PROGRAM ON ENERGY SAVING AND RENEWABLE ENERGY FOR 2022-2030

YEREVAN, 2022

Content

Abbreviations

VAT	Value-added tax
EU	European Union
TPES	Total primary energy supply
TFEC	Total final energy consumption
IRI	Islamic Republic of Iran
kg	Kilogram
SDG	Sustainable development goal
kt	kilotons
PSRC	Public Services Regulatory Commission
RA	Republic of Armenia
GDP	Gross domestic product
R2E2 Fund	Armenia Renewable Resources and Energy Efficiency Fund
UNO	United Nations Organization
MW	MegaWatt
oe	oil equivalent
GHG	Greenhouse gases
RE	Renewable energy

Introduction

1. The "Program on Energy Saving and Renewable Energy for 2022-2030" is developed based on the provisions of the "RA Government Program" approved by the 1363–A Decision of August 18, 2021, of the Government of the Republic of Armenia, and "Strategic Program for the Development of the Energy Sector of the Republic of Armenia (until 2040)". The commitments undertaken by the Republic of Armenia under various international agreements and treaties on sustainable development, renewable energy, energy saving, and climate change were taken into account in developing the Program.

2. This program defines the directions, goals, and targets of the policies pursued in energy-saving and renewable energy sectors for 2022-2030, determining the main actions and measures envisaged to ensure the set targets.

3. The program will be implemented in three stages: 1) 2022-2024, 2) 2025-2027 and 3) 2028-2030, in accordance with the Action plans ensuring the implementation of separate stages of the "Program on Energy Saving and Renewable Energy for 2022-2030" to be approved by the Government of the Republic of Armenia.

Chapter 1. Situation background

4. **Primary energy supply and energy efficiency.** Primary energy supply (PES) trends can be divided into three periods over the past decade. First, the volume of primary energy supply fluctuated sharply in 2008-2012 due to the significant economic decline and post-crisis recovery of the Armenian economy as a result of the global financial crisis of 2007-2008, then, PES stabilized in 2013-2016 and, finally, the volume of primary energy supply increased significantly in 2017-2019 exceeding the level of 2016 by about 7.5% in 2019, due to the high actual GDP growth in those years. However, in 2018 PES decreased significantly due to the unprecedentedly hot weather compared to 2017.

5. The volume of primary energy supply (excluding net exports) increased by almost 300 thousand tons of oil equivalent (toe) in 2019 compared to 2008, amounting to 3,511 thousand tons of oil equivalent. Thus, the average annual growth of primary energy supply was 0.8 percent in 2008-2019. For the same period in 2008, the average annual GDP growth rate at constant prices was 2.6 percent. As a result, the energy efficiency of GDP increased by about 21 percent. Energy efficiency is one of the critical prerequisites of the economy's competitiveness, especially for countries with a free market economy heavily dependent on imported energy resources.

6. The most common indicator of international energy efficiency comparisons is the ratio of GDP PPP constant international $[1] to the primary energy supply, expressed in kg. o. e. With this indicator, Armenia improved positions significantly between 2008-2018; Armenia's index exceeded the average of 9 Eastern European countries[2] by 2018 and was only 14% below the EU average. However, if energy efficiency is evaluated considering the GDP expressed in the current euro exchange rate, the picture will change significantly. In this case, energy efficiency is about 2.7 times lower in Armenia than in the EU and 1.7 times lower than the average of Eastern European countries.

7. Armenia is highly dependent on fossil fuel imports, and this dependence has intensified over the past decade. Over the past ten years, the share of fossil fuels (oil products and natural gas) in the primary energy supply has increased by 1.6 percentage points to 70.6% in 2019.

8. There are two main trends in structural changes in primary energy supply and imported fossil fuel in the period under review: i.e., increase in the share of natural gas and decrease in the share of oil products. Natural gas retained and strengthened its priority position with a share of 60 percent and more during the review. Natural gas accounted for more than 95% of the increase in primary energy supply during the observed period, mainly due to the growing demand for light-duty vehicles and households.

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[1] GDP PPP constant international $:

[2] Eastern Europe: Romania, Poland, Hungary, Bulgaria, Czech Republic, Slovakia, Estonia, Latvia, Lithuania.

9. Reducing dependence on imported fossil fuels is a priority for Armenia, and the leading way to achieve this goal is to accelerate the development of renewables. The share of renewables in the primary energy supply structure ranged from 11% to 12% in the last decade. The percentage of renewables was 11.7% (without biofuels-5.7 %) in 2019.

10. In terms of primary energy supply structure, Armenia is distinguished by the availability of nuclear power, which accounts for about 18 percent of the primary energy supply in the country. Although nuclear energy is not considered a renewable energy carrier, therefore both in terms of the economic benefit of electricity generation at the operating NPP and reducing GHG emissions, replacing nuclear energy with renewable energy cannot be considered as an alternative in the next 10-15 years, depending on the technical possibility of extending the lifetime of the existing nuclear power plant and financing opportunities.

11. Part of the primary energy is supplied to end-users through power conversion in the power grid. In 2019, about 30% of natural gas imports were used to generate electricity at three thermal power plants. About 40% were exported to the Islamic Republic of Iran within the "Electricity in exchange for gas" barter scheme. Thus, only 20 percent of imported natural gas is currently used to meet domestic electricity demand, providing about 1.7 billion kWh of useful electricity supply to end-users, or 28 percent of the domestic market. According to the results of recent tenders organized for the construction of solar plants and IPP indicators, to meet domestic demand by the complete replacement of natural gas by solar power, in case of unchanged domestic demand conditions, it would require the construction of renewable energy-based (except hydropower) plants of 700 MW, given that there are already about 150 MW plants in operation in the first half of 2021.

12. **Final energy consumption**. In 2008-2019, total final energy consumption was characterized by the trends typical to primary energy supply for the same period. Total final energy consumption increased by almost 10%, or an average of 0.9% per year (increase in final energy consumption for energy purposes was 9.6% or 0.8% per year) during the observed period. In absolute terms, the total final energy consumption in 2019 was 2,574 thousand t.o.e. compared to 2,339 thousand t.o.e. in 2008.

13. According to the industry branch, significant shifts occurred in the total final energy consumption structure during the observed period. In particular, the industry share in the total final energy consumption structure decreased by 18.4% points in 2019 compared to 2008, amounting to 11.8% in 2019. Meanwhile, the share of the transport and services sector increased by 5.7 and 9.5 percentage points in total final energy consumption structure during the observed period, amounting to 31% and 14% respectively in 2019. As for final energy consumption in the household sector showed only typical total consumption trends (average growth of 0.9% in 2008-2019). Therefore, the share of final energy consumption in the entire household structure has practically not changed, amounting to about 36% in 2019. Thus, the transport and household sector accounted for about 67% (or two-thirds of the total) of total final energy consumption in 2019.

14. In 2008-2019, the share of natural gas for energy purposes decreased by 2.1% points in the final energy consumption structure (due to the reduction of natural gas consumption in the industry). The share of electricity increased by 4 % points (which is mainly due to the increase in electricity consumption in the service sector). Nevertheless, according to energy sources, natural gas for energy purposes continues to dominate in the final energy consumption structure (about 60% in 2019), and the electricity share in this structure was 21% in 2019. Despite the positive developments in recent years, solar energy share in the final energy consumption structure remains very low, amounting to 0.4% in 2019.

