POLICY STUDY 01|2021

German Economic Team GEORGIA

Electricity Monitor Georgia 2021

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Executive Summary

Status quo

- Hydro power is the most important energy source in the electricity sector (65% of total supply)
- Growing supply-demand gap: rise in electricity demand over past years (52% from 2010 to 2019) due to high economic growth, low prices and cryptomining
- Seasonal mismatch of hydro electricity generation and demand: growing import dependency (12% in 2020), especially during winter months
- Import dependency on Russia and overreliance on Enguri HPP creates supply insecurity

Two challenges

1. Cost-efficient reduction of supply-demand gap
   - Demand side options: reduce implicit price subsidies, seasonal pricing and load management
   - Supply side options: construction of additional power plants – most cost-effective solution not trivial, systemic solution necessitates energy system modelling
2. Reduction of supply insecurity: diversification of imports and domestic capacities

Energy Community (EnC)

- Reforms in the context of the EnC contribute to tackling these challenges, but questions remain:
  - Deregulation of household electricity prices should be included in reforms
  - Missing support scheme for wind and solar investments

Outline

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   ii. How is electricity demand met? Supply side
   iii. Seasonal dependence on cross-border trade
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   ii. Georgia's future power plant park
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III. Institutional setting
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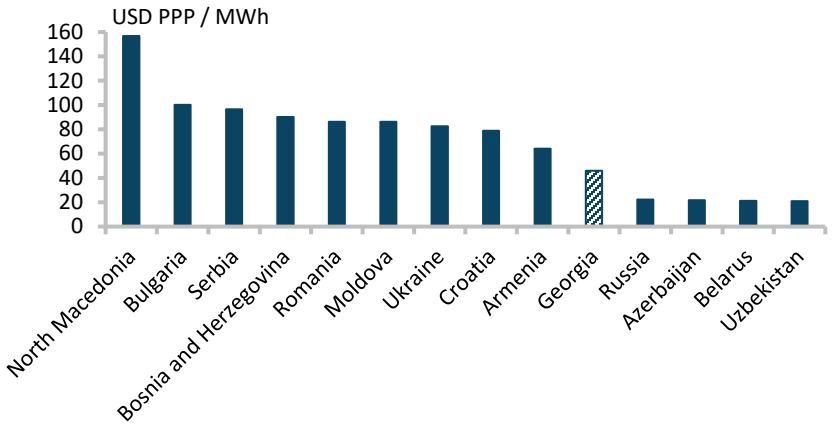
I. Status Quo

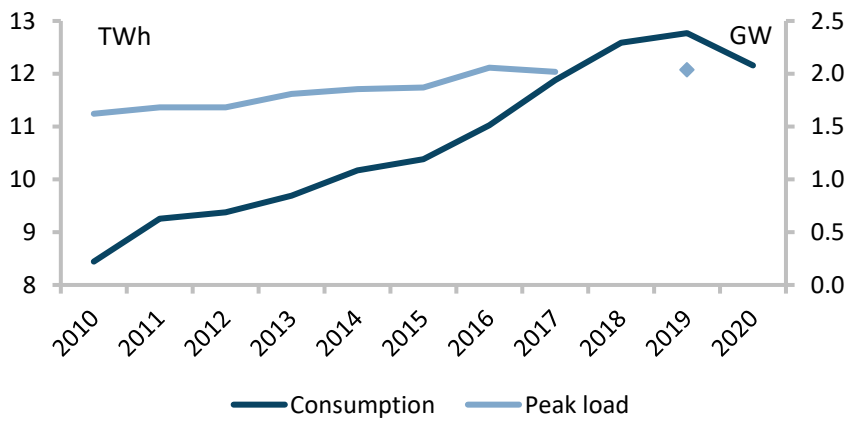
i. Electricity demand

Residential electricity prices for selected countries, 2017



Source: IEA

Domestic electricity demand 2010-2020



Sources: ESCO, GSE

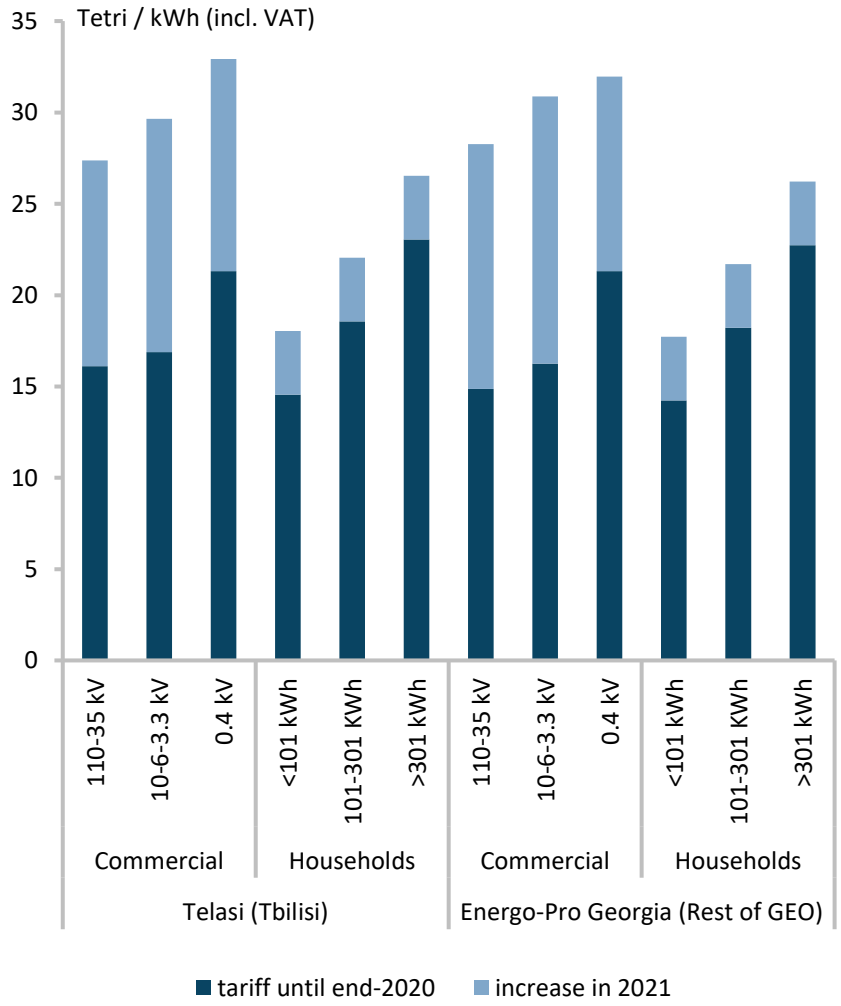
Note: For the years 2018 and 2020 no data for peak loads available

- Due to high economic growth electricity demand increased significantly in recent years
- Furthermore, low regulated prices spur electricity demand in Georgia (see next slide)
- Peak load increased by 25% over the past ten years and reached 2.0 GW in 2019
- Annual electricity consumption increased by 52% from 8.4 TWh in 2010 to 12.8 TWh in 2019
- Upwards trend was interrupted by Covid-crisis in 2020 where demand decreased to 12.2 TWh

➢ **Strong increase in demand**

Reasons for high demand, beyond economic growth

Final consumption electricity tariffs since 2021



Source: GNERC

Low electricity prices

- Tariffs for residential and commercial consumers implicitly subsidised; i.e. not covering costs incl. new investments
- Tariff increase in 2021, but private households largely excluded this year as a social support measure

