German Economic Team

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POLICY STUDY GEORGIA

The Black Sea Submarine Cable project: Economic prospects and challenges

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Executive Summary

Project background

- Black Sea Submarine Cable: proposal for a 1,200 km submarine HVDC cable linking GEO with ROU, also involving AZE and HUN (BGR and ARM also expressed interest in joining)
- Current estimates: transmission capacity of up to 1.3 GW by early 2030s with estimated cost of EUR 3-4 bn (informal estimates by key stakeholders and insiders)
- Two-year technical feasibility study expected to be completed by summer 2024

Assessment of economics

- GET analyses two scenarios on RES expansion in GEO until 2035 based on GSE's Ten-Year Network Development Plans: 380 MW in so-called G0 (LOW) and 6,530 MW in G1 (HIGH) scenario
- Assuming expansive export-oriented RES development in AZE (2,500 MW), the cable would have a high utilisation rate (over 90% in both scenarios)
- But: cable only relevant if GEO and AZE build sufficient export-oriented RES capacities
- Based on estimates for offtake prices and LCOE, the cable could be profitable in the long term, with a simple payback period of around 20 years. However, if AZE does not build export-oriented RES capacities, the simple payback period would be over 40 years (HIGH) or simply infeasible (LOW)
- Additionally: even if RES expansion materialises, the business case is currently unclear as ENTSO-E forecasts indicate higher prices in TUR than in ROU (sufficient interconnection with TUR in place)

Additional considerations

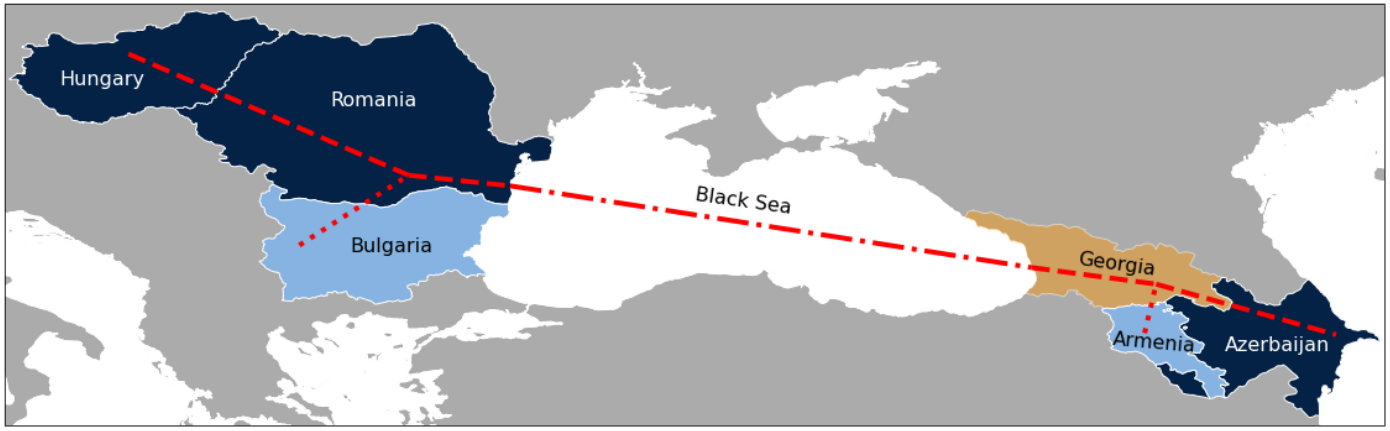
- Cable offers strategic benefits for GEO in terms of export/import diversification and energy security
- But: prospects for GEO hydropower expansion unclear and investment in grid expansion needed
- Additionally: open issues regarding legal, technical and security aspects as well as project financing

Structure

- **Introduction and background**
- **Part I: The Georgian power system**
  1. Current power plant park and electricity generation mix
  2. Cross-border interconnection capacities
  3. Trends in electricity imports and exports
- **Part II: Assessing the economics of the proposed subsea cable**
  1. Scenarios for future Georgian exports
  2. Joint export volumes of Georgia and Azerbaijan
  3. Can subsea cable investment be refinanced?
  4. Alternative: exporting to Turkey
- **Part III: Additional considerations**
  1. GEO domestic perspective
  2. Implementation and operation
- **Conclusion**

Introduction and background

- The Georgian government is considering a project for a **1,200 km submarine HVDC cable** linking **Georgia** with **Romania**, also involving **Azerbaijan** and **Hungary**
- Initial planning: transmission capacity of **1 GW** by **2029** with estimated cost of **EUR 2.3 bn**
- Current estimates: transmission capacity of up to **1.3 GW** by **early 2030s** with estimated cost of **EUR 3-4 bn** (informal estimates by key stakeholders and insiders)
- Romania, Hungary, Georgia and Azerbaijan signed agreement for realisation of the project in early 2023 (**Bulgaria** and **Armenia** expressed interest in joining the project later)
- Two-year technical feasibility study expected to be completed by summer 2024
- New export corridor aims to bolster **diversification of electricity export markets** of Southern Caucasus and the **decarbonisation of European electricity consumption**
- Combines ambitions to **develop Azeri wind power** resources in the Caspian Sea, **strengthen EU integration** and **address seasonality** of Georgian power supply
- **In this study we assess the project's economic viability and financial attractiveness, as well as possible alternative export routes and strategic aspects**

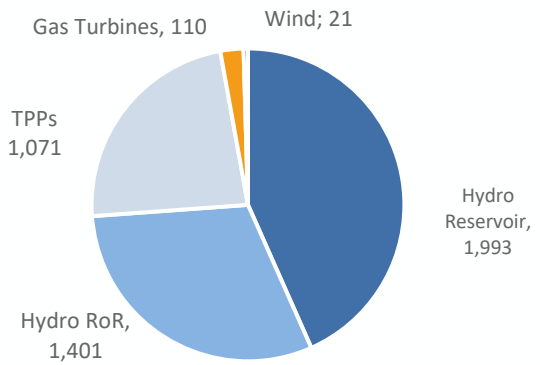


Source: Own illustration; Note: Bulgaria and Armenia in light blue expressed interest in the project later. Location of subsea cable and land-based transmission infrastructure purely illustrative

