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NAMA on Promoting Energy Efficient Lighting in the Republic of Moldova

NAMA proposal

November 2016

Republic of Moldova

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Acknowledgements
We would like to acknowledge the following stakeholders for their participation in the NAMA process: Ministry of Environment; Ministry of Economy; Energy Efficiency Agency; Moldova Technical University; Institute of Power Engineering of ASM; Soroca Rayon Council.
Special thanks to James Vener, Technical Specialist, LECBP Climate Change & Disaster Risk Reduction, Bureau for Policy and Programme Support, UNDP for valuable comments and recommendations on NAMA design document improvement

Editor
XXX
Design
XXX
November 2016

Forward

The UNDP Low Emission Capacity Building (LECB) Programme is a country-driven initiative that promotes essential cooperation between relevant institutions, engaging the public sector and industry in a concerted effort to design and implement approaches to low emission development that are consistent with national development priorities. National counterparts are supported to strengthen technical and institutional capacities to identify and formulate Nationally Appropriate Mitigation Actions (NAMAs) and Low Emission Development Strategies (LEDS) in the public and private sectors, and to strengthen the underlying greenhouse gas inventory management and Measurement, Reporting and Verification (MRV) systems.

The LECB Programme runs through 2016 and is active in 25 countries: Argentina, Bhutan, Chile, China, Colombia, Costa Rica, the Democratic Republic of Congo (DRC), Ecuador, Egypt, Ghana, Indonesia, Kenya, Lebanon, Malaysia, Mexico, Moldova, Morocco, Peru, Philippines, Tanzania, Thailand, Trinidad and Tobago, Uganda, Vietnam and Zambia.

The programme is supported through generous contributions from the European Commission, the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), and the Government of Australia.

More information can be found at www.lowemissiondevelopment.org

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Executive summary

The NAMA on Promoting Energy Efficient Lighting in the Republic of Moldova is a supported NAMA. It builds on and seeks to enhance past and ongoing efforts of the national government to increase energy efficiency in the country. With 87% of the national primary energy supply coming from imports, improving energy efficiency is a high priority of the government. The objective of the NAMA is to convert all existing, non-LED lighting systems to LED-based systems in the street lighting, public buildings and residential buildings sectors by 2030 to significantly reduce public and private expenditure on lighting, to contribute to national energy efficiency targets and to commitments to reduce national GHG emissions. Moreover, through investments in energy efficient lighting, the NAMA will promote national sustainable development by increasing safety on streets and comfort in buildings, by improving the quality of lighting, creating new jobs in the field of energy efficiency, and by eliminating health risks from mercury pollution from exposure to hazardous materials of light bulbs.

At present, the dominant lighting technologies that are currently in use in the country include: different high-pressure mercury lamps (HPM) in the street lighting sector, as well as incandescent light bulbs (IL), fluorescent (FL) and compact fluorescent lamps (CFL) in the public buildings and residential building sectors. Most of the Moldovan lighting infrastructure is outdated and will have to be replaced in coming years therefore a transition to LED lighting is considered as the best option since LEDs are currently the most energy-efficient and durable lighting technology available on the market. Preliminary estimates indicate that the full conversion to energy efficient lighting will reduce annual national electricity consumption by 502,680 MWh, resulting in savings of up to 64 million €. Moreover, national GHG emissions would be reduced by 327,314 tCO_2 per year.

To reach its target, the NAMA will use a phased approach consisting of three phases to extend the national policy and regulatory framework on energy efficient lighting and to gradually enhance national capacities to finance and scale up lighting projects in the country:

Activities and measures that will be implemented under the NAMA framework have the objective to scale up past and existing activities and resources to promote energy efficient lighting in Moldova and to remove barriers for the implementation of a national energy efficient lighting programme. The NAMA framework has four components, each of which consists of a set of activities and measures: (1) **Policy and Regulatory Framework Development and Monitoring, Verification and Enforcement (MVE)**; (2) a **Technical Support Programme** to promote the roll-out of energy efficient lighting projects; (3) an **Awareness Raising and Capacity Building Programme** to increase the purchase of LEDs by informing a range of different stakeholders about their financial and environmental benefits and to enhance local and national skills that are needed to scale up efficient lighting activities, and (4) a **Finance Mechanism** implemented as an overarching component to secure long-term funding for efficient lighting projects.

In NAMA Phase I, the Preparation Phase of the NAMA, street lighting and lighting systems in public buildings of Soroca city, which is located in the northeast of the country, will be retrofitted. Moreover, during NAMA Phase I, additional villages, cities and/or districts will be selected through a competitive selection process for implementation of LED-based lighting projects during NAMA Phase II, and this process will be repeated during NAMA Phases II and III. The cost of switching from non-LED to LED-based lighting is about 2.65 million € for the Soroca pilot project and about 192 million € for implementing LED lighting technologies at the country level by 2030.

For NAMA implementation, funding is expected to come from a mix of domestic and international funding sources. Domestic funding for NAMA activities will come from the national Energy Efficiency Fund as well as from the public budget of the central and local governments. International support is requested as well in form of grants and a zero interest loan.

The Moldovan Government has set-up an organizational structure for the development of energy efficiency measures on which the NAMA implementation process can build. The framework involves all institutions that are needed to develop, implement and manage the NAMA programme which is cross-sectoral and covers a broad range of topics such as energy efficiency, mitigation of climate change, market development and finance. Since the NAMA will be implemented within the framework of international climate policy, the Ministry of Environment will lead and supervise the NAMA implementation process. A NAMA MRV framework is currently being developed by the Government and will be finalized December 2016.

Abbreviations and acronyms

BAU	Business as Usual
C	Carbon
CDM	Clean Development Mechanism
CCO	Climate Change Office
CFL	Compact fluorescent
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
EEA	Energy Efficiency Agency
EEF	Energy Efficiency Fund
EEL	Energy efficient lighting
ESCO	Energy service company
FL	Fluorescent
GDP	Gross Domestic Product
GHG	Greenhouse gas
HPM	High-pressure mercury
HPS	High-pressure sodium
IL	Incandescent light bulb
INDC	Intended Nationally Determined Contribution
IRR	Internal rate of return
ktoe	Kilotonne of oil equivalent
kV	Kilovolt
LED	Light-emitting diode
LEDS	Low Emission Development Strategy
LEEP	Local Energy Efficiency Programme
LEEAP	Local Energy Efficiency Action Plan
LPA	Local Public Authority
MDL	Moldovan leu (pl. lei)
MoEN	Ministry of Environment
MRV	Measuring, Reporting and Verification
NEEP	National Energy Efficiency Programme
NEEAP	National Energy Efficiency Action Plan
NGO	Non-governmental organization
NPV	Net present value

UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction to energy efficient lighting in the Republic of Moldova

The Republic of Moldova depends heavily on energy imports. Approximately 87% of the primary energy supply has to be imported. To ease the situation, the Moldovan government is making efforts to promote energy efficiency through various policies and programmes. Energy efficient lighting is at the top of the list of cost-effective energy efficiency measures (Energy Community, 2012). However, the public budget for investments in energy efficiency measures is small and only a small portion is currently used to promote energy efficient lighting. The majority of past and current government interventions in the lighting sector target street lighting (Table 1). The National Energy Efficiency Programme (NEEP) 2011-2020, for example, promotes the implementation of energy efficient street lighting projects as well as measures to raise public awareness regarding best practices and benefits of energy-efficient lighting. The conversion of conventional lighting systems to LED-based systems in the street lighting sector has an estimated electricity savings potential of 0.98 kilotonne of oil equivalent or ktoe by 2020 (NEEAP 2016-2018). To date, 10% of conventional street lighting systems in urban areas – approximately 250 km - have been replaced by LED-based systems. Most of these projects were largely funded by international donors. Without donor support, projects of large-scale replication are limited due to a lack of financial resources of national and local governments.

Table 1 Overview of recent and ongoing pilot street lighting projects in Moldova

City	Description
Ocnita, Soroca, Cantemir	Moldova received a grant of € 400,000 from the European Commission to improve the street lighting systems of the cities: Ocnita, Soroca and Cantemir. Moldova's own contribution to the project is € 100,000. Approximately 710 LED luminaries will be installed, and the project is ongoing. The grant was issued within the framework of Sustainable Urban Demonstration Projects offered to Covenant of Mayors signatories. The Covenant of Mayors is the mainstream European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories.
Chisinau	On the road between Chisinau and the airport, 409 LED luminaires were installed on 10 km for a total cost of 22 million MDL. The cost includes full construction of new lighting line (installation of power transformers, underground cables, new pillars and LED luminaires).
Ustia, Dubaresi distric	In Ustia, Dubasari district, 14 km of streets received LED lighting for a total cost of 2 million MDL.
Orhei	In Orhei, the entire street lighting network was renovated. This included the installation of 1,300 LED luminaires.
Chisinau	To improve street lighting and lighting of public spaces in Chisinau, Moldova's capital, the European Bank for Reconstruction and

	Development (EBRD) and other donors are supporting a project that has the objective to replace high-pressure mercury vapor lamps by LEDs. Public spaces in Chisinau are currently lit by a network of approximately 34,000 luminaires of which only one third are actually functional. EBRD and the EBRD-administered Green Energy Special Fund (funded by the Taiwanese International Cooperation and Development Fund) are supporting the investment with a grant of € 11.7 million. In addition, the European Investment Bank is supporting the project with €10.3 million. LEDs are expected to reduce energy consumption for lighting by nearly 60% which will result in annual savings of €106,280.
Climautii de Jos	In Climautii de Jos, in the district of Soldanesti, the EU supported the implementation of 7 km of LED based street lighting. The cost of the project was € 108,120.

In public buildings, LED-based lighting is infrequently used. LEDs are sometimes used when conventional bulbs have to be replaced. The term “public buildings” includes four categories of buildings: (1) buildings in the education sector, (2) buildings in the medical sector (public hospitals, medical institutions, polyclinics), (3) buildings in the administration sector (mayoralties, district councils), and (4) buildings in the social sector (asylums, orphanages) (GIZ, 2014).

In residential buildings, the use of LED bulbs is not yet common due to a lack of awareness of the energy savings potential of such bulbs and, more importantly, due to the high up-front costs of LED bulbs compared to incandescent light bulbs.

The economic crisis which Moldova is facing has a negative impact on the use of lighting. To reduce electricity costs, daily operating hours of street lighting and public building lighting are reduced which has a negative impact on safety during night times. In all lighting sectors, low-quality light bulbs are prevalent which reduces the quality of lighting and hence the comfort in public spaces, offices, schools and homes. To improve this situation, the NAMA on Promoting Energy Efficient Lighting will implement a set of measures and incentives that promote the conversion of all non-LED lighting systems to LED-based systems in the street lighting, public buildings and residential buildings sectors by 2030. With regard to the choice of energy efficient light bulbs to be used within the framework of this NAMA, the technical features of LEDs and CFLs were compared. Ultimately, the promotion of LEDs was favoured over CFLs based on the following considerations:

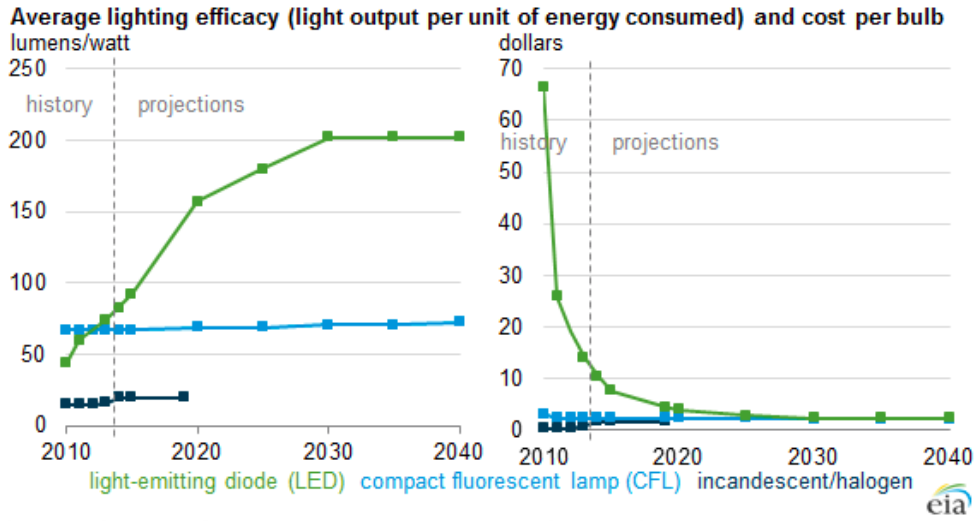
- Longer lifetime: LED bulbs last up to 10 times as long as CFLs (25,000-50,000 versus 8,000-10,000 hours);

- Cost-efficiency: Even though LEDs are more expensive, they are more cost-efficient than CFLs because they use less power (watts) per unit of light generated (lumens) and have a longer life-span;
- Mercury free: In contrast to CFLs, no mercury is used in the manufacturing of LEDs. If CFLs break or if they are improperly disposed at the end of their useful lives, mercury can be released (which is harmful for health and the environment.
- Other technical features: LEDs have a lower risk of breakage and are less sensitive to low temperatures and humidity than CFLs. In comparison to CFLs, the lifetime of LEDs is not shortened by usage patterns, i.e. on/off cycling effects.
- Lower CO_2 emissions: Since LEDs consume less energy, their use generates less CO2 emissions than the use of CFLs.

As LED lighting projects for the street lighting and public buildings sectors are designed to last for up to 20 years, all aspects of initial costs, ongoing expenses, and long-term savings were taken into consideration when selecting LED technology as the preferred technology for dissemination under the NAMA framework. In addition to the above mentioned facts, price development of LEDs and market trends where considered. Figure 1 shows the large price drop of LEDs over the last six years from almost USD 70 to about USD 8 and projections indicate that LEDs will reach the price level of CFLs by 2025. Moreover, the lighting industry and large retailers are starting to shift their efforts towards LEDs. General Electric, for example, announced at the beginning of 2016 that it will stop selling CFLs in the United States by the end of the year (The New York Times, 2016).[1]

Figure 1 Average lighting efficacy (light output per unit of energy consumed) and cost per bulb

[1] http://www.nytimes.com/2016/02/02/business/energy-environment/ge-to-phase-out-cfl-light-bulbs.html?_r=1



Source: Annual Energy Outlook (2014)[2]

[2] http://www.eia.gov/todayinenergy/index.cfm?tg=AEO2014%20(Annual%20Energy%20Outlook%202014)

2 The energy sector of the Republic of Moldova

2.1 Developments and trends in the energy sector

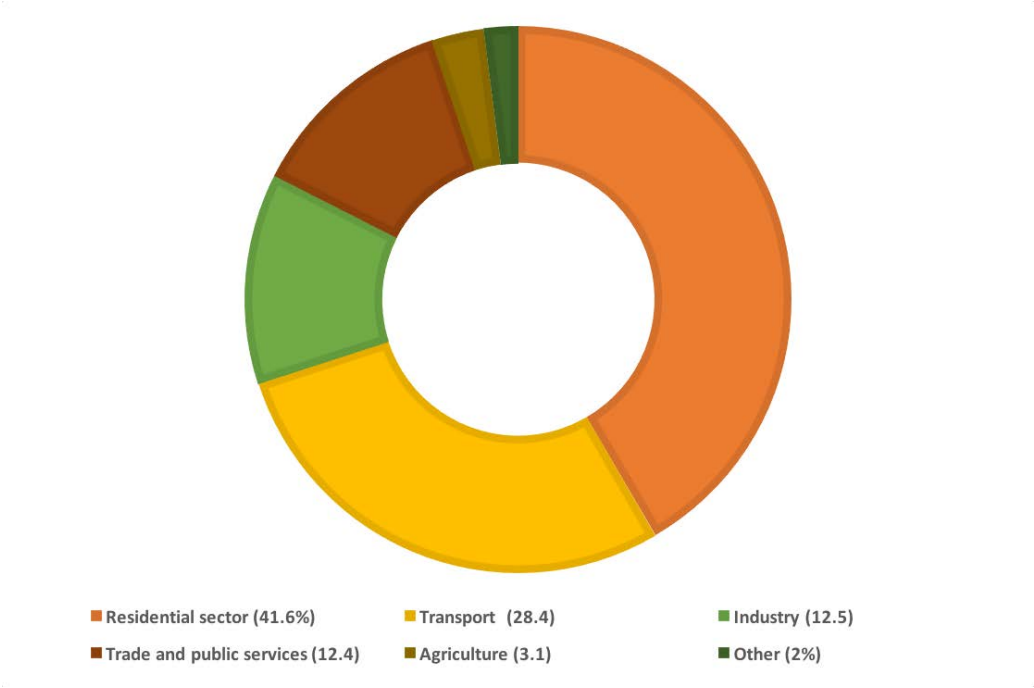
The Republic of Moldova is located in Southeast Europe, bordering Romania and Ukraine. The country is divided into 32 districts or raions, 5 municipalities (Chisinau, Balti, Comrat, Bender and Tiraspol) and 2 territorial units (Autonomous Territorial Unit Gagauzia and Transnistria). Moldova has a population of 3.55 million, of which about 58% live in rural areas (Statistica Moldovei, 2016). In 2015, the average monthly income per capita was 2350 lei (117 €) in urban areas and 1658 lei (82 €) in rural areas (Statistica Moldovei, 2016). According to the World Bank, the country is classified as a lower-middle income country where about 11% of the population lived below the national poverty line in 2015. However, in recent years, the Government has succeeded in significantly reducing the poverty rate which was about 30% in 2006[3].

