Lithium-Ion Batteries: The Incumbent Technology
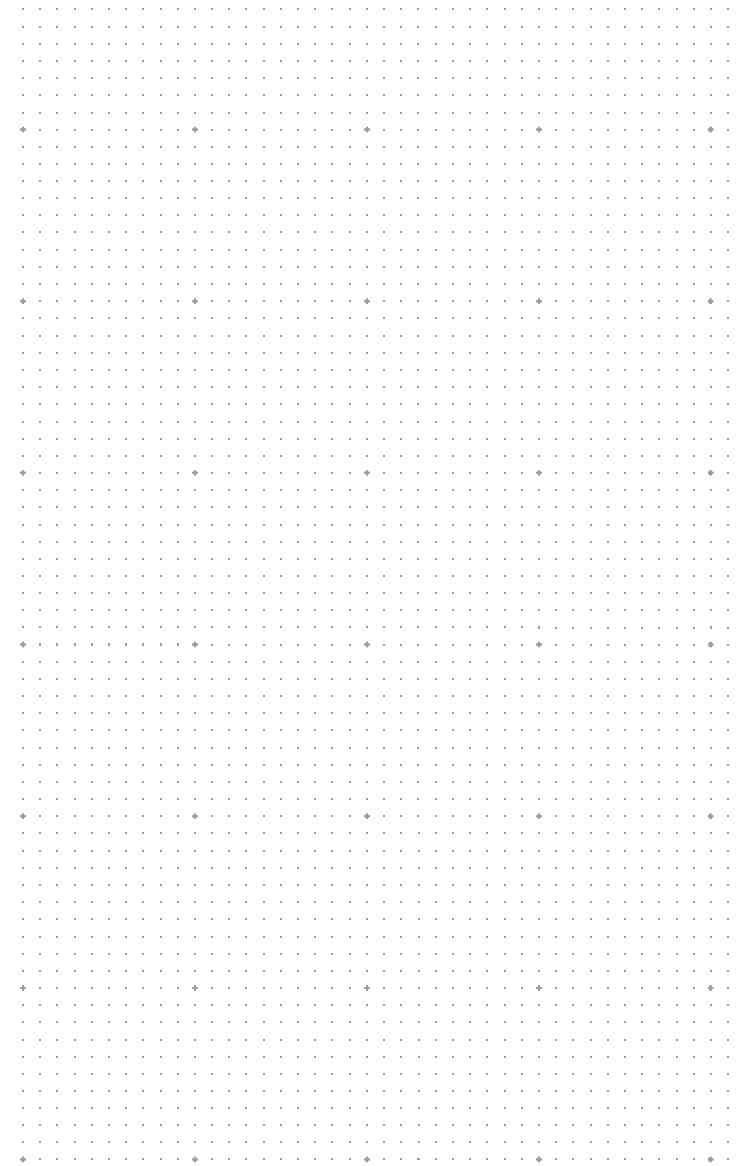
Platform for Coal Regions in Transition

