



Alessandra Vitali, September 24th-26th, 2014 – Dalmine, Italy

ABB OEM Days 2014

Transformers

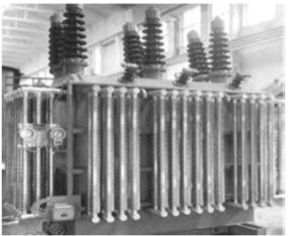
ABB OEM days

Transformers - index

- ABB – your global partner for “transformation”
- Application portfolio for OEMs
- Energy Efficiency and new EU rule N° 548
- Guidelines, features, characteristics and impact to transformers market

ABB's transformer heritage and nowadays

From a long pioneering history to one-stop shop supplier



700 years of combined experience in transformers:

- Asea
- Ansaldo/ItaTrafo/IEL/OEL/OTE
- BBC
- GE
- National Industri
- Strömberg
- Westinghouse
- Kuhlman
- Trasfor

Facts & Figures:

- Global presence in more than 100 countries
- Complete range of Power and Distribution Transformers, Components and Services
- Service organization for Global Customer support
- Voltage range up to
- 1000 kV AC and +/-
- 1200 kV DC

A global footprint

55 transformer locations and 30 service centers

Global Supply market coverage through 55 Focused Factories

They follow Market Allocations based on:

- Best Logistics
- Best Customer
- Market knowledge
- Culture
- Standards

30 Service Centers with around 1000 experts

Specialized units and plants for Transformers Service:

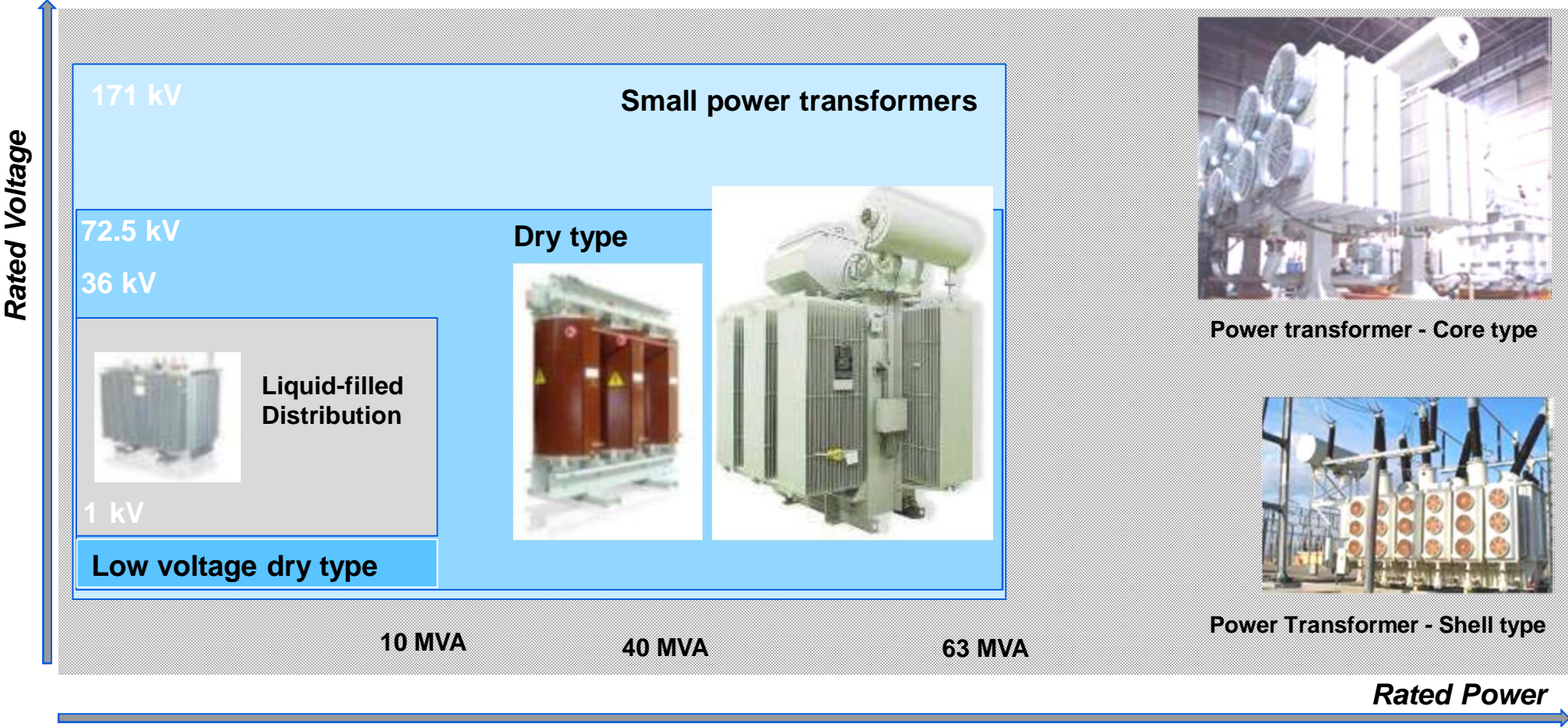
- Preventive Maintenance
- Re-manufacturing – Repair – Upgrade
- Fleet Condition and Risk Assessment
- TrafoSiteRepair and TrafoSite Testing



