SUSTAINABLE ENERGY PATHWAYS IN THE SOUTH CAUCASUS: OPPORTUNITIES FOR DEVELOPMENT AND POLITICAL CHOICES

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ADB	Asian Development Bank
AZN	Azerbaijani manat
BMUB	Bundesministeriums für Umwelt, Naturschutz, Bau und Reaktorsicherheit
CCGT	Combined cycle gas turbine
CDM	Clean Development Mechanism
CJSC	Closed Joint Stock Company
DH	District Heating
EBRD	European Bank for Reconstruction and Development
EE	Energy efficiency
EIA	Environmental Impact Assessment
ENA	Electric Networks of Armenia CJCS
EPBD	Energy Performance of Buildings Directive
ESCO	Energy Service Company
GDP	Gross domestic product
GHG	Greenhouse gas
GWh	Gigawatt Hour
HPP	Hydro power plant
HVEN	High Voltage Electric Networks CJSC (in Armenia)
IFI	International Financing Institution
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contributions
IRG	International Resources Group
KfW	Kreditanstalt für Wiederaufbau
INDC	Intended Nationally Determined Contributions
Mtoe	Million tons of oil equivalents
MWh	Megawatt hour
NAMA	Nationally Appropriate Mitigation Action
NEEAP	National Energy Efficiency Action Plan
NPP	Nuclear power plant
OCGT	Open Cycle Gas Turbine
PEEREA	Protocol on Energy Efficiency and Related Environmental Aspects
PPP	Purchasing Power Parity
PSA	Production Sharing Agreement
PSRC	Public Services Regulatory Commission (in Armenia)
PV	Photovoltaic
RE	Renewable energy
SEA	Strategic Environmental Assessment
SEAP	Sustainable Energy Action Plans
SDP	Sustainable Development Program (in Armenia)
SHPP	Small hydro power plant
SREP	Scaling Up Renewable Energy Program
toe	Tons of oil equivalent
TPES	Total primary energy supply
TPP	Thermal power plant
TWh	Terra watt hour (million kilowatt hours)
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WCED	World Commission on Environment and Development
WEG	World Experience for Georgia

FOREWORD

The strategic location of the South Caucasus region and its energy resources have played a major role in increasing the importance of the region and attracting international attention to it since the collapse of the Soviet Union. Since the 1990s, major investment has been made in new pipelines and the search for new oil and gas deposits. New strategic projects aimed at diversifying sources of energy supplies to EU countries bypassing Russia have emerged since 2006. Correspondingly, the region has found itself facing new political challenges which simultaneously provide an opportunity to become integrated into the European energy area. In addition to pipelines, a number of infrastructure projects that are to transform South Caucasus countries into electricity exporters have been planned and/or implemented over the past five years.

The political, economic, and social challenges Azerbaijan, Armenia, and Georgia face at present are completely different from each other and they have chosen different paths to cope with their respective challenges*. Having signed the Association Agreement with the EU, Georgia continues to follow its path towards Europe; Armenia chose to join the Russian-led Eurasian Union; and Azerbaijan takes maximum advantage of its abundant energy resources and is in no hurry to implement standards established by the West.

The energy sectors in the three countries have different vectors of development. Due to its geopolitical location, Armenia has failed to renounce its nuclear power plant up to now, believing that the construction of a new nuclear reactor is of vital importance for its energy independence. Georgia plans to make maximum use of existing hydro resources at its disposal, and Azerbaijan is trying to diversify markets for the export of its energy resources. Therefore, we chose the visual structure of the publication in accordance with these characteristic features. The yellow colour denotes an Armenia oriented towards developing nuclear energy, blue stands for a Georgia seeking to make maximum use of its water resources, and the dark colour is most appropriate for an Azerbaijan that is rich in oil.

It is noteworthy that all the three South Caucasus countries act on the basis of traditional energy scenarios and have not yet elaborated comprehensive climate and energy policies. However, for the purpose of cooperating with the EU or due to the aspiration to meet various international commitments, all the three countries are working on assuming certain commitments in the field of climate change and improving the legislation in the field of energy.

In 2014, the South Caucasus Regional Office of the Heinrich Boell Foundation started implementing a programme on climate change that advocates transparent change in energy policy and the shaping of sustainable energy systems in the region. The programme aims to analyse the situation in the South Caucasus countries through the lens of international experience. We also

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* Asatiani S. & Lejava N. (eds.) *South Caucasus at a Crossroad: Thorny Realities and Great Expectations,* Tbilisi, 2014.

aspire to contribute to enhancing expertise in the region and critically interpret changes under way in the sector. The programme is focused on highlighting factors of mutual influence of the energy sector and climate change and supporting compromise solutions – a topic which at present is effectively not being discussed by local specialists.

This study was done within the framework of the climate change programme. Its goal is to identify the main features of the energy sectors of Azerbaijan, Georgia, and Armenia and enable readers to draw conclusions on the extent to which the vectors of energy development of the neighbouring countries coincide and whether there is a common vision for the development of the energy sector within the region. Another important priority of the Green Political Foundation was presenting a picture of the situation in the countries in terms of renewable energy and energy efficiency to the interested public. Doing so serves as a good impetus for public discussion on sustainable energy systems. In the future, this should facilitate the emergence and consolidation of groups supporting such systems in these countries.

"Sustainable Energy Pathways in the South Caucasus: Opportunities for Development and Political Choices" raises several important questions pertaining to the sustainability and social or economic benefits of the existing energy systems. For example, how realistic is it to build a new nuclear reactor in Armenia? Why are the South Caucasus countries not using the benefits of energy efficiency? What steps should be taken to facilitate the use of renewable energy resources? We also tried to elaborate such recommendations for each of the countries that are as practical and realistic as possible. The Heinrich Boell Foundation is ready to support discussion of these recommendations within the countries.

The Heinrich Boell Foundation is particularly grateful to all five authors of the study, who worked for several months to collect all data necessary for a comprehensive analysis. This has enabled us to have a general view of the energy sector of the South Caucasus region. Of course, the authors of the study are aware that much deeper research and analysis involving various institutions are necessary in order to gain an understanding of all issues raised in individual subchapters of this study. Accordingly, we will be happy if this study gives rise to in-depth research in the issues and problems identified in this study.

Tamar Antidze, the climate change programme coordinator of the South Caucasus Regional Office of the Heinrich Boell Foundation, deserves particular thanks, as this study would have been impossible without her knowledge, efforts, and hard work.

Tbilisi, 22 May 2015

Nino Lejava,
Director,
Heinrich Boell Foundation
South Caucasus Regional Office

EXECUTIVE SUMMARY

The three countries of the South Caucasus – Armenia, Azerbaijan and Georgia – face major challenges in making their respective energy sectors' sustainable. Although all three are participants in the EU's European Neighbourhood Policy and Eastern Partnership initiatives, future EU integration perspectives and challenges differ substantially in each case.

All three countries share a common heritage. Their energy systems and infrastructures were designed for regional integration within the Soviet energy system. In that integrated power system, Armenia's nuclear power plant delivered the base load while Azerbaijan supplied the fossil-fired medium-load and Georgia's hydropower plants were available for peak-load supply. The collapse of the Soviet Union resulted in disintegration of the three countries' energy systems and economies. In addition, the 1987-1991 Nagorno-Karabach conflict and regional civil wars in the early 1990s created political instability. Thus, the countries had not only to secure and stabilise their national energy supplies, which included refurbishing power plants and electricity and gas infrastructure, but also to determine which regional economic space they wanted to belong to. Also problematic has been the fact that the pending conflict between Armenia and Azerbaijan prevents cost-effective solutions for energy exchange and transportation in the region.

All three countries have substantial hydropower and other renewable energy potential, but the endowment of fossil energy resources differs widely. Armenia possesses almost no fossil fuels and thus relies on imports. In Georgia, energy imports are less significant (70% of energy consumed rather than 90% for Armenia) but natural gas prices are lower because of in-kind payments for pipeline transit. In contrast, Azerbaijan is well endowed with both oil and gas reserves.

Over the past 20 years energy's share of GDP has decreased substantially in all three countries. The most impressive results have been achieved in Azerbaijan, mainly due to very rapid economic growth spurred by oil and gas exports. A modest annual increase in domestic energy consumption has also led to per capita GHG emissions far below European Union levels. However, a closer look at GHG emissions development shows that, except in Azerbaijan, GHG emissions per capita are growing again in Armenia and Georgia. High growth rates and current low levels of energy consumption per capita are expected to lead to increasing energy demand in subsequent years.

The countries must now to decide on the future design and capacities of their energy systems. The main challenge concerns how further economic growth and social wellbeing can be achieved while avoiding increases in GHG emissions and further dependency on energy imports. For that purpose, policies and instruments need to be developed and implemented to attract investment conducive to meeting development goals while also using energy sources in the most efficient manner.

At present, renewable energy used in these countries consists mainly of hydropower (small to large HPPs), as it is still the most cost-effective renewable source available for power generation. For electricity generation, renewables (mainly hydropower) constitute 82% of power generation in Georgia, 29% in Armenia and 8% in Azerbaijan. Apart from the share used today, there is still potential for additional hydropower (less so in Armenia than in Georgia and Azerbaijan). The lack or poor quality of Environmental Impact Assessments, cases of environmental damage and low technology standards are some of the major issues spurring public debate on hydropower in Armenia and Georgia. A lack of lessons learned from inadequate management of the planning and construction of HPPs may seriously hamper further development of this renewable source in the region.

Armenia is the only country of the three which has developed successful and supportive legal and economic frameworks for renewable energy (RE). Feed-in tariffs are in place for wind and small hydropower plants. Financial support is provided by the Renewable Resources and Energy Efficiency Fund. In contrast, Georgia has not developed any supportive mechanism or legal framework for RE. The government leaves all responsibility for investment to the market. In Azerbaijan, considerable funds were allocated for the development of a legal framework for support of RE, which

has so far not been approved by the government. Although the State Agency on Alternative and Renewable Energy Sources was created and a 20% RE target was set by the government, it remains unclear how this goal will be achieved.

As far as energy efficiency (EE) development is concerned, energy supply potential has been largely developed, while on the demand side (i.e. consumption) EE remains so far mostly undeveloped in all three countries. It is Armenia, the country with the most critical energy security situation, which has introduced at least some EE standards in newly-constructed public buildings as well as developed a National Energy Efficiency Action Plan (NEEAP) as requested for EU member states. However, it is not clear what priority EE and RE policies really have in the country. Although it is obvious that EE and RE would reduce or displace the utilization of Armenia's nuclear plant and respectively increase the costs of nuclear electricity generation, nuclear energy for the time being remains a cornerstone of the government's energy strategy.

In Georgia, the government does not yet have an approved energy strategy, and energy sector development remains market-driven through a sort of "laissez-fair" approach. Hence, the potential for EE and RE remain underdeveloped. In Azerbaijan, a shift from heavy oil to natural gas in power generation has been achieved and numerous power stations have been rehabilitated. EE on the demand side, however, remains underdeveloped in that country.

The heating sector (which includes hot water supply and cooling) is, in all three countries, one of the most intangible due to its wide dispersion. Nevertheless, the sector holds extensive EE potential. However, no strategies for future development of heating-sector potential are in place. Until recently, few foreign donor-supported activities have been carried out.

All three countries lack sound analysis on how EE potential could contribute to the satisfaction of future energy demand. In addition, coherent policies and instruments need to be developed and implemented to overcome current obstacles and unlock EE and RE potential. To offer the EU as a potential model, policies and instruments implemented in the EU usually include a comprehensive set of fiscal, financial, legal, technological, institutional, cooperative and informational instruments.

The aim of increasing electricity exports is a major impetus for the construction of power generation capacities in Armenia, Azerbaijan and Georgia, although the Georgian government has no explicitly outlined target. In general, electricity exports may help secure sustainable energy supply (especially if seasonal swaps help to overcome hydropower supply constraints during the cold season) and contribute to economic growth. Especially the export of renewable electricity, including wind energy, to Turkey (with its growing demand and higher market prices) could become attractive to producers. Nevertheless, the current plans lack sound sustainability analyses and are not coordinated across the three countries.

Improved regional energy cooperation among the three countries, with Turkey, through Turkey with the European market and in the future with Iran could provide a framework for sustainable energy systems development at lower costs. This could be attractive for all three countries. Armenia's current difficult political relations with Azerbaijan and Turkey make such a market regime less appealing for the country. An environment conducive to competitive electricity and natural gas markets for the entire region, including Russia, might benefit all potential partners. However, as long as monopolies on supply structures and political constraints dominate, such a liberalised and cooperative market design remains only a long-term vision. Short- and medium-term solutions must rely on gradual market integration via direct electricity interconnectors and the development of the countries' own EE and RE potential. First steps toward that end would include creating conditions for parallel operation of the Armenian and Georgian systems as well as agreement on the conditions under which purchase of renewable energy power could be guaranteed.

1.

INTRODUCTION

The three countries of the South Caucasus – Armenia, Azerbaijan and Georgia – face major challenges in making their respective energy sectors' sustainable. All three are integrated in the European Neighbourhood Policy and the Eastern Partnership of the EU. While Georgia is a candidate and signed the negotiation agreement with the EU in 2014, Armenia is an observer since 2010 but refused to sign the Association Agreement in September 2013. Instead, in January 2015, the country has joined the Russia- led Eurasia Customs Union with hope to gain more security and economic stability. Azerbaijan has not chosen to definitively align itself with either the EU or Russia although talks on an Association Agreement with the EU are still ongoing. For all three countries, however the harmonization process is still in place and involves modern energy and climate legislation.

The collapse of the Soviet Union resulted in disintegration of the three countries' energy systems and economies. In addition, the Nagorno-Karabach conflict between 1987 and 1991, and civil wars in early 1990s created political instability. Thus, the countries had not only to secure and stabilise national energy supply, which includes refurbishing power plants and electricity and gas infrastructure, but also to determine which economic space they want to belong to (Pataraia, T., 2015). But, the pending conflict between Armenia and Azerbaijan prevents cost effective solutions for energy exchange and transportation in the region.

Endowment of natural energy resources differs widely between the countries as do economic growth performance and population growth.

However, the countries have certain aspects in common:

- All of them share inherited energy supply infrastructure based on large-scale generation facilities and inefficient energy consumption, as well as a large modernization backlog with respect to infrastructure, energy systems and industry;
- Their energy systems and infrastructures were designed for regional integration within the Soviet energy system. In the power sector, the

"As market failure is considered a major barrier to developing the EE and RE potential, respective political targets embedded in a long term sustainable energy strategy need to be set"

nuclear power plant in Armenia delivered base load, while Azerbaijan supplied the fossil-fired medium-load and Georgia's hydro power plants were available for peak-load supply.

- Relatively low levels of energy consumption per capita due to low GDP per capita compared to EU-28 levels (low levels of possession of modern electrical appliances, etc.) and lack of high added-value production facilities;

- Lack of appropriate legal, institutional, political and economic frameworks for the development of existing substantial energy efficiency (EE) and renewable energies (RE) potentials as well as lack of sound analysis of EE and RE potential;

- Considerable economic growth since reaching critical levels economic crisis after their independence;

- Low levels of economic cooperation between the countries.

As presented in Figure 3, since 1990, all three countries show a decrease in overall energy intensity of GDP (measured as total energy consumption per output of GDP) which is the reverse of energy productivity.

Although influenced by several non-controllable factors and not providing a clear picture of the drivers for energy efficiency improvement, GDP is an aggregated indicator which is used for international comparison. Structural changes in the economy (changing shares of industries and sub-sectors with different energy efficiency levels), prices, business cycles, weather conditions etc. have a significant impact. For example, the sharp GDP growth in Azerbaijan boosted by large oil and gas exports is the main underlying factor for the observed decrease in energy intensity of GDP in this country. This does not per se imply similar energy efficiency improvement in existing sectors of the economy.

Sustainable development stands for meeting the needs of the present without compromising the ability of future generations to meet their needs (WCED, 1987). Sustainable energy development, therefore, seeks to satisfy energy needs considering at the same time social, economic and environmental consequences, when choosing energy fuels and associated technologies for the production, delivery and use of energy services (IEA et al., 2005). Therefore energy security, economic affordability and environmental integrity, are the main aspects of sustainable energy development. The main pillars of sustainable energy supply are the rational use of energy resources (energy efficiency) and the use of renewable energies in order to reduce the impact of fossil fuel energy consumption on climate change. As market failure is considered to be a major barrier to developing the EE and RE potential, respective political targets embedded in a long term sustainable energy strategy need to be set. Coherent policies and instruments need to be developed and implemented to overcome the obstacles and to unlock the potential. The policies and instruments implemented in the EU usually include a comprehensive set of fiscal, financial, legal, technological, institutional, cooperative and informational instruments.

The following chapters review the baseline conditions in each of the three countries (resource endowment, national energy markets, economic structure, development of energy demand etc.), provide a brief analysis of the existing institutional framework of the energy sector, which is an important precondition to spur energy efficiency improvement and use of renewable energies, and assess the so far developed and implemented policies in relation to their impact on sustainable energy development.

FIGURE 1
GDP (in purchase power parities) in billion 2005 USD/ capita
Source: IEA Statistics, 2014

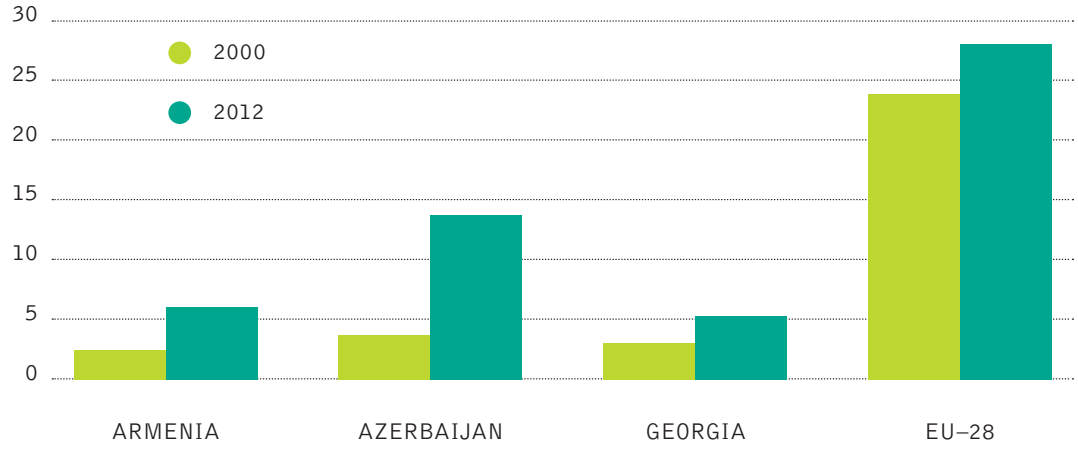


FIGURE 2
Total primary energy supply per capita (toe/capita)
Source: IEA Statistics, 2014

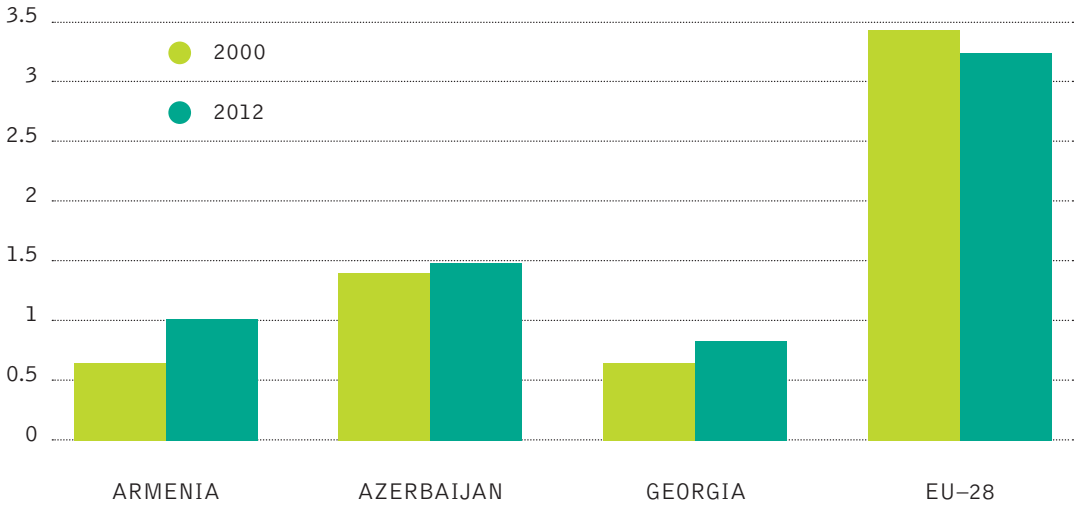
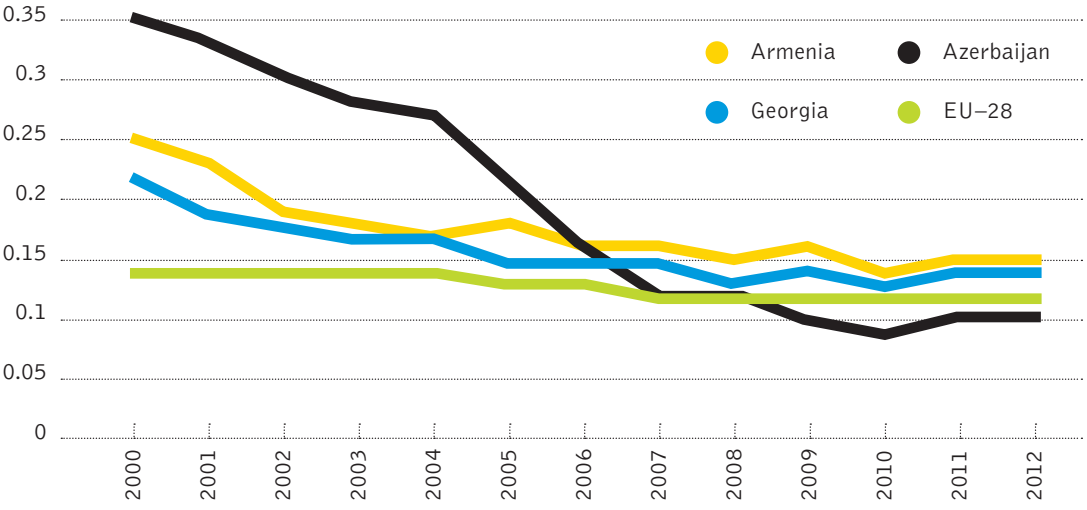


FIGURE 3
Energy intensity of GDP PPP (in toe per thousand 2005 USD)
Source: IEA Statistics , 2014



2.

ARMENIA

Photo: Razmik Pashikyan

2.1 Brief Overview of Economic Development

Albeit Armenia's population slightly declined from 3.08 million in 2000 to 2.97 million in 2013 (World Bank, 2014), considerable economic growth took place during the last ten years, and GDP per capita had more than doubled from 2000 till 2012 (see Figure 4). However, the country still belongs to the group of middle-income economies[1]. During the economic recovery since the first half of the 1990s energy consumption increased at much lower rates than GDP, which has a positive impact on lowering import dependence and mitigating climate change. This effect was not entirely due to an increase in the efficient use of energy and widespread modernization but mainly due to the factors which influenced GDP growth, such as low level of technology endowment in certain sectors and an increasing share of service sectors. The economic boom before the global financial crisis was mainly based on a foreign financed expansion of construction.

Energy consumption, as well as electricity consumption per capita are at low levels (1.47 toe/capita and 1.84 MWh/capita respectively in 2012[2]). That does not result from high energy efficiency performance but is rather due to low income and lack of economic development. High unemployment rates contribute to that fact as well.

