

Underground cables in Europe: Overview

The European Association of Wire and Cable Manufacturers
and National Associations

Presentation to RGI Workshop hosted by Amprion



Dr. Volker Wendt, Director Public Affairs
Raesfeld, 5th July 2017

Europacable, 58 Rue Marie de Bourgogne, 1000 Brussels
www.europacable.eu

What are we actually talking about?

A Tesla Model S driving on a scenic road. The car is viewed from the rear, driving away on a paved road that curves through a landscape of rolling hills and mountains under a dramatic, cloudy sky. The car's license plate reads 'MODEL S'.

Gas?
Where we're going,
we don't need gas.

Go boldly into the future.

Introducing a car so advanced it sets a new standard for premium performance. The powertrain, tucked between the rear wheels, uses energy three times more efficiently than a gas-burning engine. With no tailpipe to spew harmful emissions, Tesla vehicles liberate their owners from the petroleum-burning paradigm. They are the only cars to get more efficient from the moment they're first driven.

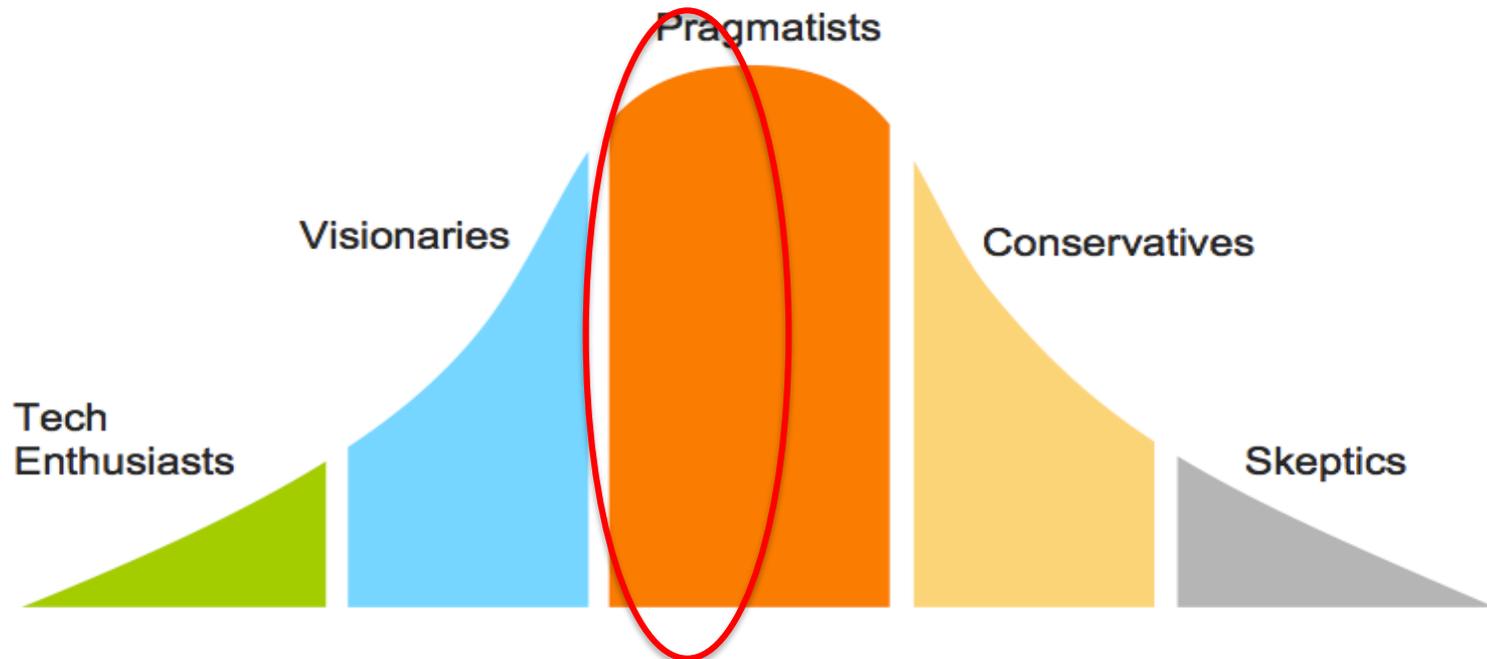


- **"Technology Adoption"** with all its challenges to our mindset, technology, legislative & regulatory frameworks, hick-ups and opportunities

What are we actually talking about?