Moldova is highly dependent on energy imports from Russia, Ukraine and Romania and imported about 87% (2,084 ktoe) of the total energy supply in 2013. About 44.7% of the imports were natural gas, 34.1% were petroleum products, 13.7% electricity and 7.5% coal. The residential sector was the largest consumer of energy, followed by the transport sector, industry, trade and public services, agriculture and other sectors (Figure 2).

The energy intensity in Moldova is still high compared to other European countries due to low efficiency of energy transformation (Energy Charter Secretariat, 2015). Different factors contribute to this low efficiency, including aging technology, equipment and networks as well as systems running at much lower than designed loads.

Figure 2 Energy consumption by sectors

[3] http://data.worldbank.org/country/moldova#cp_wdi

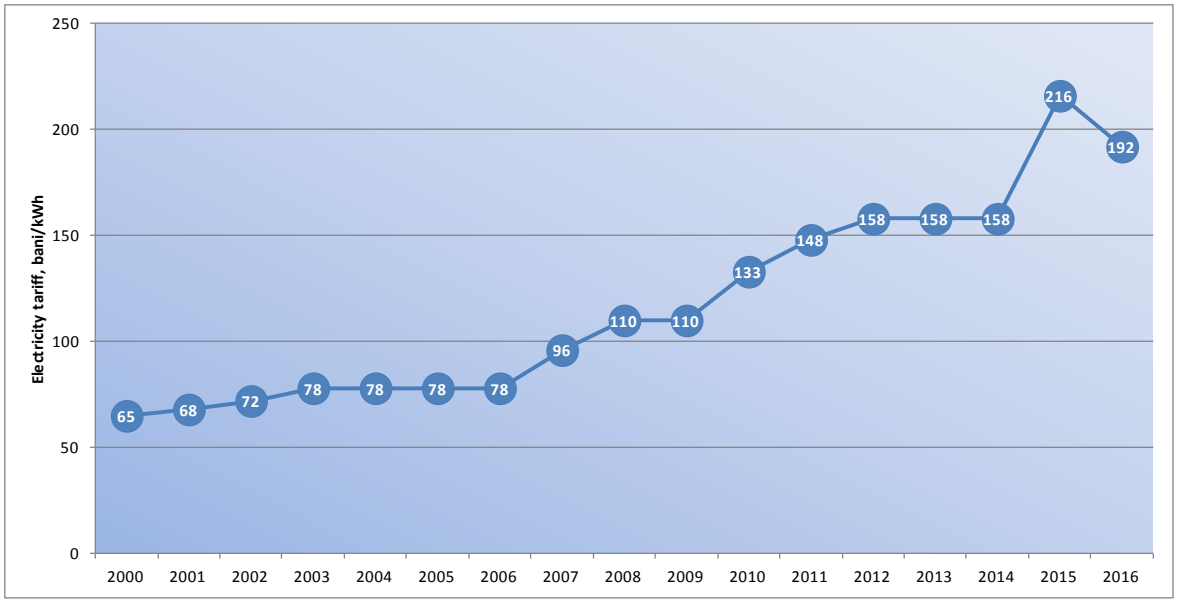


Source: National Bureau of Statistics of Moldova (2014)[4]

Over the last decade, prices for energy increased sharply resulting in a heavy burden for households, the public sector and industry. Electricity prices, for example, almost tripled over the last 10 years from 0.78 MDL/kWh in 2006 to 1.92 MDL/kWh in 2016 (Figure 3). Despite this price increase, the share of electricity consumed for lighting increased (Table 2). This development is mainly driven by an increase of electricity consumption for lighting in the residential sector due to the construction of new houses and apartment blocks.

Figure 3 Development of electricity tariffs between 2000-2016

[4] http://www.statistica.md/public/files/publicatii_electronice/balanta_energetica/BE_2014_rom.pdf



Source: Decisions of ANRE (Agency for National Regulation in Energy) no.43 from 11.09.2001, no.101 from 24.06.2003, no.254 from 31.07.2007, no. 277 from 18.01.2008, no. 300 from 30.07.2008, no. 365 from 14.01.2010, no. 470 from 11.05.2012, no.153 from 18.07.2015 and no.75 from 12.03.2016

Table 2 Electricity consumption (in GWh) by lighting sector

Year	2010	2011	2012	2013	2014	5-year average
Total electricity consumption for lighting, GWh	754	768	781	808	808	284
Street lighting	290	290	290	290	290	290
Residential buildings	227	232.	236	242	249	237
Public buildings	237	246	255	276	269	257

Source: National Bureau of Statistics (2015)[5]

The price increases and the dependency on energy imports have been among the key drivers in the formulation of energy efficiency policies and for the implementation of energy efficiency programmes and projects. Moreover, national energy and energy efficiency policy development is shaped by Moldova's relationship with the EU which has been characterized

[5] http://www.statistica.md/pageview.php?l=ro&idc=263&id=2197,

by gradual economic integration and political cooperation. The country is a member of the Energy Community since 2010 and signed an Association Agreement with the EU in 2014. Following this agreement, the Republic of Moldova has to make its legislation conform to the EU *acquis communautaire* until December 2017, i.e., core EU energy legislation related to electricity, oil, gas, environment, competition, renewables, efficiency and statistics. Moldova also plans to fully synchronise its electricity network to the European Network of Transmission System Operators for Electricity (ENTSO-E) by 2020 in order to connect to the European electricity market (Energy Charter Secretariat, 2015).

The Moldovan Government has achieved major progress in development of energy efficiency policies but the progress in their implementation is still moderate. Most of the Government interventions that were implemented so far target energy efficiency measures in buildings. Due to a limited budget, funding concentrates on improving heat supply and only a small fraction of the available budget is spent on implementing energy efficient lighting projects. Projects targeting lighting are mainly donor funded projects such as the street lighting projects presented in chapter 1. Over the last ten years, funding from the state budget for the energy sector varied between 0.1 and 0.9% of the GDP, which was equivalent to an annual contribution between 4.7 and 24 million € per year (Energy Charter Secretariat, 2015).

To promote the implementation and meet the objectives of energy efficiency policies, necessary secondary legislation and regulations need to be adopted. Moreover, enforcement mechanisms need to be put in place and incentives need to be provided to attract investments in energy efficiency (Energy Charter Secretariat, 2015).

2.2 Institutional framework with relevant stakeholders

Stakeholders in the development and implementation of the energy efficiency policies and programmes include the Ministry of Economy, the Ministry of Regional Development and Construction, the Ministry of Environment, the Ministry of Transportation and Roads Infrastructure, the Academy of Sciences, LPAs, the Consumer Protection Agency and the State Energy Inspectorate as discussed below.

Ministry of Economy. The Ministry of Economy is the central public authority that defines policy objectives and the strategic direction of activities in the area of energy efficiency. The Ministry is in charge of the Energy Efficiency Agency, the State Energy Inspectorate, the Consumer Protection Agency and a number of other administrative authorities. It is also the

founder of a number of public institutions, including the Moldovan Energy Projects Implementation Unit and the SMEs Development Organisation.

Energy Security and Energy Efficiency Department of the Ministry of Economy. The Department develops the legal and regulatory framework for energy efficiency and promotes energy efficiency projects and programmes. The Energy Efficiency Unit is one of three units that comprise the Department.

Energy Efficiency Agency (EEA). The EEA was created in 2010 and is subordinate to the Ministry of Economy. It is the administrative body in the area of energy efficiency and renewable energy and implements relevant state policy. Moreover, EEA oversees and monitors national and local energy efficiency programmes and action plans as well as international energy development programmes joined by Moldova.

Energy Efficiency Fund (EEF). The EEF was established in 2012 as an independent government body that has the objective to identify and manage financial resources for the implementation of energy efficiency measures that are outlined in energy efficiency programmes and strategies. The Fund is administered by the Management Board which has nine members: one representative each from the Ministry of Economy, the Ministry of Finance, the Ministry of Environment, the Ministry of Regional Development and Construction as well as five representatives from the private sector and international donors. The Management Board also approves the annual contribution of the state budget to the Fund which is proposed by the Ministry of Finance.

Consumer Protection Agency. The Consumer Protection Agency is an administrative authority responsible for consumer protection policy and state control over the enforcement of legislation in this area. Moreover, the Agency monitors the compliance of products and services offered on national markets with respective quality requirements, norms or standards.

Ministry of Regional Development and Constructions. The Ministry develops, promotes and implements state policy on regional development, land use planning, architecture, design and construction. With regard to energy efficiency, it develops the legal and regulatory framework necessary to achieve the objectives for its fields of activity, which includes, for example, the alignment of national building standards with EU standards.

Ministry of Environment. The Ministry of Environment is the state authority responsible for the development and promotion of state policies and strategies in the areas of environmental protection, rational use of resources and climate change.

Climate Change Office (CCO). The CCO of the Ministry of Environment provides logistical support to the Government, central and local public administration authorities, non-government and academic organizations, in activities implemented and promoted by the Republic of Moldova under the UNFCCC and the Kyoto Protocol. Moreover, the CCO implements climate change related projects and activities, including the elaboration of national GHG inventories, development and implementation of GHG mitigation projects, and the implementation of activities that aim at raising awareness on climate change related topics.

Local public authorities (LPAs). LPAs are responsible for the promotion and implementation of state policy in the field of energy efficiency at the local level. According to the national Law on Energy Efficiency, LAPs have to appoint an energy manager who develops and monitors the implementation of Local Energy Efficiency Programmes (LEEPs) and Local Energy Efficiency Action Plans (LEEAPs).

2.3 Objectives of the NAMA

The objective of the NAMA on Promoting Energy Efficient Lighting in the Republic of Moldova is to convert all non-LED lighting systems to LED-based systems in the street lighting, public buildings and residential buildings sectors by 2030 to significantly reduce private and public expenditure on lighting, to contribute to national energy efficiency targets and to commitments to reduce national GHG emissions. Moreover, investments in energy efficient lighting will promote national sustainable development by increasing safety and comfort on streets and in buildings, by creating new jobs in the field of energy efficiency, by reducing public and private spending on electricity bills and by reducing health risks from mercury pollution. By building on past and ongoing Government efforts in the area of energy efficient lighting, the NAMA will support the set-up of an enabling framework for promoting the transition to energy efficient lighting in all lighting sectors. Preliminary estimates indicate that the conversion to energy efficient lighting will reduce annual electricity consumption by 502,680 MWh, resulting in a reduction of GHG emissions of 327,314 tCO_2. Moreover, based on the estimated annual reduction of electricity consumption from the implementation of LED lighting systems, municipalities could save up € 25,169,670 annually on street lighting and € 19,344,318 on lighting in the public buildings sector, while savings of residential consumers would amount to € 20,446,902.

Activities and measures that will be implemented under the NAMA framework have the objective to scale up past and existing activities and resources to promote energy efficient lighting in Moldova and to remove barriers for the implementation of a national energy efficient

lighting programme. The NAMA framework has four components, each of which consists of a set of activities and measures:

- **Policy and Regulatory Framework Development and Monitoring, Verification and Enforcement (MVE)**: Under the Policy and Regulatory Framework Development component, all elements needed for a comprehensive phase-out strategy for inefficient light bulbs will be designed and implemented. An MVE scheme will be implemented to ensure that existing laws on product labeling and minimum energy-efficiency standards for light bulbs are properly enforced. Moreover, the development of a scheme for collection, disposal, and waste-handling of hazardous lighting products, with a focus on mercury-added lamps, will be supported.
- **Awareness Raising and Capacity Building Programme:** Awareness raising campaigns will target different stakeholder groups to increase the acceptance of energy efficient lighting products and to promote their purchase on local and national markets. The core element of capacity building will be a set of training courses which cover different aspects of efficient lighting, based on the needs of a range of stakeholders, including government officials, trainers, energy managers and auditors, and MVE staff.
- **Technical Support Programme:** The principal activity of the technical support programme will be the design and implementation of LED lighting projects throughout the country.
- **Finance mechanism:** A finance mechanism will be established from national and international sources to secure long-term funding for efficient lighting projects. National funding for NAMA activities will come from the EEF and from the public budget of central and local governments while international support is requested in form of grants and a zero interest loan.

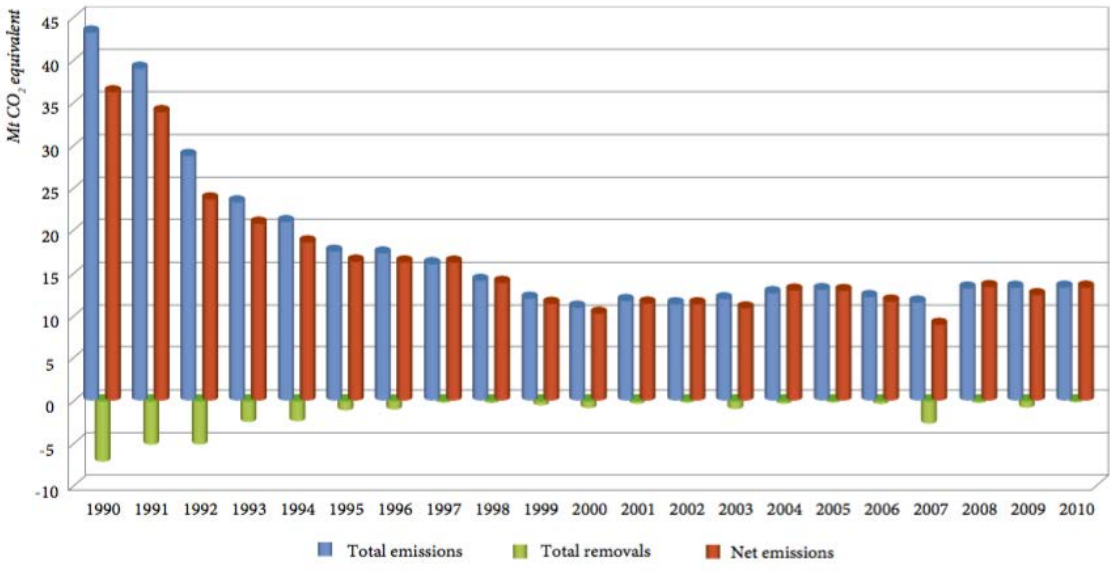
To reach its target, the NAMA will use a phased approach consisting of three phases to extend the national policy and regulatory framework on energy efficient lighting and to gradually enhance national capacities to finance and scale up lighting projects in the country:

3 Analysis of policies and barriers

3.1 Relevant national and sector strategies and policies

The Republic of Moldova contributes about 0.03% of the global GHG emissions. In 2013, the country's total GHG emissions were 12.8 Mt CO_2e and the per capita GHG emissions were less than half of the world's average. About 65.5% of the national GHG emissions originated from the energy sector, followed by the agricultural sector (16.6%), waste sector (12.2%) and industrial processes sector (5.2%). Between 1990 and 2010, national GHG emissions decreased by almost 70% (Figure 4), while GHG emissions from the energy sector decreased by almost 25% from 34.52 Mt CO_2e to 8.95 Mt CO_2e during the same period (MoEN, 2013).

Figure 4 National GHG emissions and removals between 1990 and 2010



Source: MoEN (2013)

The sharp decline of GHG emissions after 1990 is mainly a result of the economic crisis following the break up of the Soviet Union and the transition to a market economy. The transition also led to changes in the fuel mix by substituting fossil fuels with natural gas.

In 2010, the Republic of Moldova joined the Copenhagen Accord and submitted an emission reduction target to the UNFCCC Secretariat, which states that "*a reduction of no less than*

25% of the 1990 level total national GHG emissions has to be achieved by 2020 through implementation of global economic mechanisms focused on climate change mitigation, in accordance with the Convention's principles and provisions (MoEN, 2010)." The target was submitted without defining specific NAMA programmes or projects and needs for support. However, it was mentioned that significant financial, technological and capacity building support would be needed to reach the national GHG mitigation target.

A GHG emission reduction target for the energy sector is also included in several national strategies and programmes. The National Development Strategy "Moldova 2020" identifies the improvement of energy security and energy efficiency as one of seven key areas for interventions to promote sustainable economic growth and reduce poverty in the Republic of Moldova. Similar to the Copenhagen Accord target, the Strategy establishes a target to reduce GHG emissions by 25% compared to the 1990 level by 2020. Along with the GHG emission reduction target, several energy efficiency targets are defined as well, including:

- reducing the energy intensity by 10% by 2020;
- reducing energy consumption of buildings by 20% by 2020;
- insuring the renovation of 10% of public buildings by 2020 (Government of Moldova, 2012).