Greenhouse gas (GHG) emissions hit bottom in 2002 and increased slightly afterwards. Overall CO_2 emissions per capita are still low, but between 2000 and 2012 they increased by about 65% (from 1.11 to 1.83 t CO_2/capita) (IEA, 2014).

Further economic and social development requires substantial investments into the diversification of Armenia's industrial basis and into the improvement of its physical infrastructure. Both would require more energy. Thus, the main challenge is how further economic growth and social wellbeing could be achieved while avoiding increasing levels of GHG emissions and increasing dependency on energy imports. For that purpose, policies and instruments need to be developed and implemented which help to attract investment to meet the development goals most efficiently using energy sources.

---

1 Middle-income economies are those with a GNI per capita of more than $1,045 but less than $12,746 in 2013. <*http://data.worldbank.org/about/country-and-lending-groups*>.

2 IEA, Statistics.

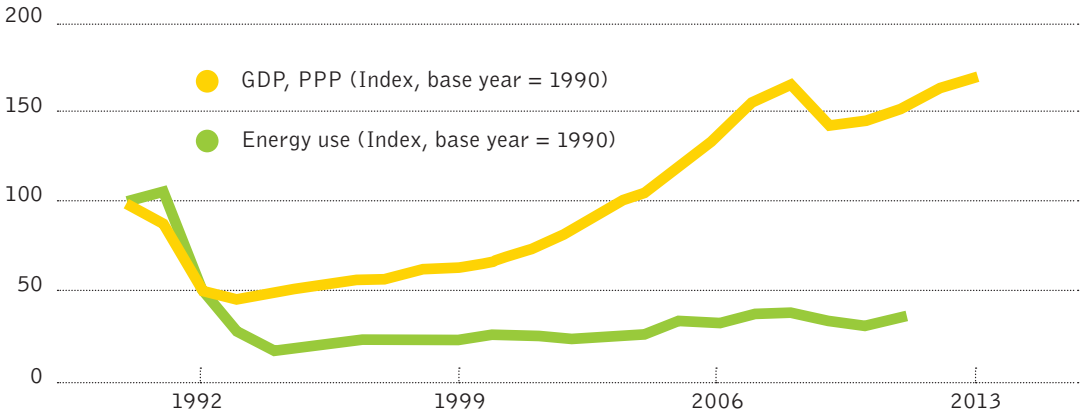


FIGURE 4
Economic growth and energy consumption in Armenia (1990=100)
Source: World Bank, 2014 (PPP in 2011 USD)

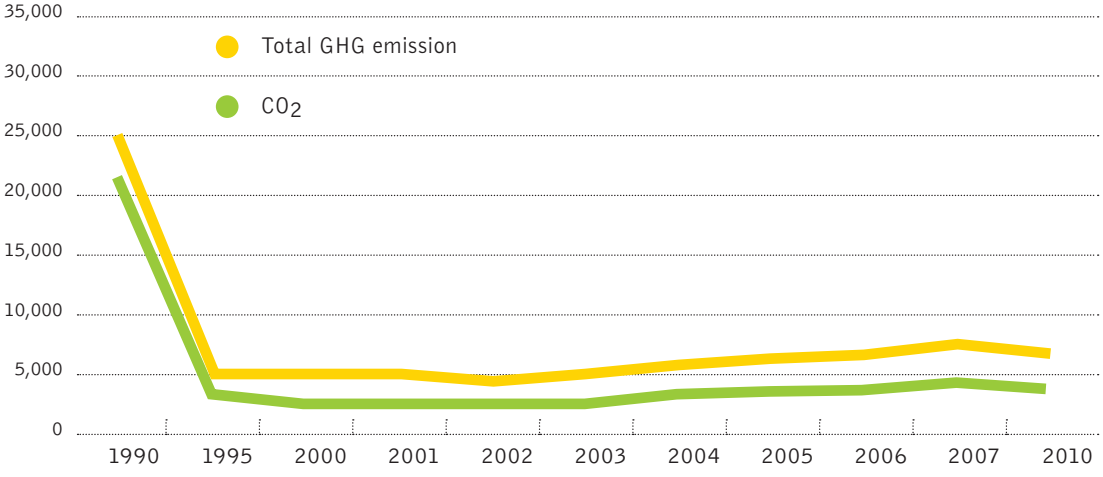


FIGURE 5
GHG Emissions in Armenia until 2010 (in Gt CO2eq excluding LULUCF)
Source: 2nd National Communication, 2010; Annual Report of the Ministry of Energy and Natural Resources of RA.

2.2 National Energy Markets and Future Trends

2.2.1 Energy supply and demand

Except for certain hydro-energy resources and a small amount of other renewables (including some fire-wood, the consumption of which led to severe deforestation), Armenia does not possess any own conventional (fossil and nuclear) fuel resources and is not a transit country for oil and gas as well. Thus, the country is heavily dependent on energy imports, which has placed an increasing burden on the balance of payments. In 2012 energy imports amounted to 90% of the total of 3.377 Mtoe primary energy supplied. The share of energy imports in TPES fluctuates slightly depending on the hydro potential. In dry years, imports increase.

Natural gas, nuclear fuel, oil products and very limited volumes of coal (less than 0.1% of TPES) are mainly imported from Russia. In order to diversify the primary energy supply, in 2009 the Armenian government signed an agreement with Iran on natural gas imports in exchange for electricity exports. The country agreed to exchange 3kWh of electricity for 1 m^3 of Iranian gas.[3] Although there is no upper limit to this

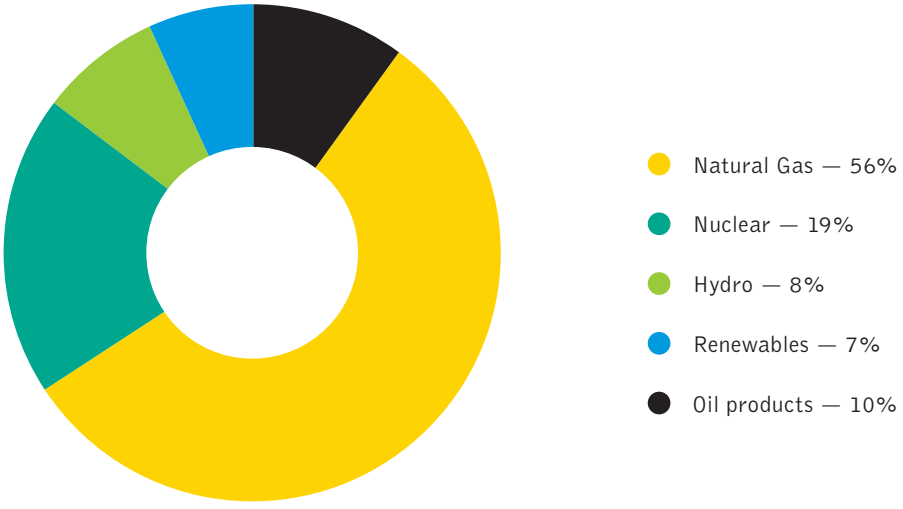


FIGURE 6
Structure of Armenia's primary energy supply (2012)
Source: USAID, 2014

3 World Bank, 2011, p. 5. Another source points out a relation of 2 kWh per 1 m^3, which is even more attractive. <*http://arka.am/en/news/economy/armenia_imported_2_451_billion_cubic_meters_of_natural_gas_from_russia_and_iran_in_2014/*>.

Technology	Capacity (MW)	Generation (GWh/year)
Wind	300	650
Utility scale solar PV	830 – 1,200	1,700 – 2,100
Concentrating solar power	1,200	2,400
Distributed solar PV	1,300	1,800
Geothermal power	at least 150	at least 1,100
Landfill gas	2	20
Small hydropower	100	340
Biogas	5	30
Biomass	30	230
Total electricity	**3,800 – 4,300**	**7,400 – 8,700**
Solar thermal hot water	200	260
Geothermal heat pumps	3,500	3,500
Total heat	**3,700**	**4,690**

TABLE 1
Renewable Energy Resource Potential in Armenia by Technology
Source: Republic of Armenia, 2014, 10

exchange, the gas imports are exclusively related to respective electricity exports and the gas pipeline from Iran leads directly to the Hrazdan TPP, without interconnection to the national gas pipeline system. Regardless of the constraints, the gas imports from Iran at low prices help improve the economics of the Armenian energy mix and Armenia seeks to expand this exchange. However, as Gazprom Armenia (ArmRusgasprom) owns the Iran-Armenia pipeline, as well as Armenia's gas infrastructure, and imports all natural gas from Russia, the company de facto controls all gas inflows. Therefore, increased gas imports from Iran are not likely to happen without agreement from Russia.

Armenia has additional potential of renewable energy which may seriously contribute to energy security and diversification of the energy supply. In 2011, a Renewable Energy Roadmap identified the technical-economic potential of RE. The assessment was updated (see Table 1) in the RE investment plan submitted to the Climate Investment Fund in 2014.

The Scaling Up Renewable Energy Program (SREP) of the Climate Investment Fund builds on the following RE targets approved by the government: Excluding big hydro power RE shall supply 21% of total electricity generated by 2020 and 26% by 2025 (see Table 6).

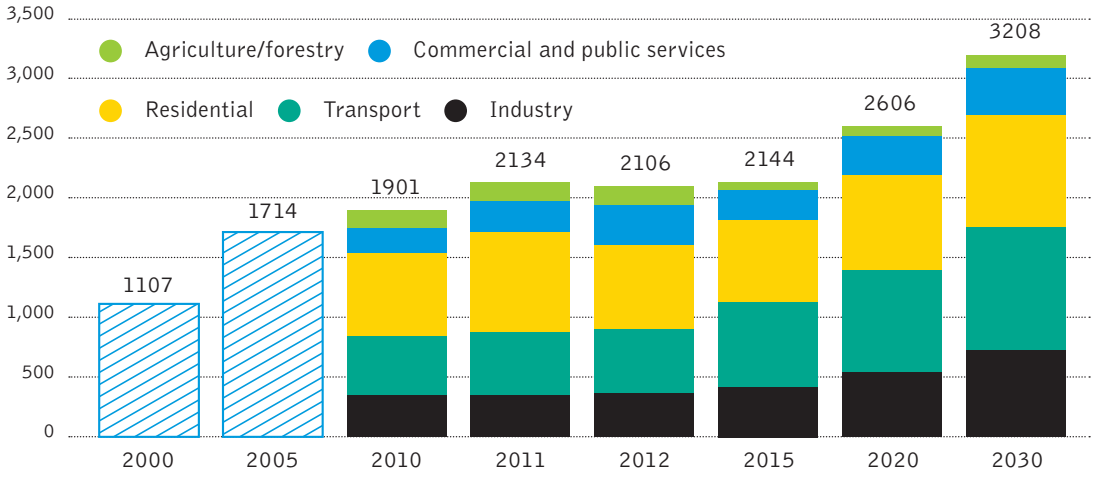


FIGURE 7
Final energy consumption in Armenia by sector (in ktoe)*
Source: USAID, 2015. Reference scenario 2015-2030.

* Data for 2000 and 2005 are from IEA, Statistics

Although reduced during the recent years, overall energy losses are still high. About 30% of the total primary energy supplied was lost through transformation, transmission and distribution (USAID, 2014). This underlines the importance of energy infrastructure improvement and EE development.

Final energy consumption has increased in recent years (see Figure 7). The residential sector was the most relevant, consuming over one third of total final energy, followed by the transport sector with a share of 25% in 2012. Nevertheless, both sectors make only insignificant contributions to GDP. Industry used only 18% of energy, which is far beyond the industry's share in the soviet era. Commercial and public services accounted for about 16% and agriculture – for about 7%. The share of the residential sector fluctuates depending on weather conditions. Only the commercial and the public service sector showed steady increase of energy consumption over the last years.

The projections are based on 2012 data and assume that transportation will be a major driver of final energy consumption by 2030. The share of industry is expected to increase as well. However, the Long-Term Strategic Development Program of the Armenian Government 2014-2025 plans an annual economic growth of up to 6-7% and a doubling of GDP by 2025. Highly qualified jobs ensuring high labour productivity is considered as the main directions. The Program, in fact, may become a straightforward strategy for a country poor in natural resources. The envisaged work places indeed may be less energy-intensive. Therefore, one would expect an increase of energy consumption in commercial and public services in a reference scenario, which would be compatible to the electricity consumption projections (Figure 10).

2.2.2 Electricity generation and consumption

After the deep fuel crisis in 1992 when consumers had only 2-4 hours of electricity per day and most households depended on firewood or electricity for heating (World Bank, 2011), the electricity system has been restored. Electricity generation in Armenia relies mainly on natural gas (54% of total installed capacity) followed by hydropower (22% of installed capacity). The nuclear power plant built in the Soviet period is still in operation and contributes 19% of total installed capacity. The NPP is used for

base load and contributed about 30% of total electricity generated in 2013. Thermal power covers seasonal peaks during fall and winter. Hydro power covers daily load variation, but has reduced operable capacity during winter months. In the Soviet past, the system worked on an integrated basis with the other South Caucasus republics, where the Armenian NPP delivered the base-load, the Azeri thermal power plants supplied the medium-load and the Georgian HPPs the peak-load.

Except large scale hydro[4], the share of RE in Armenia is still very small. In 2012, 200 MW of energy was produced by SHPPs and 2.64 MW by wind power plants (Lori-1). The latter was constructed in 2005 by the Iranian company "Sunir" using grant money provided by Iran.

Existing capacity still allows net exports of about 15% of total electricity generated.

More than half of the installed 4.4 GW total electricity generating capacity is older than 40 years. These power plants are at the end of their life-cycle; moreover many units operate far below their installed capacity.[5] They need replacement or substantial investment into refurbishment to extend their life span. The same is true for the electricity grid which requires comprehensive rehabilitation.

Efforts on modernization of power plants had been undertaken and two new modern gas-fired thermal power generation capacities were constructed (the Yerevan CCGT Unit with an installed capacity of 271.7 MW commissioned in 2010 and the Hrazdan Unit N5 with an installed capacity of 480 MW commissioned in 2011).

“About 30% of the total primary energy supplied was lost through transformation, transmission and distribution. This underlines the importance of energy infrastructure improvement and EE development”

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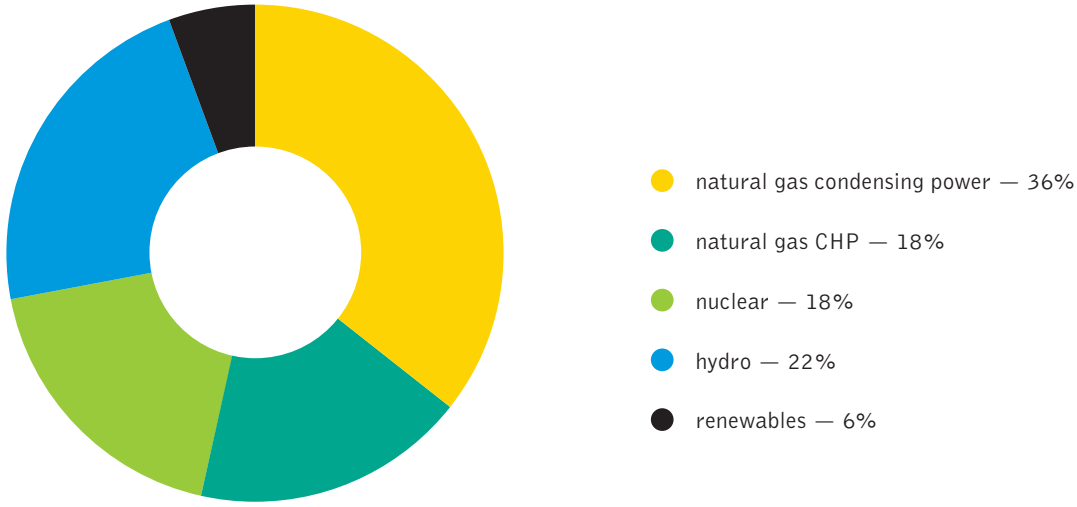
4 Installed hydro capacities above 30 MW are considered large scale HPPs. All others are considered small scale.

5 At Hrazdan TPP 800 MW are operable out of 1050 MW installed, and at Yerevan TPP only less than 10% of installed capacity. Efficiency is very low (370g of fuel per kWh) compared to new gas fired blocks at Hrazdan (260-270 g/kWh) and to the new Yerevan CCGT (170g/kWh). (World Bank, 2011).

FIGURE 8
Break-down of installed power generation capacities (2013)
Source: Armenia Energy Security Strategy Action Plan, 2014



A steadily growing electricity demand (see Figure 9) and the necessary shut-down of under-maintained infrastructure, including about 1,300 operable power generation facilities, have resulted in the need for new power-generating capacities to be constructed in order to meet an envisaged supply gap in 2017 (World Bank, 2011, 7). The operable capacity of the current nuclear power plant cannot be increased and hydro energy is dependent on weather conditions. Discharges from the Sevan Lake to the Sevan-Hrazdan cascade are limited and strongly depend on the irrigation regime. The working capacity of the Vorotan cascade power plants is also limited due to the water flow in in the river. Therefore the load of Vorotan cascade is highest during the spring-summer months and lowest during the autumn-winter months. The assessment of the gap has shown different results ranging from 800 to 1,100 MW of new, operable generation capacity in order to meet peak load and to maintain a 25% reserve margin (World Bank, 2011, 9)[6].

Substantial export capacities will remain. 75% of the capacity of the new Yerevan CCGT and of unit 5 at Hrazdan TPP, as well as full capacity of the Meghri HPP (to be operational in 2019) are dedicated to electricity export. As electricity consumption is expected to increase moderately (Figure 10), the reason for the projected sharp increase of electricity generation by 2020 may only be given by exports.

Supply reliability is a major challenge for Armenia. It could be threatened if supply of any imported fuel was interrupted. Different new capacity options have been assessed. RE and EE can play a major role to close the expected capacity gap as well a new gas fired or nuclear plants. According to the World Bank study of 2011 the combination of RE, EE and a new gas fired plant would be the least cost option (World Bank, 2011, 20). Capital costs of an NPP of about 6000 EUR/kWh including decommissioning, but excluding waste disposal and insurance, are about 7 times higher than those of a Gas Turbine Combined Cycle Plant. That will put a heavy burden on Armenia's public budget.[7]

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6 The IMF assumed a 4% annual GDP growth rate during 2011-2030. (World Bank, 2011, 11).

7 Capital costs of about 6000 EUR/kWh including decommissioning are estimated as reasonable (Schröder et al., 2013, p. 34). Investment costs for a 1100 MW NPP will amount to at least 6.6 bn EUR or almost 7 bn USD, which is about 67% of Armenia's GDP in 2013.

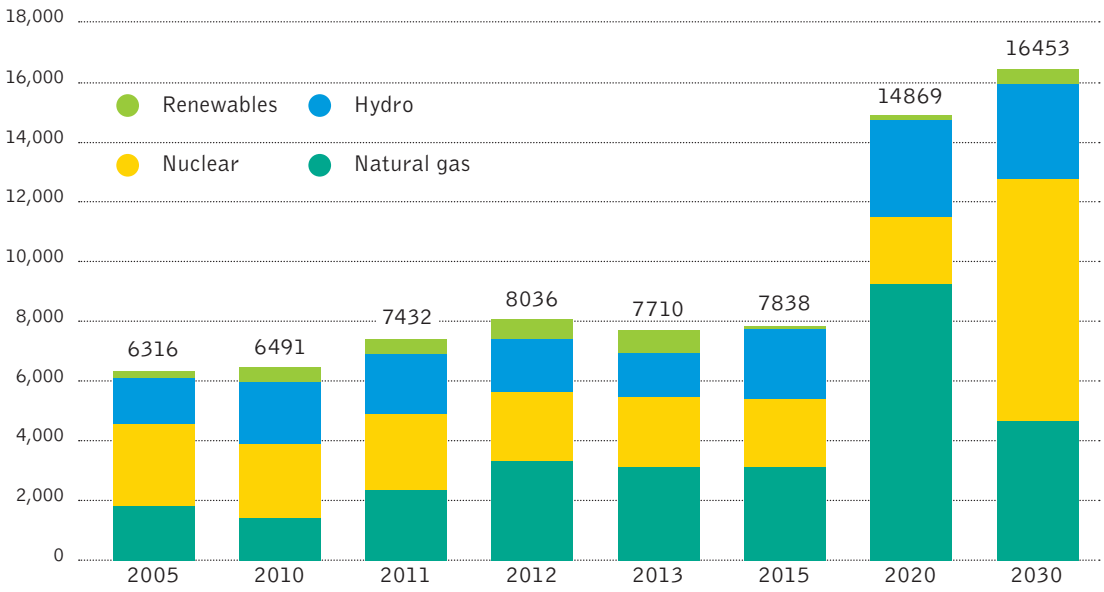

FIGURE 9
Electricity generation by fuel (in GWh)
Source: Annual Report of the Ministry of Energy and Natural Resources of RA and USAID, 2015. Reference scenario 2015-2030

Although the Armenian government recognises the EE and RE contributing to energy security it is pushing construction of a new reactor of either 1,000 or 1,200 MW. Activities started in 2008, but due to lack of investors completion of the project by 2017 is not feasible. Therefore, a decision on lifetime extension of the existing unit by 10 years was made and the commissioning of the new nuclear unit was postponed to 2026. However, it is obvious that EE and RE reduce or displace the utilization of a nuclear plant and respectively increase the costs of nuclear electricity generation. Therefore, it is not clear what real priority EE and RE do have in present energy security policy. Instead, the construction of a more flexible gas fired plant of lower capacity would allow for full development of EE and RE, as reduced utilization of such plant would decrease its generation costs.[8]

New renewable capacity was estimated to add 492 MW of capacity until 2020 (see Table 6). Number of small CHP units were constructed recently within the scope of locally and internationally financed projects and initiatives. These units are integrated into the power system and supply electricity to the national grid. Still, CHP is not a success story. A supportive feed-in tariff was introduced for small CHP which is the highest of all regulated electricity tariffs, but it turned out the plants did not connect the planned number of buildings to be supplied with heat. Instead, the owners of the plants run the CHP plants mainly for electricity generation, which was not what was intended, and the support tariffs will not be granted any longer.

Main driver boosting future electricity consumption is the sector of commercial and public services followed by industry (see Figure 10). However, correct demand assumptions need to take into consideration not only estimated GDP growth rates but also potential for energy efficiency improvement in all sectors which were estimated to be substantial (see Table 5) and will further increase due to technology development. Therefore, projections are expected to be adjusted in the future.

8 For detailed explanation see World Bank, 2011, pp. 17-22.

As mentioned above, estimation of the amount of new generating capacity needed is also substantially driven by the government's strategy to further increase electricity exports. For exports, competitive prices are crucial. It must be doubted that electricity generated by a new NPP will be competitive without additional state support. Experiences from recent examples show that construction costs usually have a tendency to increase far above ex ante estimated costs.[9]

2.2.3 Heat generation and consumption

Armenia had one of the most developed district heating systems in the USSR. About 35% of housing stock and about 90% of the multi-storey apartments and the public buildings were covered by the district heating services. During the energy blockade at the beginning of the 1990s district heating system collapsed. Many heat pipelines have been cut and individual heating devices installed. The centralised heat supply declined from 14.2 million m^2 of living space in 1990 to 0.5 million m^2 in 2006 (World Bank, 2011, 5). Currently there are more than 1500 decentralized heating systems constructed and/or rehabilitated either by private companies or under international financial support. These facilities provide heat to public and residential buildings.

