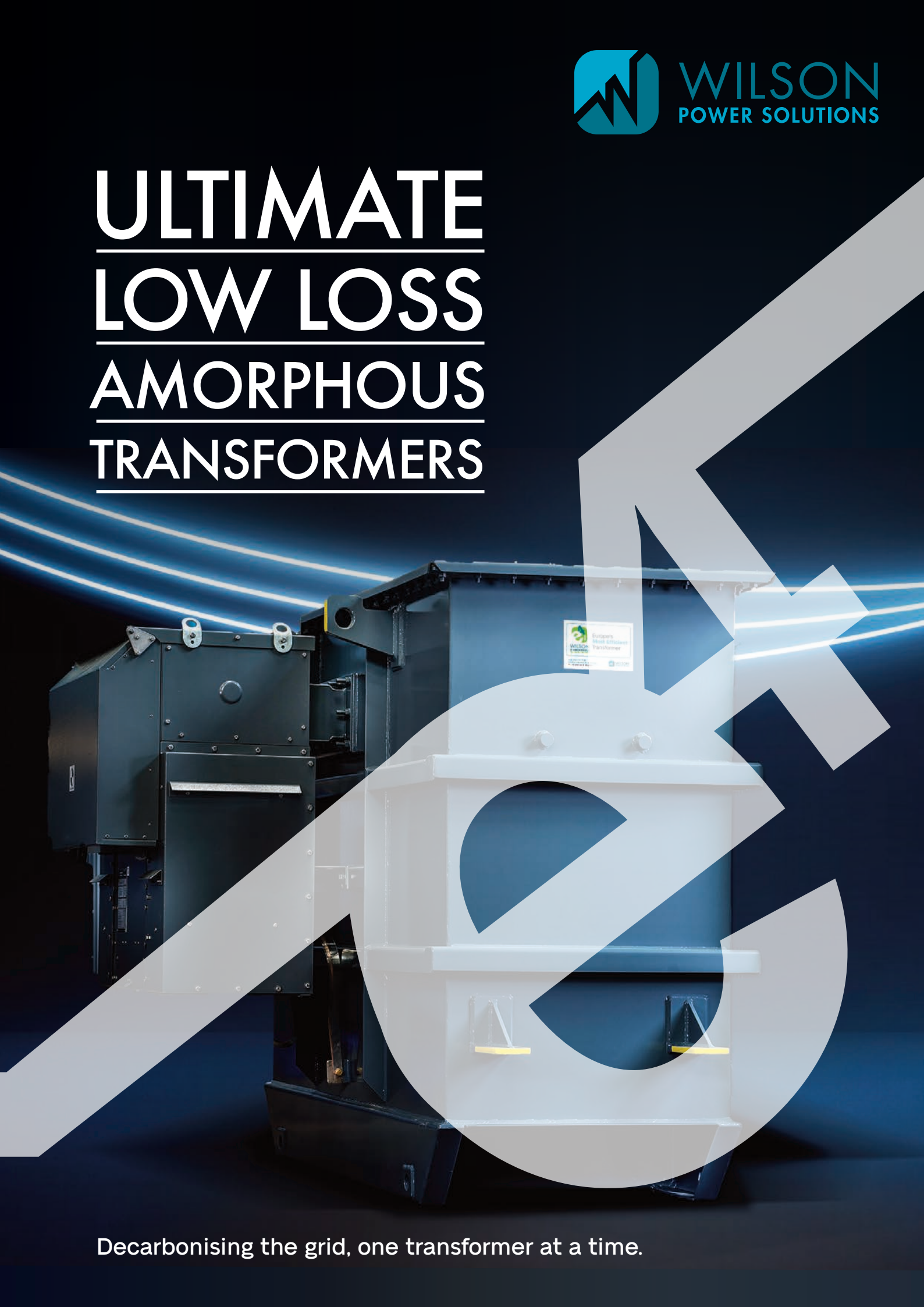
WILSON
POWER SOLUTIONS

ULTIMATE LOW LOSS AMORPHOUS TRANSFORMERS



Decarbonising the grid, one transformer at a time.

