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BSBEEP
Black Sea Buildings Energy Efficiency Plan

GA3: Integrated planning process and approaches - Implementation, planning and training

Activity GA3.2

Identification and evaluation of proposed actions for the amelioration of the environmental performance – Action Plan of Municipality of Vayk, Armenia



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Black Sea Buildings Energy Efficiency Plan (BSBEEP)

Black Sea Basin Joint Operational Programme 2007-2013

Black Sea Buildings Energy Efficiency Plan (BSBEEP) project aims at the establishment of strong regional partnerships and cooperation schemes in Black Sea area through the reinforcement of administrative capacities of local authorities and bodies in a very crucial sector (energy efficiency in buildings) having major environmental and economic impacts locally and globally.

The ultimate goal is to achieve change in the way they treating energy for buildings; facilitating change in the way local societies are acting. Furthermore, the project focuses on the establishment of a knowledge and experience exchange network aiming at the promotion of buildings energy efficiency. The network will engage a wide spectrum of organizations such as local and regional authorities, universities and research centres and NGOs which will help promoting energy efficiency in buildings at local and regional level. Meanwhile it will focus on raising awareness and mobilising private sector and leverage funds to support future initiatives.

Ten partners are participating in the BSBEEP Project from six different countries; Municipality of Kavala (GR), Municipality of Galati (RO), Municipality of Cahul (MD), Municipality of Mykolayiv (UA), Municipality of Samsun (TR), Municipality of Tekirdag (TR), Democritus University of Thrace (GR), University Dunarea de Jos of Galati (RO), American University of Armenia (AM) and Renewable Resources and Energy Efficiency Fund (AM).

More details about BSBEEP Project are available on its website: www.bsbeep.com.

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1. Executive Summary

The Municipality of Vayk became a Signatory to the EU Covenant of Mayors on 22 May 2014. The Municipality of Vayk has started devoting a lot of attention to the issues of energy saving and energy efficiency even prior to the adherence to the Covenant through development and implementation of programs and measures, as well as allocation of municipal funding for such purposes.

Table 1. Key Summary Indicators of the Vayk SEAP

Item	Vayk
Date of Adhesion	22.05.2014
Date of SEAP approval by municipal councils	02.03.2015
Baseline year for BEI	2011
Population in baseline year	6724
GHG emissions in baseline year	7515,64
Fixed year or Business as Usual (BAU)	Fixed year
GHG emission reduction commitment by 2020	1776,95
Total investment needed for implementation of SEAP, thousand Euro	1344,4
Per capita investment for SEAP implementation, Euro/person	200,0

Per capita investments for SEAP implementation varies comprises nearly 200 Euro per person. To tap on the city's energy saving potential, the following key groups of energy efficiency improvement measures were proposed for implementation until 2020:

1. Introducing new technologies of energy generation and end-use energy saving
2. Implementation of energy efficiency projects, which involve the use of alternative and renewable energy sources
3. Introducing metering and controls over the flow of fuel and energy resources in housing and utilities and the public sector
4. Implementation of measures to reduce energy end-use by municipal agencies
5. Implementation of the monitoring and control of energy efficiency - Energy management in the public sector
6. Attracting investment in energy efficiency and energy saving measures
7. Raising public awareness on efficient energy end use practices

Based on detailed analysis of energy end use in all energy consumption groups of the town, the priority sectors for Vayk community are the 9 public buildings and 41 multi-apartment residential buildings, where the most significant energy consumption occurs as well as energy saving potential exists. These have been articulated and assessed for their impact along with the relevant energy saving and energy efficiency measures in the transport sector as well as the potential for broader application of renewable energy and public outreach.

2. Sustainable Energy Actions for Vayk

The Vayk Municipality, in accordance with the Sustainable Energy Action Plan (SEAP) methodology, applies the concept of sectoral capital intensity (i.e. investments needed to reach one tone of CO₂ emission reduction per year) of measures for estimation of ecological efficiency of the proposed energy saving and GHG emission reduction measures. Sectoral capital intensity of measures proposed in SEAPs are represented in the below table.