Transformers

Technology offering

4 common global design standards with technology platforms

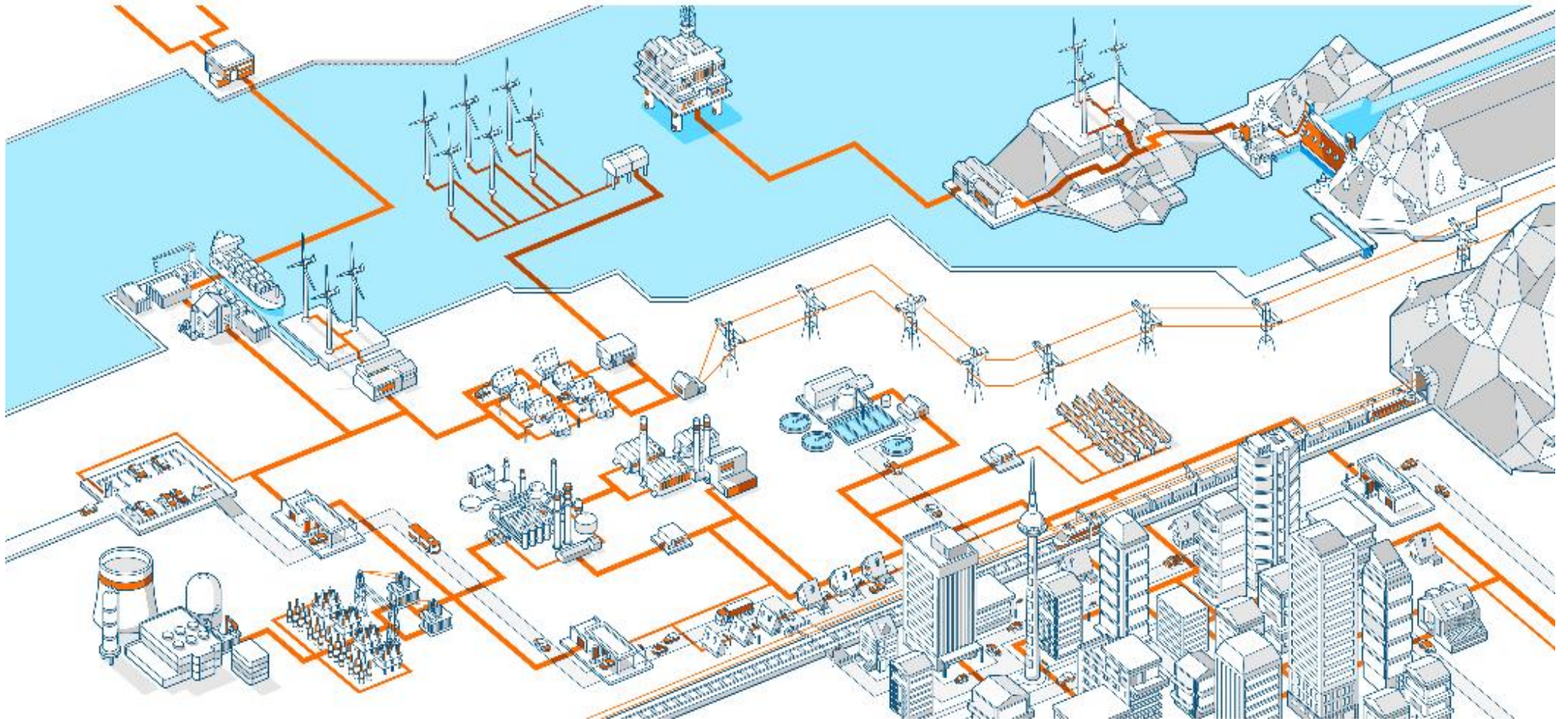


The application portfolio

Wherever you are, transformers are nearby

Applications

- Power generation
- Wind & Solar
- Transmission and distribution
- Industrial
- Commercial and residential usage
- Railway application
- Oil & Gas application
- Underwater applications



The application portfolio

Typical liquid-filled and dry-type transformers for substations



- Rated power range 50 kVA-2500 kVA
- Rated voltage max. 36 kV
- Tap-changer off-circuit
- Windings materials aluminum/copper
- Insulating fluid mineral oil
- Technologies: conservator/hermetic



