ENERGY BALANCE OF THE REPUBLIC OF ARMENIA FOR 2022

Scientific Research Institute of Energy
2024

“Energy Balance of the Republic of Armenia, 2022”

Yerevan – 2024

CONTENT

ABBREVIATIONS

AEB	Armenia Energy Balance
CJSC	Closed Joint Stock Company
CN FEA	Commodity Nomenclature of Foreign Economic Activity
CNG FS	Compressed natural gas fueling station
EB	Energy Balance
EDRC	Economic Development and Research Centre
ENA	Electric Network of Armenia
EU	European Union
GEF	Global Environmental Fund
HPP	Hydro Power Plant
HVEN	High Voltage Electric Networks
IEA	International Energy Agency
ILCS	Integrated Living Conditions Survey
M&A	Monitoring and assessment
MTAD	Ministry of Territorial Administration and Infrastructure
NPP	Nuclear Power Plant
OECD	Organization for Economic Cooperation and Development
PSRC	Public Services Regulatory Commission
PV	Photovoltaic
R2E2	Armenia Renewable Resources And Energy Efficiency Fund
RA	Republic of Armenia
RF	Russian Federation
TPP	Thermal Power Plant
UGSF	Underground gas storage facility
UNDP	United Nations Development Program
WPP	Wind Power Plant

MEASUREMENT UNITS

GWh	gigawatt*hour (10^9 Wh)
J	Joule
km	kilometer
ktoe	kiloton oil equivalent (1000 toe)
kW	kilowatt (10^3 W)
kWh	kilowatt*hour (10^3 Wh)
m^3	cubic meter
MJ	megajoule (10^6 J)
mln.	million
mln. m^3	million. cubic meter
MW	megawatt (10^6 W)
MWh	megawatt*hour (10^6 Wh)
t	ton
TJ	terajoule (10^{12} J)
toe	ton oil equivalent
W	Watt
Wh	Watt*hour

1. INTRODUCTION

Development of the RA Energy Balance is important for the assessment of the energy security level of the country, the diversification of power supply and the trends in greenhouse gas emissions, as well as for evaluation of the progress in achieving the targets of the United Nations Framework Convention on Climate Change (UNFCCC).

Energy balance is a valuable instrument for the assessment, documentation and monitoring of the energy efficiency and renewable energy indicators in the country for the given year.

Energy balance is one of the main sources for the collection of the initial data on GHG emissions in the Energy sector. It serves as aground for the development and implementation of mitigation measures addressing the environmental challenge of climate change. Implementation of the mitigation measures is of a great importance under the Paris agreement and commitments undertaken by the Republic of Armenia.

For the compilation of the Energy Balance following actions were undertaken:

- Collection of the official data from the Statistical Committee of RA (Armstat);
- Business meetings and discussions have been organized to improve data collection, in particular: (a) for the assessment of the consumption volumes of liquid fuels by sectors; (b) for evaluation of bio fuels consumption (particularly, firewood and manure);(c) to assess the production and consumption of solar PV and water heating energy;
- Methodology for the compilation of 2021 Energy Balance was analyzed;
- Collected data were analyzed, the balance indicators were calculated and the initial data were archived;
- 2022 Armenia Energy Balance was compiled and presented in Eurostat and International Energy Agency's formats.

Compilation and publication of Armenia Energy Balance is defined by the RA Law on "Energy Efficiency and Renewable Energy".

The guideline [1] published by the IEA, Eurostat and Organization for Economic Cooperation And Development (OECD) as well as the "Explanatory Note on Energy Balance of Armenia" developed by the Economic Development Research Centre (EDRC) serves as methodological base for the compilation of the 2022 Armenia Energy Balance. The main sources of the initial data and the major applied approaches for the compilation of the energy balance are reflected within the mentioned Explanatory Note.

During the compilation of the 2017 Energy Balances the Excel program has been developed by the EDRC which was revised by "Scientific Research Institute of Energy" CJSC. Slight upgrades were also made in 2022 Energy Balance, in particular, the values of imported oil products were clarified with Armstat on the basis of 10-digit classifier, as well as the values and structure of energy consumption in industrial branches.

[1] "Energy Statistics Manual", OECD/IEA, 2007
(https://ec.europa.eu/eurostat/ramon/statmanuals/files/Energy_statistics_manual_2004_EN.pdf)

2. SIGNIFICANCE OF THE ENERGY BALANCE

Energy balance is represented in the form of a standard spreadsheet format, which reflects amounts of the energy resources extracted, produced, imported, exported, stored, processed, converted, transported, distributed and used in various sectors in Armenia during the reporting period. The Energy balance of the country is presented in the Eurostat or IEA standard formats, which comply with the regulation No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics.

During the compilation of the energy balance, it is necessary to take into account the flows of energy carriers and all types of the energy by their generation, recycling, transformation, distribution, storage and final consumption cycles, as well as energy costs and possible losses for own needs.

According to the Eurostat requirements energy balances are composed using natural (TJ) units, and as for the IEA standards - the oil equivalent (1 ktoe equals to 41.868 TJ).

Collection and processing of the statistical data and compilation of the energy balance are the first steps for the analysis of the energy situation in the country allowing the assessment of the previous trends and formation of the future policy addressed to the development of the energy sector. Data in the energy balance enable the assessment of the energy efficiency level in the different sectors of the economy and households. It should be noted that emissions indicators are closely related to those of energy efficiency.

The role of clear and comprehensive information is constantly increasing and allowing to not only be limited to the qualitative conclusions, but also to reveal quantitative assessments for energy policy.

According to the IEA, in order to develop an energy policy it is necessary to have clear information about the final consumption, in particular:

- Information on the driving forces of the energy consumption,
- Information on the current energy consumption situation,
- Information about the responses on the implementation of the policy options.

All this makes an information environment, which is regularly updated and provides with a basis for the policy review and correction.

Amounts of the electricity produced by renewable sources (wind, solar, etc.) in different countries of the world still grow. The increase of their share in the energy balance ensures a reasonable level of energy independence of the country and the reduction of greenhouse gas emissions.

Development of the energy balance is necessary for:

- Assessment of the country's energy independence, including the power produced at the renewable energy sources in the energy balance;
- Study of the fuel and energy production and consumption structure;
- Study of the fuel and energy resources demand;
- Analysis of the fuel and energy balance structure for its improvement;
- Definition of the capital investments volumes for the development of the fuel and energy complex in the country;
- Identification of the export and import volumes of fuel and energy resources;
- Assessment of the energy efficiency potential;

- Identification of the greenhouse gases & other emissions volumes and the development of the measures to minimize their negative impacts on the environment, etc.

During compiling the energy balance for 2022, the recommendations presented by IEA experts were taken into account in order to exclude items that are absent in Armenia from the rows and columns of the standard balance sheet. This applies, for example.

- in terms of transfer technologies: Electric boilers, Chemical heat for electricity production, Oil refineries, etc.,
- in terms of energy resources – Crude oil, etc.

3. BALANCE COMPILATION AND APPLIED APPROACHES

This chapter presents the initial data of the main energy carriers included in the energy balance and the basic approaches applied for compilation of the balance.

3.1. Electricity Balance

General information and overview

Electric energy is one of the most developed areas in the economy of Armenia. There are both the traditional sources for electricity production that are NPP, TPP and HPPs, and the alternative sources. Recent governmental decisions contributed to the development of several alternative energy projects which includes installation of licensed and autonomous solar PV systems, solar water heaters, as well as wind power monitoring and geothermal energy exploration, etc.

Armenia exports electricity to Iran, Artsakh and to Georgia as well as imports electricity from the mentioned countries. Electricity export to Iran is realized on electricity-for-gas swapping agreement and was 75% amounting to 1178.3 mln. kWh of the overall exported electricity in 2022. The import from Iran amounted to 22.6 mln. kWh in 2022, which is mainly conditioned by the power system regimes. Electricity export to Georgia is mainly organized in the emergency switched off the 500 kV Caucasian power transmission line feeding the Georgia's power system from Russia and in 2022 it was amounted to 365.5 mln kWh (23%). In high flood seasons the power supply to the Northern parts of Armenia is performed from Georgia in the island mode and amounted to 101.2 mln. kWh in 2022. In 2022, electricity export to Artsakh was 27.4 mln. kWh and the import was practically absent.

Armenian NPP produced 2846.2 mln. kWh of electricity in 2022 which is around 32% of the total electricity production. These indicators increased against those of 2021 due to the maintenance activities undertaken for extension of the ANPP operation life time.

There are four large thermal power plants in Armenia. "Yerevan TPP" CJSC, which although is combined cycle production unit, operated in condensation mode during 2022 and produced 1761.7 mln. kWh of electricity. The "Hrazdan TPP" OJSC condensing power unit, owned by "Gazprom Armenia" CJSC, produced 890 mln. kWh of electricity in 2022. "Hrazdan-5" condensing power unit owned by "Gazprom Armenia" CJSC was operated partly and produced 3 mln kWh of electricity in 2022. The "ArmPower" CJSC in 2022 produced 1220.5 mln. kWh of electricity.

Shares of the mentioned plants in the total electricity production accordingly amount to 19.8% - Yerevan TPP, 10% - Hrazdan TPP, 0.03% - Hrazdan-5 and "ArmPower" CJSC – 13.7%. So, the shares of "Yerevan TPP" CJSC and "Hrazdan TPP" OJSC respectively decreased against those of 2021 which is a result of significant increase of Armenian NPP and "ArmPower" shares in total.

Some amount of electricity was also produced at small-scale combined cycle power plants. Total electrical energy production of "Yerevan State Medical University after Mkhitar Heratsi" and "ArmRuscogenaration" CJSC cogeneration plants in 2022 amounted to 3.5 mln. kWh or 0.04% of the overall production.

Hydro energy of Armenia are presented by two major HPP cascades owned by "International Energy Corporation" CJSC and "Contour Global Hydro Cascade" CJSC, as well as by a number of small HPPs. The HPPs of "International Energy Corporation" CJSC produced 390.6 mln. kWh and "Contour Global Hydro

Cascade" CJSC – 740.1 mln. kWh electricity in 2022, which accordingly amount to 4.4% and 8.3% of the total electricity production. Thus, the production of large hydroelectric power plants in 2022 decreased in comparison with 2021. According to the RA PSRC information, number of the small HPPs in 2022 was 189, with total installed capacity of 409 MW, and the actual electricity production of 809.2 mln. kWh. The share of small HPPs in the total net electricity supply was 9.1% which is 1.4 percent points less than in 2021.

Some amount of electricity has been produced also by Wind Farms (WF). 1.8 mln. kWh of electricity has been produced by WFs with total installed capacity of 4.2 MW amounts to 0.02% of the total generation.

Introduction of solar PV sites continues its growth in 2022. According to PSRC official website, the total installed capacity of licensed solar PV plants reached 204.8 MW in 2022 and electricity production amounted to 241.3 mln. kWh. There is a significant increase in the amount of electricity produced in the PV installations of autonomous producers. Following to the expert estimation the total installed capacity of the autonomous solar PV producers reached 196.9 MW (https://energyagency.am/category/infografiks/inqnavar-arevayin-kayanner-2023t--hounvar fbclid=IwAR2UTFHF9aE_Im4iksBSDMoOiwPpiQjYDDDnzCQ9sy0YqX86AgYdjmHhVtg), with 282.2 mln. kWh electricity annual production, according to the data provided by Armstat. Compared to 2021, the volume of electricity produced by autonomous solar PV installations increased by about 1.4 times.

Electricity is transmitted and distributed by HVEN and ENA CJSCs wherein inevitable technical losses occur. Losses in 2022 amounted to 605.6 mln. kWh which are higher by 1.1 times than indicators in 2021.

Data Sources

Data on the production and the own needs of each of the plants, as well as on the losses in the transmission and distribution processes have been collected from the MTAI official website (https://api.mtad.am/storage/pages/files/2023/02/pdf/20_14-55-sc374-63f351ab900fd.pdf). Data on the output of autonomous and licensed solar PV installations were collected from Armstat and the official website of the RA PSC. Solar water heater data was obtained from the RA Customs Service in the "make-quantity" format, which is recommended for the collection of this data. Data on electricity consumption by industry is provided by Armstat. The data on the consumption of electricity in other sectors were collected from the official website of the RA PSC.

3.2. Natural Gas Balance

General Information and Overview

The supply and sale of the natural gas in the RA domestic market is realized by the "Gazprom Armenia" CJSC. The total length of the main gas pipelines and pipes' branches operated in the gas transportation system amounts to 1683 km. Transportation of the gas carried out through the 1583.9 km length gas pipeline (https://armenia-am.gazprom.com/about/today/). Unused pipelines are in operational reserve mode.

The underground gas storage facility (UGSF) owned by Gazprom Armenia, located in Abovyan, is also used to store gas reserves. UGSF has strategic importance since it ensures the reliability of the gas supply in the country while being used to cover the seasonal and peak demand of the gas. In 2022, 45 mil.m^3 of

gas was taken from the gas pipelines and UGSF (22.2% more than in 2021), meanwhile, 73.2 mil.m^3 was pumped into the UGSF (155.9% more than in 2021).

