Approved by Noyemberyan Community Council of Elders
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Sustainable Energy and Climate Action Plan of Noyemberyan Community, Tavush Region, RA

Noyemberyan 2026

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Abbreviations

BIE	Baseline inventory of greenhouse gas emissions
USAID	United States Agency for International Development
RP/H	Residential/Private Houses
MAB	Multiappartment Building
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (German Agency for International Cooperation)
EC	European Commission
EU	European Union
SECAP	Sustainable Energy and Climate Action Plan
NDC	Nationally Determined Contributions
LED lamps	light-emitting diode lamps (bulbs, lights)
RA	Republic of Armenia
LPG	Liquified Petroleum Gas
CNPO	Community Nonprofit Organization
MP	Municipality
MEMS	Municipal Energy Management System
UNDP	United Nations' Development Program
UNO	United Nations' Organization
CPC	RA Competition Protection Commission (CPC)
REGAD	Regional Administration
PEI	Preschool educational institution
SNPO	State Non-Profit Organization
TPP	Thermal Power Plant
LGB	Local government body
HH	Household
GHG	Greenhouse gases
CNG	Compressed Natural Gas
ENA	«Electric Network of Armenia» CSJC
PSRC	Public Service Regulation Committee of RA
CJSC	Closed Joint Stock Company
COM	Covenant of Mayors
PV	Photovoltaic (conversion, module, panel, etc.)

Units of measure

kWh	kilowatt-hour, 1 kWh = 3,600 kJ
MWh	Megawtt-hour, 1MWh =1,000 kWh
GWh	Gigawtt-hour, 1 GWh = 1,000 MWh = 1,000,000 kWh
kcal	kilocalorie, 1 kcal = 1/860 kWh = 4.1868 kJ
ha	hectare, 1 ha = 10,000 m^2 = 100 acres
nm^3	Normal (standart) cubic meter
kt $CO_{2\ eq.}$	kilotonnes $CO_{2\ eq.}$ of Carbon dioxide equivalent

Introduction

The "Covenant of Mayors for Climate and Energy" initiative

The «Covenant of Mayors» is an initiative launched by the European Union, which is designed to unite local governments and regional authorities with a shared voluntary responsibility in favor of "green economic growth" and improving the quality of life. The communities signing the Covenant voluntarily agree to implement appropriate actions in the fields of energy efficiency and renewable energy within their administrative territories that will allow for a reduction of carbon dioxide (CO_2) emissions by at least 30% by 2030 or by 40% by 2050, compared to the emission level of the baseline year chosen by the community. To achieve this goal, community authorities should develop and implement Sustainable Energy and Climate Action Plans (SECAPs), which assess CO_2 emissions in urban communities in the baseline year by main sources, as well as describe measures to reduce these emissions, their implementation deadlines, and funding sources.

The initiative was initially intended for cities in the European Union member states, but in September 2011, the regional program “Support to the participation of cities in the Eastern Partnership and Central Asia in the Covenant of Mayors process” (Covenant of Mayors East) was launched, in which 11 countries, including Armenia, participate.

Participation in the Covenant of Mayors initiative enables communities to ensure the following outcomes:

- improve the environment by reducing emissions of greenhouse gases and other substances,
- identify the main energy consumption sectors of the community economy and assess the technical and economic potential of energy saving in these sectors,
- increase the quality of services provided (e.g., outdoor lighting, heat supply, transportation, etc.) and the appropriate level of comfort,
- promote more efficient use of energy resources at the community level,
- develop and prioritize energy saving measures,
- promote the attraction of local and international investments and job creation aimed at implementing the proposed measures,
- reduce the municipality's expenses related to energy consumption, increase the awareness of community residents about the advantages of using green and clean technologies.

Analysis of the Energy and Climate Policy of the Republic of Armenia

The Republic of Armenia is a party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. In fulfillment of its obligations under these international agreements, Armenia submits biennial transparency reports (BTRs) and greenhouse gas (GHG) inventory reports.

The Ministry of Environment (MOE) is the authorized state body responsible for developing and implementing state policy aimed at addressing climate change issues, as well as for fulfilling commitments undertaken under the UNFCCC and the Paris Agreement.

The Government of the Republic of Armenia adopted Resolution No. N 54-N "On Approving the Procedure for Greenhouse Gas Emissions Inventory" on 11.01.2024, thereby creating the national system for monitoring and reporting GHG emissions, ensuring the transparency, accuracy, completeness, consistency and comparability of the GHG emissions inventory.

In 2022, Armenia's GHG emissions amounted to 13,314.1 kt of carbon dioxide equivalent (kt CO2 eq.), excluding the “Land Use, Land-Use Change and Forestry” (LULUCF) sector. In 2022, the country's total emissions were about 50% (13,442 kt) below 1990 levels.

Net emissions (including removals) in 2022 amounted to 12,932.2 kt $CO_{2\ eq.}$. Overall, net emissions have decreased by 50.3% compared to 1990.

The "Energy" sector is the largest source of GHG emissions in Armenia; emissions from the sector have continuously maintained absolute dominance and, therefore, are the main factor in shaping emissions trends.

Energy-related emissions in Armenia show annual fluctuations, mainly depending on economic trends, energy supply structure, electricity export volumes, and climatic conditions.

Compared to 1990, GHG emissions from the "Energy" sector have decreased by 62.1%, due to structural changes in the economy, the widespread use of environmentally friendly fuel - natural gas (instead of previously used fuel oil and coal), the re-commissioning of the Armenian Nuclear Power Plant, and the unprecedented growth of renewable energy sources.

Since 2000, the growth in energy sector emissions has been about 90%, driven by increased road transport, improved household heating comfort, and electricity exports.

Armenia faces distinct challenges in addressing climate change. From 1929 to 2016, temperatures in Armenia increased by an average of 1.23°C, and projections show that they will increase by another 2.8°C by the 2050s. Along with the increase in temperatures, precipitation is projected to decrease by up to 8.3% by the end of the century.

These trends are already leading to more frequent droughts, heat waves, and extreme weather events, including floods and hailstorms, which pose significant risks to populations, economies, land degradation, and food security.

Due to rising temperatures and changes in precipitation, water resources vital for agriculture and hydroelectric power are being depleted, river flows are decreasing, and unmet water demand in some basins is projected to exceed 50% by 2050.

In 2021, Armenia's Nationally Determined Contributions (NDCs) were approved for a ten-year period (2021-2030), setting a new mitigation target to be achieved by 2030 through mainstreaming and integrating climate change concerns into national and sectoral development policies.

In December 2023, the Government of the Republic of Armenia approved the Long-Term Low-Emission Development Strategy of the Republic of Armenia (until 2050) (LT-LEDS).

National Inventory document for 1990-2022 includes data on anthropogenic emissions and removals, covering GHGs not controlled by the Montreal Protocol, namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF6)[1].

Nationally Determined Contribution NDC 3.0, approved by Resolution No. 1962-L of December 25, 2025, which, based on the assessment of the progress of the previous NDC and taking into account the country's conditions, presents ambitious targets for 2026-2035.

The effectiveness of the Paris Agreement in reducing global GHG emissions depends on the reliability of the emissions data used to monitor the emission reduction targets. In this regard, the Covenant of Mayors for Climate and Energy CoM-EU climate and energy action plans and their subsequent analysis play a key role.

According to the amendments to the "Strategic Program for the Development of the Energy Sector of the Republic of Armenia (until 2040)" (Decision of 26 October 2023 N 1827-L), the Government of the Republic of Armenia has planned to increase the share of renewable energy (including large hydropower plants) in electricity production to at least 50% by 2030 (and to 60% by 2040). For this purpose, it is planned

[1] The national inventory also includes estimates of emissions of precursors: carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile compounds (NMVOCs), and sulfur dioxide (SO_2).

to build solar power plants with a capacity of about 1,500 MW, including autonomous ones, and wind power plants (500 MW).

Armenia's transition to a low-carbon economy is further hampered by its landlocked geography, closed borders, and heavy dependence on imported fossil fuels, which accounted for 73.5% of energy use in 2023 according to the RA energy ballance. This dependence poses risks to economic and energy security, while limiting affordable heating options in communities.

Armenia is committed to reducing emissions while strengthening the country's adaptive capacity to address climate vulnerability. Building on previous commitments under the Paris Agreement, the NAC reflects significant progress towards Armenia's climate goal. With broad coverage of the economy, it sets targets for reducing GHG emissions by 44% (unconditional) and 52% (conditional) by 2035 compared to 1990 levels.

According to the 1990-2022 National GHG Inventory Report, net GHG emissions in the Republic of Armenia in 1990 amounted to 26,014 kt CO_{2eq} (or Gg CO_{2eq}), taking into account the recalculations made in connection with the requirement to apply the values of the IPCC 5th Assessment Report on Global Warming Potential (GWP) (new values with a 100-year time scale). Therefore, the absolute value of the target indicator (emissions in 2035) will be 14,610 kt CO_{2eq} (unconditional) and 12,498 kt CO_{2eq} (conditional[2]).

At the same time, according to that report, net GHG emissions in the Republic of Armenia in 2022 amounted to 12,932.2 kt CO2e, therefore, according to the NAP, the increase in GHG emissions in 2035 compared to 2022 should be restrained (in an unconditional version) to within 13.0%[3].

The Covenant of Mayors for Climate and Energy (CoM-EU) is the largest European initiative for climate and energy action. Through this CoM-EU framework, cities voluntarily commit to fighting climate change and thus pursue and advance the commitments of national governments at the local level.

The CoM GHG emissions accounting framework is based on the core principles of improving the quality, consistency, transparency and comparability of CoM data, while providing flexibility to meet local and regional circumstances and needs.

The Covenant of Mayors' GHG emission reduction targets are in line with the commitments and objectives set by the EU, in particular the European Climate Law (Regulation (EU) 2021/1119) , which aims to reduce GHG emissions by 55% by 2030, 90% by 2040 (compared to 1990) and achieve climate neutrality by 2050. To achieve these climate goals, EU cities must also be ambitious in their climate change mitigation strategies.

Climate change adaptation, together with mitigation measures, became one of the "cornerstones" of the EU's "Covenant of Mayors for Climate and Energy" initiative in 2015. As a result, starting this year, municipalities joining the Covenant are committing to develop adaptation measures aimed not only at reducing GHG emissions, but also at reducing identified climate risks.

In terms of adaptation, community action plans should include measures in those areas and sectors that are most vulnerable in the context of the projected impacts and risks (hazards) of climate change.

[2] Unconditional or non-conditional measures are those that Armenia is committed to implementing using identified domestic and international resources within the framework of existing national and sectoral strategies, policies and planned investments. Conditional measures are aimed at achieving a more ambitious emission reduction target by 2035, which is impossible to achieve without attracting additional international resources.

[3] In the energy sector, actual emissions in 2022 are 62.1% lower than in 1990, therefore, in order not to exceed the indicator set by the 2035 NDC (to ensure a 56% reduction compared to 1990), it is necessary to restrain (in the unconditional version) the growth of emissions to within 11.5%, and in the conditional version (in order not to exceed the 62% reduction compared to 1990 in 2035 according to the NDC), emissions in 2035 should be maintained equal to emissions in 2022 (0% growth).

Within the framework of the UNDP/GCF "National Adaptation Program to Advance Medium- and Long-Term Adaptation Planning in Armenia" project, the National Climate Change Adaptation Action Plan (NAP) and the list of measures for 2021-2025 were developed in 2021 and approved by the RA Government's Resolution No. 749-L dated 13.05.2023.

The document guides the implementation of adaptation goals and aims to combine the efforts of the government, regional administrations, local governments, civil society and academic institutions, business, and the international community to strengthen the country's capacity to adapt to climate change in 2021-2025.

In essence, the main objective of the National Adaptation Action Plan (NAP) process is to contribute to climate risk reduction and management in Armenia by identifying the most important hazards, implementing adaptation measures that eliminate or mitigate the negative impacts of these hazards, reducing socio-economic vulnerabilities and avoiding losses and damages caused by climate change. At the same time, there is a goal to ensure the coordination of adaptation measures implemented in different sectors and levels in order to optimize their effectiveness. All these processes are fully consistent with the goals of the Covenant and the commitments undertaken by the countries under the initiative.

The impacts of climate change already pose a serious challenge for almost all communities around the world: they threaten to increase vulnerability to climate hazards, reduce access to natural resources and weaken ecosystem functionality, limit citizen safety, reduce business, hinder socio-economic development, etc. Therefore, adaptation to climate change is increasingly becoming an important priority for communities.

All communities that submit a SECAP and sign the Covenant must include an energy poverty component in their action plans and submit a report on the issue of energy poverty and its reduction. Alleviating energy poverty is one of the commitments of the Noyemberyan community within the framework of the Covenant. Reducing energy poverty under the Covenant means ensuring access to affordable, secure and sustainable energy for community residents.

Signatories to the Covenant that have not committed to addressing energy poverty in their accession documents and have submitted/adopted SECAPs should progressively include this issue through the monitoring report template.

Chapter 1.Framework of the Sustainable Energy and Climate Action Plan of the Noyemberyan Community

In accordance with the Law of the Republic of Armenia "On Administrative-Territorial Division of the Republic of Armenia" of September 24, 2021 HO-328-N and the Law "On Amendments and Supplements to the Law of the Republic of Armenia "On Administrative-Territorial Division" that entered into force on 06.10.2021, as a result of the amendments made and the process of enlargement of communities, the Noyemberyan multi-residential community of Tavush region was formed, which includes the following settlements of Tavush region: Noyemberyan and Ayrum towns, Archis, Bagratashen, Baghanis, Barekamavan, Berdavan, Debedavan, Deghdavan, Dovegh, Zorakan, Lchkadzor, Koti, Koghb, Haghtanak, Voskepar, Voskevan, Ptghavan and Jujevan rural communities. Therefore, the processes for developing the Sustainable Energy and Climate Action Plan (SECAP) and the geographical scope of the document refer to the enlarged Noyemberyan community (Noyemberyan and Ayrum cities + 17 rural settlements).

In accordance with the requirements of the methodological guidelines of the "Covenant of Mayors East" EU initiative (hereinafter referred to as the Covenant)[4] , the development of the Noyemberyan community's SECAP includes the following activities:

- Compilation of a baseline inventory (BIE) of greenhouse gas (GHG) emissions:

To compile the BIE, it is necessary to define the base year (the year to which the emission reduction volume in the target year is compared). To define the base (baseline) year, the energy consumption volumes in the community are collected for five years (in this case, for 2020 - 2024) and the CO_2 emissions resulting from the use/combustion of energy carriers are calculated. As a result, the most reliable and characteristic year for the community is selected as the base (baseline) year.

According to the Covenant's methodological guidelines, the BIE must include at least three of the Covenant's four main sectors [Community buildings, equipment/structures, Tertiary (non-community) buildings, equipment/structures, Residential buildings, Transport], and GHG emission reduction measures must be proposed in at least two of the three selected main sectors (in this case, mitigation measures are included in the three proposed main sectors).

- Calculation of the target amount of GHG emissions to be reduced in the target year, based on the BIE:

The target volume of GHG emission reduction in the target year can be calculated in two scenarios: a) according to the base year scenario, in which the target volume of emissions reduction is determined based on the value of the calculated volume of emissions in the base year, and b) according to the business-as-usual (usual development) scenario, in which the target volume of GHG emission reduction is determined taking into account the development of the community and the factor of the expected growth of GHG emissions in the target year.

- Definition of mitigation measures that ensure the calculated reduction of GHG emissions in the target year:

The list of mitigation measures is identified by the sectors for which the BIE was calculated.

The main part of the proposed mitigation measures aimed at reducing GHG emissions in the SECAP are **investment** or so-called **"hard"** measures (thermal modernization of buildings, use of energy-saving technologies in lighting systems, development of a fleet of vehicles with electric motors in transport, promotion of local energy production from renewable sources, etc.).

[4] Bastos, J., Bezerra, P., Davide, M., Hernandez Moral, G. and Melica, G., How to prepare a greenhouse gas emission inventory - Covenant of Mayors Guidebook Complementary document 1, Publications Office of the European Union, Luxembourg, 2025

The other part of the proposed measures is of an **organizational** or so-called **"soft"** nature (support for the implementation of a community strategy for mitigating GHG emissions, raising awareness of stakeholders, strengthening capacities, developing an energy management system in the community).

The SECAP presents descriptions of mitigation measures, key actors, approximate volumes of required investments and possible sources of their financing, implementation deadlines and expected results (in terms of energy consumption reduction/energy production (MWh/year) and emissions reduction (t CO_2/year)).

It is expected that the full implementation of these actions will ensure the fulfillment of the commitments undertaken by the Noyemberyan community within the framework of the Covenant and will allow it to achieve the target of reducing GHG emissions by at least 40% by 2050[5] (according to the selected scenario).

1.1. Basis for the development of the Noyemberyan Community SECAP

The Noyemberyan community of the Tavush region of the Republic of Armenia joined the EU "Covenant of Mayors" initiative on April 29, 2025 by decision No. 175-A of the 6th session of the Council of Elders. Therefore, the current SECAP program of the Noyemberyan enlarged community is being developed taking into account the energy and climate issues of 17 rural settlements and 2 cities, with the selection of the base year for the period 2020-2024 and the adoption of 2050 as the target year.

As a member of the EU's "Covenant of Mayors" initiative, until 2050 the Noyemberyan community has committed to[6]:

a. continues to reduce greenhouse gas emissions in its territory,
b. increases the resilience of communities and prepares for the negative impacts of climate change,
c. fight energy poverty.

To this end, during 2026, the possibility of creating a community energy manager position/department will be studied in the community to contribute to the implementation of the community's approved SECAP[7].

1.2. Action Plan objectives and related areas

The main goal of the SECAP is to initiate prospective mid-term complex measures in various areas of community life, which will ensure a high level of efficiency in energy production and use, contributing to the reduction of energy consumption and greenhouse gas (GHG) emissions.

The Action Plan includes areas of vital activity in which support from local partners, international organizations, and financial institutions can be expected for the implementation of planned activities.

To achieve the goals of the SECAP of the Noyemberyan community of the Tavush region of the Republic of Armenia, the community must solve the following main issues:

1. Implementation of programs to increase the efficiency of energy production and use and encourage energy saving,
2. Use and application of modern technologies for the production of electrical and thermal energy, including renewable energy sources,
3. Implementation of measures aimed at reducing final energy consumption by various budgetary institutions (mainly municipal),
4. Promoting the efficient use of energy sources and end-use energy among the population and the public sector, conducting periodic awareness campaigns and monitoring,

[5] This report also considers an interim/additional Target I: at least a 30% reduction in GHG emissions by 2030.
[6] https://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/27/AcFfkQ4L2OZ7XkPPiOCBQ2k_ZrJAeaAI.pdf
[7] https://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/27/Bsb9eZ0maSEayr4ca6lRxGUhUGH8okhp.pdf

5. Attracting investments to implement measures supporting sustainable energy development and climate protection.

The following primary objects of vital activity are included in the SECAP of the Noyemberyan community of the Tavush region of the Republic of Armenia:

- residential buildings of the community,
- Community-owned buildings and structures,
- community, public, commercial, private automobile transport,
- outdoor street lighting.

The program may also involve republican or regional budgetary institutions or organizations, as well as individuals or legal entities providing various types of services.

1.3. Legal and methodological foundations of Action Plan development

The following methodological materials have been developed and adopted for use by the EC Research Center for the development of SECAPs:

1. Guide: "How to Develop a Sustainable Energy Development Action Plan (SEDAP) in Eastern Partnership and Central Asian cities", EC Joint Research Centre, Part I, 2013, revised on 26.11.2020.
2. Guide: "How to Develop a Sustainable Energy Development Action Plan (SEDAP) in Eastern Partnership and Central Asian cities", EC Joint Research Centre, Part II, Baseline Emission Inventory, 2014, revised on 26.11.2020.
3. Guide: "How to Develop a Sustainable Energy Development Action Plan (SEDAP) in Eastern Partnership and Central Asian cities", EC Joint Research Centre, Part III, Efficiency and technical measures for renewable energy provision, 2013, revised on 26.11.2020.
4. "CoM-DeP" Project Implementation Guidelines 2015, revised January 2018.

5.Technical Guide for the Modernization of Buildings under the "CoM-DeP" Program, 2015. Revised on 17.12.2020.

6.«CoM-DeP" program: street lighting guide, 2015. Revised on 17.12.2020.

7. "CoM-DeP" program: technical supervision, 2017. Revised on 17.12.2020.

8."CoM-DeP" program: measurement and verification guidelines, July 2016. revised on 17.12.2020, Thermal modernization of buildings, Repair of centralized heating systems, Street lighting.
9.Guide "How to develop a sustainable energy and climate action plan in the Eastern Partnership countries" EC Joint Research Centre, 2018,

10. "CoM-Reporting Guidelines", March 2020.

11. «How to develop an energy poverty assessment», 2025

The SECAP is also guided by the fundamental goals included in the following international and national documents:

International agreements, obligations

1. United Nations Framework Convention on Climate Change (UNFCCC) (RA ratified in May 1993 as a developing country not included in Annex 1 of the Convention.),
2.Kyoto Protocol to the UNFCCC (RA ratified in December 2002),
3. The Paris Agreement and the Doha Amendment to the Kyoto Protocol (The National Assembly of the Republic of Armenia ratified on February 8, 2017.),

4."Nationally Determined Actions/Contributions" of the Republic of Armenia under the UN Framework Convention on Climate Change (Protocol Decision No. 41 of the Government of the Republic of Armenia dated 10.09.2015),
5."National Actions of the Republic of Armenia for 2021-2030 under the Paris Agreement" (Resolution No. 610-L of 22.04.2021 of the Government of the Republic of Armenia),
6."Long-term Strategy for Low-Greenhouse Gas Emissions Development of the Republic of Armenia (until 2050)" (Resolution of the Government of the Republic of Armenia № 2318-L of 28.12.2023),
7. Third Biennial Update Report under the UNFCCC, 2021,

8.Comprehensive and Enhanced Partnership Agreement (CEPA) between Armenia and the European Union (ratified by the Parliament of Armenia on April 18, 2018),

RA legislation in the field of energy efficiency

9.The Law of the Republic of Armenia "On Energy Efficiency and Renewable Energy" (adopted on 09.11.2004) ՀՕ-122-Ն, Amendment HO-67-N of 12.05.2016)
10.The Law of the Republic of Armenia "On Accreditation" (adopted on 08.02.2012) ՀՕ-20-Ն)
11.National Programs: Energy Efficiency and Renewable Energy Program 2022-2030 (Appendix No. 1 to the RA Government Decision N 398-L of 24.03.2022)
12.Decisions of the Government of the Republic of Armenia:

- Resolution N 1399-Ն on approving the "Procedure for Conducting Energy Expertise" (adopted on 31.08.2006, amended on 10.09.2015 by No. 1026-N)
- Resolution N426-Ն "On establishing the technical regulations for electrical and electronic equipment in newly constructed residential multi-apartment buildings, as well as in facilities constructed (reconstructed, renovated) at the expense of state funds" (adopted on 12.04.2018)
- Resolution N 1504-Ն on the application of measures aimed at increasing the energy efficiency and energy consumption of facilities being constructed (reconstructed, renovated) at the expense of state funds (adopted on 25.12.2014)

13. "Long-term (until 2036) Development Pathways of the Energy System of the Republic of Armenia" strategic document (2015)
14."Program-schedule ensuring the implementation of the first phase (2022-2024) of the Energy Efficiency and Renewable Energy Program 2022-2030" (RA Government Decision No. 398-L of 24.03.2022),
15. "Strategic Program for the Development of the Energy Sector of the Republic of Armenia (until 2040)", (RA Government Decision No. 48-L of 14.01.2021),
16. "On Amendments and Supplements to the Decision of the Government of the Republic of Armenia No. 48-L of 14.01.2021" (RA Government Decision No. 1827-L of 26.10.2023),

Community development programs and work plans:

17.Five-year development program for Noyemberyan community of Tavush region of the Republic of Armenia for 2022-2026 (Approved by the decision of the Council of Elders of Noyemberyan community of Tavush region of the Republic of Armenia No. 82-N dated 24.05. 2022),

18. Noyemberyan Community Annual Work Plan for 2023-2024,

19. Urban planning regulations of Noyemberyan community,

Regulatory and legal acts in the field of energy efficiency:

- Construction Norms:
  - RACN 24-01-2016 "Thermal protection of buildings"
  - RACN II -7.02-95 "Construction Thermophysics of Building Enclosing Structures: Design Norms"
  - RACN 22-01-2024 "Construction Climatology"
  - RACN IV-12.02.01-04 "Heating, ventilation and air conditioning"
  - RACN 22-03-2017 Artificial and natural lighting

- RACN 24-02-2022 "Ensuring energy efficiency of buildings: energy efficiency assessment indicators"
- National standards:
  - AST 362-2013 Energy efficiency. Building energy performance certificate. Basic provisions. Standard form
  - AST 371- 2016 Methodology for conducting energy audits in residential and public buildings
  - List of current standards in the field of energy efficiency and energy saving in Republic of Armenia.

European Union (EU) legislation in the field of energy efficiency in buildings:

- Directive 2010/31/EU of the European Parliament and of the Council of 19.05.2010 on the energy performance of buildings. Member States shall ensure that by 31.12.2020 all new buildings are nearly zero-energy buildings (NZEBs), and that new public buildings are NZEBs from 31.12.2018. Member States shall develop national plans to increase the number of NZEBs.
- Directive 2024/1275/EU of the European Parliament and of the Council of 24.04.2024 on the energy performance of buildings. All new buildings must be zero-emission buildings by 2030, and existing buildings must be converted to zero-emission buildings by 2050.

1.4. Project implementation financing options

Funding from various sources is envisaged for the implementation of the measures included in the Action Plan. An important tool can be the redirection of financial flows from cost financing (grants) to resource-saving financing. Below are examples of some possible sources of funding.

Local sources of funding

At the local level, the main financial source for the implementation of the Program may be the community budget. Community loans or bonds secured by state guarantees may serve as one source. It is desirable to include in the medium-term community development programs the issues of financing energy modernization of buildings, increasing the efficiency of street lighting, re-equipping public transport and other similar measures.

There is a possibility to attract funds on a co-financing basis from international institutions and donor organizations, with the mandatory condition of joint participation of the community.

a) National sources of funding

Targeted programs and funds, loans, targeted cash transfers, etc. can serve as national sources.

Subsidy programs aimed at developing the economic and social infrastructure of communities implemented by the RA Government are also a proven financial source. They are a new format of community-state horizontal cooperation, which implies co-financing of a part of the cost of a capital project from the state budget if the community submits a capital project and receives a positive conclusion from the government. Depending on the specific project sector, specificity, geographical location, as well as the impact of that project on the socio-economic situation of a given community, the state budget co-finances 30 to 70 percent of the total cost of subvention programs aimed at developing community infrastructure.

b) Local sources of funding

The main financial source for the implementation of the Action Plan may be the community budget. Loans or bonds secured by state guarantees may also serve. In cases of community participation, there is an opportunity to attract funds from international institutions and donor organizations.

c) financial resources of the community population

For the implementation of the SECAP measures, in case of initiative by the population, citizens have access to "soft", "green" loans operating in commercial banks. Even in case of partial co-financing by the

population, these loans can finance the work of heat preservation in apartments, thermal modernization of buildings and structures, efficient heating systems, solar water heaters and installation of PV systems of the necessary capacity for their own needs.

d) The business environment as a source of financing

Promoting sustainable energy development and climate protection technologies is also possible through real business: encouraging the production of materials, developing entrepreneurship, etc. through advertising support, including minimum energy requirements in public procurement and providing for appropriate orders, as well as through co-financing schemes, the use of public-private partnership formats, and incentive systems.

e) Other possible sources of funding

Such funds may include environmental fees paid by enterprises that have a harmful impact on the environment in the community, international assistance funds, environmental donations, national targeted fundraising, grants, and special financial support funds.

Below is a list of a number of donor organizations and financial institutions with which you can cooperate to implement investment programs to increase energy efficiency and encourage the development of energy conservation and renewable energy:

- Global Environment Facility (GEF)
- United Nations Development Programme (UNDP)
- German Agency for International Cooperation (GIZ)
- Global Climate Partnership Fund (GCPF)
- Green Climate Fund (GCF)
- Armenia Renewable Resources and Energy Efficiency Fund (R2E2 Fund)
- World Bank (WB)
- Asian Development Bank (ADB)
- Kreditanstalt für Wiederaufbau (KfW)
- Eastern Europe Energy Efficiency and Environmental Partnership (E5P) Fund
- Habitat for Humanity Armenia (HFHA), etc.

1.5. Monitoring results as a means of controlling energy efficiency and encouraging further development

The implementation of the SECAP is supervised and coordinated by the Noyemberyan Municipality. The implementation of the Action Plan will be supervised by the relevant specialists of the Municipality. It is desirable to introduce a system of energy managers specifically designated for these purposes, with their direct participation and coordination.

The implementation of program measures is monitored in accordance with the provisions of the Covenant. The monitoring procedure can be much more detailed and divided into intermediate stages at the local level. Such a system will be transparent, quantitative, manageable and will make it possible to monitor energy use, set priorities for increasing energy efficiency and quantify and financially assess the savings resulting from reducing energy consumption.

Public oversight of the implementation of the Action Plan is carried out by representatives of public organizations whose regulations provide for activities in the fields of environmental protection, energy efficiency, energy saving, as well as renewable energy.

Control over the use of budgetary funds aimed at ensuring the implementation of the SECAP is carried out in accordance with the established procedure and in accordance with the current legislation of the Republic of Armenia.

1.6. The objectives of the five-year development plan of the Noyemberyan community

The main objectives of the 2022-2026 five-year development plan of the Noyemberyan community are:

- Garbage collection and cleaning of streets, squares, and other public areas, which will reduce the level of environmental pollution and the risk of spreading infectious diseases.
- Outdoor lighting, the lighting network will be gradually expanded. The outdoor lighting system of Noyemberyan will be renovated and upgraded. As a result, the environment will become more attractive for tourists. The level of living comfort of the community residents will increase, and their evening recreation conditions will improve.
- To build and operate a solar energy system in the city of Noyemberyan, which will provide all the city's external lighting. The solution to the problem will serve as a positive example in the field of applying the latest technologies. As a result, the energy independence of the city's utility industry will increase. In the long term, significant financial resources will be saved in the community budget.
- Water supply and drainage and irrigation: To support the final solution of the water supply problem of the villages of Barekamavan and Jujevan. As a result, the livelihoods of the residents will improve. To renovate the central section of the drainage system of the city of Noyemberyan, increasing its capacity. As a result, the central part of the city will be improved, and the risk of flooding of buildings located in the danger zone will be reduced.
- To build an internal irrigation system on 330 hectares of land in Koti village. As a result, the efficiency of land use will increase, and farmers' income will increase.
- Gas supply: complete the process of introducing an in-house gas supply network in the villages of Koti, Voskepar, Voskevan, Barekamavan and Jujevan.
- Transport, road: to carry out the repair, paving and improvement of roads in the community's settlements as much as possible, giving priority to vitally important sections of each settlement. Restore the public transport route on the Noyemberyan - Barekamavan section and within the city of Noyemberyan.
- Agriculture, primarily to promote the introduction of advanced technologies in this field, the expansion of the consumer market, and the implementation of targeted programs. Support small and medium-sized businesses processing agricultural products.
- Urban development: Redesign two semi-detached residential buildings located at Berdasar 3 in Noyemberyan city as guesthouses and complete their construction. Solving this problem will be of primary importance in the development of tourism.
- Residential and non-residential funds: Renovate the Noyemberyan community hall building. Renovate and strengthen the Noyemberyan city art school building. Renovate the Dovegh “community house” and rehabilitating the the roof. Renovate the Koti village culture house. As a result, the organization of leisure time for the village residents will improve. The works will be carried out by local labor.

It is expected that the full implementation of the mitigation actions presented in the SECAP will ensure the fulfillment of the commitments undertaken by the Noyemberyan community within the framework of the Covenant and will enable it to achieve the target of at least a 40% reduction in GHG emissions by 2050 (compared to the base year).

1.7. On social support for border communities

The RA Law HO-203-N of 01.12.2014 "On Social Support for Border Communities" and the relevant government decisions regulate the process of providing support to the settlements of border communities included in the list approved by the RA Government, in the following articles:

- The natural gas, electricity and irrigation water bills consumed by persons registered in the population register of the border community and permanently residing in the border community are partially reimbursed from the RA state budget.

The aforementioned law and government decisions also provide relevant regulations on the following issues:

- Payment of land tax and real estate property tax in the administrative territory of the RA border communities to the relevant community budget, instead of individuals and legal entities paying taxes, from the RA state budget,
- In case of deprivation of housing due to landmine explosions or military/terrorist actions, provision of equivalent housing at the expense of state budget funds,
- Implementation of the state order for medical assistance and services for RA citizens injured by landmine explosions or military/terrorist actions,
- On the implementation of the one-time assistance provided from the RA state budget to the families of deceased citizens (for funeral and cemetery improvement, preparation and installation of tombstones) in the manner and amount established by the RA Government.

1.8. About energy poverty

The "Food Security and Poverty" report published by the Statistical Committee of the Republic of Armenia reveals a worrying social picture in the Tavush region, including the Noyemberyan community, in terms of the relatively high level of poverty.

According to the RA Energy Efficiency and Renewable Energy Program for 2022-2030:

a) 58.6% of households in Armenia are unable to heat their homes sufficiently during the cold months and can be considered energy poor. The low intensity of energy consumption is largely due to the standard of living of the population.

b) Firewood is used as a heating medium by 71% of rural households. Firewood and manure remain the most common sources of heating in rural households.

c) Energy consumption in households largely depends on their standard of living.

d) The final energy consumption per capita in the HHs is about 2 times lower than the average for the EU-28 countries. And the final energy consumption per unit of the actually inhabited housing stock in the HH is 17% lower than the EU average.

e) Given the prospects for economic development and rising living standards over the next ten years, it is expected that energy demand from households will increase as a result of reducing energy poverty and underheating levels in residential areas.

Energy poverty refers to a household's lack of access to basic energy services.

Energy services should ensure an adequate level of health and well-being, including adequate heating, hot water supply, cooling, lighting and the availability of energy to power household appliances, in the appropriate national context, in accordance with existing national social policies and other relevant national policies.

Energy poverty is caused by a combination of factors, including, at least, inaccessibility, insufficient disposable income, high energy costs and low energy efficiency of housing.

Energy access and energy poverty are a cornerstone of the Covenant.

At the global level, this cornerstone/pillar is built on three energy attributes:

- **Reliable energy:** The availability and/or reliability of energy supply ensures access to economic, social and cultural interaction.
- **Sustainable energy:** Energy is produced from renewable and environmentally friendly resources, avoiding negative impacts on health, social well-being and gender equality.

- **Affordable energy:** Energy is affordable and/or buildings are energy efficient, allowing for the most cost-effective use of energy and the use of energy for economic, social and cultural purposes.

For each energy indicator, communities are provided with a set of indicators to assess local energy access and energy poverty levels.

Each region joining the Covenant can choose the most appropriate energy indicator based on its local characteristics and energy needs, adjusting its energy consumption estimate accordingly.

The measures proposed within the framework of this SECAP project will greatly contribute to the reduction of energy poverty in the Noyemberyan community, while ensuring the full implementation of the community's commitment to reducing GHG emissions.

The low standard of living of the population and the actual underheating of private houses and apartments in rural areas reduce the financial and economic indicators of such projects and the actual impact of climate mitigation.

Poverty in Armenia has been assessed since 1996 using the indicators of "extremely poor" (food line), "moderately poor" (lower line), and "poor" (upper line). Since 2019, a new, revised World Bank methodology has been in use, which has also added a median poverty line, which is the average of the upper and lower lines.

The following comparison of poverty data for 2020-2024 is available in the report of the Statistical Committee and the «Center for Economic Development and Research».

Table 1. Main poverty indicators in Armenia, (%)

Indicators	2020	2021	2022	2023	2024
Poverty level	27.0	26.5	24.8	23.7	21.7
Extreme poverty level	0.7	1.5	1.2	1.1	0.6

Table 2. Poverty rate by gender, (%)

Indicators	2020	2021	2022	2023	2024
Among men	26.3	25.8	24.7	23.7	22.5
Among women	27.9	27.3	25.0	23.8	19.4
In children (up to 5 years old)	34.1	36.7	32.3	32.2	30.2

Table 3. Poverty rate by education level, (%)

Indicators	2020	2021	2022	2023	2024
Elementary and lower	32.7	39.9	35.1	30.4	32.8
Incomplete secondary school	34.4	33.4	33.7	31.0	28.1
Secondary general school	29.5	30.0	26.0	23.8	22.7
Secondary vocational school	24.0	21.8	19.4	21.0	18.9
Higher	16.6	12.5	14.9	14.5	13.4

Table 4. Poverty level by some regions of Armenia, (%)

Indicators	2020	2021	2022	2023	2024
Total	27.0	26.5	24.8	23.7	21.7
Gegharkunik	48.1	49.1	33.9	35.4	27.6
Shirak	42.9	46.9	41.6	43.1	43.0
Syunik	6.1	2.8	5.4	7.0	6.2
Tavush	37.5	38.2	37.4	37.2	39.9

Table 5. Extreme poverty level by some regions of Armenia, (%)

Indicators	2020	2021	2022	2023	2024
Total	0.7	1.5	1.2	1.1	0.6

Gegharkunik	1.9	4.7	2.5	3.1	0.4
Shirak	2.2	3.1	3.6	4.0	2.4
Syunik	0.0	0.0	0.6	0.0	0.0
Tavush	0.7	1.3	5.0	2.6	2.0

Main poverty indicators in Armenia

The poorest region in Armenia is Shirak, where 43% of the population is poor. Tavush follows with a poverty rate of 39.9%.

Poverty levels are also higher than average in Vayots Dzor, Gegharkunik, Armavir, and Kotayk. The lowest poverty rates were recorded in Aragatsotn and Syunik.

Source: by the Statistical Committee Source: link

According to the RA 2014-2025 Strategic Development Program approved by the Appendix to the RA Government Decision No. 442-A of 27.03.2014, the main factors for poverty reduction will be the increase in the labor income of the population due to economic growth, including the progressive increase in the labor income of the poor population, as well as the increase in state expenditures on social insurance and social assistance and their targeting.

Table 6. Key target indicators for poverty reduction

Indicators	**2010**	**2011**	**2012**	**2017**	**2021**	**2025**
Poor, percent of population	35.8	35.0	32.4	23.7	18.1	13.0
Extremely poor, percent of population	3.0	3.7	2.8	2.4	2.1	1.8
Memorandum articles						
Upper general poverty threshold/line, AMD/month	33,517	36,158	37,044	43,218	48,642	54,747
Extreme poverty line, AMD/month	19,126	21,306	21,732	25,354	28,536	32,118

According to the RA Government Program (2021-2026), approved by the Appendix to the RA Government Decision N 1363-A of 18.08.2021, an annual GDP growth of more than 7% is necessary in the RA to halve poverty by 2026. By ensuring this growth rate, the quality of people's lives will significantly improve, incomes will increase, jobs will be created, and the poverty level will be reduced. The government will take steps to eliminate extreme poverty by 2026. Through the development of the capabilities and skills of poor and disadvantaged families, through the provision of employment and self-employment funds, and the application of phased poverty reduction models, families will emerge from poverty.

According to the planned measures, Armenia should implement: a) Adoption of a legal act on energy poverty taking into account the specificities of the Republic of Armenia, with the definition of characteristic indicators, b) Establishment of a mechanism for assessment and collection of gender-disaggregated data, c) Collection and assessment of gender-disaggregated data, d) Registration of energy poor energy consumers by gender, household and mapping.

All measures proposed within the framework of the SECAP are also aimed at reducing energy poverty in the community. Perhaps the most effective measure is 9.2.3.4: Restoration of thermal insulation layers of attic roofs of private houses.

If the specific cost of GHG emissions as a result of the implementation of all mitigation measures proposed within the framework of the Program (depending on the selected target year) is 2.8-2.85 thousand euros/tCO2, and in the residential sector- 1.3-1.39 thousand euros/tCO2, then in the case of the mentioned measure the specific cost of GHG emissions is 0.66 thousand euros/tCO2, therefore it is also the most affordable in the context of reducing energy poverty.

1.9. About gender sensitivity

Women are among the most vulnerable groups in terms of energy poverty. Climate change-induced instability of the energy system, potential disruptions in energy supply, and problems with access to energy services may increase the burden on women.

The Gender Strategy of Armenia for 2025–2028 sets out national priorities aimed at promoting equality in all areas. Priority 6 focuses on developing gender-sensitive and gender-responsive approaches to climate change. This priority highlights the importance of ensuring inclusive principles and raising awareness of the differential consequences of climate change impacts for women, men and vulnerable groups. In the context of climate adaptation and mitigation programmes, it is necessary to integrate gender considerations into policies and programmes, promote equal participation of men and women in decision-making processes and recognize women as key agents of change.

Within a coherent national framework, this document takes into account the importance of gender-responsive approaches to climate change and emphasizes the commitment to integrating inclusive principles into current and future adaptation and mitigation processes, contributing to resilience and sustainable development.

Chapter 2. Brief description of the Noyemberyan community

Noyemberyan community is located in the north-eastern part of the Republic of Armenia, covers the north-eastern part of the Tavush region of the Republic of Armenia and with a small layer penetrates into the central part of the region. The settlements of the community are mainly located on the lower edge of the mixed forests leading to the mountains. Almost half of the entire area of the community, 16010.42 ha, are forests.

Noyemberyan community is located in the northern part of Tavush region at an altitude of 800-900 m, in the lower part of the Voskepar mountain range, in the valley of the right tributary of the Koghb River. The total area of the community is 33886.81 km^2.

The community is located 198 km from Yerevan, 98 km from Tbilisi, and 22 km from the nearest station, Ayrum. The community is connected to the outside world by the Yerevan-Tbilisi railway and the Yerevan-Alaverdi-Tbilisi and Yerevan-Ijevan-Tbilisi highways.

The old name of Noyemberyan is Barana. According to sources, several Armenian families settled here from Aparan. Residents of nearby villages ask the newcomers, “Where did you come from?” They say, “Aparana.” After that, the name of the village remained Barana.

The territory of Noyemberyan became part of the Gugark province of Greater Armenia, and in the 10th century and early 12th century, of the Tashir-Dzoraget (Kyurikyan) kingdom. At the end of the 11th century and early 12th century, the Kyurikyan kingdom was conquered by the Seljuks, and the territory of Noyemberyan was annexed to the Gandzak Emirate. In 1118-1124, the Georgian king David the Builder liberated the territory from the Seljuks and annexed it to Virk. In 1236, it was conquered by the Mongols. In 1801, the territory of Noyemberyan was annexed to Russia. In the 19th century, it was part of the Ghazakh province of the Elizavetpol province, and in 1920-29, it was part of the Lori-Pambak province. Since 1938, Noyemberyan has become the center of the administrative district.

There is no exact data on ancient settlements in this area, but the Mshkavank Monastery and the St. Sargis Church, built in the 13th century in its immediate vicinity, and the Ghalinjakar Fortress suggest that this area was also inhabited in ancient times. Archaeological studies indicate that people have lived in the area of Noyemberyan since the Old Stone Age. There are tombs, khachkars, memorial fountains, a chapel, a monument, and a church in the city. Three Cyclopean fortresses have been discovered in Noyemberyan: the "Tpi Dash" fortress in the north, the Berdateghi fortress 2 km northeast, and the "Jukhtakeghtsi" church 2 km southwest (13th-14th centuries).

In the northern part of Noyemberyan, on a green hill, rises a huge monument-monument built in a beautiful style, visible from all sides of the city and seemingly dominating the surroundings.

The author of the Monument of Glory and Immortality is the architect Karlen Martiros Ananyan, originally from Noyemberyan. The solemn opening ceremony of the monument took place on May 9, 1980.

Source: Urban planning regulations of Noyemberyan community, Tavush region, RA (26 May 2023)

No bibliographic or lithographic information has been preserved regarding the construction date of the Church of the Holy Mother of God in Voskepar. Based on architectural analysis, it dates back to the 6th–7th centuries and is classified as a mastara-type monument.

The interior walls were probably plastered and covered with frescoes. The integrity of the temple, the perfect harmony of its proportions testifies to the great skill of the builder. The church was renovated in 1975–1977.

Source: Urban planning regulations of Noyemberyan community, Tavush region, RA (26 May 2023)

St. Sargis Church is located in the town of Noyemberyan, Tavush region of the Republic of Armenia. The church was built in 1848; it is a basilica-like structure made of tuff stone. It has a bell tower above the entrance. The church was renovated in 1903. During the Soviet years, the church was not in operation and was used as a warehouse. During the years of independence, the church was in operation again, but on July 18, 1997, it was significantly damaged by an earthquake. The church was renovated in 2005-2006 and continues to receive pilgrims to this day.

Source: Urban planning regulations of Noyemberyan community, Tavush region, RA (26 May 2023)

Mshkavank is located 3 km south of the village of Koghb in Tavush region, on a forested, high plateau. There is a dirt road from Koghb to the monastery complex. Mshkavank is included in the list of state protected monuments of Armenia under the number "10.41.23". It is currently a non-functioning monastery complex.

Source: Urban planning regulations of Noyemberyan community, Tavush region, RA (26 May 2023)

2.1. Local governance structure

The Council of Elders is the highest representative body of local self-government in the Noyemberyan community, which exercises control over the activities of the Noyemberyan community leader and the implementation of decisions made by him.

The bodies of the Council of Elders are: the Head of the Community, his first deputy and deputy, the members of the Council of Elders, and the fractions of the Council of Elders.

The Council of Elders consists of 21 members, who are elected for a five-year term.

The Council of Elders adopts decisions concerning the interests of the Community, and on issues beyond its jurisdiction, it may adopt messages addressed to the community population, the community leader, the regional governor, or other state bodies.

Structurally, the staff of the Noyemberyan Municipality consists of the following departments:

- Department of Urban Planning and Land Development, Agriculture and Environmental Protection,
- Department of Education, Culture, Social Assistance, Sports and Youth Affairs,
- Department of Development Programs, Tourism, Trade and Service,

- Secretariat, Personnel Management, Information Technology Department,
- Financial and Economic, Revenue Accounting, Collection and Procurement Department.

There are also civil works and maintenance personnel, community discretionary and administrative (staff) positions, and community veterinarians.

Brief information about the city of Ayrum and 17 rural settlements of Noyemberyan community is provided below:

Ayrum city

The city of Ayrum in Tavush province is located on the Bagratashen-Alaverdi highway. It was founded in 1937. simultaneously with the construction of a canning factory, as a workers'town. In 1960, due to the presence of up to 5-story apartment buildings, private houses, a palace of culture, and numerous household and commercial facilities, it was ranked among the cities of republican subordination.

Source: By Armtoursites - Uploader's own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=26697057

Since 2006, the settlement has had the status of a city. It does not have land plots, which is why the population has not benefited from land privatization. It is located in the north-eastern region of the Republic of Armenia, on the banks of the Debed River, at the intersection of the Armenia-Georgia M-6 interstate highways. It borders Lori region, is located at an altitude of 502 m above sea level. It is located 80 km from the regional center and 190 km from Yerevan. The climate is warm, hot in summer, the maximum temperature reaches +35 °C, winter is mild, short, lasting 3 months, cold up to -5 °C. The community has had developed agriculture since the Soviet years.

Artchis rural area/settlement

Artchis is located on the right bank of the Debed River, 4 km from the Ayrum station, about 9 km west of the city of Noyemberyan. It is rich in fruitful gardens; there are forests in the surrounding area. The climate is mild, mountainous.

Source: By Valen1988 - Uploader's own work, CC BY-SA 4.0,

Bagratashen rural area/settlement

Bagratashen is located in the immediate vicinity of the Armenian-Georgian contact line, on the banks of the Debed River. It is 73 km northwest of the city of Ijevan, the center of Tavush region.
The settlement has had several names. Among them are: Debetashen, which was used until 1972. It was renamed Bagratashen on February 23, 1972.

Source: By Dalibor Z. Chvatal, CC BY 3.0,

Baghanis rural area/settlement is located in the northeast of Tavush region, in the valley of the river of the same name. It is 32 km northwest of the regional center Ijevan, and 2 km south of the nearest settlement Voskevan village. It has an area of 1,259 km².
There are numerous historical and cultural monuments in the village, 8 of which are registered in the list of historical and cultural monuments of Armenia.

Source: link

Barekamavan rural area/settlement
Barekamavan is located about 9 km east of the city of Noyemberyan, on the northern slopes of the Voske-Pari mountain range. It was renamed Barekamavan on January 25, 1978. The village is located 1.5-2 km from the Armenian-Azerbaijani border.

Source: By Vahe Martirosyan - Uploader's own work

Berdavan rural area/settlement

The village is 1 km north of the city of Noyemberyan, on the banks of the Koghb River. It is located about 1 km from the border with Azerbaijan. It was renamed Berdavan on January 25, 1978.
Near Berdavan is the medieval Ghalinjakar fortress, which was built in the 10th-11th centuries and restored in the 17th century.
The village was previously located 1.5 km southeast of the place called Tkhadzor, and in 1898. moved and occupied the current area. On the former site there are ruins of a small fortress, after which the village was named Berda, Berdagyugh.

Source: link

Debedavan rural area/settlement
The village of Debedavan is located on the right bank of the Debed River, about 18 km northwest of the city of Noyemberyan, in the immediate vicinity of the border with Georgia.
It is the lowest settlement in the Republic of Armenia, located at an altitude of 370 m above sea level.

Source: link

Deghdzavan rural area/settlement

Deghdzavan is located about 12 km northeast of the city of Noyemberyan, on the right bank of the Debed River, 1-2 km from the state border with Georgia.

Renamed Deghdzavan on January 25, 1978. It was founded in 1978 on the basis of the production site of the Artchis wintering ground.

Source: link

Dovegh rural area/settlement

Dovegh is located about 2 km east of the city of Noyemberyan. There are different explanations for the origin of the village's name. According to one version, in ancient times the name of the settlement was Davegh, meaning upwards.

Source: link

Zorakan rural area/settlement

The village is located 6 km northwest of the city of Noyemberyan. It was renamed Zorakan on July 4, 2006. From 1988 to 1989, the village was inhabited by Armenians who were forcibly displaced here from the village of Khachisar (Char-dakhlu) in the Shamkor region of Azerbaijan.

Source: link

Lchkadzor rural area/settlement

The village is located about 7 km west of the city of Noyemberyan, on the right bank of the Debed River.