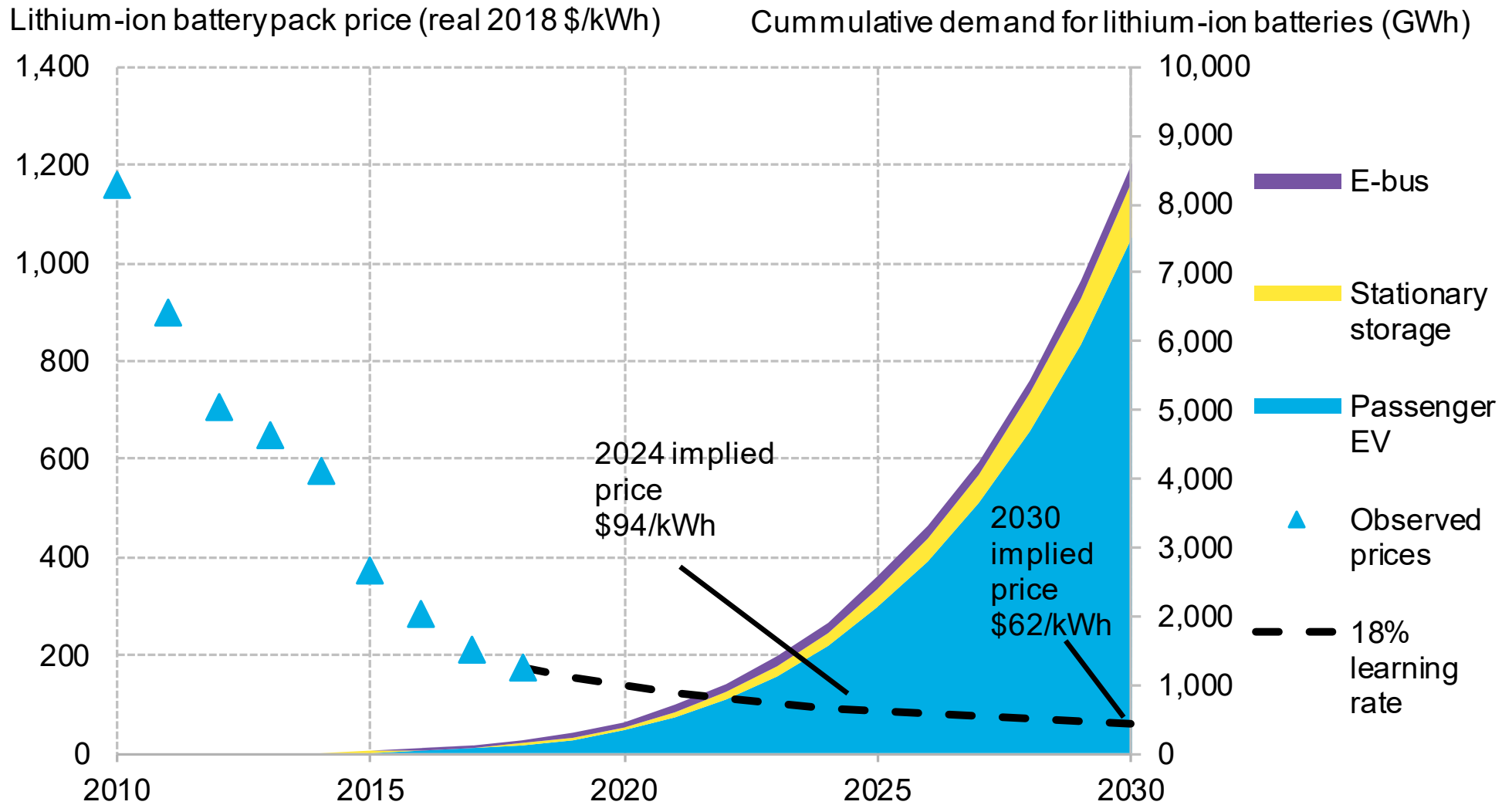James Frith

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Prices

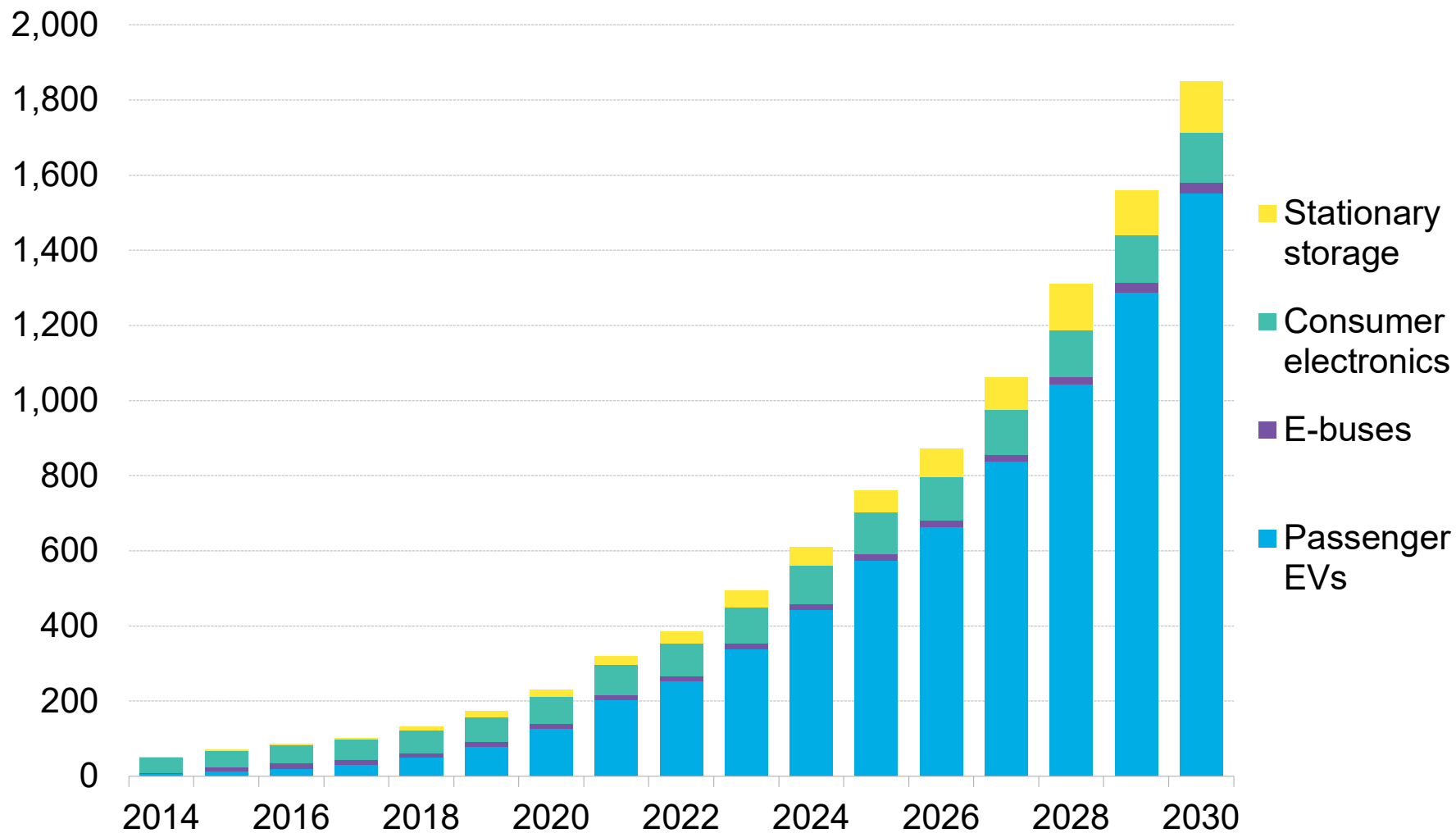**Bloomberg**NEF

Lithium-ion battery prices have fallen 85% since 2010

Lithium-ion battery pack price (real 2018 $/kWh)

Cummulative demand for lithium-ion batteries (GWh)

2024 implied price $94/kWh

2030 implied price $62/kWh

E-bus

Stationary storage

Passenger EV

▲ Observed prices

- - - 18% learning rate

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This is largely thanks to the EV industry

Annual GWh demand

Legend:
- Stationary storage
- Consumer electronics
- E-buses
- Passenger EVs

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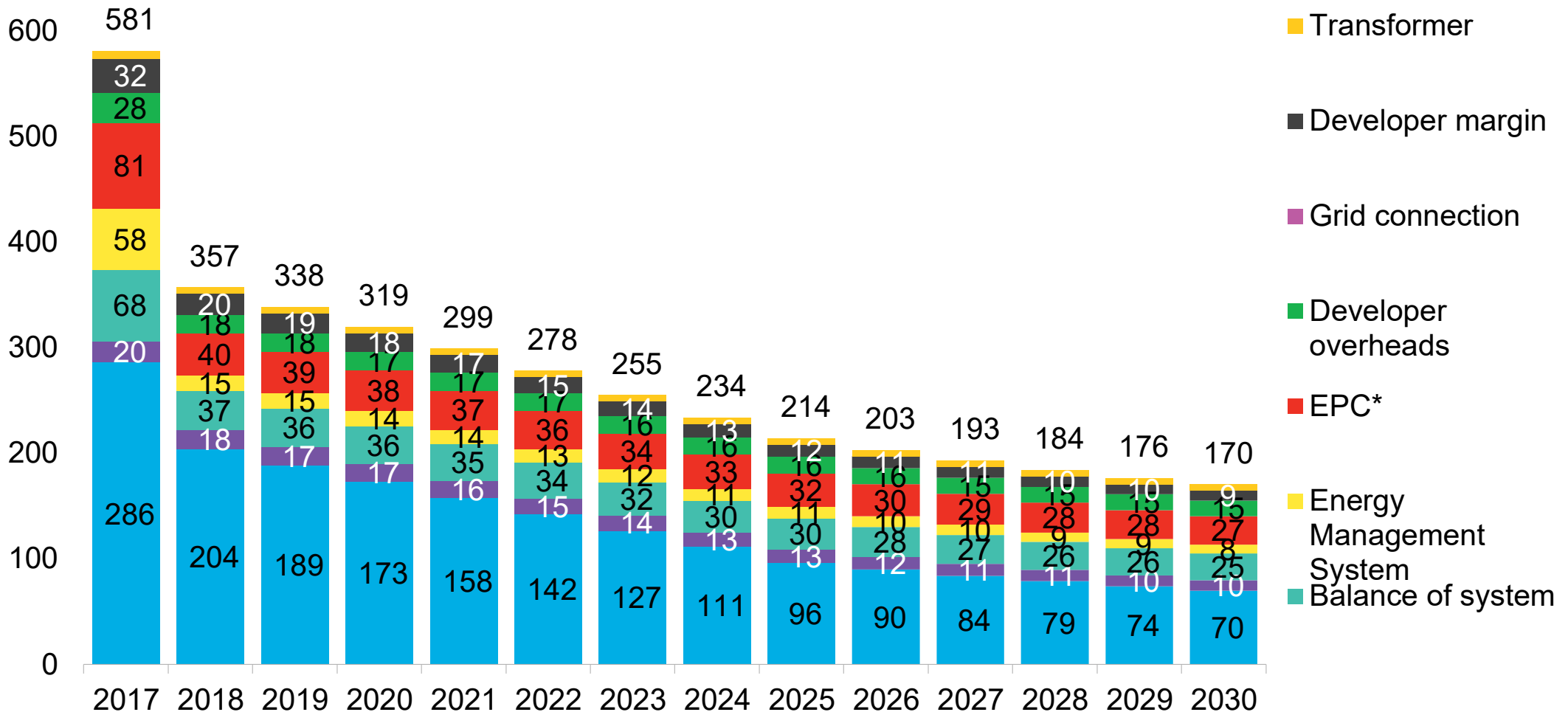**BloombergNEF**

