



# Long Duration Energy Storage (LDES): Another solution for flex?

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# Statkraft – in brief



Climate-friendly power generation

**58,5 TWh**

**97%**

Renewable energy

More than

**3 million**

energy related contracts traded per year

**5 700**

employees in 21 countries

**437**

power plants around the world

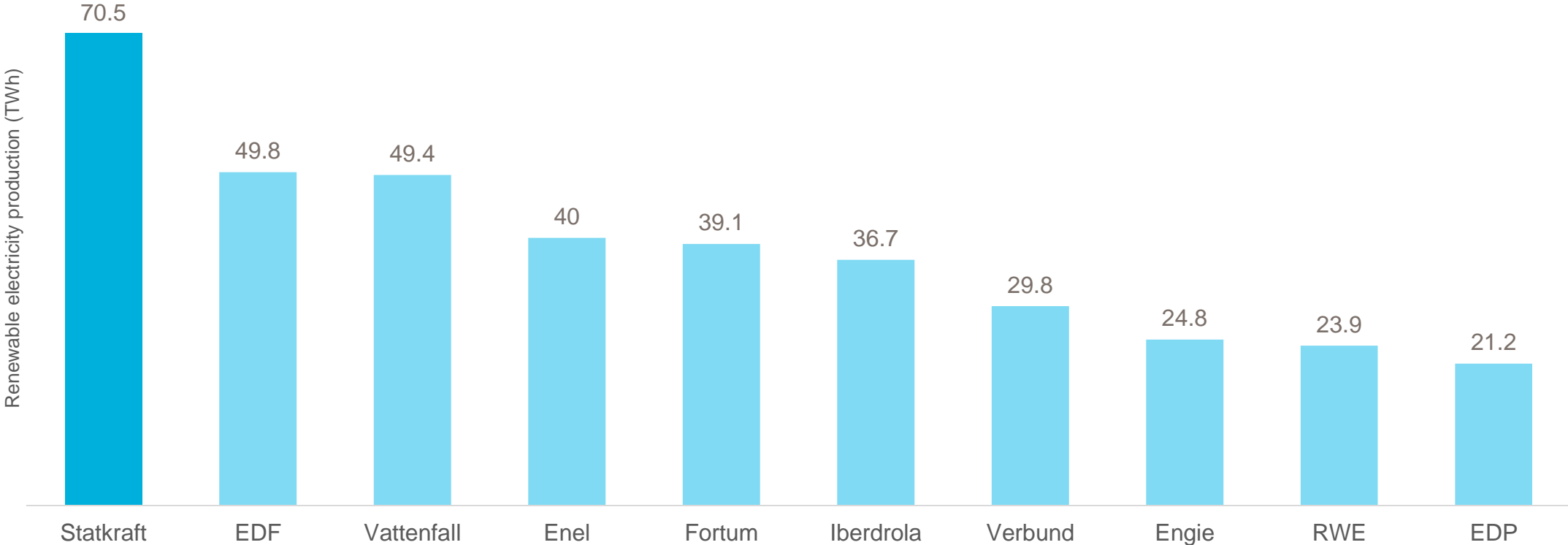


**100%**

Norwegian state-owned

# Europe's largest producer of renewable energy

Top 10 renewable power producers in Europe 2021





# Creating value by enabling a net-zero future

Provide clean flexibility –  
leveraging hydropower



Accelerate solar, wind and  
battery storage



Deliver green market  
solutions to customers



Scale new green energy  
technologies



# Agenda



## Outlook flexibility NL

Fundamentals, targets and how it is going



## Flexibility in other markets

What NL can learn from other markets in EU: long duration incentive schemes

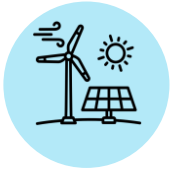


## LDES as possible solution

Electrochemical storage (non-BESS) could provide extra flex solution to grid

## Flexibility in general

# Dutch market fundamentals for flexibility: decarbonized grid by 2035 and increase in e-demand



Demand for flex will increase towards 2030 as more wind and solar will come online, with the target of a decarbonized electricity grid by 2035



