

# **National Energy Efficiency Action Plan 2010**

**REPUBLIC OF ARMENIA**  
**Draft**

21 July 2010

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## 1 Executive Summary

*(2-3 pages)*

*to be added into the final version*

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## 2 Introduction

### 2.1 *Background and context*

The Government of Armenia prioritizes energy efficiency as a means of increasing the country's energy security, increasing economic competitiveness and reducing the negative impact on the environment. The Government's commitment to promotion of energy efficiency is mainly reflected in the Law on Renewable Energy and Energy Efficiency (2005) and the National Program on Renewable Energy and Energy Efficiency (2007). The Law lays out the principles of the government's policy and governance structure supporting energy efficiency, and provides for energy efficiency standards, audits and awareness raising. The National Program on Renewable Energy and Energy Efficiency identifies the sectors with the largest energy efficiency potential and provides an outline of technical measures/solutions to be taken to realize the identified technically viable potential.

Based on the National Program on Renewable Energy and Energy Efficiency, the World Bank performed a study in 2008<sup>1</sup> which identified significant economically and financially viable energy efficiency potential; the barriers to realization of that potential and provided an overview of measures to overcome the identified barriers. To aid the implementation of the National Program, the Government of Armenia requested the World Bank to support with creation of an enabling environment for energy efficiency and financing of energy efficiency investments of public buildings. The proposed lending and TA project will contribute to achieving the Government's national priorities as it will help generate awareness of the benefits of energy efficiency investments, address other information and data gaps related to energy efficiency, remove institutional and regulatory barriers, address capacity weaknesses hindering the implementation of energy efficiency measures, and provide financing for energy efficiency investments in the public sector, drawing on the recommendations of the National Program.

Moreover, energy efficiency is a key reform area for the development policy lending operations of the World Bank in Armenia. Under the development policy operation, the Government committed to adopt a time-bound Energy Efficiency Action Plan (EEAP).

For the development of the action plan, an international consultant was hired by the Ministry of Energy and Natural Resources in summer 2010, and the elaboration of measures proposed in the following report conducted in a process of involving stakeholders from different ministries (Ministry of Energy, Ministry of Economy, Ministry of Urban Development, Ministry of Natural Protection), the Public Services Regulatory Commission, Armenian Renewable Resources and Energy Efficiency Fund, the Energy Institute, utilities, the World Bank, UNDP/GEF Armenia office, and gas and electricity companies.

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<sup>1</sup> *"The Other Renewable Resource: The Potential for Improving Energy Efficiency in Armenia". July, 2008.*

## *2.2 Scope and objectives of the EEAP*

The main objective of the action plan is to contribute to the formulation of the future energy policy of Armenia and to define concrete steps for its implementation. One of the main aims of the national policy in the energy sector is defined to improve energy efficiency and to further develop the use of renewable energy sources.

The mentioned Law on Renewable Energy and Energy Efficiency and the National Program on Renewable Energy Efficiency and Renewable Energy provide general policy measures and an assessment of energy saving potentials, however they have not been implemented so far.

The **National Energy Efficiency Action Plan** is based on past trends in energy consumption and presumes a further rise in energy demand up to 2020. It takes into consideration earlier potential assessments for energy savings in different sectors of the economy and refers to past and current projects/programmes dealing with energy efficiency issues and the main barriers to energy conservation. These projects provide an important inflow of funds and financial sources for technical assistance, rehabilitation and new infrastructure investments and as well awareness and capacity-building measures. The EEAP proposes concrete measures per sector as well as horizontal and cross-sectoral measures together with quantitative targets (in %) that can be achieved by 2020. These targets need to be compared to a baseline energy demand that considers the average demand for the 3-years period 2008-2010.

However, the first report presented here does not take into consideration actual figures regarding final energy demand across all relevant sectors of Armenian economy. The problem lies rather in the unavailability of reliable up to date statistical information on final energy demand in considered sectors. It has therefore been decided together with the Ministry of Energy and Natural Resources to define the baseline energy demand within the second EEAP to be submitted in 2012 and in the meanwhile ensure that one of the first measures of the EEAP, the national energy statistic will be implemented as soon as possible and will provide a first detailed energy balance for the years 2008-2010 (see also chapter 3.2).

## *2.3 Relevant Activities and Programmes related to Energy Efficiency in Armenia*

To encourage energy efficiency, Armenia has so far taken several steps on the political and programmatic level:

- Created a legal framework for energy efficiency. In 2005, the Government passed a Law on Energy Savings and Renewable Energy, and has since passed draft building codes (for new buildings) which mandate energy efficiency.
- Developed a National Program on Energy Savings and Renewable Energy with solid data on energy use and energy efficiency in Armenia.

- Has taken steps to improve the economic efficiency of energy use through improved regulation of energy utilities. Several barriers to economic efficiency which also affect the efficiency of energy resource use—for example, highly subsidized energy tariffs, or the absence of electricity and gas metering—have been largely removed in Armenia.
- Continued to work actively with development partners like the World Bank, the UN Development Programme, the EBRD, USAID and other donors on energy efficiency programs to improve the energy supply infrastructure (electricity and heat production facilities, transmission and distribution networks) and heat energy use in public and residential buildings.

Relevant projects and programs ongoing and of past were mostly financed with support of the above mentioned IFIs that contribute to the implementation of energy efficiency measures in Armenia:

GEF Program:

- Armenia – Improving the Energy Efficiency of the Urban Heating and Hot Water Supply (UNDP)
- Armenia Energy Efficiency Project (IBRD)
- LGGE Improving Energy Efficiency in Buildings (UNDP)

World Bank:

- Urban Heating Project – Armenia
- Electricity Supply Reliability and Energy Efficiency Project

INOGATE Programme:

- Harmonization of gas and oil technical standards and practices (E. Europe and Caucasus)
- Capacity-building for Energy Regulators in Eastern Europe and Central Asia
- Capacity building for Sustainable Energy Regulation in Eastern Europe and Central Asia
- Harmonization of electricity standards

EBRD:

- Armenian Sustainable Energy Financing Facility (ArmSEFF)

USAID:

- Commercialization of Energy Efficiency Project (CEEP)

International Finance Corporation:

- Armenia Energy Efficiency Survey Project

Millennium Challenge Account–Armenia (MCA–Armenia):

- Irrigated Agriculture Project

A more detailed list with a short description of the mentioned projects is provided in the Annex 3: List of relevant donor projects and programs ongoing and of past of this document.



### 3 Defining Targets for the Implementation of the EEAP

Armenia can save greatly by investing in energy efficiency. The 2008 World Bank Study found that Armenia could save 132 billion Armenian Dram (AMD) annually, equivalent to roughly 4.95 percent of its GDP, through energy efficiency investments. This is equal to energy savings of approximately 1.21 mtoe annually, or 1 TWh of electricity and 600 million m<sup>3</sup> of natural gas.

Apart from the generated energy and cost savings, energy efficiency is one necessary condition to diversify Armenia's energy supply and thus improve economic competitiveness. And this can be achieved at less cost than investing into new production capacities or energy imports. Energy efficiency investments are in general economically and financially viable, especially the public sector investments provide the highest return on investment overall.

#### 3.1 *Setting the path for Energy Efficiency in Armenia until 2020*

The action plan is proposing a set of relevant measures to the Government of Armenia for improving the current legal status and enforcement of legislation put in place, for capacity-building (mainly in the public sector) and institutional setting, for creating awareness across all sectors and a general environment that is more in favour of energy efficiency improvement in the following sectors:

- residential buildings
- public and private service sector
- industry
- transport
- agriculture

The overall time frame for **implementation of the action plan** is considered to be a period of ten years, **from 2010 until 2020**. Due to the fact that several measures have a longer duration, e.g. considering enforcement periods or reaction time until market actors are 'ready' to implement energy saving measures in the mentioned sectors, the action plan needs to consider medium to long term planning.

For the purpose of the first Energy Efficiency Action Plan (EEAP) presented here, apart from the list of measures, **intermediate national energy savings targets** for the following periods of implementation have been proposed. These intermediate targets shall define realistic savings as a percentage of the baseline demand to be achieved in the relevant target year, consistent with the overall national indicative energy savings target referred to in Table 1.

Regular **monitoring and evaluation** of measures shall provide the Government and involved stakeholders with a clear view if the implementation is in line with the

proposed time frame, if the intermediate energy savings targets are being achieved or if increased efforts are to be made to get back on the implementation path.

It is therefore foreseen that the Ministry of Energy shall submit to the Government the following updated EEAPs:

- a second EEAP not later than 30 June 2012 (considering implementation status until end 2011),
- a third EEAP not later than 30 June 2015 (considering implementation status until end 2014),
- a fourth EEAP not later than 30 June 2018 (considering implementation status until end 2017),
- and a fifth EEAP not later than 30 June 2021 (considering implementation status until end 2020).

All EEAPs shall describe the energy efficiency improvement measures planned and realised to reach the targets set out in Table 1.

The following EEAPs shall as well:

- include a thorough analysis and evaluation of the preceding EEAP;
- include the final results with regard to the fulfilment of the energy savings targets set out in Table 1;
- include plans for – and information on the anticipated effects of – additional measures which address any existing or expected shortfall vis-à-vis the target;
- use and gradually increase the use of efficiency indicators and benchmarks, both for the evaluation of past measures and estimated effects of planned future measures;
- be based on latest available data, supplemented with estimates.

### **3.2 *Baseline energy consumption and calculation of the national EE target***

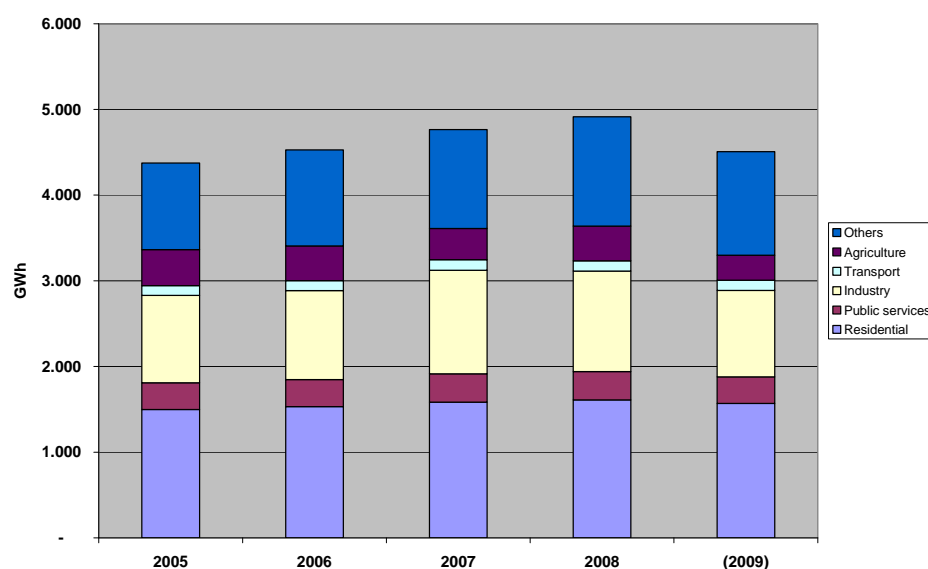
Armenia imports nearly two-thirds of its energy demand, mainly natural gas and oil, and mostly from a limited number of foreign suppliers. On the other hand it currently benefits from an electricity surplus produced from own hydro power plants, one nuclear power plant and several thermal power plants. From 2001 until 2008, the amount of electricity consumed grew steadily at about 6% p.a, which is less than the annual GDP growth average of 9-10% p.a. Other fuels used for residential heating, process heat, transportation and as fuel source for power plants have also steadily increased, in total about 7% p.a. between 2001 and 2008<sup>2</sup>. The main fuel type is natural gas. In 2009, the preliminary figures show a decline due to general economic crisis of electricity demand by about 8% and of gas demand by almost 22%, compared to 2008.

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<sup>2</sup> source: *National Program on Energy Saving and Renewable Energy, Armenian Energy Institute*

The following charts provide an overview of the electricity consumption and gas consumption in the last 5 years (2005-2008, 2009 preliminary figures) that account for estimated 75% of the total energy demand<sup>3</sup>. For the other sources, no suitable data is available.