INTRODUCING WILSON e4 ULTIMATE LOW LOSS AMORPHOUS® TRANSFORMER

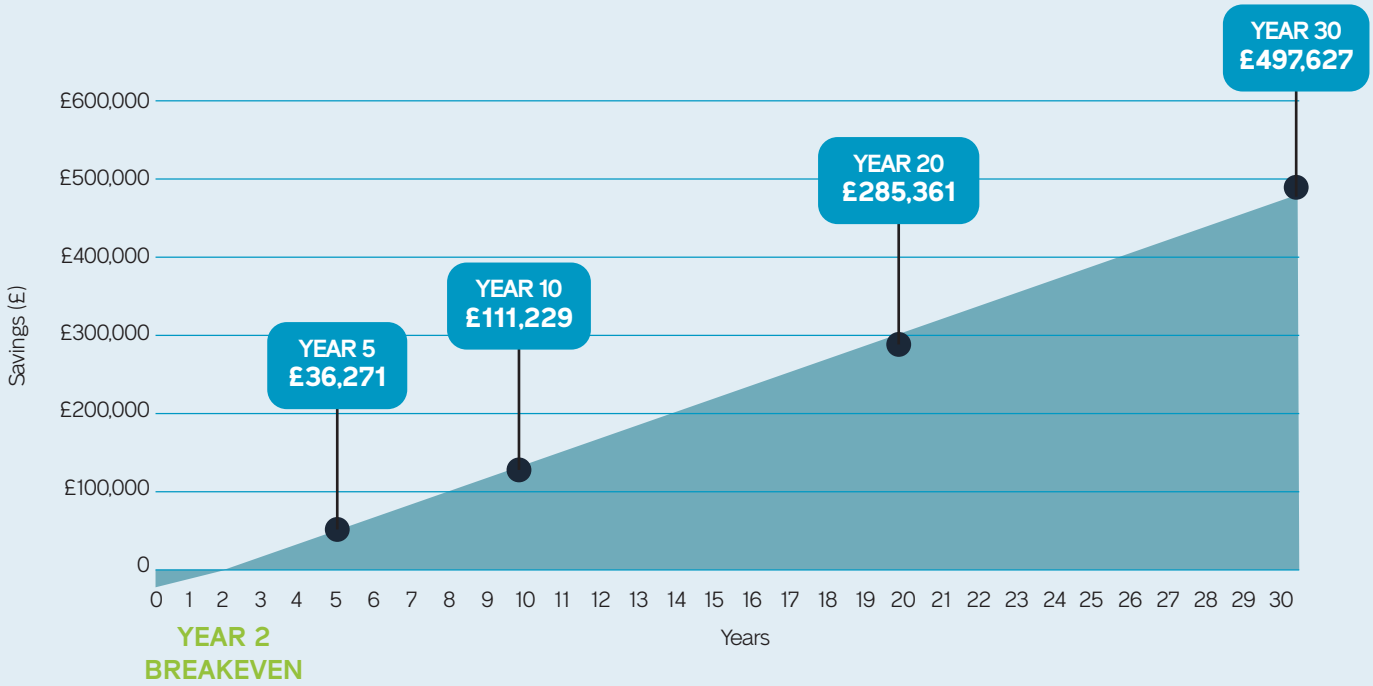
Wilson Power Solutions is proud to introduce another state-of-the-art sustainable solution to the UK market. We present our all-new product line, the most efficient transformer in the UK, Wilson e4 Ultimate Low Loss Amorphous® Transformer. A breakthrough in the distribution transformer technology – giving you the best return on investment combined with the lowest carbon and energy waste.

Being a favourite for cutting-edge technology, our amorphous offer has benefited all sectors of the market from universities and hospitals to retail and manufacturing. This has encouraged us to develop and explore further the new generation Wilson e4 Ultimate Low Loss Amorphous® Transformer.

The Wilson e4 Ultimate Low Loss Amorphous® Transformer has been engineered to reduce energy losses to the extent that it not only surpasses the UK Tier 2 regulatory standards but also sets a new benchmark for the standards to come (including Tier 3 & Tier 4). This makes our Wilson e4 transformer, the most energy-efficient solution in Europe.

PAYBACK CALCULATIONS:

ENERGY & CARBON SAVINGS LIKE NEVER BEFORE!



1000kVA Wilson e4 compared to 1970s at 70% load factor and 25p/kWh increased by 2% year on year

WHAT MAKES WILSON e4 ULTIMATE LOW LOSS TRANSFORMER THE MOST EFFICIENT TRANSFORMER IN THE UK

WILSON
e⁴AMORPHOUS
ULTIMATE LOW LOSS

+

- Unparalleled carbon and energy savings combined with favourable **total cost of ownership**
- Up to **£370k** lifetime savings when replacing an existing 1990s transformer
- Advancing **decarbonisation** through non-invasive infrastructure decision