To increase energy efficiency, the National Development Strategy aims at reducing energy intensity in the residential, industrial, transport and agricultural sectors by implementing energy efficient technologies, among other measures. Another focus is on raising public awareness regarding the need to save energy, for example by using energy efficient construction materials, appliances and technologies. To achieve the objectives, a favourable environment for investments in the energy sector needs to be created by creating and strengthening mechanisms to attract funding for energy projects.

The GHG emission reduction target as well as the energy efficiency targets are also included in the Energy Strategy of the Republic of Moldova until 2030, the document that provides guidelines for national energy sector development. The Energy Strategy defines general policy goals for 2013 to 2030 as well as specific policy objectives for the periods from 2013 to 2020 and from 2021 to 2030.

In September 2015, the Republic of Moldova submitted its Intended Nationally Determined Contribution (INDC) to the UNFCCC which states that the country *"intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 per cent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 per cent*" (Government of Moldova, 2015). Moreover, the emissions reduction target could be

increased to 78 below 1990 levels, "*conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change"*.

By mid-2016, the Government will prepare a draft LEDS for 2030. After consultations at the national level, the LEDS will be subject to approval by the Government by end of 2016. As in the draft LEDS for 2020, NAMAs are expected to be an important element of the new LEDS, which has not been finalized as of the writing of this NAMA report.

3.2 Alignment of the NAMA with national and sector strategies and policies

The Moldovan government has implemented important elements of a policy and legal framework to promote energy efficient lighting on which the NAMA will build (Figure 5).

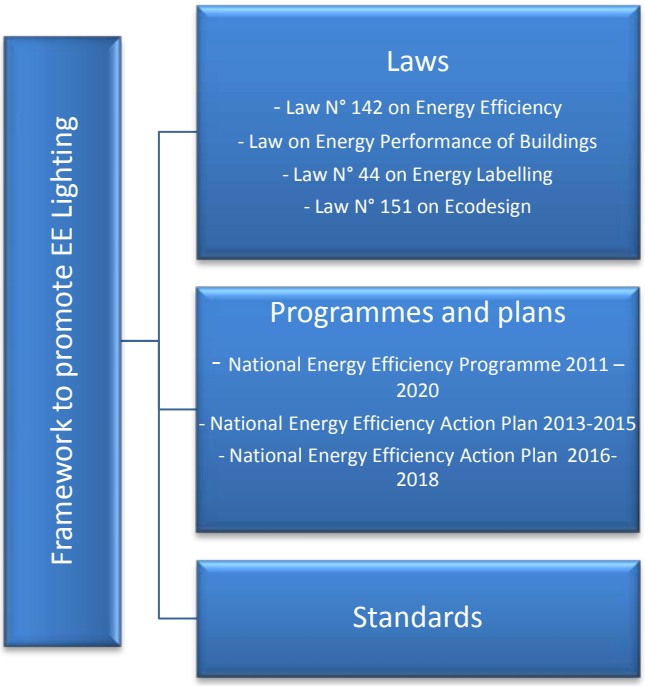
Laws targeting energy efficient lighting

- Law N° 142 on Energy Efficiency (adopted on July 2, 2010) states that administrators of publicly owned buildings are obliged to take measures in order to ensure efficient use of lighting[6]. The overall objective of the Law is to provide regulation of activities aimed at reducing the energy intensity of the national economy and the negative impact of the energy sector on the environment. According to the Law, National Energy Efficiency Programmes (NEEP) shall be elaborated every 10 years to outline the strategic direction for energy efficiency improvements, while National Energy Efficiency Action Plans (NEEAP) provide information on concrete energy efficiency measures for three-year periods.
- The Law on Energy Performance of Buildings (adopted on January 1, 2015) includes provisions on ventilation, cooling and lighting that will come into force in 2017[7].

Figure 5 Policy and legislative framework to promote energy efficient lighting in Moldova

[6] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=335818

[7] http://lex.justice.md/viewdoc.php?action=view&view=doc&id=354929&lang=1



Source: own elaboration

Following its Energy Community commitments, Moldova adopted laws to transpose the EU's Ecodesign and Energy Labelling Directives:

- Law N° 44 on labelling energy-related goods impacting energy consumption (adopted on March 27, 2014) transposes the EU's Energy Labelling Directive 2010/30/EU[8]. The Directive creates labelling requirements for individual product groups, including luminaires. The labels inform consumers on the energy efficiency performance of a product[9].
- Law N° 151 on ecodesign requirements applicable to energy-related products (adopted on July 17, 2014) transposes the EU's Ecodesign Directive 2009/125/EC[10]. Ecodesign regulations require manufacturers to decrease the energy consumption of their products by establishing minimum energy efficiency standards. By setting these standards at European level, manufacturers do not have to navigate through multiple national regulations when launching their products on the market. The ecodesign requirements for individual product groups are created under the EU's Ecodesign

[8] http://lex.justice.md/viewdoc.php?action=view&view=doc&id=352631&lang=1

[9] http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

[10] http://lex.justice.md/viewdoc.php?action=view&view=doc&id=355009&lang=1

Directive, a process managed by the European Commission.[11]

Moreover, a number of corresponding regulations were adopted which includes a regulation on labelling of electrical lamps and luminaires. The laws and regulations have come into force and NEEAP 2016-2018 stipulates a number of measures that should be implemented to ensure compliance with the regulations. Regarding compliance with the Ecodesign and Energy Labelling Directives, the adopted measures include:

- "[…] checking the economic operators in terms of their compliance with the requirements set for labelling the energy-related products. The shops and/or distribution points will be visited, at least, once a month to check the availability of labels and energy-related information;
- testing the energy-related products in an accredited European laboratory. Upon importing such products from another country, it is recommended to consider and accept the test results of energy-related products in the country of origin;
- identifying the possibilities to introduce tax incentives and customs facilities for energy-related products with high energy efficiency (Classes A to A+++). Increasing the import duties on energy-intensive products;
- setting energy performance requirements for the plants and appliances manufactured in and/or imported to the Republic of Moldova;
- increasing the import duties on incandescent light bulbs by 20% annually and applying zero-rate tax on energy-efficient light bulbs.

With regard to street lighting and NEEAP 2016-2018 implementation, the following measures were planned:

- "[…] developing proposals aimed at restricting the use of incandescent light bulbs in the public sector; […]
- replace the existing light fittings with more efficient ones […]".

National programmes and plans

- The National Energy Efficiency Programme 2011–2020 defines energy efficiency indicators and benchmarks, including for lighting appliances, and aligns them with definitions of the European Union[12].
- The NEEAP 2016-2018 includes a list of measures to improve energy efficiency in

[11] http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

[12] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=340940

different sectors[13]. Implementation of efficient lighting activities are planned for the industrial and public sectors. According to the Plan, the industrial sector should be equipped with more efficient, high-quality lighting that matches the requirements of technological processes. The optimisation of street public lighting systems is among the measures planned for the public sector to reduce power consumption in municipalities throughout the country. The target groups of this measure are LPAs who should promote: the development of projects that restrict the use of incandescent light bulbs, energy audits of existing lighting systems, replacement of incandescent bulbs by more efficient bulbs and monitoring of energy consumption of newly installed lighting systems. The optimisation of public street lighting is estimated to result in energy savings of 0.98 ktoe by 2020. Moreover, the Plan promotes several cross-sectoral measures including the development of energy service companies (ESCOs). Among their activities would be the support of LPAs to reduce energy losses in lighting systems.

Standards

- The National Institute of Standardization (INS) has released several standards for lighting which are presented in Box 1.

[13] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=346722

1. CP D.02.11 – 2014 - Recommendations for roads and street design for urban and rural areas
2. SM SR EN 40-1:2013 – Poles for street lighting. Terms and definitions
3. SM SR EN 40-2:2013 – Poles for street lighting. Part 2. General requirements and dimensions
4. SM SR EN 40-5:2010 – Poles for street lighting. Part 5. Requirements for steel poles
5. SM SR EN 40-6:2010 – Poles for street lighting. Part 6. Requirements for aluminum poles
6. SM SR EN 40-7:2010 – Poles for street lighting. Part 7. Requirements fiber reinforced poles
7. SM SR EN 60598-2-6+A1:2010 – Luminaries. Part 2. Special conditions. Section 6. Luminaries with integrated converter for incandescent lamps.
8. SM SR EN 61347-2-11:2010 – Equipment for lamps. Part 2-11: Particular prescriptions for different electronic circuits used together with luminaries.
9. SM SR EN 60432-1:2010 – Incandescent lamps. Security prescriptions. Part 1: Tungsten filament lamps for domestic and similar general lighting.
10. SM SR EN 60432-2:2010 - Incandescent lamps. Safety requirements. Part 2: Tungsten halogen filament lamps for domestic and similar general lighting
11. SM SR EN 13201-2:2011 – Public lighting. Part 2: Performance requirements
12. SM SR EN 13201-3:2011 - Public lighting. Part 3: Calculation of performance
13. SM SR EN 13201-4:2011 - Public lighting. Part 4: Methods of measuring the photometric performance
14. SM SR EN 15193:2011 - Energy performance of buildings. Energy requirements for lighting
15. SM SR EN 62031:2012 - LED modules for general lighting. Safety requirements
16. SM SR EN 60598-2-14:2013 - Lighting. Part 2-14: Particular requirements. Lighting

Box 1 Overview of relevant lighting standards

Source: National Institute for Standardization[14]

[14] http://www.estandard.md

3.3 Barriers to the implementation of the NAMA

3.3.1 Economic and financial barriers

In times of economic crisis in the Republic of Moldova, municipalities, home owners and households lack financial resources for investments in energy efficient lighting. Hence, higher initial costs for efficient lighting products compared to conventional products are an important barrier to investments in all lighting sectors (Table 3). Customers have to focus on covering short-term needs and are not able to take potential long-term savings from energy savings and longer-lasting products into account when making investment decisions. They struggle to pay their electricity bills for lighting, and refurbishment of lighting systems is done in a piecemeal fashion, replacing conventional with more efficient lighting when repairs become necessary. As a result, lighting infrastructure for street lighting and buildings often do not adhere to current standards.

Table 3 Average lamp prices of selected lamp types

	IL	FL		CFL	HPM			HPS			LED		
Power (in W)	40-100	18	36	20	125	250	400	125	250	400	4	10	12
Price (in €)	0.3	0.65	0.7	2	1.7	2.3	2.9	4	4.5	5	4.5	11	13

Source: http://lampa.md (2016)[15]

In the public sector, fiscal instruments, like a tax to help cover costs for street lighting, are lacking and therefore there is no steady flow of revenues for the refurbishment and maintenance of lighting systems and for investments in modern, energy efficient lighting infrastructure. With regard to street lighting, LPAs are in charge of its provision and maintenance work within the territory under their administration. This set-up is based on Article 3 of the Law on Local Public Administration N° 436-XVI (adopted on December 22, 2006), which gives LPAs autonomy in organizational and financial management. It includes the right to implement local tax schemes. However, according to a Government Decree from 2002, LPAs have to cover the costs of street lighting from their own budgets and cannot charge end

[15] http://shop.lampa.md/catalog/svetodiodnye-lampy-led

users for providing these services. Revenues generated by a road tax and a tax for territory planning cover part of the expenses of street lighting but also have to be used for road maintenance and related infrastructure investments. Moreover, the Law on Energy N° 1525-XIII (adopted on February 19, 1998) states that investments in local energy efficiency measures and infrastructure have to be covered from LPAs' budgets.

Another mayor barrier to investments in efficient lighting projects in the street lighting and public buildings sector is very limited access to financial services. Currently, the situation is intensified by a corruption scandal in the banking sector which affects banks' liquidity and investors' opportunities to obtain loans. Conventional loans are offered at an interest rate of around 19.5%, along with restrictive requirements for collateral, which does not match the needs of energy efficiency projects with high initial investment costs and long pay-back periods. Under current circumstances in which project developers have to compete for the few available loans, energy efficiency projects are hardly competitive. Moreover, many banks have no experience with energy efficiency project assessments and many projects are small in scale which makes their transaction costs highly prohibitive.

An ESCO market is in very early stages of development in Moldova. A few energy service providers are active in the energy efficiency market but they only take over the development of technical proposals. They do not finance project implementation because their financial capacity is limited due to a lack of project financing offered by the local banking industry. Energy service providers have been therefore unable to shift their current business model towards an ESCO business model thus far.

3.3.2 Awareness and capacity barriers

A lack of awareness of the benefits of efficient lighting – in combination with high price sensitivity of customers - is an important barrier to large-scale implementation of efficient lighting technologies in Moldova and equally affects all sectors. Promotion for LED products and easily accessible, reliable information on initial investment costs, energy savings potential and profitability of investments are generally not available.

At the government level, not all decision makers are aware of the energy and cost savings potential of efficient lighting. Moreover, energy efficient lighting projects have to compete with other projects for scarce financial and human resources, and quite often preference is given to more urgent or higher priority investments in health, education or infrastructure projects. In the field of energy efficiency, measures related to heating seem to be given higher priority than efficient lighting projects. Little financial and private sector activity despite rapidly increasing

electricity tariffs is also a sign of a lack of awareness of possible investment returns from energy efficiency projects and not only an indicator of a lack of financial resources.

In a relatively short time, the Government of Moldova has set up a comprehensive policy framework to promote energy efficiency in the country. Building up human capacity to fully implement government programmes and plans will be a longer process. The number of available professionals, who are trained to identify investment opportunities in this field to prepare bankable project proposals and to promote and monitor their implementation, is still small compared to the number of professionals required for the scaling up of energy efficiency activities. Additional training opportunities are needed to increase the number of energy efficiency professionals and to enhance the skills on energy efficient lighting of different stakeholder groups.

Technical skills to design and evaluate energy efficiency projects are reasonably well developed but they are concentrated in a few companies and institutions and are less available in rural areas. A lack of knowledge of energy managers on energy efficiency has an impact on the number and eligibility of project proposals presented to the Energy Efficiency Fund and other funding sources by LPAs.

3.3.3 Regulatory, technical and market barriers

Moldova made significant progress regarding the development of a regulatory framework to promote efficient lighting. Notably, the framework Law on the Labelling of Energy-Related Products in Moldova came into force in October 2014 and a number of energy labeling regulations were adopted to support the process. Nevertheless, Moldova remains only partially compliant with the Labelling Directive 2010/30/EU, as long as the remaining labelling regulations adopted by the Ministerial Council are not in force.[16] The adoption of these and other regulations are important steps for a transformation of the lighting sector and they need to be integrated into a coherent regulatory framework to ensure their full implementation and monitoring.

The Moldovan market for efficient lighting and related services is in early stages of development which hampers the large-scale implementation of LEDs. Due to the low demand, the availability of low-cost, high-quality products and services is still small. The market currently consists of a few specialized importers and retailers, project developers, engineering

16 https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Moldova/Energy_Efficiency

companies and one small manufacturer who assembles LEDs from imported parts. The largest share of LEDs is imported from China, while the rest is coming from different EU countries and Russia. There is no testing laboratory which is equipped to carry out performance testing of efficient lighting products and very few drop-off points for used light bulbs have been set-up.

It should be mentioned that service companies in Moldova that specialise in the design and implementation of lighting systems are well developed. Most of them are private companies. However, current capacities are likely not enough for scaling up energy efficient lighting at the country level. Some additional training of existing staff may be necessary to build up national capacities as well as the formation of new engineers and technicians.

Moreover, the large-scale implementation of efficient lighting projects is constrained by several technical barriers. Inferior quality lighting products still dominate on the Moldovan market and are commonly used in all lighting sectors. Underperforming and improperly labelled efficient lighting products create a negative image for these technologies and impede the development of the energy efficient lighting market. Moreover, inconsistent installation and maintenance practices across municipalities make project planning and budgeting difficult.

3.3.4 Institutional barriers

As noted in Chapter 1, a few efficient lighting projects are currently being planned or implemented in the street lighting sector in the Republic of Moldova. However, most of them are small in scale and some lack integrated planning. The scaling up of efficient lighting activities under the NAMA framework will require good coordination and cooperation among ministries, local governments and donors.

A lack of commercial orientation of municipalities and public agencies as well as strict budgeting and procurement procedures complicates the implementation of efficient lighting projects in the public sector. Public procurement decisions right now are centred on assets rather than energy services and focus mainly on the best price without taking into account the lifecycle costs of new equipment.

The EEA is responsible for the implementation of the state policy on efficiency and renewable energy and for taking measures for the national targets to be achieved, however its human and financial capacities have to be increased to enable the Agency to address all challenges of implementing energy efficiency and renewable energy policies and regulations within the country. Also it was noted that there is limited institutional capacity of LPAs and in some cases

an unclear mandate for the LPA regional energy managers to be appointed, which results in limited identification and implementation of the energy efficiency measures at the local and regional level.