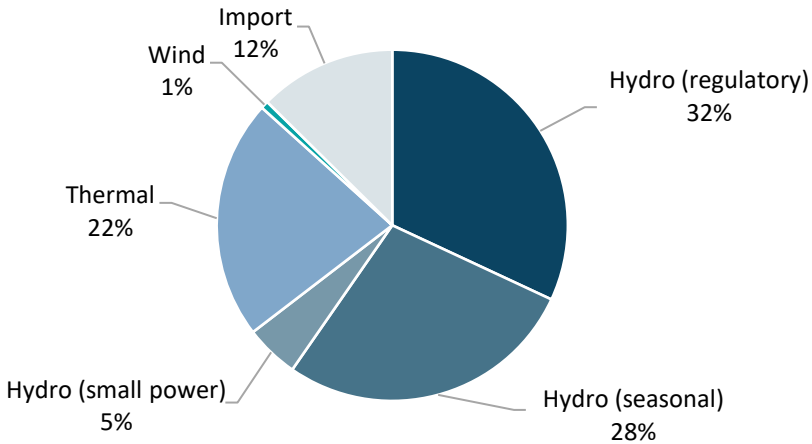
High demand by cryptominers

- Forthcoming GET study:
  - Currently: approx. 6% of total consumption (excl. Abkhazia)
  - Demand for electricity varies with prices of cryptocurrencies (around 14% in summer 2019, <1% in summer 2020)
- Miners attracted by low prices
- Practically no impact on labour market and tax revenues

➢ **Low tariffs and cryptomining contribute to high demand**

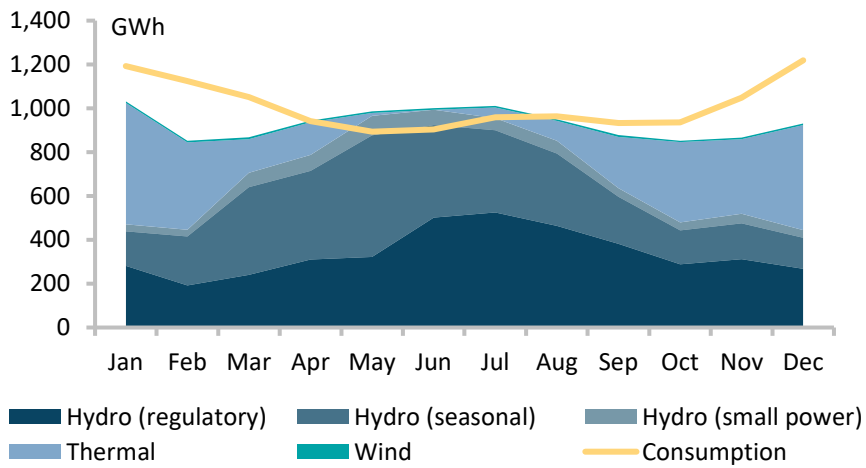
ii. How is electricity demand met? Supply side

Electricity supply 2020 (12.8 TWh)



Source: ESCO

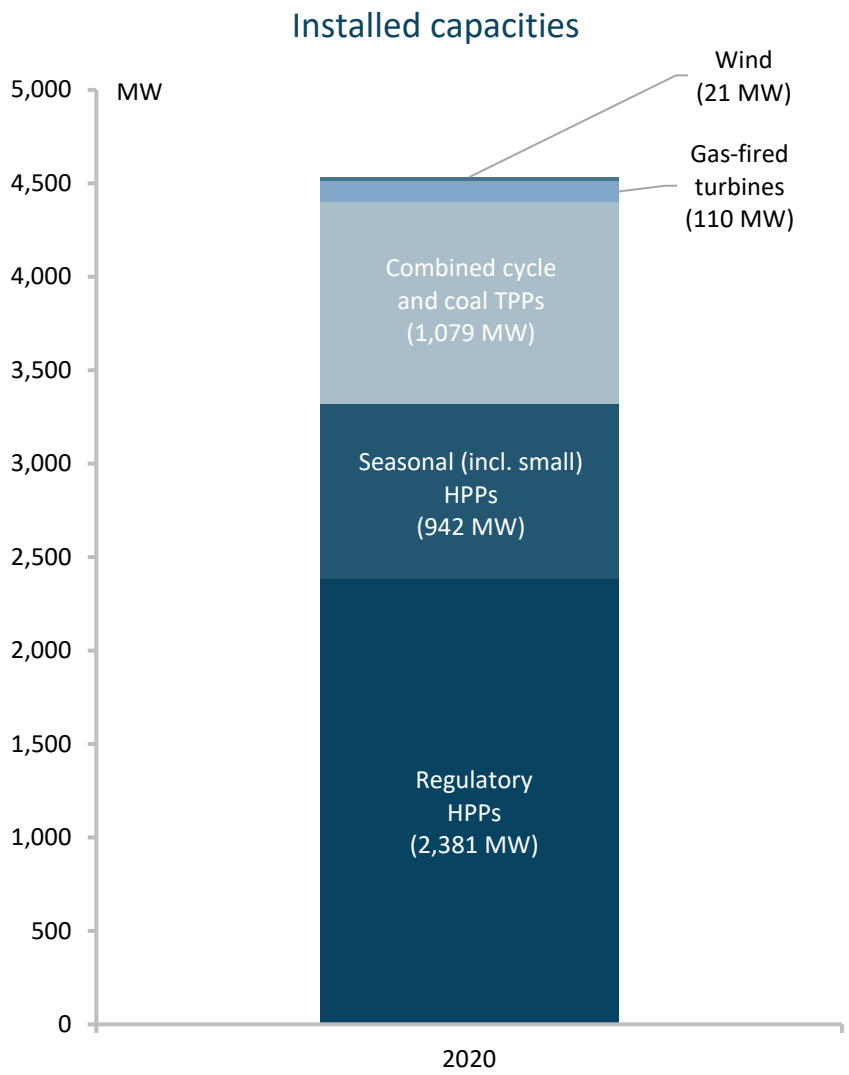
Electricity balance 2020 by month



Source: ESCO

- Domestic generation:
  - Hydro made up 65% of electricity supply
  - (Onshore) Wind accounted for only 1%
  - Remaining 22% covered by thermal power plants (mainly gas). Predominantly used in winter: provide guaranteed capacity to serve reliability of supply
- During winter months, hydro generation decreases significantly and thermal capacities are not sufficient to meet demand
- Since 2017, net importer of electricity
- In 2020, imports made up 12% of electricity supply
- Due to overall high share of hydro, carbon intensity of electricity (≈100 gCO_2/kWh) only one third of EU average

