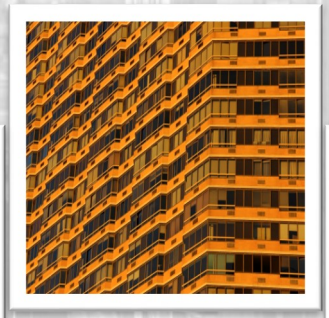


RENOVATING BELGRADE

A framework for exploring the potential to renovate the city of Belgrade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EXECUTIVE SUMMARY

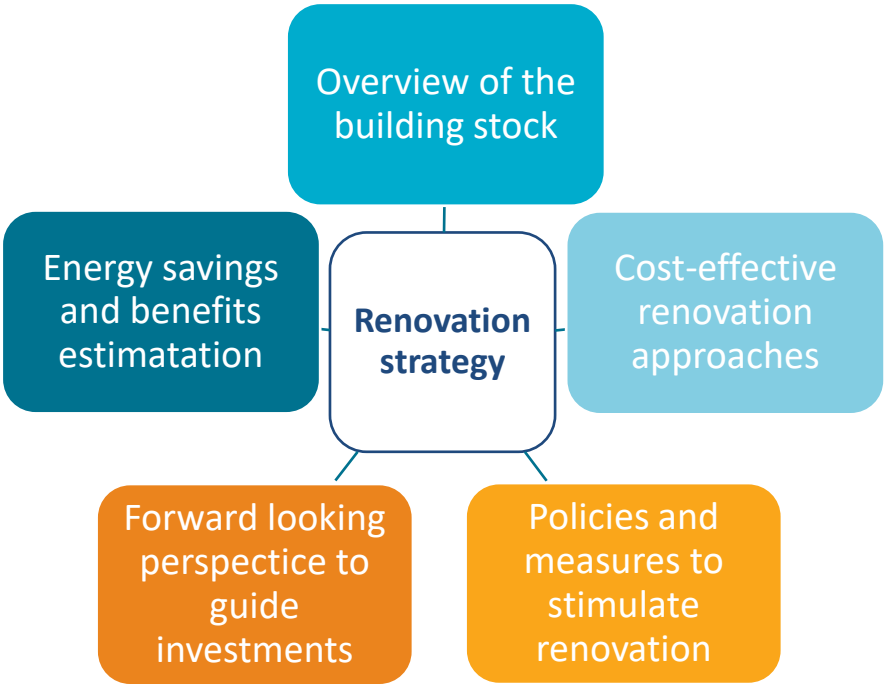
The UN Environment Programme (UN Environment) is supporting the Belgrade public authorities to improve energy efficiency of buildings and associated energy systems, as part of its role in the Building Efficiency Accelerator (BEA) and District Energy in Cities (DES) Initiative under the Sustainable Energy for all (SE4ALL) Initiative. To support this undertaking, this report by BPIE outlines the renovation potential and approaches to increasing renovation activities in Belgrade.

Gas dependency is a concern for Serbia, with 71% of gas used imported [1]. Buildings are one of the biggest consumers of energy, particularly for heating and cooling, and in Serbia district heating is, to a large extent, supplied by gas [1]. Therefore, renovation of buildings to reduce the demand for gas is crucial for energy security. There are also employment benefits to be gained from an accelerated renovation programme, which would provide a welcome boost to the Serbian economy.

In addition, Eurostat estimates that more than 41% of the overall population in Serbia cannot pay their bills on time, and around 26% live in very low-quality dwellings with serious defects, such as leaking roofs, damp walls and rotting floors [1]. These energy poverty indicators[1] are among the worst in Europe, and underline the need to improve the energy performance and quality of the building stock in Belgrade [1].

Building renovation strategies must tackle the barriers to renovation, such as poor access to financing and lack of awareness, and provide the right signals, financing framework and market confidence to ensure a long-term approach to upgrading and renovating the existing building stock to a high energy performance level.

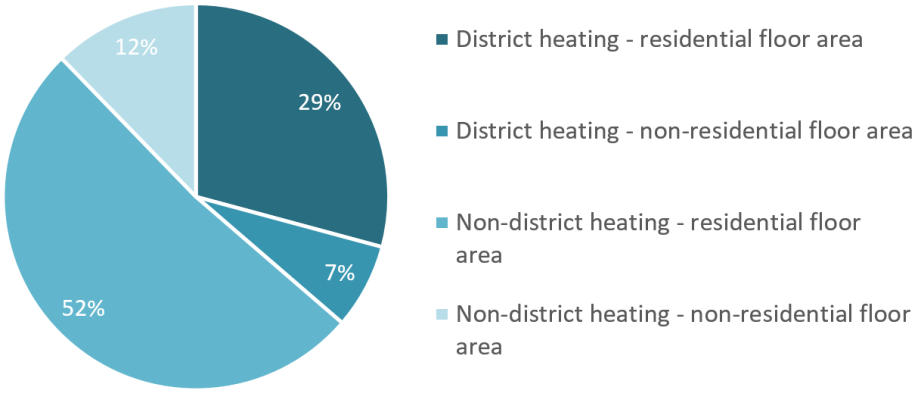
To be effective, renovation strategies should cover the following elements:



[1] Defined by the European Union Statistics on Income and Living Conditions.

comprehensive assessment of the building stock forms the basis of a renovation strategy. Although there is currently limited information and data on the building stock in Belgrade, it is possible to ascertain an overview of the state of the building stock.

Most buildings in Belgrade (81% of the floor surface) are residential buildings, of which around 36% are connected to a district heating system.



Using the available data, BPIE estimates the potential for renovation in Belgrade under three different scenarios, ranging from low/minor renovation, to deep renovation, and also considers a scenario focusing on renovating buildings connected to district heating system. These scenarios result in energy savings varying from 5% to 74%.

Below summaries the impacts of each scenario:

Low renovation scenario

- 1% renovation rate
- 15% energy savings in renovated buildings
- 33% renovated floor area (2050)
- 0.5TWh annual energy savings in 2050
- 5% annual energy savings in 2050 (compared to 2017)
- 8.4TWh cumulative savings to 2050
- 180GWh district heating energy savings
- €1.5bn investment
- €0.3bn tax income
- 250 jobs

Medium renovation scenario

- 2% renovation rate
- 45% energy savings in renovated buildings
- 66% renovated floor area (2050)
- 3TWh annual energy savings in 2050
- 30% annual energy savings in 2050 (compared to 2017)
- 50.6TWh cumulative savings to 2050
- 1.1TWh district heating energy savings
- €4.8bn investment
- €0.9bn tax income
- 800 jobs

Deep renovation scenario

- 3% renovation rate
- 75% energy savings in renovated buildings
- 100% renovated floor area (2050)
- 7.4TWh annual energy savings in 2050
- 74% annual energy savings in 2050 (compared to 2017)
- 126.5TWh cumulative savings to 2050
- 2.7TWh district heating energy savings
- €9bn investment
- €1.6bn tax income
- 1,500 jobs

District heating focused renovation scenario

- 3% renovation rate in district heated buildings
- 1% renovation rate in non-district heated buildings
- 75% energy savings in renovated district heated buildings
- 15% energy savings in non-district heated buildings
- 57% renovated floor area (2050)
- 3TWh annual energy savings in 2050
- 30% annual energy savings in 2050 (compared to 2017)
- 53.1TWh cumulative savings to 2050
- 2.7TWh district heating energy savings
- €2.6bn investment
- €0.5bn tax income
- 450 jobs

Based on these findings and experience in other regions, the following recommendations provide focus areas to ensure effective and successful approaches to renovation in the City of Belgrade:

Renovate public buildings as a first step

Focusing a renovation strategy on public buildings can be the first step to overcoming barriers to renovation of the whole building stock. Many of the barriers to renovating public buildings are the same as those for renovating residential and commercial buildings. For example, poor access to financing is a problem for owners of residential and public buildings. The creation of an energy efficiency fund can help by bringing together funding from different sources (state budget, regional or international financing streams, and development funds) into one pot from which projects can be financed for both residential and public buildings. Often such funds begin by funding public projects before being expanded to all projects.

