CABLE IN THE BLACK SEA WATER, OR A MYSTERIOUS GREEN ENERGY PROJECT

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ABSTRACT
Hungary, Romania, Georgia and Azerbaijan are planning to build a 1150 km long seabed electricity cable under the Black Sea, to transport renewable energy from the South Caucasus region into the European Union and mostly to the Hungarian electricity market. Apart from the political, economical, and technical/engineering risks and challanges to the project, EU legal barriers also pose huge problems to this enterprise. This article tries to walk the reader around the multi-angle problematics of a very complex construction project at the periphery of the European Union.

KEYWORDS
High voltage undersea electricity cable, renewable energy export, OTC contract, cross border capacity reservation

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I. Introduction

Based on the data of the International Energy Agency and the plans of the European Union, it is clear that the demand for electricity in the world, including in Europe, will drastically increase. Even today, electricity is the secondary source of energy that is an indispensable condition for the functioning of modern societies. The war in Ukraine is a frustrating demonstration of this.

In order to meet the growing demand for electricity, intensive source-side developments will be necessary throughout Europe. However, the Hungarian energy policy debates of recent years have sunk into the classic nuclear-coal-gas technological triangle. Renewable energy sources actually belonge to the „politically tolerated" category from the point of view of the classic Hungarian energy industry. It follows from all of this that little domestic attention has been paid to the technologies and project development opportunities that help the integration of renewable energy sources into the network. Accordingly, there are hardly any publications in the domestic literature that deal with the issues of high-voltage direct current transmission1, even though various high-voltage direct current project ideas have appeared in the peripheral regions of Europe, which aim to bring renewable-based electricity produced far away to Europe (eg. from North Africa).

Thats why, the professional public was surprised to learn that on December 17, 2022, in Bucharest, that "Hungary has committed itself with its partners to a unique investment in the world, we are preparing to build the world's longest undersea electricity line," as announced by its Prime Minister, and then, based on news from the domestic press, he signed the agreement on an electricity network transporting electricity from Azerbaijan to Hungary via Georgia and Romania. The exact content of the agreement cannot be identified based on the Hungarian news reports, but based on the available international sources, it is worth interpreting the project for the Hungarian energy industry as well.

The content of the project is believed to be precisely defined by Jeyhun Bayramov, Minister of Foreign Affairs of the Republic of Azerbaijan, who will refer to the investment under the title "Azerbaijan-Georgia-Romania-Hungary Black Sea Submarine Cable Project" at the meeting of the foreign ministers of the European Union's Eastern Partnership on December 12, 2022. The exact nature of the signed contract can be identified on the basis of the twitter post of Olivér Várhelyi, the commissioner responsible for neighborhood and enlargement policy of the European Union, i.e. a "Memorandum of Understanding - MoU" was signed.

Regarding the financial support of the project, it is worth recalling the words of President Mrs. Von der Leyen, according to which ".I am very much looking forward to the results of the currently ongoing feasibility study. We will be

[1] Aladár Kimpián, 'Nagyteljesítményű villamosenergia-átvitel nagy egyenfeszültségen' [High-Power Electricity Transmission at High Direct Voltage] (presentation delivered at the Energetikai Szakkollégium, Budapest, 27 March 2014) <https://www.eszk.org/attachments/l192/ea/HVDC_eloadas.pdf> accessed 31 March 2026

ready to support you. Because now we have the opportunity to financially support projects of common interest with neighboring countries...".

In February 2025, a joint company called Green Energy Corridor Power Company (GECO) was established in Bucharest by Azerbaijan, Georgia, Romania, and Hungary, with the goal to oversee the research and design phase of the Black Sea Submarine Cable Project[2]. The project has also been included in the ENTSO-E Ten-Year Network Development Plan (TYNDP) 2024–2034. It has been submitted to the European Commission to obtain "Project of Common Interest" (PCI) status — which would unlock funding and regulatory support.[3]

The fragmented public availability of information concerning the project also raises a broader issue of administrative and regulatory transparency.[4] In the case of large-scale, cross-border infrastructure projects involving public authorities, public undertakings and potential EU-level financial or regulatory support, transparency is not merely a matter of communication policy, but a condition of legal accountability, public scrutiny and informed professional debate.

