



German
Economic
Team

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POLICY BRIEFING
ARMENIA

Energy sector monitor Armenia 2024

by Daniel Sosa, Julian Grinschgl, Pavel Bilek and Dmitry Chervyakov

Executive summary

- » The Armenian energy system is heavily dependent on fossil fuels, in particular natural gas
- » The country has no domestic oil and gas production and had to import 81% of its primary energy supply in 2023
 - Armenia imports 100% of its natural gas, nuclear fuel and oil products, primarily from Russia and to lesser extent also from Iran
- » Electricity in Armenia is produced from a diversified mix of natural gas, nuclear and hydro power
- » The power plant park in Armenia is relatively large compared to peak demand
 - However, large hydro plants and the nuclear power plant are ageing and in need of replacement or modernisation. The operation of the nuclear plant was extended; plans for replacement exist
 - The government plans to significantly expand renewable energies, solar PV in particular is seen as the most promising source
- » Armenia has active interconnection infrastructure with Iran and Georgia and is a net exporter of electricity. Existing interconnections with Turkey and Azerbaijan are currently inactive
 - Further regional interconnection is desired but options to boost trade are currently limited
- » The electricity market is in the process of liberalisation, while the gas market and its infrastructure is fully controlled by Gazprom Armenia
- Heavy reliance on gas and the very low level of import diversification constitute a significant energy security risk for Armenia
- Development of renewable energy sources and expansion of regional interconnections are crucial

Structure

1. Introduction
2. Primary energy mix and imports
3. Final energy consumption
4. Sector organisation
5. Electricity
 - Demand
 - Generation and transmission
 - RES potential
 - RES plans
 - Potential of international integration
 - Market opening and tariffs
6. Gas sector issues
7. Energy efficiency
8. Emissions

1. Introduction

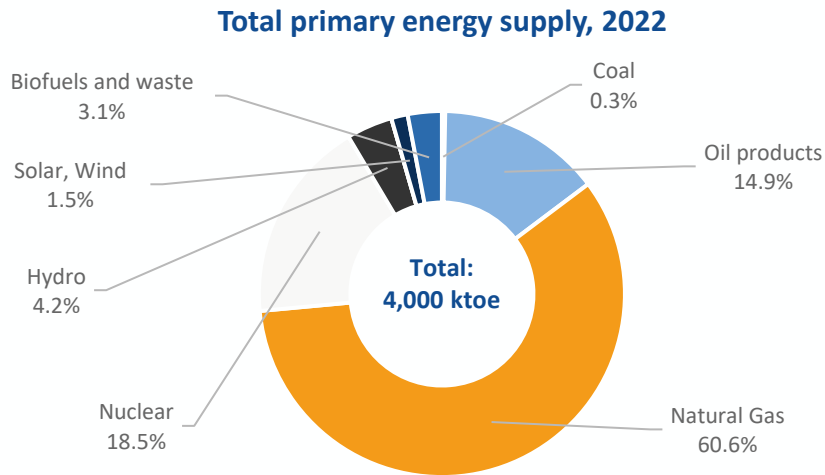
Background

- » Armenia has no domestic oil or gas reserves. As a result, the country has to import most of its energy carriers, almost exclusively from Russia
- » The country actively tries to reduce its import reliance by boosting renewable energy sources, in particular solar PV, while also addressing its lack of energy efficiency
- » Armenia's electricity market is undergoing a significant transformation as liberalization of the electricity wholesale market started in 2022 and the decision to build a new nuclear power plant has been made
- » The gas market is still vertically integrated and wholly owned by Gazprom Armenia, including all infrastructure
- » The oil market has a comparatively lower significance in Armenia and is fully liberalized