The gas distribution network includes 19350 km of high, medium and low pressure gas pipelines, as well as engineering structures located on them. In gas distribution system were operating 2642 gas regulating points, 8568 individual pressure regulators, 1433 head measuring nodes, as well as 327 electrochemical protection stations.

Diversification of the gas supply to the Republic of Armenia is ensured by the gas imported from the Russian Federation and the Islamic Republic of Iran. The agreement with Iran provides for the exchange of gas for electricity. Currently, a 400 kV double-circuit power transmission line is under construction to ensure the contractual volumes of gas imported from Iran.

In 2022, natural gas in amounts of 2599.6 mln. m^3 (6.1% more than in 2021) imported from the Russian Federation and 371.8 mln. m^3 (7.9% more than in 2021) imported from Iran. Overall import of natural for 2022 was 2971.4 mln. m^3 , which has 6.36% increase in comparison with the previous year.

Data on the imported gas are published in the annual report of the Armstat and posted on the PSRC's official website.

Following to the estimations of "Gazprom Armenia" CJSC, around 80% of the vehicles park in Armenia operates in compressed natural gas. Currently, Armenia has leading positions among the countries in the world that apply natural gas as an engine fuel. It is economically advisable compared to the oil products consumption and leads to the significant reduction of hazardous substances and greenhouse gases emissions in the atmosphere. According to the official website of "Gazprom Armenia" CJSC, today there are about 358 CNG FSs operating in Armenia. Transport sector consumed 504.8 mln. m^3 of natural gas in 2022 which is 0.1% less than in 2021. Amounts of the natural gas consumption in the transport sector (504.8 mln. m^3) was about 1.6 time less that in the household (812.1 mln. m^3) and 1.7 times higher than in the industry for energy purposes (296.7 mln. m^3).

The volume of natural gas consumption for heating greenhouses by technical method in agriculture has been clarified as 87.6 mln. m^3. Natural gas consumption in service sector was 254.9 mln. m^3.

Data Sources

Data provided by the RA PSRC, RA MTAI and Armstat served as the information source for the compilation of the natural gas balance. Information about the gas amounts imported and taken from the gas pipelines and UGSF as well as data on the gas volumes pumped into the UGSF, losses in transportation and distribution systems, transported gas amounts, own needs consumption, recovered gas volumes and consumption in the transportation sector were taken from the RA PSRC's official website. Information on the average monthly calorific value of the supplied gas is supplied by "Gazprom Armenia" CJSC by the request of RA Ministry of Territorial Administration and Infrastructure. Data on the natural gas used in the industry and agriculture sectors for energy purposes and in separate power plants were provided by the Armstat.

3.3. Thermal energy balance

General information and overview

Share of the thermal energy in the overall energy balance of Armenia is quite small (0.57%). Thermal energy is equally consumed for households and service sector.

In the beginning of 1990's, energy crisis occurred in Armenia caused by the irregular gas supply due to Armenia's low solvency and regular explosions of the gas pipeline. That was the reason for the collapse of the centralized heat supply systems. After the gas supply restoration, individual thermal equipment was widely used for hot water and heating preparation.

Currently, centralized heat supply in Armenia is implemented by small combined cycle power plants. "Yerevan State Medical University after Mkhitar Heratsi" foundation and "Lus Astkh" LLC produce heat energy for its own needs, and "ArmRuscogeneration" CJSC realizes heat supply to Hovhannisyan, Varuzhan, Isahakyan, Tumanyan, Kuchak and Narekatsi blocks of Avan administrative area in Yerevan. There is no data on the thermal energy produced in 2022 at the cogeneration station of the "Yerevan State Medical University after Mkhitar Heratsi" foundation while electricity supply to grid was 3 mln. kWh. In 2022, thermal energy and electricity were not produced in "ArmRuscogeneration" CJSC.

There was no heat supply from the main thermal power plants –"Hrazdan TPP" and "Yerevan TPP". Electricity at the "Hrazdan TPP" was produced by condensing-type units. The Combined cycle unit at "Yerevan CHPP" in 2022 operated in condensing mode.

There are some small capacity boiler houses in Armenia designed for the heating of one or several buildings.

Thermal energy sources also include solar water heaters and fruit drying equipment. There is no reliable information about the individual solar water heaters' areas and the volumes of their utilization in different sectors, particularly, in food industry and service sector. According to expert estimates based on type-quantity data of water heating systems from the tax service, solar thermal power was calculated for 2022 towards 2021 increased heat energy and added to the value of 2021 balance. In 2022, thermal power generated by solar units comprised 704.6 TJ, about 1.1 times more than 2021. The share of this energy is still insignificant and is accounted for in the chapter "Renewable energy balance".

Data sources

Information about the thermal energy produced by the "ArmRuscogeneration" CJSC combined cycle power plants was provided by the Armstat, the basis for data on the solar water heaters was the information available at the Tax Service.

3.4. Oil product balance

General information and overview

Data on the following oil products are presented in the oil product balance:

- Motor fuel types (engine gasoline, diesel fuel, petrol for jet engines, aviation kerosene)
- Liquid oil gases,
- Mazut and oil bitumen,
- Other oil products (other kerosene types, special types of gasoline, lubricants, paraffin and other oil products).

There is no oil extraction in the territory of Armenia and all the oil products are imported. Some types of the imported oil products are used in the limited amounts for the production of varnish, paints and the other products in Armenia. Imported bitumen and mazut are utilized for non-energy purposes either.

99.97% of motor gasoline was consumed in the transport sector.

In 2022, the main volume of the diesel fuel in amount of 83.3% was consumed in the transport sector. Industrial sector used around 8.6% of the diesel fuel. Diesel fuel consumed by the industrial sector is utilized to operate different types of the mechanisms (drilling rigs, cranes, telescopic towers and other mechanisms). The major consumers of the industrial sector was the mining industry and non-ferrous metallurgy.

Around 8.0% of the diesel fuel was utilized by the agriculture sector (tractors, combines and other mechanisms).

Insignificant amounts of diesel fuel are also consumed by the diesel generators which are reserve sources for power production. Data on this sector consumption aren't available.

Minor volumes of diesel fuel were also used for non-energy purposes in the chemical industry and other sectors. The share of diesel consumed for non-energy needs was 0.66% compared with total consumption.

In 2022, the main volumes of liquid petroleum gases, that are 69.68 %, were used by the transport sector and are 8.2 percent points less than in 2021. The share of liquid petroleum gas consumption in the industry was only 0.37%, and in the service sector 29.31% and households 0.64%.

Other oil products are consumed for non-energy purpose and is 11.8% in total oil product consumption.

Data sources

Information on the imports and exports of oil products, as well as data on the volume of the oil products consumption in the industrial sector, data and on the sowing and total harvesting areas of the agricultural crops, and the expert assessment of the agricultural sector on the consumption of fuel in the agriculture sector were provided by Armstat.

3.5. Coal Balance

General information and overview

The Armstat data on the imported coke, semi-coke, anthracite, lignite and other coal types were used to compile the coal balance.

In 2022, the share of coal consumed for energy purposes was only 0.39% of total energy consumption. About 92.6 % of coal was used in the household sector.

There are lignite deposits in Jajur and Dilijan. They haven't got any industrial significance, and according to the expert estimations around 500 families collect the lignite manually. Therefore, mining of the lignite in 2022 remained at the level fixed in 2021 but consumption was increased as a result of some amount of imported lignite.

Data Sources

The Armstat provided data on the volumes of the coal import and export, as well as consumption in the industrial sector. Information about the mining of the lignite was revealed using the expert assessments.

3.6. Balance of wood and other biofuels

General information and overview

Wood and other types of biofuel are considered renewable energy sources.

Types of the biofuels are:

- Industrial wastes,
- Solid household wastes,
- Solid biomass (including charcoal),
- Biogases.

Firewood and timber in Armenia are revealed in the following ways:

- Sanitary deforestation (solid biomass),
- Illegal deforestation (solid biomass),
- Fallen dry wood (solid biomass),
- Wastes from woodworking and furniture manufacturing (industrial wastes),
- Import.

Data on the timber products and firewood used for the energy purposes in the industrial sector are available and provided by RA Statistical Committee. It is more difficult to estimate the amounts of timber products and firewood consumed in the households, which also provided by the RA Statistical Committee based on the surveys.

Official data on the individual biogas facilities isn't available. In Armenia, these technologies mainly use manure. Manure is also utilized for the energy purposes as a furnace fuel, mainly for the heating purposes. Consumption of manure was evaluated by experts of industrial sector based on the data per cattle provided by the Armstat.

Limited amounts of crude and other solid residues are also imported to Armenia.

Data sources

Data on the imports and exports of the wood and other biofuels have been provided by Armstat. The data on the consumption of firewood and manure in households were also provided by the Armstat based on the results of survey. Data on manure consumption are based on expert calculations considering annual outputs per farm animal provided by Armstat.

Armstat also provided information on firewood and wood consumption in industrial sector.

3.7. Renewable energy balance

General information and overview

This chapter observes hydro, wind, solar and geothermal energy.

Hydro energy is the most developed among the other renewable energy resources in Armenia.

Total installed capacity of seven HPPs owned by the "International Energy Corporation" CJSC amounts to 561.4 MW and the production in 2022 was 390.6 million kWh.

Total installed capacity of three HPPs owned by “Contour Global Hydro Cascade” CJSC amounts to 404.2 MW and the production in 2022 was 740.1 million kWh, and electricity production in 2022 was decrease by 21% in 2021.

In 2022, 189 small HPPS were operated in Armenia which total installed capacity amounted to 409 MW and the actual annual useful supply was 790. 2 million kWh.

Three wind power plants (WPP) operated in Armenia in 2022. Total supply of the useful electricity from the WPPs was 1.7 million kWh in 2022.

Armenia has significant potential for solar energy production. Solar energy is represented by solar water heating and PV power plants. In 2022, amounts of the hot water and electricity produced by the solar technologies increased significantly compared to 2021 due to the policy realized by the RA Government. The method of balance calculation of electric energy for the calculation period between an autonomous producer and a distributor carrying out RE flows has been applied for the autonomous consumers in PV sector.

According to PSRC’s official website, useful supply among the autonomous producers in the electricity exchange amounted to 123 million kWh in 2022 as well as an additional 159.2 million kWh were estimated for individually consumed electricity produced by them, and delivery from licensed solar PV plants was 238.5 million kWh. According to the information received from the website of the Armenian Energy Agency, in 2022, the total installed capacity of autonomous PV systems was about 196.9 MW.

The total amount of electricity generated by autonomous solar installations and solar power plants is estimated at 523.5 million kWh. This indicator is about 1.8 times higher than those in 2021.

The Government of Armenia is implementing a promoting policy for the development of solar water heating technologies. The data of the customs service on water heating technologies imported to Armenia in 2022 were analyzed. According to expert estimates, the implementation of various initiatives led to an increase in energy production by 1.1 times compared to 2021.

Share of the energy produced using solar technologies in the primary production of renewable energy carriers was 18.2% in 2022.

Geothermal energy in Armenia is represented by several pilot installations which haven’t been included in the energy balance due to their insignificant production volumes.

Data sources

Data on the WPP production amounts were taken from the RA PSRC’s official website. Sources for the information on the solar technologies were the “ENA” CJSC, customs service and R2E2. The Solar Map of Armenia, as well as information on the installed capacity and the amount of electricity generated by licensed PV installations, published on the PSRC official website, served as a source of data on the sun hours duration.

4. CONCLUSION

During the task implementation:

- Energy balances of Armenia for 2010, 2011, 2012, 2014, 2015, 2016, 2017, 2018, 2019, 2020 and 2021 have been analyzed,
- Collection of the official data from Armstat, PSRC, MTAI and R2E2 have been accomplished,
- Energy Balance of Armenia for 2022 has been compiled in the formats of Eurostat and International Energy Agency,
- Draft Energy Balance of Armenia for 2022 has been discussed with the specialists from Armstat and MTAI.
- The analysis of changes in indicators included in the balance for 2015-2022 has been carried out.
- Based on compiled balance the Fact sheet was developed.

Suggestions for improving data collection.

1. In the section “Final energy consumption” of the Energy Balance, for a more precise presentation of information on the volumes of electricity and natural gas consumption by sector, it is proposed to use in the subscriber databases of "Electric Networks of Armenia" CJSC and "Gazprom Armenia" CJSC the classifier of types of economic activities approved by 2013 September 19, N 874-N the order of the RA Minister of Economy (see https://armstat.am/am/?nid=370).
2. To increase the accuracy of the calculation/estimation of solar thermal energy generation, it is recommended to get the data of solar water heaters from the RA Customs Service in "type-quantity" format.