+

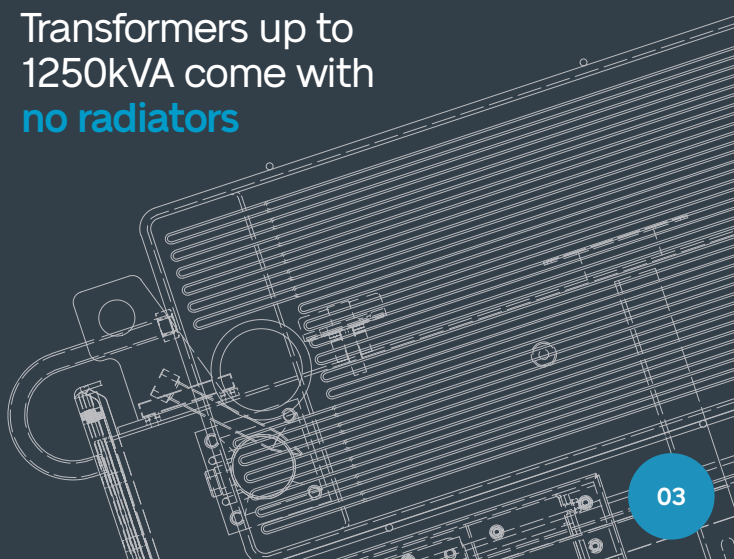
- Meets and **exceeds** Ecodesign Tier 2 (2021) specifications
- The **lowest** combined Load and No-Load Losses in the market
- **27%** more efficiency compared to Ecodesign Tier 2 requirements

+

- Over **2000** amorphous transformer installations across the UK
- **Award-winning** transformer technology
- **15 years** of proven track record and 0 failures

+

- **24-month** industry leading guarantee
- Cost effective 2-in-1 **Voltage Regulation** solution
- Transformers up to 1250kVA come with **no radiators**



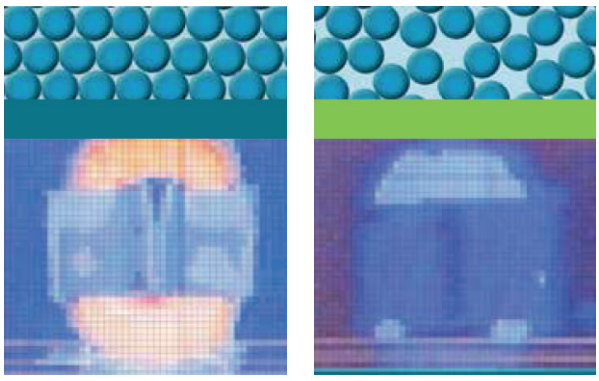
AMORPHOUS METAL TRANSFORMERS EXPLAINED

Even though the first Amorphous Transformer was made in USA in 1982, the Amorphous technology did not evolve at a fast rate until the early 2000s. Amorphous steel bulk manufacturing started in 2004 paving the way to its commercialisation.. Due to its low-loss properties and running cost benefits, manufacturers started investing in building amorphous transformers for better energy and cost-efficiency.

The traditional transformer technology advanced with the advent of carbon steel core. This evolved to silicon steel which was later replaced by Cold Rolled Grain Oriented Silicon Steel (CRGO) consisting of laminations. CRGO core technology is currently the most common composition, but it has reached its full potential making it difficult to further reduce the losses without incurring significantly higher costs.

The Wilson e4 transformer combines amorphous core material with low current density conductors to provide the lowest combined transformer losses Due to their high magnetic susceptibility, low coercivity and high resistance, the losses can be reduced to an average of 69% compared to old 1950s transformers.

Amorphous metals are made of alloys that have a random molecular structure caused by rapid cooling of molten metals that prevents crystallisation and leaves a vitrified structure in the form of thin strips. Due to the scattered molecular order, friction is reduced in the magnetisation and demagnetisations of the core resulting in less heat dissipation which boosts the transformer's overall efficiency.



Infrared (IR) images illustrate significantly lower temperature in an amorphous metal core (right) compared with a traditional silicon steel core (left).

Losses can be reduced to an average of 69% compared to old 1950's transformers.

Comparison of Properties:

Properties	Amorphous metal	CRGO
Density	7.33g/cm^3	7.65g/cm^3
Specific resistance	120 Ωm	45 Ωm
Saturation flux density	1.63 Tesla	2.03 Tesla
Typical core loss (at 50Hz, 1.4 Tesla)	0.15 Watt/kg	0.54 Watt/kg
Thickness	0.025 mm	0.23 mm
Space factor	0.84 cm^2	0.97 cm^2
Brittleness	Higher	Lower
Available form	Ribbon/foil*	Sheet/Roll
Annealing temperature	364°C	810°C
Annealing atmosphere	Inert gas	Inert gas
Specifical annealing requirement	Magnetic field annealing	-

*Standard sizes - 142.2mm, 170.2mm and 213.4mm

ECODESIGN TRANSFORMER REGULATIONS AND BEYOND

Network losses account for 1.5% of the UK's greenhouse gas (GHG) emissions. 25% of these emissions are caused by distribution transformer losses. Due to the inefficiencies of old transformer designs and the level of losses associated with them, Ecodesign regulations were launched to minimise the energy waste of transformers.

