
Forecast demand and Manufacturing capacity for HVAC and HVDC underground and submarine cables

30 January 2018

Joint ENTSO-E and EUROPACABLE paper in the context of the ENTSO-E 2016 TYNDP

Contents

| | |
|--|---|
| Contents | 2 |
| Executive Summary | 3 |
| Europe needs more transmission grids | 3 |
| Demand for HVAC and HVDC land and submarine cables..... | 4 |
| Production and Installation capacity of HVAC and HVDC land and submarine cables..... | 6 |
| Joint ENTSO-E and EUROPACABLE Commitment | 6 |

Executive Summary

In order to meet its ambitious energy and climate objectives, the European Union requires a well-integrated trans-European energy market, the pre-requisite of which will be a fully interconnected high (HV) and extra high voltage (EHV) electricity grid network.

With this Joint Paper, ENTSO-E and EUROPACABLE:

1. Highlight the importance of realizing the projects included in the ENTSO-E Ten Year Network Development Plan (TYNDP) 2016 in a timely and sustainable manner;
2. Recognise the overall coherence between the forecasted demand for HVDC land and submarine cables as identified for the TYNDP projects in the coming decade and the annual cable production capacity of European manufacturers; and therefore
3. Commit to establishing a close cooperation and annual exchange of information to reflect any risk of delay or significant changes specifically with a view to the TYNDP projects.

Europe needs more transmission grids

According to the ENTSO-E TYNDP 2016 some 40,000 km *route length* of extra high voltage (EHV) power lines on land as well as at sea will need to be built/refurbished by 2030. Current estimates foresee 53% of the total distance will have to be built using EHV underground and submarine cables, the majority of which being HVDC submarine cabling.

| 2016 TYNDP | Km route length | %km | Projects | % projects |
|---|-----------------|------------|---|------------|
| Overhead Line | 19,180 | 47 | 199 | 68 |
| Submarine cabling (incl. some land parts) | 18,075 | 44 | 54 submarine 14 mix submarine & land cable | 24 |
| Land Cabling | 3,561 | 9 | 11 land, 14 Partial underground | 8 |
| TOTAL | 40,816 | 100 | 292 | 100 |

The ENTSO-E / EUROPACABLE Joint Paper regarding the “Feasibility and Technical Aspects of Partial Undergrounding of Extra High Voltage Power Transmission Lines” published in December 2010, clearly demonstrated the benefit of TSOs and industry offering a joint position on key challenges to respond to meeting Europe’s electricity grid needs.

Further to this successful collaboration, ENTSO-E and EUROPACABLE now issue this Joint Paper to ensure the appropriate production capacity of high quality high voltage alternating (HVAC) and direct current (HVDC) land and submarine cables by European manufacturers to meet the expected demand in a timely manner.¹ Ensuring that demand and capacity for EHV cables are aligned is a prerequisite for a timely completion of Europe’s future electricity grids according to TYNDP 2016.

¹ For the purpose of this document high voltage HVAC cables are defined at a voltage of >100 kV and HVDC cables are defined at a voltage level ≥ 320 kV.

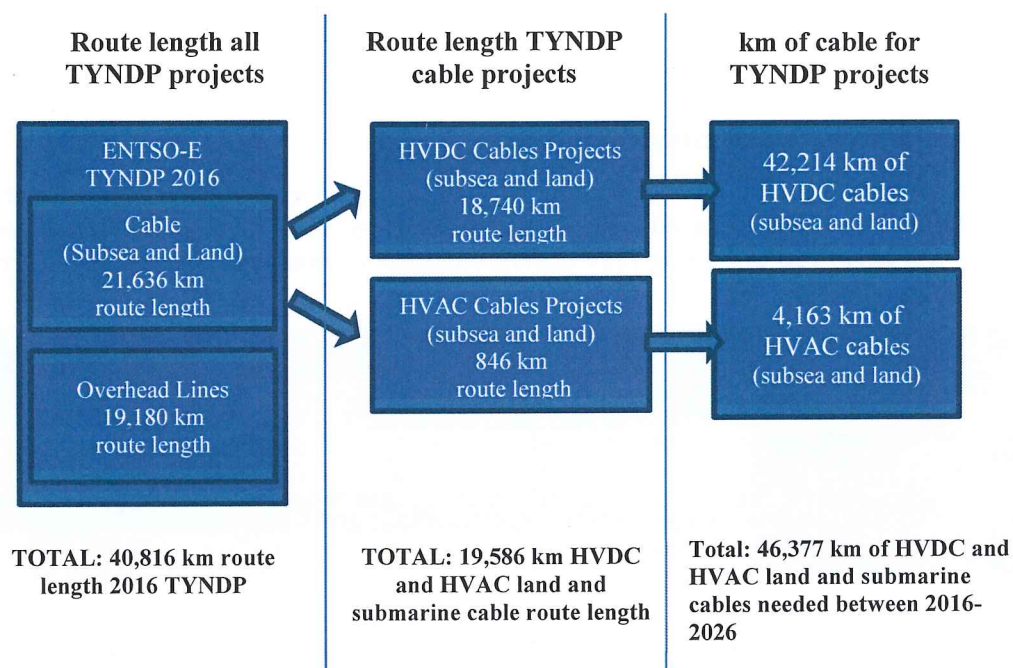
Demand for HVAC and HVDC land and submarine cables

The 2016 TYNDP identified a total of 40,816 km *route length*, i.e. km of distance, to be covered by new projects in the coming decade. Excluding overhead lines, and focussing on cables only, this foresees 21,636 km route length to be covered through cables, i.e. km of distance for:

- 18,740 km of HVDC land and submarine cables; and
- 846 km of HVAC land and submarine cables.

