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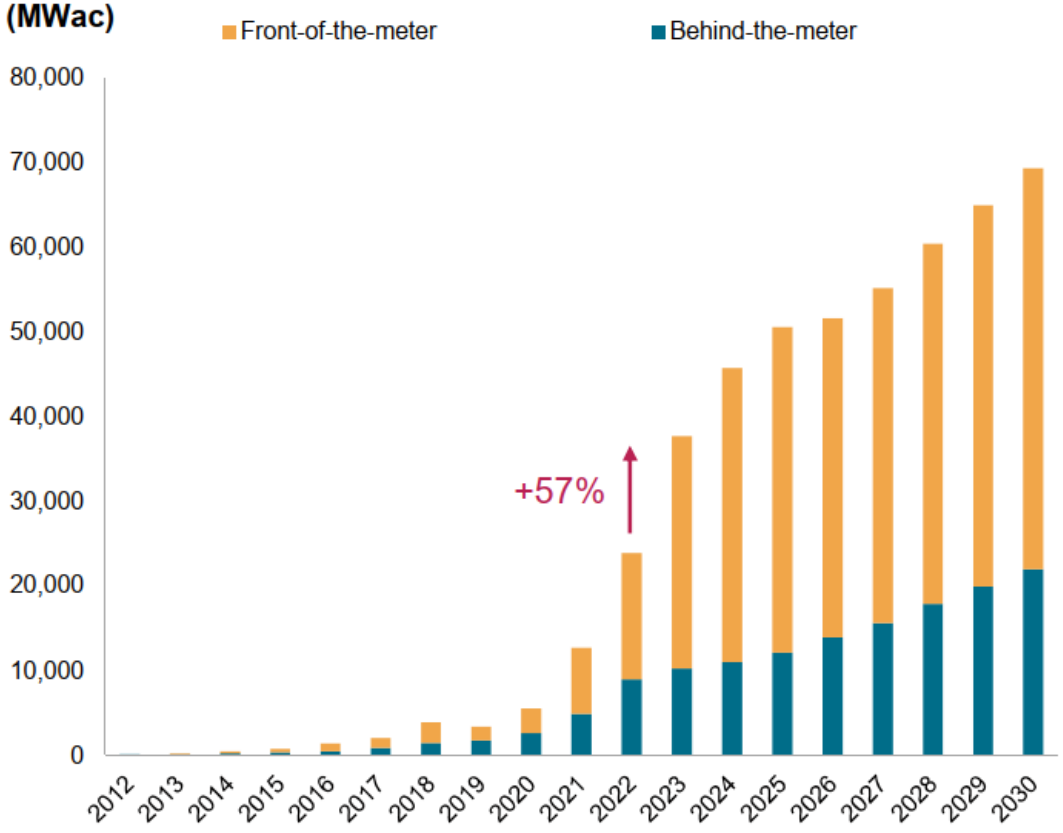
Energy storage and advanced grid functionalities: the missing piece of the 100% renewable puzzle

Higreew workshop

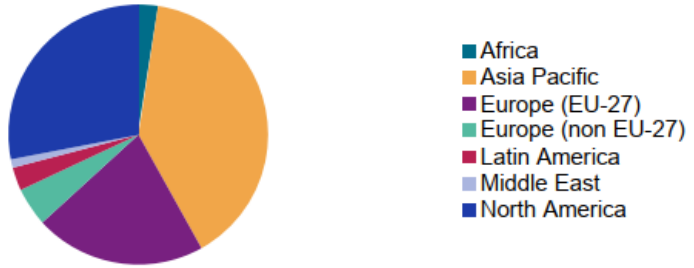
Global storage growth is very strong, with Li-On batteries being the clear leading technology

Global grid-connected energy storage gross capacity additions by siting (MWac)