Battery rack costs

Other costs

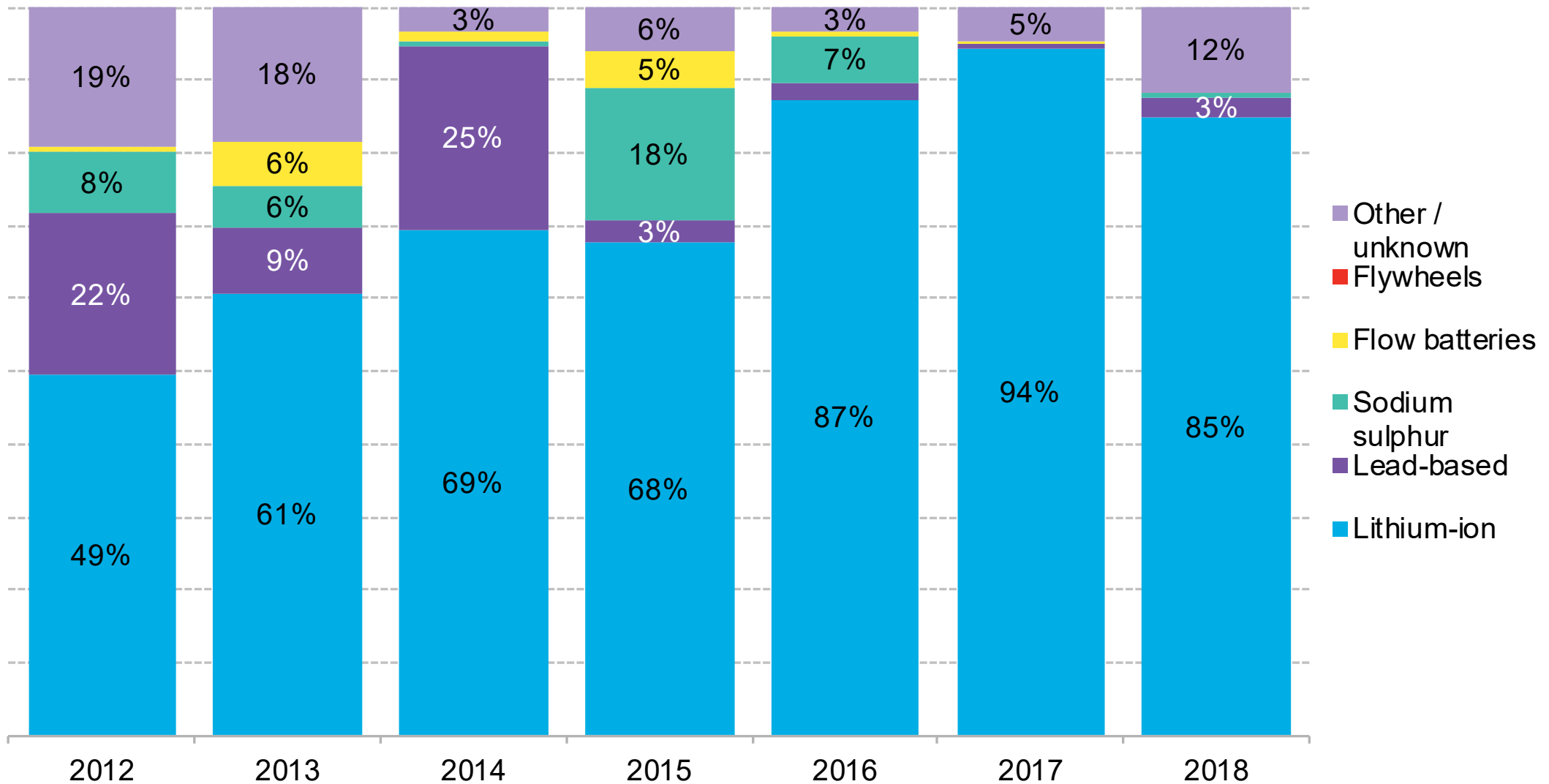**BloombergNEF**

System level prices continue to fall

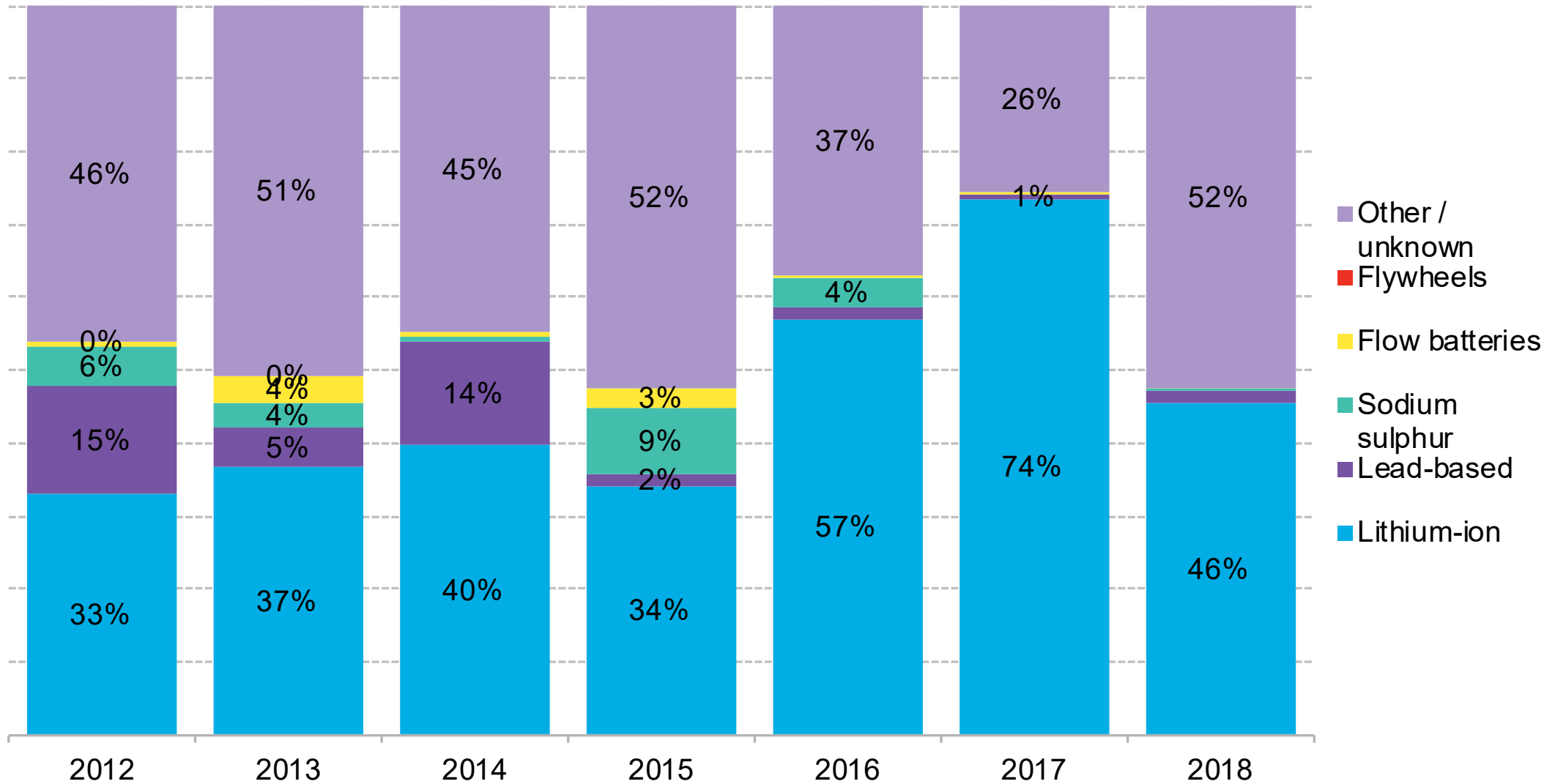## 20MW/80MWh system

Real 2018 $/kWh

Source: Bloomberg New Energy Finance. Note * Includes a 10% EPC margin. Developer overheads set at 5% of total system costs, and developer margin set at 10%.

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This has led to Lithium-ion dominating the storage market (on a power basis)

Stacked bar chart showing storage market share by technology, 2012–2018.

Year	Lithium-ion	Lead-based	Sodium sulphur	Flow batteries	Other / unknown
2012	49%	22%	8%		19%
2013	61%	9%	6%	6%	18%
2014	69%	25%			3%