Energy Balance of Armenia for 2022, Eurostat Format, aggregated, (ktoe)

N	Energy Balance of Armenia, 2022	Total	Coal	Oil	Natural Gas	Renewab-les	Nuclear	Heat	Electricity
1	2	3	4	5	6	7	8	9	10
1.1	Production	1,080.6	0.0			338.9	741.6		
1.2	Imports	3,213.8	11.5	727.0	2,450.6	14.2			10.6
1.3	International aviation bunker	-103.4		-103.4					
1.4	Exports	-135.9	0.0	-0.4		-0.4			-135.1
1.5	Stock changes	-51.7		-28.5	-23.3				
1	**Gross inland consumption**	**4,003.3**	**11.5**	**594.7**	**2,427.3**	**352.7**	**741.6**		**-124.5**
2	**Transformation input**	**-1,451.7**			**-710.1**		**-741.6**		
2.1	Nuclear power stations (MA El. Gen.)	-741.6					-741.6		
2.2	Thermal power stations (MA El. Gen.)	-709.2			-709.2				
2.3	Combined heat and power stations (CHP)	-0.9			-0.9				
2.4	Non-specified transformation input								
3	**Transformation output**	**578.2**							**578.2**
3.1	Nuclear power stations (MA El. Gen.)	244.7							244.7
3.2	Thermal power stations (MA El. Gen.) (condensing)	333.2							333.2
3.3	Combined heat and power stations (CHP) (cogeneration)	0.3							0.3
3.4	Non-specified transformation output								
4	**Exchanges and transfers, returns**					**-228.8**		**16.8**	**212.0**
4.1	Hydro power stations (MA El. Gen.) (large)					-97.2			97.2
4.2	Small hydro power stations (MA El. Gen.)					-69.6			69.6
4.3	Wind power stations (MA El. Gen.)					-0.2			0.2
4.4	Solar power stations (MA El. Gen.)					-61.8		16.8	45.0
5	**Consumption of the energy branch (for own use)**	**-42.0**			**-6.6**				**-35.4**
5.1	Nuclear power stations (MA El. Gen.)	-18.5							-18.5
5.2	Thermal power stations (El. Gen., CHP)	-13.7							-13.7
5.3	Hydro power stations (MA El. Gen.)	-3.0							-3.0

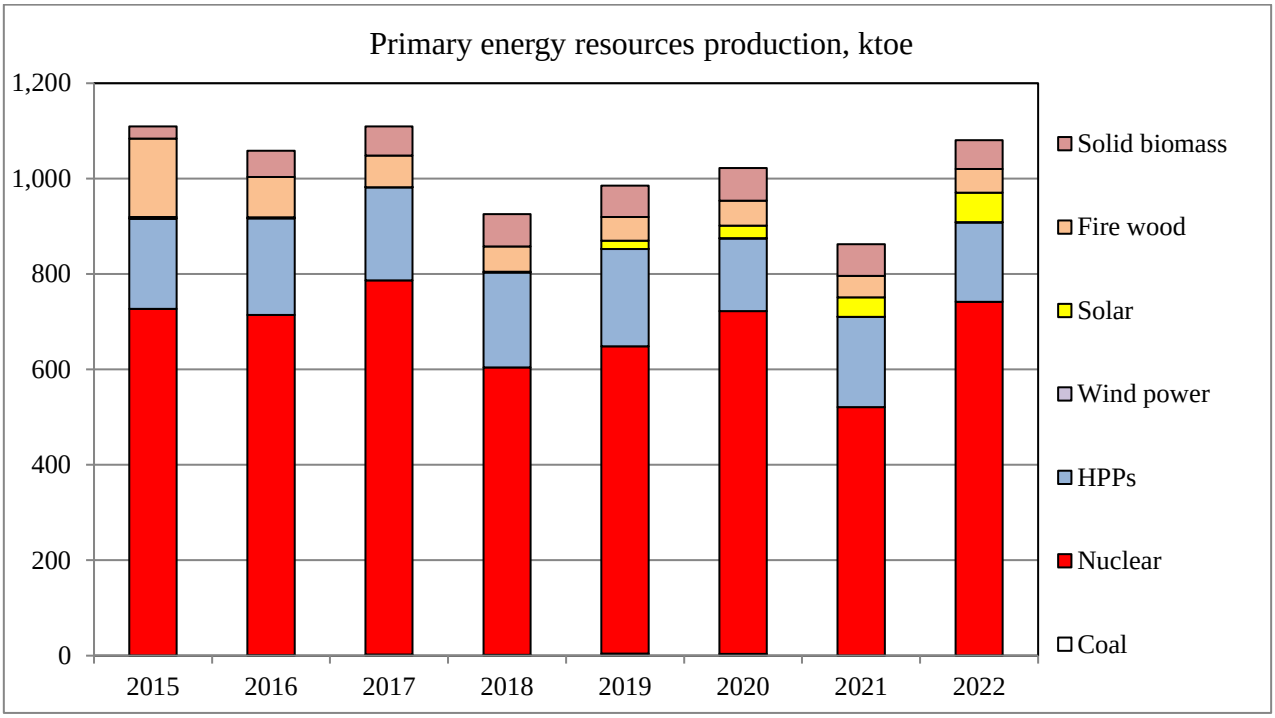
5.4	Wind power stations (MA El. Gen.)	0.0							0.0
5.5	Gas transportation	-6.6			-6.6				
5.6	Other stations	-0.2							-0.2
6	**Distribution and transmission losses**	**-149.5**			**-97.4**				**-52.1**
7	**Available for final consumption**	**2,938.4**	**11.5**	**594.7**	**1,613.2**	**123.9**		**16.8**	**578.2**
7.1	**Final non-energy consumption**	**71.0**	**0.2**	**70.3**		**0.6**			
7.1.1	*Chemical Industry*	*0.1*		*0.1*					
7.1.2	*Other sectors*	*70.9*	*0.2*	*70.1*		*0.6*			
7.2	**Final energy consumption**	**2,867.4**	**11.3**	**524.4**	**1,613.3**	**123.3**		**16.8**	**578.2**
7.2.1	**Industry**	**418.9**		**16.4**	**244.7**	**0.0**			**157.8**
7.2.1.1	*Iron and steel*	*28.0*			*16.4*				*11.6*
7.2.1.2	*Chemical and petrochemical*	*2.8*		*0.0*	*1.4*	*0.0*			*1.3*
7.2.1.3	*Non-ferrous metals*	*25.4*		*5.3*	*1.1*	*0.0*			*19.0*
7.2.1.4	*Non-metallic minerals*	*145.9*		*0.7*	*126.2*				*18.9*
7.2.1.5	*Transport equipment*	*0.0*							*0.0*
7.2.1.6	*Machinery*	*3.1*			*1.0*	*0.0*			*2.2*
7.2.1.7	*Mining and quarrying*	*83.7*		*7.8*	*8.5*	*0.0*			*67.4*
7.2.1.8	*Food, beverages and tobacco*	*98.8*		*0.0*	*74.2*	*0.0*			*24.5*
7.2.1.9	*Paper, pulp and printing*	*7.2*			*5.0*				*2.2*
7.2.1.10	*Wood and wood products*	*0.1*			*0.0*				*0.0*
7.2.1.11	*Textiles and leather*	*3.6*			*1.5*				*2.1*
7.2.1.12	*Construction*	*13.7*		*2.5*	*7.8*				*3.3*
7.2.1.13	*Non-specified (Industry)*	*6.7*		*0.0*	*1.5*				*5.2*
7.2.2	**Transport**	**887.5**		**462.7**	**416.3**				**8.5**
7.2.2.1	*Rail, metro, other electric transport*	*6.4*							*6.4*
7.2.2.2	*Road*	*879.0*		*462.7*	*416.3*				
7.2.2.3	*Aviation*	*1.4*							*1.4*
7.2.2.4	*Non-specified (Transport)*	*0.8*							*0.8*
7.2.3	**Households**	**995.7**	**10.4**	**0.7**	**669.8**	**120.8**		**8.4**	**185.7**
7.2.4	**Agriculture**	**102.0**		**14.8**	**72.3**				**14.9**
7.2.5	**Services**	**463.2**	**0.8**	**29.9**	**210.2**	**2.5**		**8.4**	**211.3**
7.3	Statistical differences	0.0			0.0				

Energy Balance of Armenia for 2022, IEA Format, aggregated, (ktoe)

N	Energy Balance of Armenia, IEA, 2022.	Coal	Oil products	Natural Gas	Nuclear	Hydro	Geothermal	Solar, Wind, Others	Biofuels and waste	Electricity	Heat	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
1.1	Production	0.0			741.6	166.8		62.0	110.1			1,080.6
1.2	Imports	11.5	727.0	2,450.6					14.2	10.6		3,213.8
1. 3	Exports	0.0	-0.4						-0.4	-135.1		-135.9
1. 4	International aviation bunker		-103.4									-103.4
1.5	Stock changes		-28.5	-23.3								-51.7
1	Total primary energy supply (TPES)	11.5	594.7	2,427.3	741.6	166.8		62.0	123.9	-124.5		4,003.3
2	Transfers											
3	Statistical differences			0.0						0.0		0.0
4	Transformation processes			-710.1	-741.6	-166.8		-62.0		790.2	16.8	-873.4
4.1	Main activity electricity plants			-709.2	-741.6	-166.8		*-20.9*		765.6		-872.8
4.2	Autoproducer electricity plants							*-24.3*		*24.3*		
4.3	Main activity producer CHP plants			-0.9						0.3		-0.6
4.4	Autoproducer CHP plants											
4.5	Main activity producer heat plants											
4.6	Autoproducer heat plants							*-16.8*			16.8	
4.7	Non specified (transformation)											
5	Energy industry own use			-6.6						-35.4		-42.0
6	Distribution losses			-97.4						-52.1		-149.5
7	Total final consumption	11.5	594.7	1,613.2					123.9	578.2	16.8	2,938.4
7.1	Final energy consumption	11.3	524.4	1,613.3					123.3	578.2	16.8	2,867.4
7.1.1	Industry		16.4	244.7					0.0	157.8		418.9
7.1.1.1	*Iron and steel*			*16.4*						*11.6*		*28.0*
7.1.1.2	*Chemical and petrochemical*		*0.0*	*1.4*					*0.0*	*1.3*		*2.8*

7.1.1.3	*Non-ferrous metals*		*5.3*	*1.1*					*0.0*	*19.0*		*25.4*
7.1.1.4	*Non-metallic minerals*		*0.7*	*126.2*						*18.9*		*145.9*
7.1.1.5	*Transport equipment*									*0.0*		*0.0*
7.1.1.6	*Machinery*			*1.0*					*0.0*	*2.2*		*3.1*
7.1.1.7	*Mining and quarrying*		*7.8*	*8.5*					*0.0*	*67.4*		*83.7*
7.1.1.8	*Food, beverages and tobacco*		*0.0*	*74.2*					*0.0*	*24.5*		*98.8*
7.1.1.9	*Paper, pulp and printing*			*5.0*						*2.2*		*7.2*
7.1.1.10	*Wood and wood products*			*0.0*						*0.0*		*0.1*
7.1.1.11	*Textiles and leather*			*1.5*						*2.1*		*3.6*
7.1.1.12	*Construction*		*2.5*	*7.8*						*3.3*		*13.7*
7.1.1.13	*Non-specified (Industry)*		*0.0*	*1.5*						*5.2*		*6.7*
7.1.2	Transport		462.7	416.3						8.5		887.5
7.1.2.1	*Rail, metro, other electric transport*									*6.4*		*6.4*
7.1.2.2	*Road*		*462.7*	*416.3*								*879.0*
7.1.2.3	*Aviation*									*1.4*		*1.4*
7.1.2.4	*Non-specified (Transport)*									*0.8*		*0.8*
7.1.3	*Other sectors*	11.3	45.4	952.2					123.3	412.0	16.8	1,561.0
7.1.3.1	*Households*	*10.4*	*0.7*	*669.8*					*120.8*	*185.7*	*8.4*	*995.7*
7.1.3.2	*Agriculture*		*14.8*	*72.3*						*14.9*		*102.0*
7.1.3.3	*Services*	*0.8*	*29.9*	*210.2*					*2.5*	*211.3*	*8.4*	*463.2*
7.2	Non-energy use	0.2	70.3						0.6			71.0
7.2.1	*Chemical Industry*		*0.1*									*0.1*
7.2.2	*Other sectors*	*0.2*	*70.1*						*0.6*			*70.9*