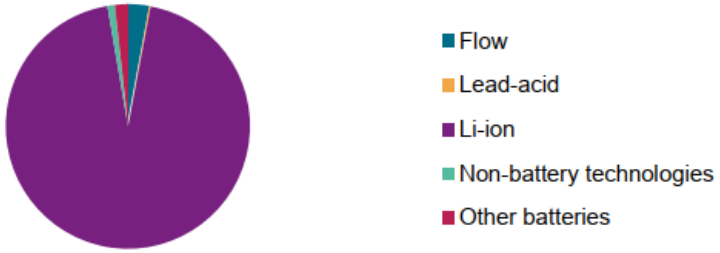


Source: IHS 2023

Gross capacity additions by region (% of MWac, 2015–30)



Gross capacity additions by technology (% of MWh, 2015–30)



Gross capacity additions to reach **40 GW** in 2023

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The massive installation of renewables requires significant amounts of storage to be manageable

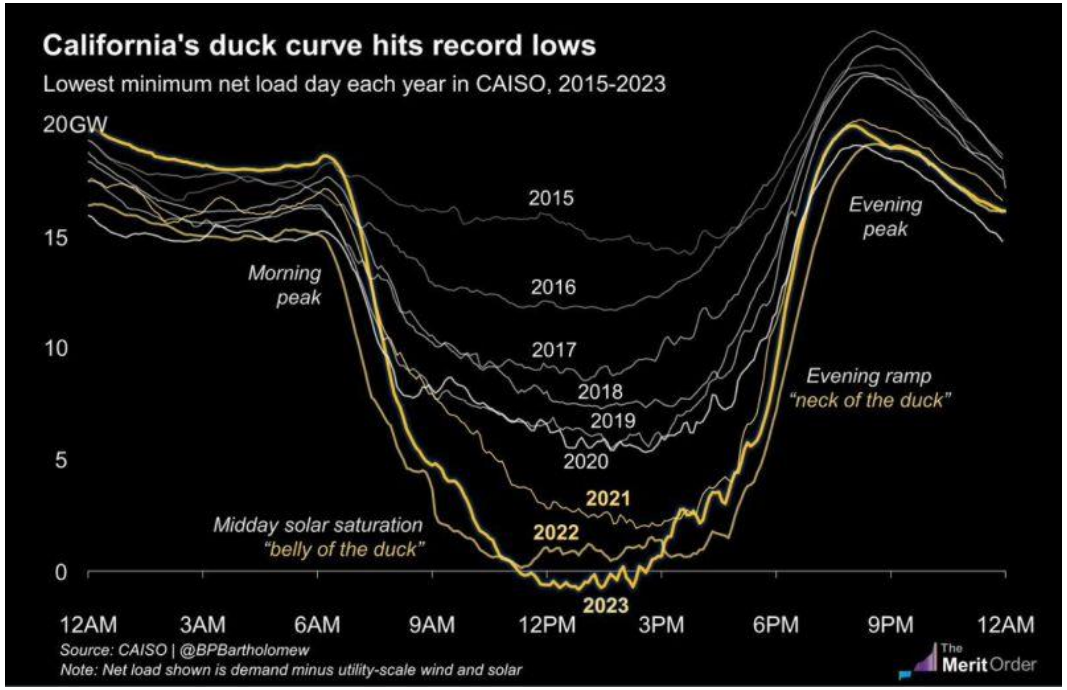
Category	2020	2030	2050
Total electricity generation (TWh)	26 800	37 300	71 200
Renewables			
Installed capacity (GW)	2 990	10 300	26 600
Share in total generation	29%	61%	88%
Share of solar PV and wind in total generation	9%	40%	68%
Carbon capture, utilisation and storage (CCUS) generation (TWh)			
Coal and gas plants equipped with CCUS	4	460	1 330
Bioenergy plants with CCUS	0	130	840
Hydrogen and ammonia			
Average blending in global coal-fired generation (without CCUS)	0%	3%	100%
Average blending in global gas-fired generation (without CCUS)	0%	9%	85%
Unabated fossil fuels			
Share of unabated coal in total electricity generation	35%	8%	0.0%
Share of unabated natural gas in total electricity generation	23%	17%	0.4%
Nuclear power	*2016-20*	*2021-30*	*2031-50*
Average annual capacity additions (GW)	7	17	24
Infrastructure			
Electricity networks investment in USD billion (2019)	260	820	800
Substations capacity (GVA)	55 900	113 000	290 400
Battery storage (GW)	18	590	3 100
Public EV charging (GW)	46	1 780	12 400

Note: GW = gigawatts; GVA = gigavolt amperes.