Tier 1 Ecodesign requirements came into effect in 2015 for distribution and power transformers placed in the market or put into service within the UK. The regulation specified Load and No-Load loss values for distribution transformers. Tier 2 followed in 2021 with more strict energy loss requirements.

Clause 11 of Ecodesign states:

"To allow an effective implementation of the regulation, National Regulating Authorities are strongly advised to take account of the effect of minimum efficiency requirements on the initial cost of the transformer and to allow for the installation of more efficient transformers than the regulation requires, whenever these are economically justified on a whole life cycle basis, including an adequate evaluation of losses reduction."

Since the early days of the regulation, Wilson Power Solutions aspired to push efficiency even further to provide the market with maximum energy and carbon savings.

Wilson e4 Ultimate Low Loss Amorphous® Transformer not only meets Ecodesign requirements but sets a new benchmark for Tier 3 for the market to catch up on.

NO-LOAD LOSSES

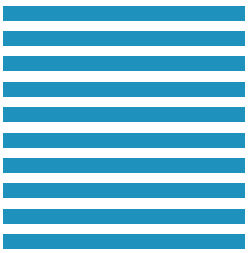
This is the power consumed by the transformer from the moment of energisation regardless of the load and is often dependent on the core material, size of the core and frequency of the power supply. These losses are sometimes referred to as core losses due to the magnetisation and demagnetisation of the transformer core and the magnetic flux circulating it, which develops Eddy Current, Hysteresis and Dielectric losses.

Eddy Current Losses

These are caused by the induced currents of the transformer core due to changing magnetic fields. The resistivity of the core is proportionate to the square of the thickness of its laminations. The strip thickness of Amorphous laminations is 0.025mm (10 times less CRGO) and has a 0.32g/cm^3 lower density compared to conventional CRGO.

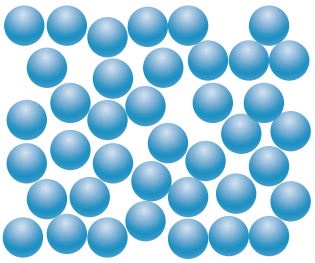
Hysteresis losses

During the magnetisation and demagnetisation of the core, the current flows in alternate directions (forward and backwards). Due to the random molecular structure of Amorphous and the swift switching ability between magnetisation and demagnetisation, there is less friction resulting in less heat.

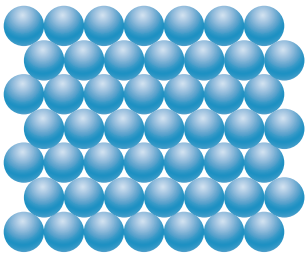


10 sheets of AMT

1 sheet of CRGO



e4 Amorphous Core



CRGO Crystalline Core

LOAD LOSSES

Referred to as winding losses, these occur when transformers are loaded. These losses occur due to the resistance of the transformer windings where energy is dissipated as heat. These losses depend on the current flowing through the transformer windings. It is pertinent to address both, load and no-load losses to improve the efficiency of the transformer.

A journey of excellence in sustainable development and efficiency at the code.

KVA Rating	Pre 2015		Tier 1 (2015) Wilson e1 Ecotrans		Tier 2 (2021) Wilson T2 Ecotrans		2024 Wilson e4 Amorphous	
	Load Losses	No Load Losses	Load Losses	No Load Losses	Load Losses	No Load Losses	Load Losses	No Load Losses
315	5350	600	3900	360	2800	324	1940	215
500	7400	900	5500	510	3900	459	2750	295
800	11000	1150	8400	650	6000	585	4265	425
1000	12500	1350	10500	770	7600	693	5610	460
1250	16000	1575	11000	950	9500	855	6930	570
1500	21000	1700	13140	1125	11285	1015	8630	625
1600	21700	1800	14000	1200	12000	1080	9170	675
2000	24000	2300	18000	1450	15000	1305	11475	815

Transformer loss comparison. All values are given in Watts [W] and refer to full load. Figures correct at date of the first publication, Mar 2024.

REPLACING YOUR OLD TRANSFORMER

Despite durable design capabilities allowing transformers to live much longer than anticipated, existing transformer assets have a significant role to play in improving efficiency across the network. Conventionally, the older the transformer, the more energy waste it produces.

When conducting a life cycle cost analysis associated with replacing old transformers with the new Wilson e4 Ultimate Low loss, it is important to understand that the benefit goes beyond the financial feasibility extending to environmental and carbon reduction and reliability advantages.

Looking at the Life Cycle Assessment (LCA), on average 95% of the carbon emissions happen during the operational and maintenance phase of the transformer. Hence, the energy efficiency of the transformer design is paramount to decarbonisation.

