

Energy Sector Issues in Armenia

**Lukas Feldhaus, Emily Häntschel, Sofia Sapozhnykova,
Nikolas Schmidt**

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1. Introduction

Introduction

Background:

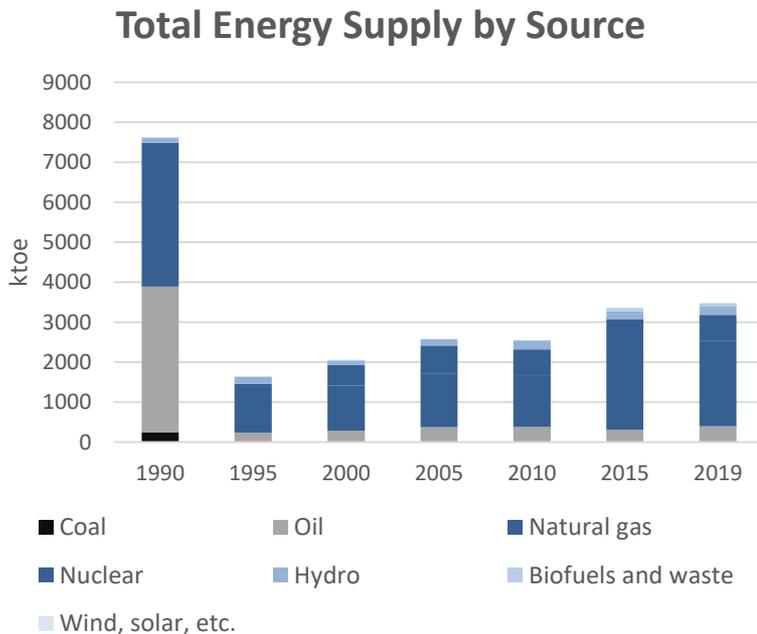
- Armenia faces growing energy demand and high dependency on imports
- Looming issues include:
 - The necessary refurbishment of the power grid and power plants
 - Increasing the country's energy efficiency
 - Replacing the lost hydropower plants in Nagorno-Karabakh and introducing new sources of renewable energy
 - Decrease the energy import dependency

Purposes of this Policy Briefing

- Identify key concerns for the energy sector in Armenia
- Outline first solutions
- Suggest areas of future study

2. Energy

Identify key energy concerns



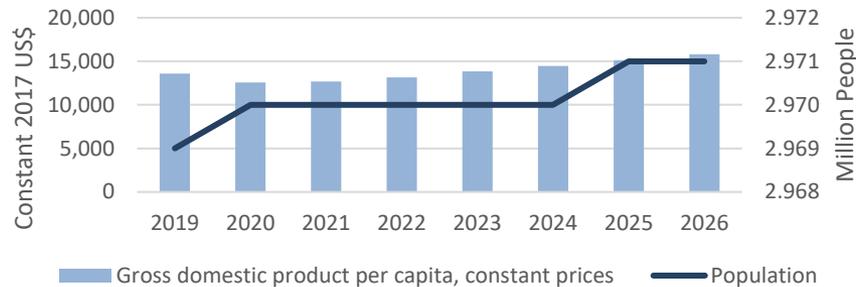
Source: ArmStat

- Armenia's energy supply depends almost entirely on natural gas and nuclear energy
- Since 2010, the share of gas has grown from 50 to 60% of total primary energy supply, while that of nuclear has decreased from 26 to 20%
- Total supply has grown by 3% annually since 2000.