Renovated public buildings can also provide useful demonstration projects which showcase renovation technologies and skills, and inspire all stakeholders (both within the municipality, the public and the construction industry) to aspire to live, work and build more efficient and higher performing renovated buildings.

Tackle buildings supplied by district heating

Renovating 100% of the district heating connected building stock by 2050 (and 40% by 2030) would reduce total energy consumption of the Belgrade building stock by 30% by 2050. This would also help to foster the needed transition to actual energy consumption based billing rather than billing by surface area. Without improving the energy performance of district heating connected buildings, this shift could increase the energy bills of some of the residents in district heated buildings. Renovation of these buildings would not only mitigate this risk but should reduce energy bills as well as improve living conditions in terms of comfort. At the same time, the “freed and available” energy could be allocated to expanding the district heating system.

Build capacity to tap into available existing funding streams

Building the capacity of municipalities to tap into available funds is important. This means building up the skills within the municipalities for developing funding application and related documentation, as well as the technical knowledge for implementing energy efficiency projects.

EU and regional financing streams could potentially be used to support renovation programmes in Belgrade. Some have a more national focus and therefore collaboration with the national government would be necessary. Others require closer cooperation with the private sector to form public-private

partnerships. To maximise the allocation of EU and other public funding sources to the renovation of buildings, it is important to use public funding to leverage private financing.

A more in-depth investigation is needed to understand eligibility criteria in more detail and identify the eligibility of the City of Belgrade to apply for funding under a specific stream.

Ensure quality and build up skills in the supply chain

Given the potential for job creation from renovating buildings in Belgrade, with between 250 and 1,500 jobs created depending on the renovation scenario, there will also be a need for training and education. This means qualification and vocational training programmes will need to be supported. If renovation works are not to the highest quality standards this will result in problems in the buildings' performance later, leading to missed energy savings, dissatisfaction of owners and occupiers and a loss of trust in the buildings industry.

Raise awareness of the benefits of energy efficiency

Monetisation of the benefits that arise in addition to the energy cost savings is often overlooked. Increased renovation, in line with the scenarios in this report, could create up to 1,500 additional jobs. As the construction sector is commonly a local employer, this additional employment would have a direct impact on Belgrade's economy.

Creating high quality and skilled jobs also delivers other advantages in terms of reduction of public expenditure on unemployment benefits and additional tax income (between €0.27billion to €1.6billion depending on the renovation scenario). These taxes can contribute to funding public projects, such as renovation of buildings, thus creating and maintaining more jobs.

More work in Serbia on identifying and quantifying the benefits of renovation, and energy efficiency in general, could be useful to foster increasing support for renovation and raise awareness of its benefits.

INTRODUCTION

The UN Environment Programme (UN Environment) is supporting the Belgrade public authorities to improve energy efficiency of buildings and associated energy systems, as part of its role in the Building Efficiency Accelerator (BEA) and District Energy in Cities (DES) Initiative under the Sustainable Energy for all (SE4ALL) Initiative. To support this undertaking, this report by BPIE outlines the renovation potential and approaches to increasing renovation activities in Belgrade. It starts by setting the scene on why renovation is relevant and important, followed by guidance on the approach to developing a renovation strategy. This includes chapters providing support and content for developing the strategy itself, including a summary of the state of the current building stock in Belgrade, an overview of the current renovation policies in Belgrade, an estimation of the potential of renovation in terms of energy savings and other resulting benefits, and an outline of potential funding mechanisms. The report concludes with recommendations based on the findings of this report and experiences in other regions to provide areas of focus to ensure effective and successful approaches to renovation in the City of Belgrade.

CONTEXT

Gas dependency is a concern for Serbia, with 71% of gas used imported [1]. Buildings are one of the biggest consumers of energy, particularly for heating and cooling, and in Serbia district heating is, to a large extent, supplied by gas [1]. Therefore, renovation of buildings to reduce the demand for gas is crucial for energy security. There are also employment benefits to be gained from an accelerated renovation programme which would provide a welcome boost to the Serbian economy.

In addition, Eurostat estimates that more than 41% of the overall population in Serbia cannot pay their bills on time, and around 26% live in very low-quality dwellings with serious defects, such as leaking roofs, damp walls and rotting floors [1]. Consequently, one family in six is not able to keep their home adequately warm and experiences higher incidences of poor health and damp-induced illnesses and diseases. These energy poverty indicators[2] are among the worst in Europe and underline the need to improve the energy performance and quality of the building stock in Belgrade [1].

While governmental and EU sources of financing such as the European financing streams can and should be used to boost the renovation market, ultimately it is building owners that are likely to be the principal funders. Suitably-designed financing schemes will need to be developed to overcome the initial capital investment barrier, as many citizens, public authorities and businesses lack the financial resources to make the upfront investment, despite it being economically attractive over the measures lifetime. Likewise, both local and national governments will need to develop other non-financial forms of support, including training, awareness raising, and regulatory measures which remove barriers and provide the right signals to consumers when undertaking work on their properties.

In short, building renovation strategies must tackle all barriers and provide the right signals, financing framework and market confidence to ensure a long-term approach to upgrading and renovating the existing building stock to a high energy performance level.

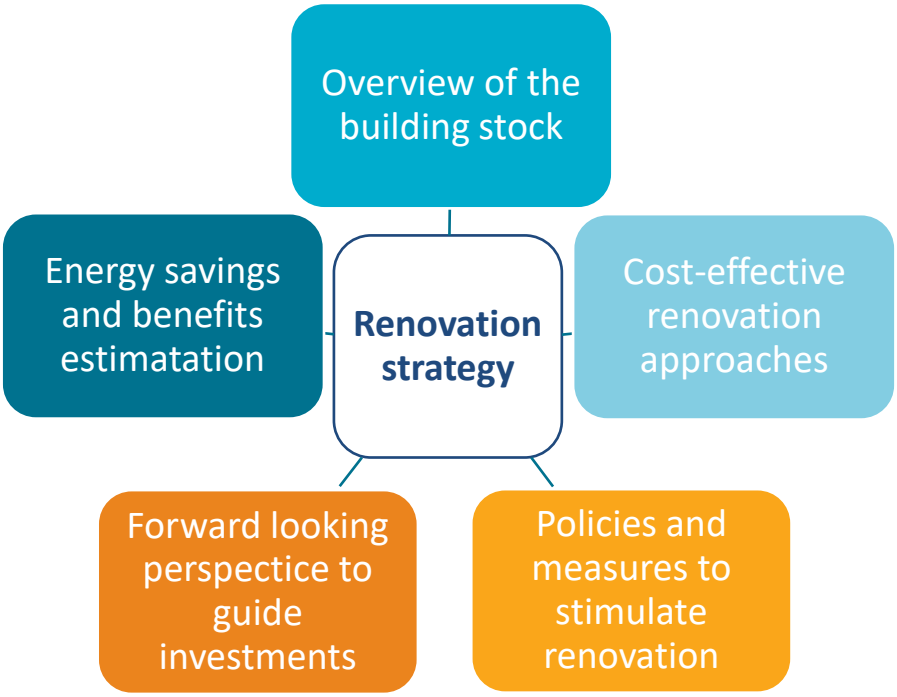
[2] Defined by the European Union Statistics on Income and Living Conditions.