Part I:
The Georgian power system

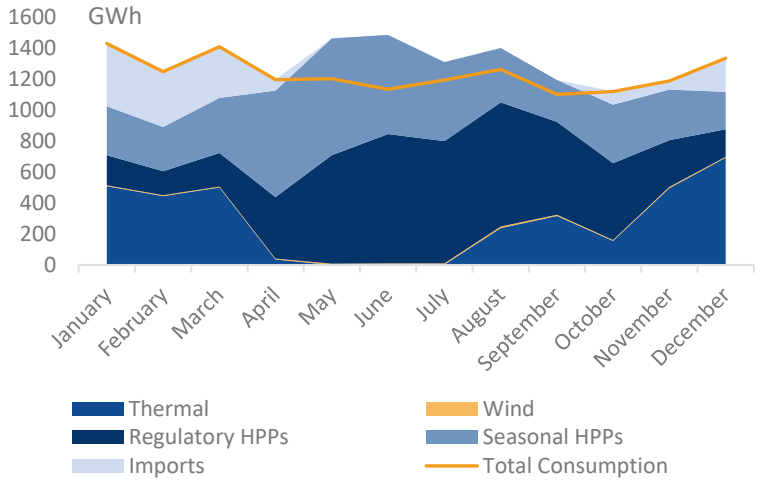
1. Current power plant park and electricity generation mix

Installed Capacity 2023 (MW) by source



Note: TPPs include coal and gas fired steam turbines, as well as combined-cycle gas turbines. *Source: Georgian State Electrosystem (GSE)*

Electricity generation by source (2022)



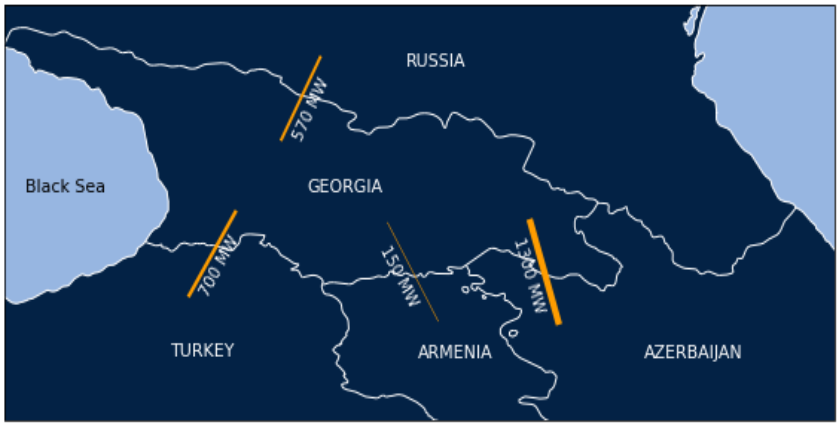
Source: GSE, Annual Balance

- Thanks to the numerous river basins, **hydropower is the country's most important source of electricity**
- Georgia has an installed capacity of 3,304 MW of reservoir and run-of-river (RoR) hydropower plants (HPPs), concentrated in the western part of the country
  - 52% are reservoir HPPs, which provide flexibility to the system with water storage systems
  - Enguri HPP (1,300 MW*) is a crucial power generation asset in the country (accounting for 28% of all installed capacity)
- **Georgia relies on thermal power plants in winter**, when hydropower production is low
  - Thermal power plants account for 23% of installed capacity, mostly located in the East
  - Natural gas for power generation mostly supplied from Azerbaijan
- **Solar and wind sectors are not fully mature**
  - One existing 21 MW wind farm (Kartli)
  - First successful **RES capacity auction** in 2023 (150 MW hydro, 77 MW wind, 70 MW solar)

*about half of which serves Abkhazia region

2. Cross-border interconnection capacities

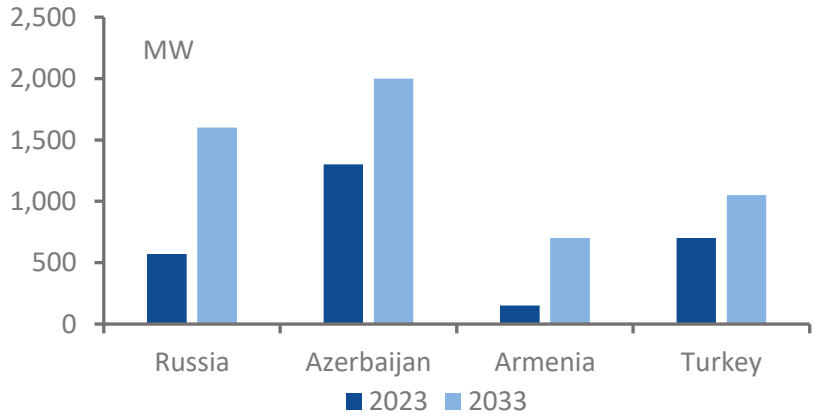
Current interconnection capacities (2023)



Note: Position of interconnectors only indicative

Source: Own illustration based on GSE, TYNDP 2023-2033

Interconnection capacity development (2023-2033)



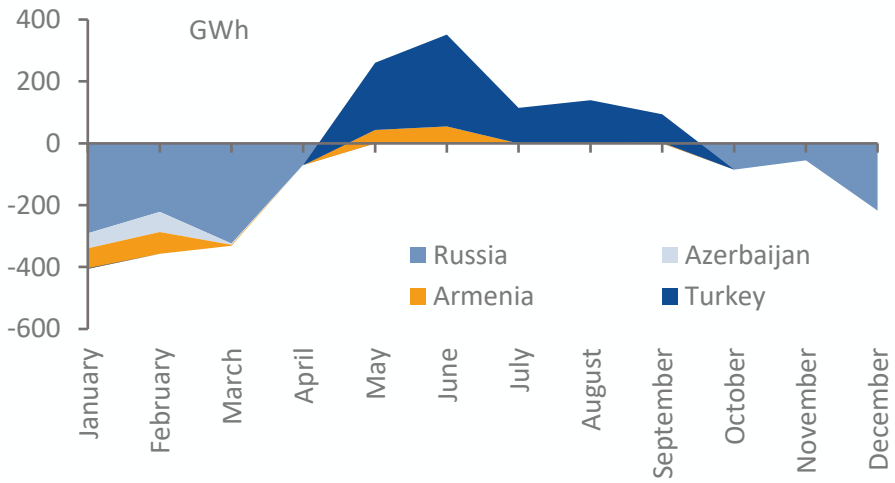
Source: GSE, TYNDP (2023-2033)