- **High concentration of energy supply**
- **Energy demand growing**

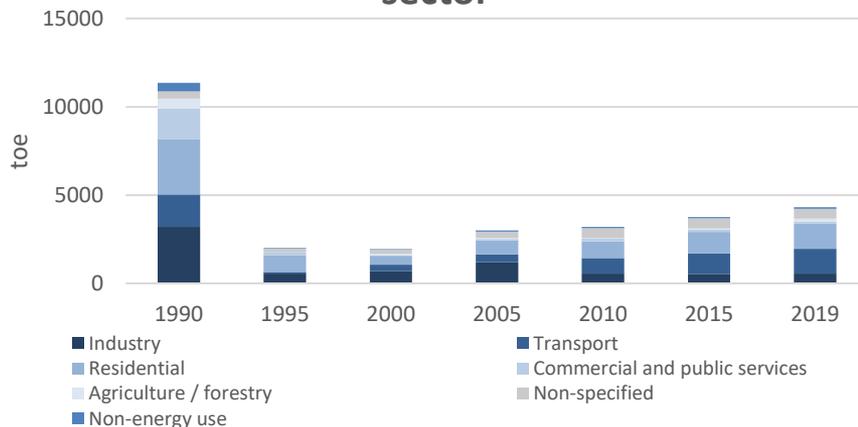
Energy - Demand

Armenia, projection of GDP per capita and population



Source: IMF World Economic Outlook, April 2021

Total final energy consumption per sector

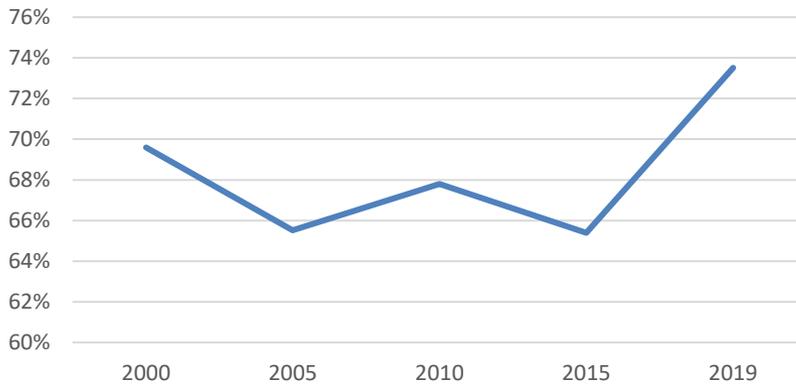


Source: IEA World Energy Balance 2020

- Growing energy demand
 - Driven by residential and transport consumption (transport causes 1/3 of final energy demand)
 - Energy demand depends on population growth and technological changes
 - **Energy-saving potential in residential and transport sectors**
- GDP growth and wealth increase will push industrial demand for energy
- **To save energy, population would need to change consumption habits**

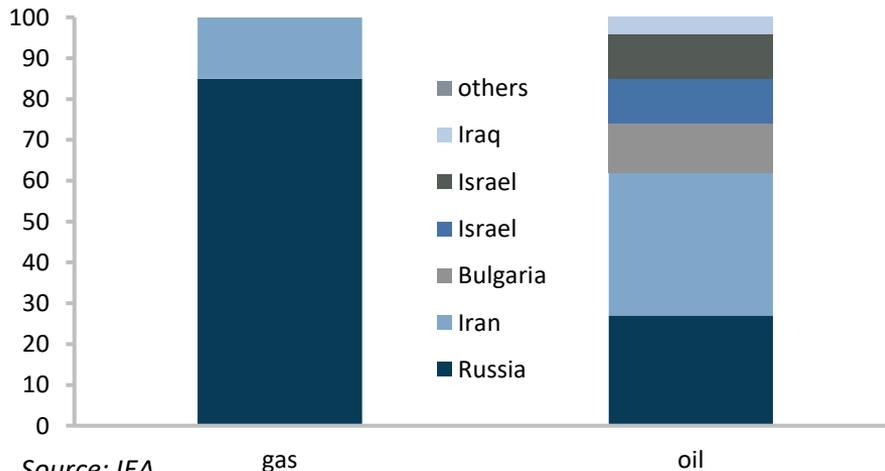
Energy security – International Integration

Net energy imports in % of TPES



Source: IEA

Energy imports by country



Source: IEA

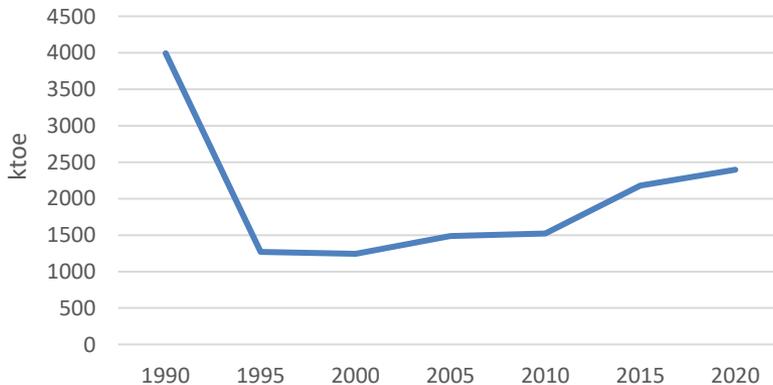
- Armenia depends strongly on **imports** of natural gas and crude oil (60% and 10% of TPES respectively in 2018). Armenia has no natural reserves of either fuel.
 - Energy imports come mainly from Russia and Iran.
 - This dependence is exacerbated due to closed borders with Turkey and Azerbaijan.
- **Armenia is excluded from regional energy projects.**
 - **This brings problems regarding security and continuity of the energy supply.**
 - **Together with oil price fluctuations this has adverse effects on energy affordability and availability.**
 - **Russia can use this energy dependence (as in Gazprom crisis 2017/18).**