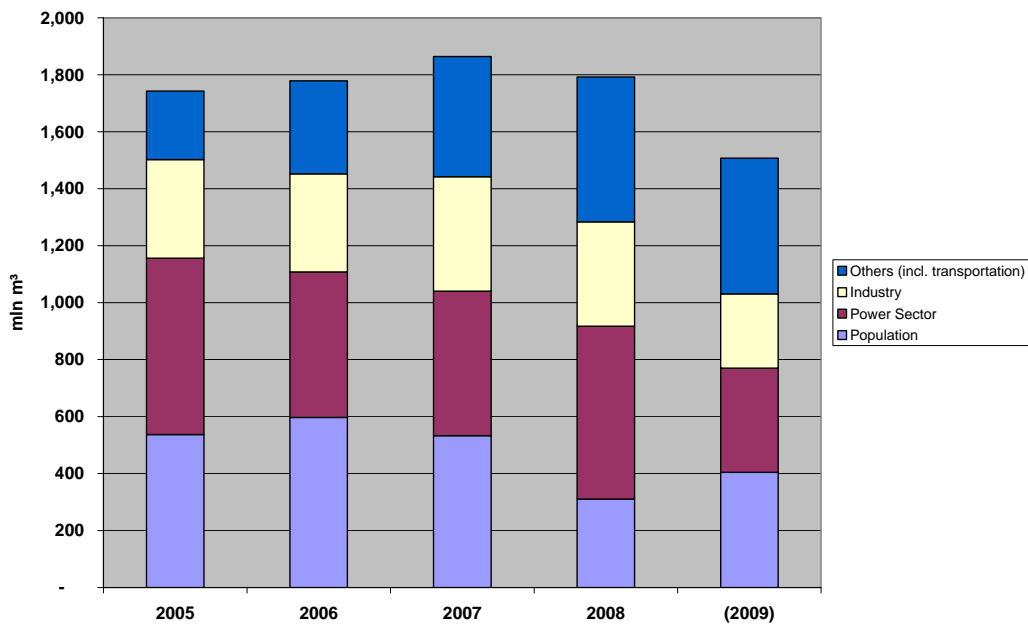
Chart 1: Electricity demand of main sectors 2005-2009 (prelim.)



Source: Armenian Scientific Energy Institute

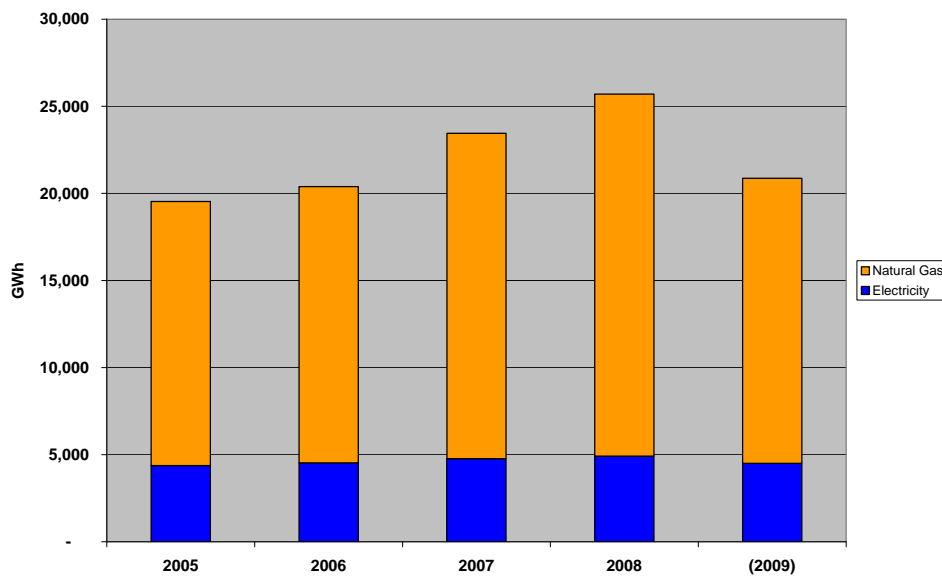
Chart 2: Natural gas demand of main sectors 2005-2009 (prelim.)

<sup>3</sup> source: 2005 data provided in National Program on Energy Efficiency and Renewable Energy



Source: Armenian Scientific Energy Institute

Chart 3: Total electricity and gas demand 2005-2009 (prelim.)



Source: Armenian Scientific Energy Institute

In the National Program on Energy Efficiency from 2007, the Armenian Scientific Energy Institute and the Energy Design Institute (Damare CJSC) provided an assessment of sectoral consumption data for the main user sectors (for 2001-2005).

However, what is missing since 1989, the last year when the energy balance was prepared, is a detailed annual energy supply and demand survey for all main sectors of economy that provides data on the annual final inland energy consumption of all energy users for the most recent years, including data on:

- energy supply (import, production, inventory changes)
- energy transformation (primary and secondary transformation processes)
- final energy demand of all relevant sectors
- useful energy demand according user categories (residential heating, industrial heat demand, stationary engines, lighting, air-conditioning, etc.)

Due to the missing basic data and with the information made available from different sources, it is at the moment not possible to draw a realistic baseline scenario that will provide a sound base to estimate absolute savings to be achieved in the target year.

Therefore, this first EEAP provides only an estimation of annual savings in relative terms (% p.a.) compared to the energy demand of the relevant sector (to be defined) where the proposed measures is part of.

As soon as detailed energy balances will become available, i.e. final energy demand per sector (in absolute terms), the second EEAP (2012) will have to update this information and provide relevant data on the calculation of the national energy saving target for the year 2020 as well as intermediate targets for the years 2011, 2014 and 2017, as proposed in the template provided in Annex 1.

The table below provides a summary of estimated energy efficiency savings that shall be reached by the implementation of measures proposed in the chapters 5 and 6.

Table 1: Estimated annual savings per measures in % (2011-2020) compared to final energy consumption baseline

Sector/Measure	Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure			
	2008	2009	2010	average 2008-2010	annual/ cumulated	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	[in %]	in TJ		
	[in TJ]	[in TJ]	[in TJ]	[in TJ]	savings	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]		
<b>I. Horizontal measures</b>																	0,0%	n/a	
I.1	Implementation of a regular national "Energy Statistic" (with annual updates)																	0,0%	n/a
I.2	Implementation of a "National Energy Agency for Energy Efficiency and Renewable Energy"																	0,0%	n/a
I.3	Financial Support for Energy Efficiency measures in all sectors																	0,0%	n/a
I.4	Information campaigns, training and education in the area of energy efficiency improvements	n/a	n/a	n/a	n/a													0,0%	n/a
I.5	Amendments to existing Energy Law and Law on Energy Saving and Renewable Energy																	0,0%	n/a
I.6	Removing inadequate gas & electricity tariff structure to encourage energy savings																	0,0%	n/a
I.7	Public Procurement for Energy Efficiency																	0,0%	n/a
<b>II. Building sector</b>						<b>annual</b>	<b>0,0%</b>	<b>0,5%</b>	<b>0,8%</b>	<b>1,4%</b>	<b>1,8%</b>	<b>2,5%</b>	<b>3,0%</b>	<b>3,7%</b>	<b>4,5%</b>	<b>5,0%</b>			
						<b>cumulated</b>	<b>0,0%</b>	<b>0,5%</b>	<b>1,3%</b>	<b>2,7%</b>	<b>4,4%</b>	<b>6,9%</b>	<b>9,9%</b>	<b>13,5%</b>	<b>18,0%</b>	<b>23,0%</b>	<b>23,0%</b>	<b>n/a</b>	
II.1	National Building Code considering energy performance of buildings						0,0%	0,3%	0,4%	0,5%	0,6%	0,7%	0,7%	0,8%	1,0%	1,0%	6,0%	n/a	
II.2	Standards and calculation methodology to assess energy performance in buildings																		
II.3	Institutional capacity-building for implementing and enforcing new standards						0,0%	0,1%	0,2%	0,3%	0,4%	0,5%	0,6%	0,7%	0,8%	0,9%	4,5%	n/a	
II.4	Establishing quality assurance/quality control (QA/QC) standards that will support the certification of key building materials for energy performance.						0,0%	0,1%	0,2%	0,3%	0,4%	0,5%	0,6%	0,7%	0,8%	0,8%	4,4%	n/a	
II.5	Set up road-test procedures for building certification and methodology for assessment of energy performance for pilot buildings						0,0%	0,0%	0,0%	0,1%	0,1%	0,2%	0,2%	0,3%	0,4%	0,4%	1,7%	n/a	
II.6	Training and education in correspondance with the promotion of integrated building design approach and new energy performance requirements in buildings	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,1%	0,2%	0,3%	0,3%	0,4%	0,4%	0,5%	2,1%	n/a	
II.7	Pilot Project: Design competition and construction of several "best-practice" buildings (e.g. school or other public building, and a multi-family house) in Yerevan and another larger city, using an integrated building design approach within available budget and time schedule for the construction of a typical building.						0,0%	0,0%	0,0%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,5%	n/a	
II.8	Development of an incentive scheme to promote energy efficient construction or reconstruction in residential and service buildings						0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,5%	0,7%	1,0%	1,3%	3,8%	n/a	

Sector/Measure		Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure	
		2008	2009	2010	average 2008-2010	annual/ cumulated	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	[in %]	in TJ
		[in TJ]	[in TJ]	[in TJ]	[in TJ]		[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]		
<b>III.</b>	<b>Public &amp; Private Service Sector</b>					annual	0,0%	0,2%	0,4%	1,1%	1,1%	1,5%	1,8%	2,3%	2,8%	3,4%		
						cumulated	0,0%	0,2%	0,6%	1,7%	2,8%	4,3%	6,1%	8,4%	11,2%	14,6%	14,6%	n/a
III.1	Information campaigns on several issues of energy efficiency to be applied in public and private service buildings	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,5%	0,5%	0,7%	0,9%	1,1%	1,3%	1,5%	6,5%	n/a
III.2	Provision of efficient energy services in public lighting	n/a	n/a	n/a	n/a		0,0%	0,2%	0,4%	0,6%	0,6%	0,7%	0,7%	0,8%	0,8%	1,0%	5,8%	n/a
III.3	Monitoring of energy consumption and achieved savings in service buildings	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,2%	0,4%	0,7%	0,9%	2,3%	n/a
<b>IV.</b>	<b>Industry sector</b>					annual	0,7%	1,3%	2,0%	2,7%	3,4%	4,3%	5,4%	6,4%	7,2%	8,2%		
						cumulated	0,7%	2,0%	4,0%	6,7%	10,1%	14,4%	19,8%	26,2%	33,4%	41,6%	41,6%	n/a
IV.1	Considering energy efficiency aspects during approval and construction of new industrial facilities	n/a	n/a	n/a	n/a		0,0%	0,1%	0,2%	0,3%	0,5%	0,5%	0,8%	0,8%	1,0%	1,0%	5,2%	n/a
IV.2	Increasing the efficiency of the central heating plants and suppliers	n/a	n/a	n/a	n/a		0,1%	0,2%	0,4%	0,4%	0,5%	0,6%	0,8%	1,0%	1,2%	1,6%	6,8%	n/a
IV.3	Implementation of Energy Efficiency Financing Facility for Industrial Enterprises	n/a	n/a	n/a	n/a		0,0%	0,2%	0,4%	0,6%	0,6%	0,8%	0,8%	1,0%	1,0%	1,2%	6,6%	n/a
IV.4	Natural gas savings through improvement of transmission pipelines and substations, and optimisation of existing boiler houses in thermal power plants	n/a	n/a	n/a	n/a		0,3%	0,4%	0,5%	0,7%	0,9%	1,2%	1,5%	1,8%	2,0%	2,2%	11,5%	n/a
IV.5	Electricity savings through improvements of existing electricity network, compensation of reactive power and improvement of transformers	n/a	n/a	n/a	n/a		0,3%	0,4%	0,5%	0,7%	0,9%	1,2%	1,5%	1,8%	2,0%	2,2%	11,5%	n/a
<b>V.</b>	<b>Transport sector</b>					annual	0,1%	0,7%	0,9%	1,4%	1,7%	2,0%	2,3%	2,5%	2,8%	2,9%		
						cumulated	0,1%	0,8%	1,7%	3,1%	4,8%	6,7%	9,0%	11,4%	14,2%	17,1%	17,1%	n/a
V.1	Development of legislative background regarding fuel efficiency and emission norms of vehicles	n/a	n/a	n/a	n/a		0,0%	0,5%	0,5%	0,8%	0,8%	0,9%	0,9%	1,0%	1,0%	1,0%	7,3%	n/a
V.2	Dissemination of information on technologies and approaches for reducing energy consumption effectively	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,1%	0,2%	0,3%	0,3%	0,4%	0,4%	0,5%	2,1%	n/a
V.3	Continuous exchange of mini buses by larger passenger buses operated by natural gas	n/a	n/a	n/a	n/a		0,1%	0,2%	0,3%	0,3%	0,4%	0,4%	0,5%	0,5%	0,6%	0,6%	3,9%	n/a
V.4	Expansion and modernisation of the electrified public transport system in the City of Yerevan	n/a	n/a	n/a	n/a		0,0%	0,0%	0,1%	0,1%	0,2%	0,2%	0,3%	0,3%	0,4%	0,4%	2,0%	n/a
V.5	Expansion and modernisation of rail transport network (passenger and freight)	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,1%	0,2%	0,2%	0,3%	0,3%	0,4%	0,4%	1,8%	n/a
<b>VI.</b>	<b>Agricultural sector</b>					annual	0,2%	0,2%	0,3%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%		
						cumulated	0,2%	0,4%	0,7%	1,1%	1,5%	1,9%	2,3%	2,7%	3,1%	3,5%	3,5%	n/a
VI.1	Utilization of gravity flow in irrigation systems and modernisation of existing pumping stations and upgrading secondary and tertiary canals	n/a	n/a	n/a	n/a		0,2%	0,2%	0,3%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%	3,5%	n/a
<b>VII.</b>	<b>Total</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>												<b>n/a</b>	<b>n/a</b>