- **Synchronized with the IPS/UPS grid** (Russia and Azerbaijan)
- **Important electricity transit country**
  - Azerbaijan-Turkey, Russia-Turkey, Russia-Armenia
- With a nominal transmission capacity of about 2,720 MW, the country is **well interconnected with neighbouring countries**
  - The ratio of nominal cross-border transmission over total installed capacity amounts to 59%
- GSE's TYNDP outlines an **ambitious expansion plan** for its land-based interconnection capacity
  - It is planned that by 2033 the country will almost double its cross-border interconnection capacity to 5,350 MW (excluding Black Sea Submarine Cable)

➢ **Georgia is already very well interconnected with neighbouring countries and plans to double interconnection capacities till 2033**

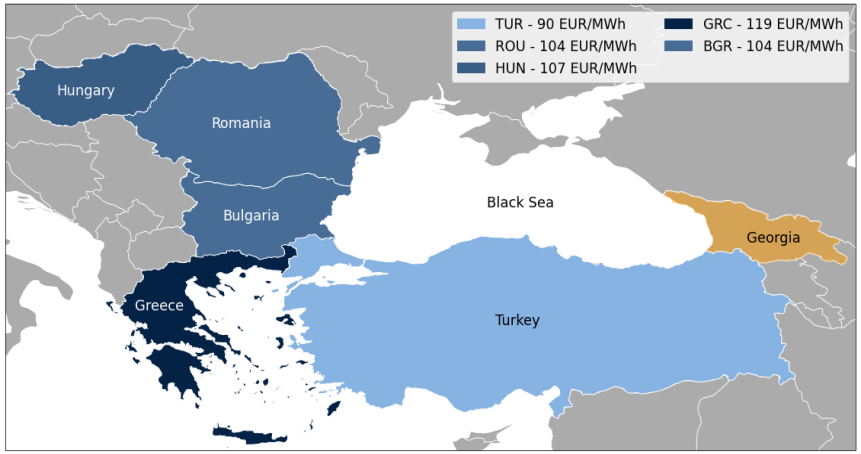
3. Trends in electricity imports and exports

Monthly electricity flows with neighboring countries (2022)



Source: GSE, Annual Balance

Average electricity prices in Southeastern Europe (2023)



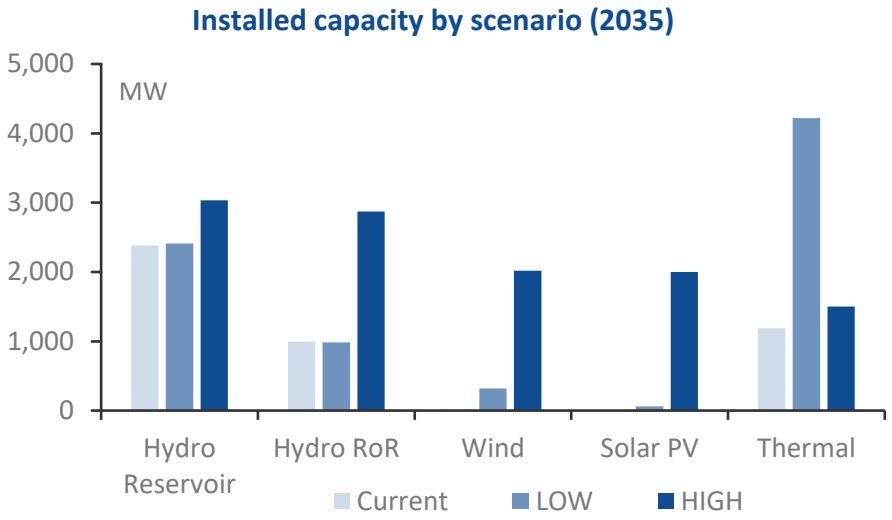
Sources: Own illustration based on ENTSO-E, EPİAŞ

- Georgia is a **net exporter during late spring and summer and a net importer in the rest of the year** (due to seasonality of hydro-power generation)
- **Electricity imports have been increasing significantly over the last decade**
  - Except for 2016, Georgia has been a net importer of electricity in the 2012-2022 period
  - The increase in imports is attributed to a growing domestic electricity demand and a stagnating generation capacity
- **Turkey** is current **main export destination**
  - Most attractive neighbouring market due to higher price environment
- Under current price conditions, **Southeastern European markets seem slightly more attractive**
  - 104-119 EUR/MWh in 2023
  - Turkey: ~90 EUR/MWh in 2023
- However, **prices expected to fall faster in Southeastern Europe than in Turkey**
  - Turkey expected to rely on more natural gas-based electricity generation for longer

