



TRANSFORMERS MAGAZINE'S
INDUSTRY NAVIGATOR

SUSTAINABILITY AND DIGITALIZATION

Digitalization is Transforming the Power Industry

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Siemens Energy

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“The change in the grid forces the adoption of digital solutions to manage future complexity.”

- everyone, everywhere, all the time.





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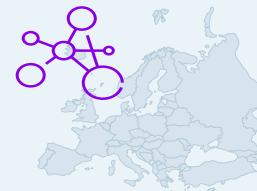
Grid must connect more renewables



58% share

Installed **renewable power** generation capacity **globally by 2030**

Grid must interconnect various power systems



~128 GW

New interconnector capacity across **Europe between 2020 and 2040** to support system resiliency

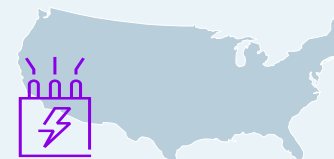
Macro Trends

Demand growth
Renewable uptake
National policy
Reliability
Decarbonization



~2x growth

Total grid capacity for high voltage transmission will almost double in **China until 2050**



38% assets

Entering end-of-life phase and need **replacement in next 20 years in the US**

Grid must manage multidirectional power flows

Grid must ensure reliability and modernization

Sustainability





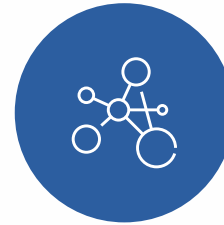
“The change in the grid forces the adoption of digital solutions to manage **future complexity**.”



Faster data flows and communication



Real-time observability and decision-making



Highly integrated coordination



Predictability and reduced human errors

Speed of Control Response

Current evolution



Automated Centralized Digital Control

Future evolution



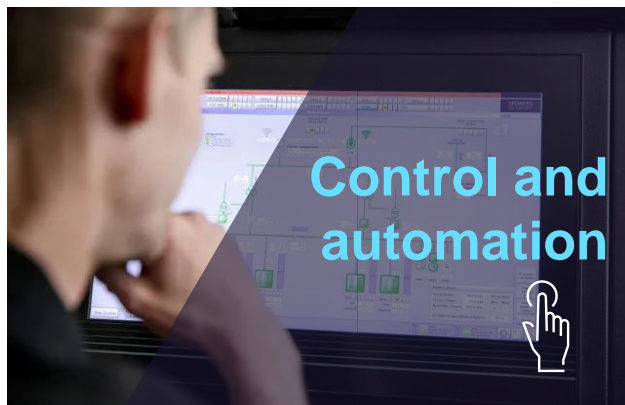
Integrated Decentralized Digital Control

Human-led / AI assisted control





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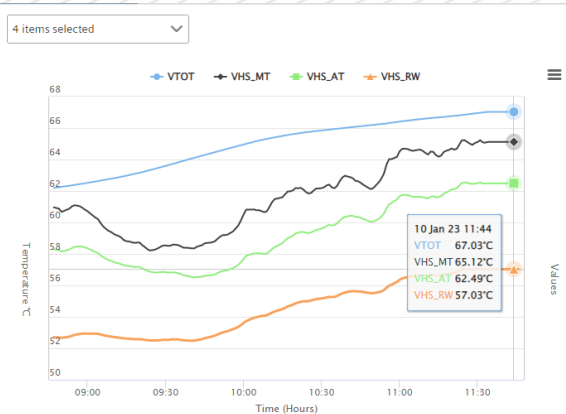
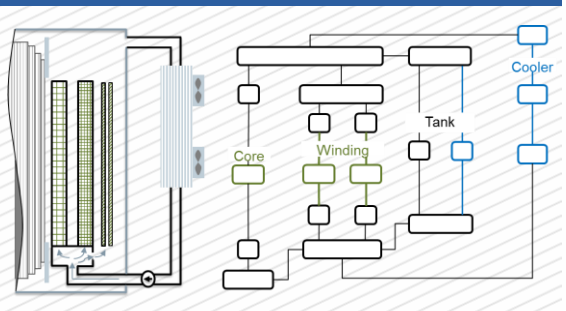






Digital Twin with Sensproducts

- ✓ All relevant **transformer mechanical & electrical components** are modeled
- ✓ Consideration of **changing cooling stages**
- ✓ Consideration of the **variable loading**
- ✓ Model is calibrated with unit-specific **design data** and **heat run test results**
- ✓ **Losses** are considered as input for model
(Scope 2 emissions)



Sensor	Current Value	Status
VS Top Oil	67.03 °C	✓
VS HS MT/I	65.12 °C	✓
VS HS AT	62.49 °C	✓
VS HS RW	57.03 °C	✓



Ageing Prediction

Lifetime Extension

Optimize existing fleet

Reduce Grey Emissions

Enhance future designs

Optimize Load / Losses





Selfcare application



SelfCare is an automated service application, that leverages online data provided by the Sensproducts (IoT Data) and product specific data models (Siemens Energy Know How) to reduce complexity and adding self maintenance to the machine.



