TECHNOLOGY FACTSHEET

Power Transformer MV-LV

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Sector	Infrastructure
ETS / Non-ETS	Non-ETS
Type of Technology	
Description	MV (medium voltage)/LV (low voltage) transformers reduce/increase voltage between MV and LV networks. A transformer is an electrical machine that, based on the principles of electromagnetic induction, transfers energy from one electrical circuit to another, without changing the frequency. During the transfer, the voltage and current change. A transformer increases or decreases the alternating current when necessary. Also, transformers are used for voltage control and load balancing (star-delta configuration). MV/LV transformers are used to convert electrical energy of higher voltage, usually up to 36 kV, to a lower voltage, usually 250 up to 435V [7]. Application of these transformers is mainly within suburban areas, public supply authorities and industrial customers. Closer to consumers, the voltage reduction is in place since operating at lower voltages requires less clearance, and it is inherently safer.
TRL level 2020	TRL 9 Commercial technology. In the European Union, there are around 4 million transformers [3].

TECHNICAL DIMENSIONS

	Functional Unit		Value and Range								
Capacity	MVA		-								
			Min		-			*Max*			
Potential			Current			2030			2050		
			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Market share		%	-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*

Capacity utlization factor	1.00
Full-load running hours per year	
Unit of Activity	
Technical lifetime (years)	25-40
Progress ratio	
Hourly profile	
Explanation	Power transformers are rated according to their maximum continuos current (A) and nominal voltage (V) output, wich result in the nominal “apparent power” output (VA).

COSTS

Year of Euro	2015

	Euro per Functional Unit	Current			2030			2050		
Investment costs	€ / MVA	28,700.00			28,700.00			28,700.00		
		17,070.00	–	28,700.00	17,070.00	–	28,700.00	17,070.00	–	28,700.00
Other costs per year	€ / MVA	-			-			-		
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Fixed operational costs per year (excl. fuel costs)	€ / MVA	146.40			132.00			106.00		
		87.00	–	146.40	78.50	–	132.00	63.00	–	106.00
Variable costs per year	€ /	-			-			-		
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Costs explanation	Fixed O&M costs are 0,51%. It is assumed that these costs are reduced by 1% per year due to efficiency improvements [3]. A small MV/LV transformer rated capacity is usually lower than 2,500 kVA. A medium MV/LV transformer ranges from 2,500 to 6300 kVA while large MV/LV transformers can reach up to 30 MVA. [7]									

ENERGY IN- AND OUTPUTS

	Energy carrier	Unit	Current			2030			2050		
Energy carriers (per unit of main output)	*Main output:* Electricity	PJ	-0.98			-0.98			-0.98		
			-0.98	–	-0.98	-0.98	–	-0.98	-0.98	–	-0.98
	Electricity	PJ	1.00			1.00			1.00		
			1.00	–	1.00	1.00	–	1.00	1.00	–	1.00
	Propane	PJ	-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
		PJ	-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*

Energy in- and Outputs explanation	A transformer can suffer some core losses from iron and losses from copper in the windings. The former occurs due to the alternating flux in the core of the transformer. These losses can be further divided into eddy current and hysteresis losses. Losses from copper occur due to the loss of heat during the circulation of current around the copper windings, resulting in loss of electrical energy. These are the most significant losses in the operation of an electrical transformer. The intensity of the energy loss determines the efficiency of an electric transformer, represented in terms of energy loss between the primary and secondary windings. HV/MV transformers are generally operated at full load, so their design is such that copper losses are minimal. Nevertheless, an MV/LV transformer is not operated at full load for most of the time. Therefore, it is designed such that losses are minimal at 60-70% of the full load [6].

MATERIAL FLOWS (OPTIONAL)

	Material	Unit	Current			2030			2050		
Material flows			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Material flows explanation											

EMISSIONS (Non-fuel/energy-related emissions or emissions reductions (e.g. CCS)

	Substance	Unit	Current			2030			2050		
Emissions			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
			-			-			-		
			Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Emissions explanation											

OTHER

Parameter	Unit	Current			2030			2050		
		-			-			-		
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
		-			-			-		
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
		-			-			-		
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
		-			-			-		
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Explanation										

REFERENCES AND SOURCES

1	CE DELFT (2017). Net voor de Toekomst.
2	Original equipment manufacturer cost data.
3	IEA (2014). ETSAP. Electricity Transmission and Distribution.
4	Energinet (2017). Technology Data – Energy transport.
5	ENTSOE (2019).Technologies for Transmission System. Technical Final version after public consultation and ACER opinion.
6	Siemens. Power engineering guide.