1. DEVELOPING A RENOVATION STRATEGY

This chapter describes the approach to developing a renovation strategy (or framework).

Renovation strategies should cover the following elements:

Figure 1 – Elements of a renovation strategy



1. **An overview of the building stock**

This should provide a comprehensive assessment of the building stock to form the basis of a renovation strategy. A detailed bottom-up breakdown by building type, age, energy carrier, climatic zone, energy performance, occupancy and ownership is fundamental to underpin subsequent steps in the strategy. Chapter 2 of this report "State of the Belgrade building sector" provides support and content for developing this section.

2. **Identification of cost-effective approaches to renovations relevant to the building type and climatic zone**

This should build on the overview of the building stock, to undertake a comprehensive appraisal of cost effective renovation opportunities. This feeds directly into the next section where the policy package is defined.

3. **Policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations**

This section identifies possible packages of measures and their cost-effectiveness. BPIE has developed a checklist of actions to provide a solid framework on which to base the renovation strategy [2]. These

measures may not be applicable in all circumstances and it is likely that they would need to be introduced over time (i.e. not in a single policy cycle). Nevertheless, the list illustrates a wide range of actions that should be considered. Some may be more appropriate at a national level, but elements of some measures could be considered at city level, such as analysis of the potential for district heating systems to provide efficient low carbon energy. Chapter 4 of this report "Existing policies and programmes in Belgrade" provides an overview of existing policies which can form the basis of this section, and chapter 3 covers some of the suggested actions.

4. **A forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions**

This should provide a comprehensive costed forward-looking perspective that identifies investment needs over time. It should cover more than simply financing but provide a long-term outlook to guide investment decisions of individuals, the construction industry and financial institutions. Chapter 5 of this report "Funding mechanisms" provides examples of potential EU and non-EU funding that could be used, and a list and description of existing financing programmes from across Europe.

It is essential to provide key actors with sufficient time and certainty to prepare and plan for changes in a sustainable way. Therefore, policies should be designed to provide appropriate long-term signals to the market and communicated in a way so that consumers and all stakeholders understand the overall objective and can plan their investments with confidence. A roadmap with key dates, targets, milestones for the introduction of legislation and support mechanisms should be considered an essential requirement of renovation strategies.

5. **An evidence-based estimate of expected energy savings and wider benefits.**

The estimation of wider benefits and energy savings of the proposed policy package should identify and value the energy savings and wider benefits over the lifetime of the policies. This should go beyond an estimation of energy savings to look at other benefits of renovation, such as job creation, reduction in public expenditure, improvement of working environment, increased tax income, etc. Chapter 3 of this report "Appraisal of the potential to renovate buildings in Belgrade" provides an estimation of the potential of renovation in terms of energy savings and other important macroeconomic benefits.

This structure and suggested content is in line with what is required for national renovation strategies under Article 4 of the EU Energy Efficiency Directive (2012/27/EU)[3]. The Directive requires all Member States of the EU to establish "long term strategies for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private". As a member of the Energy Community, Serbia is currently developing a national renovation strategy [3].

[3] The requirement for national renovation strategies will move to the revised EU Energy Performance of Buildings Directive in 2018.

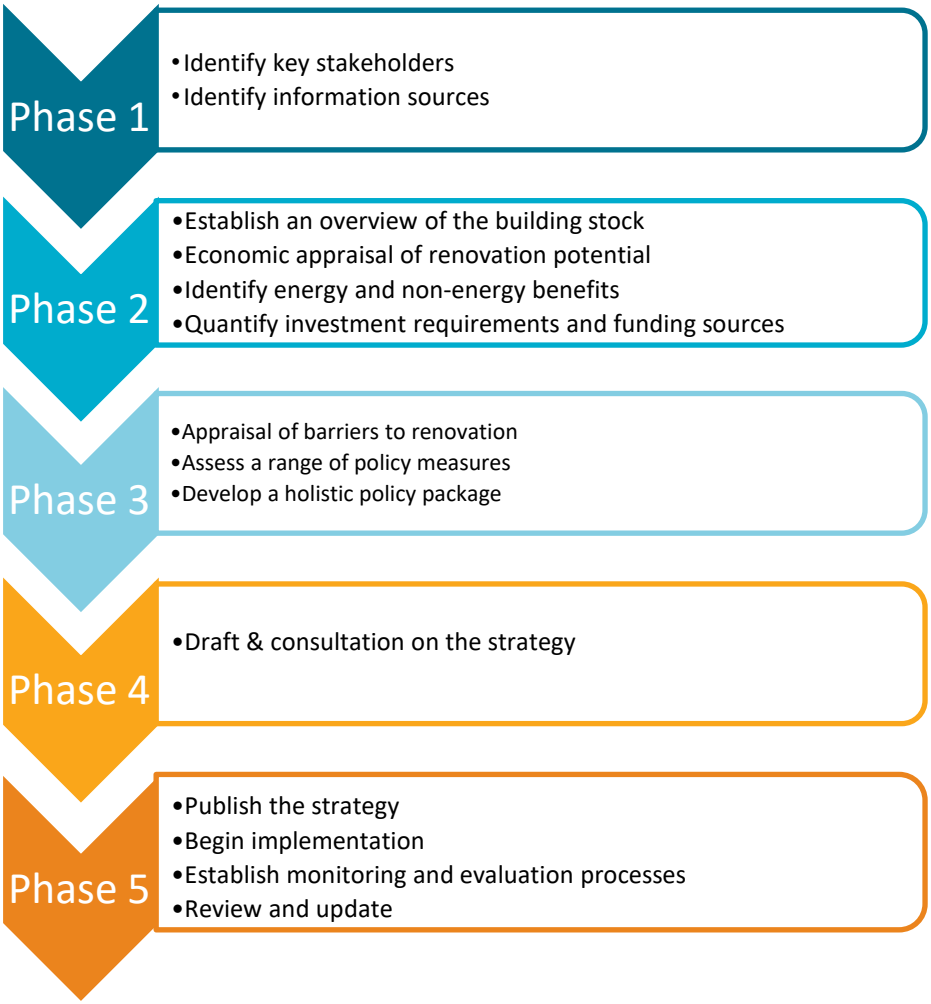
This structure is also relevant for strategies at city level, especially since city plans are required to design and implement detailed action plans to implement national plans. These city level plans help to tailor policies and measures to address local challenges, as well as inspire national action.

An outline template of a renovation strategy is included in Annex I as guidance on the formulation and format of the strategy.

Steps for establishing a renovation strategy

The process for developing and establishing a renovation strategy can be divided into 5 phases, as set out in Figure 2. **[2]**

Figure 2 - Phases in developing a renovation strategy (Source: BPIE)



Phase 1, identifying stakeholders and sources of information is an important first phase. Planning and preparation are vital to the creation of a good strategy. Identifying stakeholders ensures the involvement of the key representatives from administrations, including those working on energy, the building sector and finance, and input from external stakeholders such as sectoral experts, the finance community and representative industry bodies. Lead responsibility also needs to be defined.

Phase 2 involves the technical and economic appraisal of the potential for improving the energy performance of buildings, and phase 3, the appraisal of the policy approach. This report provides support and content for developing these phases and the important parts of a renovation strategy: the overview of the building stock and estimation of potential energy savings and wider benefits. The chapters on the existing policies, programmes, and support programmes can also be used to help to develop a package of policies.

