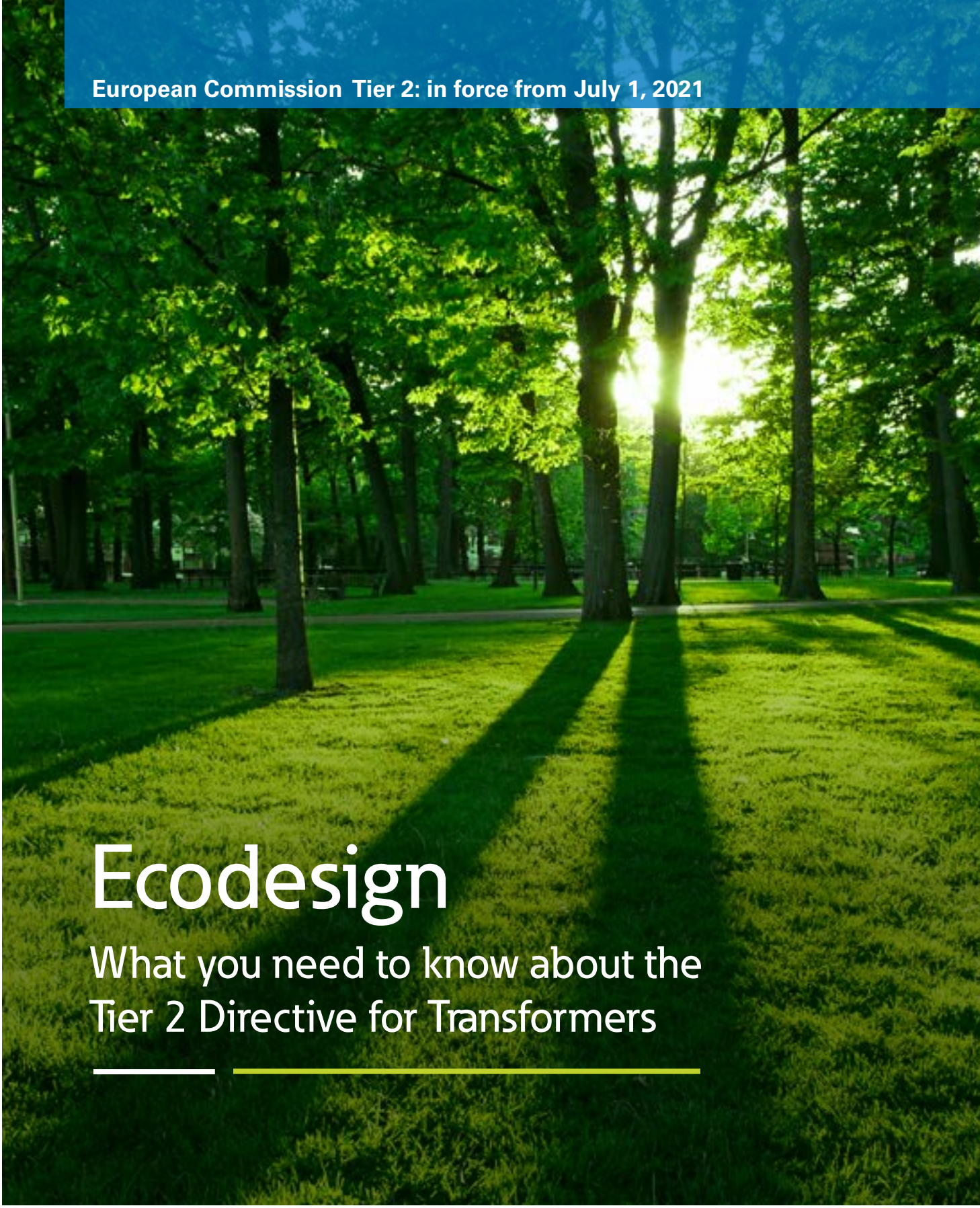
European Commission Tier 2: in force from July 1, 2021



Ecodesign

What you need to know about the Tier 2 Directive for Transformers

Powering Business Worldwide

This document will help you understand

- Tier 2's scope – and when the changes are happening
- The new directive's background and its benefits
- Technical requirements by transformer type
- What Eaton has done to be Tier 2-ready
- Next steps

Tier 2: what, why and when

What is the Directive's full name?

Commission Regulation (EU) 2019/1783 of October 1, 2019 amending Regulation (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers.

What does it apply to?

Small, medium and large power transformers

Why is it in place?

The Directive creates a framework for the setting of Ecodesign requirements to make energy-related products more efficient by decreasing energy losses and reducing environmental pollution.

From when does it take effect?

The regulation first came in on July 1, 2015 with its second stage, Tier 2, taking effect from July 1, 2021.