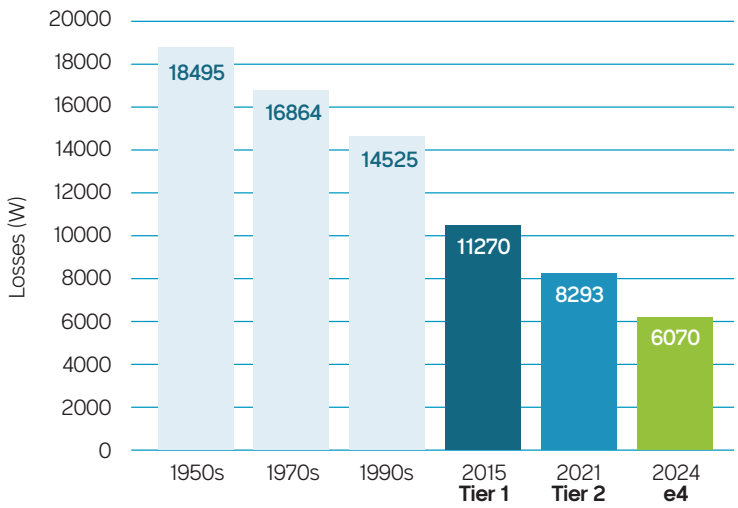
Did you know, the average age of a distribution transformer in the UK is 63 years!

Transformer Losses Comparison

Transformer Construction	Combined Losses (W)	kWh Savings (PA)	£s Savings (PA)	Carbon Savings (PA)(tCO_2e)
1950s Hot Rolled Steel	18495	64100	£16,025	17.6
1970s Early CRGO	16864	52184	£13,046	14.3
1990s Modern Standard CRGO	14525	40492	£10,123	11.1
2015 Ecodesign Tier 1 CRGO	11270	23705	£5,927	6.5
2021 Ecodesign Tier 2 CRGO	8293	10583	£2,646	2.9

Compared against Wilson e4 based on 1000kVA, 70% load factor and 25p/kWh

1000kVA Combined Losses Comparison



Transformer loss comparison - All values are given in Watts [W] and refer to full load.

With an untapped decarbonisation potential, non-invasive infrastructure decision and an excellent cost saving, replacement is a no-brainer!

IEMA Sustainability Impact Awards 2019 WINNER

REGIONAL AWARD WINNER 2021

SOLAR & STORAGE LIVE UK 2022 awards

WILSON e4 AMORPHOUS TRANSFORMER RANGE

Specification

- Three phase 315kVA to 2000kVA
- Oil-filled ONAN or KNAN filled with synthetic ester or natural ester with insulation class up to 36kV
- Primary voltage 11kV as standard with customisation options such as 3.3kV, 6.6kV, 11-6.6kV dual, 33kV
- Secondary voltage 415V as standard with customisation option such as 280V, 400V, 433V, 480V, 690V
- De-energised tap changers as standard and On-load tap changer for Wilson e4+
- Extended De-energised tapping range: -5% to +7.5% (with 2.5% increments)
- No radiators up to 1250kVA
- Bolt-on panel radiator tanks for 1500kVA and above
- Cable box type or open bushings
- BS 2562 and IEC 60076 standards or custom specification

Typical Accessories

- Winding Temperature Indicator (WTI)
- Oil Temperature Indicator (OTI)
- Ashridge 852 digital WTI and OTI protection, control, and monitoring system
- Magnetic Oil Level Gauge (MOG)
- Pressure Relief Device (PRD)
- Pressure Vacuum Gauge (PVG)
- Dehydrating Breather
- Conservator and Buchholz Relay
- Marshalling Box
- Close-coupled MV switchgear and LV cabinets/ feeder pillars
- Bund for environmental risks

