TRANSFORMERS MAGAZINE'S
INDUSTRY NAVIGATOR

INVESTMENTS, ARTIFICIAL INTELLIGENCE AND SUSTAINABILITY

CONFERENCE 2024

Enabling greener transformers with harmonized practices

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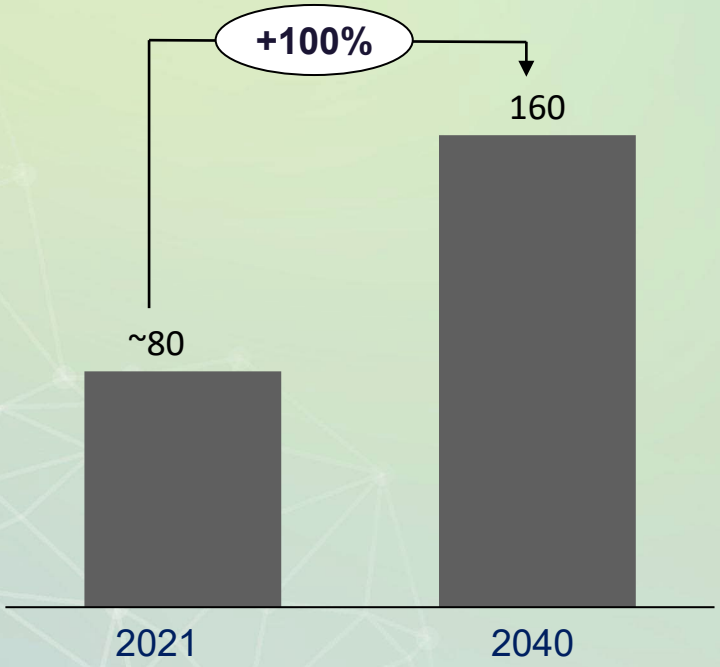
June 12th, 2024

Grid Doubling Leads to Considerable Embodied Carbon Footprint

Grid to double by 2040

Grid length in million km, incl. TSO and DSO grid



Take for example Power Transformers as one key component of the grid expansion:

>160 thousand
transformers in TSO grid requiring

>40 million t
electrical & tank steel

>10 million t
copper

Embodied carbon footprint requires the integration of sustainable practices

Source: Electricity Grids and Secure Energy Transitions (iea.blob.core.windows.net)

EU Introduces a Set of "Greener Transformer" Policies to Promote Sustainable Energy

EcoDesign Directive for Transformers, Tier 2 (2021)

Defines minimum energy efficiency requirements for power transformers

EU-Taxonomy (2023)

Defines all transformers meeting Tier 2 EcoDesign Requirements as sustainable (acc. to activity 3.20)

Net Zero Industry Act (2024)

Defines grid technologies (incl. transformers) as clean technologies contributing to decarbonization

Difficulty in Assessing "Greener Transformers" Due to Diverse Definition

Embodied Carbon

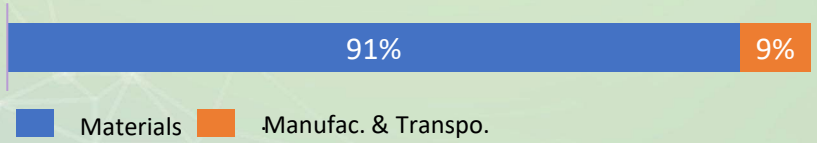
Cradle-to-Gate

Transformer

300MVA, 232/116/10kV

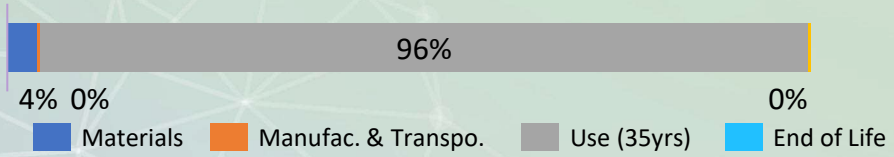
3 - 5

t CO_2e / t transformer



Product Lifecycle Emissions / Operational Carbon

Cradle-to-Grave



Why Just Examining the Transformer Carbon Footprint Isn't Enough…

- Limited scope of environmental impact
- Fails to capture supply chain complexities
- Social and economic factors

