technologies), or by market constrains (absence of biomass supplies), our recommendation is to use the best state of the art natural gas technology or consider connection to any communal district heating networks. If the latter is not available, then a high efficiency condensing boiler could be the heating source. **Condensing boilers** are water heaters fuelled by gas. They achieve high efficiency by condensing water vapour in the exhaust gases and so recovering its latent heat of vaporisation, which would otherwise have been wasted. This condensed vapour leaves the system in liquid form, via a drain. Good quality condensing boilers have efficiency of 96-98% at high calorific value, which equals at about 106 to 108% efficiency at low calorific value. Similar like heat pumps, the lower the temperature in the heating system, the more of condensing heat can be utilised. That is why condensing boilers are suitable as a heating source for very low energy buildings and for underfloor heating systems.

- **Domestic hot water**: The source of heat for domestic hot water could be the same as for space heating: a heat pump, solar thermal or in the cases where these are not sufficient similar complementary sources as a communal district heating utilities or a highly efficient condensing gas boiler. What is important to take into consideration is the installation of water-saving facets including mixing taps with thermostats and aerators, shower heads, and sensor controlled. That could reduce the use of water by at least 30% while maintaining the same effect. The average use of water in residential buildings and if to meet all hygienic needs is about 140 to 160 l per person per day. Out of that domestic hot water at temperature of 55° account for about 30 l. The annual energy use for domestic hot water in current standard residential buildings is about 80 kWh per m^2 and for the current residential energy mix that means a carbon footprint of about 20 $kgCO_2$ per m^2. For low energy buildings the annual energy use is down to about 55kWh per m^2. By using traditional energy mix in the sector, the carbon footprint of hot water is about 14-15 $kgCO_2$ per m^2. By deployment of zero-carbon solar thermal, or almost zero carbon biomass or heat pumps, this carbon footprint could be reduced to 5-6 $kgCO_2$ per m^2.

- **Mechanical ventilation**: Follow the Passive house design concept suggested to make the building airtight. That means the fresh air for occupants should be supplied by mechanical ventilation. Electricity generated by on-site PV installation can make the entire system zero carbon and by installation of a heat recovery unit also 80–90% of the waste heat from exhausted air can be recovered back into supply of fresh air. A rule of thumb provision is that an air-supply of about 30 m^3/h per person is sufficient. Should the building anticipate more intensive physical activities (exercises) or any indoor pollutants (odours, smoke, etc), the quantity of air flow should increase to about 45–60 m^3/h. For a small residential unit occupied by 4 persons that would make a ventilation unit of about 240 to 300 m^3/h maximum air-flow. For a residential unit of 80 m^2 floor area that would have had meant an annual energy use of 56 kWh/m^2. By applying an efficient waste heat recovery, this energy consumption could be reduced to below 8 kWh/m^2. By accounting for the electricity energy use by ventilators, the overall annual energy use for good quality fresh air supply will be at about 9.0 to 9.5 kWh/m^2. There are few basic considerations which should be taken into account while designing a ventilation system with waste heat recovery: (i) install a by-pass for the summer period when waste heat is not required to recover; (ii) extract air from kitchen and bathrooms, while supply the fresh air to bedrooms and living rooms; (iii) insulate well all the ducts supplying air through unconditioned areas; (iv) consider air supply routes, which could preheat the supply air (earth tubes or channels); (v) consider higher ceilings in order to accommodate the duct networks, or use purpose-made technical space.

- **Air-conditioning:** A good concept and site-sitting of the building, and use of passive shading elements, thermal mass storage and the natural air-flow can reduce to large extent the need for any mechanical air-conditioning in the climate conditions of Kyrgyzstan. There are several principles which could help to design an air-conditioning free building able to ensure good quality of thermal comfort in summer months: (i) Protect the building by adequate site-sitting from excessive insolation in summer months – this could be done by sheltering from high angle summer insolation by vegetation, ground sitting or neighbouring buildings, or by using the air-flow of prevailing winds for cross-section ventilation – both horizontal and vertical; (ii) deploy passive defence elements and divert as much as possible of excessive solar gains from the building – from lighter colours of façade and roof with higher reflection indices, to passive shadowing elements on the façade – vertical or horizontal depending on the direction of peak time solar insolation. Larger buildings might apply double-skin façade concept. Any building can use selective and low-emissive coating of window glazing or transparent façade elements. (iii) Disperse and lead out of the building as much as possible of peak solar heat by structures with high accumulation capacity position at the most exposed areas. This could be combined with intensive night cooling or day ventilation from northern-located areas to south-southwestern.