The proposed sectoral energy savings are based on potential assessments and have been adjusted to the target year. They are shown in Table 2 and further explained in the following chapters 5 and 6.

*Table 2: Estimated energy savings cumulated for each sector until 2020*

<b>Energy saving target adopted in 2020:</b>		
<b>Residential/Households</b>	<b>in %</b>	23,0%
<b>Industry</b>	<b>in %</b>	41,6%
<b>Transport</b>	<b>in %</b>	17,1%
<b>Public and commercial services</b>	<b>in %</b>	14,6%
<b>Agriculture</b>	<b>in %</b>	3,5%

Source: own calculations



## 4 Addressing Barriers for Energy Efficiency in Armenia

Different studies conducted in recent years show significant potential for Armenia to save both energy and money by investing in energy efficiency<sup>4</sup>. Potentials are addressing mainly all sectors of economy showing high economic benefit for investive and non-investive measures to be taken in the future.

Armenia has taken important steps to encourage more efficient use of energy, but many more steps must still be taken. However, the potential is mainly untackled due to a number of reasons that can be summarized in a list of barriers to addressing energy efficiency:

- The legal framework needs to be implemented and enforced. Especially in the building sector the existing building code needs binding provisions regarding thermal quality of new and existing buildings and enforced standards and methodologies to assess energy performance in buildings.
- Creating awareness about energy efficiency needs a lot of information and know-how provided to all energy consumers (private, business, service sector, etc.). Yet, there is a weak institutional setting in Armenia of communicating energy efficiency with profound capacity, e.g. through a National Agency or NGOs.
- Private consumers (i.e. households) miss general and simple information on what can be done to reduce energy demand in the daily life, such as in housing, use of electric appliances, transportation etc.
- Many political decision-makers and private businesses still fail to see the value in energy efficiency investments, despite the successes of donor-sponsored pilot projects and programs, because of missing awareness, sufficient current energy supply and to a certain extent because they simply lack information on energy consumption for and energy potentials in the main sectors.
- The natural gas tariff encourages wasteful use by some smaller customers. There tariff structure does not provide an incentive for consumers to use less energy. Furthermore, there are no other financial incentives available that would encourage saving energy.

The action plan presented in the next chapters of this document will address these main barriers and provide a set of selected instruments and action to overcome the main legal, institutional, decision-making and information barriers.

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<sup>4</sup> e.g. compare “National Program on Energy Saving and Renewable Energy of RA” (2007) or World Bank Study on “The Potential for Improving Energy Efficiency in Armenia” (2008)

## 5 Horizontal and cross-sectoral measures

### 5.1 Overview of horizontal and cross-sectoral EEI measures

<b>Target:</b>	Provide the necessary institutional setting and capacity to implement the Armenian Energy Efficiency Action Plan and ensure continuous evaluation and monitoring of activities
<b>Target group:</b>	Legislative bodies

Energy efficiency is not merely a matter of a single sector. Many measures are intertwined and mutually supportive. Energy efficiency measures affecting several or all energy consumption sectors are reflected within the horizontal activities. The main objective is to build up the necessary institutional capacities that will ensure an established structure for the implementation of the action plan.

The measures proposed are to focus on cross-sectoral issues for a wide range of user target groups:

- Legal aspects: integration of the EEAP into existing energy policies (e.g. amending the Law on Energy Efficiency and Renewable Energy by taking the action plan as one main instrument for implementation into consideration); and the necessary reinforcement of the national energy statistic. The issue of public procurement of energy efficient equipment is mainly to provide public purchasers with technical specifications and the necessary “good will” to consider the acquisition of energy efficient products and services by spending public money.
- Institutional setting: installation of a National Energy Agency. The main responsibility for taking political action will stay with the Ministry of Energy (legislation and policy making), while the new Agency will implement, coordinate implementation, evaluate and regularly report EEAP and give also technical expertise to government in developing policies. The institutional building will also require additional personnel capacities within the responsible unit of the Ministry of Energy (Division of energy efficiency) and special training should be provided for new employees in international energy efficiency practices and strategies (training financed by R2E2 and UNDP/GEF, employees salaries from state budget).
- Awareness, information campaigns and technical assistance/training on energy topics shall be enforced. It is a measures which is very long-lasting and needs to be reinforced all the time (through specific campaigns and built-up of proper material and media)

The described horizontal and cross-sectoral measures will factually not create any energy saving per se, but will be the main driver for achieving savings under the following sectoral measures described in chapter 6.

Table 3: List of horizontal and cross-sectoral measures under the Armenian NEEAP

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority
I.1	Implementation of a regular national "Energy Statistic" (with annual updates)	<p>Since 1989, there is no regular energy balance produced for Armenia. A government decree was approved in 2007 to prepare a national energy balance sheet, yet however, the decree has not been implemented.</p> <p>Necessary actions:</p> <ul style="list-style-type: none"> <li>o Build-up of personal capacities at the National Statistics Office</li> <li>o Technical assistance and training of dedicated staff to implement energy statistics according to international standards and methods (e.g. compliance with IEA)</li> <li>o Performance of sectoral surveys and analysis (households, industry, service sector, etc.), including survey of changes over the years</li> <li>o Regular update (i.e. annually) and publication</li> <li>o Elaboration of a energy balance "baseline" year (e.g. 2010) that will reflect the new methodology and provide detailed energy supply and consumption sectoral data and will serve as a basis for evaluating progress of EEAP in the future</li> </ul>	Ministry of Energy National Statistics Office	State budget EU-Inogate Programme (Technical Assistance) World Bank (GEF Grant)	2010 - 2011	High

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority
I.2	Implementation of a "National Energy Agency for Energy Efficiency and Renewable Energy"	<p>In connection with the implementation of the National Energy Efficiency Action Plan, it is necessary to embed the EEAP into a institutional setting for co-ordination and monitoring of progress made.</p> <p>The government has already established the "R2E2" (Renewable Energy and Energy Efficiency Fund) for facilitating investments in energy efficiency and renewable energy activities in Armenia. The Fund could act formally as Energy Agency with the following tasks to be additionally assigned:</p> <ul style="list-style-type: none"> <li>o Co-ordinate and manage the activities to be implemented under the Armenian EEAP</li> <li>o Regularly evaluate progress of measures implemented under the EEAP against defined baseline consumption</li> <li>o Prepare regular reports and monitoring of EEAP activities (e.g. every 2-3 years)</li> </ul> <p>Furthermore, the Energy Agency shall be co-ordinating the following activities:</p> <ul style="list-style-type: none"> <li>o developing short-term and long-term energy efficiency programs;</li> <li>o coordinating the energy efficiency activities in different branches of economy;</li> <li>o conducting information campaigns</li> <li>o developing energy efficiency standards</li> <li>o conducting certification and labelling;</li> <li>o certifying and/or licensing energy auditors;</li> </ul>	Ministry of Energy	World Bank (GEF Grant) Own funds of R2E2	2010 - 2012	High

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority
I.3	Financial Support for Energy Efficiency measures in all sectors	<p>Due to a primary lack of funding means provided by the national budget, it is a key task to provide properly adapted complementary funding of energy efficiency measures through providing all kind of private sector and donor funding to financially support the planning and realisation of energy efficiency measures. This could be done through the following mechanisms:</p> <ul style="list-style-type: none"> <li>o non-repayable grants for capacity-building/training activities and partly for financing investments</li> <li>o Instalment of a kind of revolving fund for public (state-regional-municipal level) investment projects, where the relevant public institution gets as a remuneration the possibility to make use of the annual savings to reinvest into further EE measures, rather than undergoing usual budget cuttings due to energy cost savings in the following year.</li> <li>o On-lending programmes for households, industry, SME etc. Special investment credits given from state to the banks with medium to long term maturity and low interest will allow market to implement EE measures (shared risks, new tool for financial market)</li> <li>o ensuring the budget for the realisation of particular flagship energy efficiency projects in industry, public &amp; private services or residential buildings.</li> <li>o support for development of energy services (e.g. ESCOs) - training programmes</li> </ul>	Ministry of Energy	Provision of credit lines and grant programmes from international financing institutions (UN, World Bank, EBRD, IMF, KfW, etc.) and development assistance (e.g. EU, USAID, bilateral programmes)	2010-2020	High

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority
I.4	Information campaigns, training and education in the area of energy efficiency improvements	<p>Organising and running information campaigns and educational projects on energy efficiency and financial support for actions relating to the promotion of energy efficiency.</p> <ul style="list-style-type: none"> <li>o Run nationwide campaigns on efficient energy use.</li> <li>o Organise and run information campaigns on the desirability of and savings from the use of the most energy efficient products. Campaigns will be targeted towards encouraging specific actions, e.g. residential buildings: optimising new construction (thermal requirements, integrated building design, use of optimised equipment for lighting, household appliances, heating-systems incl. pumps etc.) or ways to improve existing buildings cost-effectively</li> <li>o Information and education actions aimed at changing consumer behaviour and increasing social acceptance of solutions that improve energy efficiency in households, tertiary sector and</li> <li>o Encourage providers and consumers to pay more attention to energy efficiency labelling and to the energy consumption of products bought and sold.</li> <li>o Training for sales staff as regards energy efficiency labelling and product life cycle costs.</li> <li>o Creation of a training system for energy efficiency specialists within tertiary education, as part of various disciplines.</li> <li>o Introduction of energy efficiency subjects into education programmes at all levels.</li> </ul>	Ministry of Energy (later: National Energy Agency)	State budget International donors (e.g. UNDP/GEF, World Bank) Private sponsorship	2010-2020 ongoing process	Medium