Our Amorphous Transformers are powering these market sectors

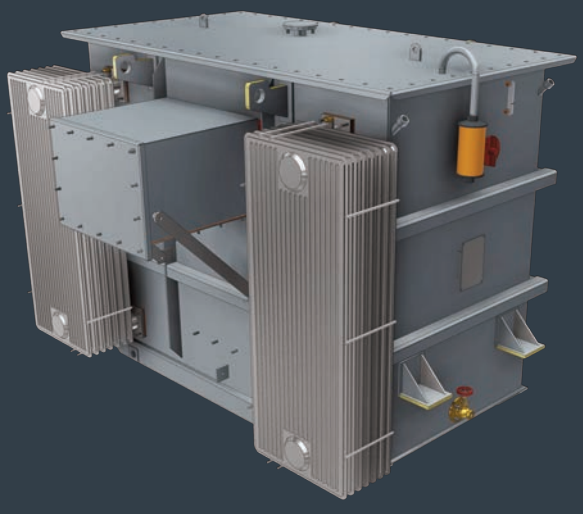
INDUSTRIAL	SUPERMARKETS	EDUCATION
390	257	236

HEALTHCARE	FOOD & BEVERAGE	EV
151	82	79

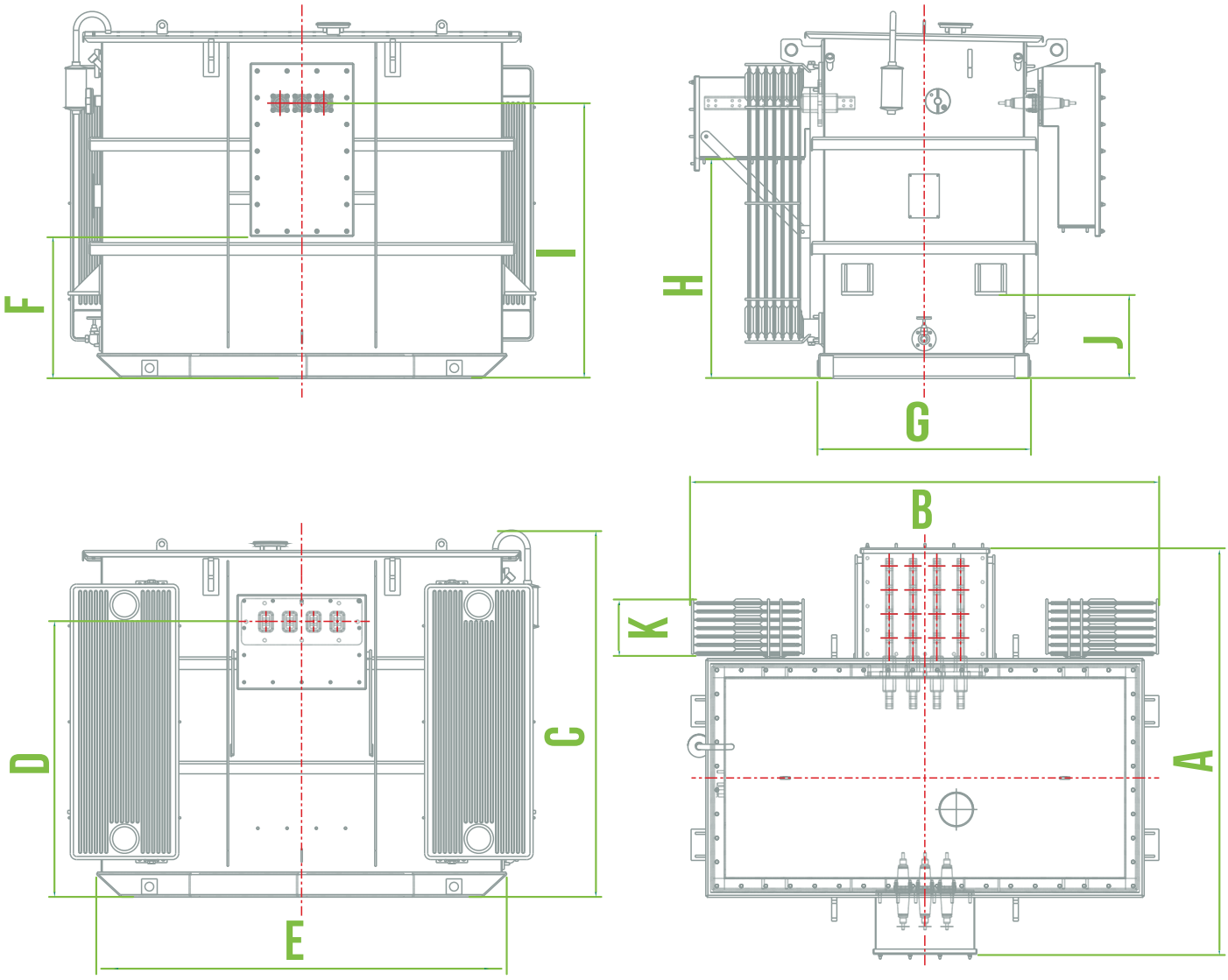
Other major sectors include ports, MOD, retail, water, solar PV, wind and biomass.

Electrical Characteristics

SL.NO	Rating (KVA)	kV/V	HV LI/PF	LV LI/PF	Z	THD%	KG
1	315	11/415	75/28	-/3	4.75	<5%	2900
2	500	11/415	75/28	-/3	4.75	<5%	3370
3	800	11/415	75/28	-/3	4.75	<5%	4380
4	1000	11/415	75/28	-/3	4.75	<5%	4550
5	1250	11/415	75/28	-/3	5	<5%	5450
6	1500	11/415	75/28	-/3	5.5	<5%	5930
7	1600	11/415	75/28	-/3	5.5	<5%	6080
8	2000	11/415	75/28	-/3	6	<5%	7400



DIMENSIONS AND TYPICAL ASSEMBLY



Representative general assembly shown for 2000kVA Wilson e4 transformer

Transformers with the rating of 315, 500, 800, 1000 and 1250 kVA come with no radiators!