Tier 1 – July 1st, 2015 ≥ **Tier 2 – July 1st, 2021**

What are Tier 2's key points?

- The Directive applies to all EU members plus the UK, Iceland, Lichtenstein and Norway.
- Its goals include improved energy efficiency and greater environmental sustainability consequently reducing CO_2 emissions.
- The regulation sets out Ecodesign requirements for placing on the market or putting into service power transformers with a minimum power rating of 5 kVA used in 50 Hz electricity transmission and distribution networks or for industrial applications.
- Manufacturers, importers and authorised representatives are responsible for ensuring Tier 2 product conformity.

Are there any exceptions?

The Directive mainly does not apply to transformers specifically designed and used for the following applications:

- Instrument transformers
- Furnace transformers
- Starting transformers
- Testing transformers
- Welding transformers
- Earthing or grounding transformers
- Transformers with low-voltage windings specifically designed for use with rectifiers to provide a DC supply
- Transformers designed for offshore applications and floating offshore applications
- Transformers designed for emergency installations
- Transformers and auto-transformers specifically designed for railway feeding systems
- Transformers for use in arc welding equipment or resistance welding equipment
- Transformers designed for explosion-proof and underground mining applications

Background to the Directive

01 2007: Initiation

The European Commission began developing transform regulations carrying out extensive studies with stakeholders including transformer manufacturers and utilities companies.

02 2014: Publication

The Ecodesign 548/2014 regulation was published in the Official Journal of the European Union – coming into effect on June 11, 2014.

03 2016: Tier 1 implementation

The Tier 1 loss level became mandatory for transformers. The '20/20/20' target was set for 2020 (20% of EU energy should come from renewables, 20% improvement in energy efficiency, 20% cut in greenhouse gas emissions from 1990 levels).

04 2019: Amendment

The amended Regulation (EU) 2019/1783 was published in November. This revised the scope, definitions and requirements of Ecodesign and included an annex with tables showing its detail.

05 2021: Tier 2 implementation

The Directive's second stage comes into force on July 1, 2021 when Tier 2 loss limits become mandatory for small, medium and large power transformers.

Reducing global CO_2 by 3.7m tons

Using more energy-efficient transformers should lead to an estimated annual saving of 16 TWh compared to 2020. This is equivalent to 3.7 million tons of CO_2 being emitted each year – or half of Denmark's total annual electricity consumption (32 TWh).

Directive requirements

For medium power transformers

a) Liquid immersed

Maximum load and no-load losses (in W) for three-phase, liquid immersed, medium power transformers with one Um ≤24kV winding and another of Um ≤1.1kV.

	Tier 1 (July 1, 2015)		Tier 2 (July 1, 2021)	
Rated Power (kVA)	Maximum load losses Pk (W) *	Maximum noload losses Po (W)*	Maximum load losses Pk (W)*	Maximum noload losses Po (W)*
≤25	C_k (900)	A_o (70)	A_k (600)	A_o-10% (63)
50	C_k (1100)	A_o (90)	A_k (750)	A_o-10% (81)
100	C_k (1750)	A_o (145)	A_k (1250)	A_o-10% (130)
160	C_k (2350)	A_o (210)	A_k (1750)	A_o-10% (189)
250	C_k (3250)	A_o (300)	A_k (2350)	A_o-10% (270)
315	C_k (3900)	A_o (360)	A_k (2800)	A_o-10% (324)
400	C_k (4600)	A_o (430)	A_k (3250)	A_o-10% (387)
500	C_k (5500)	A_o (510)	Ak (3900)	A_o-10% (459)
630	C_k (6500)	A_o (600)	A_k (4600)	A_o-10% (540)
800	C_k (8400)	A_o (650)	A_k (6000)	A_o-10% (585)
1000	C_k (10500)	A_o (770)	A_k (7600)	A_o-10% (693)
1250	B_k (11000)	A_o (950)	A_k (9500)	A_o-10% (855)
1600	B_k(14000)	A_o (1200)	A_k (12000)	A_o-10% (1080)
2000	B_k (18000)	A_o (1450)	A_k (15000)	A_o-10% (1305)
2500	B_k (22000)	A_o (1750)	A_k (18500)	A_o-10% (1575)
3150	B_k (27500)	A_o (2200)	A_k (23000)	A_o-10% (1980)