Technology Adoption

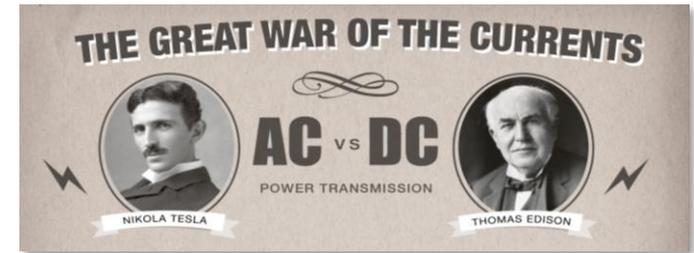
➤ *So where are we on underground cabling?*



Where are we now on undergrounding?

Underground cable technology: Mature & fully available

- Ⓒ High Voltage Alternate Current (HVAC)
 - Ⓒ up to 400 kV (systems in operation)
- Ⓒ High Voltage Direct Current (HVDC)
 - Ⓒ up to 320 kV (systems in operation)
 - Ⓒ up to 600 kV (available technology)



➤ *Now amplifying operational experience in networks*



Where are we now on undergrounding?

1996 – 2015: Visionary technology adoption

- **4,691 km total AC land cable** length installed (EHV: 220 – 500 kV XLPE), of which:
 - 1,940 km of 220 – 235 kV
 - 1,073 km of 245 – 345 kV
 - 1,678 km of 380 – 500 kV
- **Projects**
 - Abu Dhabi, Argentina, Austria, Bahrain, China, Denmark, France, Germany, India, Ireland, Italy, Japan, Mexico, The Netherlands, Portugal, Russia, Saudi Arabia, Spain, South Korea, Sweden, Switzerland, Taiwan, Tunisia, Turkey, UK, Ukraine, USA,...
- **Types**
 - Connection to power plants and substations, city feeders, replacing overhead lines in areas of outstanding beauty, airport expansions, rural/tourist areas
- **8,000 km HVDC submarine cables** additionally installed globally until 2015 (JRC Study for European Commission)
- *EHV XLPE cables have been in service for over 25 years*



Where are we now on undergrounding?

Today: Pragmatic roll out

- C** Case-by-case approach: Adapting to the specific conditions and requirements
 - C** Projects feature different innovations, e.g. installation technologies, research, stakeholder engagement etc.
- *Closely monitored from across the world: Innovators at work*



380 kV AC Raesfeld Germany

- C** Total length: 181 km
- C** 3 sections underground
- C** Raesfeld: 7 km
- C** 380 kV, 2x1800 – 2300 MVA



380 kV AC Randstadt NL

- C** Total length: 85 km
- C** 20 km partial undergrounding
- C** HVAC 380kV, 2x2635 MVA



INELFE, Interconnector France-Spain

- C** Total Length: 65 km underground
- C** 8,5 km tunnel
- C** HVDC +/- 320kV; 2 GW



Nordlink, Interconnector Norway–Germany

- C** Offshore cable: 516 km
- C** Onshore: 53 km HVDC OHL (NO); 54 km HVDC cable (DE)
- C** HVDC +/- 500 kV, 1,4 GW

Where are we now on undergrounding?

Environmental implications: 2 dimensions need to be accounted for

Construction



- ❶ Major construction site
- ❷ Usually directly buried into the ground, surrounded by sand blending, can also be installed in tunnels, ducts or pipes
- ❸ Average laying depth: 1,60 m
- ❹ Average cable length: 700 – 1000 meters
- *Vegetation re-installed after 1-2 years*

Operation



- ❶ Will blend into open countryside, but will be visible if running through forests
- ❷ No limitation on cultivation apart from deeply rooted trees
- ❸ No limitation on agriculture
- *Approx. 40 years lifetime*

Where are we now on undergrounding?