- Rated power range 100 kVA-3150 kVA
- Rated voltage max. 36 kV
- Tap-changer off-circuit
- Winding materials aluminum/copper
- Enclosures IP23
- Environmental classes C2/E2/F1

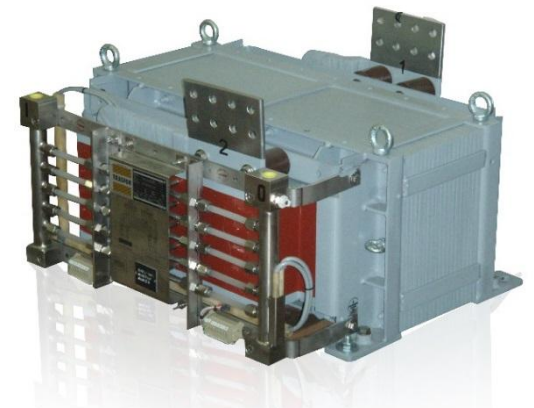
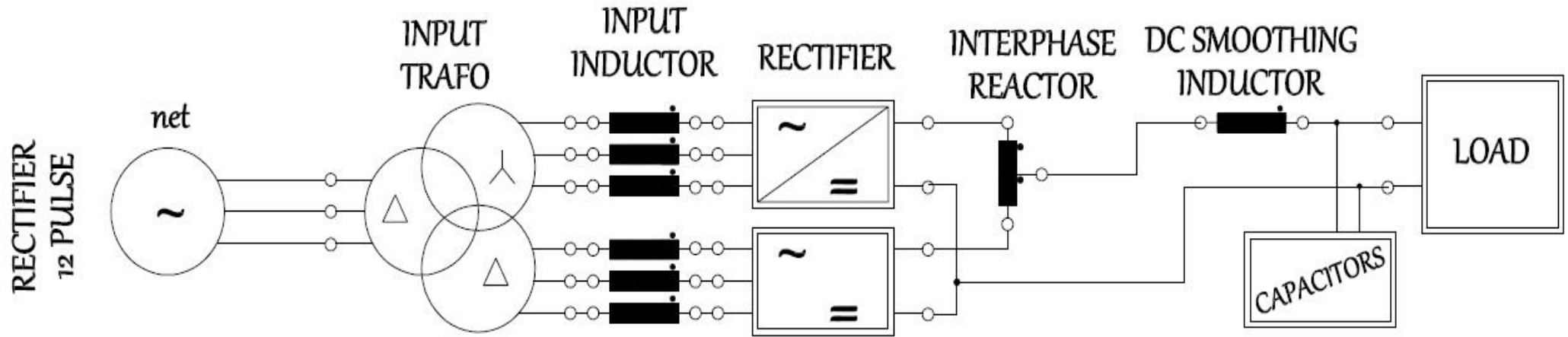
3 Technologies covering all typical applications!



The application portfolio

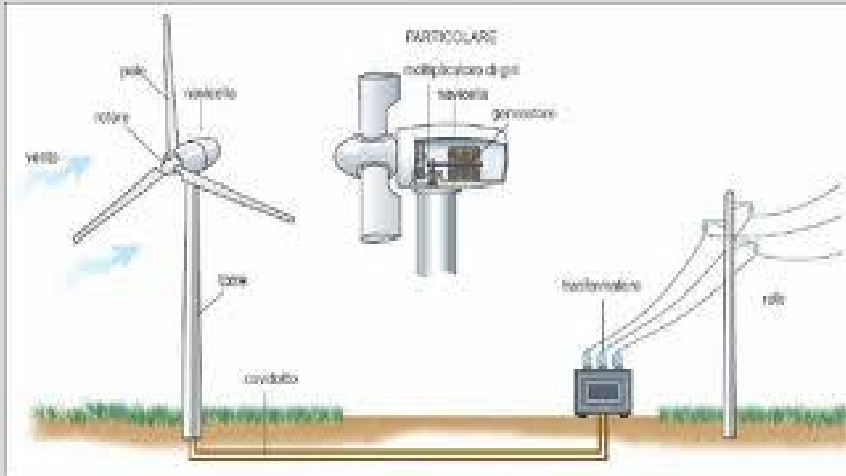
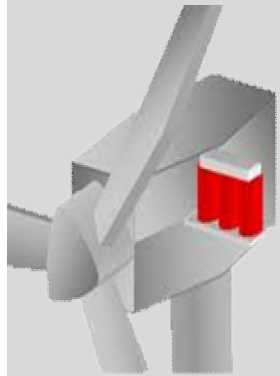
Variable speed drives and rectifiers

- Multi-pulse, multi-winding configurations
- VPI, VCC and Resibloc windings for dry-type
- Can be supplied integrated with ABB's ACS drives