2015	68%	3%	18%	5%	6%
2016	87%		7%		3%
2017	94%				5%
2018	85%	3%			12%

Legend: Other / unknown, Flywheels, Flow batteries, Sodium sulphur, Lead-based, Lithium-ion

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But other technologies can be better on an energy basis

Source: Bloomberg NEF. Note: Excludes pumped hydro. If multiple technologies are selected, the capacity is divided equally amongst them.

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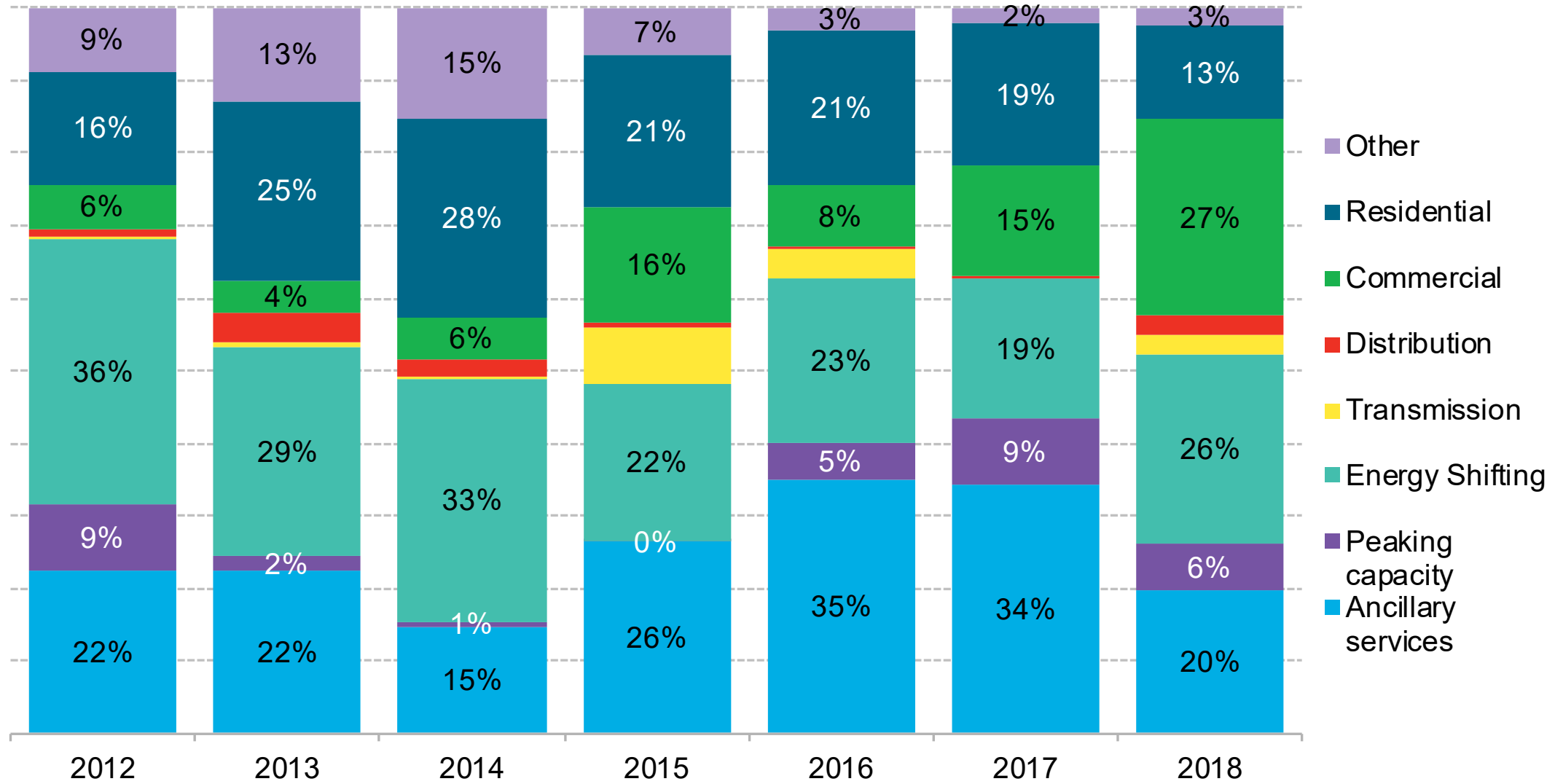# The Good & Bad

Why use storage? (and particularly lithium-ion)

Fossil Fuel generator providing frequency response

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Generating assets aren't good for quick response