4 Baseline information and NAMA targets

4.1 Baseline boundary and scenario

During the Preparation Phase, NAMA Phase I, a “pilot city” for lighting retrofit projects will be established with a focus on implementing projects in the street lighting and public buildings sectors. Moreover, awareness raising campaigns, capacity building activities and finance schemes will be developed and their effectiveness will be tested. A competitive selection process will be launched to identify additional villages, cities and/or districts for the scale up of LED-based lighting projects in NAMA Phase II, and this process will be repeated during NAMA Phases III to reach national coverage with LED lighting by 2030.

At this stage of the NAMA development process, it is proposed to start the implementation of lighting retrofit projects in NAMA Phase I in Soroca city, which has approximately 100,000 inhabitants and is located in the northeast of the country (Figure 5). Soroca is selected as a candidate for the “pilot city” approach based on the willingness and interest expressed by LPAs to participate in energy efficient lighting activities of the NAMA. For the preparation of the NAMA proposal, LPAs provided energy audit reports on lighting in public buildings which made it possible to prepare a detailed analysis of the technical and financial performance of LED lighting in this sector. Moreover, Soroca has initiated work to transform its street lighting sector by implementing LEDs, but at the moment, only a small percentage of the funding that will be needed for a full conversion is available. If Soroca received funding to complete the retrofitting process of the street lighting sector before the NAMA implementation process started, a district or city with similar characteristics as Soroca would be selected. This could be, for example, Cahul located in the South. Another reason for selecting Soroca as a “pilot city” is the aim to establish “pilot cities” for LED lighting in the Northern, Central and Southern regions to facilitate the scaling up of projects throughout the country. With Soroca, a pilot city will be established in the Northern region. Orhei, located in the Central region, is a promising pilot city candidate as well because it already has a LED-based street lighting system and could be used as a demonstration site, while a pilot city for the South would be established during NAMA Phase II.

Figure 6 Location of Soroca city

4.2 GHG impact of the NAMA

In this chapter, estimates of the GHG emission reductions of the NAMA presented. They are provided for Soroca project and the scenario of switching from non-LED lighting to LED-based lighting in the entire country. The estimates cover rural and urban street lighting as well as lighting in the public and residential building sectors.

No detailed data is available yet for calculating the GHG emission reductions at the country level. To obtain an estimate of the emission reductions, data from the Soroca, national statistics, energy audit reports and data provided by the EEA are used for the calculation. In addition, the CDM methodology AMS-II.L *Demand side activities for efficient outdoor and street lighting technologies* is used as guidance for the selection of technical parameters for the development of baseline and NAMA scenarios (UNFCCC, 2011).

Box 2 Calculation of GHG emission reduction potential of efficient street lighting technologies

GHG emission reductions are calculated based on net electricity savings times an emission factor.

$$ER_y = NES_y * EF_y$$

Where:

ER_y	Emission reduction in year *y* (tCO_2e)
EF_y	Emission factor in year *y* (tCO2/MWh)

Electricity savings through the installation of energy efficient lighting technologies are calculated as follows:

$$NES_y = \sum_{i=1}^{n} ES_{i,y} * \frac{1}{(1-TD_y)}$$

Where:

$$ES_{i,y} = (Q_{i,BL} * P_{i,BL} * O_{i,BL}) - (Q_{i,P} * P_{i,P,y} * O_{i,y})$$

Where:

NES_y	Net electricity saved in year *y* (kWh)
$ES_{i,y}$	Estimated annual electricity savings for equipment of type *i*, for the relevant type of project equipment in year *y* (kWh)
Y	*Year counter*
I	*Counter for luminaire type*
n	*Number of luminaires*
TD_y	Average annual technical grid losses (transmission and distribution)
$Q_{i,BL}$, $Q_{i,P}$	Quantity of baseline *(BL)* or NAMA *(P)* luminaires of type *i* installed. $Q_{i,BL}$ and $Q_{i,P}$ may represent a different number of luminaries, but they must represent the same illuminated area
$P_{i,BL}$	Rated power of the baseline luminaires of the group of *i* lighting devices (kW)
$P_{i,P,y}$	Rated power of the NAMA luminaires of the group of *i* lighting devices (kW)
$O_{i,BL}$, $O_{i,y}$	Annual operation hours for the baseline and NAMA luminaires

Source: Adapted from UNFCCC (2013)

Ex-ante estimates indicate that GHG emissions of rural and urban street lighting and lighting in public buildings and residential buildings will be reduced by 327,314 CO_2 annually by 2030 by switching from conventional to LED-based lighting systems

4.2.1 Direct GHG emission reduction potential of energy efficient street lighting

The CDM methodology AMS-II.L *Demand side activities for efficient outdoor and street lighting technologies* on street lighting estimates the direct GHG emission reduction potential of replacing conventional lamps or fixture combinations by energy efficient lamps by calculating the net electricity savings of the intervention. The methodology refers to lamps and fixture combinations as luminaires, which encompasses all of the components in an individual assembly of street lighting equipment, including lamp, lens and reflector, fixture housing, wiring, and driver or ballast and individual and centralized controls systems. An underlying assumption of this methodology is that replacement lamps have to have the same (or higher) lumen output as the baseline lamps.

GHG emission reductions at the country level

Available national data on street lighting covers rural and urban areas of the country, however, better data is available for urban streets. The total length of the urban illuminated streets which need LED lighting is 2,264 km (Table 4). Of these streets, approximately 10% of conventional street lamps have already been replaced by LEDs.

Table 4 Illuminated urban streets in the Republic of Moldova

Location	Number of inhabitants (in thousand)	Streets with illumination (in km)	Streets with illumination as percentage of total street length (in %)	
Chisinau municipality				
Chisinau	678.2	646.1		96.1
Codru	11.9	18.1		59
Cricova	8.7	11.9		38
Durlesti	20.1	12.3		16.5
Singera	8.5	96		61.5
Vadul lui Voda	5.2	46.6		100
Vatra	3.5	11.3		85
Total	**809.6**	**842.3**	**(Average)**	**65**
Northern Region				
Balti municipality	150.2	209.7		95
Briceni	9.9	36		100
Lipcani	5.4	29.8		100
Donduseni	10.5	29.1		79.5
Drochia	20.5	47.5		97.9

Cupcini	7.6	23.6		57.7
Edinet	18.4	37.6		43
Falesti	16.9	26.9		100
Floresti	15.5	19.1		22.1
Ghindesti	2.1	5.7		35
Marculesti	2.1	7.8		60.9
Glodeni	11.4	7.5		19.6
Frunza	1.4	5.1		100
Ocnita	9.4	17.6		58.7
Otaci	8.4	6		21.9
Costesti	2.5	8.9		100
Riscani	13.3	38		50.8
Biruinta	3.9	5		41.7
Singerei	14.8	53		88.3
Soroca	100	78.8		98.6
Total	**361.8**	**692.7**	**(Average)**	**68.5**
Central Region				
Anenii noi	11.4	4.3		15.6
Calarasi	16.5	22.7		33.6
Criuleni	8.5	24.3		100
Hincesti	17.3	16		25.8
Ialoveni	16.3	27.4		28.8
Nisporeni	14.4	42		78.4
Orhei	33.6	50.6		100
Rezina	12.8	19.8		58.6
Bicovat	1.4	4		37.7
Straseni	20.7	54.9		90.1
Soldanesti	7.5	15.7		76.2
Telenesti	8.2	28.8		95
Cornesti	2.8	5.4		19.6
Ungheni	38.4	105		80.8
Total	**209.8**	**420.9**	**(Average)**	**60**
Southern Region				
Basarabeasca	12.5	9		28.6
Cahul	39.6	106		88.4
Cantemir	5.8	7.2		94.7
Cainari	4.5	0		0
Causeni	19.9	35.2		61.9
Cimislia	14.4	33.2		56.5
Iargara	4.7	10.5		21.9
Leova	10.9	33.9		69.8

Stefan Voda	8.6	17.7		86.3
Taraclia	14.9	35.5		52.2
Tvardita	5.8	19.8		53.5
Total	**141.6**	**308**	**(Average)**	**61**
Total (all regions)	**1,522.8**	**2,263.9**		

Source: National Bureau of Statistics[17]

In addition to the cities and towns listed in Table 5, there are also 1,600 rural villages, each of which has approximately 3 km of streets that require the replacement of conventional lighting system. Hence, 4,800 km of rural streets will receive LED-based lighting systems through the NAMA by 2030.

Data from energy audits indicates that different high-pressure mercury (HPM) lamps are the most frequently installed lamp types on rural and urban streets. For the installation of LEDs, other components of the lighting system have to be replaced as well as, for example, cables and control systems. Technical parameters for the calculation of the GHG emission reduction potential of the NAMA are presented in Table 5.

Table 5 Technical parameters for the baseline and NAMA scenario for urban street lighting

Parameter	Baseline value	Value for NAMA scenario	Source
Average rated power of installed stock of lamps (in W)	250	102	Energy audit reports for street lighting submitted to EEF and energy audit reports performed for different international projects on energy efficiency implemented in Moldova
Operating hours per year	3,877	3,877	National standard
Average annual technical grid loss (transmission and distribution)	10%, default value provided by the CDM methodology	10%, default value provided by the CDM methodology	UNFCCC (2013)

[17]http://www.statistica.md/newsview.php?l=ro&id=4741&idc=168

Average lamp lifetime in hours	12,000	50,000	http://www.designrecycleinc.com
CO2 emission factor (tCO_2/MWh)	0.660	0.660	EBRD (2010)

If all non-LED urban street lighting systems were replaced by LED based systems, annual electricity savings would amount to approximately 60,750 MWh. In rural areas, annual electricity savings of 129,600 MWh can be achieved. This is equal to a reduction of electricity consumption of lighting of about 58%. Through these interventions, annual GHG emissions of street lighting will be reduced by 40,095 tCO_2 in urban areas and by 85,536 tCO_2 in rural areas, resulting in a total annual reduction of 125,631 tCO_2.

GHG emission reduction potential of Soroca city

Soroca city has 78.8 km of streets that will be retrofitted with LEDs which will result in annual energy savings of 2,128 MWh and GHG emission reductions of 1,560 tCO_2. The calculations are based on parameters presented in Table 6.

4.2.2 Direct GHG emission reduction potential of energy efficient lighting in public buildings

GHG emission reduction potential at the country level

The estimation of the GHG emission reduction potential of replacing non-LED lamps by LEDs in public buildings is more difficult compared to the street lighting sector due to a lack of data. The National Bureau of Statistics (NBS) does not provide detailed information on buildings such as the number of buildings per category, total floor area in m^2 or energy consumption. With regard to public buildings, national statistics provide only limited information on the number of education and health institutions, and on the number of users at the national and district levels (GIZ, 2014). Net electricity savings from the replacement of conventional light bulbs by LEDs in public buildings are therefore calculated based on estimates of the annual electricity consumption of lighting in public buildings and on national data from energy audits on lamp types and total average power of installed baseline lamps (Table 6). For the selection of LEDs it is considered that the total lumen output of a LED lamp should be equal to or more than that of the baseline lamp being replaced. The average annual electricity consumption of public building the period of 2010-2014 was 257 GWh.

Table 6 Technical parameters for the baseline and NAMA scenarios for the public building sector

Parameter	Baseline value	Value for NAMA scenario	Source
Type of luminaires and percentage of total amount of installed luminaires (%)	Fluorescent lamps (18 W): 70% Incandescent lamps (100 W): 30%	LED: 100%	Energy audit reports (Tirsu, 2013-2015)
Number of luminaires	Fluorescent lamps (18 W): 8,058,694 Incandescent lamps (100W): 621,671	LED (9W): 4,305,645	Own calculation
Operating hours per year	1,239	1,239	Energy audit reports (Tirsu, 2013-2015)
Average annual technical grid loss (transmission and distribution)	10%	10%	UNFCCC (2013)
Average lamp lifetime in hours	Fluorescent lamps: 7,500 Incandescent lamps: 1,200	LED: 50,000	http://www.designrecycleinc.com
CO2 emission factor (tCO_2/MWh)	0.660	0.660	EBRD (2010)

The replacement of all conventional light bulbs by LEDs in public buildings could generate electricity savings of 151.400 MWh per year which is equal to a reduction of electricity consumption of about 59%. This reduction will reduce annual GHG emissions of lighting in the public sector by 99,924 tCO_2.

GHG emission reduction potential of Soroca city

The city has 150 public buildings most of which are schools. The size of the buildings ranges from 30 to 8,500 m^2 with the average size being 850 m^2. Annual electricity consumption of lighting is 729 MWh. Of the total number of bulbs installed, 70% are fluorescent light bulbs, while 30% are incandescent bulbs. The replacement of non-LED bulbs with 8,309 LEDs will

result in annual electricity savings of 491 MWh which is equal to a reduction of 67%. Annual GHG emissions will be reduced by 324 tCO_2.

4.2.3 GHG emission reduction potential of energy efficient lighting in residential buildings

GHG emission reduction potential at the country level

For the calculation of the GHG emission reduction potential of the energy efficient lighting in residential buildings, a similar approach is taken as in the calculation for public buildings since the sector is constrained by a similar lack of data. Technical baseline and NAMA scenario parameters are presented in Table 7. Average annual electricity consumption (2010-2014) for lighting is 237 GWh.

Table 7 Technical parameters for the baseline and NAMA scenarios for the residential sector

Parameter	Baseline value	Value for NAMA scenario	Source
Type of luminaires and percentage of total amount of installed luminaires (%)	CFL lamps (20 W): 50% Incandescent lamps (100 W): 50%	LED: 100%	Energy audit reports (Tirsu, 2013-2015)
Number of luminaires	CFL lamps (20W): 3,188,306 Incandescent lamps (100W): 637,661	LED (9W): 1,877,558	Own calculation
Operating hours per year	1,860	1,860	Own estimation
Average annual technical grid loss (transmission and distribution)	10%	10%	UNFCCC (2013)
Average lamp lifetime in hours	CFL lamps: 8,000 Incandescent lamps: 1,200	LED: 50000	http://www.designrecycleinc.com
CO2 emission factor	0.660	0.660	EBRD (2010)

(tCO_2/MWh)

The replacement of all conventional light bulbs by LED lighting systems in residential buildings would result in annual electricity savings of 154,180 MWh which is equal to a reduction of electricity consumption of about 65%. Through this intervention, annual GHG emissions of street lighting in urban areas would be reduced by 101,759 tCO_2.

GHG emission reduction potential of Soroca city

There is no data available on electricity consumption of residential buildings in Soroca district therefore, at this stage of the NAMA development process, only an estimate is provided for the annual electricity savings and GHG emission reduction potential. It is assumed that 100,000 inhabitants of Soroca city, which is about 2.8% of the national population, consume 2.8% of the national electricity used in residential buildings. This is equal to 6,642 MWh per year. Moreover, assuming that the type of lamps installed is the same as at the country level, about 17,854 incandescent bulbs (100W) and 89,274 CFL bulbs (20W) would be currently used in residential buildings. The replacement of conventional bulbs by LEDs will result in annual electricity savings of 4,317 MWh (equal to a 65% reduction) and GHG emission reductions of 2,849 tCO_2.

4.2.4 Summary

Table 8 Summary of GHG mitigation impact and electricity savings in three lighting sectors

	Street lighting		Public buildings		Residential buildings		Total
NAMA scenario	**Soroca Pilot Project**	**Country level (by 2030)**	**Soroca Pilot Project**	**Country level (by 2030)**	**Soroca Pilot Project**	**County level (by 2030)**	
Electricity savings (MWh/yr)	2,128	Rural: 129,600 Urban: 67,500 Total: 197,100	491	151,400	4,317	151,180	Soroca: 6,936 County level: 502,680
GHG emission reductions (tCO2/yr)	1,560	Rural: 85,536 Urban: 40,095 Total: 125,631	324	99,924	3,066	101,759	Soroca: 4,733 Country level: 327,314

Source: own elaboration

4.3 Co-benefits of the NAMA

The NAMA on Promoting Energy Efficient Lighting will have an important impact on sustainable development in the Republic of Moldova by delivering socio-economic and environmental benefits to the population. Moreover, by delivering emission reductions and co-benefits, the NAMA will make important contributions to achieving six of the 17 SDGs of the new Agenda 2030 for sustainable development that were adopted by the United Nations (UN) in September 2015. The following section gives an overview on the contribution of the NAMA activities to the different dimensions of sustainable development. Co-benefit targets and their contribution to achieving SDGs are summarized in Table 9.