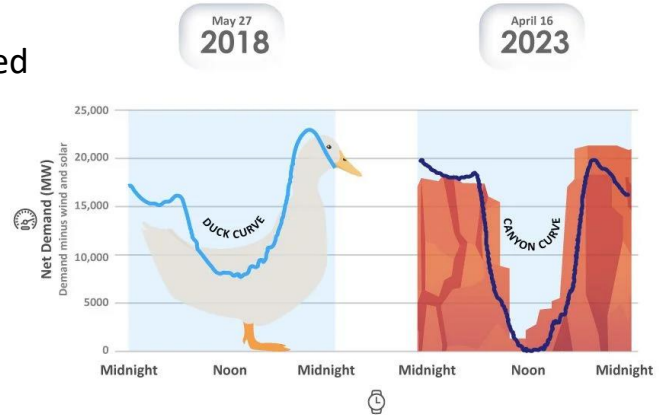
Source: IEA

IEA's Net-zero scenario would need anual avg installation of +100GW of storage until 2050

We are already seeing some problems in the network due to lack of manageability



Energy arbitrage is one of the most needed services and where technologies offering between 4 and 12h of storage (i.e. flow batteries) are required



Renewables must move from being a danger to grid stability to being an active agent in stabilising it.

Utilities + Add to myFT

National Grid electricity blackout report points to failure at wind farm

Initial probe raises the possibility that chaos was caused by new plant

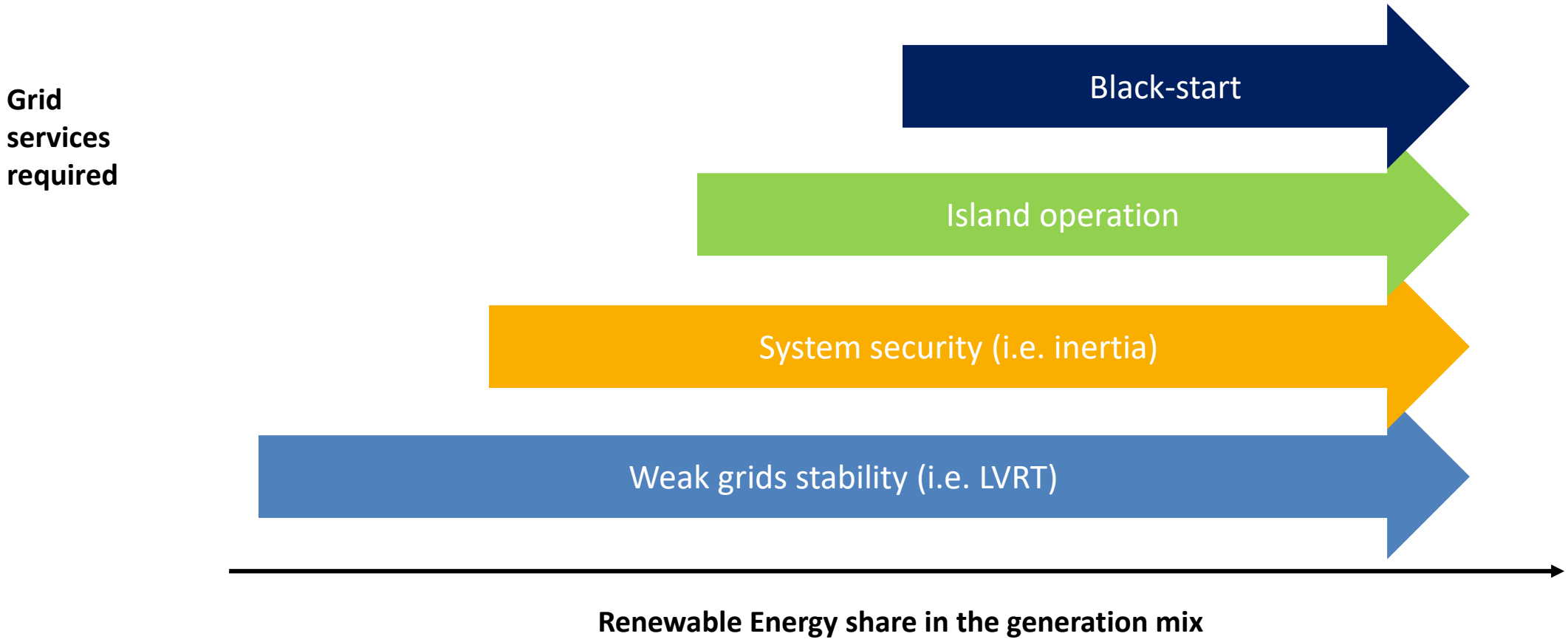
TODAY'S CLIMATE

Texas Officials Blame Renewables for Heatwave Blackout Risk. Experts Say That's Misleading

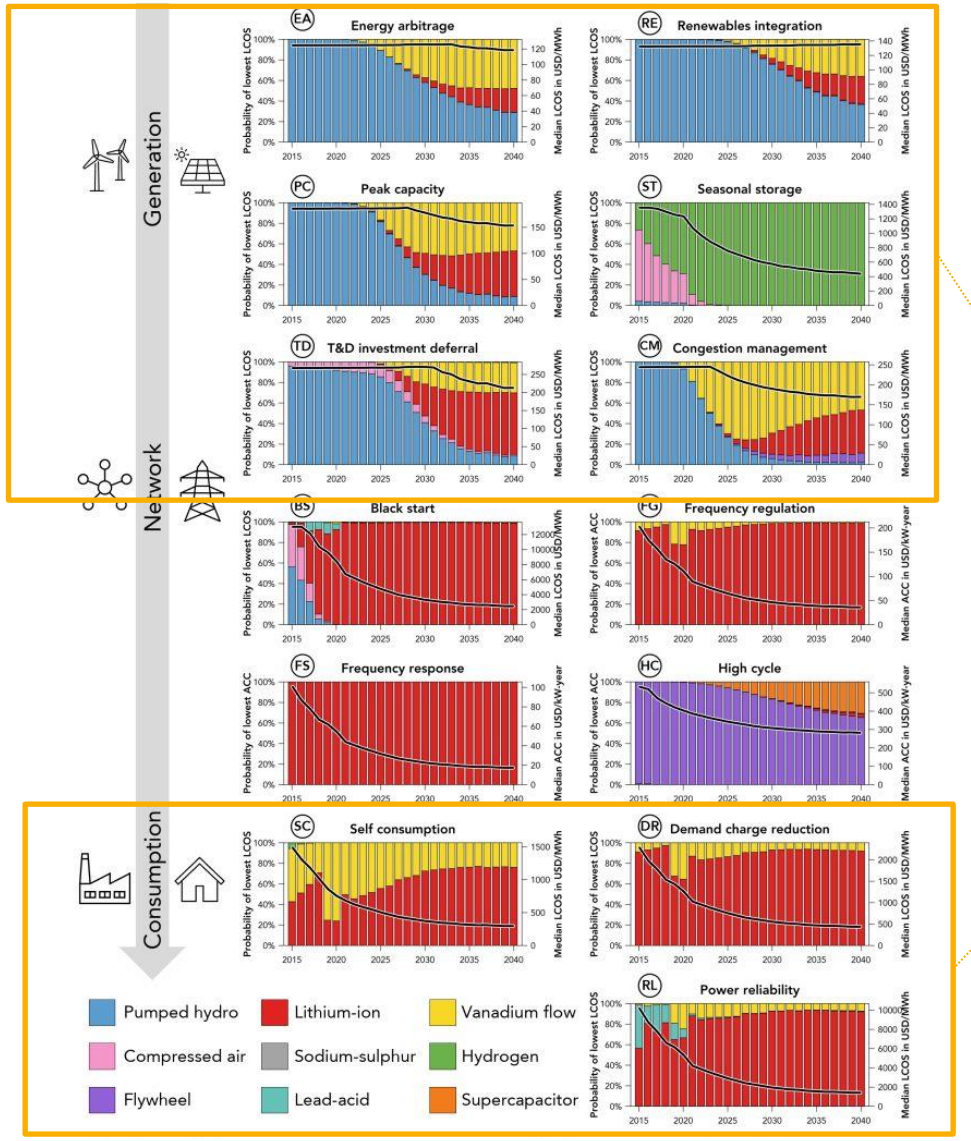
Our twice-a-week dive into the most pressing news related to our rapidly warming world.