Asset Management Strategy

improved & dynamic asset mgmt strategy



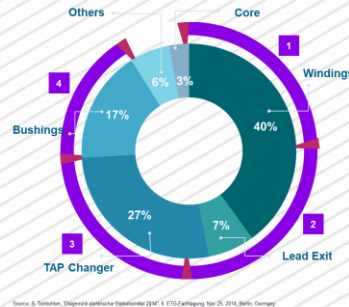
Maintenance Planning

inform you when maintenance intervention is needed



Maintenance Execution

support you how to execute maintenance intervention



Work Order
Efficiently manage automatically created work orders with our intuitive and user-friendly platform

Health Indicator
Gain valuable insights into your asset's health with our comprehensive Health Indicator

SelfCare Calculation Engine
Make data-driven decisions with confidence the engine leverages knowledge from FMEA databases to analyze raw data and provide the best course of action

FMEA Data Base
Proactively prevent equipment failures with our comprehensive FMEA database based on our OEM knowledge



Lifecycle Assessment

Protect Human Capital

Protect Nature

Optimize Asset Downtimes





DGA as a Service Concept

A scalable Digital + Service subscription that increases **asset reliability** & **service efficiency**, while reducing overall efforts and costs

“Classical approach”



Multigas
Device



Recurring + ad-
hoc oil analysis



Diagnostics

“Higher CAPEX, customer manages analysis and diagnostics”

“DGA as a service”



Connected H2
Sensor



On demand
Laboratory analysis



On demand Expert
Diagnostics

“No CAPEX, expert support closes knowledge GAP, connectivity reduces risk and improves response time”





Use-Phase GHG Emissions in PTs

Energy sector contributes

$\frac{1}{3}$ **global CO₂ emissions**

Power Transformers represent

4% of CO₂ emissions in the power system

Scope 3 Downstream of Power transformers account for

96% of CO₂ emissions in its lifecycle

Source: IEEE



Energy Efficiency in Sensproducts Platform

- ✓ Calculates load level for max. energy efficiency;
- ✓ Estimates reduced CO₂ quantity;
- ✓ Estimates financial impact of operating at recommended load;

Operating Modes

ECO

Max Output

Max Lifetime

Energy Efficiency ⓘ



Current Load Level

**55 MVA
(99.95%)**

Load Level for
maximum efficiency



Potential Savings per 24h:

87t CO₂



Potential Savings per 24h:

125.33 \$





The Joint Industry Project (JIP) with DNV

We create LCA Standards across the industry

1 Challenge

- Power equipment manufacturers start **assessing** their **product footprints**
- Evaluation, boundaries & methodologies are yet to be standardized

2 Approach

- Launch of a JIP supported by DNV
- Different stakeholders across the value chain join the project to **align and standardize LCA approaches**
- Project is divided into working packages with specific scopes and publications

3 Results

- **Recommended practices** will be published and endorsed by JIP participants and DNV as a neutral partner
- **Standardization of LCAs** will lead to better comparability across the industry and improve transparency



WHEN TRUST MATTERS

POWER TRANSFORMER SUSTAINABILITY

Know where our products come from

Standard approach towards sustainability

All players in the high voltage industry want to demonstrate their commitment to sustainable future, energy transition and decarbonization of the grid. They want to assure the reliability of their suppliers. A standard approach towards sustainable power transformers helps standardization of green transition, creating trust and confidence toward stakeholders.

Power grids and high voltage (HV) equipment are important infrastructures for economic growth and development, playing a vital role in enabling a flexible green energy market. However, to transition to a green future not only the sources of energy but also the energy infrastructure itself needs to become more environmentally friendly. The sustainability and carbon intensity of materials used in power grid equipments specially large power transformers, as well as their

performance play a pivotal role in the continuous development of the energy sector in an environmentally friendly manner. Some parties within the industry have begun assessing and quantifying their carbon footprint. However, despite advanced development in HV technology, the evaluation, boundaries, and methodology of product sustainability within the industry is yet to be standardized.



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Contacts

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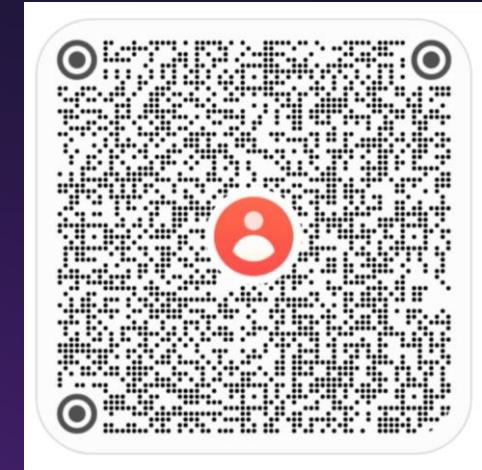
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