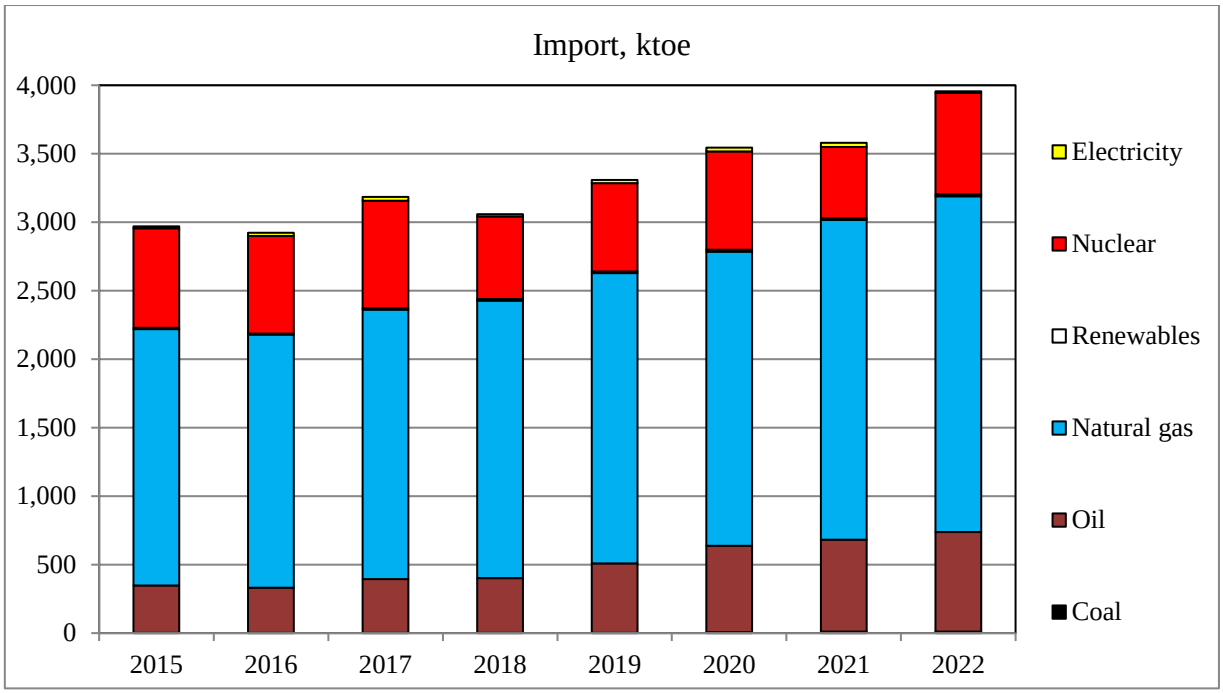
Dynamics of changes in the energy balance indicators of the Republic of Armenia for 2015-2022



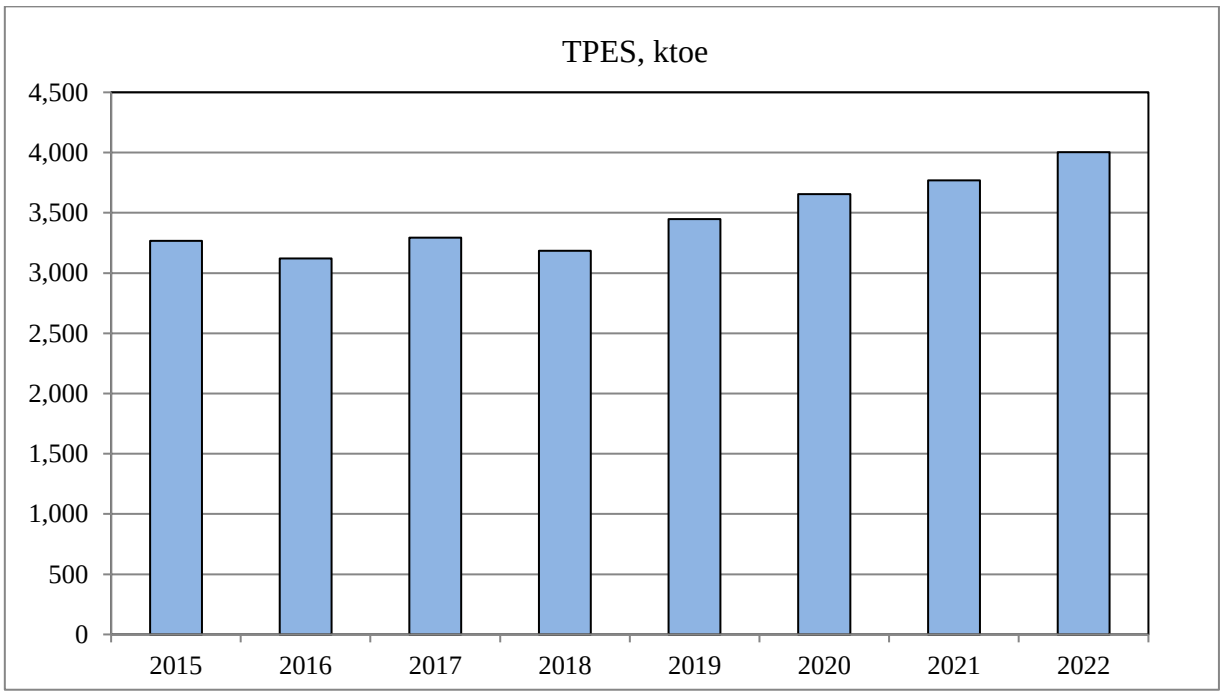
The main domestic sources of primary energy production are nuclear energy and hydro energy which share amounted to 68.6% and 15.4% correspondingly in 2022. The volumes of energy produced in HPPs have decreased compared to previous years.

The data of renewable energy production in 2015-2016 are not reliable, as the volumes of energy production from firewood, other biomass (manure) and solar installations in those years were overestimated. Since 2017, the Armstat has been adjusting the amount of firewood and other biomass consumed in households. The analysis revealed that the volume of firewood consumption in households in 2018-2022 was almost the same - about 48.9 ktoe per year. The volume of manure consumption for energy purposes in the same period was about 65. 7 ktoe per year.

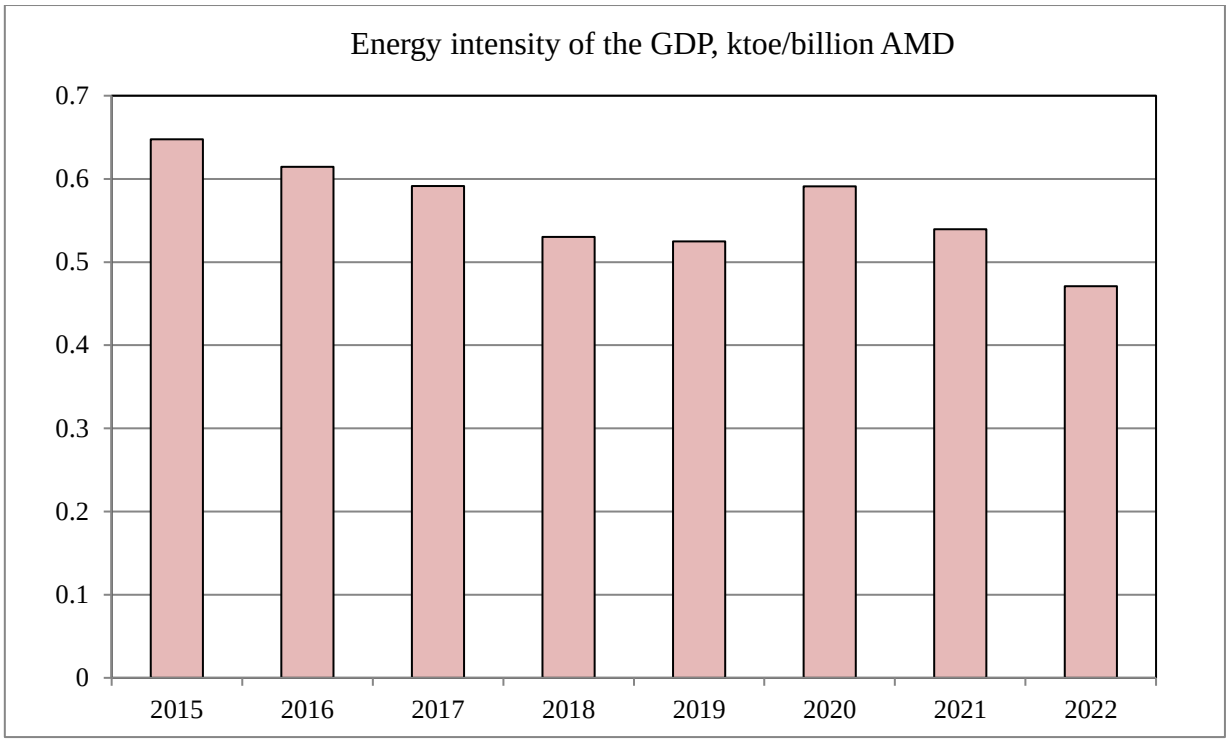
Growth of the solar energy production is significant in the result of encouraging of development of photovoltaic and solar water heating installations. For comparison, note that if in 2021 the share of energy production using solar technologies was 4.7%, then in 2022 it increased up to 5.7%.



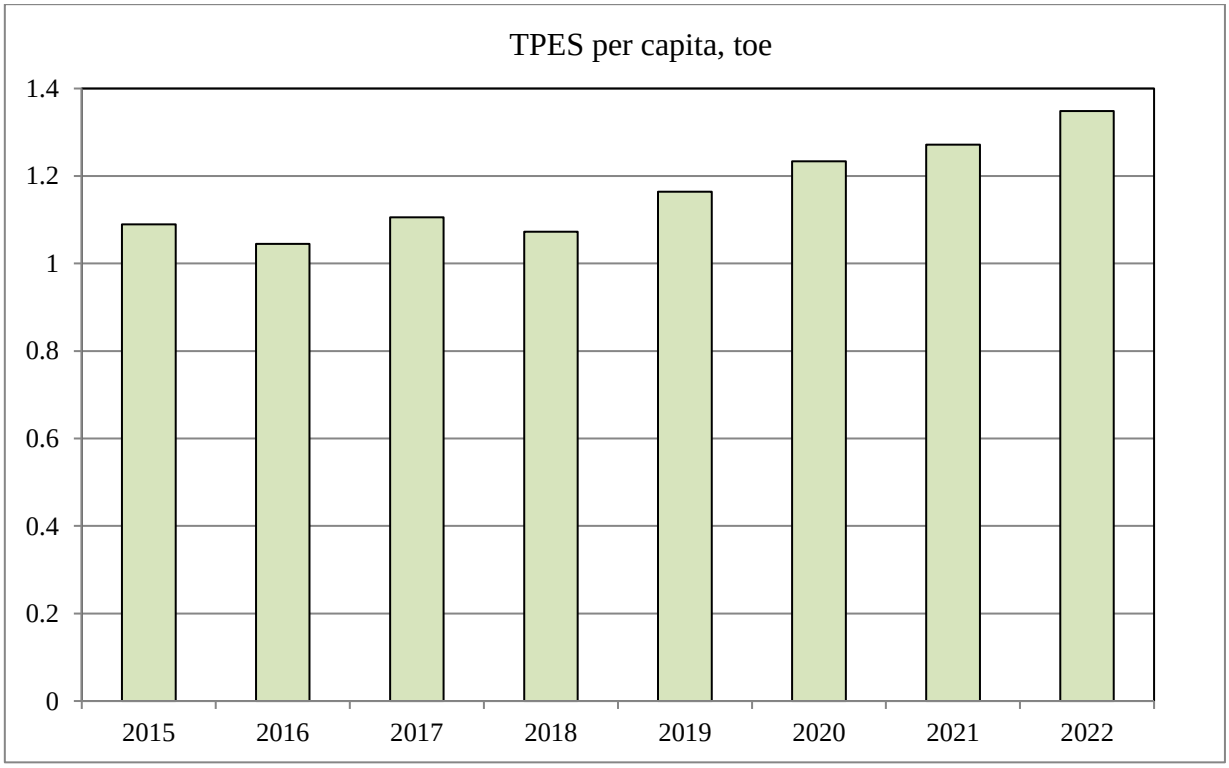
Armenia remains a country with great dependence on the imports of the energy resources. In 2022, imported energy resources in the total primary supply of energy were 80.3%. In 2022, energy imports increased by 5.0% compared to 2021. This is mainly due to an increase in imports of oil products and natural gas.