Energy Security - Natural Gas



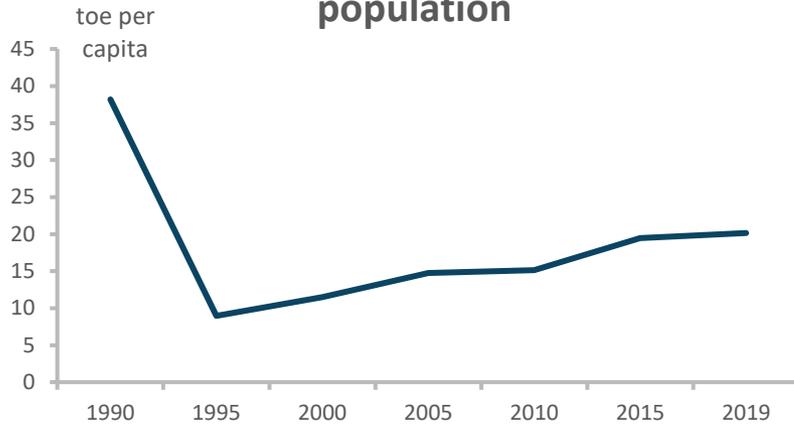
- Gas is Armenia's most important energy source. It mainly imports it from **Russia**. The pipeline dates to the Soviet era. Gas prices from Russian imports are determined via bilateral agreement. Armenia thus does not benefit from falling gas prices but is also less exposed to price fluctuations.
- **Barter agreement with Iran** allows Armenia to import Iranian gas while exporting Armenian electricity to Iran. The pipeline was built in 2009.
- Armenia's **gas transport system** is vertically integrated, entirely **owned** by Gazprom, a **Russian company**.

Natural gas imports

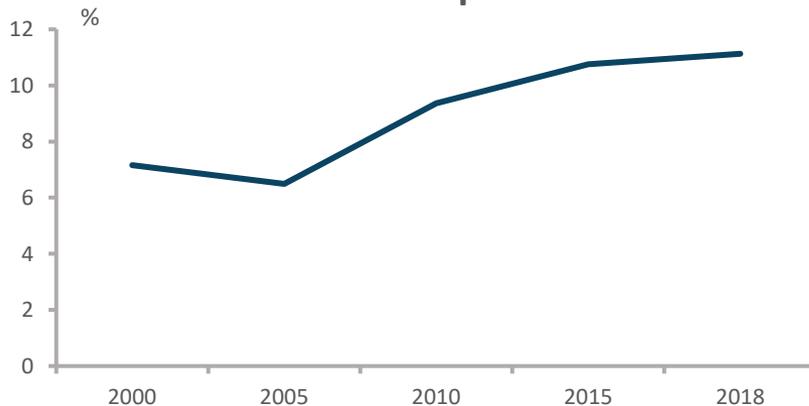


Energy security – Key policy focus areas

Total primary energy supply per population



Share of renewables in final energy consumption



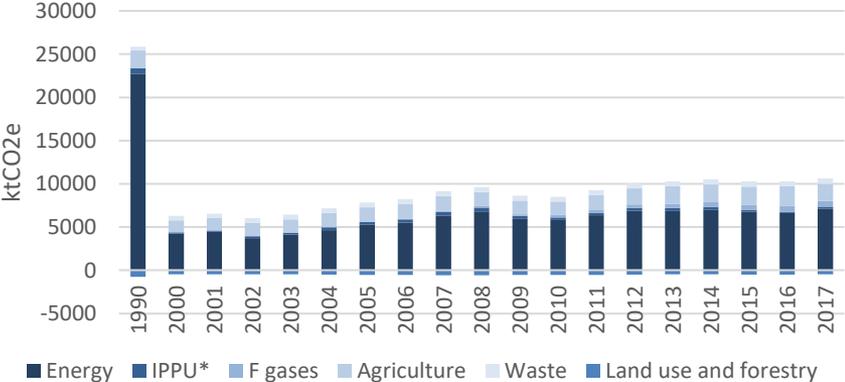
Source: IEA, note: includes hydro

Key policy focus areas:

- Energy demand rising
 - More energy is consumed per person
 - Lion's share of energy originally imported from Russia
 - Power plants crumbling (see electricity slides), share of new RES supply not growing
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- **Decrease and diversify energy sources, especially away from natural gas**
 - **Lower energy consumption (e.g. develop and implement an energy efficiency strategy)**

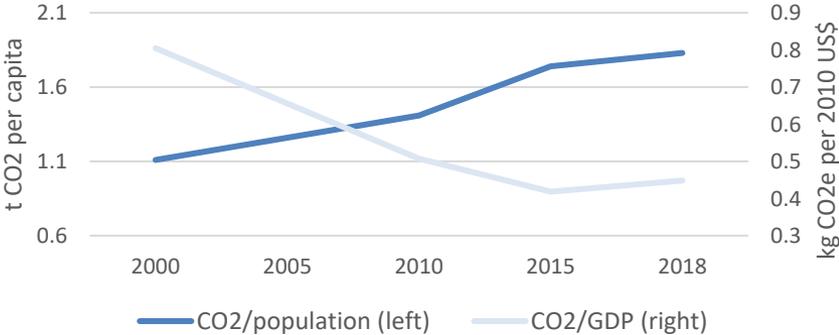
Emissions

GHG emissions per sector



Source: ArmStat
*IPPU does not include F gases

Emission development over time



Source: ArmStat, IEA Data

- Rising Emissions in Armenia
 - Main emitters: energy sector (power plants, transport, a.o.), as well as agriculture
 - Main emitting fuel: Gas
 - **Fuel switch from gas to electricity positive for energy security and emission levels**
- Rising GDP not main cause for emission increase, but energy consumption of population.
 - **Primary emission reduction via renewable electricity production and electrification**

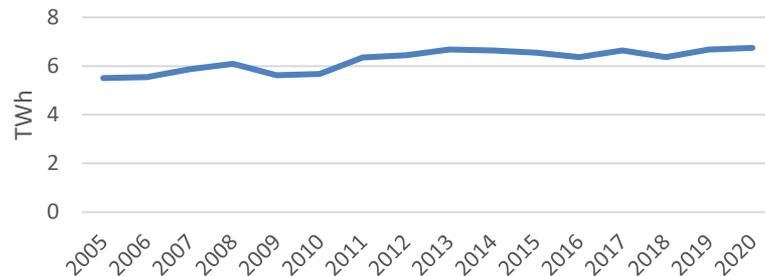
3. Electricity

Electricity – Institutional structure

- Electricity system is partially unbundled:
 - Transmission system operator state-owned
 - Distribution system operator owned by Russian company „Inter RAO“
 - Power plants part private, part state-owned (>50% capacity owned by RUS companies)
 - Market not open, prices set annually by „Public Service and Regulatory Commission“ (PSRC)
 - Market opening planned for 2022 (in Review of EE action plan)
- The regulator (PSRC) is financially independent and efficient. Yet, the selection of its board depends on the president. A meritocratic application procedure is not in place.
- **Dependence on Russian companies for functioning of the electricity system**
- **Unbundling of electricity system only partial, more progress needed**
- **Market opening will require substantially more competition on the distribution and generation side**
- **The regulator enjoys some independence, but would benefit from a more meritocratic and open selection procedure for its leadership.**

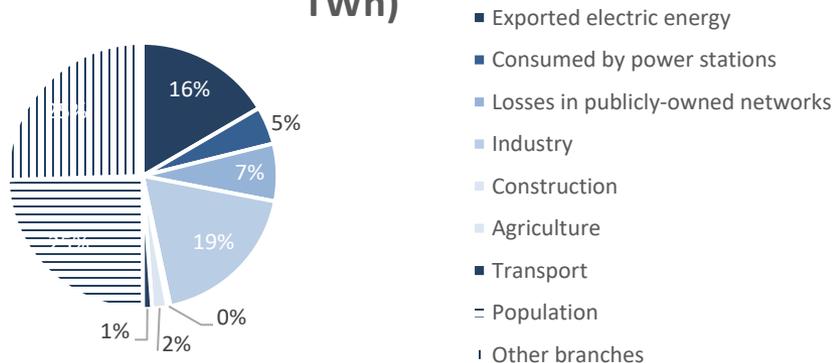
Electricity – Demand

Historic electricity demand
(including and consumption by
power plants)