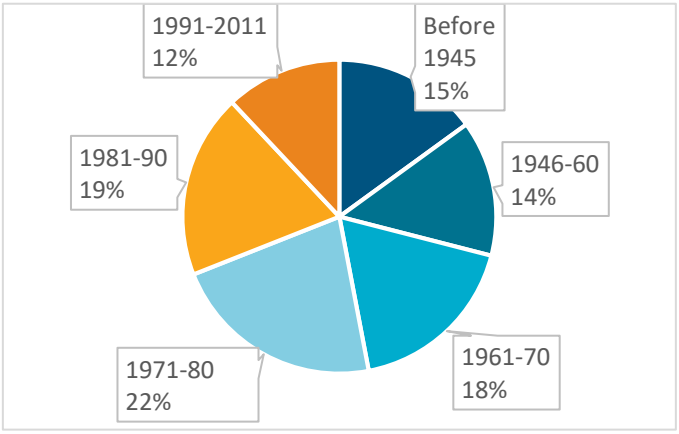
Phase 4 brings together the previous phases. This is where the renovation strategy should become a comprehensive document. Consulting local stakeholders on a draft strategy is recommended. This will ensure that local issues and the needs of different groups, from industry to consumers, are fully and properly considered.

Phase 5 takes account of feedback from the consultation process. This is also the stage when the necessary legislative mechanisms are developed to implement the strategy alongside a roadmap of key dates, targets and milestones. It may be useful to establish a taskforce including local stakeholders to take on implementation actions and ensure wide communication. Strategies should be regularly revised and updated. For national strategies this is required every 3 years under the EU Energy Efficiency Directive. This review should evaluate the impact of policies and measures to date and the potential of probable future measures.

2. STATE OF THE BELGRADE BUILDING STOCK

Available data on the structure, composition and performance of both the national Serbian building stock and the Belgrade building stock is only limited. It is estimated that the housing sector accounts for 38% of total energy consumption in Serbia [4], and almost nine out of ten buildings were built before 1991 (as shown in Figure 3).

Figure 3 - Share of residential buildings in Serbia by construction period [24]



Energy for heating is the largest energy demand in households. This is putting a considerable strain on the household income of many Serbian households. Eurostat estimates that more than 41% of the overall population in Serbia cannot pay their bills on time, while 26% live in very low-quality dwellings with serious defects, such as leaking roofs, damp walls and rotting floors. Consequently, one family in six is not able to keep their home adequately warm[4] and experiences higher incidences of poor health and damp-induced illnesses and diseases. These energy poverty indicators are among the worst in Europe and provide a further dimension to the need to improve the energy performance and quality of the building stock in Belgrade. [1]

In addition to the generally poor quality of the building stock, poor air quality is a serious problem in many parts of the city and pollution levels are rising every year [5]. Measures to reduce energy demand will also have a positive impact on the air quality.

Gas dependency is a concern for Serbia, with 71% of gas used imported [1]. Buildings are one of the biggest consumers of energy, particularly for heating and cooling, and in Serbia district heating is, to a large extent, supplied by gas [1]. Therefore, renovation of buildings to reduce the demand for gas is crucial for energy security.

The common building typologies vary across different districts, as shown in figure 4. The Belgrade city centre has a combination of multi-family houses (MFH) (i.e. apartments) and single-family houses

[4] This is defined by the European Union Statistics on Income and Living Conditions.

(SFH), while there are mainly single-family houses in Banovo Brdo and New Belgrade is characterised by multi-family houses.

Figure 4 - The building typologies of Belgrade differ depending on the district. From top to bottom: City Centre, Banovo Brdo, New Belgrade (Source: Google)

The following data for Belgrade was collected and calculated to provide a quantitative estimate of the renovation potential and associated energy savings (see chapter 3 "Appraisal of potential to renovate buildings in Belgrade"). As detailed information is lacking, data in this section is largely based on calculations and assumptions from experts.

Table 1 – Demography of Belgrade (Sources: Belgrade Statistical Bureau, City of Belgrade)

Demography		
Population	1,659,440	(Serbia: 7,186,862)
Households (single- and multi-family houses)	734,909	(Serbia: 3,231,931)
People per household	2.3	(Serbia: 2.2)

Table 2 – Building floor area data for Belgrade (Sources: UNEP-DTU Partnership, University of Belgrade, City of Belgrade, Statistical Office of the Republic of Serbia)

Building floor area in Mm²	
Total building floor area	60.3
Total residential floor area[5]	48.6
Total non-residential floor area	11.7
District heating floor area	21.9
District heating - residential floor area	17.6
District heating - non-residential floor area	4.3
Residential floor area per person	29

Most buildings in Belgrade (81% of the floor surface) are residential buildings, of which around 36% are connected to a district heating system (as shown in Figure 5).

Figure 5 - Breakdown of the Belgrade residential and non-residential building stock by district and non-district heating (Source: BPIE own analysis).

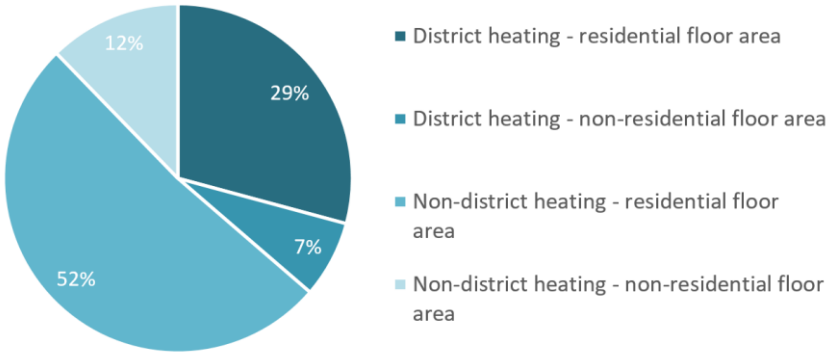


Table 3 – Energy data for Belgrade (Sources: UNEP-DTU Partnership, University of Belgrade)

Energy demand		
Total final energy demand building stock	10	TWh/year
Total residential final energy demand	7.6	TWh/year
Total non-residential final energy demand	2.4	TWh/year
District heating - final energy demand	3.6	TWh/year
District heating- residential final energy demand	2.8	TWh/year
District heating - non-residential final energy demand	0.8	TWh/year
Average residential delivered energy demand	157	kWh/m²
Average non-residential delivered energy demand	204	kWh/m²
Average delivered energy demand	166	kWh/m²

[5] As the total residential floor area is not available, two different approaches were used to calculate an assumption, both leading to the same result.

To support the development of the national renovation strategy, an information system was developed for the collection of data on issued Energy Performance Certificates (http://www.crep.gov.rs/). The collection of data is underway, and tools are under development to enable national and local institutions responsible for policy-making in the field of energy efficiency to access and analyse data from the national and local typologies of residential buildings. In time these could provide more accurate information on the building stock at city level.

3. APPRAISAL OF POTENTIAL TO RENOVATE BUILDINGS IN BELGRADE, INCLUDING DISTRICT ENERGY SYSTEM IMPLICATIONS

Scope

This analysis aims to provide a quantitative estimate of the renovation potential and the associated energy savings, combining renovation of both residential and non-residential buildings. The estimation also identifies some macroeconomic benefits arising from renovating buildings through energy performance improvement measures.

Energy savings are forecast for a selection of scenarios. The four scenarios are technology neutral and represent various levels of ambition in terms of the future development of the building renovation market, focused on two drivers:

- Renovation rates, which reflect the expansion of the renovation market following support from enabling policies, such as national renovation strategies. They are defined as a percentage of useful floor area of annually renovated buildings divided by the total useful floor area of the entire building stock.
- Renovation depths, which indicate the energy savings achieved by the choice of renovation measures.

