



1 February 2024

# Towards net-zero emission of T&D grids



# Roadmap towards net zero

Focus on specification respecting quality



**cigre**

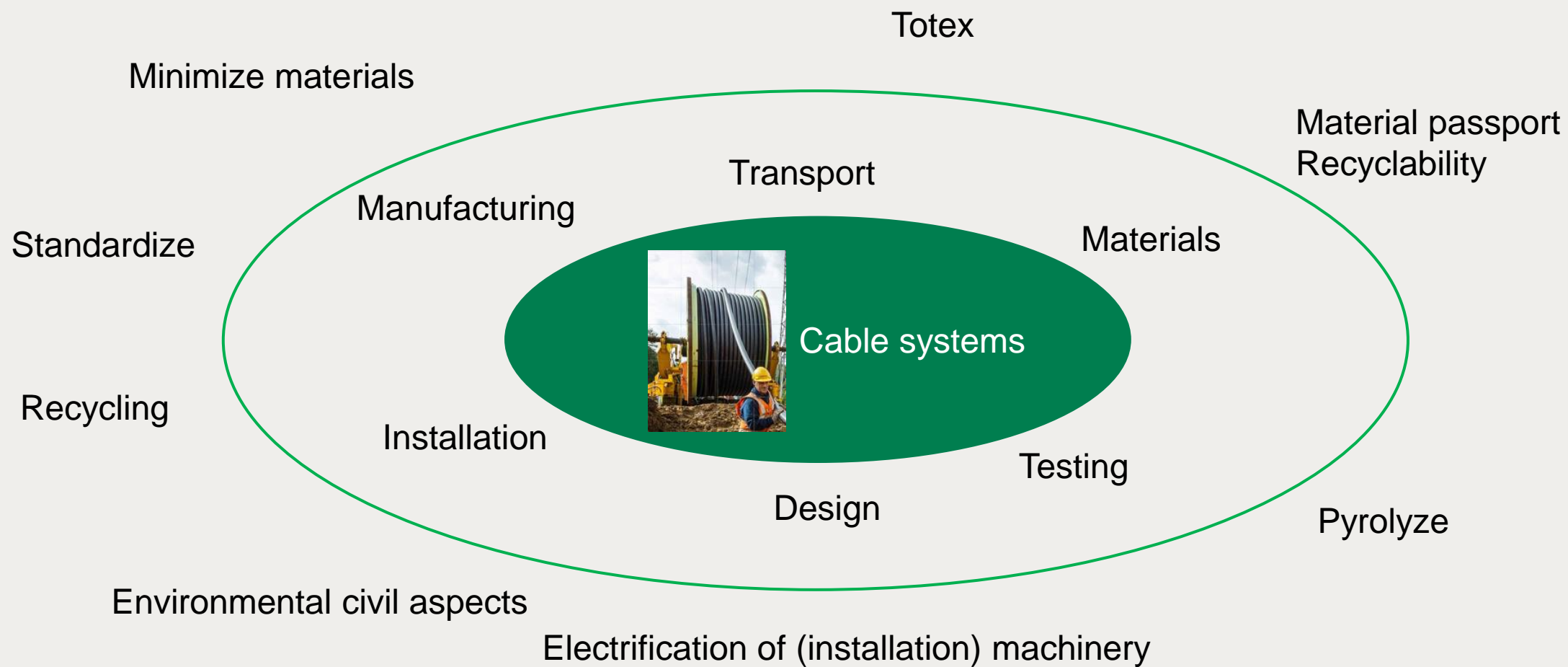
For power system expertise

# Emission reduction goals

- EU goal is carbon zero in 2050, CO2 reductions of 55% in 2030
- TenneT drives the CSR ambition by 3 pillars, People, Planet & Profit
- This presentation we go deeper on „Planet“
  - Circular, Climate, Nature
- What measures can and do we take to reduce CO2 footprint on cable systems?