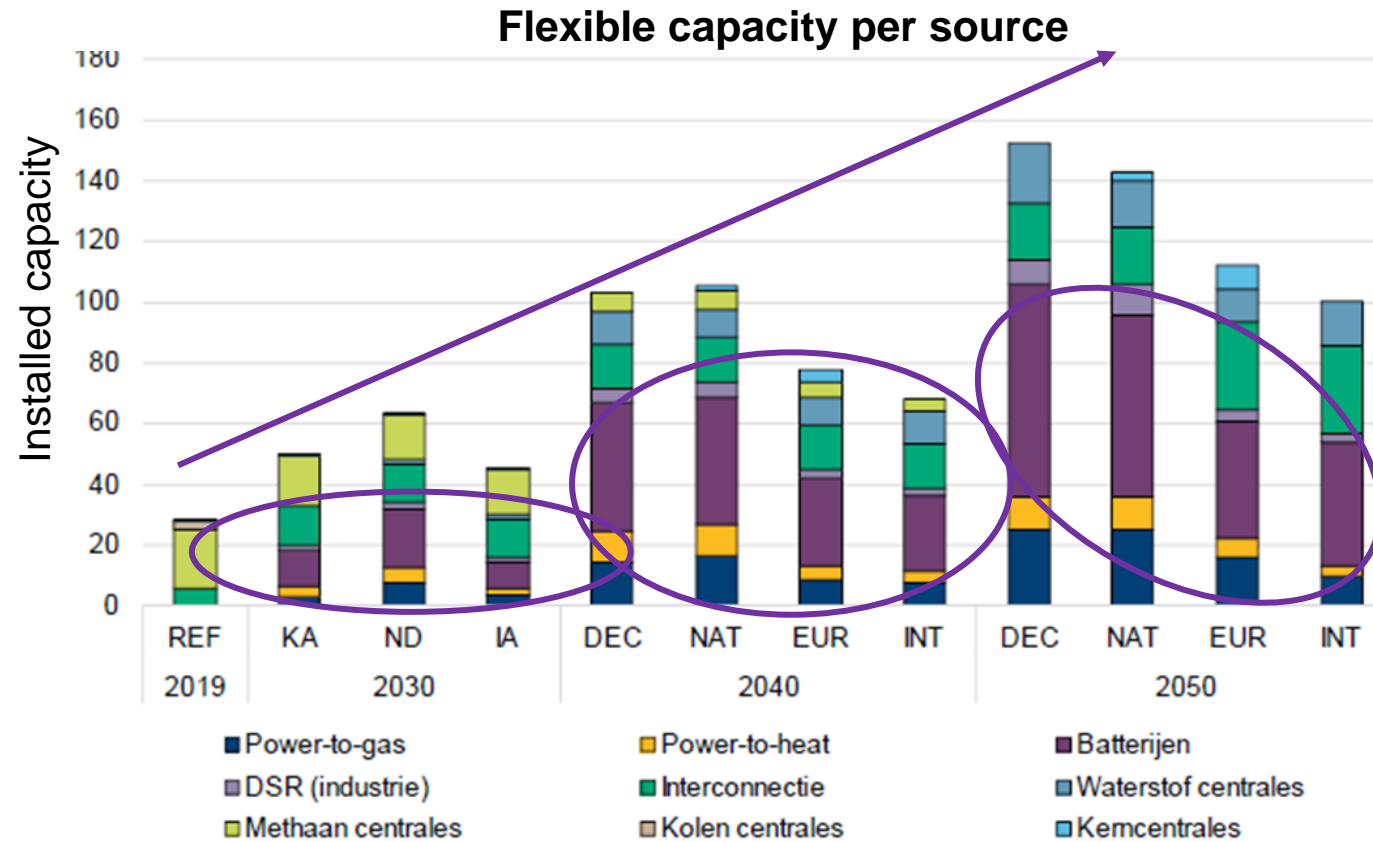
Geographically few alternatives for storage/flex possible: pumped hydro storage not possible



General demand for electricity is set to increase in coming years according to NPE – to double in 2050

## Flexibility outlook NL

# 19 GW batteries needed by 2030, 70 GW by 2050



## Flexibility outlook – other markets

### Frontrunners in flex UK and Ireland setting up auctions for >6hrs storage



- **Govt target is 80% RES-E by 2030**
- Minimum number of thermal units to reduce from 8 to 4 by 2030. Replace with Zero Carbon inertia (sync comps)
- **LDES specific auctions promoting 6+ hours. New system service products.**
- New system service market and system service products
- Increase further interconnection to GB and EU states.



- Target for zero fossil fuel operation of GB Grid for at least 1 hour in 2025.
- Target GB carbon intensity of <12g/kWh by 2030-2035.
- Strong market for ancillary/ system/grid services (paid not mandated)
- 95GW pipeline of BESS storage.
- **Capacity Market incentivises >8h storage & LDES auction expected.**



- **Govt target is to have 65% of produced energy from renewable sources by 2030**
- Addition of 71GW capacity from solar (55GW) and wind (16GW). Storage capacity needs to match with pumped storage and BESS
- **New storage auction mechanism launched in second half of 2024 for longer duration storage**

**NL has similar ambitions when it comes to decarbonizing the grid, however regulatory framework for storage limited for <4hr BESS.**

**Trend: other countries are already setting up incentives for >6hr storage**



## Flexibility in NL – what are >6hr storage solutions?

# LDES complements BESS and hydrogen (hydropower N/A in NL)

### Short duration storage

*Lithium-ion batteries typically the most cost competitive solution under*

**< 6 hours**



**Li-ion batteries** will most likely dominate up to 6 hours storage, but...

- Coupling of capacity and power makes increasing capacity expensive
- Degradation issues makes typical lifetime only 10 – 20 years
- Has issues within safety, sustainability and supply chain

