GENERAL INFORMATION

Title of NAMA

▶ **Improvement of old residential buildings envelope (exterior doors, windows and thermal insulation) in Serbia**

Description

▶ **Description of Mitigation Action**

Residential buildings in Serbia up to 1980's were generally built without any thermal insulation. That is the main reason for their tremendous energy consumption for space heating today. The objective of this project is rehabilitation of about 10% of the existing residential buildings in Serbia that were built in the period from 1950's to 1980's, what is approximately 10 millions square meters of houses and apartments buildings.

Energy efficiency improvements in selected residential buildings of different size and shape throughout Serbia, aim to:

  a. reduce heat energy consumption and costs;
  b. increase the level of indoor comfort and end users' satisfaction;
  c. reduce GHG emission.

▶ **Technology/ measure**

  1. Rehabilitation of buildings' envelope – thermal insulation of non-transparent elements including external walls, partitions to unheated spaces, roofs, ceilings, etc.
  2. Replacement of windows. Installing new five-chamber PVC frames, double glazing, low-emissivity glass, filled with argon gas.

With the application of all above-mentioned measures, specific annual energy consumption for heating will decrease from the simple average value for old targeting buildings (analysis conducted by local companies) of 160 kWh/m^{2}y to 70 kWh/m^{2}y which is limited final energy consumption for heating for rehabilitated old buildings, according to the Regulations on Energy Efficiency in Buildings (2011).

▶ **Potential Number of sites for NAMA project**

The number of potential sites for NAMA project is about 10,000 buildings with total surface floor area of 9.66 million square meters as shown in the next table. The surface area of the existing buildings for different period of construction was taken from Population and housing census in Serbia as well as Statistical Yearbook. Surface area of windows and walls was estimated for typical buildings in Serbia built in the period from 1950 to 1980.

Period of construction	Floor surface area of the existing buildings P (m²)	Area for rehabilitation (10% of P)	Windows surface area (m²)	Walls and roofs surface area (m²)
1951-1960	18,640,781	1,864,000	342,000	3,386,000
1961-1970	33,140,692	3,314,000	607,000	6,021,000
1971-1980	44,878,506	4,488,000	823,000	8,153,000
Total		9,666,000	1,772,000	17,560,000

Location

▶ Targeted residential buildings are located throughout Serbia.

NAMA Implementing Entity

▶ Serbian Ministry of Energy, Development and Environmental Protection in coordination with local municipalities.

Implementing Schedule

Depending on financial resources dynamic, the project could be implemented continuously or in phases.

Expected starting date of Action
▶ Buildings rehabilitation will start in 2013. Start of operation will continuously happen as each building's rehabilitation is completed. The reconstruction of app. 10,000 buildings should be finished in 2020.

Lifetime
▶ Expected lifetime of thermal insulation and new windows is approximately 30 years.

Current Status
▶ There are a certain number of pilot projects of improving building envelope thermal performances, resulting in heat consumption reduction and GHG emission reduction.

GIZ Project which is currently being implemented aims to support the Serbian government in the development and implementation of the national programme on energy efficiency for buildings by improving the existing legal framework, raising awareness on the importance and benefits of energy efficiency and providing information and financial resources.

Serbia established incentive system for rehabilitation of existing building envelope in certain number of houses for improving thermal insulation, increasing thermal comfort and reducing energy consumption for heating. In 2012, former Ministry of Environment, Mining and Spatial Planning granted funds of 1.3 billion RSD (approximately 13 million Euro) to tenants for rehabilitation of existing buildings.

Coverage

▶ **Sector**: Buildings energy sector
▶ **GHG Gases**: CO_2

FINANCIAL INFORMATION

Finance and Cost

► Expected cost of **preparation**:
EUR 5 million (General design or/and Feasibility study for each of the buildings)

► Expected cost of **implementation**:
EUR 723.48 million

► Expected **incremental cost** of implementation:
none

► **Financial sources**:

A part of financial sources could be provided by building owners. Other parts will include the state and some sort of non-commercial loans. Establishment of financial measures such as tax incentives for thermal insulation products, windows and exterior doors will be essential.

