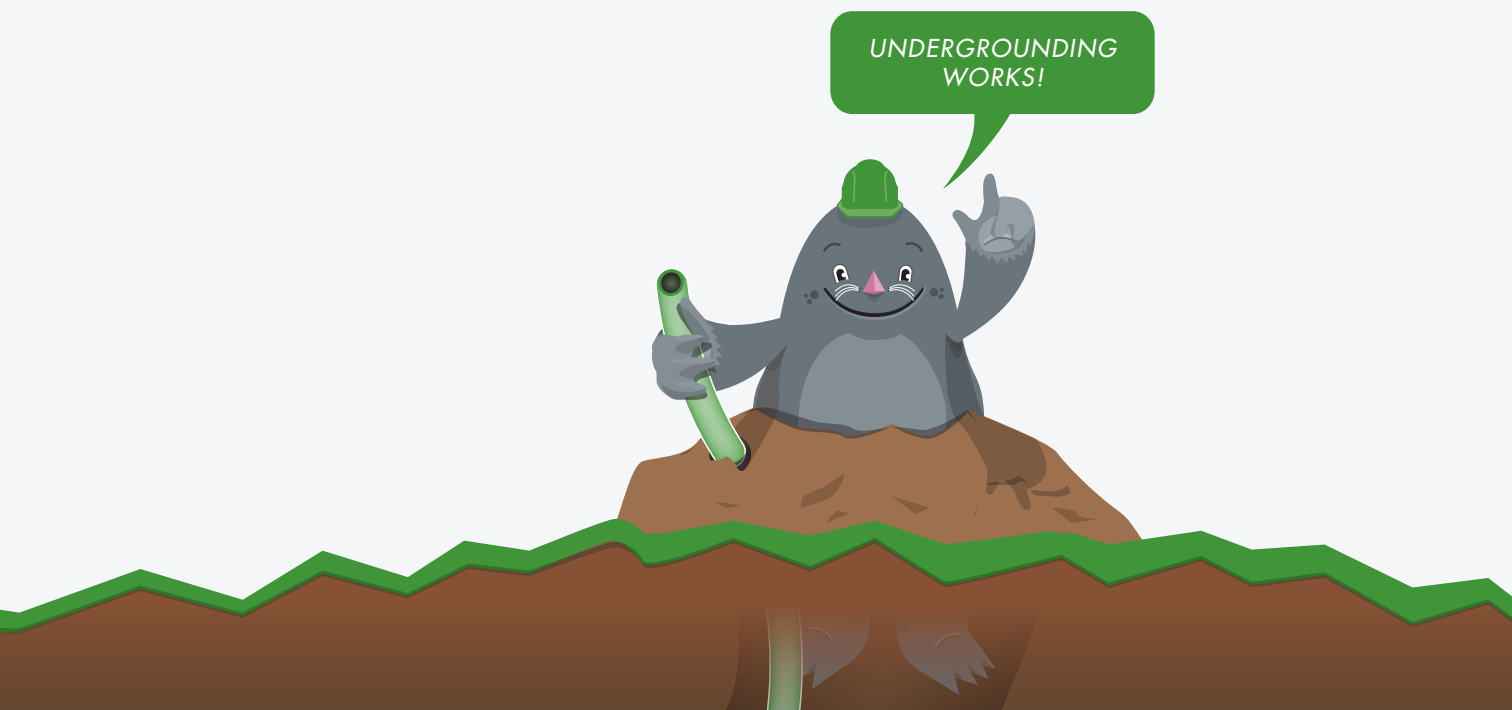


# MYTHS AND REALITIES

of Partial Undergrounding of 380 kV Electricity Powerlines



# Introducing the Europacable Concept of Partial Undergrounding

## 8 MYTHS AND REALITIES OF PARTIAL UNDERGROUNDING

Europe's electricity grids need to be upgraded and extended, notably to allow the integration of renewable energy power sources. The key question however is how and where new power lines are to be introduced, while at the same time respecting the quality of life for the people living close to such lines or the environment surrounding it.