Fossil Fuel generator providing frequency response

Battery storage providing frequency response
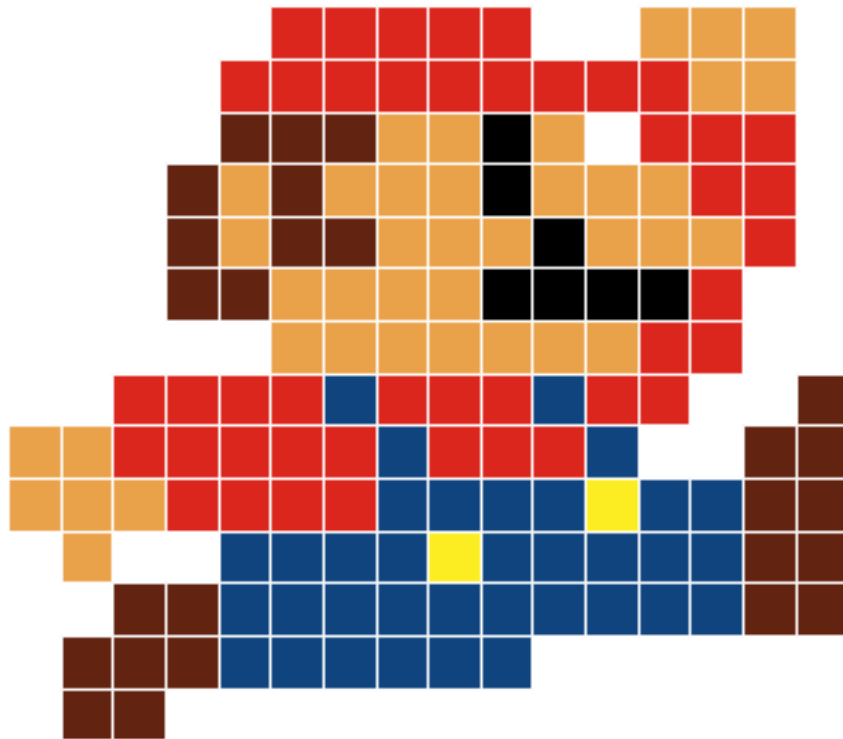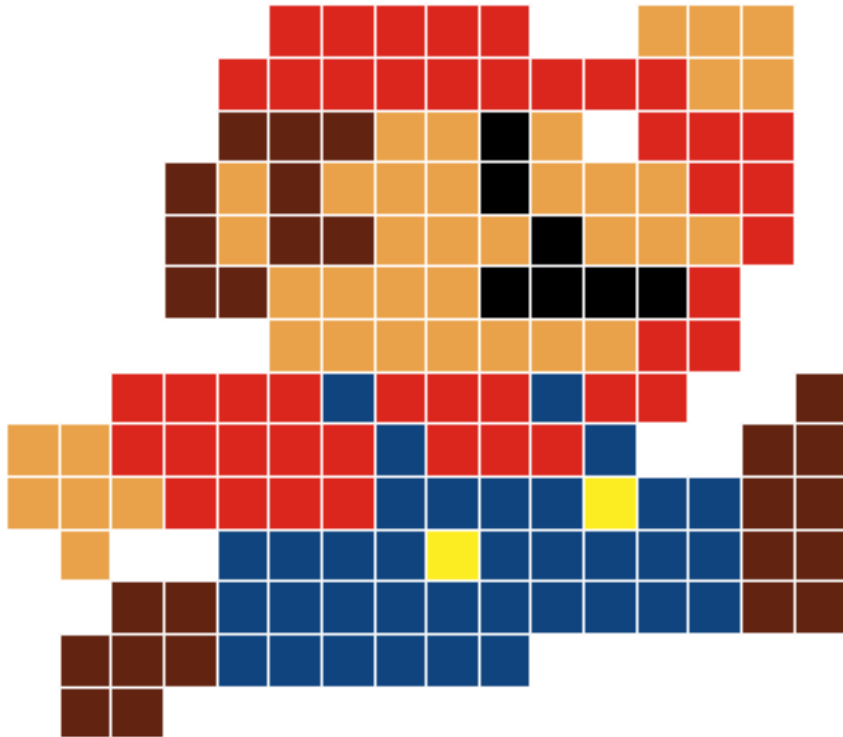
Source: Pixelartmaker.com

Source: Groundreport.com

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Lithium-ion batteries biggest weakness is commodity prices

Lithium hydroxide price - Asia

$ / metric ton
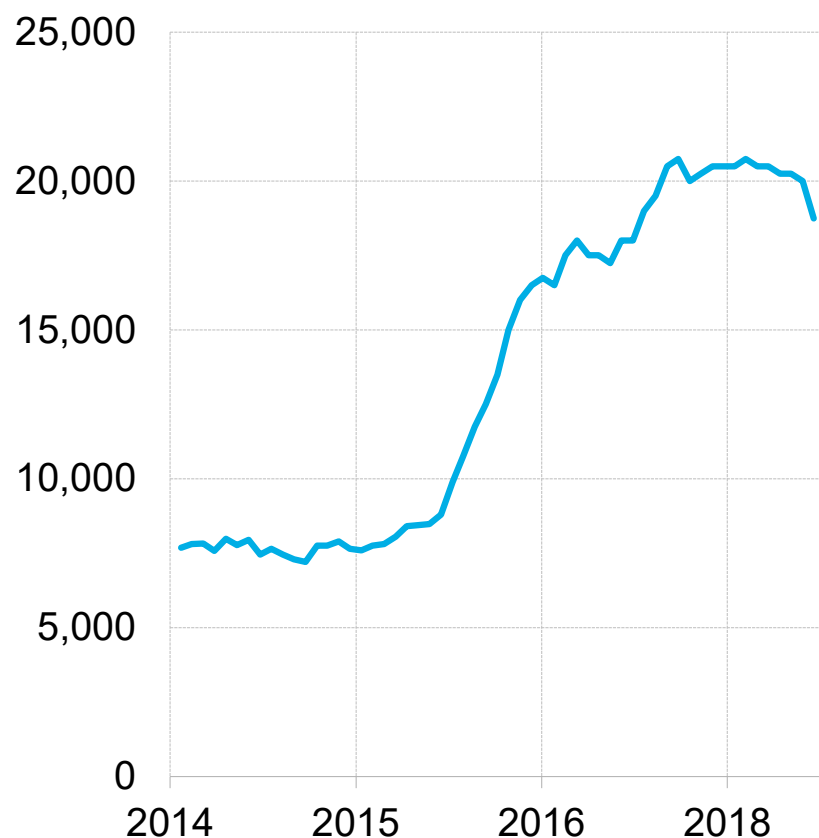
Cobalt spot price - Shanghai

$ / metric ton

Source: Bloomberg New Energy Finance, Benchmark Minerals, Antaike Note: prices correct as of January 28, 2018

Source: Bloomberg New Energy Finance, Benchmark Minerals, Antaike Note: prices correct as of January 28, 2018