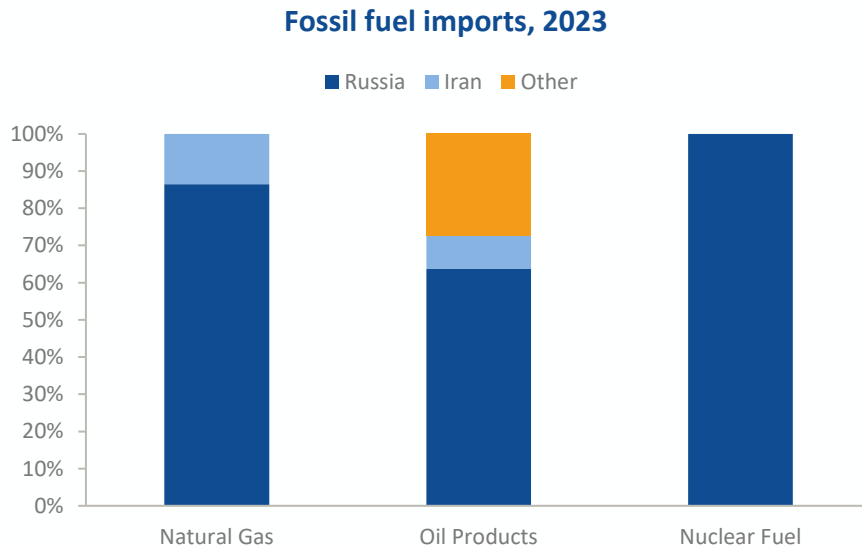
Purpose of this Policy Briefing

- » Provide an overview and update on the status of the Armenian energy system

2. Primary energy mix and imports



Source: Armstat



Source: UN Comtrade

Primary energy supply

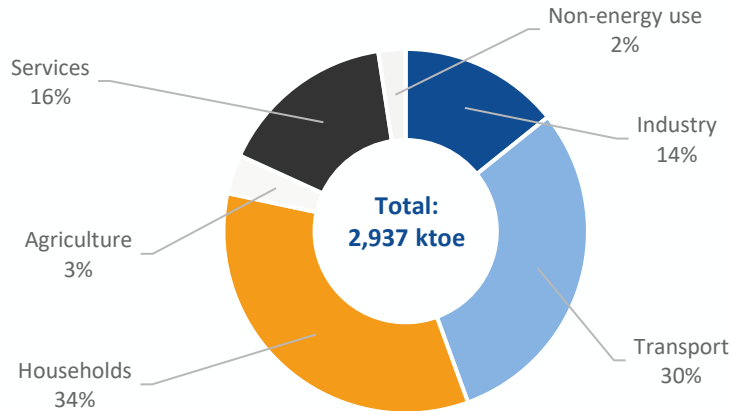
- » ARM's energy mix is heavily dependent on fossil fuels, in particular natural gas (~61%), while renewables only play a marginal role, so far (~9%)
- » The country has no domestic oil and gas production and had to import 78% of its primary energy supply in 2022

Imports

- » ARM imports almost all of its fossil fuels from only two sources - Russia and Iran
 - Imports of Russian gas decreased by ~10% (down to 240 mcm) in 2023
 - The political situation with Azerbaijan and Turkey complicates diversification
- ARM is heavily reliant on imported fossil fuels, predominantly from Russia

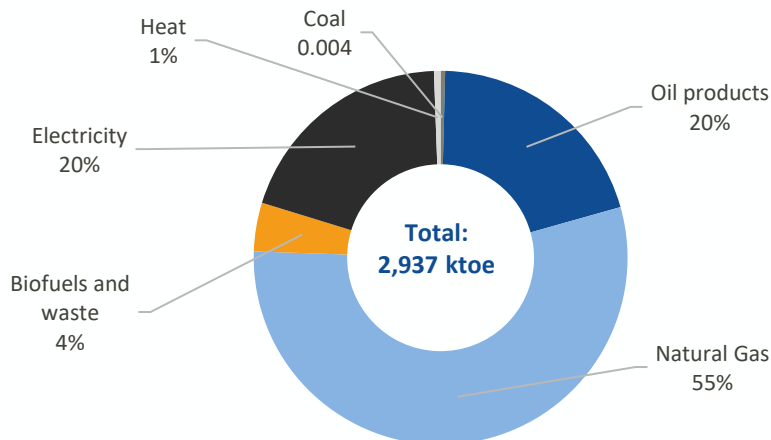
3. Final energy consumption

Final energy consumption by sector, 2022



Source: Scientific Research Institute of Energy – Energy Balance 2022

Final energy consumption by source, 2022



Source: Scientific Research Institute of Energy – Energy Balance 2022

Sectoral consumption

- » Final energy consumption grew by 56% since 2010, with households being the largest consumer in 2022
 - Households consume mostly natural gas (57%) and electricity (18%)
- » Consumption in the transport sector is split between oil products (52%) and gas (47%)
 - The int. comparatively high share of natural gas stems from ARM's large CNG-fueled car fleet

Final consumption

- » Natural gas use grew by 52% since 2010, but its overall share remained relatively stable
- » Oil products and electricity use grew by 56% and 36% respectively since 2010, while their shares remained constant
- » Biofuels usage grew fourteenfold since 2010, but its overall share in 2022 remained negligible (4%)
- Imported natural gas kept its dominant share in the ARM energy mix over the years

4. Sector organisation

Governance

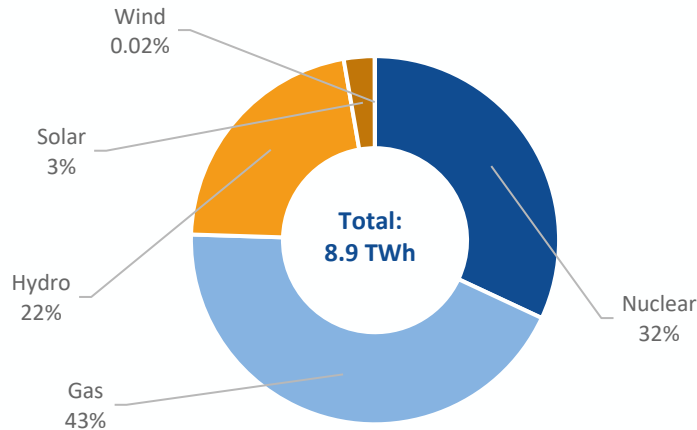
- » The **Ministry of Territorial Administration and Infrastructure** is in charge of the overall energy policy in the country and is overseeing network energy carriers such as gas and electricity. The oil product market is under the supervision of the **Ministry of Economy**
- » The **Public Service Regulatory Commission (PSRC)** is the independent regulator and is responsible for tariff setting, service quality and licensing
- » The **Committee on Nuclear Safety Regulation of the Republic of Armenia (ANRA)** regulates the nuclear sector, including radiation safety, and licenses for the operation of the Metsamor NPP
- » **Electric Networks of Armenia (ENA)** is the single distribution company that previously had an exclusive right to buy from generators and sell to consumers
- » Electricity market unbundling started in 2022. Generation and retail segments are open to private participation and the country introduced a wholesale power market
- » The gas market remains a vertically integrated monopoly owned by Gazprom Armenia
- » The oil product market is fully privatized

