TECHNOLOGY FACTSHEET

HIGH VOLTAGE NETWORK

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Sector	Infrastructure
ETS / Non-ETS	Non-ETS
Type of Technology	Network
Description	This factsheet describes overhead high voltage alternate current (HVAC) lines as a part of the high voltage network. These networks transmit large blocks of electricity over long distances. Long-distance transmission is possible due to the high voltage at which HVAC lines operate, usually ranging from 110KV to 400kV. Electricity in high voltage networks goes from power plants to substations close to end-consumers [4]. Power transformers step-up/down voltages between different areas of the transmission network, producers and distribution networks. HVAC overhead lines typically transport electricity in the transmission network. Only in Europe, there are over 474 thousand kilometres of HVAC lines [10]. Underground cables also carry electricity at high voltages. Nevertheless, the initial cost of the underground transmission system is higher compared to the overhead lines since it requires digging and trenching. HVAC lines also interconnect different areas or countries, increasing the security of supply and improving the reliability of the electricity system. Europe counts with more than 390 cross-frontier lines [10].
TRL level 2020	TRL 9
	Commercial technology.

TECHNICAL DIMENSIONS

	Functional Unit	Value and Range		
Capacity	km		-	
		Min	-	*Max*

		Unit	Current			2030			2050		
Potential				-			-			-	
			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)	50.00
Progress ratio	
Hourly profile	
Explanation	The ageing of the existing infrastructure is making it obsolete, and higher penetration of intermittent generation is causing more congestion on HVAC lines. The IEA estimates that between 2012 and 2035, the global total required transmission and distribution investment will be of around 5.5 trillion Euros. Non-OECD countries require more new capacity to expand their high voltage network. Investments in these countries make up to 60% of the global required transmission and distribution investment [4]. For the OECD region, most of the transmission and distribution investment goes to refurbishing and replacing existing infrastructure rather than building new assets.

COSTS

Year of Euro	2015

	Euro per Functional Unit	Current			2030			2050		
Investment costs	mln. € / km		1.06			1.06			1.06	
		0.58	–	5.00	0.58	–	5.00	0.58	–	5.00
Other costs per year	mln. € / km		-			-			-	
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Fixed operational costs per year (excl. fuel costs)	mln. € / km		-			-			-	
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*
Variable costs per year	mln. € /		-			-			-	
		Min	–	*Max*	*Min*	–	*Max*	*Min*	–	*Max*

Costs explanation	Only Alternate Current (AC) cables are taken into account for this factsheet. The nominal voltage of the network is the biggest cost driver. In this case a 380-400 kV, 2 circuit overhead line was taken into consideration. The costs include: engineering and comissioning, installation, materials and manufacturing. The variation for 380-400kV HVAC line was not defined by terrain difficulty or rating [1]. A typical thermal rating for a 380 kV line is 1450MVA [5].

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	
			-0.99	–	-0.98	-0.99	–	-0.98	-0.99	–	-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	At a higher voltage, the power loss due to resistance is reduced. Electricity losses are lower in HVDC than in HVAC over longer distances. For an HVAC line, losses are around 7% per 1,000 km [4]. In the Netherlands, the annual losses in transmission & distribution are about 4.7% [7], from which 2% are due to transmission [8]. Losses depend on each system and its operation. Developments of advanced cables with lower losses and higher capacity capabilities can support new installations. These new cables are expected to reduce transmission losses.

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

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