Power plant park – general description



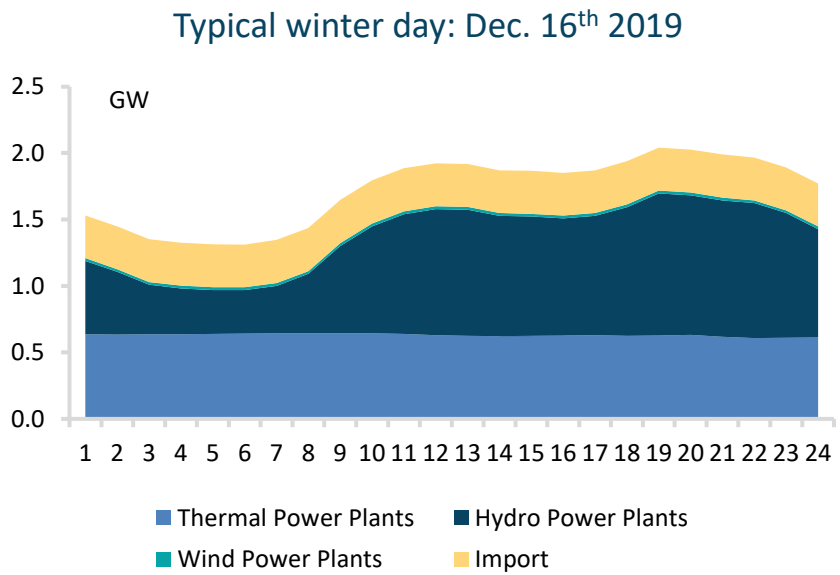
Source: GSE

- Lion's share of power plant park made up of HPPs; in total 94 hydro plants in operation at end of 2020
- Majority of installed capacity made up of regulatory HPPs with total capacity of around 2,400 MW
  - All plants built before 2000
- Seasonal and small HPPs more modern, with a range of plants built in the past 20 years
- Thermal generation saw a recent addition with Gardabani CCGT:
  - With total capacity of 0.5 GW makes up nearly half of thermal capacity and provides substantial flexibility to system
  - First of its kind; efficiency of 55%
- One onshore wind farm:
  - Kartli wind farm with 21 MW capacity

Hydro power

- Due to large hydro reservoirs, most important power source:
  - 65% of electricity supply in 2020
  - 75% of installed generating capacity
- Regulatory HPPs make up largest share with 49% of the total 8 TWh that were produced by HPPs in 2020
- One plant dominates: Enguri HPP accounted for 33% of hydro power and 25% of total electricity generation
  - Plant located at border of Georgian controlled territory
  - Around half of generated electricity supplies Georgia, other half Abkhazia
  - Enguri HPP only source of electricity for Abkhazia
  - Only noteworthy power storage plant for Georgia, but suboptimal use as not used in accordance with grid stabilisation and peaking-operation requirements
- Due to dominant market share, state of Enguri HPP crucial for supply security:
  - Was built in 1970s, previous repairs around 15 years ago
  - Beginning of 2021, plant was closed for repair works for three months (see slide 22)
  - Costs for repair works of EUR 45 m supported by EU: EUR 7 m grant from European Commission and EUR 38 m loan from EBRD

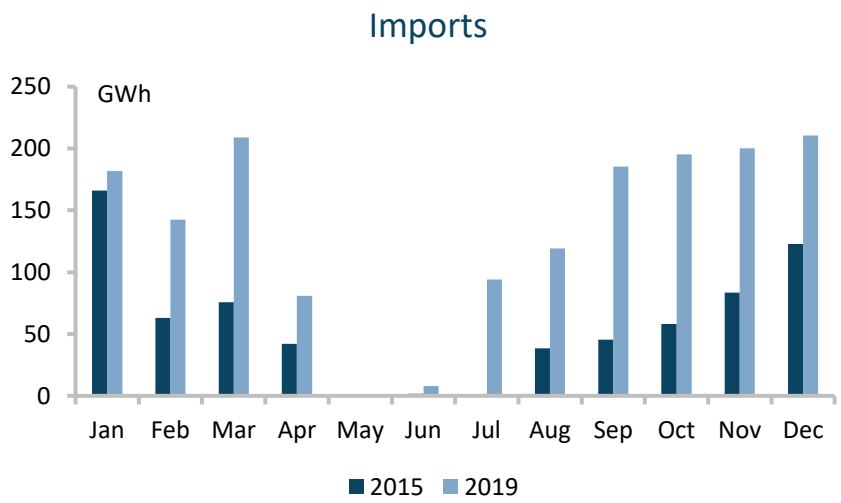
Domestic power shortage during winter



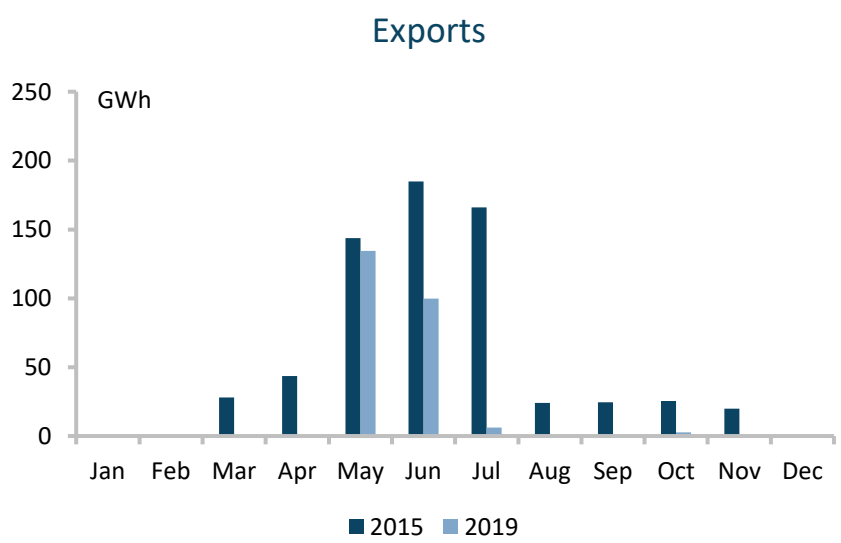
Sources: GSE

- Difficult situation during winter becomes apparent in hourly generation profile
- Installed capacity of 4.5 GW would be sufficient to cover 2019 peak demand of 2 GW at a 45% capacity utilization
- But due to low hydro availability during winter, at peak hour (6 p.m.) only 1.7 GW are covered domestically
- Interestingly, intraday flexibility provided exclusively by hydropower, thermal power plants not required to provide flexibility in winter

iii. Seasonal dependence on cross-border trade



Source: ESCO

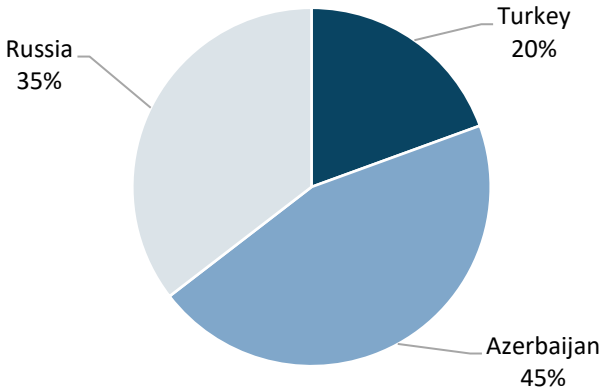


Source: ESCO

- Large dependence on seasonality of hydro power:
  - Reduced availability in winter coincides with demand peak in winter
  - Imports used to be only in winter, but in 2019 substantial imports also in summer
- With increased demand, increased dependence on imports:
  - In 2015: net imports of **0.04 TWh** (0.66 TWh exports, 0.7 TWh imports)
  - In 2019: net imports of **1.38 TWh** (0.24 TWh exports, 1.62 TWh imports)
- In 2020, situation relaxed somewhat in summer due to declining consumption, however: overall net imports increased to 1.46 TWh (0.15 TWh exports, 1.61 TWh imports)