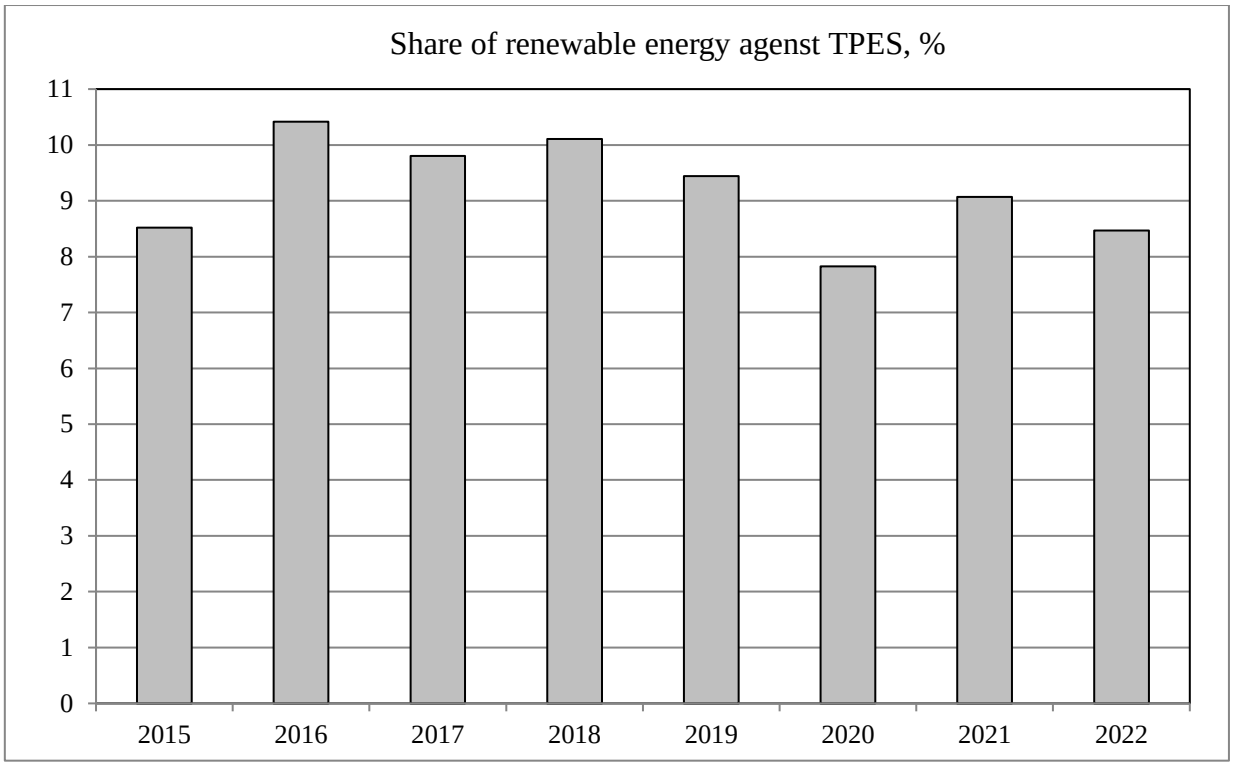
In 2022 the volume of the total primary energy supply increased by 6.2% compared to 2021.



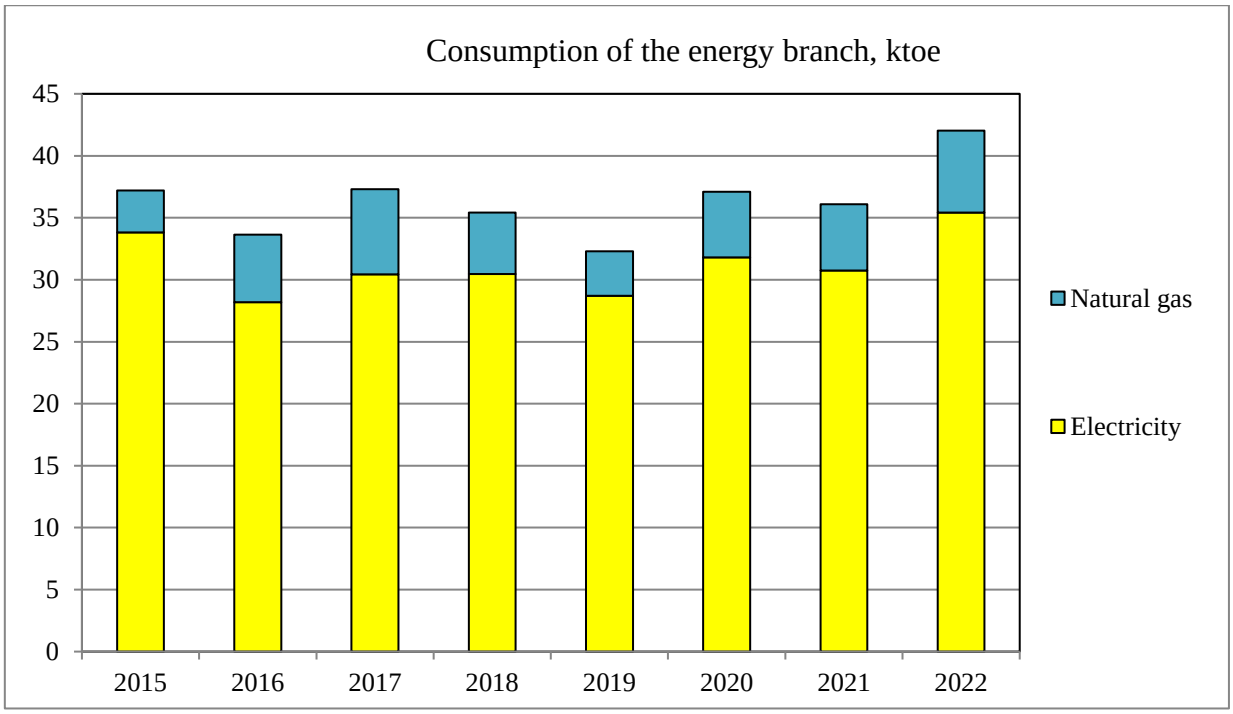
As can be seen from the depicted graphs the energy intensity of the gross domestic product continuously dropped during 2015-2019, except for 2020. In 2022 a decrease in energy intensity of 12.7% was registered compared to 2021. The reason for this decrease is the growth in gross domestic product (GDP) by 21.7% (according to the section "11.10. Production of gross domestic products" of the «Statistical Yearbook of Armenia, 2023», GDP in 2021 amounted to 6982.96 billion drams, and in 2022 - 8501.44 billion drams).



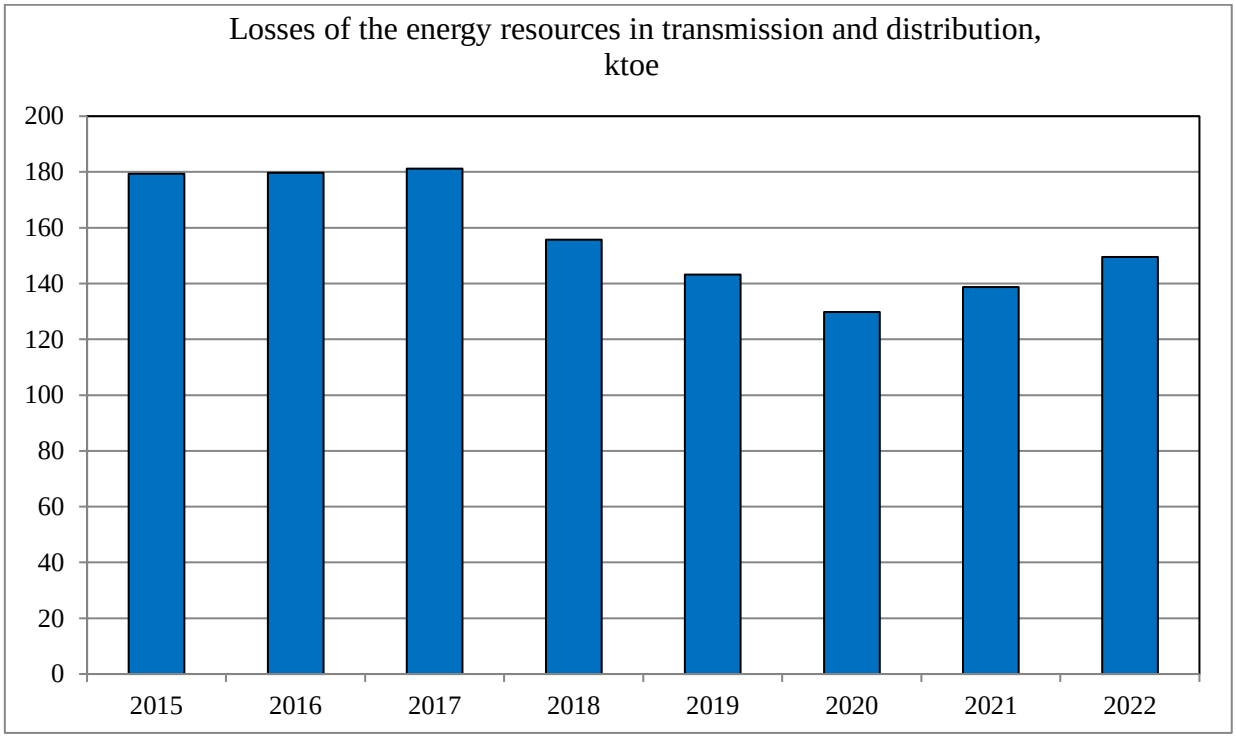
In 2022 primary energy supply per capita increased by 6.0% compared to 2021.



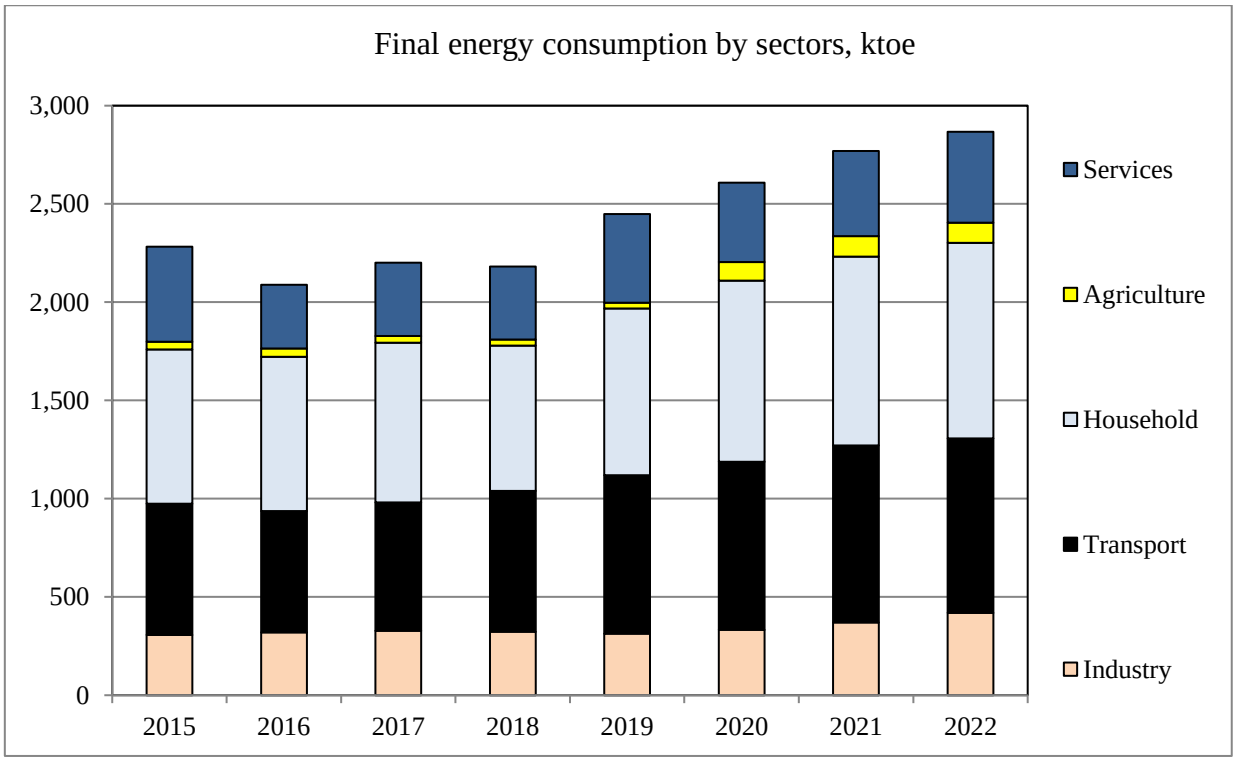
As it has already been mentioned 2015-2016 data are not reliable, as the volumes of energy production from firewood, other biomass (manure) and solar installations in those years were overestimated. In 2017-2019, as a result of adjusting the volume of these energy resources, there is a decrease in the share of renewable energy production in relation to the supply of primary energy. In 2020 this decrease has a very visible appearance as a result of the reduction of the output of hydropower plants. In 2021, there is an increase in the share of renewable energy production, which is due to the increase in the generation of HPPs and solar power plants. But in 2022 there is a decrease in the share of renewable energy production along with the increase in the volume of solar energy production, which is due to the increase in the supply of primary energy and the decrease in the output of hydropower plants.



