

# Green Power Transformers

## Eco-efficient and Innovative

A sustainable range of green eco-efficient power transformers, from 10 to 500 MVA and up to 550 kV.

GE creates and delivers customer-valued network solutions for an energy-efficient future. Our environmentally-friendly solutions are aimed at meeting major energy challenges of today and tomorrow: energy efficiency, market efficiency, grid reliability and environmental concerns.

GE Green Power Transformers offer significant environmental benefits, including better product performance, covering the 3 phases of the product life cycle:

- Manufacturing: reduced consumption of natural resources
- Operation: lower CO<sub>2</sub> emissions, limitation of environmental-risk, noise reduction. space savings and energy efficiency
- End of life: recycling capabilities of products

## Eco-efficient Power Transformers

Based on customer demand for environmentally friendly products that improve life cycle costs with limited maintenance needs and increased service lifetime, GE introduces its Green Power Transformers to accompany and assist customers with today's eco-management challenges.

A Green Power Transformer (10 to 500 MVA and up to 550 kV) is a sustainable, eco-efficient product with the following functionalities:

- Filled with natural ester instead of mineral oil
- Hermetically-sealed tank design, equipped with patented expandable radiators and OLTC with vacuum type tap changer
- Innovative technologies to reduce acoustic energy transferred and optimized design of the active part
- Optimized low loss levels
- Solvent-free paint

## Complementary Offering

- On-line MS3000 monitoring system
- Resin Impregnated Paper (RIP) bushings with composite insulators
- Cooling unit with speed-controllable EC fans



## Customer Benefits

- Optimized low loss levels
- Prevention of pollution and increased safety by using natural ester insulation liquid
- Innovative technologies to reduce noise level
- Reduced maintenance cost, extended life time and increased overload with hermetically-sealed tank design, equipped with patented expandable radiators and vacuum type tap changer
- On-line condition monitoring system MS3000
- State-of-the-art factories around the world

# A sustainable range of green eco-efficient power transformers from 10 to 500 MVA and up to 550 kV

## Key Customer Benefits

Green Power Transformers offer a new alternative for customers who want to preserve the environment by offering a lower carbon footprint, limited pollution risk and optimized life cycle costs thanks to less maintenance. Other advantages include reduced ageing, lower noise levels and increased fire safety.

To further maximise operational management and prevent faults and damages, advanced on-line monitoring systems can also be added.

## Environmental and health benefits

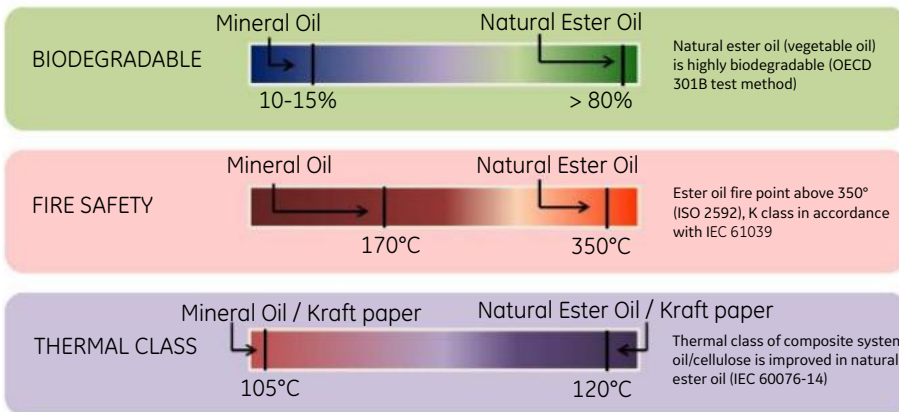
One of the key benefits offered by the Green Power Transformers is the prevention of pollution through the use of natural ester liquid instead of mineral oil. Natural ester is naturally synthesized, come from renewable resources, and is also biodegradable and non toxic, limiting pollution risk during operation, installation and end of life.

Environmental benefits also include reduced noise levels to limit disturbance in urban or ecologically sensitive areas. Noise level reduction above 10 dB (A) is made possible thanks to our selection of high-performance materials and equipment, optimized design of active parts and innovative mechanical structures.

## Increased safety

With a Green Power Transformer, fire safety is improved considerably, offering increased security, not only for operators but also for those in close proximity. Natural ester has a fire point above 350°C, more than twice as high as mineral oil. It is classified Green transformers are less flammable and reduce fire spreading.

## Comparison between conventional and green eco-efficient power transformers




### High eco-efficiency


A major benefit of the Green Power Transformer range is its optimized life cycle cost. In our standardised process, design choice and high-performance materials achieve low losses for the optimal capitalised cost of the transformer.


GE's innovative hermetically sealed tank design, equipped with patented expandable radiators, goes a step further in reducing life cycle costs: it reduces maintenance, extends life time by preventing contact between the oil and moisture, and oxygen in the atmosphere. Hermetically sealed tank design reduces cellulosic insulation and oil aging. It is further improved with the use of natural ester (vegetable oil), which increases a transformer's insulation life, thanks to higher water solubility (drying effect of paper) and higher thermal class (IEC 60076-14). Humidity equilibrium curves (Perrier-Lukic) between cellulose and oil show that moisture equilibrium is moved towards the ester.