15. **Solar energy development, constraints and state support**. Solar energy generation has overgrown around the world over the past ten years. According to the International Energy Agency (IEA), the capacity of solar power plants increased 70 times in 2019 compared to 2008. Armenia is considered a favorable country for solar energy development, even though solar energy currently plays a minor role in the primary energy supply structure (0.4 percent in 2019). Nevertheless, it should be mentioned that international tenders for the construction of two large solar power plants with 255 MW total installed capacity have been successfully processed in Armenia, and the installed capacities of IPPs recorded exponential growth in power flows in the past three years.

16. An increase in the renewable energy share, particularly in solar energy in the power system of Armenia, given its significant dependence on the hours of the day, seasonality, and unpredictable weather conditions, has certain limitations:

    1) First of all, it relates to the technical possibilities of regional integration. Currently, Armenia-Georgia 200 MW capacity power transmission lines and Armenia-Iran 350 MW transmission lines are in operation. They can ensure safe, reliable, and economically viable operation of solar power plants with up to 300-350 MW. Increasing the capacity of more solar plants requires a corresponding increase in regional flows, envisaged in the Strategic Plan for the Development of the Energy Sector of the Republic of Armenia. This refers mainly to the Armenia-IRI power transmission line, which is planned to increase by about 3.4 times in future.

    2) The world experience of recent years (California (USA), New South Wales (Australia)) shows that even well integrated power systems with a significant increase in the renewable energy share require installation of special battery energy storage systems. Even 10-15 years ago, battery energy storage systems were not considered a possible alternative for renewable energy development, given their incomparably high prices, for example, compared to natural gas-fired peak plants. Nevertheless, due to a sharp drop in battery prices in 2020, they are 20-25% behind carbon-based power plants. If these trends continue in 2025-2030, battery energy storage systems may be more profitable than today's natural gas-fired plants. Moreover, advanced storage batteries are equipped with appropriate devices that can significantly improve the solar PV plants' performance and contribute to the stability and reliability of the overall electric power system. According to preliminary estimates, to achieve the target share

of solar energy according to the "Strategic energy development program" of the Republic of Armenia the installation of about 300 MW / 1200 MW battery energy storage systems will be required.

17. Various mechanisms of state and intergovernmental support are used to increase the share of renewables almost worldwide: tax and/or customs concessions, provision of special zones/areas with appropriate infrastructures, various schemes of guaranteed purchase of products, tariff bidding with the provision of additional government guarantees, provision of quotas in fixed tariffs and guaranteed purchase terms, simplified conditions for the connection to the distribution network for IPP and encouraging prices for the purchase of a surplus product, preferential conditions for attracting credit resources mainly in developing countries, taxes on the carbon fuel use, intergovernmental carbon quotas, etc. Each of them has its advantages and disadvantages, which are applicable and expressed more or less depending on the characteristics of a particular country. Thus, in countries with a liberal electricity market, guaranteed purchases and quotas at fixed tariffs are not applied; tax incentives and carbon taxes are more applicable here. In countries where distribution networks are state-owned and have a monopoly position, there is no particular need to provide additional state guarantees. Instead, tariff tenders are conducted by the distribution networks. In most developing countries, in conditions of high risk of equity and debt capital, credit incentives are more applicable and change the propensity to consume and save, leading to additional investments. Intergovernmental quotas are more functional in countries with integrated economies and power systems, such as the European Union.

18. The following methods of state support have been applied in Armenia in recent years and currently:

   1) Simplified conditions for the connection to the distribution network for IPP and encouraged prices for surplus products purchase. This policy, adopted by the PSRC and supported by the RA Government, was perhaps the most effective policy, due to which the capacity of solar plants, exclusively through the private investments, has increased by an average of 30 MW annually in the past three years, reaching to 107 MW in June 2021. Continuing this policy, with specific changes and improvements, introducing the institute of group IPP, and installing appropriate battery energy storage systems, the increase in the upper limit of power may ensure a 200-250 MW capacity increase in solar power plants in the next 10 years.

   2) Tariff bidding with the provision of additional state guarantees. Although the Law of the Republic of Armenia "On Energy" stipulates a guaranteed purchase rate for 20 years for the plants using renewable energy resources, nevertheless, from the perspective of investors and financiers, the private distribution networks in Armenia cause additional risks that should be covered by the provision of other, non-direct guarantees from the Government. As a result of this policy, two tenders for the construction and operation of solar PV plants (Masrik-1 Solar PV plant (55 MW and 4.19 US cents per kWh at a fixed rate) and Ayg-1 solar PV plant (200 MW and 2.9 US cents per kWh at a fixed rate)) have been successfully held in the last three years. The tariff of the latest tender was comparable with the tariff of the operating NPP if

the influence of the state loan provided to NPP is not considered. Nevertheless, the continuation of this policy, particularly holding tenders for the large solar photovoltaic plants with a capacity of 320 MW envisioned by the Government of the Republic of Armenia, is highly dependant on the capacity of Armenia-IRI power transmission lines, storage systems, and improvement of high-voltage power transmission network (in particular, regarding measures for the reconstruction of substations) under the Strategic Plan for the Development of the Energy Sector of the Republic of Armenia (until 2040).

19. **Developments in this sector and the scope of SDGs**. Developments in this sector are directly related to SD Goal 7, ensuring the availability of accessible, reliable, sustainable, and advanced energy for everyone.

20. Regarding Sustainable Development Goal 7.1(ensuring overall access to affordable, reliable, and advanced energy services by 2030), it should be stated that electricity access is universal in Armenia; according to the various studies, the access rate is 99.6-100%. As for clean fuel and technologies, the number of people relying on clean fuel and technology was 96.9% in 2015, according to the demographic and health survey conducted by the RA Statistical Committee. In urban areas, it was 99.7% 92% in rural areas. However, when considering the actual statistics of the localization ("nationalization") of the problem (part of households that have a primary dependence on clean fuel and technology), the picture differs significantly, especially in terms of rural settlements. Thus, according to the regular surveys on the household living conditions conducted by the RA Statistical Committee, 69.2% of households were dependent on clean fuels and technologies in 2019 compared with 58.8 % in 2015. On the other hand, analysis of the actual results reveals a significant "gap" between urban and rural settlements. Thus, the share of households with a primary dependence on clean fuels and technologies in urban areas was 82.5% and 92.9% in 2015 and 2019, respectively, while in rural settlements, the figure was relatively low, reaching 15.5% and 31.5% in 2015 and 2019, respectively.

21. The next focus of Sustainable Development Goal 7 is the renewable energy share increase in total final energy consumption (target 7.2). Hydro, solar, wind energy, solid and liquid biofuels, geothermal and marine energy, waste are considered renewable energy sources. According to RA Statistical Committee publications, the renewable energy share in the total final energy consumption (TFEC) was 10.4 % in 2019, decreasing 0.4 % compared to 2015. This change can be considered positive as It occurred due to a decrease in the share of conventional[3] renewable energy sources (in the period under review, a 1.1 % decrease in traditional renewable energy share in the total final energy consumption structure). Whereas the share of advanced renewables[4] increased to 7% in 2019 compared to 6.2% recorded in 2015. On the other hand, considering firewood consumption growth, the renewable energy share in energy consumption was incomparably higher - 14.9% in 2019, as compared to15.8 % in 2015. Again, the share of

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[3] Biomass, firewood and waste.

[4] Hydro, solar and wind energy.

renewables decreased due to a reduction in the share of conventional renewable energy sources. Moreover, analysis of firewood consumption growth showed that the share of conventional renewables in total final energy consumption decreased to a greater extent in the period under review, amounting to 8.2% in 2019, compared to 9.9% in 2015.