The application portfolio

Renewables - windmills

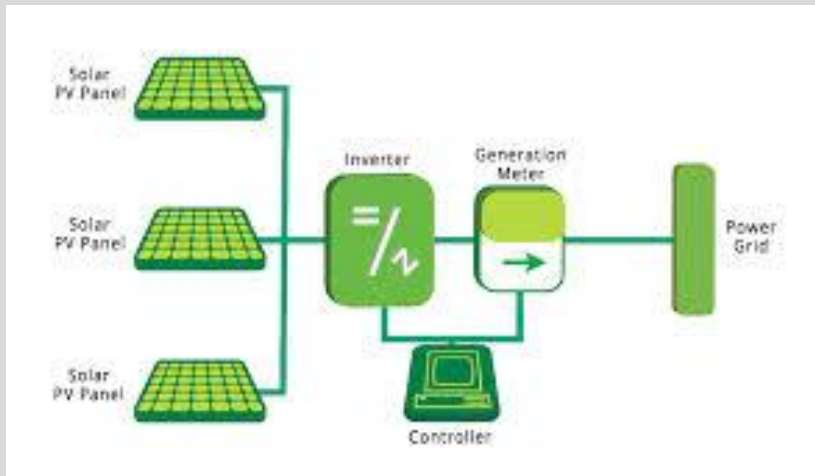


- Both on-shore and off-shore application
- Customized design
- Dry-type transformers
- Oil-filled transformers
- Water-cooled inductors
- Eco-dry transformers for highest efficiency



The application portfolio

Renewables - PV farms



- Dry-type output transformers up to 2 MVA – 36 KV
- Oil-filled output transformers up to 3 MVA – 36 KV
- Output inductors and DC choppers
- Can be supplied integrated with ABB inverters
- Eco-dry transformers for highest efficiency

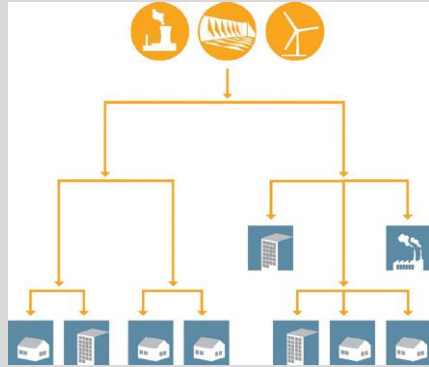


Transforming the distribution network

Changing networks

The power flow in modern networks is changing to become more complex

traditional
grids



- Centralized power generation
- One-directional power flow
- Generation follows load
- Operation based on historical experience

future
grids



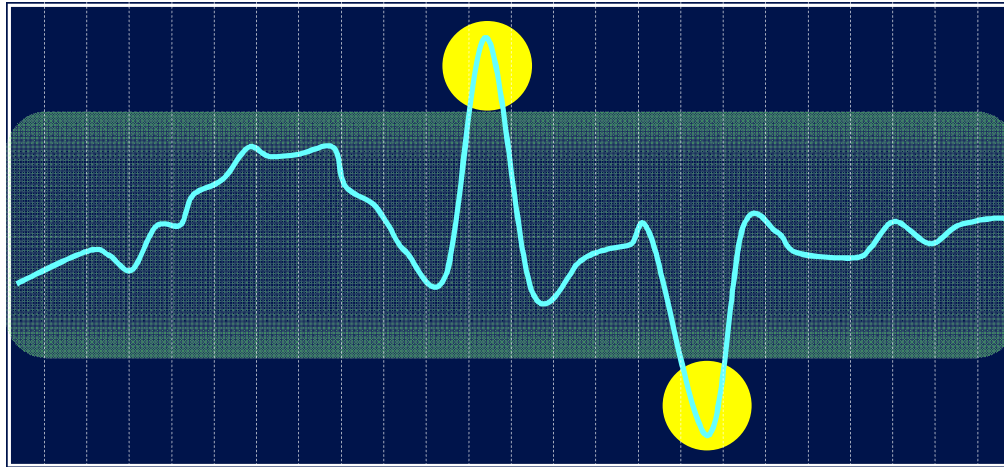
- Centralized and distributed power generation
- Multi-directional power flow
- Intermittent renewable power generation
- Consumption integrated in system operation