Table 2. Sectoral capital intensity of Vayk SEAP measures

Sector	Capital intensity of measures, Euro / tCO ₂ year
Municipal budget (including municipal street lighting)	3472
Residential sector	705
Renewable energy	2202
Transport	140
Awareness raising	241
CO ₂ reduction	90
Aggregate for all sectors	754

As it is seen for the above table, the capital intensities for the various sectors differ sizably. Average value can be estimates at about 800 Euro / tCO₂ year. The biggest investments are needed for budgetary and RE sectors. Most effective investments seem to be in residential sector. The capital intensity value for residential sector is quite close to the aggregate cost intensity of the overall SEAP largely due to the heavy weight of this sector in overall balance of GHG emission reduction.

3. Energy Efficiency Improvement Measures in the Buildings Sector

Key measures proposed for implementation in residential and public buildings are as follows:

- ✓ Thermal insulation of building envelopes;
- ✓ Replacement of roof coats with galvanized iron plates or new coating materials;
- ✓ Application of thermal insulation materials (15-20 cm thickness) on ceilings of last floors of the buildings with balks;
- ✓ Replacement of wooden windows with new energy efficient ones;
- ✓ Replacement of entrance doors of multi apartment buildings;
- ✓ Replacement of inefficient incandescent lamps with energy efficient lighting, etc.

Also the following so-called low-cost measured aimed to save heat in premises are envisaged in the buildings:

- ✓ Insulation of windows and doors with application of silicone, foam rubber, sealants, polyvinylchloride and foam plastic
- ✓ Installation of door closers
- ✓ Installation of heat reflecting screens behind radiators
- ✓ Construction of tambours

- ✓ Heat insulation of internal heat distribution networks in basements and attics, etc.

In addition to these general measures, there are also measures which are solely relevant for the municipal/public buildings, including the following:

- ✓ Development of energy monitoring and data collection
- ✓ Introduction of energy management system
- ✓ Capital renovation of kindergartens # 1 and #3
- ✓ Replacement of single-glazed windows and installation of new heating system in the municipal House of Culture

Similarly, some of the measures are solely relevant to the residential buildings, such as:

- ✓ Capital renovation of roofs
- ✓ Installation of energy efficiency lighting in the yards of the residential buildings

4. Energy Efficiency Improvement Measures in the Transport Sector

Key measures proposed in transport sector are introduced below:

- ✓ Introduction of bikeways;
- ✓ Shift to natural gas as a fuel for municipal and public transport.

5. Integration of Renewable Energy Application

In the renewable energy sector the following measures are proposed:

- ✓ Installation of individual (apartment level) solar water heaters
- ✓ Installation of solar water heaters for collective use for hot water supply and pools
- ✓ Installation of PV modules for electricity generation for illumination of entrances and yards of multi apartment buildings

Utilization of other types of RE sources on the territories of the target municipalities is not promising and, hence, is not considered in the SEAPs. From energy and ecological efficiency standpoints renewable energy is relatively “expensive” option (see table 2).

6. Public Outreach

Measures proposed for awareness raising of population and enterprises are summarized below:

- ✓ Organization of “Earth Hours”
- ✓ Organization of Energy Days
- ✓ Application of energy certificates for buildings
- ✓ Involvement of pupils of schools into energy development of municipalities
- ✓ Introduction of optional subjects on energy saving and renewable energy in schools, etc.

Assessment of Impact of the Proposed Measures

In the table 3 below energy efficiencies of the measures proposed in the SEAPs are summarized.

Table 3. Energy efficiency of SEAP measures

Sector	Unit	Impact of Proposed Energy efficiency of measures
<i>Municipal sector *</i>	MWh/year	313,3
	%	4,2
<i>Residential</i>	MWh/year	5065,0
	%	68,1
<i>Renewable energy</i>	MWh/year	346,8
	%	4,7
<i>Transport</i>	MWh/year	1483,1
	%	19,9
<i>Awareness raising</i>	MWh/year	227,2
	%	3,1
Total	MWh/year	7435,4

***) Including municipal street lighting**

The biggest relative efficiency is ensured by residential sector which requires that most of the investments. The contribution of residential sector in reduction of energy consumption is 68%, which is related to the relatively long heating season, thus higher generated savings from the investments in heat insulation of buildings.

7. Indicative Assessment of the Energy Saving Potential

Residential sector has the largest potential for energy efficiency because the vast majority of infrastructure is old and has low thermal insulation capacities. However, for identification of optimal and economically justified level of heat proofing features of the infrastructure it is required to carry out a separate and more detailed study with consideration of the existing and perspective heat insulation materials market.