22. The third target (to double the increase of energy efficiency until 2030) of Sustainable Development Goal 7 envisages that the annual energy intensity index for 2010-2030 will be doubled[5] compared with the global (the world) average energy intensity index (calculated as the ratio of primary energy supply to GDP, equivalent to purchasing power parity) for 1990-2010. Thus, the average annual energy intensity growth index from 1991 to 2010 was 1.3 % at the global level; accordingly, the third target of Sustainable Development Goal 7 is to double the average annual energy intensity growth index over the next 20 years (2011 - 2030) up to 2.6%. However, given that the average annual energy intensity growth index between 2011-2018 was lower than the average yearly target set, therefore, to achieve the initially set target, energy intensity should be improved by an average of 3%[6] per year between 2019 to 2030.

23. The energy intensity index improved at a much higher rate in 1991-2010 in Armenia (as well as in other post-soviet countries) than was the world energy intensity index. Thus, during the observed period, the energy intensity index improved by an average of 6.7% per year, exceeding the average annual energy intensity growth by more than 5 times at the global level. As a result, the energy intensity index in Armenia declined from 17.6 constant 2017 PPP $ in 1990 to 4.4 constant 2017 PPP $ in 2010. For comparison, the corresponding indicator at the global level was 7.1 constant 2017 PPP $ and 5.6 constant 2017 PPP $ respectively in 1990 and in 2010. In 1990, Armenia was considerably behind the world average in terms of the absolute energy intensity, while in 2010, it was already in a more favorable position than the world average.

24. In 2011-2018, the energy intensity index in Armenia improved by an average of 2.5% per year compared to a 2% annual improvement at the global level. As a result, the energy intensity index in 2018 was 3.63 constant 2017 PPP $, remaining below the world average of 4.75 constant 2017 PPP $.

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[5] See, 2021 Tracking SDG7 Report (https://trackingsdg7.esmap.org/downloads)

[6] See 2021 Tracking SDG7 Report (https://trackingsdg7.esmap.org/downloads)

Chapter 2. Objectives and targets

25. The Program aims to improve the energy efficiency in the economy of Armenia in the next ten years, promote energy-saving, and increase the use of renewable energy sources to enhance energy security and reliability and reduce the negative environmental impacts.

26. The program considers ensuring the set levels of primary energy supply and total final energy consumption as the main targets. In particular, the following levels of above indicators are envisaged in the projected period:

    1) *total primary energy supply (ktoe)* - 4,513 in 2024, 4,921 in 2027, 5,5295 in 2030,

    2) *total final energy consumption (ktoe)-* 3,168 in 2024, 3,544 in 2027, 38,834 in 2030.

27. The main goal for final energy consumption is the target value of the entire economy, while the sectoral targets will be indicative. In particular, final energy consumption is projected to have the following breakdown by sectors in 2030:

    1) *industry*   *443 ktoe*
    2) *transport*   *1305 ktoe*
    3) *households*   *1,260 ktoe*
    4) *services*   *523 ktoe*
    5) *agriculture*   *189 ktoe*
    6) *non-energy consumption*   *114 ktoe*

28. In addition to the primary targets, the Program sets targets in the following two areas`

    1. renewable energy development,
    2. energy-saving

29. **Renewable energy development:** Further development of renewable energy is considered a key direction of the RA Government energy policy as an essential guarantee of increasing energy independence and security and ensuring a reliable and quality electricity supply to consumers.

30. During the Program, special attention will be given to increasing electricity generation using advanced renewable energy sources (solar, wind, geothermal).

31. The Program aims to increase the share of solar energy production in total to at least 15% by 2030.

32. The utilization of battery energy storage systems is essential in achieving the goal, which will significantly improve the safety and reliability of the power system. It is planned to launch battery energy storage systems with 300 MW (1200 MWh) capacity during the program period.

33. The increased use of renewable energy will improve the share of low-carbon energy in electricity generation to meet the domestic demand (75% in 2030, compared to 72% in 2019). However, the

low-carbon energy share in total electricity generation structure will be decreased (51% in 2030 compared to 60% in 2019) given the exported electricity will be generated based on natural gas.

34. **Energy saving:** Energy saving targets are defined considering the differences between the primary energy supply and total final energy consumption indicators corresponding to the policies and baseline scenarios.

35. In particular, the Program aims to ensure that by 2030 cumulative energy saving for the total primary energy supply, calculated as the absolute value of the difference of the corresponding announced policies and baseline scenarios of total primary energy supply, will amount to 815 ktoe. Cumulative energy saving for the total final energy consumption, calculated as the absolute value of the difference of the appropriate baseline and announced policies scenarios of total final energy consumption, will amount to 931 ktoe (the latter accounts for about 20 percent of the total final energy consumption corresponding to the baseline scenario) [7].

Insert 1: Basic scenario assumptions under consideration

1. Economic growth: The Program is designed on the assumption that in real terms, GDP will grow by an average of 7% per year during the Program period. The assumptions made for economic growth are based on current forecasts and estimates of the medium and long-term economic development in Armenia, referring to the RA Government program (2021-2026).
2. Population: Population estimates are based on long-term population projections and estimates published by the United Nations. Population changes are assumed to be insignificant during the Program period.
3. Climate conditions. In terms of climate conditions, which are the next significant factor of the Project design, it is assumed that the average indicators of 2010-2019 will be maintained.

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36. The Program implementation will also contribute to the reduction of greenhouse gas emissions (GHG). In particular, it is predicted that by 2030, total GHG emissions in the energy sector will be reduced by 50% compared to the levels of 1990. At the same time, to meet the domestic demand, by 2030 greenhouse gas emissions from production will be reduced at an incomparably higher rate -by more than 60% compared to 1990.

37. The table below summarizes the main scope of the indicators of the Program:

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[7] The targets are set with reference to the basic assumptions under the Program, which are identical for both baseline and announced policy scenarios (see insert 1). Therefore, when assessing the indicators, if necessary, baseline indicators should be clarified, in particular, taking into account differences between the forcasted and actual economic growth.

Indicator	Measurement unit	1990	2019	2024	2027	2030
GDP at current prices	billion AMD		6,543	9,057	12,431	17,001
Annual average real GDP growth rate	compound interest		4.7%	3.88%	5.04%	5.57%
Annual average GDP deflator	compound interest			2.76%	3.26%	3.46%
GDP at constant prices 2008	billion AMD		5,046	6,103	7,476	9,158
GDP (expressed in constant 2017 PPP $)	mln USD		42,092	48,313	63,328	77,580
TPES	ktoe	7,709	3,511	4,513	4,921	5,295
TFEC	ktoe		2,574	3,168	3,544	3,834
TPES decrease rate compared to 1990	percent		54%	41%	36%	31%
TPES average annual growth (+) reduction (-)	compound interest			5.1%	4.3%	3.8%
GDP energy efficiency	AMD/kg oe		1,437	1,352	1,519	1,730
GDP EE growth compared to 2019	percent			-5.9%	5.7%	20.4%
GDP/ PPP 2017/ energy efficiency	USD/kg oe		11.99	11.46	12.87	14.65
GDP PPP energy intensity	toe/1000 $		0.083	0.087	0.078	0.068
GDP PPP annual average energy intensity incline against 2010	compound interest		-4.9%	-3.2%	-3.0%	-3.2%
Energy efficiency compared to TPES baseline	ktoe			95	-244	-815
Energy efficiency compared to TFEC baseline	ktoe			-109	-395	-931
Energy efficiency compared to TFEC baseline, percent	percent			-3.3%	-10.0%	-19.5%
RE share in TFEC	percent		16.0%	16.1%	15.0%	13.2%
Advanced RE share in TFEC	percent		8.0%	10.6%	10.5%	9.6%
RE share in the electricity generation system	percent		31.4%	31.4%	33.2%	31.2%
Advanced RE share in the useful electricity supply system	percent					
Energy independence, the import rate	percent		86%	74%	74%	77%
Energy GHG emissions	Gg CO2eq	22,712	7,088	9,644	10,507	11,458
Energy GHG emissions (domestic demand)	Gg CO2eq		7,446	6,954	7,817	8,768
Energy GHG emissions reduction rate compared to 1990	percent		68.8%	57.5%	53.7%	49.6%
Energy GHG emissions reduction rate compared to 1990 (domestic demand)	percent		67.2%	69.4%	65.6%	61.4%
Total GHG emissions	Gg CO2eq	25,035	10,811	14,132	15,527	17,073
Total GHG emissions (domestic demand)	Gg CO2eq		10,283	11,442	12,837	14,383
Total GHG emissions reduction rate compared to 1990	percent		56.8%	43.5%	38.0%	31.8%
Total GHG emissions reduction rate compared to 1990 (domestic demand)	percent		58.9%	54.3%	48.7%	42.5%