- **Cold water supply:** The same provisions for water saving facets apply equally as already described above in the section of hot water. However there are number of water harvesting, or water reuse techniques which could be applied for saving of particularly cold water. These are:
  - **Grey water reuse** – this is collecting separately the water from wash basins or washing machines and using it again for toilet flush or for landscape irrigation purposes. There are several techniques of grey water reuse, each applicable depending on site specifics: (i) short retention system; (ii) reedbed (biological ground system); (iii) bio-mechanical enclosed system using bacteria to break down the organic compounds in the grey water before pumping up for reuse purposes; (iv) bio-mechanical system with heat recovery similar to the above but with additional space required for a hot water tank – applicable for larger buildings or communal systems;
  - **Rainwater** harvesting by accumulating the rain water in a tank, and using it further for irrigation purposes and/or for toilet flush;
  - **Water efficiency**: water-saving facets introduced in the section of hot water are typically sensitive to particles in the public grid supply. In order to function well and over the expected lifespan, we recommend to install a washable filter at the water supply main. That will protect building internal water system and sensitive water facets. Another consideration for water efficiency exposed to high variation of grid pressure is a back-pressure valve, which could cut-off overpressure in time of low consumption and protect the water facets from higher water outflow and from excessive pressure. Such a simple measure can save up to 20% of the buildings water use.

- **Waste water**: Some opportunities for water recovery and grey water reuse have been described above. Particularly for buildings in rural areas or settlements without any public sewage we would recommend to (i) separate rain derange from sewage water coming out of the building, and process the former for irrigation purposes, and (ii) use a compact waste water treatment installation, which can treat bio-mechanically the sewage water and clean it enough for landscape irrigation purposes. The sludge can be utilised as fertiliser; Obviously both these techniques could be implemented if there is enough of space on-site, which is typically the case in Kyrgyz rural areas.

- **Pumps, drives and motors**: This applies for any pumps, fans or motors used in building services. An electric motor-powered heating, ventilation or refrigeration system may not be required to operate at 100% capacity for 100% of the time. When a refrigeration or heating system reaches a pre-set specific ambient temperature, it may not be necessary or desirable for system to continue to operate at its maximum capacity. An electric motor without the control of a variable speed drive has no way of regulating its performance and cannot deviate from maximum capacity operation. Alternatively, by introducing a variable speed drive into the system, when a set condition such as temperature is achieved, the drive can cut or reduce the motor's output and therefore save energy. A highly efficient solutions with variable speed drives can save about 60-65% of electricity used by conventional constant flow devices.

- **Horizontal and vertical transportation**: This apply for escalators, lifts or other system of transportation in larger buildings. A simple recommendation is to use systems rated by manufacturers as energy class A. These are deploying a number of energy-saving solutions including optimisation related to drives, control, and cabin and hoistway:

  - **Drive**: (i) Use of regenerative drives; (ii) Gearless machine for smooth ride quality, (iii) Efficient motor enabling a direct power transfer, avoiding loss of power, (iv) Stable start without high peak current, quickly reaching a low energy consumption level; (v) Frequency converter equipped with stand-by power mode; (vi) Environmentally friendly drives with no-oil lubrication; (vii) Compact, lightweight, and durable design that optimises material usage
  - **Control**: (i) System switching car lights and ventilation into stand-by mode when not in use; (ii) Car panel and floor indicators operating with low power LEDs; (iii) Multi-bus control system; (iv) Smart function with selective collective controls for efficient passenger transportation
  - **Car and hoistway**: (i) Car lighting equipped with energy saving lamps; (ii) Central guiding system reducing mechanical friction and energy consumption; (iii) Door drive with stand-by mode for safety and energy conservation; (iv) Machine-room-less and Eco-effective design allowing for more space in the same shaft and saving construction resources; (vi) Lead free counterweight;