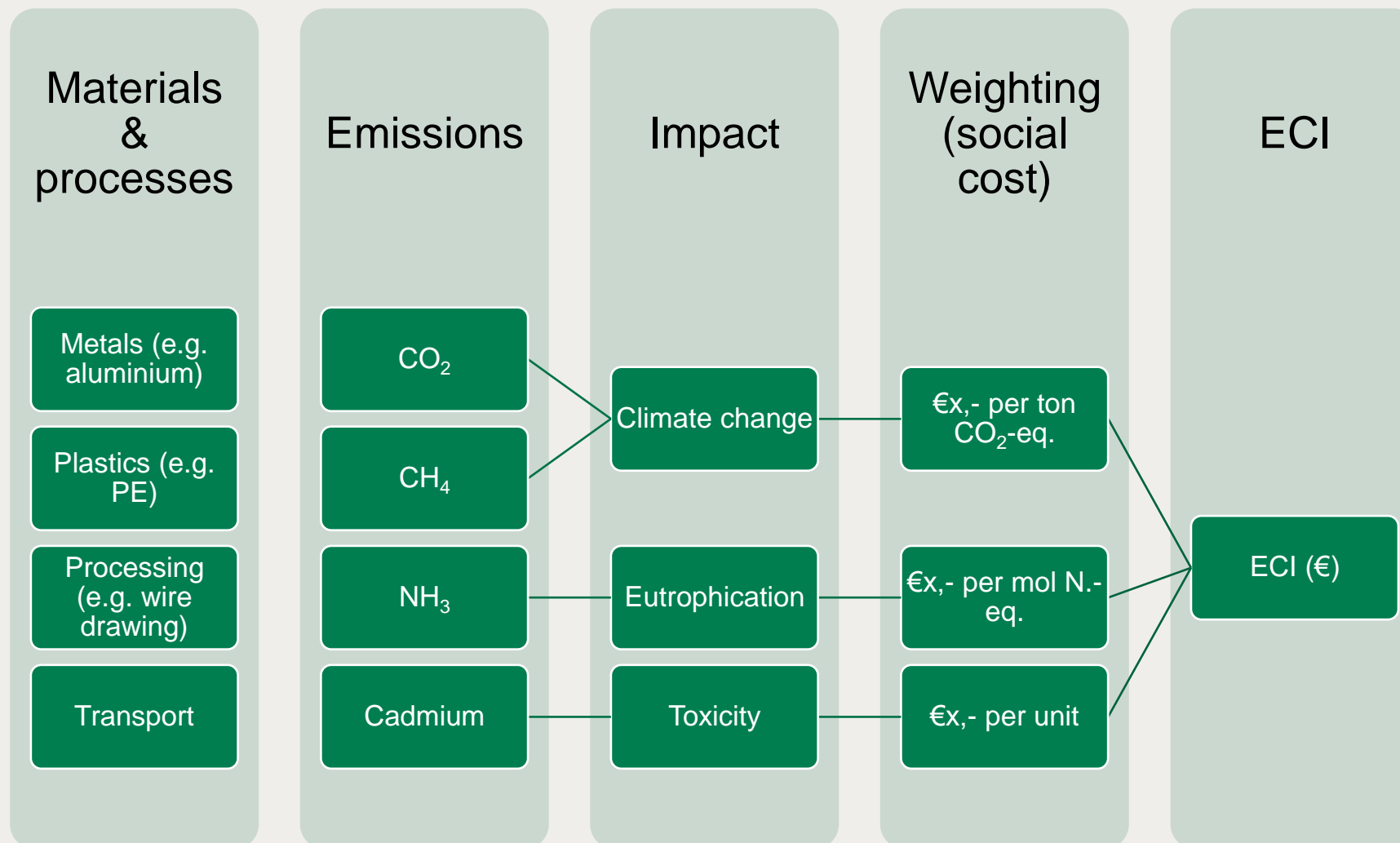
# Cable system chain



## Environmental cost indicator (ECI)

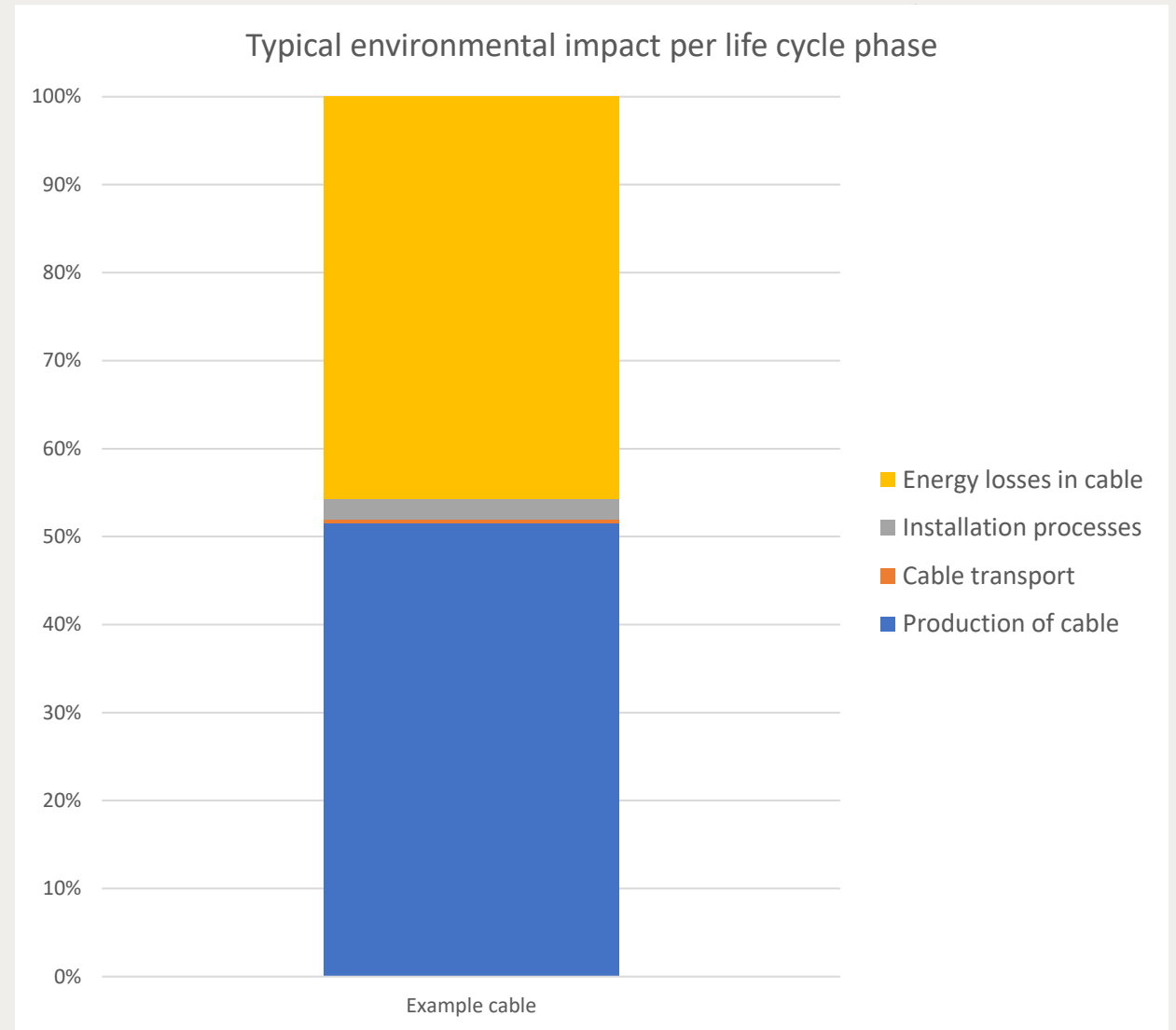
- The production, transport and processing of materials has an impact on the environment
- Climate change due to CO<sub>2</sub> emissions is one example, but also:
  - Eutrophication due to nitrogen
  - Toxicity from toxic substances such as cadmium
- Social costs are assigned to 19 of these environmental impacts
- These "environmental costs" can be used to express in a single number the various environmental impacts of a product