Dimensions (mm)

Sl.NO	Rating (KVA)	Tank type	A	B	C	D	E	F	G	H	I	J	K
1	315	1	1387	1835	1750	1320	1555	720	755	1050	1320	400	-
2	500	1	1387	1835	1750	1320	1555	720	755	1050	1320	400	-
3	800	1	1605	2010	1750	1320	1730	720	860	1050	1320	400	-
4	1000	1	1605	2010	1750	1320	1730	720	860	1050	1320	400	-
5	1250	1	1750	2250	1750	1320	1970	720	890	1050	1320	400	-
6	1500	2	1750	2250	1750	1320	1970	720	890	1050	1320	400	150
7	1600	2	1750	2250	1750	1320	1970	720	890	1050	1320	400	150
8	2000	2	2005	2292	1750	1320	2010	720	1030	1050	1320	400	270

Dimensions shown are subject to a ±10% tolerance

VOLTAGE REGULATION

WILSON
e4+AMORPHOUS
ULTIMATE LOW LOSS

Voltage regulation is crucial on sites to avoid failures and to reduce unnecessary energy losses. Numerous sites in the UK are supplied with higher than optimal voltage which increases energy wastage significantly.

Two areas of energy savings:

1 GUARANTEED SAVINGS THROUGH REDUCED TRANSFORMER LOSSES

The all-new Wilson e4 Ultimate Low Loss Transformer has been designed at a reduced secondary voltage (415V instead of 433V) and comes with one of two voltage management options. This reduces the site's footprint and avoids further system losses while removing the need for additional plant maintenance.

2 SUBSTANTIAL SAVINGS THROUGH VOLTAGE REGULATION

Guideline values for no load voltage

HV Voltage	Tap setting	LV voltage
11,000(V)	7.5% (1)	386V
11,000(V)	5% (2)	395V
11,000(V)	2.5% (3)	405V
11,000(V)	0 (4)	415V
11,000(V)	-2.5% (5)	426V
11,000(V)	-5% (6)	437V

De-Energised Tap Changer (DETC):

Wilson e4 Ultimate Low Loss Amorphous Transformers are equipped as a standard with De-Energised Tap Changers to allow easy adjustment to LV site voltage without the need of costly additional equipment. This is ideal for sites where there is no need to frequently change the voltage tapping as it requires de-energising the transformer. The DETC switch can be turned manually to adjust the secondary voltage. In addition to the industry standard 5 tap options, Wilson e4 features an extended tapping setting of +7.5%.

On Load Tap Changer (OLTC):

To provide a more responsive option, we are delighted to introduce Wilson e4+ Ultimate Low Loss Amorphous Transformer with a vacuum On-Load Tap Changer which allows voltage regulation automatically without the need to de-energise the transformer. This OLTC has the capability of a 3 second gap between operations and can do up to 500,000 operations which allows it to outlive the transformer. Being the smallest high-speed tap changes in the world, the OLTC has a wide regulation range making it suitable for applications with irregular supply patterns including random peaks and troughs.

Benefits of the OLTC:

- Large regulating range with up to 17 tap positions
- Three-second intervals
- Up to 500,000 tap change operations
- Vacuum compact solution
- Voltage regulation without power disruption
- Rapid response to voltage sags and swells
- Ability to customise the regulatory range and step voltage
- Further energy savings

CASE STUDIES

DOVECOTE PARK

Dovecote industrial farm was experiencing inrush currents from motor loads which created short-duration voltage dips on the LV network. Due to the proximity of a wind turbine, voltage fluctuations got worse during peak demand periods when the turbine was not generating power.

Wilson Amorphous Transformer was used with OLTC as a replacement to their old transformer and was configured with a 9-position tap setting. This was to target the phase-to-phase voltage of around 406 V (U) with an automatic adjustment of 1.5% increment to reduce swings irrespective of the site demand and power generation into the grid. This not only reduced the grid swing by 38 V(U) but also reduced the average by 10V(U), mitigating the undervoltage events.

FINANCIAL SAVINGS
£12,316
per annum*

CARBON SAVINGS
14.4tCO_2e
per annum

TRANSFORMER LOW LOSS SAVINGS
38,533kWh
per annum

VOLTAGE REGULATION SAVINGS
29,893kWh
per annum

(*based on electricity cost of £0.18/kWh)

ASDA

While being committed to sustainability principles and environmental performance, ASDA has been aiming to reduce energy use in their existing stores by 33% and in new stores by 45%. Due to the significant reduction in losses that it offers, Wilson Amorphous Transformer with OLTC was installed in Dunfermline site where ASDA was able to cut their electricity usage by 7% and saved an excess of £25,000 per annum with a payback period under 4 years.