Fire wood was used to large extent during the crisis in the 1990s which dropped down since 2004 when more natural gas had been imported. Today individual heating relies mainly on gas followed by electricity. However, there is some evidence that the use of firewood increases when gas prices go up. That was the case in 2008 when gas subsidies were removed by the government.[10]

Since 2007 CHP plants were started to be installed. The first unit with an installed capacity of 4.6 MW was constructed at Yerevan State Medical University. The facility is operated with natural gas

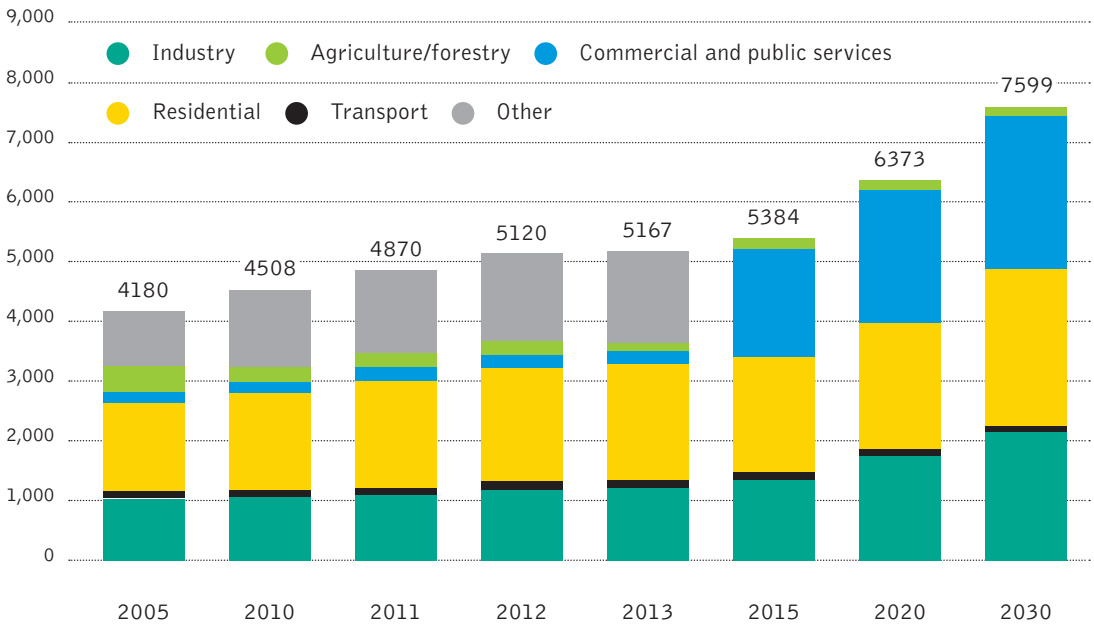

FIGURE 10
Electricity consumption in Armenia by sector (in GWh)
Source: Annual Report of the Ministry of Energy and Natural Resources of RA and USAID, 2015. Reference scenario 2015-2030

9 <*http://www.diw.de/documents/dokumentenarchiv/17/diw_01.c.417234.de/hirschhausen_masmie_workshopii_nuclear.pdf*>.

10 USAID "Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) Program in Armenia".

and supplies heat to 6 buildings of the University. In 2009 a CHP and two boilers based plant were constructed in the Avan residential district to provide heat to nearby multi-apartment buildings. The installed capacity of the CHP unit and two boilers are 2.3 MW and 7 MW correspondingly.

In general, a main problem remains the low comfort level in many buildings, which is often beyond 50% of the needed level.

2.2.4 Energy imports and exports

Although Armenia imports the bulk of energy consumed as it does not possess any own conventional fuel resource, it is a net electricity exporter (1.7 TWh in 2012) at the same time. In addition to Iran the country maintains exchange activities with Nagorno Karabakh Republic. However, electricity exports vary due to weather conditions – electricity is usually exported during the summer months (April-September) when surplus hydro power is generated and during the winter months (October-March) electricity is imported. Prices are also important and in some years lead to net imports from Georgia. The initiated construction of a high-voltage DC transmission line between Armenia and Georgia will help improve bilateral electricity trading and will increase security of supply. In addition, pressure on capacity enlargement for electricity generation in Armenia would be lowered and the load factor of generation capacities could be improved.

“It must be doubted that electricity generated by a new NPP will be competitive without additional state support”

2.3 Institutional Framework of the Energy Markets

2.3.1 Market design and regulation of market access

The institutional setting of the different energy sub-sectors varies. The natural gas market is organized as a vertical monopoly owned by Gazprom Armenia CJSC, a subsidiary of Gazprom OJSC[11] which supplies, transports, stores and distributes gas in the domestic market of Armenia. The power sector in contrast is vertically separated (unbundled) and consists of state-owned and private entities (see Figure 11). A single buyer model is implemented, where all electricity needs to be sold to one entity. In the Armenian case the single buyer is the Electric Networks of Armenia CJCS – ENA, which also owns and operates the power distribution system. It is a subsidiary of the Russian company RAO-UES. That means, the gas and the power sector are dominated by Russian companies while the heating sector is completely decentralised.

Although a grid code has not yet been adopted, non-discriminatory access to transmission and distribution networks is required by the Regulatory Commission. Access to the grid for RE is granted by Law. ENA develops technical conditions for the access to the national grid that are valid for at least 2 years and introduces these conditions to new or expanding plants. If the construction of a new power plant or an upgrade of an existing plant requires changes in distribution (ENA) or transmission (HVEN) networks, all works associated with design, construction and mounting shall be implemented by the distribution and (or) transmission company. All investments related to mentioned upgrades and changes in the networks shall be agreed with the regulator.

2.3.2 Regulation of tariffs

All public services' tariffs are regulated by the Public Services Regulatory Commission (PSRC) established in 1997. Only power generators that supply electricity for own consumption are not regulated by PSRC. The regulation applies to generation, transmission, distribution, retail and export. Tariffs for generation are two-part (for power ordered by the Energy Power System Operator and for power supplied to the national grid) for the five largest generators. Tariffs are one-part (only for power supplied to the national grid) for the rest of the generating plants.

Electricity tariffs for the end users are one-part and are defined based on voltage and time zones (time differentiated tariffs). Difference between tariffs in two time zones may be within about 30%. Hence, electricity tariffs indirectly depend on consumer groups i.e. large consumers that are fed from high voltage substations enjoy lower tariffs then those that are fed from relatively lower voltage distribution system (see Table 2).

Due to the increase of the natural gas import prices electricity tariffs for final customers have

11 The state owned Russian gas company.

been raised several times. Between 2005 and 2014, tariffs for industry more than doubled (except for day tariffs for SME on lower voltage levels) and increased by about 67% for private households and the public sector as related to day tariffs. Night tariffs also doubled for this customer group. Converted into EUR current tariffs vary between 5.5 and 7.97 EUR Cent/kWh.

Regulation is done based on a "cost+" (i.e. cost-benefit) methodology, which allows for covering all current and capital costs plus a fair profit margin. Investment aiming at improvement of reliability and efficiency of energy supply via reduction of losses and application of new technologies are encouraged by the Commission. There are no direct subsidies built into the tariff structure, with the exception of a targeted social allowance for low-income households for natural gas consumption bills over a set threshold. Tariffs may be reviewed either on the initiative of a licensee or PSRC once every 6 months.

The level of electricity tariffs in Armenia is influenced by the natural gas prices determined in gas supply agreements with Russia, by the roughly 30% of domestic large-scale hydro generated mainly by old hydro power plants at low cost, and by the depreciated equipment of most of the existing power plants. The HPPs owned by the International Energy Corporation (a Russia based company) produce electricity at lowest costs.

The level of electricity tariffs is quite low compared to respective levels in EU member states but is quite in line with the neighbour countries. In Georgia electricity tariffs range from 3.76 to 5.73 EUR Cent/kWh in 2014 and in Azerbaijan, which relies in own natural gas resources, from 2.03 to 6.09 EUR Cent/kWh.[12] Increase of the tariff (as one aspect of the investment) also helped improving the economic viability of investments. Simple payback-period of the most thermo-modernization projects decreased from 8-10 years to 5-7 years at present.

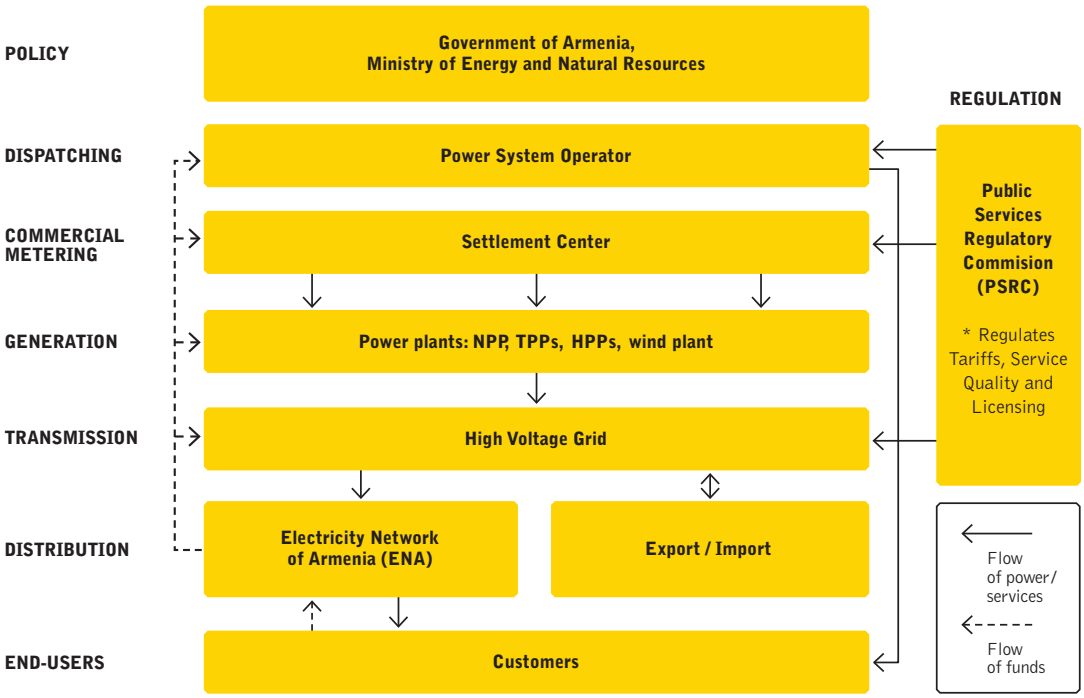

FIGURE 11
Institutional structure of the Armenian power system
Source: Preparation of SREP Investment Plan for Armenia, September 2013

12 All conversions into EUR are based on average official exchange rates in December 2014.

Type of consumer	AMD/kWh
For private households, **day**	41.85
For private households, **night**	31.85
For industry 6 (10) kV, **day**	38.85
For industry 6 (10) kV, **night**	28.85
For industry 35 & 110 kV, **day**	32.85
For industry 35 & 110 kV, **night**	28.85
For public sector, day / night	41.85 / 31.85
For commercial sector, d / n	41.85 / 31.85

TABLE 2
Electricity tariffs for final customers (in national currency)
Source: PSRC, 2014

The modernization of generation, transmission and distribution on the one hand would improve energy efficiency and reduce transportation losses, and on the other hand cause tariff increase. To keep the expected tariff increases affordable the need for new generation capacities should be kept low and load factors of the plants need to be improved.

Tariffs are also set for the natural gas transmission and distribution companies as well as for the operator of gas supply system and retail supply. One-part tariffs, which level depends on a defined monthly consumption level, are set for natural gas end users. For different consumers groups the PRSC sets tariffs in different currencies. For large consumers (which consume about 75% of all imported natural gas) the tariff is set in USD to mitigate the currency exchange rate risk for Gazprom-Armenia (the gas importing company).

Tariffs for the small customers were 38% lower in 2013 than tariffs set for the larger consumers.

Power Plant	AMD/kWh
Medzamor NPP	6.071
Hrazdan TPP	37.180
Hrazdan Unit-5 TPP	40.080
Yerewan TPP	17.594
Vorotan Cascade of HPPs	8.201
International Energy Corporation	0.931

TABLE 3
Tariffs set for electricity generators (as per 07.07.2014)
Source: PSRC, 2014

TABLE 4
Natural gas import price and tariffs for two different final customer groups (2007–2013)
Source: PSRC, 2014

Category	Unit	Tariff (including VAT)				
		01.01.2007	01.04.2008	01.04.2009	01.04.2010	07.07.2013
Natural gas purchase price at the border	USD/1000 m³	110 *	110.00	154.00	180.00	189.00
Consumers with monthly consumption below 10 thousand m³	AMD / m³	59.00	84.00	96.00	132.00	156.00
	USD / 1000m³ **	**143.37**	**204.12**	**233.28**	**320.76**	**379.08**
Consumers with monthly consumption more than 10 thousand m³	USD/1000 m³	101.25	153.26	215.00	243.13	276.98

Note: * State subsidy mechanism applied
** Constant exchange rate of USD/ADM = 410 assumed

Servicing large consumers indeed creates lower costs. However, such a considerable difference between the tariffs for these two customer groups leads to artificial increase of the reported monthly gas consumption by customers whose monthly consumption is close but still below 10 thousand m³ threshold in order to save money. This happens for building level heating systems and SMEs.[13] In order to stop misreporting and to incentivize energy efficiency measures correct metering and billing of heat according real heat consumption needs to be implemented.

Imported natural gas price increase impacted on the vulnerable Armenian economy and the population considerably. In the past, the government tried to water down this effect by subsidizing the gas price. In 2006 the subsidy was about 180 million USD. The resulting temporary, artificially low energy prices, particularly for energy-intensive industries such as the cement production, had eliminated all incentives for energy efficiency sending the market players a false signal that they can continue wastefully using energy. Estimates have shown, that if the allocated 180 million USD subsidy was targeted towards the implementation of energy efficiency measures in 21,911 multi-apartment buildings of the country each building would receive 8,215 USD. At that time this was enough to implement weatherization of building entrance doors and common space windows, and more profound measures for low-income households living in those buildings. If invested into a revolving fund, this sum could have an immense multiplier effect.[14]

In 2010 the Russian gas price increase led to a nearly 40 percent raise of the retail gas price for the residential consumers and caught them unprepared. By that time the Armenian government, which had already learned part of the lesson, provided targeted subsidies to the low-income households. In the most recent round of the gas price increase, the Armenian Government sold its 20% share in ArmRusGasProm JV to its Russian partners to maintain the gas tariffs low for a period of time (as long as the sale revenue lasted). However, experience shows, that investment into energy efficiency would have been the best solution to protect consumers against further price increases. Such an example was the R2E2's project Global Partnership for Output-Based Aid (GPOBA) offering efficient heating devices to 8300 low-income families through the Japanese Government support.

13 Since many years there has been a discussion about the need to apply the whole-sale tariff for centralized heating systems, but this discussion did not lead to any results.

14 Pasoyan A. and A. Ghukasyan, 2007.

2.4 Sustainable Energy Policies

2.4.1 Energy security

Several official documents[15] stress the following key elements for improving Armenia's energy security and only differ a bit in ranking first nuclear energy or EE and RE:

- Development of nuclear energy
- Development of RE, EE and energy savings programs
- Diversification of all primary energy resources and supply routes
- Regional integration of the country's energy system[16].

In addition to construction of the new HPPs, wind turbines, modernization of existing two TPPs, the construction of a new energy block in the Armenian nuclear power plant (NPP) and restoration of the underground storage facilities for natural gas are planned.

The official documents also stress the importance of restoration of the heat supply with maximum use of geothermal, biogas, solar and other renewable energy sources and wide scale introduction of sustainable EE measures. However, it does not provide details about the planned approach to reach that aim.

The results until present are a number of implemented projects like the new generating capacities to the Yerevan Combined Cycle Gas Power Plant, construction of the 440 MW Hrazdan-5 Combined Cycle Gas Turbine, signed agreements between trade Armenia and Georgia on Parallel Operation and on Power Supplies during Emergency Situations in order to develop the basis for electricity trade and an approved feasibility study of an interconnection transmission line with installation of a substation with B2B converter at a total capacity of 1,050 MW. Other planned measures have not yet materialized.

Currently a new Energy Strategy is under development. It considers implementing of a least cost generation plan (LCGP), which will define the development strategy to meet the criterion of obtaining energy security at the lowest cost. However, present discussion suggests that the key elements of the energy security concept will not change. EE improvement and RE are referred to as major cornerstones of Armenia's energy security policy and future energy sector development.

Apart from the generated energy and cost savings, energy efficiency is one necessary condition to diversify Armenia's energy supply and to improve economic competitiveness. EE in most cases is the least cost solution, i.e. can be achieved at less cost than investing into new production capacities or energy imports, and it can be considered an energy source itself. But,

15 Among them Energy Sector Strategy until 2025 which was approved in 2005 and the energy security concept of 23 October, 2013.

16 Armenia's energy security concept was approved on 23rd October, 2013.

as was already outlined in chapter 2.2.2, under conditions where construction of a new nuclear unit is of high priority, it is not clear what real priority EE and RE do have in present energy security policy.

2.4.2 Sustainable energy policies and instruments

Regardless the discussion on prioritization of EE and RE or nuclear energy Armenia is quite advanced compared to Georgia and Azerbaijan concerning EE and RE policy strategies. This might be no surprise because EE helps solving practical energy security issues in this energy poor country.

2.4.2.1 Energy efficiency

Energy efficiency has been addressed by several laws, national programs and action plans. The Law on Energy Saving and Renewable Energy of 2003 had outlined the main directions and mechanisms of Armenia's energy efficiency policy. They include the following:

- Targeted state-administered programs as well as incorporation of energy savings requirements in state programs on the economic development of Armenia.
- National energy saving standards to be adopted with regard to the energy efficiency for different goods and processes.

  Training and education. The topic of energy savings has to be incorporated into the curricula of elementary, secondary, graduate, supplementary and post-graduate educational institutions and to develop energy savings educational training programs for engineering staff.
- Information dissemination.
- Energy audits. Although the Law spells out several important factors and suggests certain prerequisite activities related to the development of the energy audit process in Armenia, no methodology or energy passport format is provided so far.
- Fiscal incentives.
- Update of existing compliance certification.

However, the Law does not specify any restriction or incentive mechanisms and, as a result, provisions of the law have a declarative nature. Also the first National Energy Efficiency Action Plan (NEEAP) of 2010, which aims tackling all EE relevant sectors, lacks economic incentive mechanisms. The 2nd NEEAP, which is expected to be delivered in mid-2015, will assess not only the 2010-2012 performance of the 1st NEEAP's energy efficiency improvement measures but also adjust the EE targets for 2015-2018 and elaborate detailed activities for 2013-2015. It will allow monitoring with the use of EU-approved Monitoring and Verification methodologies.

The establishment of the Armenian Renewable Resources and Energy Efficiency Fund (R2E2) in 2005 was an important step to improve the institutional framework for support of EE and RE. The fund implements grant and credit projects targeted at the development of EE and RE sectors in Armenia.

In order to strengthen institutional framework for energy efficiency and for renewable energies the Ministry of Energy and Natural Resources has established a multi-stakeholder coordination Energy Efficiency and Renewable Energy Council (including Government, NGOs, donors, including EBRD and ASE) in 2012. The Council shall discuss and comment on the developments in these fields as well as monitor and report on the progress of implementation national EE plans and programs.

Scenarios based on MARKAL-Armenia modelling exercises in 2006 had shown considerable EE potential for Armenia (see Table 5).

A World Bank Study (2008) had estimated the energy efficiency potential in the overall Armenian economy of about 1TWh of electricity and 600 million m^3 of natural gas, 97% of which could be achieved through investments that are both economically and financially viable. The study concluded that energy efficiency investment in the public sector has the highest return, followed by respective investment into industry, households and utilities.

TABLE 5
Model scenarios energy efficiency improvement until 2020 (compared to 2005 baseline)
Source: MARKAL-Armenia, 2006

Scenario	Level of implementation of determined energy efficiency measures	Potentially achievable reduction of final energy consumption
Pessimistic	30%	8%
Average	65%	17.4%
Optimistic	100%	26.7%

As the building sector has considerable EE potential the government supported by international organisations has made efforts to develop EE policies for this sector. But implementation is severely hampered by insufficient government monitoring of compliance with construction standards and rules. In practice, obsolete construction standards are the rule. There is a lack of mandatory requirements for developers, enterprise managers, and end-users, as well as the general tendency to minimize construction costs without taking future costs into account. This is coupled with low awareness of EE by energy consumers, on the one hand, and lack of technical capacity to offer EE solutions by architects, energy managers, developers, and inspectors, on the other.

The overall consensus among various stakeholders is that Armenia needs to introduce binding legislation stipulating energy auditing, energy passports/certificates and labelling of buildings, mandatory enforcement of building energy codes with compulsory application to new buildings as well as with gradual application to already existing ones to harmonize with EU Directive on Energy Performance Indicators in Buildings.

On December 25, 2014 the Armenian Government adopted the Resolution No.1504 on Integration of Energy Efficiency in New Construction or Reconstruction Projects funded by State Budget Resources, which makes energy efficiency as well as cost-effective renewable energy solutions mandatory for integration in public sector construction/reconstruction projects. The legal reform in the field of energy saving and EE is gravitating towards EU best practices and transposition of the EU Directives. In practice that is not a contradiction to the fact that the country joined the Russia-led Eurasia Customs Union in January 2015. Also Russia is implementing several EE policies which have been developed in the EU.

Energy use in industry and agriculture remains highly inefficient. The heating sector is more or less out of the policy focus although there is a huge potential for improvement of EE in heating and cooling.

In practice, main EE improvement was so far at the supply side carried out mainly by international investment into modernization of the power sector, although major inefficiencies still remain in this sector. In the near future, the substantial international support available for implementation of the planned EE and RE activities will remain a major driver.

- In 2012 the government of Armenia signed an EE program (worth 10.7 million USD) supported by the World Bank and implemented by the R2E2 Fund. The program is targeted to implement energy saving activities in public facilities to reduce the level of energy consumption by social and other public facilities (see box p.42).
- Membership in the Eastern Europe EE and Environment Partnership (E5P) will enable implementing very important EE projects. Investment by Armenia is required of about 1 million EUR to be paid in tranches in addition to which Armenia will be granted nearly 20 million EUR. However, Armenia did not yet pay the first portion of the membership fee to commence the projects.
- In 2014 EBRD offered EE investment up to 1.84 million EUR. Now Armenia must sign the agreement with EBRD in order to access it.

- UNDP/GEF is implementing a project aimed at Improving Energy Efficiency in Buildings including massive support to the Armenian Government in transposition of Directive on the Energy Performance of Buildings (EPBD) of the EU, development of secondary legislation for EE in buildings, as well as funding the first pilot thermal modernization of a residential multi-apartment building in Avan district of Yerevan, as well as social housing in Goris and Akhouryan towns.
- Also gradually evolving are the European Covenant of Mayors efforts in Armenia, with now 9 signatories, of which 3 cities already have their Sustainable Energy Action Plans (SEAPs).

These and many other efforts by IFIs (EBRD, IFC, KfW, USAID, ADB etc.) aim at eliminating investment barriers and channelling relatively affordable finance and technical assistance for sustainable energy lending.

