

Cost-Benefit Analysis (CBA) of APOLLO-LINK

Offshore interconnection between Spain and Italy

Executive Summary

This is a high-level Cost-Benefit Analysis (CBA) that examines the feasibility and advantages of the proposed APOLLO-LINK undersea cable between the substations Ramis, Spain and La Spezia, Italy. Overall, the long-term benefits are assessed to be significant with net benefits ranging from 4 to 5.2 billion Euros (over an assessment period of 25 years) or roughly 185 million Euros per year (average of the two scenarios) at investment costs of 3 billion Euros for the 660 km long interconnection.

Project Overview

The APOLLO-LINK project aims at establishing a critical energy connection between the substations Ramis, Spain, and La Spezia, Italy, through the implementation of a 525 KV HVDC undersea cable. This cable is set to traverse approximately 660 km (birdfly distance Ramis-La Spezia) beneath the Mediterranean Sea, boasting a capacity of around 2 gigawatts. In addition to its undersea segment, the project encompasses roughly 40 km of underground onshore cable infrastructure, accompanied by the integration of 4 to 6 transformers and the construction of 2 High Voltage Direct Current (HVDC) converter stations.

In its current state, the APOLLO-LINK project finds itself in the project initiation phase. The meticulous planning and permitting stages are slated to commence in 2025 and extend until 2029, with operational activities projected to commence in 2032. This timeline reflects the deliberate and methodical approach employed to ensure the successful realization of this essential energy initiative. The APOLLO-LINK aspires to serve as a pivotal conduit for power transmission, connecting two EU Member States with an innovative and robust system.

Quantitative Cost Benefits Assessment

While the preceding section provided a high-level overview of the project and its timeline, this section offers a quantitative assessment of the direct net benefit of APOLLO-LINK.

First and foremost, it is necessary to outline key assumptions that are universal across the approach. All figures are presented in Euros using 2023 real terms. Additionally, values are annual and thus do not require seasonal adjustments. The cost-benefit calculations are carried out over a 25-year operational period, starting in 2032 and running to 2057.

Furthermore, the cable is expected to operate as a price taker and not significantly influence the market. This simplifying assumption is made for the purpose of presenting results without the need for iterative calculations consideration, which would

otherwise be necessary if the cable's operations caused market fluctuations. This assumption is deemed reasonable because both Spain and Italy have significantly larger levels of energy generation and consumption compared to the flows that the cable could reasonably handle. Spain has 274 TWh of generation and 227 TWh of consumption, while Italy has 289 TWh of generation and 292 TWh of consumption, making the cable's impact relatively small in comparison.

Cost

APOLLO-LINK's cost is expected to be around 3.6 billion Euros (including operational costs). Of these, OPEX is estimated to be around 20 million Euros per year over a period of 25 years, amounting to 500 million Euros.

Project management & development	€ 190,000,000
Permitting, studies, and land acquisition	€ 50,000,000
Consenting Cost and CSR	€ 35,000,000
DC 525kV bi-pole cable	€ 1,639,000,000
HVDC Converters	€ 157,500,000
Transformer	€ 30,000,000
Converter stations	€ 100,000,000
Other	€ 880,000,000
Total	€ 3,081,500,000

Figure 1 Total CAPEX cost

The predominant portion of the project expenditure is anticipated to manifest in the form of capital expenditure (CAPEX), estimated at approximately 3.08 billion Euros. Within this allocation, the most substantial share is attributed to the offshore DC 525 kV cable, with an estimated cost nearing 1.5 billion Euros (remaining cable costs are related to the onshore connection).

Benefit

The quantifiable benefit stemming from the APOLLO-LINK project pertains to the arbitrage value generated by the electricity transmitted via the undersea cable, multiplied by the price differential it captures between Italy and Spain.

The initial step in this calculation involves determining the expected flows. In accordance with document "APOLLO-LINK: Supporting technical document demonstrating the NTC increase" (IAEW (2023))¹, the estimated availability is set at 2,091 MW, considering a 3.3% loss and accounting for 94 hours of scheduled annual maintenance, with no provision for unscheduled outages. Consequently, upon commencing operation in 2032, the annual flow is projected to be just over 17.7 terawatt-hours (TWh).

¹ Available on the APOLLO-LINK homepage: <https://www.apollo-link.eu/resources>

Subsequently, it is necessary to establish the prices in Italy and Spain, particularly the price differentials that the flow can exploit. According to ENTSOE's System Needs Study titled "Opportunities for a More Efficient Power System in 2030 and 2040," the anticipated price differential between Italy and Spain in 2030 ranges from 14 Euros per megawatt-hour (MWh) to 15 Euros per MWh. By 2040, this range is expected to expand to between 16 Euros per MWh and 18 Euros per MWh. Extrapolating this estimate further based on a linear growth trend, by 2057, the price differential is projected to fall within the range of 20 Euros per MWh to 24.5 Euros per MWh.

When combining this forecasted price differential with the annual flows, the estimated project benefit falls within the range of 7.6 billion to 8.8 billion Euros, which yields a net benefit ranging from 4 billion to 5.2 billion Euros annually, amounting to approximately 161 million Euros to 209 million Euros per year during the project's operation.

Conclusion

The APOLLO-LINK between Spain and Italy presents a promising opportunity to promote renewable energy integration, exploit arbitrage opportunities, enhance grid stability, and contribute to Europe's clean energy transition. Overall, the long-term benefits are assessed to be significant with net benefits ranging from 4 to 5.2 billion Euros (over an assessment period of 25 years) or roughly 185 million Euros per year (average of the two scenarios) at investment costs of 3 billion Euros for the 660 km long interconnection.