Public Acceptance: Cables key to deliver projects

At sea: Cable technology without alternative

- Key technology for offshore windfarms and subsea interconnections

On land: Undergrounding may facilitate public acceptance

- 32% of current grid projects across Europe are delayed
 - 15 years average delay to realise projects
 - Delays mainly due to “social resistance & lengthy permitting procedures”
- *It will be important to find the right balance between all available technologies*



400 Demonstranten fordern: „380 KV ab in die Erde“

Where are we now on undergrounding?

Underground & Submarine cables key technology for Europe's electricity grids

2016 ENTSO-E TYNDP

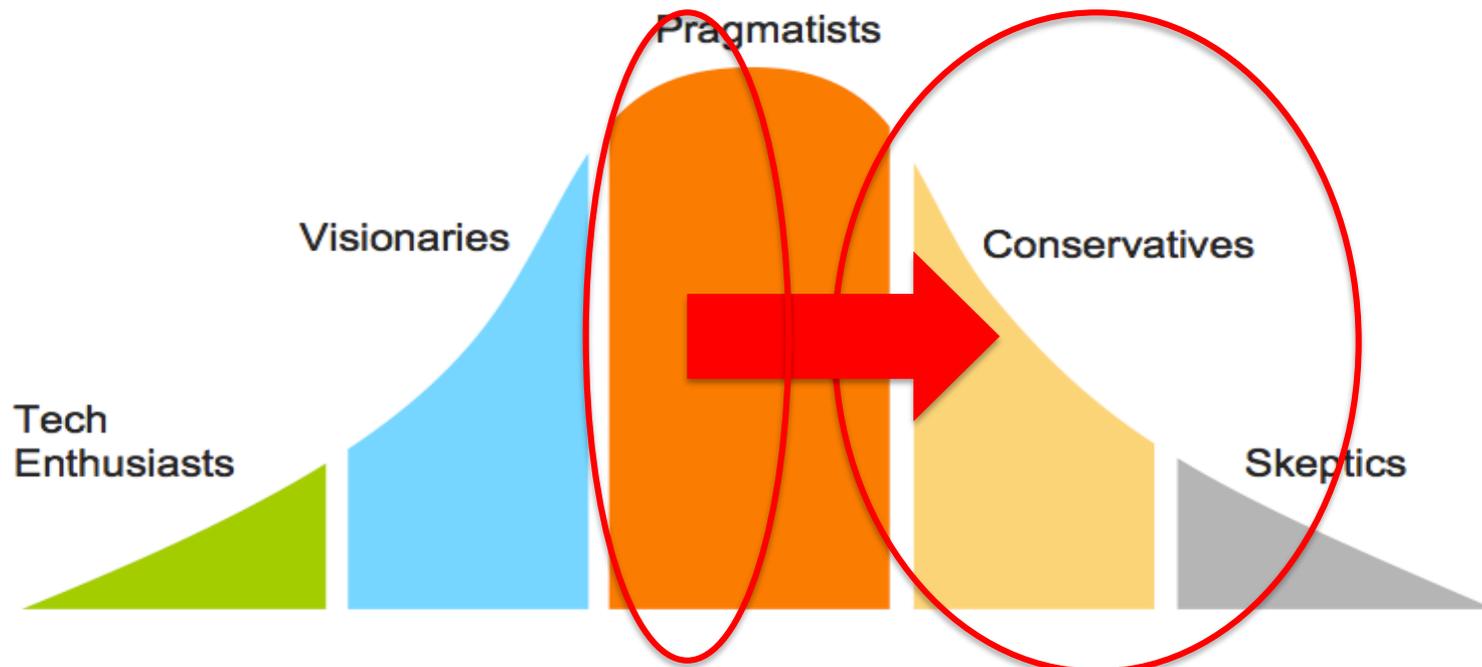
- Some 40,000 km EHV power lines to be built/refurbished by 2030
- €150 billion of investment by 2030
- 48% of total distance to be covered by EHV underground and submarine cables

| 2016 TYNDP | Km | % km | Projects | % projects |
|---|--------|------|---------------------------------------|------------|
| Overhead Line | 21,230 | 52 | 199 | 68 |
| Subsea Cabling (incl. some land parts) | 18,075 | 44 | 54 subsea 14 mix subsea&land cable | 24 |
| Land Cabling | 1,511 | 4 | 11 land; 14 PUGC | 8 |
| Total | 40,816 | 100 | 292 | 100 |