In the transport sector shift from petrol to natural gas for passenger cars is definitely justified from economic and ecological points of view. However, GHG emission reduction effect of this measure is limited because difference between emission coefficient of petrol (0,249 tCO₂/MWh) and that of natural gas (0,202 tCO₂/MWh) are quite close (taking into consideration energy values of both fuels). Nevertheless, transition from petrol to natural gas in the private transport sector is ongoing intensively and has positive influence.

8. Utilization of Renewable Energy

In renewable energy sector only solar energy plays a vital role for Vayk in the short run. Contribution of this source of renewable energy in increase of power consumption efficiency varies from 55 to 25%. Capital intensity of measures with utilization of solar energy is about 2200 Euro/tCO₂ year.

Table 4. Impact of Solar Energy Utilization Measures

Parameter	Unit	Impact
Investments till 2020	1000 Euro	181,5
Electricity generation	MWh/year	0
Thermal Energy generation	MWh/year	346,8
GHG emission reduction CO ₂	t/year	82,4
Share of energy saving from solar technologies in the total energy saving proposed in SEAP	%	4,66
Share of GHG emission reduction from solar technologies in the total GHG emission reduction proposed in SEAP	%	4,62

9. Dynamic of annual investments for 2015-2020 period

Baseline years selected for the Vayk municipality differs from year of SEAP development (earlier year is selected) as it can be seen from the table 1. As a result some part of measures have already been implemented within the period from the selected baseline years to the years of SEAP development. Hence, it makes sense to consider also that period of time (i.e. before 2015). For Vayk implementation of measures starts from 2012.

Realization of the majority of proposed measures require more than one-year period. Given that at this stage there are no exact time and work schedules for realization of the measures, annual distribution (breakdown) of investments needed for realization of the proposed measures is made evenly.

Dynamics of annual investments for already realized and planned SEAP activities are presented in the table 5 below. Information in the table is given for respective sector up to 2020.

Table 5. Distribution of investments needed for implementation of SEAP measures for 5 signatories

Sector	Distribution of investments, 1000 Euro									Total 1000 Euro
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Budgetary	104.4	62.2	0	19.5	30.0	21.0	16.0	1.0	1.0	255.1
Residential **	86.2	86.3	5.6	67.7	64.8	115.9	116.3	111.5	116.2	770.5
Transport				6.0	7.5	8.0	8.0	8.5	7.0	45.0
Renewable energy				33.0	37.5	33.0	29.0	29.0	20.0	181.5
Awareness raising			2.7	1.5	1.5	1.6	1.6	1.5	1.1	11.5
Total	190.6	148.5	8.3	127.7	141.3	179.5	170.9	151.5	145.3	1263.6
Cumulative energy saving, MWh *			1990.0	703.0	3477.0	4226.0	5449.0	6523.0	7435.4	7435.4

*) As of the end of reporting year

**) Without consideration of 75.82 thousand Euro spent in 2011 (baseline year for Vayk)

Note: the table does not consider investments for development of green zones and forestation on the territories of municipalities

10. Relative Efficiency of Energy Saving Measures

Values of energy efficiency of the proposed measures are presented in the table 3. The relative efficiency of the energy saving measures refers to the ratio of absolute saving of energy resources to the following parameters:

- ✓ total energy consumption in the baseline year (energy balance)
- ✓ energy consumption set in BEI for the baseline year
- ✓ energy consumption set in BEI for 2020 considered for BAU scenario with application of development coefficient recommended by the EU Joint Research Center (JRC)

Results of calculation of relative efficiency of SEAP measures for 5 signatories are introduced in table 6 below.

Table 6. Relative efficiency of planned SEAP measures

<i>Parameter</i>	<i>Unit</i>	<i>Efficiency</i>
<i>Annual energy consumption as per total energy balance for 2012</i>	MWh/year	35317,7
<i>Including fire-wood</i>	MWh/year	0,0
<i>Annual energy consumption set in BEI for the baseline year</i>	MWh/year	31569,8
<i>Share of energy consumption in BEI in comparison with total energy balance</i>	%	89,4
<i>Development coefficient applied in case of BAU scenario</i>	-	-
<i>Annual energy consumption in 2010 as per BAU scenario</i>	MWh/year	31569,8
<i>Energy saving potential of SEAP measures</i>	MWh/year	7435,4
<i>Energy saving in comparison with energy consumption in the baseline year</i>	%	23,55
<i>Energy saving in comparison with energy consumption in 2020</i>	%	23,55

The description of the individual energy saving, energy efficiency, outreach and carbon sequestration measures with their respective impact, cost and responsible entities, along with the potential carbon footprint and funding sources is presented in the Table 6 below.

