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# ARMENIA ELECTRICITY DEMAND FORECAST

ASSISTANCE TO ENERGY SECTOR TO  
STRENGTHEN ENERGY SECURITY AND  
REGIONAL INTEGRATION

CONTRACT NUMBER EPP-I-08-03-00008-00

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The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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## ***LIST OF ACRONYMS***

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GDP	–	Gross Domestic Product
CJSC	–	Closed Joint Stock Company
WB	–	World Bank
IEA	–	International Energy Agency
RoA	–	Republic of Armenia
JSK	–	Joint-stock company
HVL	–	High Voltage Line
kV	–	kilovolt
US\$	–	US dollar per ISO code
USc	–	US cent per ISO code
Agr.	–	Agriculture
Serv.	–	Service
Ind.	–	Industry
AMD	–	Armenian Dram
mln.	–	million
kWh	–	kilowatt-hour
MW	–	megawatt
GP	–	Gross Product
ANPP	–	Armenian Nuclear Power Plant
RES	–	Renewable Energy Sources
HPP	–	Hydro Power Plant
thous.	–	Thousand
h	–	hour
ARM	–	Armenia
AZE	–	Azerbaijan
BLR	–	Belarus
BGR	–	Bulgaria
EST	–	Estonia
GEO	–	Georgia
IRN	–	Iran, Islamic Rep.
LVA	–	Latvia
LTU	-	Lithuania

ROM	-	Romania
RUS	-	Russian Federation
UKR	-	Ukraine
HUN	-	Hungary
CZE	-	Czech Republic
POL	-	Poland
SVK	-	Slovak Republic
TUR	-	Turkey
GRC	-	Greece
ESP	-	Spain
ITA	-	Italy
FRA	-	France
DEU	-	Germany
GBR	-	United Kingdom
BEL	-	Belgium
USA	-	United States of America



## **SUMMARY**

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This report presents the results of studies carried out under Contract EI 11/12 “Medium and Long-Term Electricity Load Demand Forecasts under the Least Cost Generation Plan” signed between Tetra Tech ES, Inc and “Scientific-Research Institute of Energy” CJSC.

The report provides methodological approaches to estimate the long-term electricity demand for the sectors of economy, residential sector and transport, as well as for non-specified consumers of Armenia. The analysis of global trends of changes in macroeconomic and energy indicators depending on the level of economic development of countries, as well as retrospective indicators of Armenia was carried out. A model for estimation of future electricity demand in Armenia until 2040 was developed based on the carried analysis. The model was verified by simulation of retrospective levels of electricity consumption for 2003 – 2011 and their comparative analysis against actual data.

Assessment of the long-term electricity demand in Armenia was implemented for three main scenarios of development:

- I scenario: based on the forecasted data on development of macro-economic and energy indicators received in response to the official requests of the Ministry of Energy and Natural Resources of the Republic of Armenia,
- II scenario: based on the forecasted data of WB on GDP growth rate in Armenia for 2011– 2030, on average by 5.6% per year, as well as the assumption about moderate rates of decline in the share of agriculture and growth of the share of services in GDP,
- III scenario: based on the forecasted data of WB on GDP growth rate in Armenia in 2011 – 2030, on average by 5.6% per year, as well as the assumption about low rate of decline in the share of agriculture and high growth rate of the share of services in GDP.

A comparative analysis of the calculation results was carried out for all scenarios and sub-scenarios.

The analysis of retrospective load curve characteristics of the power system of Armenia was carried out and the assumptions about their change in the long-term future were formed. Based on these assumptions the prospective demand for regular maximum, irregular maximum and minimum electric capacity at the level of final consumption were assessed.

The issues of prospective export-import possibilities of the power system of Armenia were considered.

## **INTRODUCTORY REMARKS**

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This report includes results of studies carried out under Contract EI 11/12 “Medium and Long-Term Electricity Load Demand Forecasts under the Least Cost Generation Plan” signed between Tetra Tech ES, Inc and “Scientific-Research Institute of Energy” CJSC.

The report consists of 7 chapters and 4 attachments.

Chapter 1 “**Methodology to Forecast Long-Term Demand for Electricity in the Republic of Armenia by 2040**” describes methodological approaches used to assess the long-term electricity demand for the sectors of economy, residential sector, transport and non-specified consumers. The chapter also provides sources of information used for assessment of export-import possibilities of the Armenian power sector and methodological approaches to assess the long-term demand for electric capacity.

Chapter 2 “**Collection and Processing of Statistical Information on Retrospective Macroeconomic Indicators and Electricity Consumption Volumes**” presents data on information sources used and results of analysis of changes in electricity demand in economic sectors, residential sector, transport, and of non-specified consumers. Based on the analysis the regression dependences were received for assessment of the electricity demand, taking into consideration the global trends and retrospective indicators of Armenia.

In Chapter 3 “**Model Development and Verification**” a model was developed for estimation of the long-term electricity demand, based on the received regression dependences. The model was verified by simulation of retrospective levels of electricity consumption for 2003 -2011 and their comparative analysis against actual data.

Chapter 4 “**Results of Scenario Calculations**” describes three main scenarios for development of macro-economic indicators of Armenia and their sub-scenarios. It presents results of calculations made to forecast electricity demand for each sub-scenario.

Chapter 5 “**Comparative Analysis of Calculation Results**” discusses the analysis of the results of calculations of main scenarios and sub-scenarios.

In Chapter 6 “**Forecast of Demand for Electric Capacity in the Power Sector of Armenia**” the characteristics of the load curve shapes are calculated based on the retrospective data. The Chapter shows calculation results of demand for the maximum and minimum capacity with consideration of the assumptions about changes in characteristics of load curve shapes.

Chapter 7 “**Export-Import Potential of the Power System of Armenia**” discusses the main issues related to the enhancement of export-import possibilities of Armenia.

The report also includes the list of references and the list of acronyms.

Attachment 1 provides macroeconomic indicators of development for various countries. Attachment 2 shows indicators of electricity consumption in Armenia for 2003 – 2011.

Attachment 3 provides information on forecasted economic development of Armenia received in response to the official request of the Ministry of Energy and Natural Resources of the Republic of Armenia.

Attachment 4 provides retrospective load curves of the power system of Armenia, by duration.

## 1. **METHODOLOGY TO FORECAST LONG-TERM DEMAND FOR ELECTRICITY IN THE REPUBLIC OF ARMENIA BY 2040**

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Forecasting long-term demand for power resources is one of the key tasks in the course of planning the development of power systems. To assess the value of the long-term demand for power resources the methodical approaches of the strategic management theory [1, 2] and the regression analysis [3, 4, 5, 6] have been widely used. This present methodology is based on the principle of factor decomposition of effects from various time-depending impacting factors [7].

**Assessment of the value of electricity demand in the country's economy (without residential sector, transport and non-specified for which the demand forecast is given below).** According to the principle of factor decomposition the value of electricity demand in the country's economy is estimating by the following formula:

$$E_{Ec.} = A \sum_j S_j \cdot e_j = N \cdot b \sum_j S_j \cdot e_j, \quad (1.1)$$

where  $E_{Ec.}$  – aggregate consumption of electricity in the sectors of economy, kWh; A – aggregate volume of the gross domestic product (GDP), in mln.\$; N – population size, in mln.; b – GDP volume per capita, in \$/head; j – index of the sector of economy;  $S_j$  – the structure of economy in the form of gross product's (GP) share in the GDP, produced by j-sector ;  $e_j$  – electrical intensity of the GPj-sector of economy, in kWh/\$.

Under this formulation the task is focused on revealing to what extent the changes in the GDP value, in the economy structure and electrical intensity of the sectors of economy may have influence on the long-term electricity demand.

The comparative analysis of data from the World Bank and the International Energy Agency for a number of countries shows that while the GDP per capita grows, some changes in the structure of economy (increase of the portion of service sectors) and in the electrical intensity of GP by sectors of economy (decrease) are observed.

Nevertheless, forecasting of long-term tendencies of factor changes that impact the value of electricity demand for the developing countries, including Armenia, remains a complex task to be solved in conditions of high uncertainty.

To solve the task the following methodological approaches are implemented:

- Collection of statistical information on retrospective macro-economical indicators of Armenia development (GDP, population size, portion in the GDP of sectors of economy);
- Collection of statistical information on retrospective electricity consumption by economic sectors of Armenia (source: CJSC "Electrical Networks of Armenia") and calculation of their electrical intensity;
- Collection of statistical data on retrospective macro-economical indicators of other countries (source: WB);
- Collection of statistical data on retrospective consumption of electricity by sectors of economy of other countries (source: WB, IEA) and calculation of their electrical intensity;

- Comparative analysis of the collected data and examination of common patterns of the level of impact of various factors on the value of demand;
- Collection of data on the anticipated development of economy of Armenia, including:
  - GDP and its structure development forecast (source: Ministry of Economy and Ministry of Finance of the RoA),
  - Forecast of changes in urban and rural population sizes in Armenia (source: Ministry of Labor and Social Affairs of the RoA) ,
  - Forecasts of changes of electricity consumption in agriculture, in particular for irrigation (source: State Committee of Water Economy of the RoA Ministry of Territorial Administration) ,
  - Forecast of changes of electricity consumption for transportation (source: the Ministry of Transport and Communication),
  - Forecasts of changes of housing construction volumes in urban and rural territories (source: the RoA Ministry of Urban Development);
  - Forecasts of changes of electricity consumption by large consumers (source: Armenian Water and Sewerage CJSC, “Nairit Plant” CJSC, “Rusal Armenal” CJSC, “Dzulakentron” JSC),
- Comparative analysis of obtained data and retrospective indicators of trends of economy development of Armenia.

Based on the results of comparative analysis the main scenarios of long-term development of impacting factors are formed and the long-term demand for electricity in Armenia is calculated in accordance with (1.1).

**Assessment of electricity demand in the residential sector.** Assessment of electricity demand in the residential sector is a highly complicated task in conditions of insufficient and non-reliable initial information on general demand for energy resources (primary and secondary) and technologies being used in this sector. It is especially complicated to assess the possibilities of substitution of one energy resource by another alternative resource, since these possibilities depend on the cost and availability of this or that energy resource on the local territorial level.

To solve this task the following methodological approaches are implemented:

- Collection of statistical data on retrospective electricity consumption in the residential sector of Armenia by months for Yerevan and Armenia regions (source: Public Services Regulatory Commission of the RoA, “Electrical Networks of Armenia” CJSC);
- Collection of statistical data on retrospective natural gas consumption in the residential sector of Armenia by months (source: Public Services Regulatory Commission of the RoA, “ArmRusGasProm” CJSC);
- Comparative analysis of retrospective volumes of electricity consumption in the residential sector of Armenia and examination of common patterns of their change, as well as assessment of possibilities for mutual substitution of electricity by natural gas.

**Assessment of electricity demand in the transport sector.** Assessment of electricity demand in the transport sector was carried out based on:

- Analysis of retrospective data on energy consumption and examination of common trends,
- Use of forecasted data from the Ministry of Transport and Communication given in table A. 3.5

**Assessment of electricity demand for non-specified consumers.** Assessment of electricity demand for non-specified consumers was carried out based on:

- Expert estimation of the portion of non-specified consumers in the total amount of “Other Consumers”,
- Analysis of retrospective energy consumption data and estimation of common trends.

**Assessment of the value of export/import of electricity in Armenia.** To assess the value of import/export possibilities of the power system of Armenia the information containing in the following sources was used:

- The existing agreements between the Republic of Armenia and Islamic Republic of Iran on long-term supply of electricity to Iran in exchange for natural gas through 400 kV two-circuit HVL which is under construction,
- Tetra Tech’s Report titled “Regional Electricity System Synchronization and Trade and Market Development”.

**Assessment of the demand for electric capacity.** Assessment of the demand for electric capacity in the power sector of Armenia was estimated based on the assessment of the internal (domestic) demand for electricity and analysis of typical annual load curves.

Assessment of the domestic demand for electric capacity was implemented based on the following methodological approaches:

- Collection of retrospective information on hourly generation and useful output from bus-bars of power plants, as well as import and export of electricity (source: data base of the Automatic System for Commercial Metering of Power Consumption)
- Formation of retrospective average monthly daily load curves,
- Revealing of common tendencies of changes in the domestic demand for electric capacity to be consumed,
- Comparative analysis of daily load curves for 2005 – 2011,
- Estimation of long-term tendencies of changes in demand,
- Calculation of indicators used to characterize the configuration of load curves and analysis of tendencies of their changes,
- Assessment of long-term domestic demand for capacity with consideration of the results of long-term forecasts of demand for electricity and the tendencies of changes in daily load factors.

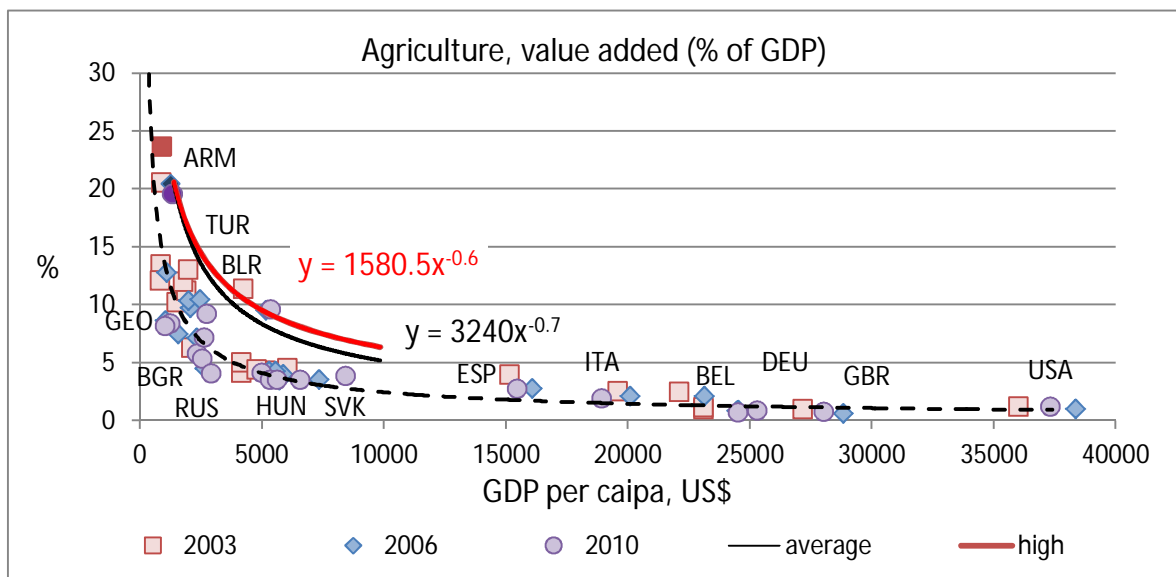
## 2. COLLECTION AND PROCESSING OF STATISTICAL INFORMATION ON RETROSPECTIVE MACROECONOMIC INDICATORS AND ELECTRICITY CONSUMPTION VOLUMES

The main sources of statistical information on retrospective macroeconomic indicators for development of Armenia and other countries were obtained from the online World Bank source as presented in Appendix A.

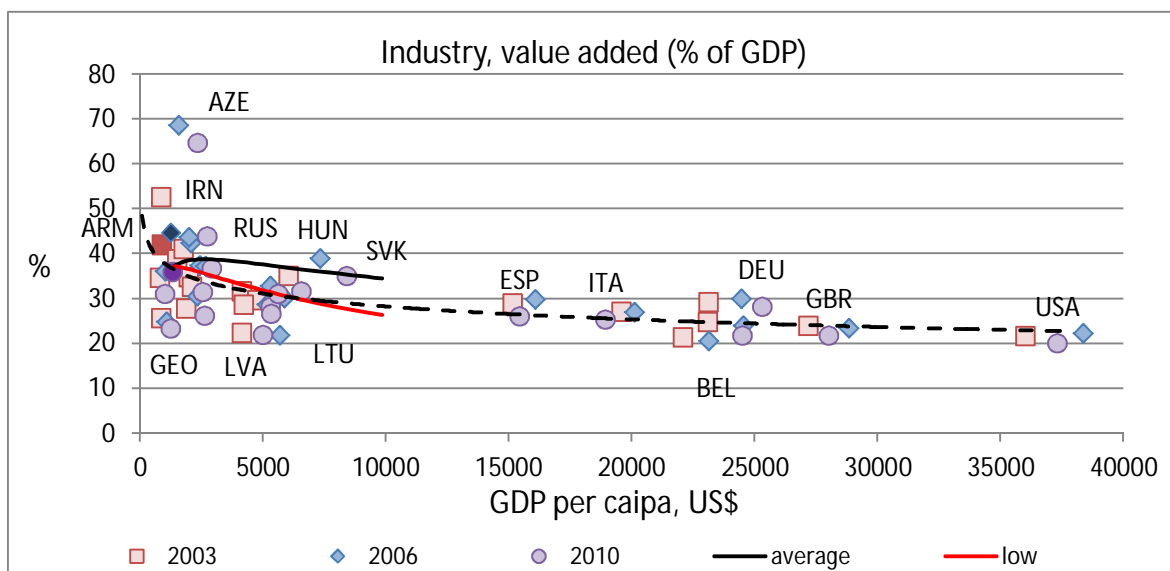
### 2.1 ANALYSIS OF CHANGES IN DEMAND FOR ELECTRICITY BY SECTORS OF ECONOMY

Diagrams 2.1 -2.3 were developed based on the processing of data given in Appendix A. They illustrate common tendencies of changes in GDP structure depending on the level of economic development of countries, which is characterized by the value of GDP per capita.

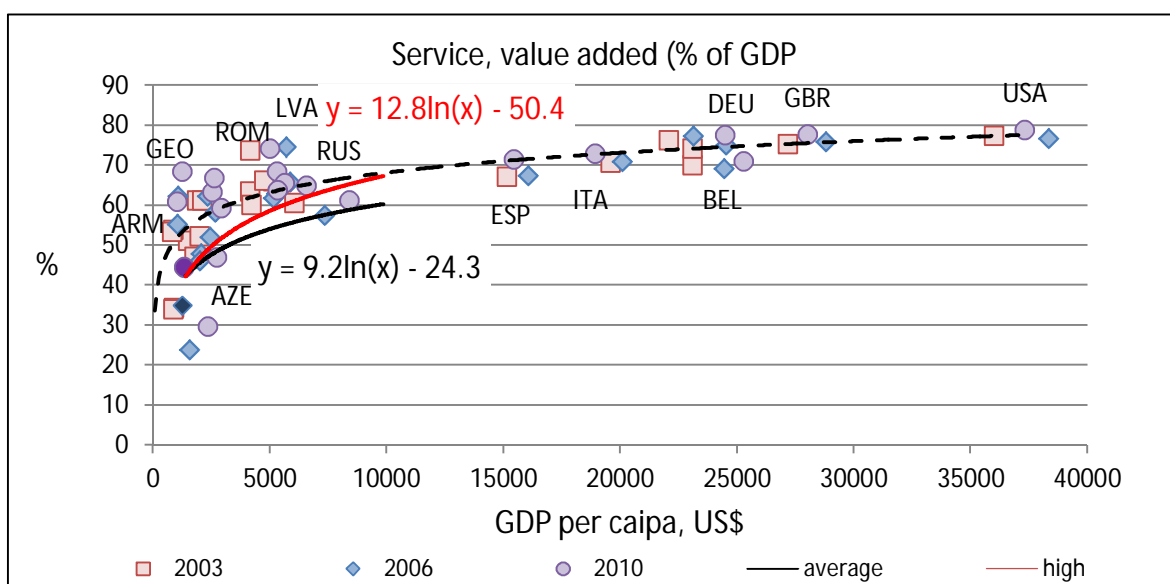
**Figure 2.1. Tendencies of changes in share of agriculture in GDP depending on GDP per capita**



**Figure 2.2. Tendencies of changes in share of industry in GDP depending on GDP per capita**



**Figure 2.3. Tendencies of changes in share of service in GDP depending on GDP per capita**



As can be seen from these figures with the growth of the level of economic development the share of agriculture in GDP is significantly decreasing, while the share of service sector is increasing. For convenience, the trend lines for 2010 (the latest data for which is available) are presented by dotted lines. The statistical analysis of trends shows strong correlation between the portion of agriculture in GDP and GDP per capita, with Pearson correlation coefficient  $R=0.9$ . There is also a satisfactory correlation with  $R=0.65$  between the share of service sector in GDP and GDP per capita. So both aforementioned indicators may be accepted as base ones.