- *Europacable analysis shows demand of some 90,000 km of HV and EHV underground and submarine cables in Europe for the period 2016-2026*

How do we move to the next level?

Technology Adoption



How do we move to the next level?

“Go bold into the future” Tesla Motor Cars

1) Successful project implementation & operation

- Complete current projects thoroughly, run them, learn from them
- Establish close co-operation between industry and TSOs
- Embark on further undergrounding projects

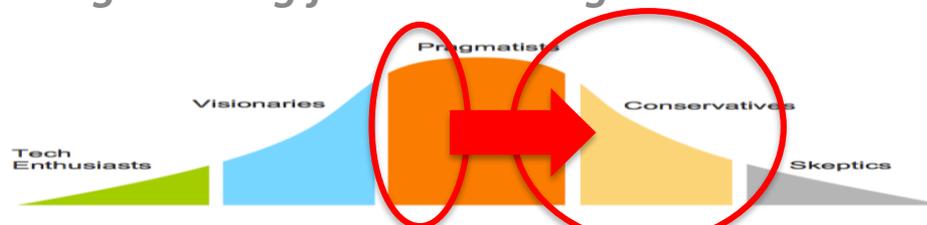
2) Respond to current & emerging challenges

- Tackle challenges that emerge along the way
- Address concerns voiced against undergrounding
- Create fora for exchange of best practices

3) Adapt policy framework

- Create compensation schemes
- Create legislative and regulatory framework firmly managing and clearly defining the deployment of underground cabling

➤ *Taking undergrounding from the “Pragmatists” to the “Conservatives”*



Our conclusions

1) Building Europe's future electricity networks is serious business

- We can not afford to take risks: *"The lights must stay on!"*

2) Cable technology is fully available

- Underground cabling is not a „*disruptive technology*“: Continuous evolution of EHV cable technology for over 100 years – and still moving forward...

3) Since 2005: “Europacable Concept of Partial Undergrounding”

- Majority of new transmission lines will be built using overhead line technology (OHL)
- For AC projects, partial undergrounding may complement OHL in sensitive areas
- For DC projects, longer distances can be undergrounded

4) Delays are the greatest cost to society

- We need a legislative framework that considers undergrounding from the outset of every project as a fully available technology option
- We need clear, strict criteria to assess undergrounding option
- We need to look at lifetime costs for the entire project, not cost of cable investment
- We need to minimize delays

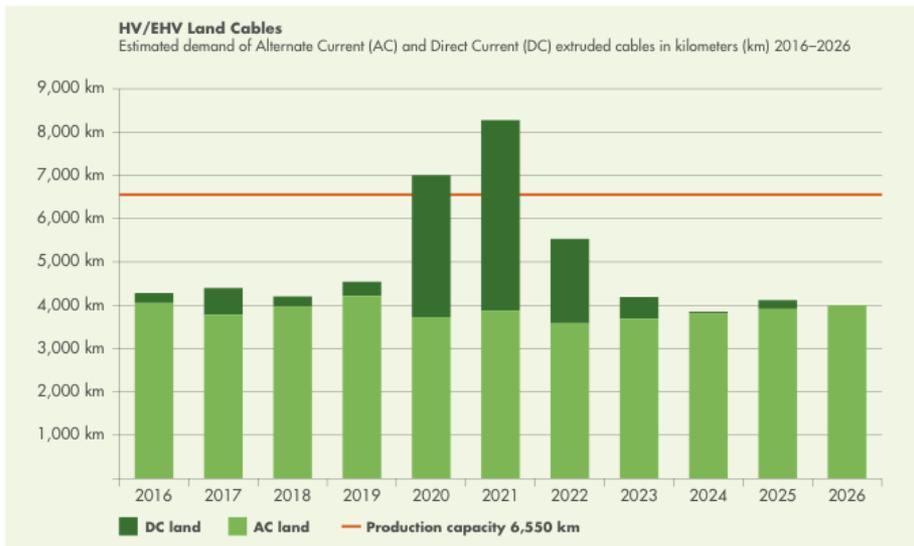


Our conclusions

5) European cable industry is ready

C We have the experience, know-how and capacity to deliver Europe's grids on time