Maintenance costs are also reduced as a result of the hermetic tank design, which requires no oil conservator and no associated devices. The vacuum tap changers avoid contact erosion and further reduce maintenance needs.


- Biodegradable Oil

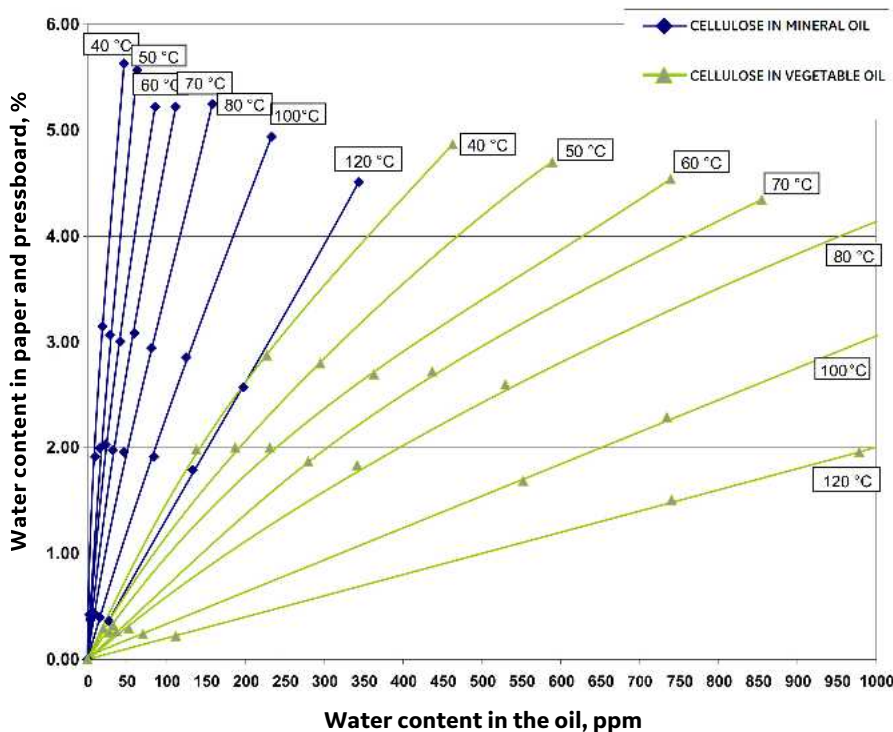

- Low Noise


- High Efficiency


- Low Maintenance


- Condition Monitoring





Green Power Transformer 110 kV, 31,5 MVA

Perrier-Lukic equilibrium curves for paper/pressboard in mineral and natural esters

## Key references

### Bringing the bulk of energy closer to consumption centres and investigating green solutions

EDF Energy installed the first purpose-built 132/33 kV 90 MVA 3-phase Green Power Transformer filled with ester in the United Kingdom. Located in Luton's interconnection substation, it is equipped with our MS monitoring system to ensure the highest availability possible during operation. This power transformer is installed close to consumption centers, and the liquid is made from edible soya beans, which are fully biodegradable and have greater fire resistant properties.

### Preserving the environment in sensitive areas and using renewable resources

Eletronorte, one of Brazil's main utilities, bought and installed a 242 kV shunt reactor, filled with ester, to promote sustainable development in the protected Amazon region. The solution, developed with oil from renewable resources, also responds to customers' concerns about the use of petroleum-based fluids in high-voltage applications.

### Green all the way from generation to transmission

EWO Energietechnologie GmbH in Germany bought Green Power Transformers that feature hermetically-sealed tank design, equipped with patented expandable radiators and with a vacuum tap changer and filled with ester for wind farm connection. On top of environmental benefits, reduced transformer maintenance is also a direct benefit of this green project.

### Low sound transformers for silent substations

PSE&G, one of the main utilities on the East Coast of the USA, needed to have 'silent' substations to be built close to consumption centres with high population densities in New Jersey State. GE's 550 MVA 230 kV auto-transformer with OLTC and ONAF cooling was the right solution. Noise reduction was achieved with optimized active part design, tank decoupling, tank designed for reduced transmission of energy, resonance absorbers and sound panels, up to -10 dB(A) on load sound level.

### Lowering maintenance and increasing service provision

In the past decade, a German railway operator purchased large series 10 and 15 MVA hermetically-sealed Green Power Transformers with patented expandable radiators and vacuum tap changers for reduced maintenance costs, optimized overload capacities and longer life time.



15 MVA 120/17.25 kV 16.7 Hz track-side hermetic transformers for railways



75 MVA 115 / 31 kV hermetic transformer with vacuum tap changer and MS3000 monitoring system for off-shore wind farm Alpha Ventus in operation since 2008

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Imagination at work