Table 4 - Energy savings compared to initial state of the building and associated renovation costs[6] (Source: BPIE own analysis)

Minor renovation depth	15% energy savings	75 €/m^2
Moderate renovation depth	45% energy savings	120 €/m^2
Deep renovation depth	75% energy savings	225€/m^2

For this assumption, both the renovation rate and depth are linear. In more advanced modelling exercises, renovation rates could grow over time, and deeper renovations could progressively take on a larger share of the market. For renovation depths, we model three renovation paths, which are assumptions of the market share of each renovation depth and its evolution over time. The assumed renovation rate varies between 1% and 3%, achieving a renovated floor area for 2030 ranging between 13% to 40%. The deepest path would be roughly in line with achieving a nearly-zero energy building stock by 2050.

Two categories of scenarios are presented:

- Renovation focused on all buildings, independent of the heat source (district heating or decentralised heating systems).
- Renovation focused on buildings connected to district heating. For this scenario, buildings connected to district heating have a higher renovation rate and depth. This scenario could be relevant for strategic reasons such as the need to decrease the energy costs of district heating or the expansion of the district heating system maintaining the same provided energy.

[6] The renovation costs are based on expert assumptions according the appointed energy savings (15%, 45% and 75%) [1].

Findings

Based on data presented in chapter 2, energy demand of 10,025 GWh in 2017 and an average energy demand per floor area of 166 kWh/m2 (combining residential and non-residential buildings), different scenarios for 2017-2050 lead to the following energy savings and other impacts, as shown in Table 5 and Figure 5.

Table 5 – Estimations of energy savings in four scenarios for a renovation period 2017-2050 (Source: BPIE own analysis)

Scenario	Low Renovation Scenario	Medium Renovation Scenario	Deep Renovation Scenario	Focus on District Heating Scenario
Renovation rate	1%	2%	3%	• 3% in DH buildings • 1% in non-DH buildings
Energy savings in renovated buildings	15%	45%	75%	• 75% in DH buildings • 15% in non-DH buildings
2030				
Renovated floor area in 2030	13%	26%	40%	20%
Annual energy savings in 2030 (GWh)	195	1,173	2,932	1,189
Annual energy savings in 2030 (compared to 2017) (%)	2%	12%	29%	9%
Cum. energy savings 2017-2030 (GWh)	1,368	8,210	20,526	8,323
2050				
Renovated floor area in 2050	33%	66%	100%	57%
Annual energy savings in 2050 (GWh)	496	2,977	7,443	3,018
Annual energy savings in 2050 (compared to 2017) (%)	5%	30%	74%	30%
Cum. energy savings 2017-2050 (GWh)	8,436	50,615	126,538	51,310
2050 monetary results				
Cum. Investment 2017-2050 (€M)	1,493	4,776	8,956	2,576
Cum. tax income 2017-2050 (€M)	271	868	1,628	468
Energy savings on the DH system (GWh)	180	1,081	2,702	2,702
Annual created jobs	250	800	1,500	450

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District heating focused renovation scenario

- 3% renovation rate in district heated buildings
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- €2.6bn investment
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- 450 jobs

Under the “deep renovation” scenario, energy demand is reduced in 2050 by 74% compared to 2017, thereby substantially increasing energy independency.

The “Focus on District Heating” scenario would renovate 100% of the district heating connected building stock by 2050 (and 40% by 2030)[7], which would result in a reduced total energy consumption of the Belgrade building stock by 30% by 2050. However, this scenario would also reduce district heating provided energy by 75%. This would help to foster the needed transition to actual energy consumption-per-household based billing rather than billing by surface area. Consumption based billing gives consumers a better understanding of their energy consumption and encourages more energy efficient practices. It is also required under the EU Energy Efficiency Directive. Without improving the energy performance of district heating connected buildings, this shift could increase the energy bills of some of the residents in district heated buildings. Renovation of these buildings would not only mitigate this risk but should reduce energy bills as well as improve living conditions in terms of comfort. At the same time, the “freed and available” energy could be allocated to expanding the district heating system to provide heat to more buildings.

The “low renovation” and “medium renovation” scenarios reduce energy demand by 5% and 30% per year respectively.

As with any infrastructure programme, renovating a large proportion of the total building stock over a 30-year period requires a significant investment. Investments could be as much as €9bn in total under the most ambitious “deep renovation” scenario but would result in greater energy cost-savings over the lifetime of the measures, more than offsetting the investment (all figures are present value).

The “medium renovation”, “deep renovation” and “focus on district heating” scenarios represent a significant ramping up in renovation activity compared to the current situation. The current practice is not yet sufficient to trigger a renovation wave within Belgrade (and the rest of Serbia). But several arguments speak in favour of raising ambition in Belgrade when it comes to renovating its buildings. At a time of rising unemployment and increased energy dependency, the employment and energy saving benefits to consumers from an accelerated renovation programme would be able provide a welcome boost to the Serbian economy continuing to suffer economic difficulties. The additional annual jobs through the increased renovation vary between 250 and 1500, depending on the scenario. As the construction sector is a local employer, this additional employment would have a direct impact on Belgrade’s economy. For this estimation, it assumed that on average 17 new jobs were created for every €1 million of expenditure at today’s prices (and estimations are rounded). [6]

[7] It should be noted that the depth of renovation may vary in the buildings renovated, specifically historic buildings which are officially protected as part of a designated environment, or because of their special architectural or historical merit, in so far that deep renovation would unacceptably alter their character or appearance.

4. EXISTING POLICIES AND PROGRAMMES IN BELGRADE

This chapter describes existing governmental programmes and regulations aimed at supporting renovation at national and local level.

National level

As a member of the Energy Community and an EU candidate country Serbia has started the process of embedding EU regulations, such as the EU Energy Performance of Buildings Directive and the EU Energy Efficiency Directive into national law. Serbia's approach is set out its Third National Energy Efficiency Action Plan (for the period to 2018) [7]. As well as the Law on the Efficient Use of energy, the Law on Planning and Construction covers policies related to the energy performance of buildings.

The Law on Planning and Construction defined for the first time in law the term energy performance of a building, alongside an obligation for Energy Performance Certificates for buildings. Underpinning this are two sub law rulebooks:

- Rulebook on energy efficiency in buildings (explaining the general procedures and principles for calculation with the list of applicable standards) [8]
- Rulebook on conditions, content and method of issuing energy performance certificates (defining the types of EPCs and procedures for issuance) [9]

Adoption of regulations started in 2011 and became obligatory from 2012. Rulebooks currently only address the building envelope, heating system and hot water preparation, but are currently under the revision and will include cooling, ventilation and lighting as part of the revision process.

Maximum energy performance values of new buildings and for existing buildings undergoing renovation are defined by the Rulebook on energy efficiency in buildings [8]. Specific values of maximum allowed energy need for heating are defined for each building type. In the table 6 values of threshold energy performance indicators are given per building type. [10]

Table 6 – Energy performance indicators for new and refurbished buildings per building type (Source: EmBuild Project)

Building use	Energy performance indicator threshold for new buildings (kWh/m²a)	Energy performance indicator threshold for renovated buildings (kWh/m²a)
Office and administration	55	65
Education and culture	65	75
Health care	100	120
Hotels and restaurants	90	100
Trades and services	80	90
Sports	70	80

The Budgetary Fund for Energy Efficiency was established in 2014. In 2016 ~€1.3million was dedicated to funding technical measures including improving energy efficiency and developing energy management systems. The United Nations Development Programme is providing additional funding of US$500,000 for projects of energy efficiency improvement in public buildings in at least 10 municipalities from 2015-2020. [10]

The Law on Housing and Maintenance of Buildings, adopted in 2016 made a significant change for residential sector. For the first time, improvement of energy efficiency was declared to be a matter of public interest, thus, the national government can now provide state budget funds for this purpose in the residential sector. This enabled the creation of the funds such as the City of Belgrade Budget Fund for Energy Efficiency (more on this below).