Eurasian Economic Union (EAEU)

- » ARM is a member of the Eurasian Economic Union. Russia proposed the formation of a common market for gas, oil (products) and electricity by 2025
- » Despite a 2019 EAEU agreement mandating reforms for third-party gas access signed by Armenia, Gazprom's monopoly persists
- Liberalisation and unbundling efforts have progressed, mainly in electricity but not gas sector

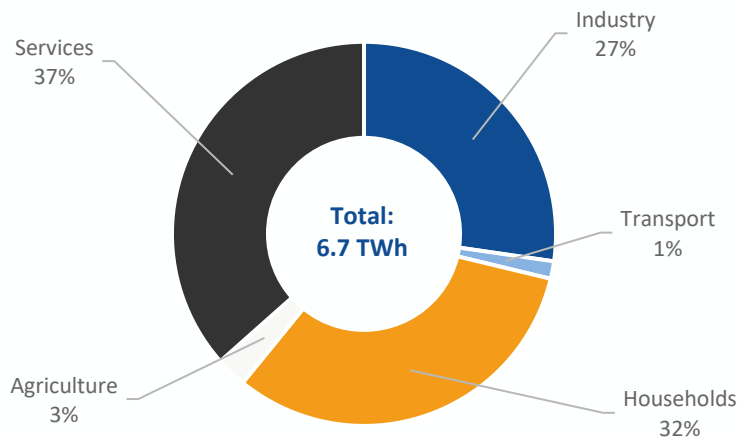
5. Electricity sector overview

Annual electricity generation, 2022



Source: Public Services Regulatory Commission of Armenia (2022)

Final electricity consumption by sector, 2022



Source: Scientific Research Institute of Energy – Energy Balance 2022

Generation mix

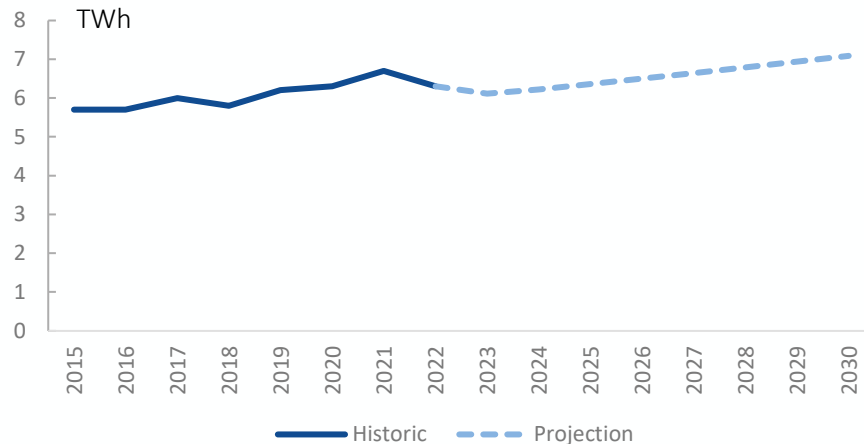
- » Diversified generation mix of natural gas, nuclear and hydro power
 - natural gas and nuclear fuel are 100% import-dependent
- » Since 2015, electricity generation from:
 - Natural gas up by 38%,
 - Hydro down by 12%
 - Nuclear up by 2%
- » Hydropower remains the main renewable energy source (74%), followed by solar (26%)

Demand

- » Electricity demand is roughly equally split between services, households and industry
- » Considerable system losses (~10%)
- Large difference between consumption and generation allows ARM to be a net exporter of electricity. Mainly to Iran (~1.1TWh in 2022)

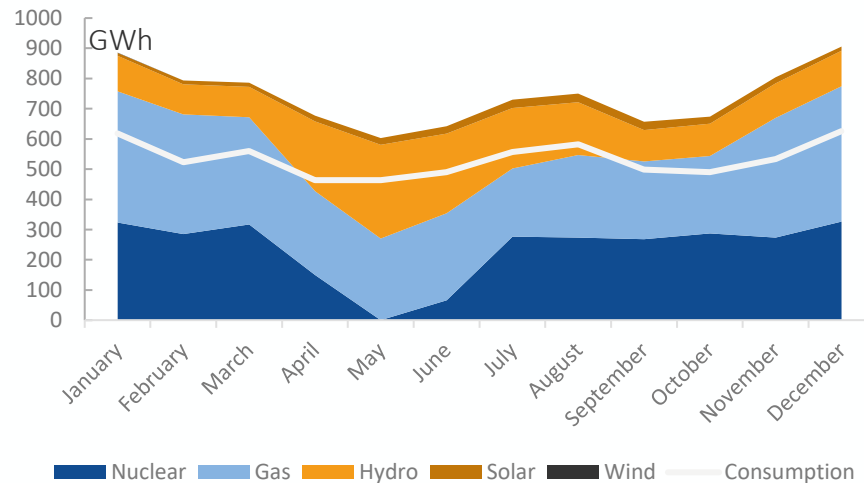
5. Electricity – demand

Electricity consumption, 2015-2030



Source: IEA; Scientific Research Institute of Energy – Energy Balance 2021; Baseline forecast - ARM Transmission Network Ten-Year Development Plan