Source: ArmStat, excluding imports and exports

How electricity was used in 2020 (8
TWh)



Source: ArmStat

Growing electricity demand

- Slowly growing electricity demand
- Prospects of a growing GDP and growing population
- Largest electricity consumption by:
 - Other (agriculture, commercial and public services, etc.): 25%
 - Population: 25%
 - Industry: 19%
 - Exports: 16%

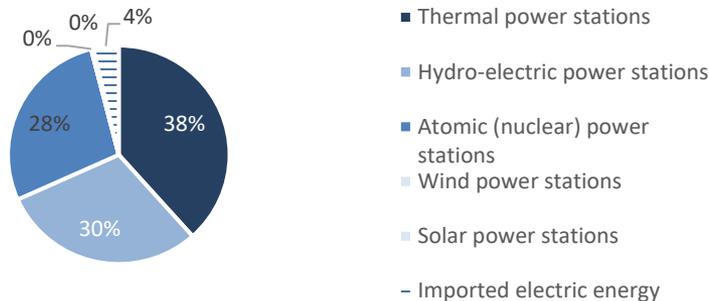
➤ **Electricity demand is projected to grow at an average annual rate of 2 percent¹**

➤ **Electricity Park must be extended to match demand, or exports decreased**

¹ Armenian Government, "Scaling up renewables plan", first revision, 2019

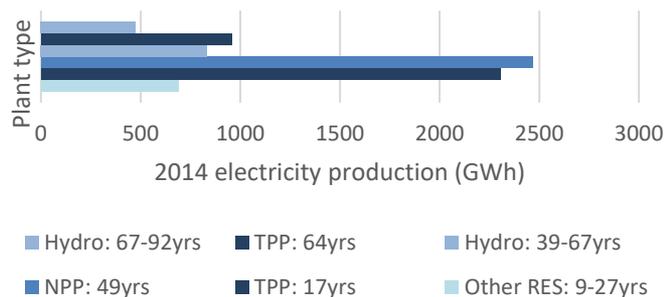
Electricity Supply

**Electricity Production Sources
2019 (Total: 7.9 TWh)**



Source: ArmStat

**Electricity production per
plant type and age**



Source: Armenia energy strategy 2036

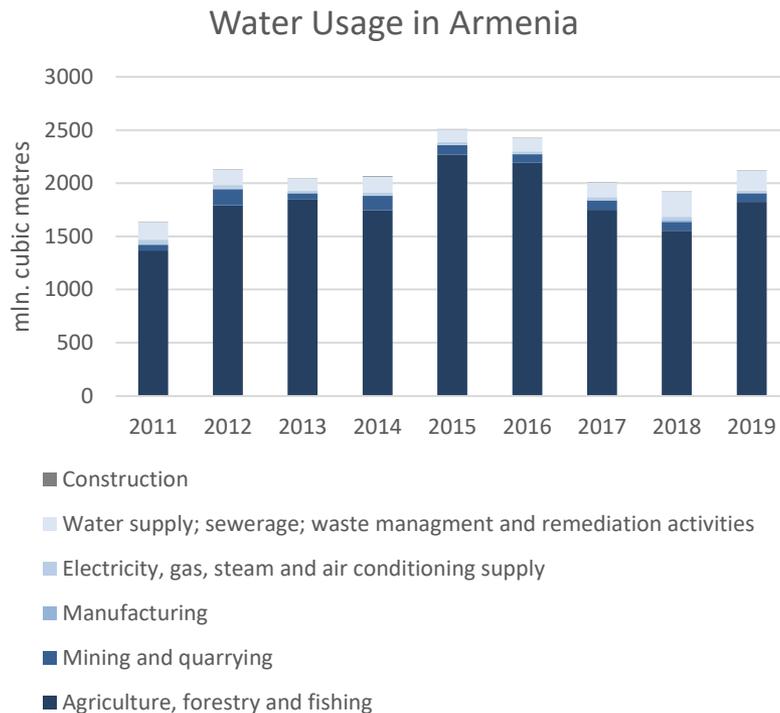
- Electricity is produced by old and inefficient powerplants
- More than half of all power plant capacity is owned by Russia
- Some HPP capacity lies in Nagorno-Karabakh
- The Powerplants are old and in the need of either dismantling or refurbishment:
 - NPP: 42 years (although not continuously operated) and in earthquake zone
 - TPPs: 50% older than 46 years (rest from 2010 or younger)
 - HPPs: Oldest 85 years, youngest 32 years old.