Analysis of retrospective indicators of economy development shows that the aforementioned trends are typical for Armenia too. In particular, the average growth rate of

GDP per capita in dollar terms (at constant 2000 year dollar) for 2003 – 2011 is 6.17% per year. GDP per capita increased from US\$ 883.25 in 2003 to US\$ 1384.09 in 2011. At the same time there was a change in the GDP structure. The share of agriculture in GDP (see Table A 1.3) before 2008 was stably decreasing on average by 4.67% per year, but in 2009 – 2011 it was increasing on average by 3.95% per year, as a result of financial crisis of 2009. However, during the period of 2003 – 2011 the share of agriculture in GDP decreased on average by 1.44% per year. Average growth of the share of service in GDP for 2003 – 2011 (see Table A 1.5) was 2.83% per year that resulted in increase of the share of service in GDP from 34.33% in 2003 to 42.2% in 2011. The share of industry in GDP in 2003 – 2008 (see Table A 1.4) also trended to increase on average by 0.84 % per year. As a result of financial crisis of 2009 the share of industry in GDP drastically decreased from 43.55% in 2008 to 35.18%, but in 2010 – 2011 there was observed its growth on average 1.86 % per year. By the results for 2003 – 2011 the share of industry in GDP was decreasing on average by 1.23% per year.

Taking into account the aforementioned retrospective trends there are two possible scenarios (presented in table 2.1) for approximation of the GDP structure indicators in Armenia to the world trends as the country's economy developed.

**Table 2.1 Formulae for calculation of GDP structure**

Scenario 1:	Formulae for calculation of GDP structure	Note
Moderate rates of decline in the share of agriculture and growth of the share of services	$S_{agr.} = 3240 * b^{-0.7}$ (2.1.a)	Shown in figures 2.1-2.3 by black line
	$S_{service.} = 9.2 * \ln(b) - 24.3$ (2.1.b)	
	$S_{ind.} = 100 - S_{agr.} - S_{service}$ (2.1.c)	
Scenario 2:	Formulae for calculation of GDP structure	Note
Low rate of decline in the share of agriculture while the growth rate of the share of service is high	$S_{agr.} = 1580.5 * b^{-0.6}$ (2.2.a)	Shown in figures 2.1-2.3 by red line
	$S_{service.} = 12.8 * \ln(b) - 50.4$ (2.2.b)	
	$S_{ind.} = 100 - S_{agr.} - S_{service}$ (2.2.c)	

The main statistical data on retrospective electricity consumption by sectors of Armenia's economy were obtained from the web page of the RoA Public Services Regulatory Commission [9] as well as data given in Appendix B provided by CJSC “Electric Networks of Armenia”.

Data given in Appendix B are processed in compliance with the standards for energy balances of International Energy Agency. In particular:

- Other consumers per expert estimations agreed upon by specialists of Tt are attributed to the following types of consumers, in conformity with the proportions mentioned below.



**Table 2.2 Other consumers**

Nº	Other consumers include	Portion
1	Medical Institutions	5%
2	Trade/commercial facilities ( <i>shops, hotels, service and etc.</i> )	40%
3	Small and Medium Business ( <i>basically industrial such as bakery, food industry, stone-working and etc.</i> )	35%
4	Non Specified	20%
<b>Total</b>		<b>100%</b>

- State-financed, medical and commercial organizations, as well as potable water supply are integrated in service sector,
- Irrigation is attributed to the agriculture sector.

So, data from Appendix B are presented in the form of Table 2.3:

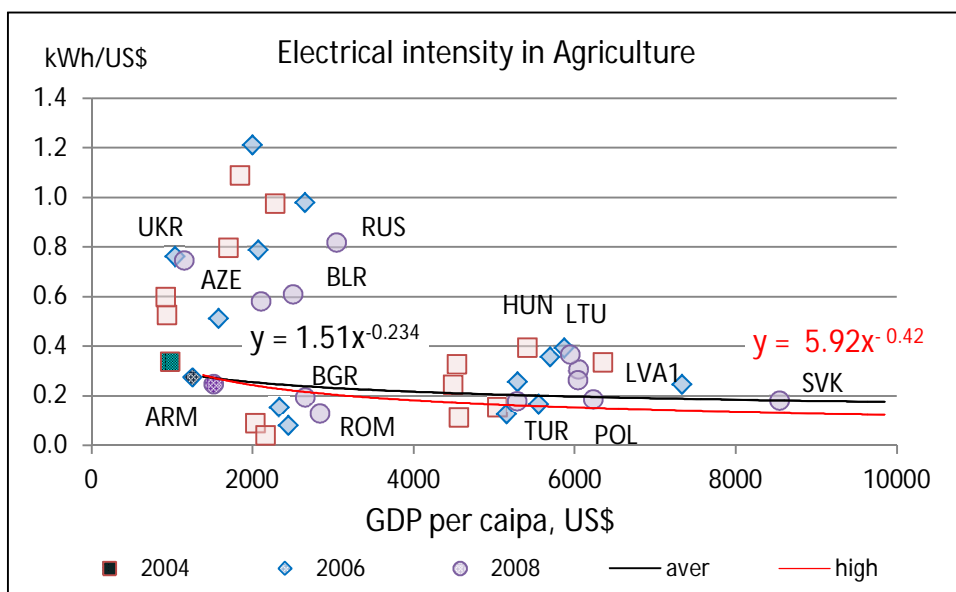
**Table 2.3 Consumption of electricity by consumer categories, mln kWh**

Category	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Yerevan</b>									
Population	747.80	824.66	849.45	849.60	861.09	815.23	759.11	767.50	855.29
Industry	419.92	577.29	577.18	550.44	663.89	642.59	546.98	540.39	534.27
Transport	42.26	48.88	32.07	32.20	32.90	32.32	31.56	31.70	33.05
Agriculture	8.67	152.88	5.52	2.86	2.09	2.05	1.57	1.62	1.53
Service	441.12	459.38	488.54	489.82	495.92	520.98	485.00	487.30	492.72
Non Specified	81.82	100.30	128.29	130.75	131.42	144.63	134.63	145.66	157.20

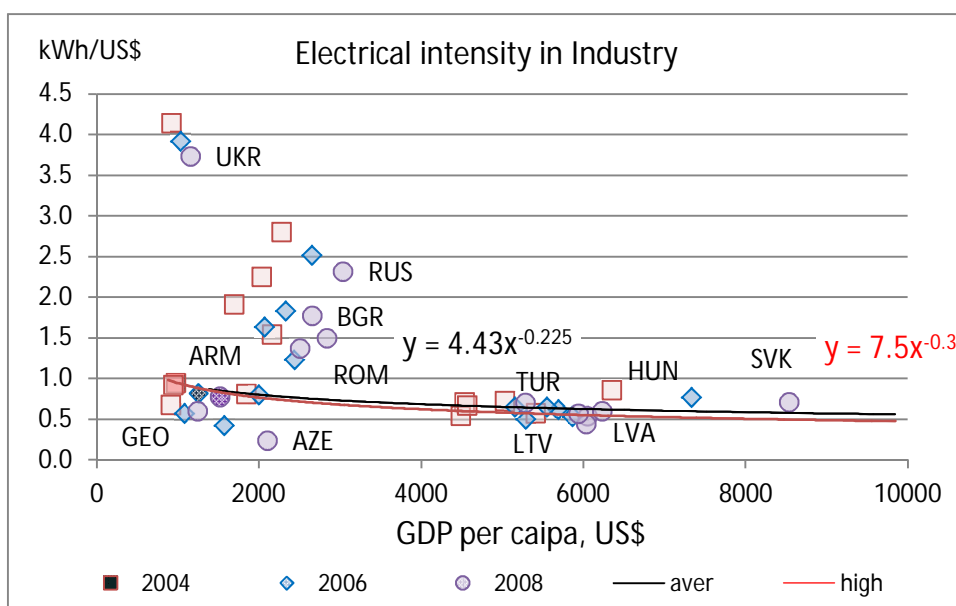
Category	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Regions</b>									
Population	597.2	612.2	648.7	681.3	724.2	794.2	794.5	843.9	952.8
Industry	631.4	633.8	836.2	920.9	988.5	1 011.4	919.7	1 003.8	1 125.9
Transport	77.3	70.0	81.1	82.9	90.1	87.7	87.4	86.9	86.6
Agriculture	214.2	107.8	223.1	224.0	178.5	220.7	122.8	123.9	119.5
Service	327.4	333.3	407.7	446.6	474.1	500.1	477.9	496.3	588.0
Non Specified	64.8	71.1	96.6	116.2	121.5	131.1	126.9	138.4	172.8

The values of electrical intensity by economic sectors of countries are determined according to the data from Appendix A. Figures 2.4 – 2.6 present diagrams for dependence of electrical intensity in economic sectors on the level of economic development of various countries, which is characterized by GDP per capita.

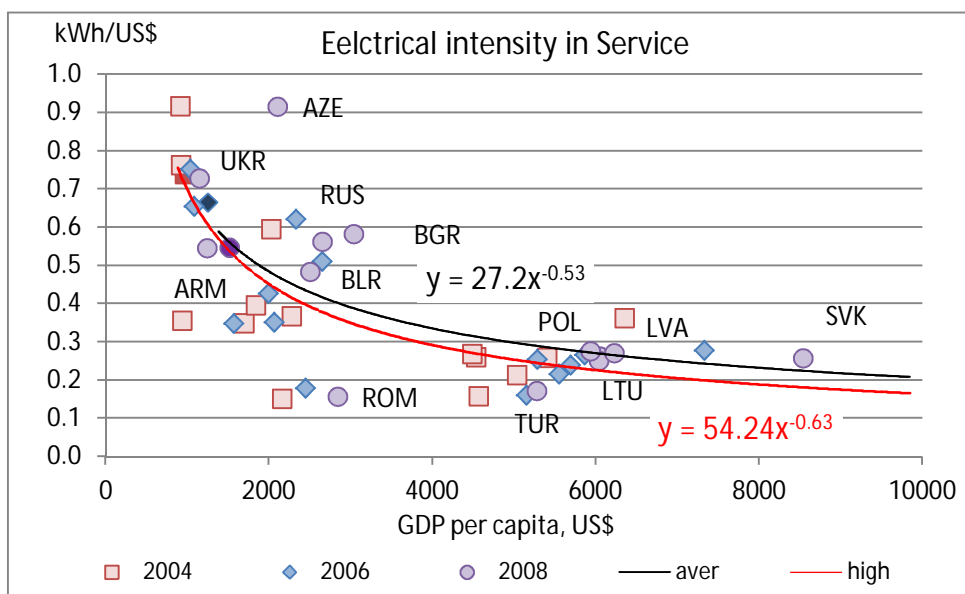
**Figure 2.4. Electrical intensity in agriculture of various countries**



**Figure 2.5. Electrical intensity in industry of various countries**



**Figure 2.6. Electrical intensity in service of various countries**



Statistical analysis of data shows that the correlation between the electric intensity in economic sectors and GDP per capita is low. Nevertheless, the presented figures show that the electric intensity in sectors trends to decline as the economic develops. The main reasons for such decline are implementation of a policy of energy conservation and use of more efficient equipment in the field of electricity consumption.

Similar trends are also typical for retrospective indicators of electrical intensity by economic sectors of Armenia. Electrical intensity in agriculture of Armenia during 2003 – 2011 reduced on average by 9.28% per year. In particular, if in 2003 – 2006 it was on average 0.31 kWh/US\$ then in the following four years - 2007-2010 it was 0.19 kWh/US\$. Electrical intensity in industry in 2003-2008 was declining on average by 2.48% per year. In 2009 the electrical intensity in industry drastically increased from 0.77 kWh/US\$ in 2008 to 0.97 kWh/US\$ due to general decline in economic development conditioned by financial crisis. In 2011 there was a decline in electrical intensity of industry by 0.62% as compared to 2010. Electric intensity in service sector was decreasing during 2003 – 2011 on average by 3.81% per year. So, if during 2003- 2011 it was on average 0.73 kWh/US\$ then during the next four years 2007-2010 it was 0.54 kWh/US\$.

To take into account the impact of energy conservation and energy efficiency on the forecasted demand for electricity, two possible sub-scenarios for change of electrical intensity in economic sectors of Armenia were considered.

**Table 2.4**      **Formulae for calculation of electrical intensity**

<u>Sub-scenario 1:</u>	Formulae for calculation of electrical intensity	Note
Base scenario with maintaining the existing decline rates for electrical intensity	$e_{agr.} = 1.51 * b^{-0.234}$ (2.3.a)	Shown in figures 2.4-2.6 by black line
	$e_{ind.} = 4.43 * b^{-0.225}$ (2.3.b)	
	$e_{service} = 27.2 * b^{-0.53}$ (2.3.c)	

<u>Sub-scenario 2:</u>	Formulae for calculation of electrical intensity	Note
Scenario with implementation of energy conservation and energy efficiency enhancement measures	$e_{agr.} = 5.92 * b^{-0.42}$ (2.4.a)	Shown in figures 2.4-2.6 by red line
	$e_{ind.} = 7.5 * b^{-0.3}$ (2.4.b)	
	$e_{service} = 54.24 * b^{-0.63}$ (2.4.c)	

## 2.2 ANALYSIS OF ELECTRICITY DEMAND CHANGE IN THE RESIDENTIAL SECTOR

Based on the data given in Appendix B and data on changes in population size in Yerevan [10], the dynamics of electricity consumption per capita in Yerevan and Armenia regions was determined. Table 2.5 presents data on changes in electricity consumption per capita in Yerevan and regions of Armenia, as well as changes in their relationships.

**Table 2.5.**      **Electricity consumption per capita in Yerevan and regions of Armenia, mln. kWh**

Residential consumption	2003	2004	2005	2006	2007	2008	2009	2010	2011
GDP per capita, US\$	883.3	975.1	109.0 <sup>1</sup>	1 253.8	1 424.2	1 520.0	1 302.5	1 326.7	1 384.1
Yerevan per person	679	748	770	770	779	736	683	687	762
Regions per person	283	290	307	322	342	374	374	396	445
Ratio (Regions/Yerevan)	0.417	0.388	0.399	0.418	0.439	0.509	0.547	0.576	0.584

Analysis of data from table 2.5 shows that electricity consumption per capita both in Yerevan and regions of Armenia increases with the growth of GDP per capita. It is necessary to mention that the growth rate of electricity consumption per capita in the regions of Armenia is significantly higher than in Yerevan. So, if in Yerevan during 2003 – 2011 the average growth rate was 1.6%, in regions it was 5.9%. This is also evidenced by the dynamics of change in the ratio of electricity consumption per capita in regions to consumption in Yerevan. Table 2.5 shows that if in 2003 it was 0.417 then in 2011 – already 0.584.

Taking into consideration the above mentioned trends in Armenia table 2.6 presents proposed models of electricity demand growth in the residential sector of Yerevan and regions of Armenia.

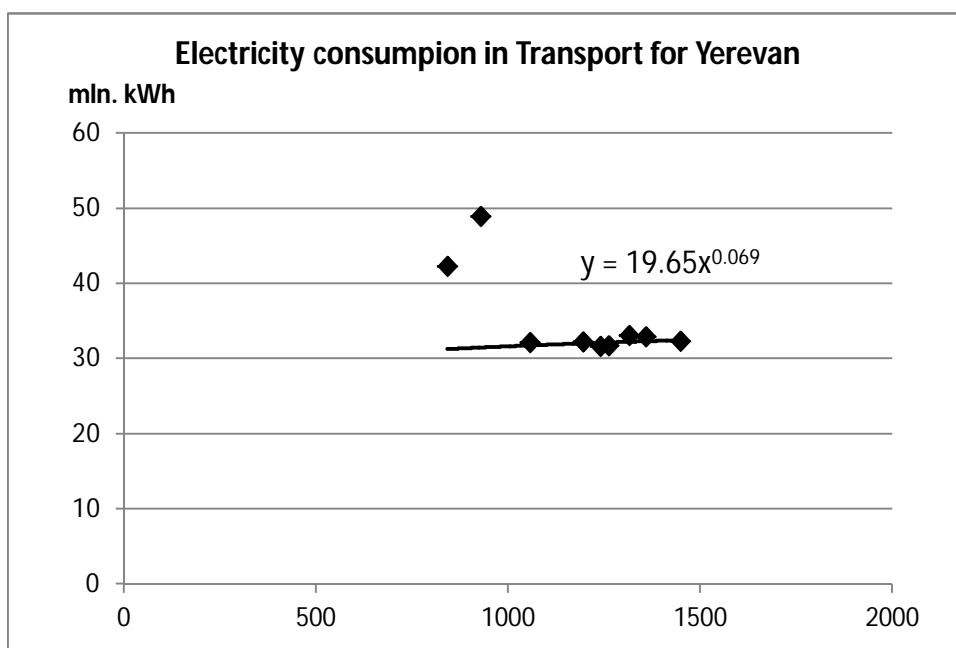
**Table 2.6. Formulae to calculate electricity demand per capita in the residential sector, kWh per capita**

Electricity demand in residential sector	Formulae for calculation	Note
Yerevan	$e_{res.Yer.} = 91.01 * \ln(b) + 88.28$ (2.5.a)	Calculations per given formulae reflect the general trend of higher demand growth in regions, while maintaining the ratio of electricity consumption in regions to Yerevan by 2040 at the level of 0.7
Regions of Armenia	$e_{res.Reg.} = 171.47 * \ln(b) - 871.94$ (2.5.b)	

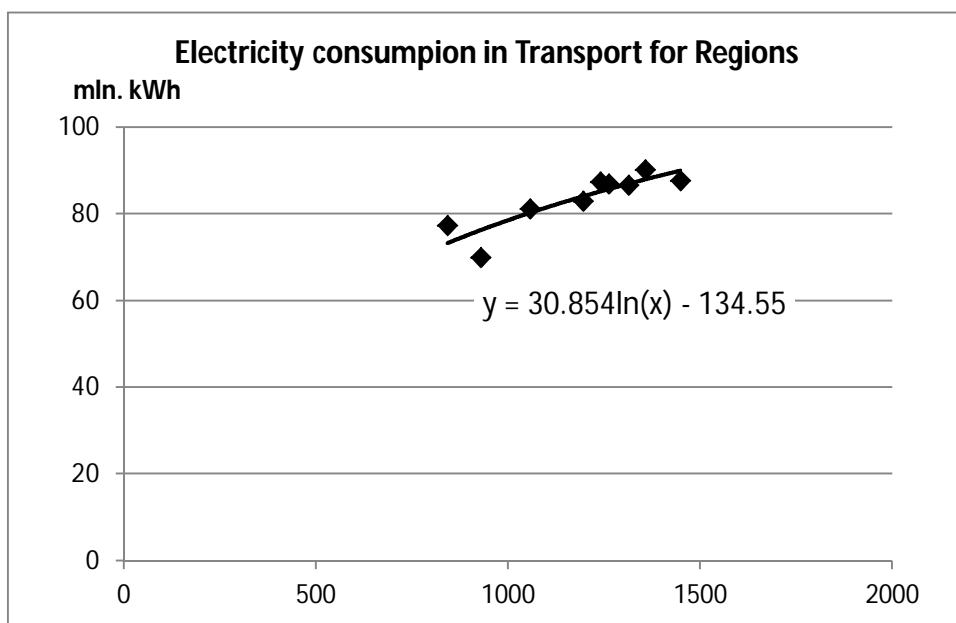
### 2.3 ANALYSIS OF ELECTRICITY DEMAND CHANGE IN TRANSPORT

Analysis of electricity consumption in transport is carried out based on the data of table 2.3. The analysis revealed that there is practically no correlation between the aggregate electricity consumption in transport and indicators of economic development (Pearson coefficient R=0.28). However, there are quite strong correlational relationships between electricity consumption in transport and GDP per capita, if Yerevan (R=0.78) and regions of Armenia (R=0.88) are considered separately. Trends in electricity consumption in transport depending on GDP per capita are presented in figures 2.7 and 2.8.