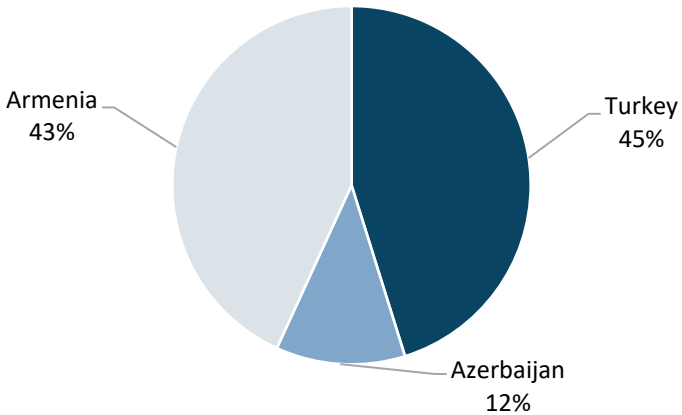
Cross-border trade: Georgia's trade partners

Imports 2020 (1.61 TWh)



Source: ESCO

Export 2020 (0.15 TWh)



Source: ESCO

- Georgia's electricity system synchronised with IPS/UPS system, which covers most of the former Soviet Union
- Interconnected with Azerbaijan, Russia, Turkey and Armenia
  - Connected to Turkish grid – which runs asynchronously – via back-to-back station
- Export prices are deregulated, import prices set by GNERC
- In 2020:
  - 80% of electricity imports from **Russia** or **Azerbaijan**
  - Exports mainly to Armenia and Turkey, while no electricity is exported to Russia
- Due to geographic location also functions as a transit country (approx. 102 GWh from Azerbaijan to Turkey in 2020)

➢ **Import dependency from Russia**

iv. Conclusion

- The majority of Georgia's power demand is met by hydro power, which leads to comparably low carbon intensity of electricity mix
- However, large dependency on hydro power comes with challenges:
  - Seasonal mismatch between demand and hydro electricity supply
- Additionally, dependence on imports (from Russia and Azerbaijan) and one power plant (Enguri HPP), is detrimental to security of supply
- While Georgia's geographical location allows to diversify between different trade partners, import dependency grew over past years with increase in demand

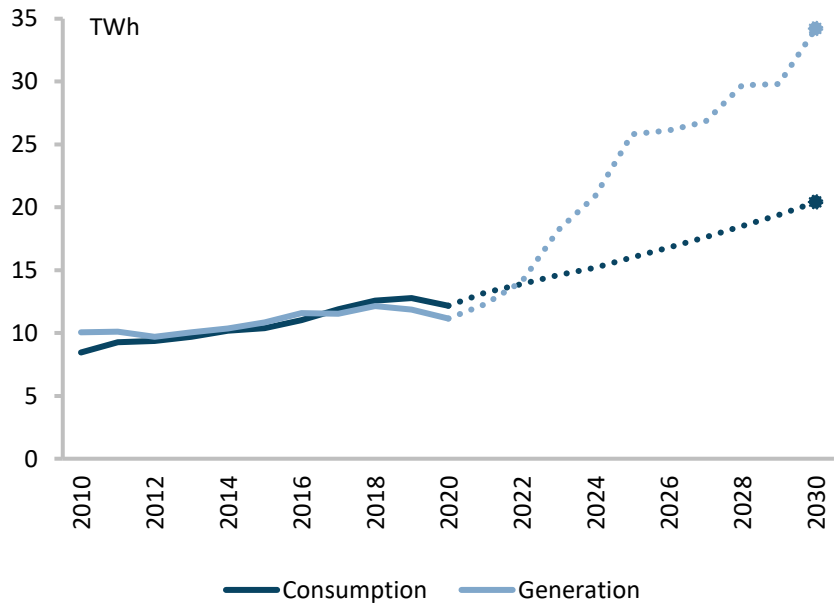
➢ Modernisation and renovation of old hydro plant stock and their operation in accordance with grid stabilisation could

1. Reduce cost of domestic power production and need for thermal generation
2. Reduce dependence on cross-border trade

II. Is Georgia well positioned for the future?

i. Electricity demand and supply in 2030

Projected electricity demand and supply*



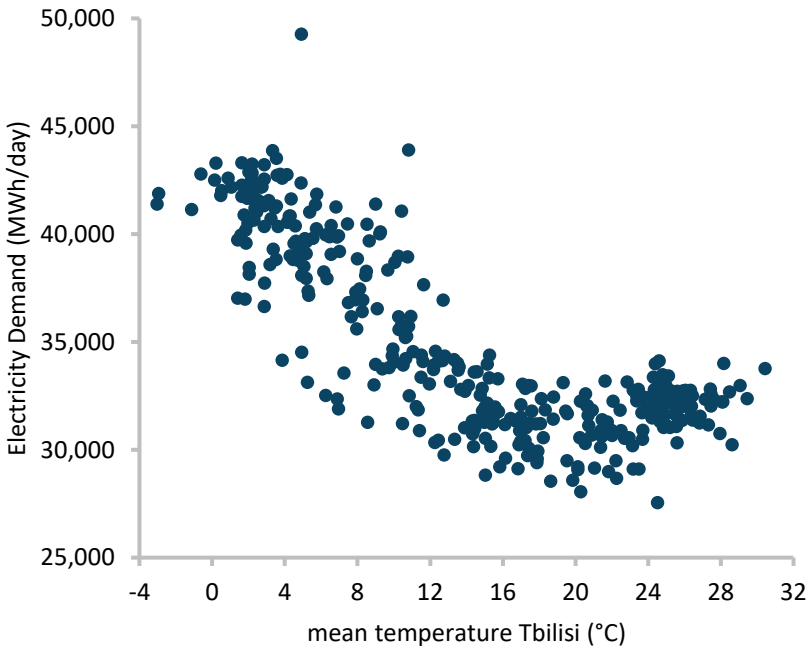
*Source: GSE; *assuming all projects in the pipeline will be realised*

- Baseline scenario of Ten Year Development Network Plan of Georgian State Electrosystem (GSE) projects electricity consumption of 20 TWh in 2030
  - 5% annual growth rate based on analysis of projection of economic parameters
  - 68% increase compared to 2020
- In contrast, generation is planned to increase by 200% compared to 2020 to 34 TWh in 2030
  - Increase can only be achieved if all of currently planned projects are realised

➢ **Plans to increase supply unrealistic, according to IEA**

Electricity demand trajectory – detailed analysis

Georgian electricity demand over mean temperature
(proxied by mean temperature in Tbilisi, data for 2020)



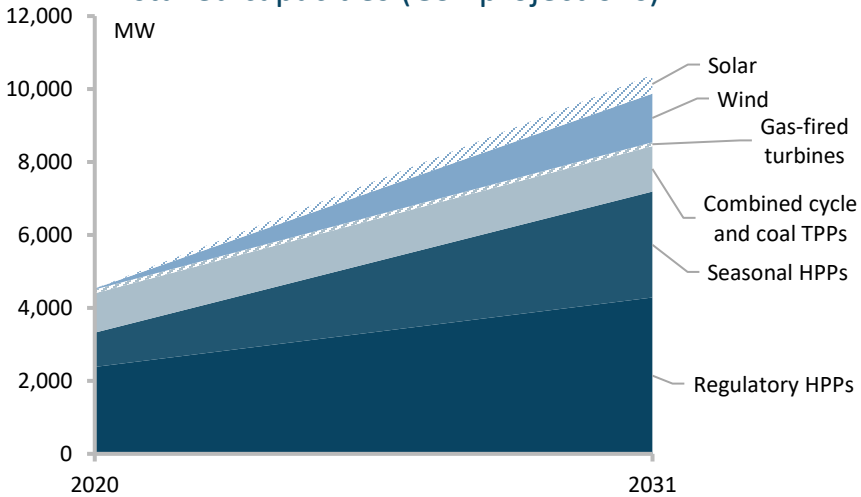
Source: own computations based on entsoe and Raspisaniye Pogodi