The details regarding the financial sources necessary for the preparation and the implementation of the project will be analyzed in the Feasibility study. The financial mechanism will be decided upon the completion of the Feasibility study.

Since the Law on Efficient Use of Energy is currently in the last phase of preparation, according to which Budget Fund will be introduced aiming to secure funds for the purposes of efficient energy use, it is possible that this project will receive support from that source also.

INFORMATION ON SUPPORT REQUIRED

Description of Support Required

Type of Support	Support required for Preparation	Support required for implementation
Financial	EUR 5 million	EUR 723.48 million*
Technical	x	x
Capacity Building	x	x

* EUR 723.48 million is the total cost of the project, of which EUR 144.696 million (20% of the total cost) would be covered by building owners. The remaining EUR 578.784 million (80%) is the total expected amount required for support. It includes EUR 217.044 million (30%) for which the state would ask a grant which would be the offered to the owners as a state subsidy and the remaining EUR 361.74 million (50%) for which some sort of non-commercial loan would be secured.

EXPECTED GHG EMISSION REDUCTIONS AND MRV

Expected Mitigation Potential

▶ **Annual reduction**: 503,929 tCO_{2e}
▶ **Total reduction**: 15,117,870 tCO_{2e} (30 years)

Methodologies and Assumptions

▶ **Methodology**: Methodology applied for ex-ante GHG estimation is shown below.

▶ **BAU scenario**: The rehabilitation of existing residential buildings without building envelope thermal insulation is not conducted. Energy efficiency of these residential buildings remains the same (very low).

▶ **Calculation of emission reductions**:

▶ **Baseline GHG emission**

Assumptions:

- Total floor areas to be rehabilitated in the existing buildings built from 1950's to 1980's: 9,666,000 m^2

- Average energy consumption for heating for buildings without thermal insulation built 30-50 years ago: 160 kWh/m^2y

- Total annual energy consumption for these buildings:
  160 kWh/m^2y x 9,666,000 m^2 = 1,546,560,000 kWh/y

- Energy is supplied by various sources (% share in the market based on the data from PE "Belgrade District Heating"):
  Electricity (40%) District heating (40%) Coal (10%) Natural gas (10%)

Fuel/energy	Share of the market [%]	Final energy [GWh/y]	Conversion factor to primary energy	Primary energy [GWh/y]	Primary energy [TJ/y]
Electricity	40	618.62	1	618.62	2,227.03
District heating	40	618.62	1.3*	804.21	2,895.16
Coal	10	154.66	1.3**	201.06	723.82
Natural gas	10	154.66	1.1**	170.13	612.47
Σ		**1,546.56**		**1,794.02**	**6,458.48**

* An average value for all heat plants in DH systems fueled with different fuels (natural gas, heavy oil, light oil, coal) including heat losses in pipelines (estimation):

$\eta_{DH} = (0.5 \cdot 0.9 + 0.3 \cdot 0.85 + 0.2 \cdot 0.75) - 0.1 = 0.76$

** Based on average value of boiler efficiency (for coal 75%, for natural gas 90 to 92%)

Fuel/energy	Primary energy	CO_2 Emission factor	CO_2 emission [t CO_2/y]
Electricity	618,620 [MWh/y]	0.945 [t CO_2/MWh]	584,596
District heating	2,895.16 [TJ/y]	71 [t CO_2/TJ]*	205,556
Coal	723.82 [TJ/y]	98.6 [t CO_2/TJ]**	71,369
Natural gas	612.47 [TJ/y]	56.1 [t CO_2/TJ]	34,360
Σ		-	**895,881**

* An average value for natural gas (50%), light and heavy oil (30%) and coal (20%) (estimation based on the data from district heating companies in Serbia).