*2010-2019

Source: 1990-2019(actual data)- RA Statistical committee, World bank Database, 2024-2030 program assumptions and estimations.

Chapter 3. Policy and measures

3.1 Renewable energy sector

38. Further development of renewable energy will be one of the priorities of the energy policy of Armenia in the next ten years.

39. In terms of scaling up the use of renewable energy potential (in particular solar energy), the program emphasizes the possibilities of introducing and developing battery energy storage systems that will improve the safety and reliability of the country's energy system.

40. As the first step in this direction, it is anticipated to develop a business model concept for the battery energy storage systems. The development of large battery energy storage systems will be carried out through public-private partnerships, considering 2 business models:

    1. A large solar power plant together with a battery energy storage system in the same location;

    2. Separate battery energy storage systems.

41. It is planned to study the possibilities of developing network battery energy storage systems, taking into account the international experience and the best practice in the sphere.

42. Regarding the operation of battery energy storage systems, special importance will be paid to changes in tariff policy to encourage the launch of battery energy storage systems.

43. The following international tender for the construction of 120 MW five large solar power plants are to be prepared and organized during the program period.

44. It is planned to initiate and carry out wind potential studies to assess the further development perspectives and feasibility of wind energy.

45. Similarly, steps will be undertaken during the program period to scale up the applied scientific research framework in renewable energy sector, creating a basis for the practical implementation of relevant outcomes.

3.2 Energy-saving

46. Regarding energy saving and energy efficiency, the program emphasizes the following three areas/sectors, 1. Households, 2. Transport, 3. Public schools, which together account for the majority of total final energy consumption. In addition, specific reference is made to industry and agriculture. The main actions and measures of the policy to be implemented in these areas are presented in the following subsections of this Program. The energy-saving and energy efficiency improvement policy will be aimed at increasing the level of "electrification" (replacing gas with electric energy) in the economy (in particular, in the residential buildings sector). Such a policy

will contribute to scaling up the use of low-carbon energy, thereby reducing the negative impact on the environment.

47. In this direction, the RA Government intends to apply the following tools:

    1. Measures for the operation of battery energy storage systems,

    2. Changes in customs regulations, promoting the use of electricity-powered equipment,

    3. Direct state support projects.

48. Additional steps will be taken to harmonize tariff policies for natural gas and electricity, making market-pricing mechanisms as applicable as possible.

49. During the program period, the RA Government intends to issue "green" bonds, the proceeds of which will be used exclusively to improve energy efficiency and energy saving.

3.3 Energy Saving and Energy Efficiency Improvement Policy and Measures in Selected Sectors

3.3.1 Household sector

50. Relative indicators of energy consumption in the household sector reveal its low-level intensity. The final energy consumption per capita in the household sector is about twice lower than the EU-28 average and higher than the same indicator of six countries among the 38 countries of the European family. And final energy consumption per unit of actual living space in a household sector is 17% lower than the EU average. Given the prospects for economic development and living standards growth of the population in the next ten years, household energy demand is expected to increase by reducing energy poverty, underheating residential areas, and expanding the use of electricity-powered appliances.

51. Natural gas consumption (60.3%) is dominant in the energy consumption structure of households, while natural gas and electricity together cover 78.5% of energy consumption. Overall, gas consumption for heating accounts for about 50% of energy consumption. The share of renewables in energy resources remains low. In 2019, solar energy consumption in the household sector amounted to 4.3 ktoe or 0.5% of total energy consumption.

52. More than half of households in the Republic of Armenia- 58.6%- cannot heat their homes sufficiently during the cold months. According to the Eurostat definition, they can be considered energy poor. The low energy intensity is mainly due to the living standards of the population. 71% of rural households use firewood for heating. Firewood and manure are the most common sources of heating for rural households. Household energy consumption is highly dependent on their living conditions and has a significant level of inequality: the Gini inequality index was 33,9% in 2018.

53. The housing stock faces the challenge of increasing energy consumption efficiency for heating purposes by improving thermal insulation. Economic development and improved living standards of the population in the long term will lead to an energy demand growth of the households. This means that thermal insulation of living spaces, common areas of apartment buildings (building entrances, staircases, etc.), the use of improved energy-consuming devices, diversification of energy sources, transition to more efficient energy sources, and renewable energy sources will be essential in terms of consumption efficiency in the near future.

54. **Energy-saving policy and measures implemented in the household sector:**

    1) Given the continued growth and prevalence of the share of natural gas consumption in the household sector in recent years, and the fact that it is mainly consumed for heating purposes, which implies emissions, current policy will be aimed at encouraging the introduction of alternative, "clean" energy-saving heating technologies. The measures taken will reduce the growth of the share of natural gas consumption in the households sector. Such actions will include, for example, promoting the use of electricity for heating purposes, encouraging investments in solar and biomass power plants, and introducing individual solar power systems. In particular, the RA Government plans to develop and implement a state supported program for the introduction of electricity-powered modern heating systems (for example, "heating pumps"), which will significantly contribute to the "electrification" and decarbonization of the economy.

    2) Considering that majority of the country's housing stock is old enough, and multi-apartment buildings prevailing in urban areas are managed mainly by condominiums, and, as a rule, repair and insulation works in common areas have not been carried out properly, measures will be taken to study and clarify the regulatory framework for the establishment and operation of condominiums, and set standards for the repair and thermal insulation of shared spaces or joint property and ensure their maintenance.

    3) Considering the current trends and forecasts in the construction of new residential buildings and the operation of new housing facilities, it is planned to establish such thermal insulation standards of new buildings that will ensure appropriate thermal insulation of residential and shared premises and heating efficiency. Besides, measures will be carried out to promote the latest and effective energy consumption technologies in new residential buildings.

    4) In rural communities where firewood and biomass are the primary heating sources, the state policy will encourage community cooperation with the private sector to develop solar and wind energy and biomass power plant projects to replace firewood demand with renewable energy sources. Priority in this direction, first of all, will be given to non-gasified rural communities.

    5) Public awareness plays an essential role in improving the energy efficiency by the population. From this point of view, there are no regular surveys on public awareness level in Armenia.

In this regard, programs will be developed and implemented to study the public awareness level and inform the population about the measures for raising, energy efficiency, opportunities and ways to use advanced energy sources, and energy-saving technologies.