- Strong correlation between temperature and electricity demand
- **Demand peak** in winter, inter alia, due to electric heating
  - **Stringent tariff reform** (and potentially seasonal pricing) can disincentivise inefficient heating and reduce projected electricity demand growth in general (e.g. from cryptominers)
  - **Load management** could be an additional option to reduce demand in the winter
- Electricity demand growth might be overestimated
- Currently: implicit subsidies provide little incentive for energy efficiency

➢ **Underlines importance of tariff reform**

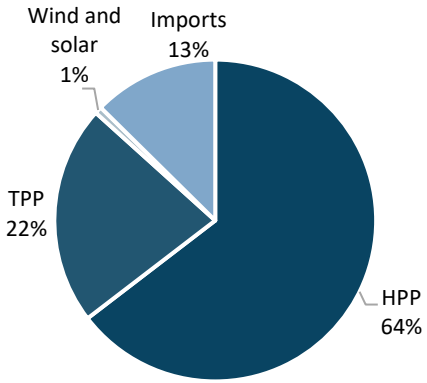
ii. Georgia's future power plant park

Installed capacities (GSE projections)

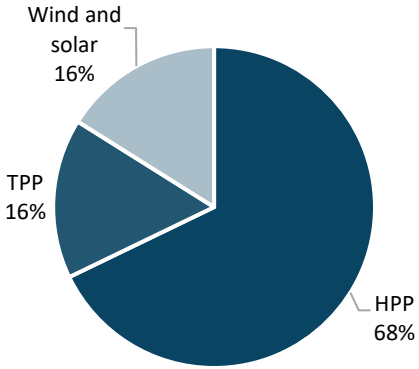


Source: GSE

Electricity supply 2020



Electricity supply 2030



Source: GSE

- Installed capacities planned to increase from 4.5 GW in 2020 to 10.4 GW in 2030
  - +3.9 GW of hydro capacities
  - +1.8 GW of non-hydro RES (1.3 GW wind, 0.5 GW solar)
  - +0.2 GW of thermal (+ replacement of old capacities by 0.5 GW of new CCGTs)
- If all projects were realised, hydro share in generation would increase to 68% while non-hydro RES share would increase to 16%
- Expansion of hydro, wind and solar would reduce dependence on imports
- But requires modernization and expansion of electricity grid: EUR 730 m for grid infrastructure investments
- Additionally, **no non-hydro renewable support scheme in place**

New hydro plants

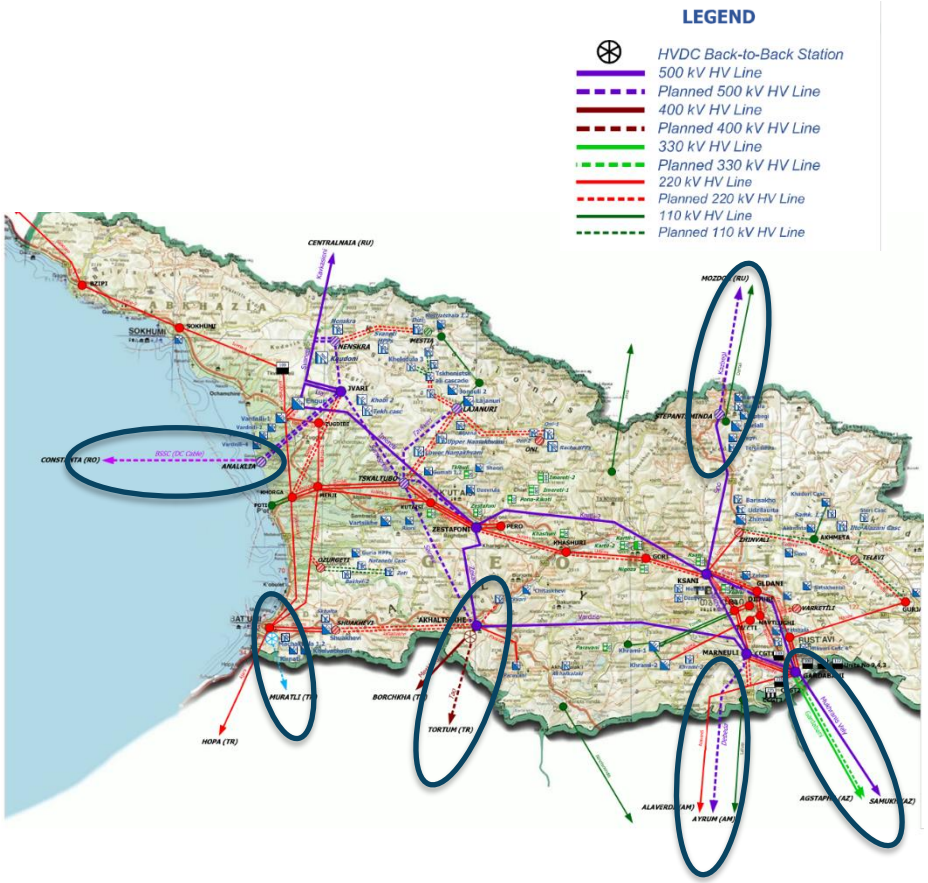
- Currently around 150 projects at various stages of implementation (GSE)
- Constructions slowed down due to delays in introduction of new market model, tightening of government policy on Power Purchase Agreements (PPAs) guarantees in 2016, problems with construction permits and strong local opposition due to negative environmental impacts
- But in 2020, act on introducing Feed-in premiums for hydro plants with installed capacity above 5 MW was adopted
- Still, according to IEA, full implementation of projects unlikely right now, but even partial implementation would already make Georgia net exporter of electricity and could improve security of supply

The future role of wind and solar power

- Currently, only one wind farm (21 MW capacity) and no substantial solar power
- Solar would produce mainly in summer, not addressing the supply-demand gap in winter
- **Wind** could potentially contribute to electricity generation in winter
- However, **no financial support scheme** in place to incentivise investments in solar and wind generation capacities
- A more detailed analysis of cost-effective deployment of different generation technologies is not trivial, a systemic solution necessitates in-depth energy system modelling