- **Electricity savings.** The replacement of conventional lighting systems by LED luminaires will result in a significant reduction of electricity consumption in the target lighting sectors. Preliminary calculations of the savings potential indicate that electricity consumption could be reduced by about 58% in the street lighting sector, by about 59% in the public buildings sector and by about 65% in the residential building sectors.
- **Savings due to reduced expenditure on lighting:** Given an average annual increase of electricity prices of 10% over the last years (see Figure 2), the implementation of LEDs will result in significant savings for households and communities. At the 2016 electricity price of € cent 12.77 per kWh, annual savings in the street lighting sector would amount to € 25,169,670 (based on a reduction in electricity consumption of 197,100 MWh/yr), and to € 19,344,318 (based on a reduction of 151,400 MWh/yr) and € 20,446,902 (based on a reduction of 151,180 MWh/yr) in the public buildings and residential buildings sectors, respectively.
- **Job creation.** The replacement of conventional lighting systems by energy efficient lighting technologies will promote the creation of new jobs that are relevant for planning, financing, implementation and monitoring of efficient lighting projects. Retrofitting and maintenance of street lighting, for example, is expected to created 4000 new jobs.
- **Elimination of mercury pollution.** Several lamp types that are frequently used in Moldova, such as CFL and HPS lamps, contain about 4-5 mg of Mercury. If old bulbs are not properly disposed, they can break and if Mercury is released, it can contaminate air, soil and water. Moreover, people who work at disposal and recycling

sites face a health risks if they are exposed to Mercury emissions. Under the NAMA framework, adequate disposal and waste handling will be promoted and Mercury waste will be progressively decreased due to the phase-out of mercury-containing light bulbs. Mercury will be collected and properly treated under the new waste-handling scheme prepared under the NAMA. Future mercury waste will be avoided due to the use of LEDs.

Table 9 Contribution of the NAMA to the delivery of co-benefits and the achievement of SDGs

Category	Benefit	Indicator	NAMA target	SDG	Selected SDG targets
Economic	Electricity savings	Electricity savings (in MWh/yr)	Street lighting: 197,100 Public buildings: 151,400 Residential buildings: 151,180	SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all	7.3 By 2030, double the global rate of improvement in energy efficiency
	Savings due to reduced expenditure on lighting	€ saved per year	Street lighting: € 25,169,670 Public buildings: € 19,344,318 Residential buildings: € 20,446,902		
	Increase of jobs in all fields that are relevant to plan, finance, implement and monitor energy efficient lighting projects	Number of jobs created	to be determined during NAMA Phase I	SDG 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services
Environmental benefits	Elimination of mercury pollution from mercury containing lamps	Percentage of mercury containing lamps replaced by LEDs by 2030	100% replacement in all lighting sectors	SDG 12: Ensure sustainable consumption and production patterns	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycles, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and environment
					9.4 By 2030, upgrade infrastructure

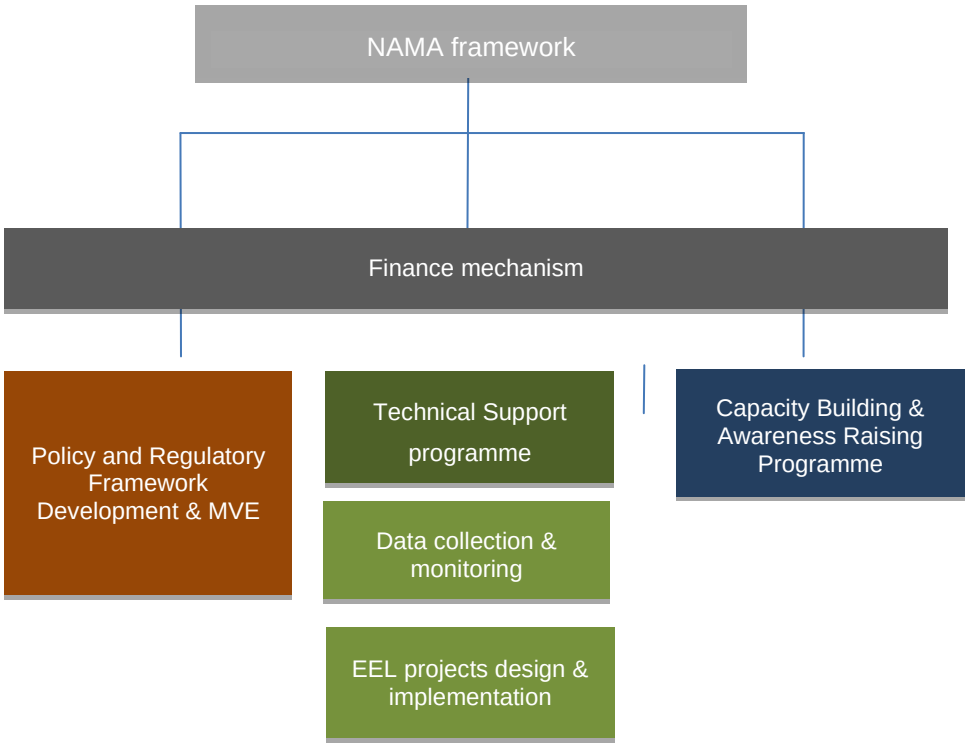
				SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
Social	National stakeholders trained to perform all activities that are necessary to plan, finance, implement and monitor energy efficient lighting projects	Number of stakeholders who received capacity building on topics relevant to their field of work	to be determined during NAMA Phase I	SDG 13: Take urgent change to combat climate change and its impacts	13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
				SDG 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

5 Measures & interventions under the NAMA

Activities and measures that will be implemented under the NAMA framework have the objective to scale up past and existing activities and resources to promote energy efficient lighting in Moldova and to remove barriers for the implementation of a national energy efficient lighting programme. To ensure efficient use of available capacities and resources, NAMA activities and measures will be integrated into existing programmes and initiatives, and only in cases where this is not feasible, stand-alone measures will be designed. Activities aim at strengthening local and national capacities to develop, finance and implement efficient lighting projects. They will be targeted at the needs of a range of different stakeholders including national and local governments, the financial sector, project developers, energy service providers and the education sector.

The NAMA framework has four components, each of which consists of a set of activities and measures to promote the large-scale implementation of efficient lighting. The components consist of: (1) Policy and Regulatory Framework Development and MVE; (2) a **Technical Support Programme** to promote the large scale rollout of energy efficient lighting projects, (3) an **Awareness Raising and Capacity Building Programme** to increase the purchase of LEDs by informing a range of different stakeholders about their financial and environmental benefits and to enhance local and national skills that are needed for a massive scale up efficient lighting activities, and (4) a **finance mechanism** will be implemented as an overarching component to secure long-term funding for efficient lighting projects (Figure 6).

Figure 7 Components of the NAMA on Energy Efficient Lighting



Source: own elaboration

5.1 Policy and regulatory framework and development of MVE

To promote the scaling up of energy efficient lighting in Moldova, the Government will continue to develop and implement elements of a policy and regulatory framework that are needed to achieve the transformation of the national lighting sector. NAMA Phase I will be used to design a detailed policy road map that lays the groundwork for this transformation. It will be based on the assessment of barriers to the scale up of energy efficient lighting that was carried out during the preparation of this NAMA proposal. The following sections give an overview on proposed measures to strengthen the policy and regulatory framework and its enforcement. The development of a standard for LED lighting is among the key priorities during NAMA Phase I. To date, Moldova does not have any standards for LED lighting in the street lighting, public buildings and residential buildings sectors. To ban low-quality LED technologies from entering national markets and to promote the scaling-up of high-quality LEDs under the NAMA framework, a national standard needs to be developed. While the standard is under development, the requirements for LED lighting projects that were established by the EEF could be used as an interim standard. Moreover, other potential measures will be discussed

and their feasibility will be assessed, such as the implementation of a tax for street lighting and the implementation of a phase-out strategy for conventional light bulbs.

5.1.1 Policy and regulatory framework development

- **Defining a phase-out strategy for inefficient lamps.** The Government has taken first steps towards making energy efficient light bulbs more cost competitive by deciding to implement a progressive import tax on IL bulbs and by applying a zero tax rate on energy efficient bulbs. However, the import tax in its current form is not far reaching enough to bridge the large price difference between IL bulbs and LEDs. A phase-out strategy for inefficient bulbs will be designed under NAMA Phase I to support stronger market penetration of LEDs. In this context, a realistic date for a market ban of inefficient bulbs, i.e. IL and halogen lamps, will be assessed and scheduled.
- **Improving the tax base of LPAs for the provision of public services.** A study conducted on the status of street lighting services in municipalities finds that the tax base of LPAs currently does not provide an adequate level of revenues to pay for electricity bills, lighting infrastructure maintenance and modernization (NALAS, 2010). The study suggests that this situation could be improved by granting LPAs the right to set taxes, for example, for the provision of lighting services. The feasibility of this option will be assessed during NAMA Phase I.
- **Provision of incentives for the residential sector.** To avoid that an indispensable service – lighting – becomes unaffordable for households due to rising prices – and ultimately the ban - of inefficient bulbs, the cost competiveness of LED technologies has to be improved. While it is anticipated that the price for LEDs will gradually decrease through the massive scale up of LED lighting projects under the NAMA framework, this will take time and LEDs have to be offered to households at affordable prices during the early phases of NAMA development. One option that will be assessed during NAMA Phase I is bulk procurement. Bulk procurement of LEDs, organized by the Government, EEA and/or utilities, will allow to achieve economies of scale and reduce the price of LEDs for the end consumer - and the price difference between LEDs and CFLs. The revenues from the import tax on IL bulbs could be used to help finance the bulk procurement.

5.1.2 Monitoring, verification and enforcement (MVE)

- NAMA MVE will be in compliance with Law N° 151 on ecodesign requirements applicable to energy-related products and Law N° 44 on labelling energy-related goods impacting energy consumption. With Law N° 151, Moldova transposed the EU's Ecodesign Directive and its respective regulations which establish minimum energy

efficiency standards for specific lamps. Law N° 44 transposes the EU's Energy Labelling Directive which will provide consumers with visual information about the quality of lamps. An MVE mechanism will be established to ensure that all products, which enter the national market and are covered by the law, comply with their respective standards and are properly labeled.

- MVE implementation should include self-declarations by importers and suppliers containing confirmation of compliance with product standards. A tool such as a centralized list or online registry that identifies suppliers and products which comply with respective requirements would facilitate the MVE process (UNEP, 2012).
- The NEEAP 2016-2018 already includes measures of monitoring (market surveillance) such as a monthly control of retailers to verify that lamps available in the market carry a label that is compliant with Law N° 44. An effective control mechanism has to be developed and enforced that has national reach, registers cases of non-compliance and includes fines or sanctions in cases of repeated non-compliance.
- In addition to market surveillance, verification of compliance with standards has to be enforced. In this context, NEEAP 2016-2018 proposes testing of "energy-related products in an accredited European laboratory. Upon importing such products from another country, it is recommended to consider and accept the test results of energy-related products in the country of origin". Accredited European testing laboratories will be selected during NAMA Phase I.

- **Collection, disposal and waste handling.** Waste management in Moldova remains a difficult and unsolved issue both in terms of organization and legislation (MoEN, 2013). In 2013, MoEN released the National Waste Management Strategy 2013-2027 of the Republic of Moldova based on which the Moldovan Government "undertakes to develop a new legal and institutional framework on waste management regulation under the EU legislation […]". One of the general objectives of the Strategy is the development of collection systems and treatment of specific waste flows, including hazardous waste. For that purpose, the Strategy divides the country in eight waste management regions and plans to establish one principal collection point for hazardous waste per region and to create conditions for its separate collection and treatment. Within the framework of the Strategy, the NAMA will support the development of a scheme for collection, disposal, and waste-handling of hazardous lighting products with a focus on mercury-added lamps which currently does not exist. For that purpose, different options for such a scheme will be assessed. The national scheme could be based, for example, on the approach of EU's Waste Electrical and

Electronic Equipment Directive (WEEE) which, among others, led to the establishment of collection schemes for CFLs in each European Member State. Under these schemes, third-party operators are contracted to organize and finance collection and recycling of lamps at the end of their useful life (UNEP 2012). Waste collection stations and/ or drop-off points are installed at public places or shops to collect CFLs for further handling.

5.2 Awareness raising and capacity building programme

5.2.1 Awareness raising

Awareness raising activities for energy efficient lighting promotion, such as advertising campaigns placed on TV, radio and in print media, and trade shows, will be designed and launched in parallel with the phase-out strategy and the implementation of efficient lighting projects. The purpose of the activities is to raise awareness among different stakeholder groups about the financial and environmental benefits of energy efficient lighting, to increase the acceptance of new lighting technologies and, by that, to increase the purchase of energy efficient lamps. Communication tools and messages will be tailored to different target groups, including end users, businesses, institutional and governmental representatives, media and schools. General information will include:

- savings potential of LEDs compared to other lamps;
- technical features of different lamp types;
- implications and timeframe of the phase-out strategy, e.g. the ban of inefficient bulbs;
- information provided by product labels;
- waste handling.

5.2.2 Capacity building

To enhance the knowledge on energy efficient lighting, a capacity building programme will be designed and implemented under the NAMA framework. The core element of the programme will be a set of training courses which cover different aspects of efficient lighting based on the specific needs of a range of stakeholders. For each course and target group, training materials will be prepared. Moreover, each course will have sessions in which participants can exchange first-hand experience from their involvement in efficient lighting projects. This will provide information on barriers and best practices which can be used to better adapt training materials to local circumstances.

The NAMA capacity building programme could be administered by the EEA. The Agency has offered many trainings in recent years to a wide audience, including energy managers, energy auditors and government officials, to comply with capacity building targets set out in the NEEP and the NEEAP. A diverse range of other institutions offer capacity building support, for example the Technical University of Moldova and the Academy of Sciences of Moldova, which can support the EEA with the implementation of the capacity building programme. The programme will be developed and rolled out during Phase I of the NAMA and will target the following stakeholders:

- **Government officials**. Government officials from local and central governments will be offered national and international trainings on selected topics that are relevant for the enhancement and strengthening of the policy and regulatory framework for the promotion of energy efficient lighting. Trainings will focus on topics such as design options for an effective phase-out strategy, including regulatory and control mechanisms, fiscal instruments and incentive schemes, and financing sources. Another topic of high relevance are policy and regulatory options for the design of a national scheme for the treatment of hazardous waste from lighting products.

- **Trainers***.* A requirement for the implementation of the NAMA on energy efficient lighting is sufficient local capacity to plan, implement and monitor efficient lighting activities. A training-for-trainers programme will be implemented to build the skills of key experts to transfer knowledge and expertise to other stakeholders. The programme will target representatives from the Energy Efficiency Agency, universities, ministries, service companies, real estate developers and contracting businesses, among others, who will participate in the implementation of the NAMA.

- **Energy managers and energy auditors***.* Energy managers and energy auditors will be offered training on energy efficient lighting for all lighting sectors. Objective of the training is to enable energy managers and auditors to identify energy saving opportunities through efficient lighting and to enhance their skills in project proposal preparation and project management. Guidance on how to formulate energy efficient lighting activities for the inclusion in annual action plans will be another important element of the training that will be specifically offered to energy managers.

5.3 Technical support programme

5.3.1 Design and implementation of LED lighting projects in the street lighting and public building sectors

The principal activity of the technical support programme will be the design and implementation of LED lighting projects .As presented in chapter 4.1, the lighting systems of streets and public buildings of Soroca city will be retrofitted during the Preparation Phase. During the Scale-up and Transformation Phases, additional villages, cities and/or districts will be chosen through a competitive application process which will include criteria such as the presentation of a technically and financially viable proposal, proposed financial contribution by the proponents, and backing of the proposal by local stakeholders.

5.3.2 Data collection and monitoring

Development of a database on energy efficient lighting projects. To track the development of energy efficient lighting projects and to facilitate the monitoring of their performance, a centrally coordinated database will be set up within the framework of the NAMA. For the set up of the database, the option of automatic reception of data from street lighting or public buildings lighting systems will be considered. This means that “smart lighting systems” would be installed that offer lamp-level management capabilities of every lamp of a lighting network to ensure that the right amount of light is provided where and when needed. The lighting networks would be connected to servers that receive and compile information from all networks, and these servers would supply their data to the centrally managed data base. This automated approach of project level data collection would facilitate MRV of efficient lighting activities carried out under the NAMA framework.

6 NAMA financial mechanism and requirements

6.1 Financial analysis

Capital investments in lighting projects will be by far the largest share of the budget needed for NAMA implementation. To select a portfolio of financial instruments that meet the financial requirements of energy efficient lighting projects to be implemented under the NAMA framework, a financial analysis with different finance scenarios was carried out for the Soroca pilot project. Table 9 gives an overview on the main financial parameters that are used for the analysis (Table 9).