➤ **Need to renew power production**

Electricity – Potential of international integration

- Armenia is a net exporter of electricity due to surpluses in the summer
- Limited electricity trade with **Georgia** since 2012
 - Problem of seasonality: both want to export in summer and import in winter
 - Caucasus Power Transmission Network: expansion supported by KfW / EIB; aim: ARM exports via GEO and TUR to EU; but: exports by GEO directly more competitive; project stalled in 2018-2020 due to feasibility concerns; tender re-opened in 2020; network will only be operational after 2025
- Electricity-for-gas deal with **Iran** more active
 - Contract until 2027: 3 kWh for 1 m³ of gas; current annual volume approx. 365-370 mcm / 1,1 GWh
 - Two lines in place, third currently underway
- Connection with **Turkey** in place, but not active
- No connection to **Azerbaijan**
- **Interconnectivity** generally **good**, but **potential for trade** rather **limited**
- **Increase in exports unlikely because new capacities are expensive, domestic demand rises and lack of new low-cost hydro potential (few available locations)**

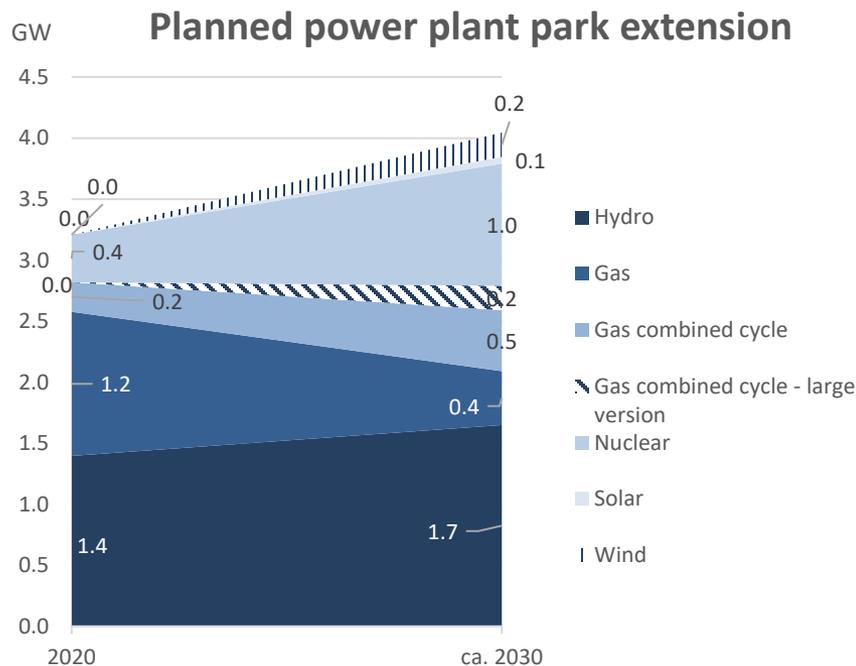
Electricity - Hydro Power



Hydropower will compete with agriculture for water usage

- 50% of river flow subject to significant annual fluctuations
- Due to climate change, inflow to some water reservoirs will decrease by up to 60% until 2100
- Agriculture main employer in Armenia, especially in rural regions
- Considerable amount of hydro power lies in Nagorno-Karabagh (> 100 MW, ca)
- **Hydropower cannot be Armenia's main future electricity source**
- **Precautions against future water poverty may be advised in some regions**