iii. Plans for future cross-border trade

2021-2031 development network plan



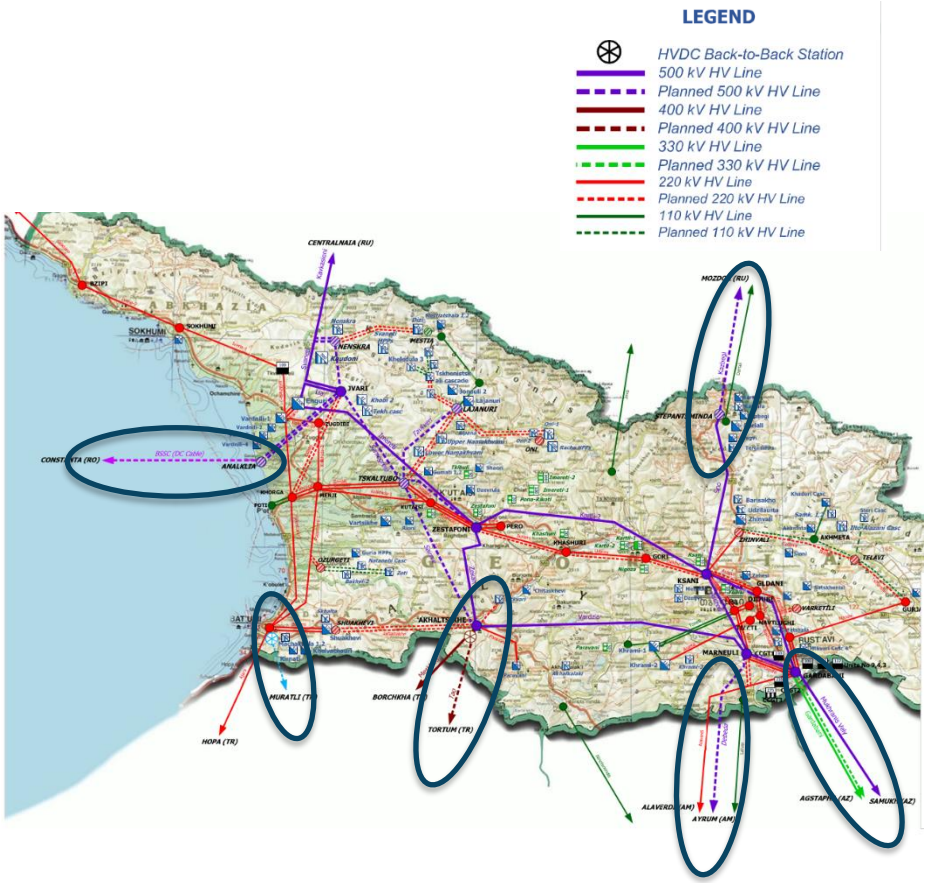
Source: GSE

Note: Dotted lines represent planned connections

- Georgia will play important role in planned regional integration of power systems of Caucasian countries
- Further cross-border connections to
  1) increase transmission capacity and
  2) improve stability of network
- In 2031, total capacity planned to reach:
  - 1,400 MW with Turkey
  - 1,600 MW with Russia
  - 700 MW with Armenia
  - 700 MW with Azerbaijan
- Additionally, connection between Georgia and synchronous grid of continental Europe planned via Georgia-Romania Black Sea submarine interconnection (feasibility study ongoing)

iv. Supply security

2021-2031 development network plan



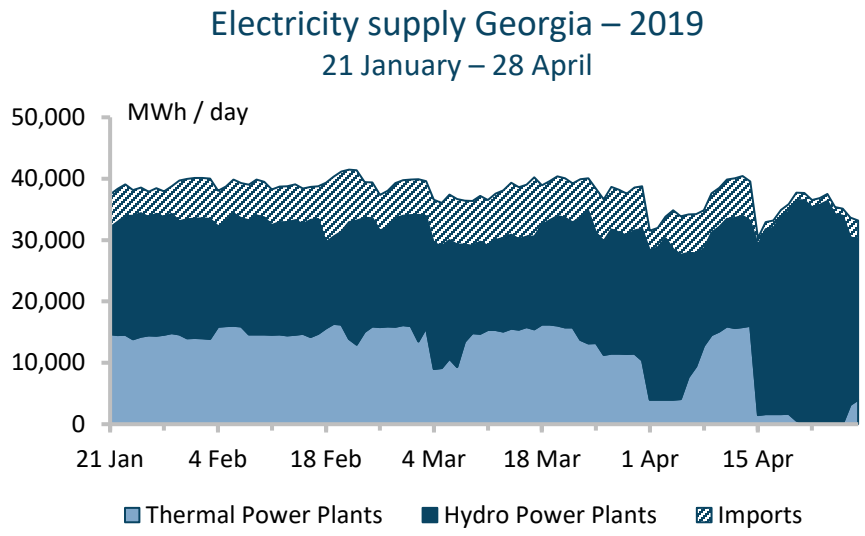
Source: GSE

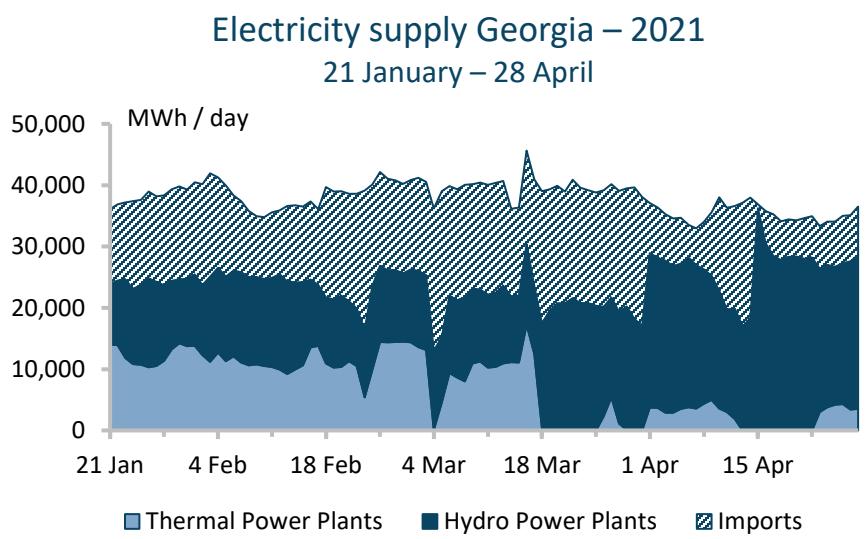
Note: Dotted lines represent planned connections

- Seasonal imports per se might not be overly problematic and make economic sense if production is cheaper in neighbouring countries
- However, import dependence from Russia problematic due to geopolitical tensions
- This holds, even if Russia needs Georgia as a transit country to sell gas (and electricity) to Armenia

➢ **Reduction of structural deficit and diversification of imports as important policy goals**

How critical is the dependence on Enguri?





Source: GSE; Note: solar, wind and exports not visible in scale, space between ticks is one week

- Enguri HPP was off the grid from 21 Jan to 28 Apr 2021 for repair works
  - Provides natural experiment for hypothetical outage of Enguri
- System seems to function without Enguri, even during critical winter months
- However, even larger dependence on imports without Enguri
- Imports accounted for 36% of total supply during repair time (2019: 16%)
  - Simultaneous halt of imports and outage of Enguri HPP would pose a real threat to the Georgian electricity system
  - The question is, how realistic is such a scenario?
  - In any case, it does not hurt to diversify imports and generation capacities