II. International legal background of seabed cables

The regulation of undersea (submarine) cables, including their laying, maintenance, and protection, is governed primarily by international law, adopted in the XIX.th century but more notably a decade later the United Nations Convention on the Law of the Sea (UNCLOS).[5] Additionally, several other legal instruments, treaties, and conventions provide complementary or supporting frameworks.

The legal regulation of undersea cables became necessary after the continental expansion of wired telegraph and telephone lines, when the two shores of the Atlantic Ocean were first connected.[6]

The world's first telecommunication undersea cable was the Transatlantic Telegraph Cable, laid in 1858. Its official name was Transatlantic Telegraph Cable, it came into service in 1858, and connected Valentia Island, Ireland with Heart's Content, Newfoundland, Canada and than the USA on land. It use, as telephone came only later, communication started Morse code signal cables. The first

[2] 'Joint venture established to manage Black Sea submarine cable project' (*Renewables.az*, 3 Februay 2025) <https://renewables.az/en/news/joint-venture-established-to-manage-black-sea-submarine-cable-project?utm_source=chatgpt.com> accessed 31 March 2026

[3] www.renewables.az accessed 31 March 2026

[4] See Balázs Hohmann, *Az átláthatóság értelmezése és követelményrendszere a közigazgatási hatósági eljárások tükrében* [The Interpretation and Requirements of Transparency in Administrative Authority Proceedings] (Novissima 2022).

[5] Richard Barnes, 'The Continuing Vitality of UNCLOS' in Jill Barrett and Richard Barnes (eds), *Law of the Sea: UNCLOS as a Living Treaty* (BIICL 2016) 459.

[6] S Jayakumar, 'UNCLOS: Two Decades On' in Myron H Nordquist, John Norton Moore and Kuen-Chen Fu (eds), *Recent Developments in the Law of the Sea and China* (Brill Nijhoff 2005) 11. https://doi.org/10.1163/9789047417378_007

successful message was sent on August 16, 1858, from Queen Victoria (UK) to President James Buchanan (USA). However, the cable failed after only about three weeks of operation due to electrical problems. A more durable **cable** was successfully laid in 1866, again connecting Ireland and Newfoundland, and it remained operational far longer.

The first international legal instrument, to regulate undersea cables in international waters was the International Convention for the Protection of Submarine Telegraph Cables – signed in Paris, 14th March 1884.
The Convention regulated the most important topics of undersea cables. That is the laying of them, security distances, responsibility for them, and criminal law responsibility for breaking or damaging the cables.

Just for curiosity, Austria-Hungary was one of the signatory states of the Convention, and it was signed by the Emperor of Austria Hungary, I. Franz Josef. The Hungarian signature of this technical novelty international instrument was put on paper contrary to the fact, that the Monarchy did not operate any undersea cables, as not being a colonial power. The only undersea cable system, that the Monarchy was connected to directly was the Adriatic cable network in Trieste and German, Italian and Ottoman lines. That is how the Empire communicated with the world.

Article I of the Convention defines the geographical scope of application of the Convention which is the non-territorial waters of the sea (12 nautical miles) and the subject is telegraph cables which end on the shores of the contracting parties.

Article II defines as „a punishable offence to break or injure a submarine cable, wilfully or by culpable negligence, in such manner as might interrupt or obstruct telegraphic communication, either wholly or partially". It is interesting to observe – having seen recent cable cutting incidents on the Baltic Sea by Russian affiliated vessels during the Ukrainian/Russain war – that only wilful and culpable wrongdoings are sanctioned. So the Convention does accept, that by accident, or by self saving, such damages may occur on the sea.

The convention provides for the case when the owner of a cable during laying or repairing his own cable brakes or injures another cable, obliging the wrongdoer to bear the costs of reparation. (Art. IV.)

Other sea vessels, when they see a cable laying vessel, should stay a way at least one nautical mile from that vessel, the same goes for the fishing nets and fishing boats.

Article VIII. of the Convention provides for the rules on the criminal procedures to be taken in the case of infraction. The main guiding rule is the rule of the flag of the ship, if that does not help in defining the jurisdiction, the nationality of the crew prevails. The procedure of proof was also very liberal under the Convention, allowing all legislation of the country of the court. Proceedings were expected to be finished as soon as possible. The contracting parties also undertook

to make the braking or damaging of the telegraph cables to be punishable crime in their respective national law (at least by fine or imprisonment or both)

It is interesting to remark, that the Convention did cover war. In case of belligerent states, it was not expected to respect its provisions. „Article XV It is understood that the stipulations of the present Convention do not in any way restrict the freedom of action of belligerents."