**Figure 2.7. Electricity consumption trends in transport for Yerevan**



**Figure 2.8. Electricity consumption trends in transport for regions of Armenia**



Thus, for modeling of electricity demand in transport the formulae of trends given in table 2.7 can be used.

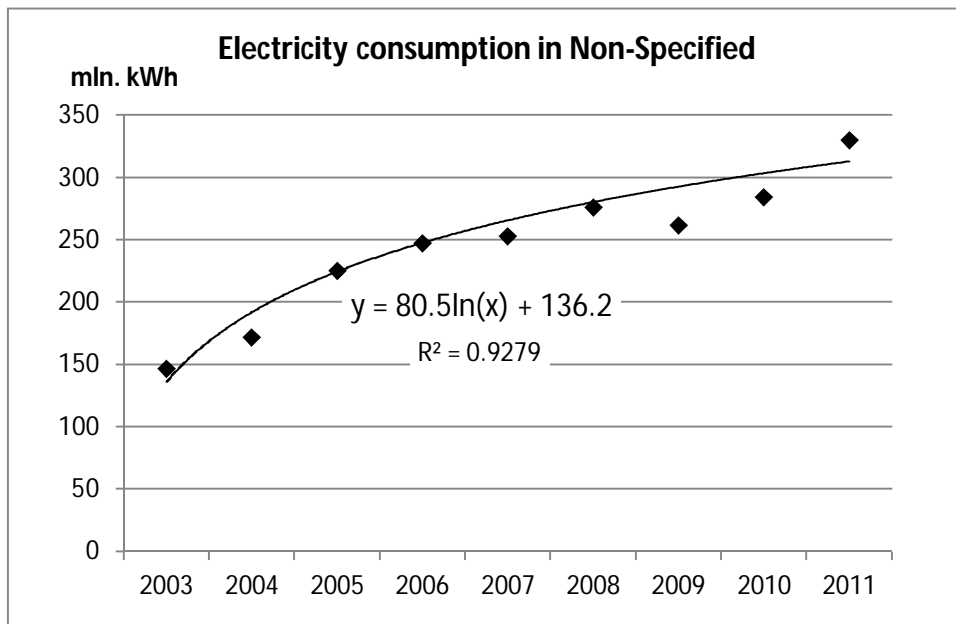
**Table 2.7. Formulae for calculation of electricity demand in transport, mln. kWh**

Electricity demand in transport	Formula for calculation
Yerevan	$E_{trans.Yer.} = 19.65 * b^{0.069}$ (2.6.a)
Regions of Armenia	$E_{trans.Reg.} = 30.85 * \ln(b) - 134.55$ (2.6.b)

#### 2.4 ANALYSIS OF CHANGE IN ELECTRICITY CONSUMPTION BY NON-SPECIFIED CONSUMERS

Analysis of electricity consumption by non-specified consumers was carried out based on the data given in Table 2.3. The analyses revealed strong correlation, with Pearson coefficient  $R= 0.96$ , between the electricity consumption by such consumers and the considered period 2003 – 2011. The trend in change of electricity consumption by non-specified consumers is presented in figure 2.9.

**Figure 2.9. Trend in electricity consumption by non-specified consumers**



Thus, for modeling of electricity demand of non-specified consumers the trend formula presented below may be used:

$$E_{N-S} = 80.5 * \ln(\text{Year} - 2002) + 136.2 \quad (2.7)$$

### 3. MODEL DEVELOPMENT AND VERIFICATION

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Based on the analysis of trends in changes of electricity demand depending on macroeconomic indicators of economic development of Armenia, presented in chapter 2, the following model for calculation of prospective electricity demand was developed:

$$E = N \cdot b \sum_j S_j \cdot e_j + (N_{Yer.} \cdot e_{res.Yer.} + N_{Reg.} \cdot e_{res.Reg.}) + (E_{trans.Yer.} + E_{trans.Reg.}) + E_{N-S} , \quad (3.1)$$

Where: E – aggregate consumption of electricity, mln. kWh;

N – population size, mln; b – GDP per capita, \$/per person; j – index of economic sector;  $S_j$  – economy structure, expressed as a share in GDP of the gross product (GP) produced by j- sector;  $e_j$  – electrical intensity of GP of j-economic sector, kWh/\$;  $N_{Yer.}$  and  $N_{Reg.}$  – population size in Yerevan and regions, mln.;  $e_{res.Yer.}$  and  $e_{res.Reg.}$  – electricity consumption per capita in Yerevan and regions, kWh per capita;  $E_{trans.Yer.}$  and  $E_{trans.Reg.}$  – electricity consumption in transport in Yerevan and regions, mln kWh;  $E_{N-S.}$  – electricity consumption by non-specified consumers, mln kWh.

Verification of the model was implemented based on running of the model using expressions 2.1, 2.3, 2.5, 2.6 and 2.7 of retrospective levels of electricity consumption for 2003 2011 and their comparative analysis against actual data. Results of calculation and comparative analysis are given in table 3.1.

As seen from table 3.1 the calculation error does not exceed 5.0% that indicates an acceptable accuracy of the model for solving of the given task.



**Table 3.1. Results of Calculation and Model Verification**

	<b>Historical Value</b>									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	
GDP (constant 2000 US\$), mln. USD	2 835.5	3 132.1	3 566.5	4 036.3	4 590.1	4 909.8	4 217.3	4 311.2	4 515.8	
Population, thousand. persons	3 210.3	3 212.2	3 215.8	3 219.2	3 222.9	3 230.1	3 237.9	3 249.5	3 262.7	
<i>on which in Yerevan</i>	1 102.0	1 101.9	1 102.9	1 103.8	1 104.9	1 107.8	1 111.3	1 116.7	1 121.9	
<i>in Regions</i>	2 108.3	2 110.3	2 112.9	2 115.4	2 118.0	2 122.3	2 126.6	2 132.8	2 140.8	
GDP per capita, US\$	883.25	975.05	1 109.03	1 253.81	1 424.19	1 520.03	1 302.46	1 326.74	1 384.09	
Value added (% of GDP)										
Agriculture	23.68	24.66	20.89	20.45	20.28	18.40	18.91	19.58	20.66	
Industry	41.99	41.12	45.30	44.66	43.91	43.55	35.81	35.96	37.14	
Service	34.33	34.22	33.81	34.89	35.81	38.05	45.28	44.46	42.20	
<b>Electricity Consumption, mln. kWh</b>	<b>3 654.0</b>	<b>3 991.6</b>	<b>4 374.4</b>	<b>4 527.5</b>	<b>4 764.2</b>	<b>4 903.0</b>	<b>4 488.0</b>	<b>4 667.4</b>	<b>5 119.7</b>	
	<b>Calculated Value of Electricity Consumption, mln. kWh</b>									
in economy	1 976	2 139	2 369	2 605	2 870	3 019	2 697	2 744	2 844	
<i>of which in Agriculture</i>	246	248	250	252	255	256	254	256	257	
<i>in Industry</i>	923	1 026	1 170	1 318	1 484	1 577	1 374	1 403	1 464	
<i>in Service</i>	807	866	949	1 035	1 131	1 185	1 068	1 086	1 123	
in residential	1 420	1 466	1 526	1 585	1 645	1 679	1 612	1 627	1 653	
<i>of which in Yerevan</i>	777.66	787.51	801.12	814.13	827.76	836.47	823.51	829.32	837.56	
<i>in Regions</i>	641.89	678.07	725.30	770.39	817.35	842.55	788.28	797.30	815.69	
in transport	106.10	109.37	113.62	117.68	121.89	124.05	118.94	119.55	120.95	
in non-specified	136.2	192.0	224.6	247.8	265.8	280.4	292.8	303.6	313.1	
<b>Electricity Demand, mln. kWh</b>	<b>3 637.7</b>	<b>3 906.3</b>	<b>4 233.4</b>	<b>4 554.9</b>	<b>4 902.8</b>	<b>5 102.1</b>	<b>4 720.2</b>	<b>4 793.9</b>	<b>4 931.4</b>	
<i>Calculating error</i>	-0.45%	-2.18%	-3.33%	0.60%	2.83%	3.90%	4.92%	2.64%	-3.82%	

#### **4. RESULTS OF SCENARIO CALCULATIONS**

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Three main scenarios of forecasted electricity demand by 2040 are considered:

- I scenario: based on the forecasted data on development of macroeconomic and energy indicators received as a result of official requests of the Ministry of Energy and Natural Resources of the RoA ,
- II scenario: based on the forecasted data of WB [11] on GDP growth rate in Armenia for 2011 -2030 on average 5.6% per year, as well as the assumption about moderate rates of decline in the share of agriculture and growth of the share of services in GDP (see table 2.1),
- III scenario: based on the forecasted data of WB [11] on GDP growth rate in Armenia for 2011 -2030 on average 5.6% per year, as well as the assumption about low rate of decline in the share of agriculture and high growth rate of the share of service in GDP (see table 2.1).

##### **I scenario**

This scenario uses the information on forecasted development of economy and electricity demand in Armenia, received in response to the official request of the Ministry of Energy and Natural Resources of the Republic of Armenia, as well as the information given in Appendix C. The volumes of electricity consumption by other consumers are accepted with consideration of the corresponding trends.

As seen from tables A.3.1.1 and A.3.1.2 of Appendix C, the data on forecasted growth rates of GDP, provided by the Ministry of Economy and the Ministry of Finance of the RoA, actually do not differ, discrepancy does not exceed 1.6%. At the same time those data differ in terms of forecasts about GDP structure.

Calculations were made for the forecasted GDP growth rates provided by the RoA Ministry of Economy and Ministry of Finance with consideration of data from table A.3.2.3 on low and from table A.3.2.4 on high scenarios of change in population size. Results of calculations are presented in tables 4.1 - 4.4.

**Table 4.1. For forecasted GDP growth rates provided by the Ministry of Economy with low scenario of change in population size**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 914.5	10 823.2	14 724.6	19 798.0	26 307.2
<i>GDP growth rate</i>	6.40%	6.50%	6.25%	6.00%	5.75%
Population, thous.. person	3 110.6	3 009.2	2 907.9	2 768.2	2 611.8
<i>of which in Yerevan</i>	1 078.5	1 070.4	1 064.8	1 060.6	1 057.1
<i>in Regions</i>	2 032.1	1 938.8	1 843.0	1 707.7	1 554.7
GDP per capita, US\$	2 544.4	3 596.7	5 063.7	7 151.9	10 072.5
<i>GDP per capita growth rate</i>	6.82%	7.22%	6.99%	7.07%	7.09%
Value added (% of GDP)					
Agriculture	16.70	14.20	13.24	11.80	10.52
Industry	42.43	43.50	41.83	43.05	44.15
Service	40.98	42.30	44.93	45.15	45.33
<b>Electricity Demand, mln.kWh</b>	<b>6 633.3</b>	<b>7 763.7</b>	<b>8 960.3</b>	<b>10 442.9</b>	<b>12 116.1</b>
in economy	4 249	5 271	6 361	7 771	9 402
<i>of which in Agriculture</i>	319	342	400	442	483
<i>in Industry</i>	2 548	3 305	4 004	5 125	6 467
<i>in Service</i>	1 382	1 624	1 958	2 203	2 451
in residential	1 850	1 947	2 030	2 079	2 099
<i>of which in Yerevan</i>	864.89	892.13	920.64	950.28	980.12
<i>in Regions</i>	985.21	1 054.38	1 109.78	1 128.77	1 118.39
in transport	165.60	157.80	163.99	175.50	186.93
in non-specified	368.9	388.6	404.4	417.7	429.0

**Table 4.2. For forecasted GDP growth rates provided by the Ministry of Economy with high scenario of change in population size**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 914.5	10 823.2	14 724.6	19 798.0	26 307.2
<i>GDP growth rate</i>	6.40%	6.50%	6.25%	6.00%	5.75%
Population, thous. person	3 469.7	3 506.8	3 543.9	3 605.4	3 659.7
<i>of which in Yerevan</i>	1 193.6	1 206.3	1 219.1	1 240.3	1 258.9
<i>in Regions</i>	2 276.1	2 300.5	2 324.8	2 365.1	2 400.7
GDP per capita, US\$	2 281.0	3 086.3	4 154.9	5 491.2	7 188.4
<i>GDP per capita growth rate</i>	5.95%	6.27%	6.03%	5.64%	5.45%
Value added (% of GDP)					
Agriculture	16.7	14.2	13.2	11.8	10.5
Industry	42.4	43.5	41.8	43.0	44.2
Service	41.0	42.3	44.9	45.2	45.3
<b>Electricity Demand, mln.kWh</b>	<b>6 943.7</b>	<b>8 262.4</b>	<b>9 694.5</b>	<b>11 566.6</b>	<b>13 753.5</b>
in economy	4 402.8	5 536.3	6 779.1	8 444.0	10 431.2
<i>of which in Agriculture</i>	326.8	354.1	418.8	470.3	523.0
<i>in Industry</i>	2 611.4	3 420.8	4 185.9	5 439.4	6 977.1
<i>in Service</i>	1 464.5	1 761.4	2 174.3	2 534.3	2 931.1
in residential	2 006.4	2 179.7	2 353.6	2 538.3	2 717.6
<i>of which in Yerevan</i>	945.3	988.6	1 032.1	1 081.5	1 128.6
<i>in Regions</i>	1 061.1	1 191.1	1 321.5	1 456.8	1 589.0
in transport	165.6	157.8	157.4	166.7	175.7
in non-specified	368.9	388.6	404.4	417.7	429.0

**Table 4.3. For forecasted GDP growth rates provided by the Ministry of Finance with low scenario of change in population size**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 936.8	10 853.7	14 766.1	19 853.7	26 381.2
<i>GDP growth rate</i>	6.50%	6.50%	6.25%	6.00%	5.75%
Population, thous.. person	3 110.6	3 009.2	2 907.9	2 768.2	2 611.8
<i>of which in Yerevan</i>	1 078.5	1 070.4	1 064.8	1 060.6	1 057.1
<i>in Regions</i>	2 032.1	1 938.8	1 843.0	1 707.7	1 554.7
GDP per capita, US\$	2 551.6	3 606.8	5 077.9	7 172.0	10 100.9
<i>GDP per capita growth rate</i>	6.92%	7.22%	6.99%	7.07%	7.09%
Value added (% of GDP)					
Agriculture	16.4	14.6	13.2	11.8	10.5
Industry	41.4	42.5	41.8	43.0	44.2
Service	42.3	42.8	44.9	45.2	45.3
<b>Electricity Demand, mln.kWh</b>	<b>6 619.9</b>	<b>7 727.8</b>	<b>8 973.8</b>	<b>10 459.1</b>	<b>12 135.6</b>
in economy	4 234.1	5 233.6	6 373.7	7 785.7	9 420.0
<i>of which in Agriculture</i>	313.5	352.0	400.8	443.0	484.3
<i>in Industry</i>	2 491.8	3 236.1	4 012.5	5 136.6	6 481.2
<i>in Service</i>	1 428.7	1 645.6	1 960.5	2 206.0	2 454.5
in residential	1 851.3	1 947.7	2 031.6	2 080.1	2 099.5
<i>on which in Yerevan</i>	865.2	892.4	920.9	950.5	980.4
<i>in Regions</i>	986.2	1 055.3	1 110.7	1 129.6	1 119.1
in transport	165.6	157.8	164.1	175.6	187.0
in non-specified	368.9	388.6	404.4	417.7	429.0

**Table 4.4. For forecasted GDP growth rates provided by the Ministry of Finance with high scenario of change in population size**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 936.8	10 853.7	14 766.1	19 853.7	26 381.2
<i>GDP growth rate</i>	6.50%	6.50%	6.25%	6.00%	5.75%
Population, thous. person	3 469.7	3 506.8	3 543.9	3 605.4	3 659.7
<i>of which in Yerevan</i>	1 193.6	1 206.3	1 219.1	1 240.3	1 258.9
<i>in Regions</i>	2 276.1	2 300.5	2 324.8	2 365.1	2 400.7
GDP per capita, US\$	2 287.5	3 095.0	4 166.6	5 506.7	7 208.7
<i>GDP per capita growth rate</i>	6.05%	6.27%	6.03%	5.64%	5.45%
Value added (% of GDP)					
Agriculture	16.4	14.6	13.2	11.8	10.5
Industry	41.4	42.5	41.8	43.0	44.2
Service	42.3	42.8	44.9	45.2	45.3
<b>Electricity Demand, mln.kWh</b>	<b>6 931.7</b>	<b>8 226.4</b>	<b>9 708.9</b>	<b>11 584.4</b>	<b>13 775.2</b>
in economy	4 389.4	5 498.9	6 792.0	8 460.2	10 451.4
<i>of which in Agriculture</i>	321.6	364.8	419.7	471.3	524.1
<i>in Industry</i>	2 553.8	3 349.4	4 195.1	5 451.3	6 992.3
<i>in Service</i>	1 513.9	1 784.6	2 177.2	2 537.6	2 935.0
in residential	2 007.8	2 181.1	2 355.0	2 539.7	2 719.0
<i>on which in Yerevan</i>	945.6	988.9	1 032.4	1 081.8	1 128.9
<i>in Regions</i>	1 062.2	1 192.2	1 322.6	1 458.0	1 590.1
in transport	165.6	157.8	157.5	166.8	175.8
in non-specified	368.9	388.6	404.4	417.7	429.0

**II scenario.**

This scenario uses the GDP growth rate forecasted by WB for 2011 – 2030, on average 5.6% per year [11]. The change in the GDP structure is accepted according to the assumption on moderate rates of decline in the share of agriculture and growth of the share of services, described by expressions (2.1). Scenario II considers two sub-scenarios: II.1 – with maintaining the existing decline rates for electrical intensity, described by expressions (2.3); II.2 –with implementation of energy conservation measures and enhancement of energy efficiency, described by expressions (2.4). The change in population size is accepted in accordance with the average rates given in table A .3.2.2.

To take into account the changes in GDP growth rates over time the following formula is used:

$$R_{GDP} = -0.0014 * \ln(\text{Year} - 2011) + 0.0589, \quad (4.1)$$

Where:  $R_{GDP}$  – GDP growth rate, %; Year – number of the next year.

The results of calculations made for sub-scenarios with maintaining the existing rates of decline in electrical intensity, as well as with implementation of energy conservation measures and enhancement of energy efficiency are presented in tables 4.5 and 4.6, respectively.