Experiences from practical implementation of EE in buildings

R2E2's experience in public building EE retrofits made obvious that the buildings were in such poor state of maintenance and repair that substantial investments in rehabilitation were needed without prospects for cost recovery. However, the Fund's estimations show that with incremental investments of about 17–20 USD/m² (this is equivalent to approximately 10% of the common average 200 USD/m² for comprehensive building rehabilitation) the natural gas consumption for heating can be reduced twice, correspondingly the GHG emissions will be reduced by around 50%. These improvements can be achieved by a comprehensive energy efficiency improvement package including insulation of walls/finishing, replacement of doors and windows, replacement of windows by walls, and roof insulation, after an efficient heating system has already been put in place.

The 8 million USD credit line of R2E2 has very strict eligibility criteria, and can only finance energy efficiency measures with attractive economic indicators (positive net present value) and only accept applications from public buildings where the comfort level is beyond 50%. As a result, energy efficiency measures which may result in substantial greenhouse gas mitigation but have lower cost-effectiveness or are proposed for suppressed demand conditions will not be eligible for finance. The documented average energy saving has been about 54%. As of the end of 2014, over 100 building EE projects were in the pipeline, and the first dozen was already under implementation.

> **“The heating sector is more or less out of the policy focus although there is a huge potential for improvement of EE in heating and cooling”**

Energy Service Companies (ESCOs) are gradually becoming a new important partners in promoting sustainable energy solutions in Armenia. Their creation has been supported by a number of donor-funded programs. As long as donor support was fully available for grant-funded energy efficiency investments, the ESCOs did not develop financing features, but built up skills for designing energy efficiency projects and for implementing the engineering work. As the R2E2 established the lending scheme for public building energy saving investments via energy saving agreements through ESCOs, more than 30 companies are now operating, which provide services such as weatherization, design, installation and maintenance of boiler houses, as well as broader consulting on related issues. However, they still do not share or guarantee amounts of energy saved in accordance with what was preliminarily estimated, neither do they bear direct financial risk (R2E2 functions as a super-ESCO bearing the major risk).

The enforcement of the declared policy priorities in the field of EE will require substantially stronger political engagement in the field of modernization and enforcement of EE standards, monitoring and enforcement of construction norms and standards, as well as introduction of incentives for promoting EE in the private sector.

2.4.2.2 Renewable Energies

Armenia has remarkable RE sources. Development of RE in Armenia is driven by the energy security goals, ensuring tariff affordability, and maximizing national resources. In 2011 a Renewable Energy Roadmap identified the RE technical-economic potential and made a first projection for RE development until 2020. The Armenian government has adjusted the findings of the Roadmap recently and adopted more ambitious RE targets until 2025 (Energy Security Concept, 2013 (see Table 6).

The government-approved RE targets are an important milestone for further RE development. If the Energy Security Strategy Action Plan of 2014 would be implemented, Armenia’s energy security would be strengthened and the environmental impact of the energy sector would be reduced. In the meantime, the Energy Law will need to be amended in order to improve terms

	Capacity installed (MW)		Generation (GWh/a)		Existing capacities (MW)
Electricity	**2020**	**2025**	**2020**	**2025**	**2013**
Small Hydro	377	397	1,049	1,106	220
Wind	50	100	117	232	2.64
Geothermal	50	100	373	745	N A
PV	40	80	88	176	0.015
TOTAL	492	677	1,627	2,259	222.65
Heat	**2020**	**2015**	**2020**	**2015**	**2013**
Geothermal heat pumps	12	25	16	33	N/A
Solar thermal	10	20	13	25	N/A

TABLE 6
Renewable energy targets 2020–2030 and existing capacities
Source: Republic of Armenia, 2014, 3

and conditions for of the guaranteed purchase of renewable power.

For different RE applications the following technologies had been identified as appropriate:

- Electricity: Small hydropower (SHPP), wind power, photovoltaics (PV), geothermal power, and biomass; Geothermal electricity is of special interest as it may serve as base load.
- Heat: Heat pumps, solar collectors (hot water), geothermal energy, and biomass;
- Transport: Biogas and liquefied biomass.

For the SREP Program of the Climate Investment Fund three investment priorities have been determined: Further exploration of geothermal power development; development of utility-scale-solar PV and renewable heat, i.e. geothermal heat pumps and solar thermal technologies (Republic of Armenia, 14, 7).

Some basic rules for implementation of RE for grid connected power generation are in place. RE producers are guaranteed to purchase every kilowatt of renewable electricity for 15 years starting from launch of the generation. Feed-in tariffs have been assigned for wind energy and small hydropower (subdivided by types of water supply) (Table 7). Solar PV has been operating so far under net metering without a tariff assigned.

Although de facto feed-in tariffs in 2014 are lower than tariffs suggested by the Road Map for 2011, the RE supporting framework led to considerable increase of renewable electricity. According to the Ministry of Energy electricity generation by RE in 2013 had already reached 10% of total electricity generation, being equivalent to 740 GWh. Hydropower is the most advanced RE in Armenia today, both large-scale HPPs and SHPPs. During 2005-2013 more than 150 million USD was invested in small hydro power plants, adding around 210 MW of new SHPP capacity, all privately owned.

The donor community played an important role in promoting development of RE in Armenia through investment and technical assistance in order to improve legal and regulatory framework, as well as through a number of projects including resource assessment and mapping. However, the development of SHPPs is well advanced already. SHPP owners created their own association and

TABLE 7
Renewable energy feed-in tariffs for different technologies (in US Cent/kWh)

RE Technology	Established Feed-in tariff *	Suggested Feed-in Tariff **		
	2014	2011	2015	2020
Wind	2.25 – 5.05	10.3	10.8	11.9
Small HPP	×	3.6	5.9	7.4
Solar PV	×	47.4	38.0	24.0
Geothermal Low-cost	×	×	×	3.6
Geothermal High-cost	×	×	×	6.8

* Source: *www.psrc.am* exchange rate AMD/USD 0.0024

** Source: RE Roadmap of Armenia, 2011

some evidence seems to be there that many SHPP are already operating under market conditions.

The potential for SHPPs accounts still for some additional 114.5 MW or an average of 264 GWh/a respectively until 2020 (R2E2, 2011). Nevertheless, the current RE policy in Armenia is escorted by heavy public and local discussions. Negative environmental impacts during construction (temporary) and operation (e.g. creating obstacles for migrating fish stock if proper fish bypasses are not installed; in case of wind farms- low-frequency noise, threat of bird's collision with turbine flaps, visual pollution of the landscape, etc.) as well as ownership issues are being discussed.

Therefore, further RE development requires several problems to be solved, which are of legal and regulatory nature on the one hand and related to business and technical solutions on the other hand. Competing land claims, negative environmental impacts, differences between actual construction costs and study cost estimates, poor performance and low reliability of used technologies that have often been imported from China (R2E2, 2011) are some additional major issues which need to be resolved. As there is competition in water use, priority was assigned to drinking water followed by irrigation needs, HPP construction needs comply with this order. Implementation of Strategic Environmental Assessment (SEA) would transparently assess advantages as well as disadvantages of RE prior to investment and would help solve main of the current questions.

An increase of the current feed-in tariffs for some technologies as well as their more frequent adjustment to inflation and exchange rates are required as well. While installation costs of SHPPs in the past have been ranging between 700 USD/kW and 1000 USD/kW with electricity generation costs below 7 US Cent/kWh, future SHPPs are expected to need higher capital investment (between 1200 and 1500 USD/kW) in order to install more efficient and reliable turbines at the remaining sites with lower capacity factors (R2E2, 2011). Wind power, which has quite substantial power comes still at higher costs (Republic of Armenia, 2014, 30) and will therefore be developed much slower. Poor coordination between the authorities and issuance of power purchase agreements (PPA) only after a power plant is constructed are additional obstacles.

17 That means that the country had no binding quantitative commitment for GHG emissions reductions.

2.4.2.3 Climate change mitigation

Armenia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1993 and is a non-Annex B Party to the Kyoto Protocol[17]. The Ministry of Nature Protection has been appointed as the Designated National Authority (DNA) for the Clean Development Mechanism (CDM). While all national procedures for CDM project approval are in place, only a few initiatives addressing municipal landfilled gas, agricultural biogas or small hydropower plants had been successful under this mechanism.

Although Armenia does not have quantitative commitments to reduce GHG emissions the government is encouraged to make additional efforts to fully implement the Cancun and Durban decisions and in particular devise a low-carbon development strategy. It has passed a number of laws and is implementing national and sectoral development programs, which contribute to the reduction of GHG emissions, and is willing to voluntarily undertake climate change mitigation measures if support from developed countries would be available for these efforts.[18]

A national GHG inventory report has been developed and for the first time the inventory included the F gases[19]. In addition, a Five-year Action Plan on implementation of the UNFCCC commitments, including the development and approval of the NAMA Program by 2015, was adopted, which stipulates elaboration of NAMAs until 2015.

With support by UNDP, the Ministry of Nature Protection is currently building capacity on low carbon development and NAMAs in Armenia. In addition, GIZ may support establishing a NAMA conceptual framework (and selected NAMA proposals additional to this NAMA) for 2015. Armenia developed and uploaded its first NAMA project to the Registry addressing the potential for energy efficiency in public buildings and social housing.

Despite the legal efforts which have been initiated on different fronts to help improve the framework for mitigation as well as adaptation of climate change, the mitigation policy and measures do not take into account the synergies under global environmental conventions. There are lack of adequate linkages between climate change related processes and economic and social development. The currently elaborated low-emission development strategies are a first step focusing on cross-cutting issues and coordinated efforts in different practice areas related to climate change. This should include not only the legal and regulatory framework, but also financing schemes, capacity building efforts, awareness and outreach, technological conversions, etc.

Regional integration is an additional opportunity to strengthen sustainable energy policy. One cross-cutting policy platform related to regional integration is the Eurasian Customs Union. While Armenia had spent years preparing for associate membership with EU, many policy plans and programs have targeted transposition of European Directives. Some of them still remain on track, such as the transposition of the EU Directive on Energy Performance in Buildings. Armenia maintains the status of an Observer in the Energy Community and remains on the relevant task forces and coordination groups on energy efficiency and renewable energies. On the other hand, the Armenian Government's political decision was not to sign the associate membership agreement, and instead sign the Eurasian Customs Union Treaty. Within the Customs Union roadmap Armenia is planning to join several agreements in order to ensure access to the services provided by the natural monopolies involved in power transmission and gas transportation systems.

18 Armenia has already submitted its voluntary political commitment to reduce GHG emissions associating with the UNFCCC Copenhagen Accords, and communicated its mitigation priorities.

19 Fluorinated greenhouse gases.

2.5 Strategic Priorities for Sustainable Energy Development

The Sustainable Development Program of Armenia adopted in 2008 had no specific reference to climate change mitigation and low emission development. In November 2012 the Program was revised (Government Resolution No 442N from 27 March 2014). The adjusted Program emphasized the importance of improving the building conditions of educational, cultural, and judicial institutions.

The Rio+20 report of the Republic of Armenia (2012) outlined the key directions of the 2014-2025 program above, and some of the priorities including the problems of the capital City of Yerevan related to ongoing urban development, where since 1997-98, the launch of spot construction with multistorey buildings has often been at the expense of green zones, playgrounds and other public space, creating unprecedented density, contraction of green areas, climate change, and growth of seismic risks of the city, particularly the Centre. This hampers sustainable urban development and violates the principles of European Landscape Convention, which Armenia has joined.

- Armenia's 2014-2025 Sustainable Development Program (SDP) contains three main objectives:
- Reduction of poverty in 2008 – 2021 to the extent that poverty will not be a problem of economic development, and extreme poverty will be totally eliminated and will no longer be a significant social phenomenon.
- Elimination of human poverty and ensuring accelerated human development, as a result of which, in a few years, the country should have moved from the group of countries with average human development to the group of countries with high level of human development.
- Mitigation of disproportions of the territorial development and acceleration of economic growth of underdeveloped regions by developing and implementing a relevant territorial policy.

It is striking that none of these priorities focus directly on sustainable energy development. The SDP economic policy priorities focus on quality of growth through ensuring accelerated, sustainable and poor-oriented economic growth. Two types of policies are considered fundamental:

- Establishing the respective framework conditions for growth. This includes the design and introduction of the main elements and institutions for a knowledge-based economy, as well as the institutional modernization of the country, which also can be considered as the environment where economic growth takes place.
- Direct policy with the main priority to undertake public investments in infrastructure sectors.

While the reduction of GHG emissions is still among the targets to pursue within the commitments under the UNFCCC, Armenia's energy independence and its reduction of the cost of energy generation are of higher strategic importance.

2.6

Recommendations

Armenia is still on track to transpose some of the EU Directives. On the other hand, the Armenian government opted not to sign the EU association membership agreement, but rather to and sign up for the Eurasian Customs Union, which does not have serious EE or RE conditions. However, international experiences in any case will be important to follow on in order to reach the country's development goals and priorities and to prepare decision making on future shape of the energy sector. Below are recommendations for short, medium and long-term actions.

The short-term

- **Least-cost solutions should be the basis for decision making on new electricity generation capacities.** The needs for replacement of the outdated capacity stock for electricity generating is a challenge and at the same time a huge opportunity for Armenia to develop a sustainable power sector. At least three main questions are to be solved: What is the size of the capacity gap, what would be the role of EE and RE to fill the gap and what type and size of an additional new conventional power plant (gas or nuclear) needs to be build. In a country where energy tariffs are of huge social importance the decision making criteria should be least-cost solutions with lowest impact on tariffs, meeting peak demand and maintaining supply diversity.[20] The discussion at the national level on the one hand needs to integrate results of sound analysis already available, and on the other hand, to be opened further for public discussion in order to make all pros and cons transparent.

- To transfer the above explained challenge into an opportunity for improving energy security and lowering energy dependency, EE and RE need to be developed further.

  Achievement of RE energy targets requires improvement of legal and economic framework. For SHPPs implementation of Strategic Environmental Assessment in line with international rules is crucial to develop the remaining potential. Results of respective analysis need to be transferred to public discussions about RE and the current investment plans. For so called "new" renewables like wind, PV and geothermal power the feed-in tariff need to be reviewed or implemented and international donor support needs to be attracted.

  An official EE target needs to be set, approved and adjusted over time. So far the main focus is on EE in buildings only. As preparation of a new building code is already well advanced, activities to raise awareness among the residents and buildings owners as well as among, architects, construction companies need to be developed, and crafts men need to be trained in order to pave the way for implementation of the new EE standards for buildings. An overall EE target would spur development of appropriate EE policies for other sectors as well.

- **Assess competitiveness of the new capacities which are planned for electricity exports.** A considerable bulk of the new capacities planned to be built is related to electricity exports. Electricity trade is crucial and can be efficient for Armenia while relying on seasonal hydropower. As other fuels have to be imported, competitiveness of electricity exports generated by gas and new nuclear reactor need to be assessed carefully in order to ensure a long term sustainable value added.

- **Use Conference of the Parties 21 for seeking additional international financial support for a low carbon emission path.** Efforts to continue developing with low carbon emissions level per capita in the low income country are worth to be offered as a contribution of Armenia to the international community. Preparation of the currently prepared NAMA and INDC are preliminary steps. A more comprehensive offer of Intended Nationally Determined Contributions (INDC) might be worth to be prepared.

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20 The World Bank (2011, 20) estimated the option of a new 550MW gas power plant combined with 168 MW renewable energy and with 110 MW from energy efficiency increase as least cost solution.

The medium-term

- **Introduction of the EE target aiming to underpin the role of EE in Armenia`s energy security should be followed by the implementation of a comprehensive EE policy framework including introducing and establishing minimal EE standards in line with the EU Ecodesign Directive, economic and financial incentives and information and awareness raising measures.**

  Identify and highlight EE effects on economic growth, social and environmental development. Current modelling exercises also need to be improved and enlarged by macro-economic modelling exercises.

- **Develop new approaches for heat supply, including a comprehensive support program for solar heating and hot water preparation on the one hand and EE refurbishment of buildings and new, ambitious EE standards on the other hand.** These measures have significant importance since both the des-integrated heat sector and space heating and cooling are key drivers for electricity demand.

- Develop and introduce sustainable forest management based on economic incentives (for example "Saving Book Approach"[21]) and a concept of sustainable reforestation. .

The long-term

- **Spur development of regional electricity markets.** The connection with Georgia should be seen as a first step which in future could be expanded to electricity deficient regions of Turkey and Iran. Also, establishing a competitive regional market would contribute to decreasing energy security costs and protect Armenia from fuel suppliers' monopoly.

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21 As an incentive, the tenants, who lease a deserted plot get a deposit account with a certain amount of money per ha, to be withdrawn over a time period of several years. <*http://www.giz.de/en/downloads/giz2012-en-savings-book-approach.pdf*>.

3.

AZERBAIJAN

3.1 Brief Overview of Economic Development

Since the mid-1990s Azerbaijan's economic performance has been very dynamic. This has largely been due to the country's increasing oil and gas extraction rates and respective exports, which contribute to nearly 50% of its GDP. In addition, annual population growth was roughly 1.3% in 2013 (World Bank, 2014). Benefiting from oil and gas income growth, the construction, banking and real estate sectors have also contributed to Azerbaijan's recent economic surge. Nevertheless, oil exports remain the major driving force. In order to ensure that Azerbaijan enters the post-oil period with a modern and vibrant private sector, however, diversification of the economy is critical. Due to the high price volatility of crude oil there is high fluctuation in oil income. Furthermore, worldwide oil exports are expected to decline starting in 2018 (EIA, 2014). Therefore, further development of the existing energy efficiency (EE) potential and the use of renewable energy (RE) sources need to be important policy priorities.

Following the economic crisis of the mid-1990s transition period, energy consumption hit rock-bottom in 1999 and increased only slightly afterwards. Overall energy efficiency, shown below as energy use as a share of GDP, has increased substantially as economic growth decoupled from energy consumption.

GHG emissions also decreased, including an additional visible decline since 2006 (see Figure 13). The main reasons for this include the country's switch from oil to natural gas in power generation (see Figure 16) as well as the efforts undertaken by SOCAR, the state oil and gas company, to capture huge amounts of associated gases contributing to high CH4 emissions. Additional measures like the rehabilitation of power plants and heat boilers as well as a considerable rise in electricity tariffs in 2007 (Energy Charter Secretariat, 2013, 29) and the introduction of metering devices also contributed to Azerbaijan's energy savings and, as a result, to GHG emission reductions. The latter in particular helped achieve a 90% collection rate on electricity bills.

CO_2 emissions per capita dropped from 3.46 tCO_2/capita (2000) to 3.15 tCO_2/capita (2012) while the overall population grew substantially by roughly 1.25 million people during this period (IEA, 2014).

The country's strategy through 2020[22] aims for ambitious economic growth. GDP per capita is marked for increase to 13,000 USD, and economic diversification away from the oil and gas sector is to be spurred by an annual GDP growth rate of 7% in the non-oil sector. The energy intensity of GDP and CO_2 emissions as a share of GDP are also expected to decline to levels consistent with those of OECD countries.

22 Azerbaijan - 2020 glance to future development concept.

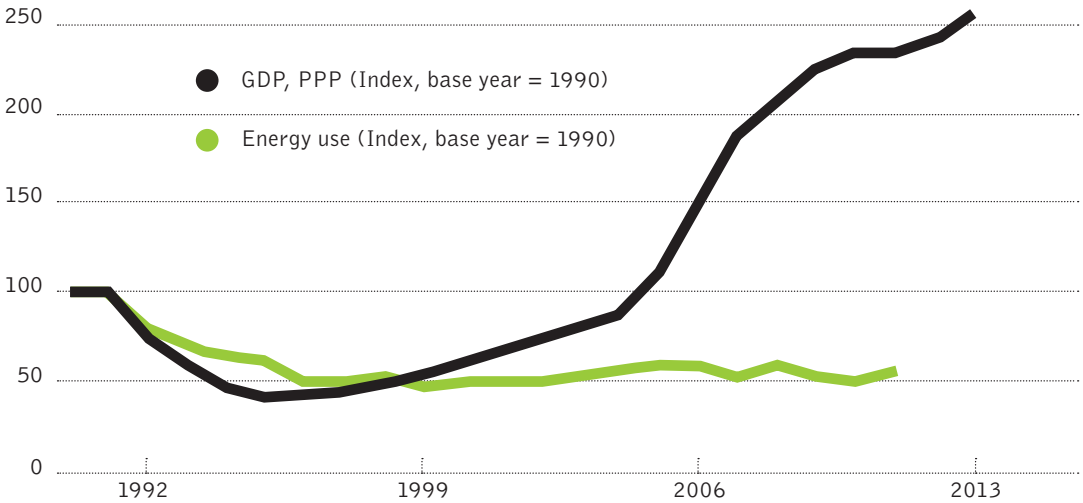

FIGURE 12
Economic growth and energy consumption in Azerbaijan (1990=100)
Source: World Bank, 2014 (PPP in 2011 USD)

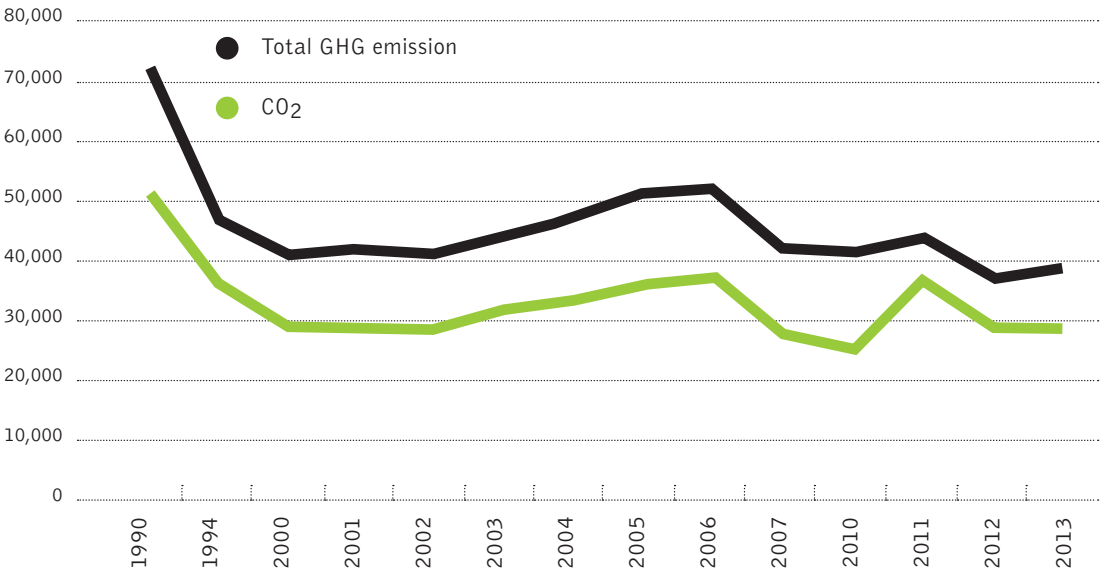

FIGURE 13
GHG Emissions in Azerbaijan until 2012 (in Gt CO_{2eq})
Source: 2nd National Communication, 2010 and State Agency of Statistics, 2014

3.2 National Energy Markets and Future Trends

3.2.1 Energy supply and demand

Azerbaijan's proven crude oil reserves are estimated to be about 7 billion barrels (EIA, 2014). The country`s main hydrocarbon basins are located offshore in the Caspian Sea, particularly in the Azeri Chirag Guneshli (ACG) fields. However, crude oil exports peaked in 2010 when they averaged roughly 908,000 bbl/d and oil exports have declined each year since then.[23] The country's proven natural gas reserves total roughly 991.086 billion m^3 (EIA, 2014).[24] The Shah Deniz gas field is the largest in Azerbaijan and is currently being developed in two phases. Phase 1 is already in operation. After transportation issues (selection of pipeline routes to the European Union and Turkey) have been solved, phase 2 will begin in 2017 with the goal of supplying the European and Turkish markets by 2019.