Source: By Karlen Bidzikyan - Uploader's own work, CC0,

Koti rural area/settlement

The village is located near the Armenian-Azerbaijani contact line. In 1991 it was renamed Koti. According to tradition, the village was named Koti or Koteri village because in order to keep the houses free from the smoke of the furnace and to make the smoke exit faster, koters were placed on the eaves. The eaves served as a chimney, the chimney was not covered with brick or stone, since the eaves also served as a window.

11 km east of Koti is the Geghategh village site, the 9th-18th centuries. Surb Sargis monastery complex, 5 km east - the 1st millennium BC. "Aghi Aghbyur" fortress.

Source: By GeoO - Բեռնողի սեփական աշխատանք, CC BY-SA 4.0,

Haghtanak rural area/settlement was founded in 1949 on the basis of a collective farm. With the construction of a water pumping station, fruit orchards were established on land with steppe vegetation cover.

Source: link

Koghb rural area/settlement

The settlement is located on the highway leading from Ijevan to the Bagratashen checkpoint, southwest of Berdavan. The city of Noyemberyan is located to the east of the village, and the village is surrounded by forested mountains to the northwest, west, and southwest. It is 50 km from the regional center Ijevan, 195 km from the capital Yerevan, and 4 km from the nearest city of Noyemberyan. It is 750 m above sea level. The Koghb River flows through the border zone of the settlement. It is about 5 km from the Armenian-Azerbaijani contact line.

Source: By Artyom Mamyan - Uploader's own work, CC BY-SA 4.0,

The Zikatar nature reserve is located in Koghb. It has an area of 150 hectares and occupies the northeastern slopes of the Dzigkatar peak of the Gugarats mountain range, the upper parts of the basins of the right-bank tributaries of the Koghb River. It is 1,250-1,650 m above sea level.

Voskepar rural area/settlement

The village is located in the northeast of the region, on the Armenian-Azerbaijani border, on the Ijevan-Noyemberyan highway. The villages of Baghanis are located to the north of the village, Atcharkut to the south, and Kirants to the southeast. The settlement of Voskepar is located 22 km northwest of the regional center, Ijevan, in a straight line, and 32 km by highway. It is located on the right-bank, north-facing slope of the Voskepar River. It is 740-920 m above sea level.

Source: By Andrey Bobrovsky, CC BY 3.0,

The village has a centuries-old history and is rich in historical and cultural monuments. The nature is beautiful, consisting mostly of forested mountains, and the river of the same name flows through the natural-wild area. The name "Voskepar" symbolizes fertility and abundance according to some data.

Voskevan rural area/settlement is located 33 km northwest of the regional center, on the southern slope of the Voskepar mountain range. Voskevan is 16 km from Noyemberyan by highway, 45 km from the regional center Ijevan, and 180 km from the capital Yerevan.

Source: link

Ptghavan rural area/settlement is located about 12 km northwest of the town of Noyemberyan, on the right bank of the Debed River. The Bagratashen border checkpoint is located not far from the village.

Source: By 05arman - Բեռնողի սեփական աշխատանք, CC BY-SA 4.0,

Jujevan rural area/settlement

The village is located at the southern and southwestern foothills of Elak Mountain (1,361 m) on the eastern and northeastern end of the Gugarats mountain range, at an altitude of 1,000-1,100 m above sea level, in the upper reaches of the Baghanis River, 7 km from the state border of Armenia. The village was founded in 1874.

Source: link

Along the highway, the village of Jujevan is located 8 km from Noyemberyan, 53 km from the regional center Ijevan, and 190 km from the capital Yerevan. The location of the village was the oldest place of human settlement, which existed since the Stone Age. Stone Age structures have been found in the areas called "Paru Kar" and "Plolik Hogh". The areas surrounding the village have existed as settlements continuously since the Bronze Age to the present day. There are Bronze Age cyclopean structures. The most notable of them are "Arami Blur", "Poplozi Blur", "Kocholi Blur" and other peaks.

2.2. Geography

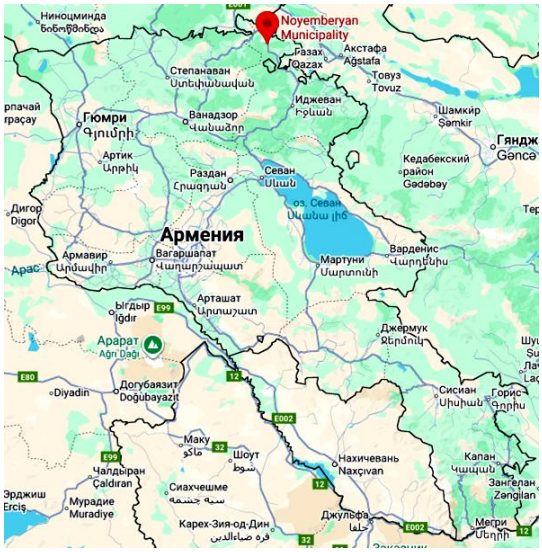
The Noyemberyan community of the Tavush region of the Republic of Armenia is located in the northeastern part of the Republic of Armenia at an altitude of 800-900 m, in the lower part of the Voskepar mountain range, in the valley of the right tributary of the Koghb River. It covers the northeastern part of the Tavush region of the Republic of Armenia and with a small layer penetrates into the central part of the region. The settlements of the community are mainly located on the lower edge of the mixed forests going towards the mountains. Almost half of the entire area of the community, 16,010.42 ha, are forests.

The area is characterized by a warm, moderately humid, temperate climate with mild winters. The average annual temperature is 10.4 °C. The annual amount of atmospheric precipitation is 541 mm. The thickness of the snow cover in winter varies within 10-12 cm. The annual duration of sunshine reaches about 2,100 hours. The annual radiation balance is about 45 kcal/cm^2. The average annual wind speed is 1.8 m/s.

Southwestern and northeastern winds prevail throughout the year.

With its climatic conditions and picturesque landscape, the region is considered one of the most beautiful places in Armenia and has long had a reputation as a wonderful summer resort. The region is characterized as a climatic resort zone. Comfortable conditions for climatotherapy prevail in the territory of the community from May to October.

The axis of the community's road network is the section of the M16 interstate highway connecting Armenia with Georgia that passes through the community. The community center, the city of Noyemberyan, is 195 km from the capital Yerevan and 55 km from the regional center Ijevan. An interstate highway passes through the city, and the railway station in the city of Ayrum is 25 km away.



Source: GoogleMaps

Source: https://hy.wikipedia.org/wiki/ Noyemberyan

Noyemberyan community on the map of RA

The Noyemberyan community includes the following settlements: the cities of Noyemberyan and Ayrum and 17 rural settlements (the rural communities of Archis, Bagratashen, Baghanis, Barekamavan, Berdavan, Debedavan, Deghdzavan, Dovegh, Zorakan, Lchkadzor, Koti, Koghb, Haghtanak, Voskepar, Voskevan, Ptghavan and Jujevan).

The cities of Noyemberyan and Ayrum and the rural settlements of Noyemberyan community on the map of Armenia (Source: Google maps ®)

The table below shows the administrative area of Noyemberyan community in hectares by settlement, as well as the territorial share (in %) of each settlement in the total administrative area of the enlarged community.

Settlement	Area		Settlement	Area	
	ha	(%)		ha	(%)
Noyemberyan city	2688.04	4.72%	Zorakan	1805.76	3.17%
Ayrum city	163.19	0.29%	Lchkadzor	2159	3.79%
Artchis	1904.21	3.34%	Koti	5011.52	8.80%
Bagratashen	2290	4.02%	Koghb	11194	19.65%
Baghanis	2384.55	4.19%	Haghtanak	1659	2.91%
Barekamavan	1977.38	3.47%	Voskepar	6395.12	11.23%
Berdavan	3969.41	6.97%	Voskevan	2790.7	4.90%
Debedavan	786.81	1.38%	Ptghavan	570.57	1.00%
Deghdzavan	625.57	1.10%	Jujevan	6648.15	11.67%
Dovegh	1937.93	3.40%	-	-	-

2.3. Community history

There is no exact data on ancient settlements in this area, but the “Mshkavank” and “Surb Sargis” churches, built in the 13th century in its immediate vicinity, and the “Ghalinjakar” fortress suggest that this area was also inhabited in ancient times.

Archaeological studies indicate that people have lived in the area of Noyemberyan since the Old Stone Age. In ancient times, the area of Noyemberyan was part of the Gugark province of Greater Armenia, and from the beginning of the 12th century, it was part of the Tashir-Dzoraget kingdom. As a result of the Russo-Turkish war, from 1801 the settlement came under the rule of the Russian Empire until the Bolshevik Revolution. In the 19th century, it was part of the Ghazakh province of the Elizavetpol province (nahang, gubernia), and from 1920-1929, it was part of the Lori-Pambak province. Since 1938, Noyemberyan has become the center of the administrative district.

The population is engaged in animal husbandry, gardening, farming, public and private service sectors, crafts, and construction.

In the Noyemberyan area, there are iron ores, copper deposits, white felsite reserves, and mineral waters.

Noyemberyan houses hotels, restaurants, two churches, one primary and one high school, music, art and sports schools, 2 kindergartens, a preschool named after Sargis Zurabyan (child development center), a cultural center, a medical center, a post office, a police department, a NSS department, a community hall, a state vocational college, mobile operator service points, dental, diagnostic, centers, supermarkets, shops, pharmacies, notary offices, an emergency response unit, and libraries. Noyemberyan has traditionally played an active role in the development of Armenian sports. Popular sports in Noyemberyan include wrestling, volleyball, taekwondo, chess, etc. The administrative area of Noyemberyan community is 33,886.81 ha.

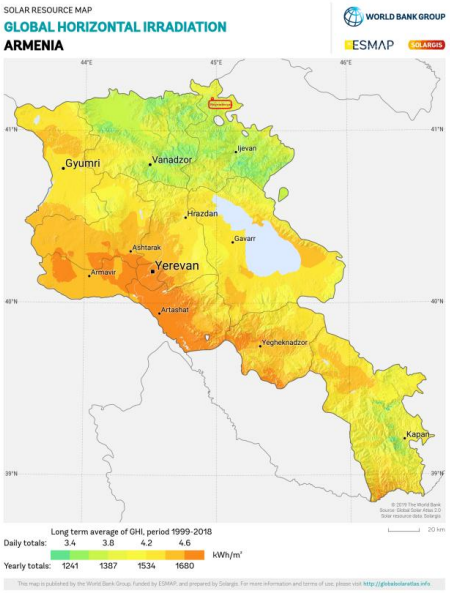
The majority of the population of Noyemberyan is Armenian, speaking the Lori dialect. According to the National Statistical Service, the population of the enlarged community of Noyemberyan in 2014-2024 by settlement is presented in **Table 3**.

2.4. Climatic conditions

The relief of the Noyemberyan community is complex, the slopes are steep, indented, the central part of the area is flat. The seismic hazard level is estimated at 0.2-0.3g. The slope angle of the surface varies within 3-25 °.

With its climatic conditions and picturesque landscape, the region is considered one of the most beautiful places in Armenia and has long had a reputation as a wonderful summer resort. The region is characterized as a resort climatic zone. Comfortable conditions for climatotherapy prevail in the territory of the community from May to October.

The average temperature in January is from -3°C to +2°C, in July it is +17...+23°C, annual precipitation is 500-600 mm (541 mm), the vegetation period is 150-200 days. The major rivers are Debed, Baghanis, Voskepar, Koghb.



According to RACN 22-01-2024 "Construction Climatology" Construction Norms", Annual solar radiation varies around 2,100 hours, with a maximum of 149.1 hours in July[8].
The total radiation of the horizontal surface under average cloudiness is 1,380.7 kWh/m^2, which is slightly lower than the average indicator for the republic.

https://globalsolaratlas.info/download/armenia

The calculation characteristics, start, end, and duration of the heating season in the Noyemberyan community are given in **Tables 1 and 2**.

Table 1. Calculation characteristics of the heating period

Coldest five-day mean air temperature (^{0}C)	Average temperature with average daily temperature for the period: not higher than, °C			Degree-days of heating period at indoor temperature (+20°C)		
with 98% probability of occurrence	(0)	(≤ 8°C)	(≤ 10°C)	117	189	215
-18 (°C)	-4.6 (°C)	-1.2 (°C)	0.1 (°C)	2,878	4,007	4,279

Table 2. Start, end and duration of the heating period

Multi-year daily mean air temperature transition	Beginning*	End*	Duration* (days)
Heating period (stable transition of air temperature to 0°C in spring and autumn)[9]	24 November	8 March	104
Heating period (≤ 8°C)	18 October	24 April	189
Heating period (≤ 10°C)	6 October	8 May	215

* According to the RACN 22-01-2024 "Construction Climatology"

2.5. Economy

Tavush region is located in the northeast of Armenia. It borders Azerbaijan to the east, Georgia to the north, Lori to the west, Gegharkunik to the south, and Kotayk to the southwest. In 2024, the shares of the main sectors of the regional economy in the total volume of the corresponding sectors of the RA economy were: ➢ industry 1.4%, ➢ agriculture 4.5%, ➢ construction 3.0%, ➢ retail trade 2.4%, ➢ services 0.9%.

Tavush region is relatively poor in minerals. The leading sectors in animal husbandry are cattle breeding and pig breeding, and in plant breeding - the cultivation of grain crops and viticulture. In recent

[8] https://pvgis.com/en (Annual photovoltaic energy production hours)
[9] https://weatherspark.com/y/103465/Average-Weather-in-Noyemberyan-Armenia-Year-Round

years, fruit growing has been developing, for which the region previously enjoyed great fame. In recent years, orchards have been established, in which figs and persimmons predominate. Beekeeping is also developing year by year.

The leading sector of the economy of Tavush region is the manufacturing industry. The most dominant are the food industry and wood processing.

Freight and passenger transportation in the region is carried out by road. The North Caucasus-Tbilisi-Yerevan gas pipeline passes through the center of the region. A 7-kilometer section of the Yerevan-Tbilisi railway passes along the northern border, along the Debed River.

The Ayrum Border Crossing and Bagratashen Border Crossing customs checkpoints are located in the Tavush Province region.

Agriculture plays a significant role in the economic life of the city of Noyemberyan, the main direction of which is animal husbandry and field cultivation. In recent years, stone production has also been developing. The city of Ayrum is a city near the railway station, the main occupation of the population is retail trade. Ayrum is the lowest city in Armenia, about 500 m above sea level. The distance from Yerevan to the city of Noyemberyan (population: 4.3 thousand people at the beginning of 2023) is 187 km. The distance from Yerevan to the city of Ayrum (population: 1.8 thousand people at the beginning of 2023) is 206 km.

Of the community's 56,813.93 ha of land resources, 28,452.86 ha are of agricultural significance, which are used as arable land, grasslands, and pastures.

Among the community's main issues, the following are important to note: the socio-economic problems of the population, infrastructure deficiencies with the poor condition of intra-community roads, the need to increase lighting on intra-community streets, the deterioration of the drinking and irrigation water network, the poor and degraded conditions of the buildings and properties of community-owned facilities, the poor condition of the commonly owned areas of apartment buildings, such as roofs and staircases, quality problems in the educational and healthcare sectors, the limited availability of cultural and sports activities, as well as challenges arising from the border situation and post-war conditions.

The five-year development plan of Noyemberyan community for 2022-2026 envisages the development of agriculture through the introduction of innovative technologies in the community, the development of tourism, the formation of educational and work structures in the field of modern digital technologies, the implementation of programs, the development of the business environment, the promotion of investments, the improvement of the well-being of socially vulnerable residents, the empowerment of women and youth, the promotion of public activism, the development of culture and education, the creation of new opportunities, environmental protection, the establishment and development of renewable energy infrastructure in the community.

2.6. Population

The majority of the population of the city of Noyemberyan is Armenian, speaking the Lori dialect. The population is engaged in animal breeding, gardening, farming, working in the state and private service sectors, crafts, and construction. The population of the settlement in 1831 was 294 people, in 1897 - 1,197, in 1926 - 1,901, in 1939 - 2,655, in 1959 - 3,138, in 1970 - 4,330, in 1980 - 5,115, in 1989 - 6,116, in 2001 - 5,486, in 2004 - 5,500, in 2011 - 4,904, in 2025 - 4,500 people.

The population density in the Tavush region of the Republic of Armenia is 43 people/km^2. The number of registered births as of 2024 is 297, and the number of deaths is 250. There is no clear data on the number of marriages and divorces.

According to the Statistical Committee of the Republic of Armenia, the population of the enlarged community of Noyemberyan at the beginning of 2014-2024 by settlements is presented in **Table 3**. The change in the total population of the enlarged community of Noyemberyan, the population of the cities of

Noyemberyan and Ayrum, and the total indicators of the rural settlements of the community during the period 2014-2024 is presented in **Chart 1**, and the age composition of the permanent population of the community is presented in **Chart 2**.

Table 3. Population of the enlarged community of Noyemberyan in 2014-2024

Settlement	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Noyemberyan city	5205	5104	4930	4800	4683	4584	4514	4517	4373	4327	4536
Ayrum city	2061	2019	1957	1935	1895	1849	1815	1795	1746	1747	1850
Artchis	1127	1122	1128	1088	1054	1066	1038	1043	1060	1070	1080
Bagratashen	2808	2770	2775	2810	2823	2841	2870	2848	2842	2851	2869
Baghanis	835	847	856	856	842	850	824	842	841	840	838
Barekamavan	293	253	232	227	219	197	172	164	163	161	164
Berdavan	3195	3222	3265	3202	3180	3213	3224	3226	3247	3242	3267
Debedavan	615	605	599	590	603	608	538	541	553	542	562
Deghdzavan	284	282	293	301	312	291	302	292	297	300	302
Dovegh	529	540	538	526	472	502	533	533	550	540	528
Zorakan	865	893	916	919	926	881	833	812	818	825	871
Lchkadzor	411	414	432	430	389	390	398	400	404	408	406
Koti	2092	2055	2020	1993	1965	1977	1965	1942	1930	1922	1935
Koghb	4519	4538	4554	4585	4602	4601	4580	4590	4601	4598	4609
Haghtanak	1272	1283	1301	1300	1308	1226	1233	1181	1140	1127	1128
Voskepar	875	841	836	818	782	771	756	740	723	721	711
Voskevan	1346	1369	1398	1386	1361	1364	1348	1347	1343	1331	1343
Ptghavan	833	829	841	789	797	817	789	771	781	790	793
Jujevan	573	574	554	550	480	474	482	488	465	477	484
Total	**29738**	**29560**	**29425**	**29105**	**28693**	**28502**	**28214**	**28072**	**27877**	**27819**	**28276**
Total rural arreas	**22472**	**22437**	**22538**	**22370**	**22115**	**22069**	**21885**	**21760**	**21758**	**21745**	**21890**

As it can be seen from the Table above, the population of Noyemberyan city in 2014 was 17.5% of the community's population, in 2018 - 16.32%, in 2020, 2021 and 2024 - ~16%. The population of Ayrum city in 2014 was 6.93% of the community's population, in 2018 - 6.6%, in 2020 - 6.43%, in 2021 - 6.39% and in 2024 - 6.54%.

The largest rural settlements in the community are Archis (2018: 3.67%, 2024: 3.82%), Bagratashen (2018- 9.84%, 2024- 10.15%), Berdavan (2018- 11.0%, 2024- 11.55%), Koti (2018- 6.85%, 2024- 6.84%), Koghb (2018- 16.04%, 2024- 16.30%) and Voskevan (2018- 4.74%, 2024- 4.75%). The population of the mentioned rural settlements for the observed period was 1,000 people or more.

The population decrease in most settlements was observed until 2018-2022, after which a non-significant increase was observed. In the city of Noyemberyan, this dynamics by the number of people is as follows: 5205 (2014)-4327 (2023)-4536 (2024), in the city of Ayrum: 2061 (2014)-1746 (2022)-1850 (2024), in Debedavan: 615 (2014)-538 (2020)-562 (2024), in Dovegh: 529 (2014)-472 (2018)-528 (2024). Despite this, in some settlements, compared to 2014, population growth was recorded in 2024: in Bagratashen: 61 people, in Berdavan: 72 people, in Deghdzavan: 18 people, in Koghb: 90 people. In other places, the population has remained more or less the same.

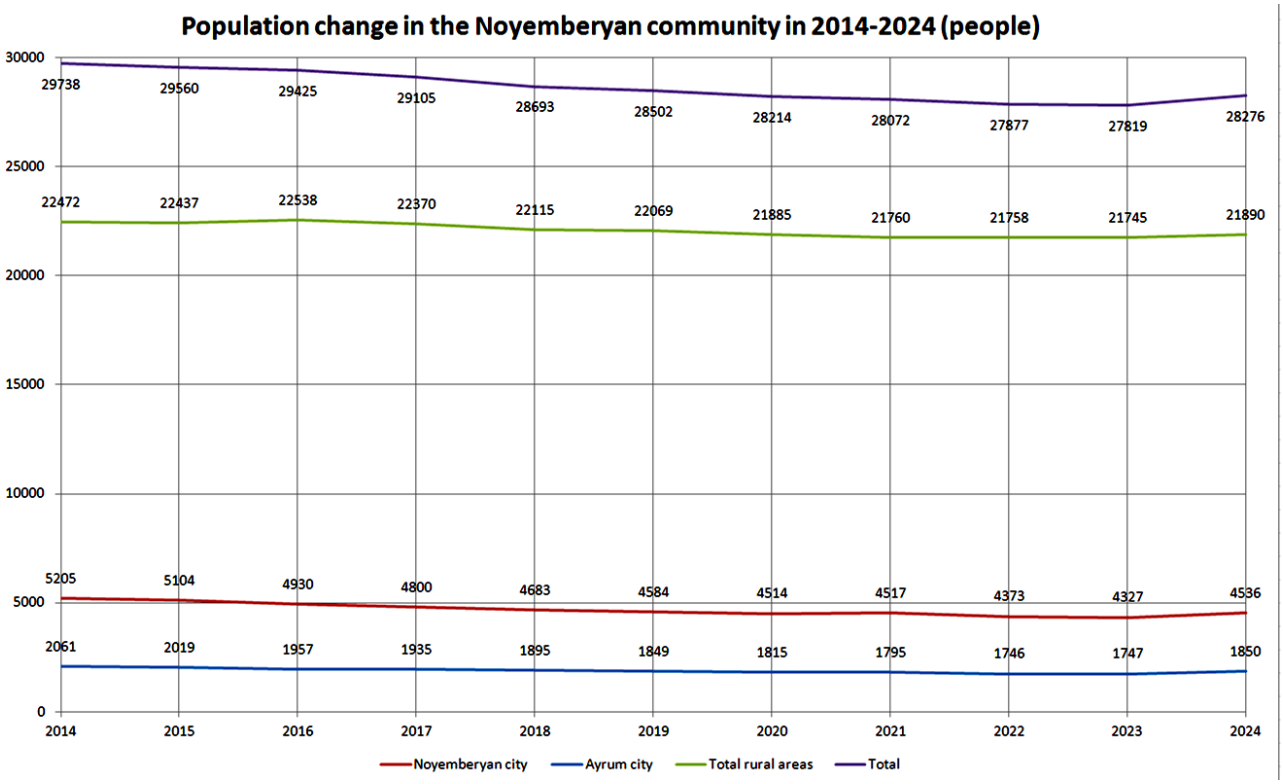


Chart 1. Population change in the Noyemberyan community 2014-2024

As it can be seen from **Chart 1**, the population of Noyemberyan community decreased by 4.91% during 2014-2024, including that of Noyemberyan city by 12.85%, that of Ayrum city by 10.24%, and that of rural settlements by 2.59%.

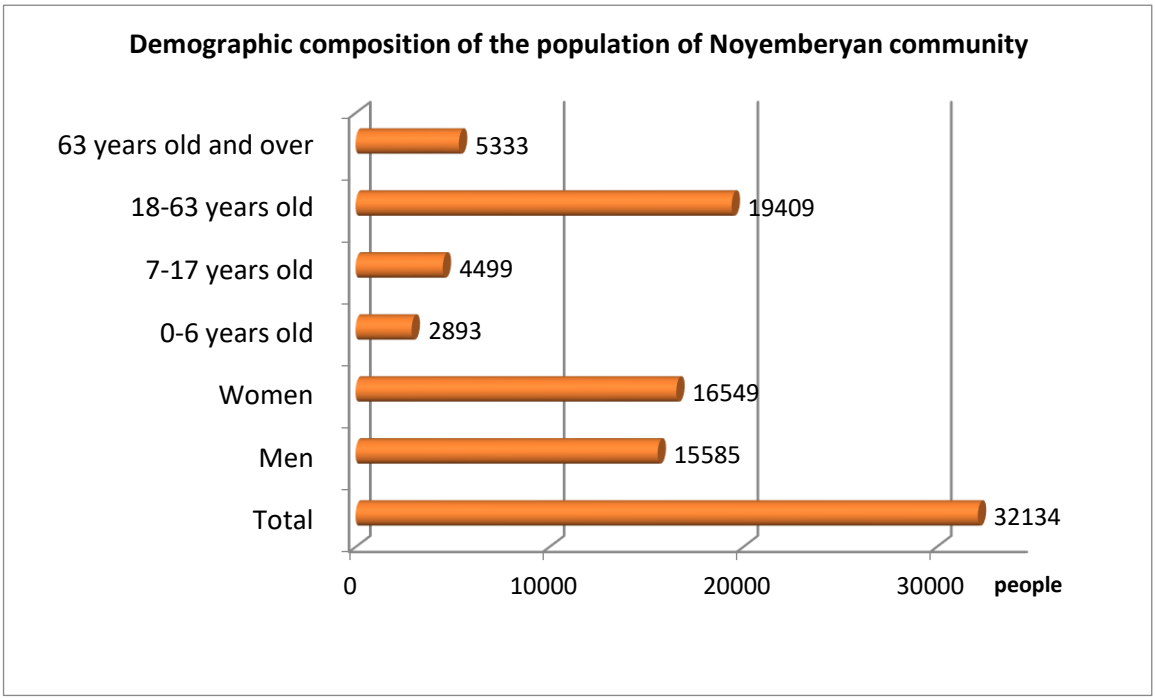


Chart 2. The age composition of the community's permanent population, according to the community's 2022-2026 five-year development plan

51.5% of the community's population is women, 49.5% is men. The largest number is between the ages of 18-63. There are 687 beneficiaries, 836 people with disabilities, 5,333 pensioners, and 157 refugees. There are 8,033 unemployed people, and 13,496 employed people.

2.7. Employment of the community population

Employment of the population and job creation are among the key issues of the Noyemberyan community. There is a high level of unemployment in the community. There are 8,033 unemployed people, and the number of employed people is 13,496. There are people leaving for work abroad. Young families are not provided with housing conditions, as a result of which there is a risk of youth emigration and the aging of the community. The low level of employment among residents leads to low social well-being. About 40% of the community's population does not have stable sources of income. It is necessary to implement development programs aimed at developing the entrepreneurial abilities of residents, establishing/expanding micro and small businesses, as well as establishing a career center that will provide direct support and consultation to potential beneficiaries. There is a need to implement the investment of various social services for social protection in the community, for which some program projects have been developed in conjunction with the five-year community development program.

However, several dozen industrial enterprises operate in the community. There is a developed system of trade and household services. Crafts are developed, in particular woodworking, carpet weaving, and stonework. Sports and art are developed.

The community has the land resources necessary for development, but the irrigation system is problematic, because of which significant lands are not irrigated and, therefore, are not cultivated. There are also problems in terms of the volume of pastures and their effective management. Agricultural cooperation is almost non-existent; the rates of farm enlargement are very low. The majority of lands are not irrigated due to the absence and unusability of the irrigation system. The community does not have a wholesale agricultural market.

The community's recreational areas, springs, need cleaning, installation of trash cans, and in some cases, improvement of drinking water lines, for which needs assessment work is being carried out.

The community has sufficient outdoor lighting systems, most of the settlements have modern energy-saving systems installed. It is planned to construct/expand an outdoor lighting network along the interstate road, which will ensure sufficient lighting on the interstate road sections of all settlements.

2.8. Community housing stock

In the Noyemberyan community, the common areas of multi-apartment buildings (MABs) - roofs, staircases - are in a deplorable state. There is a need to carry out renovation works on community MABs, as well as to promote construction of housing. There is also a need to assess the sesimic risks of the housing stock, and if necessary, implement risk mitigation measures. The total number of households (HHs) in the Noyemberyan community is 9,274.

The community's housing stock includes 53 multi-apartment buildings [21 in Noyemberyan city (782 apartment units) and 32 in Ayrum city (550 apartment units)].

According to the Urban Planning Regulations of the Noyemberyan community, the construction of residential buildings in the community began in the late 1950s. The buildings were built with load-bearing walls. The main building materials were tuff and basalt. In the 1980s, the construction of typical multi-apartment buildings with reinforced concrete load-bearing structures began. The construction method with reinforced concrete load-bearing structures created the opportunity to implement larger openings for windows. Multi-apartment residential buildings built with reinforced concrete structures already had five floors. The prefabricated reinforced concrete slabs are covered with tuff and felsite stone cladding.

The MABs are mainly Soviet-era structures with all the consequences that come with it. It is advisable to assess their technical condition, since the buildings are 50 years old and more.

In 2023, the total number of private houses in the cities of Noyemberyan and Ayrum was 1,877, of which 1,720 were in Noyemberyan (with a total area of 273,818 sq. m) and 157 in Ayrum (with a total area of 28,368 sq. m).

Information on the MABs of the cities of Noyemberyan and Ayrum is published annually by the Statistical Committee.

The number of existing MABs in the community by storeys, external wall materials, and roof shape is presented in **Table 4**.

Table 4. Number of existing MABs in Noyemberyan community by storeys, external wall materials, and roof shape

The MABs of the Noyemebryan community at the end of 2023	Number of buildings	including			Roof shape	
		stone	panel	Reinforced concrete cast	tilted	flat
In the Noyemebryan community, in total, including:	**254**	**254**	**-**	**-**	**254**	**-**
In the cities of Noyemberyan and Ayrum, in total, of which	**53**	**53**	-	-	**53**	**-**
In the city of Noyemberyan, in total	**21**	**21**	-	-	**21**	**-**
5 -storey	16	16	-	-	16	-
4 -storey	3	3	-	-	3	-
3 -storey	2	2	-	-	2	-
2 -storey	-	-	-	-	-	-
1 -storey	-	-	-	-	-	-
In the city of Ayrum, in total	**32**	**32**	-	-	**32**	**-**
5 -storey	5	5	-	-	5	-
4 -storey	2	2	-	-	2	-
3 -storey	9	9	-	-	9	-
2 -storey	15	15	-	-	15	-
1 -storey	1	1	-	-	1	-
In rural areas, in total	**201**	**201**	**-**	**-**	**201**	**-**
5 -storey	-	-	-	-	-	-
4 -storey	2	2	-	-	2	-
3 -storey	4	4	-	-	4	-
2 -storey	62	62	-	-	62	-
1 -storey	133	133	-	-	133	-

Source: information provided by the Noyemberyan Municipality and the RA Housing Fund and Utilities Economy in 2023.
https://armstat.am/file/article/sv_06_24a_5160.pdf

The number of private single-family houses in Noyemberyan community in 2022-2024 by Noyemberyan and Ayrum towns and rural settlements is given in **Table 5**.

Table 5. The number of private single-family houses in the towns of Noyemberyan and Ayrum and in the rural areas of the community in 2024

Community settlements	Quantity (pcs)			%
	2022	2023	2024	2024
Noyemberyan private houses	1720	1720	1720	23.4%
Ayrum city's private houses	157	157	157	2.1%
Artchis village's private houses	350	350	348	4.7%
Bagratashen village's private houses	290	290	290	3.9%
Baghanis village's private houses	249	249	254	3.5%
Barekamavan village's private houses	140	140	140	1.9%

Berdavan village's private houses	809	809	812	11.1%
Debedavan village's private houses	89	89	89	1.2%
Deghdzavan village's private houses	69	69	69	0.9%
Dovegh village's private houses	157	157	157	2.1%
Zorakan village's private houses	365	365	365	5.0%
Ltchkadzor village's private houses	104	104	104	1.4%
Koti village's private houses	590	575	545	7.4%
Kogb village's private houses	1,165	1,260	1,365	18.6%
Haghtanak village's private houses	81	81	81	1.1%
Voskepar village's private houses	299	299	299	4.1%
Voskevan village's private houses	342	342	344	4.7%
Ptghavan village's private houses	58	58	58	0.8%
Jujevan village's private houses	149	149	149	2.0%
Private houses, in total	7,183	7,263	7,346	100.0%
Growth index of private houses	100.0%	101.1%	102.3%	
Total apartment units in the community	1,928	1,928	1,928	
Total households in the community	9,111	9,191	9,274	
Growth Index of Total Households	100.0%	100.9%	101.8%	

Source: data provided by the Noyemberyan Municipality.

The following issues are also considered to be of great importance for the Noyemberyan community:

- Repair of roofs and improvement of courtyards of multi-apartment residential buildings (MABs) and modernization of community street lighting.
- Renovation of the entrances to the MABs, sewage, drinking and irrigation water lines.
- Promoting and implementing thermal insulation, thermal modernization, and integration of renewable energy sources in MABs.

Figure 1. Types of buildings in the community's housing stock

Stone-built MABs (5 -storey)
Source: https://hy.armradio.am/archives/233770

MABs (4 -storey)
Source: https://tavushmedia.am

Stone-built residential buildings in the community (5 -storey), tilted roof (©CCGE)


Stone-built MABs (4 -storey), with tilted roofs (©CCGE)


Private houses (©CCGE)

Source: link

Source: https://www.ajurd.am/hy/lot-item?i=18844#gallery-5

2.9. Community-owned structures

There is a need to implement the introduction of various social protection services in the community, for which purpose program projects in 4 directions have been developed and presented in conjunction with the 5-year program.

According to the 2023 annual work plan of the Noyemberyan community of the Tavush region of the Republic of Armenia (approved by the decision of the Noyemberyan community council of elders No. 136-A of April 28, 2023), a number of important programs and initiatives aimed at the development of the community were implemented in the community in 2023, including 16 subvention programs. In 2022, the number of subvention programs was 20.

It is planned to implement measures to increase energy efficiency: renovation of building roofs and increasing the thermal resistance of enclosing structures, ensuring energy-efficient heating, installation of photovoltaic panels for electricity production, etc.

Within the framework of environmental protection, the following are planned: monitoring work to preserve the community's ecosystem, increasing the volume of renewable energy sources, raising awareness about energy efficiency, introducing technologies for obtaining fuel from biomass (briquettes). Organizing eco-educational camps to form responsibility for the environment, introducing innovative technologies, etc.

Most of the buildings under the jurisdiction of the community are in need of renovation. Detailed information about the latter is available in the 2022-2026 five-year development plan of the Noyemberyan community.

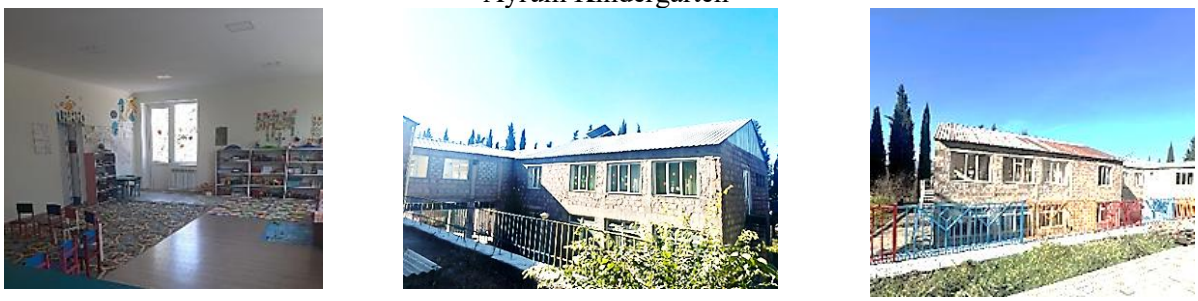
Below, **Figure 2** presents pictures of the buildings of the preschools operating in the Noyemberyan community, **Table 6** contains data on the types of preschool buildings, number of floors, condition, gasification and heating, and **Figure 3** presents pictures of other community-owned structures.

Figure 2. Existing preschools in Noyemberyan community (©CCGE)

Noyemberyan Kindergarten No. 1

Noyemberyan Kindergarten No. 2

Ayrum Kindergarten



Artchis Kindergarten

Bagratashen kindergarten under construction

Baghanis Kindergarten



Berdavan Manger Kindergarten





Debedavan Kindergarten Dovegh Kindergarten

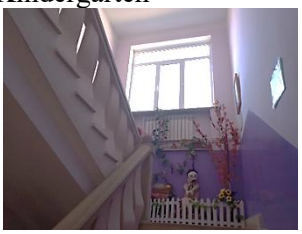



Zorakan Kindergarten




Koti Kindergarten Voskevan Kindergarten



Koghb Kindergarten




Haghtanak Kindergarten Voskepar Kindergarten



Ptghavan Kindergarten



Jujevan Kindergarten

Source: Data provided by the Noyemberyan Municipality.

As it can be seen from the information presented in **Table 6** by the administrative heads of the settlements of Noyemberyan community, about 85% of kindergartens are gasified and heated by systems equipped with natural gas boilers, and 40% have autonomous photovoltaic stations.

Table 6. Data on preschool organizations (NGOs)

	Name of the NGO	Building type	Number of storeys	Building usage/operation/	Year of construction	Condition	Heating system
1.	**Kindergarten No. 1 of Noyemberyan**	stone-built	1	full	1960	satisfactory	Gas boiler
2.	**Kindergarten No. 2 of Noyemberyan**	stone-built	2	full	1965	satisfactory	Gas boiler
3.	**Kindergarten of Ayrum city**	stone-built	2	full	1969	good	Gas boiler
4.	**Archis village kindergarten**	stone-built	2	full	1985	satisfactory	Gas boiler
5.	**Bagratashen Kindergarten**	stone-built	1	newly built	2025	new	Gas boiler
6.	**Baghanis Kindergarten**	stone-built	1	full	2019	good	Gas boiler
7.	**Barekamavan Kindergarten**	stone-built	1	not used	ш/չ	bad	Destroyed
8.	**Berdavan Manger-Kindergarten**	stone-built	2	full	ш/չ	satisfactory	Gas boiler
9	**Dovegh village kindergarten***	stone-built panel	3	full	1989	satisfactory	electric heater
10	**Koti village kindergarten**	stone-built	2	full	1964	good	Gas boiler
11	**Koghb village kindergarten 1**	stone-built	2	newly built	2025	new	Gas boiler
12	**Koghb village kindergarten 2**	stone-built	2	full	1971	good	Gas boiler
13	**Haghtanak Kindergarten**	stone-built	2	full	ш/չ	good	Gas boiler
14	**Voskepar Kindergarten**	stone-built	1	partial	2025	good	electric heater
15	**Voskevan Kindergarten**	stone-built	2	full	2014	good	Gas boiler
16	**Ptghavan Kindergarten**	stone-built	2	full	1965	good	Gas boiler
17	**Jujevan Kindergarten ***	stone-built	2	full	ш/չ	satisfactory	Gas boiler

* Used in conjunction with the administrative head's office.

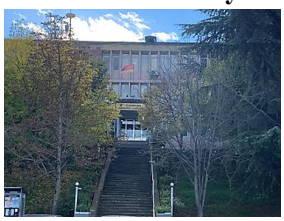
To achieve the goals set out in the community's 2022-2026 five-year development plan and annual work plan (AWP), the community's priority tasks include:

- To activate the involvement of various community-based organizations, international financial, as well as public and charitable organizations, and individuals, to consistently implement reforms for the socio-economic development of the community.
- Provide well-lit intra-community roads and streets and a well-maintained housing stock.
- Constantly monitor the improvement of community-owned building and property conditions, and the improvement of the population's living environment (greening, reconstruction of the sewage collector, etc.).
- Improving the quality of services provided to the population (education, water supply, garbage collection, etc.).
- Expansion of jobs in the community, rational use of natural resources, and development of trade, service sectors, and agriculture.

To achieve these development goals, close cooperation between local authorities, community residents, civil society, and businesspeople is of great importance.

Pictures of community-owned structures located in Noyemberyan community are provided in **Figure 3**.

Community-owned structures, NGO's of Noyemberyan community (©CCGE)

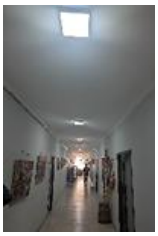


Noyemberyan Municipality




Cultural center






Art school




Music school Children's library



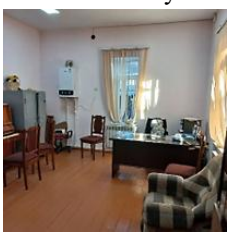

Sports school




"Serving the Community Economy" NGO



Ayrum Cultural Center

Bagratashen Music School

Voskepar Banquet Hall




Berdavan Art Center

Dovegh Palace of Culture





Koti Village Cultural Center




Koghb Cultural Center

Voskevan Cultural Center



Voskepar Cultural Center

Figure 3. Community-owned structures

In the coming years, as a result of the implementation of the outlined policy and the program approved in the community, the community administration expects to have a more well-organized, energy-efficient, green, economically developed community, living an active spiritual, cultural, and sports life, and a more prosperous community for its residents.

Table 7 presents data on the types of buildings, number of floors (storeys), condition, gasification and heating of community-owned structures and cultural institutions located in the Noyemberyan community.

Table 7. Data on community-owned structures

	Name of community-owned structure	Building type	Number of storeys	Building usage/operation/	Year of construction	Condition	Heating system type
1	Noyemberyan Municipality	stone-built	3	full	1976	satisfactory	Gas boiler
2	Cultural center	stone-built	2	full	1950	satisfactory	Electric heater
3	Sports school	stone-built	2	full	1976	satisfactory	Electric heater
4	Art school	stone-built	2	full	1970	satisfactory	Electric heater
5	Music school	stone-built	2	full	1959	satisfactory	Gas boiler
6	Library	stone-built	2	full	1985	satisfactory	Electric heater
7	"Serving the Community Economy" NGO	stone-built	2	full	1960	satisfactory	Gas boiler
8	Ayrum Cultural Center	stone-built	2	full	1972	good	Electric heater
9	Ayrum City Music School	stone-built	1	partial	2021	good	Gas boiler
10	Bagratashen Music School	stone-built	1	full	1960	bad	Gas boiler
11	Berdavan Cultural Center	stone-built	2	full	ш/ş	satisfactory	Electric heater
12	Berdavan Music School	panel	2	full	ш/ş	good	Gas boiler
13	Dovegh Village House of Culture	stone-built	1	partial	2003	good	Electric heater
14	Koti Village Palace of Culture	stone-built	2	partial	1986	bad	Wood stove and Electric heater
15	Koghb Village Palace of Culture	stone-built	2	full	1970	satisfactory	Wood stove
16	Koghb village music school	stone-built	1	full	2018	good	Gas boiler
17	Voskepar Palace of Culture	stone-built	2	full	1962	satisfactory	Wood stove and Electric heater
18	Voskepar Banquet Hall	stone-built	1	full	2017	good	Gas boiler
19	Voskevan Palace of Culture	stone-built	2	full	1976	good	Electric heater

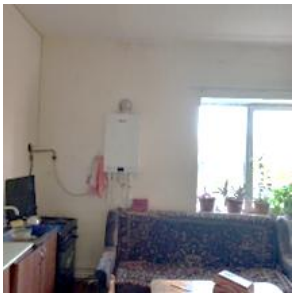
As it can be seen from the information provided, the community-owned buildings of the cities of Noyemberyan and Ayrum and rural settlements are heated mainly by systems equipped with electrical and natural gas boilers. Firewood is used for heating (calculated as renewable) in the buildings of cultural institutions in some rural settlements (there is no consumption of manure (dung) and coal).

The offices of the administrative heads of rural settlements are mainly stone, one- or two-storey buildings, the condition of which is currently assessed as satisfactory. They are mainly 1960-1980. structures and some are used partially, about 50% as of 2024 are not gasified and are heated by electrical heaters. About 20% of the offices are also heated with firewood (according to data provided by the municipality, heating with coal, manure and other fuels is not carried out).

Pictures of the offices of the administrative heads of the municipally owned city of Ayrum and rural settlements are presented in **Figure 4**. **Table 8** presents data on the types of office buildings, number of floors, condition, gasification and heating.


Ayrum City Administrative Head's Office





Artchis

Bagratashen Administrative Office

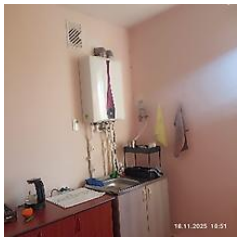


Baghanis

Barekamavan



Office of the administrative head of Berdavan settlement


Office of the administrative head of Deghdzavan settlement




Dovegh Administrative Head's Office *

Koghb Administrative Head's Office


Zorakan Administrative Head's Office


Voskepar Administrative Head's Office


Debedavan


Koti village Administrative Head's Office


Lchkadzor Administrative Head's Office


Haghtanak Administrative Head's Office



Voskevan Administrative Head's Office


Ptghavan Administrative Head's Office


Jujevan Administrative Head's Office

* Used in conjunction with the kindergarten

Figure 4. The offices of the administrative heads of the city of Ayrum and the rural settlements of the community, (©CCGE)

Table 8. Data on the offices of the administrative heads of the city of Ayrum and the rural settlements of the community

	Name of community-owned structure	Building type	Number of storeys	Building usage/operation/	Year of construction	Condition	Heating system
1.	**Ayrum city's** Administrative Head's Office	stone-built	1	partial	2021	good	Natural Gas Boiler
2.	**Artchis village's** Administrative Head's Office	stone-built	2	full	1975	satisfactory	Gas stove
3.	**Bagratashen village's** Administrative Head's Office	stone-built	2	full	1982	satisfactory	Natural Gas Boiler
4.	**Baghanis** Administrative Head's Office	stone-built	2	full	1974	good	Electrical heater
5.	**Barekamavan** Administrative Head's Office	stone-built	1	partial	n/a	satisfactory	Electrical heater
6.	**Berdavan village's** Administrative Head's Office	stone-built	2	full	1972	good	Natural Gas Boiler
7.	**Debedavan village's** Administrative Head's Office	stone-built	1	full	1960	good	Wood stove
8.	**Deghdzavan** Administrative Head's Office	stone-built	1	full	2012	good	Natural Gas Boiler
9.	**Dovegh village's** Administrative Head's Office *	Stone-built, RC slab	3	full	1989	satisfactory	Electrical heater
10.	**Lchkadzor** Administrative Head's Office	stone-built	1	full	1932	bad	Wood stove
11.	**Koti village's** Administrative Head's Office	stone-built	2	full	1964	satisfactory	Wood stove Electrical heater
12	**Koghb village's** Administrative Head's Office	stone-built	2	full	1973	good	Natural Gas Boiler
13	**Haghtanak** Administrative Head's Office	stone-built	2	partial	ա/չ	good	Electrical heater
14	**Voskepar** Administrative Head's Office	stone-built	2	full	2013	good	Natural Gas Boiler
15	**Voskevan** Administrative Head's Office	stone-built	1	partial	1960	bad	Wood stove
16	**Ptghavan** Administrative Head's Office	stone-built	1	partial	1960	bad	Electrical heater
17	**Jujevan** Administrative Head's Office	stone-built	2	full	n/a	satisfactory	Gas stove

* Used in conjunction with kindergarten,

Chapter 3. Energy consumption assessment in Noyemberyan community

The energy sources used in the Noyemberyan community are electricity, natural gas, including compressed natural gas (CNG) as a motor fuel, firewood, motor fuels: gasoline and diesel fuel, and liquefied petroleum gas (LPG).

As in the entire territory of the Republic of Armenia, the supply of electricity and natural gas to consumers in the Noyemberyan community is also carried out by centralized service providers " Electric Networks of Armenia" (ENA) and " Gazprom Armenia" CJSC. The companies operate in a regulated market, and the tariffs for the services provided are set by the Public Services Regulatory Commission of the Republic of Armenia (PSRC).

The tariffs for electricity sold to consumers by "Electric Networks of Armenia" CJSC, effective at the time of preparation of this report (entered into force on February 1, 2022), in accordance with the Decision No. 478-N of the Public Services Regulatory Commission of the Republic of Armenia dated December 29, 2021, are:

Voltage	Monthly consumption	Tariff (VAT included)	
		Daytime	Daytime
Population			
0.38 kV	under 200 kWh	46.48 AMD/kWh	36.48 AMD/kWh
0.38 kV	201- 400 kWh	48.48 AMD/kWh	38.48 AMD/kWh
0.38 kV	over 400 kWh	53.48 AMD/kWh	43.48 AMD/kWh
0.38 kV	Socially vulnerable families *	29.99 AMD/kWh	19.99 AMD/kWh
Other consumers (except population)			
0.38 kV		53.48 AMD/kWh	43.48 AMD/kWh
6 - 110 kV voltage-powered consumers			
6 (10) kV		50.48 AMD/kWh	40.48 AMD/kWh
35 kV		44.48 AMD/kWh	40.48 AMD/kWh
110 kV		41.98 AMD/kWh	37.98 AMD/kWh

* Socially vulnerable families are defined in accordance with the RA Government Decision No. 1122-N of 03.11.2016.

It is necessary to note that the tariffs for electricity sold to consumers by the ENA are set by the PSRC in order to promote energy saving: with an increase in monthly consumption indicators, the tariff also increases. At the same time, the principle of subsidy and cross-subsidy is absent during tariff formation: with the reduction of voltage in the network and, accordingly, the increase in operating costs, the tariff also increases, and consumers of 0.38 kV voltage, including the population, pay the highest tariff.

Perhaps, there are only discounts determined by the social factor: a) the establishment of discounted tariffs for «ENA» and «Gazprom Armenia» CJSC by the RA Social Insurance Institution for socially vulnerable families, and b) the partial compensation by the government of the fees for electricity (50% of the annual consumption of 1,440 kWh) and natural gas (50% of the annual consumption of 360 m^3) consumed in border communities.

Electricity tariff changes are presented from 2016 to the present (January 2026), for the period that includes the 2022-2024 period considered for selecting the baseline year in this SECAP.