**Table 4.5. II scenario with maintaining of the existing rates of electrical intensity decline**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 431.4	9 732.4	12 716.1	16 586.0	21 604.2
GDP growth rate	5.58%	5.52%	5.48%	5.45%	5.42%
Population, thous. person	3 286.1	3 250.7	3 215.4	3 171.1	3 126.9
<i>on which in Yerevan</i>	1 130.1	1 120.7	1 108.5	1 093.9	1 078.7
<i>in Regions</i>	2 155.9	2 130.1	2 106.9	2 077.2	2 048.2
GDP per capita, US\$	2 261.5	2 993.9	3 954.7	5 230.3	6 909.2
GDP per capita growth rate	5.56%	5.75%	5.71%	5.74%	5.72%
Value added (% of GDP)					
Agriculture	14.5	11.9	9.8	8.1	6.7
Industry	38.7	38.7	38.3	37.4	36.3
Service	46.8	49.3	51.9	54.5	57.0
<b>Electricity Demand, mln.kWh</b>					
in economy	6 487.6	7 445.9	8 515.7	9 702.7	11 030.2
	4 085.4	4 903.7	5 842.2	6 908.7	8 121.9

<i>of which in Agriculture</i>	267.7	269.7	271.7	273.0	274.2
<i>in Industry</i>	2 241.3	2 756.5	3 343.9	4 007.4	4 755.0
<i>in Service</i>	1 576.4	1 877.5	2 226.5	2 628.3	3 092.7
in residential	1 896.1	2 007.1	2 113.3	2 211.3	2 304.9
<i>of which in Yerevan</i>	894.2	915.3	933.5	949.0	963.1
<i>in Regions</i>	1 001.9	1 091.8	1 179.9	1 262.3	1 341.8
in transport	137.2	146.5	155.8	165.1	174.3
in non-specified	368.9	388.6	404.4	417.7	429.0

**Table 4.6. II scenario with implementation of energy conservation measures and enhancement of energy efficiency**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 431.4	9 732.4	12 716.1	16 586.0	21 604.2
GDP growth rate	5.58%	5.52%	5.48%	5.45%	5.42%
Population, thous. person	3 286.1	3 250.7	3 215.4	3 171.1	3 126.9
<i>of which in Yerevan</i>	1 130.1	1 120.7	1 108.5	1 093.9	1 078.7
<i>in Regions</i>	2 155.9	2 130.1	2 106.9	2 077.2	2 048.2
GDP per capita, US\$	2 261.5	2 993.9	3 954.7	5 230.3	6 909.2
GDP per capita growth rate	5.56%	5.75%	5.71%	5.74%	5.72%
Value added (% of GDP)					
Agriculture	14.5	11.9	9.8	8.1	6.7
Industry	38.7	38.7	38.3	37.4	36.3
Service	46.8	49.3	51.9	54.5	57.0
<b>Electricity Demand, mln.kWh</b>	<b>6 229.8</b>	<b>7 022.7</b>	<b>7 883.0</b>	<b>8 807.6</b>	<b>9 811.7</b>
in economy	3 827.6	4 480.5	5 209.4	6 013.6	6 903.4
<i>of which in Agriculture</i>	249.5	238.6	228.3	217.7	207.6
<i>in Industry</i>	2 126.0	2 560.3	3 041.8	3 569.7	4 148.1
<i>in Service</i>	1 452.1	1 681.5	1 939.4	2 226.2	2 547.7
in residential	1 896.1	2 007.1	2 113.3	2 211.3	2 304.9
<i>on which in Yerevan</i>	894.2	915.3	933.5	949.0	963.1



<i>in Regions</i>	1 001.9	1 091.8	1 179.9	1 262.3	1 341.8
in transport	137.2	146.5	155.8	165.1	174.3
in non-specified	368.9	388.6	404.4	417.7	429.0

### **III scenario**

This scenario uses GDP growth rates forecasted by WB for 2011 – 2030 on average 5.6% per year [11]. The change in the GDP structure is accepted according to the assumption on low rates of decline in the share of agriculture while growth rate of the share of services is high, described by expressions (2.2). Scenario III considers two sub-scenarios: III.1 – with maintaining the existing decline rates for electrical intensity, described by expressions (2.3); III.2 – with implementation of energy conservation measures and enhancement of energy efficiency, described by expressions (2.4). Change in population size is accepted in accordance with the average rates given in table A .3.2.2.

To take into account the changes in GDP growth rates over time the formula (4.1) is used.

The results of calculations made for sub-scenarios with maintaining the existing rates of decline in electrical intensity, as well as with implementation of energy conservation measures and enhancement of energy efficiency are presented in tables 4.7 and 4.8, respectively.

**Table 4.7. III scenario with maintaining the existing rates of electrical intensity decline**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 431.4	9 732.4	12 716.1	16 586.0	21 604.2
<i>GDP growth rate</i>	5.58%	5.52%	5.48%	5.45%	5.42%
Population, thous. person	3 286.1	3 250.7	3 215.4	3 171.1	3 126.9
<i>of which in Yerevan</i>	1 130.1	1 120.7	1 108.5	1 093.9	1 078.7
<i>in Regions</i>	2 155.9	2 130.1	2 106.9	2 077.2	2 048.2
GDP per capita, US\$	2 261.5	2 993.9	3 954.7	5 230.3	6 909.2
<i>GDP per capita growth rate</i>	5.56%	5.75%	5.71%	5.74%	5.72%
Value added (% of GDP)					
Agriculture	15.4	13.0	11.0	9.3	7.9
Industry	36.2	35.0	33.4	31.5	29.4
Service	48.5	52.1	55.6	59.2	62.8
<b>Electricity Demand, mln.kWh</b>	<b>6 414.1</b>	<b>7 305.9</b>	<b>8 281.8</b>	<b>9 337.2</b>	<b>10 483.0</b>
in economy	4 011.9	4 763.7	5 608.2	6 543.2	7 574.7
<i>of which in Agriculture</i>	282.7	293.0	303.5	313.5	323.8
<i>in Industry</i>	2 095.3	2 489.9	2 918.8	3 373.4	3 847.7
<i>in Service</i>	1 633.9	1 980.8	2 386.0	2 856.2	3 403.2
in residential	1 896.1	2 007.1	2 113.3	2 211.3	2 304.9

<i>of which in Yerevan</i>	894.2	915.3	933.5	949.0	963.1
<i>in Regions</i>	1 001.9	1 091.8	1 179.9	1 262.3	1 341.8
in transport	137.2	146.5	155.8	165.1	174.3
in non-specified	368.9	388.6	404.4	417.7	429.0

**Table 4.8. III scenario with implementation of energy conservation measures and enhancement of energy efficiency**

	2020	2025	2030	2035	2040
GDP (constant 2000 US\$), mln. USD	7 431.4	9 732.4	12 716.1	16 586.0	21 604.2
<i>GDP growth rate</i>	5.58%	5.52%	5.48%	5.45%	5.42%
Population, thous. person	3 286.1	3 250.7	3 215.4	3 171.1	3 126.9
<i>of which in Yerevan</i>	1 130.1	1 120.7	1 108.5	1 093.9	1 078.7
<i>in Regions</i>	2 155.9	2 130.1	2 106.9	2 077.2	2 048.2
GDP per capita, US\$	2 261.5	2 993.9	3 954.7	5 230.3	6 909.2
<i>GDP per capita growth rate</i>	5.56%	5.75%	5.71%	5.74%	5.72%
Value added (% of GDP)					
Agriculture	15.4	13.0	11.0	9.3	7.9
Industry	36.2	35.0	33.4	31.5	29.4
Service	48.5	52.1	55.6	59.2	62.8
<b>Electricity Demand, mln.kWh</b>	<b>6 158.3</b>	<b>6 888.2</b>	<b>7 661.8</b>	<b>8 468.3</b>	<b>9 313.6</b>
in economy	3 756.1	4 346.0	4 988.3	5 674.3	6 405.3
<i>of which in Agriculture</i>	263.5	259.2	254.9	250.0	245.2
<i>in Industry</i>	1 987.6	2 312.7	2 655.1	3 005.0	3 356.6
<i>in Service</i>	1 505.0	1 774.1	2 078.3	2 419.3	2 803.5
in residential	1 896.1	2 007.1	2 113.3	2 211.3	2 304.9
<i>of which in Yerevan</i>	894.2	915.3	933.5		963.1
<i>in Regions</i>	1 001.9	1 091.8	1 179.9		1 341.8
in transport	137.2	146.5	155.8		174.3
in non-specified	368.9	388.6	404.4		429.0

## 5. COMPARATIVE ANALYSIS OF CALCULATION RESULTS

Table 5.1 presents the comparative analysis of forecasted electricity demands for four sub-scenarios calculated based on the data provided by the Ministry of Economy and the Ministry of Finance of the Republic of Armenia (see tables 4.1-4.4).

**Table 5.1. Comparative analysis of the calculation results of forecasted electricity demand for sub-scenarios of I scenario, mln kWh**

Scenario of changes in population size	Forecasted GDP growth rates	2020	2025	2030	2035	2040
low	Ministry of Energy	6 633.3	7 763.7	8 960.3	10 442.9	12 116.1
	Ministry of Finance	6 619.9	7 727.8	8 973.8	10 459.1	12 135.6
high	Ministry of Energy	6 943.7	8 262.4	9 694.5	11 566.6	13 753.5
	Ministry of Finance	6 931.7	8 226.4	9 708.9	11 584.4	13 775.2

Analysis of the data given in table 5.1 shows that despite some differences in forecasted rates and GDP structure, the results of calculations made based on the data provided by the Ministry of Economy and the Ministry of Finance of the Republic of Armenia are practically identical. The forecasts of changes in population size have the main influence on the forecasted electricity demand. In the scenario with high population growth compared to the scenario with low population growth the forecasted demand for electricity was higher by 4.7% in 2020 and by 13.5% in 2040.

Table 5.2 shows comparative analysis of forecasted electricity demands for two sub-scenarios of scenarios II and III calculated in accordance with the GDP growth rates of World Bank (see tables 4.5-4.8).

**Table 5.2. Comparative analysis of the calculation results of the forecasted electricity demand for sub-scenarios II and III, mln kWh**

Changes in the structure of GDP	Forecasted rates of decline in electrical intensity	2020	2025	2030	2035	2040
moderate rates of decline in the share of agriculture and growth of the share of service	with maintaining the existing decline rates	6 487.6	7 445.9	8 515.7	9 702.7	11 030.2
	with enhancement of energy efficiency	6 229.8	7 022.7	7 883.0	8 807.6	9 811.7
low rate of decline in the share of agriculture and high growth rate of the share of service	with maintaining the existing decline rates	6 414.1	7 305.9	8 281.8	9 337.2	10 483.0
	with enhancement of energy efficiency	6 158.3	6 888.2	7 661.8	8 468.3	9 313.6

Analysis of the data given in table 5.2 shows that the differences in forecasted structures of GDP have almost no effect on the results of calculations. In II scenario the forecasted demand for electricity was lower by about 1.5% in 2020 and about 5% in 2040 compared to both sub-scenarios of III scenario. The assumptions about decline in electric intensity in the sectors of economy have greater effect on the forecasted demand for electricity. In sub-scenario with implementation of energy conservation measures and enhancement of energy efficiency, the electricity demand was lower by about 4% in 2020 and by about 11% in 2040 compared to sub-scenario with maintaining the existing rates of decline in electrical intensity.

Finally, the analysis of data presented in tables 5.1 and 5.2 shows that forecasts of electricity consumption calculated based on data provided by the Ministry of Economy and the Ministry of Finance of the Republic of Armenia are higher than the forecasts calculated according to the WB data. On average this increase is negligible for 2020 and is 5%, but for 2040 it is about 17%.

## 6. FORECAST OF DEMAND FOR ELECTRIC CAPACITY IN THE POWER SECTOR OF ARMENIA

The data of Automatic System for Commercial Metering of Power Consumption for 2008 – 2011 were used as initial data for assessment of the demand for electric capacity in the power sector of Armenia. Load duration curves developed based on these data are presented in Appendix D. These data do not include own needs of power plants and export/import of electricity.

Table 6.1 present data on maximal, minimal and average capacities for 2008 -2011 by months.

**Table 6.1. Average, minimum and maximum capacities of the Armenia power sector, MW**

Month	1	2	3	4	5	6	7	8	9	10	11	12
2008												
$P_{aver}$	838	772	607	564	560	588	623	618	590	578	631	719
$P_{min}$	494	503	346	354	362	389	391	376	352	312	364	426
$P_{max}$	1173	1055	917	786	757	777	807	829	850	1001	899	1107
2009												
$P_{aver}$	735	642	610	538	504	519	555	542	530	552	638	710
$P_{min}$	467	393	388	328	326	329	350	348	317	302	363	441
$P_{max}$	1026	915	964	770	713	712	738	770	771	936	947	1038
2010												
$P_{aver}$	683	684	616	548	520	569	603	599	565	557	642	702
$P_{min}$	472	423	354	338	321	348	398	399	347	329	330	416
$P_{max}$	1014	977	1029	774	908	759	780	815	785	795	1075	1090
2011												
$P_{aver}$	723	746	660	618	576	602	644	633	579	602	769	850
$P_{min}$	413	467	395	378	369	385	421	404	352	325	441	373
$P_{max}$	1034	1044	960	894	796	821	843	851	835	1171	1107	1455

The following relative indicators are used to characterize the shape of load curves:

- irregularity coefficient

$$\alpha = \frac{P_{min}}{P_{max}}, \quad (6.1)$$

- load factor

$$\beta = \frac{P_{aver}}{P_{max}}, \quad (6.2)$$

- load factor of the variable part of a load curve

$$\delta = \frac{(P_{aver} - P_{min})}{(P_{max} - P_{min})}. \quad (6.3)$$

Values of coefficients of the shape of load curves for 2008-2011 are presented in table 6.2.

**Table 6.2. Values of coefficients of the shape of load curves of the Armenian Power System**

Month	1	2	3	4	5	6	7	8	9	10	11	12	Yearly
2008													
$\beta$	0.71	0.73	0.66	0.72	0.74	0.76	0.77	0.75	0.69	0.58	0.70	0.65	0.55
$\alpha$	0.42	0.48	0.38	0.45	0.48	0.50	0.48	0.45	0.41	0.31	0.40	0.38	0.27
$\delta$	0.51	0.49	0.46	0.49	0.50	0.51	0.56	0.53	0.48	0.39	0.50	0.43	0.38
2009													
$\beta$	0.72	0.70	0.63	0.70	0.71	0.73	0.75	0.70	0.69	0.59	0.67	0.68	0.57
$\alpha$	0.46	0.43	0.40	0.43	0.46	0.46	0.47	0.45	0.41	0.32	0.38	0.42	0.29
$\delta$	0.48	0.48	0.39	0.48	0.46	0.50	0.53	0.46	0.47	0.39	0.47	0.45	0.39
2010													
$\beta$	0.67	0.70	0.60	0.71	0.57	0.75	0.77	0.73	0.72	0.70	0.60	0.64	0.56
$\alpha$	0.47	0.43	0.34	0.44	0.35	0.46	0.51	0.49	0.44	0.41	0.31	0.38	0.29
$\delta$	0.39	0.47	0.39	0.48	0.34	0.54	0.54	0.48	0.50	0.49	0.42	0.42	0.37
2011													
$\beta$	0.70	0.71	0.69	0.69	0.72	0.73	0.76	0.74	0.69	0.51	0.69	0.58	0.46
$\alpha$	0.40	0.45	0.41	0.42	0.46	0.47	0.50	0.47	0.42	0.28	0.40	0.26	0.22
$\delta$	0.50	0.48	0.47	0.47	0.48	0.50	0.53	0.51	0.47	0.33	0.49	0.44	0.30
Average for 2008-2011													
$\beta$	0.70	0.71	0.65	0.70	0.69	0.74	0.77	0.73	0.70	0.60	0.67	0.64	0.53
$\alpha$	0.44	0.45	0.38	0.43	0.44	0.47	0.49	0.47	0.42	0.33	0.37	0.36	0.27
$\delta$	0.47	0.48	0.42	0.48	0.45	0.51	0.54	0.50	0.48	0.40	0.47	0.44	0.36

Information presented in table 6.2 indicates relative stability of coefficients of load curve shape by months. At the same time annual indicators of coefficients are characterized by significant scattering. This is due to reduction of electricity consumption in 2009, as well as a jump of absolute peak of capacity in January of 2011. For further analysis the average value of load factor  $\beta = 0.53$  is accepted as a base.

To account for losses in the power system of Armenia, the uniform coefficient  $k_{loss} = 0.1$  for the entire considered period is accepted, i.e. 10% of electricity entered into the power system. Then the demand for maximum capacity, without own needs of power plants, can be determined according to the formula:

$$P_{max} = \frac{P_{aver}}{\beta} = \frac{E_{net-gen}}{T_{year} \beta} = \frac{E}{T_{year} \beta (1 - k_{loss})}, \quad (6.4)$$

Where:  $E_{net-gen}$  – net electricity delivered to the power system from bus bars of power plants;  $E$  – value of electricity demand, calculated by formula (3.1).

Load factors for scenarios considered in chapter 4 are accepted equal:

- For scenarios I and II the value is  $\beta = 0.53$  in 2012 and it gradually increase up to  $\beta = 0.6$  by 2040, since these scenarios assume a high share of industry in GDP that leads to compaction of the load curve.
- For scenario III with the value of  $\beta = 0.53$  in 2012 and its gradual increase up to  $\beta = 0.55$  by 2040, since that scenario assumes a high share of services in GDP which is characterized by an uneven schedule of power consumption.

The calculation results of demand for electric capacity in the power system of Armenia w/o own needs of power plants and export/import are presented in tables 6.3 and 6.4.

**Table 6.3. Comparative analysis of calculation results of forecasted demand for electric capacity for sub-scenarios of I scenario, MW**

Scenario of changes in population size	Forecasted growth rated of GDP	2020	2025	2030	2035	2040
low	Ministry of Economy	1 530	1 751	1 977	2 255	2 561
	Ministry of Finance	1 527	1 743	1 980	2 258	2 565
high	Ministry of Economy	1 601	1 863	2 139	2 497	2 907
	Ministry of Finance	1 599	1 855	2 142	2 501	2 912

Analysis of data presented in table 6.3 shows that in I scenario the forecasted demand for electric capacity is mainly affected by forecasts about changes in population size. In the scenario of high population growth compared to the scenario with low population growth the forecasted demand for capacity was higher by 4.7% in 2020 and by 13.5% in 2040.

**Table 6.4. Comparative analysis of calculation results of forecasted demand for electric capacity for sub-scenarios of scenarios I and II, MW**

Changes in the structure of GDP	Forecasted rates of decline in electrical intensity	2020	2025	2030	2035	2040
moderate rates of decline in the share of agriculture and growth of the share of service	with maintaining the existing decline rates	1 496	1 679	1 878	2 095	2 332
	with enhancement of energy efficiency	1 437	1 584	1 739	1 902	2 074
low rate of decline in the share of agriculture and high growth rate of the share of service	with maintaining the existing decline rates	1 519	1 718	1 935	2 167	2 418
	with enhancement of energy efficiency	1 458	1 620	1 790	1 966	2 148

Analysis of data presented in table 6.4 shows that the difference in forecasted structures of GDP has almost no effect on the results of calculations. In II scenario the forecasted

demand for capacity was lower by about 1.5% in 2020 and about 3.7% in 2040 compared to both sub-scenarios of III scenario. The assumptions about decline in electric intensity in the economic sectors have greater effect on the forecasted demand for capacity. In sub-scenario with implementation of energy conservation measures and enhancement of energy efficiency, the demand for capacity was lower by about 4% in 2020 and by about 11% in 2040 compared to sub-scenario with maintaining the existing rates of decline in electrical intensity.

Finally, the analysis of data presented in tables 6.3 and 6.4 shows that forecasts of demand for capacity calculated based on data provided by the Ministry of Economy and the Ministry of Finance of the Republic of Armenia are higher than the forecasts calculated according to the WB data. On average this increase is negligible for 2020 and is 5.6%, but for 2040 it is about 18%.

Calculation of irregular maximum capacity that takes into account the random nature of capacity deviation is made according to the following formula:

$$P_{max}^{nonreg} = 0.01 * P_{max} + 1.24 * \sqrt{P_{max}} . \quad (6.5)$$

The results of the irregular maximum calculation for the considered scenarios are given in tables 6.5 and 6.6.

**Table 6.5. The results of calculation of irregular maximum capacity for I scenario, MW**

Scenario of changes in population size	Forecasted GDP growth rates	2020	2025	2030	2035	2040
low	Ministry of Economy	64	69	75	81	88
	Ministry of Finance	64	69	75	82	88
high	Ministry of Economy	66	72	79	87	96
	Ministry of Finance	66	72	79	87	96



**Table 6.6. The results of calculation of irregular maximum capacity for II and III scenarios, MW**

Changes in the structure of GDP	Forecasted rates of decline in electrical intensity	2020	2025	2030	2035	2040
moderate rates of decline in the share of agriculture and growth of the share of service	with maintaining the existing rates	63	68	73	78	83
	with enhancement of energy efficiency	61	65	69	73	77
low rate of decline in the share of agriculture and high growth rate of the share of service	with maintaining the existing rates	64	69	74	79	85
	with enhancement of energy efficiency	62	66	70	75	79

The value of the forecasted minimum capacity can be calculated with consideration of the expression (6.3) at the average value of  $\delta = 0.35$  from table 6.2. The calculation results are given in tables 6.7 and 6.8.