- **Lighting:** *Luminous efficacy* is a measurement commonly used in the lighting industry that indicates the ability of a light source to emit visible light using a given amount of electrical power. It is a ratio of the visible energy emitted to the power that goes into the bulb from the electrical line (visible energy emitted is also known as *luminous flux*, and the units are measured in *lumens*). The most efficient lighting fixtures used at present in buildings are LED lighting fixtures. Good quality LED lighting fixtures available on the market can have about 90 to 110 lm/W efficiency. There are products however with over 120 lm/W. Important is to account for the colour index of artificial light. More on the subject is elaborated in the section of *Health and Well-being*. LED technology is beating traditional incandescent light bulbs by nearly a whole order of magnitude (5 to 8 times as efficient depending on the desired brightness). Also, LED lights typically last 10 to 20 times as long (15–25 years) as an incandescent bulb (1–2 years). They also last nearly twice as long as the next best alternative (CFLs last approximately 10 years). *Low Pressure Sodium* lamps offer the most efficient outdoor lighting solution at about 130 lm/W. In addition to adopting lighting sources of better efficiency there are number of lighting management techniques, which could help to reduce energy use and optimise the quality of artificial light:

- deliver as much as possible of daylight. This can be done by design of building fabric, with sufficient size and design of windows or other transparent elements of the façade. The and span of building plan should not exceed 6 meters if we want to enhance access to daylight. For certain buildings (retail) application of skylights or sun-pipes collecting the daylight and directing into interior could be a good option too;
- deliver as much light as needed and when needed by application of dimmable lighting fixtures, and by sensor control. This sensor control can monitor presence of people, intensity of daylight, so artificial light is switched-on only when needed and at intensity as needed. Sensor control can be combined with automatic switch-off if the space is not in use;
- zoning the internal space allowing to distribute light only and when needed by the occupants. The most advanced technique of zoning lighting management is Digital Addressable Lighting Interface (DALI). It assigns an IP address to every lighting fixture (typically LED) and allows its individual control by the building management system or applications available to individual occupants.

- **High voltage installations**: One of the main power equipment in bigger buildings are transformers or entire transformer stations. Similar like for other energy-consuming equipment a simple rule is to seek for transformers at energy rating class A. If energy rating is missing an indication of efficiency levels is given by the *Minimum Peak Efficiency Index* (%). For liquid immersed power transformers an acceptable minimum efficiency levels is 99,398% for capacity at 500kVA, or 98,570% for dry type transformers at capacity of 400kVA and high voltage above 36kV. Minimum energy efficiency criteria are specified in the EU EcoDesign Regulation 019/1783 with regard to small, medium and large power transformers. Particularly efficient are *amorphous metal transformer*. The magnetic core of this transformer is made with a ferromagnetic amorphous metal. The typical material (Metglas) is an alloy of iron with boron, silicon, and phosphorus in the form of thin (e.g. 25 μm) foils rapidly cooled from melt. The high resistance and thin foils lead to low losses by eddy currents when subjected to alternating magnetic fields. On the downside amorphous alloys have a lower saturation induction and often a higher magnetostriction compared to conventional crystalline iron-silicon electrical steel.

Use of renewables

For conditions of Kyrgyzstan, taking into consideration the rate and availability of solar irradiance as well as the volatility of the national grid system, we propose a combination of on-site electricity-generating PV system with an adequate power storage system and invertor, and of solar thermal system for domestic hot water and/or in combination for space heating with sufficient thermal storage capacity of at least 200 litres per building occupant in smaller size residential buildings, or as calculated by design and taking into account the factors of simultaneous water or heat use for larger buildings. The latest draft of the UK Building Regulations[51] require that the store should be at least 80% of the daily hot water demand or 25 litres for every sq. m of collector area.

The capacity of both solar thermal and the PV system would be dependent on available roof area, exposed to solar irradiance, preferably oriented to south, south-west, west or south-east in the order of preference as quoted.