The Concept of Partial Undergrounding can be applied at any voltage level. However, we believe that today the largest potential to facilitate grid extensions lies with 380kV extra high voltage (EHV) cross linked polyethylene (XLPE) alternating current (AC) cables.

Seeking to offer an innovative solution to this challenge, the European wire and cable manufacturers, represented by Europacable, have developed the **Concept of Partial Undergrounding**:

There are many myths about what EHV XLPE AC cables can and cannot do. With this brochure we would like to address those myths, present the facts and offer our view on the most important issues.

**This concept proposes to underground extra high voltage power lines in sensitive areas complementing overhead lines where their deployment is restricted by public concerns or environmental limitations.**

The technical information we provide here is based on the Joint Paper Europacable prepared with ENTSO-E under the guidance of the European Commission DG Energy. The paper is available at [www.europacable.com](http://www.europacable.com)

### CONCEPT OF PARTIAL UNDERGROUNDING: NEW FLEXIBILITY FOR FUTURE ELECTRICITY GRIDS

- Alternative, possibly shorter routes
- Faster realisation due to higher public acceptance
- Limited visual impact, as line can be adapted individually to surrounding landscape
- Reduction of cost multiples as higher expenditure for undergrounding is limited to only sections
- Pilot projects allow European manufacturers to further demonstrate their technology expertise, thus securing Europe's leadership in this sector

*“Partial undergrounding is not an option. EHV XLPE cables are not ‘State of the Art’. It is too complex to integrate them into the existing transmission systems.”*

## PARTIAL UNDERGROUNDING: THE TECHNOLOGY IS AVAILABLE

In Europe, and around the world, EHV XLPE cables are increasingly used as a component in electricity transmission projects. Whether or not they meet legal definitions of “state of the art” depends on the local terminology.

Fact is, EHV XLPE cables are available, well established and operate safely in accordance with relevant standards.

Integrating a partially undergrounded section into a meshed AC overhead line system is a highly complex undertaking which requires thorough analysis on a case by case basis. But: it is entirely feasible.

### FACTS

- EHV XLPE cables are proven and established components for partial undergrounding
- Over 200 km of 400 kV XLPE cables installed in Europe since 1996 – many more in other parts of the world
- Integrating underground sections into the grid is complex and needs to be analysed on a case-by-case basis, but is entirely feasible

*“EHV XLPE cables are not reliable – notably joint bays are a weakness. Like in Berlin, they can explode and if they do it takes forever to repair, putting energy supply at a risk.”*

### FACTS

- EHV XLPE cables are reliable. Once in the ground, they are well protected against external impacts
- EHV XLPE cables undergo double testing: after production and after installation
- Joining EHV cables is a delicate task which needs to be executed by trained experts with utmost care
- Today's joint bay technology is highly reliable
- According to CIGRE Technical Brochure 379 more than 1/3 of cable faults were repaired and the cable system was re-energized within 1 week and more than 75% within 1 month

EUROPACABLE VIEW:

## EHV XLPE CABLE SYSTEMS: RELIABLE ENERGY TRANSMISSION

XLPE cables systems are a reliable transmission technology that performs well based on established international standards. This said, any manmade technology can fail – as did a joint bay in Berlin in December 2009.

### In the case of failure, 3 aspects are critical:

- Secure power supplies: The “n-1” criterion guarantees that the 2nd cable system will carry the full load to secure power.

- Shorten repair times: XLPE cables are custom made per project and spare cable is recommended to be kept in stock.

- Use current technology: Europacable members constantly drive R&D forward. The technology used in Berlin is no longer available on the market.



*“EHV XLPE cables have a significant impact on the environment, they dry out the soil and wide trenches are required.”*

FACTS

- Trenches for 4 cable systems will be up to 25 meters
- Installation works required for the cables are a temporary impact on the environment
- After completion, vegetation will be reinstated after 1-2 years
- Apart from deeply rooted trees, there are no limitations to cultivation on top of the cable trench, including agricultural farming
- No drying of the soil under normal load conditions

EHV XLPE CABLE SYSTEMS:  
LIMITED ENVIRONMENTAL IMPACT

Any EHV installation impacts the environment. This said, vegetation on top of the cable will be normally reinstated after 1-2 years. There is no restriction on cultivation apart from deeply rooted trees.