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority
I.5	Amendments to existing Energy Law and Law on Energy Saving and Renewable Energy	The Energy Efficiency Action Plan of the Republic of Armenia has to be implemented into existing legislation and by-laws (decrees) to ensure its recognition and governmental commitment for implementing the actions and measures foreseen in this action plan and ensure the institutional setting.	Ministry of Energy	State budget	2010-2011	High
I.6	Removing inadequate gas & electricity tariff structure to encourage energy savings	<p>The current natural gas tariff discourages energy savings for smaller gas consumers. Consumers who consume more than 10,000 m<sup>3</sup> per month enjoy a tariff which is roughly half the tariff for customers who consume below that level. This tariff structure provides incentive to some small consumers who are near the 10,000 m<sup>3</sup> per month level of consumption to use more gas solely for the purpose of putting themselves in the lower tariff category.</p> <p>There have been several attempts to discuss improvements in the tariff structure between the Gas company and PSRC, and a study was prepared under the GEF project "Armenia – Improving Energy Efficiency of Municipal Heating and Hot Water Supply" initiated by UNDP/GEF to provide fundamentals for revision of the Natural Gas Pricing and Tariff Setting Principles.</p> <p>Simultaneously, the inadequacies in the setting of the electricity tariff shall be also overcome by setting up a consumer oriented tariff structure (e.g. providing day and night tariffs) to encourage energy savings.</p>	Ministry of Energy, Public Service Regulatory Commission	State budget	2010-2011	Medium

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority
1.7	Public Procurement for Energy Efficiency	<p>Public procurement contracts must include energy efficiency aspects when buying products, services or works. Specific criteria for public authorities and contracting parties need to be prepared, such as technical specifications and evaluation criteria for the purchase of public goods, works and services in all sectors, e.g. in the fields of:</p> <ul style="list-style-type: none"> <li>o (re)construction of buildings</li> <li>o lighting</li> <li>o ICT and office equipment</li> <li>o air-conditioning and cooling</li> <li>o household appliances (e.g. refrigerators, washing machines, coffee-machines)</li> <li>o vehicles</li> </ul> <p>At the same time it should be ensured that the annual planning of public budgets - especially when taking into consideration necessary investments into infrastructure - construction, purchase of equipment, etc. - should consider energy efficiency aspects already in the budgeting phase.</p>	<p>Public Procurement Agency (under Government) Ministry of Energy, Ministry of Finance, Ministry of Urban Development</p>	Relies to purchase of goods, works and services made from state/municipal budget	2012-2015	Medium



## 6 Sectoral presentation and assessment of energy efficiency improvement programmes, energy services, and other measures to improve energy efficiency

### 6.1 *Energy efficiency improvement measures in the building sector*

<b>Overall Target:</b>	Reduction of the amount of energy used for heating and cooling while ensuring thermal comfort, and reduction of energy consumption in the preparation of hot water; implementation of the necessary legal and institutional framework; provision of large-scale information and awareness raising campaigns amongst all stakeholders
<b>Target group:</b>	Owners, tenants and operators of buildings (family houses, residential buildings, office buildings, healthcare facilities), architects, planners, construction companies, legislative bodies

#### 6.1.1 *General introduction on the building sector*

Almost all the Armenian housing stock has been constructed during Soviet period some 35-60 years ago without any regard to energy efficiency. Many of these buildings are now in obsolete condition and do not provide for minimum hygienic and comfort living conditions. Energy use per square meter is almost 3-5 times higher than in EU and varies between 320 and 690 kWh/m<sup>2</sup> per year.

Also at present construction works in Armenia are performed more or less according to former Soviet practices and norms that almost do not involve buildings' energy performance and improvement issues. Such designs and construction works result in excessive energy consumption and growing amount of GHG emissions.

Currently, residential and public buildings in the country are of low thermal-technical performance resulting in growing demand for and consumption of thermal energy. Buildings' low thermal technical performance reflects insufficient heat conduction resistance of building envelope and unnecessary expansion of glass cover. Besides, state supervision of mandatory implementation of current norms is absent. Armenia has voted for Intergovernmental construction norm MSN 2.04-02-2004 "Thermal Insulation of the Buildings," developed by Intergovernmental Normative-Technical Commission on Standards and Certification in Building Sector of CIS, however it has not been adopted and applied in Armenia.

According to preliminary research, via efficient thermal insulation of residential and public buildings, it is possible to reduce energy consumption for heating at least by 20-40%.

New housing stock is largely privately owned and often built with limited financial means, leading to the use of inadequate building materials. It is therefore recommended to put an emphasis on low- and no-costs energy efficiency measures to

overcome the lack of finance, while strengthening enforcement of the new building regulations.

Used building materials are rarely certified or labelled for thermal quality, while imported materials and components lack labels or are labelled in an inconsistent manner. There is some potential for developing domestic materials, and a domestic production of quality construction materials could be developed through the use of licenses for foreign components. However, this would require substantial investments in plants capacity, technology adaptation, training and marketing that seem to be premature at this stage, given limited market size. Such investments would only be viable when the standards enforcement capacities are in place, and when a real demand is effective on the market.

Since 2004, Armenia is involved in the European Neighbourhood Policy (ENP). The implementation of ENP action plan was approved in 2006 and is to contribute to harmonization of Armenian legislation, norms and standards with EU criteria. In this regard, improvement of energy efficiency of buildings and constructions also needs paying attention to EU directives.

According to EU Directive on “Energy Performance of Buildings”, cap values of energy consumption in buildings, buildings’ efficiency rankings, specific consumption of thermal energy for heating etc. should be identified upon discretion of each country based on climatic conditions, technical and demographic data.

At the same time, improvement of buildings’ energy efficiency level is reflected in certain provisions of the Armenian “Law on Energy Saving and Renewable Energy” and of the “National Program on Energy Saving and Renewable Energy”. In this context, the Armenian Ministry of Energy and Natural Resources, in cooperation with the “Armenia - Improving the Energy Efficiency of Municipal Heating and Hot Water Supply” UNDP/GEF project, initiated a harmonization process of standards relevant to the sector. The Project’s work plan for 2009-2010 includes harmonization issues to international and European standards.

#### *6.1.2 Overview of sector-specific measures*

Summarizing one can say that apart from climate, the energy consumption in this sector is significantly affected by the thermal-technical properties of buildings, the efficiency of heating and cooling systems, their regular inspection, maintenance and the behaviour of residents.

The main barriers in the building sector can be defined as follows:

- lack of available energy statistics and qualitative data on energy demand in the building sector
- appropriate legislation (codes, standards, norms) and its enforcement to induce energy efficient (re)construction,
- coherent strategy for building sector development and plans for new constructions and renovation of existing buildings,

- availability of funds to support EE investments (e.g. availability of a national grant scheme to support reconstruction of residential buildings),
- as well as knowledge and willingness of housing owners, planners, architects and operators of buildings to improve the quality of buildings and support residents in adopting energy efficiency user practices;

Therefore, the main target for the developing measures in the building sector can be specified as follows:

- upgrading existing legislation and all by-laws (standards, norms) to reflect the necessary efforts to be made in increasing the energy of buildings
- establish necessary capacities on the enforcement level
- train students at university and employees of companies in the planning/design and construction sector to comply with new integrated design and building standards
- develop pilot projects to demonstrate building best-practice (for rehabilitation and new buildings) and
- provide further incentives to promote energy efficient construction at all levels

A broad range of measures proposed for existing and new buildings will account for **approx. 23% of total energy savings of the building sector** projected under the Armenian EEAP by 2020.

The % savings attributed to each kind of measures is being demonstrated in Table 4. Marked red are the relevant intermediate energy saving target years, according to which the following energy savings are foreseen:

- 2011: 0%
- 2014: 2.7%
- 2017: 9.9%
- 2020: 23.0%

Table 5 provides a more detailed description of the measures of the building sector.

Table 4: Estimated savings per measure in the building sector from 2011-2020

Sector/Measure		Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure		
		2008	2009	2010	average 2008-2010	annual/ cumulated	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
		[in TJ]	[in TJ]	[in TJ]	[in TJ]	savings	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	in TJ
						annual	0,0%	0,5%	0,8%	1,4%	1,8%	2,5%	3,0%	3,7%	4,5%	5,0%			
<b>II.</b>	<b>Building sector</b>					<b>cumulated</b>	<b>0,0%</b>	<b>0,5%</b>	<b>1,3%</b>	<b>2,7%</b>	<b>4,4%</b>	<b>6,9%</b>	<b>9,9%</b>	<b>13,5%</b>	<b>18,0%</b>	<b>23,0%</b>	<b>23,0%</b>	<b>n/a</b>	
II.1	National Building Code considering energy performance of buildings						0,0%	0,3%	0,4%	0,5%	0,6%	0,7%	0,7%	0,8%	1,0%	1,0%	6,0%	n/a	
II.2	Standards and calculation methodology to assess energy performance in buildings						0,0%	0,1%	0,2%	0,3%	0,4%	0,5%	0,6%	0,7%	0,8%	0,9%	4,5%	n/a	
II.3	Institutional capacity-building for implementing and enforcing new standards						0,0%	0,1%	0,2%	0,3%	0,4%	0,5%	0,6%	0,7%	0,8%	0,8%	4,4%	n/a	
II.4	Establishing quality assurance/quality control (QA/QC) standards that will support the certification of key building materials for energy performance.						0,0%	0,0%	0,0%	0,1%	0,1%	0,2%	0,2%	0,3%	0,4%	0,4%	1,7%	n/a	
II.5	Set up road-test procedures for building certification and methodology for assessment of energy performance for pilot buildings	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,1%	0,2%	0,3%	0,3%	0,4%	0,4%	0,5%	2,1%	n/a	
II.6	Training and education in correspondance with the promotion of integrated building design approach and new energy performance requirements in buildings						0,0%	0,0%	0,0%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%	0,5%	n/a	
II.7	Pilot Project: Design competition and construction of several "best-practice" buildings (e.g. school or other public building, and a multi-family house) in Yerevan and another larger city, using an integrated building design approach within available budget and time schedule for the construction of a typical building.						0,0%	0,0%	0,0%	0,0%	0,3%	0,5%	0,7%	1,0%	1,3%	3,8%	n/a		
II.8	Development of an incentive scheme to promote energy efficient construction or reconstruction in residential and service buildings						0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,5%	0,7%	1,0%	1,3%	3,8%	n/a	

Table 5: List of measures in the building sector specified under the Armenian NEEAP

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
II.1	National Building Code considering energy performance of buildings	Adoption of a National Building code considering energy performance of buildings (compatible with international best practices, such as the European Energy Performance Building Directive) with regular revisions of the building code (e.g. all 3 years). The new code will consider the total building energy performance (including heating, hot water, air conditioning and ventilation) and set specific targets concerning the maximum energy demand of buildings. Construction permits are to be issued taking into consideration that all requirements according the new building code are applied.	Ministry of Energy, Ministry of Economy, Ministry of Urban Development	UNDP/GEF	2010 - 2012	High	
II.2	Standards and calculation methodology to assess energy performance in buildings	Elaborate and adopt national calculation methodology to determine building energy consumption based on standardized use and establish minimal requirements for thermal properties of a building, heating and air-conditioning systems, application of renewable energy sources and relevant design aspects of buildings (e.g. inclusion of passive solar elements).	Ministry of Energy, Ministry of Economy, Ministry of Urban Development	UNDP/GEF	2010 - 2012	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
II.3	Institutional capacity-building for implementing and enforcing new standards	Develop responsibilities and clear procedures within the responsible Ministry of Urban Development to address the enforcement of the new building energy efficiency codes and standards. Train staff to ensure compliance with the new code throughout design, construction and maintenance phases, through capacity building in energy audits. Define procedures and methodology for issuance of building energy passports and the types of buildings for which the passports will become compulsory.	Ministry of Urban Development	UNDP/GEF	2010 - 2012	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
II.4	Establishing quality assurance/quality control (QA/QC) standards that will support the certification of key building materials for energy performance.	Establish a mandatory testing system for the conformity of construction materials with building energy performance according to national standards. Establish performance requirements for materials produced locally or imported, which will allow builders and designers to make better informed decisions about the performance of the construction materials used in new buildings. Introduce a voluntary certification and labelling scheme for construction materials (e.g. windows, insulation, boilers, etc.) to provide incentives for high-quality materials to enter the Armenian market. Furthermore, national norms for QA/QC shall be established in manufacturing facilities and assistance for suppliers to comply with energy-efficiency related national standards	Ministry of Urban Development, Ministry of Economy	UNDP/GEF	2010 - 2012	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
II.5	Set up road-test procedures for building certification and methodology for assessment of energy performance for pilot buildings	Set up road-test procedures for building certification and methodology for assessment of energy performance for several pilot buildings (e.g. schools, residential buildings) to be constructed following integrated building design approach. Use experiences and outcomes from relevant projects, such as UNDP/GEF Project on "Improving the Energy Efficiency of Municipal Heating and Hot Water Supply" (UNDP/GEF/00035799)	Ministry of Urban Development	UNDP/GEF	2012 - 2014	Medium	