By the rule of thumb, the size of a solar thermal system should be sized to meet the hot water energy demand of 50 to 70% of the people using the building. That means about 5 to 6m^2 of evacuated tube collectors for a typical one-family dwelling. About 10m^2 applied in low-energy or zero energy

51 UK Building Regulations: Approved Documents L, F and Overheating (consultation version), 2021: https://www.gov.uk/government/publications/building-regulations-approved-documents-l-f-and-overheating-consultation-version

building should provide about 50% of heat demand for both domestic hot water as well as for space heating. Water temperature can reach up to 90º in summer and about 35 to 40º in winter, so an inter-seasonal accumulation tank is needed at the capacity specified above. The solar thermal system should be provided with additional heating source for two reasons: (i) heat up the quantity of water needed for winter months when sun irradiance might not be sufficient, and (ii) heat-up the hot water accumulated up to 60º in order to prevent from legionella bacteria, which might contaminate the water at lower temperatures. Solar thermal could also provide a good source for low-temperature space heating like low-temperature surface radiators or underfloor heating. In any case this option is applicable only in buildings designed up to the heating protection provisions as specified in section Thermal protection of building fabric. There are two main types of solar thermal panels:

- Flat plate collectors, which are less efficient , with efficiency of thermal conversion at about 30% and lifespan at about 20 years. They require thermal storage of minimum 50 to 80 litres per $1m^2$ of panel area. Optimal inclination for installation is about 35-40º tilt angle. This type of panels can harness about 500 to 600 kWh per 1 m^2 per year.
- Evacuated tubes: These are more expensive, but at higher thermal conversion efficiency at about 50º. Lifespan is longer at about 25-30 years and require thermal storage of about 70 to 100 litres per m^2 of panels. These panels can be installed flat on the roof and without inclination. This type of panels can harness about 600 to 750 kWh per 1 m^2 per year.
- Both solar thermal systems specified above should have well-insulated pipework (min thickness of high-grade insulation at 25mm or by rule of thumb as equal to diameter) as well as well-insulated tank storage with thickness of at least 100mm of high-grade insulation. Using dark roof colours will increase thermal efficiency. However, dark colours should not be applied in green vegetation roofs if solar collectors are to be installed among plants.

Photovoltaic (PV) systems convert sunlight into direct current electricity using semiconducting materials in photo cells. They remain a relatively inefficient technologies, although efficiency has improved over the past 10-15 years. The following basic types of PV panels are available on the market:

- ***Monocrystalline*** solar panels have the highest efficiency rates, typically in the 16-20% range. This higher efficiency rate means they produce more power per panel surface, and are therefore very space-efficient. Monocrystalline solar panels tend to be more efficient and resilient in warmer weather conditions. In conditions of Kyrgyzstan, a capacity of 1kW of peak power generation (at optimal conditions) will require about 7.2 m^2 of monocrystalline panel surface or about 140 W per 1 m^2. The power generated by $1m^2$ of monocrystalline panels is about 150 to 160 kWh per year.
- ***Polycrystalline*** panels have lower efficiency at about 12 to 14%. They are more sensitive to weather conditions and increase of air temperature in summer months. A 1 kW peak power will require about 9.5 to $10m^2$ of panel surface. Or respectively $1m^2$ panel surface has a capacity of about 100 to 110 W. Annual power generation is about 110kWh per m^2 of panel surface per year.
- ***Amorphous*** panels has the lowest efficiency of about 10 to 12%, but works well with diffuse light. 1 kW of peak power requires about $20m^2$ of panel surface. Amorphous silicon is frequently used for a special type of photovoltaic system called thin film. A **thin-film solar cell** is a second generation solar cell that is made by depositing one or more thin layers, or thin film of photovoltaic material on a substrate, such as glass, plastic or metal. Thin-film solar cells are commercially used in several technologies, including cadmium telluride (CdTe), copper indium gallium diselenide (CIGS), and amorphous thin-film silicon (a-Si, TF-Si). Film thickness varies from a few nanometres (nm) to tens of micrometres (µm), much thinner than thin-film's rival technology, the conventional, first-generation mono or poly-crystalline silicon solar cell (c-Si), that uses wafers of up to 200 µm thick. This allows thin film cells to be flexible, and lower in weight. It is used

in building-integrated photovoltaics and as semi-transparent, photovoltaic glazing material that can be laminated onto windows. New types of thin film cells have reached conversion efficiency at 21.7% in laboratory conditions, or about 18% at field tests, which makes them comparable with mono-crystalline cells. However the lifespan is much shorter at about 10 to 20 years.

