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Replicable Measures for Eastern Partnership cities

Examples of the Measures for Sustainable Urban Demonstration Projects

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Abstract

This document described examples of measures that could be used for Sustainable Urban Demonstration projects (SUDeP) in the Eastern Partnership cities (Moldova, Belarus, Georgia, Armenia, and Azerbaijan). The examples of measures with high degree of replicability are selected from the Sustainable Energy Action Plan (SEAPs) of Belarus and Georgia. The measures are focused on achieving energy savings and improving energy efficiency in the sectors where local authorities have the control and influence. In addition, measures on renewable energy are considered along with measures on information systems to monitor and control energy consumption.

Abstract: This document aims to present examples of measures that could be used for Sustainable Urban Demonstration projects (SUDeP)[1] in the Eastern Partnership cities (Moldova, Belarus, Georgia, Armenia, and Azerbaijan). The examples of measures with high degree of replicability are selected from the Sustainable Energy Action Plan (SEAPs) developed within the context of the Covenant of Mayors initiative[2]. The measures are focused on achieving energy savings and improving energy efficiency in the sectors where local authorities have the most control and influence. In addition, measures on renewable energy are considered along with measures on information systems to monitor and control energy consumption.

The measures described in this document are based on information included in the SEAPs submitted by local authorities of Eastern Partnership cities. This document focuses on the measures with high degree of replicability from Belarus and Georgia[3], whereas a detailed technical description of such measures can be found in the guidebook "How to develop the Sustainable Energy Action Plan (SEAP) in the Eastern Partnership and Central Asian Cities"[4].

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[1] More information can be found at: https://webgate.ec.europa.eu/europeaid/online-services/index.cfm?do=publi.welcome&nbPubliList=15&orderby=upd&orderbyad=Desc&searchtype=RS&aofr=135376

[2] More information can be found at: http://www.soglasheniemerov.eu/index_ru.html

[3] At the moment of writing this document, SEAPs from two countries, Belarus and Georgia, were available. For the replicable measures for Ukraine, please refer to the document "Replicable Measures from Sustainable Energy Action Plans of Ukraine", available at JRC website: http://iet.jrc.ec.europa.eu/energyefficiency/covenant-mayors

[4] The Guidebook can be found at: http://www.soglasheniemerov.eu/support/library_ru.html

INTRODUCTION

In the document, the measures with a high degree of replicability (i.e., that can be replicated) are grouped by the area of intervention (i.e., sectors) where local authorities have the most control and influence, namely:

- Public and residential buildings
- Public lighting
- Municipal utilities
- Transport
- Solid waste management, wastewater treatment
- Renewable energy
- Information systems to monitor & control energy consumption.

In the above sectors, the measures focus on achieving energy savings and improving energy efficiency. Furthermore, the increase of share of renewable and greenhouse gases emissions reduction are considered. Although the scope of most of the measures is one fold, for some others these objectives can be overlapping, e.g.: projects on retrofitting buildings and buildings heating systems not only they increase energy efficiency but they also reduce the total energy consumption. In other projects such as energy efficient lighting bulbs, the increase in energy efficiency can lead to the increase in numbers of lighting points that improves life quality and comfort. For projects related to waste management and wastewater treatment facilities the sole objective of reduction greenhouse gas emissions is relevant.

In the next sections the short description of the measures is presented, for the detailed technical description please refer to the guidebook "How to develop the Sustainable Energy Action Plan (SEAP) in the Eastern Partnership and Central Asian Cities"[5].

1. PUBLIC AND RESIDENTIAL BUILDINGS: ENERGY SAVING MEASURES

In Georgia, the conditions of the majority of buildings are rather poor from energy efficiency prospective. They are built according to old standards dated to Soviet time and they had very little or no retrofitting and renovation work. In the majority of such buildings energy saving potential is very high, because buildings are outdated, external walls do not have sufficient insulation layers and entrances to the buildings (usually block of flats) do not have construction elements and doors to protect from the energy losses to the environment. Therefore, the following measures have a high potential to be replicated:

- ***Renovation of municipal buildings.*** Kindergardens and other municipal buildings are renovated to improve a building envelope, i.e. external walls and roofs. It also involves replacing of the doors and windows with models of metal-plastic frame. In some buildings, doors and windows are replaced, in others – insulated with a tape, for example rubber sealing that sticks to the frame to close any gaps and keep out drafts. According to the Georgian SEAPs' estimations, these measures provide savings of energy to approximately 40%. This is because the current conditions of majority of building are very poor and built according to old standard dated to Soviet time.
- ***Renovation and improvement of insulation in residential buildings.*** Residential buildings are renovated to insulate external building walls and reparation of roofs. The entrance doors to the blocks of flats are replaced by hermetic metal-plastic frame doors. Those doors are

[5] The Guidebook can be found at: http://www.soglasheniemerov.eu/support/library_ru.html

usually old wooden doors that no longer fit well in its jamb and do not close tightly thus increasing heat losses in the winter. According to estimations made in Georgian SEAPs, these measures provide energy savings for approximately 30%.