Not surprisingly, oil and natural gas (mainly associated gas resulting from oil extraction) currently dominate Azerbaijan's primary energy supply structure (see Figure 14).

The bulk of domestic energy consumption is accounted for by the residential sector. However, the transportation sector has become the major driver of energy consumption since 2000, while consumption by the industrial sector has declined. The decreased industrial consumption did not result from massive implementation of energy efficiency measures in existing industries, but rather from the phasing out of old industries.

There are no reliable data available on expected future energy consumption. The outcomes of the modelling exercises within the LEAP-project[25] became available only at the end of April 2015.

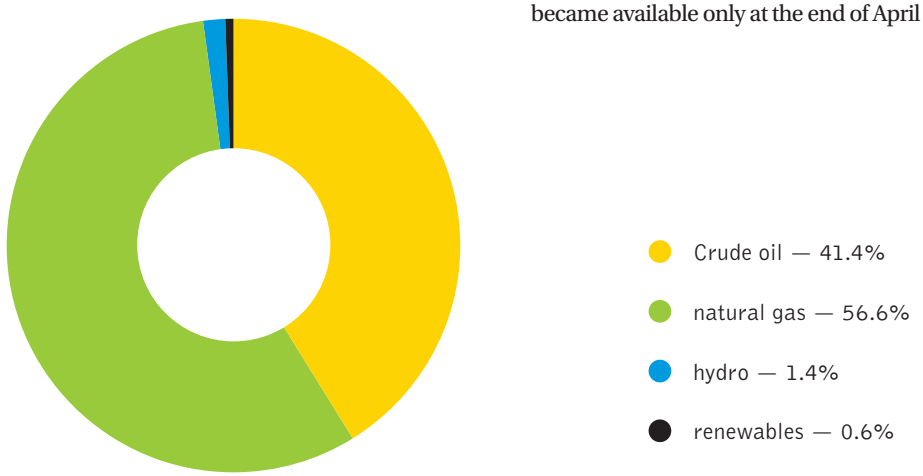

FIGURE 14
Breakdown of Azerbaijan's primary energy supply (2011)
Source: Energy Charter Secretariat, 2013

23 <*http://www.eia.gov/countries/cab.cfm?fips=aj*>.

24 35 trillion cubic feet; <*http://www.eia.gov/countries/cab.cfm?fips=AJ*>.

25 The Long-range Energy Alternatives Planning (LEAP) project is being financed by the ADB and implemented by the Abt Associates (USA).

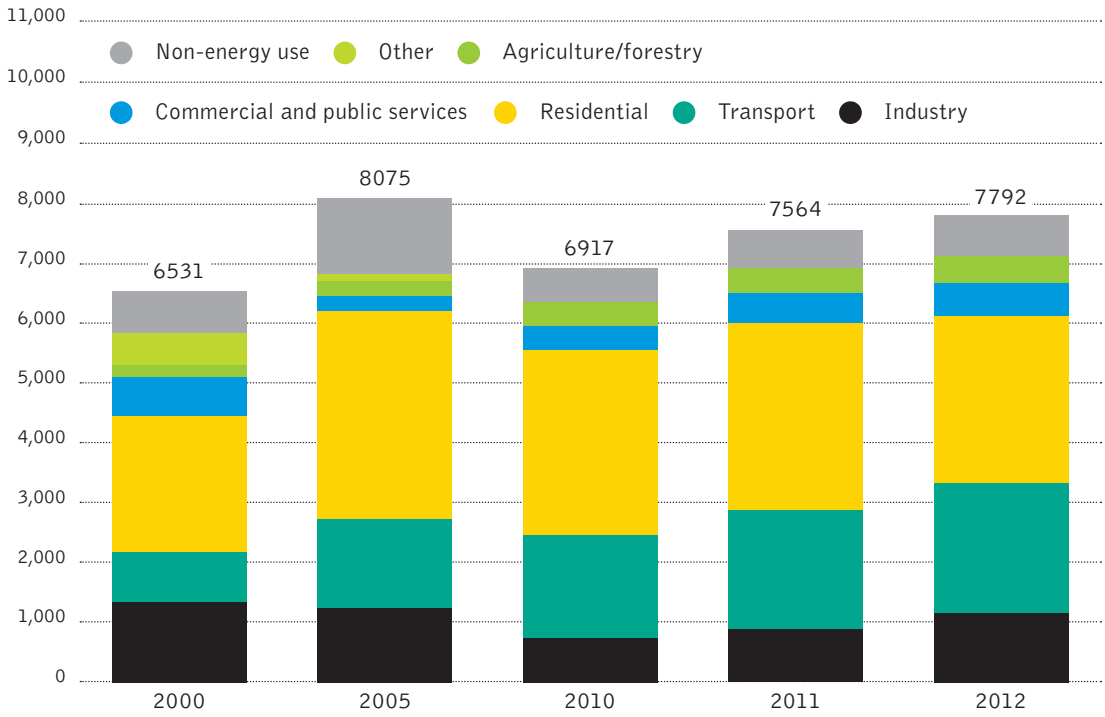

FIGURE 15
Final energy consumption (ktoe)[26]
Source: IEA Statistics, 2014

3.2.2 Electricity generation and demand

The country has an installed capacity of 7,310 MW, mainly relying on natural gas (85.2%) and hydropower (14.8%) (State Agency of Statistics of Azerbaijan, 2014). Electricity generation and consumption have continuously increased since 2000. The sharp cutback in 2010 (see Figure 16) was due to the electricity tariff reform of 2007. Although they started from a low level, household electricity tariffs almost tripled. In addition, electricity prices for industry and wholesale customers were raised drastically during the same period (Fichtner, 2014, 7).

Azerbaijan was a net importer of electricity until 2000 but has increasingly become a net exporter since then (539 GWh in 2012). Exports to Russia are in fact needed to balance the load. Energy trade with Turkey and Iran is mainly based on swap conditions for balancing the electricity supply to Nakhchivan. Electricity generation is projected to increase substantially until 2035 as the country continues to shift away from oil. The respective generation capacities are planned to increase up to 350 MW in 2014 and up to 700 MW in 2015. Electricity generation in Azerbaijan will finally rely primarily on natural gas, while slightly increasing the share of hydropower and other renewables.

However, the very small share of renewable power projected in electricity generation is far from its estimated technical and economic potential. Table 8 shows the impressive natural potential for RE use in Azerbaijan. Currently, various renewable power generation technologies are being tested in practice. Although international support for RE has been provided, there remains a huge technical-economic potential which is not yet developed.

After the decline in 2010, electricity consumption increased (see Figure 17) and even surpassed earlier demand forecasts conducted in 2005 (PREGA, 2005). Several additional electricity demand forecasts carried out in recent years[27] all estimate a steady increase in demand until 2025. Depending on economic growth assumptions, the forecasts for 2025 vary between 31.4 TWh (low growth) and 44.8

27 By AzerEnergy in 2009, by Mercados in 2010 and by JICA/TEPSCO in 2013, which have been updated by Fichtner in 2013.

26 Data available from Energy Charter Secretariat (2013) based on national information show a slightly higher consumption level but do not provide data for 2012. Therefore, we use IEA data.

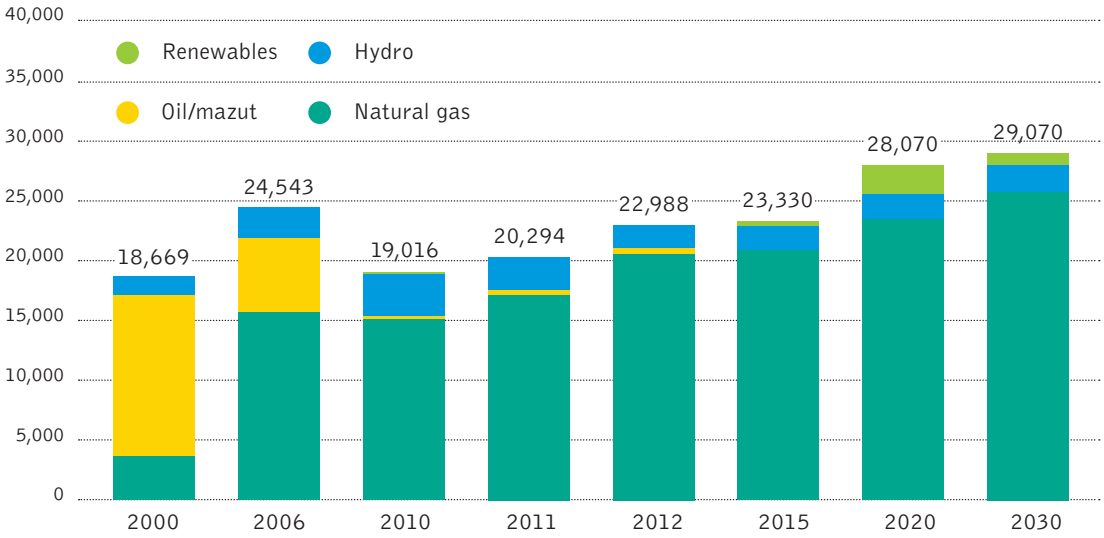

FIGURE 16
Electricity generation by fuel (in GWh)
Source: EIA, 2014 and World Energy Outlook, 2010

TWh (high growth) (Fichtner, 2013, 16). Electricity demand is therefore expected to at least double in comparison to 2012 figures. Although population growth of about 17.5% is expected by 2050[28] (which contributes to increasing electricity demand), the overall growth perspective is still heavily reliant on income from oil and gas exports. Taking into consideration Azerbaijan's recent decline in economic growth forecasts[29] due to lower crude oil prices and stagnant domestic oil production, demand may actually be lower than these forecasts estimate.

3.2.3 Heat generation

As in all former Soviet republics, centralized heat supply by District Heating (DH) companies was

AZERBAIJAN	Natural potential	Technical-economic potential	Existing capacities
Wind energy	×	9,100 – 10,700 GWh	62.4 MWh
Big Hydro (> 20 MW)	40,000 GWh	7,000 GWh	1042 MW
Small Hydro (< 20 MW)	5,000 GWh	3,200 GWh	47.5 MW
PV	> 5000 MW	N/A	1.8 MW
Solar thermal	> 5000 MW	N/A	1.3 MW
Geothermal energy	> 800 MWh	N/A	N/A
Biomass	6.9 mln. m³	4.9 mln. m³	35 MW
Biogass	N/A	N/A	1 MW

TABLE 8
Renewable energies potential and current stage
Source: SAARES, 2014

28 <*http://en.trend.az/azerbaijan/politics/2126653.html*>.

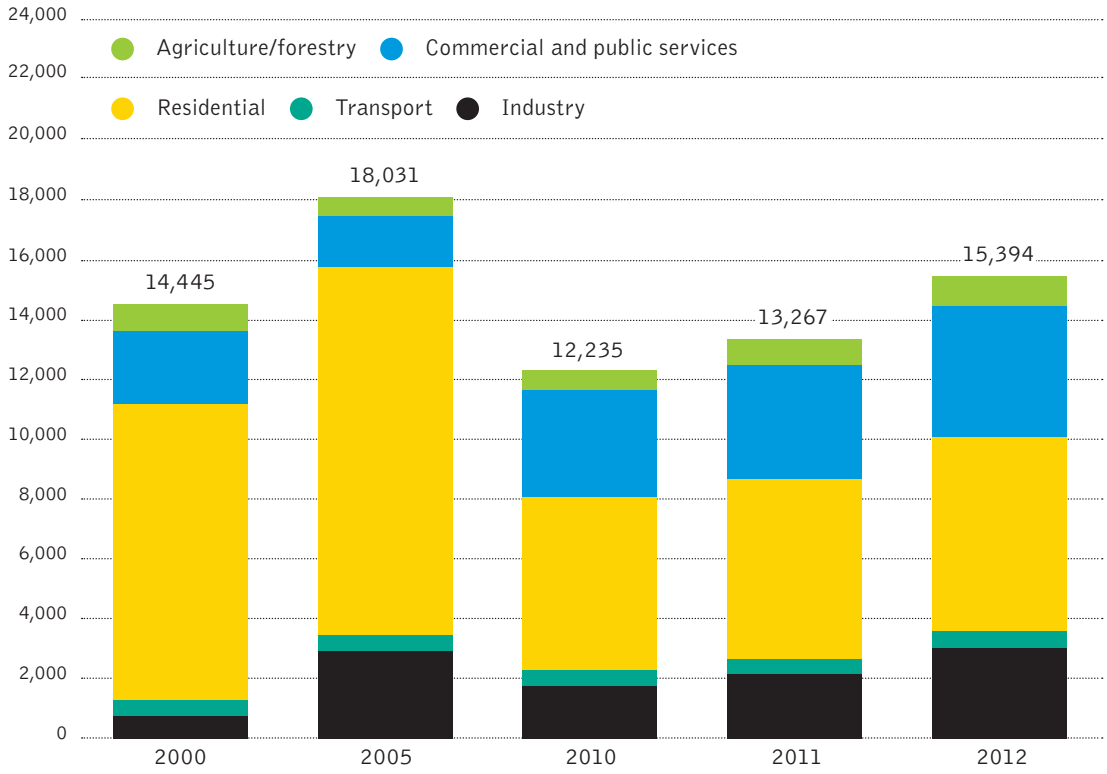

FIGURE 17
Electricity demand by sectors (GWh)
Source: EIA, 2014

common. However, during the 1990s the quality of heat supply declined and many DH companies stopped working. In 2005 the state-owned joint stock company Azerheatsupply was established in order to improve the country's heat supply management. The company owns DH companies in several cities, supplying heat to private households and public buildings. In 2011, 3,424 buildings were supplied by DH companies(91% of them in Baku and 9% in the country's regions). Efforts have been undertaken in recent years to rebuild and modernize the DH companies operating in the regions. Numerous developments for rebuilding and repairing heat distribution lines are underway. Due to government policy, however, heat prices are not allowed to increase after modernizing developments have been implemented. Investment into modernization therefore depends heavily on state budget capacity.

For newer buildings, private companies supplying heat by gas-fired small boilers have emerged. Large companies like SOCAR, which operate and provide residential buildings for their own staff (which was a customary practice for large companies during Soviet times), are a third important player in the heating sector. They also supply heat to their own administrative buildings by gas-fired boiler houses. Buildings in the countryside rely mainly on individual heating units, and the gas distribution grid in these areas is widely spread. "Gasification" of the entire country (except for some remote areas in the mountains) is an overall strategy of the government.

In addition to heating, cooling also spurs energy demand. Although the construction rate of new buildings is stunning, so far no innovative centralized cooling systems have been installed. Instead, cooling is provided by electric air conditioning. In order to implement energy-efficient and innovative technical solutions for building cooling systems, the introduction of new building standards focusing on higher energy efficiency are essential. Such standards would reduce energy demand as well as GHG emissions.

29 IMF, WEO (2014), and World Bank: Global Economic Perspectives (2015).

3.3 Institutional Framework of the Energy Market

3.3.1 Market design and regulation of market access

With the exception of the fairly dispersed heating sector, the energy markets in Azerbaijan are heavily regulated and dominated by vertically-integrated, state-owned monopolies.

SOCAR is the vertically-integrated state holding company in the oil and gas sector. It is responsible for oil and gas exploration, extraction, processing, transportation and refining. Other responsibilities include gas condensate processing and the marketing and supply of petroleum/petrochemical products for domestic and international markets. SOCAR also owns Azerbaijan's gas distribution pipeline network. The company produces about 20% of the country's oil output (EIA, 2014) and also represents the country's main GHG emitter.

The Azerbaijan International Operating Company (AIOC) (responsible for about 80% of Azerbaijan's oil output) was established for cooperation with foreign companies in PSAs and has made significant direct investments in the development of oil and gas fields, as well as in the construction of the South Caucasus Pipeline (SCP) and the Baku –Tbilisi – Ceyhan (BTC) pipeline. However, foreign oil companies do not supply the national market in Azerbaijan and therefore do not contribute to market competition.

In the electricity sector, the state-owned company Azer Energy is the major player. It implements the state development plan for the electricity sector and carries out investments on behalf of the state. Also, it is the biggest power producer in the country, which at the same time owns and operates the transmission and distribution grids with two exceptions: the lines in Baku, which are operated by Baku Electric Network, and the power system in Nakhchivan, which is owned and operated by the State Energy Agency of Nakhchivan Autonomous Republic.

Apart from Nakhchivan, which has an autonomous electricity system, there are four electricity generation companies in addition to Azer Energy:

- SOCAR, owning 77 MW of natural gas-fired power stations;
- SAARES with about 146.8 MW alternative generation capacities;
- Azersun, a food processing holding owning 45 MW power generation capacities; and
- Two private owners of small hydropower stations.

Thus, there is no competition in the gas and electricity sectors. Neither in the power nor the gas sector is unbundling of generation, transmission and distribution functions required. Functional and/or managerial disaggregation as well as accounting have not been accomplished or planned thus far. However, some small hydropower plants have been privatized and one

independent regional power distribution company was created. Although the State Program on Development of the Fuel and Energy Sector for the period 2005-2015 had considered developing the private sector in electricity generation, there is no transparently regulated third-party access for new entrants in the electricity sector. All aspects of access need to be negotiated between the investor and the government, which is a major barrier for private investors. This is especially true for smaller investors who might be willing to invest in RE.

Centralized heat supply is organized by the state-owned company Azerheatsupply. In the city of Baku and the surrounding region, Baku Heat Supply JSC is responsible for the production, transmission, distribution and sale of heat. In addition, it is responsible for the provision of related services to private households and public buildings (educational institutions, health enterprises and other social institutions).

3.3.2 Regulation of tariffs

The Tariff Council established in 2005 sets the wholesale and retail prices for electricity, gas prices for final customers and tariffs for central heating, all of which are based on "cost+" (i.e. cost-benefit) methodologies. They take into account costs based on the generators' reports and allow for a determined profit rate. The current tariff rate, however, also incorporates subsidy amounts determined by the government rather than by the Tariff Council. In practice there are huge implicit subsidies to Azer Energy due to its fuel prices being lower than what SOCAR normally receives on the open market (Energy Charter Secretariat, 2013, 50). [30]

Electricity and natural gas tariffs are generally lower in Azerbaijan than in Armenia and Georgia. Converted into EUR, electricity tariffs vary between 0.02 and 0.06 AZN/kWh (about 2 and 6 EURCent/kWh),[31] depending on the consumer type.

TABLE 9
Energy tariffs Azerbaijan (2014)
Source: Resolution of the Tariff Council of the Republic of Azerbaijan (2007) and (2013), JICA (2013)

	Electricity (nat. currency / kWh)	Central Heat (nat. currency / TJ)	Natural gas (nat. currency / MJ)	Hot water (nat. currency / m³)
For private households	0.06	716.4	2.61	0.4
For industry	0.02* – 0.042**	716.4	1.10	1.5
For public sector	0.02	716.4	2.61	N/A
For commercial sector	0.06	716.4	2.61	N/A
*** Nighttime * Daytime**				

30 The amount of this subsidy has been conservatively estimated by ADB at about 650 million USD per year, <*http://www.adb.org/sites/default/files/linked-documents/cps-aze-2014-2018-ssa-02.pdf*>.

31 At a AZN/EUR exchange rate of 1.016.

3.4 Sustainable Energy Policies

3.4.1 Energy security

Energy independence has been an important goal for Azerbaijan since it gained political independence. A long-term oil strategy was developed in order to help the country use its abundant oil reserves more efficiently for economic and social development perspectives. The development strategy was financially and technically supported by foreign donors. Since 1998 Azerbaijan has been self-sufficient in terms of meeting domestic oil demand, and since 2007 the same has been true of gas demand. Oil and gas exports became an issue for attaining economic development. Oil and gas importing countries, especially EU member states, place a premium on the stability of oil and gas imports, and the Strategic Energy Partnership between the EU and Azerbaijan set up in 2005 was strengthened for this reason. Further steps were taken in view of the construction of the Southern Gas Corridor, which should bolster European energy security.

Like many other oil-rich countries, the country established a State Oil Fund in December 1999. The Fund accumulates a portion of oil export revenues and transforms them into financial assets intended to generate perpetual income for current and future generations. In addition, the Fund also finances strategically important infrastructure and social projects.

Therefore, neither energy independence nor diversification of energy supply are current drivers of RE and EE development, as they are in many energy-importing countries. However, since oil and gas export prices are higher than domestic prices, there should at least be an indirect incentive to invest in EE and RE. In addition, the predicted oil peak in 2017 (see 3.1) is another reason why EE and RE need to be developed with greater urgency. Unfortunately, in practice development is cumbersome and lacks political priority.

There is no clear-cut energy strategy for the country based on projections of future development. However, the "Azerbaijan 2020 – Glance to Future" Development Concept includes some of the main aspects of the country's energy strategy, and within the framework of this concept an action plan is currently being prepared by various ministries.

3.4.2 Sustainable energy policies

3.4.2.1 Energy efficiency

The legal and institutional framework surrounding EE is still very weak. There is no special law or any secondary regulation on EE, even though the Law on Utilization of Energy Resources of 1996 envisages some important administrative and investment measures supporting it. These measures include: a mandatory state certification of energy-intensive equipment; the provision of subsidies for the implementation of EE measures to be provided by the State Fund for

Rational Use of Energy Resources (as well as for research and development in this field); and standards of efficient use for different technologies and resources. However, due to the absence of regulatory acts concerning the State Fund for Rational Use of Energy Resources, many of the planned activities have not been implemented in practice.

There are also several state programs such as the National Programme on Environmentally Sustainable Social and Economic Development 2003 – 2010, the State Program for the Development of the Fuel and Energy Sector 2005 – 2015, the State Program of Poverty Reduction and Economics Development in the Republic of Azerbaijan 2008 – 2015 and others including plans and activities mainly directed at improving energy efficiency on the supply side (i.e. rehabilitation and modernization of power sector stations, oil and gas extraction and processing, reduction of losses in transmission and introduction of RE). These programs have the following targets:

- Decrease of energy intensity of electricity generation by 20% by the end of 2015 (down from 313g of conditional fuel/kWh in 2011 to 260g) in order to reduce GHG emissions in the energy sector (in 2013 the level of energy intensity of electricity generation was 304g/kWh (SAARES, 2014);
- Full wastewater treatment by the end of 2015;
- 80% treatment of solid household waste from large cities by end of 2015; and
- Decrease of energy intensity and carbon dioxide emissions per unit of GDP to OECD levels.

However, there are no incentive schemes or instruments in place for reaching these targets, nor is there a sectoral breakdown of the overall energy intensity and carbon target in relation to GDP. Also, the overall macroeconomic target had not been specified until now. No energy efficiency measures on the demand side are envisaged. Although the two major driving forces for energy demand and GHG emissions – the booming construction

> “Since oil and gas export prices are higher than domestic prices, there should at least be an indirect incentive to invest in EE and RE. The predicted oil peak is another reason why EE and RE need to be developed with greater urgency”

sector and rapid extension of road transport[32] – are obvious, only a few policies are in place to improve energy efficiency in these areas. As long as infrastructure and buildings have long lifecycles, huge lock-in effects are created that require increased investment in the future to make these structures more energy efficient. Even though EE issues are known to developers in Azerbaijan, they are generally not implemented since they add to the cost of projects (Energy Charter Secretariat, 2013, 56). The introduction of classifying automobiles according to pollution (including CO_2) levels in 2012 prevented the import of cars below these standards, which demonstrated some awareness of the problem. Since April 2014 fuel standards have been introduced and have gradually lowered fuel-related pollution.[33]

A draft State Program of Development, Technical Regulation and Standardization of Energy Efficiency had been developed in 2011 but is still not approved. The EE measures implemented thus far have been financed by investment credits from EBRD, Asian Development Bank, KfW and USAID or have relied on investments from the state budget.