Table 7. List of Measures, their impact, and financing consideration

Description of the Measure	Implementer/ Funding source	Cost (Thousand EURO)	Energy Saving, Natural Gas (MWh)	Energy Saving, Electricity (MWh)	Reduction of GHG emissions	Timeline
					t CO ₂	
Municipal Buildings						
Introducing Municipal Energy Management System	Municipality	1,0	21,90	14,28	8,32	2015 -2020
Capital Renovation of Kindergarten №3	Municipality and NGO Kamrjak	88,3	139,4	0	33,13	2011
Capital Renovation of Kindergarten №2	Municipality	33,1	23,34	0,68	5,69	2013
Window replacement and Installation of new doors in the Cultural Center	Municipality and Counterpart International	16,1	16,70	0,69	4,12	2012
Replacement of Single-with Double-glazed inowdws in in the Arts School and installation of individual heating system	Municipality and Counterpart International	8,5	50,74	1,17	12,31	2013
Space Heat conservation in the public sector	Municipality and R2E2	7,5	11	0	2,61	2015-2020
Multi-apartment residential Buildings						
Capital Renovation of roofs in 12 residential buildings	Municipality and regional administration	258,8	1724,6	0	409,85	2011-2013
Installation of energy efficiency windows (replacement) in 18 residential buildings	Municipality and households	37,5	43,29	2,16	10,76	2014-2020

Enhancing the Thermal Protection Characteristics of the Building envelope in 18 buildings with solar PV installations	Municipality	323,15	1879,9	30,65	453,43	2015-2020
Installation of energy efficiency lighting in the yards of residential buildings	Municipality and owners	1,32	0	25,4	5,54	2014-2019
Installation of energy efficiency lighting in single-family houses	Municipality and households	3,55	0	84,36	18,39	2015-2017
Enhancing the Thermal Protection Characteristics of the Building envelope in 10 buildings with roof repair	Municipality and households	180,00	1110	0,68	263,94	2017-2020
Space Heat conservation in the residential buildings	Municipality and households	42,0	192,94	0	38,97	2015-2020
	Municipality and R2E2	20,6	0	14,9	3,25	2013
Street-Lighting						
continued improvement of the Municipal Street-Lighting	Municipality and other sources	80	0	18,43	4.02	2015 -2018
Installation of solar water heating systems on two social buildings	Municipality and	12,5	16,8	0	3,99	2015-2016
	R2E2					
Installation of solar water heating systems for hot water preparation in residential buildings	Municipality and households	169,0	330	0	78,42	2016-2020

Awareness Measures							
Organization of "Energy Days"	Municipality	4,0	28,5	25,7	11,36	2014-2020	
Development of Building energy Labels	Municipality	0,5	28,5	12,9	8,55	2015-2020	
Organization of Trainings and seminars for school children, public sector decision-makers, private companies	Municipality	5,0	28,5	25,7	11.35	2015-2020	
Organization of "The Earth Hour"	Municipality	1,0		0,84	0,18	2015-2020	
Envolving the school and kinder-garten children in the energy development of the town	Municipality and management	1,0	31,0	21,3	10,91	2015-2020	
	of schools						
Carbon Sequestration							
Rehabilitation of Green Spaces	Municipality, State budget	5,0	0	0	55,5	2015-2020	
Transport Sector							
	Implementer/ Funding source	Cost (Thousand EURO)	Energy Saving, Natural Gas (MWh)	Energy Saving, Gasoline (MWh)	Energy Saving, Diesel (MWh)	Reduction of GHG emissions, t CO2	Timeline
Optimization of Transport Network	Municipality, State Budget, Ministry of Finance	35,0	646,3	293.6	36.9	213,6	2015-2020
Development of Bike-Lances and pedestrian spaces	Municipality, State Budget, Ministry of Finance	10,0	336.8	169.5	0	108.8	2015-2020