- ***Installation of energy efficient light bulbs in residential buildings.*** In residential buildings non-efficient incandescent bulbs are replaced with modern energy efficient bulbs. Ineffective incandescent lamps, commonly used in Georgia, consume a lot of electricity and have short lifespan. According to calculations presented in Georgian SEAPs, such bulbs are profitable in the long-term, but additional motivation is required for introducing modern light bulbs in households because bulbs price for the majority of the citizens is too high compared to their income.

- ***Promoting the use of efficient light bulbs residential buildings.*** The use of efficient light bulbs in residential buildings is promoted by providing such bulbs to the residents of selected dwellings. One efficient light bulb is installed in every flat of block of flats, preferably in living rooms, where lighting is most frequently used (as it is the place where families usually spend most of their time). The implementation of this measure is supported by explanatory information/advice (provided to the residents of buildings) on the economical and environmental benefits of installing such light bulbs.

In Belarus, the majority of the building stock needs to be improved from energy efficiency prospective as it requires retrofitting and renovation work. The following measures have a high potential to be replicated:

- ***Providing energy audit in public buildings***. This technical study identifies a potential energy savings in buildings and a first step before taking the final decision on identifying the energy efficiency measures to be implemented. It analyses the characteristics of the building construction and equipment, as well as the energy consumption and performance data, which are collected by means of surveys, measurements or energy consumption bills provided by utilities and operators.

- ***Installation of heat recovery systems in municipal buildings, including HVAC system*** (heating, ventilation and air conditioning system). For heat recuperation, the exhaust air from a building is used to heat up incoming air that is supplied to ventilation system. For this a heat exchanger with additional van and air filters are installed.

- ***Improving insulation of walls and roofs in municipal buildings.*** Thermal performance of the walls is improved by placing an additional slab or cover of insulating material, insulation is also used to fill cavity walls.
- ***Replacement of windows in municipal buildings***. The typical solution is to replace an old wooden frame window with window of metal-plastic frames.

2. PUBLIC LIGHTING: ENERGY EFFICIENCY MEASURES

Based on the SEAPs developed in Georgia, the following measures have a high potential to be replicated:

- ***Increase of energy efficiency of street lighting.*** High pressure mercury light bulbs are replaced with sodium light bulbs. According to estimations made in Georgian SEAPs, the efficiency will increase by 2-2.5 folds.

- ***Increase of energy efficiency of traffic lights.*** Incandescent halogen lamps are replaced by LED light bulbs, reducing electricity consumption by over 50%.

- ***Intelligent Street Lighting Management Centre:*** The core element of intelligent street lighting system is stepless dimming of the lamp depending on i) the time of the day, and ii) intensity of car traffic on the highways when motions detectors are installed. It includes sensor management of street lighting, including regulation of streets illumination in accordance with street traffic intensity. The system reduces the intensity of the light output at night when streets/roads are empty and increases the voltage when cars are approaching. The same mechanism also works in tunnels. Since lighting power is not directly related to the voltage, the following approach can be applied to regulate brightness of the light: to provide electricity with a full voltage for the first 5-10 minutes and after 10 minutes to reduce power to 195 watt. According to estimation provided in Georgian SEAPs, 25 % power reduction is achieved, while lighting is diminished by only 7%. After midnight, power could be reduced to 140 watt, thus decreasing energy consumption by 63 percent. In addition, the system provides stabilization of voltage and makes the street lighting network efficient and reliable. During the fluctuation of voltage, the pressure and temperature of bulbs is maintained. In addition to making it even more effective, the system can be managed by GSM mobile telephone network as well that makes it even more effective. According to estimation provided in Georgian SEAPs, the development and integration of an intelligent street lighting system will increase the savings of electricity by 40%-60%.