Monthly consumption	Since 01.08.2015	Since 01.08.2016	Since 01.02.2017	Since 01.02.2019	Since 01.02.2021	Since 01.02.2022 up to now
Daytime (7:00 -23:00) tariff (VAT included), population 0.38 kV						
Under 200 kWh	48.78	46.20	44.98		44.98	46.48
Under 400 kWh						48.48
400 kWh and more					47.98	53.48
Socially vulnerable families *			40.00	29.99		
Nighttime (23:00 - 7:00) tariff (VAT included), population 0.38 kV						
Under 200 kWh	38.78	36.20	34.98		34.98	36.48
Under 400 kWh						38.48

400 kWh and more					37.98	43.48
Socially vulnerable families *			30.00	19.99		19.99
Average daily tariff (including VAT), population – 0.38 kV						
Average, under 200 kWh	45.45	42.87	41.647		41.647	43.15
Average, under 400 kWh						45.15
Average, 400 kWh and more					44.647	50.15
Average, Socially vulnerable families *			36.667	26.657		26.66

* Annual consumption up to 1440 kWh

According to the Decision No. 83-N of the Public Services Regulatory Commission of the Republic of Armenia dated March 1, 2022, the following tariffs have been established for natural gas sold to consumers by Gazprom Armenia CJSC (from April 1, 2022):

Consumer groups			Tariff (VAT included)
Socially vulnerable families *		Annual consumption up to 600 cubic meters	100,000 AMD/ thousand cubic meters
		Annual consumption exceeding 600 cubic meters	143,700 AMD/ thousand cubic meters
Greenhouse farms	From November 1 to March 31		233.9 USD (equivalent AMD)/thousand cubic meters
	From April 1 to October 31	Monthly consumption up to 10,000 cubic meters	143,700 AMD/ thousand cubic meters
		Exceeding 10,000 cubic meters per month	265.81 USD (equivalent AMD)/thousand cubic meters
Canned goods, beverages and dairy manufacturers			233.9 USD (equivalent AMD)/thousand cubic meters
Other consumers not included in the above groups (including the population)		Monthly consumption up to 10,000 cubic meters	143,700 AMD/ thousand cubic meters
		Exceeding 10,000 cubic meters per month	265.81 USD (equivalent AMD)/thousand cubic meters

* Socially vulnerable families are defined in accordance with the RA Government Decision No. 1122-N of 03.11.2016.

The changes in the natural gas tariff from 2016 to the present (January 2026) are as follows:

Monthly consumption	Unit of measure	Since 07.07. 2013	Since 01.07. 2016	Since 01.01. 2017	Since 01.08. 2018	Since 01.08. 2019	Since 19.07. 2020	Since 1.04.2022 to now
Monthly consumption up to 10,000 cubic meters	AMD/thousand cubic meters	156,000	146,700	139,000				143,700
Socially vulnerable families *				100,000	80,000	100,000		
Exceeding 10,000 cubic meters per month	USD (equivalent AMD)/thousand cubic meters	276.98	257.56	242.1			255.91	265.81
Canned goods, beverages and dairy manufacturers				212.0			224.0	233.9

* Annual consumption up to 600 cubic meters

The gasoline, diesel, and LPG markets are not regulated by the PSRC due to their non-monopoly nature. However, the Commission for the Protection of Competition (CPC) of the Republic of Armenia monitors energy prices to prevent cartels, entry barriers, and excess profits in different market segments.

Official publications of the RA energy balances for 2020, 2021, 2022 and 2023 were also studied.

The community energy balance was compiled using data obtained from energy supply companies and/or developed based on data provided by communities and available from other open sources.

In the absence of accurate statistical data, some indicators, in particular, for example, the consumption volumes of firewood, manure, coal or liquid petroleum fuels, have been assessed at an expert

level, based on the information provided by the municipality, the results of studies conducted in relevant sectors, previously compiled similar programs and other available data.

Reliable and credible information on the energy consumption volumes ensuring the vital activity of the community has been collected for the Noyemberyan community for the period 2020-2024. The selection of the base year for the community's BIE (the year to which the volume of emission reduction in the target year is compared) was made from this period, guided by the methodological requirements of the Covenant, 2024 was selected as the base (baseline) year.

The availability and dynamics of the number of population and apartments (households, HHs) in the community also make it possible to assess the specific energy consumption indicators [per capita or per apartment (household)] in various spheres of life. The latter, in turn, makes it possible to assess the most effective, affordable and expedient areas in terms of measures aimed at increasing energy efficiency, and to consider investment priorities accordingly.

Detailed information on the annual consumption of energy carriers by the population, community institutions, automobile (motor) transport and street lighting in Noyemberyan community during the mentioned period is presented and analyzed in the relevant sections of this report.

The physical quantities of energy carriers given in the above sections are expressed in energy units using the coefficients recommended in the guidelines published by the The European Commission Joint Research Centre (JRC) Institute for Energy and Transport (IET) or the normative indicators adopted in the Republic of Armenia, which are summarized in **Table 9**.

Table 9. Energy conversion factors and indicators

Energy carrier	Value	Unit of measure	Comment
Natural gas *	9.42	kWh/m^3	Corresponds to a Net calorific value (NCV) of combustion of gas of 8,100 kcal/m^3
Gasoline	9.2	kWh/l	or 12.3 kWh/kg (density is assumed to be 0.75 kg/l)
Diesel fuel	10	kWh/l	or 11.9 kWh/kg (density is assumed to be 0.84 kg/l)
LPG	7.3	kWh/l	13.1 kWh/kg (density is assumed to be 0.555 kg/l)
Firewood	2.476	MWh/m^3	Corresponds to the NCV of combustion of firewood equal to 3,000 kcal/kg. The volumetric mass of firewood is assumed to be 710 kg/m^3.
Manure	3.2	kWh/kg	Corresponds to the NCV of combustion of manure equal to 2.771 kcal/kg.

* The CNG conversion factors and indicators are identical.

Chapter 4. Energy consumption in residential sector

The population of Noyemberyan community uses electricity, natural gas, firewood, and also liquefied petroleum gas (LPG). Electricity is used for lighting, household appliances, heating (the latter mainly in non-gasified households), and cooking, natural gas for heating, hot water supply, and cooking, firewood is also mainly in non-gasified households (HH) for heating (also for hot domestic water and cooking), LPG is used in limited volumes mainly in non-gasified settlements for cooking, and there is no consumption of coal and manure.

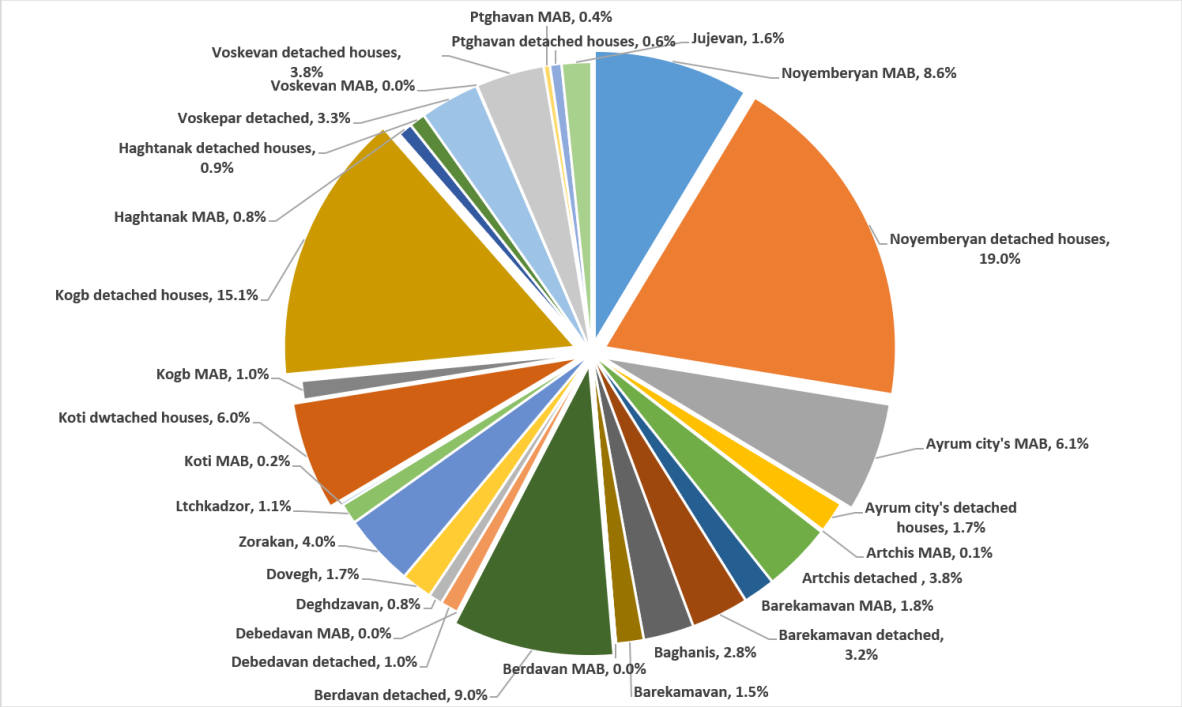


Chart 3. The structure of apartments and private houses (households) in the community

In fact, according to 2024 data, in the 254 MAB residential buildings of Noyemberyan community (of which 21 in Noyemberyan and 32 in Ayrum) there are only 1,924 apartments (on average about 7.6 apartments per building), which makes up only 20.8% of the total households (HHs) in the community.

Private single-family houses make up 79.2% of the total HHs. In Noyemberyan - 23.4%, Koghb - 18.6%, Berdavan - 11.1%, Koti - 7.4%, etc. The energy carriers used in private houses are: firewood, natural gas, electricity and LPG (coal and manure are not used). Only natural gas and electricity are used in apartments (the remaining energy carriers are not used). The consumption structure in detached houses and apartments is different (the analysis will be presented below).

The volumes of natural gas and electricity consumption are presented by energy supply organizations, and the volumes of firewood, manure, coal, and LPG consumption were assessed at an expert level, based on information provided by the administrative heads of settlements.

4.1. Electricity consumption by the population

The annual amounts of electricity consumption by the population of Noyemberyan community in 2020-2024 are presented in **Table 10** according to the corresponding letter from the ENA, provided by the relevant department of the community municipality.

Table 10. Annual electricity consumption in the residential sector

Multi-apartment buildings, private houses, households	Unit of Measure	Annual consumption of electrical energy					Remarks
		2020	2021	2022	2023	2024	
MABs in Noyemberyan	MWh	1,090.9	1,057.6	1,068.1	1,070.8	1,092.7	
	%	100	97.0%	97.9%	98.2%	100.2%	Consumption index
Specific consumption in MABs	kWh/year	1,395	1,352	1,366	1,369	1,397	Per apartment
Private houses in Noyemberyan	MWh	1,458.52	1,451.58	1,430.34	1,437.07	1,500.58	
	%	100	99.5%	98.1%	98.5%	102.9%	Consumption index
Specific consumption in private houses	kWh/year	848	844	832	836	872	Per single family house
Total in Noyemberyan	MWh	2,549.40	2,509.20	2,498.43	2,507.91	2,593.32	
	%	100	98.4%	98.0%	98.4%	101.7%	Consumption index
Specific household consumption	kWh/year	1,019	1,003	999	1,002	1,037	Per household
Apartments in Ayrum + villages	MWh	1,979.29	1,945.28	1,897.58	1,880.99	1,965.15	
	%	100	98.3%	95.9%	95.0%	99.3%	Consumption index
Specific consumption in MABs	kWh/year	1,727	1,697	1,656	1,641	1,715	Per apartment
Private houses in Ayrum + villages	MWh	7,936.3	7,816.6	7,748.7	7,860.5	8,484.4	
	%	100	98.5%	97.6%	99.0%	106.9%	Consumption index
Specific consumption in private houses	kWh/year	1,411	1,389	1,377	1,397	1,508	Per single family house
Total in Ayrum and rural settlements	MWh	9,915.6	9,761.9	9,646.3	9,741.5	10,449.6	
	%	100	98.5%	97.3%	98.2%	105.4%	Consumption index
Specific household consumption in Ayrum and rural settlements	kWh/year	1,464	1,442	1,424	1,438	1,543	Per household
MABs in the community	MWh	3,070.2	3,002.9	2,965.7	2,951.8	3,057.9	
	%	100	97.8%	96.6%	96.1%	99.6%	Consumption index
Specific consumption in MABs	kWh/year	1,592	1,558	1,538	1,531	1,586	Per apartment
Private houses in the community	MWh	9,394.8	9,268.2	9,179.0	9,297.5	9,985.0	
	%	100	98.7%	97.7%	99.0%	106.3%	Consumption index
Specific consumption in private houses	kWh/year	1,279	1,262	1,250	1,266	1,359	Per single family house
Total in the community	MWh	12,465.0	12,271.1	12,144.7	12,249.4	13,042.9	
	%	100	98.4%	97.4%	98.3%	104.6%	Consumption index
Specific household consumption	kWh/year	1,344	1,323	1,310	1,321	1,406	Per household

The quantities of electricity consumption by the population in Noyemberyan community during the five years under review (2020-2024) are variable; a decrease in 2020-2022 and an increase in 2022-2024, the fluctuations compared to 2020 are -2.6 +4.6%. In private houses, over the same period, electricity consumption increased by about 6.3%, in apartments - decreased by 0.4%. At the same time, the specific consumption indicators in apartments are higher (on average by 17.8%) than in private houses, by years, respectively: in 2020 - 19.7%, in 2021 - 19.0%, in 2022 - 18.8%, in 2023 - 17.3%, in 2024 - 14.3%. As a

result of discussions with the responsible employees of the municipality, this phenomenon was explained by the fact that electricity is also used for heating purposes in apartments, while firewood and natural gas are mainly used for heating in private houses.

During the observed five-year period, an increase in the absolute value of electricity consumption in the community was recorded by about 4.6%.

The absolute and specific indicators of electricity consumption in households for the period 2020-2024 are presented in the graphs below.

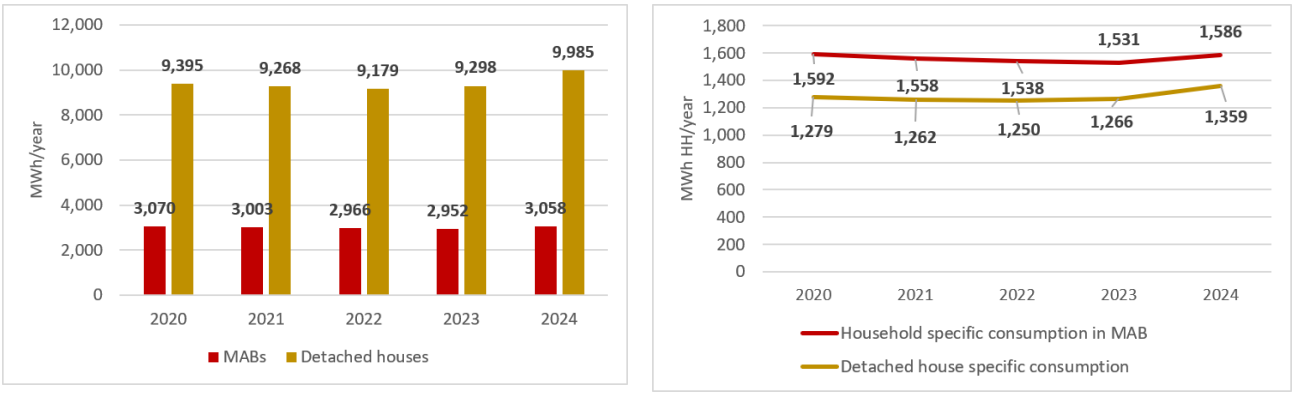


Chart 4. Absolute and specific indicators of electricity consumption of apartments and private houses for 2020-2024

The average monthly specific indicators of electricity consumption in MABs and private houses (in drams) for 2024 are: in apartments of Noyemberyan community - 5,968 drams/month, and in private houses - 5,114 drams/month. On average, the cost of each household is 5,292 drams/month or 63,499 drams/year.

The calculated average monthly/specific dram/month indicators are considered reasonable. It should also be taken into account that the data are average monthly for the year, calculated at the average daily tariff set for 2024 (average consumption up to 400 kWh per month), and empty/unoccupied apartments and private houses (which amounted to 20.8-21.0%) are not taken into account.

4.2. Natural gas consumption by the population

The Republic of Armenia is considered one of the most gasified countries in the world, 96.6% of settlements are considered gasified, while the settlements of Noyemberyan community are gasified by only 94.7% (by settlements): 18 out of 19 settlements are not gasified, and by households (HHs) 82.3-84.0% are gasified. Natural gas is one of the main energy carriers for the energy supply of the population of gasified settlements. The annual quantities of natural gas consumption by the population of Noyemberyan community in 2020-2024 are presented in **Table 11** according to the relevant letter provided by «Gazprom Armenia» CJSC to the relevant department of the municipality.

Table 11. Natural gas consumption in the residential sector

Multi-apartment buildings, private houses, and households	Annual consumption, thousand m^3/year					Annual consumption, MWh/year				
	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024
MABs in Noyemberyan	308	309	319	310	349	2,901	2,910	3,001	2,922	3,289
Consumption index, %	100%	100.3%	103.4%	100.7%	113.4%	100.0%	100.3%	103.4%	100.7%	113.4%
Specific apartment consumption	394	395	407	397	447	3,710	3,722	3,837	3,737	4,206
	(nm^3/year)					(kWh/year)				
Private houses	527	526	566	586	687	4,967	4,958	5,332	5,522	6,476

in Noyemberyan										
Consumption index, %	100%	99.8%	107.3%	111.2%	130.4%	100.0%	99.8%	107.3%	111.2%	130.4%
Specific consumption of private houses	307	306	329	341	400	2,888	2,882	3,100	3,210	3,765
	(nm^3/year)					(kWh/year)				
Total in Noyemberyan	835	835	885	896	1,037	7,868	7,868	8,332	8,444	9,765
Consumption index, %	100%	100.0%	105.9%	107.3%	124.1%	100.0%	100.0%	105.9%	107.3%	124.1%
Specific household consumption in Noyemberyan	334	334	354	358	414	3,145	3,145	3,330	3,375	3,903
	(nm^3/year)					(kWh/year)				
Apartments in Ayrum + villages	238	244	251	241	247	2,239	2,300	2,364	2,271	2,325
Consumption index, %	100%	102.8%	105.6%	101.5%	103.9%	100.0%	102.8%	105.6%	101.5%	103.9%
Specific household consumption in MABs in Ayrum + villages	207	213	219	210	215	1,953	2,007	2,063	1,982	2,029
	(nm^3/year)					(kWh/year)				
Private houses in Ayrum + villages	1,871	1,939	2,193	2,315	2,893	17,620	18,262	20,662	21,808	27,254
Consumption index, %	100%	103.6%	117.3%	123.8%	154.7%	100.0%	103.6%	117.3%	123.8%	154.7%
Specific consumption of private houses	332	345	390	412	514	3132	3246	3673	3876	4844
	(nm^3/year)					(kWh/year)				
Total in Ayrum + rural settlements	2,108	2,183	2,444	2,556	3,140	19,859	20,562	23,026	24,080	29,580
Consumption index, %	100%	103.5%	115.9%	121.3%	148.9%	100.0%	103.5%	115.9%	121.3%	148.9%
Specific household consumption in Ayrum + rural settlements	311	322	361	377	464	2933	3036	3400	3556	4368
	(nm^3/year)					(kWh/year)				
Multi-apartment buildings in the community	546	553	569	551	596	5,139.6	5,210.5	5,364.6	5,193.3	5,614.6
Consumption index, %	100.0 %	101.4%	104.4%	101.0%	109.2%	100.0%	101.4%	104.4%	101.0%	109.2%
Specific apartment consumption in MAB	283	287	295	286	309	2,666	2,703	2,782	2,694	2,912
	(nm^3/year)					(kWh/year)				
Private houses in the community	2,398	2,465	2,759	2,901	3,581	22,588	23,219	25,994	27,330	33,730
Consumption index, %	100%	102.8%	115.1%	121.0%	149.3%	100.0%	102.8%	115.1%	121.0%	149.3%
Specific consumption of private houses	326	336	376	395	487	3075	3161	3539	3720	4592
	(nm^3/year)					(kWh/year)				
Total in the community	**2,943**	**3,018**	**3,329**	**3,453**	**4,177**	**27,727**	**28,430**	**31,359**	**32,524**	**39,345**
Consumption	**100**	**102.5%**	**113.1%**	**117.3%**	**141.9%**	**100.0%**	**102.5%**	**113.1%**	**117.3%**	**141.9%**

index, %										
Specific household consumption	317	325	359	372	450	2,990	3,066	3,381	3,507	4,242
	(nm³/year)					**(kWh/year)**				

The conversion from physical volumes of natural gas to energy value was performed using the average lower working heat value of natural gas combustion, 9.42 kWh/m³, which corresponds to approximately 8,100 kcal/m³.

The volume of natural gas consumption by the population of Noyemberyan community has recorded a continuous increase (compared to 2020) over the five years under review: by 2.5% in 2021, by 13.1% in 2022, by 17.3% in 2023, and by 41.9% in 2024. The trend in consumption growth is significantly more dynamic in private houses in the community than in apartments.

At the same time, the specific consumption of natural gas in private houses in the community is consistently higher than in apartments and has a growth trend, which is respectively: in 2020 - 15.3%, in 2021 - 17.0%, in 2022 - 27.2%, in 2023 - 38.1%, in 2024 - 57.7%. The latter is explained by the fact that the heated surfaces in apartments are smaller, electricity is also used for heating, and is also calculated in relation to the total number of apartments. The difference is largely due to the level of comfort (heated surface, actual duration of heating and indoor air temperature), which is of significant importance for assessing this ratio.

The number of private houses in the residential sector of the community is 79.2% (relative to total households), with 76.6% of detached houses being located in rural areas, where the poverty level is higher, the latter leading to energy poverty: during the heating period, the family concentrates in one room, which is heated mainly with firewood stoves, at an insufficient temperature and for a non-normative period.

The absolute (thousand m³/year and MWh/year) and specific (Nm³/year household and kWh/year household) indicators of natural gas consumption in households for the period 2020-2024 are presented in the charts below.

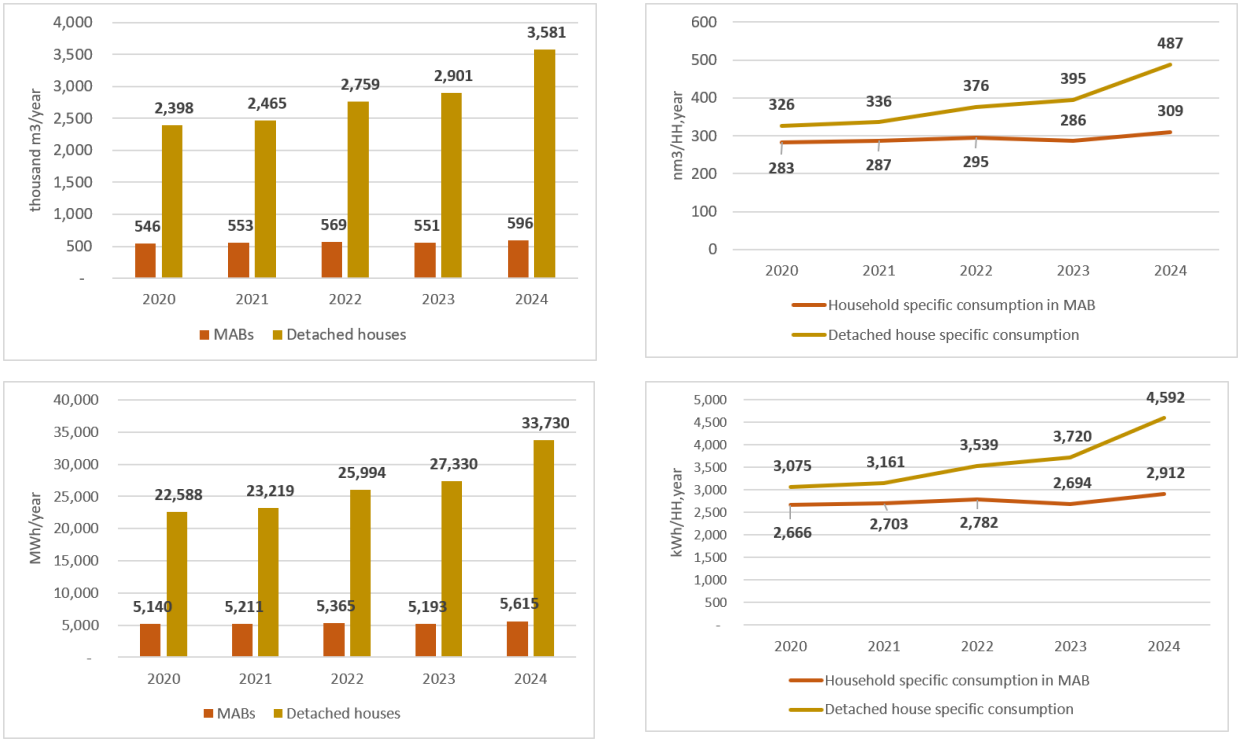


Chart 5. Absolute and specific consumption of natural gas in apartments and private houses of the community's MABs in 2020-2024.

The consumption of natural gas by the population of Noyemberyan community in 2024 amounted to only 4.177 mln m^3, including 3.581 mln m^3 in gasified private houses, and 0.596 mln m^3 in apartments.

The specific indicators of natural gas consumption (in drams) in MABs and private houses for 2024 are 64.7 thousand drams per year, or an average of 5,393 drams per month, including 44.4 thousand drams per year for all apartments in the community, or an average of 3,702 drams per month, and in private houses 70.0 thousand drams per year or an average of 5,835 drams per month (for all private houses).

The average monthly/specific indicators calculated for the Noyemberyan community are considered reasonable. It is necessary to take into account the climatic conditions of the area, the fact that these data are averages for the year, are calculated at a rate of 143.7 drams/nm^3, and the calculations do not take into account empty/uninhabited apartments and private houses [which constitute a significant number, around 20%, according to **Table 14**].

4.3. Consumption of firewood, manure, LPG, and coal by the population

Among other energy sources, firewood (during the heating period) and LPG (propane-butane mixture, for cooking) are used in the residential sector, and only in private houses (no other fuel than natural gas and electricity is used in apartments). According to the information provided by the administrative heads of settlements, in 2022-2024, there was no use of coal and manure in households.

Since there is no reliable system for recording the consumption of the mentioned fuels, therefore, the assessment of the consumption of firewood and LPG was carried out at the expert level, based on the information provided by the administrative heads of settlements.

According to the 1990-2019 report of the National Greenhouse Gas Inventory of the Republic of Armenia and the Energy Balance, data on the quantities of firewood consumed in the Republic of Armenia vary. Research and surveys by some international organizations are also available as a guide.

Data on firewood in energy balances are obtained based on household researches/surveys conducted by the Statistical Committee of the Republic of Armenia (SC), and in GHG inventory calculations, based on references provided by "Hayantar".

The consumption of firewood and LPG (also manure and coal) by the population in the Noyemberyan community was estimated by analyzing the information provided by the relevant subdivision of the Noyemberyan community administration and the offices of the administrative heads of rural settlements (see **Table 14**), and the results of the calculations are summarized in **Table 12**.

Settlements	Total number of existing HHs	Fuel used							
		Firewood		Manure		LPG		Coal	
		m^3/year	Number of HHs	m^3/year	Number of HHs	kg/year	Number of HHs	t/year	Number of HHs
Noyemberyan MABs	782	-	-	-	-	-	-	-	-
Noyemberyan private houses	1,720	6,880	860	-	-	-	-	-	-
Ayrum city's MABs	550	-	-	-	-	-	-	-	-
Ayrum city's private houses	157	308	44	-	-	-	-	-	-
Artchis village's MABs	11	-	-	-	-	-	-	-	-
Artchis village's private houses	348	2,349	261	-	-	-	-	-	-
Bagratashen MABs	161	-	-	-	-	-	-	-	-
Bagratashen village	290	1,276	160	-	-	-	-	-	-
Baghanis village	254	508	64	-	-	3,048	25	-	-
Barekamavan village	140	2,100	140	-	-	-	-	-	-
Berdavan village's MABs	4	-	-	-	-	-	-	-	-
Berdavan village	813	5,203	650	-	-	-	-	-	-

Debedavan village's MABs	26	-	-	-	-	-	-	-	-
Debedavan village	89	460	53	-	-	63	3	-	-
Deghdzavan village	69	331	41	-	-	48	1	-	-
Dovegh village	157	1,005	126	-	-	-	-	-	-
Zorakan village	365	1,022	128	-	-	-	-	-	-
Lchkadzor village	104	572	57	-	-	-	-	-	-
Koti village MABs	30	-	-	-	-	-	-	-	-
Koti village	545	7,358	491	-	-	35,970	300	-	-
Koghb village's MABs	94	-	-	-	-	-	-	-	-
Koghb village's private houses	1,365	4,914	614	-	-	-	-	-	-
Haghtanak village's MABs	72	-	-	-	-	-	-	-	-
Haghtanak village's private houses	81	389	49	-	-	-	-	-	-
Voskepar village	299	807	135	-	-	-	-	-	-
Voskevan village's MABs	4	-	-	-	-	-	-	-	-
Voskevan village	344	1,738	201	-	-	244	13	-	-
Ptghavan village's MABs	32	-	-	-	-	-	-	-	-
Ptghavan village	58	70	12	-	-	-	-	-	-
Jujevan village	149	939	134	-	-	-	-	-	-
Total	9,274	38,210	4,216	-	-	39,373	343	-	-
HHs' %	100%		45.5%		0.0%		3.7%		0.0%

For households that did not provide data, averaged indicators were used.

Table 12.Consumption of firewood, manure, LPG and coal in the residential sector by settlement for 2024

According to the estimates, out of 9,274 households in the community (7,346 private houses and 1,928 apartments), only 45.5% (or 4,216 households, the indicator is close to the national average, the average annual household consumption is 9.1 m^3/year) use firewood, and only about 3.7% use LPG (or 343 households, the indicator is lower than the national average, the average annual household consumption is 115 kg/year).

Thus, the annual consumption of firewood by households in the community is 38,210 m^3 or 27,129 t, and the consumption of LPG is 39,373 kg or 39.4 t. These data are taken as the basis for the baseline year 2024. For the four years preceding that year, the indicators are conventionally adjusted in proportion to the population size.

The results of the calculations are given in **Table 13**, in which the energy equivalents of fuels are calculated based on their characteristics.

The values and densities of the lower heat of combustion of firewood and LPG are presented below. The values specified for LPG are accepted provided that the propane/butane ratio is equal to 70/30, and the average temperature of the liquid mixture is 15°C. At the same time, since, in the case of the population, the accounting and sale of LPG is carried out in weight units, therefore, the questionnaire was filled out and the calculations were made accordingly.

- NCV of firewood, 3,000 kcal/kg or 3.488 kWh/kg, or 2.476 MWh/m^3 (3,488 x 710/1000)
- Volumetric mass of firewood 710 kg/m^3,
- NCV of manure 2,771 kcal/kg or 3.2 kWh/kg, or 2.0 MWh/m^3 (3,200 x 625/1000)
- Volumetric mass of manure 625 kg/m^3,
- NCV of LPG 7.3 kWh/l or 13.14 kWh/kg,
- Volumetric mass of LPG 0.555 kg/l,

- NCV of anthracite: 26.7 MJ/kg or 7.4 kWh/kg.

The use of non-renewable firewood for heating in households is of great concern from a GHG emissions perspective. When designing mitigation measures, it is necessary to consider measures to replace the use of non-renewable firewood with other fuels.

Table 13. Consumption of firewood, manure, coal and LPG in the residential sector of the community

Fuel type	Unit of measure	Annual fuel consumption				
		2020	2021	2022	2023	2024
Firewood	m^3/year	46,497	38,481	38,603	38,567	38,210
	MWh/year	115,125	95,280	95,582	95,491	94,609
Manure	t/year	-	-	-	-	-
	MWh/year	-	-	-	-	-
LPG	t/year	48	40	40	40	39
	MWh/year	630	521	523	522	517
Coal	t/year	-	-	-	-	-
	MWh/year	-	-	-	-	-
Total	**MWh/year**	43,062	35,639	35,752	35,718	35,388

A noticeable reduction in fuel consumption is observed for the mentioned years, which is mainly proportional to the decrease in the population of the community. The GHG emission factor of the LPG is adopted in accordance with the IPCC guidelines, at 0.227 tons CO_2/MWh. The topic related to emissions will be discussed in detail in the relevant section of this report.

In the case of firewood, according to the Guidelines for the Development of the SECAP, the emission factor of the main greenhouse gas, carbon dioxide, resulting from combustion depends on the nature of the origin of the wood. If it is a product of natural forest growth, then this factor is taken as 0 t CO_2/MWh, if it is a product of direct deforestation, then 0.403 t CO_2/MWh[10].

It is extremely difficult to assess the sources of origin and supply of firewood in the Republic of Armenia. In this regard, at the expert level, it is conventionally accepted that about 70% of the firewood used is brought from other regions or neighboring countries and is a product of natural forest growth, and 30% is a result of direct deforestation. When compiling the BIE, emission factors for firewood used will be applied to the volumes obtained according to this ratio.

The ratio of firewood (renewable and non-renewable), manure, coal, and LPG used by the population in the community in the base year is presented in **Chart 6**.

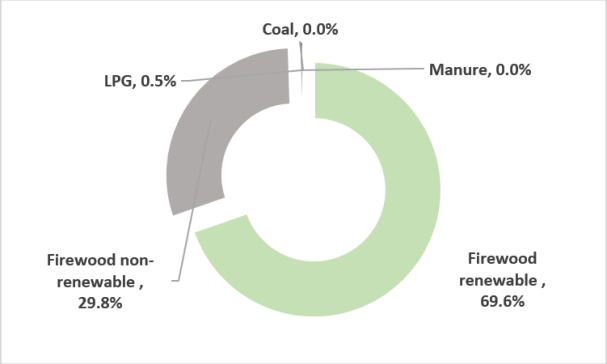


Chart 6. Consumption of firewood (renewable and non-renewable), coal, LPG and manure in the community, 2024 (MWh, %)

[10] Source: How to Develop a Sustainable Energy Action Plan (SEAP) in Eastern Partnership and Central Asian Cities - A Guide, Part 2, Baseline Emissions Inventory, 2014.

4.4. Total energy consumption of the community population

In order to have more accurate information on the consumption of energy carriers by the population in Noyemberyan community in 2024, and at the same time to observe the dynamics of consumption in 2022-2024, relevant questionnaires were sent to the offices of the administrative heads of Noyemberyan city and other rural communities. The responses received are presented below in **Table 14**. The responses to the questionnaires were analyzed and the average indicators obtained were used in the calculations.

Settlements	Firewood use, %			Manure use, %			Use of liquefied petroleum gas, %			Coal use, %			Uninhabited households, pcs.		Gasification, %	
	2022	2024	Consumption per average household m^3/year	2022	2024	Consumption per average household m^3/year	2022	2024	Consumption per average household kg/year	2022	2024	Consumption per average household t/year	2022	2024	2022	2024
Noyemberyan MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	50	55	99	99
Noyemberyan private houses	50%	50%	8	0%	0%	0	0%	0%	0	0%	0%	0	430	430	95	97
Ayrum city's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	120	121	98	98
Ayrum city's private houses	30%	28%	7	0%	0%	0	0%	0%	0	0%	0%	0	34	35		
Artchis village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	2	2	85	90
Artchis village's private houses	70%	75%	9	0%	0%	0	0%	0%	0	0%	0%	0	60	60		
Bagratashen MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	35	35	68	70
Bagratashen village	65%	55%	8	0%	0%	0	0%	0%	0	0%	0%	0	35	40		
Baghanis village	25%	25%	8	0%	0%	7	10%	10%	120	0%	0%	0	47	42	75	75
Barekamavan village	100%	100%	15	0%	0%	0	0%	0%	0	0%	0%	0	58	58	0	0
Berdavan village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	105	105	90	90
Berdavan village	80%	80%	8	0%	0%	0	0%	0%	0	0%	0%	0				
Debedavan village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	0	0	82.3	84.0
Debedavan village	63%	58%	8.6	0%	0%	0.4	4%	4%	18.2	0%	0%	0	20	20		
Deghdzavan village	70%	60%	8	0%	0%	0	1%	1%	70	0%	0%	0	15	15	98	99
Dovegh village	80%	80%	8	0%	0%	0	0%	0%	0	0%	0%	0	0	19	82.3	99
Zorakan village	35%	35%	8	0%	0%	0	0%	0%	0	0%	0%	0	130	100	65	65
Lchkadzor village	60%	55%	10	0%	0%	0	1%	0%	0	0%	0%	0	10	10	95	95
Koti village MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	3	3	82.3	84.0
Koti village	95%	90%	15	0%	0%	0	60%	55%	120	0%	0%	0	140	145	40	45
Koghb village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	20	21	90	90
Koghb village's private houses	45%	45%	8	0%	0%	0	0%	0%	0	0%	0%	0	297	300		
Haghtanak village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	16	16	90	90
Haghtanak village's private houses	70%	60%	8	0%	0%	0	0%	0%	0	0%	0%	0	53	49		
Voskepar village	45%	45%	6	0%	0%	0	0%	0%	0	0%	0%	0	102	103	67	67
Voskevan village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	1	1	82.3	84.0
Voskevan village	63%	58%	8.6	0%	0%	0.4	4%	4%	18.2	0%	0%	0	75	76		
Ptghavan village's MABs	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	7	7	82.3	84.0
Ptghavan village	20%	20%	6	0%	0%	0	0%	0%	0	0%	0%	0	0	15	80	80
Jujevan village	95%	90%	7	0%	0%	0	0%	0%	0	0%	0%	0	24	26	80	90

Table 14.About use of firewood, manure, LPG, coal, uninhabited households and gasification in the community

100% of households are electricity subscribers, at the same time, as can be seen from the table, one settlement or 5.3% is not gasified (94.7% of settlements are gasified, where 91.5% of community's households are located), 45.5% of households use firewood, 3.7% use LPG, there is no use of manure and coal. The number of empty households is worrying. Uninhabited households (in 2024) make up 21.0% of the total or about 1,950 households (in 2022, respectively, 20.8%, or about 1,930), this phenomenon is considered temporary, therefore it is not taken into account in the calculations of specific consumption of energy carriers.

It is naturally appropriate to present the total energy consumption of the population in energy units (the most understandable and convenient unit is kWh and/or 10^3 kWh = 1 MWh, if necessary, it can be converted to other energy units, the conversion factors are presented at the beginning of the report, in the Units of Measurement section). The given physical quantities of energy carriers are expressed in energy

equivalents, using the factors indicated in **Table 9**. The consumption volumes of energy carriers in the residential sector of Noyemberyan community for 2020-2024 are summarized in **Table 15**.

Table 15. Population energy consumption data for 2020-2024

Energy carrier	Type of buildings	Energy carriers' consumption, MWh				
		2020	2021	2022	2023	2024
Electrical energy	MABs	3,070.2	3,002.9	2,965.7	2,951.8	3,057.9
	Private houses	9,394.8	9,268.2	9,179.0	9,297.5	9,985.0
Natural gas	MABs	5,139.6	5,210.5	5,364.6	5,193.3	5,614.6
	Private houses	22,587.6	23,219.3	25,993.9	27,330.3	33,730.2
Firewood	MABs	-	-	-	-	-
	Private houses	115,125.4	95,280.1	95,582.2	95,491.3	94,609.1
Manure	MABs	-	-	-	-	-
	Private houses	-	-	-	-	-
LPG	MABs	-	-	-	-	-
	Private houses	629.6	521.0	522.7	522.2	517.4
Coal	MABs	-	-	-	-	-
	Private houses	-	-	-	-	-
Total	MABs	8,209.7	8,213.4	8,330.3	8,145.2	8,672.5
	Private houses	147,737.3	128,288.7	131,277.9	132,641.3	138,841.7
Total	HHs	155,947.1	136,502.2	139,608.1	140,786.5	147,514.2

In the Noyemberyan community, the existing public MABs make up only 20.8% of the total number of households, while private houses make up 79.2%, of which 76.6% are in the city of Ayrum and rural settlements.

The structure of energy consumption in MABs is very different from that in private houses. **Chart 7** shows the structure of energy consumed by MABs and private houses for 2024.

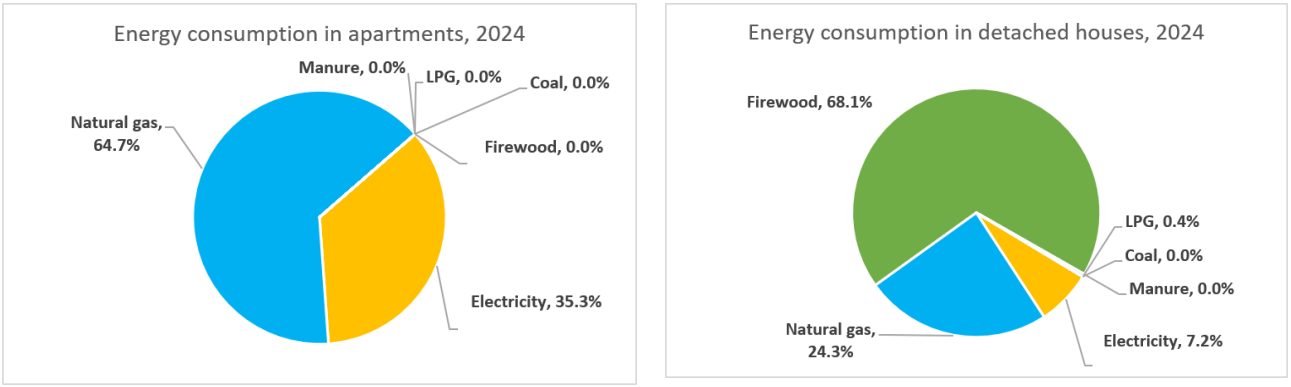
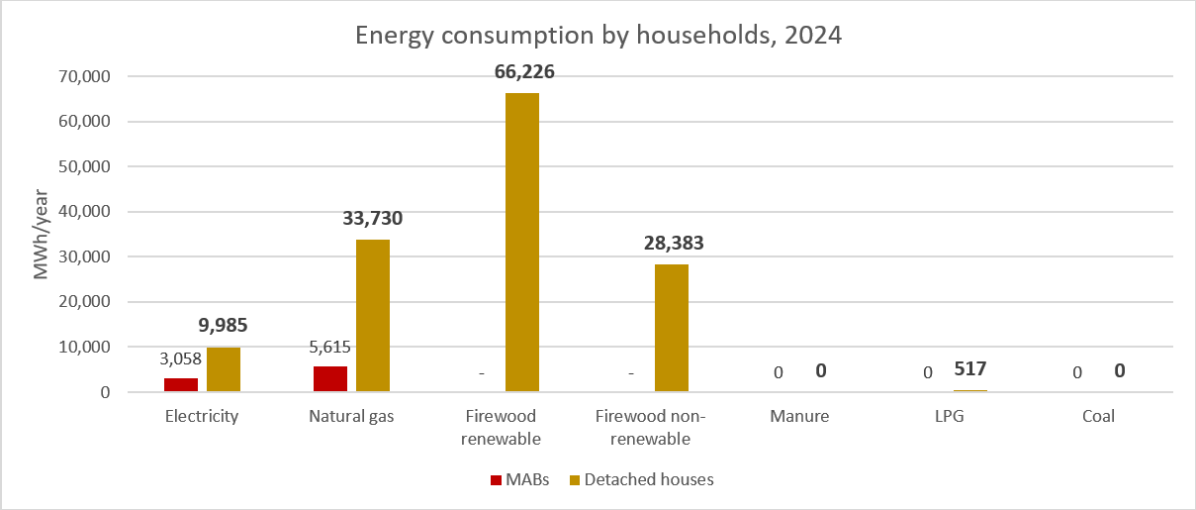


Chart 7. Structure of energy consumption in the residential sector of the community (MAB apartments and private houses), in %

As in almost all community settlements of the Republic of Armenia, in the Noyemberyan community, natural gas consumption dominates in MABs (64.7%), and private houses (24.3%), while the role of firewood is greater in private houses (68.1%).

The structure of energy consumption in the residential sector by energy carriers for households in the community, as well as the overall structure of energy carrier consumption in the residential sector of the community, is presented in **Chart 8**.



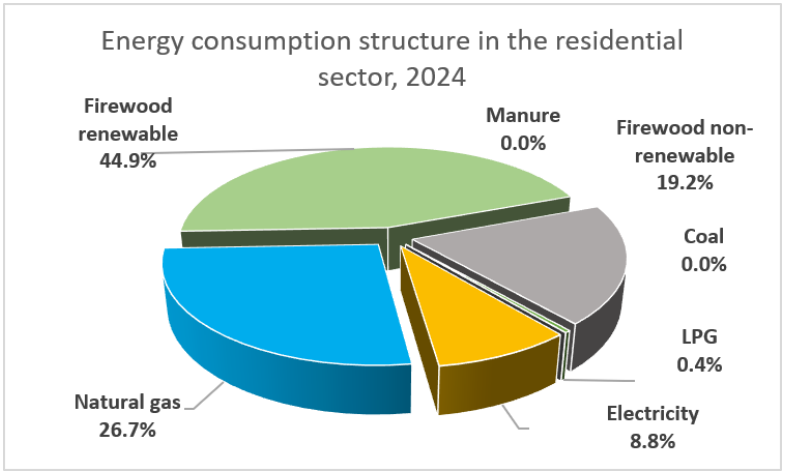


Chart 8. The structure of population energy consumption in 2024

Chapter 5. Energy consumption of municipal institutions

Institutions and organizations under the jurisdiction of Noyemberyan community and financed from the community budget cover their energy demand mainly through electricity and natural gas. The offices of the administrative heads of four rural communities and three cultural institutions were informed about the use of firewood. According to the submitted references, no other fuel consumption was recorded during the years under review.

According to the data presented for 2024, administrative offices, preschool educational institutions, and cultural centers mainly use natural gas for heating purposes 71.0%, electricity 20.0%, and firewood 9.0%. The above is due to the presence of photovoltaic panels in municipal buildings for their own needs, but it should also be taken into account that for consumers without solar panels, under current energy tariffs, 1 kWh of useful thermal energy produced using natural gas (assuming the efficiency of the heating device to be 85-92%) is about 2.5-2.7 times cheaper than the useful thermal energy obtained using electric heaters, and the reduction in CO2 emissions (in the case of the coefficients used within the framework of this report) will be 1.4-8.9%.

Below is an analysis of the energy sources used in all municipal institutions.

5.1. Electricity, natural gas and firewood consumption in municipal institutions

Natural gas consumption by community institutions

Some of the budgetary institutions of Noyemberyan community (55.6% of buildings in Noyemberyan city, 55.6% of administrative head offices/buildings in Ayrum city and rural settlements, 84.6% of kindergartens, 46.2% of cultural institutions) are subscribers and consumers of natural gas. The annual volumes of natural gas consumption by community institutions in physical units (nm^3) and energy equivalents (MWh) are presented in **Tables 16** and **17**, respectively.

Table 16. Physical volumes of natural gas consumption in CNPOs in 2022-2024 (nm^3/year)

No	Name of institution or organization	Natural gas consumption, m^3/year		
		2022	2023	2024
1	Noyemberyan Municipality	9,700	9,700	9,700
2	Kindergarten № 1	7,015	6,337	3,654
3	Kindergarten № 2	14,720	12,790	11,390
4	Cultural Center	0	0	0
5	Sports School	0	0	0
6	Art School	0	0	0
7	Music School	8,270	7,820	8,700
8	Library	0	0	0
9	"Serving the Community Economy" NGO	0	0	260
In total in Noyemberyan city		**39,705**	**36,647**	**33,704**
Consumption Index, %		100%	92.30%	84.89%
10	Offices of Administrative Heads of settlements	7,532	7,662	10,054
11	Kindergartens in Ayrum city and rural areas	60,520	61,347	63,266
12	Cultural Centers of Ayrum city and rural areas	0	1,011	1,011
In total in rural areas		**68,053**	**70,021**	**74,331**
Consumption Index, %		100%	102.89%	109.23%
In total in the community		**107,758**	**106,668**	**108,035**
Consumption Index, %		100%	98.99%	100.26%

Natural gas consumption is increasing over the years in organizations in the city of Ayrum and rural settlements, but is decreasing in institutions located in Noyemberyan. In the Noyemberyan community, the total consumption of natural gas in 2022-2024 is almost unchanged. This indicates that in parallel with the gasification rates in the community, there is also an increase in the share of electric heating. However, in absolute terms, natural gas consumption in community buildings is about 2.4% of population consumption.

A conversion factor of 9.42 kWh/m^3 was used to estimate the energy equivalents of the physical volumes of natural gas given in **Table 16**. This corresponds to a lower heating value (lower calorific value) of natural gas of 8,100 kcal/m^3. These data are summarized in **Table 17** below.

Table 17. Energy equivalents of natural gas consumption in CNPOs in 2022-2024 (MWh/year)

No	Name of institution or organization	Natural gas consumption, MWh/year		
		2022	2023	2024
1	Noyemberyan Municipality	91.374	91.374	91.374
2	Kindergarten № 1	66.081	59.695	34.421
3	Kindergarten № 2	138.662	120.482	107.294
4	Cultural Center	0	0	0
5	Sports School	0	0	0
6	Art School	0	0	0
7	Music School	77.903	73.664	81.954
8	Library	0	0	0
9	"Serving the Community Economy" NGO	0	0	2.449
In total in Noyemberyan city		**374.0**	**345.2**	**317.5**
Consumption Index, %		100%	92.30%	84.89%
10	Offices of Administrative Heads of settlements	70.954	72.180	94.706
11	Kindergartens in Ayrum city and rural areas	570.100	577.889	595.964
12	Cultural Centers of Ayrum city and rural areas	0	9.525	9.525
In total in rural areas		**641.1**	**659.6**	**700.2**
Consumption Index, %		100%	102.89%	109.23%
In total in the community		**1,015.1**	**1,004.8**	**1,017.7**
Consumption Index, %		100%	98.99%	100.26%

Natural gas consumption by Noyemberyan city, Ayrum and rural settlements of the community, as well as the community as a whole, is depicted in **Chart 9**.

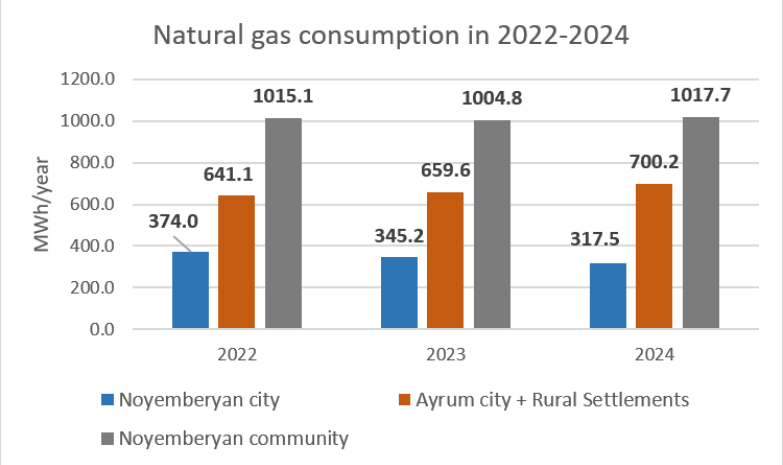


Chart 9. Structure of natural gas consumption by municipal institutions

Electricity consumption by community/municipal institutions

The annual electricity consumption data of community-funded educational institutions, cultural, sports and other institutions and organizations, as well as the offices of the administrative heads of Noyemberyan Municipality, Ayrum City and rural settlements of the community for the period 2022-2024 are presented in **Table 18**.