The UNCLOS convention, nearly a century later, further developed the principles worked out by the telegraph cable convention.

Its Article 21, which regulates laws and regulations of the coastal State, on territorial waters, says: *„The coastal State may adopt laws and regulations, in conformity with the provisions of this Convention and other rules of international law, relating to innocent passage through the territorial sea, in respect of all or any of the following: (a) the safety of navigation and the regulation of maritime traffic; (b) the protection of navigational aids and facilities and other facilities or installations; (c) the protection of cables and pipelines"*

Article 51 deals with existing agreements, traditional fishing rights and existing submarine cables and it says: *„2. An archipelagic State shall respect existing submarine cables laid by other States and passing through its waters without making a landfall. An archipelagic State shall permit the maintenance and replacement of such cables upon receiving due notice of their location and the intention to repair or replace them"* The Baltic Sea is one of the mostly cabled seas in the world. Telecommunication, electricity and even natural gas pipelines cross it. Reparaing or replacing them was a non issue during peace time for the coastal states, but events gone an unexpected way with the sabotage of Nordstream 1 and Nordstream 2, the two Russian gas pipelines, as well as the cutting of a dozen of telecommunication and electricity cables, by the so called „shadow fleet", using ship anchors.[7]

The route of any undersea cables is determined by consent of the Coastal State, as says Article 58 and Article 79 of the UNCLOS, through the Exclusive Economic Zone and the continental shelf, there are only safety conditions that shall be met. Coastal states are not entitled to block pipeline or cable projects on that ground. It is now appropriate to examine the content of Article 79:

Submarine cables and pipelines on the continental shelf

1. „All States are entitled to lay submarine cables and pipelines on the continental shelf, in accordance with the provisions of this article.

2. Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines, the coastal State may not impede the laying or maintenance of such cables or pipelines.

3. The delineation of the course for the laying of such pipelines on the continental shelf is subject to the consent of the coastal State.

[7] Bill Whitaker, 'Concerns about possible Russian sabotage persist amid rash of cable cuts in the Baltic Sea' (*CBS News*, 28 September 2025) <https://www.cbsnews.com/news/concerns-about-possible-russian-sabotage-baltic-sea-cable-cuts-60-minutes-transcript/> accessed 31 March 2026

4. Nothing in this Part affects the right of the coastal State to establish conditions for cables or pipelines entering its territory or territorial sea, or its jurisdiction over cables and pipelines constructed or used in connection with the exploration of its continental shelf or exploitation of its resources or the operations of artificial islands, installations and structures under its jurisdiction.
5. When laying submarine cables or pipelines, States shall have due regard to cables or pipelines already in position. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced."

One of the most contemporary example of laying a large scale undersea pipeline was the construction of the Nordstream 2 pipeline, where the course of the pipeline pair had to be modified by the investor multiple time, due to concerns of the effected coastal states.[8]

Article 112 deals with the right of States to lay submarine cables and pipelines and declares that „ 1. All States are entitled to lay submarine cables and pipelines on the bed of the high seas beyond the continental shelf. 2. Article 79, paragraph 5, applies to such cables and pipelines. „ That concerns the high seas over the continental shelfs, where only safety reasons rule over the economic ones.

Article 113 is an alread known rule from the Telegraph Cable Convention, making it obligatory for member states to have rules in their respective internal legal system to sanction wilful or culpable negligence breaking or damaging cables and pipelines. *„ Breaking or injury of a submarine cable or pipeline Every State shall adopt the laws and regulations necessary to provide that the breaking or injury by a ship flying its flag or by a person subject to its jurisdiction of a submarine cable beneath the high seas done wilfully or through culpable negligence, in such a manner as to be liable to interrupt or obstruct telegraphic or telephonic communications, and similarly the breaking or injury of a submarine pipeline or high-voltage power cable, shall be a punishable offence. This provision shall apply also to conduct calculated or likely to result in such breaking or injury. However, it shall not apply to any break or injury caused by persons who acted merely with the legitimate object of saving their lives or their ships, after having taken all necessary precautions to avoid such break or injury."*