And Currently, No Industry Standard Available for Transformer LCA…

- Different (outdated) CO2e databases for lifecycle assessment (LCA) calculation
- Missing data or procedure on how to select material data
- Supplier LCAs partially not available or no guidance on how to include in product LCA

Enhancing Sustainability Transparency via Standardization

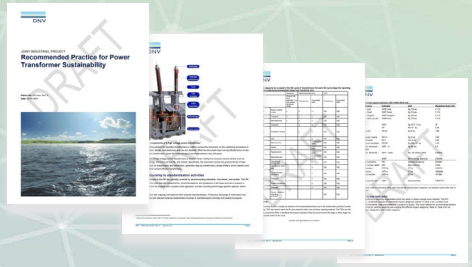
1st step: Joint Industry Project (JIP) with DNV: LCA for Transformers

Result

LCA best practice report published and endorsed by JIP participants and DNV

Report covers

- Clarification on calculation scope and method
- Recommendations for LCA considering material types' impact and uncertainty
- Determination of scenarios to reduce variation when project-specific data is not available



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2nd step: CIGRE Joint Working Group A2 | C3: LCA for Transformers

Working Streams

1	2	3	4	5
Materials	Design	Manufacturing	Operations	End of Life

- Potential structure for Technical Brochure
- Many possible case studies exist

Task Force Teams

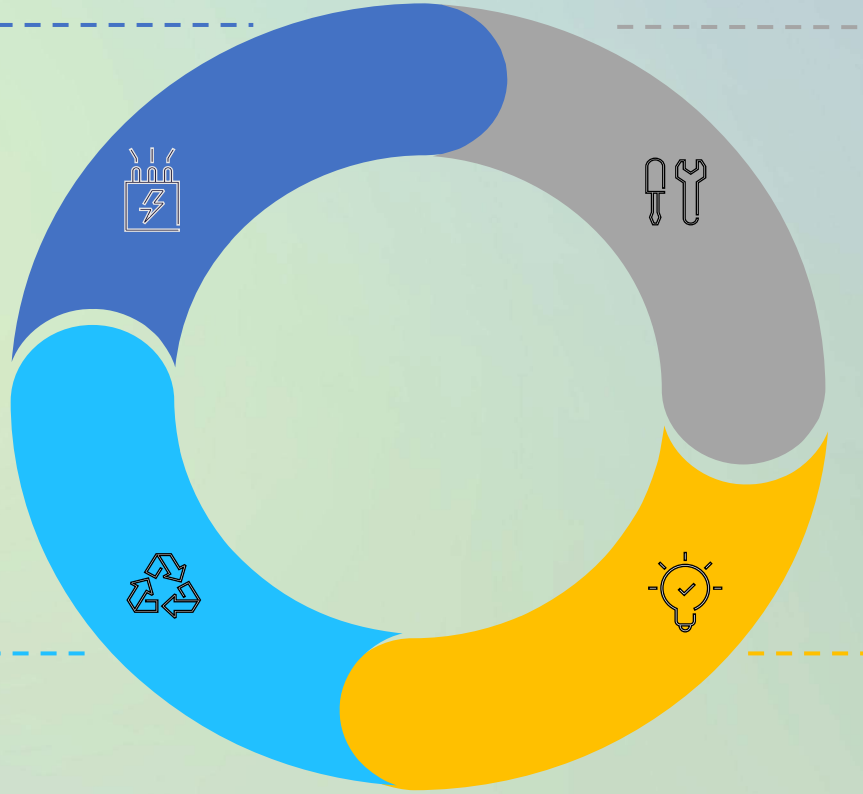
A	B	C
Stand. & Reg.	Liaison & Interf.	Countr. / Reg. View

Support the Working Streams and influence potential structure and content of Technical Brochure

Enhancing Transformer Environmental Footprint through Sustainable and Circular Practices

Design/ Material

- **Compact transformer design**, built to last for up to 40 years
- **Use of CO_2-reduced materials**
  - e.g. bluemint® steel by thyssenkrupp, piloted in *Amprion's Ultranet project*
- **Alternative insulation liquids**
  - Natural Esters
  - Regeneration & recycling of synthetic ester



Manufacturing

Climate Neutral Program (CNP)