**Table 6.7. The results of minimum capacity calculation for sub-scenarios of I scenario, MW**

Scenario of changes in population size	Forecasted GDP growth rates	2020	2025	2030	2035	2040
low	Ministry of Economy	471	572	684	824	985
	Ministry of Finance	470	570	685	825	987
high	Ministry of Economy	493	609	740	912	1 118
	Ministry of Finance	492	606	741	914	1 120

**Table 6.8. The results of calculation of minimum capacity for sub-scenarios of the II and III scenarios, MW**

Changes in the structure of GDP	Forecasted rates of decline in electrical intensity	2020	2025	2030	2035	2040
moderate rates of decline in the share of agriculture and growth of the share of service	with maintaining the existing rates	460	549	650	765	897
	with enhancement of energy efficiency	442	518	602	695	798
low rate of decline in the share of agriculture and high growth rate of the share of service	with maintaining the existing rates	434	500	574	655	744
	with enhancement of energy efficiency	417	472	531	594	661

Note that the data on forecasted maximum and minimum demand for electric capacity given in tables 6.3 – 6.8 characterize the end-use load curves, i. e. do not include losses in the transmission and distribution networks, own needs of power plants and export/import of electricity.

## 7. EXPORT-IMPORT POTENTIAL OF THE POWER SYSTEM OF ARMENIA

### 7.1 ARMENIA- GEORGIA

As of today the export – import potential of the power system of Armenia in the part of trade with Georgia is limited by the capacity of the existing 220 and 110 kV lines. According to the official data presented on the web page of the Public Services Regulatory Commission of the RoA [9], the volumes of export/import between Armenia and Georgia were:

	mln. kWh								
	2003	2004	2005	2006	2007	2008	2009	2010	2011
Import	0.0	0.0	0.0	0.0	0.0	0.0	19.8	89.4	117.5
Export	212.4	474.5	656.2	185.7	0.0	0.0	0.0	0.0	0.0

Export-import potential of the power system of Armenia in terms of expansion of the trade with Georgia was estimated within the framework of studies carried out by Tt under the USAID project “Assistance to Energy Sector to Strengthen Energy Security and Regional Integration” and reflected in the report “Economic Efficiency of the Armenian Power System Integration and Analysis of Impacts of New Renewable Development in Armenia”, Yerevan 2012.

The report presents results of options for calculating the export-import possibilities of the Armenia power system for 2020 without new renewables, with small new HPPs, as well as with new small HPPs and Loriberd and Shnokh HPPs. Table 7.1 presents summarized data on calculation results.

**Table 7.1. Summary data on assessment of the export-import potential of the Armenian Power System with Georgia for 2020.**

Scenario	Sub-scenario	mln. kWh	
		export	import
With the existing ANPP	Without new RES and with shifting of the planned outage of the ANPP to the spring period	<b>170.5</b>	<b>493.3</b>
	With new SHPPs and with shifting of the planned outage of the ANPP to the spring period	<b>424.2</b>	<b>406.9</b>
	With new SHPPs +Loriberd and Shnokh HPPs and with shifting of the planned outage of the ANPP to the spring period	<b>404.7</b>	<b>338.9</b>
With ANPP decommissioning	Without new RES	<b>0.0</b>	<b>862.2</b>
	With new RES	<b>1.1</b>	<b>533.4</b>
	With new RES+Loriberd and Shnokh HPPs	<b>45.7</b>	<b>288.7</b>

With the purpose to increase the export-import potential of the Armenian and Georgian power systems, currently the KfW has ordered a feasibility study of the construction of 400 kV Armenia-Georgia transmission line.

## 7.2 ARMENIA-IRAN

Currently the export-import of the power system of Armenian in terms of trading with Iran is limited by the transfer capability of the existing two-circuit line of 220 kV. According to the official data provided on the web-page of the Public Services Regulatory Commission [9], the export-import exchange between Armenia and Iran were as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Import	262.7	215.0	319.9	351.6	408.7	337.8	245.9	156.7	71.4
Export	275.1	445.8	389.0	422.5	313.3	359.6	336.0	1061.2	1382.9

mln. kWh

Currently, Armenia-Iran 400 kV two-circuit line with up to 1000 MW transfer capability is being under construction. According to the achieved agreements with the Iranian side on realization of the scheme “electricity in exchange for natural gas”, as well as considering the transfer capabilities of the Iran-Armenia gas pipeline and 400 kV transmission line under construction, it is supposed to increase the export to Iran over the mentioned line up to 6.9 billion/kWh/year.

## 7.3 ARMENIA-TURKEY

In spite of availability of 220 kV Gyumri (Armenia) – Kars (Turkey) transmission line there is no power flow over this line. Nevertheless, in the studies under the USAID assistance on development of transmission networks of the Black Sea region [12] they are considering possibilities of realization in the medium-term perspective of up to 200 MW power flows between Armenia and Turkey over the mentioned line.

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**APPENDIX A. MACROECONOMIC INDICATORS OF DEVELOPMENT FOR VARIOUS COUNTRIES**

Source: <http://databank.worldbank.org/ddp/home.do?Step=3&id=4>

Table A.1.1

*Population, mln. person*

Country Name	2003	2004	2005	2006	2007	2008	2009	2010	2011
Armenia	3.06	3.06	3.07	3.07	3.07	3.08	3.08	3.09	3.10
Azerbaijan	8.23	8.31	8.39	8.48	8.58	8.76	8.95	9.05	9.17
Belarus	9.87	9.82	9.78	9.73	9.70	9.60	9.51	9.49	9.47
Bulgaria	7.82	7.78	7.74	7.70	7.66	7.62	7.59	7.53	7.48
Georgia	4.33	4.32	4.36	4.40	4.39	4.38	4.41	4.45	4.49
Iran, Islamic Rep.	68.06	68.89	69.73	70.58	71.44	72.29	73.14	73.97	74.80
Latvia	2.33	2.31	2.30	2.29	2.28	2.27	2.25	2.24	2.22
Lithuania	3.45	3.44	3.41	3.39	3.38	3.36	3.34	3.29	3.20
Romania	21.74	21.68	21.63	21.59	21.55	21.51	21.48	21.44	21.39
Russian Federation	144.60	143.85	143.15	142.50	142.10	141.95	141.91	141.75	141.93
Ukraine	47.81	47.45	47.11	46.79	46.51	46.26	46.05	45.87	45.71
Hungary	10.13	10.11	10.09	10.07	10.06	10.04	10.02	10.00	9.97
Poland	38.20	38.18	38.17	38.14	38.12	38.13	38.15	38.18	38.22
Slovak Republic	5.38	5.38	5.39	5.39	5.40	5.41	5.42	5.43	5.44
Turkey	66.34	67.24	68.14	69.06	69.99	70.92	71.85	72.75	73.64
Greece	11.02	11.06	11.10	11.15	11.19	11.24	11.28	11.32	11.30
Spain	42.00	42.69	43.40	44.12	44.88	45.56	45.91	46.07	46.24
Italy	57.60	58.18	58.61	58.94	59.38	59.83	60.19	60.48	60.77
France	62.24	62.70	63.18	63.62	64.01	64.37	64.72	65.08	65.44
Germany	82.53	82.52	82.47	82.38	82.27	82.11	81.90	81.78	81.73
United Kingdom	59.57	59.87	60.22	60.60	60.99	61.39	61.81	62.23	62.64
Belgium	10.38	10.42	10.48	10.55	10.63	10.71	10.80	10.90	11.01
United States	290.11	292.81	295.52	298.38	301.23	304.09	306.77	309.35	311.59

Table A.1.2

*GDP, billion US\$ (constant 2000 US\$)*

Country Name	2003	2004	2005	2006	2007	2008	2009	2010	2011
Armenia	2.7	3.0	3.4	3.8	4.4	4.7	4.0	4.1	4.3
Azerbaijan	7.1	7.9	9.9	13.4	16.7	18.5	20.2	21.2	21.4
Belarus	15.0	16.7	18.3	20.1	21.9	24.1	24.1	26.0	27.4
Bulgaria	14.8	15.8	16.8	18.0	19.1	20.3	19.2	19.2	19.6
Georgia	3.8	4.0	4.4	4.8	5.4	5.5	5.3	5.6	6.0
Iran, Islamic Rep.	120.9	127.1	133.0	140.8	151.8	155.3	158.1	0.0	0.0
Latvia	9.7	10.5	11.6	13.0	14.3	13.7	11.3	11.2	11.8
Lithuania	14.4	15.4	16.6	17.9	19.7	20.3	17.3	17.5	18.6
Romania	43.3	46.9	48.9	52.8	55.9	61.2	56.0	56.5	56.3
Russian Federation	306.7	328.7	349.7	378.2	410.5	432.0	398.2	415.3	433.2
Ukraine	39.3	44.0	45.2	48.5	52.4	53.6	45.6	47.5	50.0
Hungary	52.2	54.7	56.9	59.1	59.2	59.7	55.6	56.3	57.3
Poland	182.6	192.4	199.4	211.8	226.1	237.7	241.6	251.0	262.0
Slovak Republic	32.6	34.2	36.5	39.5	43.7	46.2	43.9	45.8	47.3
Turkey	280.9	307.2	333.0	356.0	372.6	375.1	357.0	389.7	422.7
Greece	142.1	148.3	151.7	160.1	164.9	164.6	159.2	153.6	143.0
Spain	637.0	657.8	681.4	709.1	733.8	740.3	712.6	712.2	717.2
Italy	1129.1	1148.7	1159.4	1184.9	1204.8	1190.9	1125.4	1145.7	1150.7
France	1375.5	1410.5	1436.3	1471.7	1505.3	1504.1	1456.8	1481.0	1506.1
Germany	1908.0	1930.1	1943.3	2015.2	2081.1	2103.7	1995.8	2069.5	2131.5
United Kingdom	1619.4	1667.2	1702.0	1746.4	1806.9	1787.0	1708.8	1744.6	1756.0
Belgium	239.7	247.5	251.8	258.7	266.2	268.8	261.3	267.1	272.3
United States	10450.1	10813.7	11146.3	11442.7	11660.9	11619.1	11209.2	11547.9	11744.2

Table A.1.3

*Agriculture, value added (% of GDP)*

Country Name	2003	2004	2005	2006	2007	2008	2009	2010	2011
Armenia	23.68	24.66	20.89	20.45	20.28	18.40	18.91	19.58	20.66
Azerbaijan	13.46	11.84	9.90	7.50	7.00	5.97	6.65	5.75	5.76
Belarus	10.20	10.33	9.77	9.75	9.34	9.78	9.43	9.22	8.13
Bulgaria	11.20	10.73	9.07	7.17	5.58	7.16	4.84	5.36	5.27
Georgia	20.55	17.92	16.69	12.82	10.70	9.39	9.36	8.41	7.23
Iran, Islamic Rep.	11.97	11.23	10.19	10.36	10.22	N/A	N/A	N/A	N/A
Latvia	4.13	4.42	3.97	3.51	3.58	3.05	3.30	4.14	N/A
Lithuania	5.00	4.66	4.82	4.30	3.94	3.72	3.36	3.51	N/A
Romania	13.03	14.33	10.14	10.51	8.78	7.14	7.16	7.14	6.97
Russian Federation	6.26	5.62	4.97	4.52	4.41	4.40	4.68	4.04	N/A
Ukraine	12.10	11.93	10.40	8.68	7.46	7.90	8.26	8.17	8.29
Hungary	4.30	4.85	4.18	4.01	4.02	4.28	3.37	3.53	N/A
Poland	4.39	5.10	4.53	4.29	4.33	3.73	3.65	3.54	N/A
Slovak Republic	4.52	4.07	3.65	3.59	4.06	4.21	3.95	3.86	N/A
Turkey	11.39	10.92	10.80	9.52	8.68	8.61	9.35	9.60	9.16
Spain	3.96	3.62	3.20	2.79	2.88	2.66	2.67	2.71	N/A
Italy	2.52	2.51	2.19	2.11	2.05	2.01	1.89	1.89	N/A
France	2.49	2.46	2.29	2.11	2.22	2.06	1.76	N/A	N/A
Germany	0.99	1.10	0.87	0.85	0.96	0.90	0.82	0.88	N/A
United Kingdom	0.97	1.00	0.67	0.66	0.69	0.79	0.72	0.72	N/A
Belgium	1.12	1.11	0.83	0.90	0.88	0.67	0.67	0.70	N/A
United States	1.20	1.35	1.21	1.04	1.13	1.22	1.10	1.18	N/A



Table A.1.4

*Industry, value added (% of GDP)*

Country Name	2003	2004	2005	2006	2007	2008	2009	2010	2011
Armenia	41.99	41.12	45.30	44.66	43.91	43.55	35.81	35.96	37.14
Azerbaijan	52.58	54.72	63.60	68.71	68.49	70.22	61.08	64.72	66.81
Belarus	38.69	40.87	41.76	42.38	42.17	44.26	42.28	43.91	40.99
Bulgaria	27.75	27.27	28.99	30.57	32.25	30.41	31.34	31.39	31.37
Georgia	25.65	26.42	26.85	24.86	24.31	21.88	21.86	23.23	18.22
Iran, Islamic Rep.	40.95	42.74	44.71	43.64	44.47	N/A	N/A	N/A	N/A
Latvia	22.32	22.26	21.58	21.91	23.25	23.04	20.65	21.81	N/A
Lithuania	31.57	33.06	32.86	32.86	32.60	31.59	26.95	28.16	N/A
Romania	34.76	34.95	34.97	37.42	35.30	25.23	25.96	26.20	25.44
Russian Federation	32.57	36.33	38.08	37.23	36.44	36.12	33.71	36.68	N/A
Ukraine	34.59	35.88	32.35	36.12	36.73	33.62	29.62	30.95	31.42
Hungary	29.71	30.55	30.01	30.17	30.19	29.54	29.97	31.03	N/A
Poland	29.56	30.76	30.71	31.11	31.64	31.54	31.74	31.63	N/A
Slovak Republic	34.95	36.54	36.47	39.03	38.47	38.71	35.25	34.94	N/A
Turkey	28.62	28.52	28.51	28.67	28.26	27.69	25.94	26.65	27.06
Spain	28.92	29.13	29.74	29.85	29.15	28.40	26.27	25.96	N/A
Italy	26.95	26.88	26.72	27.02	27.35	26.83	25.21	25.23	N/A
France	21.34	20.97	20.79	20.55	20.62	20.47	19.06	N/A	N/A
Germany	29.10	29.48	29.40	30.03	30.48	29.75	26.76	28.17	N/A
United Kingdom	23.87	23.42	23.47	23.49	23.00	22.82	21.21	21.67	N/A
Belgium	24.71	24.53	24.02	23.97	23.69	23.10	21.62	21.77	N/A
United States	21.57	22.04	22.19	22.24	21.99	21.13	19.61	20.00	N/A

Table A.1.5

*Service, value added (% of GDP)*

Country Name	2003	2004	2005	2006	2007	2008	2009	2010	2011
Armenia	34.33	34.22	33.81	34.89	35.81	38.05	45.28	44.46	42.20
Azerbaijan	33.95	33.44	26.51	23.79	24.50	23.81	32.27	29.53	27.43
Belarus	51.11	48.80	48.47	47.86	48.48	45.96	48.29	46.86	50.88
Bulgaria	61.05	62.00	61.95	62.26	62.17	62.43	63.82	63.26	63.36
Georgia	53.80	55.66	56.46	62.32	65.00	68.73	68.78	68.37	74.56
Iran, Islamic Rep.	47.08	46.04	45.10	45.99	45.31	N/A	N/A	N/A	N/A
Latvia	73.55	73.32	74.46	74.59	73.17	73.91	76.06	74.05	N/A
Lithuania	63.43	62.28	62.33	62.84	63.46	64.70	69.69	68.34	N/A
Romania	52.21	50.71	54.89	52.07	55.92	67.63	66.88	66.66	67.59
Russian Federation	61.17	58.05	56.96	58.25	59.15	59.48	61.61	59.28	N/A
Ukraine	53.31	52.20	57.26	55.20	55.81	58.48	62.13	60.88	60.29
Hungary	65.98	64.60	65.81	65.82	65.78	66.17	66.65	65.44	N/A
Poland	66.05	64.14	64.76	64.60	64.04	64.73	64.61	64.83	N/A
Slovak Republic	60.53	59.38	59.88	57.39	57.46	57.08	60.81	61.20	N/A
Turkey	59.99	60.56	60.69	61.80	63.07	63.71	64.71	63.75	63.78
Spain	67.12	67.25	67.06	67.36	67.98	68.94	71.06	71.33	N/A
Italy	70.53	70.61	71.09	70.88	70.61	71.15	72.90	72.87	N/A
France	76.17	76.57	76.92	77.34	77.17	77.47	79.17		N/A
Germany	69.91	69.41	69.73	69.12	68.56	69.35	72.42	70.96	N/A
United Kingdom	75.16	75.58	75.86	75.85	76.31	76.39	78.07	77.61	N/A
Belgium	74.17	74.37	75.15	75.12	75.43	76.23	77.71	77.54	N/A
United States	77.23	76.62	76.60	76.72	76.88	77.65	79.28	78.82	N/A

Table A .1.6

*Electricity Consumption in Agriculture, mln. kWh*

Country Name	2004	2006	2008
Armenia	255.9	232.6	221.0
Azerbaijan	488.5	511.7	639.7
Belarus	1372.3	1546.8	1430.5
Bulgaria	151.2	197.7	279.1
Georgia	N/A	N/A	N/A
Iran, Islamic Rep.	15502.8	17666.0	21189.9
Latvia	151.2	162.8	127.9
Lithuania	174.5	197.7	197.7
Romania	267.5	441.9	558.2
Russian Federation	17991.6	16770.5	15526.1
Ukraine	3140.1	3209.9	3151.7
Hungary	1046.7	930.4	930.4
Poland	1511.9	1511.9	1628.2
Slovak Republic	465.2	348.9	348.9
Turkey	3721.6	4303.1	5698.7
Greece	2791.2	2674.9	3140.1
Spain	5233.5	6047.6	6047.6
Italy	5117.2	5466.1	5582.4
France	3140.1	3256.4	3837.9
Germany	7908.4	8257.3	8722.5
United Kingdom	4186.8	4186.8	4070.5
Belgium	232.6	930.4	1046.7
United States	N/A	N/A	N/A

Table A .1.7

*Electricity Consumption in Industry, mln. kWh*

Country Name	2004	2006	2008
Armenia	907.1	1035.1	1174.6
Azerbaijan	3942.6	3884.4	2977.3
Belarus	13025.6	13921.1	14525.9
Bulgaria	9711.1	10036.7	10874.1
Georgia	709.4	674.5	709.4
Iran, Islamic Rep.	43705.5	48776.2	54358.6
Latvia	1639.8	1756.1	1686.4
Lithuania	2744.7	2930.8	2802.8
Romania	25260.4	24283.4	22992.5
Russian Federation	334153.2	353621.8	360146.2
Ukraine	65372.2	68686.8	67151.6
Hungary	9536.6	9420.3	9885.5
Poland	42449.5	42798.4	44310.3
Slovak Republic	10699.6	11862.6	12560.4
Turkey	58033.7	66407.3	72338.6
Greece	13956.0	14188.6	15467.9
Spain	101529.9	106879.7	103274.4
Italy	144212.0	147352.1	141653.4
France	136652.5	138862.2	141188.2
Germany	233879.3	229459.9	242136.6
United Kingdom	115951.1	116300.0	113625.1
Belgium	40356.1	40239.8	39076.8
United States	922491.6	916909.2	915048.4

Table A .1.8

*Electricity Consumption in Service, mln. kWh*

Country Name	2004	2006	2008
Armenia	325.6	756.0	872.3
Azerbaijan	930.4	1104.9	4024.0
Belarus	2837.7	3384.3	5338.2
Bulgaria	5826.6	6943.1	7094.3
Georgia	2023.6	1942.2	2046.9
Iran, Islamic Rep.	23132.1	27656.1	31191.7
Latvia	1988.7	2326.0	2640.0
Lithuania	2570.2	2861.0	3256.4
Romania	3582.0	4896.2	6431.4
Russian Federation	69826.5	112415.6	149375.7
Ukraine	17503.2	20154.8	22748.3
Hungary	9071.4	10350.7	10815.9
Poland	26167.5	29423.9	41286.5
Slovak Republic	7326.9	6280.2	6745.4
Turkey	29307.6	35355.2	40705.0
Greece	15816.8	17793.9	19654.7
Spain	60708.6	65825.8	78269.9
Italy	70012.6	78037.3	82805.6
France	117230.4	126650.7	108275.3
Germany	114904.4	130372.3	118742.3
United Kingdom	95017.1	97343.1	97692.0
Belgium	11978.9	17096.1	20817.7
United States	1230686.6	1300001.4	1336170.7