Though that rule for basic responsibility for damaging or breaking cables and pipelines is extended by Article 114 of the UNCLOS to owners of existing undersea infrastructure, by saying that *„Breaking or injury by owners of a submarine cable or pipeline of another submarine cable or pipeline Every State shall adopt the laws and regulations necessary to provide that, if persons subject to its jurisdiction who are the owners of a submarine cable or pipeline beneath the high seas, in laying or repairing that cable or pipeline, cause a break in or injury to another cable or pipeline, they shall bear the cost of the repairs."*

On other relevant legal instrument is the ITU instruments with their technical standards. International Telecommunication Union (ITU) although not a

[8] Martin Russell, 'The Nord Stream 2 pipeline: Economic, environmental and geopolitical issues' (*European Parliamentary Research Service Briefing*, July 2021) <https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690705/EPRS_BRI(2021)690705_EN.pdf> accessed 31 March 2026

legal regulatory body for laying cables, ITU governs technical standards and coordination for global telecommunications infrastructure, and collaborates with UN bodies on spectrum allocation and interference protection.

III. The project

The basic idea of the planned project is to connect the Georgian and Romanian electricity systems with an undersea cable. This would make it possible to connect the energy systems of the South Caucasus and the energy systems of continental Europe, which would improve the security of supply of the Georgian electricity system. When planning the project, they started from the basic situation that the Georgian electricity system is based to a significant level on hydropower plants, the production of which is highly dependent on the rainfall conditions of the region, but at the same time, the country already has a strong network connection with all the countries of the region, or it can be further strengthened. Therefore, any available domestic surpluses, as well as renewable-based electricity produced in the region and not used locally, could be exported to the European Union.

To implement the idea, JSC Georgian State Electrosystem (GSE) and Transelectrica started a joint study. The Georgians also received support from the World Bank for the preparation of a foundational study, and the construction of a 1,000 MW submarine cable was also included in the Georgian 10-year network development plan. The ENTSO-E network development plan prepared in 2022 also includes the Georgian-Romanian cable project.

Following further support from the World Bank and an international tender, Georgia signed a contract with the Italian energy consulting firm CESI SpA, which began the development of a feasibility study. According to the contract worth nearly 2.5 million euros, the preparation of the feasibility study began on May 11, 2022 and will last 18 months. According to a Georgian statement, "as part of the study, GSE is actively cooperating with the Romanian transmission system operator Transelectrica. The Ministry of Economy and Sustainable Development of Georgia conducts regular consultations on the project with the competent ministries of Romania, Armenia and Azerbaijan, as well as with GSE - the energy companies of the mentioned countries".

VI. The technical content

As planned, in the transmission project, a 500 kV dual-system transmission line will be built on the Georgian side between the existing 500 kV Jvari and the new 500 kV Anaklia substations (seaside). In the future, a two-pole 500 kV direct current submarine cable would be built between Anaklia and Constanta (Constanta Nord or Medgidia Sud). For this purpose, the construction of a 500/500 kV AC/DC converter station with an installed capacity of 2x500 MW is planned at the Anaklia substation. A DC/AC station of similar capacity is also required at the Romanian connection point. According to the first estimates, the total length of the submarine

cable would be 1,100 kilometers, which would also include a 95 km land section. Therefore, the project does not involve further internal Romanian network development or Hungarian transmission network is also not involved in the project. At least such ideas cannot be identified from the network development plan of ENTSO-E.

Among the ENTSO-E planning data, it is stated that the CAPEX cost of the investment is 2118.85 M€, while the OPEX cost is 9.42 M€/year, which also includes the cost of network loss. These costs - based on the values - are probably due to the conversion of the World Bank cost estimate from that time in €. Since European inflation has been quite high since then and the €/USD exchange rate is approx. 10% deterioration also occurred, so it is likely that we are not much wrong if approx. We calculate with 20% higher costs. Based on all of this, in the case of an investment that is just starting, with a 25-year time span, a 10% internal rate of return, a construction period lasting 4 years, assuming 90% capacity utilization and without EU support, the transmission fee on the busbar of the Constanta Nord substation is about €56/MWh for delivered electricity.

If we add to this the LCOE cost of the renewable energy sources mentioned in the political statements, the Romanian transmission tariff and the costs of the Romanian-Hungarian border crossing, then electricity could arrive on the Hungarian electricity market at a price of approximately €110-140/MWh (due to the risks, presumably around the upper limit of the band may be the actual price), but not in large quantities either. Whether this calculated price is too much or too little cannot be said yet. For example, compared to the current Hungarian spot market prices, this is a smaller value, but this price level is approximately in the order of magnitude of the German "base load" product price for delivery in 2026. In any case, it is obvious that this cost level can no longer be called favorable compared to other local production technologies. In addition, the possibility of long-term delivery to Hungary is highly limited, since the end of the cable will be in the Constanta Nord substation.