# Environmental cost indicator (ECI)



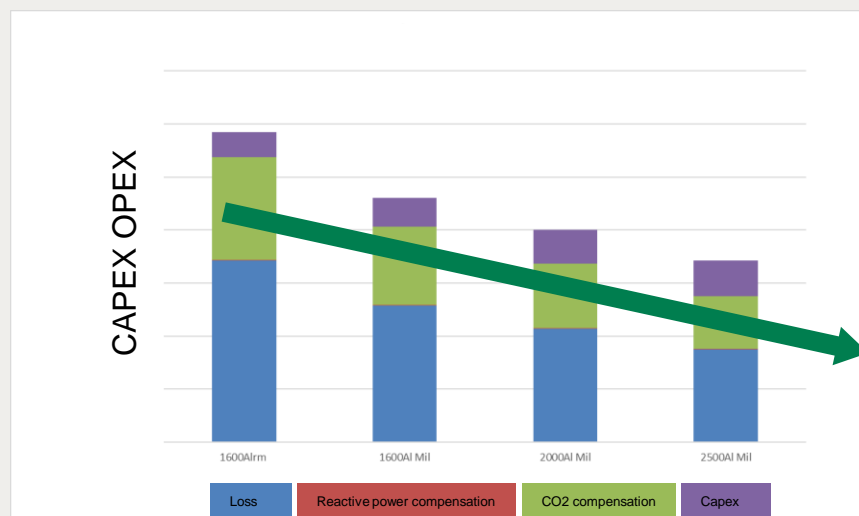
## Environmental-impact of cable

- Production of materials and energy losses in the cable are the main contributors to environmental impact
- A larger cross-sectional cable core with less energy loss is more beneficial than a thinner cable with more energy loss



# Conductor loss

- High power means large quantity conducting material
  - At lower power transport, ac loss improves → ! Less CO2 emission !