b) Pole-mounted – 25 to 400 kVA

	Tier 1 (July 1, 2015)		Tier 2 (July 1, 2021)	
Rated Power (kVA)	Maximum load losses (in W)*	Maximum no-load losses (in W)*	Maximum load losses (in W)*	Maximum no-load losses (in W)*
25	C_k (900)	A_o (70)	B_k (725)	A_o (70)
50	C_k (1100)	A_o (90)	B_k (875)	A_o (90)
100	C_k (1750)	A_o (145)	B_k (1475)	A_o (145)
160	C_k+32% (3102)	C_o (300)	C_k+32% (3102)	C_o-10% (270)
200	C_k (2750)	C_o (356)	B_k (2333)	B_o (310)
250	C_k (3250)	C_o (425)	B_k (2750)	B_o (360)
315	C_k (3900)	C_o (520)	B_k (3250)	B_o (440)

c) Dry type

	Tier 1 (July 1, 2015)		Tier 2 (July 1, 2021)	
Rated Power (kVA)	Maximum load losses Pk (W)*	Maximum no-load losses Po (W)*	Maximum load losses Pk (W)*	Maximum no-load losses Po (W)*
≤50	B_k (1700)	A_o (200)	A_k (1500)	A_o-10% (180)
100	B_k (2050)	A_o (280)	A_k (1800)	A_o-10% (252)
160	B_k (2900)	A_o (400)	A_k (2600)	A_o-10% (360)
250	B_k (3800)	A_o (520)	A_k (3400)	A_o-10% (468)
400	B_k (5500)	A_o (750)	A_k (4500)	A_o-10% (675)
630	B_k (7600)	A_o (1100)	A_k (7100)	A_o-10% (990)
800	A_k (8000)	A_o (1300)	A_k (8000)	A_o-10% (1170)
1000	A_k (9000)	A_o (1550)	A_k (9000)	A_o-10% (1395)
1250	A_k (11000)	A_o (1800)	A_k (11000)	A_o-10% (1620)
1600	A_k (13000)	A_o (2200)	A_k (13000)	A_o-10% (1980)
2000	A_k (16000)	A_o (2600)	A_k (16000)	A_o-10% (2340)
2500	A_k (19000)	A_o (3100)	A_k (19000)	A_o-10% (2790)
3150	A_k (22000)	A_o (3800)	A_k (22000)	A_o-10% (3420)

d) Correction factors to be applied to the load and no-load losses indicated in Tables 1 to 3 for medium power transformers with special combinations of winding voltages (for rated power ≤ 3150 kVA)

Maximum permissible losses to be increased by factors as indicated tables below, based on individual product type.

Special combination of voltages in one winding		Load losses (Pk)	No load losses (Po)
For both liquid immersed (Table a) and dry type (Table c)		No correction	No correction
Primary highest voltage for equipment Um ≤ 24kV	Secondary highest voltage for equipment Um > 3,6kV		
For liquid immersed (Table a)		10%	15%
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um ≤ 3,6kV		
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um > 3,6kV	10%	15%
For dry type (Table c)		10%	15%
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um ≤ 3,6kV		
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um > 3,6kV	15%	20%

e) Correction factors to be applied to the load and no-load losses indicated in Tables 1-4 for medium power transformers with dual voltage in one or both windings differing more than 10% and rated power ≤ 3150 kVA.

Type of dual voltage	Reference voltage for the application of correction factors	Load losses (Pk)(*)	No load losses (Po)(*)
Dual voltage on one winding with reduced power output on the lower low-voltage winding AND maximum available power on the lower voltage of the low-voltage winding limited to 0,85 of the rated power assigned to the low-voltage winding at its higher voltage	Losses shall be calculated based on the higher voltage of the low-voltage winding	No correction	No correction
Dual voltage on one winding with reduced power output on the lower high-voltage winding AND maximum available power on the lower voltage of the high-voltage winding limited to 0,85 of the rated power assigned to the high-voltage winding at its higher voltage	Losses shall be calculated based on the higher voltage of the high-voltage winding	No correction	No correction
Dual voltage on one winding AND full rated power available on both windings, i.e., the full nominal power is available regardless of the combination of voltages.	The losses shall be calculated based on the higher voltage of the dual voltage winding	10%	15%
Dual voltage on both windings AND rated power available on all combinations of windings, i.e., both voltages on one winding are fully rated in combination with one of the voltages on the other winding	The losses shall be calculted based on the higher voltages of both dual voltage windings	20%	20%

For large power transformers

a) Liquid immersed

Rated Power (MVA)	Tier 1 (July 1, 2015) Minimum Peak Efficiency Index (%)	Tier 2 (July 1, 2021) Minimum Peak Efficiency Index (%)
≤ 0.025	97.742	98.251
0.05	98.584	98.891
0.1	98.867	99.093
0.16	99.012	99.191
0.25	99.112	99.283
0.315	99.154	99.320
0.4	99.209	99.369
0.5	99.247	99.398
0.63	99.295	99.437
0.8	99.343	99.473
1	99.360	99.484
1.25	99.418	99.487
1.6	99.424	99.494
2	99.426	99.502
2.5	99.441	99.514
3.15	99.444	99.518
4	99.465	99.532
5	99.483	99.548
6.3	99.510	99.571
8	99.535	99.593
10	99.560	99.615
12.5	99.588	99.640
16	99.615	99.663
20	99.639	99.684
25	99.657	99.700
31.5	99.671	99.712
40	99.684	99.724
50	99.696	99.734
63	99.709	99.745
80	99.723	99.758
100	99.737	99.770
125	99.737	99.780
160	99.737	99.790
≥200	99.737	99.797