6) Considering the need for monitoring the key indicators of energy consumption by the households and existing gaps in information, it is required to improve the reliability and comparability of data for obtaining internationally accepted energy efficiency and consumption intensity indicators on a sustainable and comparable basis. Special studies will be conducted in this direction, or update the survey toolkits for households' living standards, that is undertaken annually by the Statistical Committee of the RA.

55. Forecasts and targets

1) Energy saving in the household's sector largely depends on the economic development and the living standards of the population. On the one hand, the improvement of living standards will lead to a reduction in energy poverty and inequality and a gradual improvement of underheating, which will lead to an increase in energy consumption. On the other hand, the improvement of living standards and economic growth will allow the application of energy-saving technologies, thermal insulation measures in residential sector with some time delay, and the implementation of the above steps will contribute the improvement of energy saving by the population.

2) To this end, two scenarios have been developed for the households, i.e. for the residential sector energy consumption forecasts. The first scenario is soley based on the economic development forecasts while maintaining current trends (baseline scenario), and the second one considers the impact of improvement measures in energy efficiency and energy saving (policy scenario). This approach allowed to obtain projections of energy savings for the period 2021-2030.

3) According to economic development forecasts, energy savings in the policy scenario will begin after 2028 compared to the baseline development scenario and will be about 150,000 tons of oil equivalent in 2030. According to the forecasts, proposed measures, and expected economic development trends, household energy consumption is projected to exceed 2019 by about 21 percent in 2025 and about 36 percent in 2030. Final energy consumption per capita in the household's sector by 2030 is projected to be about 77% of the 28 EU countries' average in 2019. The final energy consumption of actual housing stock will increase by 32% in 2030 compared to 2019.

3.3.2 Transport sector

56. Energy consumption increased by 34.4% between 2008 and 2019 in the transport sector, reaching 802 ktoe. The average annual growth rate for the stated period was 2.7%. During the same period, Armenia's total energy consumption rate was much lower, amounting to only 9.6%, and the

average annual growth was 0.8%. As a result, the transport sector's energy consumption share in the total energy consumption increased significantly during 2008-2019, from 26.1% in 2008 to 32.7% in 2019. Energy consumption per capita in the transport sector as of 2018 amounted to 0.24 toe.

57. The international comparisons of energy consumption in the transport sector show a definite correlation between GDP per capita and energy consumption in the transport sector: the higher is the GDP per capita, the higher is the energy consumption in the transport sector. At the same time, international comparisons show that the transport sector in Armenia is more energy-intensive than the required level of economic development, so energy efficiency in the transport sector is low. This indicates a potential for energy efficiency improvement in the transport sector in Armenia and, according to preliminary estimates, could amount to 27-37% of the energy consumption in the transport sector.

58. Studies also show that one of the main differences in Armenia's overland passenger transportation is the distribution of energy consumption between public transport and passenger cars compared to many European countries. Thus, in three European countries selected for comparison (Austria, Slovakia, Hungary), more than half of the energy consumption in overland passenger transportation (52-54%) structure is accounted for by public transport. The picture is entirely different in Armenia: only 18% of energy consumption in overland passenger transportation is accounted for by public transport, the remaining 82% is consumed by passenger cars. It should be noted that overland passenger transportation in Armenia accounts for about 70% of the energy consumption of the entire transport sector, which once again emphasizes the importance of improving energy efficiency in the transport sector.

59. Considering the above mentioned and the fact that energy consumption efficiency by passenger cars is 3 or more times lower than public transport, it can be concluded that Armenia's overland passenger transportation structure is characterized by relatively high energy intensity. Summing up, it can be stated that changing the energy-intensive structure of overland passenger transportation will be important in improving energy efficiency in the transport sector in Armenia. In this regard, the policy will mainly be aimed at gradually increasing the share of public transport in the structure of overland passenger transportation.

60. One of the main reasons for the relatively low share of public transport in the overland passenger transportation structure is Armenia's low quality of public transport services. A sociological survey[8] conducted in Yerevan in 2017 showed that the dissatisfaction index for Yerevan transport among the population was relatively high, especially in the case of minibusses, that account for about 55% of passenger flow. According to the survey results in terms of minibusses, passengers

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[8] Report on "Yerevan Transport System Reforms in the Context of Low-Carbon Development Policy", EU-UNDP "EU4 Climate" regional project.

were dissatisfied with the availability of seats during rush hours (dissatisfaction index was 83%), accessibility in the evening (74%), driver behavior (67-71%), condition and cleanliness of vehicles (68%).

61. As for passenger cars, their owners in Armenia are in a preferential condition than the other European countries mentioned above since they pay much lower (in the regions they are usually exempted from these fees) for certain car maintenance services. It is mainly about paying for public (street) parking. Thus, the public (street) parking charge is 100 AMD per hour in Yerevan. At the same time, car owners can use public (street) parking for one month paying only 2000 AMD, and for the year by paying 12000 AMD. The policy of public (street) parking payments in Yerevan pursues only fiscal goals, considering these payments as a source of replenishment of the city's budget, and paying less importance to the regulatory role of these payments. It can be concluded that relatively high charges for public (street) parking, high quality of public transportation services are factors that make public transport more preferable for the population, increasing its share in total passenger transportation.

62. **Energy saving policy priorities in the transport sector and measures to be implemented:**

   1) <u>Improving effectiveness and quality of public transportation services:</u> From the point of view of improving energy efficiency and energy saving in the transport sector, it is essential to improve the effectiveness and quality of public transport services. The policy is aimed at launching a new, more energy-efficient route network and structure for public transport, especially in Yerevan. It seeks to improve the quality of public transport services through the constant renewal of busses, upgrading qualifications of drivers and other measures to ensure comfortable transportation conditions for passengers. At the same time, the policy will gradually increase the number of electric vehicles in the public transportation stock. It is expected that public transportation modernization will seriously impact the energy consumption efficiency of the entire transport sector. On the one hand, this can lead to significant energy savings by introducing a new energy-saving route network and structure and on the other, it can increase the share of public transport in the overall passenger transportation structure through quality improvement of public transportation services.

   2) <u>Improving the regulatory role of public (street) parking fee policy:</u> Currently, the public (street) parking payment policy in Armenia (mainly in Yerevan) pursues primarily fiscal goals, considering these payments only as a source of replenishment of the community budget. It is planned to significantly change this policy ideology in future, increasing the role of its regulatory component. First of all, this refers to the capital Yerevan. The new public (street) parking fee policy introduced in Yerevan will effectively manage traffic flows to unload the city center and adjacent administrative districts. It should be noted that the introduction of a new public (street) parking policy will be carried out only after the completion of the main stage of public transport modernization; otherwise, it will not serve its purpose and will become an additional burden for vehicle owners.

3) **Promotion of the use of electric vehicles:** It is planned to continue and expand the scope of current policy to promote the use of electric vehicles. The Law of the Republic of Armenia «On Amendments to the Tax Code of RA» came into force on July 1, 2019, according to which the import and alienation[9] of electric vehicles (passenger cars, motorcycles, mopeds) are VAT exempted. As part of the new public (street) parking policy described above, new privileges are envisaged for electric vehicle owners.In addition to privileges for electric vehicle owners, the policy will also introduce and expand electric vehicle charging infrastructures throughout Armenia. It will be implemented through the public-private partnership model.