For all the mono- or poly-crystalline PV installations the lifespan is about 20 to 25 years with annual drop of efficiency at about 0.5%. Some of components might need earlier replacement after 15 years. The following practical recommendations are applicable for on-site Solar PV installations in buildings:

- Tilt the angle of installation at about 35 to 40º in order to optimise the electricity generation. Best location is on pitched roof and better to avoid vertical installation on the facades as this can drop efficiency by some 30-35%.
- Underperforming of PV systems is often caused by overshadowing or dirty surface.
- Overheating can also result in drop of efficiency. Allow at least 150 mm of air gap for air circulation at the back of PV panels. Better to install panels on lighter colours surfaces or green roofs in order to help with cooling the panels down.
- Capacity and functionality of the PV inverter should reflect the PV output array.
- A sensible capacity of a PV system for a low energy building would be around 4 to 5kW peak power capacity. That would mean about 28 to 35 m^2 of panel surface or about 30 to 38 m^2 of roof area facing south, or south-west.
- A good use combination to support a low-carbon buildings is to make the PV system power a heat pump for space heating or air-conditioning, with a battery storage to cover for the peak demand periods and where solar irradiance is at lower rate.

Health and well-being

The WELL Building Institute identifies seven key criteria for Well-being in buildings:

- **Air:** Availability of good quality of fresh air and at sufficient quantity is one of the most important factors for well-being in buildings. There are two basic considerations for good air quality in buildings: (i) reduce the rate of indoor pollution by using materials and finishes (paints, sides, furniture, carpets, etc) with low emissions of pollutants (VOC, formaldehydes, dust and particles), and (ii) ensure sufficient and controlled supply of fresh air at the time needed and at high energy efficiency (see provisions for mechanical ventilation above). It is also important that any combustion sources (stoves, chimneys, boilers) used indoor are provided with enough of air for a good combustion efficiency. Application of these in an air-tight low energy building without supply of air for combustion can result in emission of CO, which are highly toxic.
- **Comfort:** Create an indoor environment that is distraction-free, productive, and soothing. Solutions include design standards and recommendations, thermal and acoustic controllability, and policy implementation covering acoustic and thermal parameters that are known sources of discomfort. Parameters for ***thermal comfort*** are well-knows: indoor air temperature in the range of 20-21ºC, overall temperature of surfaces and air not lower than 38K, and relative humidity with 40-60% range. ***Acoustic comfort*** is the well-being and feeling of a building or house occupants regarding the acoustic environment (noise-producing transport, equipment, activity, neighbourhood). Providing acoustic comfort consists in minimising intruding noise and to maintain satisfaction among residents (home and workspace). Acoustic comfort is driven by physical properties of building structures, which should limit the spread of noise by both air and building structures (e.g. floors). By rule of thumb air-born noises can be blocked by high-density structures, ideally of multiple layers including at least one with high absorption quality. Noise generated in the

structures and transmitted through them can be addressed by applying low-density layers of materials in otherwise heavy and high-density structures (e.g. concrete ceilings). There are three effective strategies to reduce noise pollution and achieve better acoustic comfort in buildings: ***Absorb noise*** by application of absorptive materials reduce the volume of noises reflected back into a space, the length of time they last and the distance they travel. ***Block the noise*** by using walls, doors and other physical structures. However, green buildings feature more open plan that their traditional counterparts. In open plan spaces, workstation partitions above seated head height (150-160cm) are essential to attenuate the noises passing to an occupant's nearest neighbours. If they are shorter, they do little more than hold up the desks. ***Cover noise***: while many people believe they can achieve effective acoustics by only absorbing and blocking, these strategies simply reduce and contain noise. One must also ensure that the background sound level in the space is sufficient to provide speech privacy and reduce the amount of disruption caused by the remaining noises in the space.