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Cobalt can be avoided
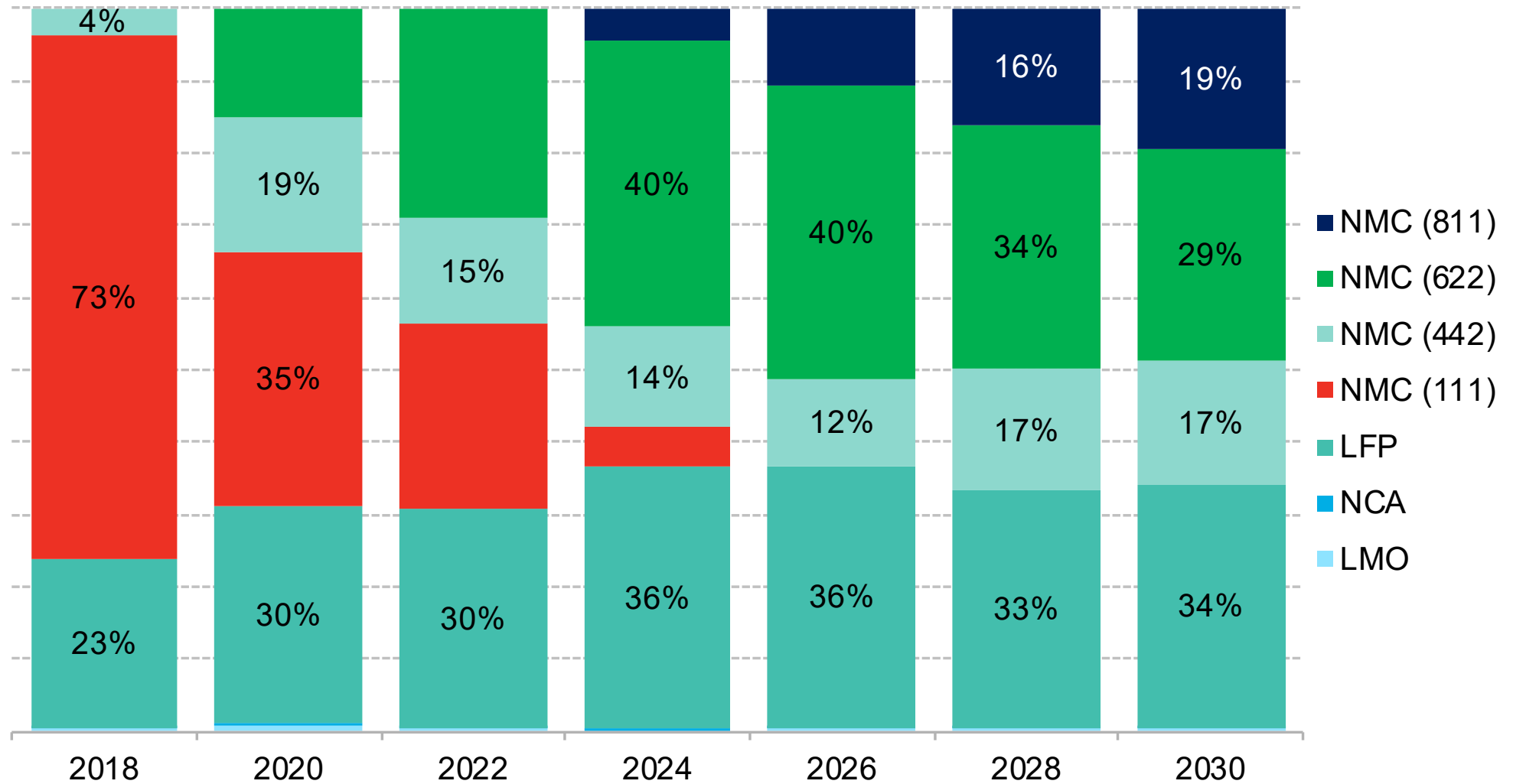
Source: Bloomberg NEF Note: Excludes pumped hydro. If multiple applications are selected, the capacity is divided equally amongst them.
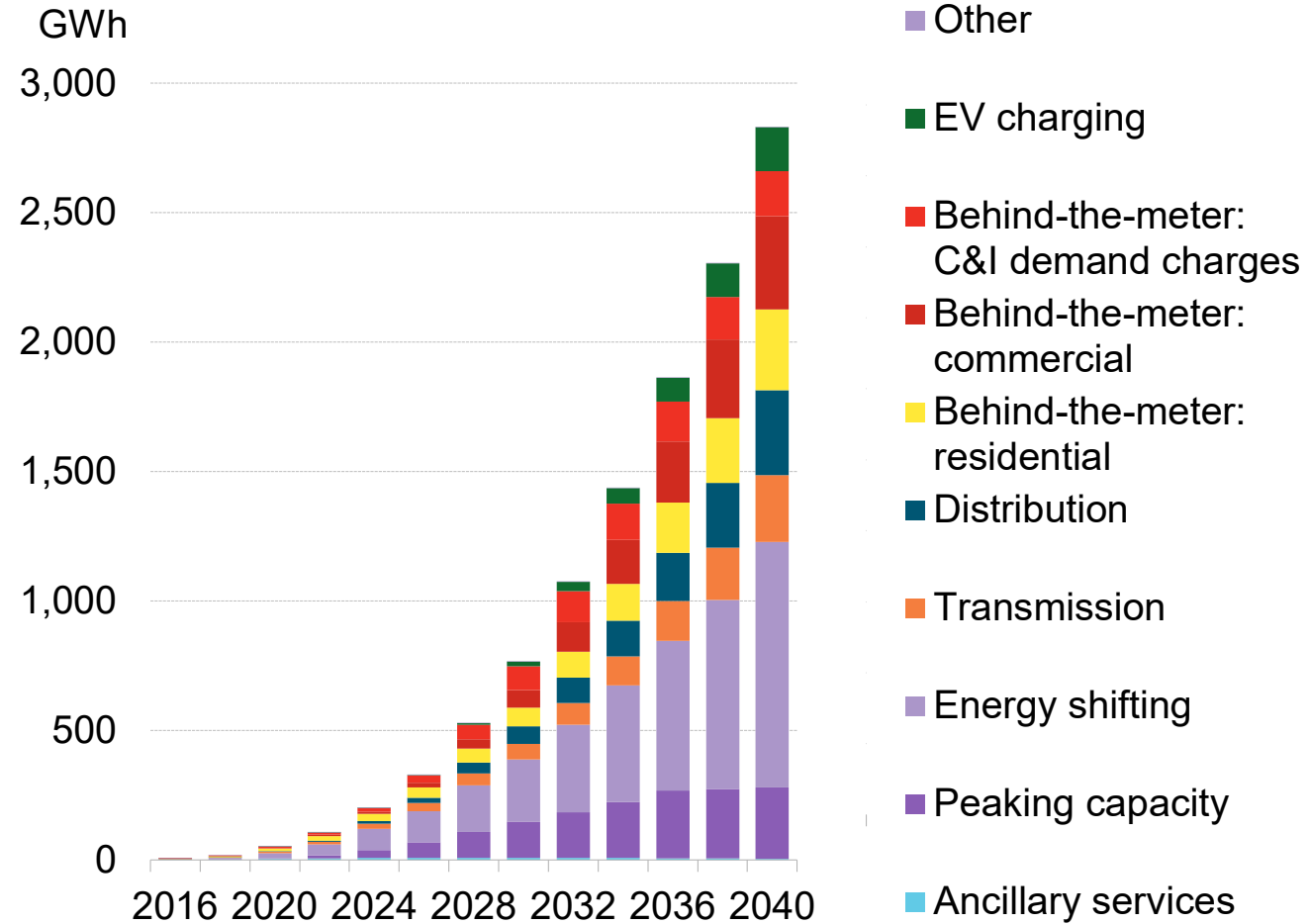
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What does the future look like?
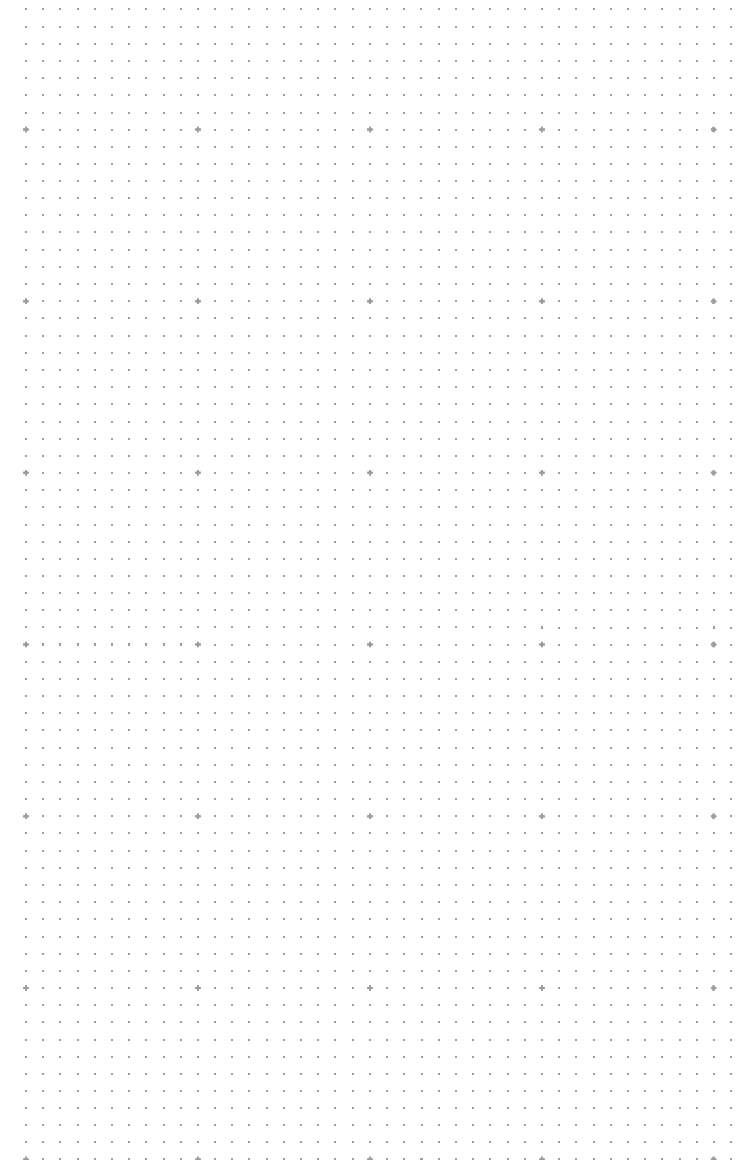
Energy shifting dominates the market