The width of the cable trench depends mainly on the desired transmission capacity. For an indicative example

of a 400kV XLPE cable system (3.600 A per circuit, 4 trenches) 20 – 25 meters will be required. Under normal load operations, the cable temperature will not lead to a drying of the surrounding soil. Studies show that only under long-term full load conditions the soil may heat up by approximately 2°C.



*“Electromagnetic fields of electricity transmission lines, and particularly of underground cables, are a significant risk to human health.”*

FACTS

- Exposure to magnetic fields under a typical overhead line or above an underground cable system carrying 400 kV does not exceed the reference level of 100µT based on EU Recommendation 199/519/EC
- As the underground cable is shielded, there is no exposure to an electric field above ground
- The EMF from a cable dissipates quicker than from an overhead line as you move away from the line

EUROPACABLE VIEW:

SAFE ELECTRICITY TRANSMISSION:  
NO RISKS TO HUMAN HEALTH

Many modern technologies create electromagnetic fields (EMFs). EU Recommendation 1999/519/EC indicates a maximum level of 100 µT for public exposure based on values established by the International Commission on Non-Ionising Radiation (ICNIRP).

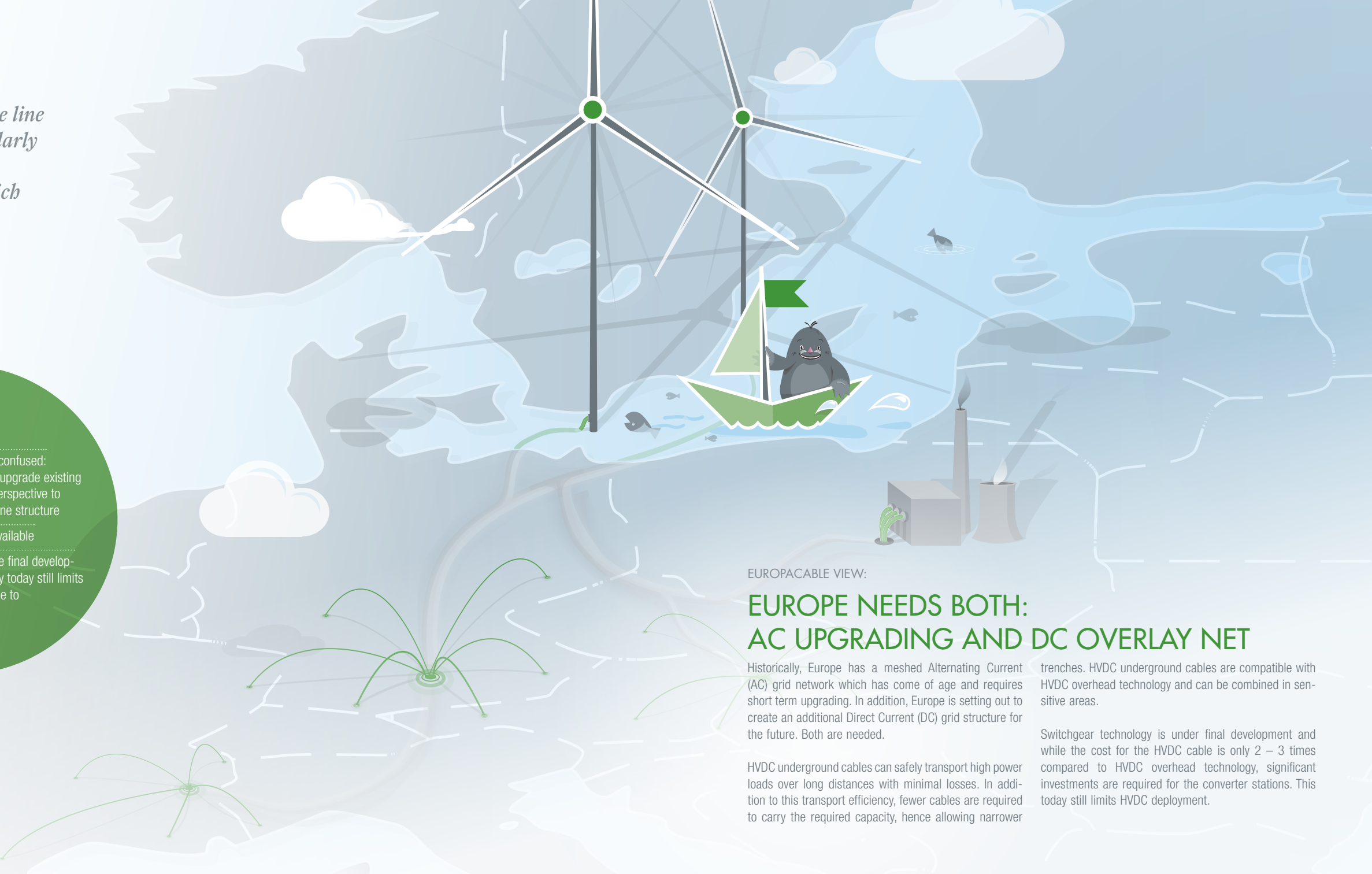
A typical transmission project, whether overhead line or partially underground carrying 400 kV, will show a

