TECHNOLOGY FACTSHEET

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NICKLE CADMIUM (NiCd) BATTERY FOR POWER APPLICATIONS

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Sector	Electricity generation
ETS / Non-ETS	Non-ETS
Type of Technology	Storage
Description	Nickle Cadmium (NiCd) batteries store electricity through a reversible chemical reaction. The basic components are a container, electrodes, and an electrolyte. By loading the battery, the electricity is transformed into chemical energy, while during discharge, electrochemical reactions occur at the two electrodes generating a flow of electrons through an external circuit (DNV KEMA, 2013). The NiCd battery is a mature technology (>100 years) (Chen et al., 2009), however there has been limited commercial success at utility-scale (Luo et al., 2015). Projects can reach up to 40 MW capacity and typically have discharge times of less than an hour (Chen et al., 2009). The main drawbacks are high costs, toxicity of the materials, and performance degradation due to memory effect (Luo et al., 2015).
TRL level 2020	TRL 9
	NiCd batteries are a commercial technology (DNV KEMA 2013, Luo et al. 2015). One example is a NiCd facility operating as spinning reserve in Golden Valley, Alaska (Chen et al., 2009). However, there has been limited success with NiCd projects and it is therefore considered unlikely that NiCd batteries will be heavily used for future large-scale electricity storage (Luo et al., 2015).

TECHNICAL DIMENSIONS

	Functional Unit		Value and Range								
Capacity	kW		20,000								
			1			-			40,000		
Potential	Global	GWe	Current			2030			2050		
			N/A			-			-		
			-	–	-	Min	–	Max	Min	–	Max
Market share	Global utility scale electricity storage	%	0.02			-			-		
			0.02	–	0.02	Min	–	Max	Min	–	Max
Capacity utlization factor	Specify here										
Full-load running hours per year											
Unit of Activity	PJ/year										
Technical lifetime (years)	5-20 years, 2,000-2,500 cycles (Chen et al., 2009)										
Progress ratio	N/A										
Hourly profile	No										
Explanation	kW is used as functional unit because the amount of power a battery can deliver for short periods of time is more relevant for power applications than the amount of energy that can be stored in the battery. The typical capacity of a single cell is a few kW. Individual cells can be linked to reach a total capacity of up to 40 MW. The 40 MW example given by Chen et al. (2009) consists of 4 battery strings, each of 3440 cells (ca. 3 kW per cell). The potential for all battery types is high as there are no significant space or resource constraints, instead demand for storage and costs are usually determining factors when it comes to potential installed capacity. As of 2015, Ni-Cd batteries have 0.02% of the utility storage market share, which is dominated by pumped hydro at 99% market share (IRENA, 2015).										

COSTS

	Euro per Functional Unit	Current			2030			2050		
Year of Euro	2015									
Investment costs	€ / kW	800			-			-		
		400	–	1,200	Min	–	Max	Min	–	Max
Other costs per year	€ / kW	-			-			-		
		Min	–	Max	Min	–	Max	Min	–	Max
Fixed operational costs per year (excl. fuel costs)	€ / kW	18			-			-		
		Min	–	Max	Min	–	Max	Min	–	Max
Variable costs per year	€ / MWh	N/A			-			-		
		-	–	-	Min	–	Max	Min	–	Max
Costs explanation	There is a significant level of uncertainty about the investment costs due to limited data available in literature.									

ENERGY IN- AND OUTPUTS

	Energy carrier	Unit	Current			2030			2050		
Energy carriers (per unit of main output)	*Main output:* Electricity	PJ	-1.00			-			-		
			-1.00	–	-1.00	Min	–	Max	Min	–	Max
	Electricity	PJ	1.40			-			-		
			1.20	–	1.67	Min	–	Max	Min	–	Max
		PJ	-			-			-		
			Min	–	Max	Min	–	Max	Min	–	Max
		PJ	-			-			-		
			Min	–	Max	Min	–	Max	Min	–	Max
Energy in- and Outputs explanation	The required amount of electricity input for 1 PJ of electricity output is calculated based on roundtrip efficiencies of 60-83% (Luo et al., 2015; Chen et al., 2009).										

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		
Depth of discharge	%	80			-			-		
		Min	–	Max	Min	–	Max	Min	–	Max
Charge time	Hours	2.50			-			-		
		1.00	–	4.00	Min	–	Max	Min	–	Max
Discharge time	Hours	0.19			-			-		
		0.12	–	0.25	Min	–	Max	Min	–	Max
Self discharge	% / month	12.00			-			-		
		1.00	–	18.00	Min	–	Max	Min	–	Max
Explanation	Discharge time estimates range from seconds up to 8 hours (Chen et al., 2009; Luo et al., 2015), however the only examples provided by Chen et al. (2009) and Luo et al. (2015) have a discharge time of up to 15 minutes.									

REFERENCES AND SOURCES

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Chen et al (2009). Progress in electrical energy storage system: A critical review

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