Monthly electricity generation, 2022



Source: Public Services Regulatory Commission of Armenia (2022)

Demand development

- » Electricity consumption is projected to grow only modestly until 2030
- » Armenia was well-equipped in recent years to meet demand requirements
- » However: the roll-out of variable generation currently poses a challenge for balancing
 - Storage and interconnections need to be strengthened

Hydro-agriculture trade-off

- » Strong trade-off between water usage for electricity (hydropower) and agriculture
 - 50% of river flow is subject to significant annual fluctuations
 - Rising temperatures could double water consumption for crops by 2100
 - At the same time: agriculture is the main employer, especially in rural regions
- » Demand growth remains modest, but storage and interconnections are needed for electricity balancing
- » Higher peaks during summer and trade-off with agriculture pose challenges

5. Electricity sector - installed capacities

Plant Name	Fuel Source	Nameplate capacity (MW)	Avail. capacity (MW)	Ownership	Start of operation	Decommissioning
NPP CJSC	Nuclear	856	448.25	State-owned	1976	Extended to 2026
Hrazdan TPP (Unit 1-4)	Gas	410	0	Tashir Group	1972-1974	Supplementary use
Hrazdan TPP (Unit 5 - CCGT)	Gas	467	440	Gazprom Armenia	2011	2033
Yerevan CCGT-1	Gas	233	233	State-owned	2010	2036+
Yerevan CCGT-2	Gas	254	254	ArmPower CSJC	2021	2036+
Sevan-Hrazdan HPP Cascade	Hydro	561	472	Tashir Group	1949-1962	2036+
Vorotan HPP Cascade	Hydro	404	404	Contour Global Hydro	1977-1989	2036+
Small HPP	Hydro	423	423	Various		
Utility-scale Solar	Solar	473	473	Various		
Wind	Wind	8	8	Various		
Total		4089	3155			

Source: authors own compilation based on IEA; IRENA; ARM Transmission Network Ten-Year Development Plan; GEM-Monitor; PSRC.; **data for 2023**

Note: Slight deviations of installed & available capacities are reported by the different sources.

Capacity mix

- » Installed capacity is relatively large (~4 GW) compared to peak demand (~1.3 GW)
 - Available capacity is significantly lower (3.1 GW) as ~ 40% of installed capacity is more than 40 years old and in need of modernisation and/or replacement
- » ARM extended lifetime of nuclear reactor until 2026 and may be further extended through 2036
- » There are plans to build a new reactor until 2036
 - Plans for a Russian 1000-1200 MW VVER-1200 reactor most advanced, but ARM also in talks with US for a small modular reactor instead
- » Yerevan CCGT-2 commissioned in 2021 and plans to expand RES until 2030 (see slide on RES plans)
- ARM has ample generation capacity, but needs to modernise its power sector

5. Renewable Energy Potential

Solar

- » Technical potential of 39.7 GW
- » Expansion is limited by to country size and land availability

Wind

- » Technical potential of 500 MW. Highest wind speed in mountains and passes, implying higher costs
- » On government's request, ADB is currently developing a viability assessment for potential wind power projects in ARM

Hydro

- » Most of ARM's hydropower potential is already utilized
- » Small hydro was still being expanded in recent years, but additional technical potential limited (~50 MW)
- » Possible competition with agricultural sector limits potential

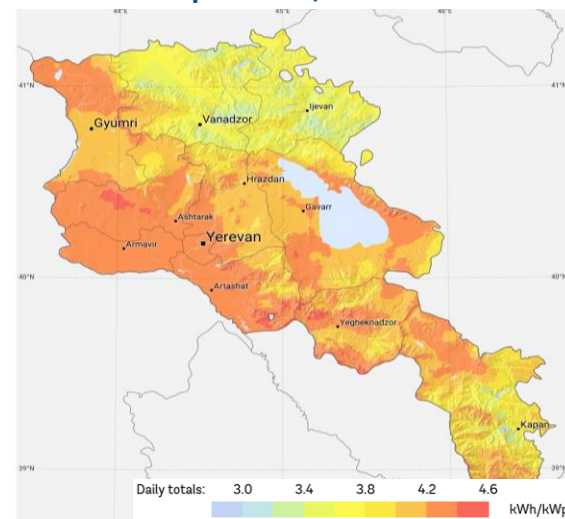
Geothermal

- » Geothermal potential is estimated at ~150 MW, plans for a 25 MW plant in Jermaghbyur, currently on hold