To cover this, ENTSO-E and EUROPACABLE estimate that in total Europe will need some 46,000 km of HVAC and HVDC land and submarine cables² in the coming decade³, i.e. a total amount of km of cables as follows:

- 42,214 km of HVDC land and submarine cables; and
- 4,163 km of HVAC land and submarine cables.



In view of the fact the vast majority of these projects (i.e. over 42,000 km) is planned using HVDC land and submarine cables, this paper focuses on HVDC cable demand and production capacity.

² Please note that for the purpose of this paper we define “km of cables” as the “route length multiplied by the number of cables required per phase or circuit”. This may also be referred to as “system length”.

³ Whilst we recognize that at member state level additional cables will be required for projects included only in national TSO development plans, this Joint Paper focusses on TYNDP 2016 projects only.

Recognizing that on average cables will be produced two to three years prior to the expected project completion, ENTSO-E and EUROPACABLE expect the following demand for HVDC land and submarine cables per year in the coming decade⁴:

| Year | DC LAND cable km | | | DC Submarine cable km | | | Grand TOTAL |
|--------------|------------------|--------------|---------------|-----------------------|---------------|---------------|---------------|
| | 320kV | >320kV | Total | 320kV | >320kV | Total | |
| 2017 | - | 100 | 100 | 480 | 740 | 1,220 | 1,320 |
| 2018 | 100 | 100 | 200 | 1,029 | 1,219 | 2,248 | 2,448 |
| 2019 | 103 | - | 103 | 1,786 | 2,267 | 4,053 | 4,156 |
| 2020 | 103 | 150 | 253 | 1,957 | 2,131 | 4,088 | 4,341 |
| 2021 | - | 2,020 | 2,020 | 2,625 | 1,911 | 4,536 | 6,556 |
| 2022 | 426 | 1,870 | 2,296 | 2,245 | 1,648 | 3,893 | 6,189 |
| 2023 | 557 | 1,870 | 2,427 | 2,320 | 810 | 3,130 | 5,557 |
| 2024 | 962 | 1,870 | 2,832 | 3,560 | 560 | 4,120 | 6,952 |
| 2025 | 425 | 100 | 525 | 2,250 | 460 | 2,710 | 3,235 |
| 2026 | 20 | 100 | 120 | 1,080 | 260 | 1,340 | 1,460 |
| Total | 2,696 | 8,200 | 10,876 | 19,332 | 12,006 | 31,338 | 42,214 |

This demand forecast is based on the following assumptions

1. Project data (e.g. capacity, current, voltage, route length, status, estimated date of completion) taken principally from ENTSO-E TYNDP 2016 including Regional Plans
2. Route length converted to cable km to estimate potential cable demand as follows:

| | Transmission Capacity MVA/MW(DC) | Cables per phase |
|-----------------------------|-------------------------------------|------------------|
| DC land >320 kV one system | 1000 | 2 |
| DC land >320 kV two systems | 2000 | 4 |
| DC subsea >320kV | 500 | 2 |
| DC subsea 500kV | >1000 and < 2000 | 2 |

3. Tender date assumed to be an average of 3 years before project completion date (exceptions small HVAC subsea 2 years, large HVDC 4 years)

⁴ Please note that for German HVDC land projects, we assume for about 80% to be underground cables and using five 525 kV XLPE cables, i.e. four to carry the load and one backup cable.

Production and Installation capacity of HVAC and HVDC land and submarine cables

In 2016, EUROPACABLE member companies had a total of some 11,000 km of annual production capacity of HVDC and HVAC cables:

| | Annual production capacity (km of cable) |
|---|--|
| Extruded HV /EHV Land cables | 6,550 |
| Extruded and MI HV / EHV Submarine cables | 4,730 |
| TOTAL | 11,280 |

To further specify the HVDC capacity in the context of this paper, EUROPACABLE members aggregated their dedicated annual production capacity of HVDC land and submarine cables early 2018 as follows:

| Annual production capacity (km of cable) | Land Only | Land & Submarine |
|--|-----------|------------------|
| 320 kV HVDC | 6,090 | 6,980 |
| 320 kV and 525 kV HVDC | 5,550 | 6,440 |

This annual HVDC production capacity of European manufacturers clearly matches the demand forecasted for each year for the ENTSO-E TYNDP projects in the coming decade. As can be seen from the tables above, additional capacity is available to respond to HVAC projects at national level which are not specifically included in this paper.

Joint ENTSO-E and EUROPACABLE Commitment

In view of the above mentioned importance of a timely completion of the projects singled out in the ENTSO-E TYNDP, ENTSO-E and EUROPACABLE herewith:

1. Highlight the importance of realizing the projects included in the ENTSO-E Ten Year Network Development Plan (TYNDP) 2016 in a timely and sustainable manner;
2. Recognise the overall coherence between the forecasted demand for HVDC land and submarine cables as identified for the TYNDP projects in the coming decade and the annual cable production capacity of European manufacturers; and therefore
3. Commit to establishing a close cooperation and annual exchange of information to reflect any risk of delay or significant changes with a view to the projects of common interest.

ENTSO-E and EUROPACABLE jointly recognize that only high quality products and installations will offer the required high level of security of supply for Europe's society.

For ENTSO-E

.....
Laurent Schmitt, Secretary-General

Date: 30/1/2018

For EUROPACABLE

.....
Thomas Neesen, Secretary General

Date: 30/1/2018