No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
II.6	Training and education in correspondance with the promotion of integrated building design approach and new energy performance requirements in buildings	Promotion of best energy design and construction practices in the construction sector: (1) Develop and introduce module on energy efficient building design in the curricula of University for Architecture and Construction and provide training assistance and other support materials (Teachers' Guide) for teaching staff; (2) Design and deliver training courses for staff in the field of building energy performance, solar architecture and applications for renewable energy sources in buildings; (3) Provide training courses for practicing architects and engineers concerning the application of the new codes and calculation methodologies; (4) Raise awareness of building constructors on economic, environment and social benefits of integrated building design and on locally available and tested technologies, materials and other EE applications in buildings (e.g. through public events at major construction events); (5) Organize information campaign for the general public promoting benefits of the new building code and the Energy Passport; (6) promote results of pilot buildings and integrated building design regularly through the national media;	Ministry of Education and Science	State budget Intl. donors	2010-2020	Medium	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
II.7	Pilot Project: Design competition and construction of several "best-practice" buildings (e.g. school or other public building, and a multi-family house) in Yerevan and another larger city, using an integrated building design approach within available budget and time schedule for the construction of a typical building.	Pilot project should cover the following: (1) low- or no-cost measures; (2) monitor energy performance of pilot buildings; (3) Adopt a new standard design for newly constructed buildings (e.g. schools) based on the ones applied in the pilot buildings; (5) introduce integrated energy efficient design methodology in all planned public construction (technical specifications for public procurement);	Ministry of Urban Development, Ministry of Education, Ministry of Finance, Technical Assistance from Donors	UNDP/GEF	2012 - 2014	Medium	
II.8	Development of an incentive scheme to promote energy efficient construction or reconstruction in residential and service buildings	Development of an incentive scheme for energy efficient construction or reconstruction. Provide appropriate and financially sound support mechanisms that would allow the building owners to comply with enhanced standards and simultaneously accept the opportunity to invest into cost-effective energy efficiency measures by realising visible benefits (e.g. small scale subsidy and financing schemes, support for energy passport)	Ministry of Energy, Ministry of Finance, with international donors and national banks	State budget Intl. donors	2012 - 2015	Low	

## 6.2 Energy efficiency improvement measures in the public and private service sector

<b>Target:</b>	Reduction, or minimisation of energy consumption in public and private service sector focussing on a various range of applications in buildings and public space (e.g. street-lighting, use of office equipment, air-conditioning)
<b>Target group:</b>	Public administration (ministries, towns/municipalities), public lighting operators, private office owners and tenants, employees in these companies

### 6.2.1 General introduction on the public and private service sector

The Armenian economy is agricultural-industrial oriented, with a developing service sector. The structure of 2004 GDP in Armenia is: 40% in industrial sector, 35% in service sector (including construction and transportation), and 25% in agriculture. The share of service sector is 1.5-2 times lower than in developed countries (50-70%).

The energy intensity index in the service sector of Armenia, 90.4 kg oe/\$1,000 USD is close to that of many developed and developing countries: Estonia, 91 kg oe/\$1,000 USD, Latvia, 99.7 kg oe/\$1,000 USD, Czech Republic, 114.8 kg oe/\$1,000 USD (see Figure 1). According to the “National Program on Energy Saving and Renewable Energy of Republic of Armenia” paper (2007), the developing service sector in Armenia is experiencing the same issues of energy efficiency as in developed countries and do not represent a high energy saving potential.

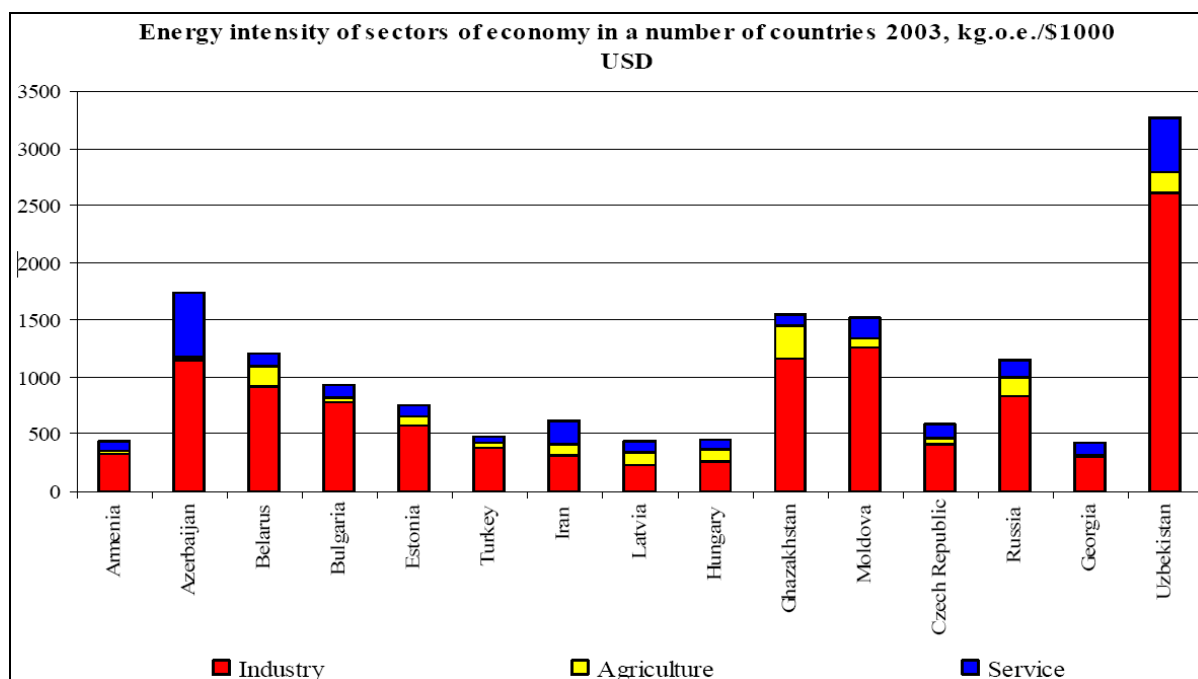


Figure 1: Energy intensity of economy in a number of countries in 2003, kg oe/thous.USD

Source: *Scientific Research Institute of Energy for the Alliance to Save Energy/USAID: "National Program on Energy Saving and Renewable Energy of Republic of Armenia"; Yerevan 2007 as by Key World Energy Statistics from IEA: <http://www.iea.org/dbtw-wpd/Textbase/stats/nmcbalancetable.asp>*

### 6.2.2 Overview of sector-specific measures

The operation of buildings is a relevant cost factor in the public sector due to the share of energy costs in the total budget. The general energy efficiency measures focusing on buildings are already specified in chapter 6.1.

In addition to the energy consumption in buildings, operation of lighting in buildings and public street-lighting in towns and municipalities contribute to the final energy consumption in the public sector. Lighting projects are mainly financed out of municipal budgets. However, incentives to implement efficiency measures are low, because usually the created energy cost savings are not flowing back into the municipality budget for operations. Finding ways and models to change this will definitely increase the interest in becoming more energy conscious.

As for street-lighting, the largest consumer in this area is the City of Yerevan, in other towns and municipalities the issue of street-lighting is of less importance, mainly due to absence of fully operated lighting-systems. Lighting in general is, to a large extent, being consumed inefficiently, which results from the use of obsolete light sources, unreliable regulation (switching, declining power supply voltage) and wrong positioning and location of light sources. Upgrading of public lighting will focus on the installation of modern highly efficient light sources for public lighting as well and reliable and efficient regulation and management of operation.

Apart from lighting, heating and cooling of buildings and use of various equipment (ICT, office equipment, household appliances used in offices etc.) are the most significant consumers in service buildings. Together with the improvement of the energy efficiency of mentioned equipment, efficient user behaviour constitutes for a large saving potential (from 20% to 60%, depending on the baseline) in this area.

The three measures proposed for the service sector can save up to **approx. 15% of total energy savings of sector** by 2020.

The % savings attributed to each kind of measures is being demonstrated in Table 6. The relevant intermediate energy saving target years, according to which the following energy savings are foreseen, are:

- 2011: 0%
- 2014: 1.7%
- 2017: 6.1%
- 2020: 14.6%

Table 7 provides a more detailed description of the measures of the building sector.

Table 6: Estimated savings per measure in the service sector from 2011-2020

Sector/Measure		Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure	
		2008	2009	2010	average 2008-2010	annual/ cumulated	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	[in %]	in TJ
		[in TJ]	[in TJ]	[in TJ]	[in TJ]	savings	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]
<b>III.</b>	<b>Public &amp; Private Service Sector</b>					annual	0,0%	0,2%	0,4%	1,1%	1,1%	1,5%	1,8%	2,3%	2,8%	3,4%		
						cumulated	0,0%	0,2%	0,6%	1,7%	2,8%	4,3%	6,1%	8,4%	11,2%	14,6%	14,6%	n/a
III.1	Information campaigns on several issues of energy efficiency to be applied in public and private service buildings	n/a	n/a	n/a	n/a		0,0%	0,0%	0,0%	0,5%	0,5%	0,7%	0,9%	1,1%	1,3%	1,5%	6,5%	n/a
III.2	Provision of efficient energy services in public lighting						0,0%	0,2%	0,4%	0,6%	0,6%	0,7%	0,7%	0,8%	0,8%	1,0%	5,8%	n/a
III.3	Monitoring of energy consumption and achieved savings in service buildings						0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,2%	0,4%	0,7%	0,9%	2,3%	n/a

Table 7: List of measures in the service sector specified under the Armenian NEEAP

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
III.1	Information campaigns on several issues of energy efficiency to be applied in public and private service buildings	<p>Office equipment and room ventilation and conditioning systems used in service buildings provide usually a great potential for energy efficiency through changing of user behaviour and optimising existing systems through energy efficient operation. The result are significant savings on the operation costs and higher user comfort. The advantages and types of measures to be adopted to optimise existing facilities and systems shall be transmitted through public information campaigns specifically addressing the following issues:</p> <ul style="list-style-type: none"> <li>- operating lighting in offices efficiently</li> <li>- use of office equipment (computers, printers, copiers, servers, etc.)</li> <li>- air-conditioning and ventilation</li> <li>- other household appliances used in offices (e.g. refrigerators, cookers, etc.)</li> <li>- availability of energy efficiency labels and how they can be used for purchasing decisions</li> </ul>	Ministry of Energy National Energy Agency		2010 – 2020 (continuous activity)	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
III.2	Provision of efficient energy services in public lighting	Defining minimum requirements for provision of lighting services in public space (e.g. safety conditions), including focus on energy efficiency of public lighting (e.g. learning from experiences made in City of Yerevan); provide consultancy and support to other Armenian municipalities and townships in the area of operation and upgrading of the public lighting systems; Provide examples of financing such projects through ESCOs	Ministry of Energy Municipalities	World Bank	2010 - 2015	Medium	
III.3	Monitoring of energy consumption and achieved savings in service buildings	"Energy accounting" or regular monitoring of energy consumption in public buildings is an important aspect to improve the consciousness regarding energy use. Many building operators however do not know about their building energy consumption and energy costs accrued. The idea is to support the introduction of building energy accounting to monitor energy consumption and savings in case of rehabilitations.	National Energy Agency	Building owners	2015 - 2020	Low	

### 6.3 *Energy efficiency improvement measures in industry sectors (including energy production)*

<b>Target:</b>	Reduction of energy intensity with respect to value-added production in the industry; optimisation of energy supply in the country's power plants and distribution network
<b>Target group:</b>	Stakeholders in industrial production and energy utilities

#### 6.3.1 *General introduction on the industry sector*

The 40% share of industry in the GDP (2004) of Armenia is close to the one in developed countries (30-40%).