To a certain extent, SOCAR is a positive example. The company has implemented its own climate change strategy that includes: 1) lowering the carbon intensity of its business by introducing energy efficiency measures; 2) reducing the flaring of associated gas; and 3) using renewable energy. A complementary action plan was introduced based on a GHG emissions inventory and an analysis of the company's business units (SOCAR, 2013). The company implemented other important measures including replacing old oil-fueled heating boilers with modern ones (which decreased emissions by 25%) and introducing energy-efficiency measures in its premises. The company, though state-owned, understood the win-win situation of such policy as every amount of oil and gas saved will become export earnings for the company.

The fragmented measures undertaken so far on the national level have not unlocked the country's considerable energy efficiency potential on the energy supply side, nor have they on the demand side (buildings, agriculture, waste management, etc.). EE needs to become a genuine political priority. This is particularly important in a country that is largely ruled based on the "top-down" principle. At the initial stage, the existing rules need to be enforced. In addition to rehabilitating district heating, USAID's district heating strategy[34] should be adopted, which would help to reduce the huge losses in heat distribution. Introducing and establishing efficient cooling systems is also critical, especially when it comes to newly-constructed residential and office buildings. Cooling should be a factor in the new building code which UNDP is developing in Azerbaijan.

3.4.2.2 Renewable energies

Taking into consideration that RE could play a significant role in the country's future development, the State Program on the Use of Alternative and Renewable Energy Sources (2005-2013) was approved in 2004. It established the target that the country should obtain 20% of its electricity from renewable sources by 2020. The establishment of the State Agency on Alternative and Renewable Energy Resources (SAARES) in 2013 was an important step toward creating institutional responsibility for the development of renewable energies. The agency is responsible for the development, implementation and regulation of state policies concerning alternative and renewable energies.

A state budget of 60 million USD has been allocated for the development of RE. In addition, international donors have supported the

32 The number of vehicles on the roads of Azerbaijan has increased roughly threefold from 1993 to 2011, and from 1995 to 2010 the number of passenger cars per 1,000 people increased by 2.6 times from 35 to 91; Aliyeva, 2012, p. 8.

33 *<http://www.1news.az/economy/20140328112909826.html>.*

34 Azerbaijan - 2020 glance to future development concept.

TABLE 10
Renewable energy capacities proposed to be installed until (2013-2020)
Source: SAARES, 2014

Type of RE	Solar PV	Solar Thermal Power	Geothermal Power	Small Hydro	Wind	Biomass
MW	600	2500	150	500	1000	250

agency's programs and pilot projects intended to spur the development of renewable energies. The European Union launched a project in 2010 to support energy sector reforms in the country. Its second phase started two years later and included the development of an action plan for RE Development in Azerbaijan. The action plan includes the:

- preparation of a comprehensive strategy for energy sector development based on market economy principles;
- preparation and implementation of measures to increase energy efficiency and the use of alternative energy sources;
- harmonization of the legislative framework of Azerbaijan's energy sector with EU directives; and
- organization of activities in SAARES in accordance with European standards.

UNDP has also promoted RE in Azerbaijan in cooperation with SAARES, with financial support from the European Union (about 500,000 EUR) and the Norwegian government (790,000 USD). The program aimed at construction of a small HPP in order to demonstrate its feasibility in Azerbaijan and to assess the potential for renewable power, particularly in remote and rural areas.

SAARES prepared a draft setting out the national strategy for the use of alternative energy sources for the period 2012-2020. It was submitted to the Cabinet of Ministers for approval but currently remains pending. This draft strategy is in line with EU 2020 targets and projects the following figures for 2020: 20% reduction of GHG emissions; 20% share of RE; and a 20% increase in energy efficiency. It also envisages the development of wind and solar power as well as the usage of biomass, solid waste, solar thermal installations and an increase in small hydropower. The following instalment of RE capacities is proposed for the period 2013 – 2020:

Implementation of the plan was calculated to result in fossil fuels savings of about 1.290 mn tons of fuel equivalent (SAARES, 2014).

Aiming to develop the necessary legal framework during 2010-2011, the International Ecoenergy Academy implemented a project called "Improvement of Azerbaijan's legislation relating to Renewable Energy Sources and Energy Efficiency and bringing it in conformity to the EU legislation." The project undertook substantial efforts for developing the necessary legal framework, developing draft laws and standards regulating the development of non-traditional renewable energy sources as well as energy conservation. Among these initiatives are the draft laws "On Energy Saving and Increasing Energy Efficiency" and "On utilization of Renewable Energy Sources" and, in addition, 21 secondary legislation documents for ensuring the implementation of these laws. Furthermore, a proposal package with required amendments for 17 existing laws was prepared and submitted to the Azerbaijani government. All of them are currently awaiting government approval.

Due to the above factors, a supporting legal framework for RE does not exist. So far, electricity generated by RE needs to compete with electricity generated by fossil fuels. However, wind and solar energy are not yet competitive. This is a major barrier for RE, as current electricity tariffs are very low (between 2 and 6 EURCent/kWh, depending on the consumer

group). Only hydropower is competitive. Therefore, apart from several initial pilot projects using wind and solar energy, hydropower is still the most important renewable energy resource. In accordance with a hydropower program prepared by Azer Energy, about 1.3 GW-worth of new hydropower implements could be installed, including small HPPs.

SAARES proposed an incentive mechanism for RE which would rely on the price differential of export earnings from natural gas saved by RE and exported instead. However, the proposal still needs approval from the government.

Azerbaijan is currently preparing its Intended Nationally Determined Contributions for international climate negotiations (COP 21st), and a possible target of 30% renewable energy in total energy consumption by 2030 (Aliyev, 2014) suggests some interest to enforce RE development in case the Azerbaijani INDC is approved.[35] However, such targets cannot be achieved without an overall stable framework encouraging long-term investment into RE and offering a transparent business environment to potential investors. Approval of the draft National Strategy for RE proposed by SAARES could be the first step toward establishing the necessary framework.

3.4.2.3 Climate change mitigation

Azerbaijan ratified the UNFCCC in 1995 and established the State Commission on Climate Change in 1997. The country is a party to the Kyoto protocol and has actively participated in the CDM mechanism.

Azerbaijan and SOCAR are members of the Global Gas Flaring Reduction Partnership (GGFR), which supports national efforts to use currently flared gas by promoting effective regulatory frameworks and tackling the constraints on gas utilization, such as insufficient infrastructure and poor access to local and international energy markets. The partnership has helped SOCAR by providing know-how and technical support to reduce associated gas flaring. The company has reduced its total GHG emissions by more than 20% from 2010 through 2012 (SOCAR, 2013, p.58). As peak oil demand is expected in 2018, fugitive emissions from oil extraction are expected to decline thereafter. The government and SOCAR have also re-forested a remarkable 103,000 ha over the last decade (Aliyev, 2014).

Additionally, the draft INDC for the international climate change negotiations in 2015 and three NAMAs in the energy sector have been developed.

35 In 2012 RE accounted for 1.8% of total primary energy supply, 3.3% of total final energy consumption, 7.9% of total electricity production and about 12% of final electricity consumption (IEA). The target of 30% of TPES would be overly ambitious. Therefore, the target may relate to final electricity consumption. INDCs are planned to be approved by the government by May 2015.

3.5 Strategic Priorities for Sustainable Energy Development

The main strategic priorities for Azerbaijan are the economic development goals of the concept – "Azerbaijan 2020 – Glance to Future" – described in Chapter 3.1. The State Program on Poverty Reduction and Sustainable Development in the Republic of Azerbaijan for 2008-2015 includes the following targets related to energy sector development and sustainability issues:

- Improve natural gas supply to private households through a centralised gas supply system (the share was 81.2% in 2007 and increased to 83.4% in 2013);
- Increase heat supply to residential and non-residential buildings by 2015 from a level of 22.7% in 2006;
- Ensure complete satisfaction of the country's energy demand by national resources and guarantee uninterrupted electricity power supply for all households by 2015;
- Decrease fuel intensity of electricity generation (per kWh) by 20% in order to reduce GHG emissions in the energy sector by 2015 (in 2006 energy intensity of electricity generation was 386 g standardised fuel per kWh; in 2013 a level of 310g/kWh was achieved);
- Increase the proportion of forest areas in total land area to 12.5% by 2015 (the share was 11.5% in 2007);
- Achieve complete sewage treatment in the country by 2015 (the rate was 57.9% in 2006); and
- Achieve 80% recycling and neutralisation of solid household wastes in the country's large cities by 2015 (starting from 10.9% in 2006, according to national sources).

Priorities set out in the different programs related to sustainable energy focus mainly on the supply side – construction of new power plants, continuation of refurbishing power plants and transmission networks, increased use of alternative and renewable energies, reduction of technical losses in energy production and transmission, and the opening of the energy sector to private businesses. The inherent energy efficiency goals of the energy supply side development are understood to directly strengthen Azerbaijan's position in the international energy trade. The latter is also a priority goal. Therefore, the country aims at:

- Improving its position as a transit country in the export of hydrocarbon resources extracted from the Caspian region;

- Broadly diversifying current oil and gas export routes; and

- Creating new trans-regional energy corridors with the participation of other producer countries in the Caspian region.

The main weakness of the state-run programs is that they do not elaborate how to achieve the stated goals by means other than budget financing or third-party investment. The programs mention improvements in metering, accounting and control systems in accordance with best international practices, but there are not any instructions as to how to achieve these goals. Thus there is a lack of appropriate instruments and incentives for increasing energy efficiency.

The use of alternative energies – not only new renewable energies but also waste-to-energy measures – is defined as a priority. However, strategic programs and the development of legal and economic frameworks for achieving these goals are in limbo.

As assessments above have shown, the strategies and programs implemented hitherto have underestimated the need for demand-side energy efficiency development policies in reaching the overall efficiency goals. Spurring the intended future development by mainly relying on public budget funding of technology investment appears unrealistic. Public budgets are limited and fluctuating; in order to attract necessary private investment, the right framework and level playing field need to be established. In addition, legal, economic and fiscal incentives need to be set.

3.6

Recommendations

Legislative harmonization of the sustainable energy sector with EU directives is still a policy goal in Azerbaijan. It should be implemented. The draft laws and secondary regulation that was developed with considerable financial international support must finally be passed. Below are recommendations for short, medium and long-term actions.

The short-term

- **Spurring stakeholder discussion and approval of the pending legal and regulatory documents in order to shape an appropriate framework for attracting private investment into EE and RE.**

  This is also true for the draft support law for renewable energies. The rules need to include transparent electricity tariff-setting procedures that avoid bargaining practices as well as transparent and non-discriminatory rules for grid access, in addition to guaranteed power purchase. Implementation of a fixed feed-in price for renewable energies by type of technology would be especially helpful in supporting the introduction of new renewable technologies like wind and solar PV.

- **Implement high-ranking institutional responsibility for EE.** An EE Agency, or rather the assigning of some EE responsibilities to SAARES (including initial funding), is needed to deliver important information to costumers, raise awareness on concrete and achievable benefits from EE measures, propose and coordinate elaboration of necessary draft regulation and initiate public-private partnerships for EE investments. The vast experience of such agencies in EU member states can be used, as can bilateral or EU technical support.

- **Implementation of the State Fund for Rational Use of Energy Resources as it was stated in the law "On Utilization of Energy Resources" of 1996.** There is empirical evidence suggesting that EE requires additional financial support in other market economies as well. By supporting EE measures in different fields, the Fund could help develop a market for new EE services (energy audits, EE advice, maintenance of new technologies, etc.) in cooperation with the responsible EE body.

A huge block of new buildings is currently being constructed according to non-sufficient energy efficiency standards. As such buildings will last for about 20-30 years without refurbishment this will create a lock-in effect for energy efficiency in the building sector. To avoid this, new building standards focusing on higher energy efficiency need to be implemented. Voluntary schemes for the implementation of such standards could be combined with profit tax relief for construction companies in the early stages of implementation. Later on, mandatory implementation should be introduced. Both need to be strongly monitored by state authorities.

- **The current Energy Sector Support Program (ERSP) funded by the EU will help Azerbaijan's government review the national energy strategy, including the promotion of EE and RE.** This work needs to be continued after finalisation of the EU Program, and implementation of this strategy needs to be regularly monitored and adjusted. Therefore, the government needs to train and institutionalise respective analytical national competences for sustainable energy development.

The medium-term

- **As it can be expected that energy tariffs (including electricity tariffs) will remain at low levels in the near future, economic incentive schemes like tax benefits and public funding which support EE measures in industry, the service sector (SMEs) and in private households could help to incentivise demand-side EE development.**

- **This approach should also introduce minimum EE standards on electric appliances, especially for air conditioning, pumps and electrical engines as well as other appliances in accordance with the EU Eco-design Directive.** These introduced standards should be combined with an awareness-raising campaign to help maximize the effectiveness of the incentive scheme.

- **Preparation and implementation of EE and CO_2 emission standards for cars and freight vehicles combined with vehicle taxation in order to raise EE potential and reduce CO_2 emissions in the transport sector.**

- **Development and implementation of a comprehensive program to introduce solar co-heating, hot water preparation and solar cooling into the building sector.**

  As current hot water and electricity tariffs do not provide any economic incentives, a subsidy-funded support program – which includes a determined target amount of installations – could help develop a future market for solar collectors. Such markets would create new jobs for those implementing and maintaining such technologies. Producing solar collectors could also offer new business opportunities for private companies in Azerbaijan. The program may be combined with the recommended EE standards for new buildings, but it could also be made available for existing buildings. Such technologies are especially of interest for existing single-family homes in rural areas.

- **Setting energy intensity benchmarks for the various economic sectors would help identify their EE potential, thereby recognizing their contribution to achieving the overall development targets.** Based on such an analysis, the development of efficient sector approaches and implementation of sector-oriented policies are needed.

The long-term

- **Improvement of public transport systems will be crucial in dense cities such as Baku in order to reduce the number of private cars on the road, thereby mitigating air pollution and traffic jams.** Further positive developments could include the enlargement of existing underground transport systems or the widening of road lanes exclusively for use of public transport, in order to make public transport more attractive. (Priority lanes for public buses would allow for faster speeds to avoid traffic jams.) For this purpose, (as well as for other demand-side EE activities) the use of international climate change mitigation mechanisms and instruments such as INDCs or NAMAs may be useful.

- **Introduction of solar thermal heating into district heating systems in order to reduce CO_2 emissions.** Respective best practice analyses need to be carried out, and support measures (including information, awareness raising, training, etc.) must be developed.

- **Spur development of regional integration in electricity markets, including RE.** Taking into account electricity export ambitions and Azerbaijan's increasing export potential in a South Caucasus energy market that includes Turkey, regional integration would benefit not only Azerbaijan but the entire region. The current cooperation between Azerbaijan, Georgia and Turkey is an indicator of further development in this direction.

4.

GEORGIA

4.1 Brief Overview of Economic Development

Due to the economic crisis, energy consumption declined also in Georgia until the mid 1990s and reached the bottom in 2001. Afterwards energy consumption recovered slowly at a far less rate than economic growth. Total primary energy supply per capita increased from 0.65 toe/capita in 2000 (the same level as in Armenia) to 0.83 toe/capita in 2012 which was far below the EU-28 average level (3.24. toe/capita). Final energy consumption increased since 2003 (the year with the lowest level) by about 50% to 3,036 ktoe in 2012 and electricity consumption per capita increased from 1.45 MWh/capita in 2000 to 1.93 MWh/capita in 2012. Overall population increased slowly by 1.5% within 12 years (2000 – 2012) (IEA Statistics).

The considerably high economic growth rates of about 6.5% between 2010 and 2012 slowed down after the 2012 elections and decreased to 3.2% in 2013. Growth recovered in 2014 and is projected to be an average of 5.5% over the medium term (World Bank, 2015). Capital budget underspending and contraction of the capital expenditures by the private investors affected by the political and policy uncertainty, contributed to a recession in the construction and marked slow-down in the industrial sector. Increase of export as a result of the renewed access to the Russian market since July 2013, geographical location giving possibility to connect East-West transport routes and tourism are potential drivers of economic growth of Georgia (World Bank, 2015).

Quite substantial increase of energy consumption has taken place since 2002, which resulted in a constant increase of GHG emissions. The data are fluctuating due to the seasonality of hydropower which is the key national energy resource. Although at low levels, due to low energy consumption per capita, CO_2 emissions per capita more than doubled from 0.67 t CO_2/capita in 2002 to 1.52 t CO_2/capita in 2012. That indicates no shift in the fuel structure of energy towards renewable energies, but the share of fossil fuel increase. A main challenge for Georgia is to foster future economic growth without increasing GHG emissions. This poses the question: What technologies are affordable and how could the country benefit from international technology transfer?

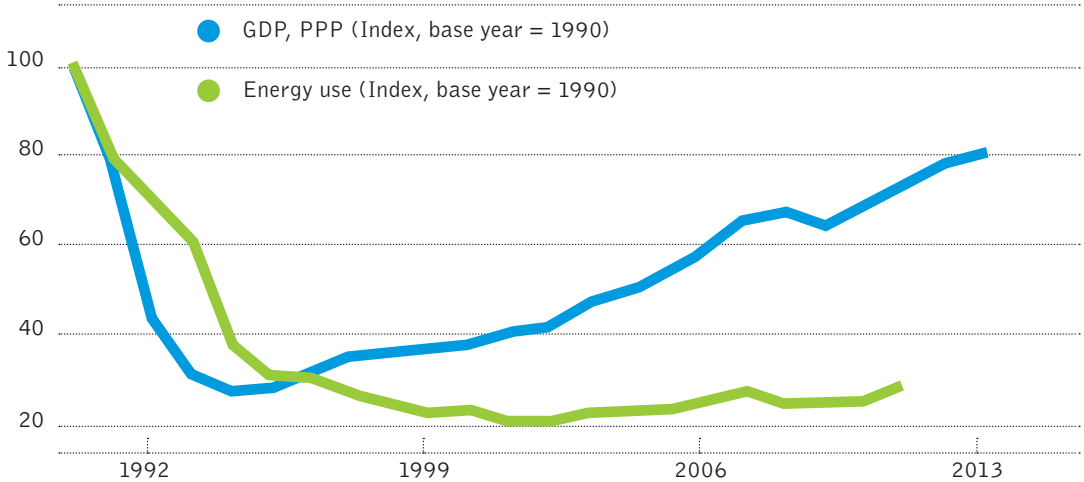

FIGURE 18
Economic growth and energy consumption in Georgia (1990=100)
Source: World Bank, 2014 (PPP in 2011 USD)

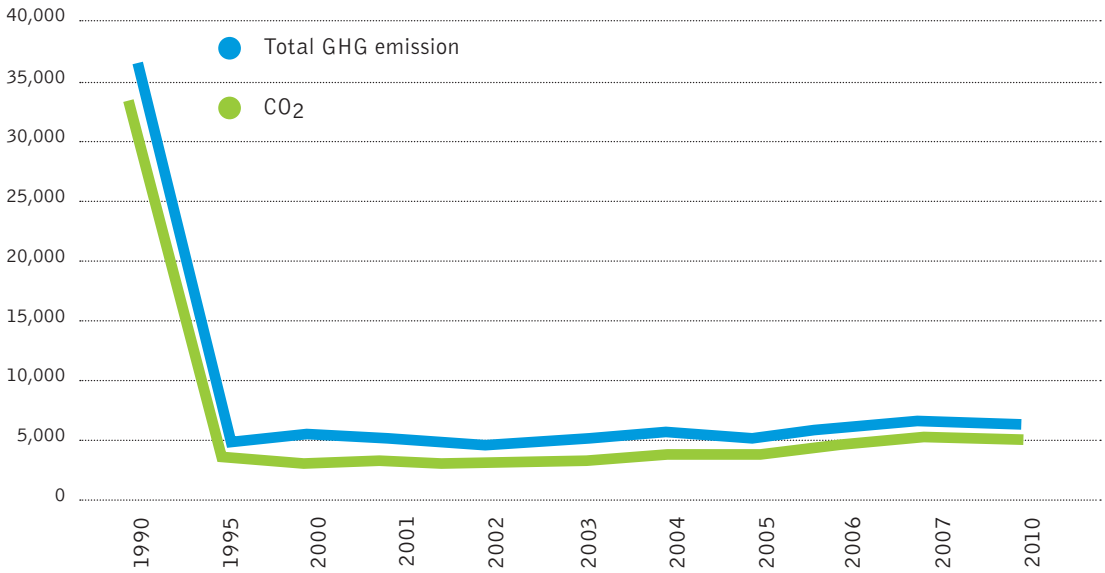

FIGURE 19
GHG and CO_2 emissions in Georgia (in Gt CO_{2eq})
Source: 2nd National communication to UNFCCC, 2009

4.2 National Energy Markets and Future Trends

4.2.1 Energy supply and demand

In 2014, for a first time since many years, Georgia prepared an officially approved energy balance. However, neither energy sector development strategy nor policies for sustainable energy development do exist in Georgia until now. The reason may be an overestimation of market forces for sustainable development, and an overliberal approach neglecting the role of policy in market economies. This is surprising as Georgia has signed the Association Agreement with the EU which aims implementing EU policies for sustainable energy development and the authorities are negotiating the membership in European Energy Community as a mechanism of implementation of the EU energy acquis. Georgia does not have much fossil fuel resources which contribute to the country's total primary energy supply. Nevertheless, the renewable energy potential is substantial (see Table 11, pg.88).

Although hydropower contributes about 17% to primary energy supply, Georgia is strongly relying on fossil fuels which are mostly imported (except some coal and peat). Coal production was about 107 ktoe in 2012.

The supply of oil products to Georgia is reasonably diversified as there are no trade restrictions. Natural gas is imported from Azerbaijan (proceeds from South Caspian Pipeline agreement and direct purchase) and from Russia (proceeds from transit of Russian gas to Armenia). Hydro

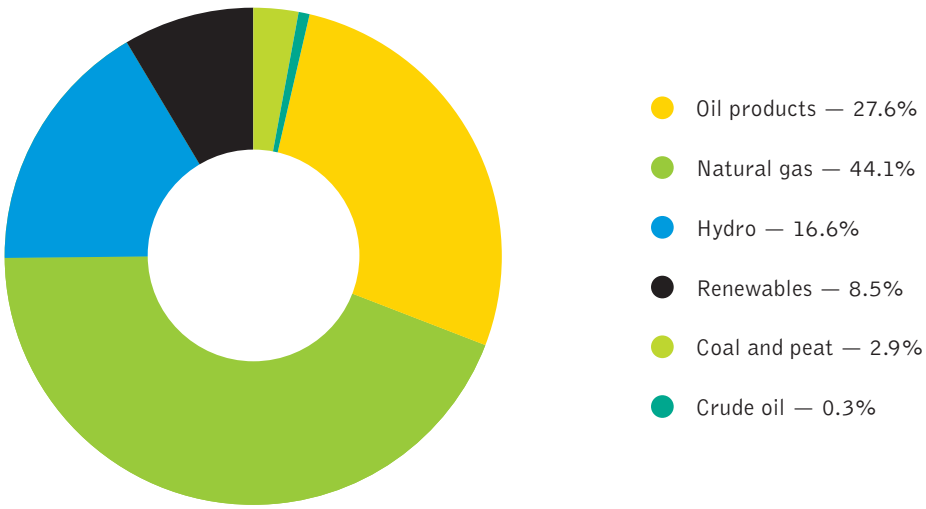

FIGURE 20
Breakdown of primary energy supply in Georgia 2012
Source: IEA, 2014
*Except HPP

energy and fuel wood, the only national energy sources so far, represented about 25% of TPES in 2012 (IEA, 2012). According to national estimations, fuel wood constitutes up to 12% of Georgia's domestic energy supply and about 37% of indigenous TPES[36]. Fire wood is being used for cooking and heating but numbers are uncertain. The reasons of vast fire wood usage are the lack of the gas infrastructure[37] and unaffordable gas prices for low income groups of the population. Natural gas supply is growing due to gasification of the regions and fuel is slowly switching from gasoline to gas in transport sector.