Picture: Tbilisi at night (Source: Tbilisi Sustainable Energy Action Plan)

Based on the SEAPs developed in Belarus, the following measures have a high potential to be replicated:

- ***Installation of Light Emission Diode (LED)*** technologies for street lighting and traffic lights - When compared to incandescent bulbs, LED reduced energy consumption by 50% and reduce maintenance costs (because LED's lifespan is 100,000 hours, which makes 10 times more than incandescent bulbs) LED emitted light is brighter than the incandescent lights, making them more visible in adverse conditions

- ***Installation of lighting management systems in entrances of residential buildings,*** with occupancy and motion controls, time scheduling and luminaire optimisation. Lighting control devices are installed to regulate the operation of the lighting system in response to an external signal (manual contact, occupancy, clock, light level).

3. MUNICIPAL UTILITIES: ENERGY EFFICIENCY

In this sector, the energy efficient measures are described for municipal facilities/premises that are owned or managed by local authorities. In some countries these o facilities include district heating systems and water supply systems. Energy efficient measures typically focus on renovation of such systems and optimal control and regulation.

The following measures have a high potential to be replicated in Belarus:

- ***Modernization of pumping equipment.*** Pumping stations with regulation equipment are renovated and upgraded. Variable speed driven pumps and efficient pumps with frequency inverter are installed to adjust motor speeds individually. Such pumps reduce electricity consumption and ensure optimum regulation of pressure losses in pipelines networks. This

- ***Modernization of heat supply network***. Pipelines that have exceeded their operational life time are replaced by preinsulated pipes made of polyurethane foam insulation. This reduces heat losses from a district heating network that reduces final energy consumption.

4. TRANSPORT : ENERGY SAVING MEASURES, "GREEN" TRANSPORT

In Georgia, similar to other countries, the transport sector represents the main source of national greenhouse gas emissions (GHG). Steady growth of transport fleet, large share of second-hand vehicles in the cars fleet, bad conditions of roads and lack of relevant restrictions on fuel quality are the major reasons causing large GHG emissions from this sector. Taking into consideration the rate of urbanization and the economic growth, GHG emissions are expected to further increase in the future.

The measures decried below focus mainly on municipal and public transport, where local authorities have much more levers to implement the measures. For private transport only informational measures are foreseen, although some measures such as improvement of motor roads will indirectly affect all types of transport including private transport.

- ***Improvement of infrastructure*** implementing the measures on improvement of infrastructure optimizes the routs for motor transport, save fuel due to better road conditions and decreased number of stops.

    - ***Road rehabilitation.*** Roads in poor conditions represent a significant factor for extra fuel consumption, which have an impact on environment and economy. Rehabilitation of roads will significantly improve traffic conditions and maximizing permeability of existing network. Therefore, improvement of the roads has significant GHG emission reduction potential.

    - ***Reconstruction of roads to inner yards of buildings.*** This measure improves traffic and save fuel consumption and have potential for emission reduction.

- ***Establishing of traffic management center.*** With a help of installed sensors in traffic lights this center creates ,,green-corridors" on selected roads of the most congested traffic. They minimize the number of stops and enable to save fuel. According to expert judgment provided in the Georgian SEAPs the traffic management improvement measures will enable to reduce entire road transport emissions by 5%.

- ***Optimization of public transport service.*** It involves optimization of routs their length, fleet number, and schedule. According to an expert judgment provided in the Georgian SEAPs, at least 3% reduction can be achieved.

- ***Renovation/rehabilitation of public transport*** Outdated busses and mini-busses are replaced my more efficient ones. Regular inspection of public transport and their maintenance is required as part of this measure.

- ***Renovation of municipal transport fleet.*** Obsolete vehicles that operate on diesel (unusually 6-12 years old) are replaced with more efficient ones.

- ***Promotion of public transport:***

- Improvement of bus stops making them more comfortable and installation of informational boards;
- Media coverage;
- Enhancement of conveniences at bus stops by arranging electrical boards at bus stops
- Creation of web-page with routes and schedules
- Introduction of the payment scheme by cards, under profitable conditions for the passengers.

These measures can not immediately reduce emissions, but they contribute to the process of promoting public transport that ultimately reduces the number of private cars. It can also change behaviour stereotypes that facilitate the reduction of fuel consumption and the corresponding GHG emissions. Long-term effect of such measure makes them even more important.