FINANCIAL SAVINGS
£25,000
per annum*

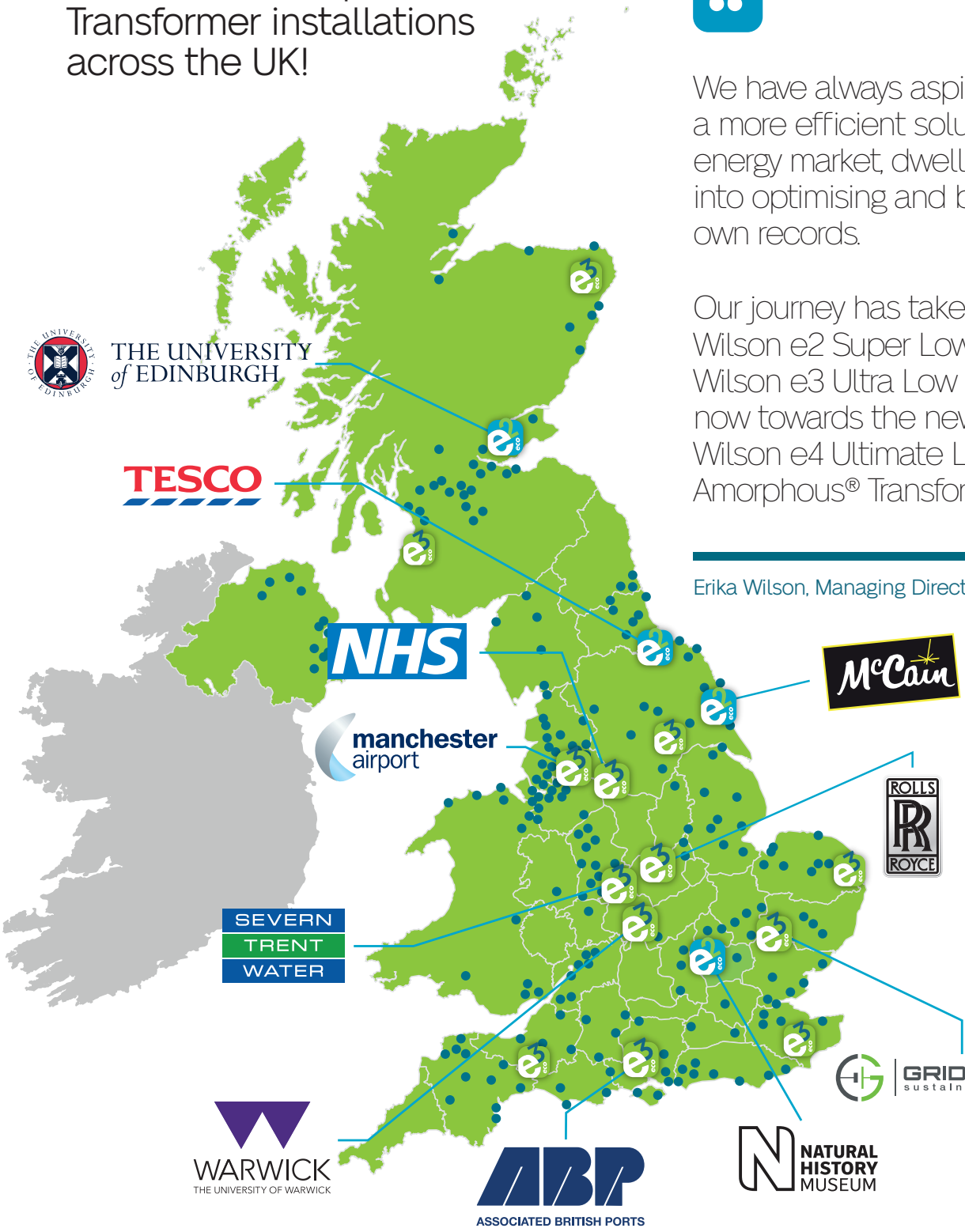
CARBON SAVINGS
59.1tCO_2e
per annum

LOW LOSS & VOLTAGE SAVINGS
285,000kWh
per annum

(*based on electricity cost of £0.09/kWh)

DECARBONISING THE GRID, ONE TRANSFORMER AT A TIME

Over 2000 Amorphous Transformer installations across the UK!



Some of the highlighted transformer installations across the UK.

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We have always aspired to offer a more efficient solution to the energy market, dwelling further into optimising and beating our own records.

Our journey has taken us from Wilson e2 Super Low Loss to Wilson e3 Ultra Low Loss and now towards the new generation Wilson e4 Ultimate Low Loss Amorphous® Transformers.

Erika Wilson, Managing Director

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WILSON POWER SOLUTIONS