**APPENDIX B. INDICATORS OF ELECTRICITY CONSUMPTION IN ARMENIA FOR 2003 – 2011**

Source: "Electric Networks of Armenia" CJSC

Table A .2.1

**Electricity consumption in 2003, million kWh**

	01		02		03		04		05		06		07		08		09		10		11		12	
Consumers	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.
Population	109.1	59.7	79.7	50.5	82.0	53.9	50.5	45.7	41.7	42.6	40.2	41.9	42.9	45.6	43.8	47.2	44.1	46.1	47.3	49.8	70.3	55.8	96.3	58.3
Budget organizations	14.4	12.7	12.8	12.0	11.8	11.7	6.9	7.9	4.2	5.0	3.6	4.0	3.9	3.8	3.8	3.9	4.1	4.3	4.8	5.3	9.8	8.6	13.4	10.8
Industry	19.3	43.1	20.0	40.8	20.4	44.0	15.9	45.0	15.4	48.9	17.5	38.4	30.3	48.1	31.9	43.4	31.8	48.8	24.6	48.5	26.2	34.5	23.6	34.6
<i>on which Nairit (Chemical)</i>	3.5	0.0	4.2	0.0	2.8	0.0	1.4	0.0	1.4	0.0	3.4	0.0	15.9	0.0	17.8	0.0	18.6	0.0	11.0	0.0	2.7	0.0	5.0	0.0
<i>Mining and smelting</i>	0.0	28.6	0.0	26.7	0.0	27.5	0.0	23.6	0.0	23.2	0.0	22.5	0.0	23.6	0.0	22.4	0.0	23.2	0.0	24.8	0.0	25.3	0.0	25.5
<i>Cement plants</i>	0.0	0.8	0.0	0.7	0.0	1.4	0.0	7.5	0.0	12.4	0.0	3.5	0.0	12.7	0.0	8.0	0.0	11.4	0.0	9.0	5.3	0.6	1.2	0.2
<i>Others</i>	15.8	13.7	15.7	13.4	17.6	15.2	14.5	13.8	13.9	13.2	14.1	12.3	14.4	11.8	14.1	13.0	13.2	14.1	13.6	14.6	18.1	8.6	17.4	8.9
Transport	4.4	7.9	3.6	6.9	3.9	7.8	3.0	7.1	2.7	6.4	2.6	5.8	2.7	6.4	2.7	6.3	2.6	6.4	2.8	6.0	5.4	4.9	6.0	5.5
Irrigation	0.1	0.8	0.0	0.8	0.0	0.8	0.0	1.1	0.3	32.5	0.4	41.9	0.7	46.3	0.5	45.6	0.3	27.0	0.2	11.8	5.2	4.2	0.7	1.3
Drinking water	15.3	9.3	13.6	8.1	14.5	8.3	13.3	7.2	13.2	7.7	12.7	7.7	13.3	9.3	13.4	9.5	13.0	8.0	13.4	7.5	14.9	4.1	12.9	5.0
Others	48.1	36.1	42.2	32.1	40.8	32.4	28.8	26.4	24.6	21.2	24.5	20.5	27.8	23.1	28.3	23.8	27.4	23.6	28.5	24.9	40.1	27.7	48.0	32.3
<b>TOTAL</b>	<b>210.6</b>	<b>169.6</b>	<b>172.0</b>	<b>151.1</b>	<b>173.4</b>	<b>159.0</b>	<b>118.3</b>	<b>140.3</b>	<b>102.1</b>	<b>164.4</b>	<b>101.4</b>	<b>160.1</b>	<b>121.6</b>	<b>182.6</b>	<b>124.4</b>	<b>179.7</b>	<b>123.3</b>	<b>164.1</b>	<b>121.6</b>	<b>153.8</b>	<b>171.9</b>	<b>139.9</b>	<b>200.9</b>	<b>147.9</b>

Table A .2.2

**Electricity consumption in 2004, million kWh**

	01		02		03		04		05		06		07		08		09		10		11		12	
Consumers	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.
Population	123.4	64.9	93.7	51.2	66.0	49.3	53.2	45.4	46.1	44.7	44.0	43.4	45.4	46.5	47.4	49.1	47.5	45.2	51.5	49.8	68.8	51.7	137.5	70.9
Budget organizations	14.1	12.1	14.3	13.8	9.8	10.1	7.4	7.9	5.3	5.8	4.4	4.2	4.3	4.1	4.6	4.1	4.6	4.8	5.3	7.0	9.1	10.8	15.5	16.9
Industry	38.6	38.4	36.6	35.7	46.4	38.8	44.3	37.5	46.9	37.8	40.5	32.6	37.8	39.8	32.6	35.2	30.2	34.7	13.7	60.5	14.6	57.0	19.6	61.2
<i>on which Nairit (Chemical)</i>	20.8	0.0	17.8	0.0	18.4	0.0	17.6	0.0	20.2	0.0	19.4	0.0	9.8	0.0	5.4	0.0	3.8	0.0	3.7	0.0	3.1	0.0	5.1	0.0
<i>Mining and smelting</i>	0.0	30.1	0.0	26.9	0.0	26.3	0.0	25.0	0.0	26.0	0.0	24.3	0.0	25.8	0.0	25.1	0.0	25.7	0.0	27.6	0.0	27.9	0.0	28.4
<i>Cement plants</i>	0.9	0.2	1.3	0.4	10.4	3.7	10.1	4.1	9.7	4.3	5.3	0.5	10.7	5.8	10.2	1.5	9.5	0.9	0.0	17.4	0.0	13.3	0.0	15.2
<i>Others</i>	16.8	8.1	17.4	8.4	17.7	8.8	16.6	8.4	17.0	7.5	15.8	7.7	17.3	8.3	16.9	8.6	16.8	8.0	10.1	15.5	11.5	15.8	14.5	17.6
Transport	6.8	6.1	5.5	4.8	4.7	5.7	4.2	5.3	3.8	5.3	3.6	4.7	3.7	4.8	3.9	5.3	3.7	5.4	2.4	6.8	2.8	7.2	3.8	8.5
Irrigation	0.4	0.9	0.4	0.8	0.4	1.1	8.5	4.5	19.2	7.0	33.1	13.0	31.5	17.5	35.8	20.0	22.9	10.8	0.5	14.6	0.3	16.5	0.1	1.1
Drinking water	15.2	6.3	12.8	5.4	12.9	5.4	11.5	5.0	11.3	4.8	11.2	4.6	11.3	5.0	11.8	5.6	10.9	4.8	8.0	7.7	8.2	7.6	9.7	9.4
Others	52.9	35.8	47.9	30.2	41.0	27.3	35.9	23.6	32.3	20.8	32.2	19.4	35.3	21.4	37.0	21.7	38.1	20.6	38.0	27.4	45.9	46.6	65.0	60.9
<b>TOTAL</b>	<b>251.4</b>	<b>164.6</b>	<b>211.1</b>	<b>142.0</b>	<b>181.3</b>	<b>137.7</b>	<b>165.0</b>	<b>129.1</b>	<b>164.8</b>	<b>126.1</b>	<b>168.9</b>	<b>122.0</b>	<b>169.4</b>	<b>139.1</b>	<b>173.1</b>	<b>141.1</b>	<b>158.0</b>	<b>126.4</b>	<b>119.6</b>	<b>173.7</b>	<b>149.6</b>	<b>197.3</b>	<b>251.2</b>	<b>228.9</b>

Table A .2.3

**Electricity consumption in 2005, million kWh**

	01		02		03		04		05		06		07		08		09		10		11		12		
	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	
Consumers																									
Population	119.7	61.5	108.2	54.9	81.4	54.6	54.2	46.9	48.5	46.5	46.7	45.9	50.4	51.6	50.2	52.3	49.1	49.3	53.7	53.8	72.4	59.0	114.9	72.5	
Budget organizations	14.4	13.5	14.8	13.7	10.8	11.3	6.6	7.2	4.6	5.7	4.2	4.2	4.5	3.9	4.5	4.1	4.3	4.6	5.5	7.2	9.3	11.2	13.1	14.3	
Industry	24.8	50.4	28.7	49.5	33.3	52.9	30.0	51.3	29.4	49.4	28.4	50.0	31.0	54.4	31.8	58.5	30.3	60.2	30.8	56.4	31.9	63.7	22.3	70.5	
on which Nairit (Chemical)	13.5	0.0	16.2	0.0	20.9	0.0	19.9	0.0	19.7	0.0	18.2	0.0	20.4	0.0	21.2	0.0	19.9	0.0	19.7	0.0	19.6	0.0	8.2	0.0	
Mining and smelting	0.0	29.5	0.0	27.2	0.0	28.1	0.0	26.6	0.0	25.8	0.0	24.8	0.0	25.0	0.0	27.0	0.0	25.9	0.0	27.8	0.0	28.5	0.0	30.6	
Cement plants	0.0	7.1	0.0	7.5	0.0	9.3	0.0	11.1	0.0	10.8	0.0	11.2	0.0	14.0	0.0	16.4	0.0	18.8	0.0	12.1	0.0	17.8	0.0	17.8	
Others	11.4	13.7	12.5	14.7	12.3	15.4	10.1	13.6	9.7	12.8	10.2	14.0	10.5	15.3	10.6	15.2	10.4	15.5	11.1	16.5	12.3	17.3	14.1	22.1	
Transport	3.4	7.6	3.2	6.6	3.0	7.2	2.5	6.5	2.3	5.7	2.2	6.1	2.2	6.0	2.3	6.6	2.2	6.8	2.5	7.0	2.8	7.2	3.6	7.8	
Irrigation	0.1	0.6	0.1	0.5	0.0	0.7	0.1	4.8	0.7	25.8	1.2	43.2	1.2	49.8	1.2	48.7	0.6	29.4	0.2	10.1	0.1	8.6	0.1	0.8	
Drinking water	8.7	8.4	8.0	7.7	8.6	8.1	8.1	7.1	8.4	7.1	8.2	7.0	9.0	8.1	9.4	8.0	8.7	7.0	8.5	7.0	8.3	6.6	9.4	7.5	
Others	57.4	52.8	55.2	49.9	49.2	46.7	94.1	35.0	76.3	32.3	36.4	29.7	39.5	34.5	40.8	33.0	37.7	32.6	42.7	36.2	51.2	45.2	61.0	55.1	
<b>TOTAL</b>	<b>228.5</b>	<b>194.7</b>	<b>218.1</b>	<b>182.7</b>	<b>186.3</b>	<b>181.6</b>	<b>195.5</b>	<b>158.8</b>	<b>170.3</b>	<b>172.5</b>	<b>127.1</b>	<b>186.2</b>	<b>137.8</b>	<b>208.3</b>	<b>140.2</b>	<b>211.1</b>	<b>133.0</b>	<b>189.8</b>	<b>143.8</b>	<b>177.7</b>	<b>176.0</b>	<b>201.4</b>	<b>224.3</b>	<b>228.6</b>	



Table A .2.4

Electricity consumption in 2006, million kWh

Consumers	01		02		03		04		05		06		07		08		09		10		11		12	
	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.
Population	114.3	66.4	103.6	59.3	72.6	55.5	51.8	48.3	49.5	47.9	48.8	48.7	49.8	52.4	52.3	54.9	49.7	51.0	53.6	55.0	74.4	60.8	129.2	81.0
Budget organizations	12.9	14.1	13.6	14.1	9.8	11.5	6.0	7.8	5.0	6.3	4.8	4.7	4.6	4.5	4.9	4.7	4.7	4.8	5.5	6.6	9.7	11.1	14.8	16.6
Industry	16.1	53.9	24.6	51.3	23.6	59.9	30.1	59.4	30.5	55.7	30.9	53.6	27.5	59.6	28.1	60.4	18.5	57.4	20.1	66.4	32.7	68.4	38.8	71.5
on which Nairit (Chemical)	4.7	0.0	11.9	0.0	11.5	0.0	20.3	0.0	20.2	0.0	20.2	0.0	16.1	0.0	16.7	0.0	7.8	0.0	7.6	0.0	17.8	0.0	21.5	0.0
Mining and smelting	0.0	32.3	0.0	30.6	0.0	30.8	0.0	27.6	0.0	27.7	0.0	26.5	0.0	26.9	0.0	28.5	0.0	29.6	0.0	31.4	0.0	31.6	0.0	35.2
Cement plants	0.0	4.6	0.0	6.7	0.0	15.2	0.0	17.6	0.0	15.1	0.0	14.4	0.0	19.3	0.0	18.0	0.0	13.4	0.0	18.2	0.0	19.1	0.0	17.0
Others	11.4	16.9	12.7	14.0	12.1	13.9	9.8	14.3	10.3	12.9	10.7	12.7	11.3	13.4	11.4	13.9	10.7	14.4	12.6	16.7	14.8	17.8	17.4	19.3
Transport	3.3	6.9	3.2	6.4	3.0	6.7	2.4	6.3	2.4	6.2	2.2	6.0	2.2	6.4	2.2	7.0	2.3	6.8	2.5	7.2	2.9	7.8	3.6	9.1
Irrigation	0.1	0.6	0.1	0.5	0.1	0.5	0.1	2.9	0.2	18.5	0.6	50.3	0.5	47.1	0.6	56.7	0.4	36.2	0.1	4.3	0.0	5.4	0.0	1.0
Drinking water	8.3	7.0	7.9	6.4	8.3	6.2	7.9	5.7	8.6	5.7	8.3	6.3	8.8	6.9	8.9	7.1	8.1	6.6	7.9	6.4	7.7	6.5	8.7	7.7
Others	59.3	57.3	57.9	55.2	51.6	50.2	72.9	42.4	72.7	42.5	41.1	38.8	43.9	42.8	44.8	45.8	41.2	42.5	44.7	43.0	53.3	50.7	70.2	69.9
<b>TOTAL</b>	<b>214.3</b>	<b>206.2</b>	<b>211.1</b>	<b>193.1</b>	<b>169.0</b>	<b>190.6</b>	<b>171.2</b>	<b>172.8</b>	<b>168.8</b>	<b>182.7</b>	<b>136.8</b>	<b>208.3</b>	<b>137.2</b>	<b>219.7</b>	<b>141.8</b>	<b>236.7</b>	<b>124.9</b>	<b>205.3</b>	<b>134.4</b>	<b>188.9</b>	<b>180.7</b>	<b>210.8</b>	<b>265.4</b>	<b>256.8</b>

Table A .2.5

Electricity consumption in 2007, million kWh

	01		02		03		04		05		06		07		08		09		10		11		12		
	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	
Consumers																									
Population	128.9	72.6	94.3	60.1	77.3	60.7	62.4	54.6	51.7	50.2	48.7	49.7	51.8	54.6	52.6	56.7	52.5	54.2	55.0	57.5	74.6	66.2	111.2	87.1	
Budget organizations	15.1	16.2	14.0	14.5	11.1	13.1	8.7	10.4	5.5	6.2	4.9	4.6	5.1	4.7	5.0	4.7	5.2	5.0	5.8	6.6	10.1	11.8	13.9	16.4	
Industry	35.8	53.8	33.6	58.1	35.5	64.0	33.1	64.0	36.0	64.8	29.0	62.0	37.4	65.4	36.2	63.5	37.7	62.7	36.4	70.8	39.9	71.2	43.4	75.7	
on which Nairit (Chemical)	19.2	0.0	18.0	0.0	18.7	0.0	18.2	0.0	19.9	0.0	12.7	0.0	19.8	0.0	18.4	0.0	20.2	0.0	18.9	0.0	20.0	0.1	20.7	0.0	
Mining and smelting	0.0	35.1	0.0	33.1	0.0	35.7	0.0	31.7	0.0	28.7	0.0	27.4	0.0	29.0	0.0	30.1	0.0	30.5	0.0	33.5	0.0	33.7	0.0	36.1	
Cement plants	0.0	3.4	0.0	12.2	0.0	13.3	0.0	17.7	0.0	19.6	0.0	20.1	0.0	20.6	0.0	13.8	0.0	18.3	0.0	19.3	0.0	18.2	0.0	19.4	
Others	16.6	15.2	15.6	12.8	16.7	15.0	14.9	14.6	16.1	16.5	16.3	14.5	17.7	15.7	17.8	19.6	17.5	13.8	17.5	18.1	20.0	19.2	22.7	20.1	
Transport	3.6	8.9	3.1	7.3	3.0	7.0	2.7	6.5	2.4	6.6	2.3	7.1	2.3	7.7	2.3	8.3	2.3	7.9	2.4	6.3	2.9	7.8	3.6	8.7	
Irrigation	0.0	0.6	0.0	0.6	0.0	0.7	0.0	1.8	0.1	14.9	0.5	35.5	0.5	33.8	0.5	37.9	0.3	34.3	0.1	13.5	0.0	4.3	0.0	0.6	
Drinking water	10.1	8.5	8.3	7.0	7.7	7.4	7.4	7.0	7.6	6.8	7.5	6.7	8.2	7.3	8.1	7.4	7.6	6.9	7.6	6.9	7.6	6.7	8.0	7.8	
Others	71.4	64.1	61.1	57.1	55.7	61.2	48.5	54.7	50.8	38.5	43.7	36.9	46.6	42.1	47.9	43.6	46.4	42.0	49.8	46.2	61.1	52.3	73.8	69.0	
<b>TOTAL</b>	<b>265.1</b>	<b>224.6</b>	<b>214.4</b>	<b>204.7</b>	<b>190.4</b>	<b>214.0</b>	<b>162.8</b>	<b>199.0</b>	<b>154.1</b>	<b>188.0</b>	<b>136.6</b>	<b>202.6</b>	<b>151.9</b>	<b>215.7</b>	<b>152.6</b>	<b>222.1</b>	<b>152.0</b>	<b>212.9</b>	<b>157.1</b>	<b>207.8</b>	<b>196.3</b>	<b>220.2</b>	<b>253.9</b>	<b>265.3</b>	

Table A .2.6

**Electricity consumption in 2008, million kWh**

	01		02		03		04		05		06		07		08		09		10		11		12		
	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	
Consumers																									
Population	114.0	83.7	95.4	71.5	65.1	61.2	51.9	53.6	52.6	56.4	51.1	55.3	55.2	61.3	55.5	62.7	53.4	59.3	55.7	63.6	68.8	72.0	96.6	93.5	
Budget organizations	15.2	17.7	14.8	17.3	9.2	11.1	6.1	7.0	5.7	6.6	5.2	5.2	5.7	5.3	5.6	5.2	5.6	5.5	6.3	7.6	9.5	11.8	12.6	16.4	
Industry	35.6	63.6	35.3	56.7	39.5	66.4	34.6	66.0	30.0	68.3	38.1	65.5	40.1	65.2	30.0	63.2	33.0	66.4	32.8	73.4	19.4	64.9	21.2	62.4	
on which Nairit (Chemical)	13.6	0.0	13.9	0.0	19.8	0.0	16.0	0.0	11.1	0.0	20.6	0.0	20.4	0.0	11.4	0.0	14.6	0.0	16.5	0.0	3.6	0.0	1.8	0.0	
Mining and smelting	0.0	36.5	0.0	35.3	0.0	34.0	0.0	30.7	0.0	32.0	0.0	30.6	0.0	32.3	0.0	33.4	0.0	34.4	0.0	36.2	0.0	36.0	0.0	35.6	
Cement plants	0.0	12.4	0.0	4.3	0.0	15.0	0.0	20.9	0.0	18.3	0.0	18.4	0.0	19.2	0.0	17.5	0.0	15.4	0.0	19.4	0.0	13.6	0.0	10.2	
Others	22.0	14.8	21.4	17.1	19.6	17.4	18.6	14.4	18.9	18.0	17.5	16.4	19.8	13.7	18.6	12.3	18.3	16.5	16.2	17.8	15.8	15.3	19.4	16.5	
Transport	3.6	8.4	3.4	7.8	2.8	7.2	2.4	7.0	2.4	6.8	2.3	6.5	2.3	6.5	2.2	6.3	2.3	6.9	2.5	7.5	2.9	7.9	3.3	8.9	
Irrigation	0.0	0.5	0.0	0.4	0.0	0.8	0.1	18.3	0.1	29.1	0.4	37.2	0.5	48.5	0.5	48.0	0.2	25.6	0.0	6.8	0.0	4.7	0.0	0.7	
Drinking water	8.5	8.3	7.8	7.6	8.1	6.9	7.5	6.6	7.4	6.8	7.5	6.8	8.0	7.5	8.0	7.8	7.5	7.4	8.0	7.4	7.9	7.1	8.1	8.2	
Others	74.0	68.9	70.1	64.0	52.9	47.9	45.2	47.4	46.3	47.1	46.4	45.0	53.7	52.7	100.5	52.4	52.8	50.4	52.4	55.0	60.8	55.3	68.2	69.4	
<b>TOTAL</b>	<b>250.9</b>	<b>251.1</b>	<b>226.9</b>	<b>225.4</b>	<b>177.5</b>	<b>201.4</b>	<b>147.7</b>	<b>205.9</b>	<b>144.5</b>	<b>221.2</b>	<b>151.0</b>	<b>221.6</b>	<b>165.4</b>	<b>247.0</b>	<b>202.3</b>	<b>245.8</b>	<b>154.8</b>	<b>221.4</b>	<b>157.7</b>	<b>221.3</b>	<b>169.2</b>	<b>223.6</b>	<b>210.0</b>	<b>259.4</b>	