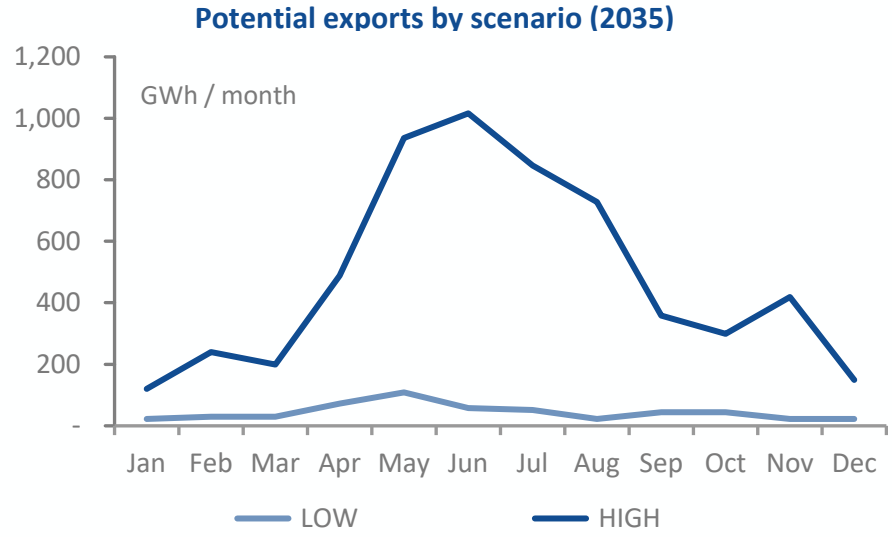
Part II:

Assessing the economics of the proposed subsea cable

1. Scenarios for future Georgian exports



Source: GSE

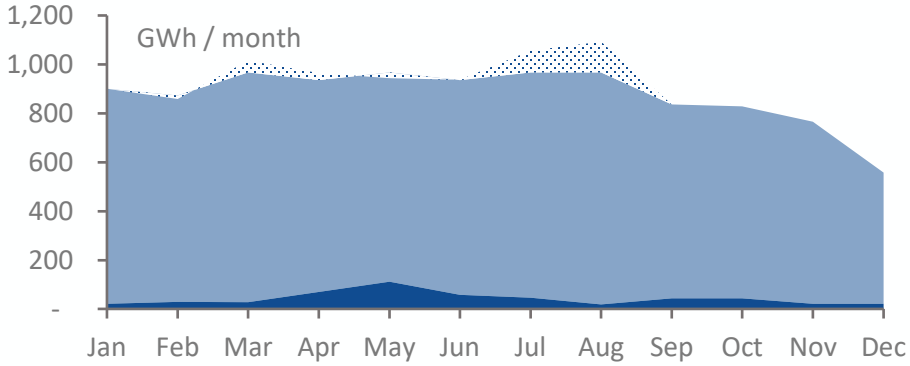


Source: GSE

- Estimates of potential Georgian exports based on **GSE Adequacy Assessment** and **Ten-Year Network Development Plan**
- Two scenarios: **LOW** (G0) and **HIGH** (G1)
- **LOW scenario** assumes current challenges in expanding hydropower persist in the future
  - 380 MW of RES (incl. hydro) added until 2035
- **HIGH scenario** implies an optimistic expansion of hydropower and other renewable sources
  - 6,530 MW of RES (incl. hydro) added until 2035
- Both assume a medium **4.5% p.a. growth in electricity demand** (L2)
- **Limited export potential in LOW scenario**
  - 520 GWh in 2035
- **Much larger exports in HIGH scenario**
  - 5,800 GWh in 2035
  - **Large seasonal variation, peak in summer** due to expansion in hydro and solar power

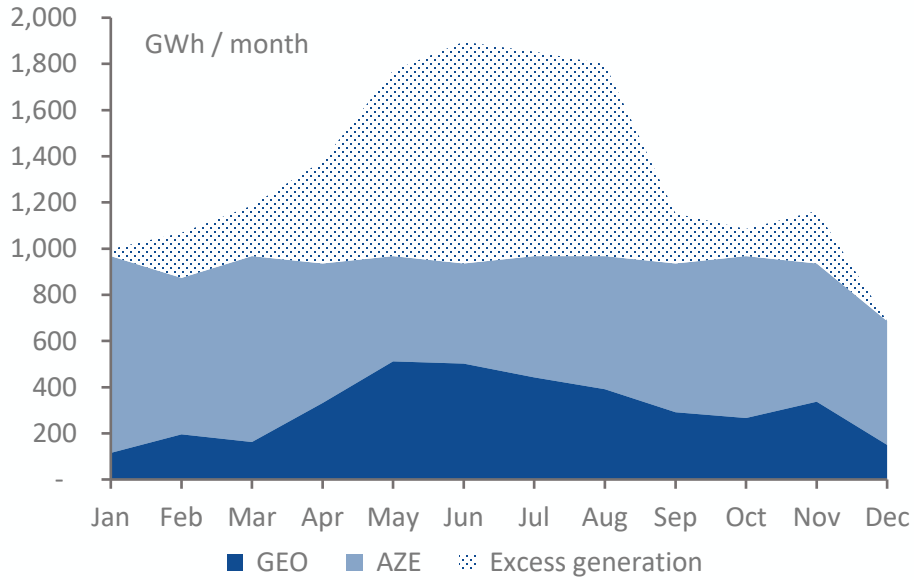
2. Joint export volumes of Georgia and Azerbaijan

Subsea cable export volumes (LOW scenario 2035)



Source: Own calculations

Subsea cable export volumes (HIGH scenario 2035)



Source: Own calculations

» Subsea cable **joint project with Azerbaijan**

Assumptions

» No reliable information on **RES expansion plans** in AZE. Assumed **Azeri export-oriented RES development**

- 2,000 MW wind power
- 500 MW solar PV

Results

» **High utilisation rate** for subsea cable

- LOW: 92%
- HIGH: 98%

» **Large difference in GEO share**

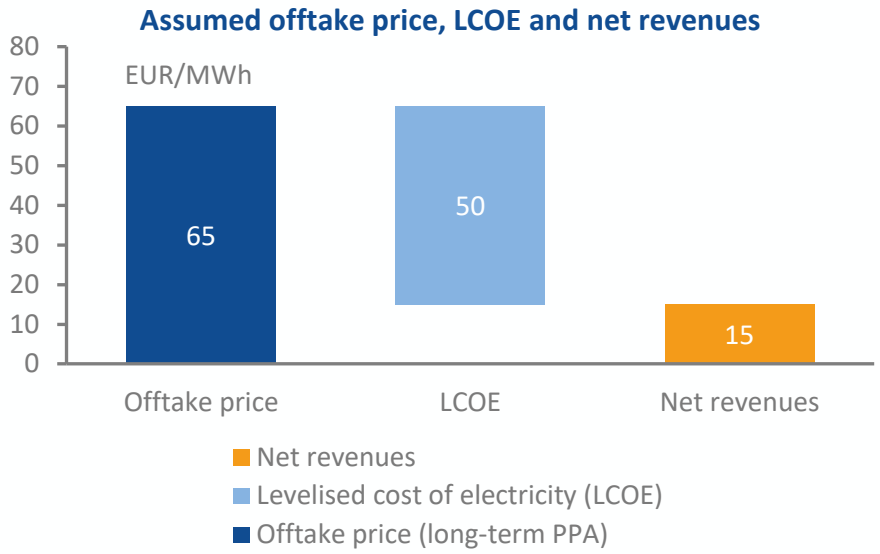
- LOW: 5% of total exports
- HIGH: 33% of total exports