And yet, we did not mention the expected phyisical and market losses of the infrastructure. We know that the North Sea Link (UK–Norway, 720 km, ±525 kV HVDC) reports losses of approximately 4% end-to-end and this is an over a thousand kilometer long cable.[9]

But then comes another problem: further transmission from there is only possible under EU internal electricity market rules (there is no mention of the construction of any direct Hungarian-Romanian pipeline in the project), which on the one hand builds on the commercial interconnection of the markets, and on the other hand it is not possible to make capacity restrictions beyond one year at border crossings. This hardly worked out and industry accepted legal restriction in itself

[9] Jeremy Gordonnat and James Hunt, 'Subsea cable key challenges of an intercontinental power link: case study of Australia–Singapore interconnector' (2020) 4(2) *Energy Transitions* 169. https://doi.org/10.1007/s41825-020-00032-z

prevents long term agreements. The electricity industry works differently than the gas industry. There have been no capacity restrictions here for a long time, and that is no way, that the countries of interest can exempt themselves from under it.

Article 16(9) of the Electricity Regulation is key here. It says: *"Capacity shall be allocated via market-based mechanisms, such as auctions. No transmission capacity shall be reserved for the exclusive use of any market participant or category of participants."* Additionally: *"The maximum contract duration for the procurement of balancing capacity shall be one year."* So, explicit reservations of cross-border capacity for more than one year are not allowed, unless very specific exceptions apply (usually with NRA or ACER approval). And the reason for that is very simple: to prevent market foreclosure. Long-term cross-border capacity reservations can block access for others (especially new entrants), and distort price signals in the day-ahead and intraday electricity markets. Also EU policy promote liquid, short-term markets (especially day-ahead and intraday), with cross-zonal capacities made available close to real time, not locked up long in advance. Reserving capacity long-term can result in underuse or inefficient allocation, especially when market conditions change. The EU wants capacity to go where it's most needed. Market mechanisms with long-term physical transmission rights (PTRs) have mostly been phased out or converted into financial transmission rights (FTRs) on forward markets (e.g. long-term capacity rights up to 1 year via auctions, not bilateral reservation).

So then, what is still allowed? Long-term transmission rights (LTTRs) via Auctions, which means that TSOs must offer long-term cross-zonal capacity rights (monthly and annual products), but these are: non-exclusivity (allocated via competitive international auctions), financial or option-based (not physical reservations) and typically "use-it-or-sell-it" (UIOSI). Market participants can secure hedging via: FTRs / PTRs up to 12 months via coordinated capacity auctions.

The only exemption is granted by Article 63 of the Electricity Directive or Article 19 of Regulation 2019/943, for: new interconnectors, merchant investments, projects granted exemption by NRAs and approved by ACER or the European Commission, and these rare exemptions must be temporary, not harming competition and being transparent and proportionate.

Well, all can be said about the planned Black Sea Cable at present, but not these.

Also, some more obstacles pop up when we look at the conditions of OTC contracts, longer than 1 year, where the basic rule is that long-term OTC contracts must not distort competition or create market foreclosure. Contracts cannot block market access for new entrants. Market-dominant players must not abuse their position (Article 102 TFEU) and long-term Power Purchase Agreements (PPAs) must not restrict flexibility or liquidity of the short-term markets.

Also the Regulation (EU) No 1227/2011 on Wholesale Energy Market Integrity and Transparency (REMIT) says that all wholesale energy contracts,

including long-term OTC ones, must be reported to the Agency for the Cooperation of Energy Regulators (ACER), and even if OTC, the contract must be registered if it relates to supply or transportation of electricity within the EU and affects cross-border trade, so transparency must be ensured even if the deal is private or state or business secret.