Voltage regulation Technical solution

Standard Distribution Transformer



+/-10% voltage bandwidth as per the DIN EN 50610 standard



01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 24:00

Max Infeed/No Load



Voltage regulation problems

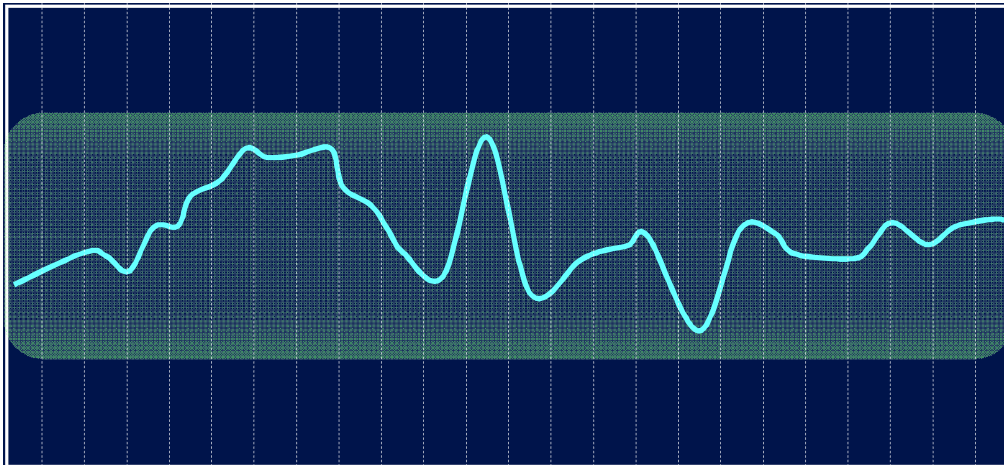


No Infeed/Max load

Smart-R-Trafo



+/-10% voltage bandwidth as per the DIN EN 50610 standard



01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 24:00

Max Infeed/No Load



Voltage is automatically regulated by Smart-R-Trafo



No Infeed/Max load

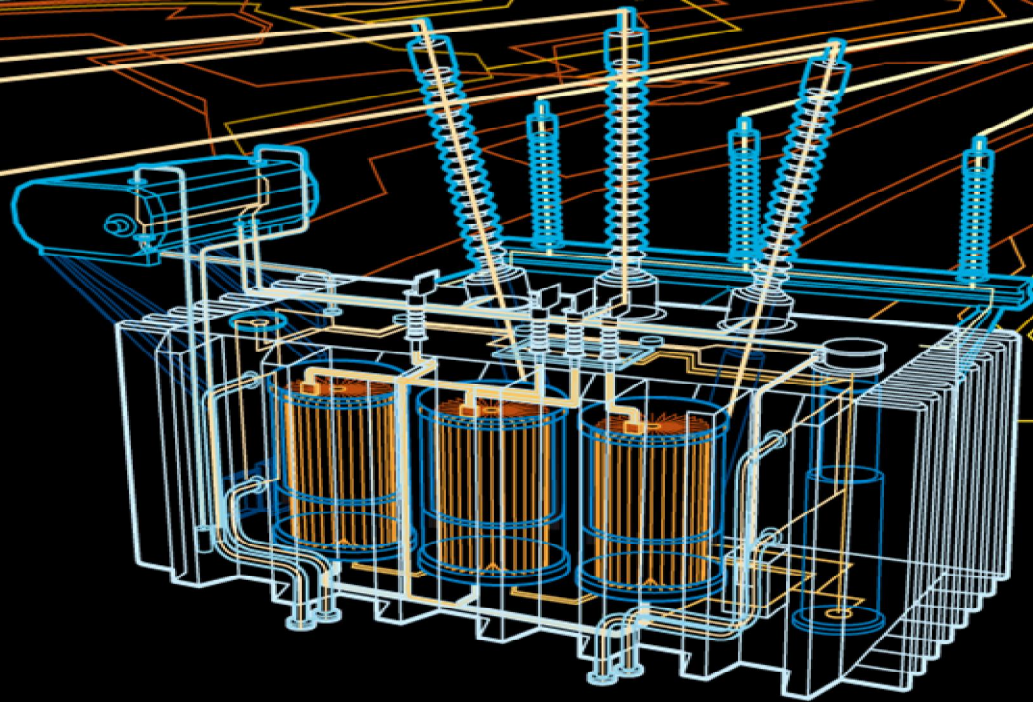
Voltage regulation Smart-R-trafo



Main features

- Power rating - 250 kVA to 800 kVA
- Voltage - up to 24 kV
- Tap changer - configurable for 5, 7 & 9 position (e.g. $\pm 4 \times 2.5\%$)
- Vector Group - all Delta and Star configurations suitable
- Automatic voltage regulation on-load
- No changes in transformer footprint
- No service required as switching contacts are maintenance free
- Communication with external SCADA system
 - Automatic, remote and manual modes
 - Ethernet and RS232 interfaces
 - Control system protocols IEC 608705101, 608705104, 61850

Distribution transformer with automatic voltage regulation already available in ABB product portfolio