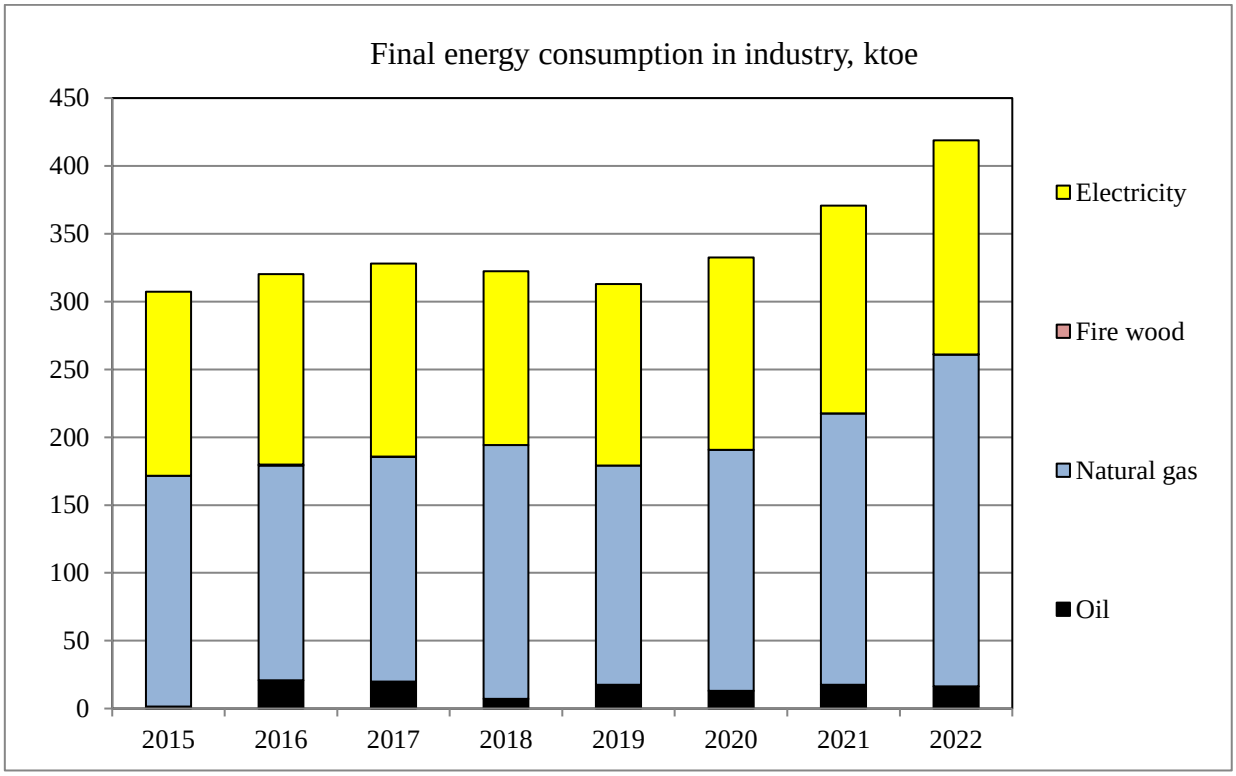
In 2022, there is a certain increase in energy consumption for own needs in comparison with 2021, though it increase by 23.5% in the case of natural gas and increased by 15.2% in electricity. This increase is due to the reoperation of the Hrazdan-5 station in 2022, as well as an increase in the generation of the NPP.

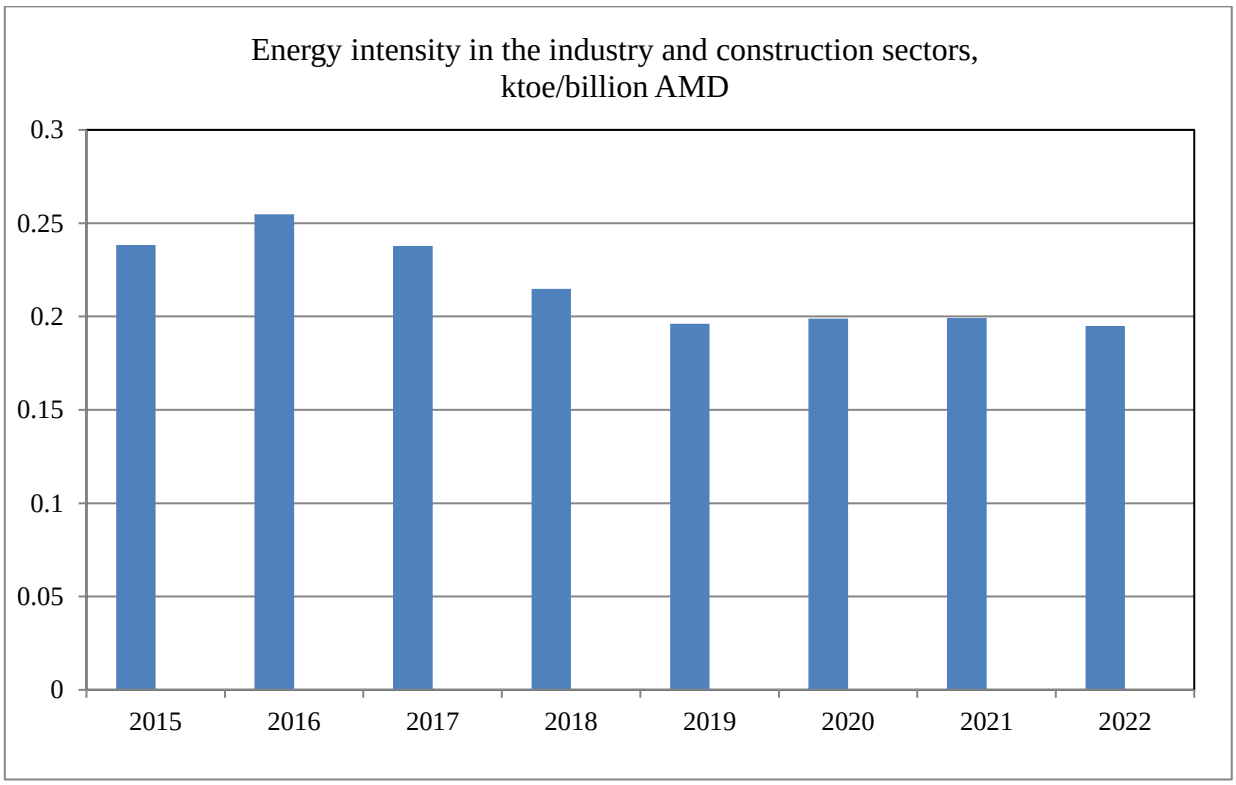


Loss of energy resources increased in 2022 by 7.8% compared to 2021, which is conditioned by increased losses in both the natural gas and electricity distribution and transmission systems.

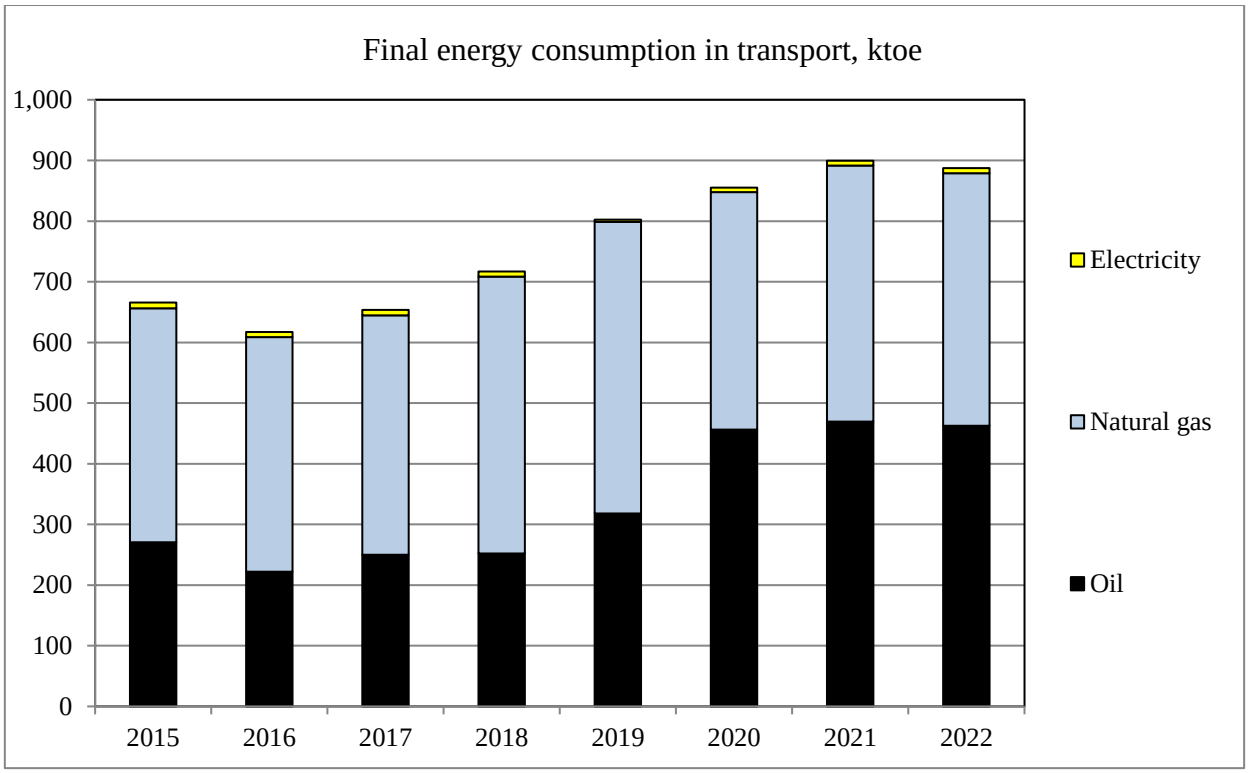


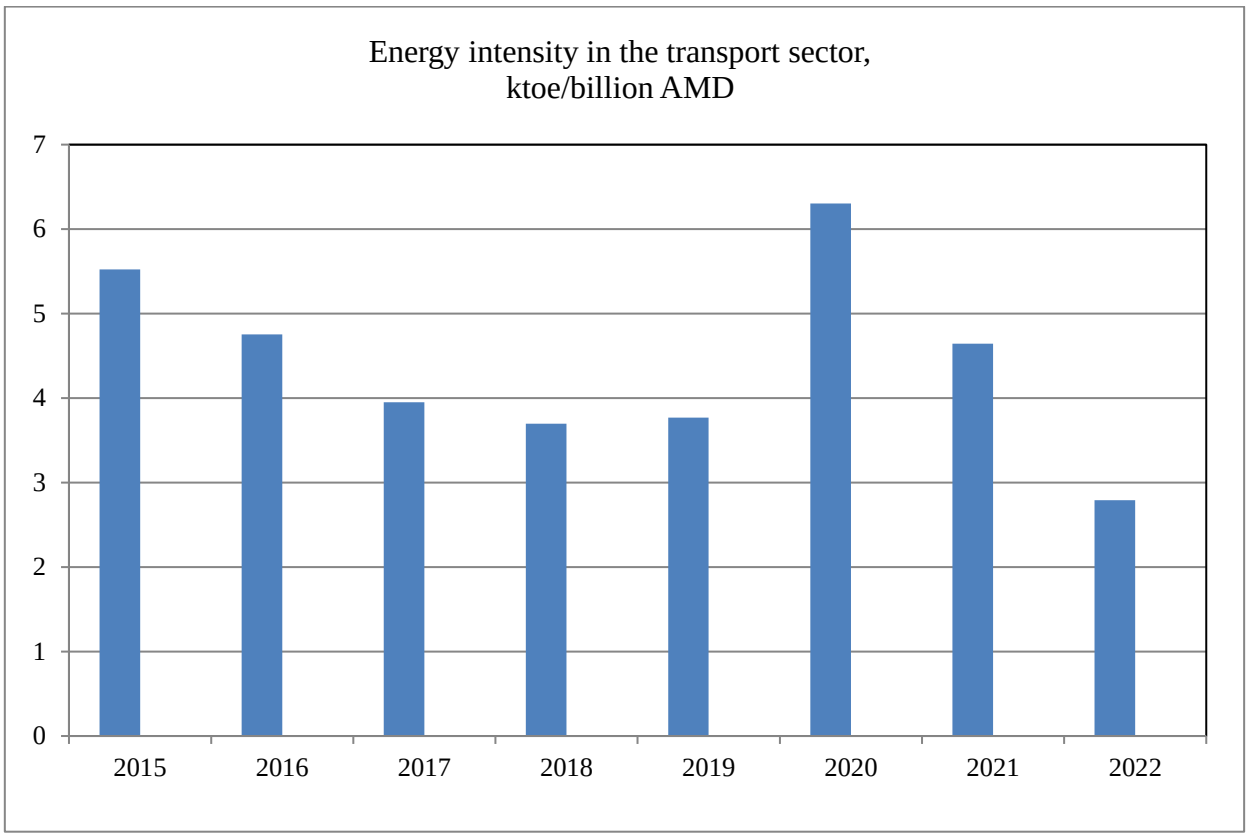
In 2022 the main sector of the energy consumption was the household which share was 34.7% against the total amounts of the final consumption for energy purposes. The transport share was 31.0%. The share of service sector was 16.2%, industry – 14.6%,and agriculture – 3. 6%:





In 2022, a certain increase in energy consumption is observed - 13.0% in the industry, including construction compared to 2021. This increase is due to the increase in the consumption of natural gas. There is a decrease the energy intensity of these sectors – by about 2.2% compared to 2021.