According to the Energy Community Secretariat [3], Serbia achieved progress towards transposition and implementation of the energy efficiency acquis with the adoption of the 3rd Energy Efficiency Action Plan, but additional secondary legislation mainly linked to the buildings acquis is still missing and should be adopted without delay. It also recommends that the priority for Serbia in the forthcoming period is the transposition of the Energy Efficiency Directive, this would include development of a national renovation strategy.

City level

The City of Belgrade Budget Fund for Energy Efficiency (BEEEF) is expected to be launched in 2018 for energy efficiency and renewable energy projects to save heat and electricity in the city of Belgrade.

The Fund may draw from financing sources such as funds from the budget of the City of Belgrade (expenditure plan of the Secretariat for Energy), financial investors and funds, commercial banks and donors, including funding provided by International or Bilateral donor agencies or intergovernmental agreements.

Every building efficiency project supported by the BEEEF should contribute to achieving the Fund's overarching goals of:

- Reducing greenhouse gas emissions
- Reducing the energy use per unit habitable area
- Promoting environmental sustainability within the City of Belgrade
- Reducing the energy expenditures of the City of Belgrade
- Improving the indoor living and working conditions
- Increasing the energy security of the City of Belgrade and Republic of Serbia as a whole

In its initial phases the BEEEF will finance the renovation of buildings that are publicly owned by the City, or on which the City of Belgrade has special property rights (including schools, universities, hospitals, administrative buildings, cultural facilities). Once the Fund starts operating as a revolving mechanism it will finance energy efficiency measures in buildings from all sectors, including industrial, commercial, multifamily residential, and single family residential buildings. [11]

5. FUNDING MECHANISMS

This chapter describes potential EU and regional financing streams which are available and could potentially be used to support renovation programmes in the City of Belgrade.

EU financing streams

The EU supports investments in countries outside the European Union, especially in neighbouring countries and EU candidate countries, such as Serbia.

Instrument for Pre-accession Assistance

The Instrument for Pre-accession Assistance (IPA) is used to support reforms in the countries looking to join the European Union [12]. It provides financial and technical assistance to enable countries to prepare for participation in the EU. For 2014-2020, €11.7Billion will be distributed by the IPA. [13]

When a country joins the EU, they must comply with the "acquis communautaire", including EU Directives such as the Energy Performance of Buildings Directive and the Energy Efficiency Directive. The EU Energy Efficiency Directive requires both national renovation strategies (Article 4) and renovation of public buildings (Article 5). Therefore, the IPA could be used to help to comply with these requirements and in doing so be used to renovate the buildings in Belgrade, particularly those used or owned by Central Government, or to implement renovation measures under national renovation strategies.

Regional financing streams

Investment and development banks and regional financial programmes play a role in facilitating the creation of the right conditions for growth and sustainable development, and in directing investment to strategic projects. Figure 7 lists the regional investment programmes of interest in Serbia.

Figure 7 – Regional financing streams

Green for Growth Fund Southeast Europe

The Green for Growth Fund Southeast Europe (GGF) was initiated in 2009 by the European Investment Bank (EIB) and KfW to enhance energy efficiency and foster renewable energies in South-East Europe, in the form of a public-private partnership with a layered risk/return structure. [13]

Western Balkans Investment Framework

The Western Balkans Investment Framework (WBIF)[8] has two main objectives: pooling grants, loans and expertise to finance priority investment projects; and strengthening coherence and synergies among donors to increase the positive impact and visibility of investments in the Western Balkans [14]. To date, the WBIF has contributed €22.6 Million to three energy efficiency related projects in building [13] s. WBIF provided €1.3billion for technical assistance under the "Energy Efficiency in Public Buildings" project in Serbia, which is also funded by KfW (the German government-owned development bank) and the involved municipalities [7].

Regional Energy Efficiency Programme

The Regional Energy Efficiency Programme (REEP) integrates finance, technical assistance and policy dialogue. It is the main funding instrument in the Western Balkans region supporting energy efficiency investments [13]. One of the main tools of the REEP is the Western Balkans Sustainable Energy Financing Facility II (WeBSEFF II), which aims to reduce energy intensity and promote diverse sources of green energy. WeBSEFF II has a budget of €106.5 Million [15]. The facility is used to encourage private and municipal borrowers to pursue sustainable energy projects that are challenging to develop, finance and implement [16]. 15% of the WeBSEFF II goes to increasing energy efficiency in buildings [17].

Existing examples of financing programmes

There are several examples of financing programmes that might be useful sources of inspiration for the City of Belgrade. Figure 8 lists such examples, and Annex II provides links to more information on each of these examples. More explanation of two schemes which specifically target municipalities and/or public buildings is provided further below.

Figure 8 – Existing financing programmes from across the EU (more information in Annex II)

[8] More information is here: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/western-balkans-conference/wbif-a4-def_en.pdf

Thermo-renovation and Repairs Fund, Poland

The Thermo-renovation and Repairs Fund in Poland offers grants for renovation or repair of existing buildings, targeting mostly multi-family and public buildings. It is an ongoing programme administered by the National Economy Bank (BGK), funded through national sources.

For the years 1999-2014, a total of €449million was invested in the renovation of almost 35,000 buildings. The scheme requires the preparation of an energy audit to verify the actual energy savings and choose the optimum renovation measures to reach at least minimum technical requirements. The Fund covers measures such as thermo-renovation of buildings, structural repairs of buildings, decreasing the losses in district heating networks, and changes of heat source.

The scheme addresses mainly financial barriers since housing cooperatives and associations usually do not have money to cover the cost of the investment. With the help of the Fund they get support and easier access to commercial loans. In most cases the loan is paid off from the savings in energy costs.

In the first year of operation, 1999, only 71 projects were supported but more recently between 2,500 to 3,300 projects are supported every year. Support measures contributed to the success of the scheme such as publicity and education campaigns and technical assistance of energy auditors. [18]

Energy Efficiency and Renewable Sources Fund (EERSF), Bulgaria

The Energy Efficiency and Renewable Sources Fund (EERSF) offers Bulgarian companies, municipalities and private individuals loans or guarantees for energy efficiency projects. It works entirely as a revolving fund, reinvesting the refund loans in new projects.