TenneT standardized 150kV cable types:  
 EYAKrvlwd 87/150 kV 1x1600 Almil Al 1,2mm  
 EYAKrvlwd 87/150 kV 1x2500 Almil Al 1,2mm  
 EYAKrvlwd 87/150 kV 1x3500 Almil Al 1,2mm

>3500AL  
 Solutions as standard!?

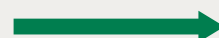
AC circuit 350MVA, with 2 parallel circuits → total loss over lifetime

**1600mm<sup>2</sup> → 129 GWh**

**3500mm<sup>2</sup> → 59 GWh**

1kWh=0.526kg CO2

**Results in 36 Ktons CO2 reduction**

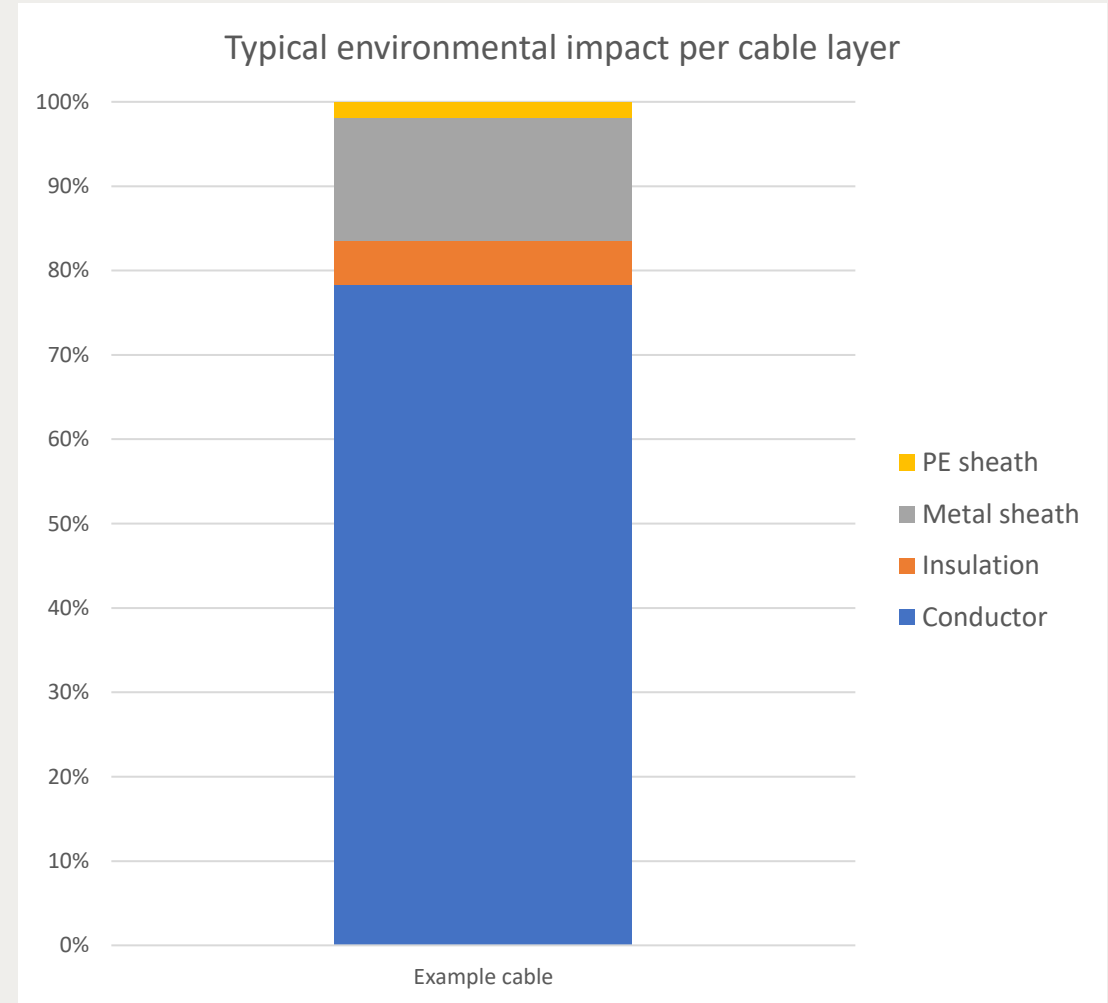


Comparable with CO2 emissions  
 of 75.000 households



# Environmental impact of materials

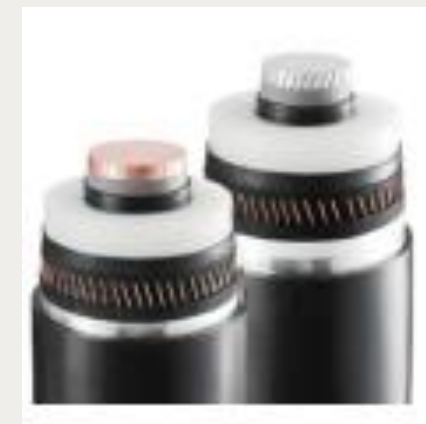
- The metal in the cable has the most impact
- Aluminum and copper have a similar ECI-scores, but this is highly dependent on the production method and recycled content
- The environmental effects of copper and aluminum are different



Source: 

## Insulation

- Chemical Recycling → improving circularity by pyrolyze
  - Recycled PE to be used in lower grade solutions, such as pipes
- Decoupling from fossil → using renewable feedstock as virgin equivalent
  - Not suitable for consumptions, waste and residues from vegetable oil refining
  - Cooking oil from food industry