Biogas

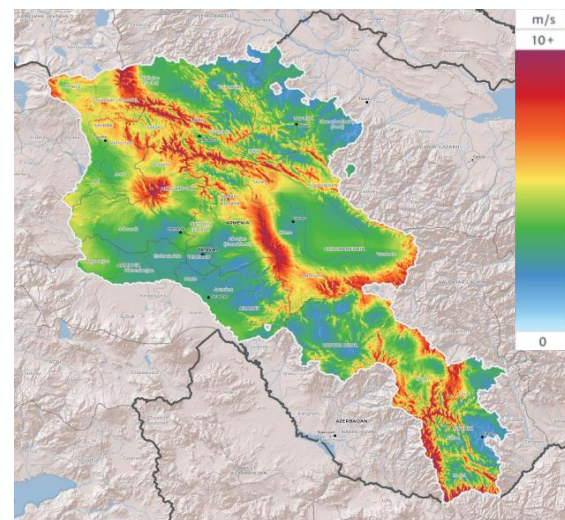
- » Potential of 135 mcm per year, but so far not widely used
- Significant potential to scale up RES, particular solar PV

Solar potential, 1994-2023



Source: Global Solar Atlas

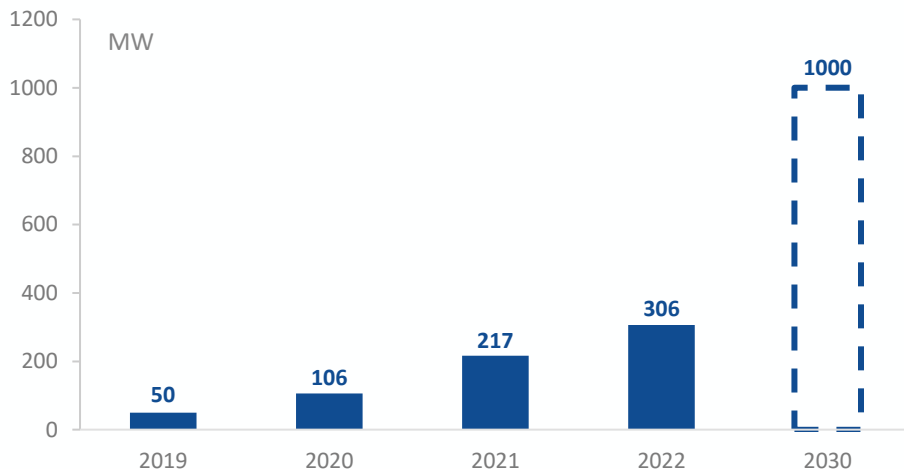
Wind potential, 1994-2023



Source: Global Wind Atlas

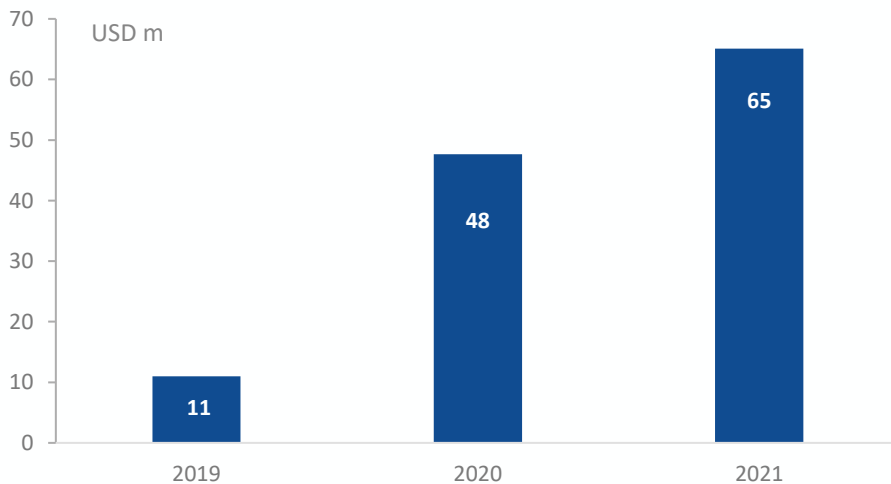
5. Electricity – RES Plans

Installed utility-scale solar capacity



Source: IRENA

Clean energy investments



Source: Global Climatescope - BNEF

Government plans

- » Government plans to increase renewables to 66% of the power generation mix by 2036
- » Armenia has RES auctions, a feed-in tariff policy, and net metering to encourage renewable energy uptake
- » Hydro power remains the backbone of ARM's renewable generation (1425 MW capacity in 2023)
- » Wind rollout goals envision 500 MW by 2040, but developments remain uncertain with no tangible project in the pipeline

Solar PV

- » Solar PV is expanding rapidly and is envisaged to reach 1000 MW by 2030 (~15% of total electricity generation capacity)
 - "Ayg-1" PV plant is under development with an installed capacity of 200 MW
- » Focus on developing RES, especially solar PV