Table 10 Financial parameters

Parameter	NAMA project	Source:
Street lighting		
Replacement cost per urban street km (including material, labour and transport costs) (€)	15,000	
Replacement cost per rural street km (including material, labour and transport costs) (€)	15,000	Energy audit reports from EEF and other international organisations
Annual operation and management costs per street km (€) (1.5% of capital expenditure)	225	
Public buildings		
Average lamp price (€)	10	
Cost of lamp fixture (€)	2.5	
Luminaire replacement cost (labour) (€)	2.0	Energy audit reports from
Transport cost per luminaire (€)	1.0	EEF and other international
Annual operation and management costs per luminaire (€) (1.5% of capital expenditure)	0.23	organisations
Residential buildings		
Lamp price (€)	10	Energy audit reports from
Cost of lamp fixture	2.5	EEF and other international organisations
General		
Loan interest rate (national financial	19.5	Reuters (2015)[18]

[18] http://www.reuters.com/article/moldova-interest-rate-idUSL5N1112FV20150826

market)		
Average annual increase of the electricity tariff (%)	1.8	Own calculation
Electricity price (Euro cents per kWh) (0.4 kV)	12.77	Energy audit reports

Based on the financial parameters provided in Table 9 and technical parameters presented in sections 4.2.1 – 4.2.3, the resources needed for installing LED-based lighting systems can be calculated for Soroca city and the country level (Table 10). The total cost of installing LED technology at the country level is 191,863,119 €.

Table 11 Financial resources needed for LED installation

NAMA project	Project size	Implementation costs (€)
Street lighting		
Soroca district	78.8 km to be retrofitted	1,182,000
Country level – Urban streets	2,264 km to be retrofitted	33,960,000
Country level – Rural streets	4,800 km to be retrofitted	72,000,000
Public buildings		
Soroca district	8,309 luminaires to be installed	128,789
Country level	4,153,681 luminaires to be installed	64,382,056
Residential buildings		
Soroca district	107,128 luminaires to be installed	1,339,100
Country level	1,721,685 luminaires to be installed	21,521,063
Total (Soroca district)		**2,649,889**
Total (county level)		**191,863,119**

As a next step, a cash flow analysis was performed to determine the profitability of LED implementation under different scenarios, considering expected future increases of electricity tariffs, different loan interest rates and technology costs.

Cash flow analysis for the LED street lighting project in Soroca city

A cash flow analysis is performed for retrofitting 78.8 street km with LED technology in Soroca, considering the expected cost savings from reduced electricity consumption. The duration of the projects is 13 years based on the expected lifetime of LEDs. LED installation is assumed to be carried out over a two-year period, retrofitting 39.4 street km per year. The results are compared based on three financial indicators: (1) Net present value (NPV), (2) Internal rate of return (IRR) and (3) Payback period (PP). The results of the calculations for different scenarios are presented in Table 11. For the calculation of the NPV, a social discount rate of 8.5% is used.

Table 12 Results of the cash flow analysis for the Soroca street lighting project

Scenario	**Financial indicators**			**Description**
	NPV (million €)	**IRR (%)**	**PP (years)**	
1. Project financed entirely from LPA's budget	0.82	21	5.58	Though this scenario is not a realistic one considering the budget constraints of LPAs, it shows the profitability of the investment in LED-based lighting systems.
2. 80% of investment costs are covered with a commercial bank loan with a 19.5% interest rate and a 5-year payback period. 20% are financed with LPA's budget	(0.01)	8	8.7	With a commercial loan under current market conditions, the NPV of the investment in LED lighting becomes negative.
3. Same conditions as in Scenario 2, but considering the projected annual increase of the electricity tariff	0.45	13	8.4	Scenario 3 highlights the impact of higher electricity prices on the profitability of the investment.
4. Finance sources: - International loan (0% interest) with a 5-year payback period: 50% - Loan from EEF with a 5-year payback period (0%	0.25	12	8.2	With a zero-percent interest loan, the NPV of the investment is positive but the IRR remains below the interest rate for commercial loans.

interest): 20% - Contribution from Central Government: 20% - Contribution from LPA: 10%				
5. Same conditions as in Scenario 4, but considering the projected annual increase of the electricity tariff	0.61	16	6.5	Scenario 5 highlights the impact of higher electricity prices on the profitability of the investment. With a zero-interest loan and an annually increasing electricity tariff, the IRR of the investment is close to the interest rate of commercial loans.
6. Finance sources: - International grant (10% of investment) - International loan (0% interest) with a 5-year payback period: 50% - Loan from EEF with a 5-year payback period (0% interest): 20% - Contribution from Central Government: 20% - Contribution from LPA: 10%	0.41	15	6.8	With a zero-percent interest loan, the NPV of the investment is positive but the IRR remains below the interest rate for commercial loans.
7. Same conditions as in Scenario 6, but considering the projected annual increase of the electricity tariff	0.77	20	6.0	Scenario 7 demonstrates the impact of higher electricity prices on the profitability of the investment. With a zero-interest loan and a 10% grant, the IRR of the investment rises above the interest rate of commercial loans.
8. Finance sources as in Scenario 3. Expected electricity tariff for 2030 is used (16,33 € cent per kWh)	1.24	26	4.4	Scenario 8 highlights the impact of higher electricity prices on the profitability of the investment.

Source: own elaboration

Cash flow analysis for LED projects in public buildings of Soroca

A cash flow analysis was performed for switching conventional lighting to LED based lighting in public buildings in Soroca. In the project, 8,309 LED lamps and relevant infrastructure will be installed. The duration of the projects is based on a conservative estimate of the lifetime of LEDs which is 25,000 hours. With 1,239 operating hours per year, the period for the cash flow analysis is 20 years. The results are compared based on three financial indicators: (1) Net present value (NPV), (2) Internal rate of return (IRR) and (3) Payback period (PP). The results of the calculations for different scenarios are presented in Table 12. For the calculation of the

NPV, a social discount rate of 8.5% is used.

Table 13 Results of the cash flow analysis for public buildings in Soroca

Scenario	**Financial indicators**			**Description**
	NPV (million €)	**IRR (%)**	**PP (years)**	
1. Project financed entirely from LPA's budget	0.39	49%	2.4	This scenario shows the profitability of the investment in LED-based lighting systems in the public buildings sector. However, this scenario is not considered realistic due to the budget constraints of LPAs.
2. 80% of investment costs are covered with a commercial bank loan with a 19.5% interest rate and a 5-year payback period. 20% are financed with LPA's budget	0.29	32	4.1	Even with a commercial interest loan of 19.5%, the investment is highly profitable. The scenario is not considered realistic do to the limited availability of commercial bank loans.
3. Same conditions as in Scenario 2, but considering the projected annual increase of the electricity tariff	0.42	38	3.7	Annually increasing electricity tariffs increase the profitability of the investment. The scenario is not considered realistic do to the limited availability of commercial bank loans.
4. Finance sources: - International loan (0% interest): 50% - Loan from EEF (0% interest): 20% - Contribution from Central Government: 20% - Contribution from LPA: 10%	0.32	40	3.0	With zero-interest loans from international sources and the EEF, the investment is highly profitable. The performance of a sensitivity analysis shows that the investment remains profitable even with a 50% increase in investment costs (NPV = 0.24, IRR = 24%).
5. Same conditions as in Scenario 4, but considering the projected annual increase of the electricity tariff	0.45	42	3.2	The investment is highly profitable even with a 50% increase in investment costs (NPV = 0.36, IRR = 27%).

Source: own elaboration

Cash flow analysis for LED replacement in residential buildings of Soroca

The replacement of conventional light bulbs by LED lamps is a highly profitable investment in the residential buildings sector. For example, switching from a 70W incandescent light bulb to a 9W LED lamps results in annual savings of 14 € due to reduced electricity consumption. The investment pays off within the first year of using LEDs.

6.2 NAMA financial mechanism and funding sources

The implementation of the NAMA on Promoting Energy Efficient Lighting will require significant funding to overcome market barriers and to establish supporting infrastructure. Resources, primarily financial, but also human, technological and institutional, are required to effectively implement an integrated policy approach. Funding from national and international sources is needed to finance the implementation of the NAMA components and their measures and activities (Figure 7). National funding for NAMA activities will come from the EEF as well as from the public budget of the central and local governments. International support is proposed to be in the form of grants and a zero interest loan.

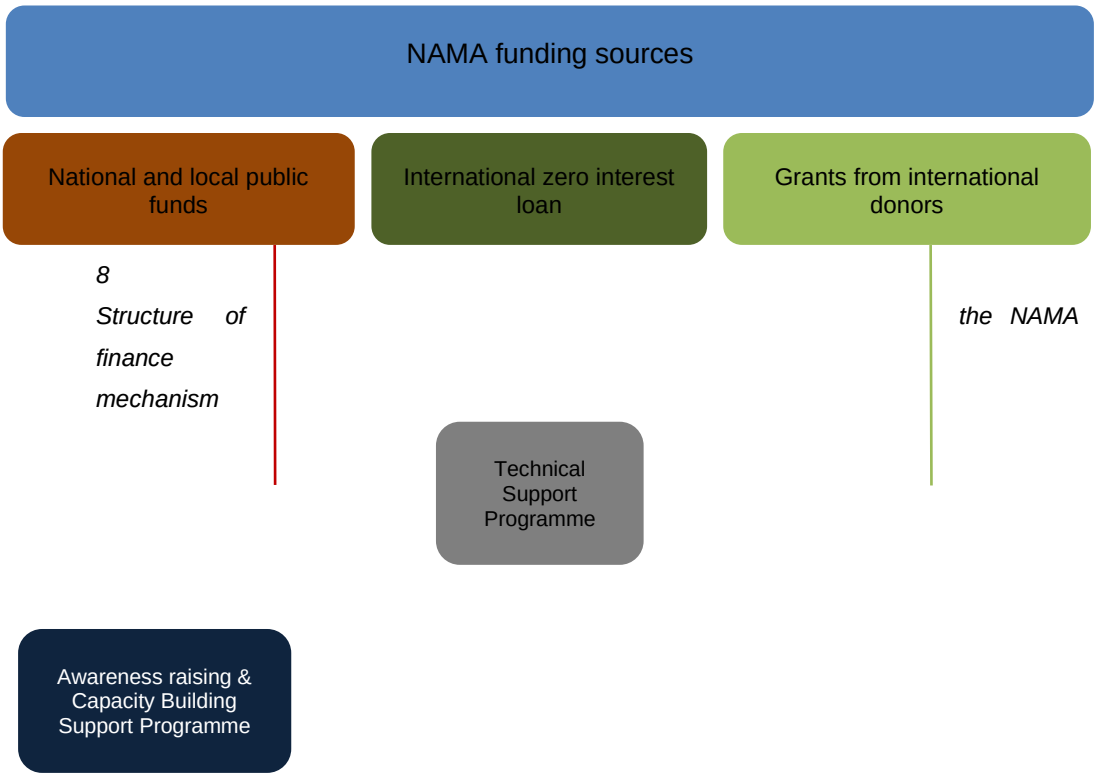
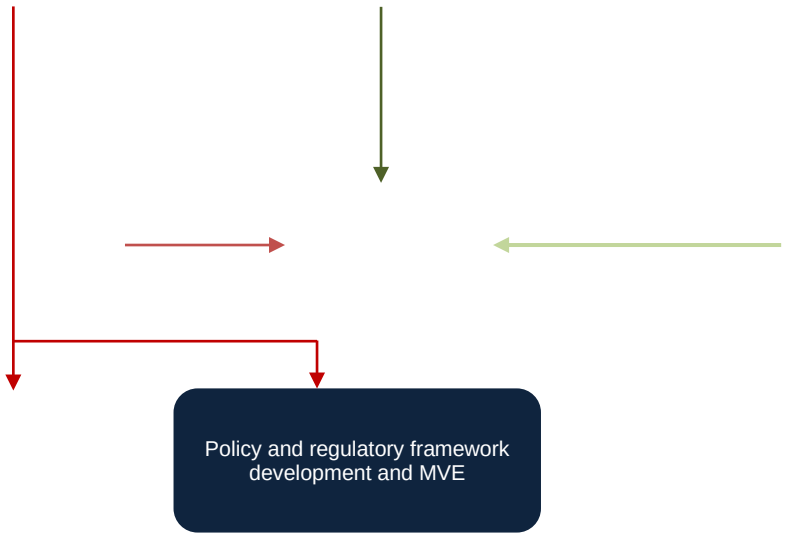


Figure 8 Structure of finance mechanism the NAMA



Source: own elaboration

The cost of switching from inefficient to LED-based lighting is about 2.65 million € for the Soroca pilot project and about 192 million € for implementing LED lighting technologies at the country level by 2030. These amounts cover the costs of the energy efficient lighting projects to be developed under the Technical Support Programme of the NAMA, but do not include the costs of the other NAMA components. The costs of developing the policy and regulatory framework of the MVE scheme for energy efficient lighting will be covered by the Government of Moldova as part of the country's "national ambition". A detailed budget for developing and implementing the Awareness Raising and Capacity Building Programme will be determined during NAMA Phase I.

Based on currently available data, finance scenario 6 for the street lighting sector and scenario 4 for the public buildings sector are selected to estimate the need for international financial support for the implementation of LED technologies in the street lighting and public building sectors. The distribution of costs between national and international sources will be as followed:

Table 14 Distribution of costs and proposed sources of funding for energy efficient lighting projects in the street lighting and public buildings sectors at the country level

Lighting sector	Source of funding	Percentage	Total (in €)

Street lighting	International grant	10% of the total amount of capital investment The remaining amount will be distributed as follows:	Rural: 7,200,000 Urban: 3.396,000
	EEF	20	Rural: 12,960,000 Urban: 6,112,800
	Central government	20	Rural: 12,960,000 Urban: 6,112,800
	Local government	10	Rural: 6,480,000 Urban: 3,056,400
	International loan (zero % interest rate)	50	Rural: 32,400,000 Urban: 15,282,000
Total			**105,960,000**
Public buildings			
	EEF	20	12,876,411
	Central government	20	12,876,411
	Local government	10	6,438,206
	International loan (zero % interest rate)	50	32,191,028
Total			**64,382,056**

Table 15 includes the costs for the implementation of the Soroca retrofitting project. A detailed breakdown of costs for this project and their distribution is given in Table 14.

Table 15 Distribution of costs and proposed sources of funding for energy efficient lighting projects in the street lighting and public buildings sectors in Soroca

Lighting sector	Source of funding	Percentage	Total (in €)
Street lighting	International grant	10% of the total amount of capital investment The remaining amount	118,200

		will be distributed as follows:	
	EEF	20	212,760
	Central government	20	212,760
	Local government	10	106,380
	International loan (zero % interest rate)	50	531,900
Total			**1,1820,000**
Public buildings			
	EEF	20	25,758
	Central government	20	25,758
	Local government	10	12,879
	International loan (zero % interest rate)	50	64,395
Total			**128,790**

The bulk procurement of LED lamps for residential buildings will be organized by the Government.

7 NAMA implementation structure

7.1 Description of key operation bodies and implementing partners

The Government has set-up an organizational structure for the development of energy efficiency measures on which the NAMA can build. The key operation bodies and implementing partners which constitute the framework are shown in Figure 9.

The framework involves all institutions that are needed to develop, implement and manage the NAMA programme which is cross-sectoral and covers a broad range of topics such as energy efficiency, mitigation of climate change, market development and financing. The institutions and their general roles and responsibilities in the area of energy efficiency are described in section 2.2. In the context of the NAMA, the institutions will divide tasks and responsibilities as follows:

Ministry of Environment

- **Responsibilities:** Responsible for communicating with the UNFCCC regarding the, NAMA and MRV.
- The CCO of the MoEN has the mandate to promote and implement climate change related programmes and projects and will be responsible for communicating and reporting NAMA relevant activities at the international level, for example, to the UNFCCC.
- At the national level, a NAMA MRV framework is currently being developed. In the proposed framework, MoEN will have the overall responsibility for NAMAs and the MRV of NAMAs which includes a mandate to prioritize, evaluate, approve/reject and monitor NAMAs.
- Together with other relevant ministries, MoEN will work on the enhancement and implementation of the policy and regulatory framework for the promotion of energy efficient lighting. Moreover, MoEN will lead the development process of a scheme for collection, disposal, and waste-handling of hazardous lighting products which is in line with the National Waste Management Strategy 2017-2023.