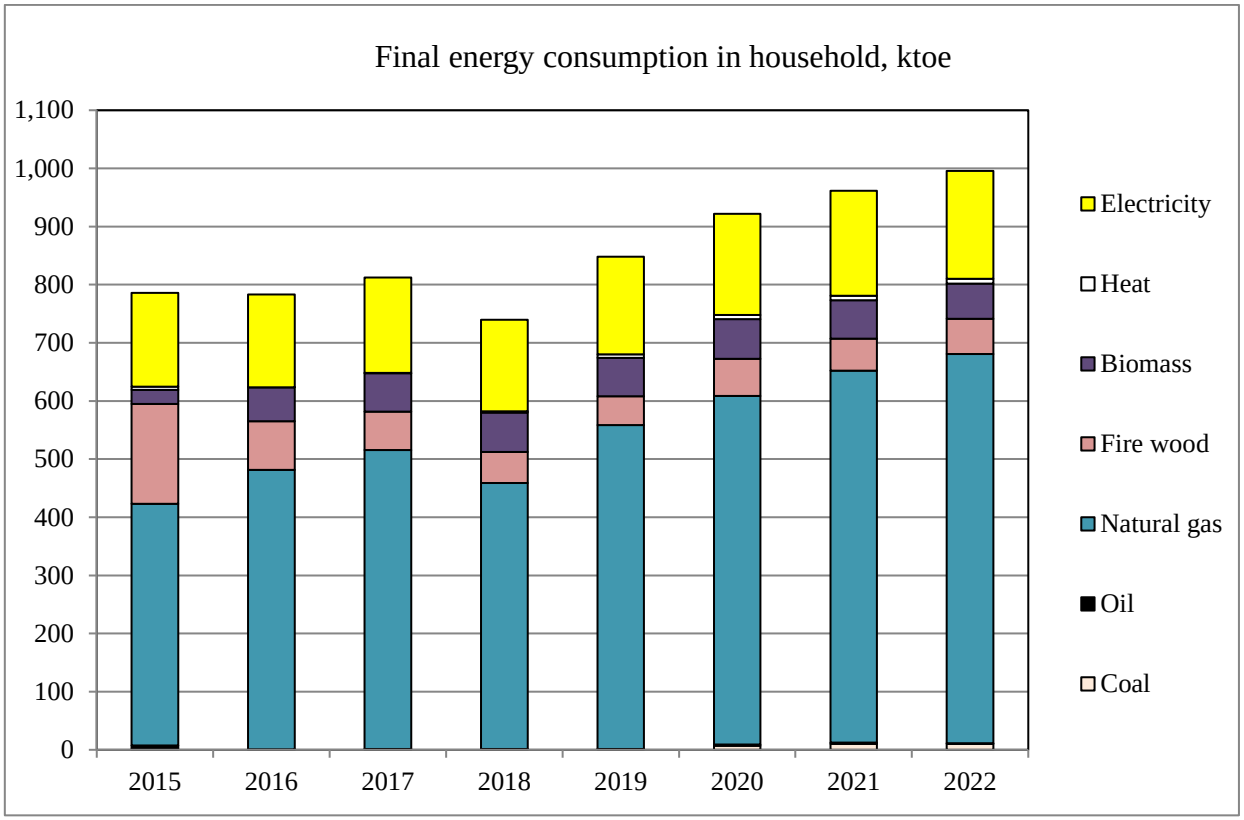


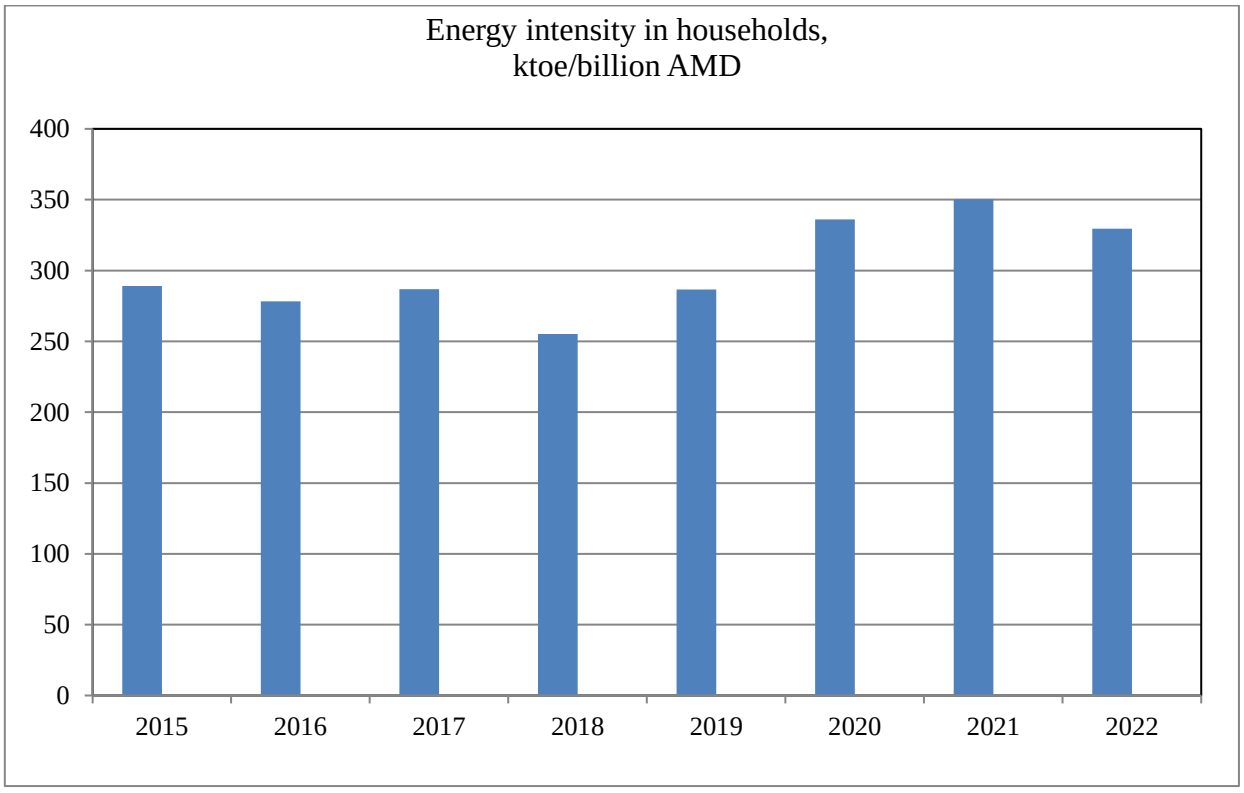


In 2022 there is a decrease in energy consumption, in the transport sector (1.4% compared to 2021). This is mainly due to the decrease in the use of natural gas as motor fuel and the consumption of oil products.

The energy intensity of the transport sector has decreased by about 39. 9% compared to 2021. This is mainly due to the increase in value added in the transport sector by 64.1% (according to the section "11.10. Production of gross domestic products" of the «Statistical Yearbook of Armenia,

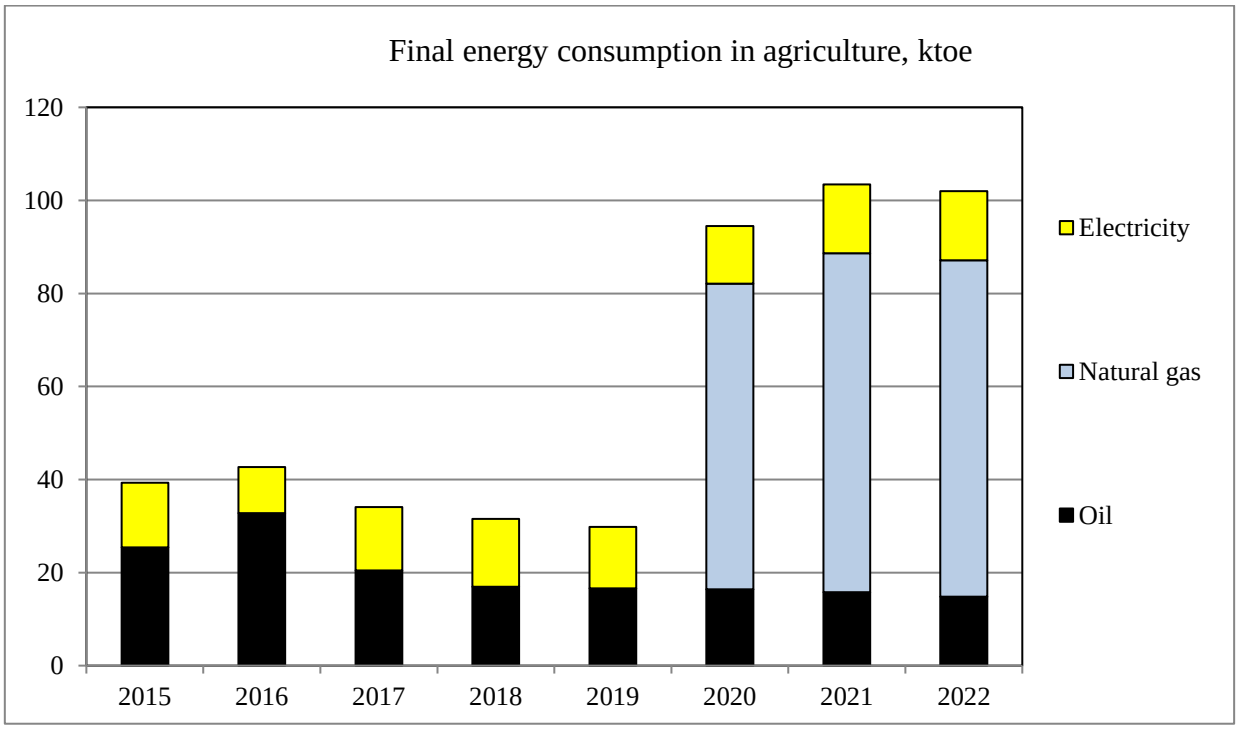
2023», value added in the transport sector in 2021 amounted to 193.8 billion drams, and in 2022 – 318.0 billion drams).

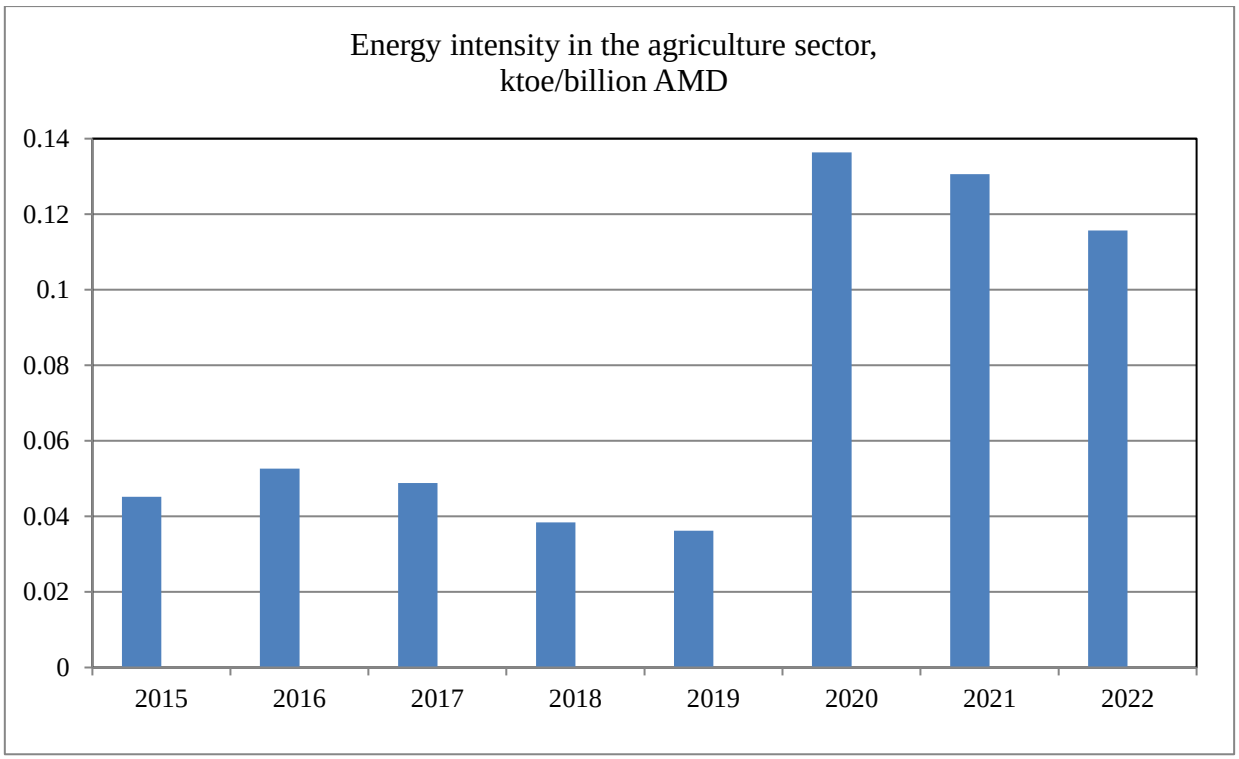




The consumption of the energy resources in the households increased by 3.6% in 2022 compared to 2021. This is mainly conditioned by the increase of consumption of natural gas by 4.7% and of electricity by 2.8%.