** An average value for lignite and brown coal used in Serbia.

▶ **GHG emission after implementing project (10,000 buildings rehabilitation)**
Total floor areas to be rehabilitated in the existing buildings built from 1950's to 1980's: 9,666,000 m^2
Average energy consumption for heating after buildings rehabilitation (according to the new Regulation on Energy Efficiency in Buildings): 70 kWh/m^{2}y.
Total energy consumption: 70 kWh/m^{2}y x 9,666,000 m^2 = 676,620,000 kWh/y
Energy is supplied by various sources (% share in the market):

Electricity (40%) District heating (40%) Coal (10%) Natural gas (10%)

Fuel/energy	Share of the market [%]	Final energy [GWh/y]	Conversion factor to primary energy	Primary energy [GWh/y]	Primary energy [TJ/y]
Electricity	40	270.65	1	270.65	974.34
District heating	40	270.65	1.3*	351.85	1,266.66
Coal	10	67.66	1.3	87.96	316.66
Natural gas	10	67.66	1.1	74.43	267.95
Σ		**676.62**		**784.89**	**2,825.61**

* An average value for all heat plants in DH systems fueled with different fuels

Fuel/energy	Primary energy	CO_2 Emission factor	CO_2 emission [t CO_2/y]
Electricity	270,650 [MWh/y]	0.945 [t CO_2/MWh]	255,764
District heating	1,266.66 [TJ/y]	71 [t CO_2/TJ]*	89,933
Coal	316.66 [TJ/y]	98.6 [t CO_2/TJ]**	31,223
Natural gas	267.95 [TJ/y]	56.1 [t CO_2/TJ]	15,032
Σ		-	**391,952**

* An average value for natural gas (50%), light and heavy oil (30%) and coal (20%):

$$EF_{DH} = (0.5 \cdot 56.1 + 0.3 \cdot 77.4 + 0.2 \cdot 98.6) = 71$$

** For mixture of lignite and brown coal used in boilers in Serbia.

▶ **GHG emission reduction**

GHG emission reduction = $895,881 - 391,952 = 503,929$ [t CO_{2e}/y]

Measurement, Reporting, and Verification (MRV)

Monitoring Plan

Improvement of old residential buildings envelope will be implemented according to the Regulations on Energy Efficiency in Buildings (2011) and Regulations on Certification of Energy Performance of Buildings (2011).

The Regulations on Energy Efficiency in Buildings prescribes the energy performance and the way to calculate thermal performance of buildings, as well as the requirements regarding energy performance for new and existing facilities. The Regulations categorizes buildings based on energy properties and methods of calculating thermal properties.

Regulation on Certification of Energy Performance of Buildings requires building owners to prepare energy plan for their building before rehabilitation works, and have to receive energy audit and certification by accredited companies and then submit the "Energy Passport" (please see below for the contents of Energy Passport) to responsible entities (Ministries or Municipalities). After implementation, building owners have to receive re-certification by accredited companies and submit revised Energy Passport to responsible entities (Ministries or Municipalities).

Ministry of Construction and Urbanism will monitor all issued Energy Passports before and after implementation of the proposed rehabilitation works, and confirm CO_2 emission of the building in each Energy Passport.

Energy Passport includes the following information;
1. General information of the Building, Energy certificates for buildings
2. Data on building, climate condition, HVAC (heating, ventilation, and air conditioning), building envelope
3. Data on heating system of the building, heating control system, heat loss of the building, Energy needs of the building, energy consumption, CO_2 emissions
4. Proposals for improvement of the energy efficiency of the building

Through comparison of the CO_2 emission described in each Energy Passport (before/ after), CO_2 emission reduction will be confirmed.