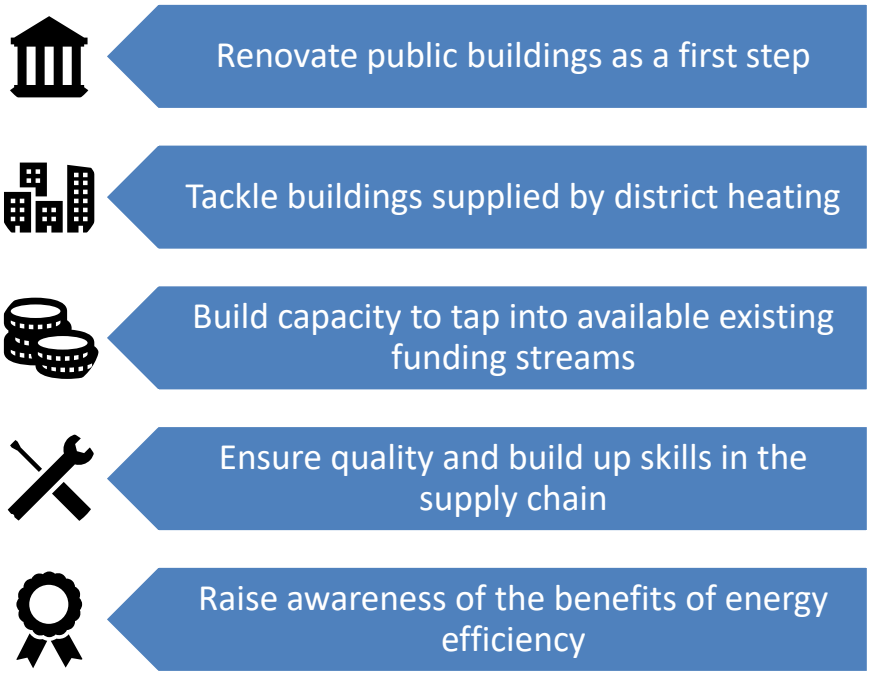
The Fund received initial funding from the Global Environment Fund through the World Bank's International Bank of Reconstruction and Development, the Government of Bulgaria, the Government of Austria, and from the Bulgarian private sector. It aims to provide revolving project finance and technical assistance for public (municipalities, universities, hospitals) and private sector (businesses and residential) energy efficiency projects in Bulgaria.

The Fund serves three major roles: it is a lending institution, a credit guarantee facility and at the same time a technical assistance provider. It provides technical assistance to Bulgarian enterprises, municipalities and residents in developing energy efficiency and renewable energy projects and provides their financing or co-financing or acts as guarantor towards other financing institutions or commercial lenders.

To date, the EERSF has supported more than 200 energy efficiency projects. [18]

6. RECOMMENDATIONS

The following recommendations are based on the findings of the previous chapters and experiences in other regions. They provide areas of focus to ensure effective and successful approaches to renovation in the City of Belgrade.



- **Renovate public buildings as a first step**

Focusing a renovation strategy on public buildings can be the first step to overcoming barriers to renovation of the whole building stock. Many of the barriers to renovating public buildings are the same as those for renovating residential and commercial buildings. For example, poor access to financing is a problem for owners of residential and public buildings. The creation of an energy efficiency fund can help by bringing together funding from different sources (state budget, regional or international financing streams, and development funds) into one pot from which projects can be financed for both residential and public buildings. Often such funds begin by funding public projects before being expanded to all projects.

Similarly, lack of skills in the construction sector is another major barrier. The same skills are needed for renovation of all buildings. By overcoming this barrier first by focusing on public buildings, the wider barrier is also dealt with. Renovated public buildings can provide useful demonstration projects which showcase renovation technologies and skills, and inspire all stakeholders (both within the municipality, the public and the construction industry) to aspire to live, work and build more efficient and higher performing renovated buildings.

- **Tackle buildings supplied by district heating**

Renovating 100% of the district heating connected building stock by 2050 (and 40% by 2030) would reduce total energy consumption of the Belgrade building stock by 30% by 2050. This would also help to foster the needed transition to actual energy consumption-based billing rather than billing by

surface area. Without improving the energy performance of district heating connected buildings, this shift could increase the energy bills of some of the residents in district heated buildings. Renovation of these buildings would not only mitigate this risk but should reduce energy bills as well as improve living conditions in terms of comfort. At the same time, the "freed and available" energy could be allocated to expanding the district heating system to provide heat to more buildings. Untargeted renovations, while providing overall benefits to recipients, will miss the opportunity to create an energy saving strategy combining both demand and supply side measures.

- **Build capacity to tap into available existing funding streams**

EU and regional financing streams could potentially be used to support renovation programmes in Belgrade. Some have a more national focus and therefore collaboration with the national government would be necessary. Others require closer cooperation with the private sector to form public-private partnerships. The Western Balkans Sustainable Energy Financing Facility for example is used to encourage private and municipal borrowers to pursue sustainable energy projects that are often challenging to develop, finance and implement. This could be the case in Belgrade. A more in-depth investigation is needed to understand eligibility criteria in more detail and identify the eligibility of the City of Belgrade to apply for funding under a specific stream.

Building the capacity of municipalities to tap into available funds is important. This means building up the skills within the municipalities for developing funding application and related documentation, as well as the technical knowledge for implementing energy efficiency projects.

To maximise the allocation of EU and other public funding sources to the renovation of buildings, it is important to use public funding to leverage private financing. This is particularly important for financing the renovation of residential and commercial buildings, and means leveraging the building owners' own resources and those of the investment community. Technical guidance on financing the energy renovation of buildings from the European Commission is also a useful source of inspiration for developing financing programmes [19].

- **Ensure quality and build up skills in the supply chain**

Given the potential for job creation from renovating buildings in Belgrade, between 250 and 1,500 jobs created depending on the renovation scenario, there will also be a need for training and education. This means qualification and vocational training programmes will need to be supported.

If renovation works are not to the highest quality standards this will result in problems in the buildings' performance later, leading to missed energy savings, dissatisfaction of owners and occupiers and a loss of trust in the buildings industry. It is therefore essential to ensure high quality training in the many trades involved in renovating the building stock.

Establishing integrated quality frameworks which address knowledge enhancement (i.e. retraining or specialisation) and value of knowledge (i.e. certification for skills) would help to ensure high quality workmanship. Examinations of competences or similar instruments such as "declarations of conformity" are crucial and should be offered by independent certification entities. Demonstration projects that bring together the public and building professionals to illustrate the feasibility of renovation are also an important element.

- ## Raise awareness of the benefits of energy efficiency

Monetisation of the benefits that arise in addition to the energy cost savings is often overlooked.

The cost of a public subsidy provided to stimulate deep renovation may be more than offset by the benefits that result from it. In the context of public buildings, energy efficiency improvements can ease pressure on public finances (i.e. budgets of public authorities), by generating increased tax revenues through increased economic activity and by reducing expenditure on energy and unemployment benefits. In addition to saving money, improvements in energy efficiency can lead to improved indoor air quality and thermal comfort, which have productivity benefits. These result from fewer days of work missed [20]. Productivity improvements due to better air quality can reach 8-11% [21]. Furthermore, the environment benefits from reductions in carbon emissions and energy use which can enhance organisational image and improve public relations [22]. The IEA's report on "Capturing the Multiple Benefits of Energy Efficiency" provides a particularly comprehensive overview of the benefits of energy efficiency and specifically renovation [23].

Increased renovation, in line with the scenarios in this report, could create up to 1,500 additional jobs. As the construction sector is commonly known as a local employer, this additional employment would have a direct impact on Belgrade's economy. Creating high quality and skilled jobs delivers other advantages in terms of reduction of public expenditure on unemployment benefits and additional tax income (between €0.27billion to €1.6billion depending on the renovation scenario). These taxes can contribute to funding public projects, such as renovation of buildings, thus creating and maintaining more jobs.

More work in Serbia on identifying and quantifying the benefits of renovation, and energy efficiency in general, could be useful to foster increasing support for renovation and raise awareness of its benefits.

Actions to raise awareness of energy efficiency and its benefits are intrinsically linked to encouraging changes in the behaviour of energy consumers. Promoting the benefits of energy efficiency, including explaining what energy efficiency measures (including renovation) can do, can provide a stimulus for changing the way consumers use energy or encourage greater renovation.