Table 18. Total energy consumption of community-owned/municipal institutions (MWh/year)

No	Name of institution	Annual electricity consumption, MWh/year		
		2022	2023	2024
1	Noyemberyan Municipality	18.5	21.5	20.46
2	Kindergarten № 1	0.81	0.405	-
3	Kindergarten № 2	1.0	-	-
4	Cultural Center	0.86	1.14	2.38
5	Sports School	3.2	3.55	9.03
6	Art School	-	-	-
7	Music School	1.88	1.96	2.65
8	Library	1.92	2.35	2.21
9	"Serving the Community Economy" NGO	7.25	6.52	7.28
In total in Noyemberyan city		**35.415**	**37.420**	**44.010**
Consumption Index, %		100%	105.7%	124.3%
10	Offices of Administrative Heads of settlements	77.1	104.3	102.1
11	Kindergartens in rural areas	38.1	37.1	39.1
12	Cultural Centers of rural areas	90.0	66.5	78.3
In total in rural areas		**205.3**	**207.8**	**219.5**
Consumption Index, %		100%	101.23%	106.90%
In total in the community		**240.7**	**245.2**	**263.5**
Consumption Index, %		100%	101.89%	109.46%

Electricity consumption is increasing over the years both in the city of Noyemberyan (perhaps at a faster pace), as well as in the city of Ayrum and in organizations of rural settlements. In 2024, the total electricity consumption in the community of Noyemberyan increased by about 9.5% compared to 2022. It accounts for about 2.0% of the population's electricity consumption, which is a similar indicator compared to other communities of the Republic of Armenia.

Electricity consumption for 2022-2024 by Noyemberyan city, Ayrum city, rural settlements, and the general community is shown in **Chart 10.**

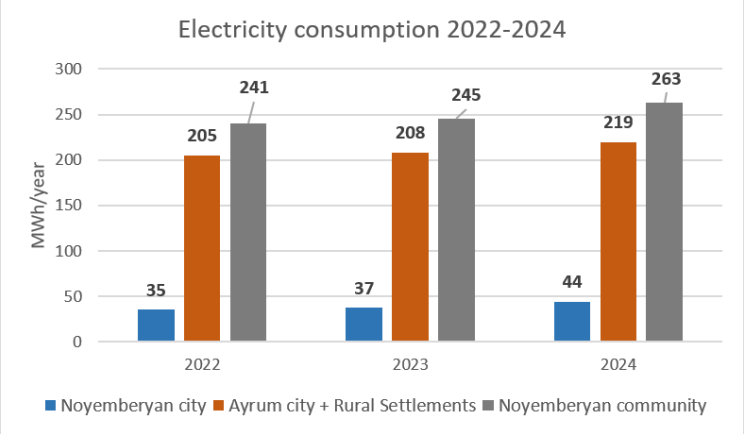


Chart 10. Structure of electricity consumption by municipal institutions

Firewood consumption in community/municipal institutions

Some of the budgetary institutions in the rural settlements of Noyemberyan community also consume firewood. The annual volumes of firewood consumption by community institutions in physical units (m^3) and energy equivalents (MWh) are presented in **Table 19**, respectively. In the case of firewood, the same annual consumption is presented for the specified period, therefore, the dynamics of consumption is not considered.

Table 19. Annual volumes of firewood consumption in CNPOs in 2022-2024 (m^3/year) and (MWh/year)

No	Name of institution or organization	Annual firewood consumption	
		m^3/year	MWh/year
1	Noyemberyan Municipality, PEI-s № 1 and № 2, Cultural Center, Sports School, Art School, Music School, Library, "Serving the Community Economy" NGO	0	0
In total in Noyemberyan city		**0**	**0**
2	Offices of Administrative Heads of settlements	24.0	59.424
3	Kindergartens in Ayrum city and rural areas	0	0
4	Cultural Centers of Ayrum city and rural areas	24.0	59.424
In total in rural areas		**48.0**	**118.848**
In total in the community		**48.0**	**118.8**

The offices of the administrative heads of the Debedavan, Lchkadzor, Koti and Voskevan rural communities, as well as the cultural palaces of the Koti, Koghb and Voskepar rural communities, reported on the consumption of firewood. Heating with firewood was not carried out in kindergartens during the specified period.

To estimate the energy equivalents of physical volumes of firewood, a conversion factor was used, which was taken equal to 2.476 MWh/m^3.

Firewood consumption in community-owned organizations accounts for 0.18% of renewable firewood consumed by the population.

Firewood consumption by rural settlements of Noyemberyan community and the community as a whole is depicted in **Chart 11**.

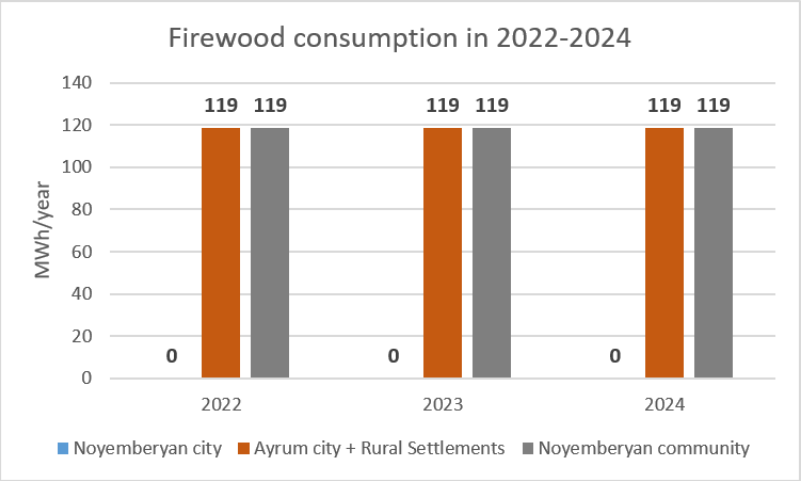


Chart 11. Structure of firewood consumption by community-owned institutions

The costs of electricity, natural gas and firewood spent by all community-owned organizations in Noyemberyan community were accepted according to the actually consumed and recorded data presented by the relevant specialists of the community municipality[11].

[11] Electricity generated in own solar photovoltaic plants and consumed for own needs is not included in the calculations of consumed electricity.

5.2. Total energy consumption of community institutions

The overall energy consumption indicators by institutions under Municipality jurisdiction for 2022-2024 are given in **Table 20.**

Table 20. Total energy consumption of community institutions

No	Name of institution or organization	Energy consumption, MWh/year		
		2022	2023	2024
1	Noyemberyan Municipality, Kindergartens № 1 and № 2, Cultural Center, Sports School, Art School, Music School, Library, "Serving the Community Economy" NGO	409.436	382.635	361.502
In total in Noyemberyan city		**409.436**	**382.635**	**361.502**
Consumption Index, %		100%	93.45%	94.48%
2	Offices of Administrative Heads of settlements	207.483	235.893	256.204
3	Kindergartens in Ayrum city and rural areas	608.247	614.939	635.090
4	Cultural Centers of Ayrum city and rural areas	149.465	135.436	147.213
In total in rural areas		965.195	986.267	1,038.506
Consumption Index, %		100%	102.18%	107.60%
In total in the community		1,374.631	1,368.902	1,400.008
Consumption Index, %		100%	99.58%	101.85%

The dynamics of energy consumption (electricity + natural gas + firewood) by Noyemberyan city, Ayrum city, rural settlements, and the general community is depicted in **Chart 12.**

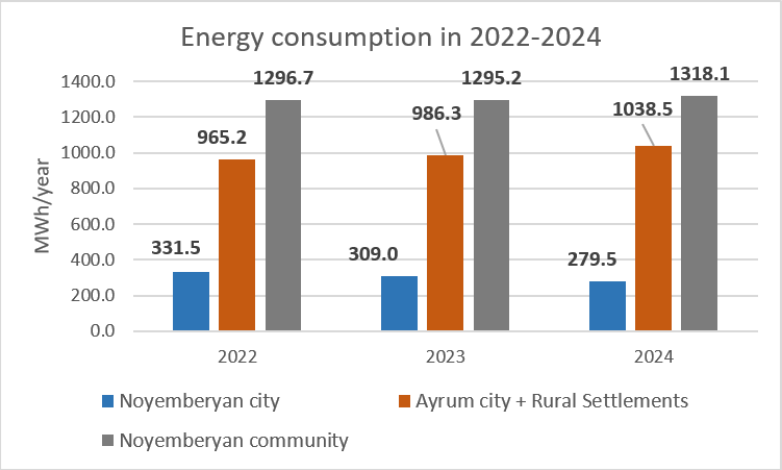


Chart 12. Energy consumption structure of municipal institutions

The tabular data shows that; however, the summary consumption of energy carriers is more stable. In Noyemberyan, there is a continuous reduction in energy carriers (also due to the production of renewable energy for own needs), and in Ayrum and rural settlements - an increase (which also indicates financial improvements in community budget organizations), as a result, energy consumption by community-owned institutions fluctuates by about 1.8% during 2022-2024.

Energy consumption (electricity + natural gas + firewood) by energy carrier and by the cities of Noyemberyan, Ayrum and rural settlements and the general community is depicted in **Chart 13.**

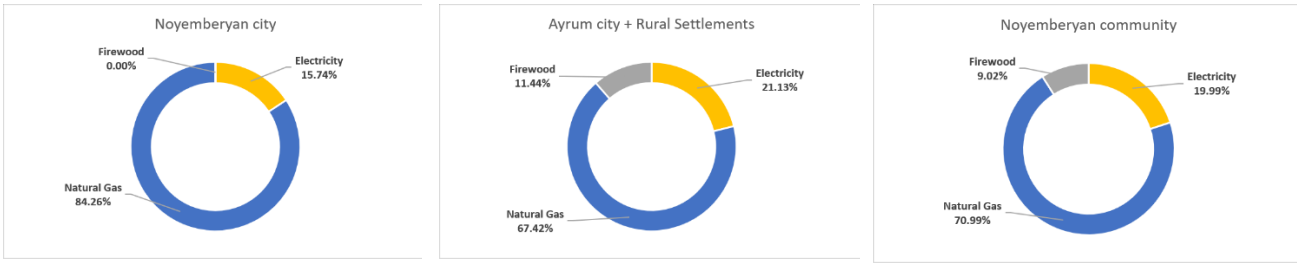


Chart 13. Consumption structure of municipal institutions by energy carriers, 2024

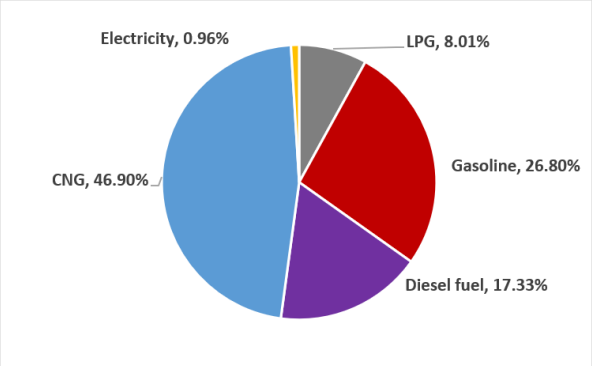
Analyzing the annual energy consumption indicators of buildings under the jurisdiction of the Noyemberyan community's Municipality for the base year 2024, it can be concluded that natural gas is predominant in different proportions in both urban and rural areas.

All data presented in the analysis are actual consumption data and are provided by the relevant department of the Noyemberyan Municipality.

Chapter 6. Energy consumption in automobile transport

The automobile sector includes municipal, public, private, and commercial transport. As in other settlements in the Republic of Armenia, the primary motor fuel in Noyemberyan is compressed natural gas (CNG), and electrified ground vehicles are in very limited supply as of 2022-2024.

It is assumed that the structure of fuel consumption in the transport sector of Noyemberyan community will be comparable to the average statistical indicators recorded in other communities of the Republic of Armenia and on a national scale.



According to the Energy balance of RA, in 2022, 887.5 thousand tons of oil equivalent (ktoe) of final energy was used in the transport sector in the Republic of Armenia. The types of energy/fuels consumed are: CNG, gasoline, diesel fuel, LPG and electricity. Their structure is presented in **Chart 14.**

Chart 14. Structure of fuel consumed in the road transport sector in Armenia in 2022

The objective difficulties in assessing the energy consumption of vehicles [lack of clear information on average annual mileage, specific fuel consumption (l/100km or kg/100km), number of vehicles retrofitted with CNG, etc.] were overcome thanks to joint expert discussions.

Information about the community's trucks and passenger vehicles from the responsible department of the municipality is presented in the Tables below.

To express the costs of motor fuels used in vehicles in energy units, supporting guidelines developed by a professional body of the European Commission were used, which propose appropriate conversion factors for different types of motor fuels[12].

Energy consumption indicators were assessed for all main types of vehicles included in the transport sector: light passenger cars, light and heavy trucks, as well as buses and other specialized vehicles.

The number of vehicles in the community by fuel type (gasoline, diesel fuel, CNG, LPG) and other technical indicators (annual mileage, specific fuel consumption, etc.) were estimated through joint expert discussions, as a result of averaging the indicators presented by Noyemberyan and the settlements and applying proportional calculation methods.

6.1. Energy consumption of public and community automobile transport

In Noyemberyan community, the automobile transport sector consists of public, community, private and commercial vehicle subsectors. The functions of the public transport subsector are carried out by vehicles of the two mentioned subsectors, mainly by means of owners with the status of physical persons or individual entrepreneurs. Public motor (automobile) transport provides intra-community and inter-community transport services (mainly in the regional center). The number of vehicles involved is quite limited and includes medium-capacity buses, minibuses and taxis. According to the presented data, no serious changes have occurred in the composition of motor transport in recent years.

In the Noyemberyan community in 2022-2024, about 12 minibuses operated, mainly from Ijevan to Noyemberyan and the settlements of the community. In the public transport subsector in 2022-2024, mainly

[12] Guidebook "How to develop a SECAP in the Eastern Partnership Countries", EC, Ispra, 2018, JRC113659

compressed natural gas (CNG) was used, and in the case of taxis, also liquefied petroleum gas (LPG). Electric vehicles were not yet available in those years.

The quantitative and technical indicators of public transport vehicles in the mentioned years are presented in **Table 21.**

Table 21. Technical indicators of public transport

Type of motor transport	Quantity: pcs	Fuel	Mileage, km/car	Annual fuel consumption		
				m^3/100 km l/100 km	10^3 m^3 10^3 l	MWh
Minibuses (Noyemberyan, Ayrum, settlements, Ijevan)	12	CNG	36,500	16	70.1	660.154
	6	LPG	36,500	16	35.0	255.792
Taxis (intra-community)	25	CNG	12,000	12	36.0	339.120
	20	LPG	12,000	14	33.6	245.280
Total	63					1,500.3

Source: data provided by Noyemberyan Municipality.

In the table, the energy value of CNG and LPG has been estimated according to the energy conversion coefficients and indicators given in **Table 9**:

- CNG: 9.42 kWh/m^3 or 12.9 kWh/kg, density: 0.7278 kg/m^3,
- LPG: 7.3 kWh/l or 13.1 kWh/kg, density: 0.555 kg/l.

The public transport subsector uses (as of 2022-2024) the most affordable and appropriate motor fuels in the Republic of Armenia: CNG (66.6%) and LPG (33.4%), which is typical for other communities in the Republic of Armenia as well.

The fleet of municipal vehicles, in addition to vehicles serving institutions, also includes vehicles providing special services. The quantitative, technical and energy indicators of vehicles of this subsector for 2022-2024 are presented in **Table 22.** In the table, the energy values of liquid motor fuels are estimated according to the coefficients recommended in the EC directives[13], the values of which are:

- gasoline: 9.2 kWh/l or 12.3 kWh/kg, density: 0.75 kg/liter,
- diesel fuel: 10.0 kWh/l or 11.9 kWh/kg, density: 0.84 kg/liter.

Table 22. Energy consumption of municipal transport in 2024

Type of motor transport	Quantity, pcs.	Fuel type	Mileage, km/car	Motor fuel consumption		
				m^3/100 km, l/100 km	10^3 m^3 or 10^3 l	MWh
Passenger cars						
Toyota Corola Gasoline 100%	1	Gasoline	72,200	7.9	5.70	52.47
Nissan Sentra Gasoline 100%	1	Gasoline	55,500	8.0	4.44	40.85
Minibus JAC Diesel fuel 100%	3	Diesel fuel	30,000	20	18.0	180.0
Minibus FORD Diesel fuel 100%	2	Diesel fuel	18,000	25	9.0	90.0
UAZ Patriot Diesel fuel 100%	4	Diesel fuel	15,000	18	10.8	108.0
Passenger cars total, by motor fuel		Gasoline			10.14	93.32

[13] How to Develop a Sustainable Energy Action Plan (SEAP) in Eastern Partnership and Central Asian Cities - A GUIDE. Part II, Baseline Emissions Inventory, 2014.

		CNG			0	0
		Diesel fuel			37.80	378.00
		Total				471.32
Trucks and special vehicles						
МАЗ/MAZ dump truck	3	Diesel fuel	10,000	25	7.50	75.00
МАЗ/MAZ garbage truck	4	Diesel fuel	5,700	22	5.02	50.16
МАЗ/MAZ crane	1	Diesel fuel	8,000	38	3.04	30.40
КамАЗ/KAMAZ	1	Diesel fuel	10,000	35	3.50	35.00
ЗИЛ/ZIL	4	Diesel fuel	7,000	35	9.80	98.00
GAZ 53	3	CNG	5,000	25	3.75	35.33
Trucks, special vehicles by motor fuel		CNG			3.75	35.33
		Diesel fuel			28.86	288.56
		Total trucks				323.89
Total municipal, by motor fuel		**Gasoline**			**10.14**	**93.32**
		CNG			**3.75**	**35.33**
		Diesel fuel			**66.66**	**666.56**
		Total				**795.21**

Source: data provided by Noyemberyan Municipality

The share of CNG in the community transport subsector is 4.44%, which is typical for other communities of the Republic of Armenia as well, taking into account that special vehicles mainly run on diesel fuel (83.82%), the share of gasoline is 11.74%, and LPG and electricity are not used. The energy consumption of community motor transport was assessed according to data provided by the community municipality.

The proportion of fuel consumed in the public and community transport sector of Noyemberyan community is presented in **Chart 15.**

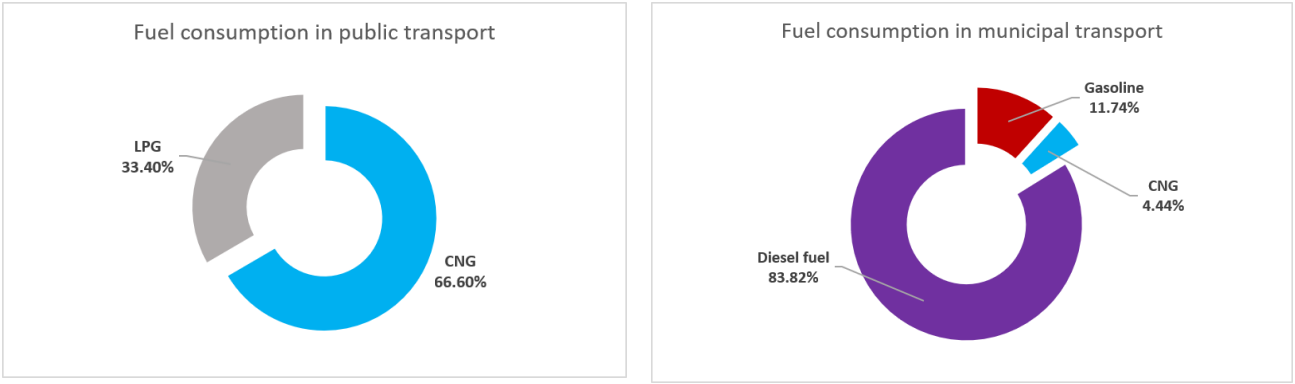


Chart 15. Structure of fuel consumed in public and community transport sectors

As a rule, the fuel consumed by municipal/community motor vehicles constitutes 2-3% of the total consumption in community's transport sector, the largest share in the sector belongs to the private and commercial subsector, in order to accurately estimate energy costs in this sector, information provided by the Noyemberyan Municipality and the heads of all settlements was taken into account.

6.2. Energy consumption of private and commercial automobile transport

The Municipality has submitted data on the number of private and commercial vehicles in Noyemberyan and all settlements of the community by type (passenger vehicles with up to and more than 10 seats, trucks (freight and passenger vehicles), specialized, etc.) for 2022-2024. However, taking into account the insignificant change in the indicators, this report presents the indicators for the base year 2024.

The proportion of vehicles by fuel type in some unique cases was determined based on joint expert assessments and averaged data.

In practice, the numbers of cars in relatively active operation are estimated using an approximate expert method, assuming their share to be within 70-90% of the total number of registered cars.

The physical quantities and technical indicators characterizing the energy intensity/content of liquid and gaseous motor fuels consumed by active, in-service vehicles of the private and commercial subsector for the baseline year 2024 are summarized in **Table 23.** The energy equivalents corresponding to the natural volumes of fuel are calculated according to the conversion factors given in **Table 9.**

Table 23. Energy consumption of private and commercial transport

Type of cars	Fuel type	Quantity, pieces	Factor, %	Mileage, km/car	Motor fuel consumption		
					l or kWh or m^3/ 100 km	l or m^3/year	MWh
Passenger vehicles with up to 10 seats	CNG	4,214	0.7	13,375	10	3,944,998	37,162
	Gasoline	1,208	0.8	13,375	10	1,292,241	11,889
	Diesel fuel	197	0.8	13,375	11	232,375	2,324
	LPG	820	0.7	13,375	15	1,151,527	8,406
	Electricity	30	0.9	13,375	25	90,995	91
Total		6,469					59,871
Trucks (+passenger vehicles with more than 10 seats)	CNG	869	0.7	5,751	30	1,049,031	9,882
	Gasoline	2	0.8	5,751	25	2,643	24
	Diesel fuel	655	0.8	5,751	32	964,189	9,642
	LPG	0	0.7	5,751	30	0	0
	Electricity	0	0.9	5,751	30	0	0
Total		1,526					19,548
Total fleet		**7,995**					**79,419**

In the baseline 2024 energy consumption balance of vehicles in this subsector, the role of compressed natural gas is the highest at 59.2%. This indicator is very close to the average indicator of the republic. Then, CNG is followed by diesel fuel at 15.1%, gasoline at 15.0%, and liquefied petroleum gas (LPG) at 10.6% and electricity at 0.1%.

The proportion of fuel consumed in the private and commercial passenger and freight transport sector in Noyemberyan Community is given in **Chart 16,** and the proportion of total fuel consumed in the private and commercial transport sector in the Community is given in **Chart 17.**

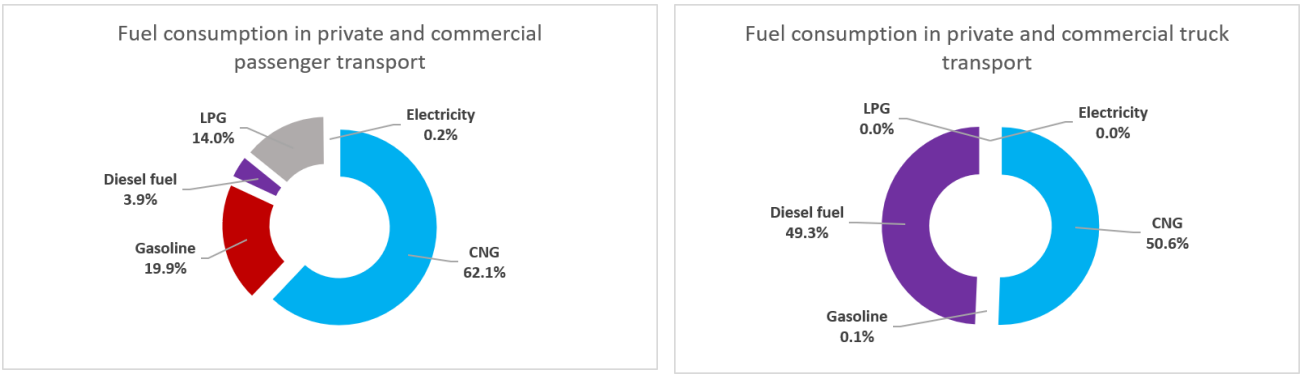


Chart 16. Structure of fuel consumed in private and commercial, passenger and freight transport in 2024

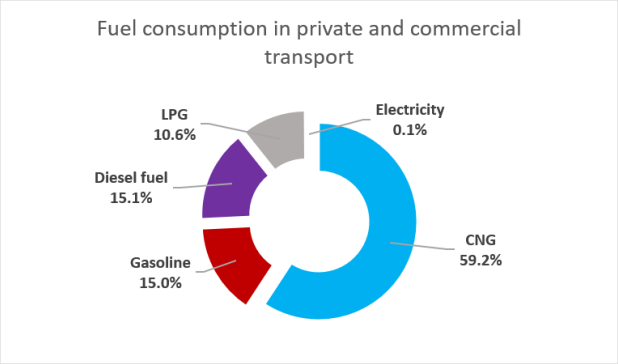


Chart 17. Structure of fuel consumed in private and commercial transport in 2024

The Community transport sector uses all fossil fuels and a small amount of electricity. This report will propose replacing fossil fuel vehicles with electric vehicles, the financial benefits and feasibility of which in terms of reducing GHG emissions will be substantiated by appropriate calculations.

6.3. Total energy consumption of the transport sector

Combining the data obtained for the three subsectors allows us to estimate the total energy consumption of the community in the transport sector and to identify the share of each subsector in the total energy consumption. The energy consumption of the transport sector by subsectors and by type of motor fuels is presented in **Table 24.** The table also summarizes the structure/proportion of energy consumption in the transport sector by sub-sectors and fuel types.

The structure of energy consumption by type of motor fuel is reflected in the last row of **Table 24**, and the structure by subsectors is reflected in the last column of the table. It follows from the data in the table that the most energy-intensive is the private and commercial transport subsector, at 97.3 %, and the most widely used motor fuel is compressed natural gas, with a share of 58.9 %.

Table 24. Energy consumption structure of the transport sector

Transport subsector	Annual consumption of transport motor fuels, MWh/year					Total consumption	
	Gasoline	Diesel fuel	CNG	LPG	Electricity	MWh/year	%
Community/Municipal	0	0	999.3	501.1	0	**1,500.3**	**1.84%**
Public	93.3	666.6	35.3	0	0	**795.2**	**0.97%**
Private and commercial	11,913.0	11,966.0	47,044.0	8,406.0	91	**79,419.0**	**97.27%**
Total, MWh	**12,006.0**	**12,632.0**	**48,078.0**	**8,907.0**	**91**	**81,715.0**	**100.00%**
Total, %	**14.69%**	**15.46%**	**58.84%**	**10.90%**	**0.11%**	**100.00%**	

The structure of energy consumption in the transport sector of Noyemberyan community by fuel type is presented in **Chart 18**, and by sub-sectors in **Chart 19.**

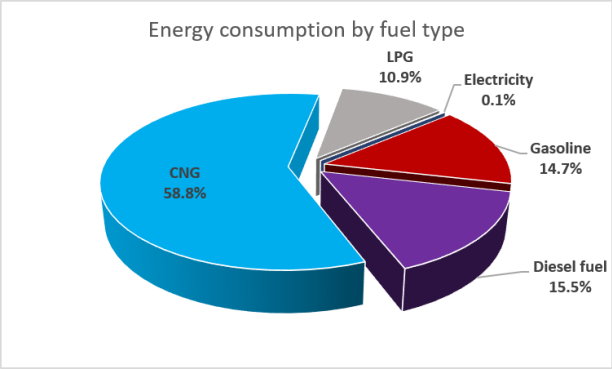


Chart 18. Structure of fuel consumed in the transport sector

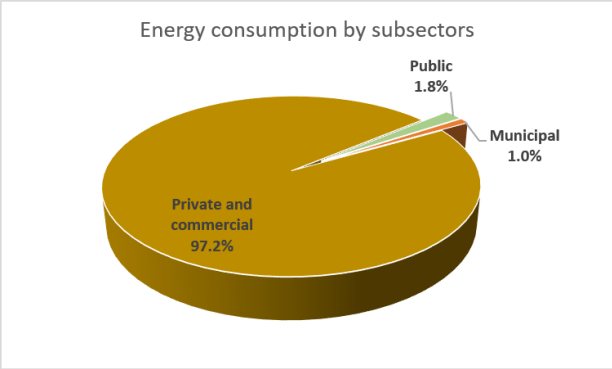


Chart 19. Energy consumption structures by subsectors

The quantities of natural gas supplied to the community's CNG filling stations in 2020-2024 are given in **Chart 20.**

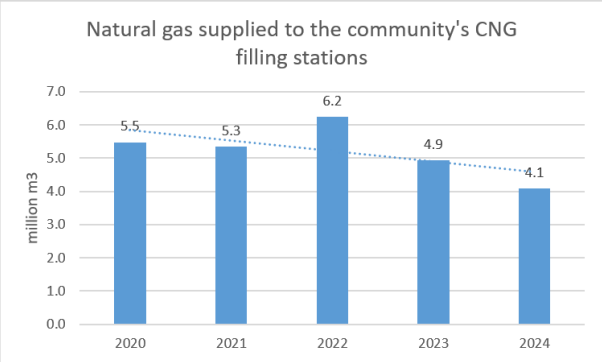


Chart 20. The quantities of natural gas supplied to the community's CNG stations in 2020-2024

As seen in the **Chart 20,** the demand for CNG in the community's CNG filling stations mainly meets the demand of other communities in Armenia. The latter is also determined by the geographical location of the community. The chart also shows a trend of decreasing demand for CNG during 2020-2024., which is characteristic for all CNG stations of the Republic of Armenia.

Chapter 7. Electricity consumption in the street lighting system

The street lighting system of Noyemberyan community is an object of community budget financing. The system does not include advertising, information, traffic regulation, architectural and other types of lighting installations.

The main technical data and annual operation and maintenance indicators of the street lighting system of Akhurian community for 2024 are presented in **Table 25**[14].

Table 25. Technical characteristics and annual electricity consumption indicators of the street lighting system of Noyemberyan community

Characteristic name	Unit of measurement	The value of the indicator in 2024		
		In Noyemberyan	In Ayrum and rural areas	In community
Street light poles	piece	960	3,948	4,908
Number of lights	piece	960	3,948	4,908
including incandescent lamps	piece	-	61	61
	W	-	93	93
including fluorescent (CFL) lamps	piece	360	945	1,305
	W	75	72	73
including sodium lamps	piece	-	-	-
	W	-	-	-
including LED lamps	piece	600	2,702	3,302
	W	60	59	59
Total length of illuminated streets	km	29.0	119.1	148.1
System installed capacity	*kW*	63.0	237.6	300.6
Annual electricity consumption	MWh	113.4	546.1	659.5
Annual working hours	*h/year*	1,800	2,299	2,194

The community is working to expand, modernize, and increase energy efficiency and comfort of the street lighting system,

Replacing incandescent and fluorescent lighting with LED lamps, increasing the number of lighting fixtures, improving the level of lighting comfort (as well as increasing annual operating hours), and lighting previously dark streets can lead to a certain increase in the electrical installed capacity of the system and a reduction in specific electricity consumption.

The data presented in **Table 26** on the street lighting systems of all settlements in Noyemberyan community were provided by the offices of the administrative heads of the settlements:

[14] Source: Reference from the relevant department of Noyemberyan Municipality

2022	Unit	Noyemberyan city	Ayrum city	Artchis	Bagratashen	Baghanis	Barekamavan	Berdavan	Debedavan	Deghdzavan	Dovegh	Zorakan	Lchkadzor	Koti	Koghb	Haghtanak	Voskepar	Voskevan	Ptghavan	Jujevan	Total Ayrum and Rural Settlements	Total Community
Street light poles	piece	960	185	160	420	115	100	440	71	82	260	160	150	300	177	250	125	242	155	75	3,467	4,427
Number of lights	piece	960	185	160	420	115	100	440	71	82	260	160	150	300	177	250	125	242	155	75	3,467	4,427
including incandescent lamps	piece	-	-	-	-	-	-	-	-	-	-	-	-	70	-	-	-	-	-	41	111	111
	W	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	60	85	85
including fluorescent (CFL) lamps	piece	360	105	160	260	-	40	150	-	-	-	-	150	-	-	-	55	120	70	-	1,005	1,365
	W	75	50	70	50	-	75	75	-	-	-	-	50	-	-	-	75	75	75	-	69	71
including sodium lamps	piece	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
including LED lamps	piece	600	80	0	160	115	60	290	71	82	260	160	0	230	177	250	70	122	85	34	2,166	2,766
	W	60	50	0	60	50	60	60	40	38	60	60	0	60	60	50	60	50	60	100	57	58
Total length of illuminated streets	km	29.0	1.5	9.2	10.0	4.0	3.0	15.0	1.99	2.3	7.8	3.9	4.5	8.5	4.5	7.0	6.0	8.0	4.5	2.6	104.3	133.3
System installed capacity	kW	63.0	9.3	11.2	22.6	5.8	6.6	28.7	2.8	3.1	15.6	9.6	7.5	20.8	10.6	12.5	8.3	15.1	10.4	5.9	206.3	269.3
Annual electricity consumption	MWh	113.4	15.0	16.8	82.5	10.4	11.9	51.6	8.3	9.1	28.1	23.4	13.5	54.1	25.8	30.4	20.3	36.7	28.1	7.9	473.8	587.2
Annual working hours	h/year	1,800	1,622	1,500	3,650	1,800	1,800	1,800	2,920	2,920	1,800	2,433	1,800	2,600	2,433	2,433	2,433	2,433	2,715	1,350	2,297	2,181

2023	Unit	Noyemberyan city	Ayrum city	Artchis	Bagratashen	Baghanis	Barekamavan	Berdavan	Debedavan	Deghdzavan	Dovegh	Zorakan	Lchkadzor	Koti	Koghb	Haghtanak	Voskepar	Voskevan	Ptghavan	Jujevan	Total Ayrum and Rural Settlements	Total Community
Street light poles	piece	960	205	180	440	122	100	440	71	82	260	160	150	350	177	250	135	242	155	76	3,595	4,555
Number of lights	piece	960	205	180	440	122	100	440	71	82	260	160	150	350	177	250	135	242	155	76	3,595	4,555
including incandescent lamps	piece	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	29	79	79
	W	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	60	85	85
այդ թվում՝ լյումինեսցենտային (ԴՆԱՏ) լամպեր	piece	360	115	180	220	0	40	150	-	-	-	-	150	-	-	-	55	120	70	-	985	1,345
	W	75	50	70	50	0	75	75	-	-	-	-	50	-	-	-	75	75	75	-	71	72
including sodium lamps	piece	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
including LED lamps	piece	600	90	-	220	122	60	290	71	82	260	160	-	300	177	250	80	122	85	47	2,326	2,926
	W	60	50	-	60	60	60	60	40	38	60	60	-	60	60	50	60	50	60	100	58	58
Total length of illuminated streets	km	29.0	1.7	10.8	10.5	5.0	3.0	15.0	1.99	2.3	7.8	3.9	4.5	11.0	4.5	7.0	7.0	8.0	4.5	2.6	111.1	140.1
System installed capacity	kW	63.0	10.3	12.6	24.2	7.3	6.6	28.7	2.8	3.1	15.6	9.6	7.5	23.0	10.6	12.5	8.9	15.1	10.4	6.4	215.2	278.2
Annual electricity consumption	MWh	113.4	16.0	18.9	88.3	13.2	11.9	51.6	8.3	9.1	28.1	23.4	13.5	59.8	25.8	30.4	21.7	36.7	28.1	8.7	493.5	606.9
Annual working hours	h/year	1,800	1,561	1,500	3,650	1,800	1,800	1,800	2,920	2,920	1,800	2,433	1,800	2,600	2,433	2,433	2,433	2,433	2,715	1,350	2,293	2,181

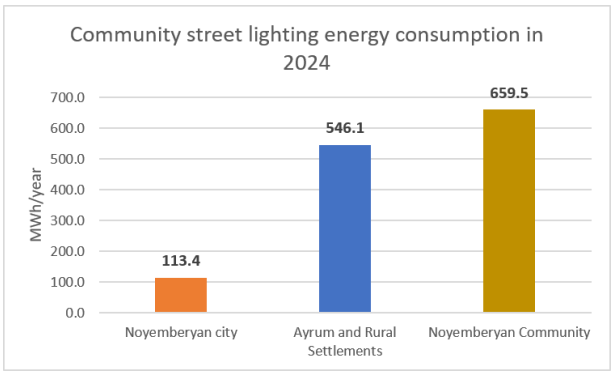
2024	Unit	Noyemberyan city	Ayrum city	Artchis	Bagratashen	Baghanis	Barekamavan	Berdavan	Debedavan	Deghdzavan	Dovegh	Zorakan	Lchkadzor	Koti	Koghb	Haghtanak	Voskepar	Voskevan	Ptghavan	Jujevan	Total Ayrum and Rural Settlements	Total Community
Street light poles	piece	960	240	180	480	122	100	500	71	82	260	165	150	480	230	250	150	246	155	87	3,948	4,908
Number of lights	piece	960	240	180	480	122	100	500	71	82	260	165	150	480	230	250	150	246	155	87	3,948	4,908
including incandescent lamps	piece	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	11	61	61
	W	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	60	93	93
այդ թվում՝ լյումինեսցենտային (ԴՆԱՏ) լամպեր	piece	360	130	180	180	0	40	150	-	-	-	-	150	-	-	-	55	120	70	-	945	1,305
	W	75	50	70	50	0	75	75	-	-	-	-	50	-	-	-	75	75	75	-	72	73
including sodium lamps	piece	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
including LED lamps	piece	600	110	-	300	122	60	350	71	82	260	165	-	430	230	250	95	126	85	76	2,702	3,302
	W	60	50	-	60	60	60	60	40	38	60	60	-	60	60	50	60	50	60	100	59	59
Total length of illuminated streets	km	29.0	2.2	10.8	11.0	5.0	3.0	16.0	2.0	2.3	7.8	4.0	4.5	14.0	6.5	7.0	7.5	8.0	4.5	3.0	119.1	148.1
System installed capacity	kW	63.0	12.0	12.6	27.0	7.3	6.6	32.3	2.8	3.1	15.6	9.9	7.5	30.8	13.8	12.5	9.8	15.3	10.4	8.3	237.6	300.6
Annual electricity consumption	MWh	113.4	18.0	18.9	98.6	13.2	11.9	58.1	8.3	9.1	28.1	24.1	13.5	80.1	33.6	30.4	23.9	37.2	28.1	11.2	546.1	659.5
Annual working hours	h/year	1,800	1,500	1,500	3,650	1,800	1,800	1,800	2,920	2,920	1,800	2,433	1,800	2,600	2,433	2,433	2,433	2,433	2,715	1,350	2,299	2,194

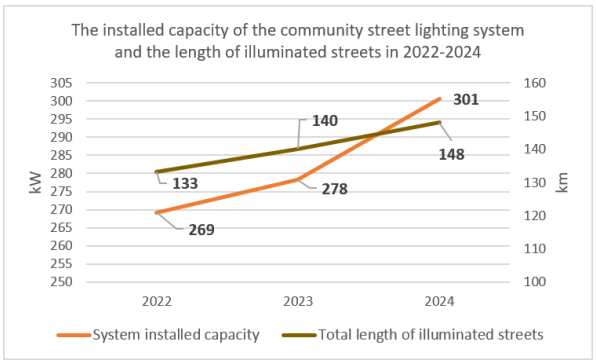
Table 26. Technical characteristics and annual electricity consumption indicators of street lighting systems in Noyemberyan community settlements for 2022-2024

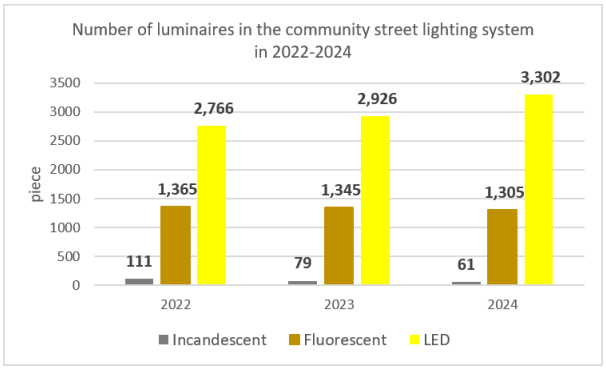
Some missing data reported by some settlements were accepted based on averaging the available indicators and used to obtain the overall data for rural settlements and the community.

The following characteristics of the Community street lighting systems are presented in **Chart 21**: a) The structure of electric energy consumption by Noyemberyan city, Ayrum city and rural settlements and Noyemberyan community in 2024, b) the installed capacity (left axis) and the length of illuminated streets

(right axis) in 2022-2024. c) the number of luminaires in the lighting system by type in 2022-2024. d) the annual working hours (left axis) and the annual electricity consumption (right axis) in 2022-2024.







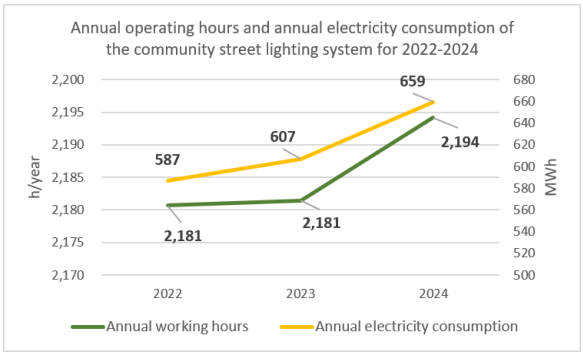


Chart 21. Parameters of community street lighting systems

The annual electricity consumption by the street lighting systems of Noyemberyan community is 659,470 kWh/year.

Chapter 8. Development of a baseline GHG emissions inventory

The year 2024 is selected as the baseline year for the development of the Noyemberyan community's SECAP. Reliable and credible information on the energy consumption volumes ensuring the vital activities of the Noyemberyan community has been collected and analyzed for 2020-2024. The base year was selected based on the methodological requirements of the Covenant.

The choice of the base year 2024 is reasonable and representative also for the following reason: some data for years prior to 2022 are due to the 2019–2020 coronavirus pandemic and the 44-day war and their consequences.

8.1. Main sources of GHG emissions

In the energy sector, of the three greenhouse gases emitted by the combustion of fossil fuels: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), this program only accounts for the first, which accounts for the vast majority (up to 98%) of total emissions associated with fuel combustion. Fugitive emissions of methane are also not included in the calculations. CO_2 emissions in the sectors under consideration are generated by the combustion of fossil fuels (natural gas, gasoline, diesel fuel, LPG) and non-renewable firewood.

The baseline emissions inventory takes into account only those sources of CO_2 emissions that are included in the Sustainable Energy and Climate Action Plan of the Noyemberyan community. These sources are:

- ✓ Municipal institutions whose work activities are accompanied by the use of electricity, as well as GHG emissions resulting from the combustion of natural gas.
- ✓ The residential sector, which is a major consumer of electricity, natural gas and firewood, and their use is also associated with CO_2 emissions.
- ✓ Automobile transport, where carbon dioxide and other greenhouse gases are produced and released into the atmosphere as a result of the combustion of liquid and gaseous motor fuels used.
- ✓ The municipal street lighting system, which is an object of municipal budget financing, in which the production of electricity used is accompanied by the generation of CO_2.

After specifying the sources of GHG emissions, the emission volumes are calculated based on the emission factors for various energy carriers, which were developed by the IPCC and are considered pan-European norms. The numerical values of these factors for the Republic of Armenia are given below [15]:

- Electrical energy: 0.241 tons of CO_2/MWh
- Natural gas: 0.202 tons of CO_2/MWh
- Compressed natural gas (CNG): 0.202 tons of CO_2/MWh
- Motor gasoline: 0.249 tons of CO_2/MWh
- Diesel fuel: 0.267 tons of CO_2/MWh
- Liquefied petroleum gases: 0.227 tons of CO_2/MWh
- Firewood (non-sustainable)[16]: 0.403 tons of CO_2/MWh
- Firewood (sustainable)[17]: 0 tons of CO_2/MWh

[15] Source: How to Develop a Sustainable Energy Action Plan (SEAP) in Eastern Partnership and Central Asian Cities – A Guide. Part II – Baseline Emissions Inventory. 2014.

[16] Firewood resulting from unsustainable forest management (when deforestation rates exceed natural forest growth rates), which is a non-renewable resource and whose combustion results in carbon dioxide emissions.

- Manure (sludge, dung): 0 tons of CO_2/MWh
- Anthracite: 0.354 tons of CO_2/MWh
- Brown coal: 0.364 tons of CO_2/MWh

To estimate GHG emissions in the base year, the quantitative indicators of energy consumption recorded in each sector [expressed in energy units (MWh)] are multiplied by the corresponding GHG emission factors:

Carbon dioxide emissions (tons of CO_2) =

Energy consumption (MWh) x CO_2 emission factor (tons of CO_2/MWh)

Based on these factors, in the following section 8.2 the volumes of GHG emissions are calculated and the target obligations of the community in terms of reducing GHG emissions is identified.

8.2. Baseline GHG emissions inventory

The GHG BIE is developed for the baseline year 2024. The baseline emissions inventory includes the absolute energy consumption indicators of all sectors listed in the previous section. The quantities of energy carriers used in the baseline year by specific sectors and areas are presented in **Table 27.**

Table 27. Energy carrier consumption volumes for the baseline year 2024

Energy carrier	Unit of measurement	Energy carrier consumption volumes				Total consumption	
		Municipal	Population	Transport	Street lighting*	10^3 m^3, 10^3 l or MWh	%
Electrical energy	MWh	263.5	13,042.9	91.0	659.5	**14,056.8**	**6.1%**
Natural Gas	10^3 m^3	99.3	4,176.7	-	-	**4,276.1**	**-**
	MWh	935.7	39,344.8	-	-	**40,280.5**	**17.4%**
Compressed Natural Gas	10^3 m^3	-	-	5,103.9	-	**5,103.9**	**-**
	MWh	-	-	48,078.4	-	**48,078.4**	**20.8%**
Firewood (non-renewable)	10^3 m^3	-	11.5	-	-	**11.5**	**-**
	MWh	-	28,382.7	-	-	**28,382.7**	**12.3%**
Firewood (renewable)	10^3 m^3	0.048	26.7	-	-	**26.8**	**-**
	MWh	118.8	66,226.4	-	-	**66,345.2**	**28.7%**
Manure	10^3 tons	-	-	-	-	**-**	**-**
	MWh	-	-	-	-	**-**	**0.0%**
LPG in HHs	10^3 tons	-	39.4	-	-	**39.4**	**-**
	MWh	-	517.4	-	-	**517.4**	**0.22%**
Coal	10^3 tons	-	-	-	-	**-**	**-**
	MWh	-	-	-	-	**-**	**0.00%**
Gasoline	10^3 l	-	-	1,305.0	-	**1,305.0**	**-**
	MWh	-	-	12,006.3	-	**12,006.3**	**5.2%**

[17] Firewood generated through natural growth of timber, which qualifies as a renewable resource resulting from sustainable forest management (when, on average, forest growth equals or exceeds deforestation), and in calculations, emissions from the combustion of timber classified in this group are considered zero, in accordance with the requirements of the Covenant's methodological guidelines.

Diesel fuel	10^3 l	-	-	1,263.2	-	**1,263.2**	-
	MWh	-	-	12,632.2	-	**12,632.2**	**5.5%**
LPG in transport	10^3 l	-	-	1,220.2	-	**1,220.2**	-
	MWh	-	-	8,907.2	-	**8,907.2**	**3.9%**
Total	**MWh**	**1,318.1**	**147,514.2**	**81,715.0**	**659.5**	**231,206.7**	**100.0%**
	%	**0.6%**	**63.8%**	**35.3%**	**0.3%**	**100.0%**	

* In the community street lighting system, only external lighting data are presented in the electricity consumption.

The dominant role in the structure of energy consumption included in the GHG inventory belongs to the population, with a share of 63.8 % in the base year. The transport sector occupies the second place in the baseline inventory, with a share of 35.3 %.

The ratio of energy carrier consumption in the Noyemberyan community in the base year by final consumption sectors is presented in **Chart 22**, and **Chart 23** depicts the ratio of energy carrier consumption in the community in the base year by energy carrier types.

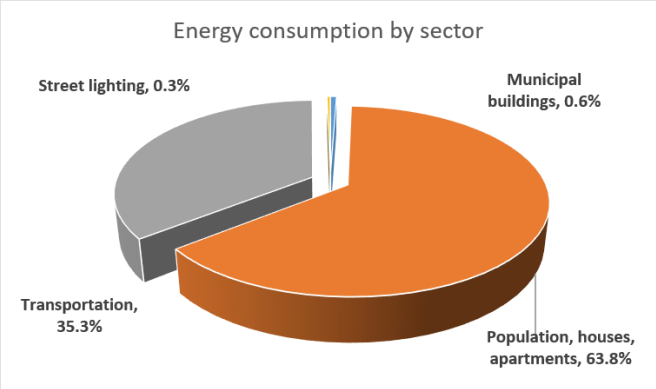


Chart 22. Energy consumption breakdown in the base year by final consumption sectors

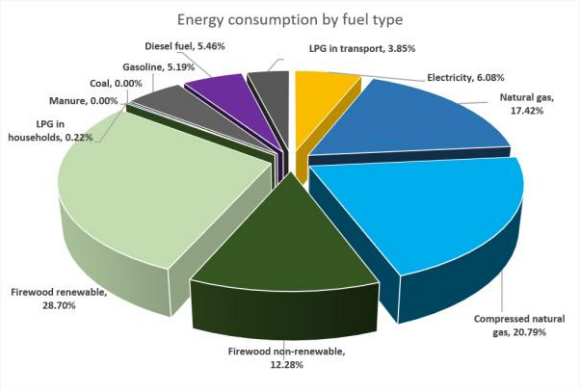


Chart 23. Energy consumption breakdown in the base year by energy carrier type

Renewable firewood dominates over the remaining fuels - 28.7%, the second is CNG - 20.8%, then natural gas - 17.4% (CNG + natural gas - 32.2%). According to the SECAPs compiled in recent years for other communities, the large-scale use of firewood (renewable + non-renewable - 41.0%) is also characteristic of many communities of the republic, and especially private houses in rural settlements. The above-mentioned are followed by electricity - 6.1%, a significant share of which is produced in thermal power plants, also using natural gas, and liquid motor fuels (diesel fuel - 5.5%, gasoline - 5.2%, LPG - 4.1%), totaling 14.8%.