- **Target:** Become climate neutral in our own operations by 2030
- **Achieved 100% green** electricity in 2023
- **Improving electrification** and prevention of GHG emitting processes, improved efficiency in our factories globally

End of Life (EoL)

- **Over 95%** of our transformers' total weight can be recycled
- Improving recycling efficiency, using *Circular Economy* models

Lifetime / Use Phase

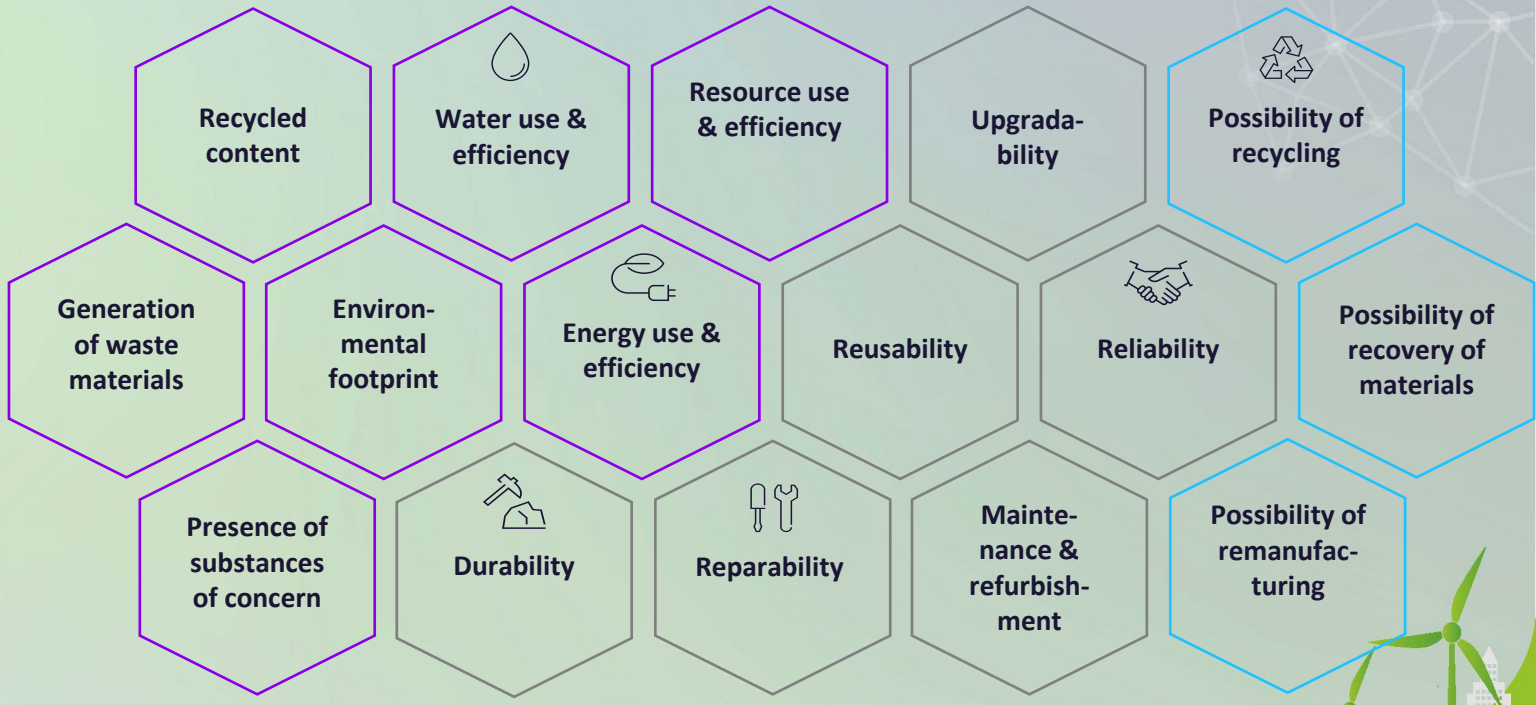
- **EcoDesign Directive,** highest perfomance efficiency

ESPR's New Sustainability and Eco-Design Approach Expands to Include Material Efficiency

- Broad scope
- New sustainability & ecodesign aspects
- Horizontal measures
- Strong focus on product information

Key product aspects under ESPR

Article 5 – EcoDesign requirements



Thank You

for your attention