The following measures have a high potential to be replicated in Belarus:

- ***Development and implementation of the sustainable urban mobility plan***. It includes the analysis of the local situation, collecting data on the transport loads in a city and identifying overloaded routs with continuous traffic jams. Special care is to be given to reduce the heavy cargo transportation in a city.
- ***Creating parking places*** in the strategic locations in a city that make it possible to change a means of transport: for example, first to travel by car (in the places where public transport is limited), then park a car and continue a journey by a public transport.
- ***Optimizing of public transport network*** to increase service reliability and time-competitiveness.
- ***Developing cycling infrastructure.*** It involves constructing cycling lanes and integrating network of cycling paths to connect various districts of a city. They are designed to be integrated with green space and pedestrian zones, other roads and the buildings of urban areas. The cycling paths are marked on roads that are wide enough to have space for cyclists. In cases where it is not possible, cycling paths are marked on the pedestrian pavements.

- ***Promoting the use of bicycles among students***. A programme was developed to promote the use of bicycle among students and provide information on the cycling paths and connections.

5. SOLID WASTE MANAGEMENT, WASTEWATER TREATMENT: IMPROVING QUALITY OF SERVICES

In this sector, the measures aiming at reducing greenhouse gas emission in waste management and wastewater treatment facilities are to be considered. E.g.: measures such as an establishing a system for separate waste collection in a city (a door-to-door waste collection), constructing a plant of recycling solid waste, which uses incineration to convert municipal solid waste to energy by combustion can be included in this section. Additionally measures such as the production of biogas for cogeneration plant from decomposition of organic waste of sewage and residual waters can also be considered.

In Georgia, waste incineration practice is not common and only medical waste is incinerated for example in Tbilisi. The management of municipal landfill is very relevant, where the methane produced in the landfill can be recovered and used for energy purposes. In closed landfills a methane flare method can be used.

- ***Methane Flare and Recovery from Landfills.***
  - ***Construction and Operation of Landfill Gas Collection and Flare System*** - The Landfill Gas collection system is composed of vertical collection holes, gas collection pipes, an airtight sheet, gasholders, measuring instruments, and blowers. The additional

equipment includes methane-tanks, gas-holders, measuring devices, and a flare for the remaining gas.

- ***Construction and Operation of Landfill Gas Recovery System at Landfill***. The landfill is equipped with an LFG collecting system (pipes) and a collector pipe. The system should entail ways for the use of the recovered gas (inner use, consumption for electricity and/or heat, use in transport, etc), and additional equipment needed depending on the final use of the recovered gas (methane-tanks, gas-holders, measuring devices, a flare for the remaining gas, etc). The operation of the system implies checking of the facilities/devices and insurances of the system's proper functioning to the extent of its designed capacity.

Regarding the wastewater sector in Georgia, there is a clear emphasis on infrastructure and on the improvement of the quality of service, cost recovery, financial sustainability of regional water companies, and operational efficiencies. Furthermore, a demand management through reduced water losses is a relevant issue along with ensuring the poor and vulnerable members of society have access to the water services.

- ***Rehabilitation of the wastewater treatment plant.*** Wastewater treatment plant has a large potential for GHG reduction through methane and N2O recovery. It includes of complex cycle of biological and chemical treatment with a by-product that can be further recycled. This cycle consists of a preliminary wastewater treatment (removing physical objects), primary (i.e., sedimentation) and secondary treatments (biological and chemical treatments). It produces a by-product - sludge, which is incinerated to separate gas and slash. Slash - de-methanized dried masses of sludge - can be composted and used in agriculture as nitrogen-containing fertilizer. The gas, manly made by methane and carbon dioxide, can be used as a fuel to provide the plant with electricity and heat. Rehabilitation and renovation of every step in this cycle contributes to quality water that is released into the environment as well as recovering methane for further use.
  - ***Renovation of the plant*** – A system for the secondary treatment cycle, providing biological and chemical treatments of wastewater, is refurbished and updated. Outdated equipment and devises (that exceeded their operational life time) were replaced with a modern devises for digesters, gas holders, and an aeration system. After implementing this measure, treated water reaches a quality that can be released into the environment. A by-product, the recovered methane, is to be held in new gas-holders, and used or sold. Sludge, removed after the waste water treatment, is composted for use in agriculture as fertilizer or dumped in the landfill.
  - ***Rehabilitation of operation of tertiary treatments.*** It will provide proper use of a sludge, which a by-product of secondary treatment with biological and chemical processes. After implementing this measure, the equipment is to be installed to separate gas (methane) for the sludge. The remaining de-methanized dried masses of sludge - slash - are to be composted and used in agriculture as nitrogen-containing fertilizer. The recovered methane is to be held in updated gas-holders and be further used as fuel inside the plant (i.e., provide the plant with electricity and heat) or for outer purposes.