5. Electricity integration

Armenia's electricity transmission system



Source: IEA

Cross border interconnection capacity

Iran	Georgia	Turkey	Azerbaijan
340 MW	200 MW	Inactive	Inactive

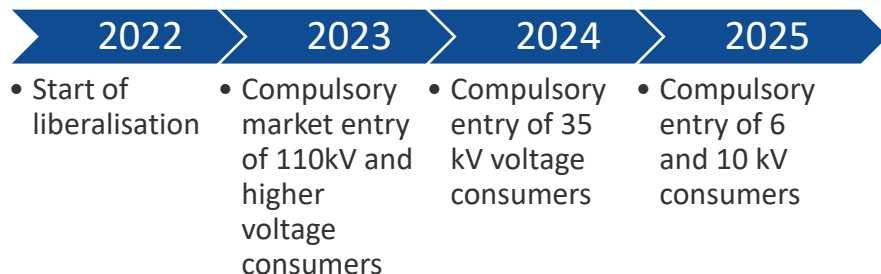
Source: IEA

Boosting trade

- » Energy strategy from 2020 envisages ARM to become significant electricity exporter, **BUT:**
- » Connections with **GEO** exist but limited trade
 - Not synchronised and problem of seasonality: GEO also wants to export during summer months
 - Plans to expand capacity to 700 MW
- » ARM is a net exporter of electricity to IRI (2023: 1.1 TWh) as part of gas-for-elec. deal
 - Barter deal foresees 3 kWh electricity for 1m³ gas (~6kWh of electricity)
 - Plans to expand deal to 600 mcm gas for 1.8 TWh electricity, up to 5 TWh
 - Third power line is under construction, raising capacity from 340 to 1200 MW
- » Connections with TUR and AZE are in place, but not used for political reasons
- » Other regional integration plans (e.g. “Black Sea power ring”, “North-South corridor”) currently on hold
- Options to diversify and boost trade with neighbours are limited

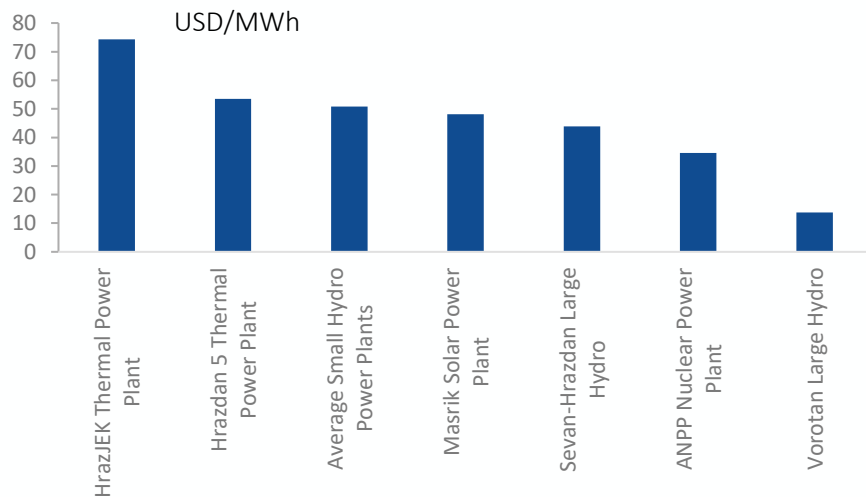
5. Tariffs and market opening

Liberalisation schedule of electricity market



Source: ampop.am, <https://ampop.am/en/how-the-wholesale-electricity-market-works-in-armenia/>

Selected producer tariffs, 2023



Source: [aex.setcenter.am](https://www.setcenter.am); Note: Data as of 6th November 2023; Average 2022 USD-ARD FX rate

Gradual market opening

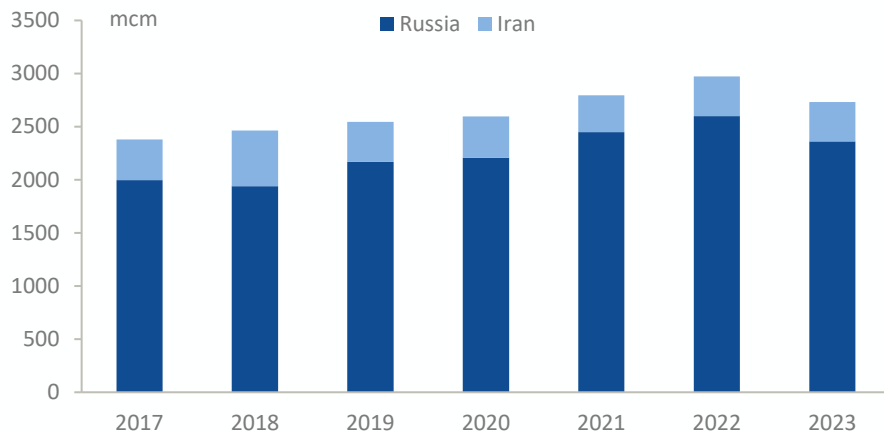
- » Since 2022: gradual market liberalisation
 - Before: regulator set tariffs; Electric Networks of Armenia (ENA) had exclusive right to buy and sell electricity
- » Gradual inclusion of more consumer groups, but in 2022 only 5.3% of the total electricity volume was traded under new rules
- » From Feb-23: largest electricity consumers required to buy electricity under new market regulation (or face higher tariffs)