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ANNEX I: OUTLINE OF A RENOVATION STRATEGY

SECTION 1: AN OVERVIEW OF THE BUILDING STOCK

Step 1: Identify main building categories:

Public buildings:

i) Offices/administrative buildings
ii) Educational buildings
iii) Hospitals/health establishments
iv) Sport facilities

Step 2: Identify age bands which have a material bearing on building energy performance:

i) Traditional construction types, including historic buildings (typically pre-1900)
ii) Buildings constructed prior to regulations on energy performance (e.g. 1901-1960)
iii) Early phase building regulations
iv) Mid-phase building regulations
v) New (2001-2012)

Step 3: Quantify the number, type, size (floor area) of each combination of building type and age band.

Step 4: Identify the energy use and performance characteristics of each building combination:

i) Construction type and U-value of main building elements:
   (1) Floor
   (2) Walls
   (3) Windows and External Doors
   (4) Roof
ii) Air infiltration rate
iii) Energy systems (and typical replacement lifecycles):
   (1) HVAC system type/performance level/controls
   (2) Hot water provision
   (3) Lighting systems/controls
iv) Maintenance (e.g. mandatory safety checks/servicing)
v) Energy use for:
   (1) Heating
   (2) Cooling
   (3) Ventilation
   (4) Hot water
   (5) Lighting
   (6) Appliances
vi) Energy carriers:
   (1) Gas (natural gas or LPG)
   (2) Liquid fuels (oil, etc.)
   (3) Solid fuels (coal, etc.)
vii) Renewable energies:
   (a) Solar energy for hot water generation
   (b) Solar PV
   (c) Wind
   (d) Heat pump (type and Coefficient of Performance)
   (e) Biomass (wood-chips, wood-pellets)
   (f) Other (specify)
viii) District heating (identify energy carriers)

SECTION 2: IDENTIFICATION OF COST-EFFECTIVE APPROACHES TO RENOVATION

Step 1: Identify opportunities for retrofit of energy efficiency measures for each building category:

i) Fabric measures - building envelope
ii) Exterior windows and doors
iii) Technical facilities – heating/ventilation/cooling/hot water
iv) Air tightness / infiltration
v) Lighting
vi) Appliances
vii) Shading, sunblind's to avoid cooling in summer

Step 2: Identify opportunities for retrofit of renewable energy measures:

i) Solar energy for hot water generation
ii) Solar energy for generation of electric energy (Photovoltaics)
iii) Optimal use of passive solar energy
iv) Wind
v) Heat pumps
vi) Biomass
vii) Biogas
viii) Geothermal hot water

Step 3: Identify opportunity to connect to a district heating system

Step 4: Identify package[s] of measures that can achieve at least 60% energy saving (deep renovation) or at least up to the prevailing energy performance requirements for new buildings of the same category

Step 5: Identify cost effectiveness of the different packages of measures been determined using cost optimality methodology, taking account of:

i) Costs:
Total installed cost of renovation measures, less any avoided cost due to end-of-life replacement or by undertaking renovation alongside other building maintenance, new construction or modernisation measures.
Transaction costs, including costs of temporary relocation of occupants

ii) Benefits (where possible quantified):
Economic Benefits: Energy Cost Savings; Economic Stimulus; Impact on GDP; Property Values; Industrial Competitiveness; Impact on Public Finances; Energy Import Bill
Societal Benefits: Reduction in Fuel Poverty; Health Benefits; Increased Comfort/Productivity
Environmental Benefits: Carbon Saving; Air quality improvement

Energy System Benefits: Energy Security; Avoided New Generation Capacity; Reduced Peak Loads

Step 6: Determine whether deep renovations are best undertaken as a single package, or staged over a period of time (step by step implementation)

SECTION 3: POLICIES AND MEASURES

Step 1: Identify existing policies and measures, including: i) Regulatory (EU, national, regional and local) ii) Fiscal (tax incentives, grants, subsidies, loans, etc.) iii) Information campaigns iv) Voluntary agreements v) Other
Step 2: Identify barriers to deep renovation and policies/measures to overcome them (including existing policies and measures identified and packages identified in section 2)
Step 3: Set out a holistic policy package based on packages identified in section 2 and addressing identified barriers, with a particular focus on measures to be introduced within the next 3 years

SECTION 4: FORWARD LOOKING PERSPECTIVE

Step 1: Quantify total annual investment requirements to 2050 to deliver policy package
Step 2: Identify existing sources of funding for building energy renovation i) Local public funds ii) National public funds iii) EU Structural/Cohesion funds iv) Banks and other sources of finance, e.g. pension funds and investment trusts
Step 3: Identify possible new funding sources and mechanisms
Step 4: Set out roadmap with key dates, targets, milestones for the introduction of policies and measures

SECTION 5: IDENTIFICATION OF WIDER BENEFITS

Step 1: Identify the attractiveness to building owners of their direct energy cost saving benefits
Step 2: Identify the societal benefits arising from deep renovation (building on benefits identified in section 2)
Step 3: Identify ways in which externalities (e.g. societal benefits from reduced CO2 emissions, increased energy security etc.) can be internalised for the benefit of the investor

ANNEX II: LINKS TO FURTHER INFORMATION ON EXISTING FINANCING PROGRAMMES

Programme of energy renovation of family homes 2014-2020 - Croatia	http://www.mgipu.hr/default.aspx?id=32756 (in English) http://www.mgipu.hr/default.aspx?id=26533 (in Croatian)
Programme for Renovating (upgrading) Multi-apartment Buildings - Lithuania	http://atnaujinkbusta.lt/ (in Lithuanian) http://documents.worldbank.org/curated/en/219131468101065684/pdf/893220WP0P133200000201400601601 8 -42.pdf World Bank report with overview of all the changes until 2014 (in English)
Domestic environmental support programme - Austria	https://www.bmnt.gv.at/umwelt/klimaschutz/ufi/ufi.html (in Austrian)
Green fund scheme (Groenfonds) - Netherlands	https://www.rvo.nl/subsidies-regelingen/regeling-groenprojecten/projectcategorie%C3%ABn (in Dutch) https://www.rvo.nl/subsidies-regelingen/regeling-groenprojecten/projectcategorie%C3%ABn/energiebesparing (in Dutch)
Thermo-renovation and Repairs Fund - Poland	http://bpie.eu/publication/financing-building-energy-performance-improvement-in-poland-status-report/ (in English and Polish)
Redeveloping Energy Efficiently Scheme (part of the CO2 Buildings Renovation Programme) - Germany	https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilien/Finanzierungsangebote/Energieeffizient-Sanieren-Kredit-(151-152)/ (in German) https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilien/Finanzierungsangebote/Energieeffizient-Sanieren-Zuschuss-(430)/ (in German)
Slovak Sustainable Energy Financing Facility (SlovSEFF) - Slovakia	http://www.slovseff.eu/index.php/en/ (in English)
Home Energy Efficient Programme (HEEPS) - UK	http://www.energysavingtrust.org.uk/scotland/grants-loans/heeps
New Green Savings Programme (Nová zelená úsporám) - Czech Republic	http://www.novazelenausporam.cz/ (in Czech)
Energy Efficiency and Renewable Sources Fund (EERSF) - Bulgaria	http://www.bgeef.com/ (in English)
Better Energy Homes - Ireland	https://www.seai.ie/grants/home-grants/better-energy-homes/
Loans, technical assistance and grants for renovation of multi-apartment buildings (KREDEX) - Estonia	http://www.kredex.ee/en/apartment-association/ (in English) https://www.fi-compass.eu/sites/default/files/publications/case_study_renovation_loan_programme_estonia_0.pdf EIB case study report (in English)

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