To calculate greenhouse gas emissions, it is necessary to multiply the net energy consumption volumes of energy carriers (expressed in energy units) given in **Table 27** by the corresponding CO2 emission factors. The factors were developed by the IPCC and their numerical values are given in Section 8.1 of this chapter.

In the Republic of Armenia, it is extremely difficult to assess the sources of origin and supply of firewood. In this regard, at the expert level, it is conventionally accepted that about 70% of the firewood used is a product of natural forest growth (under conditions of sustainable forest management, when an average forest growth is equal to or exceeds the volume of deforestation and firewood is considered a renewable resource generated at the expense of natural growth of timber), the emissions from the combustion of which are considered zero (0 t CO2/MWh).

Meanwhile, firewood resulting from unsustainable forest management (when deforestation rates exceed natural forest growth rates) is a non-renewable resource, with a GHG emission factor of 0.403 t

CO2/MWh. Therefore, replacing 30% of the firewood used with other fossil fuels with lower emission factors will also be proposed as a mitigation measure.

The results of calculating the quantities of greenhouse gas emissions (only CO2 - carbon dioxide) resulting from the use of energy carriers involved in the BIE are presented in **Table 28.**

Table 28. GHG emissions in baseline year 2024

Energy carrier	GHG emissions, t CO_2				Emissions	
	Municipal	Population	Transport	Street lighting	t CO_2/year	%
Electrical energy	63.5	3,143.3	21.9	158.9	**3,387.7**	**8.23%**
Natural gas	189.0	7,947.7	-	-	**8,136.7**	**19.76%**
CNG	-	-	9,711.8	-	**9,711.8**	**23.59%**
Firewood non-renewable	-	11,438.2	-	-	**11,438.2**	**27.78%**
Firewood renewable	-	-	-	-	-	-
Manure	-	-	-	-	-	-
LPG in HHs	-	117.4	-	-	**117.4**	**0.29%**
Coal		-	-	-	-	-
Gasoline	-	-	2,989.6	-	**2,989.6**	**7.26%**
Diesel fuel	-	-	3,372.8	-	**3,372.8**	**8.19%**
LPG in transport	-	-	2,021.9	-	**2,021.9**	**4.91%**
Total, tons of CO2/year	**252.5**	**22,646.7**	**18,118.0**	**158.9**	**41,176.2**	**100.00%**
Total, %	**0.61%**	**55.00%**	**44.00%**	**0.39%**	**100.00%**	

The table shows that the population and transport maintain their leading positions in the emissions balance. By fuel type, non-renewable firewood, CNG and natural gas have the highest emission values.

Thus, in the Noyemberyan community of the Tavush region of the Republic of Armenia, **41,176.2 tons of CO_2** were emitted in the baseline year 2024 as a result of the vital activity of the population and the economy. This value is the baseline for assessing the target commitments of the community within the framework of the Covenant of Mayors. The community voluntarily assumed these commitments by becoming a participant in the Covenant initiative.

The ratio of CO_2 emissions in the base year is given in the charts.

It is evident from **Chart 24** that the dominant role in the structure of GHG emissions in the community belongs to the population, whose share in the total CO2 emissions balance of the base year is 55.0%, and the share of transport is 44.0%.

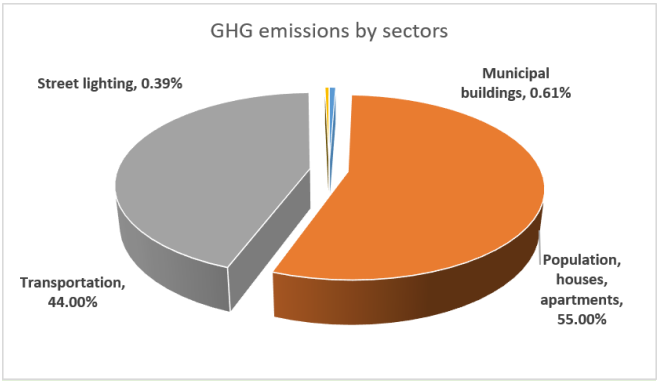


Chart 24. GHG emissions in the base year by consumption sectors

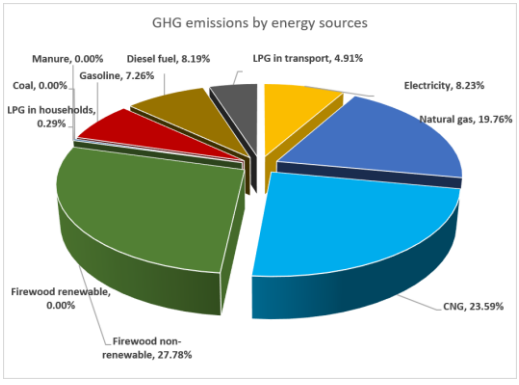


Chart 25. GHG emissions in the base year by energy carrier

Chart 25 shows that natural gas emissions together with CNG account for 43.3% (19.8+23.6), and non-renewable firewood emissions account for 27.8%. The third source of CO2 emissions in the community is electricity - 8.2%, which is also a result of the combustion of exclusively natural gas in RA thermal power plants. The total share of liquid fuels used in automobile transport is 20.4%.

8.3. Target amount of GHG emissions reduction

According to the Covenant procedures, local governments of the Eastern Partnership countries are authorized to independently decide on the approaches to estimating the target ammounts of GHG emission reductions, based on one of the following two scenarios proposed by the European Commission:

- **Baseline year scenario,** in which the target emission reduction volume by 2050 is determined based on the estimated value of emissions in the baseline year.
- **Business as usual (normal development) scenario,** in which the target amount of emission reductions by 2050 is determined by taking into account the expected inevitable increase in GHG emissions by 2050 due to community development (e.g. population growth, economic development, expansion of street lighting and transport systems, etc.).

In the second approach, depending on the duration of the period from the baseline year to the target year 2050, a coefficient is introduced that takes into account the development of the community during that period and, naturally, the increase in emissions.

Over the past few years, the volumes of energy consumption in the Noyemberyan community have been variable, with no stable growth or decrease trends recorded, which can be confirmed by studying, for example, **tables 10-15**. The same can be said about the population size. Taking these circumstances into account, for the assessment of the target volumes of greenhouse gas emission reduction in the community in 2050, it is expedient and realistic to orientate with the first of the proposed approaches, taking as a basis the cadastral data for baseline year 2024.

Therefore, in the case of the adopted option, the volume of target commitments for reducing GHG emissions in the Noyemberyan enlarged community by 2050 is:

41,176.17 x 0.4 = 16,470.47 tons of CO_2/year

In order to reduce the level of GHG emissions recorded in the base year by 16,470.47 tons of CO2/year in the target year (2050), this SECAP proposes appropriate measures to reduce GHG emissions, which are summarized in **Chapter 9**. An interim target will also be set to reduce GHG emissions by 30% in 2030 compared to the base year:

41,176.17 x 0.3 = 12,352.85 t CO_2/year

Upon the completion of the full implementation of this Program, aimed at increasing the efficiency of energy/energy carrier use, promoting the development of energy conservation and renewable energy, and ultimately mitigating climate change, GHG emissions will be reduced by **16,580.68 t CO_2**, (by 2030-**12,435.29 t CO_2**), which slightly exceeds the target commitments.

The financial investments required for the implementation of the project amount to approximately **46.4 mln. euros** (for 2030-**35.5 mln. euros**). It should be noted that the total investment package does not include expenses for measures not directly related to energy efficiency, such as organizational measures, expansion of forested areas, etc.

Considering the fact that the residential sector is the clear leader in terms of GHG emission reduction potential and, consequently, commitments, the Noyemberyan Municipality should consistently carry out work to inform the population and introduce incentive mechanisms. Only with the active involvement of the residential sector can the implementation of this Program be realistic.

The implementation of the expected GHG emission reductions in the transport sector assumes the active participation of the private and commercial sectors in terms of organizing the work and financial investments (otherwise, the implementation of the Project may be jeopardized).

With the active involvement, joint work, and targeted funding of the members of the Noyemberyan Municipality Council of Elders, the offices of the administrative heads of the settlements, the residents of Noyemberyan, Ayrum, and rural communities, private and commercial entities, the implementation of this SECAP can be realistic and contribute to the further sustainable development of the community.

Chapter 9. "Sustainable Energy and Climate Action Plan" Measures

In order to fulfill its commitments under the Covenant, the Noyemberyan Enlarged Community is implementing measures aimed at reducing the volume of GHG emissions recorded in baseline year 2024 by 40% by 2050 (in parallel, a 30% reduction option by 2030 is also being considered). Measures to reduce GHG emissions are planned in different areas and are mainly aimed at encouraging energy saving and increase of energy efficiency, and expanding the use of renewable energy resources.

The main part of the measures proposed in the section of this SECAP aimed at reducing GHG emissions are investment or so-called "hard" measures, which mainly provide for thermal modernization of buildings, development of a fleet of electric vehicles in transport, local energy production from renewable sources, etc. The implementation of these actions requires certain investments and ensures the full fulfillment of the community's commitment to reducing GHG emissions.

The other part of the proposed measures is of an organizational, "soft" nature and is mainly aimed at raising awareness and strengthening the capacities of target groups of society, relevant specialists of community structures and other stakeholders in the implementation of the community strategy in the context of emission reduction, including through the creation and improvement of an energy management system in the community.

9.1. Organizational "soft" measures

The proper implementation of the awareness-raising or horizontal/soft measures of the Action Plan requires the active participation of local governments and the input of organizational skills of community structures. The implementation of measures of this nature, as a rule, does not require the involvement of significant financial resources and is designed to contribute to raising the awareness of the community population, institutional leaders, businessmen and individual entrepreneurs on the need for energy saving and climate mitigation. For this reason, this group of measures is called awareness-raising and also “Soft”.

It is often difficult to give an accurate quantitative assessment of the energy or environmental efficiency of “soft” measures; however, such assessments have been made on the basis of expert assessments, with certain reservations.

The latter are advisory in nature and are not included in the SECAP summary table. Consistent implementation of such events is highly encouraged.

Measure 9.1.1. Implementation of a Municipal Energy Management System (CEMS)

The introduction of a MEMS in the Noyemberyan community is an important tool for managing energy flows and environmental issues.

The Guide for the Implementation of the Energy Management System and the Institute of Energy Manager in RA Communities, the main goal of which is to assist RA communities in organizing energy consumption management in community-owned and community-managed buildings, was also provided to the RA Ministry of Territorial Administration and Infrastructure in 2020.

The introduction of a MEMS and the appointment of an energy manager will greatly contribute to the systematic and constant monitoring and management of energy flow parameters (technological, economic, social, and environmental) within the community.

The energy management department will carry out an inventory of municipal and public MAB buildings in the community, compile a database of their thermotechnical indicators, classifying the buildings according to previously developed criteria. The introduction of the MEMS aims to ensure the sustainability of the energy management of the Noyemberyan community and will also provide significant economic benefits as a result of prudent management of the community budget.

First of all, the energy manager should undertake the following tasks:

- Create a list of work tasks and targets for the energy management department, define and plan practical steps to achieve the targets.
- Establish criteria and mechanisms for selecting buildings for modernization from the point of view of energy-efficiency.
- Organize the implementation of energy audits and monitoring of municipal buildings and public MABs under community jurisdiction, in order to identify and control the main energy indicators of buildings.
- Ensure calculation and analysis of key indicators of thermal and energy efficiency of buildings, including baseline energy consumption, specific energy consumption, comfort level, etc.
- Make an assessment of the necessary investments, energy saving potential, GHG emission reduction and other energy and financial and economic indicators for buildings subject to modernization.

It is expected that as a result of the introduction of MEMS, at least a 10% reduction in energy consumption and GHG emissions can be achieved in community-owned structures.

The implementer	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	10.0	26.3	93.6	25.252	2026

Calculation of GHG reduction by electricity and natural gas components:

$E_{el.en.}$ = 263.5 MWh/year x 0.1 x 0.241 t CO_2/ MWh = 6.350 tons of CO_2/year,

B_{gas} = 935.7 MWh/year x 0.1 x 0.202 t CO_2/ MWh = 18.902 tons of CO_2/year:

Measure 9.1.2. Participation in events organized by international organizations on climate and energy

International organizations such as the World Bank (WB), the United Nations Development Programme (UNDP), the German Agency for International Cooperation (GIZ) and others regularly organize events on climate mitigation and adaptation, promoting energy efficiency and the use of renewable energy sources. It is expected to ensure the active participation of municipal employees and the population in such events. For example, participation in the global event "Earth Hour". This is a global movement organized by the World-Wide Fund for Nature (WWF). The event is held annually (usually at the end of March), encouraging individuals, communities and businesses to turn off non-essential electrical lighting and other energy-consuming devices for one hour from 8:30 PM to 9:30 PM, as a symbol of commitment to the planet.

The "Earth Hour" is designed to demonstrate the effectiveness of saving electricity for just one hour a year. The average hourly values of electricity consumption are estimated by assuming that:

- 80% of the population's daily consumption occurs within 10 hours,
- 90% of the municipal institutions' daily consumption: within 8 hours.

In that case, the energy efficiency of the measure will be determined as:

- in the residential sector: E= 0.8 x 13042.905/365/10 = 2.859 MWh/year,
- in municipal institutions: E= 0.9 x 263.5/260/8 = 0.114 MWh/year.

The implementer	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	1.0	2.973	-	0.716	2025–2030

Another such event is participation in the EU Sustainable Energy Week (ESEW), the largest annual event organized by the European Commission and dedicated to the effective use of renewable energy in Europe.

Measure 9.1.3. Optional climate change mitigation courses in schools

Young people, and especially schoolchildren, can greatly contribute to solving the energy and climate problems of the community. The goal of the event is to instill a caring attitude towards energy carriers among schoolchildren, as well as to realize the advantages of using renewable energy sources. It is accepted that if a part of school-age children, remembering the knowledge acquired during classes, manages to turn off an unnecessarily turned-on light or gas stove at least once a day, we can expect a reduction in annual consumption by about 0.8%. The results are presented in the table below.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP and schools	3.50	104.343	314.758	88.728	2025–2027

Measure 9.1.4. Involving young people in the sustainable energy development process of the community

It is very important to ensure the participation of employees of the municipality and offices of the administrative heads of settlements in events regularly organized by international organizations on the topics of climate mitigation and adaptation, energy efficiency, and renewable energy sources.

At the same time, it is necessary to encourage the participation of the community's proactive youth and active population in the implementation of the mentioned programs. The implementation of the program's goals largely depends on the level of population involvement.

It is assumed that within the framework of this event, informational and educational materials on energy saving and energy efficiency will be distributed among youth and, in particular, schoolchildren, as a result of which, thanks to the active promotion of green and sustainable development ideas by schoolchildren involved in this process, a certain part of the population of Noyemberyan community (schoolchildren's families) will initiate and implement energy-saving measures in apartments and houses, including the installation of PV panels, the purchase of electric cars, energy-saving household appliances, energy-efficient renovation, etc.

The daily consistent work of the entire staff of the municipal council members and the offices of the heads of administrative settlements is expected to ensure the effective implementation of the measure. As a result of daily targeted work, an annual reduction of about 0.5% in all areas of energy consumption can be expected, also as a result of behavioral changes. The results are estimated in the table below.

The implementer	Cost, 10^3 euros	Energy conservation/saving, MWh/year							Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	CNG	Firewood non-renewable	Gasoline	Diesel fuel	LPG		
Noyemberyan MP	10.0	65.2	196.7	240.4	141.9	60.0	63.2	47.1	203.7	2025 – 2030

Similar organizational measures can be expanded as needed, in accordance with the wishes, abilities and capabilities of the municipality The funding volume of the proposed 4 soft measures is 36.0 thousand euros, the total estimated energy savings are 1,356.6 MWh/year, and the reduction of GHG emissions is 318.41 t CO_2/year.

9.2. "Hard" investment measures

In order to mitigate global climate change and fulfill the commitment of Noyemberyan community to reduce emissions by 40% by the target year 2050 (and option 2: by 30% by 2030) under the Covenant, this section presents measures requiring investments, the implementation of which is expected to result in tangible results in reducing CO2 emissions. Measures of this nature are proposed for the main sectors included in the SECAP's BIE: community/municipal buildings, residential buildings, transport and outdoor lighting.

When proposing measures, the following areas of development of green technologies that have gained momentum in Armenia in recent years were taken into account: the installation of autonomous solar power plants, the thermal modernization of buildings within the framework of state subsidy programs, and the import of electric vehicles.

The presented measures are consistent with the provisions of the documents defining the energy and climate strategies of the Republic of Armenia, mentioned above in the SECAP, as well as with decisions and development programs adopted at the national and local levels.

The above-mentioned trends and development rates in the Republic are also paramount for the development of the Sustainable Energy and Climate Action Plan of the Noyemberyan community.

The following subsections present the main measures of the SECAP in various areas of community life. These activities, which require the investment of significant financial resources, ensure the full implementation of target commitments.

9.2.1 Measures at community-owned structures

The measures proposed in community-owned/municipal buildings are consistent with the provisions of the RA Government Resolution No. 1504-N of 25.12.2014 "On the application of measures aimed at increasing energy saving and energy efficiency in facilities being constructed (reconstructed, renovated) at the expense of state funds".

The following measures are being considered to reduce the volume of thermal and electrical energy consumption in buildings, reduce their operating costs, and ensure regulatory comfort conditions:

- Thermal insulation of external envelope structures- external walls, attic floors, basements, with certified thermal insulation construction materials;
- Application of volumetric layout solutions that ensure the minimum possible surfaces of external cladding structures;
- Use/replacement of energy-efficient windows and entrance doors;
- Use of energy-efficient systems and equipment for heating, ventilation, air conditioning, hot water supply and lighting;
- Use of solar water heating and photovoltaic equipment and heat pumps.

Energy efficiency measures implemented in community-owned/municipal institutions must be economically justified and ensure savings of community budget funds. Financial savings accumulated from year to year are encouraged to be invested in the community revolving fund and used to expand energy efficiency measures, involving new streets and buildings, and implementing energy efficiency improvement programs.

Measure 9.2.1.1 Partial savings in electrical and thermal energy in municipal buildings through simple energy saving measures

These measures are considered a priority in terms of time. The planned measures are not related to large investments. The successful implementation of these measures requires the mobilization of

administrative resources and mandatory participation of institutions in necessary moderate-volume work. The measure envisages the following types of work:

- installation of radiant heat flow reflectors in the rear parts of heating system heaters,
- thermal "sealing" of windows and exterior doors using silicone, foam rubber, insulating foams or other modern materials (replacement, adjustment of sealing rubbers of aluminum and metal-plastic, euro windows and doors),
- adjustment of heating and hot water supply modes, thermal insulation of external pipes,
- installation of light thresholds (tambours) for entrance doors of buildings,
- installation of motion sensors and automatic electrical power switches.

The measures in the CNPOs (NCOs) can be implemented as soon as possible, by 2027. It is estimated that as a result, annual electricity savings of 2% and natural gas savings of 6% can be achieved in the buildings of institutions financed from the community budget [including natural gas equivalent to saved thermal energy (calculated COP/efficiency 90%)]. In the baseline year, community institutions consumed 263.5 MWh/year of electricity and 935.7 MWh/year of natural gas.

The results of the calculations performed are applied to the two considered options (**Target 1: 40% by 2050 and Target 2: 30% in 2030**) and are summarized in the table below.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	20.00	5.269	62.382	13.871	2026-2027

Measure 9.2.1.2 Restoration of thermal insulation layers in attics of municipal buildings

The thermal insulation layers in the attics of some of the buildings of the CNPOs have deteriorated, disappeared or are missing. It is planned to restore the thermal insulation layers in all buildings under community control within the next 1-2 years.

The thickness of the planned thermal insulation layer is assumed to be 16 cm (blankets made of local raw materials, expanded perlite or mineral wool), the coefficient of thermal conductivity is 0.045 W/(m^2°C), the thermal resistance of the roof structure of the last floors of the buildings is assumed to be 0.65 m^2°C/W, which increases by 3.556 due to the insulation layer, thus making 4.206 m^2°C/W. The average attic area of the building is assumed to be 140 m^2, the temperature coefficient of the attic is 0.75. Since there are buildings in the community that are heated with electric energy, it is estimated that 15% of the consumed electricity is used for heating purposes. And to calculate the expected savings in useful thermal energy from the transition to final energy, natural gas, the average COP/efficiency of heating boilers and furnaces is taken to be 90%. From an economic point of view, this measure is very attractive, as it requires minimal initial investments for one unit of GHG reduction.

The results are summarized in the table below and are applicable to the two options/targets considered.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	41.596	7.904	207.940	43.909	2026-2030

Measure 9.2.1.3 Renovation of community cultural centers, kindergartens, and administrative offices

The measure is a work envisaged by the Noyemberyan community five-year development program for 2022-2026 and annual work plans. The works are being implemented with the financing of the Noyemberyan community budget and through subvention programs, co-financing from the RA state budget and community budget. According to the Program, it is specifically planned to carry out capital repairs (preliminary total cost: million drams): Koghb Cultural Center (102.1), Bagratashen Palace of Culture (53.2), Artchis Cultural House (58.4), Voskevan Administrative Office (8.91), Ptghavan Banquet Hall (6.84), Noyemberyan School of Fine Arts (18.49), Dovegh Administrative Office (5.36), Noyemberyan Community Hall (Municipality) Administrative Building (27.2) (partial), etc.

It is difficult to estimate the exact amount of energy efficiency and the resulting energy and environmental benefits from the renovation of municipal buildings. However, it is accepted that the total amount of energy efficiency renovation works carried out in municipal buildings is around 8% of the preliminary total budget, and as a result, it can be expected an improvement in energy consumption indicators of around 5% for electricity and 15% for natural gas.

The results of the measure are summarized in the table below and are applicable to the two options/targets considered.

The implementers	Cost, 10^3 euros*	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	50.3	6.587	70.180	15.764	2026-2030 թթ.

** The estimated cost of the measure is approximate*

Measure 9.2.1.4 Installation of solar water heaters in kindergartens

All preschool educational institutions in Noyemberyan community consume about 77.3 thousand m^3 of natural gas annually. The transition to solar water heating in these preschools is beneficial both from the point of view of economic and climate protection, as well as the formation of a caring attitude towards energy among children.

It is assumed that favorable technical conditions can be created in kindergartens for the installation of solar collectors. Each hybrid system with an absorption surface of about 30 m^2, together with a gas heater, will be able to produce the necessary useful thermal energy for hot water supply. If we assume that about 30% of the 728.3 MWh of natural gas consumed annually is used for domestic hot water, then the installation of solar water heaters can save about 22.2 thousand m^3 of natural gas, the energy equivalent of which will be about 218.5 MWh/year. The energy and environmental benefits expected from the full-scale implementation of this measure are presented in the table below.

The results of the measure are applicable to both observed targets.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	115.2	-	218.5	44.132	2024-2028

Measure 9.2.1.5 Replacing inefficient lamps with LED lamps in community-owned organizations

In the internal lighting systems of municipal institutions, some of the luminaires used in 2024 were still incandescent lamps. Replacing them with modern energy-efficient LED lamps available on the local market can achieve a fivefold reduction in the required electricity consumption without reducing the luminous flux.

There is a need to replace low-efficiency incandescent or fluorescent lamps in internal lighting systems with modern energy-efficient LED lamps in the institutions of the Noyemberyan community. From an economic point of view, this measure is very attractive, as it requires minimal initial investments for the reduction of one unit of GHG.

The measure plans to replace an average of 20 incandescent lamps (100 W) with LED lamps in municipal buildings of all levels. The operating hours of the lamps in these facilities are assumed to be 4.5 hours/day and 260 days/year, and the incandescent lamps to be replaced are replaced with LED lamps of about 18 W. The annual amount of electric energy saved will be:

$$E = 260 \times 52 \times 20 \times (100-18) \times 4.5/10^6 = 99.778 \text{ MWh/year}$$

The results of the measure are applicable to both observed targets.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	4.7	99.778	-	24.046	2024-2026 թթ.

Measure 9.2.1.6 Installation of PV modules in municipal institutions

Solar radiation indicators in Noyemberyan conditions - the total radiation of a horizontal surface under average cloudiness is 1,381.0 kWh/m^2. According to the current regulations, individuals and legal entities can install autonomous solar power plants with a capacity of up to 150 kW to meet their own electricity needs. In recent years, this green technology has been developing in Armenia with almost geometric progression.

It is also known that with appropriate orientation of PV modules, each kW of peak power is capable of producing about 1,400 kWh of electricity per year in Noyemberyan conditions. It is proposed to allocate 40-50 m^2 of sunlit area for installing PV modules in community-owned institutions that do not have PV modules. That is, the installed capacity in each building will be about 6.5 kW on average (only 202.8 kW for 60% of 52 organizations), each of which will produce about 9.1 MWh of electricity per year. The results of the measure are applicable to both observed targets.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	152.1	283.9	-	68.425	2024-2028

In particular, in the event of a positive assessment of the new seismic conclusion, the German Agency for International Cooperation (GIZ) is considering installing a solar power plant on the roof of the Bagratashen Cultural Center.

9.2.2 Local production of electrical energy

The enlarged community of Noyemberyan, in order to ensure sustainable development, intends to cooperate with international organizations, promoting low-carbon development, increasing energy efficiency and the use of renewable energy resources.

In the current conditions of liberalization of the electricity market, the community of Noyemberyan plans to build a 0.6 MW community commercial PV power plant, equipped with rechargeable batteries. This system is intended for 24-hour operation, in sunny weather, excess energy is accumulated in them, which is also used in case of possible outages or accidents.

Measure 9.2.2.1 Construction of a community commercial PV power plant

Within the framework of this measure, it is planned to build and operate a 0.6 MW community commercial PV power plant (equipped with storage and rechargeable batteries) in Noyemberyan community during 2024-2030, whose annual production will reach about 840 MWh.

The implementation of the measures will require 576,000 euros. Sources of financing may include the municipal budget, subsidy programs or financial support provided by foundations and international organizations. The results of the calculation of renewable energy production and GHG emission reduction are presented in the table below.

The results of the measure are applicable to both observed targets.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	576.0	840.0	0	202.44	2024-2030

9.2.3 Measures in the residential sector

The residential sector of Noyemberyan community is a major consumer of energy carriers, using electricity, natural gas, firewood, and small amounts of liquefied petroleum gas.

According to the Covenant methodology, this sector is the main one of the four sectors where the reduction of energy consumption and the resulting reduction of GHG emissions are included in the BIE and the list of mitigation measures.

The population accounts for the majority of energy consumption in the community - 63.8%, and GHG emissions - 55.0%, therefore the main part of GHG emission reductions should also be expected from the residential sector. The role of the population in fulfilling the community's target commitments cannot be underestimated.

The multi-apartment building stock of Noyemberyan, like other communities, was mainly built during the Soviet era, with very low regulatory requirements for thermal protection of buildings typical of that period, largely ignoring the issues of energy saving and energy efficiency, which have become a priority as a result of the increase in energy prices.

The MAB sector has significant energy saving potential, and energy efficiency measures implemented here can significantly reduce GHG emissions. The buildings were built mainly with tuff stone, with the "Midis" arrangement, whose thermal resistance is better than that of panel buildings, but they do not meet the thermal protection requirements in force in Armenia.

In general, the same characteristic can be given to private houses, which are also built without thermal insulation of walls and attics, where, however, along with the potential for energy efficiency, the use of solar energy is also promising, both in terms of local production of electrical and thermal energy. Among

the negative phenomena of the sector are the factor of “energy poverty” and the inability of households to provide a normative level of heating comfort, along with other social problems.

The low baseline level of energy consumption significantly reduces the energy saving potential of the proposed measures. And the implementation of measures to increase the energy efficiency of buildings often does not lead to a reduction in energy consumption, but instead contributes to an improvement in the level of comfort. The mentioned factors reduce the business attractiveness of such projects, as well as the actual impact on climate mitigation.

A complete package of thermal modernization measures in buildings can require significant investments and long payback periods. Therefore, all these factors need to be taken into account during the planning and implementation of measures.

At the same time, the municipality does not have direct leverage over the implementation of energy saving measures by owners of private houses and apartments. However, the residential sector is included in the BIE and, accordingly, in the list of mitigation actions of the SECAP, taking into account the social, energy and climate benefits of the measures proposed here.

Taking into account the above-mentioned circumstances, the Noyemberyan Municipality is willing to consistently implement large-scale campaigns to raise public awareness about the business benefits of energy efficiency and ensure active participation of community residents in the implementation of such measures.

According to the RACN 24-01-2016 "Thermal Protection of Buildings", RACN II-7.02-95 "Construction Thermophysics of Building Enclosing Structures" and RACN 24-01-2024 "Construction Climatology", the thermal resistances (R-values) of building enclosing structures in Noyemberyan community (number of degree-days 4,007) for residential buildings must provide the following values:

Exterior building envelope	Required values $(m^2 \cdot °C)/W$
Roofing and weatherproofing	4.27
Cold basement and attic covers	3.97
Exterior walls	3.06
Exterior windows and doors	0.45

In the stone MABs of Noyemberyan community, it is proposed to implement partial thermal modernization works of the buildings within the framework of the State Subsidy Program, co-financed by the UNDP-GCF Program.

Since similar work has not been carried out in the community before, below are examples of similar work carried out in other communities in a similar climatic zone:

Address: Akhtala, Abovyan 20

Partially thermally modernized in 2023. Energy saving 9%

Annual energy savings: 203,159 kWh (calculations are presented for heating and ventilation, assuming that 100% comfort level is provided in the building)

Energy performance before: 106, after: 96 kWh/m² year.

The cost of the project is 7.9 million AMD.

Energy efficiency class: before: E, after: D.

30 apartments, 120 residents, built in the 1970s, frame-panel, 5 storeys, total area: 2,520 m², tilted/sloping roof.

The exterior walls are 500 mm thick with tufa midis lining.
The covering is 220 mm thick reinforced concrete slabs with round holes.

Work carried out: a) replacement of the entrance doors and staircase windows, b) repair of the damaged walls and ceiling, c) thermal insulation of the attic floor with a 150 mm thick thermal insulation layer of mineral wool slabs, completely repairing the roof.

Address: Akhtala, Stepan Shahumyan 8

Partially thermally modernized in 2023. Energy saving 6%

Annual energy savings: 175,850 **kWh** (calculations are presented for heating and ventilation, assuming that 100% comfort level is provided in the building).

Energy performance before: 107, after: 102 kWh/m² year. **The cost of the project is 6.1 million AMD.** Energy efficiency class: before: D, after: D.

Tilted/sloping roof. 32 apartments, 128 residents, built in the 1960s, tufa stone, 4 storeys, total area: 2,520 m².

The exterior walls are 500 mm thick, covered with 220 mm reinforced concrete slabs with round holes, without thermal insulation.

Work carried out: a) replacement of the entrance doors and staircase windows, b) repair of the damaged walls and ceiling, c) thermal insulation of the attic floor using 200 mm thick expanded perlite blankets, completely repairing the roof.

Address: Akhtala, Ordzhonikidze 1

Partially thermally modernized in 2022. Energy saving 11%

Annual energy savings: 207,896 **kWh** (calculations are presented for heating and ventilation, assuming that 100% comfort level is provided in the building)

Energy performance before: 94, after: 83 kWh/m² year. **The cost of the project is 4.3 million AMD.** Energy efficiency class: before: D, after: C.

Tilted/sloping roof. 45 apartments, 128 residents, built in the 1970s, tufa stone, 4 stories, total area: 2,759 m².

The exterior walls are 500 mm thick, covered with 220 mm reinforced concrete slabs with round holes, without thermal insulation.

Work carried out: a) replacement of the entrance doors and staircase windows, b) repair of the damaged walls and ceiling, c) thermal insulation of the attic floor using 200 mm thick expanded perlite blankets, completely repairing the roof.

In the mentioned buildings, the current condition of the external envelope structures of the buildings before thermal modernization is identical to the 3, 4 and 5-storey apartment buildings of Noyemberyan community: natural gas boilers and gas stoves as well as electric heaters are used for heating the apartments.

The heat transfer resistance values of the external envelope structures of the building are lower than the requirements of the norms in force in the Republic of Armenia.

It is recommended to implement similar thermal modernization measures.

Measure 9.2.3.1 Partial thermal modernization of 21 5-storey, 7 4-storey and 15 4-storey stone-built multi-apartment buildings in Noyemberyan community

Following the example of the successful thermal modernization of MABs implemented within the framework of the state subsidy program (co-financed by the UNDP-GCF Project), it is proposed to gradually implement partial thermal modernization works of the existing 5-storey (21 units), 4-storey (7 units) and 3-storey (15 units) stone-built buildings during 2026-2030:

- Thermal insulation of attic floors and repair/replacement of roof coverings,
- Replacement of entrance doors and windows with new energy-efficient windows and doors,
- Installation of automatic interior lighting systems in entrances and stairwells.

It is expected that the energy savings in the partially insulated MAB will amount to about 101.6 MWh/year in 5-storey buildings[18], about 87.9 MWh/year in 4-storey buildings, and about 83.2 MWh/year in 3-storey buildings, i.e., the total (useful energy) annual savings will amount to: 2,133.2 MWh/year in 21 5-storey buildings, 615.5 MWh/year in 7 4-storey buildings, and 1,247.4 MWh/year in 15 3-storey buildings (useful energy).

For the conversion from useful to final energy (the latter will be used in the calculations of GHG emission reductions), the average efficiency of natural gas, heating boilers/stoves used in buildings is assumed to be 85%. Based on the survey[19] results, it is assumed that families living in buildings spend, on average, 80% natural gas and 20% electricity on heating their apartments, therefore, within the framework of this measure, the calculation of GHG emission reductions will be carried out in the same proportion.

The implementation of the measures will require the following investments: 372.0 thousand euros for 21 5-storey buildings, 95.7 thousand euros for 7 4-storey buildings, and 144.6 thousand euros for 15 4-storey buildings, a total of 612.4 thousand euros.

The results of the energy savings and GHG emission reduction calculations are presented in the table below. The results of the measure are applicable to both targets considered.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	612.387	799.2	3761.0	952.322	2026-2030

Measure 9.2.3.2 Partial thermal modernization of 16 1 and 2-storey multi-appartment buildings in the city of Ayrum and 195 1 and 2-storey multi-appartment buildings in rural areas

The measure is essentially a repetition of measure 8.2.3.1 for 1 and 2-storey MABs. The nature of the work to be carried out, cost indicators, energy consumption, etc., have the same content, and the volume indicators have been recalculated within 15% of the figures recorded for 4-storey buildings.

The results of the measure are presented in the table below. This measure is recommended for use only for the **40% GHG reduction target by 2050**.

[18] According to energy audits and calculations conducted by UNDP-GCF project experts, the average energy efficiency of these buildings, under regulatory conditions, is estimated at around 115 (kWh/m^2 year). Considering that the BIE includes actual energy consumption data, and the comfort level of these buildings is not more than 40-50%, , the actual energy efficiency of the buildings is estimated accordingly.

[19] Results of a survey on heating in rural areas conducted within the framework of the UNDP-GCF project.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
Noyemberyan MP	432.920	556.565	2,619.131	663.197	2026-2050

Measure 9.2.3.3 Partial thermal modernization of MABs and private houses through simple energy saving measures

The measure envisages the following activities:

- installation of radiant heat flow reflectors in the rear parts of heating system heaters,
- thermal "sealing" of windows and exterior doors using silicone, foam rubber, insulating foams or other modern materials (replacement, adjustment of sealing rubbers of aluminum and metal-plastic, euro windows and doors),
- adjustment of heating and hot water supply modes, thermal insulation of external pipes,
- installation of light thresholds (tambours) for entrance doors of buildings,
- installation of motion sensors and automatic electrical power switches.

It is assumed that, given the modest number of financial resources required, 40% of the apartments in the MAB-s and private houses (for the 30% GHG reduction target by 2030) and 60% (for the 40% GHG reduction target by 2050) will be able to participate in this measure. It is also assumed that the implementation of the measure will save 7% of the natural gas and firewood consumed by the population in the base year, and 3% of the electricity. The LPG consumed by the population has not been considered, since it is not used for heating purposes. The cost of the measure has been estimated at 60 euros per apartment in the MABs and 100 euros per private house.

For the calculation of final energy, the following efficiency ratios for heating equipment are used for natural gas and firewood, respectively: 85%, 70%. The results of the calculation of energy savings and GHG emission reductions are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Firewood*		
MP&HH	335.28	156.5	1,101.7	2,649.1	757.055	2026-2030

Table 2.By 2050, a 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Firewood*		
MP&HH	502.82	234.8	1,652.5	3,973.6	1,135.582	2026-2050

*30% of the specified amount is non-renewable firewood, the GHG emission factor of which is 0.403 t CO_2/MWh, and the remaining 70% is renewable and the GHG emissions are equal to 0.

Measure 9.2.3.4 Restoration of thermal insulation layers of attic roofs of private houses

The community's private houses were mainly built and put into operation many years ago. Due to the deterioration or complete absence of thermal insulation layers in the attics of a significant part of residential buildings, heat losses from the ceilings of the top floors many times exceed the regulatory indicators.

Restoration of thermal insulation layers of attic floors is the most effective measure for thermal modernization of buildings in terms of investment/savings ratio. The measure requires relatively modest financial resources, and the result is incomparably better. For this purpose, locally produced thermal insulation materials/structures (expanded perlite blankets, mineral wool slabs or extruded polystyrene foam

slabs) can be used. The main prerequisite is to keep the thermal insulation layer free from moisture. The thickness of the layer is 15-20 cm; the thermal conductivity coefficient of the material is 0.045 W/(m·°C). The thermal resistance of the floor covering of the last floors is taken as 0.75 m^2·°C/W. With insulation with the specified parameters, it increases by at least 3.23 and is about 3.98 m^2·°C/W.

The attic area of each private house is assumed to be 80 m^2, the attic temperature coefficient is 0.7 and the comfort coefficient is 0.7. It is assumed that 35% or about 2,572 private houses (by 2030- 30% GHG reduction target) and 40% or about 2,940 (by 2050- 40% GHG reduction target) will participate in the measure implementation. As a result of the measure, the energy savings used for heating will amount to:

Target 1: Q=2,572x80x (20+1.2) x189 x 24 x (1.33-0.25) x0.7x0.7x10^{-6}= 10,471.04 MWh/year.

Target 2: Q=2,940x80x (20+1.2) x189 x 24 x (1.33-0.25) x0.7x0.7x10^{-6}= 11,969.23 MWh/year.

The calculation of GHG emission reduction is carried out taking into account that the share of electricity among the energy carriers used for heating in private houses is 20%, and the proportion of thermal energy produced as a result of burning natural gas and firewood used to obtain thermal energy (for the remaining 80%) (on a community scale, corresponding to the quantities consumed in private houses) is as follows:

Total consumption in private houses of Noyemberyan community		
Natural gas	Firewood	Total
33,730	94,609	128,339
26.28%	73.72%	100.00%

The efficiency indicators of the equipment for the transition from useful energy to final energy are accepted: for gas boilers, stoves and water heaters, the COP/eeficiency is on average 85%, and for wood stoves 70%. The cost of thermal insulation of 1 sq.m. of the attic floor (for example, with expanded perlite blankets) is estimated at around 6.73 euros (3,000 AMD).

The results of the energy savings and GHG emission reduction calculations are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Firewood*		
MP&HH	1,384.2	2,094.2	2,590.1	8,821.8	2,094.458	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Firewood*		
MP&HH	1,582.2	2,393.8	2,960.7	10,084.0	2,394.132	2026-2040

*30% of the specified amount is non-renewable firewood, the GHG emission factor of which is 0.403 t CO_2/MWh, and the remaining 70% is renewable and the GHG emissions are equal to 0.

Measure 9.2.3.5 Installation of energy-efficient lamps in the residential sector

For interior lighting in apartments and private houses, incandescent lamps still continue to be used in 2024. Replacing them with LED lamps is economically feasible in the current conditions in terms of specific investment (euro/t CO2 ratio).

It is planned that about 30% of the households of Noyemberyan community, i.e. about 516 apartments and 2,721 private houses (**30% GHG reduction target by 2030**) and about 60%, i.e. about 1,032 apartments and 4,409 private houses (**40% GHG reduction target by 2050**) will participate in the measure

implementation. It is planned that about 100 W light bulbs of the participants will be replaced with 18 W LED bulbs. In total, the number of LED bulbs to be replaced is: in the appartments of the MABs: 4 bulbs in each- 2,064 pieces for **Target I** (4,128 for **Target II**), and in the private houses: 5 bulbs in each- 11,025 pieces for **Target I** (22,045 for **Target II**).

The annual electricity savings and GHG emission reduction calculation results are presented in the tables below[20].

Target 1: Q= (2,064+11,025) x (100+18) x4.5 x 350x10^{-6}= 1,690.4 MWh/year.

Target 2: Q= (4,128+22,045) x (100+18) x4.5 x 350x10^{-6}= 3,380.2 MWh/year.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Other		
MP&HH	58.7	1,690.4	-	-	407.397	2026-2028

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Other		
MP&HH	117.4	3,380.2	-	-	814.639	2026-2038

Measure 9.2.3.6 Installation of energy-efficient windows in residential MABs

Energy-efficient windows are quite expensive (around 30,000 AMD per 1 m^2) and their use is naturally not carried out solely for the purpose of reducing GHG emissions. The specific investments are very large (unlike, for example, the thermal insulation of the attic).

The installation of new metal-plastic or aluminum windows has more aesthetic and comfort purposes. In this regard, the measure is considered appropriate to implement at the end of the target period, starting from 2028 to 2030 in the **case of Target I** and from 2038 to 2050 in **the case of Target II**.

It is planned to attract about 50% of 70% of the housing units of MABs (those whose windows are still old as of the base year) up to 602 apartments (**Target I**) and about 80% up to 963 apartments (**Target II**). The thermal resistances of existing and energy-efficient windows are taken as 0.28 and 0.45 K·m^2/W, respectively, the luminous surface of one window is 1.8 m^2, the average number of new windows installed in one apartment is 3, the average level of comfort in apartments is 50%. The use of new windows will also improve natural lighting.

The annual saving of thermal energy is determined by the following formula:

Target I: Q = 3 x 602 x 1.8 x (20+ 1.2) x 189 x 24 x (1/0.28 -1/0.45) x 0.5/10^6 = 210.886 MWh/year,

Target II: Q = 3 x 963 x 1.8 x (20+ 1.2) x 189 x 24 x (1/0.28 -1/0.45) x 0.5/10^6 = 337.347 MWh/year.

There is no burning of firewood and manure for heating in MABs. The electricity consumption for heating is estimated at 20%. The final and useful energy transfer coefficient, COP/efficiency, for natural gas equipment (wall, gas boiler and stove) is 85%, for electric heating equipment - 100%.

[20] It is estimated that the lamps work 350 days a year, 4.5 hours a day, and the cost of one lamp is 2,000 drams.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Other		
MP&HH	218.68	42.177	198.481	-	50.258	2028-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Other		
MP&HH	349.82	67.469	317.503	-	80.396	2038-2040

Measure 9.2.3.7 Installation of energy-efficient windows in private houses

The measure is a repeat of the previous one for private houses. The thermal characteristics of existing old, wooden-framed (sometimes with single-pane glass) and new windows in private houses are assumed to be the same: 0.28 and 0.45 $K \cdot m^2/W$, the number of windows to be renovated in each house is 4, and the translucent area of each window is 1.8 m^2. It is assumed that within the framework of **Target I**, 40% of 70% of private houses (of those houses whose windows are still old as of the base year) will be involved in the measure implementation, 2,058 houses will be involved (over five years), starting from 2026, 412 houses each year until 2030, and within the framework of **Target II**, 80% of the same 70% of private houses will be involved (as of the base year), starting from 2026, 165 houses each year until 2050, i.e., a total of about 4,115 houses (over twenty-five years). It is assumed that the comfort level in private houses is 70%, the cost of 1 m^2 of energy-saving windows is 30,000 AMD, and the Euro/Armenian dram exchange rate is 1/445.96 (the average rate of the Central Bank of RA for January 2026). The results of the calculation are presented below:

Target I: $Q = 4 \times 2{,}058 \times 1.8 \times (20+ 1.2) \times 189 \times 24 \times (1/0.28 - 1/0.45) \times 0.7/10^6 = 1{,}345.563$ MWh/year,

Target II: $Q = 4 \times 4{,}115 \times 1.8 \times (20+ 1.2) \times 189 \times 24 \times (1/0.28 - 1/0.45) \times 0.7/10^6 = 2{,}691.126$ MWh/year.

The calculation of GHG emission reduction is carried out taking into account that the share of electricity used for heating in private houses is 20%, and it is also taken into account that the proportion of natural gas and firewood used to obtain thermal energy (for the remaining 80%) is 26.28%/73.72%, respectively.

For the transition from useful energy to final energy, the following equipment efficiency indicators are adopted: for gas boilers, water heaters, and stoves, the COP/efficiency is 85%, and for firewood and manure stoves, it is 70%. The results of the energy savings and GHG emission reduction calculations are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Firewood *		
MP&HH	996.65	269.113	332.8	933.6	244.959	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Firewood *		
MP&HH	1,993.31	538.225	665.7	1,867.1	489.917	2026-2050

*30% of the specified amount is non-renewable firewood, the GHG emission factor of which is 0.403 t CO_2/MWh, and the remaining 70% is renewable and the GHG emissions are equal to 0.

Measure 9.2.3.8 Installation of solar water heaters in the apartments of the MABs

In the MABs of Noyemberyan community, it is possible to install solar water heaters in apartments that are natural gas subscribers (at least those on the top floors). It is estimated that at least 10% of the MABs in the community, a total of about 172 apartments (35 apartments per year over 5 years), have the technical capabilities to install and operate solar/gas hybrid water heaters.

It is planned to install combined water heaters with an absorption area of 2.7 m^2 (as 1 stage of sequential heating) in each of the selected apartments. The solar component of the hybrid system will be able to produce up to 800-850 kWh/(m^2·year) of useful thermal energy. As a result of operation, thermal energy and equivalent natural gas savings will amount to:

$$Q = 309 \times 2.7 \times 850/1000 = 394.74 \text{ MWh/year},$$

$$B = 394.74 / 0.85 = 464.4 \text{ MWh/year}.$$

The results of the calculations are summarized in the table below:

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Natural gas	Firewood	Other		
R2E2, MP&HH	148.608	464.4	-	-	93.809	2026-2030

Measure 9.2.3.9 Installation of solar water heaters in the private houses

With the same justification as in the event 9.2.3.8, it is planned to install solar water heaters with an absorption area of 3.0 m^2 in 400 private houses using natural gas every year in the five-year period 2026-2030. In total, 2,000 private houses or 27.2% of the total will participate in the measure implementation. The annual savings in thermal energy and equivalent natural gas (the COP/efficiency of the gas water heater is assumed to be 85%) will be:

$$Q = 2{,}000 \times 3.0 \times 850/1000 = 5{,}100.0 \text{ MWh/year},$$

$$B = Q/0.85 = 5{,}100.0 / 0.85 = 6{,}000.0 \text{ MWh/year (final energy)}.$$

The results of the calculations are summarized in the table below.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO2 emissions, t/year	Years of implementation
		Natural gas	Firewood	Manure		
R2E2, MP&HHs	1,728.0	6,000.0	-	-	1,212.0	2026-2030

Measure 9.2.3.10 Installation of photovoltaic systems in private houses

According to **Table 10**, the average specific annual electricity consumption in private houses of Noyemberyan community in 2024 is 1,359 kWh/year, i.e. 1.5 kW peak PV capacity, which will require about 9-12 m^2 of area and will produce about 2,100 kWh per year, is on average sufficient for an average private house.

Within the framework of this measure, it is planned to install 1.5 kW peak PV modules to meet the private houses' own electricity demand. The panels can operate with "ENA" CJSC on the "Net metering" principle, as well as with a hybrid system (with the presence of accumulators), according to the regulatory acts of the RA PSRC.

Within the framework of **Target I**, it is assumed that for a capacity of 1.5 kW, at least 30.0% of private houses or 2,205 private houses (an average of 441 houses per year) can have a sun-exposed area on

the roof that is not shaded during the entire daylight hours; and within the framework of **Target II**, 50.0% or 3,675 private houses (an average of 147 houses per year). Under the conditions of Noyemberyan, each kW of peak photovoltaic capacity can produce at least 1,400 kWh of "green" electricity per year. Therefore, by the end of the target periods, we can expect:

Target I Q = 2,205 x 1.5 x 1,400/1000 = 4,629.9 MWh/year,

Target II Q = 3,675 x 1.5 x 1,400/1000 = 7,716.5 MWh/year,

The results of the energy savings and GHG emission reduction calculations are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Other		
MP&HH	5,236.2	4,629.9	-	-	1,115.799	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas	Other		
MP&HH	8,726.9	7,716.5	-	-	1,859.664	2026-2050

Measure 9.2.3.11 Use of natural gas in private houses instead of firewood resulting from unsustainable forest management

Many households in the Noyemberyan community, including those that are natural gas subscribers, heat their private houses with firewood.

30% of the burned firewood, according to the Covenant's methodological guidelines, is estimated to be firewood resulting from unsustainable forest management, which is a non-renewable resource (whose GHG emission factor is assumed to be 0.403 t CO_2/MWh).

In the context of this measure, it is proposed that, as a result of expanding gasification in settlements, increasing the number of subscribers, and improving people's well-being, the aforementioned firewood generated as a result of unsustainable management of the forest will be replaced with natural gas.

Heating, hot water supply, and cooking with natural gas are naturally much more convenient than using other fuels (firewood, etc.).

Firewood generated through natural forest growth is considered a renewable resource and the emissions from burning that firewood is zero.

The measure applies only to firewood, which is considered a non-renewable resource and is used by the population.

According to **Table 27**, the non-renewable, non-sustainable portion of the firewood burned in the base year is 11.5 thousand m^3, or expressed in energy units, it is 28,382.7 MWh/year, the emissions of which are 11,438.2 t CO_2/year (according to **Table 28**).

It is recommended to undertake consistent work and replace at least 35% (within **Target I**) and 50% (within **Target II**) of non-renewable firewood with natural gas, which is quite realistic due to the availability of gasification in the community and the consistent fight against illegal logging of firewood.

Within the framework of **Target I**, if the final energy of non-renewable firewood, 9,933,955 MWh/year (28,382.729 x 35% = 9,933.955, the emission of which is 4,003.384 t CO_2/year), is used in the form of natural gas, 1,054.560 thousand m^3 of natural gas will be saved, from which 2,006.659 t CO2/year will be emitted (1,054.560 thousand m^3 x 9.42 kWh/m^3 x 0.202 t CO_2/MWh).