6. RENEWABLE ENERGY: BIOMASS AND SOLAR/WIND ENERGY

Based on the SEAPs developed in Georgia, the following measures have a high potential to be replicated:

- ***Installation of solar batteries in kindergartens. S***olar batteries are installed in kindergartens for hot tap water preparation, which was previously done by natural gas fired boilers. After implementation of such measure, natural gas boilers (if any) are typically used for space heating only. This significantly reduces the consumption of

natural gas and corresponding GHG emissions because kindergardens have a high demand for hot tap water due to washing, clearing and cooking activities that are performed locally. According to estimates provided in SEAPs developed in Georgia, in most of the cases installation of the solar collector can reduce GHG emissions by 5 folds during the operational period to 2020.

- ***Installation of solar collectors in sports schools and hospitals***. This measure is similar to the ones previously described. This measure foresees the application of solar vacuum collectors for the hot water supply in municipal sports facilities, schools and hospitals, which reduce the natural gas consumption and corresponding GHG emissions.
- ***Installation of boiler on biomass briquettes in municipal buildings***. Fuel briquette, made from preliminary dried and compressed biomass products (wood) are considered for space heating of municipal buildings. A natural gas boiler is replaced by biomass boiler, and a central heating hydronic system is installed in some municipal kindergardens. Other kindergardens (the majority, for example, in Tbilisi) do not have a central hydronic heating systems, and have individual gas or electric heaters. For example in some cases individual gas heaters are installed only in common rooms (i.e., the playrooms), and energy consumption doesn't cover the baseline energy demand of the kindergarden facilities.

The following measures have a high potential to be replicated in Belarus:

- ***Installation of solar collectors to produce domestic hot water in municipal buildings.*** Solar collectors are installed in the municipal building with very high hot water demands (for example sport centres with a swimming pool etc.). Such installation complements an existing heating system (gas boilers) and helps to reduce gas consumption. Solar collectors are typically installed on the roof of existing buildings.

- ***Installation of wood chip boilers***. Biomass boilers (wood chips) are applied for individual heating systems in municipal buildings. The biomass boilers burn such CO_2 neutral products as pellets and wood chips[6]. The replacement of fossil fuel boilers can be done during a building refurbishment and should also foresee a storage room for wood chips. The advantage of such system is that the heat distribution installation and radiators in a building are the ones used with the previous installation.

6.1. INFORMATION SYSTEMS TO MONITOR & CONTROL ENERGY CONSUMPTION, AIR QUALITY

There are many measures that can be applied in the sector of Information System (ITC). Based on the experience of EU cities the following measures have been identified as the best practices [[7]]:

- Integrated modelling solution based on BIM (building information modelling)
- Smart metering for energy consumption and awareness
- Building management systems
- Wireless sensor networks for energy performance assessment software

6 However, this is the case only if biomass is produced in a sustainable manner. For more information please refer to the Guidebook at: http://www.soglasheniemerov.eu/support/library_ru.html

7 http://www.greendigitalcharter.eu/wp-content/uploads/2012/11/2010-ICT-Supported-Energy-Efficiency-in-Construction_.pdf

- Standards-based energy performance assessment software
- Energy performance audit solutions
- Websites for collecting and disseminating energy-efficiency “good practices”
- Standards-based solutions for building life-cycle management
- Standards-based energy data exchange solutions

Application of Building Management System in municipal and residential buildings is a measure that have a high potential to be replicated. In most applications is a computer-based control system that collected data on energy consumption of building from heat and electricity metering devises. It can also connect mechanical and electrical equipments such as heating, cooling, and ventilation. In the EU cities, it sometimes includes lighting, and some appliances, in addition to fire systems, and security systems. An advanced Building Management System also has the ability to control the building's energy production and storage systems (photovoltaic panels, combined heat and power generators, batteries, etc.) along with the possibility to retrieve information from the Internet, like weather forecasts.

It uses a combination of:

- Wired or wireless sensors (for occupancy, movement, light fluxes, internal solar radiations, windows and doors states, blinds, indoor/outdoor conditions such as temperature, humidity, CO2, air quality.);
- Actuators for heating, cooling, ventilation systems, (can also include blinds, doors and windows, lights, energy production equipments);
- Meters for water, air flow and for energy (heat, electricity, gas),
- Centralized or distributed/embedded intelligence software, for activity monitoring, timetables implementation, optimization algorithms and user interfaces (real-time data display, alarms, remote control features, etc.),
- A central communication network using proprietary or open-standards.

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