63. Predictions and targets

1) Energy consumption forecasts in the transport sector are made for the following two scenarios:

   a. Baseline scenario: According to the forecasts, no measures have been taken to improve energy efficiency and energy-saving in the transport sector, and current trends continue.

   b. Policy scenario: The projections consider the impact of energy efficiency and energy-saving improvement policies in the transport sector.

2) The following assumptions served as a basis for assessing the impact of energy efficiency and energy-saving policies in the transport sector:

   a. From 2022, the share of electric vehicles in the structure of the light-duty vehicle will gradually increase to 10% by 2030.

   b. The introduction of a new public transport network in Yerevan will increase the energy efficiency of public transport by 70% from 2022.

   c. From 2023, the share of electric vehicles in the public transport stock will gradually increase to 50% by 2030.

   d. As a result of the improvement in public transport services and the new public (street) parking fee policy, the share of public transport in passenger transportation structure will gradually increase, reaching 60% by 2030.

3) As a result of energy efficiency and energy-saving policies performed in the transport sector, the expected annual energy savings will reach 744 ktoe or 36% energy consumption by 2030.

3.3.3 Public schools

64. Among the measures aimed at improving energy efficiency and energy saving in the public sphere, the Program emphasizes implementing measures in public schools. According to the studies, school buildings occupy a significant proportion of public buildings' entire structure

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[9] A proposal to extend VAT privileges for another two years was approved (until January 1, 2024) at the session of the Government of the RA on November 18, 2021.

(estimated at around 43 % in 2019). On the other hand, public schools are financed from the State budget and operate under the authority of the Government of Armenia.

65. According to the Public Schools energy consumption survey conducted in 2019 and the R2E2 Fund's energy consumption analysis based on the energy-saving indicators after the schools' EE upgrades, energy-saving potential in schools amounted to 152.28 million kWh or 13,1 ktoe, which is about 50% of the schools' energy consumption in 2019.

66. Based on the international experience of promoting energy efficiency in schools, it can be concluded that capital renovations and modernization measures lead to energy saving. Still, also cost-effective energy-saving measures can reduce school energy consumption by 5-10 percent.

67. The total area of public schools in Armenia is 3,351,000 square meters, of which 15-25 percent may be feasible for installing PV plants depending on climatic conditions. Considering the average annual output of a 1-square meter plant in Armenia (340 kWh/year), the energy-saving potential of the school rooftop PV plant is estimated at 171-285 million kWh or 14.7-24.5 ktoe.

68. Improving energy efficiency in schools involves three groups of actions:

   1) Improvement of thermal insulation of schools and modernization of heating and lighting systems;

   2) Low-cost measures such as training of school staff and students;

   3) Installation of solar PV panels on the roofs of the school buildings.

69. **Targets:** Considering that it will not be possible to carry out energy-saving renovations/upgrades in all public schools by 2030 and analyzing energy-saving targets for public schools in other countries, as well as the projects already implemented in Armenia, the Program aims to achieve the following objectives: to reduce total energy consumption in public schools by at least 15% compared to the baseline scenario by 2030, and to reduce the energy consumption of any renovated school by at least 40%. To achieve this goal, it is planned to carry out energy-saving repairs/upgrades in an average of 40 schools per year. Since the annual electricity consumption in 70% of schools does not exceed 17,000 kWh, it is expected to install at least 10 kW solar PV plants on the school rooftops. Consequently, annual energy savings will increase by an average of 5.2 million kWh, or 0.45 ktoe.

70. To achieve this goal, it is planned to implement the following **activities:**

   1) Create a single electronic monitoring system for schools that will allow the schools to fill in their energy consumption data monthly or quarterly.

   2) Number schools according to the region and community to monitor energy consumption.

   3) Identify the schools with maximum energy consumption and make a list of schools to be renovated each year.

4) Introduce energy-saving passports for the schools before and after the implementation of energy-saving measures.

5) Organize training courses on energy saving in schools, which will involve both the staff and students.

6) Carry out mapping /examination of school rooftops to assess the actual potential of installing solar PV panels and water heaters.

7) Install solar PV panels on school rooftops according to a pre-agreed schedule.

3.3.4 Other sectors

71. **Industry:** Although energy consumption did not change significantly in the industry (including the construction sphere) in absolute terms during 2015-2019, the industry share in the total final energy consumption structure decreased by 1.4 % compared to 2015, reaching 11.8% in 2019. At the same time, the energy intensity of the sector has improved considerably. The energy intensity of industry emissions (excluding construction) in 2019 was estimated at 182 kg of oil equivalent / million AMD (in 2015 prices) compared to 246 kilograms of oil equivalent / million AMD (in 2015 prices).

72. According to the policy scenario considered in the Program framework, the estimated energy savings in the industry are pretty conservative (19 ktoe) in 2030. It amounted to 2% of the estimated total energy savings (or about 4% of the final energy consumption in the industry under the baseline scenario considered under the Program).

73. Energy efficiency in this sector will be mainly addressed by expected development of the industry due to the overall policy of the Government aimed at improving the environment for investments in the country and increasing country's attractiveness. At the same time, it is expected that the Government policy for energy efficiency and energy-saving improvement will create favorable conditions for entrepreneurs of the industry sector to replace natural gas with electricity and introduce modern technological solutions (including utilization of renewables).

74. **Agriculture:** According to the Statistical Committee of Armenia, final energy consumption in the agriculture sector as of 2019 was about 30 ktoe, compared to 40 ktoe in 2015. As a result of this change, the share of agriculture in total final energy consumption declined by about 0.6% during the period under review, amounting to 1.2% in 2019. However, this figure does not include high rates of the greenhouse economy in the final energy consumption in recent years. Final energy consumption in the agricultural sector (including greenhouses) in 2019 was estimated at 107 ktoe.

75. Greenhouses, which are considered a priority for the agricultural sector development, are expected to continue to grow and exceed the sector's average in the coming years. Greenhouses, therefore, have a significant role in terms of energy-saving and energy efficiency in agriculture.

76. Government support projects and policies (particularly cross-subsidization of natural gas) have contributed to the rapid development of greenhouses in recent years. Nevertheless, the RA Government intends to review the sector's state support mechanisms (avoiding "cross-subsidies" over time) and encourage entrepreneurs to introduce and develop modern energy-saving technologies.

77. Changes in the country's energy balance approaches are aimed to record the final energy consumption in the agricultural sector during the Program period and reflect energy consumption indicators of greenhouses in the agricultural industry.

78. As a result of the Program implementation, the final energy consumption in agriculture in 2030 is expected to be 189 ktoe and energy-saving 34 ktoe (3.7 % of the estimated total energy-saving or about 15 percent of the final energy consumption in agriculture according to the baseline scenario considered under the program).

Chapter 4. Technical regulatory issues

79. Ensuring progress in energy saving and energy efficiency and fulfilling the international commitments undertaken by the Republic of Armenia assumes necessary amendments, continuous development, and enactment of the normative framework regulating the sector.

80. In this regard, the approximation of the RA Legislation to the provisions of EU Directive 27/2012, stipulated by the Government Decree No.666-L of June 1, 2019, in the framework of the Comprehensive and Enhanced Partnership Agreement (CEPA) signed between the Republic of Armenia and the European Union in 2017 is essential in terms of introducing best international practices. In relation to this, preparatory works have already been carried out, and relevant legislative changes will be completed by 2022.

81. Another important direction to improve the regulatory framework, is the development of methodologies to assess the energy performance and economic viability of the buildings, ensuring their compliance with the provisions of the technical regulation on energy saving and energy efficiency in the newly constructed multi-apartment buildings, as well as in the facilities under construction (reconstructed, renovated) through the state funds, that is approved by the RA Government Decree No. 426-N of 2014.