- **Fitness:** Utilise building design technologies and knowledge-based strategies to encourage physical activity. Requirements are designed to provide numerous opportunities for activity and exertion, enabling occupants to accommodate fitness regimens within their daily schedule.
- **Light:** Lighting design should take into account provisions to maximise the use of daylight and minimise disruption to the body's circadian rhythm. Circadian rhythms are 24-hour cycles that are part of the body's internal clock, running in the background to carry out essential functions and processes. One of the most important and well-known circadian rhythms is the sleep-wake cycle. Availability of daylight is expressed through *Daylight factor*. It is daylight available indoor as a proportion of the light available outdoor at the same time. A recommended daylight factor for indoor areas should be around 5%. A minimum required for any habitable rooms is 2%. Requirements for window performance and design, light output and lighting controls, and task-appropriate illumination levels are included to improve energy, mood and productivity. By increasing the size and particularly the height of windows increases also the depth of daylight. While this is welcome it can create problems with increased heat loss, glare and solar overheating. Heat loss can be addressed by application of windows with triple glazing and distribution of space heating elements to limit the effect of cold 'radiance' of colder surfaces. Solar overheating can be addressed by shading elements on the façade preventing of direct solar exposure during summer peaks. *Glare* is the discomfort with vision caused by a bright object appearing the field of view. It occurs as a result of how the eye adapts to its visual environment. Glare can be reduced in two ways: (i) by reducing the contrast between surfaces in the room and the window, and (ii) by ensuring the windows are not placed in important fields of view.
- **Water:** Optimise water quality while promoting accessibility. Strategies include removal of contaminants through filtration and treatment, and appropriate placement of water facets at easier convenience for the building occupants.
- **Nourishment:** Encourage healthy eating habits by providing occupants with healthier food choices, behavioural cues, and knowledge about nutrient quality.
- **Mind:** Support mental and emotional health, providing the occupant with regular feedback and knowledge about their environment through design elements, relaxation spaces, and state-of-the-art technology.

Adaptability

In order to achieve better adaptability it is important that designers consider from the very concept on how buildings will perform and change over time. There are several simple concepts which can help to make one building a more adaptable:[52]

52 RIBA. The green building bible, Volume 1, Fourth Edition, 2009

- Minimise the number of internal structural components (columns and load-bearing walls) and optimise the structural grid to allow for future uses. A simple structural grid is a better one.
- Allow some redundancy so that additions and future changes can be accommodated. Ensure that floor loads used in design reflect future foreseeable changes in occupancy patterns
- Separate structure from cladding where possible in order to allow independent alternations and replacements
- Allow for good vertical connectivity with spacious staircases, lifts and service routing
- Separate services into clear accessible locations to allow easy change or upgrade. Raised floors can also permit easier upgrade of building services
- Design with a building depth allowing as much as possible of daylight
- Integrate finishes so they can be easily upgraded and replaced without making access to other components difficult.
- Provide a 'loose-fit' to allow some redundancy to accommodate future additions and changes
- Keep design simple to help for future changes. Strong interdependence reduces the scope for change
- Provide sufficient space for machinery in order to allow easy dismantling, renovations or additions
- Avoid any complex composite materials that would be difficult to separate in future
- Incorporate each component so that it can easily be replaced and recycled when obsolete
- Consider drainage carefully as this can be a limitation factor in future uses.

7.2. Construction stage

(applicable for construction companies, builders and suppliers of technologies)

Site-sitting and conceptual considerations	Conducted in compliance with design specification
Construction materials	Construction process generates significant quantities of waste. There are several recommendations which could help to reduce its quantity and respectively the carbon footprint of construction stage: • Follow the bill of quantity as per design documentation and do not order any excessive redundancy quantities – at maximum 5% • Give preference to prefabricated products and systems with easy assembly on site • Separate different streams of waste and particularly of recyclable or reusable materials. Dispose them according to regulations or reuse if possible • Give preference to electricity or battery driven construction machinery

Thermal protection of building fabric	Install in good quality by accredited professionals and in compliance with design specification. Always ask for completion certificates of engineering systems and thermal protection installation.
Engineering systems (mechanical and electrical installations	
Use of renewables	
Health and well-being	Not applicable
Adaptability	