Tariffs for households

- » Households largely continue to keep their old contracts (2022: 80-103 USD/MWh)
- » Subsidised tariff for low income HH available
- ARM is currently undergoing a comprehensive but gradual liberalisation of its electricity market
- Consumer groups can now freely choose their supplier, fostering competition

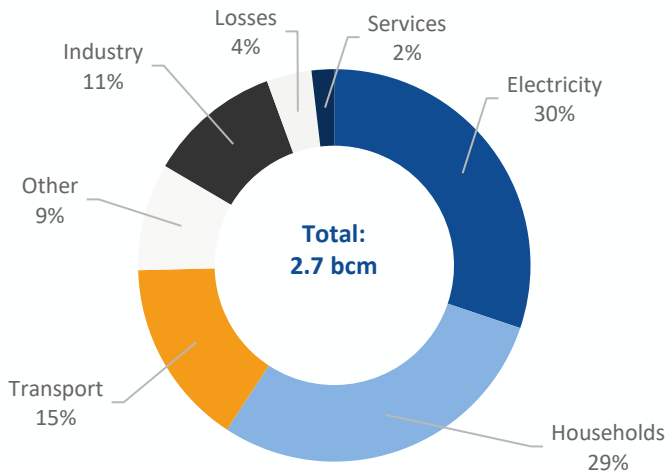
6. Gas sector issues

Armenian gas imports



Source: Public Services Regulatory Commission of Armenia (2024)

Gas consumption, 2023



Source: Public Services Regulatory Commission of Armenia (2024)

Dependence on Russia

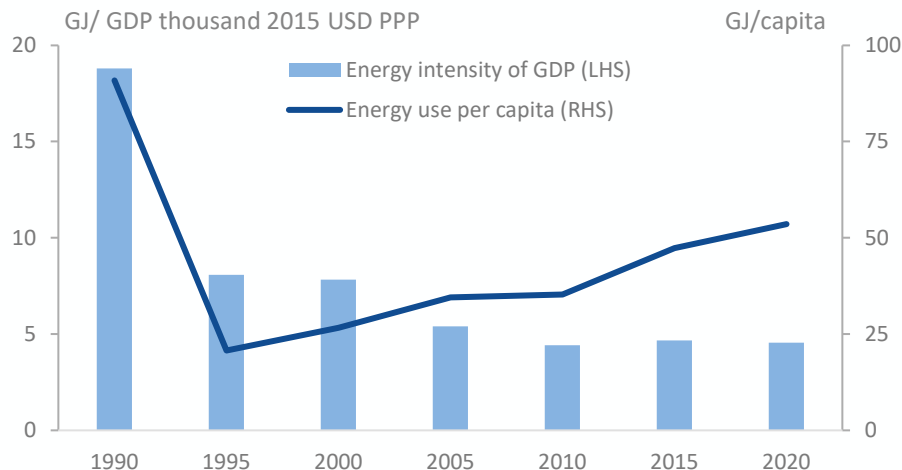
- » The gas sector and its infrastructure are a vertically integrated monopoly, wholly owned by Gazprom Armenia
 - Gazprom obtained infrastructure in exchange for relief from gas-related debts and below market gas supplies (currently USD 165 per 1000m³)
- » 2023: 86% (2.3 bcm) gas imports from RUS
 - Imports RUS gas via GEO with an effect. annual pipeline capacity of 10 bcm
- » Also: some gas imports from IRI (2023: 0.4 bcm); pipeline with a capacity of 2.3 bcm
 - In theory, IRI could meet most of ARM gas needs; but Gazprom owns pipelines

Common gas market

- » EAEU plans to launch a common gas market in 2025; strengthens gas dependency on RUS
 - Requires members to prioritize meeting their gas needs from EAEU production
 - Limits third party access to gas system
- High dependency on RUS in the gas sector