While not a blanket ban, contracts longer than one year shall not be suitable for certain services such as: balancing capacity or ancillary services, where EU rules limit contract durations (typically to 1 year or less, unless a derogation is granted). Contractual arrangements must not hinder the TSO's ability to manage system balancing and congestion. The relevant TSOs or NRAs may scrutinize long-term capacity commitments if they affect grid reliability or cross-border flows. And than come the national rules and regulations jungle:

While EU law allows long-term OTC contracts, Member States may impose additional conditions, e.g.: Notification or pre-approval of contracts involving regulated entities. Special provisions for contracts with public undertakings or capacity mechanisms. Definition of what counts as a "long-term contract" (some countries consider >1 month, others >1 year). (Example: Romania changed its definition in 2021 to allow "long-term" contracts from 1 month onward on centralized markets, expanding the OTC flexibility.)

For the Hungarian side, the possibly available capacity does not seem too significant either. If the capacity is only distributed proportionally and the project promoters do not involve an actor who has already operated a long submarine cable, Hungary would get about 250 MW of the 1,000 MW capacity.

From the point of view of the technical evaluation of the project, it is also important to know that the most recent similar (currently the longest) submarine cable project put into operation in Europe is the North Sea Link. The cable is a 720 km long, 1,400 MW North Sea cable link connecting the electricity systems of Norway and the United Kingdom, which began operations in October 2021. The length of the cable, which is a proud political feature of the project, actually results in a cable at least 50% longer than the current longest cable, which may present a number of previously unforseen technical problems.[10] Only the acknowledged economic electricity market losses on the North Sea Link, as declared by Nordpool

[10] Hitachi Energy, a global technology leader that is advancing a sustainable energy future for all, today announced it has handed over the North Sea Link power interconnector to Statnett, the national power grid operator in Norway, and National Grid, which owns and manages gas and electricity infrastructure in the UK and northeastern United States. The link, which is the world's longest subsea power interconnector, is enabled by HVDC Light®, Hitachi Energy's high-voltage direct current (HVDC) technology, interconnects Norway's and the UK's power grids, which are separated by the North Sea. North Sea Link has the capacity to transmit 1,400 megawatts (MW) of renewable power through a 720-kilometer HVDC underwater cable, which is enough electricity to supply 1.4 million UK homes.*1 It allows Norway to import wind power from the UK and the UK to import hydropower from Norway. This efficient power exchange will help increase grid resilience in both countries, reduce fossil-fuel power generation in the UK and avoid 23 million tons of carbon emissions by 2030.

are currently set at 3,4%.[11] Losses are not linear to distance, physical electricity losses,[12] due the law of Ohm can reach higher numbers. [13] More information about both physical and financial/market loss factors can be found in this article, analyzing the nordic subsea cables.[14]

Geology does not help the project either, since the bottom of the Black Sea consists of two basins: the Western Black Sea and the Eastern Black Sea, which are separated from each other by the Central Black Sea High (Andrusov Ridge). The maximum water depth is 2245 m. Both basins are tectonically active as a result of the continued northward movement of the Arabian Plate causing the westward movement of the Anatolian Block along the North and East Anatolian Faults. And from this it does not seem that there is peace at the bottom of the sea.

V. Renewable energy from the Caucasus?

The source page of the above project also seems rather uncertain. Based on Azeri data, the country's total installed electricity generation capacity is 7,542.2 MW. Of this, the installed capacity of power plants operating with renewable energy sources is 1304.5 MW, which is 17.3% of the total capacity. The installed capacity of renewable energy sources – excluding large hydropower plants – was 194 MW in 2021, which is 2.5% of the total electricity generation capacity. Instead of the increased use of existing hydropower plants, the amount of electricity produced from renewable energy sources accounted for only 5.8% of the total production. Currently, therefore, the electricity production in Azerbaijan contains a low proportion of renewable energy sources, and is mainly based on fossil energy sources. In 2021, Azerbaijan's electricity production was 27.8 TWh, of which about 1.6 TWh was exported, which, based on the above, came mainly from fossil sources.

However, it is also an undoubted fact that an investment program was launched in 2022 for the intensive use of renewable energy sources. Based on the official potential estimate in Azerbaijan, the potential of economically viable and technically feasible renewable energy sources is 27,000 MW (of which 3,000 MW wind energy, 23,000 MW solar energy, 380 MW biomass and 520 MW hydropower). However, it is also important from the point of view of energy production that the capacity utilization of solar and wind power plants in Azerbaijan is 16-17% based on IRENA data. We cannot expect significantly different capacity utilization from

[11] Nord Pool, 'Loss functionality' <https://www.nordpoolgroup.com/en/trading/Day-ahead-trading/loss-functionality/> accessed 31 March 2026.