7.3 Operation and management. Retrofit and Renovation

(applicable for asset owners and facility managers)

Site-sitting and conceptual considerations	Not applicable
Construction materials	Follow recommendations on the choice of materials for refurbishment as suggested in the Design section. Always give preference to natural, locally sourced materials or materials with low carbon footprint.
Thermal protection of building fabric	Seeks opportunities to improve thermal protection of buildings and their air-tightness in compliance with criteria suggested at design stage. Ensure that the ventilation system is able to deliver sufficient quantity of fresh air as per health and well-being requirements.
Engineering systems (mechanical and electrical installations	There are few basic concepts which should be taken into account while considering a replacement, up-grade or retrofit of building engineering systems: • Check for the best-in-class high energy or resource efficiency system. Discuss with a professional about applicability and integration in the existing building. Give preference to renewable energy or electricity fuelled systems • Apply the highest level of automation and control as possible • Ensure that the new system do not compromise on health and well-being concepts • Design and install the new system in a way allowing easy access, easy replacement or dismantling

Use of renewables	It is important for achieving the outcomes expected out of renewable energy installation to follow a set of simple rules at operation stage: • Conduct regular monitoring, maintenance and cleaning from snow, leaves, bird droppings and dust. Failures to do so will reduce system performance by more than 15% • Monitor solar panel outputs with a simple and visible display, able to identify system failures. Any issues identified should be rectified swiftly and low performing systems recommissioned • Conduct full system checks by accredited installer every 5-7 years
Health and well-being	Follow provisions suggested for health and well-being at design stage. Make sure that the retrofit or renovation will not negatively impact any of the health and well-being criteria (air, water, light, noise, thermal comfort, fitness, nourishment and mind).
Adaptability	Follow adaptability principles as described in design stage for any of sections, components or systems being replaced or retrofitted. Remember that future use of building, might require to dismantle the given component or system or use the functional unit of the building in a different way.

7.4. End of life

(applicable for construction companies and waste disposal companies)

Site-sitting and conceptual considerations	Not applicable
Construction materials	The amount of waste generated in construction sites is typically 100-180 kg per m^2 of built area, while demolition projects can generate up to 1500 kg/m^2 of demolished area. A demolition will remove all the mass of a building, excepting parts that are too costly to dig up and that can be safely left in ground (for example, concrete pipes). The EU Green Public Procurement for Offices sets the core target for site waste at 110 kg per m^2 (comprehensive criteria target being 70 kg); or just below 6% of total use of materials in a building. Furthermore, Waste Framework Directive requires a 70% reuse, recycling or material recovery (or backfilling) rate by 2020. The EU Green Public Procurement for Offices sets out a core criterion for non-hazardous waste reuse, recycling and recovery at 55%, excluding excavations and backfilling, and with the comprehensive criteria at 80%. These targets would be very challenging to achieve in conditions of Kyrgyzstan at present. There are however several practical recommendations, which could help building owners or construction companies conducting demolition works: **Separate different streams of waste** and particularly of recyclable or reusable materials. Dispose them according to regulations or reuse if possible

<table>
<tr><td></td><td>Dismantle clean wood to make MDF or chipboard. If wood can be separated from other materials so that it is clean, it may be suitable for processing into boards. This will substitute wood industry by-products in the manufacturing, and also enable storing carbon for longer.

Refurbish bricks for use in new buildings. Brick refurbishing works when bricks are valued and landfill taxes are high enough. This is done for example in the UK and Denmark. Within the European Union, bringing reclaimed or refurbished bricks to the market (for other use than in same project from which they were extracted) requires a CE marking.

Similar product reuse can also apply for windows, partition walls, ventilation ducting and other products that can be disassembled in non-destructive methods can provide an opportunity to reuse materials for other construction projects. This requires availability of a business willing to reprocess and clean such materials for reuse, which will very likely require incentives to work commercially.

Make aggregate from demolished concrete. Crushed concrete is a good material for sub-base layers and it retains some hydrogenic properties. In addition, once crushed and in interaction with air, it will suck carbon dioxide out of the air. This is based on carbonisation which is basically recovering in the chemical bonds some of the carbon released in the cement kiln as part of calcination process. This increases the environmental benefits significantly.