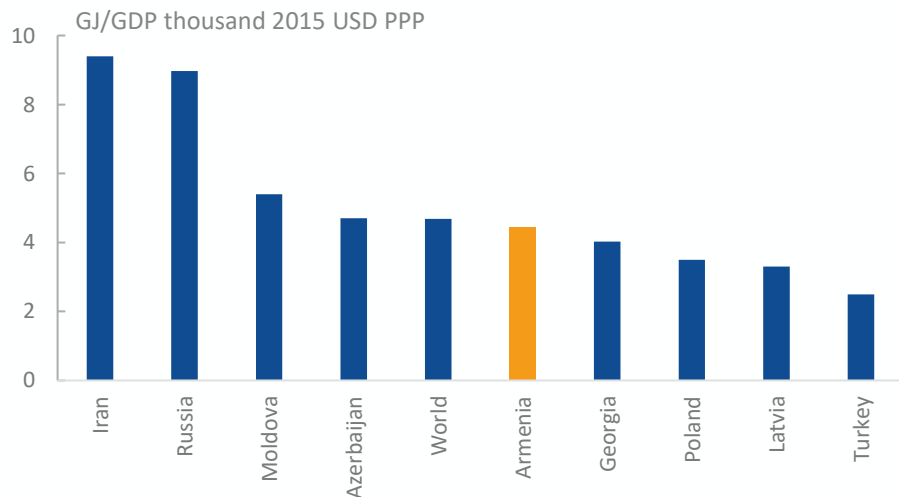
7. Energy efficiency

Energy intensity



Source: IEA

Energy efficiency in comparison, 2021



Source: IEA

Large potential

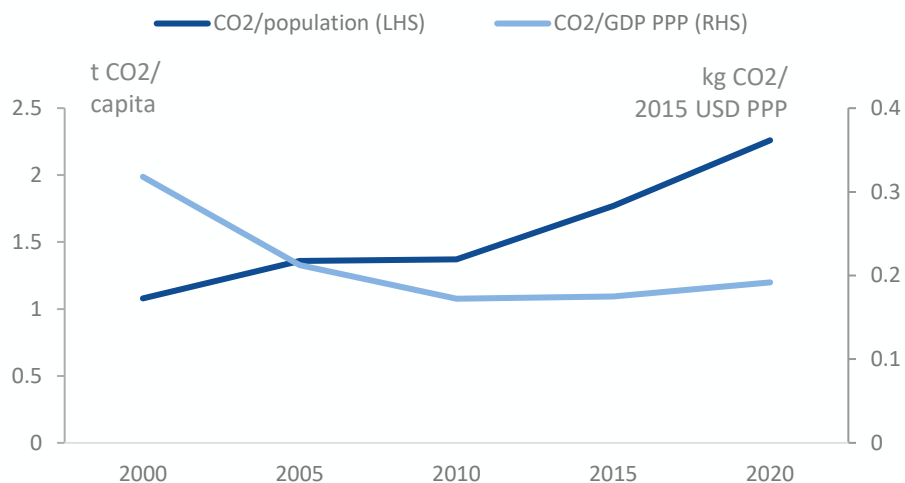
- » Given large import dependence of ARM, energy efficiency is crucial
- » In 2022, government adopted a range of policy measures and action plans
- » Overall saving potential is estimated at 931 ktoe (24% of consumption in 2021), mostly in transport sector (744 ktoe)

Energy efficiency stagnation

- » Energy intensity of economy is stagnating since 2010 while energy usage per capita is increasing as a result of econ. development
- » No large energy-intensive industries; HH consume most energy (34% in 2021), but at low level in global comparison
 - Sign of poor thermal comfort rather than high energy efficiency in residential sector
- » Energy efficiency is a key tool in addressing energy challenges in ARM

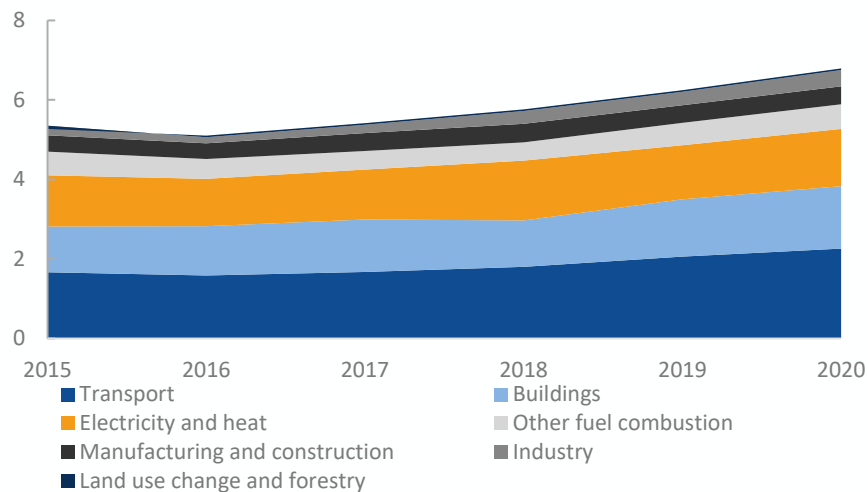
8. Emissions

Emissions development and intensity



Source: IEA

CO2 emissions by sector



Source: Climate Watch (2023)

Emission development and goals

- » In the NDC 2021-2030, ARM set goal to reduce GHG emission by 40% until 2030 compared with the base year 1990
 - Target already achieved due to economic decline following break-up of USSR
- » CO₂ emissions rose by 55% between 2010-2021, but dropped by 66% since 1990

Emission drivers

- » Stable emission intensity of GDP but rising intensity per capita
 - Increased energy consumption of population as main cause for CO₂ emissions increase
- » Largest emitting sector is the transport (33%) followed by buildings (23%) and electricity and heat production (21%), making natural gas the largest emitting fuel source
- Electrification, renewable deployment and higher energy efficiency are key levers to reduce emissions

About the German Economic Team

Financed by the Federal Ministry for Economic Affairs and Climate Action, the German Economic Team (GET) advises the governments of Ukraine, Belarus*, Moldova, Kosovo, Armenia, Georgia and Uzbekistan on economic policy matters. Berlin Economics has been commissioned with the implementation of the consultancy.

**Advisory activities in Belarus are currently suspended.*

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