▶ **Data and parameters to be monitored**:

CO_2 Emission reduction will be calculated as follows.

$$ER_y = \sum n \ (BE_i - PE_i)$$

Where:
ER y = Emission Reduction in Year y
n   = Number of rehabilitated buildings that with Energy Passports issued.
BE i = CO_2 Emission before rehabilitation in building i
PE i = CO_2 Emission after rehabilitation in building i

Data / Parameter	ER_i
Unit	kg-CO_2/ year
Description	Amount of CO_2 Emission Reduction as a result of building envelope improvement
Source of data	Energy Passport issued to each rehabilitated building (both Energy Passports that are prepared before and after rehabilitation will be monitored)
Measurement procedures	Ministry of Construction and Urbanism will monitor all issued Energy Passports before and after implementation of rehabilitation works, and confirm CO_2 emission of the building. Through comparison of the CO_2 emissions described in each Energy Passports (before/ after), CO_2 emission reduction will be calculated.
Monitoring frequency	Once a year
QA/QC procedures	via web-site

▶ **Monitoring plan and structure:**

The final structure of the project has not yet been completely defined, as it is being developed as part of the GIZ Project - Energy Efficiency in Buildings, which will result in setting up a web site which will contain all the data, information and analysis regarding the subject of energy efficiency in buildings and GHG emissions. As a result of cooperation of GIZ and the Faculty of Architecture of Belgrade University, with the support of the Ministry of Construction and Urbanism, the Typology project was completed, results of which are available on www.building-typology.eu with detailed information of types of residential buildings in Serbia. This information will be used in the preparation of the Feasibility study of this project.

The concept of monitoring structure is shown in the figure below.
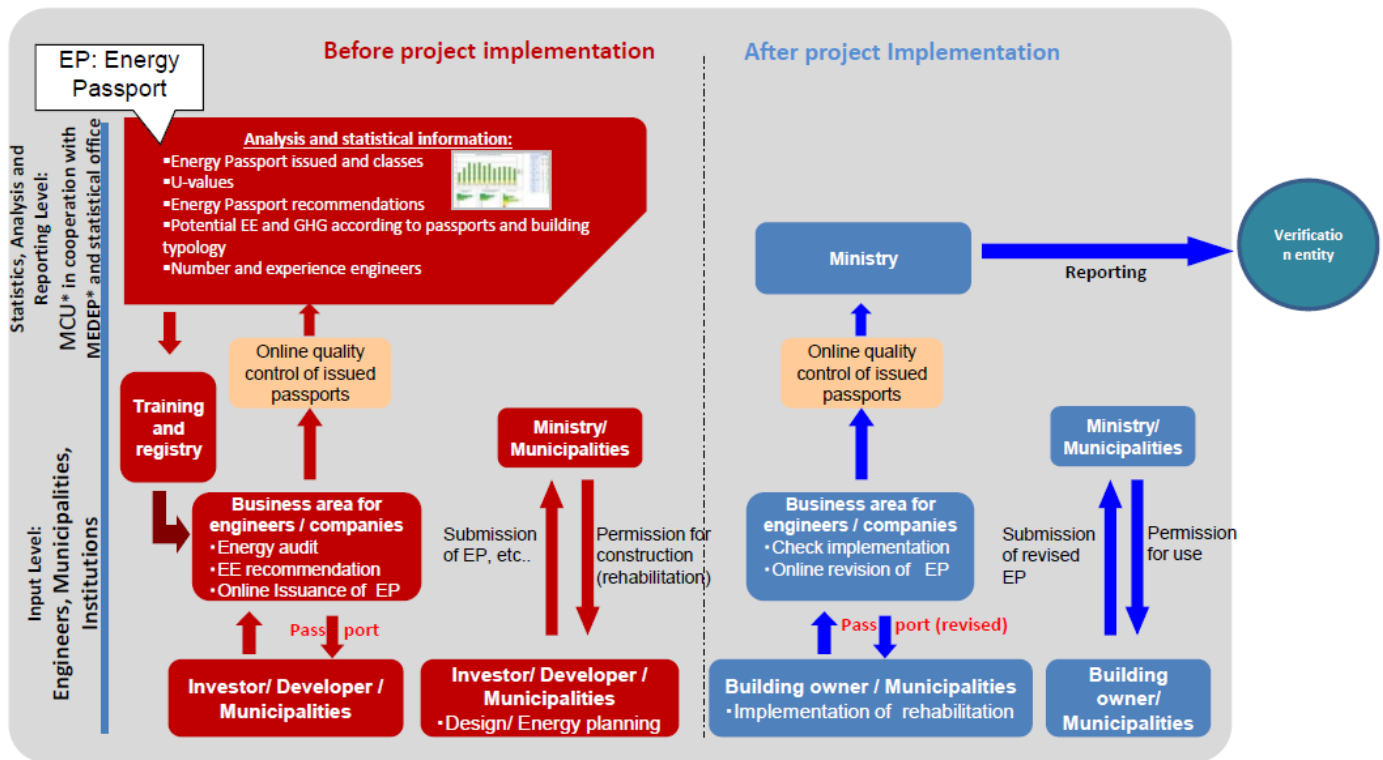
* MCU: Ministry of Construction and Urbanism
* MEDEP: Ministry of Energy, Development and Environmental Protection
* EP: Energy Passport