Supply glass as cullet to glass production. Window glass cannot be recycled within the normal glass recycling, but window glass can be used in a float glass factory. This will save significant amount of energy from the manufacturing process.

Dismantle clean gypsum boards to manufacturing. Only fully clean gypsum can be received by gypsum manufacturing. This requires that materials are separated very carefully and stored and transported separately as well. Where this is managed (e.g. by feeding back wasted parts of gypsum boards or otherwise by cleanly disassembled gypsum boards), this will save a significant amount of energy in the process.</td></tr>
<tr><td>Thermal protection of building fabric</td><td>Not applicable</td></tr>
<tr><td>Engineering systems (mechanical and electrical installations</td><td rowspan="2">Most of engineering systems and renewable energy components contain valuable materials, which are fully recyclable.

At system decommissioning contact suppliers and enquire about taking-back schemes or contact material recycling yards for authorised disposal. That can improve the whole-life cycle carbon footprint and generate some profit rather than cost of disposing these recyclable components.</td></tr>
<tr><td>Use of renewables</td></tr>
<tr><td>Health and well-being</td><td>Not applicable</td></tr>
<tr><td>Adaptability</td><td>Not applicable</td></tr>
</table>

CONCLUSION

The *Green Building Guidelines* are a part of the broader cycle of the SCP Switch-Asia initiatives for Kyrgyzstan, and a logical continuation of the analytical paper 'Enhancing Sustainable Consumption and Production tools and Circular Economy approach in the Building sector with a focus on Energy Efficiency' (2021). Both papers have been produced by the Unison Group in partnership with the Ministry of Economy and Commerce of the Kyrgyz Republic, and aim at enhancing the knowledge and awareness of the Kyrgyz government officials and relevant stakeholders in adopting the recognised practices and tools of the European countries in the building sector.

These Green Building Guidelines speak about green buildings which, according to the World Bank Council, are designed, constructed and/or operated in a way that reduces or eliminates negative impacts on the natural environment. There are a number of features which can make a building 'green' or 'sustainable'. These include an efficient use of energy, water and other resources; use of renewable energy, such as solar energy; pollution and waste reduction measures and the enabling of re-use and recycling; good indoor environmental air quality; use of materials that are non-toxic, ethical and sustainable; a design that enables adaptation to a changing environment.

The recommendations provided for building designers, architects and urban planners emphasise that future-proof design does not mean spending more money right now. Many useful concepts can be easily implemented simply by planning ahead and thinking differently about the site and building design. These Guidelines introduce a number of simple, basic recommendations, which should be taken into consideration by building professionals at the initial concept and design stage of the building.

These Guidelines also analyse the policies, legal and regulatory documents related to sustainable consumption and production (SCP) in buildings and in the construction sector, and refer to international best practices. The SCP concept is relatively new for Kyrgyzstan, thus no independent national action plan or roadmap on SCP exists as yet. These Guidelines could be used as the basis for preparing the SCP roadmap and particularly the action and capacity development plans aimed at raising awareness among stakeholders and the public in the important sector of buildings and construction.

Nevertheless, the government initiatives including the Green Economy Development Program of Kyrgyzstan for 2019–2023 do provide a good platform for SCP and the overall sustainability of the building sector as it is relevant to the context of the Kyrgyz Republic, where nearly 85% of the housing stock, 77% of the administrative buildings and over 60% of public buildings (such as schools and hospitals) were built before 1991.

As described in these Guidelines, the EU's Green Public Procurement for Offices sets out a core criterion for non-hazardous waste reuse, recycling and recovery at 55%, excluding excavations and backfilling, and with the comprehensive criteria at 80%. Although these targets might be very challenging to achieve in the current conditions of Kyrgyzstan, the Guidelines provide several practical recommendations, which could help building owners or construction companies in conducting the demolition works such as waste separations, dismantling clean wood, refurbishing bricks for use, etc.

Finally, while analysing the concept of green buildings, the authors reviewed and selected the best practices of the European counties and included them in this publication, along with the reference materials.

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