82. Currently, the draft standards ISO 52000-1 and ISO 52000-2 are in circulation for energy efficiency calculation and assessment. Development and enactment of other ISO 52000 standards are in progress and will be completed by 2023.

83. Considering that solar energy sector is a relatively new and rapidly developing sector in Armenia, there are still regulatory gaps in it. In this regard, it is planned to create (and/or localize) basic (essential) standards to ensure the sector's regulatory framework, followed by the development and implementation of relevant normative technical documents. The regulation of this sector is crucial given that energy efficiency measures in buildings include solar technology solutions.

Chapter 5. The Program and the scope of SDGs

84. The Program will directly contribute to the achievement of the objectives stipulated by Sustainable Development Goal 7. In addition, the Program creates prerequisites for the further enlargement of the SDG framework to reflect the peculiarities of Armenia in this regard and emphasize the priorities of the foreseen policy.

85. Considering that the energy system of Armenia is heavily dependent on imported natural gas (resulting in GHG emissions that harm both public health and the environment), and given that the Program emphasizes substitution of natural gas explicitly by electricity (especially in the households sector) in terms of economic decarbonization and mitigation of dependence on imported fuel, an additional indicator will be introduced to assess Armenia's progress in SDG 7.1, i.e., consider clean energy without natural gas.

86. Although the baseline and announced policy scenarios show a decrease in the share of renewable energy in the total final energy consumption in 2030 as compared to 2019 (in the baseline scenario by 4.6 percentage points, and in case of the announced policy scenario by 4.2 percentage points), the trends in the share of separate energy sources vary significantly under both scenarios. In particular, according to the baseline scenario, it is estimated that the share of both conventional and modern renewable energy in the total final energy consumption will decrease in 2030 compared to 2019 by 2.1 and 2.5 percentage points, respectively. In contrast, under the announced policy scenario, the renewable energy share in total final energy consumption will be reduced by more than twice the share of traditional renewables against the baseline (by 4.5 percentage points in 2030 compared to 2019). At the same time, under the announced policy scenario the expected startup of large industrial-scale solar power plants in the program period will contribute to a significant increase in the solar energy share to about 3.4% by 2030, compared to 0.5% in 2019. Given the fact that no substantial changes in hydropower are foreseen in the coming years (given limited resources and the possible negative impact on the environment), the hydropower share in the total final energy consumption will be 3.6% in 2030, reducing by 2.6 percentage points compared to 2019, which, in fact, "will be compensated" by increasing the share of other renewable energy sources. Regarding traditional renewable energy sources (biomass, firewood, and waste), it should be stated that if they continue to be applied in ways (not clean and unsafe for health) that are currently used in Armenia, the state policy will not encourage their use, but rather reduce the volume of their service.

87. Taking into account the above mentioned and the priorities and main directions of energy policy in Armenia in the coming years, a new national indicator will be introduced and monitored to assess the progress of Sustainable Development Goal 7,2, i.e., the share of advanced renewable energy sources (excluding hydropower) in the total final energy consumption.

88. The expected energy intensity changes relevant to the baseline and announced policy scenarios observed in the program are presented below:

	1990	2010	2018	2030
Baseline scenario				
Energy intensity, constant 2017 PPP $ (Armenia)	17.61	4.45	3.63	3.48
Energy intensity, constant 2017 PPP $ (world level)	7.14	5.58	4.75	3.30
Average annual change compared to 1990 (Armenia)		-6.65%		-3.97%
Average annual change compared to 1990 (world average) baseline		-1.20%		-1.91%
Average annual change compared to 2010- SDG 7.3 (world level)			-1.99%	-2.6%
Average annual change compared to 2010 (Armenia)			-2.50%	-1.22%
Announced policy scenario				
Energy intensity, constant 2017 PPP $ (Armenia)	17.61	4.45	3.63	3.01
Energy intensity, constant 2017 PPP $ (world level)	7.14	5.58	4.75	3.30
Average annual change compared to 1990 (Armenia)		-6.65%		-4.32%
Average annual change compared to 1990 (world average) baseline		-1.20%		-1.91%
Average annual change compared to 2010 -SDG 7.3 (world level)			-1.99%	-2.6%
Average annual change compared to 2010 (Armenia)			-2.50%	-1.93%

89. According to the baseline scenario, energy intensity will decrease by an average of 1.22% annually between 2011 and 2030, which is almost twice as much as global SDG 7.3. According to the baseline scenario, energy intensity in Armenia by 2030 is estimated higher than the corresponding SDG indicator. Nevertheless, even under these conditions, the average annual energy intensity rate in Armenia in 1991-2030 (about 4%) is expected to be about twice as high as the world average (1.9%). The announced policy scenario of the Program is aimed at a rather ambitious path of energy efficiency improvement - an average annual reduction of about 2% between 2011-2030. This improvement rate is close to the world level of the last ten years. In the case of such development, the energy intensity index in Armenia will be lower in absolute terms in 2030 than the world energy intensity index corresponding to SDG 7.3 in absolute terms. Thus, according to this scenario, the energy intensity index in Armenia in 2030 will be 3 constant 2017 PPP $, compared to 3.3 constant 2017 PPP $ in 2030. At the same time, it is estimated that the average annual energy intensity rate (4.3%) in Armenia during 1991-2030 will be more than twice as high as the world average (1.9%).

90. Given the above stated, it is clear that the approach adopted at the global level, i.e., doubling the average annual energy intensity rate in 2011 - 2030 compared to 1991 - 2010, cannot be applied in the case of Armenia. Using this approach would mean that energy intensity would have to improve by 13.4% in 2011-2030, which is unrealistic given the possible changes in the economy's structure and the prospects for economic development in Armenia in the next ten years. It is planned to localize Sustainable Development Goal 7.3, taking the energy intensity absolute values as a basis for comparison. It will be formulated as follows: "Ensure a higher level of energy efficiency by 2030 compared to the world average". In this case, progress will be measured by the

absolute energy intensity index, calculated as the ratio of GDP equal to the primary energy supply and purchasing power parity.

Chapter 6. Macroeconomic impact assessment of the Program

91. The Program will have a positive impact in terms of the economic growth potential, the price pressure of fossil fuel on the economy and employment, and reduction of currency risks.

92. The Program's main positive impact will be the reduction of the relative import of fossil fuels, except natural gas imported for electricity exports. Compared to the baseline scenario in the last seven years of the Program period (2024-2030), fossil fuel imports will decline by about $2 billion, or 1.3 percent[10] of nominal GDP during 2024-2030, given the fuel import prices remain unchanged. This impact will peak in 2030 when savings are around 1.6% of GDP.

93. As a result of the relative decline in fossil fuel imports, especially in terms of final energy consumption, the demand for domestic goods and services and savings and other imported goods and services, depending on imports for personal consumption trends, will be increased. The use of additional revenues from reduced fossil fuel imports to purchase domestic goods and services, in turn, increases the production volume of the domestic suppliers - a multiplier effect. The multiplication coefficient varies between 1.7-2.3 and depends on the depth of internal integration of economic sectors.

94. Macroeconomic impacts are evaluated using a specially designed model with low-level to high-level scenarios. A high-level scenario, as opposed to a low-level scenario, assumes:

    1) Lower import propensity: Given the fact that fossil fuel imports have no domestic alternative and thus its structural reduction will not be replaced by other energy imports,

    2) Higher GDP multiplier: The additional income generated is expected to purchase goods and services from domestic manufacturers with a deeper chain of domestic vendors.