[12] Wilfried Frelin, Christophe Moreau, Dag Willen, Carsten Thidemann, Volker Waschk, Gabriel de Robien and Nathalie Boudinet, 'Measurements of Losses on Three-Core Submarine Power Cables' in *Jicable'15: 9th International Conference on Insulated Power Cables* (Versailles, 21–25 June 2015) paper B3.7, 1.

[13] Hossein Farahmand, Daniel Huertas-Hernando, Leif Warland, Magnus Korpås and Harald G Svendsen, 'Impact of System Power Losses on the Value of an Offshore Grid for North Sea Offshore Wind' in *2011 IEEE Trondheim PowerTech* (IEEE 2011) 1. https://doi.org/10.1109/PTC.2011.6019345

[14] Andrea Tosatto and Spyros Chatzivasileiadis, 'HVDC Loss Factors in the Nordic Power Market' (2021) 190 *Electric Power Systems Research* 106710. https://doi.org/10.1016/j.epsr.2020.106710

new investments either, as this basically depends on the geographical conditions. As a consequence, there appears to be a contradiction between the production possibilities of the possible renewable capacities in Azerbaijan and the capacity utilization necessary for the return of the planned pipeline. Obviously, this contradiction could be refined with a more detailed modeling that accurately depicts the possibilities of hydropower plants (presumably this will also be done by CESI SpA experts), but at first glance, the difference seems very large.

The situation on the Georgian side of the Azeri-Georgian border is also peculiar. Georgia's electricity production in 2021 was 12.6 TWh, with an import balance of 1.6 TWh. So, Georgia's electricity system currently relies on imports, but about 81% of its own production came from hydropower plants. In 2021, the total installed electricity generation capacity in Georgia is 4,525.1 MW. Of this, 105 operating hydropower plants account for the largest part, which represents approximately 3,350 MW (74%). In addition, there are 20.7 MW of wind power plants (0.5%), while the remaining 1154.4 MW (25.5%) are fossil (mainly gas-based) generating units. Georgian wind farms operate at 20-22% capacity utilization, while solar panels operate at 14-20% capacity utilization. Based on the official Georgian estimate, the country has significant hydropower potential (15,000 MW), but approx. 3,000 MW of solar and wind power plants could also be integrated into the system.

VI. Conclusions

Based on the above, if we leave aside the technical issues of the establishment and the uncertain political environment of the Black Sea with the ongoing Russian/Ukrainian war, it cannot be ruled out that the jointly optimized production of the Georgian and Azeri hydropower plants, as well as the Azeri solar and wind power plants, would be able to fill the submarine cable, but these Azeri solar and wind power capacities do not exist yet.

Will there be such a capacity when the cable is ready? How can you create a business model for electricity transmission via cable, in which we just don't know what price, what capacity and what capacity utilization we want to reach? How many internal EU electricity market rules should be observed and respected until the investors feel it legally safe to move into such a huge project?

For the time being, integrated operation with Georgian hydropower plants also seems to be a theoretical possibility, since this would require a very closely integrated market operation between the two countries, and it is not clear what interest these countries have in the joint export of renewable energy when their own fossil production should also be used. and it could be replaced with renewables (this is especially possible in the case of Azerbaijan). It is worth recalling that the World Bank's preliminary investigation, completed earlier, also started from the assumption that the cable is being built solely for the purpose of renewable electricity transmission.

Perhaps this is also why the President of Azerbaijan stated in July 2022 that the development of the use of renewable energy sources "...allows us to save natural gas and export the saved natural gas, especially given that the demand for our gas has now increased dramatically...".

Overall, the project raises a number of technical and business questions, but Hungary also has another strategic problem. It is not clear how Hungary, as a mainland state, can participate in the production of a renewable project that is connected to an area far from the EU. The rules of the internal market are completely clear, i.e. long-term capacities cannot be booked at border crossings, as analyzed in detail above.

And this rule will not be changed for a single cable project, as it is the basis of internal market integration. If there was no internal energy market integration, the Hungarian renewable energy potential would not be exploited either.

Maybe the idea of the European "Super Grid" should be dealt with here as well? Furthermore, it might be worth thinking about the distance from which electricity should be delivered to the territory of the EU?

There is certainly a distance that no longer results in a physically and both commercially feasible project, even if it seems like a good idea politically. However, one thing is certain, if a feasibility study were not prepared, we would have no chance to answer the above questions more precisely.

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