The industry sector of Armenia has, as compared to other sectors, also a low energy intensity characteristic, 329.4 kg oe/\$1,000 USD, compared to the one for Uzbekistan, 2616 kg oe/\$1,000 USD, Estonia, 569 kg oe/\$1,000 USD, Moldova, 1264 kg oe/\$1,000 USD, and Georgia, 304 kg oe/\$1,000 USD (see Figure 1).

This means that the load of the energy intensive production is very low (e.g. "Nairit" factory, "Polyvinylacetate" factory, etc.), and that the share of production using modern energy efficient technologies is fairly high (food production, non-energy intensive production).

Nevertheless, it is necessary to make use of energy efficient technologies and production methods which make it possible to reduce energy intensity of the production in the main energy consuming industrial sectors (such as chemical industry, metallurgy), but also within the larger sector smaller and medium-sized companies.

#### 6.3.2 *Overview of sector-specific measures*

The measures to improve energy efficiency in the industry must be particularly targeted at energy demand, monitoring and management in the individual technological processes, introduction of innovative approaches primarily aimed at reducing the energy intensity of industrial production, and investments in energy efficiency in the selected industrial branches. In order for these measures to be effective, a change must occur in people's mentalities and behaviour. The National Program on Energy Saving and Renewable Energy has assessed a series of measures throughout the specific sectors, which need to be tackled.

Reference is therefore made to the existing potential analyses and studies, one of which was also prepared by the International Finance Co-operation (IFC), that is helping Armenian financial institutions develop sustainable energy finance products, thereby increasing renewable energy generation and lowering electricity waste and greenhouse-gas emissions. Another of these sustainable energy financing institutions



("ArmSEFF" programme, see Annex 3: List of relevant donor projects and programs ongoing and of past) is being developed by the EBRD (envisaged start: autumn 2010).

A focus is also to be given to the power and gas sector. Obsolete and old infrastructure, a high share of production and transmission losses are putting a pressure on the utilities to maintain their systems reliable and make them fit for the future – which is showing sharp increases of energy demand (up to 10% p.a. until 2020, once the "economic crisis" is over). Although there are several programs running with support from e.g. the World Bank, continuous improvement and maintenance of existing energy production and distribution facilities remains a high priority for ensuring a sustainable and reliable energy system. Together with the improvement of the infrastructure, measures to ensure the affordability of gas and electricity tariffs (as described as an improvement measure in chapter 5) have to be enforced.

*A summary of the critical measures proposed can be found in*

Table 9. The table is split into demand side measures on the one hand (i.e. efficiency measures at industrial users) and on the other hand on measures focussing on the supply side (looking for improvements in the supply and distribution of heat and electricity through utilities).

The targeted savings to be reached by 2020 are significant and could reach **approx. 42% of total energy savings of the industry (and energy production) sector.**

The % savings are also given in Table 8. The relevant intermediate energy saving targets are as follows:

- 2011: 0%
- 2014: 2.7%
- 2017: 9.9%
- 2020: 23.0%

Table 8: Estimated savings per measure in the industrial sector from 2011-2020

Sector/Measure		Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure	
		2008	2009	2010	average 2008-2010	annual/ cumulated	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	[in %]	in TJ
		[in TJ]	[in TJ]	[in TJ]	[in TJ]	savings	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]
<b>IV.</b>	<b>Industry sector</b>					annual	0,7%	1,3%	2,0%	2,7%	3,4%	4,3%	5,4%	6,4%	7,2%	8,2%		
						cumulated	0,7%	2,0%	4,0%	6,7%	10,1%	14,4%	19,8%	26,2%	33,4%	41,6%	41,6%	n/a
IV.1	Considering energy efficiency aspects during approval and construction of new industrial facilities	n/a	n/a	n/a	n/a		0,0%	0,1%	0,2%	0,3%	0,5%	0,5%	0,8%	0,8%	1,0%	1,0%	5,2%	n/a
IV.2	Increasing the efficiency of the central heating plants and suppliers						0,1%	0,2%	0,4%	0,4%	0,5%	0,6%	0,8%	1,0%	1,2%	1,6%	6,8%	n/a
IV.3	Implementation of Energy Efficiency Financing Facility for Industrial Enterprises						0,0%	0,2%	0,4%	0,6%	0,6%	0,8%	0,8%	1,0%	1,0%	1,2%	6,6%	n/a
IV.4	Natural gas savings through improvement of transmission pipelines and substations, and optimisation of existing boiler houses in thermal power plants						0,3%	0,4%	0,5%	0,7%	0,9%	1,2%	1,5%	1,8%	2,0%	2,2%	11,5%	n/a
IV.5	Electricity savings through improvements of existing electricity network, compensation of reactive power and improvement of transformers						0,3%	0,4%	0,5%	0,7%	0,9%	1,2%	1,5%	1,8%	2,0%	2,2%	11,5%	n/a

Table 9: List of measures in the industrial sector specified under the Armenian NEEAP

No	Title of the EEI measure	Description of measure	Responsibility	Funding Source	Duration	Priority	Estimated Energy Saving
<b>Demand side measures</b>							
IV.1	Considering energy efficiency aspects during approval and construction of new industrial facilities	When applying for permissions of new facilities (or in case of extensions/rehabilitations), the Government shall impose an obligation to introduce energy efficient technologies (or for rehabilitations ensuring the improvement of the energy efficiency of the existing system) and require regular inspections during the operation of the facilities. This would impose adaptations to existing legal background (Law on Energy, Law on Energy Efficiency and Renewable Energy).	Ministry of Economy??? PSRC	State budget	2010 - 2012	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding Source	Duration	Priority	Estimated Energy Saving
<b>Demand side measures</b>							
IV.2	Increasing the efficiency of the central heating plants and suppliers	<p>Similar to measure 1, the existing legislation shall be amended towards the obligation for heat producers and suppliers to comply with the rules of efficient operation of a system of heating facilities, e.g. operation meeting the energy efficiency indicators for heat generation and distribution facilities and normative heat consumption indicators, which means achieving optimum energy efficiency of a heating facility (also, e.g. by means of producing combined heat and power) (2) regular verification of the efficiency of the operation of a system of heating facilities (regular inspection).</p> <p>The National Agency of Technical Safety is doing such inspections already for larger boiler houses and installations, but just for safety reasons.</p>	Ministry of Economy???	State budget	2010 - 2012	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding Source	Duration	Priority	Estimated Energy Saving
<b>Demand side measures</b>							
IV.3	Implementation of Energy Efficiency Financing Facility for Industrial Enterprises	<p>As already in place in many CEE countries a TA programme and credit line for energy efficiency shall be implemented providing financing means to companies interested in improvements of energy efficiency of their technical processes. The implementation process works usually as follows: (1) performance of energy audits of industrial enterprises by external experts (TA - free assistance); (2) determining the energy savings potential; (3) preparing measures for technical processes improvements or restructuring the operation of enterprises; (4) loan agreements (with more favourable conditions offered through the Facility than the free market).</p> <p>Apart from the existence or implementation of such facility, specific awareness raising measures need to be put in place targeted at management and technical staff to show the benefits of energy efficiency investments:</p> <ul style="list-style-type: none"> <li>- decreased (energy) costs lead to higher competitiveness</li> <li>- improved technical processes leads to improved outputs and increased revenues</li> <li>- reduced company risk increases the value of the company</li> <li>- improving the environment will improve also the company image</li> </ul>	Ministry of Energy, (with support from European Bank for Reconstruction and Development)	EBRD, local banks	2010 - 2015	High	

No	Title of the EEI measure	end-use EEI action targeted	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
<b>Supply side measures</b>							
IV.4	Natural gas savings through improvement of transmission pipelines and substations, and optimisation of existing boiler houses in thermal power plants	<ul style="list-style-type: none"> <li>o Thermal insulation of existing transmission pipelines and substations would significantly reduce the losses of heat. Estimations show a saving potential of about 2% of total gas demand.</li> <li>o Through the optimisation of – mostly – outdated boiler technology in thermal power plants another 2% of total gas demand can be saved. Generally, the old technology of production units and distribution network will need to be subject for continuous improvement and maintenance</li> </ul>	Ministry of Energy, Armgazprom	World Bank	2010 - 2020	High	
IV.5	Electricity savings through improvements of existing electricity network, compensation of reactive power and improvement of transformers	<ul style="list-style-type: none"> <li>o Electricity transmission and distribution losses (of which most of the losses are at the distribution level) are considerably higher than the international standard of 6-7 percent, at roughly 15 percent. Investments into the network are necessary to reduce high amount of losses and thus contribute to safer supply of energy</li> <li>o Technical losses in the transformers and transformer substations as well as distribution lines are to be tackled, especially on the medium and low voltage systems</li> </ul>	Ministry of Energy, Electric Networks of Armenia	World Bank	2010-2020	High	

#### 6.4 *Energy efficiency improvement measures in the transport sector*

<b>Target:</b>	Reduction and minimisation of energy consumption in freight and passenger transport; increasing opportunities for public transport
<b>Target group:</b>	Traffic participants, transport route owners and operators, owners and operators of means of transport, state administration, local and regional governments

##### 6.4.1 *General introduction on the transport sector*

The provision of transport linkages and transit carriages has a key role for the development of trade-economic relations between countries. For all developing countries, especially those which are landlocked as Armenia, it is crucial to implement transit carriages in the light of the tariffs in use and to spur infrastructure development, modernization of available transport stock, etc. The transport policy of Armenia is conducted onwards the creation of integrated Euro-Asian transport network, elaboration of mechanisms for unification of legislative acts and other regulations. Currently, Armenia is implementing the necessary internal state procedures for joining to the existing agreements and conventions in the field of transport, which have been signed in the framework of UN Economic Commission for Europe.

The Republic of Armenia, which has a quite developed network of roads and railways, having into consideration the specific geographical situation of the country, extends major attention to the modernization of transport infrastructures and for attracting investments in the said sector, especially for the reconstruction of artificial facilities – bridges and tunnels. In regard with its effectiveness, high priority is given to the implementation of combined container carriages and modernization of container terminals.

Functioning and expansion of international transport corridors is one of the basic preconditions for the development of region. The Republic of Armenia, as whole South Caucasian region, is located on the crossroad of several transport corridors and has a great potential for the implementation of transit carriages. In the range of mentioned corridors, we have especially to emphasize international transport corridor Europe – Caucasus – Asia or so called Silk Road. TRACECA corridor, for about 10 years of its existence, has turned into the main linking conjunction, which connects Europe with Asia.

The major issue, however, remain the quite underdeveloped means of public transportation means across the country and especially within its largest city, Yerevan. Individual means of transportation are a huge traffic problem within the city (e.g. there a ten times more minibuses operated than regular larger buses), causing congestion and high emissions from this sector. Moreover, the electrified transport means, such as



railway, trolley buses or metro (one line in Yerevan) are playing a very limited role in transport means of the country.

#### *6.4.2 Overview of sector-specific measures*

The energy saving measures for the transport sector include the development of specific emission norms for vehicles in combination with some incentives to reduce the emission level, further the optimization of vehicles and routes, especially when it comes to the introduction of new energy efficient public transportation to force the replacement of old vehicles with newer, efficient ones, but still maintain the quite unique large share of gas driven cars in the world. One important aspect is related to the creation of awareness among drivers to drive cars efficiently and consider opportunities to reduce the amount of annual mileage. This shall be also supported by the increase of the public transport systems offered in the city of Yerevan.