Transformers

Energy Efficiency

Eco design directive

Focus on energy saving



More awareness on environmental sustainability



Economical crisis and scarcity of resources



Need of improved energy efficiency products



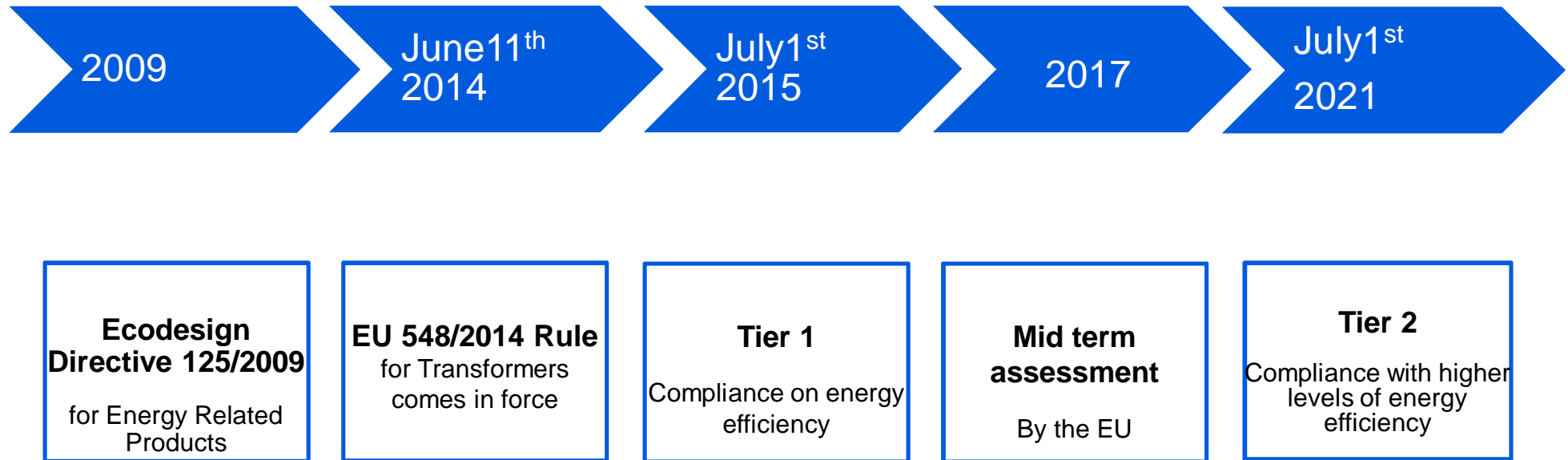
ECO-design directive No. 2009/125 for energy related products



Transformers Energy Efficiency

Energy Saving for Transformers

Timeline



Transformers energy efficiency

What changes



The **EU Rule 548/2014** introduces following significant changes:

- The rule impacts on both dry and oil transformers (with some exemptions)
- No power ratings limitations
- Up to power ratings of 3150 kVA given allowable values of losses
- For power ratings > 3150 kVA introduction of “Peak Efficiency Index”
- Staged decrease of max allowable losses
- Zero tolerances on both load and no-load losses

Transformers energy efficiency

Exemption from the EU rule N°548



- Instrument transformers
- Testing transformers
- Transformers with LV windings for use with rectifiers to provide DC supply
- Transformers connected to furnaces
- Welding transformers
- Transformers for explosion proof and underground mining applications
- Transformers for off-shore and floating off-shore applications
- Transformers for emergency installations
- Earthing or grounding transformers
- Traction transformers mounted on rolling stock
- Transformers for railway feeding systems
- Motor starting transformers
- MV-MV interface transformers
- LPT where it isn't technically feasible to meet the min. efficiency requirements
- LPT where a replacement would entail disproportionate costs

Transformers energy efficiency


Zero tolerances

EN50541's classes:
(Dry Tpe)

Ak

Bk

~~**Ck**~~

Load Losses Pk
Current Tolerance: **+15%** (IEC60076-1)

New Tolerance: **0%**


EN50541's classes
(Dry type)


A0

~~**B0**~~

~~**C0**~~

~~**D0**~~

No-Load Losses P0
Current Tolerance: **+15%** (IEC60076-1)

New Tolerance: **0%**

Total Losses: Pk + P0
Current Tolerance: **+10%** (IEC60076-1)

New Tolerance: **0%**



Transformers energy efficiency

Oil transformers

Liquid-filled distribution transformers with one winding with $U_m \leq 24 \text{ kV}$ and the other one with $U_m \leq 1,1 \text{ KV}$

| | Step 1 (from 1st July 2015) | | | | Step 2 (from 1st July 2021) | |
|-----------------------|--------------------------------|--------------|------------------------------|--------------|--------------------------------|-------------------------------|
| Power Rating (kVA) | Max. Load Losses Pk (W) | ΔP_k | Max No-load Losses P0 (W) | ΔP_0 | Max Load Losses Pk (W) | Max. No-load Losses P0 (W) |
| 25 – 1000 | Ck | -20% | A0 | -50% | Ak | A0-10% |
| 1001 - 3150 | Bk | | A0 | | Ak | A0-10% |