» Significant excess generation in HIGH scenario

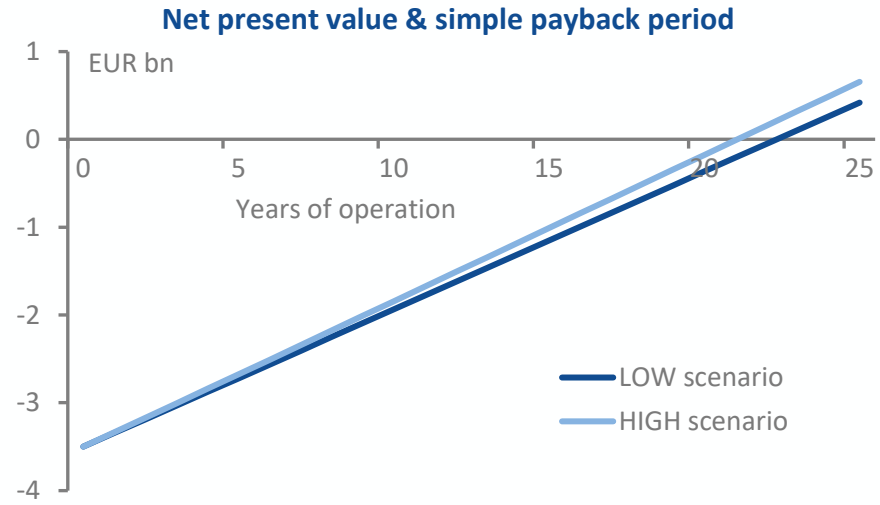
- Could be utilised to decarbonise domestically

➢ **Cable only relevant if GEO and AZE build sufficient export-oriented RES capacities**

3. Can subsea cable investment be refinanced?



Source: IRENA, S&P, expert interviews, own calculations



Source: Own calculations

Assumptions

- Investment cost: EUR 3.5 bn
  - based on informal estimates by key stakeholders and insiders (see Annex IV)
- Long-term PPA with offtakers in Romania/Hungary for 65 EUR/MWh
  - Based on forecasts for renewable PPAs
- Levelised cost of electricity (LCOE) at 50 EUR/MWh
  - Based on market research and local experts*

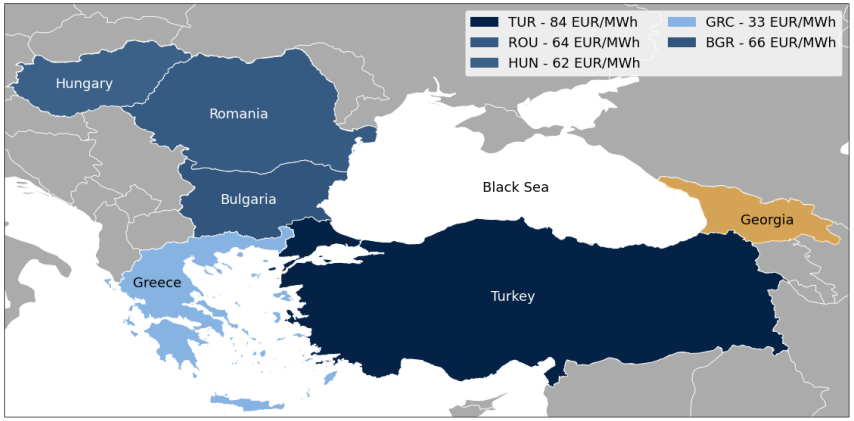
Results

- **Net revenues**
  - 15 EUR/MWh or ~ EUR 160 m p.a.
- **Simple payback period**
  - 21 (HIGH) to 22 years (LOW)
- **In principle, the subsea cable could be profitable in the long term**
  - However, if AZE does not build **export-oriented RES capacities, simple payback period would be over 40 years** (HIGH) or simply **infeasible** (LOW)

*average LCOE based on 50-60 EUR/MWh (GEO) and 40-50 EUR/MWh (AZE)

4. Alternative: exporting to Turkey

Average electricity prices in Southeastern Europe (2030, proj.)



Source: Own illustration based on ENTSO-E

Planned interconnection capacity (2033)

Note: position of interconnectors only indicative.

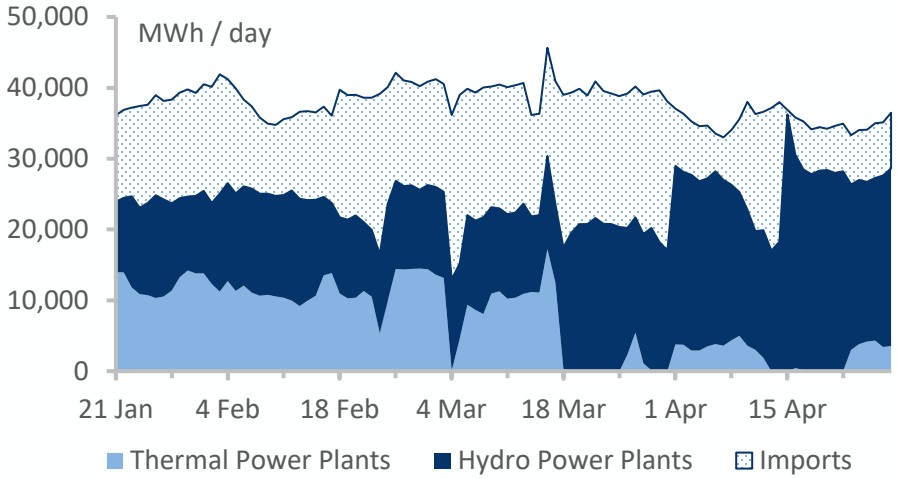
Source: Own illustration based on GSE, TYNDP 2023-2033