Table A .2.7

**Electricity consumption in 2009, million kWh**

	01		02		03		04		05		06		07		08		09		10		11		12		
	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	
Consumers																									
Population	96.1	83.2	72.5	68.6	72.5	70.1	57.4	60.5	51.8	57.2	50.1	56.7	53.4	61.8	51.2	61.8	52.2	59.9	54.8	63.7	65.6	72.3	81.5	78.9	
Budget organizations	13.9	16.8	11.0	13.8	10.3	12.9	7.9	9.9	5.7	7.0	5.2	5.5	5.8	5.3	5.2	5.3	5.6	5.9	6.2	7.2	9.1	11.0	10.7	13.3	
Industry	18.3	61.2	17.9	52.9	22.5	64.9	31.4	47.3	27.9	47.5	22.8	52.1	21.2	61.6	20.0	61.4	21.7	56.2	31.7	63.9	35.1	69.2	41.0	59.3	
on which Nairit (Chemical)	1.1	0.0	0.9	0.0	2.9	0.0	14.1	0.0	12.0	0.0	5.1	0.0	2.4	0.0	2.6	0.0	3.8	0.0	13.0	0.0	15.4	0.0	19.8	0.1	
Mining and smelting	0.0	37.1	0.0	29.2	0.0	29.8	0.0	28.1	0.0	26.8	0.0	26.6	0.0	31.4	0.0	32.2	0.0	32.1	0.0	35.0	0.0	36.4	0.0	39.6	
Cement plants	0.0	9.9	0.0	9.9	0.0	19.5	0.0	4.5	0.0	6.7	0.0	10.1	0.0	14.4	0.0	14.2	0.0	9.4	0.0	13.0	0.0	16.8	0.0	3.8	
Others	17.2	14.2	17.0	13.8	19.6	15.6	17.3	14.7	15.8	14.0	17.7	15.4	18.8	15.9	17.4	15.0	17.9	14.7	18.7	16.0	19.7	16.1	21.2	15.8	
Transport	3.4	8.1	2.9	6.9	3.0	7.7	2.5	6.7	2.4	6.3	2.3	6.3	2.3	6.8	2.3	7.4	2.3	7.2	2.5	7.9	2.7	7.8	3.0	8.3	
Irrigation	0.0	0.5	0.0	0.4	0.0	0.6	0.0	2.9	0.1	18.4	0.4	22.5	0.4	28.7	0.4	25.7	0.2	13.9	0.0	5.8	0.0	2.8	0.0	0.7	
Drinking water	8.2	7.8	7.3	6.4	7.8	6.8	7.3	6.4	7.5	6.4	7.2	6.2	7.2	6.7	7.2	6.7	6.7	6.2	6.5	6.3	6.2	6.2	6.4	6.4	
Others	71.0	67.4	57.3	59.5	58.2	60.2	50.4	57.0	47.2	47.3	48.8	39.4	54.8	50.0	52.6	47.0	52.5	45.7	54.5	45.1	59.1	52.8	66.9	63.1	
<b>TOTAL</b>	<b>210.9</b>	<b>245.1</b>	<b>168.8</b>	<b>208.5</b>	<b>174.3</b>	<b>223.3</b>	<b>156.9</b>	<b>190.7</b>	<b>142.5</b>	<b>190.1</b>	<b>136.7</b>	<b>188.6</b>	<b>145.1</b>	<b>220.8</b>	<b>138.9</b>	<b>215.3</b>	<b>141.2</b>	<b>194.9</b>	<b>156.1</b>	<b>199.8</b>	<b>177.8</b>	<b>222.2</b>	<b>209.6</b>	<b>230.0</b>	

Table A .2.8

**Electricity consumption in 2010, million kWh**

	01		02		03		04		05		06		07		08		09		10		11		12		
	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	
Consumers																									
Population	85.0	91.0	72.7	71.6	66.9	69.9	57.3	63.1	55.1	61.7	53.1	60.9	57.4	67.0	56.8	67.8	56.1	64.6	58.0	68.4	67.6	75.9	81.4	82.1	
Budget organizations	10.9	15.2	10.6	13.8	9.1	12.1	7.6	9.5	5.8	7.5	5.8	5.4	6.1	5.4	5.9	5.6	6.0	5.7	6.4	7.9	9.1	11.4	10.5	14.1	
Industry	36.3	61.1	27.3	62.8	29.8	71.7	20.6	55.0	20.9	55.7	21.2	63.8	20.9	65.9	21.5	63.4	19.8	55.2	21.2	67.1	22.3	69.0	23.7	71.1	
on which Nairit (Chemical)	17.1	0.0	8.2	0.0	9.3	0.0	1.1	0.0	1.0	0.0	0.9	0.0	0.9	0.0	1.0	0.0	0.9	0.0	1.0	0.0	1.0	0.0	1.1	0.0	
Mining and smelting	0.0	38.9	0.0	36.6	0.0	36.8	0.0	35.0	0.0	33.3	0.0	33.1	0.0	32.4	0.0	34.2	0.0	33.8	0.0	35.3	0.0	36.8	0.0	41.6	
Cement plants	0.0	9.0	0.0	10.5	0.0	17.7	0.0	5.2	0.0	5.8	0.0	14.6	0.0	17.1	0.0	13.7	0.0	6.3	0.0	15.3	0.0	15.1	0.0	11.7	
Others	19.2	13.1	19.0	15.7	20.5	17.2	19.5	14.8	19.9	16.5	20.3	16.1	20.0	16.3	20.5	15.4	19.0	15.1	20.2	16.5	21.2	17.1	22.6	17.8	
Transport	2.9	7.0	2.7	6.6	2.8	7.6	2.6	6.7	2.5	6.8	2.4	6.9	2.4	7.3	2.5	8.8	2.4	6.6	2.6	7.2	2.7	7.7	3.1	7.8	
Irrigation	0.0	0.6	0.0	0.5	0.0	0.7	0.0	2.7	0.1	5.9	0.4	22.7	0.4	33.4	0.4	32.0	0.2	18.1	0.0	3.3	0.0	3.5	0.0	0.5	
Drinking water	6.5	6.7	5.7	6.0	6.0	6.2	5.7	5.8	5.7	5.7	5.6	5.8	6.1	6.3	5.9	6.5	5.5	5.7	4.9	5.6	4.2	5.4	4.0	5.7	
Others	64.1	59.7	60.2	55.6	58.0	54.9	96.4	46.9	53.5	42.4	56.7	41.2	61.6	45.3	34.1	51.4	56.9	49.7	56.7	47.0	63.4	51.9	66.5	145.7	
<b>TOTAL</b>	<b>205.8</b>	<b>241.3</b>	<b>179.2</b>	<b>216.9</b>	<b>172.6</b>	<b>223.3</b>	<b>190.3</b>	<b>189.7</b>	<b>143.8</b>	<b>185.7</b>	<b>145.1</b>	<b>206.8</b>	<b>154.9</b>	<b>230.6</b>	<b>127.1</b>	<b>235.3</b>	<b>147.0</b>	<b>205.5</b>	<b>149.9</b>	<b>206.4</b>	<b>169.3</b>	<b>224.7</b>	<b>189.2</b>	<b>327.0</b>	

Table A .2.9

Electricity consumption in 2011, million kWh

	01		02		03		04		05		06		07		08		09		10		11		12	
Consumers	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.	Yer.	Reg.
Population	97.5	104.4	84.8	85.8	75.6	81.5	59.4	69.7	55.9	64.8	54.5	64.0	59.9	71.3	58.5	72.1	54.9	66.8	61.3	75.4	87.5	94.5	105.6	102.6
Budget organizations	11.4	16.9	11.5	16.0	10.0	14.0	7.9	10.6	6.2	7.8	5.8	6.0	6.3	5.9	6.0	6.2	5.7	6.4	7.1	9.3	11.4	15.4	12.5	17.1
Industry	21.9	62.4	21.4	58.7	22.6	65.9	20.5	68.2	20.6	61.2	20.8	66.8	20.4	69.9	21.0	66.9	20.1	65.1	21.1	77.7	23.7	79.8	25.0	80.8
<i>on which Nairit (Chemical)</i>	1.0	0.0	0.9	0.0	0.9	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.9	0.0	1.0	0.0
<i>Mining and smelting</i>	0.0	42.0	0.0	38.0	0.0	42.4	0.0	36.6	0.0	35.7	0.0	34.9	0.0	35.3	0.0	36.9	0.0	37.9	0.0	43.6	0.0	46.2	0.0	52.6
<i>Cement plants</i>	0.0	2.4	0.0	2.9	0.0	4.5	0.0	14.0	0.0	7.7	0.0	15.1	0.0	17.6	0.0	11.6	0.0	9.4	0.0	14.3	0.0	13.2	0.0	7.3
<i>Others</i>	20.9	18.0	20.5	17.8	21.7	19.0	19.8	17.5	19.9	17.8	20.1	16.8	19.7	17.0	20.3	18.4	19.5	17.8	20.4	19.8	22.9	20.4	24.0	20.9
Transport	3.1	7.1	2.9	7.0	3.0	7.2	2.6	6.6	2.5	6.2	2.4	6.3	2.4	7.0	2.5	7.7	2.5	7.6	2.6	7.5	3.0	7.6	3.4	8.8
Irrigation	0.0	0.5	0.0	0.5	0.0	0.7	0.0	2.3	0.0	10.0	0.3	18.6	0.4	32.4	0.4	31.2	0.2	15.0	0.0	4.7	0.0	3.1	0.0	0.6
Drinking water	4.1	6.1	3.6	5.5	3.7	5.9	3.1	5.5	3.0	5.3	3.2	5.6	3.6	6.5	3.5	6.2	2.9	5.4	2.1	5.1	2.1	5.1	2.5	5.6
Others	69.0	66.4	68.0	65.0	65.3	74.9	56.1	64.4	56.3	58.9	60.0	95.0	67.9	55.8	64.5	55.1	57.8	101.8	60.2	70.0	79.9	76.0	80.9	80.8
<b>TOTAL</b>	<b>206.9</b>	<b>263.8</b>	<b>192.2</b>	<b>238.5</b>	<b>180.2</b>	<b>250.0</b>	<b>149.6</b>	<b>227.2</b>	<b>144.6</b>	<b>214.1</b>	<b>147.0</b>	<b>262.3</b>	<b>161.0</b>	<b>248.6</b>	<b>156.4</b>	<b>245.3</b>	<b>144.1</b>	<b>268.1</b>	<b>154.4</b>	<b>249.6</b>	<b>207.7</b>	<b>281.5</b>	<b>230.0</b>	<b>296.4</b>

**APPENDIX C. INFORMATION ON FORECASTED ECONOMIC DEVELOPMENT OF ARMENIA, RECEIVED IN RESPONSE TO OFFICIAL REQUEST OF THE MINISTRY OF ENERGY AND NATURAL RESOURCES OF THE REPUBLIC OF ARMENIA**

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A.3.1. Forecasts of GDP and its structure

A.3.1.1. GDP and real growth of main sectors, %

Item	2012	2013	2014	2015	2017	2021	2025
GDP	7	6.3	6.3	6.3	6.5	6.4	6.5
Industry	10.7	9.9	9.4	9.5	9.6	8.8	8.8
Agriculture	8	5	4.7	4	4	3.8	3.5
Construction	2.6	4.5	5	5.5	6.5	6.5	6.5
Services	6.7	6	6.1	6.2	6.2	6.4	6.5
Net taxes	6	6	6	6	6	6	6

GDP structure by sectors, %

Item	2012	2013	2014	2015	2017	2021	2025
Industry	16.8	17.4	17.9	18.4	19.3	21	22.4
Agriculture	20.1	19.9	19.6	19.2	18.2	16.2	14.2
Construction	12.3	12.1	11.9	11.9	11.7	11.5	11.3
Services	40	39.9	39.8	39.8	40.3	41.2	42.3
Net taxes	10.8	10.8	10.8	10.7	10.6	10.2	9.8

Source: Ministry of Economy of the RoA

A.3.1.2. Forecast of actual growth of GDP and its structure over the years 2012-2025

Year	GDP actual growth, %	Industry portion, %	Agriculture portion, %	Construction portion, %	Services Sector portion, %	Net taxes portion, %
2012	7.1	16.6	19.6	11.9	40.5	11.4
2013	6.2	17	19.1	11.4	41	11.6
2014	6.3	17.4	18.7	10.9	41.3	11.8
2015	6.3	17.8	18.3	10.5	41.5	12
2016	6.4	18.2	17.9	10	41.7	12.2
2017	6.5	18.6	17.5	9.6	41.9	12.3
2018	6.4	19.1	17.1	9.2	42	12.5
2019	6.5	19.5	16.7	8.8	42.2	12.7
2020	6.5	20	16.4	8.5	42.3	12.9
2021	6.4	20.4	16	8.1	42.5	13.1
2022	6.4	20.7	15.6	7.8	42.6	13.3
2023	6.5	21.1	15.3	7.5	42.7	13.5
2024	6.5	21.5	14.9	7.1	42.8	13.7
2025	6.5	21.9	14.6	6.8	42.8	13.8

Source: Ministry of Finance of the RoA



### A.3.2. Forecasts of changes in population size

#### A.3.2.1. Projected number of population in constant scenario

year	2005	2010	2012	2015	2020	2025	2030	2035
population	3218783	3237610	3241449	3238737	3204649	3129941	3026931	2900402

#### A.3.2.2. Projected number of population in average scenario

year	2005	2010	2012	2015	2020	2030	2035
population	3219672	3250728	3265073	3282189	3286073	3215411	3171146

#### A.3.2.3. Projected number of population in low scenario

year	2005	2010	2012	2015	2020	2030	2035
population	3218783	3212709	3197894	3172090	3110579	2907883	2768223

#### A.3.2.4. Projected number of population in high scenario

year	2005	2010	2012	2015	2020	2030	2035
population	3219484	3288623	3333554	3396104	3469701	3543942	3605398

**Source: Ministry of Labor and Social Affairs of the RoA**

### A.3.3. Forecasts of changes in electricity consumption for water supply and sewerage

mln. kWh

Name of company	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Sevan-Hrazdan-jrar	45.00	44.80	44.60	44.40	44.20	44.00	43.80	43.60	43.40	43.20	43.00	42.80	42.60
Akhuryan-Araqs-jrar	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09
Melioracia	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Hay-jrmugh-koyughi	41.00	40.80	40.60	40.40	40.20	40.00	39.80	39.60	39.40	39.20	39.00	38.80	38.60
Shirak-jrmugh-koyughi	1.10	1.10	1.09	1.08	1.07	1.06	1.05	1.04	1.03	1.02	1.01	1.00	0.99
Nor Akunq	3.50	3.48	3.46	3.44	3.42	3.40	3.38	3.36	3.34	3.32	3.30	3.28	3.26
Lori-jrmugh-koyughi	0.90	0.90	0.89	0.89	0.88	0.88	0.87	0.87	0.86	0.86	0.85	0.85	0.84
Yerevan Jur	55.00	54.70	54.40	54.10	53.80	53.50	53.20	52.90	52.60	52.30	52.00	51.70	51.40
<b>Water companies</b>	<b>114.6</b>	<b>114.5</b>	<b>114.7</b>	<b>114.8</b>	<b>103.1</b>	<b>103.6</b>	<b>104.2</b>	<b>104.7</b>	<b>105.2</b>	<b>105.7</b>	<b>106.3</b>	<b>106.8</b>	<b>107.3</b>

**Source: State Committee of Water Economy of the RoA Ministry of Territorial Administration**

### A.3.4. Forecasts of changes in the volume of housing construction in urban and rural areas

It is planned to put into operation residential accommodation (apartments) in urban and rural areas with total area of 4000.0 thousand m<sup>2</sup>

**Source: Ministry of Civil Construction of the RoA**

### A.3.5. Forecasts of changes in electricity consumption in Transport and Communication

mln. kWh

Item	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Connection and telecommunications	12.5	14.2	15.0	12.3	12.8	13.5	13.8	14.1	14.4	14.7	15.1	15.4	15.7
Electric transport	87.4	113.9	124.0	135.3	153.0	160.8	163.6	165.6	164.0	162.4	161.1	159.5	157.8
<b>TOTAL</b>	<b>99.9</b>	<b>128.1</b>	<b>139.0</b>	<b>147.6</b>	<b>165.8</b>	<b>174.3</b>	<b>177.4</b>	<b>179.7</b>	<b>178.4</b>	<b>177.1</b>	<b>176.2</b>	<b>174.9</b>	<b>173.5</b>

Note: The connection and telecommunications sector includes data provided by the following organizations:

- "Republic center of telecommunications" State Non-Commercial Organization
- "Armenian television and radio transmitting network" CJSC
- "Haypost" CJSC

The electric transport sector includes data provided by the following organizations:

- "South Caucasus railway roads" CJSC
- Yerevan underground railway
- "Yerevan electric transport" CJSC

**Source: Ministry of Transport and Communication of the RoA**

A. 3.6. Forecasts of changes in electricity consumption by large consumers

A.3.6.1.

Significant changes in current volume of electricity consumption (which is about 40 mln kWh per year) are not expected up to 2025.

**source: Armenian Water and Sewerage CJSC**

A.3.6.2

Years	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Nairit, mln. kWh	185.75	258.5	234.5	235.5	236.5	237.5	238.5	239.5	240.5	241.5	242.5	243.5	244.5

**Source: "Nairit Plant" CJSC**

A.3.6.3

By 2025 volumes of electric energy consumption will increase by 8-10%.