magnetic field exposure in the range of 65 to 75 µT. These values will vary with the clearance to ground for the overhead line and the depth of the underground cable as well as additional specific configurations. In any case they will not exceed the maximum references as set by the EU Recommendation.

*“Rather than building an AC line, let’s fully underground a long distance line by using HVDC technology – particularly when linking off shore wind farms to centres of electricity consumption which are much further inland.”*

FACTS

- Two discussions must not be confused: today’s need to refurbish and upgrade existing AC networks and the future perspective to build an additional DC backbone structure
- HVAC and HVDC cables are available
- The cost of conversion and the final development of switchgear technology today still limits DC deployment and experience to date is limited



EUROPACABLE VIEW:

EUROPE NEEDS BOTH:  
AC UPGRADING AND DC OVERLAY NET

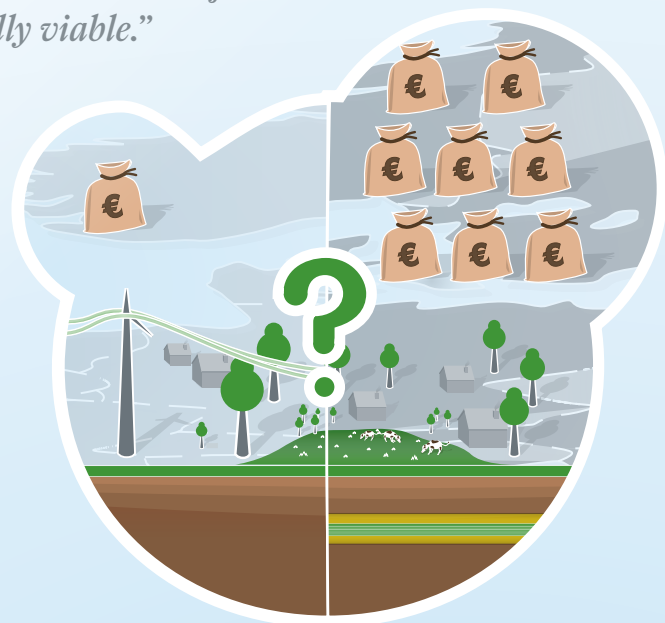
Historically, Europe has a meshed Alternating Current (AC) grid network which has come of age and requires short term upgrading. In addition, Europe is setting out to create an additional Direct Current (DC) grid structure for the future. Both are needed.