Europacable analysis of estimated demand and supply of HV/EHV transmission cables in Europe 2016–2026



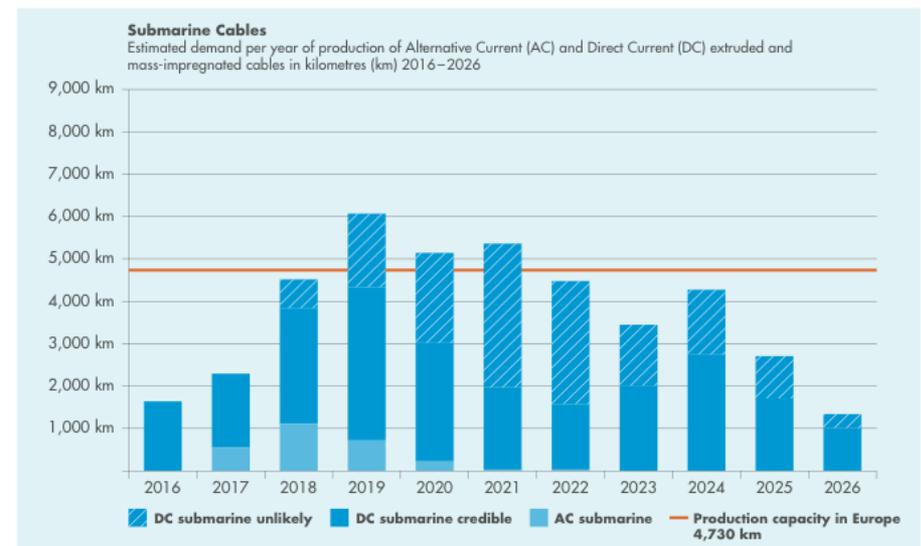
Data Sources 2016–2026

- ENTSO-E TYNDP 2016
- ENTSO-E TYNDP 2016 Regional Plans
- TSO National Plans
- Europacable annual estimate of HV (110kV-219kV) cable

Europacable Analysis 2016

- Annual production capacity of Alternate Current (AC) and Direct Current (DC) extruded High Voltage (HV) and Extra High Voltage (EHV) land cables in 2016: 6,550 km

Europacable analysis of HV/EHV transmission cables demand in Europe 2016–2026 based on estimated year of production



Europacable Analysis 2016: Annual production capacity in Europe of Alternate Current (AC) and Direct Current (DC) extruded and mass-impregnated High Voltage (HV) and Extra High Voltage (EHV) submarine cables in 2016: 4,730 km

Estimated year of production based on Europacable assumption that production is split over the 2 years prior to completion date, with an exception for very large projects where it is extended to 4 years. Expected completion dates and demand are taken from ENTSO-E TYNDP 2016, TSO National Plans and Europacable annual estimate of HV (110-219kV) cable demand.

2016–18 data includes 4,320km of projects awarded pre-2016 in manufacture

Thank you for your attention

**SOMEDAY,
ARCHAEOLOGISTS
WILL FIND THIS
AND SCRATCH
THEIR HEADS.**

Free yourself from dependence on gasoline. With its 300 horsepower, emission-free motor, the Tesla Roadster proves that electric vehicles can be as exhilarating to drive as they are efficient to own. At last, someone has discovered the missing link between power and fuel-efficiency.

DRIVING HAS EVOLVED. **TESLA**

Europacable, 58 Rue Marie de Bourgogne, 1000 Brussels

www.europacable.eu