- Market prices in ROU comparable to TUR now, with **expectations of higher prices in TUR in the future** (ENTSO-E forecast):
  - 84 EUR/MWh in 2030
  - 83 EUR/MWh in 2040
- **Interconnection with Turkey exists**
  - 700 MW now, 1,050 MW in 2030s
  - Sufficient capacity, limited congestion for GEO exports until 2035 even in HIGH scenario
  - Additional interconnection cheaper to build
- **GEO could export to Turkey and generate higher (net) revenues**
  - EUR 180 m p.a. in HIGH scenario (2035)
- **Exports would first flow to Turkey and only to Romania if GEO-TUR line is congested**
  - Unless long-term PPAs are concluded
  - Risk that utilisation rate is substantially lower than estimated
- **Even if RES expansion materialises, no clear business case for subsea cable due to higher forecast prices in TUR than in ROU**

Part III:
Additional considerations

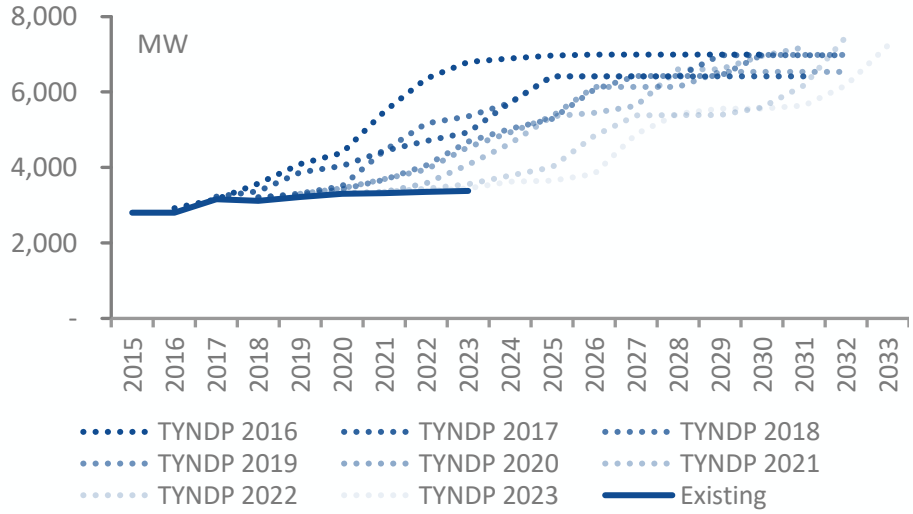
1. GEO domestic perspective

Electricity supply during Enguri maintenance (2021)



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

Existing and projected installed hydropower capacities



Source: GSE

Prospects

» **Subsea cable could reduce dependency on TUR as main export market**

» **Subsea cable could potentially increase GEO energy security**

- Emergency imports for Enguri maintenance, failure or interruption of electricity/gas imports
- However, **existing power lines from Turkey and Azerbaijan can provide the same**
- Imports via existing lines replaced Enguri during maintenance in 1H2021

Challenges

» **Unclear prospects for GEO hydropower expansion**

- Local resistance to new hydro projects
- Track record of overly optimistic network development plans (also see Annex II)

» **Domestic GEO grid needs substantial additional investments** (strengthen East-West corridor)

2. Implementation and operation

Legal / technical / security aspects

» **Legal aspects**

- If the cable is to bypass Russian and Ukrainian territory, it would need to pass through the **exclusive economic zone (EEZ) of Turkey**

» **Technical difficulties**

- **Supply chain issues:** market for HVDC lines and substations is small, specialised and concentrated; order books are full for years ahead (mainly due to offshore wind parks)
- **Construction:** the cable would be longer than all existing subsea cables, including 700 out of 1,200 km being >2,000m below sea level

Security / sabotage risks

- Cable is physically vulnerable, easy access for Russian navy due to location

Project financing

» **Insurability / bankability unclear**

- Mainly related to security concerns, see above
- Additionally: uncertain business case may prove to be impediment for funding

» **High risk of cost overrun**

- Mainly relates to technical difficulties as outlined above

» **Undetermined project financing**

- What share for GEO, AZE, ROU, BGR, HUN, BGR and EU?

Conclusion

Conclusion: business case

» There are two sides to be considered regarding the Black Sea Submarine Cable: **business case** and **strategic dimensions**

Business case

» Status quo:

- GEO has mostly been a **net importer of electricity** on a yearly basis in recent years
- Exports are only possible in late spring and summer
- The increase in electricity demand (consumption) tends to outpace capacity increases

» Necessary condition: **Sufficient additional RES capacities in GEO and AZE**

- If GEO and AZE do not build sufficient export-oriented renewable capacities, investment of submarine cable might not be recovered
- On the other hand, if exports are locked in through long-term PPAs, a high utilisation rate could be achieved, and investment costs could be refinanced within slightly over two decades

» However: **exports to Turkey are likely financially more attractive** and **sufficient transmission capacity is already in place**

- Moreover, adding transmission capacity to Turkey is substantially cheaper
- Without long-term PPAs, exports might be diverted to Turkey either way
- Risk of substantially lower subsea cable utilisation rate, high **stranded asset risk**

➢ **No clear business case for the cable at the moment**

Conclusion: strategic dimensions

Strategic dimensions

» Status quo:

- No link to Europe so far
- Exports strongly dominated by Turkey; imports come mainly from Russia

» Potential offered by the Black Sea Submarine Cable:

- Provide a **direct link to the EU** and thus provide **diversification** and **lower supply risk** as well as increased cooperation with EU partners
- Implication 1: unlocking of **additional export markets** for GEO and AZE and **reduction of dependency on TUR** as main export market
- Implication 2: **reduced dependence on RUS for imports** in case of supply shocks
- Additionally, the cable might provide an (indirect) incentive for increasing capacities due to linking GEO with new markets

» However: this potential is balanced by

- So far, **unclear prospects for GEO hydropower and grid expansion**
- Potential obstacles regarding **legal and technical aspects**
- **Sabotage risk**, which may prove to be impediment for **insurability**
- High cost of the project and **potential cost overruns**

➢ **Cable would offer some strategic benefits**

Conclusion: outlook and discussion

Outlook and open discussion points

- **Not the right time to make final investment decision**, only proceed once:
  - RES expansion plans in GEO and AZE more concrete
  - Price projections for ROU and TUR clearer
  - Financing of project clarified
- **Scenarios for RES expansion in GEO**
  - Undertake detailed electricity system modelling (capacity expansion & dispatch optimisation)
  - Show different pathways for GEO to become net exporter (again)
  - Potentially as integrated South Caucasus model (with different scenarios for ARM and AZE power system development)
- **Potential involvement of ARM**
  - ARM and EU have expressed interest for the country to join the project
  - High potential for RES, more transit through cable and inclusion of the whole South Caucasus
- **Comparison to ITA-MNE cable**
  - Supports integration of Western Balkan countries into EU; very successful story for MNE
  - But: main interest from ITA (green energy imports), thus ITA ready to finance the project
  - Here: financing dependent on feasibility of the project, much more difficult to implement

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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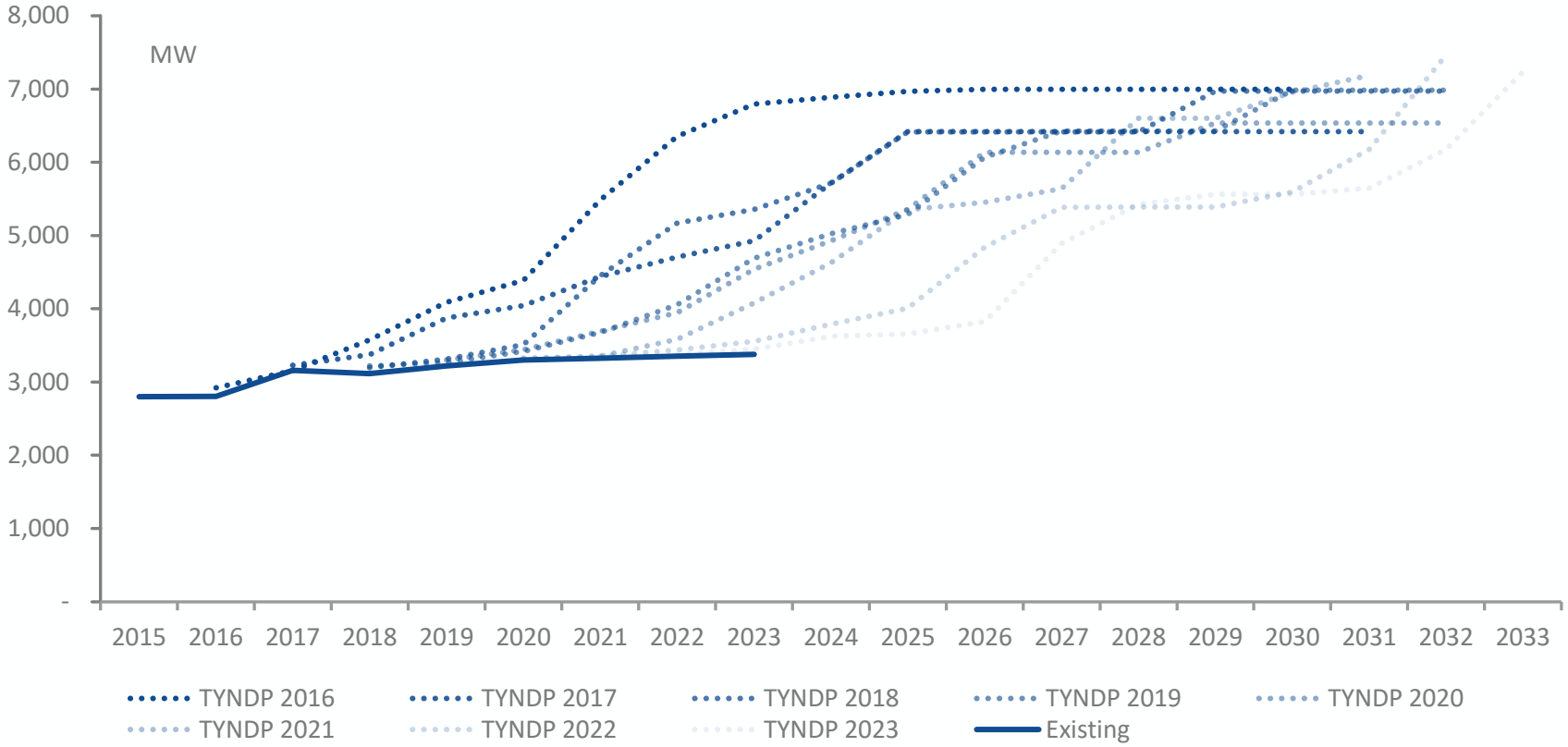
Annex I: Overview of assumptions and results

	LOW	HIGH
Assumptions		
Georgia		
Scenario in GSE TYNDP	G0	G1
Additional RES by 2035	380 MW	6,530 MW
Annual growth in electricity demand	4.5%	4.5%
Azerbaijan		
Export-oriented RES expansion	2,000 MW (wind) 500 MW (PV)	2,000 MW (wind) 500 MW (PV)
Prices / costs		
Offtake price in ROU/HUN	65 EUR/MWh	65 EUR/MWh
Levelised cost of electricity LCOE (avg.)	50 EUR/MWh	50 EUR/MWh
Project fundamentals		
Investment costs	EUR 3.5 bn	EUR 3.5 bn
Transmission capacity	1.3 GW	1.3 GW
Results		
GEO export potential in 2035	520 GWh	5,800 GWh
Utilisation rate	92%	98%
GEO share in total exports	5%	33%
Simple payback period (with AZE capacities)	22 years	21 years
Simple payback period (without AZE capacities)	infeasible	40 years