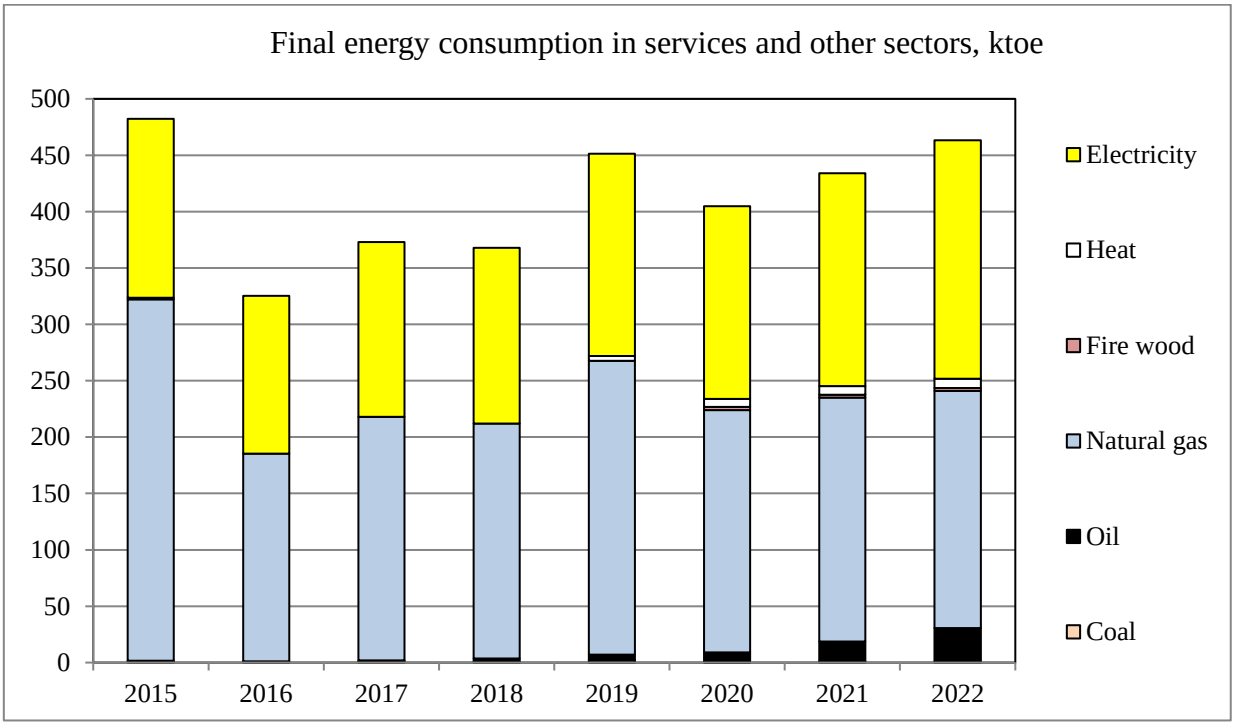
The energy intensity in the households was almost at the same level in 2015- 2017 (around 285 ktoe/billion drams). Since 2019 there is an increase in energy intensity, but in 2022 there is a decrease by 5.9% compared to 2021. This is mainly due to the increase of energy resources consumption and increase in value added in the household by 10.1%. (according to the section "11.10. Production of gross domestic products" of the «Statistical Yearbook of Armenia, 2023», value added in the household sector in 2021 amounted to 2.74 billion drams, and in 2022 – 3.02 billion drams).

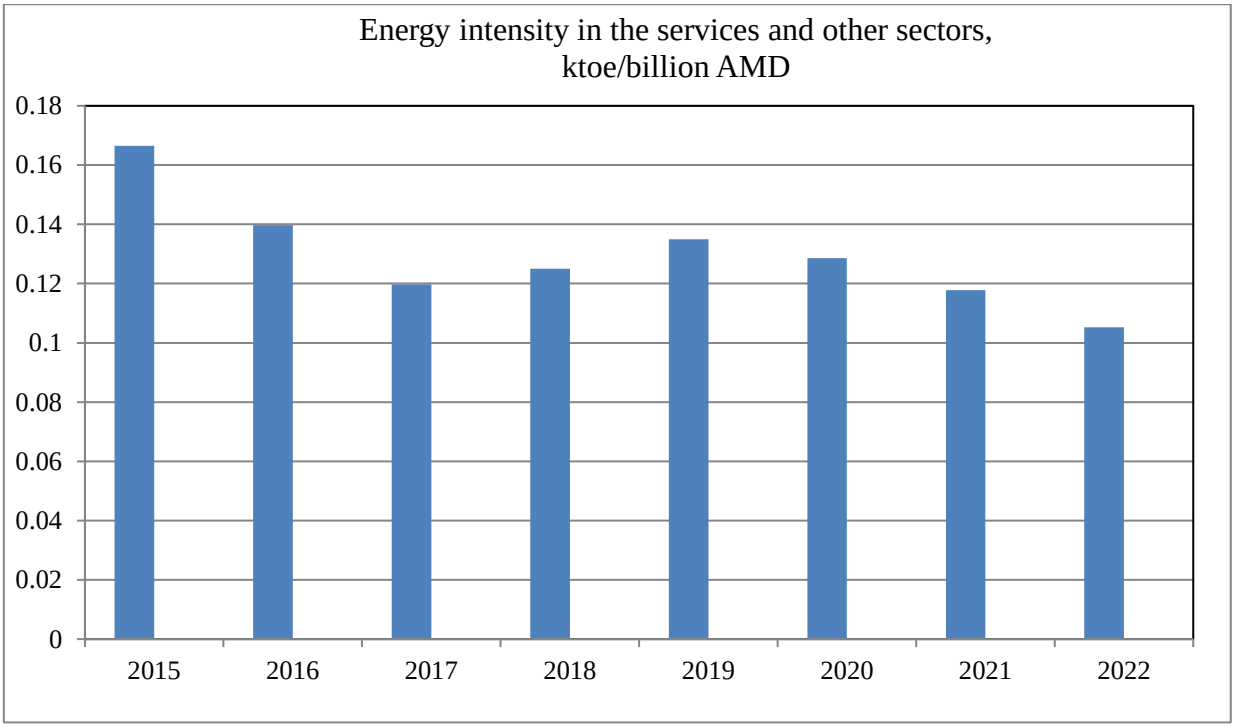




The energy consumption in the agriculture sector decreased in 2022 by around 1.4% compared to 2021. This is mainly due to the decrease of the oil products consumption by 6.3%.

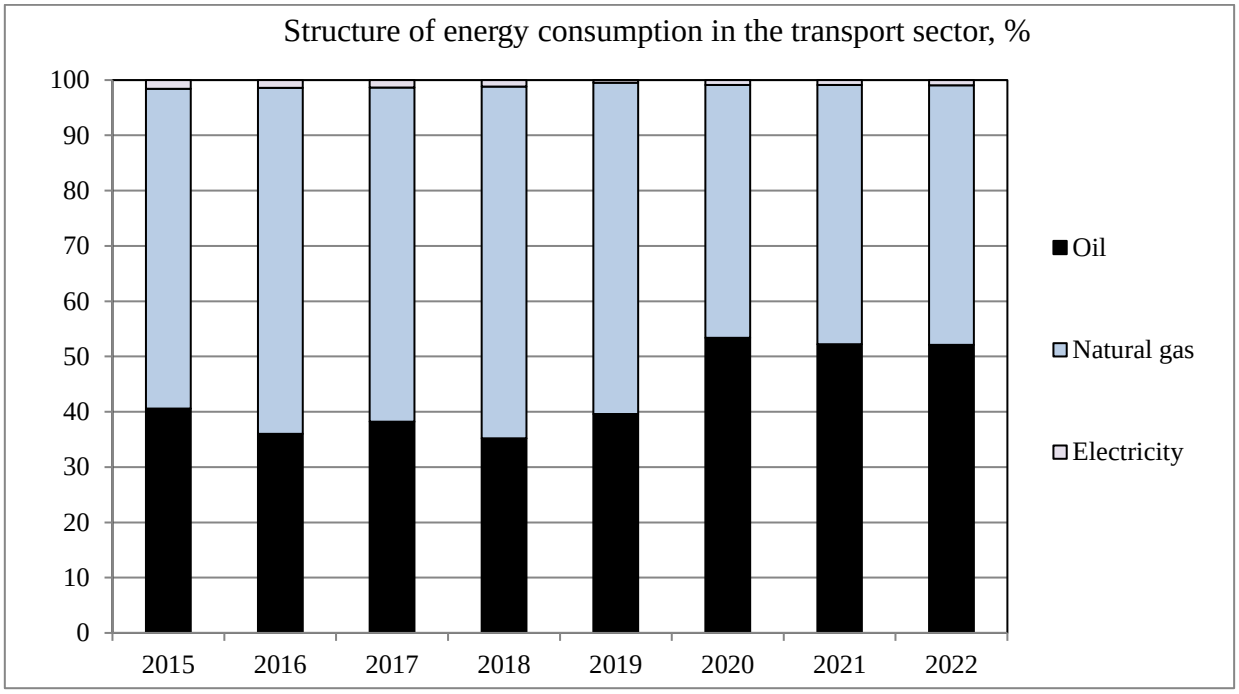
The energy intensity in the agriculture sector decreased by 11.5% compared to 2021. This is mainly due to the low growth of consumption of energy resources compared to the increase in the value added of the sector by 11.4%. (according to the section "11.10. Production of gross domestic products" of the «Statistical Yearbook of Armenia, 2023», value added in the agriculture sector in 2021 amounted to 791.7 billion drams, and in 2022 – 881.9 billion drams).





The consumption of the energy resources in the service and other sectors in 2022 increased by about 6.7% compared to 2021. This is due to an increase in the consumption of oil product and electricity.

The energy intensity of these sectors was continuously dropping during 2015-2018 and increased only in 2019. The energy intensity of services and other sectors decreased by 10.7% in 2022 compared to 2021.



It can be seen from the graph that there is an insignificant increase in the natural gas and electricity consumption and slight reduction of oil production consumption. In 2022, the share of consumed natural gas in the transport sector was 46.9% of the energy consumed, oil products - 52.1%, and electricity – 1.0%.

Conclusions

1. During 2015-2017 there was growth in the total primary energy supply, and in 2018 there was some certain decrease (around 4.5% decrease in 2018 compared to 2017). Subsequently, there was an increase in the total primary energy supply in 2019 by 8.1% compared to 2018, and in 2020 by 5.6% compared to 2019, and in 2021 by 4.8% compared to 2020, and in 2022 by 6.2% compared to 2021.
2. The energy intensity of the gross domestic product continuously dropped during 2015-2019, except for 2020. In 2021, there is a decrease in energy intensity by 7.2% compared to 2020, and in 2022, there is a decrease in energy intensity by 12.7% compared to 2021 due to an increase in gross domestic product (GDP) by 21.7%.
3. Total primary energy supply per capita increased around 6.0% in 2022 compared to 2021.
4. The main source for the domestic production of the primary energy resources remains nuclear energy which share amounted to 68.6% of domestic production in 2022 and hydro energy - amounted to 15.4%.
5. The volume of firewood consumption in the household during 2018-2022 was at the level of about 48.9 ktoe and the volume of biomass (manure) - about 65.7 ktoe.
6. The volume of energy production using solar technologies has significantly increased, the share of which in the volume of domestic production of primary energy resources in 2022 amounted to 5.7%.
7. Armenia remains a country with great dependence on the imports of the energy resources. In 2022 the share of imported energy resources in the total primary supply was 80.3%, while the share of domestic production – 27.0%.
8. A certain decrease of the energy consumption for own needs by 16.5% is observed in 2022 compared to 2021. At the same time the losses of the energy resources in 2022 increased by 7.8% compared to 2021.
9. The main sectors for the energy consumption were the households and transport the share of which in 2022 amounted to 34.7% and 31.0% against the total amounts of the final consumption for energy purposes. The share of service sector in 2022 was 16.2%, industry sector – 14.6%, and agriculture sector – 3.6%.
10. Energy consumption in 2022 compared to 2021:
    - increase in industry by 13.0%,
    - decrease in transport by 1.4%,
    - increase in households by 3.6%,
    - decrease in agriculture by 1.4%,
    - increase in service and other sectors by 6.7%.
11. Energy intensity in 2022 compared to 2021:
    - decrease in industry by 2.2%,
    - decrease in transport by 39.9%,
    - decrease in households by 5.9%,
    - decrease in agriculture by 11.5%,
    - decrease in service and other sectors by 10.7%.

The increase and decrease in the values of energy intensity is due to an increase and decrease in the gross domestic product and its components.

12. The structure of energy consumption in the transport sector in 2022 consisted of:
    - share of oil products – 52.1%,
    - share of natural gas – 46.9%,
    - share of electricity – 1.0%.