Therefore, replacing the specified amount of non-renewable firewood (by final energy) with natural gas at zero energy savings results in a reduction of 1,996.725 t CO_2/year in GHG emissions[21].

Accordingly, within the framework of **Target II**, if the final energy of non-renewable fuelwood, 14,191.364 MWh/year (28,382.729 x 50% = 14,191.364, the emission of which is 5,719.120 t CO2/year), is used in the form of natural gas, 1,506.514 thousand m^3 of natural gas will be saved, from which only 2,866.656 t CO2/year will be emitted (1,506.514 thousand m^3 x 9.42 kWh/m^3 x 0.202 t CO2/MWh).

Therefore, replacing the specified amount of non-renewable firewood (by final energy) with natural gas, assuming zero energy savings, results in a reduction of 2,852.464 t CO2/year in GHG emissions.

The investment in this measure will be implemented by the residents and will amount to approximately 881.780 thousand euros (within **Target I**) and 1,232.595 thousand euros (within **Target II**). The costs of the participants in this measure are: connection to the gas pipeline (or replacement of the in-house gas pipeline) and purchase of gas-consuming equipment: boiler or furnace and water heater, gas stove, etc. According to the analytical calculation, 10.5% of households (using firewood) in the community, or approximately 441 (within **Target I**) and 14.6% of households, or approximately 616 (within **Target II**), should participate in the measure, each of which will contribute approximately 2,000 euros.

The results of the energy savings and GHG emission reduction calculations are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Firewood	Natural gas	Other		
MP&HH	881.780	9,933.955	-9,933.955	-	1,996.725	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year			Reduction of CO_2 emissions, t/year	Years of implementation
		Firewood	Natural gas	Other		
MP&HH	1,232.595	14,191.365	-14,191.365	-	2,852.4643	2026-2050

Note. As a result of the implementation of the proposed measure **9.2.3.11**, one fossil fuel is replaced by another, more environmentally friendly fuel, and the energy-neutral result ensures a significant reduction in GHG emissions. The presented proposals are assessed as the most realistic in the current conditions.

In terms of social problems and investment reduction, it should be noted that many households, already being natural gas subscribers (therefore, connection costs are not required), prefer the use of non-renewable firewood (illegal logging, etc.). At the same time, to organize natural gas heating, it is also possible to implement much more affordable stove heating instead of water-circulation heating (many have stoves but do not use them).

Naturally, the use of renewable energy (solar photovoltaic, wind, biomass, renewable firewood, manure, local production of biofuels from agricultural residues, etc.) instead of natural gas is undoubtedly more appropriate.

Therefore, below are also presented (for future energy managers and decision-makers of the community) options where non-renewable firewood is replaced by renewable energy and provide the same results in reducing GHG emissions.

[21] The calculation is carried out at the final energy level. If recalculated to useful energy, the indicator will increase accordingly, since the efficiency of natural gas-fired equipment (boiler, gas stove, water heater) (85-92%) is higher than the efficiency of a wood-fired stove (65-70%).

Use of renewable energy sources in private houses instead of firewood generated by unsustainable forest management

*According to **Table 26**, the non-renewable, non-sustainable part of the fuelwood burned in the base year is 11.5 thousand m^3, or expressed in energy units, it is 28,382.729 MWh/year, the emissions of which are 11,438.240 t CO_2/year (according to **Table 27**).*

*It is recommended to undertake consistent work and replace at least 17% (under **Target I**) and 25% (under **Target II**) of non-renewable firewood with renewable energy sources.*

*Within the framework of **Target I**, if the final energy of 4,954.653 MWh/year (28,382.729 x 17% = 4,954.653, the emission of which is 1,996.725 t CO_2/year) of non-renewable firewood is used in the form of renewable energy sources, 4,954.653 MWh/year will be saved, but 0 t CO_2/year will be emitted.*

Therefore, replacing the specified amount of non-renewable firewood (by final energy) with renewable energy sources results in a reduction of 1,996.725 t CO_2/year in GHG emissions even at zero energy savings.

*Accordingly, within the framework of **Target II,** if the final energy of the amount of non-renewable firewood, 7,078.075 MWh/year (28,382.729 x 25% = 7,078.075, the emission of which is 2,852.464 t CO_2/year), used in the form of renewable energy sources, will be saved by 7,078.075 MWh/year, from which 0 t CO_2/year will be emitted.*

Therefore, replacing the specified amount of non-renewable firewood (by final energy) with renewable energy sources results in a reduction of 2,852.464 t CO_2/year in GHG emissions, even assuming zero energy savings.

*According to calculations, 5.4% of households (using firewood) in the community, or about 226 (within **Target I**) and 7.6% of households, or about 322 (within **Target II**), should participate in the measure implementation.*

Measure 9.2.3.12 Implementation of photovoltaic lighting in common areas of MABs

Lighting of common areas of MABs, such as courtyards, front entrance, stairwells /staircases, stairways/, etc., with PV converters is economically feasible and realistic. In the climatic conditions of the community, about 1,400 kWh of electricity can be expected to be produced annually from 1 kW of peak power. For 30% of the 254 MABs in the community, 76, a system of PV installations with 1 kW of peak power can be envisaged, which will be able to produce the following amount of electricity annually:

$$E = 76 \times 0.25 \times 4 \times 1{,}400/10^3 = 106.4 \text{ MWh/year.}$$

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
MP, R2E2, HH	72.2	106.4	-	25.642	2026-2030

9.2.4 Measures in the transport sector

According to the 2024 BIE of the Noyemberyan community, the transport sector is the 2nd largest consumer of energy (35.3%) and the 2nd largest source of GHG emissions (44.0%).

In the transport sector of Noyemberyan community, GHG emissions were calculated in three subsectors: municipal vehicles (share of energy consumption in transport 1.0%), public transport (1.8%), and private and commercial (97.2%) transport.

Vehicles operating in the community run on the following fuels: CNG (share of energy consumption in transport: 58.8%), diesel fuel (15.5%), gasoline (14.7%), and LPG (10.9%). Mitigation measures have been considered in all three subsectors.

The 2022-2026 Five-Year Development Program of the Noyemberyan Community of the Tavush Region of the Republic of Armenia (Approved by the Resolution No. 82-N of the Council of Elders of the Noyemberyan Community of the Tavush Region of the Republic of Armenia dated on 24.05. 2022) plans to implement works that will contribute to the reduction of GHG emissions in the transport sector:

- A transport system for internal transportation has been introduced in the community, which is still in the pilot phase. There is a need to study the developed schedule and improve it according to the convenience of residents.
- The internal roads of the community, in the case of the majority of settlements, are in need of repair/maintenance. In some cases, tuff paving works may be more effective instead of asphalt paving.

The transition of gasoline-powered vehicles to CNG was not considered as a measure. The measures mainly concern the replacement of existing fossil-fuel passenger vehicles with electric vehicles.

To encourage the use of electric vehicles, the Noyemberyan Municipality, in collaboration with relevant stakeholders and partners, should undertake certain promotional activities:

- Organization of preferential (free) parking spaces for electric vehicles in central parts of the city.
- Construction of community charging stations for electric vehicles, or provision of suitable preferential terms for private charging stations.
- Make the construction of electric vehicle charging stations a prerequisite for issuing construction permits, etc.

A modern electric car consumes about 12-16 kWh of electricity per 100 km. Taking into account the complex terrain, weather conditions and other factors (service life, etc.) that affect the energy consumption of electric vehicles, the calculations assume a value of 20-25 kWh/100 km for passenger cars, and 30-40 kWh/100 km for minibuses and buses.

Below is an example of replacing an average fossil fuel (CNG) car with an electric car[22].

A passenger car with an internal combustion engine (ICE) consumes an average of 10 m^3 of CNG (or 7.2 kg of CNG or about 94.2 kWh of energy) or an equivalent amount of other fossil fuels per 100 km, while an electric car consumes about 20.0 kWh of electricity per 100 km, or 94.2 kWh /20.0 kWh = 4.71 times less final energy.

The final energy savings and CO2 emission reductions of an CNG-powered vehicle with an average annual mileage of 10,000 km can be calculated as follows:

$$E=[1{,}000(m^3/\text{year}) \times 9.42(kWh/m^3/)–10{,}000(km) \times 20(kWh/100\ km)/100]/1000 = 7{,}420\ kWh/\text{year}$$

$$E = 9.420\ MWh/\text{year} – 2.000\ MWh/\text{year} = 7.420\ MWh/\text{year (or 78.8 \%)}$$

and reduction of CO_2 emmisions will be:

$$F = [9{,}420(kWh) \times 0.202(kgCO_2/kWh) – 2{,}000(kWh) \times 0.241(kgCO_2/kWh)]/1000 = 1.421\ t/\text{year}$$

$$F = 1{,}902.8\ kgCO_2/\text{year} - 482.0\ kgCO_2/\text{year} = 1{,}420.8\ kgCO_2/\text{year (or 74.7 \%, or 3.95 times)}$$

Therefore, the implementation of these measures is very effective in terms of reducing GHG emissions, and at the same time very profitable from a financial perspective.

Measure 9.2.4.1 Partial replacement of municipal passenger vehicles with electric passenger vehicles

Taking into account the factor of reducing the prices of electric vehicles and making them more accessible, within the framework of this measure, it is envisaged to replace municipal passenger cars with electric vehicles within the framework of two targets.

According to the presented data, municipal passenger cars run on gasoline and diesel fuel and have a fairly high annual mileage (on average 38 thousand km). Taking into account the existing privileges for the import of electric vehicles, as well as their favorable impact on the environment, it is envisaged within the framework of this measure:

[22] This calculation (also for other fossil fuels) will be used in the evaluation of all transport sector measures.

Within the framework of **Target I**, from 2026 to 2030 (in 5 years), 2 gasoline-powered and 3 diesel-powered passenger cars under municipal jurisdiction will be replaced with electric vehicles (electromobiles-EM) (one vehicle per year). The cost of a light passenger car is estimated at up to 20,000 euros, and that of a minibus at 30,000 euros.

Table 1.By 2030, 30% GHG reduction target

Fuel	km/year	l/100 km	kWh/ 100km	l/year	kWh/l	MWh/year	kgCO_2/kWh	tCO_2/year
Gasoline (2 cars)	127,700	7.94		10,144		93.3	0.249	23.24
Diesel fuel (3 cars)	90,000	20		18,000	10	180.0	0.267	48.06
Total (5 cars)	217,700	12.93		28,1434		273.3		71.30
EM (5 cars)	217,700		25			54.4	0.241	13.12
Savings (5 cars)						218.9		58.2

Within the framework of **Target II**, from 2026 to 2037 (in 11 years), 2 gasoline-powered and 9 diesel-powered passenger cars under municipal jurisdiction will be replaced with electric vehicles (one vehicle per year). The vehicle values are estimated to be the same.

Table 2.By 2050, 40% GHG reduction target

Fuel	km/year	l/100 km	kWh/ 100km	l/year	kWh/l	MWh/year	kgCO_2/kWh	tCO_2/year
Gasoline (2 cars)	127,700	7.94		10,144		93.3	0.249	23.24
Diesel fuel (9 cars)	186,000	20.32		37,800	10	378.0	0.267	100.93
Total (11 cars)	313,700	15.28		47,944		471.3		124.16
EM (11 cars)	313,700		25			78.4	0.241	18.90
Savings (11 cars)						392.9		105.3

The results of the calculation of Energy Savings and CO2 Emissions Reduction as a result of the implementation of the measure are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP	130.0	- 54.4	-	93.3	180.0	-	58.181	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP	310.0	-78.4	-	93.3	378.0	-	105.263	2026-2037

Measure 9.2.4.2 Partial replacement of minibuses and taxis in public transport with electric vehicles

The use of electric vehicles in public transport should be encouraged through the implementation of the above-mentioned incentive actions. Investments in the measure are made by route operators, private companies, and individuals, which is a good example of private-community cooperation.

Within the framework of **Target I**, it is proposed to consider replacing 9 intra-community and inter-city (medium capacity) minibuses with electric small vehicles of the same capacity (about 50% of the transport operating in the base year) and their operation on the corresponding routes, over a period of five years (about 2 units per year). The new minibuses will replace vehicles operating on CNG and LPG, and at least 18 intra-community and city taxis operating on gas fuel (CNG and LPG) will also be replaced with electric vehicles (about 40% of the vehicles operating in 2024, or 3-4 units per year).

Within the framework of **Target II**, it is proposed to consider and encourage the replacement of 15 minibuses (about 80%) and 35 taxis (about 70%) with electric equivalent vehicles.

The results of the calculation of the expected energy savings and CO_2 emission reductions in public transport as a result of the implementation of the measure are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP, private entities	630.0	-250.65	452.16	-	-	238.27	85.02	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP, private entities	1,150.0	-870.0	711.40	-	-	482.38	146.74	2026-2050

Measure 9.2.4.3 Partial replacement of private and commercial passenger transport vehicles with electric vehicles

Taking into account the factor of reducing the prices of electric vehicles and making them more affordable for the population and commercial organizations, within the framework of **Target I** of this measure, it is envisaged that by 2030, about 15% of the existing car fleet will be updated by private and commercial entities of the community and old cars will be replaced: about 193 cars per year (for 2026-2030), and within the framework of **Target II** - by 2050 - 18% or 1,159 cars or 47 cars per year.

As can be seen from the above calculation, replacing a fossil fuel-powered vehicle with an equivalent electric vehicle, depending on many factors, can provide an average reduction in GHG emissions of about 75% (or 2-3 tCO2/year), while simultaneously providing a significant reduction in fuel consumption and financial feasibility.

The replacement of passenger cars (powered by CNG, LPG, gasoline, and diesel) with equivalent electric vehicles is being considered.

Calculations were made based on the indicators given in **Table 24:**

Before the measure **(Target I)**

Fuel	Quantity, pcs	Mileage, km/car	l or m^3/ 100 km	10^3 l, 10^3 m^3/ year	MWh/ year	t CO_2/ year
CNG	632.1	13,375	10	845.4	7,964.0	1608.7
Gasoline	181.2	13,375	10	242.4	2,229.7	555.2
LPG	29.55	13,375	11	43.5	434.8	116.1
Diesel fuel	123	13,375	15	246.8	1,801.4	408.9
Total	965.85				12,429.8	2,688.9

After the measure **(Target I)**

Fuel	Quantity, pcs	Mileage, km/car	kWh/ 100 km	kWh/ year	MWh/ year	t CO_2/ year
El. energy	632.1	13,375	20	1,690,868	1,690.9	407.5
El. energy	181.2	13,375	20	484,710	484.7	116.8
El. energy	29.55	13,375	20	79,046	79.0	19.1
El. energy	123	13,375	20	329,025	329.0	79.3
Total	965.85				2,583.6	622.7

Before the measure **(Target II)**

Fuel	Quantity, pcs	Mileage, km/car	l or m^3/ 100 km	10^3 l, 10^3 m^3/ year	MWh/ year	t CO_2/ year
CNG	758.52	13,375	10	1,014.5	9,556.8	1,930.5
Gasoline	217.44	13,375	10	290.8	2,675.6	666.2
LPG	35.46	13,375	11	52.2	521.7	139.3
Diesel fuel	147.6	13,375	15	296.1	2,161.7	490.7
Total	1,159.02				14,915.8	3,226.7

After the measure **(Target II)**

Fuel	Quantity, pcs	Mileage, km/car	kWh/ 100 km	kWh/ year	MWh/ year	t CO_2/ year
El. energy	758.52	13,375	20	2,029,041	2,029.0	489.0
El. energy	217.44	13,375	20	581,652	581.7	140.2
El. energy	35.46	13,375	20	94,856	94.9	22.9
El. energy	147.6	13,375	20	394,830	394.8	95.2
Total	1,293.8				3,100.4	747.2

The share of private and commercial transport in the total is large, therefore, to ensure the implementation of this measure, the municipality must carry out consistent work among the population and business people.

The results of the calculation of the expected energy savings and CO_2 emission reductions in public transport as a result of the implementation of the measure are presented in the tables below.

Table 1.By 2030, 30% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP, private entities	19,320.0	- 2,583.6	7,964.0	2,229.7	434.8	1,801.4	1,503.628	2026-2030

Table 2.By 2050, 40% GHG reduction target

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP, private entities	32,700.0	- 3,100.4	9,556.8	2,675.6	521.7	2,161.7	1,503.628	2026-2050

The dynamics of imports of electric vehicles in Armenia during 2018-2022 demonstrate their demand. If in 2020 354 vehicles were imported (in 2018: 5, in 2019: 149), then in 2022 3,833 purely electric vehicles were imported, and in 2024 the quota for import of 8,000 units at 0% customs duty by the decision

of the Eurasian Economic Commission (EEC) Council and excluding VAT was consumed/ exhausted. The import of plug-in hybrid vehicles is also large.

Measure 9.2.4.4 Asphalting, improvement of community streets, installation and marking of traffic signs and information boards

As stated in the five-year development plan of the Noyemberyan community, one of the painful aspects of the community is the implementation of the improvement and asphalting of intra-community roads. The existing unimproved and dilapidated roads in the community are inconvenient and dangerous for pedestrians and car traffic. 1,052,492.01 thousand drams are planned for the capital renovation of intra-community roads.

Thanks to the repair and asphalting works, the operating modes of motor transport will be improved and the duration of idling modes of vehicles will be reduced, the probability of operating with low gear ratios and, consequently, driving with excessive fuel consumption will decrease, etc.

It is practically impossible to quantify the expected energy savings as a result of the implementation of the measure. However, it is estimated that about 60% of the annual energy consumption of the community's vehicle fleet falls on the repaired roads and as a result, fuel consumption is reduced by about 5.0%. The results are applicable to both targets. The amount of fuel savings according to the base year statistics is given below and in the table.

- In gasoline-powered vehicles: $\Delta E = 0.05 \times 10{,}273.0 \times 0.6 = 360.2$ MWh/year,
- In diesel-powered vehicles: $\Delta E = 0.05 \times 6{,}330.0 \times 0.6 = 379.0$ MWh/year,
- In CNG-powered vehicles: $\Delta E = 0.05 \times 35{,}504.0 \times 0.6 = 1442.4$ MWh/year,
- In LPG-powered vehicles: $\Delta E = 0.05 \times 6{,}237.0 \times 0.6 = 267.2$ MWh/year,
- In electric vehicles: $\Delta E = 0.05 \times 91.0 \times 0.6 = 6.2$ MWh/year.

The implementer	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
MP	2,360.1	2.7	1,442.4	360.2	379.0	267.2	549.001	2026-2030

Measure 9.2.4.5 Creating cycling infrastructure

Cycling infrastructure (cycling paths, bicycle parking lots, etc.) does not require particularly large investments. It is important to choose the right bicycle parking lots that will make cycling for business or personal purposes attractive. They should be created near large shopping centers, universities, budgetary and administrative institutions, and service facilities, within the field of view of municipal transport surveillance cameras.

Quantifying the effectiveness of the measure is a rather complex task. The program tentatively assumes that fuel efficiency will be expressed as a reduction of approximately 1.0% of total annual consumption:

- In gasoline-powered vehicles: $\Delta E = 0.01 \times 12{,}006.3 = 120.1$ MWh/year,
- In diesel-powered vehicles: $\Delta E = 0.01 \times 12{,}632.2 = 126.3$ MWh/year,
- In CNG-powered vehicles: $\Delta E = 0.01 \times 48{,}078.4 = 480.8$ MWh/year,
- In LPG-powered vehicles: $\Delta E = 0.01 \times 8{,}907.2 = 89.1$ MWh/year:
- In electric vehicles: $\Delta E = 0.01 \times 91.0 = 0.9$ MWh/year.

The implementation of the measure will also be facilitated by cycling races that have recently become more popular in Armenia.

The implementer	Cost, 10^3 euros	Energy conservation/saving, MWh/year					Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	CNG	Gasoline	Diesel fuel	LPG		
ՀՊ	20.0	0.9	480.8	120.1	126.3	89.1	181.180	2026-2029

9.2.5 Measures in the street lighting system

The 2022-2026 five-year development plan of the Noyemberyan community of the Tavush region of the Republic of Armenia plans to implement:

- Construction/expansion of an external lighting network along the interstate road, which will provide sufficient lighting in all residential areas on the interstate road sections from Bagratashen to the end of Baghanis (Voskevan intersection, 27.5 km)
- Expansion of the night lighting network of the streets of Ayrum city (project cost, 3,000.0 thousand drams)
- Repair and improvement of inter-settlement and intra-settlement roads and streets and installation, expansion, enlargement and maintenance of outdoor lighting systems (source of financing: municipal budget)

Measure 9.2.5.1. Replacing incandescent and fluorescent lighting with LED lights

In 2022-2024, street lighting in Noyemberyan community is provided by LEDs, but on some streets, about 61 incandescent (average power 93 W) and 1,305 fluorescent (average power 73 W) luminaires are still in operation. Replacing them with 30 W (average) LED luminaires can significantly reduce annual electricity consumption and at the same time increase lighting comfort by about 2 times.

It is assumed that all existing low-efficiency luminaires are replaced with 30 W LED luminaires and the operating modes of 2024 are maintained. Under these conditions, the annual electricity savings in the system will be determined as follows:

$$\Delta E = 2{,}194 \times (61 + 1{,}305) \times (73.89-30)/10^6 = 131.548 \text{ MWh/year}$$

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
MP, R2E2	6.13	131.548	-	31.703	2026-2028

Measure 9.2.5.2. Expansion of the outdoor lighting network in the community

The five-year development program of the Noyemberyan community envisages further expansion of the street lighting network with high-efficiency LED-lamps.

According to the information provided, in the base year, only 4,908 lamps are in operation in the community, of which 3,302 (59 W average power) are LED-lamps. It is assumed that number of LED-lamps will increase by 20% or 982 (current average power). LED-lamps are planned to be installed in 2026-2028. in place of the missing lamps. The new lamps do not replace inefficient lamps, but are installed additionally. The results of the effectiveness of the measure are presented in tabular form.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
MP, R2E2	4.91	-146.507	-	-35.308	2026-2030

The implementation of this measure will greatly contribute to the fulfillment of the community's commitments under the five-year plan, in particular for the expansion of outdoor lighting systems and the expansion of the night lighting network, despite the negative impact in terms of reducing GHG emissions.

Measure 9.2.5.3. Construction of an autonomous PV station powering the street lighting system of the city of Noyemberyan

Within the framework of the attitude towards the feasibility of using renewable energy sources (affordability of technologies) in the Noyemberyan community, active use of solar renewable resources is planned.

The use of solar power is considered as a reliable and promising solution for the street lighting network. It is assumed that a self-sufficient PV installation will be installed, which will allow reducing the amount of electricity purchased from the distribution network and mitigating the impact of GHG emissions on the climate.

The installed electrical capacity of the outdoor lighting network in 2024 was about 63.0 kW, the annual consumption of electrical energy was 113.4 MWh/year. Taking into account the prospects for network expansion in the coming years, it is assumed that the total installed capacity of PV installations can be envisaged at 120 kW (equipped with storage batteries). In case of excess electricity generated, it is proposed to direct it to electric vehicle charging stations. Maintaining the operating indicators of the lighting system in the baseline year, the expected annual savings values are presented in the table below.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO_2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
MP, R2E2	102.00	168.0	-	40.488	2026-2030

Measure 9.2.5.4. Construction of autonomous PV stations powering street lighting systems in rural areas of the community

According to the logic of the previous measure and taking into account the continuous improvement of street lighting systems in rural areas, it is advisable to build autonomous PV power plants that power street lighting systems.

The installed electrical capacity of the lighting networks in 2024 amounted to about 237.6 kW, the annual consumption of electrical energy: 546.1 MWh/year. Taking into account the prospects for the expansion of the network in the near future, it is assumed that the installed total capacity of the PV plant should be 300 kW (equipped with storage batteries). In case of excess electricity produced, it is proposed to direct it to electric vehicle charging stations.

The number and locations of autonomous solar power plants will be determined based on the logic of ensuring their most efficient operation. The implementation of the measure will allow to zero out the GHG emissions of street lighting in rural settlements of the community by 2030. The implementation of the measures will require an investment of about 270.0 thousand euros and a total area of about 2,500 m^2. The administrative heads of the municipality and rural settlements are responsible for the implementation. The results of the calculation of renewable energy production and GHG emissions reduction are presented in the table below.

The implementers	Cost, 10^3 euros	Energy conservation/saving, MWh/year		Reduction of CO2 emissions, t/year	Years of implementation
		Electrical energy	Natural gas		
MP, R2E2	270.0	420.0	-	101.220	2026-2030

The German Agency for International Cooperation (GIZ) is considering the construction of a 45-kW solar power plant and street lighting in Bagratashen.

9.2.6 Development of green spaces

Green spaces not only create a necessary and attractive environment for recreation, recovery, and tourism, but also act as carbon dioxide absorbers, the contribution of which to climate protection cannot be underestimated.

The five-year development plan of the Noyemberyan community envisages the following in all settlements: increasing green areas, creating an environment necessary for the sustainable development of green agriculture, innovative tourism, socially responsible business, and modern digital technologies.

This section provides theoretical quantitative estimates of environmental effectiveness that are not included in the two summary tables of the SECAP (main Target I and intermediate Target II), but can be calculated and taken into account when assessing SECAP performance.

The environmental effectiveness of the measures is aimed at mitigating the negative impact of global warming on the climate.

Measure 9.2.6.1 Expansion of forested areas

Depending on the tree species, each hectare of forested area absorbs about 120-280 kg of carbon dioxide (on average 200 kg) from the atmospheric air during one sunny day and releases 180-200 kg of oxygen. A significant part of the total area of the community is of agricultural importance.

It is possible to envisage an annual expansion of forest cover in the community by 0.5-1.0 ha, starting from 2026 until the end of the target year.

Measure 9.2.6.2 Expansion of green areas

According to reliable sources, urban green lawns are able not only to clean the air from dust, but also absorb carbon dioxide during the day, producing oxygen. Moreover, 1 ar of green lawn can provide 11-12 kg of CO2 absorption per year. Thus, thanks to 1 ha of green lawn, 1.1-1.2 tons of CO2 absorption can be achieved annually, which is equivalent to the same amount of GHG emissions reduction.

It is proposed to restore and expand at least 100 ar of green areas every year until 2050.

Chapter 10. Summary of measures to reduce GHG emissions

Within the framework of the Noyemberyan community's SECAP, the list of measures aimed at reducing GHG emissions by the community authorities by 2050 (also by 2030) includes costly and non-costly measures. The implementation of 28 (27 in the case of 2030) measures of the first group will allow reducing baseline emissions by **16,580.68 t CO_2/year** in 2050 (also in 2030) (**12,435.29 t CO_2/year** in the case of 2030), which exceeds the commitments undertaken by 0.67%[23].

Thus, investments totaling approximately **46.4 million Euros** (**35.4 million Euros** in 2030) can ensure the fulfillment of the quantitative commitments undertaken by the community within the framework of the Covenant, namely, a reduction of at least 40% (30%) of the volume of BIE registered in the baseline year.

The tables below present GHG emissions in the main sectors included in the BIE, both in the baseline (2024) and target years 2050 (2030).

Table 29. GHG emissions in 2024 and 2050 by target sectors

	Greenhouse gas emissions, t CO_2/year					
	Municipal buildings	**Residential setor**	**Transport**	**Street Lighting**	**Local energy production**	**Total**
BIE, 2024	252.5	22,646.7	18,118.0	158.9	0	41,176.17
Reductions as a result of meaures	210.15	12,573.76	3,456.23	138.10	202.44	16,580.68
	1.27%	75.83%	20.84%	0.83%	1.22%	100.00%
Emissions in the target year: 2050	42.4	10072.9	14661.8	20.8	-202.4	24595.5
Reduction, %	83.22%	55.52%	19.08%	86.89%		40.27%

Table 30. GHG emissions in 2024 and 2030 by target sectors

	Greenhouse gas emissions, t CO_2/year					
	Municipal buildings	**Residential setor**	**Transport**	**Street Lighting**	**Local energy production**	**Total**
BIE, 2024	252.5	22,646.7	18,118.0	158.9	0	41,176.17
Reductions as a result of meaures	210.15	8,950.42	2,934.17	138.10	202.44	12,435.29
	1.69%	71.98%	23.60%	1.11%	1.63%	100.00%
Emissions in the target year: 2030	42.4	13696.2	15183.9	20.8	-202.4	28740.9
Reduction, %	83.22%	39.52%	16.19%	86.89%		30.20%

The largest share of GHG emission reductions is naturally expected to come from the residential sector - 75.86% of the total CO_2 reductions in the community (Target I: 71.98%), then from transport - 20.84% (Target I: 23.60%), the share of reductions in the community/municipal buildings, street lighting and local energy production sectors is 3.32% (Target I: 4.43%).

GHG emission reductions in the Street Lighting and Local Energy Production sectors also take into account the increase in electricity demand for intra-community purposes: expansion of lighting systems, construction of community charging stations for electric vehicles, etc.

The ratios of energy savings and GHG emission reductions (**Target II: 2050**) by consumption sectors and energy carriers are presented in **Charts 26 and 28** (%, in MWh), **27 and 29** (%, in t CO_2).

[23] The summary table does not include "soft" measures and Green Space Development measures.

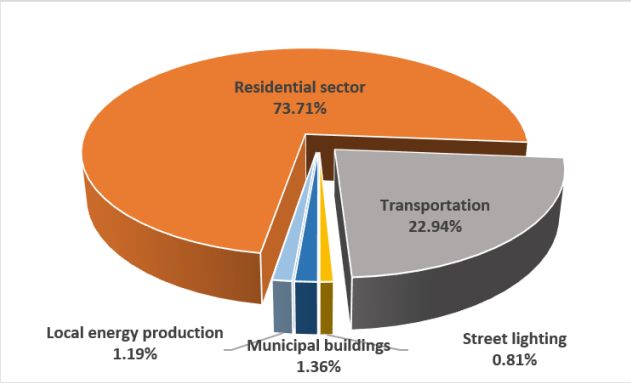


Chart 26. Structure of energy savings by sector (Target II: 2050)

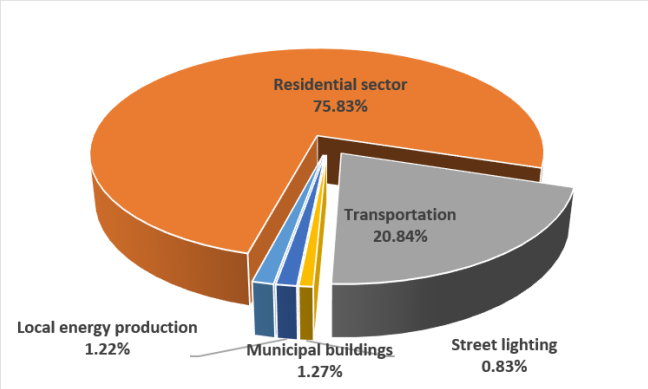


Chart 27. Structure of GHG emission reductions by sector (Target II: 2050)

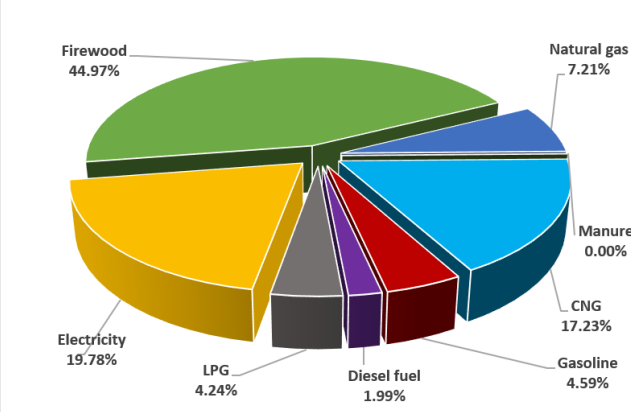


Chart 28. Structure of energy savings by type (Target II: 2050)

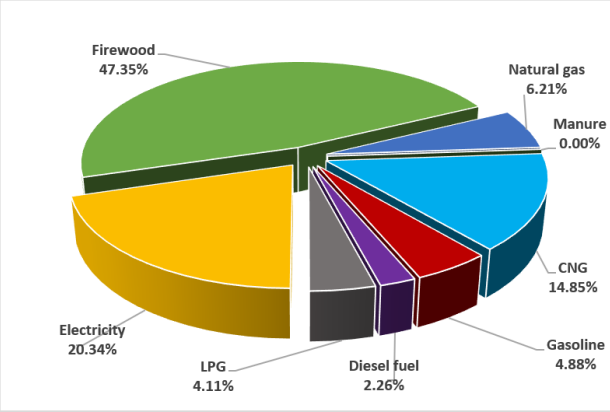


Chart 29. Structure of GHG emission reductions by energy carrier (Target II: 2050)

The largest sector for energy savings is naturally the population (73.71% of the projected reduction), followed by transport (22.94%). The same applies to the reduction of GHG emissions, 75.83% and 20.84%, respectively.

By energy carriers, the largest savings are expected from firewood resulting from unsustainable forest management: 44.97%, electricity: 19.78%, CNG: 17.23%, natural gas: 7.21%, the total share of LPG, diesel fuel and gasoline is 10.82%.

The largest reduction in GHG emissions from energy/fuel combustion is expected from firewood resulting from unsustainable forest management: 47.35%, electricity: 20.34%, CNG: 14.85%, natural gas: 6.21%, the total share of LPG, diesel fuel and gasoline is 11.25%.

A comparison of GHG emissions by sector and energy carrier in the base (2024) and target (2050) years is presented in **Charts 30 and 31**.

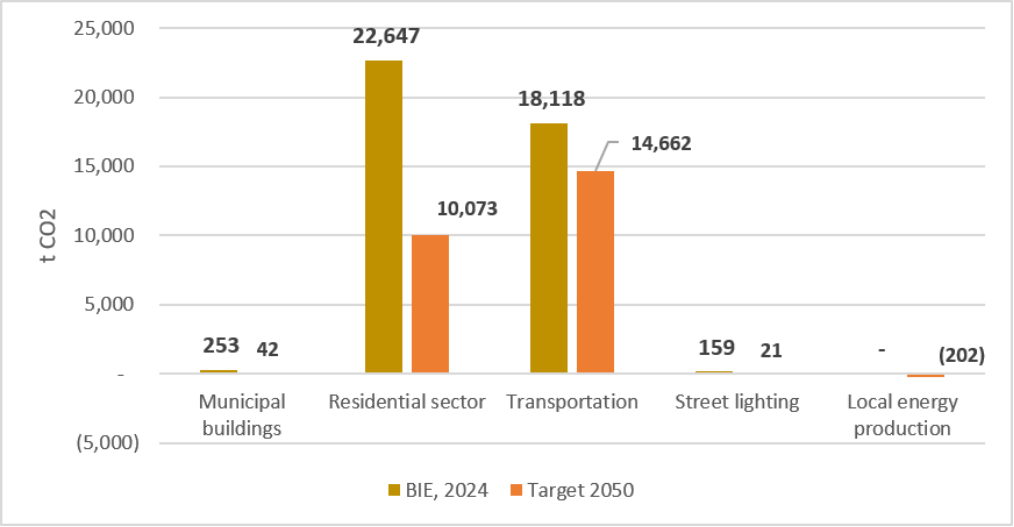


Chart 30. Comparison of baseline and target (2050) emissions by sector (tCO_2/year)

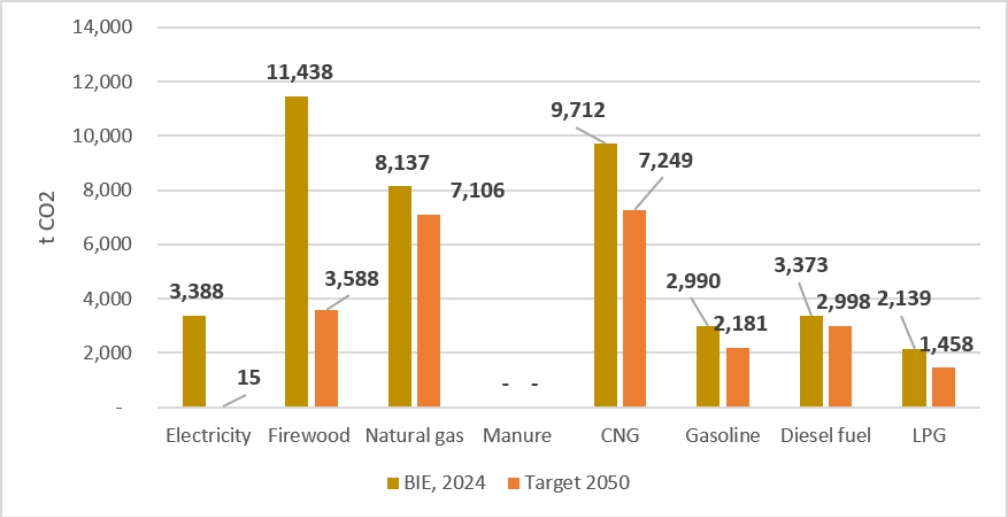


Chart 31. Comparison of baseline and target (2050) emissions by energy carrier (tCO_2/year)

The ratios of energy savings and GHG emission reductions (**Target I: 2030**) by consumption sectors and energy carriers are presented in **Charts 32 and 34** (%, by MWh), **33 and 35** (%, by t CO2).

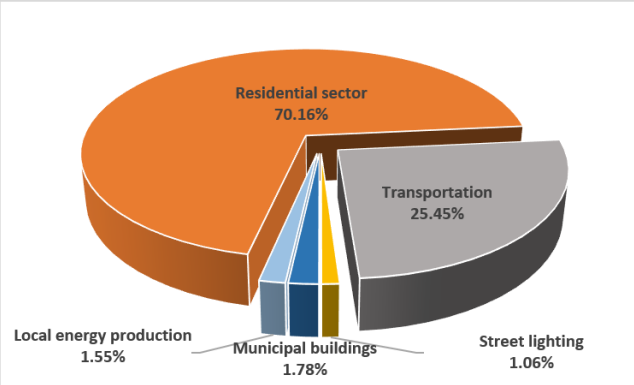


Chart 32. Structure of energy savings by sector (Target I: 2030)

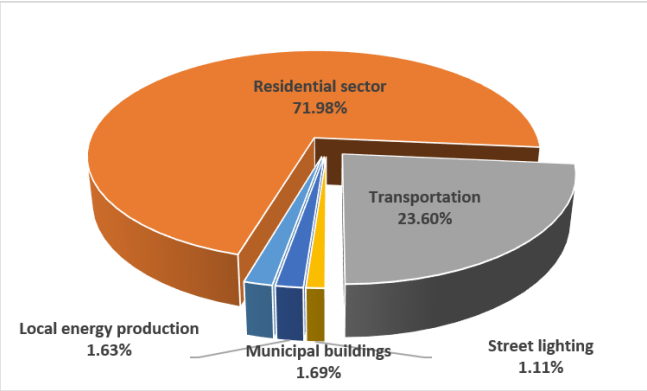


Chart 33. Structure of GHG emission reductions by sector (Target I: 2030)

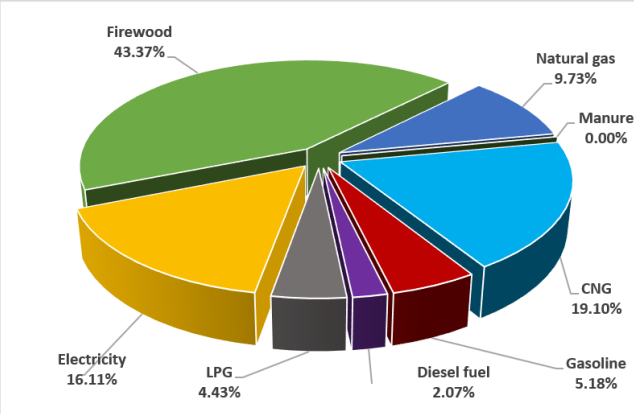


Chart 34. Energy saving structure by type (Target I: 2030)

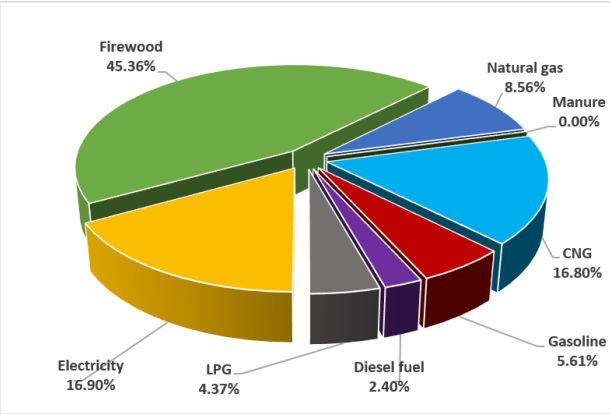


Chart 35. Structure of GHG emission reductions by energy carrier (Target I: 2030)

The largest sector of energy savings is naturally the population (70.16% of the projected reduction), followed by transport (25.45%). The same applies to the reduction of GHG emissions, respectively 71.98% and 23.60%.

By energy carriers, the largest savings are expected from firewood resulting from unsustainable forest management: 43.37%, from CNG: 19.10%, from electricity: 16.11%, from natural gas: 9.73%, the total share of LPG, diesel fuel and gasoline is 11.68%.

The largest reduction in GHG emissions from energy/fuel combustion is expected from firewood resulting from unsustainable forest management: 45.36%, from CNG: 16.80%, from electricity: 16.90%, from natural gas: 8.56%, the total share of LPG, diesel fuel and gasoline is 12.39%.

A comparison of GHG emissions by sector and energy carrier in the base (2024) and target (2030) years is presented in **Charts 36 and 37**.

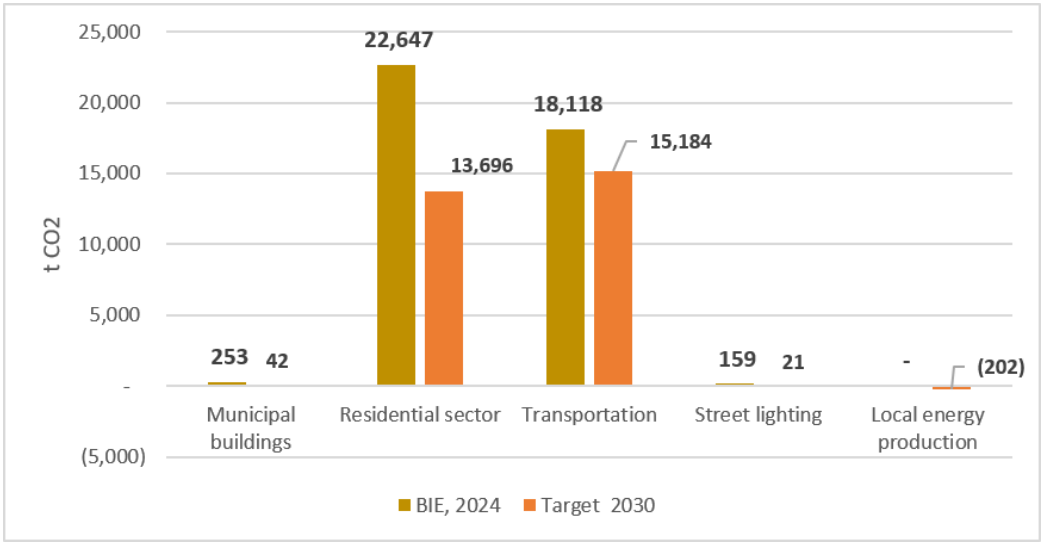


Chart 36. Comparison of baseline and target (2030) emissions by sector (tCO2/year)

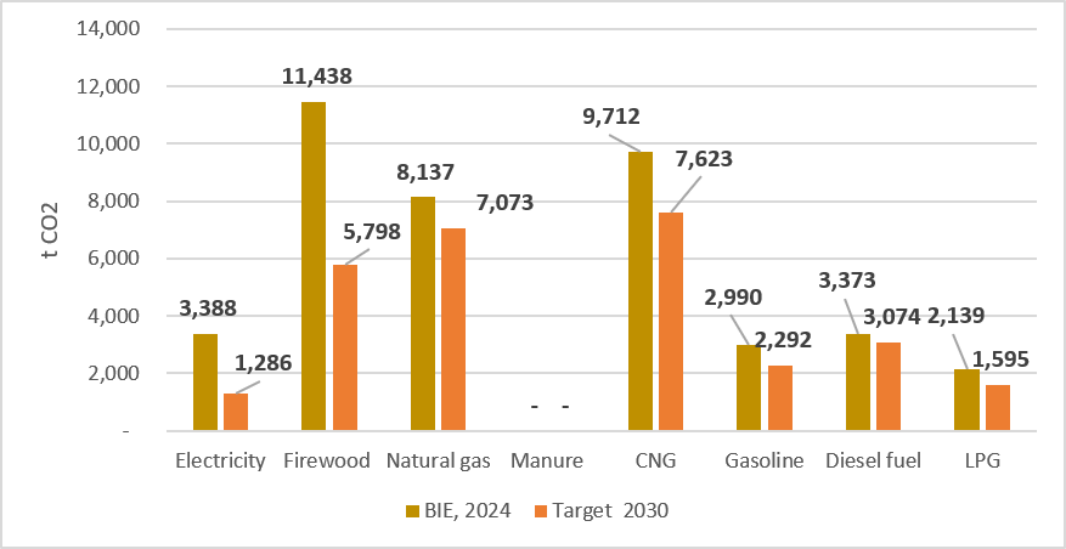


Chart 37. Comparison of baseline and target (2030) emissions by energy carrier (tCO2/year)

The financial investments required for the implementation of the proposed (**Target II: 2050**) mitigation investment "hard" measures aimed at reducing GHG emissions in the SECAP and the specific values of GHG emission reduction by sectors are presented in **Table 31**.

As mentioned, the "soft" organizational measures regularly organized by the municipality are not associated with large financial costs and are considered as activities that contribute to the implementation of mitigation measures.

Table 31. Financial investments required for the implementation of mitigation measures and specific values of GHG emissions (Target II: 2050)

Sector	Investments		Specific cost of reducing 1 ton of CO_2
	1,000 Euros	%	1,000 euros/t CO_2
Municipal buildings	383.88	0.83%	1.83
Local energy production	576.00	1.24%	2.85
Residential sector	17,499.18	37.72%	1.39
Transport	27,545.46	59.38%	7.97
Street lighting	383.04	0.83%	2.77
TOTAL	**46,387.55**	**100.00%**	**2.80**

According to the table, an investment of 46.4 million euros is required to ensure the reduction of 16,580.68 tons of CO2 emissions as a result of the implementation of the SECAP. According to the table, the cost of reducing 1 kg of CO_2 is on average 2.80 euros.

The most expensive specific cost mitigation measures are in the transport sector (7.97 euros/kg CO_2) due to the high costs of measures, including street renovation, asphalting, and the purchase of electric vehicles.

In MABs and private houses, it is recommended to first implement measures to increase energy efficiency, and then use renewable energy sources to fully or partially meet the already reduced energy demand.

The summary table of measures envisaged in the Noyemberyan community's SECAP (**Target II: 2050**) is presented in **Table 33**.

The table also suggests the timeframes for implementing the measures, which will probably be set by the municipality, taking into account the availability of necessary financial resources and many other factors.

The financial investments required for the implementation of the proposed in the SECAP (**Target I: 2030**) mitigation investment "hard" measures and the specific values of GHG emission reductions, by sectors, are presented in **Table 32**.

Table 32. Financial investments required for the implementation of mitigation measures and specific GHG emissions (Target I: 2030)

Sector	Investments		Specific cost of reducing 1 ton of CO_2
	1,000 Euros	%	1,000 euros/t CO_2
Municipal buildings	383.88	1.08%	1.83
Local energy production	576.00	1.62%	2.85
Residential sector	11,672.61	32.90%	1.30
Transport	22,460.06	63.31%	7.65
Street lighting	383.04	1.08%	2.77
TOTAL	**35,475.59**	**100.00%**	**2.85**

According to the table, an investment of 35.5 million euros is required to ensure the reduction of 12,435.29 tons of CO_2 emissions as a result of the implementation of the SECAP. According to the table, the cost of reducing 1 kg of CO_2 is 2.85 euros on average.

The most expensive specific cost mitigation measures are in the transport sector (7.65 euros/kg CO_2) due to the high costs of measures, including street renovation, asphalting, and the purchase of electric vehicles.

The summary table of measures envisaged under the Noyemberyan community's SECAP (**Target I: 2030**) is presented in **Table 34**.