By Rachel Rodriguez
July 15, 2022

As conventional synchronous generators are retired, renewable technologies must fill the gap and provide the grid ancillary services needed



Flow batteries are expected to cover a growing share of the required grid ancillary services



Schmidt & Staffell (2023). *Monetizing Energy Storage*. Oxford University Press. www.EnergyStorage.ninja

RFB Will play a key role both in Generation (Utility) and Consumption (Commercial & Industrial markets)

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Grid-forming inverters are the solution for RE to be able to provide advanced grid functionalities

Grid-following inverters		Grid-forming inverters
Inverter control system measures and synchronises to the grid voltage waveform, adjusting power output to 'follow' voltage.		Inverter control system sets an internal voltage waveform reference and adjusts power output to help maintain this voltage.
Require a voltage reference signal from other generators to operate. If the inverter loses this voltage/frequency source it shuts down.		No reliance on external grid voltage to maintain predictable power production so can operate with or without the support of other generators.
Can provide grid support autonomously by adjusting output power in response to local measurements of voltage and frequency. However, response speed is limited and high penetrations of grid following inverters can potentially exacerbate disturbances.		Can inherently help stabilise the grid by adjusting output power instantaneously to maintain local voltage and frequency (i.e. synthetic inertia).
Most inverter systems in the NEM today are grid-following, with some providing grid supporting functionality.		There are many different types and implementations of grid-forming inverter control systems, with trials underway internationally and in Australia to demonstrate their grid supporting capability.

There are already commercial projects with grid-forming functionalities and the most advanced inverters already provide these functionalities

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DIVE BRIEF

California funds 60 MWh tribal long-duration storage project with nation's largest vanadium redox flow battery

Published Nov. 9, 2022

Kavya Balaraman
Senior Reporter

Dive Brief:

- The California Energy Commission has issued a $31 million grant to build a 60 MWh long-duration energy storage system that is expected to provide backup power to the Viejas Tribe of Kumeyaay Indians and bolster the reliability of the energy system statewide.
- The project will include a 10 MWh vanadium redox flow battery from Invinity Energy Systems, expected to be the largest in the country once set up, and a zinc hybrid cathode battery system developed by Eos Energy Enterprises.

Redox Flow Batteries providing advanced grid functionalities are a Reality!!!

Energy Superhub Oxford

Home About

Energy innovation

EDF Renewables has installed the UK's first transmission-connected battery, sited at National Grid's Cowley Substation.

The 'hybrid' Lithium-ion/vanadium flow battery will leverage the strengths of each technology to support more renewables, increase grid resiliency and create a smarter, more flexible system.

Hybrid battery

The battery consists of a 50MW Wartsila lithium-ion battery and a 2MW Invinity Energy Systems vanadium flow battery. A combined energy management system controls and communicates with the Optimisation and Trading Engine (OTE) which will decide the optimum charge/discharge schedule for the battery.

This combination provides synergies for supporting National Grid's frequency response tenders, allowing the vanadium flow (which doesn't degrade) to do much of the heavy lifting in providing a frequency response service together with the lithium-ion, thus reducing degradation on the lithium-ion.


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