    3) The share of higher-paid workers in GDP. In the low-level scenario, this indicator is assumed to be 37.7% in the amount of the actual value of 2019, which is significantly lower than the average of European countries. The increase in the share of the workers' wages is based on the RA Government program, according to which the ideology of inclusive economic growth is fixed.

    4) Increase in import prices of fossil fuels.

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[10] It should be noted that, despite the considerable uncertainty of the world fossil fuel prices, and according to the international organizations and specialized companies estimates, about 20-30 per cent increase is the more likely scenario for the next 10 years. On the one hand this is connected with the world economy and population growth, especially the rapid growth of energy demand in developing countries, and, on the other hand, to the limited resources of economically efficient fossil fuel. Of course, the utilization rate of renewables in recent years may partially reduce the price pressure on fossil fuels, but the operating capacities (cars, power plants, domestic heating appliancies) will be a significant counterweight over the next ten years.

95. The main assumptions for the difference between the low- and high-level scenarios are presented in the table below:

Indicator	Low	High
Propensity to import, GDP rate	58	47
GDP multiplier	1.85	2.10
Growth in fossil fuel prices, annual rate	0	20
The share of wages of paid workers in GDP, rate	37.7	45.0

96. Summary of macroeconomic impact assessments are presented in the table below:

Indicator	Low	High
Real GDP average annual growth in 2024-2030, percentage point	1.0	1.7
Employment growth in 2024-2030 (thousand person)	95	179

97. The impact of a 20 percent increase in fossil fuel import prices on the economic growth under the baseline scenario was estimated using a well-designed model. According to the stress test, a single time rise in fossil fuel prices of 20% will reduce real GDP by 0.1-0.5 percentage points.

Chapter 7. Program monitoring and evaluation

98. The Ministry of Territorial Administration of the Republic of Armenia will approve the Program monitoring and evaluation plan, which will, inter alia, guide the evaluation of the Program's progress, identify problems in the course of its implementation, and, if necessary, develop proposals for reviewing the objectives.

99. Program monitoring is expected to be continuous, with progress evaluation reports prepared every three years.

100. The monitoring and evaluation plan will specify the indicators to be monitored and the details of the procedures to be followed. In particular, the Program will clearly define a mechanism for assessing energy efficiency, including adjusting the baseline scenario in case of discrepancies in scheduled economic growth and actual performance. In addition, the monitoring and evaluation plan will provide details on Program's main objectives for the interim program period.

101. In terms of the progress assessment, it is essential to identify and clarify baseline data, especially in the sectors separated by the Program. To this end, in 2022, it is planned to conduct representative studies relevant to the methodology to obtain sustainable and comparable information on internationally recognized energy efficiency and consumption intensity indicators. For this purpose, it is scheduled to carry out special surveys or to modify the household survey instruments carried out annually by the RA Statistical Committee.

Annexes

Table 1. Key indicators corresponding to the baseline scenario

		1990	2019	2024	2027	2030
GDP at current prices	billion AMD		6,543	9,057	12,431	17,001
Annual average real GDP growth rate	compound interest		4.7%*	3.88%	5.04%	5.57%
Annual average GDP deflator	compound interest			2.76%	3.26%	3.46%
GDP at 2008 constant prices	billion AMD		5,046	6,103	7,476	9,158
GDP (expressed in constant 2017 PPP $)	mln USD		42,092	51,695	63,328	77,580
TPES	ktoe	7,709	3,511	4,418	5,166	6,110
TFEC	ktoe		2,574	3,277	3,939	4,765
TPES decrease rate compared to 1990	percent		54%	43%	33%	21%
TPES average annual growth (+) reduction(-)	compound interest			4.7%	4.9%	5.2%
GDP energy efficiency	AMD/kg oe		1,437	1,381	1,447	1,499
GDP EE growth compared with 2019	percent			-3.9%	0.7%	4.3%
GDP/ Energy intensity, constant 2017 PPP $	USD/kg oe		11.99	11.70	12.26	12.70
GDP energy intensity PPP	toe/1000 $		0.083	0.085	0.082	0.079
GDP PPP annual average energy intensity incline against 2010	compound interest		-4.9%	-3.0%	-2.8%	-2.5%
RE share in TFEC	percent		16.0%	13.2%	11.7%	10.3%
Advanced RE share in TFEC	percent		8.0%	6.4%	5.3%	4.3%
RE share in the electricity generation system	percent		31.4%	28.7%	26.2%	23.8%
Energy independence, the import rate	percent		86%	83%	86%	88%
Energy GHG emissions	GHG CO2eq	22,712	7,088	8,731	10,667	13,123
Energy GHG emissions reduction rate compared to 1990	percent		68.8%	61.6%	53.0%	42.2%
Total GHG emissions	GHG CO2eq	25,035	10,811	13,521	16,238	19,603
Total GHG emissions reduction rate compared to 1990	percent		56.8%	46.0%	35.1%	21.7%

* 2010-2019:

Source: 1990-2019 (actual data) - Statistical Committee of the Republic of Armenia, World Bank database, program assumptions and estimates for 2024-2030.

Table 2. Energy consumption and energy-saving forecasts in the households' sector

	2019	2021	2024	2027	2030
	Baseline scenario, ktoe				
Total	**923.4**	**940.2**	**1,017.1**	**1,171.4**	**1,352.0**
Natural gas	557.0	566.8	594.7	693.0	809.1
Electricity	168.0	171.6	194.5	220.7	251.0
Biomass	192.4	195.7	221.6	251.1	285.2
Firewood	160.0	163.4	186.1	212.3	242.5
Solar and wind power	4.3	4.3	4.5	4.6	4.8
Other	1.8	1.8	1.9	1.9	2.0
	Policy scenario, ktoe				
Total	**923.4**	**989.9**	**1,098.4**	**1,222.1**	**1,260.1**
Natural gas	557.0	619.7	720.5	811.6	812.2
Electricity	168.0	177.1	189.1	214.7	239.1
Biomass	32.3	30.2	30.7	31.1	31.8
Firewood	160.0	153.9	141.7	127.1	104.7
Solar and wind power	4.3	6.8	13.6	34.2	68.2
other	1.9	2.1	2.7	3.4	4.1
	Energy-saving, ktoe				
Energy-saving, cumulative energy saving					91.9

Source: *2019 (actual data) - Statistical Committee of the Republic of Armenia, (RA energy balance), program assumptions and estimates for 2021-2030.*

Table 3. Energy consumption and energy-saving forecasts in the transport sector

	2019	2022	2024	2027	2030
	Baseline scenario, ktoe				
Total	**883**	**1042**	**1230**	**1584**	**2049**
Fuel	393	459	535	678	863
Natural gas	481	575	686	898	1177
Electricity	9	9	9	9	9
	Scenario 2, ktoe				
Total	**883**	**985**	**1052**	**1168**	**1305**
Fuel	393	437	457	492	532
Natural gas	481	538	581	653	736
Electricity	9	10	14	23	38
	Energy-saving, ktoe				
Total energy saving, including the following factors,	-	57	178	416	744
Increase of public transport share in the passenger transportation structure	-	0	82	244	470
Gradual increase of the electric vehicles share in the passenger car stock	-	7	21	46	77
Introduction of a new public transport route network in Yerevan	-	50	64	83	96
Replacement of public transport stock with electric vehicles	-	0	11	43	102

Source: 2019 (actual data) - Statistical Committee of the Republic of Armenia, energy balance, program assumptions and estimates for 2022-2030.