Table 33. Summary table of cost-intensive measures envisaged in the Noyemberyan community's SECAP (Target II: 2050)

No	Brief description of the measure	Financing volume, thousand euros	Energy conservation/savings, MWh/year					GHG emissions reduction, t CO_2/year					Years of implementation
			EE	FW	NG	Other	Total	EE	FW	NG	Other	Total	
9.2 "Hard" investment measures													
9.2.1 Community-owned structures													
9.2.1.1	Partial savings in electrical and thermal energy in municipal buildings through simple energy saving measures	20.00	5.27	-	62.38	-	67.65	1.27	-	12.60	-	13.87	2026-2027
9.2.1.2	Restoration of thermal insulation layers in attics of municipal buildings	41.60	7.90	-	207.94	-	215.84	1.90	-	42.00	-	43.91	2026-2030
9.2.1.3	Renovation of community cultural centers, kindergartens, and administrative offices	50.32	6.59	-	70.18	-	76.77	1.59	-	14.18	-	15.76	2022-2026
9.2.1.4	Installation of solar water heaters in kindergartens	115.20	-	-	218.48	-	218.48	-	-	44.13	-	44.13	2024-2028
9.2.1.5	Replacing inefficient lamps with LED lamps in community-owned organizations	4.66	99.78	-	-	-	99.78	24.05	-	-	-	24.05	2024-2026
9.2.1.6	Installation of PV modules in municipal institutions	152.10	283.92	-	-	-	283.92	68.42	-	-	-	68.42	2024-2028
Total 9.2.1		**383.88**	**403.46**	**-**	**558.98**	**-**	**962.44**	**97.23**	**-**	**112.91**		**210.15**	**1.27%**
9.2.2 Local production of electrical energy													
9.2.2.1	Construction of a community commercial PV power plant	576.00	840.00	-	-	-	840.00	202.44	-	-	-	202.44	2026-2030
Total 9.2.2		**576.00**	**840.00**	**-**	**-**	**-**	**840.00**	**202.44**	**-**	**-**	**-**	**202.44**	**1.27%**
No	**Brief description of the measure**	**Financing volume, thousand euros**	**Energy conservation/savings, MWh/year**					**GHG emissions reduction, t CO2/year**					**Years of implementation**
			EE	**FW**	**NG**	**Other**	**Total**	**EE**	**FW**	**NG**	**Other**	**Total**	
9.2.3 Residential sector													
9.2.3.1	Partial thermal modernization of 21 5-storey, 7 4-storey and 15 4-storey stone-built multi-apartment buildings in Noyemberyan community	612.39	799.2	-	3,761.0	-	4,560.16	192.6	-	759.7	-	952.32	2026-2030

9.2.3.2	Partial thermal modernization of 16 1 and 2-storey multi-appartment buildings in the city of Ayrum and 195 1 and 2-storey multi-appartment buildings in rural areas	432.92	556.6	-	2,619.1	-	3,175.70	134.1	-	529.1	-	663.20	2026-2050
9.2.3.3	Partial thermal modernization of MABs and private houses through simple energy saving measures	502.82	234.8	5,676.5	1,944.1	-	7,855.42	56.6	686.3	392.7	-	1,135.58	2026-2050
9.2.3.4	Restoration of thermal insulation layers of attic roofs of private houses	1,582.20	2,393.8	10,084.	2,960.7	-	15,438.52	576.9	1,219.2	598.1	-	2,394.13	2026-2040
9.2.3.5	Installation of energy-efficient lamps in the residential sector	117.38	3,380.2	-	-	-	3,380.24	814.6	-	-	-	814.64	2025-2038
9.2.3.6	Installation of energy-efficient windows in residential MA buildings	349.82	67.5	-	317.5	-	384.97	16.3	-	64.1	-	80.40	2028-2030
9.2.3.7	Installation of energy-efficient windows in private houses	1,993.31	538.2	1,867.1	665.7	-	3,071.05	129.7	225.7	134.5		489.92	2026-2050
9.2.3.8	Installation of solar water heaters in the apartments of the MABs	148.61	-	-	464.4	-	464.40	-	-	93.8	-	93.81	2026-2030
9.2.3.9	Installation of solar water heaters in the private houses	1,728.00	-	-	6,000.0	-	6,000.00	-	-	1,212.0	-	1,212.00	2026-2030
9.2.3.10	Installation of photovoltaic systems in private houses	8,726.94	7,716.5	-	-	-	7,716.45	1,859.7	-	-	-	1,859.66	2024-2030
9.2.3.11	Use of natural gas in private houses instead of firewood resulting from unsustainable forest management	1,232.60	-	14,191.4	(14,191.4)	-	(0.00)	-	5,719.1	(2,866.7)	-	2,852.46	2026-2030
9.2.3.12	Implementation of photovoltaic lighting in common areas of MABs	72.20	106.4	-	-	-	106.40	25.6	-	-	-	25.64	2026-2030
Total 9.2.3		**17,499.18**	**15,793.2**	**31,819.0**	**4,541.12**	**-**	**52,153.31**	**3,806.16**	**7,850.3**	**917.31**	**-**	**12,573.76**	**75.83%**
No	**Brief description of the measure**	**Financing volume, thousand euros**	**Energy conservation/savings, MWh/year**						**GHG emissions reduction, t CO2/year**						**Years of implementation**
			EE	**CNG**	**Gasoline**	**Diesel**	**LPG**	**Total**	**EE**	**CNG**	**Gasoline**	**Diesel**	**LPG**	**Total**	
9.2.4 Transport sector															
9.2.4.1	Partial replacement of municipal passenger vehicles with electric passenger vehicles	310.00	(78.43)	-	93.32	378.00	-	392.90	(18.90)	-	23.24	100.93	-	105.26	2026-2037

9.2.4.2	Partial replacement of minibuses and taxis in public transport with electric vehicles	1,675.00	(441.75)	711.40	-	-	482.38	752.03	(106.46)	143.70	-	-	109.50	146.74	2026-2050
9.2.4.3	Partial replacement of private and commercial passenger transport vehicles with electric vehicles	23,180.40	(3,100.4)	9,556.8	2,675.6	521.71	2,161.7	11,815.4	(747.2)	1,930.5	666.22	139.30	490.70	2,479.5	2026-2050
9.2.4.4	Asphalting, improvement of community streets, installation and marking of traffic signs and information boards	2,360.06	2.73	1,442.35	360.19	378.97	267.22	2,451.45	0.66	291.35	89.69	101.18	60.66	543.54	2026-2028
9.2.4.5	Creating cycling infrastructure	20.00	0.91	480.78	120.06	126.32	89.07	817.15	0.22	97.12	29.90	33.73	20.22	181.18	2026-2029
Total 9.2.4		**27,545.46**	**(3,616.9)**	**12,191.3**	**3,249.17**	**1,404.99**	**3,000.37**	**16,228.9**	**(871.68)**	**2,462.6**	**809.04**	**375.13**	**681.08**	**3,456.23**	**20.84%**
No	**Brief description of the measure**	**Financing volume, thousand euros**	**Energy conservation/savings, MWh/year**						**GHG emissions reduction, t CO2/year**						**Years of implementation**
			EE	**FW**	**NG**	**Other**	**Total**		**EE**	**FW**	**NG**	**Other**	**Total**		
9.2.5 Sector of street lighting system															
9.2.5.1	Replacing incandescent and fluorescent lighting with LED lights	6.13	131.55	-	-	-	131.55		31.70	-	-	-	31.70		2026-2028
9.2.5.2	Expansion of the outdoor lighting network in the community	4.91	(146.5)	-	-	-	(146.51)		(35.31)	-	-	-	(35.31)		2025-2026
9.2.5.3	Construction of an autonomous PV station powering the street lighting system of the city of Noyemberyan	102.00	168.00	-	-	-	168.00		40.49	-	-	-	40.49		2026-2030
9.2.5.4	Construction of autonomous PV stations powering street lighting systems in rural areas of the community	270.00	420.00	-	-	-	420.00		101.22	-	-	-	101.22		2026-2030
Total 9.2.5		**383.04**	**573.04**	**-**	**-**	**-**	**637.40**		**573.04**	**138.10**	**-**	**-**	**138.10**		**0.83%**
TOTAL		**46,387.5**											**16,580.68**		**100%**

Table 34. Summary table of cost-intensive measures planned under the Noyemberyan Community Environmental Action Plan (Target I: 2030)

No	Brief description of the measure	Financing volume, thousand euros	Energy conservation/savings, MWh/year					GHG emissions reduction, t CO2/year					Years of implementation
			EE	FW	NG	Other	Total	EE	FW	NG	Other	Total	
9.2 "Hard" investment measures													
9.2.1 Community-owned structures													
9.2.1.1	Partial savings in electrical and thermal energy in municipal buildings through simple energy saving measures	20.00	5.27	-	62.38	-	67.65	1.27	-	12.60	-	13.87	2026-2027
9.2.1.2	Restoration of thermal insulation layers in attics of municipal buildings	41.60	7.90	-	207.94	-	215.84	1.90	-	42.00	-	43.91	2026-2030
9.2.1.3	Renovation of community cultural centers, kindergartens, and administrative offices	50.32	6.59	-	70.18	-	76.77	1.59	-	14.18	-	15.76	2022-2026
.2.1.4	Installation of solar water heaters in kindergartens	115.20	-	-	218.48	-	218.48	-	-	44.13	-	44.13	2024-2028
9.2.1.5	Replacing inefficient lamps with LED lamps in community-owned organizations	4.66	99.78	-	-	-	99.78	24.05	-	-	-	24.05	2024-2026
9.2.1.6	Installation of PV modules in municipal institutions	152.10	283.92	-	-	-	283.92	68.42	-	-	-	68.42	2024-2028
Total 9.2.1		**383.88**	**403.46**	**-**	**558.98**	**-**	**962.44**	**97.23**	**-**	**112.91**		**210.15**	**1.69%**
9.2.2 Local production of electrical energy													
9.2.2.1	Construction of a community commercial PV power plant	576.00	840.00	-	-	-	840.00	202.44	-	-	-	202.44	2026-2030
Total 9.2.2		**576.00**	**840.00**	**-**	**-**	**-**	**840.00**	**202.44**	**-**	**-**	**-**	**202.44**	**1.63%**
No	**Brief description of the measure**	**Financing volume, thousand euros**	**Energy conservation/savings, MWh/year**					**GHG emissions reduction, t CO2/year**					**Years of implementation**
			EE	**FW**	**NG**	**Other**	**Total**	**EE**	**FW**	**NG**	**Other**	**Total**	
9.2.3 Residential sector													
9.2.3.1	Partial thermal modernization of 21 5-storey, 7 4-storey and 15 4-storey stone-built multi-apartment buildings in Noyemberyan community	612.39	799.2	-	3,761.0	-	4,560.16	192.6	-	759.7	-	952.32	2026-2030

9.2.3.2	Partial thermal modernization of MABs and private houses through simple energy saving measures	335.28	156.5	3,784.4	1,296.1	-	5,236.94	37.7	457.5	261.8	-	757.05		2026-2030
9.2.3.3	Restoration of thermal insulation layers of attic roofs of private houses	1,384.16	2,094.2	8,821.8	2,590.1	-	13,506.08	504.7	1,066.5	523.2	-	2,094.46		2022-2030
9.2.3.4	Installation of energy-efficient lamps in the residential sector	58.70	1,690.4	-	-	-	1,690.44	407.4	-	-	-	407.40		2026-2028
9.2.3.5	Installation of energy-efficient windows in residential MA buildings	218.68	42.2	-	198.5	-	240.66	10.2	-	40.1	-	50.26		2028-2030
9.2.3.6	Installation of energy-efficient windows in private houses	996.65	269.1	933.6	332.8	-	1,535.53	64.9	112.9	67.2		244.96		2026-2030
9.2.3.7	Installation of solar water heaters in the apartments of the MABs	148.61	-	-	464.4	-	464.40	-	-	93.8	-	93.81		2026-2030
9.2.3.8	Installation of solar water heaters in the private houses	1,728.00	-	-	6,000.0	-	6,000.00	-	-	1,212.0	-	1,212.00		2026-2030
9.2.3.9	Installation of photovoltaic systems in private houses	5,236.16	4,629.9	-	-	-	4,629.87	1,115.8	-	-	-	1,115.80		2024-2030
9.2.3.10	Use of natural gas in private houses instead of firewood resulting from unsustainable forest management	881.78	-	9,934.0	(9,934.0)	-	-	-	4,003.4	(2,006.7)	-	1,996.73		2026-2030
9.2.3.11	Implementation of photovoltaic lighting in common areas of MABs	72.20	106.4	-	-	-	106.40	25.6	-	-	-	25.64		2026-2030
Total 9.2.3		**11,672.61**	**9,787.9**	**23,473.7**	**4,708.9**	**-**	**37,970.49**	**2,358.89**	**5,640.3**	**951.20**	**-**	**8,950.42**		**71.98%**
No	**Brief description of the measure**	**Financing volume, thousand euros**	**Energy conservation/savings, MWh/year**						**GHG emissions reduction, t CO2/year**						**Years of implementation**
			EE	**CNG**	**Gasoline**	**Diesel**	**LPG**	**Total**	**EE**	**CNG**	**Gasoline**	**Diesel**	**LPG**	**Total**	
9.2.4 Տրանսպորտային սեկտոր															
9.2.4.1	Partial replacement of municipal passenger vehicles with electric passenger vehicles	130.00	(54.43)	-	93.32	180.00	-	218.90	(13.12)	-	23.24	48.06	-	58.18	2026-2030
9.2.4.2	Partial replacement of minibuses and taxis in public transport with electric vehicles	630.00	(250.65)	452.16	-	-	238.27	439.78	(60.41)	91.34	-	-	54.09	85.02	2026-2030

9.2.4.3	Partial replacement of private and commercial passenger transport vehicles with electric vehicles	19,320.00	(2,583.7)	7,963.99	2,229.67	434.75	1,801.41	9,846.17	(622.66)	1,608.7	555.19	116.08	408.92	2,066.25	2026-2030
9.2.4.4	Asphalting, improvement of community streets, installation and marking of traffic signs and information boards	2,360.06	2.73	1,442.35	360.19	378.97	267.22	2,451.45	0.66	291.35	89.69	101.18	60.66	543.54	2026-2028
9.2.4.5	Creating cycling infrastructure	20.00	0.91	480.78	120.06	126.32	89.07	817.15	0.22	97.12	29.90	33.73	20.22	181.18	2026-2029
Total 9.2.4		**22,460.06**	**(2,885.1)**	**10,339.3**	**2,803.24**	**1,120.04**	**2,395.97**	**13,773.5**	**(695.31)**	**2,088.5**	**698.01**	**299.05**	**543.89**	**2,934.17**	**23.60%**
No	**Brief description of the measure**	**Financing volume, thousand euros**	**Energy conservation/savings, MWh/year**						**GHG emissions reduction, t CO2/year**						**Years of implementation**
			EE	**FW**	**NG**	**Other**	**Total**		**EE**	**FW**	**NG**	**Other**	**Total**		
9.2.5 Sector of street lighting system															
9.2.5.1	Replacing incandescent and fluorescent lighting with LED lights	6.13	131.55	-	-	-	131.55		31.70	-	-	-	31.70		2026-2028
9.2.5.2	Expansion of the outdoor lighting network in the community	4.91	(146.5)	-	-	-	(146.51)		(35.31)	-	-	-	(35.31)		2025-2026
9.2.5.3	Construction of an autonomous PV station powering the street lighting system of the city of Noyemberyan	102.00	168.00	-	-	-	168.00		40.49	-	-	-	40.49		2026-2030
9.2.5.4	Construction of autonomous PV stations powering street lighting systems in rural areas of the community	270.00	420.00	-	-	-	420.00		101.22	-	-	-	101.22		2026-2030
Total 9.2.5		**383.04**	**573.04**	**-**	**-**	**-**	**637.40**		**573.04**	**138.10**	**-**	**-**	**138.10**		**1.11%**
TOTAL		**35,475.6**											**12,435.29**		**100%**

Conclusions on the mitigation component of the SECAP

Local government bodies can significantly contribute to the efficient use of energy resources and the resolution of climate protection issues at the local and national levels. It is necessary for community authorities to develop a strategy that identifies the main energy consumers in various sectors of life, assesses the annual volumes of energy consumption and greenhouse gas emissions.

Recognizing the importance of the strategic plan being developed, the Noyemberyan Community Council of Elders decided to join the EU's "Covenant of Mayors" initiative, which aims to support communities in Europe and the Eastern Partnership countries in implementing a sustainable energy policy, reducing communities' dependence on fossil fuels and contributing to the mitigation of global climate change.

This Sustainable Energy and Climate Action Plan represents the energy development strategy of the Noyemberyan community, the implementation of which will ensure the fulfillment of the target commitments undertaken by the community within the framework of the CoM. The plan may be periodically reviewed and supplemented with new economically and technically justified measures.

The existence of the SECAP, approved by the Noyemberyan Community Council of Elders and accepted by the Joint Research Center of the European Commission, provides the community with an opportunity:

- to join the "club" of advanced and developed European cities and get the opportunity to use EU information and regulatory sources and expert support;
- take advantage of preferential loan or grant funds provided by EU financial institutions and donor organizations to communities that are members of the CoM;
- to become closely acquainted with modern leading energy technologies, the peculiarities of their use, and to participate in experience exchange activities;
- to contribute to raising awareness among the community population and other stakeholders and implementing energy-saving measures;
- to create new jobs during and as a result of the implementation of the measures, reducing the financial burden on the community budget.

Chapter 11. Climate Change Vulnerability Assessment of the Noyemberyan Community and Adaptation Measures

11.1. The Adaptation Component in the Covenant

Climate change adaptation, together with mitigation measures, became one of the "cornerstones" of the EU's "Covenant of Mayors for Climate and Energy" initiative in 2015. As a result, since that year, the municipalities that are members of the Covenant have committed to developing adaptation measures aimed not only at reducing GHG emissions, but also at reducing identified climate risks.

In terms of adaptation, community action plans should include measures in those areas and sectors that are most vulnerable in the context of the projected impacts and climate change risks (hazards).

Vulnerable areas can vary significantly from community to community, encompassing sectors such as buildings, transport, energy, waste management, land use planning, etc. For this reason, having a deep understanding of climate hazards and vulnerabilities by local governments can be of paramount importance in developing appropriate adaptation strategies.

11.2. Armenia's policy on climate change

Within the framework of the UNDP/GCF "National Adaptation Plan to Advance Medium- and Long-Term Adaptation Planning in Armenia" project, the National Climate Change Adaptation Plan (NAP) and the list of measures for 2021-2025 were developed in 2021 and approved by the RA Government's Decision No. 749-L dated 13.05.2021.

The document guides the implementation of adaptation goals and aims to combine the efforts of the government, regional administrations, local governments, civil society and academic institutions, business, and the international community to strengthen the country's capacity to adapt to climate change in 2021-2025.

In essence, the main goal of the NAP process is to contribute to the reduction and management of climate risks in Armenia by identifying the most important hazards, implementing adaptation measures that eliminate or mitigate the negative impacts of these hazards, reducing socio-economic vulnerabilities and avoiding losses and damages caused by climate change. At the same time, there is a goal to ensure the coordination of adaptation measures implemented in different sectors and levels in order to optimize their effectiveness. All these processes are fully consistent with the goals of the Covenant and the commitments undertaken by communities under the initiative.

The NAP is a constituent and most important component of the regions with planning and implementation of measures to increase the climate resilience of communities. In this context, the following are of utmost importance for Armenia: identification of climate change risks by communities, as well as community strategies and adaptation measures developed to minimize the negative impact of these risks on the population's livelihoods and various sectors of the economy.

The results of the localization of regional climate change scenarios, and the vulnerability of various sectors of the Armenian economy and natural ecosystems under these scenarios, have been assessed and included in the four national communications of the Republic of Armenia under the United Nations Framework Convention on Climate Change (UNFCCC), which were published in 1998, 2000, 2015 and 2020.

11.3. Noyemberyan Climatic conditions

According to the amendments to the Law "On Amendments and Supplements to the Law of the Republic of Armenia on Administrative Territorial Division" that entered into force on 06.10.2021, the Noyemberyan community also includes Ayrum and Koghb, previously merged communities, and currently includes 19 settlements. Thus, the presentation of climate change trends, forecasts and scenarios for the Noyemberyan enlarged community formed as a result of the enlargement of the communities is summarized based on relevant data related to climate change for the city of Noyemberyan, the center of the community, which is available in existing analyses, studies and literature. Climate hazards, risk and vulnerability assessments, as well as proposed adaptation measures are summarized for the Noyemberyan enlarged community.

The Noyemberyan enlarged community is located on the foothills and intermountain depressions of the Gugarats Mountains stretching across the northeastern part of the Republic of Armenia. The community is located 198 km from Yerevan, 98 km from Tbilisi, 55 km to the northwest from the regional center of Ijevan, and 22 km from the nearest railway station, Ayrum.

Figure 5. Panorama of the city of Noyemberyan (https://noyemberyan.am)

The relief of Noyemberyan is complex, the slopes are steep, the surface is mountainous, highly fragmented, with an average elevation of 1,000 meters, the highest being Mount Salkut at 2,001 meters, and the lowest at 375 meters near the village of Debedavan.

The climate is distinguished by its great diversity. Each valley and mountain slope is distinguished by its own unique microclimate. Dry subtropical and moderately warm, relatively humid types predominate. The hydrographic network is relatively poorly developed. The rivers belong to the Kura basin. The large rivers, Debed and Voskepar, flow through the border parts of the region.

The area is characterized by a warm, moderately humid, temperate climate with mild winters. The average annual temperature is 10.4^0C. The annual amount of atmospheric precipitation is 541 mm. The thickness of the snow cover in winter varies between 10-12 sm. The annual duration of sunshine reaches about 2100 hours. The annual radiation balance is about 45 kcal/sm^2. The average annual wind speed is 1.8 m/s. South-westerly and north-easterly winds prevail throughout the year.

With its climatic conditions and picturesque landscape, the region is considered one of the most beautiful places in Armenia and is characterized as a climatic resort zone. Comfortable conditions for climatotherapy prevail in the territory of the community from May to October.

The climatic zones of Noyemberyan are presented in **Figure 6.**

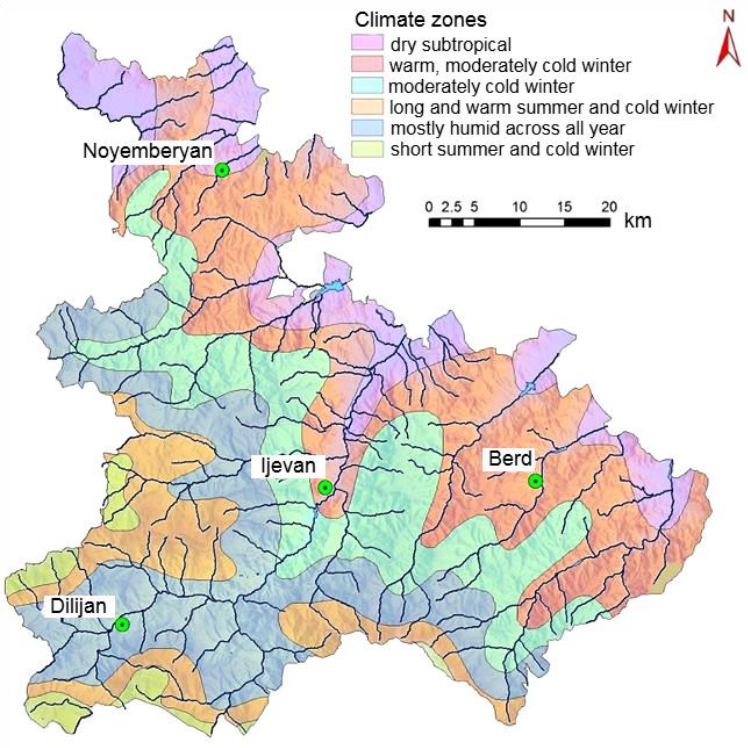


Figure 6. Climatic zones of Tavush region[24]:

A brief climatic profile of the community is provided in **Table 35** below.

Table 35. Climatic characteristics of the Noyemberyan community

Average annual precipitation (mm) 500-600mm	541
Average air temperature in January (^{0}C) +2-3	-1
Average air temperature in July (^{0}C) +30+35	+17

(Source: https://noyemberyan.am)

The main climatic elements of Tavush region by altitude zones (Noyemberyan community is located in the northern part of Tavush region, at an altitude of 800-900 m above sea level) are presented in **Table 36**.

[24] "Tavush Region Climate Change Adaptation Plan", UNDP, 2022, 73 pages.

Table 36. The main climatic elements of Tavush region according to altitude zones[25]

Climatic Elements	Timethe	Height above sea level, m											
		600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800
Air temperature, ºC	January	0.96	-0.04	-1.04	-2.04	-3.04	-4.04	-5.04	-6.04	-7.04	-8.04	-9.04	-10.0
	July	22.4	21.4	20.4	19.4	18.4	17.4	16.4	15.4	14.4	13.4	12.4	11.4
Darkness correction, hPa	January	946.8	926.4	906.0	885.6	865.2	844.8	824.4	804.0	783.6	763.2	742.8	722.4
	July	941.0	922.0	903.0	884.0	865.0	846.0	827.0	808.0	789.0	770.0	751.0	732.0
Relative air humidity, %	January	73	66	61	63	64	65	66	68	69	70	71	72
	July	69	70	72	74	76	78	79	81	83	85	87	88
Absolute air humidity, hPa	January	4.5	4.3	4.1	3.9	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.3
	July	18.4	17.8	17.2	16.6	16.0	15.4	14.8	14.2	13.6	13.0	12.4	11.8
Precipitation amount, mm	January	18	22	26	30	34	38	42	46	50	54	58	62
	July	51	53	55	56	58	60	62	64	65	67	69	71
Wind speed, m/s	January	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4
	July	1.5	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.9
Carbon dioxide content in air, g/m3	January	299	291	282	274	267	258	250	242	235	226	219	211
	July	257	251	246	240	235	228	222	216	212	206	200	195
Duration of the heating period (≤ 8 ºC), days		142	154	166	177	189	200	211	222	233	244	255	266
Frost formation dates	v	14.11	09.11	05.11	01.11	27.10	23.10	18.10	14.10	10.10	05.10	01.10	26.09
	sh	26.03	03.04	10.04	18.04	26.04	04.05	12.05	19.05	27.05	04.06	12.06	20.06
Duration of frost-free period, days		266	255	244	232	221	209	198	187	175	164	152	141
Optimal season	beginning	31.03	06.04	12.04	18.04	25.04	01.05	07.05	13.05	19.05	26.05	01.06	07.06
	end	07.11	2.11	27.10	22.10	17.10	12.10	7.10	2.10	28.09	23.09	18.09	13.09
Optimal season duration, days		223	211	199	188	176	165	154	143	132	121	110	99

Below table characterizes the climatic regime of the Noyemberyan community according to the meteorological stations of the Koghb and Bagratashen settlements. The tables use the data of the Construction Climatology Norms of the Armenian Construction Code (ACC) 22-01-2024 (**Table 37**).

Table 37. The climatic regime of the Noyemberyan community (Construction Climatology, ACCC 22-01-2024)

Air temperature

Settlement	Monthly average											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Koghb	-0.1	1.1	4.2	10.0	15.0	18.5	21.9	21.6	17.3	11.7	6.4	2.2
Bagratashen	0.3	1.7	5.6	11.6	16.5	20.1	23.1	22.6	18.3	12.4	6.7	2.2
Average annual temperature, °C			**The absolute minimum, °C**					**The absolute maximum, °C**				
10.8 (Lament) 11.8 (Bagratashen)			-19 (Kolb) -21 (Bagratashen)					38 (Kolb) 42 (Bagratashen)				

[25] Current status and development prospects of climate services in Armenia. State Hydrometeorological and Monitoring Service of the Republic of Armenia, Report "Creating favorable conditions for the preparation of Armenia's third national communication under the United Nations Framework Convention on Climate Change" within the framework of the UNDP-GEF/00060737 Project: Lusabats Publishing House, 2013, 64 pages.

Relative humidity

Settlement	Relative monthly humidity (%)											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Bagratashen	78	77	74	73	77	74	71	72	77	81	82	80

Average annual	Average monthly hours at 3 p.m.	
	Coldest month, %	Hottest month, %
76	78	71

Precipitation and snow cover

Settlement	Precipitation (monthly average/daily maximum) mm											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Bagratashen	22/18	26/30	41/29	52/36	76/56	76/84	46/82	34/55	35/39	38/39	34/42	20/23
Koghb	23/-	29/-	52/-	61/-	85/-	92/-	48/-	38/-	42/-	49/-	41/-	21/-

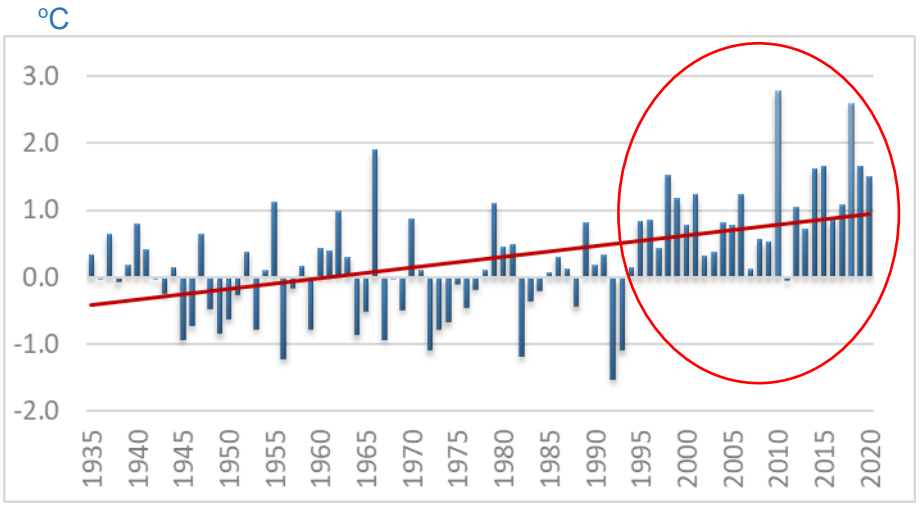
Annual	Snow cover	
	Number of days with snow cover per year	Maximum amount of water in snow, mm
500/84 (Bagratashen) 581/- (Koghb)	13 (Bagratashen)	70 (Bagratashen)

11.4. Climate change in Noyemberyan

The results of the localization of regional climate change scenarios and the climate change projected in Armenia under these scenarios, as well as its impacts on various sectors of the economy and natural ecosystems, have been assessed and included in the four national communications of the Republic of Armenia under the UNFCCC, which were published in 1998, 2000, 2015 and 2020.

Observations of climate indicators record the steadily changing process of the climate in the republic. The amount of precipitation is regularly decreasing year by year, the average air temperature and relative humidity are increasing, which are associated with an increase in the average air temperature and surface evaporation. According to the Fourth National Communication of the Republic of Armenia on Climate Change, during the period of 1935-2020, the average annual precipitation in the republic has decreased compared to the baseline (592 mm, 1961-1990) by almost 14%, and the annual average air temperature has increased above normal (5.5^0C, 1961-1990) by 1.38^0C (**Chart 38**). The climate is becoming quite worrying and the available statistical data allow us to draw certain conclusions.

a)



b)

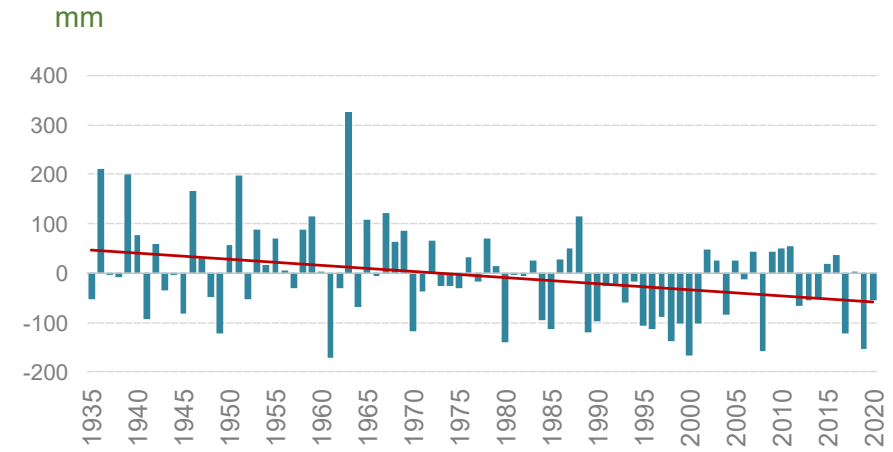
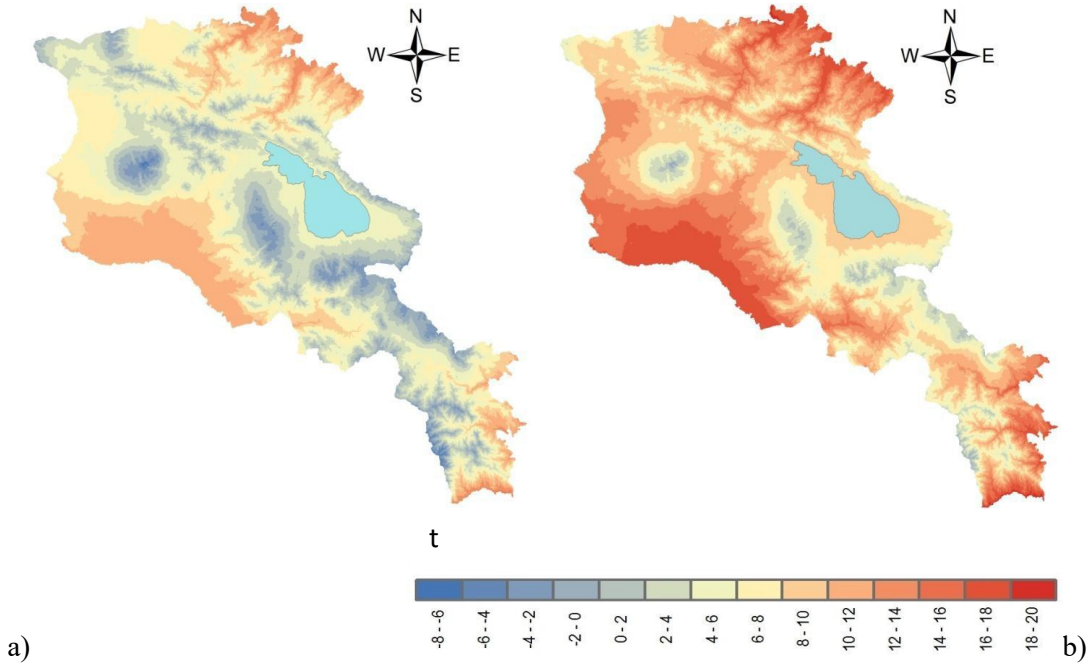


Chart 38. The deviation of the annual average temperature (0^0C) from the 1961-1990 average in Armenia; b) The deviation of the average annual precipitation from the 1961-1990 average in Armenia. (4th National Communication on Climate Change)

11.4.1. Observed climate change in Noyemberyan

The observed present and future climate change projections for Tavush region temperature and precipitation data are used.

According to the air temperature distribution in the regions of Armenia in **Figure 7** for the base period and 50-80 years later, it can be seen that the average annual air temperature in the Tavush valley region is 12-14^{0}C for 1961-1990 (Fig. 3-a), and in 2071-2100 according to the RCP8.5 scenario it will reach 18-20^{0}C (Fig. 3-b).



a) b)

Figure 7. Distribution of annual average air temperature values in Armenia a) under the baseline and b) under the RCP 8.5 scenario for 2071-2100. (4th National Communication on Climate Change)

Temperature changes also affect water resources. The rivers of the region belong to the Caspian Sea (Kur River) basin and are fed by meltwater, groundwater and rainwater. The Aghstev River flows through the center of the region to the northeast. Natural lakes are Lake Parz near Dilijan and the smaller Lake Gosh. The artificial reservoirs of Joghaz, Hakhum, Tavush, Aygedzor and Ijevan are located in the region.

Based on the materials of the report "Identifying and analyzing gaps and obstacles in legal, institutional, vulnerability assessment and adaptation planning in the field of water resources management under climate change" (UNDP, 2020), the assessment of the change in river flow for the period 1991-2017 compared to the base period 1961-1990 showed that trends in the actual river flow were observed especially in the Aghstev and Tavush rivers by 10-25%, while the magnitude of the growth trends in the Debed River basin is small (up to 5%) (**Table 38**).

Table 38. Changes in the actual flow of rivers in Tavush region from 1991 to 2017 compared to the base flow from 1961 to 1990 [26]

	River observation point	1961-1990	1991-2017	the change	
				million m^3	%
2	Debed-Ayrum	1054.5	1055.9	1.47	0.14
4	Aghstev-Ijevan	296.4	345.7	49.3	16.6
5	Getik-Gosh	109.5	116.5	7.08	6.47
17	Hakhum-Tsaghkavan	49.4	41.9	-7.53	-15.2
18	Tavush-Berd	18.4	23.6	5.17	28.1

[26] "Identification and analysis of gaps and obstacles in legal, institutional, vulnerability assessment and adaptation planning in the field of water resources management under climate change" UNDP Project, 2020.

Within the framework of the UNDP "Climate Change in the South Caucasus" project (2009-2011), the vulnerability of the river flow for the Debed and Aghstev transboundary river basins was analyzed according to the results of the ECHAM5, GFDL CM2.X, GISS-ER and HadCM3 regional atmospheric circulation models. By testing historical data, these models were adapted for the South Caucasus countries in order to obtain more reliable results. The averaged results of the above-mentioned 4 models for the A2 scenario show that the annual flow of the Debed River will decrease by 10-11% by 2040, by 29-37% by 2070, and by 55-62% by 2100. The annual flow of the Aghstev River by 2040 will decrease by 11-14% by 2070, by 31-37% by 2100, by 62-72% (**Table 39**).

Table 39. Projected changes in the annual flow of the Aghstev and Debed rivers according to the A2 scenario: [27]

River observation point	Stream change							
	1961-1990		2030		2070		2100	
	million m^3	%	million m^3	%	million m^3	%	million m^3	%
Debed-Ayrum	1054	0	937	-11	669	-37	402	-62
Aghstev-Ijevan	286	0	255	-11	196	-31	108	-62
Voskepar (with its Kirants tributary) – Voskepar	67	0	58	-14	42	-37	19	-72

For the entire territory of Armenia, according to data from 45 operating meteorological stations, about 27 indices proposed by the World Meteorological Organization have been evaluated for the period of 1935-2016, which can be applied in a number of areas: healthcare, agriculture, water resources, etc.

The indices were calculated for each station based on their observation data sets. The number of summer days (Tmax>25°C) increased at all altitudes during the observed period (1935-2016). The number of cold days decreased by 1 during the same period, 4-3 by 5 days/10 years, and the number of frost days has been reduced to 0.4-2.3 days/10 years. The duration of heat waves has increased accordingly by 2.0-7 for 6 days.

The following coefficients characterizing climatic extreme conditions were also evaluated according to altitudes: number of consecutive dry days, number of wet days, duration of rainless period. The number of consecutive dry days during the observed period, 1935-2016, increased by 0.3-1 by 6 days/10 years, the number of days with heavy precipitation (R10mm) at altitudes up to 2000 m has increased by 0 for 7 days.

The indices of the number of consecutive days with precipitation less than 1 mm (CDD) and the number of days with temperature above 25°C (SU25) were estimated for all meteorological stations in Armenia using data from 1935-2016. The results were mapped and presented in **Figure 8**.

[27] "Identification and analysis of gaps and obstacles in legal, institutional, vulnerability assessment and adaptation planning in the field of water resources management under climate change" UNDP-CFC Project, 2020.

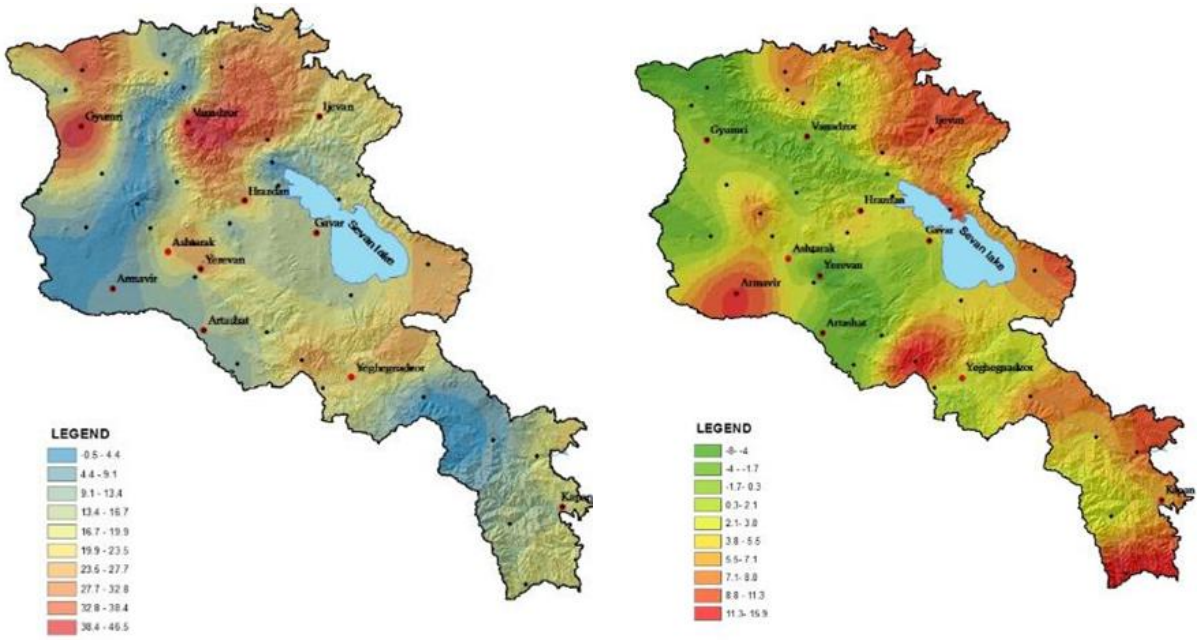


Figure 8. Spatial distribution of changes in a) SU25 and b) CDD indices in Armenia during 1935-2016.

The results of the analysis show that during 1935-2016, the above indices have increasing trends throughout the territory of the republic. These indices are very characteristic of the increase in the frequency of droughts, which in turn are caused by thermal depression, and can also lead to forest fires and desertification.

11.4.2. Climatic and other natural hazards and risks threatening the Noyemberyan community, extracted from existing studies

Armenia is located in a high-risk zone for natural hazards. The World Bank has included Armenia in the list of 60 countries prone to disasters. The probability of a disaster and its severity are high. The main threats include storms, hail, floods, and landslides.

As an example, we can consider the catastrophic flood on the night of May 25-26, 2024, when the rivers and their tributaries of the northern basin of Armenia overflowed their banks and flooded the surrounding settlements, pastures and gardens. The Tashir, Alaverdi, Pambak, Tumanyan, Stepanavan, Gyulagarak communities of Lori region, Noyemberyan, Dilijan, Ijevan communities of Tavush region suffered from the flood, which were declared a disaster zone and the borders of the disaster zone were defined by the RA Government's Decision No. 772-N of May 27, 2024. The disaster zone of Noyemberyan community included the city of Ayrum, the villages of Archis, Bagratashen, Debedavan, Haghtanak and Ptghavan.

In order to study trends related to hazardous meteorological phenomena in the territory of Armenia, an analysis of the most frequently observed hazardous phenomena in the territory of the country during 1975-2016, including frost, hail, strong winds, and heavy precipitation, was conducted within the framework of the 4th National Communication on Climate Change.

During 1975-2016, the total number of dangerous phenomena in the territory of Armenia increased by about 40 cases compared to 1961-1990 average, which is 23.5% of the multi-year average value.

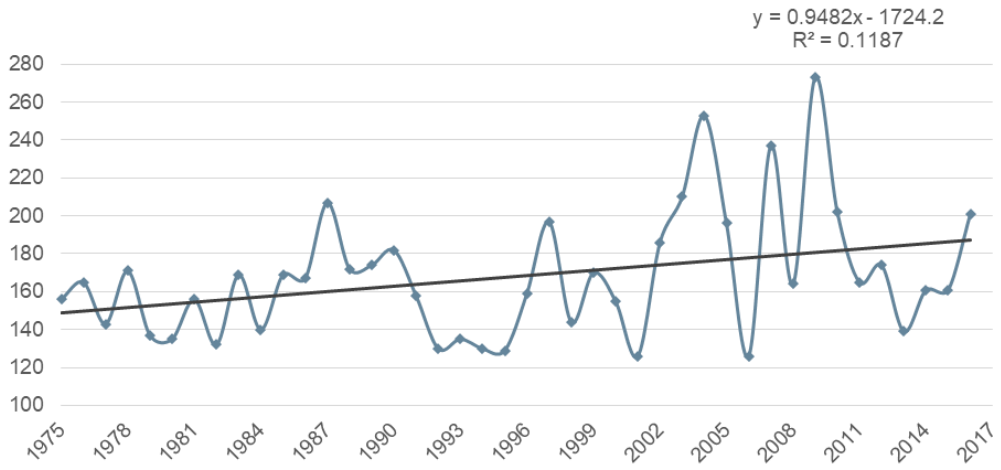


Chart 39. Cumulative number of hazardous events: frost, hail, strong winds and heavy precipitation observed in the territory of Armenia during 1975-2016. (4th National Communication on Climate Change)

In Tavush, trough situations are observed for a duration of 25-45 days. Mostly weak troughs are observed, the highest probability of which (90-98%) is observed only at altitudes of 400-800m. The duration decreases sharply at altitudes of 800m, reaching 7 days. [28]

Monthly and annual wind speed values increase with altitude. Maximum values (≥20 m/s) are observed in winter, while in low-lying and foothill regions, due to mountain-valley circulation, they are observed in summer, and the minimum values are observed in winter. [29]

Hail incidence trends for 1961-2019 (constructed based on hydrometeorological data from the UNDP office) are presented in **Chart 40**.

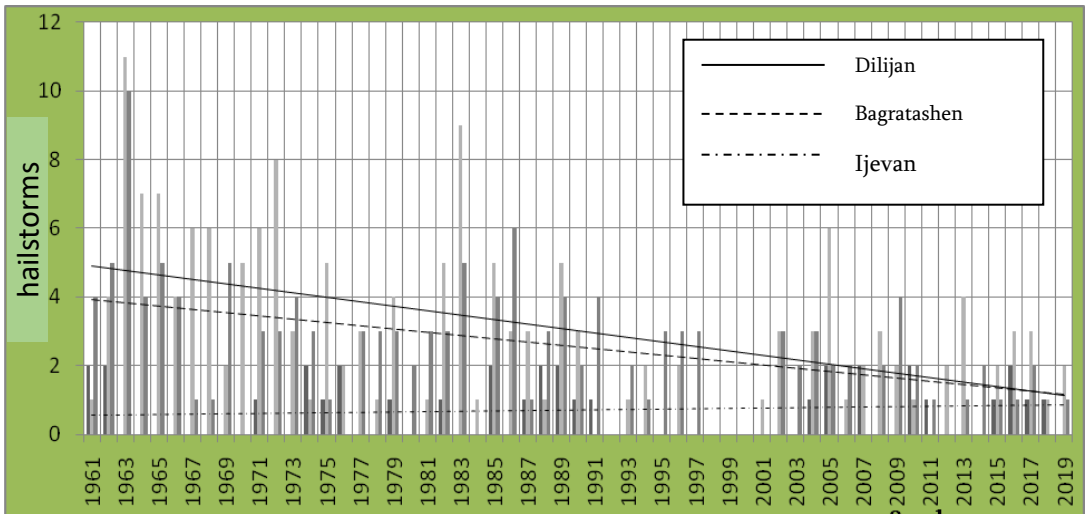


Chart 40. Hailstorms in Ijevan, Dilijan and Bagratashen communities of Tavush region.

In general, the region (Bagratashen, Berd) is distinguished by the minimum number of drought days, as precipitation is relatively high and daytime temperatures are not high. [30]

[28] Assessment of the vulnerability and adaptation of the agricultural sector to climate change in Armenia: legal and institutional framework. UNDP, 2021
[29] See 5

Drought phenomena are observed in Tavush region in all seasons of the year. Autumn and spring droughts usually occur in conditions of not high (20-25^{0}C) temperatures, but prolonged periods of rainlessness.

Late spring and early autumn frosts are caused by cold air intrusions from the west and northwest. The frost period at the bottom of the depressions is 2-26 days longer than the duration of the period with temperatures above 10^{0}C. That is, the low-lying regions of the region are more dangerous.

Calculations show that between 1955 and 2016, both minimum and maximum temperatures increased by 1.5-2 degrees Celsius, and 1^{0}C and 1.0–2.0^{0}C respectively. During the same period, the amount of precipitation also decreased, both annually and during the growing season.[31] This trend continues in the face of global climate change.

According to climate change scenarios, the frequency of unstable weather accompanied by thunderstorms and hail is likely to increase in spring and summer. In this case, the agricultural plains of the middle mountainous belt of the northern and southern regions of Armenia will be most vulnerable.[32] The vulnerability of Armenia's regions to hydrometeorological hazardous events (HMEs), according to their degree of hazard, is presented in **Figure 9**.

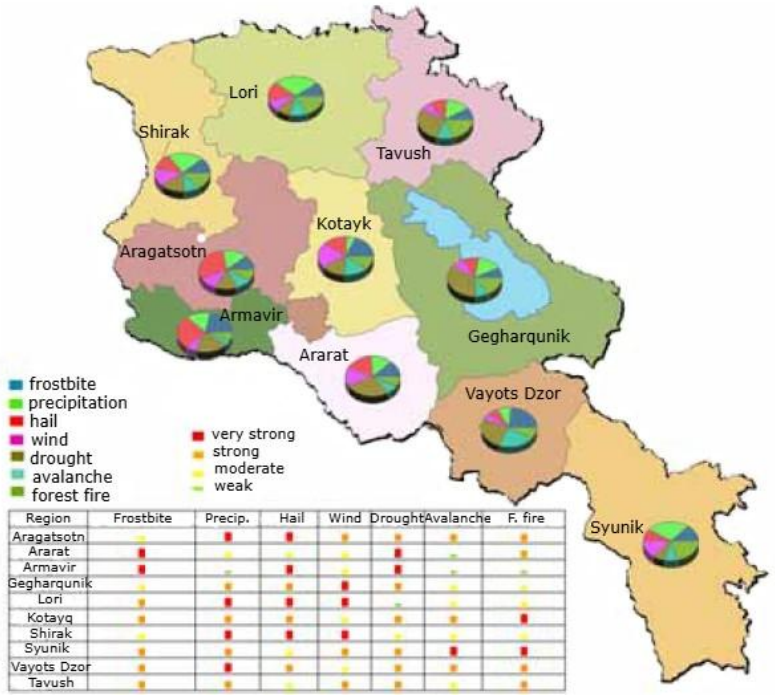


Figure 9. Vulnerability of Armenia's regions to HMEs (https://nature-ic.am/)

The overall hydrometeorological vulnerability map of Armenia calculated according to individual factors, such as maximum and minimum air temperatures, precipitation, maximum wind speed, and river

[30] Hakobyan S. Analysis and assessment of hazardous meteorological phenomena in Tavush region. YSU SSS Scientific Articles Collection 1.1 (27), 2019, 64-73.
[31] Assessment of the vulnerability of the agricultural sector to climate change and climate change adaptation in Armenia: legal and institutional framework. UNDP, 2021.
[32] Climate Risk Management in Armenia: Report. (https://nature-ic.am/), 2013.

flow velocity, based on daily data collected from 35 stations over the past 30 years, is presented in **Figure 10**[33].