### LDES

**typically the most cost competitive solution for storage duration between**

**6 to 150 hours**

- Can be cost-effective over **different durations**
- Has **low marginal cost of storage** by decoupling of the quantity of electricity stored (capacity) and the charge/discharge speed (power)
- Can be widely **deployable and scalable**
- Has **lower lead times** than T&D upgrades and PSH
- Has **longer life spans** than li-ion

### Very long duration storage

*Fully dispatchable such as gas peakers, pumped hydro and hydrogen most competitive above*

**150 hours <**







**Hydro** will likely be deployed where feasible, but is geographically limited and has long lead time.

**H<sub>2</sub>**

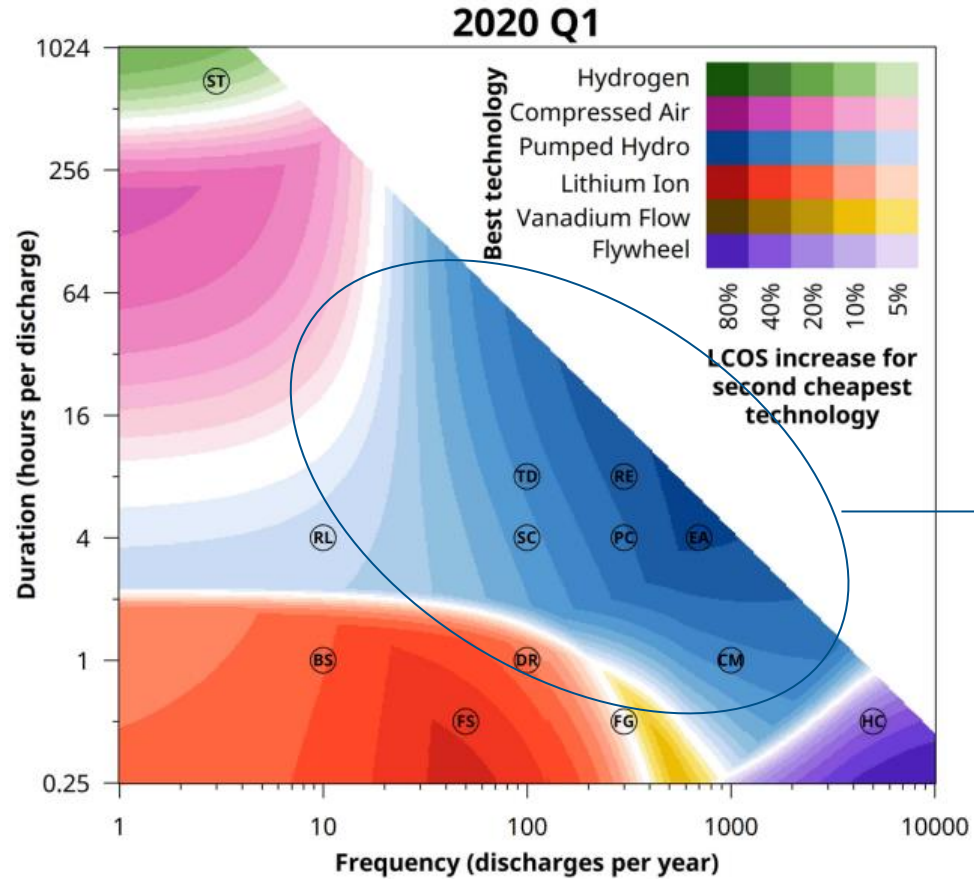
**Hydrogen incl. derivatives** are expected to dominate seasonal storage, but low efficiency from conversion, safety and infrastructure can limit use for medium term storage.

# Different types of LDES spanning 15+ technologies

 <b>Mechanical</b>	 <b>Electrochemical</b>	 <b>Chemical</b>	 <b>Thermal</b>
Compressed air (CAES) Gravity based Liquid CO2 Liquid air (LAES) Novel pumped hydro (NPSH)	Flow batteries Metal air batteries Hybrid flow batteries New chemistries (Sodium-ion, sodium-sulfur, zinc, etc.)	Power-to-hydrogen-to-power Power-to-synthetic-gases-to-power Hydrogen to Ammonia to combustion	<b>Sensible heat</b> (increase the temperature directly) <b>Latent heat</b> (changing the phase of a material, for example from liquid to gas) <b>Thermochemical</b> (reactions with heat exertion)

# Flexibility solutions still emerging

## What are the possibilities for >6hrs electricity storage?



?



**Flexibility will be key challenge in energy system in coming years with >50% of grid renewable energy**

**Which form is still uncertain as PSH is limited and others are still under development, but NL will need all forms of flex other than BESS and H2**

**Solutions: targets for the grid needed and capacity mechanism for solutions for >6hrs storage**





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