Electricity – Investment plans



Sources: Armenian Energy Strategy 2036, Armstat, Scaling Up RES - Revision 2019

Big investment need

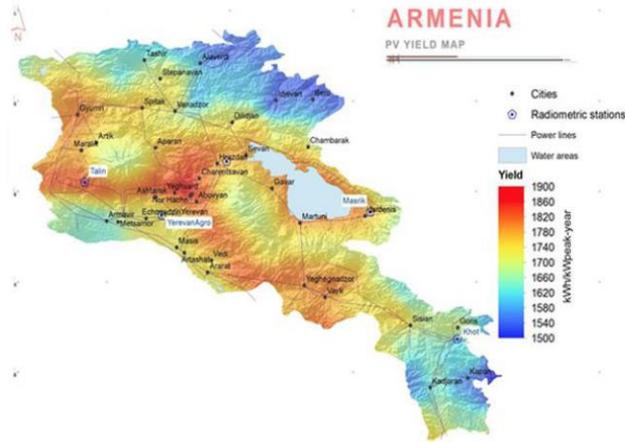
- Very low utilisation rates due to old power plants (NPP 61%, TPPs 16%, HPP 21%)
 - Electricity exports may have to be cut to supply own demand
 - Geothermal PP failed
 - Current extension plans for RES not ambitious
- **Plans biased towards NPP and HPP**
- **Small RES targets despite great potential (next slide)**

Unclear financing

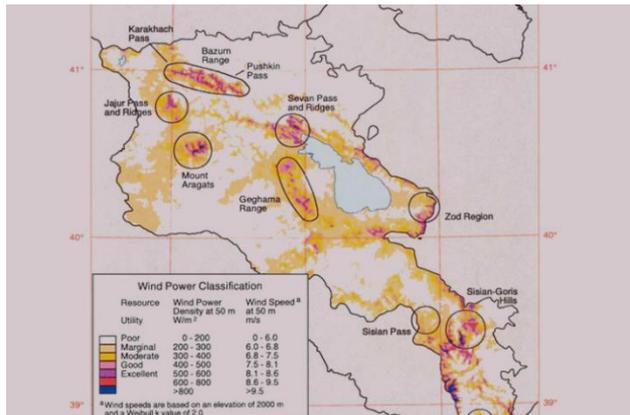
- Even if investors pay building cost under Public Private Partnerships, generation cost will be higher than today, as most of today's power plants have already been written off.
- **Who will pay the increasing tariffs?**

Electricity – RES potential

Solar resource map Armenia (avg.: 1700kWh/m2 annually, EU: ca 1000 kWh/m2)



Wind resource map Armenia



Source: Armenian Energy Agency

Massive potential for solar and wind

- Very high solar potential, close to economic activity around Yerevan and other larger cities
 - Wind potential highest in mountains and passes, implying higher transmission cost
- **Solar is the prime candidate for large-scale expansion**