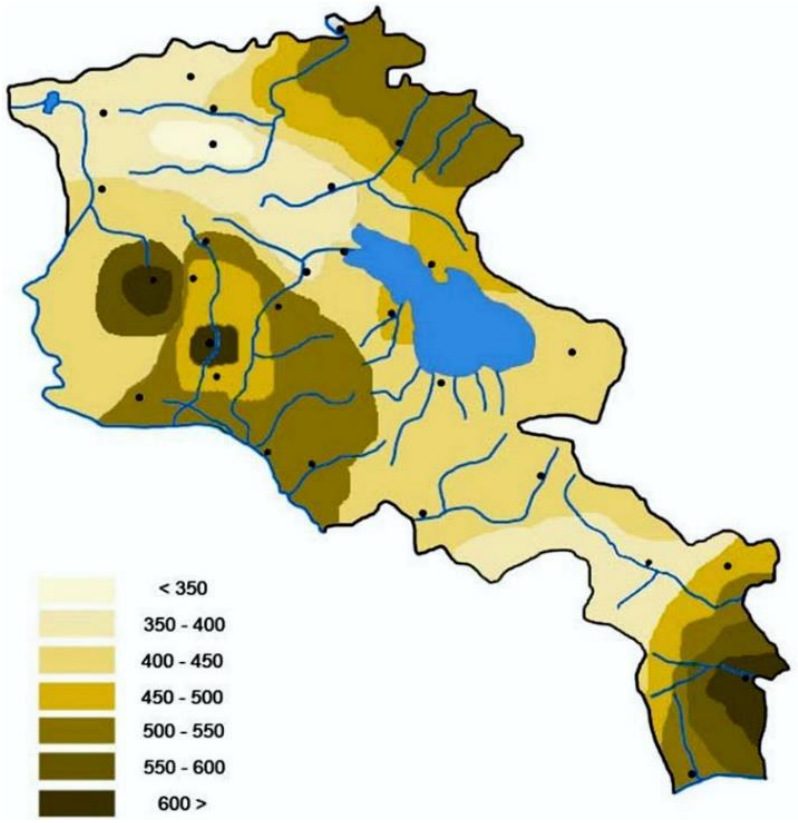


Figure 10. Spatial distribution map of hydrometeorological vulnerability of Armenia (UNDP)

Droughts are observed almost every year in the lowlands of the republic, and the recurrence of droughts in the foothills is about 50%. During 2000-2017, the duration of droughts increased by about 33 days compared to 1961-1990 (the average duration of drought during 1961-1990 was 87 days). In recent years, the upper boundary of the drought zone has expanded to include mountainous regions.

About 80% of the territory of the Republic of Armenia is subject to varying degrees of desertification, which has occurred both as a result of anthropogenic activities and is conditioned by the influence of natural factors and geomorphological features. According to the Strategy to Combat Desertification in the Republic of Armenia, Tavush region is located in a zone of desertification risk or potential risk (**Figure 11**).

[33] Current status and development prospects of climate services in Armenia. State Hydrometeorological and Monitoring Service of the Republic of Armenia, Report "Creating favorable conditions for the preparation of Armenia's third national communication under the United Nations Framework Convention on Climate Change" within the framework of the UNDP-GEF/00060737 Project: Lusabats Publishing House, 2013, 64 pages.

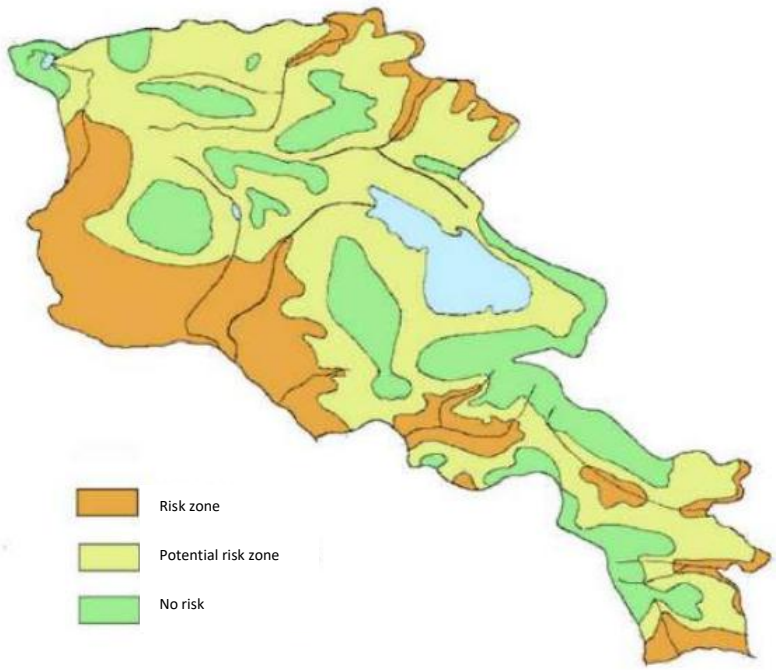


Figure 11. Desertification risk zone of Armenia, according to the Strategy and National Action Plan to Combat Desertification in the Republic of Armenia, 2015

Among the dangerous hydrometeorological phenomena, frost, precipitation, forest fires, drought and wind have a high degree of danger for the Tavush region, while avalanches and hail have a moderate degree of danger.[34]

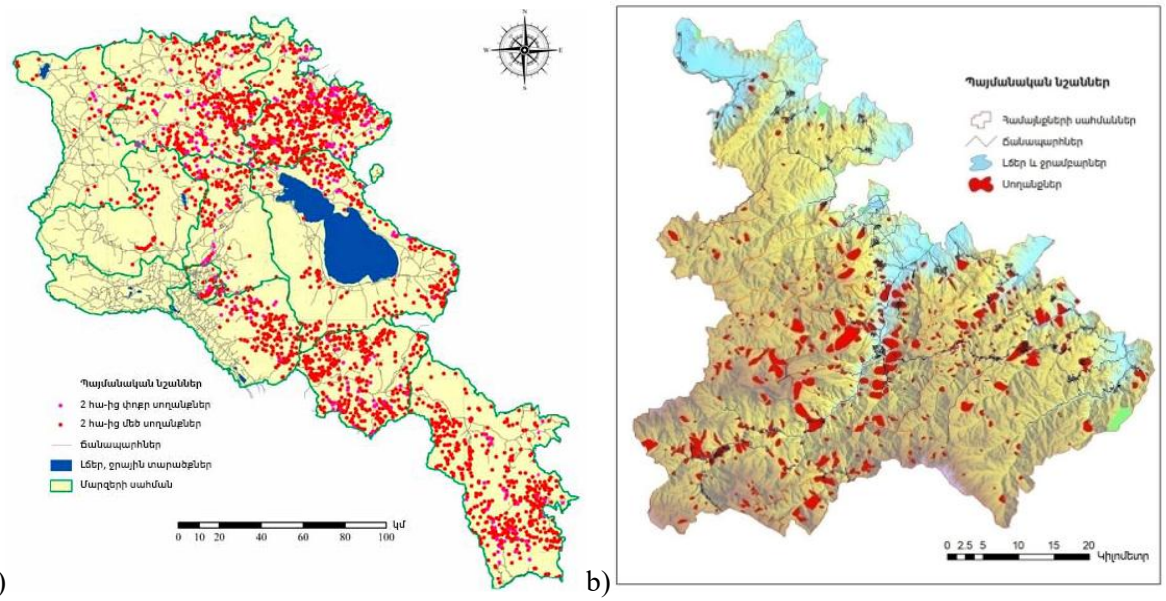
Settlements and infrastructure in Tavush region are threatened by dangerous natural phenomena such as floods, mudflows, landslides, and rockfalls caused by climatic features.[35] The latter can not only cause great destruction and damage to settlements, roads, nearby structures and infrastructure located in their territory, but also cause human casualties.

Of the mentioned hazards, landslides are especially widespread in mountainous and foothill regions, where mountain rocks slide down steep slopes under the influence of gravity, due to frequent heavy precipitation and overmoistening of the slopes. A significant part of the landslides is located within the borders of Ijevan, in the basins of the Dilijan, Debed, Aghstev and other rivers.

The 151 landslides occupy 210.62 sq km (8%) of the Tavush region, which has an area of 2740.67 sq km.[36]

A map of the prevalence of landslides in Armenia is presented in **Figure 12**.

[34] Fourth National Communication on Climate Change, 2020.
[35] Tavush Region Adaptation Plan. "National Adaptation Plan to Advance Medium- and Long-Term Adaptation Planning in Armenia." UNDP, 2022.
36 Gaginyan R.Kh., Vardanyan V.P., Hovhannisyan A.H. Integral assessment and mapping of natural disaster risk in the RA regions. YSU Scientific Bulletin. 3, 2015, 25-30.

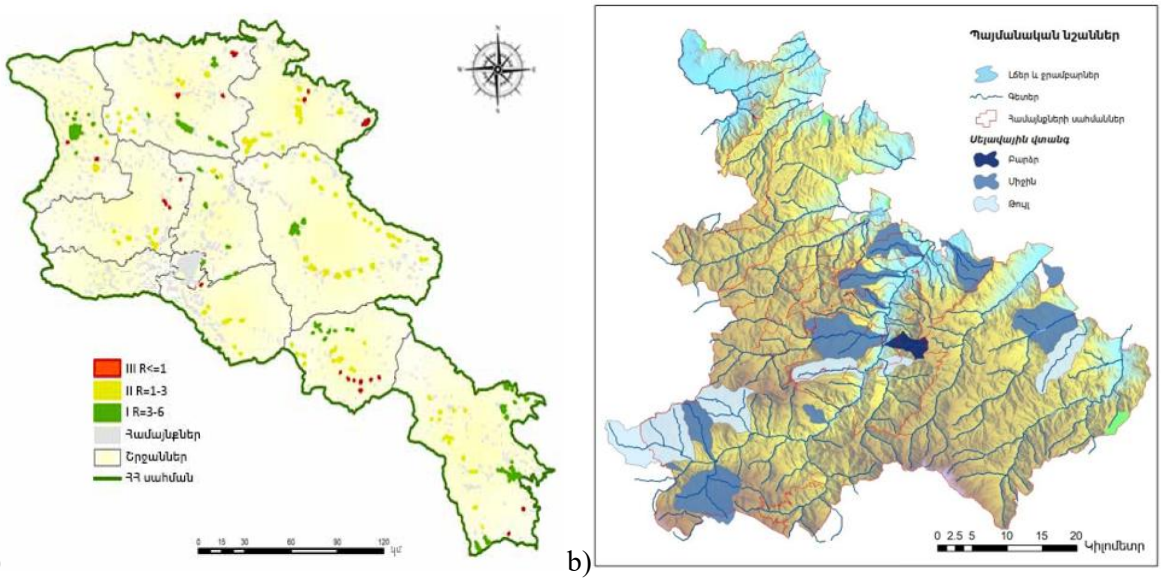


a) b)

Figure 12. a) The spread of landslides in the territory of the Republic of Armenia (4th National Communication on Climate Change), b) Landslide hazard map of Tavush region[37]

The number of rockfalls recorded between 2012 and 2018 has increased compared to previous years. In recent years, rockfalls have become more frequent in Tavush region. 38

A map of the distribution of mudflows in Armenia is presented in **Figure 13**.



a) b)

Figure 13. a) Flood-prone settlements in Armenia by risk level (RI-III) (4th National Communication on Climate Change), b) Flood hazard map of Tavush region (*https://sustainable-caucasus.unepgrid.ch/layers/geonode:mudflow_arm*)

37 The study on landslide disaster management in the Republic of Armenia. Final report, Vol. IV, KOKUSAI KOGYO CO., LTD. and NIPPON KOEI CO., LTD., Yerevan, 2006.
38 Hovhannisyan A.H. Armenia Principles of comprehensive study of the potential hazard and vulnerability of an area to natural disasters for the purpose of risk assessment. Ageographical sciences candidate scientific degree requestAbstract: Yerevan, 2014.

The number of communities affected by natural hazards as of 2014 by region and their area is summarized in **Table 40**.

Table 40. Number of communities affected by hazards by region and their area of coverage.[39]

N	Region	Region surface	Total amount of communities	Communities with hazards																	
				Hail		Flooding		Mudflow		Landslide		Strong wing		Extensive precipitation		Frost		Drought		Rockfall	
				Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %	Number of communities	Community surface %
1	Yerevan	22.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Aragatsotn	329.69	113	100	94.0	48	37.2	29	39.5	3	1.9	66	54.2	7	7.3	21	20.8	46	34.3	7	4.6
3	Ararat	964.66	89	53	66.5	24	32.3	18	39.7	4	21.0	20	40.3	1	0.8	3	7.6	9	34.5	4	6.1
4	Armavir	135.17	93	56	74.1	9	10.2	12	11.7	0	0.0	20	26.3	5	8.4	0	0.0	3	2.1	0	0.0
5	Gegharqunik	111.46	92	50	62.0	57	63.3	17	25.2	5	6	48	51.2	61	66.4	19	31.6	3	2.9	3	3.4
6	Lori	801.79	112	95	84.3	37	30.9	16	16.8	8	7.7	60	58.0	15	14.4	22	20.9	51	45.1	15	12.6
7	Kotayq	082.49	64	14	15.1	18	33.7	8	22.6	3	4.3	20	26.2	5	8.6	1	3.3	3	1.6	10	19.1
8	Shirak	674.80	118	84	69.1	30	26.0	26	25.1	3	2.9	78	64.1	7	6.0	4	2.2	1	1.0	0	0.0
9	Syunik	264.38	105	31	28.8	11	10.2	12	8.7	6	4.4	50	45.0	10	15.0	1	2.0	60	48.2	14	12.2
10	Vayots Dzor	300.00	43	38	81.4	26	56.3	17	39.8	10	18.3	33	70.7	11	25.2	11	22.5	1	6.4	12	23.5
11	Tavush	705.48	60	40	67.5	22	39.9	2	7.7	17	33.1	8	24.9	4	7.8	14	14.3	2	3.2	6	15.6
	Total	8592.70	890	561	63.4	282	35.7	157	23.7	59	10.2	403	48.6	126	19.8	96	14.2	179	21.1	71	10.5

From the above studies, it can be concluded that mudflows are relatively less risky for Tavush (**Figure 8**), as well as that in general *Tavush region is located in the low-risk zone of the natural disaster risk assessment scale.*

A comprehensive assessment of risks arising from natural hazards was carried out, including risk values associated with hazards such as hail, frostbite, mudflows, landslides and other consequences (11 types in total), as well as environmental, social and economic vulnerability indicators (16 in total). Natural hazards risk has been assessed as a product of potential hazard and vulnerability. In the natural hazard risk map developed for Armenia, presented in **Figure 14**, Tavush region is also in the group of low-risk regions.

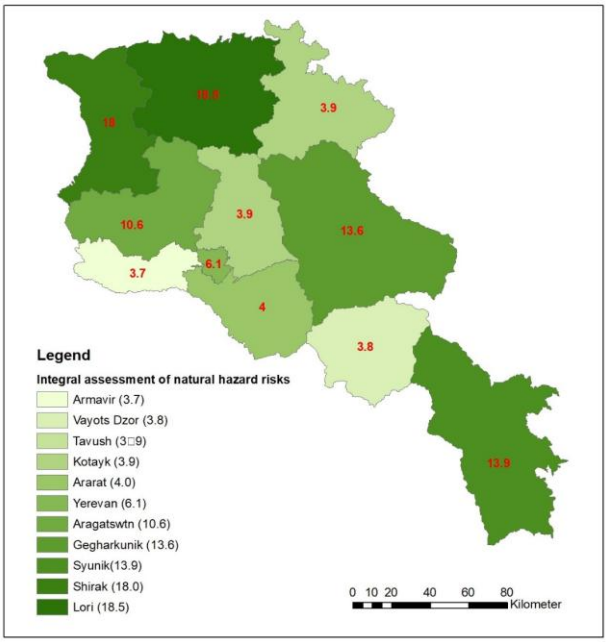


Figure 14. Comprehensive Natural Hazard Risk Assessment Map of Armenia by Region (UNDP, 2023)

[39] Climate Change Risk Analysis and Assessment: TAVUSH. SUMMARY "Mitigating Climate Change Risks in Rural Communities through Improved Local Development Planning" UNDP, 2014.

The UNDP study of Tavush region also presents an assessment of the region's vulnerability to climate change, presented in terms of the share of the weights of different sectors (**Figure 15**), from which it follows that the most important sectors in terms of vulnerability of Tavush region are water resources and agriculture, followed by settlements, energy and healthcare.

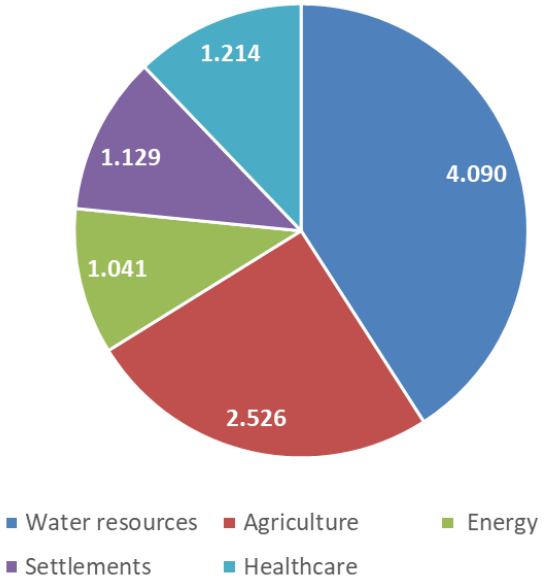


Figure 15. Weights of sectors in Tavush region, with a distribution of 10 points[40]

Thus, the following conclusions were summarized:

- The settlements of the Noyemberyan community are vulnerable to climate change, as precipitation has decreased here in the last decade along with increasing temperatures.
- Droughts are considered the main climatic risk in Noyemberyan community, as the average annual number of their days is significantly higher than in other dangerous events.
- Frosts and hailstorms follow droughts in terms of frequency. Hailstorms and froststorms have decreased in the last decade, which is also a consequence of climate warming.

Thus, it can be stated that based on the existing studies, the following climatic and climatic-related hazards can be identified for the Noyemberyan community: **frostbite**, **heavy rainfall**, **river flooding/flooding**, **forest fire**, **drought**, **rockfall**, **landslide** and **strong wind.**

11.4.3. Natural hazards and risks identified by the Noyemberyan enlarged community

The identified climatic and other natural hazards and risks specific to the Noyemberyan enlarged community are presented in **Table 41**.

[40] Tavush Region Adaptation Plan. "National Adaptation Plan to Advance Medium- and Long-Term Adaptation Planning in Armenia." UNDP, 2022.

Table 41. Climate hazards of the Noyemberyan enlarged community

	Climate risk	Description	Impact
1	**Landslide**	Landslides have occurred in 9 settlements of the community, resulting in damage to residential buildings, structures, homesteads, roads, etc.	Landslide sites threaten residential homes and the community road.
2	**Rockfall**	There are rockfall hazards in 9 settlements of the community.	Rockfall sites pose a threat to residential homes and roads.
3	**Thunderstorm / lightning**	Thunderstorms and lightning are observed throughout the community, especially in May, June, July, September, October, and November.	Lightning strikes mainly threaten those engaged in livestock breeding and farming in the community's fields. Damage is also caused to the population's household appliances and equipment.
4	**River overflow / Flooding**	River floods are frequent in 13 settlements of the community, which mainly occur in April-June.	Coastal cultivated land, grasslands, croplands, inter-village and inter-field roads, bridges, homesteads and gardens, animals, etc. are being damaged.
5	**Drought**	Starting in May-June, droughts are frequently observed throughout the community due to lack of rainfall and lack of irrigation.	There is a decrease in farming in the community, mainly areas near homes are cultivated and irrigated, where vegetable and melon crops are grown; the likelihood of infectious diseases increases.
6	**Frostbite**	The community is characterized by early frosts, especially in April, May, June, September, October, and November.	Yield decline, crop loss and consequently material losses.
7	**Heavy rainfall**	The community is characterized by heavy rainfall, especially during the months of April-July and September-November.	Heavy rainfall causes mudflows, river overflows, and floods. During heavy rains, landslides in the community become more active.
8	**Hail**	Crop losses due to hailstorms in the community reach 50-60%.	The agricultural sector suffers particularly great damage from hailstorms, as well as damage to crops, buildings, and vehicles.
9	**Strong winds**	Regular strong winds cause great damage to settlements.	Damage electricity poles and wires, as well as the roofs and windows of residential houses and buildings. The winds also cause great damage to the agricultural sector, particularly in the summer-autumn period.
10	**Flood**	14 settlements of the community are located in landslide-prone zones. Due to the lack of storm drains, landslides caused by heavy rainfall in spring and autumn flow along inter-village roads, damaging them and filling up plots of land near houses and basements.	Damage community roads, bridges, houses, homesteads, farmlands, etc. They cause as well soil erosion.
11	**Forest fire, Grassland fire**	14 settlements in the community are susceptible to forest fires. Hot summer weather conditions can cause fires in the community's grasslands.	Can cause the extinction of animals and plants, reduce soil fertility, and cause erosion.

11.4.4. Climate change risk assessment

Summarizing the available information, the results of the studies, and the identified hazards of the Noyemberyan enlarged community, each of the most frequently mentioned climate hazards in the community was assigned a risk level, which should guide the planning and implementation priorities of further work.

Thus, the risk level was determined based on the combination of the probability and consequences of a given hazardous event, through which the overall risk of a given hazard was assessed.

Refraining from using different terminology, the risk assessment was conducted for heavy rainfall, river flooding, mudflows, frost, landslides, drought, forest fires, as well as hail, rockfall and storm hazards, the brief definitions of which are presented in **Table 42** below.

Table 42. Definitions of climate hazards

Hazard	Definition
Heavy precipitation	A significant precipitation event that occurs over a period of 1h, 3h, 6h, 12h, 24h, or 48h, where the total amount of precipitation exceeds a certain threshold defined for a given location.
River flooding	Flooding of a number of rivers and catchment systems, floodplains, or coastal areas as a result of water exceeding the carrying capacity of the riverbed and overflowing natural banks or artificial barriers.
Flood	A large flow of water caused by heavy rainfall, containing large amounts of debris and other materials, and can cause damage to settlements, industrial facilities, highways, irrigation systems, etc.
Frostbite	A decrease in air or soil surface temperature below 0°C during the growing season.
Landslide	Gravity-induced slopes or sloping terrain, rocks, mass movement.
Drought	A complex of meteorological factors, combined with high air temperature and reduced humidity due to a prolonged absence of precipitation, which leads to a disruption of the water balance of plants and their destruction (atmospheric and soil droughts are distinguished).
Forest fire	An uncontrolled fire in a forest/woodland area, which can be caused by lightning, extreme hot weather conditions, spontaneous combustion of dried plants, etc.
Hail	5-50mm in diameter of transparent, or partly or completely opaque particles of ice precipitation, falling in irregular or ball form.
Rockfall	A sudden and very rapid shedding of rocks, stones, and soil masses caused by heavy rain, rapid melting of snow/ice, physical, chemical, and biological weathering, or earthquakes.
Storm	An atmospheric disturbance that may be characterized by strong winds and accompanied by rain, snow, or other precipitation, and by thunder and lightning.

The probability and consequences of hazards were assessed according to the scale presented below and taking into account the results of available analyses (**Table 43**).

Table 43. Hazard assessment scale

N	Probability		Consequences
1	Low	The threat is unlikely to occur.	A hazard represents a low level of potential concern for the community. If it occurs, it will lead to some consequences for the community, but these will have little or no significance for everyday life.
2	Medium/ Moderate	The emergence of danger is likely.	The hazard represents a medium level of potential concern for the community. If it occurs, it will have consequences for the community, but they will be of medium importance for daily life.
3	High	The threat is highly likely to occur.	A hazard represents a high (or highest) level of potential concern for a community. If it occurs, it will have extremely serious consequences for the community and daily life.

Taking into account the existing studies, based on the assessment of the probability and consequences of hazardous phenomena, risks were calculated (*risk = probability x consequence*) and a

risk matrix was developed (**Figure 16**), according to which drought and heavy precipitation represent a high level of risk for the Noyemberyan enlarged community, as well as hail, frost and strong winds have a moderate level of risk.

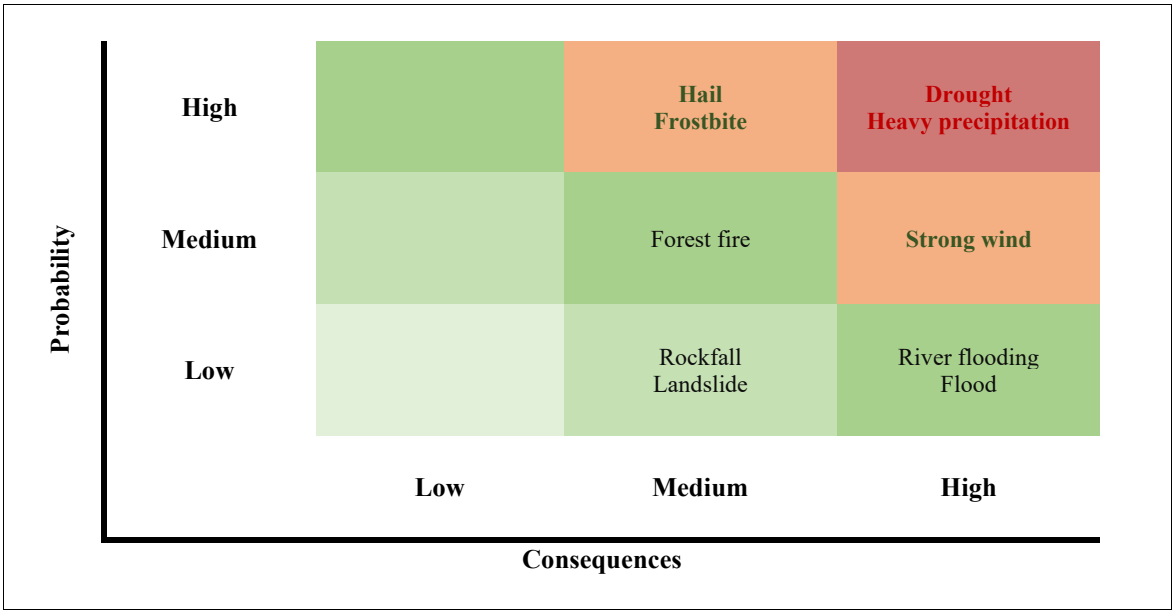


Figure 16. Risk matrix of the Noyemberyan community.

For all of the above-mentioned high-level climate hazards and risks, their impact on various sectors was studied, which was a key component for the vulnerability assessment.

11.4.5. Climate change impact and vulnerability assessment

Climate change is evident in the territory of the Republic, which may theoretically and directly be related to the intensification of natural dangerous climatic phenomena in recent years.

Thus, according to the observations of "Armhydromet" SNCO, over the past decades, as a result of climate change, the frequency and intensity of hydrometeorological phenomena such as severe frost, heavy rains and hail, droughts, and heat waves have increased significantly in the republic.

The number of cases of rapid snowmelt, as well as unseasonal river flooding, has increased, which in turn contributes to more intense occurrence of floods and mudflows.

The negative impacts of climate change are already being felt in human health, infrastructure, agriculture, and a number of other sectors.

The adverse impact of climate change on the health of the population may be due to an increase in extremely high and low temperature days and sharp fluctuations in atmospheric pressure, heat waves, which are a risk factor for various diseases, especially cardiovascular diseases.

The assessment of current and future climate hazards (risks) specific to the community was carried out in accordance with the Covenant of Mayors methodology and the Covenant Reporting Guidelines, based on the summarized climate hazards and risks, available information[41], as well as survey results from settlements.

[41] Including the "Tavush Region Adaptation Plan" developed by UNDP in 2022.

Table 44 below summarizes the indicators of frequency, impact and intensity of hazards, which were obtained taking into account the results of the analysis of information extracted from relevant sources.

Table 44. Noyemberyan community's present and future climate hazards

Climate risk	The current risk of hazard occurring		Future threats		
	Probability of hazard	The impact of the threat	Expected change in hazard intensity	Expected change in hazard frequency	Deadlines
Drought	High	High	Unchanged	Growth	Medium term
Heavy precipitation	High	High	Unchanged	Unchanged	Medium term
Hail	High	Moderate	Unchanged	Unchanged	Short-term
Frostbite	High	Moderate	Unchanged	Unchanged	Short-term
Storms	Moderate	High	Unchanged	Unchanged	Short-term

The vulnerability assessment for the Noyemberyan community was carried out taking into account the levels of their impact on the community economy and other sectors, and vulnerability to the increase in the number of diseases and energy risks was also emphasized.

The socio-economic, physical and environmental vulnerabilities typical of the Noyemberyan community are summarized in **Table 45**.

Table 45. Socio-economic and physical and environmental vulnerabilities typical of the Noyemberyan community

Vulnerability type	Vulnerability description
Socio-economic	Hail will negatively impact community agriculture, causing material damage and raising food and nutrition security issues. Storms will lead to damage to housing infrastructure and social tensions. Prolonged dry weather will threaten people's lives and health and contribute to the deterioration of sanitary and hygienic conditions.
Physical and environmental	Prolonged dry weather will contribute to the deterioration of agricultural lands. Frosts will affect the environmental hazard, as well as increase the safety risk for the community population. Strong winds mainly threaten the roofs of buildings and power lines.

Sectoral vulnerability assessment

Based on the climate hazards identified in **Table 44**, their impact, intensity and frequency, the impact of the most typical hazards on the community economy and target sectors was assessed.

Taking into account the available studies, as well as the results of surveys received from settlements, the impact of the above-mentioned most dangerous phenomena on various sectors is summarized in **Table 46** by the degree of impact (high and moderate).

Table 46. Potential vulnerability of key sectors in Noyemberyan community to selected climate hazards

Sector	Description
DROUGHT	
Agriculture / Forestry	Increased risk of fire in forests adjacent to fields.
	Decline in productivity of homesteads, forests and agriculture.
	Significant increase in financial and labor costs related to seeds, fertilizers, sowing, as well as crop insurance.
	Deterioration/degradation of agricultural lands.
Water resources	Increase in agricultural and forestry irrigation volumes.
	Reduction in the volume and quality of water resources, increased load on the water supply and wastewater systems.
	Overexploitation of water resources.
Environment and biodiversity	Decrease or deterioration in the quality of ecosystem services.
	Accelerated habitat degradation for some species of animals and plants.
	Increasing pest populations.
HEAVY PRECIPITATION	
Agriculture / Forestry	Decline of the agricultural and food industries.
Buildings and structures	Damage to buildings and structures, as well as infrastructure.
Environment and biodiversity	Accelerated habitat degradation for some species of animals and plants.
Transport	Significant damage to roads and other transport infrastructure.
HAIL	
Agriculture / Forestry	Decline of the agricultural and food industries.
	Increased susceptibility of plants to wound-related diseases.
Transport	Damage to vehicles.
	Damage to asphalt road surfaces.
Buildings and structures	Damage to buildings and structures, as well as to infrastructure.
FROSTBITE	
Agriculture / Forestry	Decline of the agricultural and food industries.
Environment and biodiversity	Plant damage. Accelerated habitat degradation for some species of animals and plants.
STORMS	
Buildings and structures	Damage or demolition of roofs of buildings and structures and the need for related restoration work.
Energy	Failure of substations and underground networks.

Summarizing in the context of climate change for Noyemberyan community, the results of the analysis of the impact of climate and other natural hazards on the community economy and target sectors should also mention the main factors contributing to the increase in the negative impact of climate risks, which should be taken into account when developing a concept for increasing the climate resilience of any community.

Such factors include:[42]

- Concentration of resources and capacities at the national level, in the absence or lack of financial and human resources and capacity at local governments, including the lack of clear responsibilities for disaster risk reduction and response.
- Inadequate management of water resources, sanitation systems, and solid waste, leading to disease outbreaks, floods, and landslides.
- The degradation of ecosystems due to human activities, such as deforestation, overgrazing, construction, environmental pollution, the use of wetlands, and unsustainable resource extraction, which threaten the ability to provide essential services.
- Deteriorated infrastructure and a stock of emergency level buildings, which could lead to the collapse of structures.
- Adverse effects of climate change, which could lead to abrupt (extreme) increases or decreases in temperature and precipitation (depending on country situations), which will affect the frequency, intensity and spread of floods and other climate-related disasters.

Vulnerable population groups

The poor are among the most vulnerable groups to climate change. The adaptive capacity of poor citizens is severely limited, as they lack the resources to protect themselves from crises and their consequences, and the places where they live are most vulnerable to climate hazards.

In Armenia, as in the rest of the world, the poverty rate among women is higher than among men. There are a number of reasons for the latter, including the more often informal employment of women, and consequently the instability of income. It is noteworthy that poverty among women is higher, as they spend more time on housework and raising children.

In terms of vulnerability to the negative impacts of climate change, the elderly can also be noted. Although the poverty rate in the age group over 60 in the Republic of Armenia is below average[43], but climate change may have a greater negative impact on the health of older people.

According to the World Health Organization[44], the elderly are more vulnerable to prolonged extreme heat and cold weather conditions, air pollution, and the spread of infectious diseases, as they have a harder time adapting to such conditions and have weaker immune systems.

One of the issues related to infrastructure and services is the limited mobility, which hinders the mobility of the population, and in particular women. The availability of safe and accessible public transport systems increases women's mobility and expands opportunities for time use and economic empowerment.

Table 47 below presents the population vulnerability to each of the most important or significant climatic and other natural hazards.

[42] МСУОБ ООН (2012) Improving the resilience of cities to disasters - Handbook for the heads of municipalities and local authorities. Geneva, Switzerland. International strategy of the UN to reduce the danger of disasters.

[43] https://armstat.am/file/article/poverty_2021_a_2..pdf

[44] https://cdn.who.int/media/docs/default-source/decade-of-healthy-ageing/decade-connection-series-climatechange.pdf?sfvrsn=e926d220_3&download=true

Table 47. Vulnerable population groups

Climatic or another natural hazard	Vulnerable groups	Vulnerability level
Drought	Those living or working in affected areas, especially the elderly, chronically ill, children, those working outdoors in the heat, those with mobility issues, athletes, and the homeless.	Moderate
Storm	Residents of the community and visitors.	Moderate
Hail	Residents of the community and visitors, all persons living or working in remote areas, low-income households.	Moderate
Heavy precipitation	All persons living/working in the affected areas, especially the elderly, chronically ill, children, outdoor workers, people with limited mobility, athletes, homeless people, etc. Those living around the Debed River are particularly vulnerable.	High
Frostbite	Residents of the community and visitors.	Moderate

Adaptive capacity

Adaptive capacity or adaptability is the possibility of the ecosystems, institutions, people and other organisms to respond to the probable damages or use the consequences to adapt.

In other words, adaptive capacity can be described as the ability of a person or system to adapt to climate change (including climate variability and extremes), reduce potential damages, take advantage of opportunities, or cope with consequences. Adaptive capacity is a function of available financial resources, human resources, and adaptation options. Capacities may vary depending on climate hazards and target sectors. For example, a region or community that is well-prepared to withstand floods may be extremely vulnerable to a heat wave.

From this perspective, it is very important to conduct the adaptation assessment in the context of specific risks and sectors, which can be the subject of a separate detailed study.

According to a report by the United Nations Office for Disaster Risk Reduction, Cities or communities are considered sustainable[45]:

- where the risk of disasters is minimized, as the population lives in houses and regions equipped with the necessary engineering infrastructure and built according to reasonable construction standards, where illegal construction is not carried out, especially in coastal areas and on steep slopes;
- where there is a competent and responsible city government, representing broad segments of the population, which is interested in sustainable urban development processes and is ready to allocate the necessary funds for the development of its own capacities to solve managerial and organizational problems before, during and after natural disasters;
- where local authorities and residents are aware of the existing risks and create a local information base on the damages caused by natural hazards, as well as threats and risks, also indicating the most vulnerable groups of the population;
- where people have the opportunity to participate in decision-making and the development of their communities, together with local authorities;
- where measures are taken to prevent or mitigate the consequences of disasters, monitoring and early warning technologies are implemented to protect infrastructure, residents' property, cultural values, as well as natural and economic resources;
- where it is possible to minimize material and social damage caused by extreme weather events and hazards caused by human activity;

[45] МСУОБ ООН (2012) Improving the resilience of cities to disasters - Handbook for the heads of municipalities and local authorities. Geneva, Switzerland. International strategy of the UN to reduce the danger of disasters.

- where there are opportunities for rapid response and implementation of measures for the immediate restoration of vital services, as well as social, organizational and economic activities, after each emergency;
- where people recognize that all of the above measures also play an important role in strengthening community resilience to the impacts of adverse natural phenomena, including GHG emission reduction and adaptation.

According to the Covenant of Mayors Reporting Guidelines[46], the following five factors of adaptive capacity are defined, which describe the current ability of a community in a given area to adapt to the impacts of climate change:

- **Service availability**: access to basic services (e.g. healthcare, education, etc.).
- **Socio-economic**: interaction between the economy and society, combined with the presence of relevant assets (e.g. economic health, employment, poverty, immigration), as well as the level of social awareness and cohesion.
- **Governmental and institutional**: the existence of the institutional environment, regulations and policies (e.g. laws on restrictions, preventive measures, urban development policies), the leadership and competences of local government bodies, the capacities of staff and existing organizational structures (e.g. knowledge and skills of staff, the level of interaction between relevant departments and bodies of municipalities), the existence of a sufficient budget for climate (adaptation) actions.
- **Physical and environmental**: availability of resources (e.g. water, land, environmental services) and their management practices, availability of physical infrastructure and conditions for its use and maintenance (e.g. green-blue infrastructures[47], health and educational institutions, emergency response facilities).
- **Knowledge and innovation**. availability of data and knowledge (e.g. methodologies, guidelines, assessment and monitoring frameworks), availability and access to technologies and technical applications (e.g. meteorological systems, early warning systems, flood control systems) and the skills and capacities needed to use them, and innovation potential.

Each community should have the opportunity to assess its sectoral adaptive capacity to climate change, taking into account the factors mentioned above.

The main branches of economic development of the Noyemberyan community are agriculture, tourism, as well as small and medium-sized enterprises. Through the budgets of state, community, donor institutions and private investments, steps are being taken to develop the above-mentioned sectors, which can contribute to strengthening the community's adaptive capacity to climate change.

Despite the fact that the adaptive capacity of the Noyemberyan community is very low, it is worth noting the community's capabilities and factors for coping with climate change, which are:

[46] Reporting Guidelines, Covenant of Mayors - Europe Office in March 2020

[47] Green-blue infrastructures: natural and semi-natural territories strategically planned as systems, which have environmental features, which Ecosystems are created and maintained services wide to provide a framework, such as water cleaning, air quality control, reduced heat stress, rest areas, as well as climate change mitigation and adaptability. Green (land) and blue (aquatic) territories are the systems that can improve surrounding environment conditions and, therefore, residents of communities' health and life quality. It also supports green economy, creation of jobs opportunities and contribute biodiversity. At the local (community) level, green infrastructure practices include rainwater-irrigated gardens, permeable pavements, green roofs, water infiltration systems, trees and tree boxes, and rainwater harvesting systems, etc. Blue infrastructure usually refers to urban water infrastructure, including ponds, lakes, rivers, streams, as well as rainwater and stormwater removal, storage, and use systems.

- **Access to basic services:** Noyemberyan community has access to information sources and means of communication, inter-community roads, access to education, availability of health facilities, availability of banks and credit organizations.
- **Physical and environmental**. The Noyemberyan community has favorable climatic conditions and a favorable economic and geographical location, access to drinking water, forests and natural springs, which, if properly used and managed, will contribute to the development of agricultural activities, as well as the tourism sector.

11.5. Climate change adaptation measures

Thus, based on the climate and other natural hazards listed in **Table 46**, Noyemberyan community vulnerabilities of the main sectors, as well as taking into account the "Tavush Region Adaptation Plan" developed in 2023 and the proposed priority solutions for climate change adaptation, a short-term (until 2030) and medium-term (until 2050) scenario has been developed by the specialists of the municipality and the experts of the Program. The list of adaptation measures to be implemented is summarized in **Table 48**.

It is worth noting that in the enlarged Noyemberyan community, the vulnerability assessment of sectors to climate risks, as well as the identification of targeted adaptation measures, is the subject of a separate, detailed and comprehensive study. Within the framework of the SECAP, the main climate hazards have been identified and initial adaptation measures have been proposed, which will subsequently require separate studies to make more objective decisions on their prioritization, implementation approaches, and funding volumes and sources.

The included programs are planned to be implemented with investments from the community and state budgets, local and international donor organizations, private companies, and philanthropists.

Implementing planned adaptation measures simultaneously provides multiple social, economic and environmental benefits. Socially, they increase the protection and inclusive participation of the community population, especially women and vulnerable groups living in poverty; economically, they contribute to income stabilization, damage and loss reduction; and environmentally, they ensure the conservation of natural resources, emission reduction, and long-term sustainability. Thus, the combined effect of the measures contributes to strengthening community resilience and sustainable development.

The SECAP also includes activities of priority/key importance for the community, for the implementation of which the community, in the absence of clear funding sources, seeks funding sources.

Table 48. List of adaptation measures to be implemented by 2050 within the framework of the Noyemberyan Community SECAP

Description	Risks / hazards	Responsible / beneficiaries	Possible source of funding	Terms	Social, economic and environmental benefits
AGRICULTURE / FORESTRY					
1.1. Ensuring sufficient irrigation of agricultural lands and studying and implementing the feasibility of introducing drought-resistant/drought-tolerant crops in the context of climate hazards.	drought	Municipality, water supply companies, agricultural enterprises, RA Ministry of Territorial Administration and Infrastructure.	Municipality, water supply companies, agricultural enterprises, RA Ministry of Territorial Administration and Infrastructure.	2026-2050	Reduce crop losses and increase food security by ensuring the sustainability of the livelihoods of women and other vulnerable groups, reducing poverty risks, and contributing to the economic resilience of rural communities.
1.2. Apply vegetated windbreaks in areas frequently affected by strong winds.	storms	Municipality, international companies, agricultural enterprises, individuals	Community budget, state budget, donors, international programs, other sources	2026-2050	Reduces agricultural losses and ensures crop stability, contributing to food security, protecting the livelihoods of women and vulnerable groups, as well as increases the economic resilience of rural communities.
1.3. Introduction and use of effective anti-hail systems, etc. Development and implementation of a reporting and alert system, increasing the level of awareness and communication.	hail	Municipality, international companies, agricultural enterprises, individuals.	Community budget, state budget, donors, international programs, other sources	2026-2030	They reduce agricultural losses and ensure crop stability, increasing food security, promoting the protection of women and vulnerable groups, and reducing poverty risks.
1.4. Development of a program for the introduction of insurance mechanisms for agricultural activities, as well as financial support for residents and organizations engaged in agriculture.	climate extremes	Municipality, insurance companies, agricultural enterprises, RA Ministry of Environment and RA Ministry of Territorial Administration and Infrastructure.	Community budget, state budget, international programs.	2026-2050	Reduces income instability and poverty risks, ensures economic stability and social protection of rural communities, especially for women and vulnerable groups. These measures also promote the continuity of agricultural activities and contribute to environmental protection.
1.5. Increasing the level of awareness of the population, ensuring access to necessary advisory services. *	climate extremes	Municipality, international programs, private sector.	State budget, international programs, owners. (Required investment:	2026-2030	Contribute to social protection, economic sustainability of rural communities, and the formation of environmentally responsible behavior,

			about 0.2 million euros)		emphasizing the inclusive participation of women and vulnerable groups and poverty-sensitive approaches.
1.6. Ensuring access to financial and credit advisory services.	climate extremes	Municipality, financial organizations.	Community budget, state budget, international programs.	2026-2030	Contributes to the financial stability and income security of agricultural workers, ensuring the inclusive participation of women and vulnerable groups, reducing poverty risks, and promoting the socio-economic resilience of communities.
BUILDINGS AND STRUCTURES					
2.1. When designing new buildings and structures in the community, consider construction standards under climate change, as these structures must be operated in conditions of heavy rainfall, strong winds, and hail.	storms heavy precipitation hail	Municipality, design organizations, developers and owners, supervisory bodies.	Community budget, state budget, international programs, private sector.	2026-2050	Reduces damage from climate hazards and ensures the safe operation of structures, increasing the social protection of communities, promoting the sustainability of the livelihoods of women and vulnerable groups, and reducing economic losses.
2.2. Study the physical condition of residential homes and buildings, while assessing the actual level of negative impacts of climate change and developing work plans aimed at reducing losses.	storms heavy precipitation	Municipality, design organizations, developers and owners, supervisory bodies.	Community budget, state budget, international programs, private sector.	2026-2030	They enable the development of loss reduction plans that ensure social protection of the population, reduce economic losses, and promote the formation of resilient and environmentally responsible communities, emphasizing the needs of women and vulnerable groups.
2.3. Regular inspection of community-owned buildings, inventory of buildings with defects and damaged foundations, repair and/or waterproofing.	heavy precipitation mudflow	Municipality, residents, service organizations, condominiums.	Community budget, state budget, residents' funds, other sources.	2026-2050	They reduce damage from climate hazards, ensure social protection of the population and the safety of vulnerable groups, reduce economic losses, and contribute to the long-term sustainable operation of structures.
2.4. Inspection of roofs of multi-apartment buildings, inventory of roofs vulnerable to heavy rainfall, hail and strong winds, repair of vulnerable roofs, replacement of	storms heavy precipitation hail	Municipality, residents, service organizations, condominiums.	Community budget, state budget, residents' funds, other sources.	2026-2030	Reduces damage from climate hazards and ensures the safe operation of structures, increasing the social protection of the population, the

roof coverings (e.g. with galvanized sheet metal), reinforcement of supporting structures/bearing structures, replacement of worn-out timber, modernization of the drainage system. *			(Required investment: approximately 1 million euros)		sustainability of the livelihoods of vulnerable groups and women, reducing economic losses, and promoting the resilience of communities.
2.5. Dissemination, awareness and training of safety standards among the population.	climate extremes	Municipality, residents, service organizations, condominiums.	Community budget, state budget, residents' funds, other sources.	2026-2030	They increase population awareness and preparedness, ensuring social protection, inclusive participation of vulnerable groups and women, reducing poverty risks, and promoting the economic and environmental resilience of communities.
TRANSPORT					
3.1. Monitoring the quality of road surface, timely and proper ongoing repair of damaged sections in order to prevent infrastructure deterioration and deterioration of traffic safety during heavy rainfall, hail and mudflows.	hail heavy precipitation mudflow	Municipality, road construction organizations.	Community budget, state budget.	2026-2050	Preventing infrastructure degradation and deteriorating traffic safety by ensuring social protection for the population, reducing economic losses, and promoting community resilience to climate hazards.
3.2. Ensuring the smooth operation of stormwater and stormwater drainage systems and storm drains, proper cleaning, prevention of blockages and repair. *	heavy precipitation mudflow	Municipality, road construction and operating organizations, etc.	Community budget, state budget, international programs, donors, etc. (Required investment: approximately 0.5 million euros)	2025-2030	They reduce the damage caused by climate hazards, ensure social protection of the population and the security of vulnerable groups, reduce infrastructural and economic losses, and contribute to the long-term resilience of communities.
3.3. Installation of information signs in danger zones. *	climate extremes	Municipality, road construction and operating organizations, etc.	Community budget, state budget, international programs, donors, etc. (Required investment: approximately 0.1 million euros)	2026-2030	Increases the awareness and level of security of the population, ensuring social protection, inclusive participation of vulnerable groups and women, reducing poverty risks, and promoting the economic and environmental resilience of communities.
WATER RESOURCES					

4.1. Study of existing irrigation and drinking water pipelines and water supply systems and identification of deficiencies, repair of damaged infrastructure or, if necessary, construction of new pipelines.	drought extreme hot	Municipality, water supply companies.	Community budget, state budget, private sector, international programs, donors, etc.	2026-2050	They ensure social protection of the population and the sustainability of the livelihoods of vulnerable groups, especially women, reduce economic losses and contribute to the long-term resilience of communities to climate hazards.
4.2. Ensuring uninterrupted operation of irrigation systems, introducing water-saving and modern irrigation technologies, and creating water storage reserves.	drought extreme hot	Municipality, "Veolia Jur" CJSC	Community budget, state budget, private sector, international programs, donors, etc.	2026-2030	They increase water use efficiency, ensure food security in rural communities and the sustainability of livelihoods of vulnerable groups, especially women, reduce economic losses, and contribute to environmental sustainability through the creation of water storage reserves.
4.3. Organization of information campaigns on reducing water consumption and saving and using water economically.	drought	Municipality, water supply companies, NGOs, donors.	Community budget, private sector.	2026-2030	They raise awareness among the population, ensure social protection and inclusive participation of vulnerable groups, especially women, reduce economic losses, and contribute to the effective and environmentally sustainable management of water resources.
ENVIRONMENT AND BIODIVERSITY					
5.1. Development of community/regional/plant cultivation policies driven by climate change.	climate extremes	Municipality, RA Ministry of Environment, environmental organizations.	Community budget, international programs and other sources.	2026-2030	Ensures social protection of communities and inclusive participation of vulnerable groups, especially women, reduces agricultural damage and economic losses, as well as promotes environmental sustainability, contributing to the formation of long-term resilience.
5.2. Conservation of unlicensed landfills and prevention of their emergence and spread.	Extreme heat, storm	Municipality, public organizations, international programs, private sector, RA Ministry of	Community budget, state budget, donors, international programs, other sources.	2026-2030	They reduce health and social risks, ensure the protection of communities and the sustainability of the livelihoods of vulnerable groups, especially women,

		Environment.			reduce economic losses, and contribute to environmental sustainability by promoting the creation of a clean and safe environment.
ENERGY					
6.1. Large-scale use of renewable energy resources for energy supply of community-owned structures. *	climate extremes	Municipality	Community budget, state budget, donors. (Required investment: approximately 0.5 million euros)	2026-2030	Reduces economic costs and energy dependence, ensures social protection of the population and the sustainability of the livelihoods of vulnerable groups, especially women, as well as promotes environmental sustainability by reducing emissions and contributing to the formation of a clean environment.

*Note: * Key actions.*

Conclusions - Climate Change Adaptation

The impacts of climate change already pose a serious challenge for almost all cities around the world: they threaten to increase vulnerability to climate hazards, reduce access to natural resources and weaken ecosystem functionality, limit citizen safety, reduce business, hinder socio-economic development, etc. Therefore, adaptation to climate change is increasingly becoming an important priority for cities.

As a result of this analysis, an assessment of the climate hazards, risks, and vulnerabilities specific to the community was conducted for the Noyemberyan enlarged community, based on which initial adaptation measures were proposed to reduce or eliminate the identified risks.

Thus, based on international and local best practices, as well as taking into account the available information and methodologies, the vulnerability of the Noyemberyan community has been assessed as high for the risks of drought and heavy precipitation, and moderate for the risks of frost, hail, and storms.

In total, 20 measures (including 5 key measures) have been proposed for the community to adapt to identified climate risks, the feasibility and priority of which should be determined by the municipality within the framework of a more detailed study and development of a more comprehensive climate strategy, taking into account the financial and technical capabilities of the community, as well as the opinions of beneficiaries and community residents.

The measures in the indicated quantities were proposed according to the following main areas:

- Agriculture: 6
- Buildings and structures: 5
- Transport: 3
- Water resources: 3
- Environment: 2
- Energy: 1

Since the assessment of financial resources required for the implementation of adaptation measures is generally a rather complex and time-consuming process that may require a separate study, the financial volumes of adaptation measures in this plan are presented as approximate, only for key actions and based on investments in similar measures in the five-year community development plan.