HVDC underground cables can safely transport high power loads over long distances with minimal losses. In addition to this transport efficiency, fewer cables are required to carry the required capacity, hence allowing narrower

trenches. HVDC underground cables are compatible with HVDC overhead technology and can be combined in sensitive areas.

Switchgear technology is under final development and while the cost for the HVDC cable is only 2 – 3 times compared to HVDC overhead technology, significant investments are required for the converter stations. This today still limits HVDC deployment.

*“EHV XLPE cables are 15 to 20 times more expensive and therefore not economically viable.”*



## PARTIAL UNDERGROUNDING: MAKING SENSE OF THE ECONOMICS

Investment cost for 400 kV XLPE cables installed in Europe over the past 10 years were generally around 5 – 10 times higher than for overhead lines. This is due to higher component prices as well as installation costs, which can be up to 60% depending on soil conditions.

It is important to underline that cost considerations should not only reference installation costs, but should

be based on a full life cycle analysis including costs of operation, losses of property value and costs related to the delay of line construction.

When applying the Concept of Partial Undergrounding, these higher costs only apply to the undergrounded sections. Therefore the cost factor for realizing the actual projects will average around 1.2 – 2 times only.

### FACTS

- On average, underground cabling will be 5 – 10 times more expensive than overhead lines
- This said, this cost factor only applies to the undergrounded section, not to the entire project. Here the cost factor will be as low as 1.2 – 2 times

#### Example:

- › Total length of line: 100 KM
- › Distance to be undergrounded: 10 KM
- › Cost factor x10 for undergrounding
- › Total added cost to entire line: Factor 1.9



*“The cost of undergrounding will significantly raise our electricity bills. Consumers will not accept this additional cost burden.”*

FACTS

- Electricity transmission only represents 4% of the consumer electricity bill
- Research shows customers are willing to pay more for undergrounding new power lines
- The additional burden on the annual electricity bill would be minimal