The proposed measures in the transport sector will account for **approx. 17% of total energy savings projected under the Armenian EEAP**. The annual % savings including the intermediate energy saving targets up to 2020 are given in Table 10 as follows:

- 2011: 0.1%
- 2014: 3.1%
- 2017: 9.0%
- 2020: 17.1%

Table 10: Estimated savings per measure in the transport sector from 2011-2020

Sector/Measure		Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure	
		2008	2009	2010	average 2008-2010	annual/ cumulated	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	[in %]	in TJ
		[in TJ]	[in TJ]	[in TJ]	[in TJ]	savings	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]
<b>V.</b>	<b>Transport sector</b>					annual	0,1%	0,7%	0,9%	1,4%	1,7%	2,0%	2,3%	2,5%	2,8%	2,9%		
						cumulated	0,1%	0,8%	1,7%	3,1%	4,8%	6,7%	9,0%	11,4%	14,2%	17,1%	17,1%	n/a
V.1	Development of legislative background regarding fuel efficiency and emission norms of vehicles						0,0%	0,5%	0,5%	0,8%	0,8%	0,9%	0,9%	1,0%	1,0%	1,0%	7,3%	n/a
V.2	Dissemination of information on technologies and approaches for reducing energy consumption effectively						0,0%	0,0%	0,0%	0,1%	0,2%	0,3%	0,3%	0,4%	0,4%	0,5%	2,1%	n/a
V.3	Continuous exchange of mini buses by larger passenger buses operated by natural gas	n/a	n/a	n/a	n/a		0,1%	0,2%	0,3%	0,3%	0,4%	0,4%	0,5%	0,5%	0,6%	0,6%	3,9%	n/a
V.4	Expansion and modernisation of the electrified public transport system in the City of Yerevan						0,0%	0,0%	0,1%	0,1%	0,2%	0,2%	0,3%	0,3%	0,4%	0,4%	2,0%	n/a
V.5	Expansion and modernisation of rail transport network (passenger and freight)						0,0%	0,0%	0,0%	0,1%	0,2%	0,2%	0,3%	0,3%	0,4%	0,4%	1,8%	n/a

Table 11: List of measures in the industrial sector specified under the Armenian NEEAP

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
V.1	Development of legislative background regarding fuel efficiency and emission norms of vehicles	<p>In order to realise the significant potential for motor fuel savings in transportation, the economic advantages of cars with a smaller engine size and less fuel consumption shall be fostered.</p> <ul style="list-style-type: none"> <li>- Impose norms regarding fuel efficiency of new cars and restrictions of emissions (NOx, CO2, particulate matter, etc.).</li> <li>- Obligatory annual inspection of technical conditions of motor vehicles and evtl. suspension of driving permissions in case of non-compliance</li> <li>- Applying a differential tax rate for passenger cars depending on engine size and age for main fuel types (natural and liquid oil gas, diesel and gasoline) shall lead to increased awareness of users.</li> </ul>	Ministry of Transport Ministry of Economy	State Budget	2010 - 2012	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
V.2	Dissemination of information on technologies and approaches for reducing energy consumption effectively	Dissemination of information to users regarding updated legislation and on ways of economising petrol (e.g. change in air pressure in passenger car tyres, driving skills and others). Especially in the area of heavy traffic (trucks, buses) training of drivers for fuel efficiency shall be encouraged.	Ministry of Transport	State budget International donors	2012 - 2020	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
V.3	Continuous exchange of mini-buses by larger passenger buses operated by natural gas	<p>In total, there are about 2,800 mini-buses (10-12 seats) running on Yerevan's public bus routes, only about 300 larger buses (with 25-30 seats). They are operated by private companies that mostly use gas (90%) for driving them due to cheaper running costs. However, mini-buses are one reason for increasing traffic congestion in town which is becoming an environmental problem. The City's plan is to replace in the long-term 2 mini-buses by a large bus (also being operated by natural gas, currently at about 50%). This will bring fuel savings at higher capacity and contribute to reducing congestion. Estimated fuel savings is 20-25% per passenger-kilometer.</p> <p>The necessary measure is to adapt public tenders for operating bus routes, which are renewed every 4 years, and include large buses as compulsory vehicles. Fuel types have not been specified so far, but as gas is much cheaper than regular diesel or gasoline, the operators will prefer to run gas-operated buses anyway.</p>	City of Yerevan	Private companies (applying for concessions to operate bus lines)	2010 - 2020	High	

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
V.4	Expansion and modernisation of the electrified public transport system in the City of Yerevan	According to Department of Transport of City of Yerevan, there are several plans to expand the existing metro line, trolley buses network, and build a cable car (to connect mountainous parts of the City) as part of the electrical transport system. However, plans are mostly been abandoned due to lack of financing.	City of Yerevan	Infrastructure Programmes financed through IFIs	2010 - 2020	Medium	
V.5	Expansion and modernisation of rail transport network (passenger and freight)	(1) acquisition of electric rail cars and electric multiple units (2) the permanent monitoring and management of electricity consumed for train traction in passenger and freight transport	Ministry of Transport Ministry of Economy	Infrastructure Programmes financed through IFIs	2010 - 2020	Low	

## 6.5 *Energy efficiency improvement measures in the agricultural sector*

<b>Target:</b>	Structural reforms in agricultural and rural development, and reduction of energy intensity in irrigation systems
<b>Target group:</b>	Owners and operators of agricultural businesses / operations

### 6.5.1 *General introduction on the agricultural sector*

Armenia has 2.1 million hectares of agricultural land, 72% of the country's land area. Most of this, however, are mountain pastures, and cultivable land is 480,000 hectares (452,900 hectares arable land, 27,300 hectares in orchards and vineyards), or 16% of the country's area. In 2006, 46% of the work force was employed in agriculture (up from 26% in 1991), and agriculture contributed about 21% of the country's GDP. Back in 1991, Armenia imported still about 65 percent of its food.

Agriculture is carried out mainly in the valleys and mountainsides of Armenia's uneven terrain, with the highest mountain pastures used for livestock grazing. Fertile volcanic soil allows cultivation of wheat and barley as well as pasturage for sheep, goats, and horses. With the help of irrigation, figs, pomegranates, apricots, and olives also are grown in the limited subtropical Aras River valley and in the valleys north of Yerevan, where the richest farmland is found. Armenia also produces peaches, walnuts, and quince.

Agricultural production is heavily biased toward crops, which in 2006 accounted for 64% of gross agricultural output. The principal agricultural products are grains (mostly wheat and barley), potatoes, vegetables, grapes and fruits. The share of production was significantly increasing compared to the year 1989. Livestock production (meat, milk and eggs) stayed more or less constant except milk production, which increased significantly during the post Soviet period.

On the other hand, agriculture provides a significant share in the country's energy demand, mainly through intensive irrigation. Almost 80% of agricultural products is coming from irrigated lands, which generally use electric pumping rather than free-flowing gravity schemes. In former Soviet era, there were about 400 pumping stations in the country, and as electricity always used to be very cheap, nobody cared about the additional irrigation costs. This has changed over the last years, especially due to an initiative started in 2006 by the Millennium Challenge Account-Armenia (MCA-Armenia), a State Non Commercial Organization established by the Government of Armenia and supported by the Government of U.S. through the creation of a foundation that would financially support countries in transition. One main focus of MCA-Armenia is to improve current irrigation schemes by converting from pump to gravity-fed irrigation, reducing water losses and improving drainage and thus contribute to a significant energy saving in the agricultural sector.

The energy intensity of Armenian agriculture sector, 24 kg oe/\$1,000 USD, is close to the one in Georgia, 8.2 kg oe/\$1,000 USD, Azerbaijan, 20 kg oe/\$1,000 USD, and Bulgaria, 42.6 kg oe/\$1,000 USD. This shows a low level of mechanization in agriculture (see Figure 1). However, one of the major energy consumers in the sector are the irrigation systems using mainly obsolete and inefficient water pumps.

### 6.5.2 Overview of sector-specific measures

The main measure for the agricultural sector addressed in the action plan is following the activities conducted by the MCA Armenia program to rehabilitate existing drainage and pumping systems, rebuild existing secondary and tertiary canals and introduce several new gravity irrigation schemes that will reduce the demand for electrical pumping.

Chart 4: MCA-Armenia Irrigated Agriculture Project



Source: MCA-Armenia

The effect of this measure is de facto a decrease of the energy intensity (by about 15% in average), nevertheless the total energy consumption is going to increase due to the fact that in most of the projects mentioned in the chart below are also dedicated to increase the amount of irrigated land. **The total effect on the energy consumption is thus estimated to be roughly 3% until 2020.**

The annual % savings including the intermediate energy saving targets up to 2020 are given in Table 12 as follows:

- o 2011: 0.2%



- 2014: 1.1%
- 2017: 2.3%
- 2020: 3.5%

Table 12: Estimated savings per measure in the agricultural sector from 2011-2020

Sector/Measure		Baseline Final Energy Consumption				Estimated annual savings per measure in % of the average final energy consumption 2008-10											Aggregated savings per measure	
		2008	2009	2010	average 2008-2010	annual/ cumulated savings	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	[in %]	in TJ
		[in TJ]	[in TJ]	[in TJ]	[in TJ]		[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]	[in %]		
VI.	Agricultural sector					annual	0,2%	0,2%	0,3%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%		
						cumulated	0,2%	0,4%	0,7%	1,1%	1,5%	1,9%	2,3%	2,7%	3,1%	3,5%	3,5%	n/a
VI.1	Utilization of gravity flow in irrigation systems and modernisation of existing pumping stations and upgrading secondary and tertiary canals	n/a	n/a	n/a	n/a		0,2%	0,2%	0,3%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%	3,5%	n/a

Table 13: List of measures in the agricultural sector specified under the Armenian NEEAP

No	Title of the EEI measure	Description of measure	Responsibility	Funding source	Duration	Priority	Estimated Energy Saving
VI.1	Utilization of gravity flow in irrigation systems and modernisation of existing pumping stations and upgrading secondary and tertiary canals	<p>The MCA programme activities foresee the following measures:</p> <p>(1) Installation of 5 gravity schemes (Spitak, Aygezard, Mantash, Shenik, Vardenis) which will rehabilitate in total more than 30 km of existing canals and provide highly improved irrigation. At the same time the possible arable land area will be enlarged;</p> <p>(2) Installation of energy efficient pumping stations: some pumping stations will be rehabilitated and some renewed with efficient pumps, in total 17 pumping stations will be rehabilitated.</p> <p>(3) Rehabilitation of 6 main canals, 250 km of tertiary canals and of Ararat valley drainage system</p>	Ministry of Agriculture, Ministry of Energy	Millenium Challenge Account Armenia	2010 – 2012	High	

## 7 References

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5	Global Environment Facility - GEF: <a href="http://www.thegef.org/gef/gef_country_prg/AM">http://www.thegef.org/gef/gef_country_prg/AM</a> ; (21.7.2010)
6	The Other Renewable Source: The Potential for Improving Energy Efficiency in Armenia, Report to the World Bank (2008)
7	Second Communication of the Republic of Armenia to the United Nations Framework Convention on Climate Change, UNDP/GEF (2009)
8	UNDP/GEF Project Document “Improving Energy Efficiency in Buildings”, UNDP/GEF (2009)

## Annex 1: Template for the calculation of the national energy saving target

	Total final energy consumption Armenia				
	2006	2007	2008	2009	2010
	Unit [TJ]				
Final inland energy consumption within the scope of the EEAP					
Residential/Households					
Industry					
Transport					
Public and commercial services					
Agriculture					
Non-energy use					
<b>Average final consumption over 5-year period:</b>					
<b>Energy saving target adopted in 2020:</b>					
Residential/Households				in %	23,0%
Industry				in %	41,6%
Transport				in %	17,1%
Public and commercial services				in %	14,6%
Agriculture				in %	3,5%
Non-energy use				in %	n/a
Total savings (for all sectors)				in TJ	
<b>Intermediate energy saving targets in the years (total):</b>					
				[in TJ]	2011
					2014
					2017
					2020

## Annex 2: Projections of greenhouse gas emissions for Armenia from 2005 to 2020

The GHG projections are taken from the “Second Communication of the Republic of Armenia to the United Nations Framework Convention on Climate Change”. They provide an indication of the development of greenhouse gases that are indirectly also a result of energy use in the country.

The data are based on a 6.0% average annual economic growth and expected volumes of activities in various sectors of economy. Two scenarios of greenhouse gas emissions are being considered – *business-as-usual*, which assumes the continuation of the existing practices and relationships at national level, but also includes certain modernization processes corresponding to international trends, and *rapid stabilization*, which includes measures contributing to the reduction of greenhouse gas emissions planned by national and sectoral development programs.