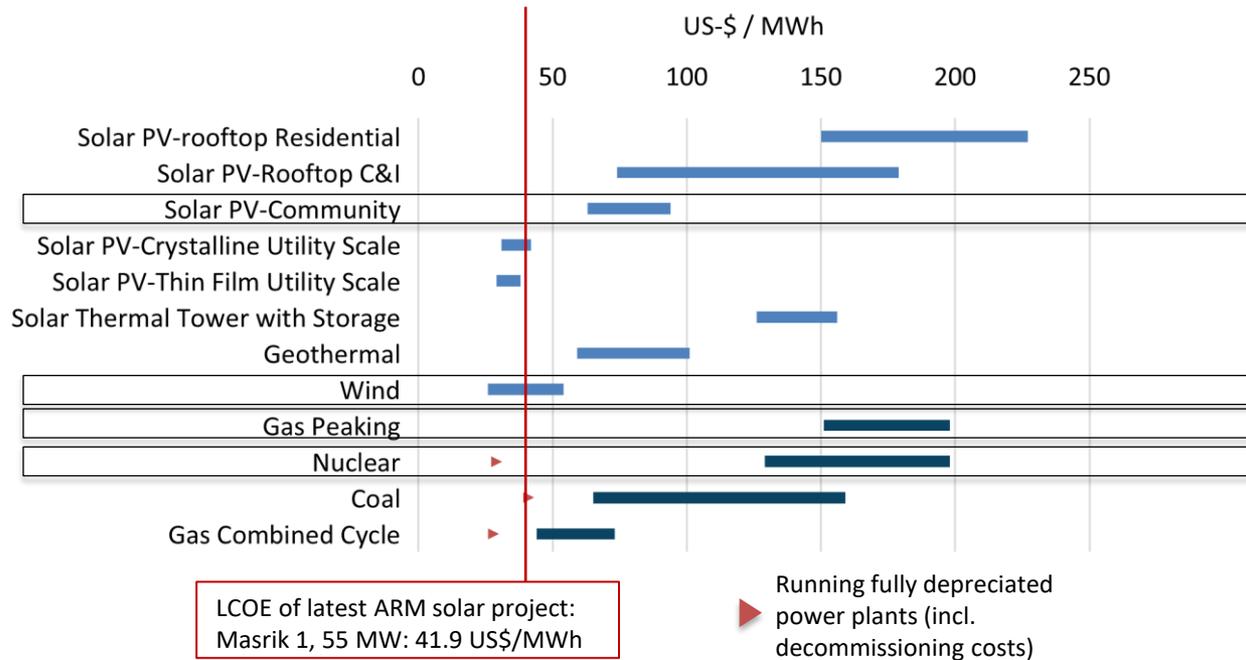
No significant projects in the pipeline

- Solar Power plant (55 MW), US\$ 35m from IFC and EBRD, competitively tendered, US\$ 0.042 per kWh
- **Gov not ambitious about RES**

Electricity System Costs

RES cheapest: Levelised Cost of Electricity

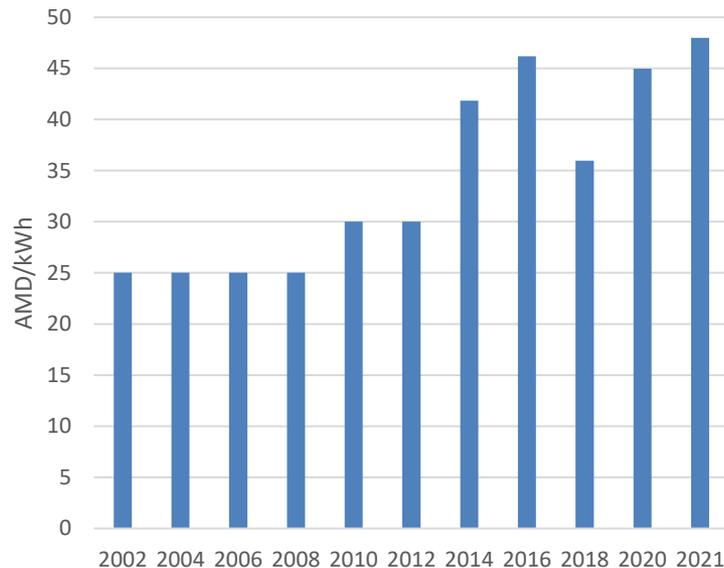
Source: Lazard, 2020



- USAID study finds RES to be cheaper than both gas and nuclear
- ENA does not invest in necessary grid infrastructure
- **RES cheapest option, but grid needs to be extended and improved**
- **To plan a new energy park, Armenia could conduct a grid feasibility study and cost-benefit analyses for different energy sources**

Energy prices

Daytime tariffs, low-kV household consumers, more than 400kWh annual consumption



Sources: Energy Community, EBRD, Armenpress

Tariffs increase necessary

- Tariffs set annually by PSRC, granting generators, TSOs and DSOs a “fair” profit on their expenses
- Electricity prices subject to public outrage, e.g., protests „Electric Yerevan“ in 2015
- Residential tariffs grew 100% from 2002-2015, but have only hovered since then
- Investments into new power plants would increase tariffs
- **Tariffs increases necessary to finance new power plants**

Conclusion

4. Conclusion

Conclusion

1. Amid great dependence on natural gas resources, diversification of energy supply is key
 1. Taking advantage of huge & cheap RES potential is a sensible strategy
 2. Investment costs for new (RES) power plants will increase electricity prices
 3. Decreasing dependency on gas would improve Armenia's energy security
2. Energy efficiency measures should be implemented among the main consumers (transport sector and residential buildings)
3. An ongoing tariff reform necessary to ensure cost-recovering electricity generation and incentives for energy efficiency
4. Unbundling and de-monopolisation is crucial for improving competition
5. Increased regional electricity trade currently faces many obstacles and is no panacea for energy supply problems

About the German Economic Team



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

CONTACT

Emily Haentschel, Project Manager Armenia
haentschel@berlin-economics.com

German Economic Team
c/o BE Berlin Economics GmbH
Schillerstraße 59
10627 Berlin

Tel: +49 30 / 20 61 34 64 0
info@german-economic-team.com
www.german-economic-team.com

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