Transformers energy efficiency

Dry transformers

Dry-type distribution transformers with one winding with $U_m \leq 24 \text{ kV}$ and the other one with $U_m \leq 1,1 \text{ KV}$

| | Step 1 (from 1st July 2015) | | | | Step 2 (from 1st July 2021) | |
|-----------------------|--------------------------------|--------------|----------------------------------|--------------|--------------------------------|----------------------------------|
| Power Rating (kVA) | Max. Load Losses Pk (W) | ΔP_k | Max. No-load Losses P0 (W) | ΔP_0 | Max Load Losses Pk (W) | Max. No-load Losses P0 (W) |
| 25 – 630 | Bk | -15% | A0 | -30% | Ak | A0-10% |
| 631- 3150 | Ak | | | | Ak | A0-10% |

Transformers energy efficiency CE marking

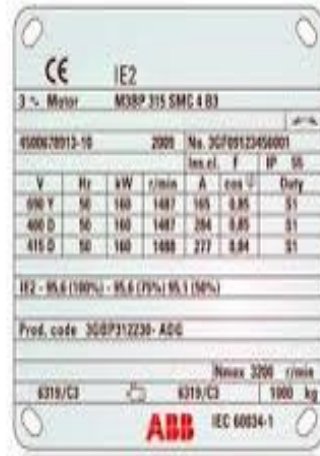


ABB transformer rating plate showing CE marking, IE2 efficiency class, and technical specifications.

| V | Hz | kVA | r/min | A | cos φ | Duty |
|-------|----|-----|-------|-----|-------|------|
| 990 Y | 50 | 160 | 1487 | 165 | 0.85 | S1 |
| 400 D | 50 | 160 | 1487 | 394 | 0.85 | S1 |
| 415 D | 50 | 160 | 1488 | 277 | 0.84 | S1 |

IE2 - 95.6 (100%) - 95.6 (75%) 95.1 (50%)

Prod. code 300P312230-AGG

Nmax 2200 r/min

6319/C3 6319/C3 1000 kg

ABB IEC 60034-1

CE

- It will be the manufacturer's responsibility to ensure that the transformer is compliant
- CE marking is a key indicator of a product compliance with EU legislation to be put on main rating plate as proof of compliance
- Customers must verify the presence of the CE marking on the rating plate
- The rating plate will have to bear also load-loss, no-load loss and cooling-loss and information on the weight of the main components

Transformers energy efficiency

Key elements



- Distribution Transformers are already very efficient (+98%) yet load and no-load losses can be further improved
- Energy saving possibility in new building applications
- The industry state-of-the-art already allows the construction of transformers with losses in compliance to the new rule
- A higher energy efficiency means increase of dimensions and product price to be paid back thanks to lower electricity fares