As a result of the implemented measures, by 2020, greenhouse gas emissions will amount to 61% of their level in 1990 (92% in the case of business-as-usual scenario), but however will almost double in the BAU scenario between 2010 and 2020 (+52% in the stabilization scenario). And the largest share of emissions (73%) will continue to fall on the energy sector.

Chart 5: Projections of greenhouse gas emissions (Gg CO<sub>2</sub> equivalent, excl. LULUCF)

	2005	2010	2015	2020
<b>Business-as-usual</b>	<b>6226</b>	<b>11591.3</b>	<b>18964.8</b>	<b>23125.3</b>
Energy	4315.5	9048.3	15461.2	18471.8
Industrial processes	317.7	505.0	761.0	963.5
Agriculture	1080.3	1430.1	2077.6	2954.8
Waste	509.5	607.9	665.0	735.2
<b>Rapid stabilization</b>	<b>6226</b>	<b>9995.6</b>	<b>15383.4</b>	<b>15216.6</b>
Energy	4315.5	7802.2	12336.7	11108.3
Industrial processes	317.7	395.0	596.0	754.5
Agriculture	1080.3	1402.8	2030.6	2901.6
Waste	509.5	395.6	420.1	452.2

Source: Second National Communication of Armenia to the UNFCCC (2009)

## Annex 3: List of relevant donor projects and programs ongoing and of past

### GEF Program:

- **Armenia – Improving the Energy Efficiency of the Urban Heating and Hot Water Supply (UNDP)<sup>5</sup>:**

The project aims to reduce greenhouse gas (GHG) emissions resulting from current heat and hot water supply practices in Armenian cities. The project consists of four components: (1) Strengthening the role of condominiums in organizing and managing the heat and hot water supply services at the building level. (2) Supporting the restructuring process and building the capacity of the existing DH companies to improve the efficiency of their operations. (3) Supporting the emerging new service providers in offering their services to the condominiums and structuring financing for the investments needed. (4) Documenting and disseminating the results, experiences and lessons learned nationally and regionally.

The project was approved in May 2003. Total project costs sum up to 12,030,121 US\$ whereof GEF project grant amount to 2,950,000 US\$.

- **Armenia Energy Efficiency Project (IBRD)<sup>6</sup>:**

The Armenian Energy Efficiency Project will reduce energy intensity of the Armenian economy by funding public sector energy efficiency investments and removing existing information, existing information, knowledge, regulatory, and financial barriers that hamper the wide penetration of energy efficiency investments in public buildings and the commercial and residential sectors in the country.

The project was approved in March 2010. Total project costs sum up to around 15,910,000 US\$ whereof GEF project grant amount to 1,820,000 US\$.

- **LGGE Improving Energy Efficiency in Buildings (UNDP)<sup>7</sup>:**

The aim of this project is to reduce GHG emissions and energy consumption in the Armenian buildings sector.

The project was approved in June 2009. Total project costs sum up to around 3,440,450 US\$ whereof GEF project grant amount to 1,045,000 US\$.

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<sup>5</sup> source: <http://gefonline.org/projectDetailsSQL.cfm?projID=1116>; 19.7.2010

<sup>6</sup> source: <http://gefonline.org/projectDetailsSQL.cfm?projID=3973>; 19.7.2010

<sup>7</sup> source: <http://gefonline.org/projectDetailsSQL.cfm?projID=3935>; 19.7.2010

World Bank:

▪ **Urban Heating Project – Armenia<sup>8</sup>:**

The objective of the Urban Heating Project for Armenia is to support the Borrower to increase the use of clean, efficient, safe and affordable heating technologies in urban schools and multi-apartment buildings. The changes are related to: (1) reallocation of credit proceeds from 'goods and works for others' and 'grants' categories both financing capital grants to the urban poor for gas and heating services to the 'goods and works for school heating systems' category financing rehabilitation of the heating system of urban schools; (2) extension of the project closing date by six months to allow rehabilitation of the heating system of additional schools; and (3) increase of the disbursement percentage for 'goods and works' category of expenses from 80 percent to 90 percent so as to maintain the co-financing requirement by the Government of Armenia on the same level as before the reallocation.

The project was approved in July 2005 and will be closed by the end of 2010. Total project costs sum up to around 21,950,000 US\$ whereof IBRD and IDA commitment add up to 15,000,000 US\$.

▪ **Electricity Supply Reliability and Energy Efficiency Project<sup>9</sup>:**

The power sector in Armenia addresses four serious challenges: (1) emerging power supply gap, (2) jeopardized power supply reliability, (3) the affordability of energy tariffs, and (4) the financial viability of the sector is threatened; This project will enhance the reliability of the power supply by improving the power transmission network back-bone infrastructure and will reduce the power supply gap by improving the utilization of the country's energy efficiency potential. The project is currently under preparation and estimated to be approved by the board in March 2011. Total project cost are 44,000,000 US\$ whereof IBRD and IDA commitment sums up to 36,000,000 US\$.

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<sup>8</sup> source: <http://www.worldbank.org.am/external/default/main?pagePK=64027221&piPK=64027220&theSitePK=301579&menuPK=301612&Projectid=P057880>; 19.7.2010

<sup>9</sup> source: <http://www.worldbank.org.am/external/projects/main?pagePK=64283627&piPK=73230&theSitePK=301579&menuPK=301613&Projectid=P116748>; 19.7.2010



INOGATE Programme:

▪ **Harmonization of gas and oil technical standards and practices (E. Europe and Caucasus)<sup>10</sup>:**

The project aims to support the countries' adoption of international standards, rules and practices for design, construction, manufacturing, testing, certification, accreditation, operation and maintenance applied for all main components of gas and oil production / transmission / storage. The project started in December 2007 and will last till August 2010. The total project budget is 2,930,500 €

▪ **Capacity-building for Energy Regulators in Eastern Europe and Central Asia<sup>11</sup>:**

The project is to promote and advocate good and sound energy regulatory practices in the Partner Countries of the INOGATE Programme and to harmonize energy regulatory practices among them. The project will allow the transfer of EU best practices and the strengthening of cooperation among the countries involved. Furthermore, the project will aim to educate relevant ministerial level decision makers of these countries about the purposes and benefits of an independent energy regulatory organization.

Beneficiary countries are: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan; The project started in January 2009 and will last till July 2010. The total project budget is 330,000 €

▪ **Capacity building for Sustainable Energy Regulation in Eastern Europe and Central Asia<sup>12</sup>:**

This is the “successor-project” of the before mentioned one. It started in March 2010 and is planned to last till October 2011. The calculated budget sums up to 505,856 €

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<sup>10</sup> source: [http://www.inogate.org/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/harmonisation-gas-and-oil-technical-standards-and-80104](http://www.inogate.org/inogate_programme/inogate_projects/ongoing-inogate-projects/inogate_programme/inogate_projects/ongoing-inogate-projects/harmonisation-gas-and-oil-technical-standards-and-80104); 20.7.2010

<sup>11</sup> source: [http://www.inogate.org/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/capacity-building-energy-regulators-eastern-46112](http://www.inogate.org/inogate_programme/inogate_projects/ongoing-inogate-projects/inogate_programme/inogate_projects/ongoing-inogate-projects/capacity-building-energy-regulators-eastern-46112); 20.7.2010

<sup>12</sup> source: [http://www.inogate.org/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/capcity-building-sustainable-energy-regulation](http://www.inogate.org/inogate_programme/inogate_projects/ongoing-inogate-projects/inogate_programme/inogate_projects/ongoing-inogate-projects/capcity-building-sustainable-energy-regulation); 20.7.2010

▪ **Harmonization of electricity standards:**<sup>13</sup>

The project's objective is to assist the INOGATE Partner Countries in adopting international standards, rules and practices in the electricity sector. It is anticipated that cooperation on standardization within the framework of the INOGATE Programme will lead to market integration and convergence. The Project seeks to increase infrastructure efficiency, enhance quality and reliability of equipment, ensure safety in electricity transmission and distribution and facilitate trade and investments in modern technologies.

Partner countries are: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

The project started in September 2009 and will last till March 2011. The total project budget is 1,482,500 €.

EBRD:

▪ **Armenian Sustainable Energy Financing Facility (ArmSEFF):**<sup>14</sup>

The EBRD's Sustainable Energy Initiative (SEI) was launched in 2006 to address the twin challenges of energy efficiency and climate change. SEI market segments include, besides others, the segment for Sustainable Energy Financing Facilities (SEFFs) through financial intermediaries. One of the long-lasting benefits of this segment is the transfer of specific skills to the local market. In addition to the economic and environmental benefits of the investments themselves, local bank staff becomes familiar with the particulars of sustainable energy investments and in which business sectors to find them; prospective borrowers learn why sustainable energy projects make good business sense and how to finance them.

Moreover local engineers become aware of the best practice investment opportunities and where to identify them. As a result of regular exposure to international experts, this additional capacity builds up from both formal training and on-the-job learning by doing. The project development and implementation legacy that remains will facilitate the financing of future sustainable energy investment opportunities.

This project will start in near future in Armenia.

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<sup>13</sup> source: [http://www.inogate.org/inogate\\_programme/inogate\\_projects/ongoing-inogate-projects/harmonization-technical-standards-rules-and/](http://www.inogate.org/inogate_programme/inogate_projects/ongoing-inogate-projects/harmonization-technical-standards-rules-and/); 20.7.2010

<sup>14</sup> source: <http://www.ebrd.org/downloads/research/factsheets/sei.pdf>; 20.7.2010

USAID:

• **Commercialization of Energy Efficiency Project (CEEP):**<sup>15</sup>

This program is working with private sector energy service companies and the banking sector to increase the availability of bank financing for energy efficiency projects to encourage the development of viable energy efficiency market. CEEP was implemented by Advanced Engineering Associates International (AEAI).

It started in June 2007 and will end in November 2010. The project budget sums up to 3,200,000 US.

International Finance Corporation:

▪ **Armenia Energy Efficiency Survey Project:**<sup>16</sup>

The main goal of the project is to assess the current market for energy efficiency financing in Armenia and to raise awareness among local financial institutions, small and medium enterprises (SMEs), and policy makers about existing opportunities for energy efficiency financing in the country. By identifying best practices in SME energy efficiency and finance, the survey will also provide benchmarks with other countries and might lead to a more comprehensive program to increase energy efficiency in Armenia and the region.

The project started in 2008 and is still ongoing. It is supported with funds from the Austrian Technical Assistance Trust Fund and IFC.

Millennium Challenge Account–Armenia (MCA–Armenia):

▪ **Irrigated Agriculture Project:**<sup>17</sup>

In 2006, the Millennium Challenge Corporation signed a five-year Compact with the Government of Armenia aimed at reducing rural poverty through a sustainable increase in the economic performance of the agricultural sector. The Millennium Challenge Corporation is a U.S. Government agency designed to work with developing countries, based on the principle that aid is most effective when it reinforces sound political, economic, and social policies that promote poverty reduction through economic growth.

MCA-Armenia, a State Non-Commercial Organization established by the Government of Armenia, is responsible for overseeing the transparent implementation of the Compact signed between the Millennium Challenge Corporation and the Government of Armenia.

Presently MCA-Armenia has one major project – Irrigated Agriculture project (USD 120 million) which includes Irrigation Infrastructure Rehabilitation component and farmers' assisting Water-To-Market activity (USD 32 million) along with its Institutional Strengthening Sub-Activity (around USD 4 million).

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<sup>15</sup> source: <http://armenia.usaid.gov/en/node/270>, 20.7.2010

<sup>16</sup> source: [http://www.ifc.org/ifcext/eca.nsf/Content/Armenia\\_AdvisoryProjects#Armenia%20Energy%20Efficiency%20Survey](http://www.ifc.org/ifcext/eca.nsf/Content/Armenia_AdvisoryProjects#Armenia%20Energy%20Efficiency%20Survey), 20.7.2010

<sup>17</sup> source: [http://www.mca.am/new/enversion/pdf/QB\\_mca\\_ENG\\_13.pdf](http://www.mca.am/new/enversion/pdf/QB_mca_ENG_13.pdf); 20.7.2010