- One of the frontrunner is Borealis
- Qualification of polyolefins is performed by ISCC PLUS-certificate



## What do we do in cable system designs

- Standardize systems
- Minimize on products
- Widely use of aluminum conductor
- Towards trenchless installation technologies
- Strive to re-use of components/materials



Customer is specifying, but how to deal with a CSR change ?

Dialogue with business chain partners is of importance !  
(Understanding needs and the possibilities)

## 3-core cable connections

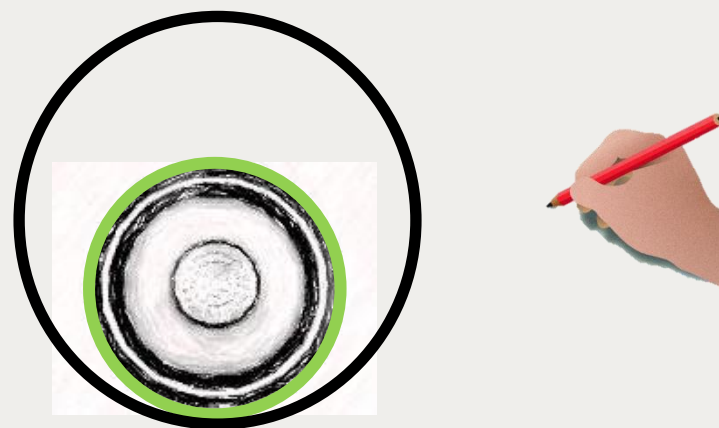
- Three core cable type
  - Parallel circuits
  - Twisted pairs or 3 core
  - In duct
- 
- Minimized jointing
  - Less magnetic pollution
  - Optimized losses
  - No asymmetry
  - Closer spacing
  - Protection by use of pipe and future proof solution
  - Less transport



Water floating installation

# 1 cable fits all

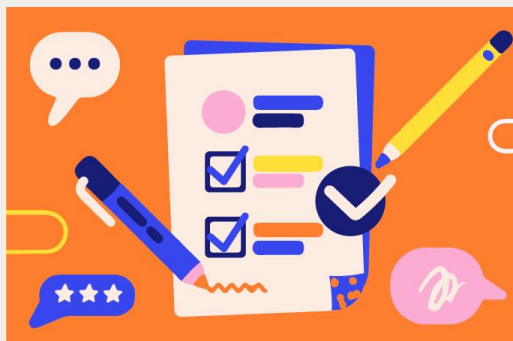
- One single cable for 110-400kV voltage range? (since most impact is shown on conductor, assumption reasonable costs)
  - Super clean insulation material → enabling thinner dielectric layer
  - Enabling higher temperatures at EV?
  - Specifying a reduced cable lifetime, using pipe retrofit principle?