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Energy shifting will create new opportunities for storage

Cumulative storage deployments by application, based on power output
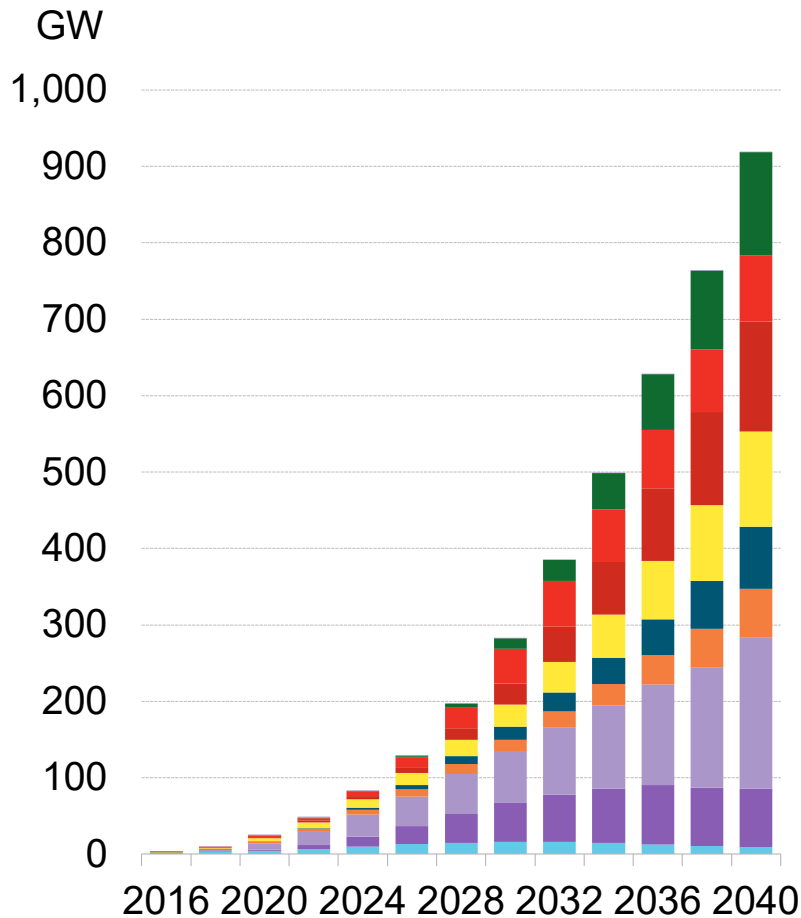
Cumulative storage deployments by application, based on energy capacity

Legend:
- Other
- EV charging
- Behind-the-meter: C&I demand charges
- Behind-the-meter: commercial
- Behind-the-meter: residential
- Distribution
- Transmission
- Energy shifting
- Peaking capacity
- Ancillary services

Source: Bloomberg New Energy Finance

Source: Bloomberg New Energy Finance

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There are somethings lithium-ion probably wont be able to do

Generation (GW)