Georgia benefits substantially from the natural gas transit between neighbouring countries by obtaining the in-kind fee and the cheap optional gas. The in-kind fee is about 10% of the gas delivered from Russia and averages about 200 million m^3/a. In addition, 5% of the natural gas transit volume of the South Caspian Pipeline plus 500 mn m^3 of natural gas are delivered to Georgia at lower prices.[38] The in-kind fee is not monetized at market price but rather used for subsidisation through a compound deal with SOCAR Gas.

Under supervision of the Ministry of Environment and Natural Resources Protection of Georgia, an USAID funded project – Enhancing Capacity for Low Emissions Development Strategy (EC-LEDS) is currently being carried out. The Ministry of Energy is working on development of a sound national energy strategy. Based on the MARKAL-Georgia model several scenarios have been developed within this project, but have not been published yet. Therefore, the present research refers to the reference scenario prepared by World Experience for Georgia (WEG) (see Figure 21). Although this scenario does not have an official status, at present, it is the only base for reasonable projections.

The reference scenario shows a steady increase of final energy consumption until 2030 with a much higher growth rate over five (2015-2020) and ten years (2020-2030) compared to the previous years.[39] It results in an increase of the energy

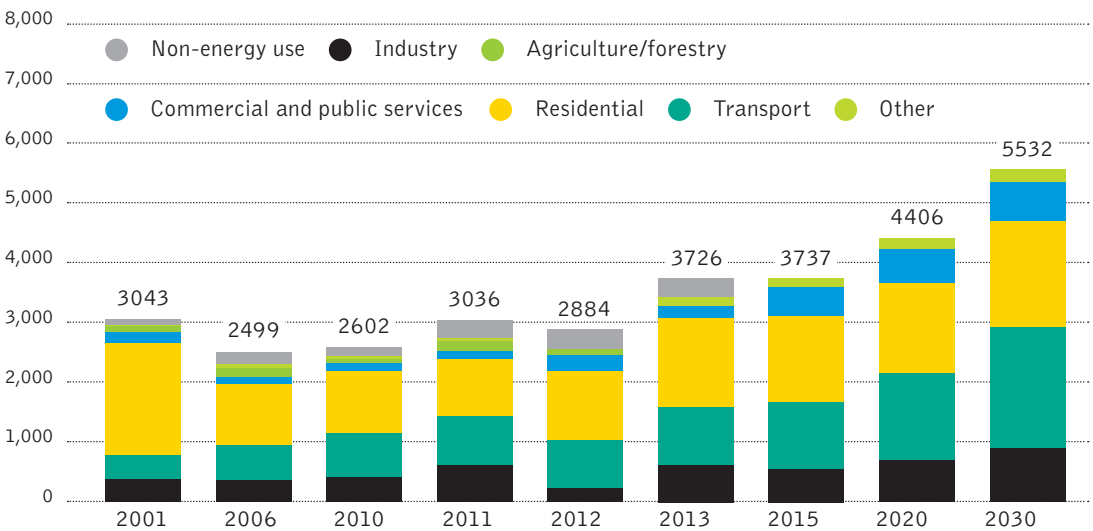

FIGURE 21
Development of final energy consumption in Georgia (ktoe)
Source:
2001 TACIS energy balance, 2010-2011 IEA, 2013 GEOSTAT energy balance, 2006, 2012, 2015, 2020, 2030
WEG, 2014

36 GEOSTAT 2013, energy balance.

37 Gasification of rural areas is being actively conducted.

38 *<http://www.bp.com/content/dam/bp-country/en_az/pdf/legalagreements/SHA_eng_HGA_Host_Government_Agreement_Georgia__English_.pdf>.*

39 This reference scenario assumes a 0.5% annual growth rate of population and a 5 % annual average GDP growth rate until 2030. For agriculture, industry, commercial services and transportation the following average annual growth rates were assumed: 3.3 %; 3.9%; 5% and 3.8%.

consumption in the residential sector as well as in the commercial, public service and transport sectors. In order to sustain the estimated high growth rates in the longer term it is necessary to increase the competitiveness of the Georgian economy, improve professional education of the labour force and promote reallocation of the resources from the low value-added to higher value-added sectors, which are usually less energy intensive. Through increasing the share of low-energy intensive sectors, like services, such shift would lead to an increase of the overall energy efficiency of GDP. In addition, investing into new technologies would also increase energy efficiency within other growth relevant sub-sectors. The WEG 2014 energy demand projection did not fully consider the development of this EE potential.

4.2.2 Electricity generation and demand

The electricity system of Georgia relies mainly on hydropower (generated more than 80% of domestic electricity in 2014). The remaining electricity is produced by natural gas fired thermal power plants or is imported. Out of the total 2,657 MW installed hydro power capacities in 2013, 54% are reservoir HPPs, 25% run of river HPPs and 3% deregulated small HPPs. Almost half of the country's power generation (4.3 TWh) is produced by two power plants – Enguri and Vardnili HPPs that are under the state ownership.

At present, increased hydro generation and reduced demand during spring and summer results in an electricity surplus which is exported to Russia and Turkey. However, Georgia's hydro generation is still insufficient to cover the electricity demand in winter. Therefore, three thermal power plants operating on imported gas generate electricity only in cold seasons. This also results in net electricity imports, which varies according to the weather conditions. Experts suggest complementary expansion of wind power, which exhibits seasonal characteristics similar to electricity consumption, i.e. peak production in winter (Kelbakiani, G. and Pignatti, N., 2013).

The model scenario results (see Figure 22) implies replacement of the ageing power plants and infrastructure, as well as investment in additional capacity development summing up to almost 4,277 million EUR until 2030 translating into challenging average annual investment of 235 million EUR. Electricity generation is expected to increase, relying mainly on increase of hydro

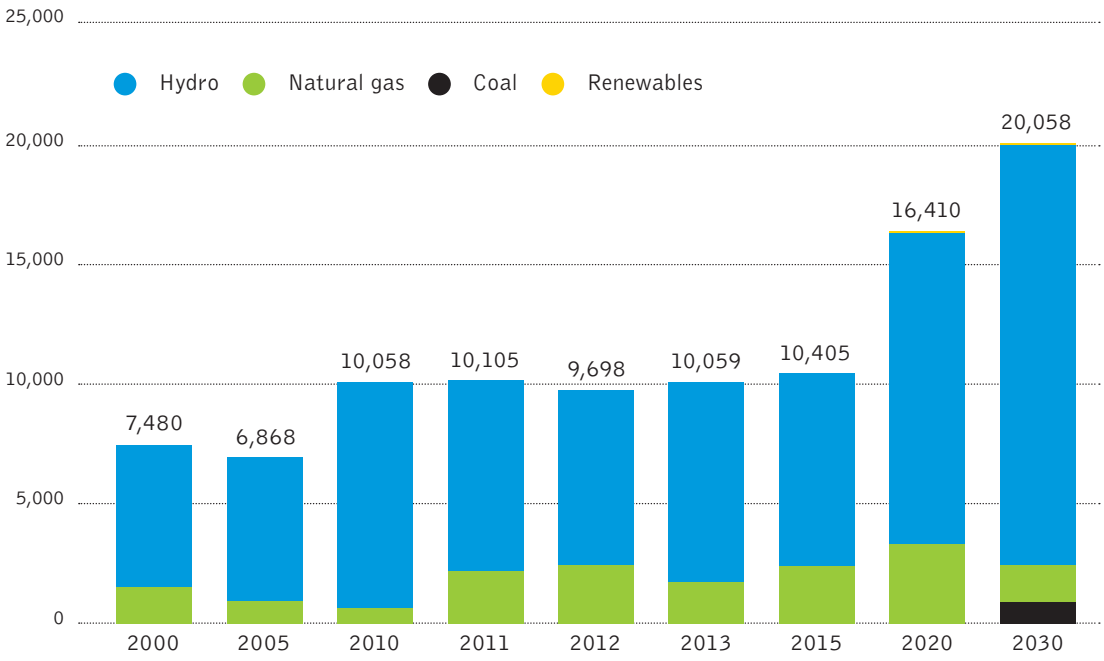

FIGURE 22
Electricity generation and projections in Georgia (in GWh)
Source: 2001 TACIS official energy balance, 2005 IEA data, 2010–2012 WEG assessments; 2015–2030 WEG assessment using MARKAL Scenario

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Complete implementation of the EU requirements on EIA procedures, which require transparency and public involvement, would be a first step towards developing hydropower potential to the acceptable extent. Proper regulation and implementation of the financial guarantees for the environmental and social risks posed by hydropower projects are additional requirements”

energy and on a moderate increase of natural gas. However, projections for 2030 carried out by WEG include Georgian coal power generation by coal extracted in Georgia. The projections, which are not officially approved, do not include other renewable energy sources than hydro although their potential is substantial. Instead, use of national coal resources is considered for 2030. New scenarios which are being developed in line with the preparation of the new Energy Strategy, unfortunately, were not yet available.

The analysis carried out by international experts has shown that RE can contribute to the country's electricity demand by replacing imported natural gas throughout the year. For this purpose the summer market needs to be developed when there is already an excess of hydropower (WEG, 2008, 1.6 -1.12).

As only 12 % of Georgia's hydropower potential is currently being utilized (World Bank, 2015) the Georgian government is focused on development of the existing potential by securing the private investment. These plans, however, are very much debated in the public. The landslides which took place in the Dariali valley and violations of the different standards (Green Alternative, 2014a) have spurred a discussion about the planning and developing the new HPPs. Low quality Environmental Impact Assessment (EIA) and non existence of Strategic Environmental Assessment are one of the main reasons which led to opposition of construction of new HPPs in environmentally sensitive areas. In order to enable further use of Georgia hydro power sources for energy security and economic growth, development and implementation of sustainability criteria are crucial (Green Alternative, 2014b). Complete implementation of the EU requirements on EIA procedures, which require transparency and public involvement, would be a first step to help developing the country's hydropower potential to the acceptable extent. Establishing the rules for the sustainable stretch use, proper regulation and implementation of the financial guarantees for the environmental and social risks posed by hydropower projects are additional requirements.

4.2.3 Heating and cooling

Space heating and hot water supply in Georgia is done individually with natural gas, electricity, fuel wood and some geothermal water. Cooling is usually supplied by the electric air conditioners. There was no detailed information on heating available. However, modelling exercises have shown a significant potential of EE improvement, which can be achieved explicitly in this sector (WEG and IRG, 2012, 16).

TABLE 11
Renewable energies potential in Georgia
Source: WEG, 2008 and WINROCK, 2007

GEORGIA	Natural potential	Technical-economic potential	Existing capacities
Wind energy	N/A	5 TWh	0 TWh
Big Hydro (> 20 MW)	40 TWh	N/A	2490.7 MW
Small Hydro (< 20 MW)	N/A	5 TWh	166.4 MW
PV	1550 kWh/m²	60–120 GWh	0 MW
Solar thermal	1550 kWh/m²	N/A	N/A
Geothermal energy	300 MW	100 MW	N/A
Biomass	12 TWh	4 TWh	N/A
Biogass	2.4 mln.m³	N/A	0

4.3 Institutional Framework of the Energy Market

4.3.1 Market design and regulation of market access

The electricity sector has been deregulated and electricity generation, transmission and distribution have been formally unbundled. Georgian generation and distribution sectors are mostly privately owned and the de-regulation and unbundling suggests a liberalized open market. However there is an important fact that shall be pointed out in this regard. As Figure 23 shows, ownership in the power market is divided into several, partially vertically integrated segments owned by Energo-Pro (orange), RAO-UES (blue), State (yellow), Abkhazian (purple) and major generator/consumer companies (green). The generation and supply/distribution or generation and transmission, generation and consumption businesses have the same owners, or are united within a single company. Since the bilateral power purchase agreements are the main form of electricity trade, one can expect that the buyers procure electricity mostly from own generation sources. In addition, the electricity from

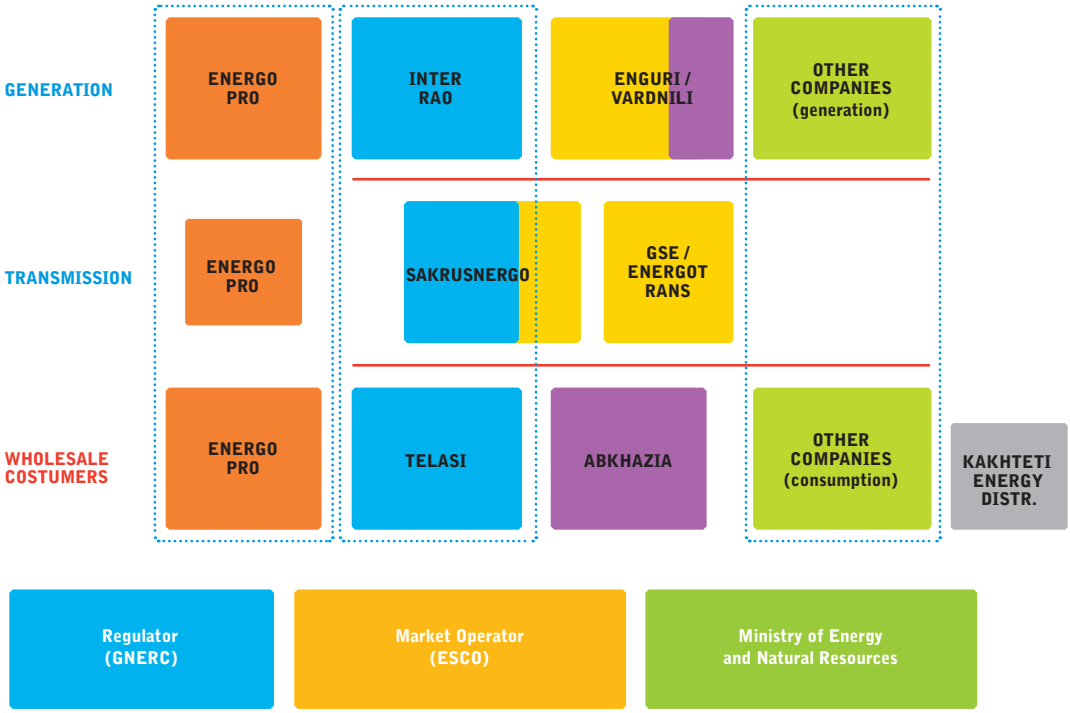

FIGURE 23
Ownership structure of the Georgian electricity market

Enguri and the expensive electricity from thermal power plants, as well as system reserve obligations, are distributed based on the principles that need more transparency.

In practice some more important in-efficiencies take place. According to the Law of Georgia on Electricity and Natural Gas, which defines the functions of the main governing and regulatory bodies as well as other conditions of the energy market in Georgia, the Ministry of Energy shall relinquish the regulatory rights. At the same time the ministry approves the Market Rules and thus interferes with market regulation which in fact was a function of the regulator until 2006. According to the same clause, the Ministry should give up ownership and operational rights. However the ministry is managing the state shares in the energy sector entities (Enguri, GSE, 25% of Telasi shares etc.). This can be considered as direct and/or partial involvement in ownership and the operational activities. In addition Ministry of Energy directly negotiates with potential investors with regard to the conditions and the site allocation for new HPPs. It is also involved in setting the tariff levels and conditions for the investment and operation for the main participants of energy market.

Commercially the power system is operated by the Electricity Market Operator (ESCO). The ESCO is responsible for ensuring stability of the Georgian electricity sector, uninterrupted electricity supply and fair trade principles. It shall also introduce a better trade model.

The natural gas market has been unbundled as well, but due to the high dependency on in-kind natural gas supply, involvement of the government is substantial. The Georgian Oil and

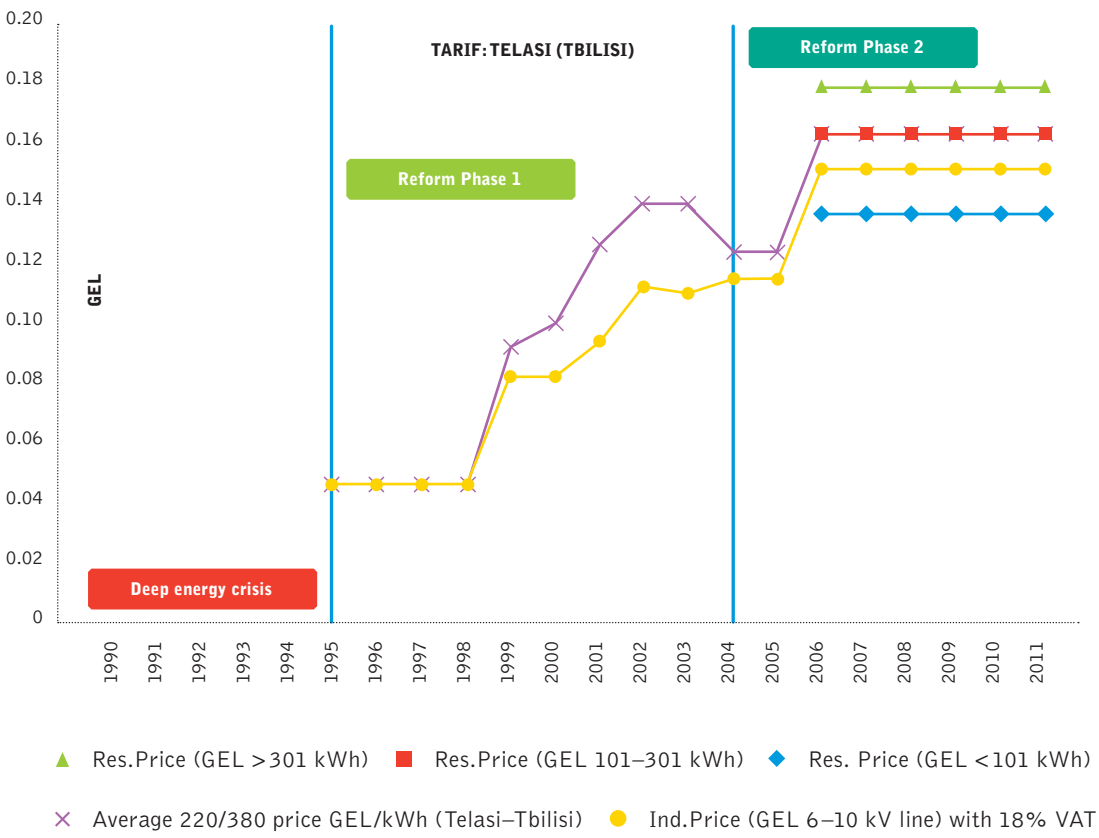

FIGURE 24
Electricity tariffs in Tbilisi
Source: Georgian National Energy and Water Supply Regulatory Commission, 2012

Gas Corporation[40] (GOGC) was established in March 2006 and is owned by the state-owned Partnership Fund. The company is managed by the Ministry of Energy. GOGC is ensuring long term and sustainable development of the wholesale natural gas market in order to achieve energy security of Georgia. It mainly focuses its activities on natural gas import. GOGC supplies more than half of Georgia's market with natural gas.

The Georgian Gas Transportation Company, a daughter company of GOGC, operates the natural gas transmission pipelines, distribution stations. There are seven main gas distribution companies which supply the final consumers. Three of them are daughter companies of the Azerbaijan national oil and gas company SOCAR.

4.3.2 Regulation of tariffs

Electricity Tariffs

According to the Law on Electricity and Natural Gas – all electricity tariffs are being approved by the Georgian National Energy and Water Supply Regulatory Commission (GNERC). These include: upper margins of energy tariffs for generation companies including hydropower and thermal power, guaranteed reserve capacity tariffs for thermal power plants, tariffs for network operators and end user tariffs. In practice however, this approval has followed by the bilateral negotiations between the Ministry of Energy and major utility companies (Energo-Pro, RAO UES, SOCAR) and was a mere confirmation of the agreements rather than the result of an

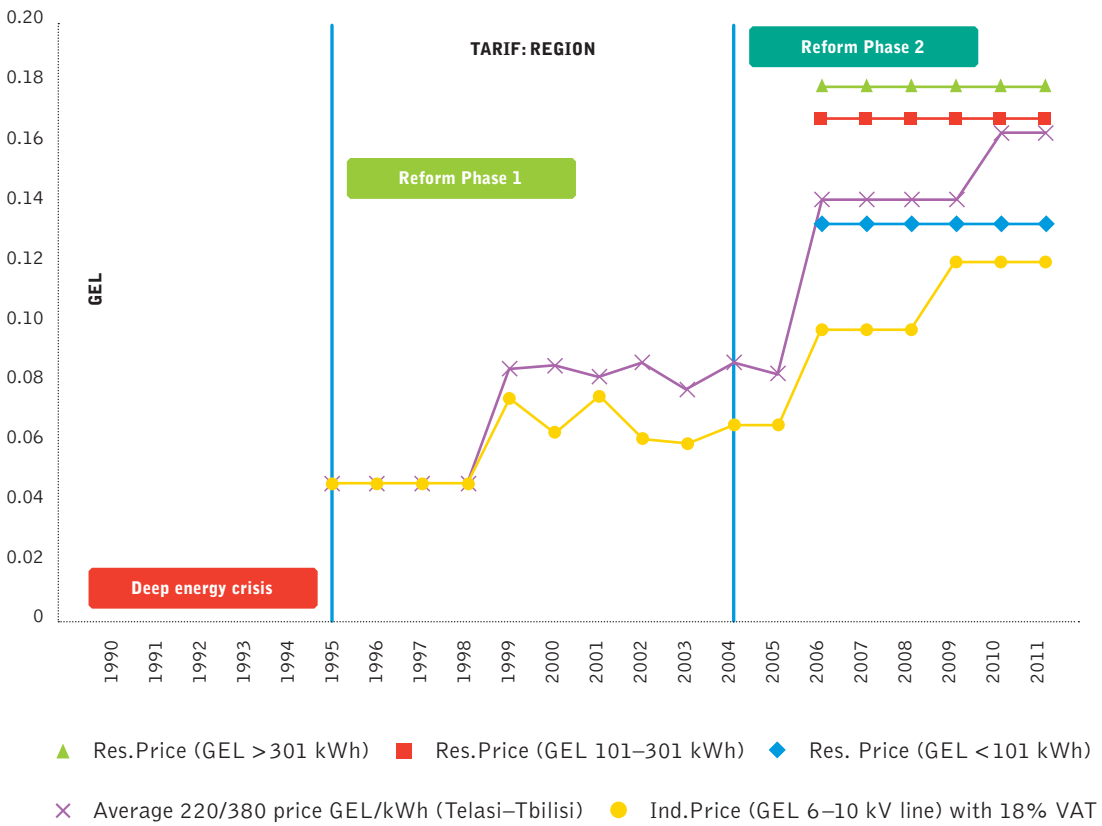

FIGURE 25
Electricity tariffs outside of Tbilisi
Source: Georgian National Energy and Water Supply Regulatory Commission, 2012

40 www.gogc.ge.