HV+EHV

# Qualification

- Proven technology provides operational comfort!
- Network availability is our first priority
- Implementation of new materials or innovative ways requires certification / qualification
- This in order to proof that the quality is obtain over lifetime;
  - Certification associations
  - Partnerships / relations
  - References of comparable implementation



# Future cable system thoughts

Towards “greener” cables systems

**“It’s not easy  
being green.”**

—Kermit the Frog



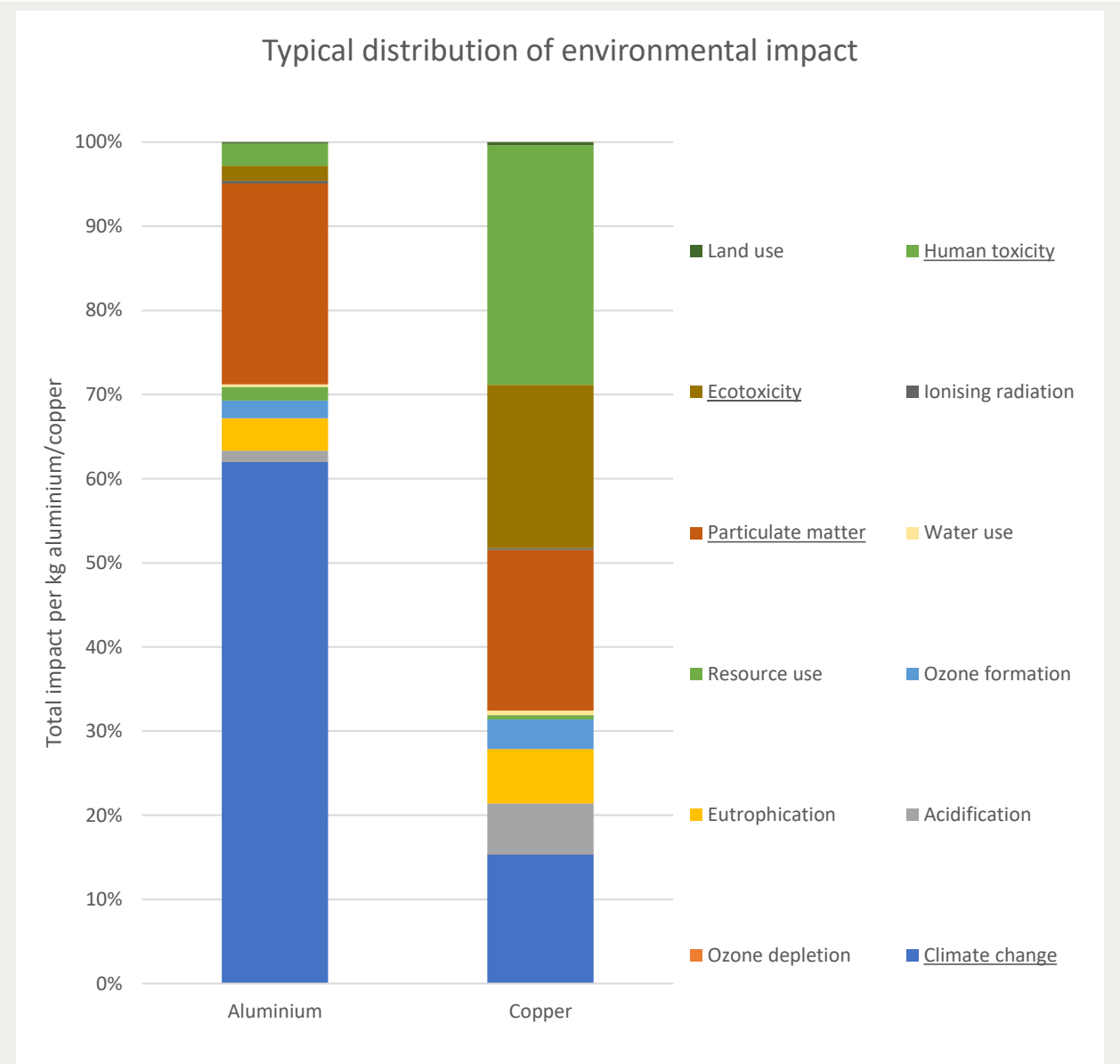
# Other slides

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# Environmental impact of metal

- Aluminum and copper both impact:
  - Climate change
  - Particulate matter
- This is mainly due to the generation of the processing energy
- Copper also has a large impact on:
  - Human/eco-toxicity
- This is caused by emissions and waste products from the production process





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