Minimum PEI values for MVA ratings that fall in between the ratings given in this table shall be calculated by linear interpolation.

b) Dry type with Um ≤ 36 kV

Rated Power (MVA)	Tier 1 (July 1, 2015) Minimum Peak Efficiency Index (%)	Tier 2 (July 1, 2021) Minimum Peak Efficiency Index (%)
3.15<Sr≤4	99.348	99.382
5	99.354	99.387
6.3	99.356	99.389
8	99.357	99.390
≥10	99.357	99.390

Minimum PEI values for MVA ratings that fall in between the ratings given in this table shall be calculated by linear interpolation.

c) Dry type with Um > 36 kV

Rated Power (MVA)	Tier 1 (July 1, 2015) Minimum Peak Efficiency Index (%)	Tier 2 (July 1, 2021) Minimum Peak Efficiency Index (%)
≤ 0.05	96.174	96.590
0.1	97.514	97.790
0.16	97.792	98.016
0.25	98.155	98.345
0.4	98.334	98.570
0.63	98.494	98.619
0.8	98.677	98.745
1	98.775	98.837
1.25	98.832	98.892
1.6	98.903	98.960
2	98.942	98.996
2.5	98.933	99.045
3.15	99.048	99.097
4	99.158	99.225
5	99.200	99.265
6.3	99.242	99.303
8	99.298	99.356
10	99.330	99.385
12.5	99.370	99.422
16	99.416	99.464
20	99.468	99.513
25	99.521	99.564
31.5	99.551	99.592
40	99.567	99.607
50	99.585	99.623
≥63	99.590	99.626

Declaring conformity and CE marking

Manufacturers must present a signed EC Declaration of Conformity document stating:

- Their name and address
- Model identifier – an alphanumeric code to distinguish different models from the same manufacturer
- Rated power, load loss and no-load loss
- The weight of all main power transformer components
- The value of the Peak Efficiency Index for MPT (where applicable) and LPT

CE marking

- All transformers must bear a CE marking as a sign of compliance with the Directive

CE

What July 1, 2021 means in practice

The rules regarding the manufacturing and delivery of Tier 2 transformers are subject to the guidance set out in the **Blue Guide** which covers European Union product regulation from 2016. The guide defines two stages which clarify how the Tier 2 implementation date affects transformer contracts and deliveries:

Placing on the market (only relevant for manufacturers and importers)

- A product is placed on the market when it is made available for the first time in the Union market
- After July 1, 2021, manufacturers and importers will no longer have the right to deliver a Tier 1 transformer, even if the contract has been signed before this date. Any transformer placed on the market thereafter must conform to Tier 2 requirements

Making available (only relevant 'distributor to distributor' or 'distributor to user')

- Products made available on the market must comply with the applicable European Union harmonization legislation at the moment they are placed on the market
- After July 1, 2021, a distributor can deliver and put Tier 1 transformers in service as long as they have been placed on the market before that date

Is Eaton Tier 2-ready?

Building on its Tier 1 experience, Eaton is very well prepared for the coming changes – already designing and manufacturing transformers that don't just meet but exceed Tier 2-compliance requirements:

- Guaranteeing low loss levels by using proven design methodologies and highly efficient core steel grades
- Delivering lower loss levels than those required by Tier 2
- Widening choice through even more energy-efficient transformers

Next steps

The Regulation will be reviewed to see if technological progress will make further amendment necessary. Any such changes will be presented to the Consultation Forum by July 1, 2023, addressing:

- The extent to which Tier 2 requirements have been cost-effective
- Whether it is appropriate to introduce stricter Tier 3 requirements
- The possibility of utilising the PEI calculation for losses in absolute values for MPT
- The possibility of adopting a technology-neutral approach to the minimum requirements set out for liquid immersed, dry type and, possibly, electronic transformers

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Ulusoy Elektrik Imalat Taahhut
ve Ticaret A.S.
Anadolu OSB, Malikoy Mah. Dumlupinar
Cad. No: 8 Temelli 06909
Ankara, TURKEY
Tel: +90 312 502 06 63
ulusoy.info@eaton.com
www.eaton.com

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