NAMA Implementation Unit (NAMA-IU)

- **Responsibilities:** NAMA lead and supervision, coordinating body responsible for financial, operational and administrative activities of the NAMA

- **General overview NAMA-IU**. The NAMA-IU is a noncommercial, nonprofit entity with legal status. It is being created by government decree. The Unit operates on principles of administrative and financial autonomy and has special settlement accounts in banks, including in foreign currency.
- With regard to the responsibilities and activities of the NAMA-IU, it will:
  a) issue tenders for the selection and engagement of national and/ foreign experts and contract with them for the purchase of services and goods;
  b) establish a tender evaluation committee and oversee its work;
  c) carry out all purchases (of goods and works) required within the framework of the NAMA;
  d) supervise the fulfillment of contracts on the procurement of goods, services or performance of work;
  e) coordinate and control the fulfillment of project components;
  f) exercise other responsibilities as needed within NAMA implementation activities;
  g) be responsible for negotiating international support for NAMA implementation with international donors. If financial support is granted, the NAMA IU will be the recipient and responsible for channeling resources to the implementers of the NAMA programmes, i.e., LPAs, EEA, among others.
- **Supervisory Committee (SC).** NAMA-IU leadership is carried out by a Supervisory Committee (SC) and Executive Director (ED). The supreme governing body of the Unit is the SC. SC is empowered to take decisions on all matters of Unit activity, which are not assigned to the competence of the ED. The exclusive competences of the SC include:
  a) directing overall NAMA implementation;
  b) defending the interests of project beneficiaries;
  c) taking the leading role in resolving any problem that may impede the efficient implementation of the NAMA;
  d) coordination of all decisions relevant for NAMA implementation; informing the public about the NAMA implementation process; providing incentives for private sector engagement in the NAMA, etc.
- SC meetings shall be convened at least every three months or whenever necessary.
- **Executive Director (ED).** The ED has the following rights and obligations:
  a) to represent the NAMA-IU;
  b) to oversee the procurement of consulting services and goods;
  c) to supervise the accomplishment of tasks by the NAMA-IU staff;
  d) to facilitate, to monitor and to supervise the NAMA implementation process;
  e) to prepare progress reports and to submit them quarterly to MoEN, to members of

the SC as well as to the Permanent Technical Committee for monitoring and evaluation of the implementation process of NAMA activities financed by Donors;

f) to prepare the agendas for meetings, to provide the necessary information and to prepare minutes;

g) to draw up reports and to submit them to Donors, in accordance with the requirements of the Grant and/or Loan Agreement;

h) to ensure transparent operation of the financial management system and to prepare for annual audits;

i) to hire and dismiss the staff of NAMA-UI, in coordination with the SC of the Project implementation Unit.

- **Structure of the SC.** The structure of the SC of the implementation unit of the NAMA is as follows:

a) Ministry of Environment - Minister, Chairman of the Committee

b) Ministry of Finance - Head of department, responsible for energy sector

c) Ministry of Economy - Vice minister

d) Ministry of Health - Vice minister

e) Ministry of Regional Development and Construction – Vice minister

f) Donor - Project coordinator

g) EEA - Director

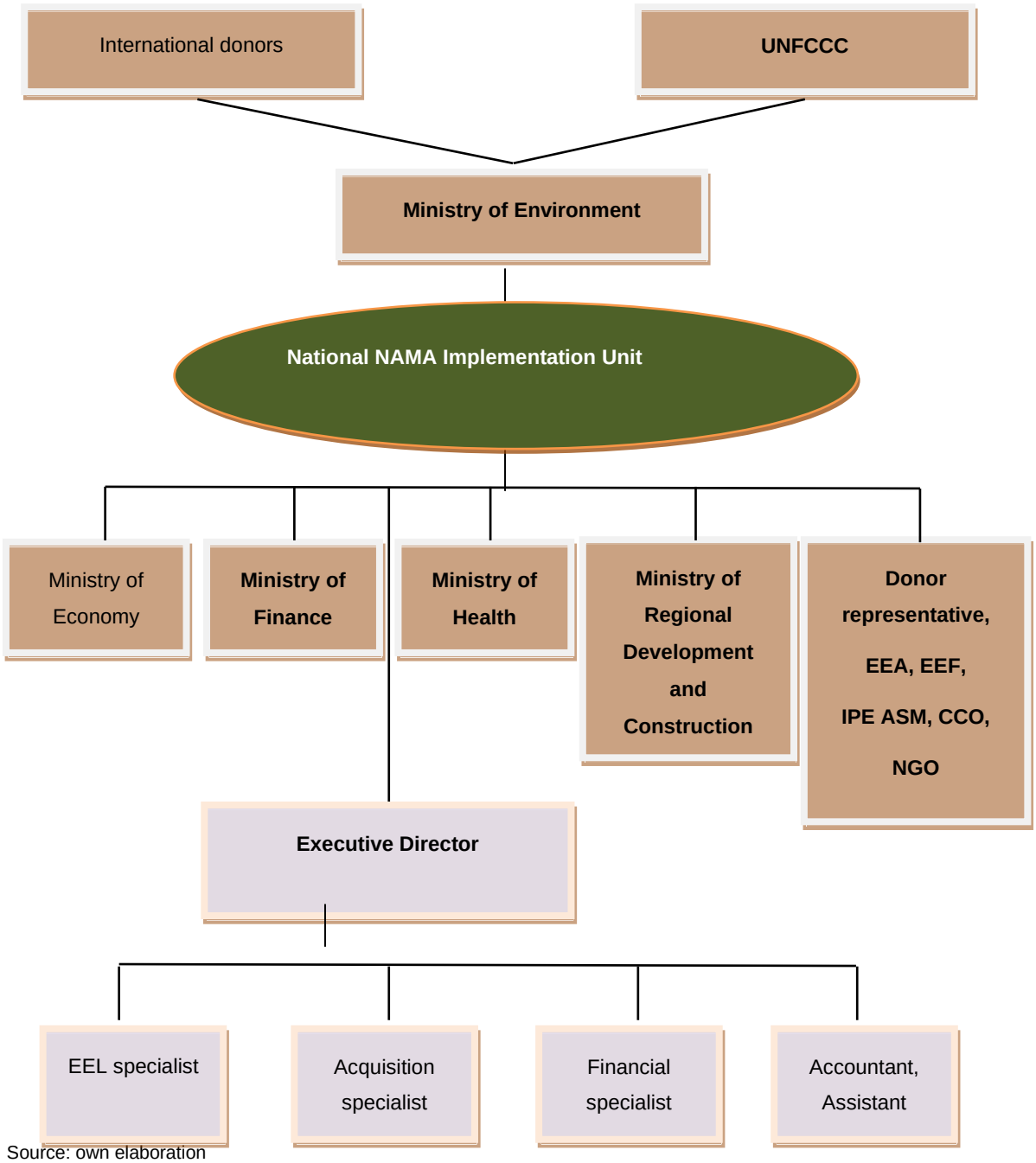
h) EEF - Director

i) Climate Change Office (CCO) - Manager

j) The Institute of Power Engineering of the Academy of Sciences of Moldova (IPE ASM) - Vice director

k) Patronage Association in the Field of Energy (NGO) - President

Figure 9 Institutional framework for NAMA implementation



Source: own elaboration

7.2 Implementation schedule

As presented in chapter 5, the NAMA will be implemented in a phased approach consisting of three phases: a Demonstration Phase (2016-2018), a Scale-up phase (2019-2023) and a Transformation Phase (2024-2030).

Figure 10 presents a detailed implementation schedule for the three phases of the NAMA.

Figure 10 Implementation plan for the Energy Efficient Lighting NAMA

Measure	Phase 1		Phase 2				Phase 3							
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical support programme														
Design and implementation of projects in the street lighting and public buildings sector														
Retrofitting of the street lighting and lighting systems in the public buildings sector in Soroca city														
Call for EEL project proposals for implementation in NAMA Phase II and selection of projects														
Energy audits in selected cities and districts during Phase II														
Implementation of street lighting projects during Phase II														
Call for EEL project proposals for implementation in NAMA Phase II and selection of projects														
Energy audits in selected cities and districts during Phase III														
Implementation of street lighting projects during Phase III														

Data collection and monitoring														
Design and establishment of a central database														
Project monitoring														
Awareness raising and capacity building programme														
Development of tools for awareness raising campaigns targeted at different stakeholder groups														
Execution of awareness raising campaigns														
Development of capacity building activities for different stakeholder groups														
Capacity building of different stakeholder groups														
Policy and regulatory framework development & MVE														
Design of a phase-out strategy for inefficient lighting														
Analyzing options to improve the tax base of LPAs for the provision of public services														
Design of incentives for promoting the uptake of LEDs in the residential sector														
Design of an MVE scheme														
Design of a waste management strategy for mercury containing lamps														
Implementation of activities and measures under this NAMA component														
NAMA finance mechanism														
Finance of NAMA activities														

More detailed Implementation plan is presented in Annex 1.

8 Measuring, reporting and verification

8.1 Proposed framework for MRV of NAMAs

A national NAMA MRV framework is currently being developed by the Government and will be finalized in approximately December 2016. The national MRV system that was developed for CDM projects serves as guidance for the set-up of the NAMA MRV scheme. The proposed institutional framework for the NAMA consists of MoEN, a National Commission, a Technical Committee and a MRV-NAMA Group (Pedersen, M. 2015) (Figure 11).

- **MoEN.** In the proposed scheme, MoEN will have the overall responsibility for NAMAs and the MRV of NAMAs which includes a mandate to prioritize, evaluate, approve/reject and monitor NAMAs.

  It is proposed that MoEN is the institution responsible to compile and evaluate MRV information at the national level. For that purpose, a national data management system will be established. MoEN can delegate part of the day to day administrative work to the MRV-NAMA Group.

  Moreover, MoEN will organize the NAMA verification process. A combination of different verifiers (First, Second and Third Party verifiers) will be considered to increase the quality of verification. Hence, a NAMA could be subject, for example, to First and Third Party verification. To ensure international and national credibility, it is proposed to use an international system of verifiers.

  The CCO of the MoEN has the mandate to promote and implement climate change related programmes and projects and will be responsible for communicating and reporting NAMA relevant activities at the international level, for example, to the UNFCCC.

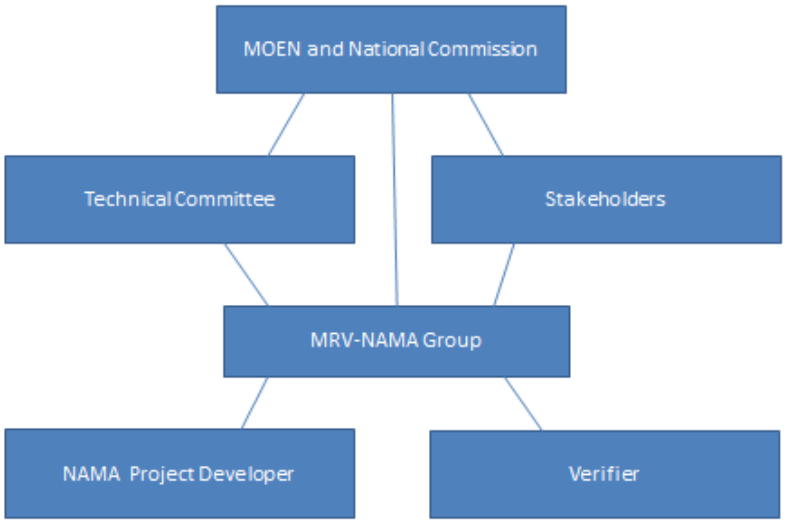
- **National Commission.** The “National Commission for Implementing Provisions of the UNFCCC and Provisions of the Kyoto Protocol” was established in 2003 (GD No. 1574 from 26.12.2003) with the mandate to communicate with the UNFCCC on CDM related matters, to evaluate CDM projects and to issue national Letters of Approval for CDM projects. The responsibility of the Commission will be extended to cover NAMAs.
- **Technical Committee**. A Technical Committee will be established to support the National Commission and its main task will be to evaluate NAMAs during all phases of NAMA development and implementation. The Technical Committee will have permanent experts which cover key aspects of a NAMAs related to: i) legal and

administrative aspects, ii) policy and strategy, iii) financing, iv) technical aspects and v) MRV.

The Technical Committee will work based on a TOR and budget for each NAMA forwarded by the National Commission and it will prepare evaluation reports to the National Commission. Moreover, the Technical Committee, with support from the MRV-NAMA Group, will have informal consultations with NAMA Project Developers to clarify issues in the NAMA proposals.

- **Stakeholders.** Stakeholders are ministries and/or other institutions that have a role in the development and implementation of a NAMA. They will provide project developers with information that is needed to develop NAMA proposals and may support the MRV process if the NAMA is developed in their respective sectors.

Figure 11 Proposed institutional set-up for a NAMA MRV scheme



Source: Pedersen, M. (2015)

- **MRV NAMA Group.** It is proposed to establish a MRV NAMA Group, which would have the specific function to support the MoEN with all activities related to the MRV of NAMAs, including data collection, processing and preparation of MRV reports. The Group is proposed to consist of 10-15 experts.
- **NAMA project developer.** A NAMA project developer will be hired by MoEN to develop a NAMA proposal based on TOR provided by MoEN.

8.2 Measurement

8.2.1 Emission reductions

For the street lighting and public buildings sectors, the CDM methodology AMS-II.L was used as guidance for the selection of parameters for the calculation of the GHG emission reduction potential of the NAMA. This methodology was also used as a starting point for the development of an MRV scheme for the street lighting and public building sectors (Box 3) (UNFCCC, 2013).

Box 3 Proposed MRV parameters for the street lighting and public buildings sectors

Data / Parameter:	**a. Outage factor** **b. Annual failure rate** **c. Average annual operating hours** **d. Average project equipment power** **e. Number of project luminaires placed in service and operating under the project activity**
Data Unit:	a. hours b. % c. hours d. kW e. -
Description:	Parameters to be measured after project implementation
Monitoring frequency	To be determined

8.2.2 Sustainable development

Box 4 Proposed MRV indicators for sustainable development

Data / Parameter:	Economic benefits a. Job creation b. Energy security
Data Unit:	a. Number of new jobs created through NAMA activities

	b. Reduction of annual electricity consumption per NAMA project (MWh/yr); Savings from reduced electricity consumption per NAMA project (MDL/yr)
Monitoring frequency:	To be determined

Data / Parameter:	**Social benefits** Improved quality of life a. Reduction of accidents b. Reduction of crime c. Health improvements
Data Unit:	a. Number of accidents reported per year b. Number of assaults reported per year c. Number of diseases reported due to improper handling and disposal from Mercury waste
Monitoring frequency:	To be determined

Data / Parameter:	**Environmental benefits** Reduction of mercury (Hg) pollution
Data Unit:	mg Hg/yr
Description:	Proper handling and reduction of Hg will be tracked at disposal sites
Monitoring frequency:	To be determined

8.2.3 Support

As mentioned in section 8.1, NAMAs will be monitored using standardized templates. In case of the efficient lighting NAMA, beneficiaries of energy efficient lighting projects will be required to periodically fill out the monitoring templates, which will have a section on support. Beneficiaries have to submit their templates to the CCO for processing.

Box 5 Proposed MRV indicators for support

Data / Parameter:	**a. Financial support** **b. Capacity building support** **c. Technology transfer**
Data Unit:	a. MDL/year and NAMA component/activity b. Number of trainings organized per year; number of people trained per year; number of training materials (type) received/distributed per year c. Number of light bulb technologies (type) and quantity received per year
Monitoring frequency:	To be determined

8.3 Reporting

See section 8.1.

8.4 Verification and evaluation

The NAMA monitoring template will be approved by Government Decree and monitoring will therefore have the status of an official statistical census. According to the national legal framework, the provision of incorrect information is an illegal act. In addition to the data provided by beneficiaries, staff of CCO/EPA will be involved in NAMA monitoring on project sites, using mechanisms for cross-checking the information provided by project owners. In the establishment of this process, mechanisms established by the UNFCCC for preparation of national GHG inventory report will be considered. Practical and appropriate instruments for NAMA MRV will be developed within the framework of the UNDP LECB project and will be gradually implemented up to 2018.

9 Risk management

As presented in different sections of this NAMA proposal, the Government of Moldova is in the process of setting up all elements of a framework that will enable the successful implementation of NAMAs in the country. Elements of this framework include policies and programmes that promote climate change mitigation, establish targets for GHG emission reduction and energy efficiency as well as for sustainable development. Moreover, it includes an institutional framework that integrates all Government bodies that are needed to plan, finance, implement and monitor NAMAs. However, even with good planning and preparation of a robust enabling framework for NAMAs, the implementation of NAMAs, including the NAMA on Promoting Energy Efficient Lighting, may face some challenges and risk. Risks and proposed mitigation measures are presented in

Table 16 Risk and mitigation measures

Potential risk	Proposed risk mitigation measure
<u>Financial</u> Lack of international (financial) support	Early involvement of potential donors in the NAMA planning process, including donors that already finance or have financed similar projects in the country. Preparation of a detailed, realistic and transparent NAMA finance plan. Promotion of the NAMA at the international level, for example, through its registration at the UNFCCC NAMA Registry.
<u>Social</u> Lack of adoption of proposed technologies	Set-up of both a regulatory and an incentive framework that complement each other to promote the use of LEDs. Different NAMA components and activities address this risk.
Lack of adequate coordination among stakeholders	Clear definition of tasks and responsibilities of stakeholders; involvement of all relevant stakeholders in the decision-making process.