Germany low renewable generation week, 2040
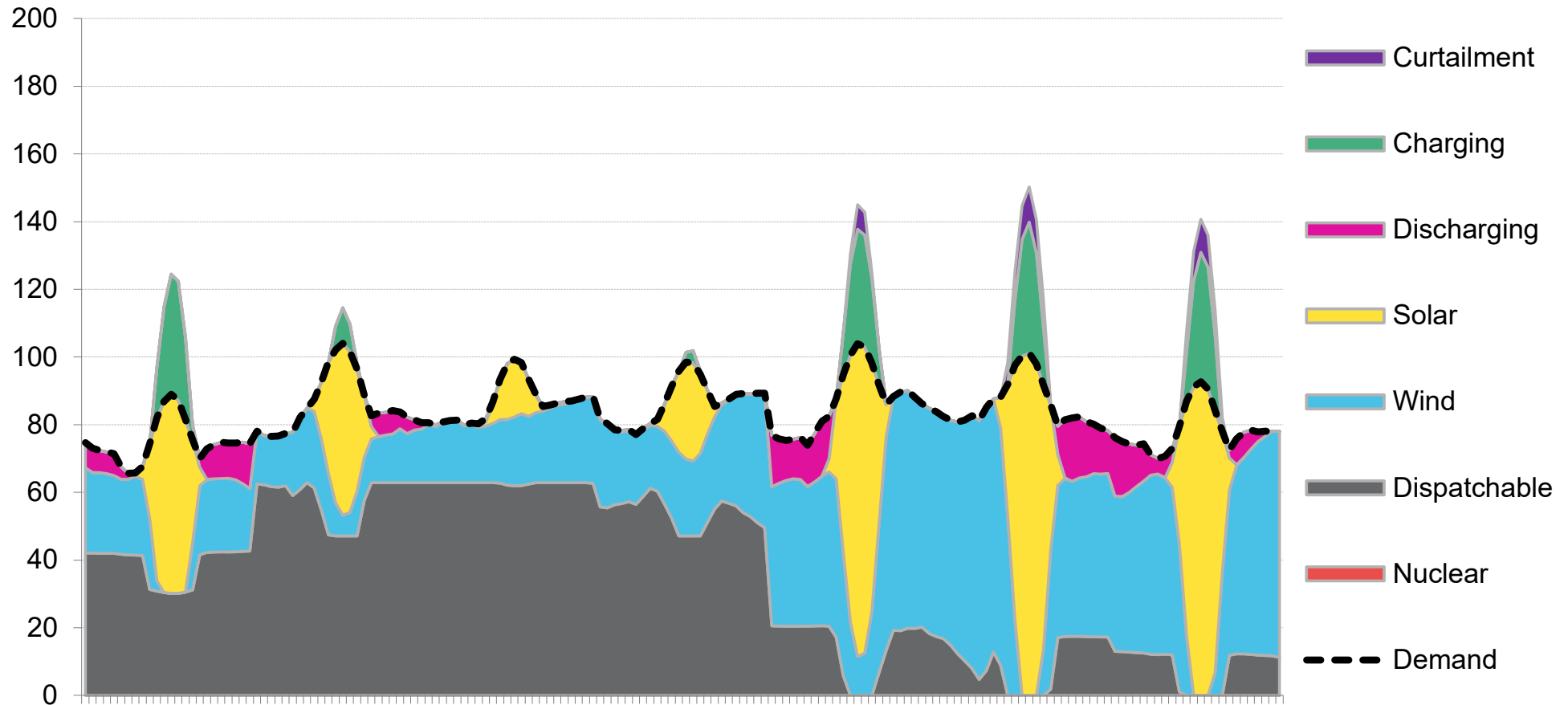
Source: Bloomberg NEF

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Particularly long duration energy shifting

Generation (GW)

Germany high renewable generation week, 2040

New storage technologies, with a long storage duration, are needed for shifting loads by weeks or months

12hrs

Curtailment
Charging
Discharging
Solar
Wind
Dispatchable
Nuclear
Demand
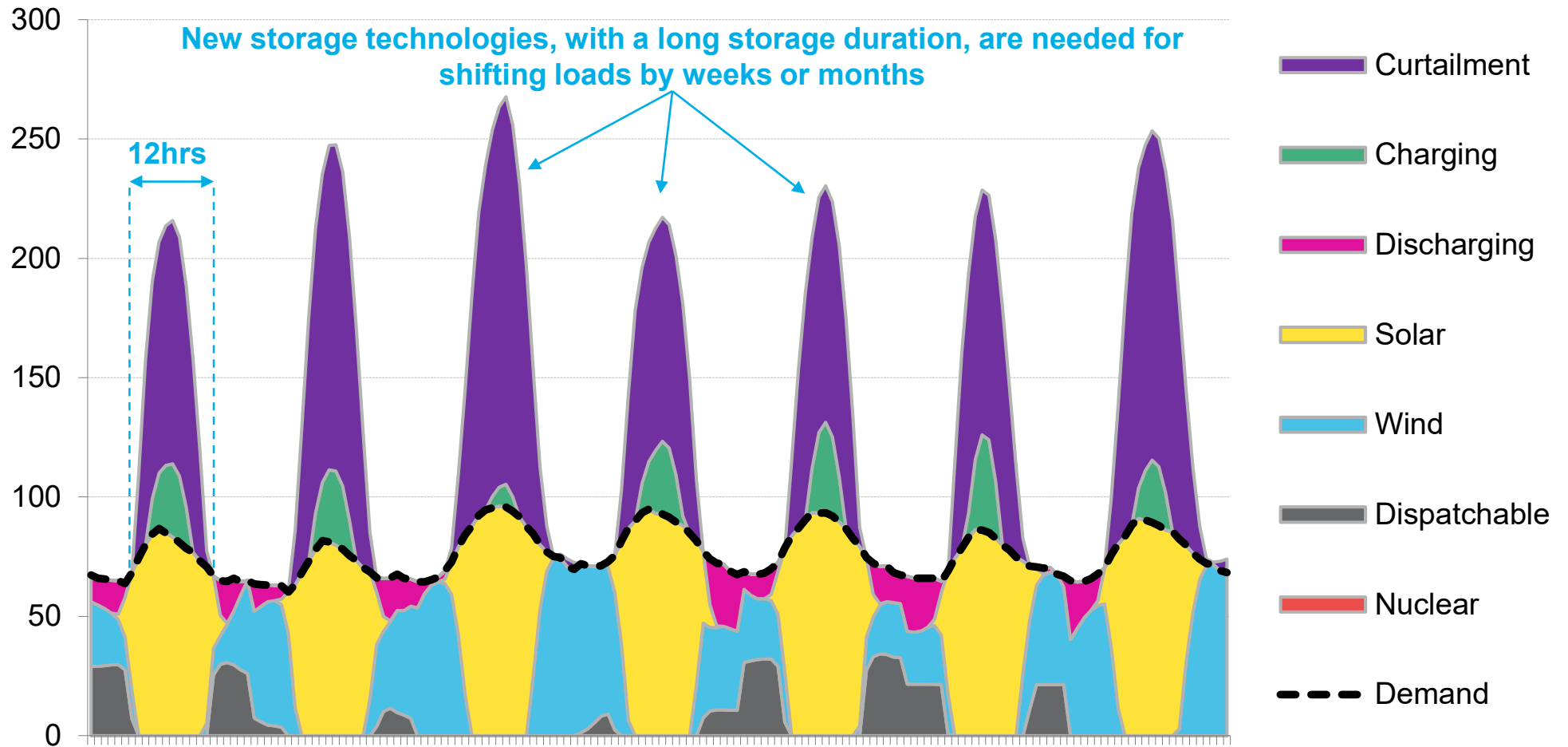
Source: Bloomberg NEF

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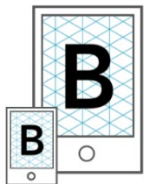
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