TABLE 12
Electricity tariffs for private households, excluding VAT (in Tetri/kWh)

Levels	JSC Telasi		JSC Energo-Pro
	01/04/2013–31/12/2016	01/01/2017–31/12/2025	01/04/2013–31/08/2014
< 101 kWh	8.034	11.424	7.63
101 – 301 kWh	10.56	13.56	11
> 301 kWh	14.998	14.998	14.83

independent economic calculations based on application of particular licensee.

As electricity generation costs differ substantially between existing HPPs, reflecting low marginal costs (0.7 USCent/kWh in 2009), and gas fired thermal power plant (6.7 USCent/kWh for the 110-MW Energy Invest OCGT, including a 2.2 USCent/kWh capacity payment) (ECON, 2010, 2) the tariffs set for the generators vary as well.[41]

Electricity tariffs for final customers have been raised several times. The tariff increases were much higher in Tbilisi than in the regions (see Figure 23 and Figure 24). Since 2006, three different tariffs for private households have been introduced related to the volumes of electricity consumed. The regulation primarily is social oriented. Consumers at lower consumption levels, usually lower income groups, pay a lower tariff. This is a first attempt to provide an economic incentive for energy efficiency.

Since 2008 various changes have been introduced for private households' tariffs. In 2013 electricity tariffs for private households supplied by Telasi and by Energo-Pro had been reduced. This reduction was agreed to take place until 2016. From 2017 until 2025 electricity tariffs for private households supplied by Telasi will equal to the tariffs that were in force until January 1, 2013 (see Table 12).

According to adjustments made in October and December 2013[42] guaranteed capacity payment and electricity generation marginal tariff for thermal power plants were changed for the following companies for precisely defined periods: Georgian International Energy Corporation, Mtkvari Energy and G-Power.

Although tariffs have been adjusted, the tariff system, however, was not based on a transparent economic mechanism. Instead, it was determined by direct non-transparent negotiations between the ministry and the utility companies. These negotiations have led to several minor tariff reductions in electricity and natural gas which leave many questions concerning the nature of the whole deal between the government and energy companies. Recently that was improved and tariffs for Energo-Pro have been set based on incentive regulation (price cap).

Natural gas tariffs

Although the tariffs should be set by the regulator, in practice tariffs are negotiated between ministry of energy and the respective energy company. As result of the Memorandum of Understanding (MoU) which was signed between the Ministry of Energy and the gas supply companies in 2013, residential gas consumption tariff decreased by 5 Tetris including VAT. This was rather a political compromise to comply with pre-election promises, than an economically justified measure. Furthermore like the case of MoUs with electricity utilities, it may have implied waivers on investment obligations under the previous MoU. The information on these agreements is not disclosed, although it affects most citizens of Georgia and therefore should be in public domain.

41 All conversions into EUR are based on average official exchange rates in December 2014.

42 Adjustments were related to GNERC's Decision #33 of December 4, 2008.

4.4 Sustainable Energy Policies

4.4.1 Energy security

Although Georgia is highly dependent on external energy sources, a comprehensive and well-prepared policy document on reducing the external energy dependence and increasing the level of energy security does not exist until now. Even worse, a sound stock taking on current energy use, as usually done in the national energy balance, has been carried out only in 2014. This is an important precondition for development of energy security considerations and respective policies. In addition, a huge indigenous energy resource – the fuel wood – is practically left out of the energy policy area.

International cooperation would be an important aspect for Georgia's energy security. On the one hand, attracting international investment could help to spur development of national energy sources and energy efficiency potential. On the other hand, further regional integration of electricity grids could help easing supply constraints. Ratification of the Association Agreement with the European Union which took place on 18 July 2014 could become an important incentive to implement the respective framework for enlarged international cooperation also in the field of EE and RE.

Diversification of energy supply

The construction and operation of the natural gas storage with a capacity of 300 million m^3 as it was announced by the Georgian Oil and Gas Corporation would be a significant contribution to reduction of additional gas imports during winter. This would also increase energy security by balancing supply and demand of gas. The potential contribution of

> "Unfortunately, there is insufficient political will for duly incorporating energy efficiency and renewable energy (other than hydro) in the energy strategy"

renewable energies and energy efficiency to energy security needs to be explored. For this purpose, a coherent government strategy together with proper energy policy shall be elaborated. The latter shall take into account the emergency issues and mitigate the adverse results of potential energy disruptions in future.

Although approval of the new, not yet published energy strategy is being expected, coherent energy policies are still lacking. The existing document of 2008 does not provide the grounds for comprehensive government action for achieving energy security. Instead, the diversification of energy supply and development of own hydro potential are provided as the main directions of increasing the energy security. Currently the Ministry of energy is working on a new version of energy policy which has been out for public commenting.

Sophisticated energy planning, which is needed for the development of strategy, is at its early stages. After several years of attempts under different donor projects a rigorous strategic planning model based on MARKAL is available to be used by the Ministry of Energy. A series of trainings were conducted and the analytical department of the Ministry of Energy is finally taking an initiative to manage the model. However no practical application has been made yet. The capacity of the analytical department needs to be strengthened further and internal process of cooperation needs to be established between policy makers, analysts and modelling experts. The model and the process can be developed further in order to establish a real planning capacity within the ministry of energy, to avoid formal superficial process and erroneous use of the model potentially leading to biased and unjust decisions. A conflict of interest may arise since the ministry is involved in operating capacities and ownership decisions related to the sector. Unfortunately, there is insufficient political will for duly incorporating energy efficiency and renewable energy (other than hydro) in the energy strategy.

4.4.2 Sustainable energy policies and instruments

4.4.2.1 Energy efficiency

Comprehensive analysis carried out by WEG and IRG in 2012 (WEG and IRG, 2012) shows the positive potential of EE and RE development on economic performance. Some of the most cost-effective areas for energy efficiency investment have been identified which include residential and commercial space heating, lighting and industrial process heat. Additional analysis of EE potential might identify a bigger line of cost-effective measures. However, the EE potential is largely neglected by the government and is mostly left to the market actors.

There are barriers to EE market development including long payback periods due to low energy prices, lack of information, scarcity of cheap financing mechanisms, poor technical capacity, high transaction costs and extra hidden costs (e.g. appliance and building standards, information campaigns etc.). In order to overcome those barriers serious policy interventions based on the best international experience are needed. Analysis has shown that only reducing barriers to energy efficiency uptake would save about almost 600 million EUR of investment into the energy system (WEG and IRG, 2012, 5).

Although no specific energy efficiency policy instruments are enacted by the Georgian government and no specified body responsible for EE is in place, some of the regulations and activities impact on development of the existing huge energy efficiency potential. For example, the diversification of electricity tariffs for residential customers according to consumption levels (see Table 12) sets a first incentive to rationally use electricity. However, the tariffs have not been adjusted for inflation or increased due to other regulatory factors for eight years. Thus, the impact on energy saving has diminished. Higher tariffs accompanied by targeted EE investment for low income households would be more appropriate to support EE improvement.

From 2010 till 2012 energy intensity in industry, transport and agricultural sectors decreased while there was some increase in the service sector which is the least energy intensive sector. One of the reasons may be the extensive growth of the commercial sector, which is more energy intensive than other service sectors.

Membership in the Covenant of Mayors (COM) has become quite popular among the Georgian cities. Eight municipalities have signed the covenant and developed or are in a process of developing their

respective Sustainable Energy Action Plans (SEAP). Tbilisi and Batumi are the leading municipalities in this process. This process is not explicitly supported by the central government however it has a potential to influence the decisions on adopting the respective legislation in future. The activities carried out locally also raise public awareness on energy efficiency. However, as municipalities are not well prepared to design and implement sustainable energy measures and practices, there is a threat that the process will be implemented only formally and therefore, might not have the expected substantial effect on municipalities and citizens.

Ministry of Economy and Sustainable Development is working on development of the building code with due place devoted to energy efficiency of buildings. If adopted the building code should have a strong positive impact on building industry as well as sustainability of energy use in Georgia. However, lack of experienced experts is a problem. Also general weak law enforcement may become a problem once the code will be approved for implementation.

4.4.2.2 Renewable energies

There is neither a renewable energy law nor other supportive policies or action plans in place. The draft law on renewable policies elaborated was not yet adopted. The main focus of the government is on attraction of investment to large and medium size hydropower plants, leaving the concrete procedures mainly to the market[43]. Since June 2007 all small hydropower plants can sell their output to ESCO at average ESCO tariff. The tax benefits, including VAT exemptions, which had been in place for RE before 2005, have been eliminated by the new tax code (WEG, 2008, 13). Other renewables, like wind and PV, are neglected although they could contribute to overcome the seasonal problem of hydropower.

Access to the power market for new market entrants is granted and construction permits are assigned in accordance with the certain rules. For the bigger hydropower plants the Georgian government assigns construction permits in case purchase of electricity can be assured (negotiations with eligible

43 Resolution of Government of Georgia No214, August 21, 2013, on Rules of expression of interest for feasibility study, construction, ownership and operation of power plants in Georgia.

> “Barriers serious policy interventions based on the best international experience are needed. Analysis has shown that only reducing barriers to energy efficiency uptake would save almost 600 million EUR of investment into the energy system”

TABLE 13
Energy intensity development 2010–2012 (in toe/1000 EUR 2003 prices)
Source: GEOSTAT year book 2012 pg.190, own calculations

	2010	2011	2012
Energy intensity in industry	0.350	0.470	0.142
Energy intensity in transport	1.367	1.396	1.215
Energy intensity in agriculture	0.165	0.241	0.151
Energy intensity in service sector	0.045	0.058	0.082

customers and distribution companies need to be successful). For HPPs below 13 MW, access to grid is secured by the government in case the plant supplies electricity to the balancing market. In any case, investors have to carry out a certain bargaining procedure with the government.

Due to seasonal supply of hydropower, interest of the private investors in new HPPs is first of all linked to possible electricity exports, mainly to Turkey, where electricity prices are at higher level. 20% of the electricity generated, however, has to be supplied to the Georgian market in winter.

For development of mainly grid connected renewable energy, the government has established the Georgian Energy Development Fund (GEDF). The Fund is a state owned agency developing, engineering and investing in renewable energy projects. The business model of the GEDF is to prepare projects and sell them to potential investors including own equity participation. The GEDF is currently developing the first 20 MW wind farm in Georgia near the city of Gori. But wind still remains one of the untapped resources although the potential is well studied.

A huge problem for renewable energy in Georgia is lacking political responsibility for fuel wood (about half of all indigenous sources of TPES). Ministry of Environment and Natural Resources is responsible for regulation of the forest sector. Specifically, its agency – National Agency of Forestry defines the targets for wood cutting and provides the schemes for fuel wood distribution. In 2014 Georgia adopted the new forest Code but until now there are number of deficiencies associated with proper implementation of the regulations. As a result of this vast resource is used extremely inefficiently. The following factors contribute to this inefficiency:

- Poor forest management resulting in forest degradation.[44]
- Inefficient stoves.
- Waste of heat due to lacking heat insulation and weatherization in rural dwellings.
- Habit of burning the wood with high moisture content.

There is an urgent need for expedient government intervention and development of a state strategy for efficient use of biomass otherwise, as the recent studies show (CENN, 2014), the high rate of wood fuel use and waste combined with current forestry practices can lead to increased energy poverty in winter and large forest devastation.

Experiences with implementation of solar water heaters in rural areas show, that this technology can help overcome fuel poverty and avoid unsustainable use of fire wood. About 430 solar collectors have been installed by the Women in Europe for a Common Future, an international NGO, and their partners, and their performance has been monitored. The collectors proved usefulness and showed an average annual reduction of 700 kg CO_2 per collector, which resulted in financial savings per household (WECF, 2014). Solar water heaters are the most cost effective technology and they could be deployed in large quantities.

44 The major problem for forests were the fact that since 1994 till 2004 there was almost no import of Gas from Russia, and large electricity crisis that time fuelwood consumption increased significantly both in rural and urban areas.

However, due to plenty of market and regulatory barriers, solar water heaters remain to be rare. To overcome the barriers and pave the way for mass introduction an appropriate government policy needs to be developed and implemented. This is also true for the development of other small scale, off-grid renewable energy technologies including biogas, geothermal, off-grid SHPPs and wind for which currently no supportive measures or policies are in place.

4.4.2.3 Climate change mitigation

Georgia does not have international obligations for reducing GHG emissions. Correspondingly, mitigation of climate change through emissions reduction is not part of any government policy or a program although Georgia participates in international cooperation on climate change as a non-Annex 1 Party to the Kyoto protocol of UNFCCC. The government has reported through National Communications on GHG emissions and has prepared Technology Needs Assessment as part of the technology transfer process. Georgia has associated to the Copenhagen Accord in 31 January 2010. Currently NAMAs are being prepared for energy efficient buildings, implementation of solar water heaters and for efficient wood stove technologies.

There have been attempts to participate in international carbon markets by using the Clean Development Mechanism. Eight Georgian CDM projects have been registered summing up to about 2 million tons of CO2eq annual emission reductions. However most of the projects could not attract finances through CDM mechanisms. In 2013 an initiative for development of a Low Emission Development Strategy (LEDS) was launched supported by the US EC-LEDS Program. A high-level inter-ministerial committee and a LEDS working group have been established under the leadership of the Ministry of Environment and Natural Resources Protection. Based on the results of the LEDS the INDC will be defined. Different possible versions for Georgia's contribution are discussed:

- Quantified emission limitation or reduction commitment – base year 1990
- Deviation from baseline
- Emission intensity – GHG emission per GDP. (Lazriev, 2014)
- So far no decision has been adopted.

> **"the high rate of wood fuel use and waste combined with current forestry practices can lead to increased energy poverty in winter and large forest devastation"**

4.5 Strategic Priorities for Sustainable Energy Development

Strategic priorities for sustainable energy development in Georgia are not yet defined. In fact, priorities rely mainly on: establishment of additional electricity generation capacities (hydropower as well as natural gas), usage of the gas transit opportunity to obtain natural gas as in-kind fee for international gas transit and construction of a natural gas storage in order to secure energy demand in winter, when hydropower capacities are not able to cover the demand.

However, a draft Energy Policy document was elaborated in August 2014 and published for public discussions. It is worth considering the strategic priorities which are highlighted by the document:

- Diversification of energy supply sources and optimal exploitation of energy recourses. Exploration and development of national fossil fuel resources (such as natural gas, oil and coal) are among the strategic priorities. Utilization of Georgia's renewable energy resources and particularly further development of the hydropower have high strategic importance. Moreover, Georgia is visualized as a regional centre producing and trading with clean energy.

- Gradual approximation and later harmonization of Georgia's legislative and regulatory framework with the EU's Energy acquis.

The process is expected to facilitate:

- A competitive, transparent and effective energy market model as well as the creation of an attractive and stable investment climate;
- The development of energy trade between Georgia and EU countries;
- The exploration of renewable energy resources and
- The energy efficiency oriented activities in the country through economically and ecologically feasible means.

Improving energy markets and energy trading mechanisms. This includes: improvement of legal and commercial relations, establishment of transparent institutional structures, improvement of the regulatory framework and better integration of Georgia`s energy system into the regional energy systems, strengthening Georgia's importance as a transit route in the region, using its strategic geopolitical location for enhancing its role through carrying out of East-West and North-South transit projects.

Development and implementation of an integrated approach to energy efficiency in Georgia. The policy document highlights the importance of energy efficiency programs, respective legislative background and incentives to promote energy efficiency mechanisms.

Taking into account components of environmental protection. The draft document recognizes the importance of addressing to the best international practice in order to minimize environmental and social impacts when it comes to big energy infrastructural projects.

- Improving service quality and protection of consumer interests by:

  - Strengthening the functions of regulatory body in order to avoid the monopolies.
  - Developing new standards of the service and establishing adequate service quality monitoring rules.
  - Establishing transparent and justified tariffs
  - Ensuring undisrupted energy delivery to the vulnerable groups of the society through social programs and subsides.

These strategic priorities are in line with the "Economic and Social Development Strategy: Georgia 2020" which was adopted in 2014 and aims to raise competitiveness and welfare of the country ultimately. The document emphasizes the importance of maximal utilisation of national energy resources (especially hydropower) in order to reduce energy dependency and increase energy security. It also highlights the significance of improving the natural gas and electricity infrastructure in the rural areas in order to raise efficiency of the consumption of national resources and to improve social conditions. The strategy assumes an increase of total annual electricity generation to 14.0 TWh by 2020 (baseline 10.17 TWh in 2014) and decreasing respective imports.

To implement the Strategy in practice, considerable efforts need to be undertaken. Proper utilization of Georgia' s hydropower and other renewable resources is not the only challenge that needs to be addressed through a well prepared energy strategy, integration of regional energy markets and proper market mechanism. However, the ongoing hot dispute over environmental and social impacts of large hydropower projects clearly indicates the high importance of developing and observing the proper environmental and social impact assessment procedures for energy infrastructure projects.

Setting up a sophisticated cross border mechanism for the electricity trading is a necessary step for integration of electricity market with Turkey and Europe. (Turkey is already connected to ENTSOE and operates its electricity sector under ENTSOE rules). This mechanism also requires higher standard of systems and organization in internal balancing market as well as establishment of the system of grid code that will organize the activities of system and market operators.

"Setting up a sophisticated cross border mechanism for the electricity trading is a necessary step for integration of electricity market with Turkey and Europe"

Georgia could potentially become an initiator of regional trade with clean energy. However, concrete mechanisms need to be elaborated beyond the vision statement and support mechanisms need to be put in place to spur development of renewable (clean) energy. Also a coordination of internal RE policies with those of the neighboring countries is required.

4.6

Recommendations

Many of the current and emerging problems of Georgia's energy sector are related to poor legislation, the absence of strategic planning, poor governance and regulation, non-transparent markets and the presence of vertically integrated utilities whose activities are regulated by the government rather than by an independent regulator following international best practices. Environmental and social issues are not properly addressed and there is little if any rationale for sustainable energy development.

Harmonisation and expedited implementation of the EU Energy Acquis through membership in the Energy Community as well as gradual and sustainable implementation of EU energy directives should become a top priority. It could have a direct positive impact on all issues of sustainable energy systems development. The directives include targets to achieve, which are important as success will be measurable. Below are recommendations for short, medium and long-term actions.

The short-term

- **Approval of official EE and RE targets and elaboration of a NEEAP by 2020.** The current debate about energy policy modelling results should be used to officially approve EE and RE targets and incorporate them into the new strategy.[45] These targets could be offered as contribution (INDC) of Georgia to the upcoming international climate change negotiations in Paris 2015 seeking international support for implementation, thus linking the contribution to international technology transfer. A NEEAP, which needs to be adjusted over time, would help defining and developing the appropriate measures and policies to achieve the targets. EU methodological guidance for elaboration of a NEEAP is available.

- **Development a comprehensive approach for implementation of the envisaged new building code.** Experiences in the EU show that EE in buildings needs concerted actions combining new technical standards, raising awareness and distribution of information among private building owners as well as education of professional construction companies and crafts men and financial support. Therefore, adaptation of a new building code should be used in order to develop such an integrated approach. Support of donors and new climate change mechanisms like NAMAs can provide co-financing and technical support. For that purpose a targeted comprehensive approach for EE initially in the newly constructed public buildings should be developed. Implementation needs to be monitored.

- **Set up an EE and RE Agency.** EU experiences show that disperse energy efficiency potential and the variety of RE technology applications require high-level institutional responsibility for development and implementation of policies and measures to foster EE and RE. Energy Agencies have been set up in all EU member states for that purpose. Such agency is lacking in Georgia, but is important to establish.

- **Implement and monitor implementation of Environmental Impact Assessment in accordance with international rules for all RE projects. RE, including both medium size and small hydro, can significantly contribute to sustainable energy development and economic growth in the country.** In order to transfer the potential into real projects the current obstacles need to be overcome and the public needs to be involved into the decision making process. Additionally, government shall introduce the rules for sustainable stretch use, proper regulation and implementation of financial guarantees for the environmental and social risks posed by RE projects.

- **Elaborate and adopt sound renewable energy legislation (including regulation of all relevant topics, like non-discriminatory grid access, guaranteed purchase, appropriate financial support schemes for grid-connected and off-grid RE).** There is an abundant experience within EU countries which may help selecting policy approaches appropriate for Georgia. Financial support schemes for RE technologies which are not yet competitive could be feed-in tariffs, auctions, quotas combined with green certificates or a combination of tools. The policy approaches should also consider the importance of political responsibility for fuel wood, as well as development of a strategy for sustainable forest management (including forest use for energy purposes

45 Analysis has shown the targets would substantially increase the specified positive effects (WEG and IRG, 2012).

and sustainable afforestation) combined with a sound approach to overcome fuel poverty.

- **Strengthen and institutionalise independent analytical competence for sustainable energy development.** Today, analysis and capacities strongly depend on foreign support. However, future development of sustainable energy policies requires comprehensive research and analysis of EE and RE potential. There is a need to explore in more detail the positive impact of EE and RE on economic growth, on attracting new investment, on creation of new jobs and improvement of qualification, on opening up new businesses, and on improving the environment. It would bring transparency, higher professional and institutional standards and stability which accelerate progress and mitigate the current risks to energy security and sustainable development of the energy sector.

The medium-term

- **Elaboration of a comprehensive EE framework including sub-laws and rules for development of EE potential in all sectors (industry, service and commercial sector, agriculture, transportation) of the economy.** This activity needs to be accompanied by regular adjustments of the NEEAP. Having the right framework consisting of legal, economic, financial and informational tools, is important in order to attract private investments. It provides investors with a clear long-term perspective, and helps to improve infrastructure as well as quality of service to consumers. Such approach can rely on experiences of EU member states which need to be adjusted to Georgia's conditions.

- **Development of a strategy for sustainable heating (including hot water) and cooling.** The heating and cooling sector is quite under-developed so far and has a huge energy saving and GHG reduction potential. Sound analysis needs to be carried out first in order to develop proposals for integrated solutions in dense cities as well as for remote areas. RE could deliver an important part of the solution. Current experiences in Georgia resulting from solar heating pilot projects could be the basis for designing and launching a solar heat and hot water program in rural areas. The capabilities and competences of the Georgian Energy Development Fund should be used for this purpose.

- **Enlarging the comprehensive approach for EE in buildings described above to the existing building stock.** The existing building stock needs tailored economic incentives, financial support and respective awareness raising initiatives.

- **Implement transparent and equal rules for new entrants to the electricity market (both legal and practical).** For wider deployment of RE small, medium or community owned companies and even citizens with low bargaining power, shall have easy access to electricity market. Independence of the regulator and adjustment of current legal framework are crucial for this.

- **Improving energy tariff regulation by setting up transparent schemes should also be part of such rules.** The current in-transparent tariff policy based on bilateral bargaining between companies and the government is a major barrier for small and medium size private investors.

The use of national coal resources for electricity generation should be analysed and assessed. Georgia's coal resources are small[46] and by no means sustainable. Moreover, power generation by coal fired plants has hugely negative impact on the environment with enormous implications for social health and the climate. Lastly, electricity from new coal power plants will be expensive as respective costs are generated by the construction of new power plants as well as the necessary infrastructure.

The long-term

- **Development of a regional electricity market between neighbour countries to foster competition and open electricity trading, including RE electricity.** The connection with Armenia is a first step. Turkey has completed the synchronous operation of the power system with its system of ENTSO-E (European Network of Transmission System Operators for Electricity). Georgia joining the Energy Community Treaty would be a second step to facilitate development.

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46 National proven reserves of coal were estimated to amount to 407 million tons (Gochitashvili book, 2012).

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