10 References

Energy Charter Secretariat, 2015. In-depth review of the energy efficiency of Moldova. Available at: http://www.energycharter.org/what-we-do/energy-efficiency/energy-efficiency-country-reviews/in-depth-review-of-energy-efficiency-policies-and-programmes/in-depth-energy-efficiency-review-of-moldova-2015/

Energy Community, 2012. Energy efficiency in buildings in the contracting parties of the Energy Community. Available at: https://www.energy-community.org/pls/portal/docs/2514181.PDF

GIZ, 2014. Modernization of local public services in the Republic of Moldova. Intervention area 2: Regional planning and programming. Regional Sector Program on Energy Efficiency in Public Buildings: Development Region South. Final version. Available at: www.serviciilocale.md

Government of the Republic of Moldova, 2012. National Development Strategy "Moldova 2020": Seven solutions for economic growth and poverty reduction. Available at: http://www.old.cancelaria.gov.md/lib.php?l=en&idc=435

Government of the Republic of Moldova, 2015. Republic of Moldova's Intended National Determined Contribution. Available at: http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf

Michaelowa et al., 2013. Smart street lighting initiative NAMA. Implementation plan. Available at: http://www.paklim.org/index.php/news-events/item/129-smart-street-lighting-initiative-ssli-nama-implementation-plan/129-smart-street-lighting-initiative-ssli-nama-implementation-plan.html

Ministry of Environment, 2010. Association of the Republic of Moldova to the Copenhagen Accord. Available at: https://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/moldovacphaccord_app2.pdf

Ministry of Environment, 2013. Third National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change. Available at: http://unfccc.int/resource/docs/natc/mdanc3.pdf

Ministry of Environment, 2013b. National Waste Management Strategy of the Republic of Moldova. Available at: http://serviciilocale.md/public/files/deseuri/2013_01_24_NATIONAL_WASTE_MANAGEMENT_STRATEGY_2013-27_ENG.pdf

NALAS (2010). Quick response request. Network of Associations of Local Authorities of South-East Europe. Available at: www.nalas.eu/Home/Download/Read-the-complete-quick-response-pdf

Pedersen, 2015. Conceptual framework for MRV of NAMAs, Republic of Moldova. Available at: www.clima.md

Statistica Moldovei, 2016. Moldova in figures. Statistical pocket-book 2016. Available at: http://www.statistica.md/public/files/publicatii_electronice/Moldova_in_cifre/2016/Moldova_cifre_eng_fra.pdf

UNEP, 2012. Achieving the global transition to energy efficient lighting toolkit. Available at: http://learning.enlighten-initiative.org/ebook/en_lighten_english_complete.pdf

UNFCCC, 2013. II.L. Demand-side activities for efficient outdoor and street lighting technologies. Available at: https://cdm.unfccc.int/filestorage/C/D/M/CDM_AMSVWHGGYBKA6MQWUJW9BQ4VMXDU0VUMT/EB60_repan18_SSC-II.L_ver01.pdf?t=aUl8bzk0MDU4fDBrIwSFYq_CX0_l0_lSEm4J

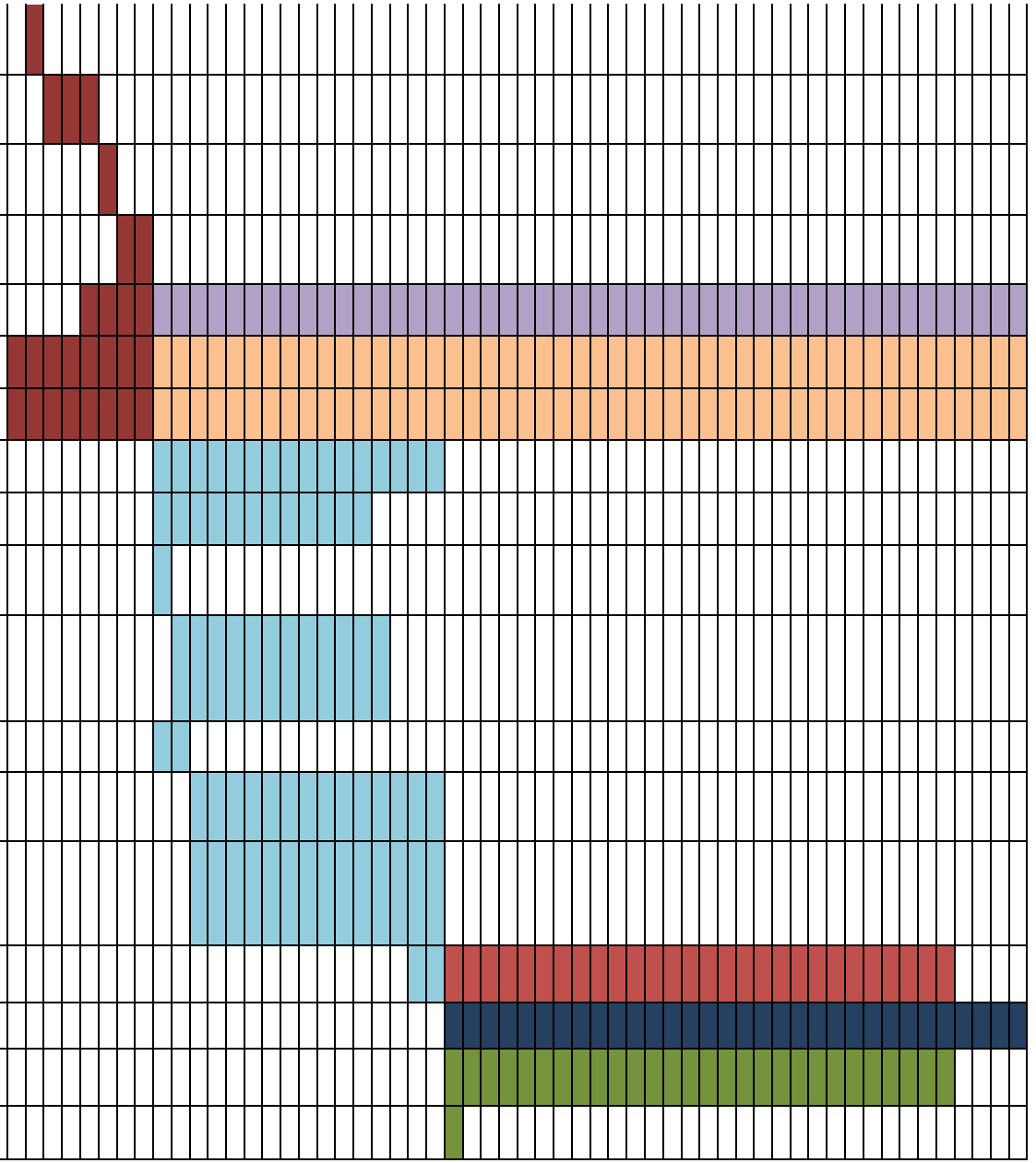
Annex 1. Detailed roadmap for implementation of Energy Efficiency Light

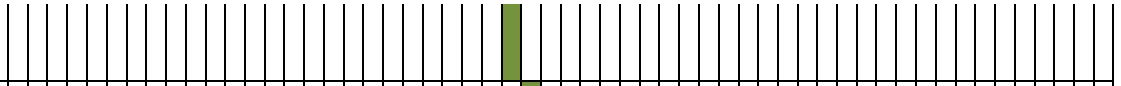
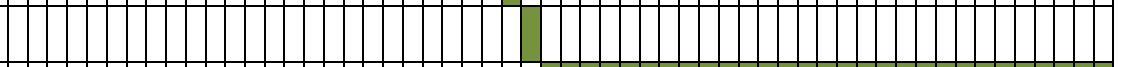
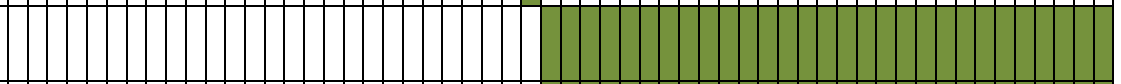
Roadmap for NAMA implementation				PHASE I								PHASE II												PHASE III																							
				2017				2018				2019				2020				2021				2022				2023				2024				2025				2026				2027				2028				2029				2030			
Tasks, activities, stages	Responsible	Start	End	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Technical support Programme	Env.Ministry	1Q2017	4Q2030																																																		
PHASE I implementation	Env.Ministry	1Q2017	4Q2018																																																		
Selection of pilot city (Soroca) and providing Energy Audit for street and public buildings lighting	NAMA Implementation Unit (IU), EEF, EEA	1Q2017	1Q2017																																																	
Project documentation design	EEF, EEA	2Q2017	2Q2017																																																	
Organisation of tender for companies selection to provide efficient street light and efficient lighting systems in public buildings	NAMA IU, FEE, EEA	3Q2017	4Q2017																																																	
Works on street and public buildings light modernisation	NAMA IU, FEE, EEA Companies	1Q2018	4Q2018																																																	
Verification of done works if its are in line with project documentation	Independent company selected by NAMA IU or EEF, EEA	1Q2018	4Q2018																																																	
Preview works for PHASE II and PHASE III	Env.Ministry	1Q2017	4Q2018																																																	
Launch of Calls for project proposals in field of Efficient Energy Light for implementation of PHASE II of NAMA and selection of projects	NAMA IU, FEE, EEA	3Q2018	4Q2018																																																	
Selection of some additional cities based on competition for implementation of efficient lighting solutions in PHASE II	NAMA IU, FEE, EEA	4Q2018	4Q2018																																																	
Data collection and monitoring	NAMA IU, FEE, EEA	1Q2017	4Q2030																																																	
Selection by tender of company for performing project design	NAMA IU, FEE, EEA	1Q2017	1Q2017																																																	
Selection by tender of company which will perform database	UI NAMA, FEE	2Q2017	2Q2017																																																	
Realization of database	NAMA IU, FEE, EEA, Company	3Q2017	3Q2018																																																	
Projects monitoring	NAMA IU, FEE, EEA	4Q2018	4Q2030																																																	

Programme for rising capacities and awareness	NAMA IU, FEE, EEA	1Q2017	4Q2030	
Elaboration of tools for companies involved in rising awareness oriented to different stakeholders groups.	NAMA IU, FEE, EEA	1Q2017	4Q2018	
Tender for selection of companies, which will perform tools for rising awareness oriented to different stakeholders groups.	NAMA IU, FEE, EEA	1Q2017	1Q2017	
Realisation of tools for companies, which will perform tools for rising awareness oriented to different stakeholders groups.	NAMA IU, FEE, EEA, Company	2Q2017	4Q2018	
Selection of company for performing action directed to increasing awareness of stakeholders	NAMA IU, FEE, EEA	1Q2018	1Q2018	
Realisation of company for performing action directed to increasing awareness of stakeholders	NAMA IU, FEE, EEA, Company	2Q2018	4Q2022	
Selection of companies, which will elaborate the necessary activities of capacities rising for different stakeholders groups.	NAMA IU, FEE, EEA	1Q2017	1Q2017	
Elaboration of activities for rising capacities of different stakeholders groups	NAMA IU, FEE, EEA, Company	2Q2017	4Q2020	
Selection of companies, which will provide rising of capacities for different stakeholders groups.	NAMA IU, FEE, EEA	1Q2018	1Q2018	
Rising of capacities for different stakeholders groups	NAMA IU, FEE, EEA, Company	2Q2018	4Q2022	
Development of policies and regulatory frame as well as Measurement, Verification and Approval (MVA)	NAMA IU, FEE, EEA	1Q2017	4Q2030	
Elaboration of strategy for removal of inefficient light	NAMA IU, FEE, EEA	1Q2017	4Q2018	
Launch of competition for selection of specialists involved in realisation of strategy for removal of inefficient light.	NAMA IU, FEE, EEA	1Q2017	1Q2017	
Contracting of specialists selected for realisation of strategy for removal of inefficient light.	NAMA IU, FEE, EEA	2Q2017	2Q2017	
Elaboration of strategy for removal of inefficient light	NAMA IU, FEE, EEA, Company	3Q2017	1Q2018	
Public consultation of Strategy draft and necessary correctness	NAMA IU, FEE, EEA, Company	2Q2018	2Q2018	
Adoption by Government, Parliament	NAMA IU, FEE, EEA	3Q2018	4Q2018	

Analysis of opportunities for improvement of tax formation methodology of LPA in order to ensure public services	NAMA IU, FEE, EEA	1Q2017	4Q2017	
Selection by tender of company for realization of study on improvement of tax formation methodology of LPA in order to ensure public services	NAMA IU, FEE, EEA	1Q2017	1Q2017	
Contracting of company selected for study realization	NAMA IU, FEE, EEA, Company	2Q2017	2Q2017	
Elaboration of incentives to promote and implement Energy Efficient LED-based light in residential sector	NAMA IU, FEE, EEA	1Q2017	4Q2018	
Selection of company for elaboration of incentives to promote and implement Energy Efficient LED-based light in residential sector	NAMA IU, FEE, EEA	1Q2017	1Q2017	
Contracting of company selected for realization of incentives mechanism for residential sector	NAMA IU, FEE, EEA	2Q2017	2Q2017	
Realisation of draft of document for incentives in residential sector to promote LED-based light	NAMA IU, FEE, EEA, Company	3Q2017	1Q2018	
Public consultation of draft for residential sector incentives	NAMA IU, FEE, EEA, Company	2Q2018	2Q2018	
Adoption by Government, Parliament of Document regarding incentives in residential sector for promoting energy efficient light	NAMA IU, FEE, EEA	2Q2018	4Q2018	
Elaboration of schemes for MVA	NAMA IU, FEE, EEA	1Q2017	4Q2018	
Launch of competition for selection of specialists for MVA realisation	NAMA IU, FEE, EEA	1Q2017	1Q2017	
Agreement with company selected for MVA elaboration	NAMA IU, FEE, EEA	2Q2017	2Q2017	
Realisation of MVA schemes	NAMA IU, FEE, EEA, Company	3Q2017	1Q2018	
Public consultation of MVA schemes, including National consultants in the field	NAMA IU, FEE, EEA, Company	2Q2018	2Q2018	
Adoption of MVA schemes by Technical Committee of NAMA IU	NAMA IU, FEE, EEA, Company	3Q2018	4Q2018	
Elaboration of waste management Strategy for lamps which containing mercury	NAMA IU, FEE, EEA	1Q2017	4Q2018	
Launch of competition for selection of specialists in realization of waste management Strategy for lamps which containing mercury	NAMA IU, FEE, EEA	1Q2017	1Q2017	

Contracting of specialists for realization of waste management Strategy for lamps which containing mercury	NAMA IU, FEE, EEA	2Q2017	2Q2017	
Elaboration of waste management Strategy for lamps which containing mercury	NAMA IU, FEE, EEA, Company	3Q2017	1Q2018	
Public consultation of elaborated Strategy and necessary correctness	NAMA IU, FEE, EEA, Company	2Q2018	2Q2018	
Adoption by Government, Parliament of Strategy	NAMA IU, FEE, EEA, Company	3Q2018	4Q2018	
Implementation of activities in frame of this NAMA component	UI NAMA, FEE, AEE	1Q2018	4Q2030	
Financial Mechanism of NAMA	NAMA IU, FEE, EEA	1Q2017	4Q2030	
Financing of NAMA activities	UI NAMA, FEE, AEE	1Q2017	4Q2030	
IMPLEMENTATION OF PHASE II	UI NAMA, FEE, AEE	1Q2019	4Q2022	
Performing Energy Audits Reports (EAR) in selected cities and rayons in Phase II	NAMA IU, FEE, EEA	1Q2019	4Q2022	
Launch of tender for selection of companies to provide design of selected technical solution in EAR	NAMA IU, FEE, EEA	1Q2019	1Q2019	
Agreement with companies for projects design	NAMA IU, FEE, EEA, companies	2Q2019	1Q2020	
Tender for selecting companies to implement energy efficient projects	NAMA IU, FEE, EEA	1Q2019	2Q2019	
Agreement with companies selected for implementation of energy efficient projects	NAMA IU, FEE, EEA, companies	3Q2019	4Q2022	
Verification of performed works if its corresponds to project documentation	Company selected by NAMA IU, EEA, EEF	3Q2019	4Q2022	
Launch of Calls for projects in PHASE III	NAMA IU, FEE, EEA	3Q2022	4Q2029	
IMPLEMENTATION OF PHASE III	NAMA IU, FEE, EEA	1Q2023	4Q2030	
Realisation of EAR in PHASE III	NAMA IU, FEE, EEA	1Q2023	4Q2029	
Tender for selection of project design companies to implement technical solution given by EAR	NAMA IU, FEE, EEA	1Q2023	1Q2023	



Agreement with selected companies and realization of project documentation	NAMA IU, FEE, EEA, Company	2Q2023	2Q2023	
Tender for selection of companies to implement projects of energy efficient light	NAMA IU, FEE, EEA	3Q2023	3Q2023	
Agreement with companies which will implement projects on energy efficient light	NAMA IU, FEE, EEA, Company	4Q2023	4Q2030	
Verification of works done by the companies if its corresponds to project documentation	Company selected by NAMA IU, EEA, EEF	4Q2023	4Q2030