**Source: "Rusal Armenal" CJSC**

A.3.6.4

Year	Months (thousand kWh)											
	1	2	3	4	5	6	7	8	9	10	11	12
2013	900	1000	1250	1250	1350	1360	1360	1370	1370	1390	1390	1390
2015	900	1000	1250	1250	1350	1360	1360	1370	1370	1390	1390	1390
2020	900	1000	1250	1250	1350	1360	1360	1370	1370	1390	1390	1390
2025	900	1000	1250	1250	1350	1360	1360	1370	1370	1390	1390	1390

Source: "Dzulakentron" JSC

A.3.6.5

Year	thousand kWh
2012-2019	32516
2019-2025	39226

**Source: "Yerevan Brewery" CJSC**

A.3.6.6

Year	MWh
2015	6 500
2020	7 000
2025	7 500

**Source: "Ashtarak-Kat" CJSC**

A.3.6.7

Year	mln. kWh
2013	31
2014	33
2015	35
2016-2025	38

**Source: "Viva Cell MTS"**

**APPENDIX D. LOAD-DURATION CURVES OF THE ARMENIAN POWER SYSTEM**

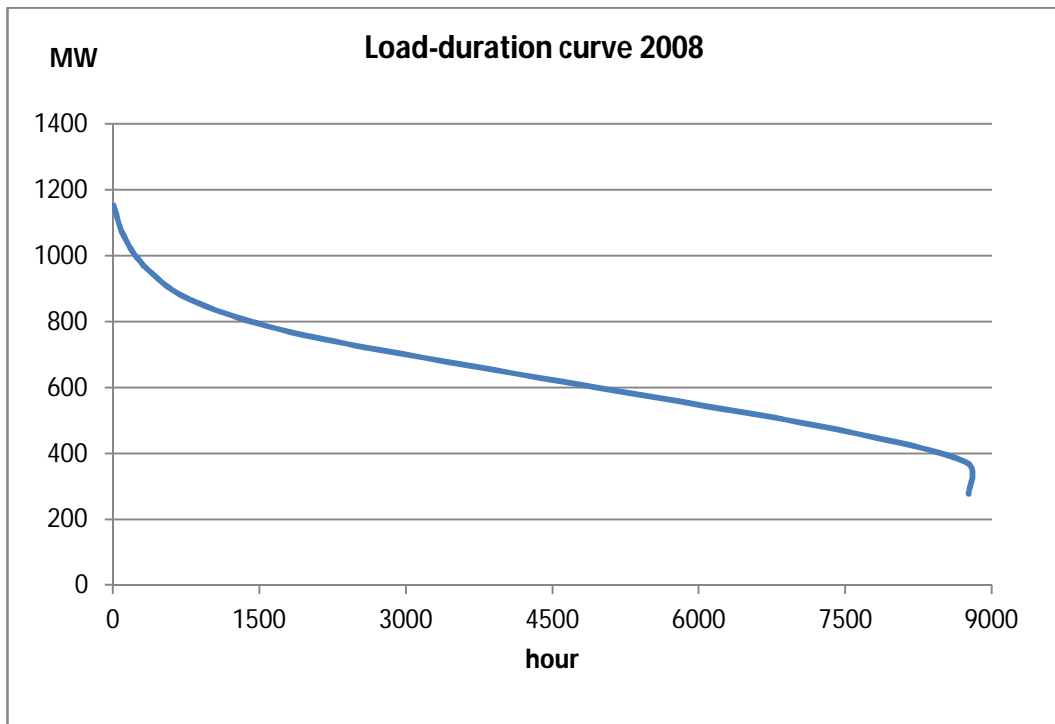


Fig. A .4.1

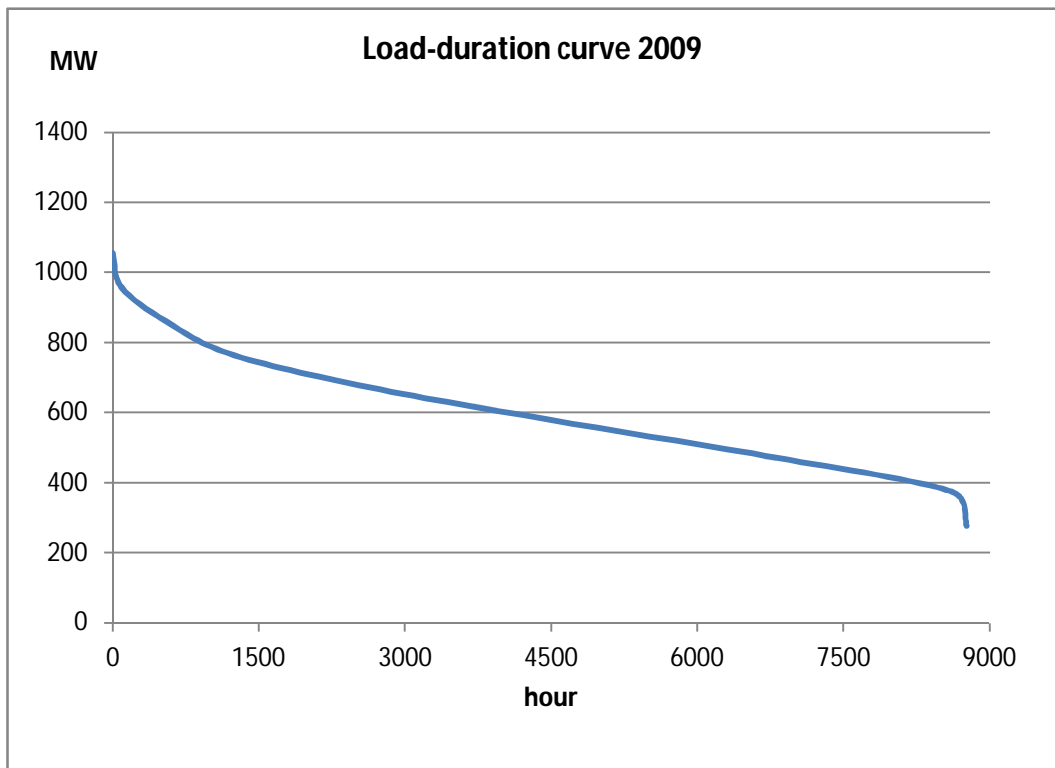


Fig. A .4.2

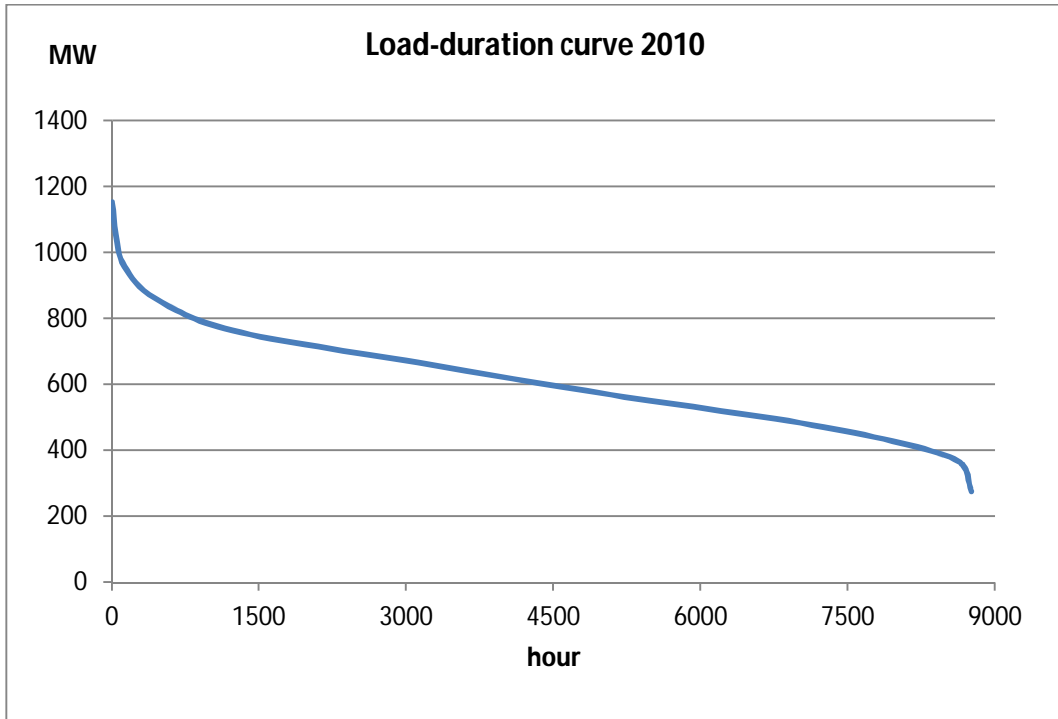


Fig. A .4.3

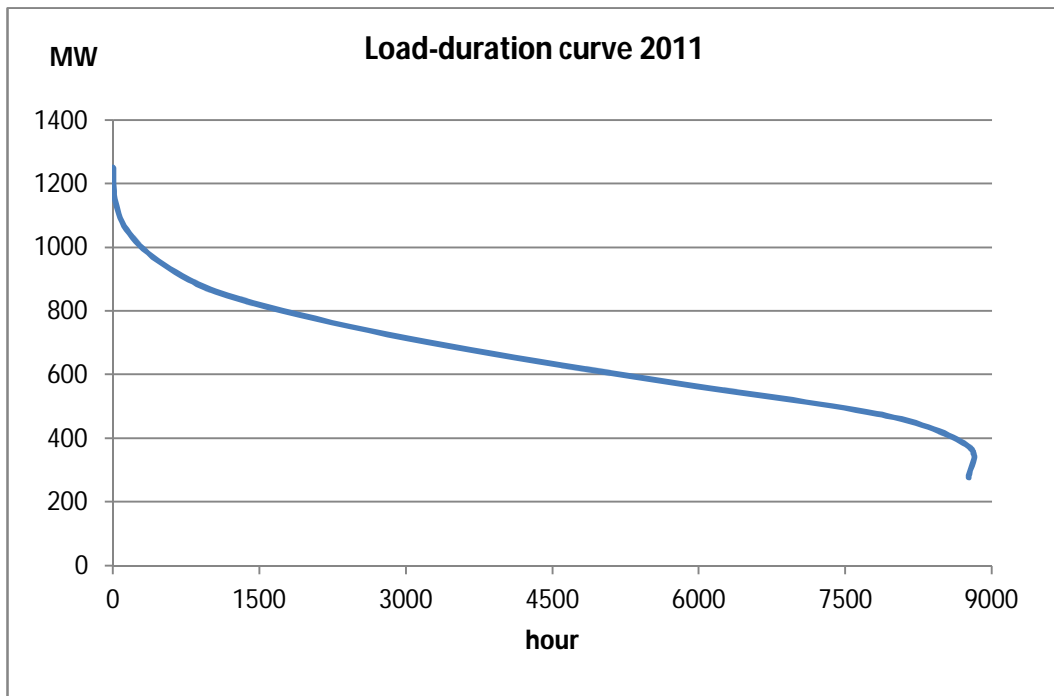


Fig. A .4.4



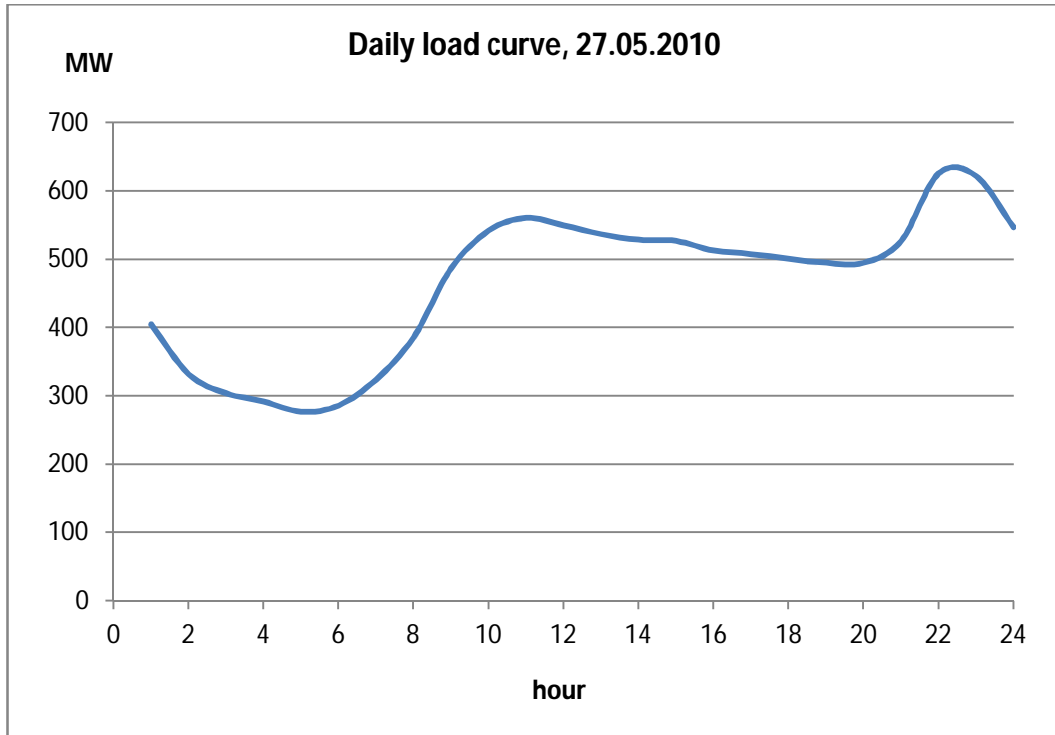


Fig. A .4.5

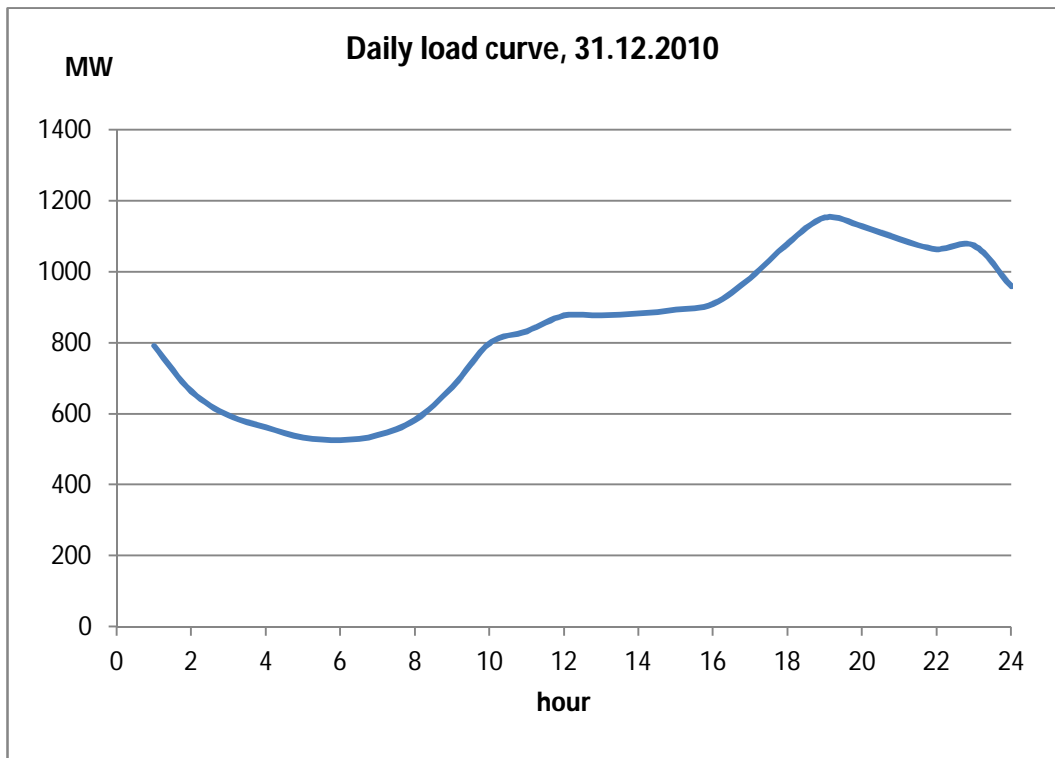


Fig. A .4.6

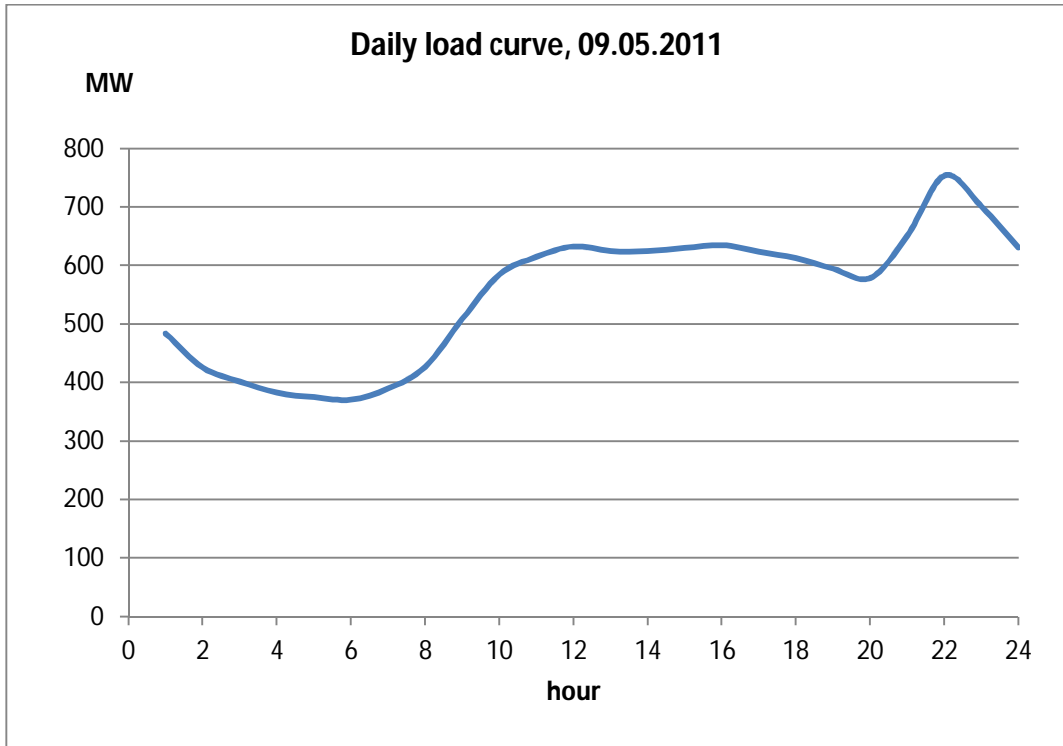


Fig. A .4.7

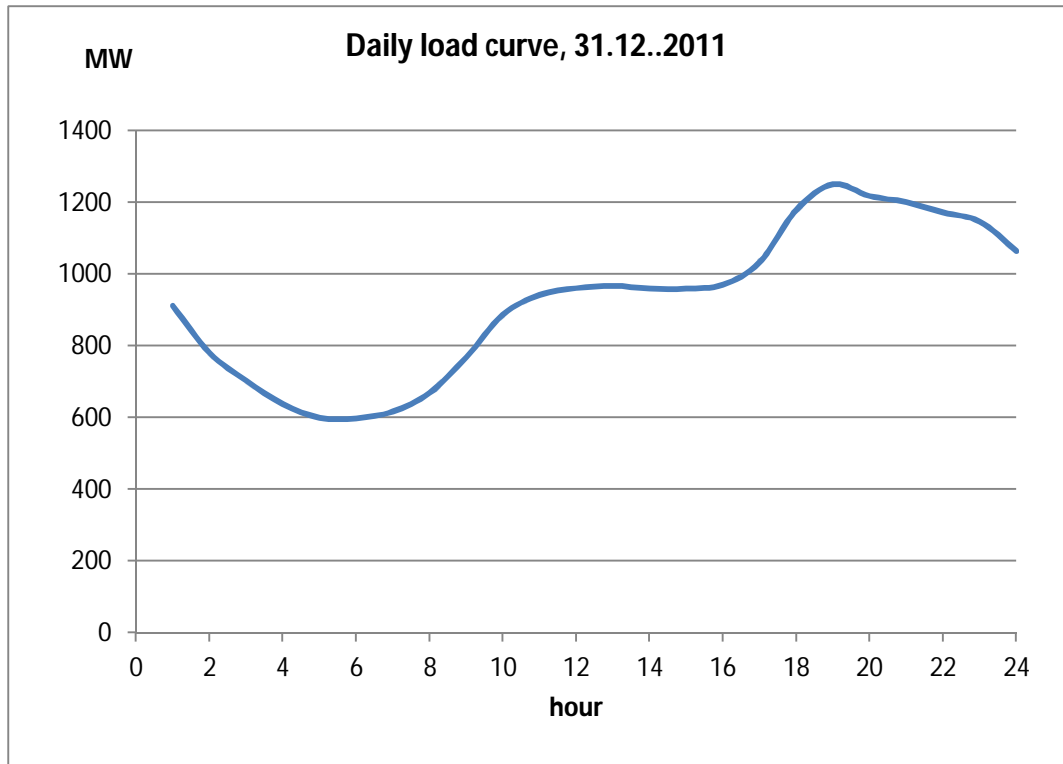


Fig. A .4.8