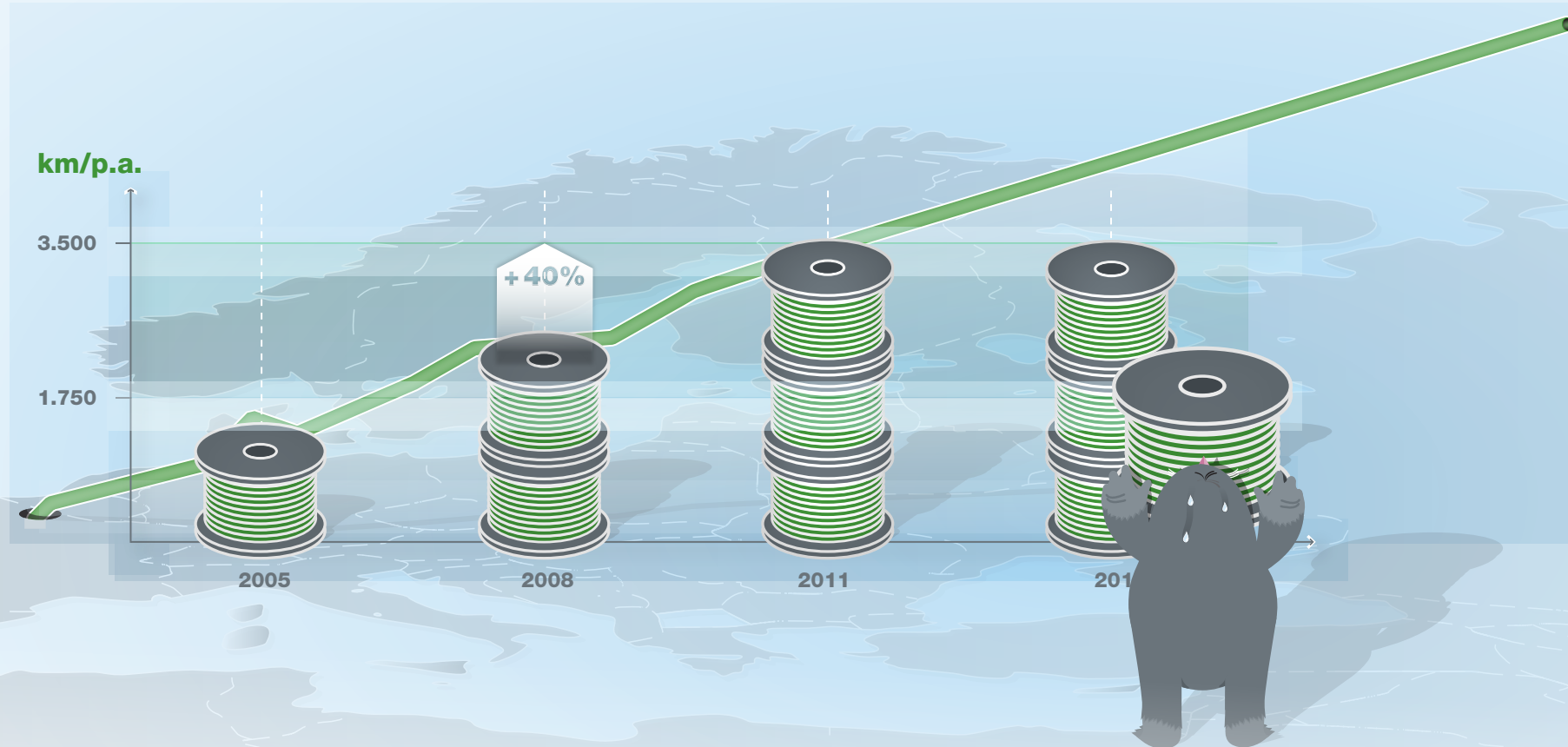
TRANSMISSION COSTS:  
THE MINOR PART IN YOUR ELECTRICITY BILL

A recent study conducted for UK’s National Grid shows that in public perception the cost of electricity transmission represents 10% of the domestic electricity bill when in fact it is only 4%.

42% believe that electricity transmission costs represent good value for money compared to 17% who do not. National Grid’s own consultation showed 97% of respondents favouring some form of undergrounding of new lines to preserve visual amenity.

47% are prepared to pay for undergrounding all new lines in the UK – which is striking, as undergrounding all new lines in the UK would only lead to a €6 increase of the annual electricity bill, representing a 1% increase. Deploying the Concept of Partial Undergrounding would obviously cost less than this.

*“The cable industry will not be able to deliver the amount of cables required. Therefore cabling is not an option.”*



## FACTS

- Europacable member companies manufacture XLPE EHV underground cables at 22 production facilities across Europe
- With an average capacity of 150 km of cable per year, total production capacity amounts to around 3,500 km of EHV p.a.
- Since 2008, production capacity of EHV cables has increased by 40%

## EUROPACABLE VIEW:

# EUROPEAN WIRE AND CABLE INDUSTRY: RESPONDING TO INCREASED DEMAND

Europe needs to complete its electricity market to integrate renewables and to secure supplies. To do so, the European Commission has earmarked € 140bn in electricity grid investments by 2020. In its 2010 Ten Year Network Development Plan, ENTSO-E has identified 35,000 km of new transmission lines and 7,000 km of existing line upgrades by 2020.

Responding to this challenge, Europacable members have increased production capacity by 40% since 2008.

Given the significant investments required for EHV production, the European wire and cable industry needs clear regulatory frameworks enabling the use of its components to balance the investment risks it is willing to take.

The Europacable Concept of Partial Undergrounding proposes to underground extra high voltage power lines in sensitive areas complementing overhead lines where their deployment is restricted by public concerns or environmental limitations.

## ABOUT EUROPACABLE

Europacable represents approximately 85% of the European wire and cable manufacturers. Founded in 1991, our member companies and national associations include global technology leaders as well SME's highly specialized in the production of energy-, telecommunication- and data-cables. With over 55.000 employees

across Europe and € 20 billion of wire and cable consumption in 2009, Europacable member companies produce some 38 million km of cables p.a. in Europe alone. Europacable is registered with the EU Institutions at 453103789-92.

### CONTACT US

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