v. Conclusion

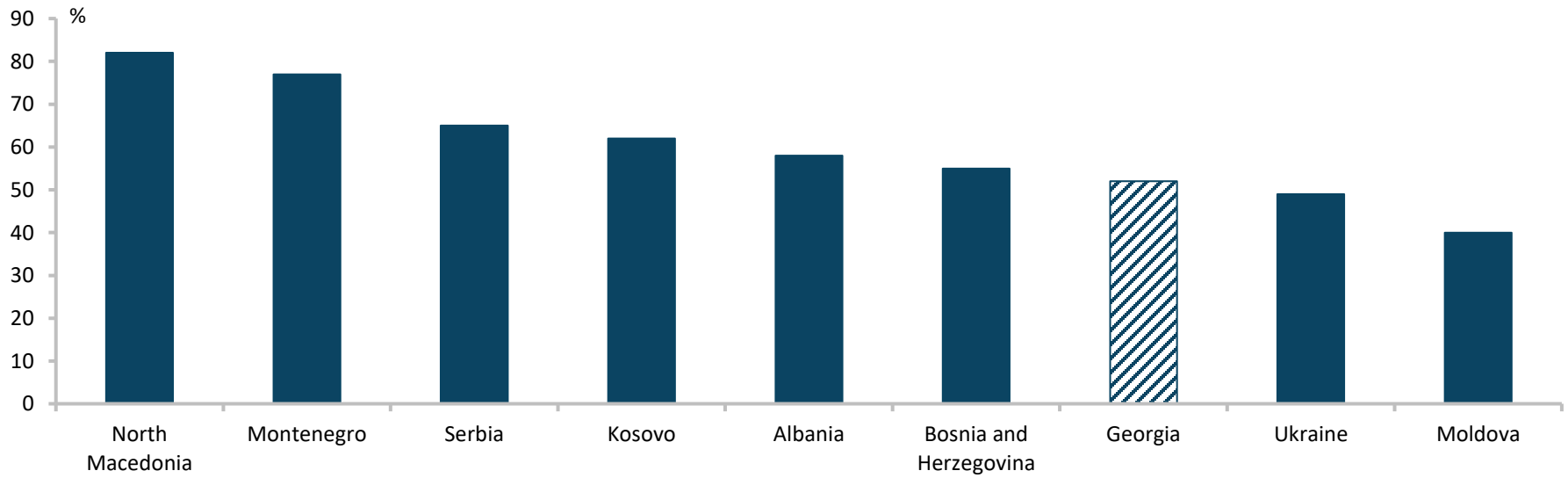
- Georgia is expecting a substantial increase of 68% in electricity demand in the next ten years
- Furthermore, dependence on imports from Russia and one large HPP (Enguri) can be interpreted as supply insecurity
- These challenges are currently planned to be countered with ambitious plans to increase capacity of power plant park by 200%
- However, realisation of all planned projects is unlikely due to:
  1. Missing financial support schemes for non-hydro renewables
  2. Slowed down construction of hydro plants
- Both demand and supply options should be considered to close the supply-demand gap
  - **Demand side options:** stringent tariff reform (incl. for residential tariffs), potentially seasonal pricing and load management
  - **Supply side options:** Renovation/upgrading of existing HPPs, additional generation capacities (cost-efficient capacity mix not trivial), reliable incentive scheme for RES investments, diversification of imports

III. Institutional setting

i. Georgia and the EU

- Georgia-EU Association Agreement came into force in 2016; in 2017 full member of Energy Community
  - Shaped reforms in following years as Georgia undertook and continues to implement measures to transpose EU Energy Acquis into national legislation
- Electricity sector: highest implementation progress of Energy Community reforms (current status: 52% implemented)

Implementation progress of Energy Community reforms by Contracting Parties (Electricity Sector)



Source: Energy Community

Benefits of EU-oriented reforms

- Benefits of reforms:
  - Setting stable framework capable of attracting investments
  - Enhancing security of supply
  - Develop competition and efficient prices
  - Path to integration with EU energy market
- Milestone achieved with adoption of the Law on Energy and Water Supply in 2019, which transposes obligations on unbundling, third party access, wholesale and retail trade and regional cooperation
- Part of this is the electricity market opening: Electricity Market Concept design adopted in 2020, but market opening was postponed to January 2022 (see next slide)
- Gradual liberalisation of commercial electricity retail prices, implicit subsidies to residential consumer prices remain

Energy Community reform implementation – next steps

- Postponement of electricity market opening from July 2021 to January 2022, also due to the need for further testing of organised markets on the Georgian Energy Exchange
  - ➢ Important to move ahead with market opening in order to:
    - Ensure predictability of regulatory environment for investors
    - Further pursue reforms that build on a functioning liberalised market
- Reform of renewable support scheme
  - – Plans for moving from feed-in tariffs to market-based contracts-for-difference
  - ➢ Important to include variable renewables in the new support scheme, currently no support for non-hydro renewables (see slide 17)
- Submission of National Energy and Climate Plan (NECP) expected in the coming months
  - Meanwhile, need to involve more stakeholders – particularly civil society – to reconciliate trade-off between building more HPPs vs. larger import dependency / reliance on other sources of electricity generation

Example of reforms: Electricity market opening

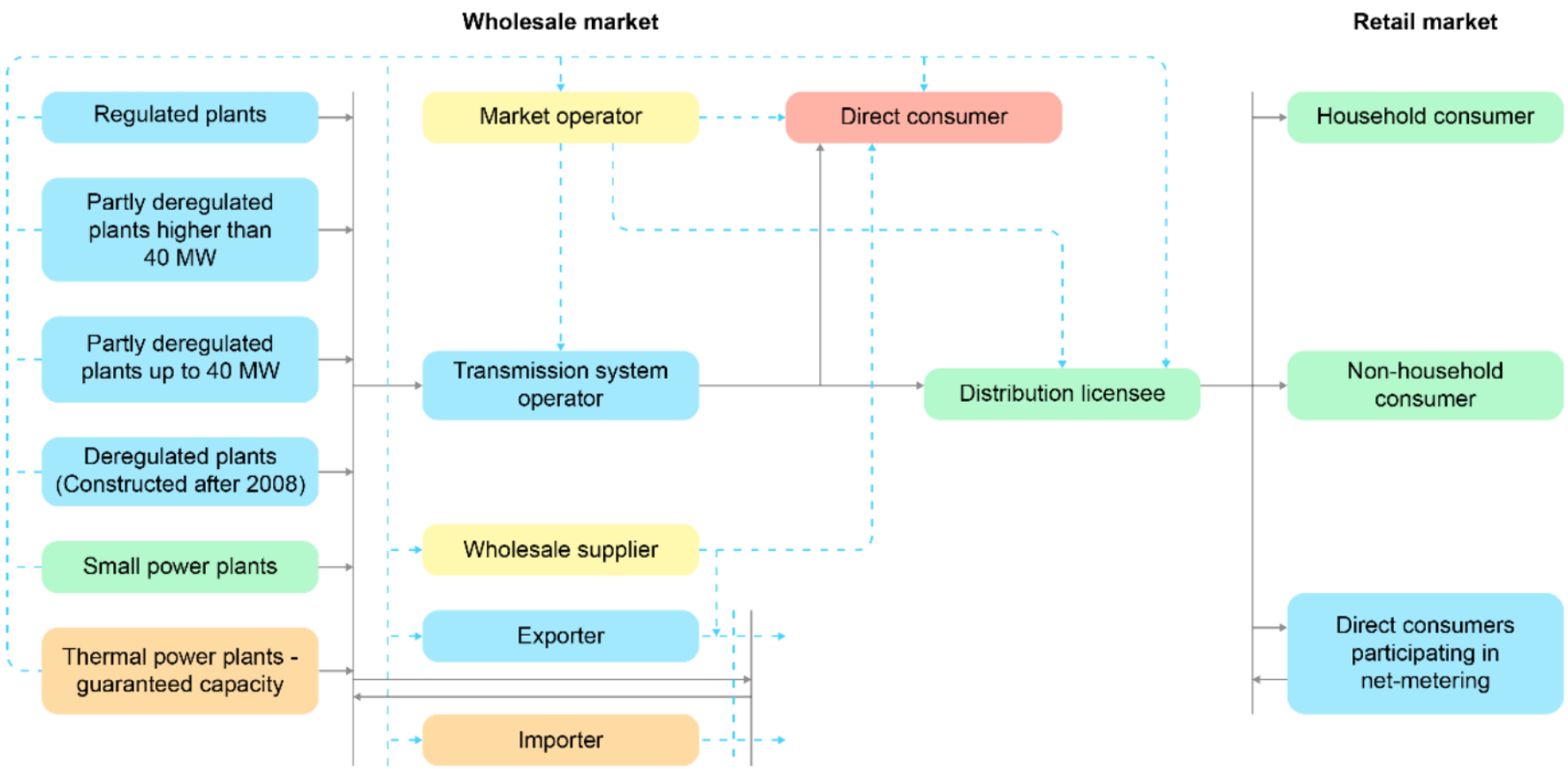
- Electricity market opening (re-)scheduled for January 2022 (*for a graphical representation of the old and new market model see Annex I and II*)
- Changes e.g. result for electricity trade, wholesale prices and retail prices:

	Old market	From January 2022
Electricity trade	**Trade via ESCO:** • 90% direct contracts i.e. bilateral contracts between producers and large consumers or distribution companies • Around 10% balancing	**Trade only via organized market segments:** • Day-ahead market, intraday market, bilateral agreement market and from July 2022 (or January 2023 if also postponed) ancillary services market
Wholesale prices	**Five types** of generating companies: 1. Regulated stations 2. Semi-deregulated seasonal stations (ceiling tariffs and licenses) 3. Deregulated stations (free tariffs, licences issued by regulatory body) 4. Guaranteed reserve sources (thermal, two tariffs incl. capacity payments) 5. Small stations (without licences and regulated tariffs)	**Prices are formed freely** based on trade. However, financial settlement performed by **Wholesale Public Service Organization**: • Fulfilment of PPAs by purchasing electricity and selling it on organized market segments • Financial settlement of PPAs, renewable or other support schemes, public service producers, public service suppliers • Public service producers will be progressively reduced
Retail prices	**Regulated consumer prices for all consumer groups**, depending on level of consumption. Tariffs set by GNERC.	• **Stepwise opening of retail market and deregulation of prices** starting in 2022. By 2026 all consumers **except for households and small enterprises** shall have chosen a supplier • Households and small enterprises that did not choose supplier are supplied at regulated prices by Universal Service Suppliers • USS purchase electricity on day-ahead market: 1. If difference market price and contract price is positive WPSO pays difference 2. If difference negative USS pay difference to WPSO

ii. Conclusion

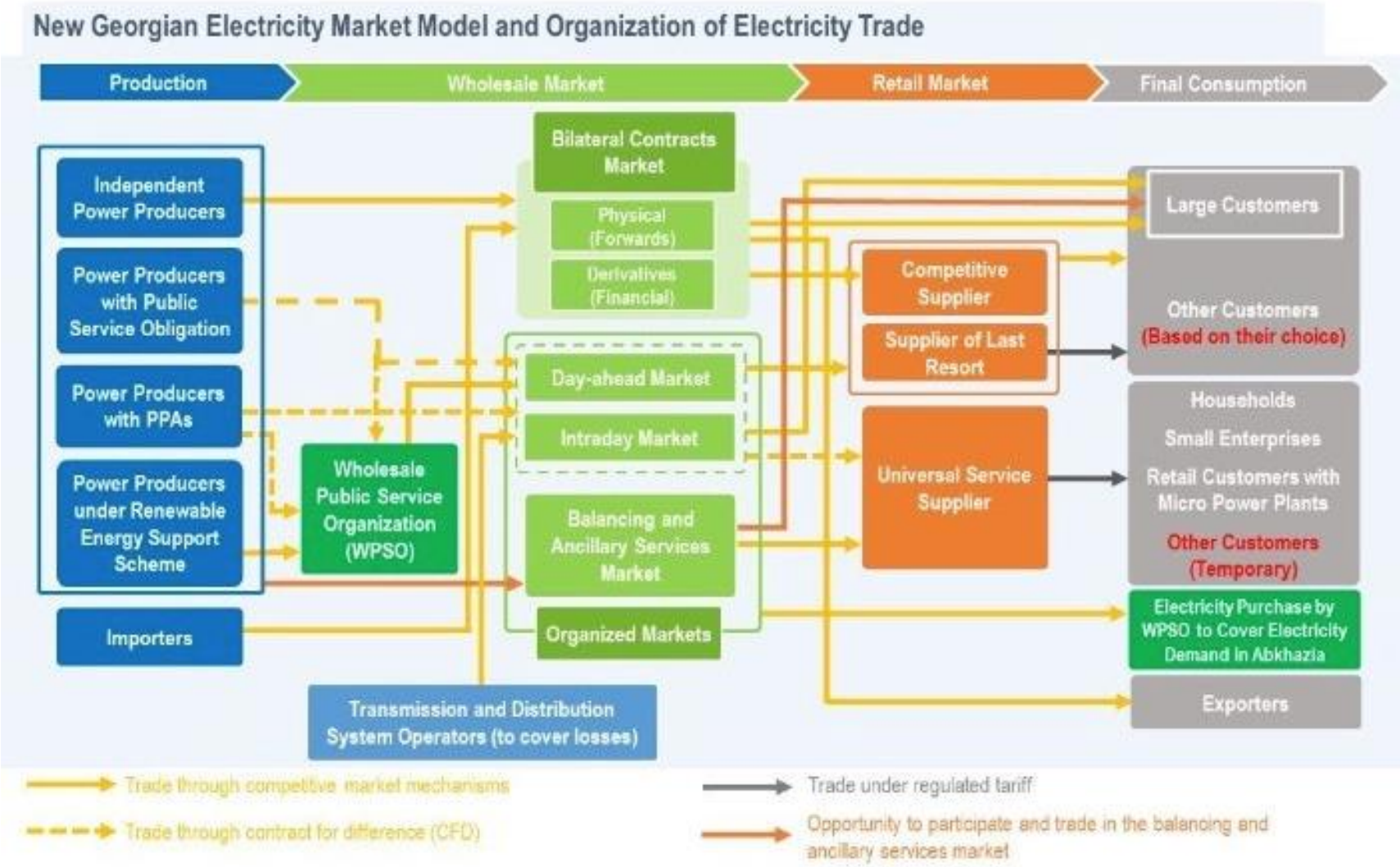
- Since accessing to Energy Community, several reforms undertaken
- Reforms pave the way for stable regulatory framework which allows for attracting investments, increasing security of supply, increasing competition and integrating with the EU energy market
- Electricity market opening major step to be achieved in 2022
  - Electricity will exclusively be traded via organised market segments
  - Wholesale prices will be formed freely on the market but financial settlement of PPAs or public service obligations through WPSO
  - Stepwise opening of retail market until 2026 (except for household customers or small enterprises)
- **Some open questions remain:**
  1. **Financial support schemes for non-hydro renewables?**
  2. **Deregulation of household prices?**

Annex I: Old electricity market



Source: IEA

Annex II: New electricity market



Source: Energy Regulators Regional Association

About the German Economic Team

Financed by the Federal Ministry for Economic Affairs and Energy, 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.

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