Monitoring will be conducted both before and after the project implementation. Before the implementation, the following will be conducted: submission of the Energy Passport by the investors/developers/municipalities to either Ministry or the municipalities upon which permission of construction will be issued; online quality control of issued passports; analysis and statistical processing of the data regarding: Energy Passports, U-values, Energy Passport recommendations, potential EE and GHG according to passports and building typology, number of experienced engineers, etc. The data will be submitted by engineers, municipalities and institutions involved. The entire system will also be accessible to general public via internet.

After the implementation, following monitoring activities will be conducted: submission of the revised Energy Passport by the companies authorized for certification/ to the Ministry or the municipalities upon which permission for use will be issued; online quality control of issued passports submitted to the Ministry; submission of the reports to the Verification entity.

► **Domestic MRV arrangements**

- ► <u>Domestic MRV arrangement of Serbia is currently under development.</u>
- ► It is expected that under the Serbian domestic MRV system, a NAMA implementing entity is responsible for the Measurement (M) and Reporting (R) activities, which will go through Verification (V) from third party.
- ► It is expected that the MRV of the proposed NAMA will be conducted in the following manner.

1. Ministry of Construction and Urbanism will conduct and supervise the Measurement activities based on the above-mentioned monitoring plan in order to calculate the emission reductions achieved by the NAMA.

2. Ministry of Construction and Urbanism will prepare a Report that contains information on 1) the detailed result of the monitoring activities conducted based on the monitoring plan, 2) the result of emission reduction calculation, and 3) any support received under NAMA scheme from Annex-I countries or international organizations regarding financial support, technical support, or support on capacity building.

OTHER INFORMATION

Contribution to Sustainable Development

The project will have various positive economic, social and environmental effects. The project counts on the involvement of local partners in terms of production of construction products, project design and execution of works. It will increase demand and production of construction products, thus resulting in increase of revenue and employment of local companies, contributing to economic development of all regions of Serbia. The project requires the involvement of stakeholders at local level (enterprises, certified engineers, local authorities for issuing building permits). As for the environmental impact - the implementation of the project will result in reduction of energy consumption, reduction of GHG emissions and the increase the level of indoor comfort and end users' satisfaction.

Stakeholder consultation

Numerous meetings with building owners, representatives of local authorities and certified engineers have been held so far in 30 communities throughout Serbia, as a part of the project of GIZ. Implementation of energy efficiency measures and GHG emission reductions were promoted, raising awareness amongst members of the local communities and local authorities regarding the positive impacts of the introduction of the energy efficiency measures and Energy Passports.

CONTACT INFORMATION

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