Source: own calculations based on data by GSE, IRENA, S&P and expert interviews

Annex II: Reliability of past GSE projections

Existing and projected installed hydropower capacities (according to past TYNDPs)



Source: GSE

- GSE has consistently been too optimistic in projecting expansion of hydropower
- In practice, many hydropower projects have been delayed or cancelled due to local opposition
- **Casts doubt on current optimistic projections**

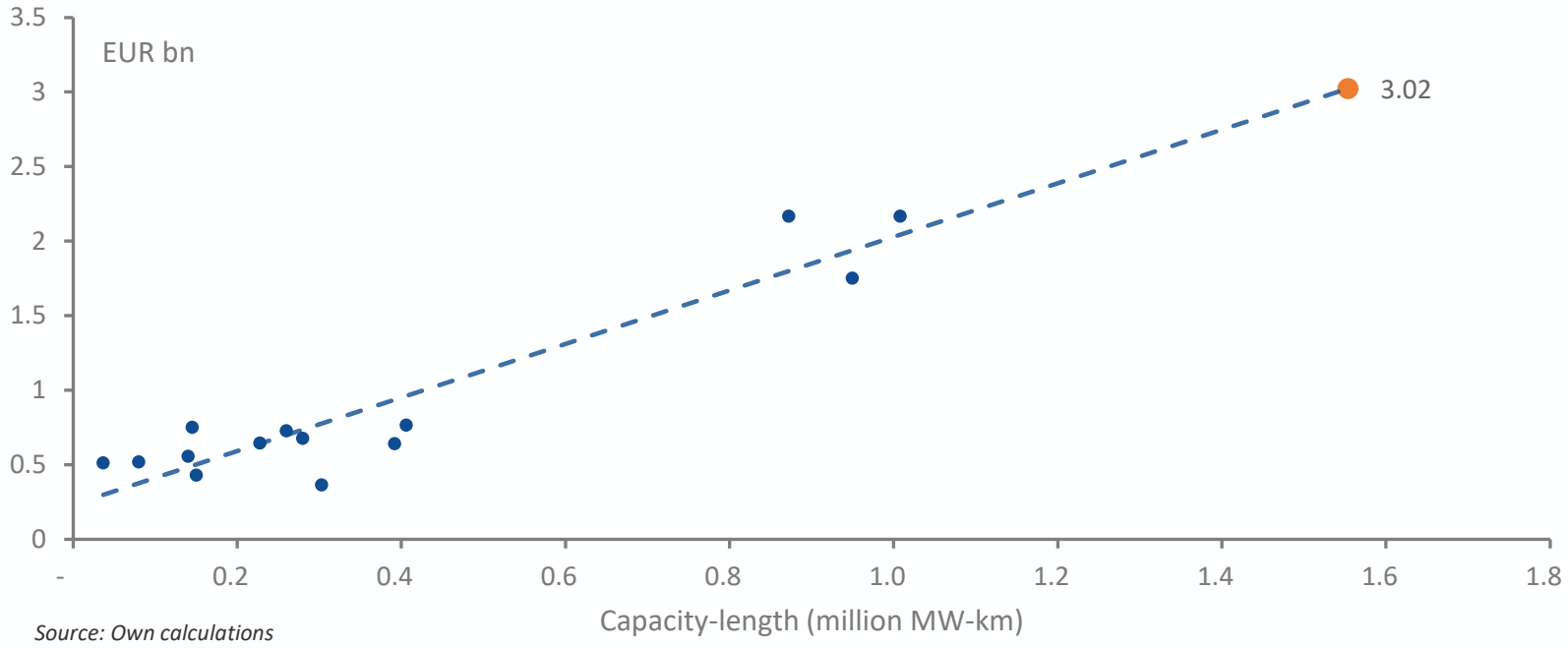
Annex III: Assumptions in previous World Bank study

- A previous study on the Black Sea Submarine Cable commissioned by the World Bank in 2020 came to a more positive conclusion regarding the business prospects
- Question: why do the results differ?
- Reason 1: very optimistic expansion of **GEO hydropower capacities**
  - *"scenarios […] are based on Georgian TYNDP […] but with somewhat more optimistic expectations than applied by GSE in TYNDP"*
  - However, GSE's TYNDP scenarios are already very optimistic (see Annex II)
  - GSE's TYNDP G1, G2 and G3 scenarios are used, all of which assume that 100% of planned capacities will be built (with some share of projects being delayed by 5 or 10 years in G1/G2)
- Reason 2: prices for EU markets are assumed to remain > 100 USD/MWh, **TUR electricity wholesale prices assumed to drop** to 69 USD/MWh (2035) and 36 USD/MWh (2040)
  - This is based on ENTSO-E TYNDP 2018, not in line with latest available ENTSO-E estimates (from 2023)

➢ **World Bank study likely overestimates available generation capacities for export and might underestimate potential revenues from exports to TUR**

Annex IV: Benchmarking subsea cable costs

Project cost (in 2023-EUR) and capacity-length (rated capacity times length of cable) for existing HVDC subsea cables



Source: Own calculations

- Initially communicated official cost estimate: **EUR 2.3 bn**
- However, key stakeholders and insiders currently expect a project cost of **EUR 3-4 bn**
- A simple benchmarking exercise based on past project costs for existing high-voltage subsea cables yields a cost estimate of **slightly over EUR 3 bn**
- Due to particular difficulties of the Black Sea Submarine Cable project vs. existing subsea cables (depth of the seabed, geopolitical environment, etc.) we deem a cost somewhere in the middle of the range expected by key stakeholders and insiders plausible (**~ EUR 3.5 bn**)