Transformers energy efficiency

Eco dry for increased efficiency

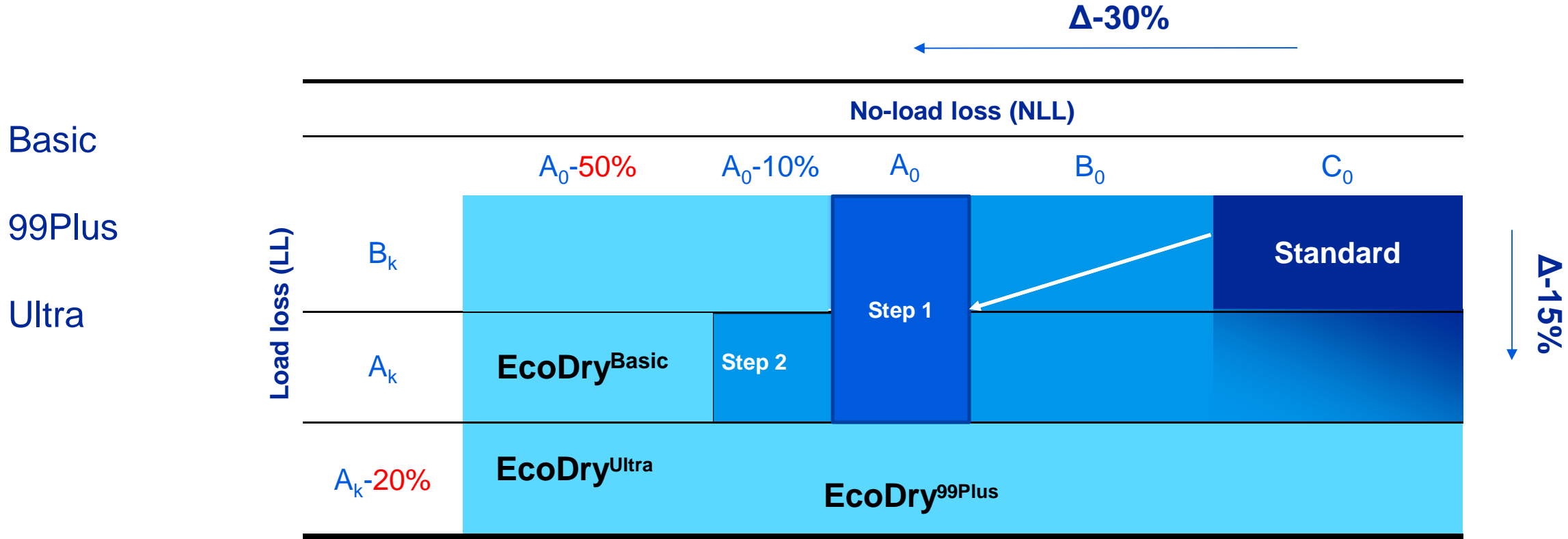


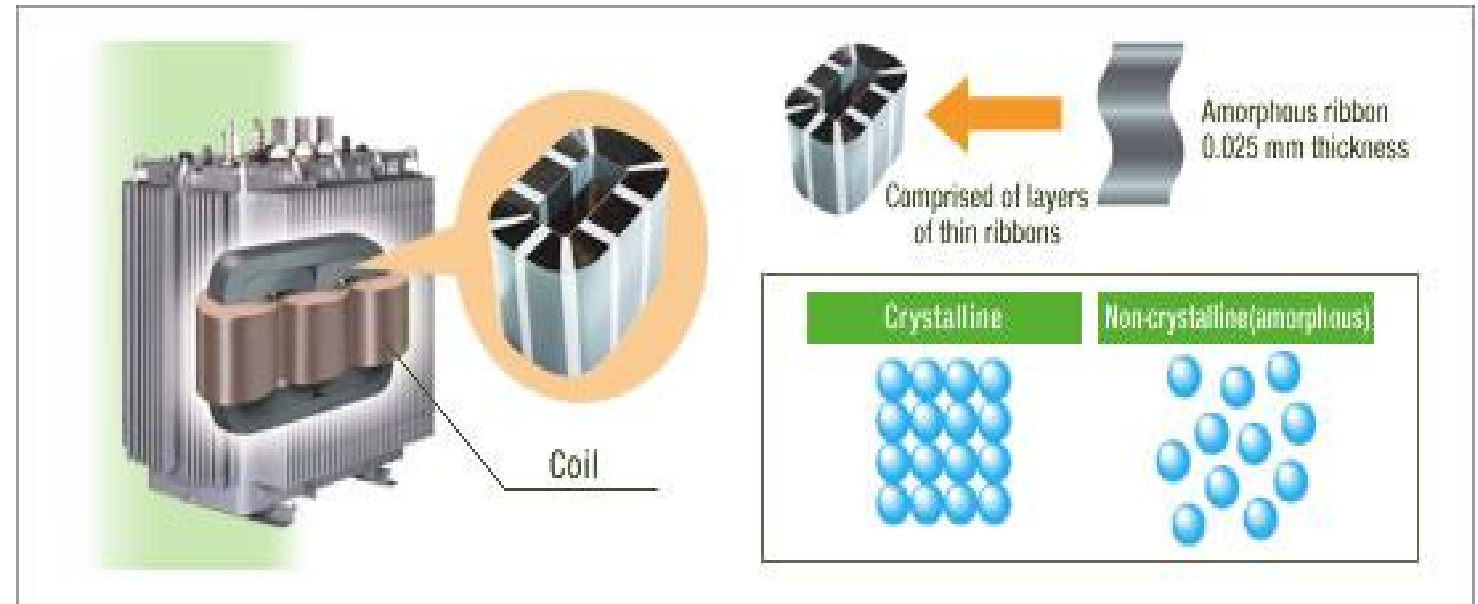
ABB is already capable of offering transformers with losses lower than those prescribed by the Regulation

Transformers energy efficiency

Amorphous core for extremely low no-load losses



ABB is capable of constructing transformers with amorphous magnetic core with no-load losses lower than those prescribed by Step 2 (2021) of the standard



Transformers energy efficiency

Benefits to ABB's customers

- Proximity to your business
- Tailor-made solutions for OEMs' applications
- Reliability and technical expertise
- Sustainability
- Solutions compliant to the EU rule
- Ultra-efficient product lines

Transformers energy efficiency
Questions & answers



Questions & Answers

Power and productivity
for a better world™

