Preparing for the Future of Energy

BloombergNEF's New Energy Outlook

Michael Steele

October 11, 2018

BloombergNEF

Introduction: Bloomberg NEF

Who we are

500 Bloomberg research professionals in 19 locations*

*** Part of the Bloomberg LP network of 19,000 employees in 176 locations.**

The comprehensive Bloomberg research solution

Primary research

In-depth analysis on clean energy, advanced transport, commodities, and emerging technologies

BNEF

- 200 research professionals in 16 locations
- Generating over 700 insight reports annually
- Proprietary data, forecasts, and analysis

Investment research

Analysis on 1,800 companies across 10 sectors

Bloomberg Intelligence

- 300 research professionals in 12 locations
- Generating over 100 research notes a day
- Analyst-curated third-party and company-reported data

News, data & analytics

Leading global financial information provider

Companies | **Commodities** | **Bloomberg Economics**

- 19,000 employees in 176 locations
- 5,000 Bloomberg News stories a day
- Third-party and public data
- Terminal & Excel tools and analytics

Bloomberg NEF primary research

Clean Energy

Solar | Wind | Storage | Decentralized Energy | Frontier Power | Impact on Power & Utilities

Advanced Transport

Electrified Transport | Autonomous Driving | Shared Mobility | Impact on Transport | Impact on Oil & Power

Commodities

LNG & Gas | Oil & Products | Power | Carbon

Digital Industry

Internet of Things | Automation & Advanced Analytics | Advanced Materials | Impact on Industrials and Energy

The Road So Far

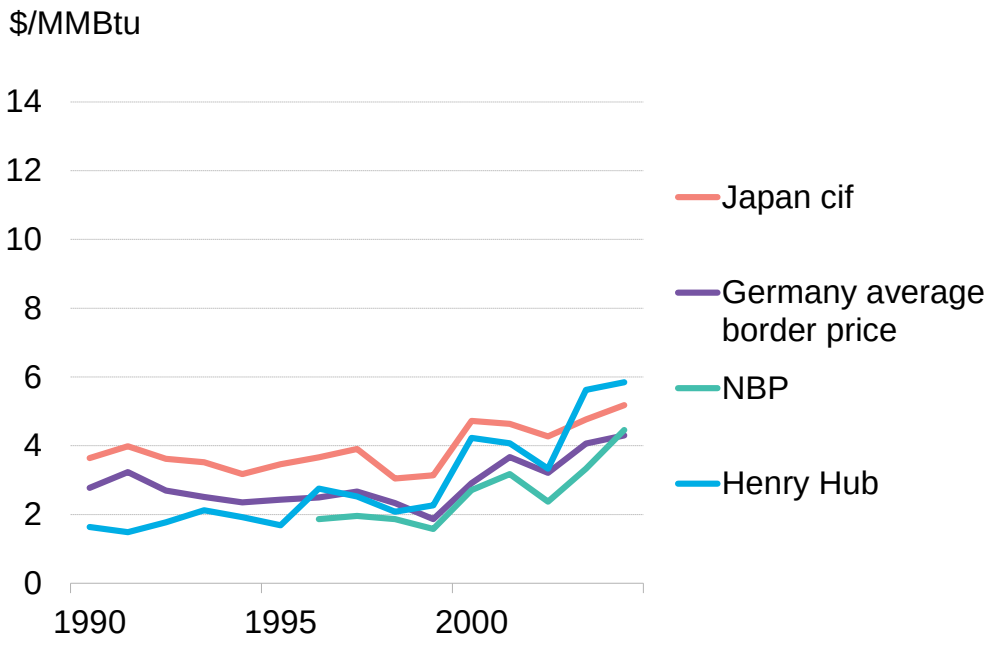
Recent evolution of energy in the U.S.

The world in 2004…

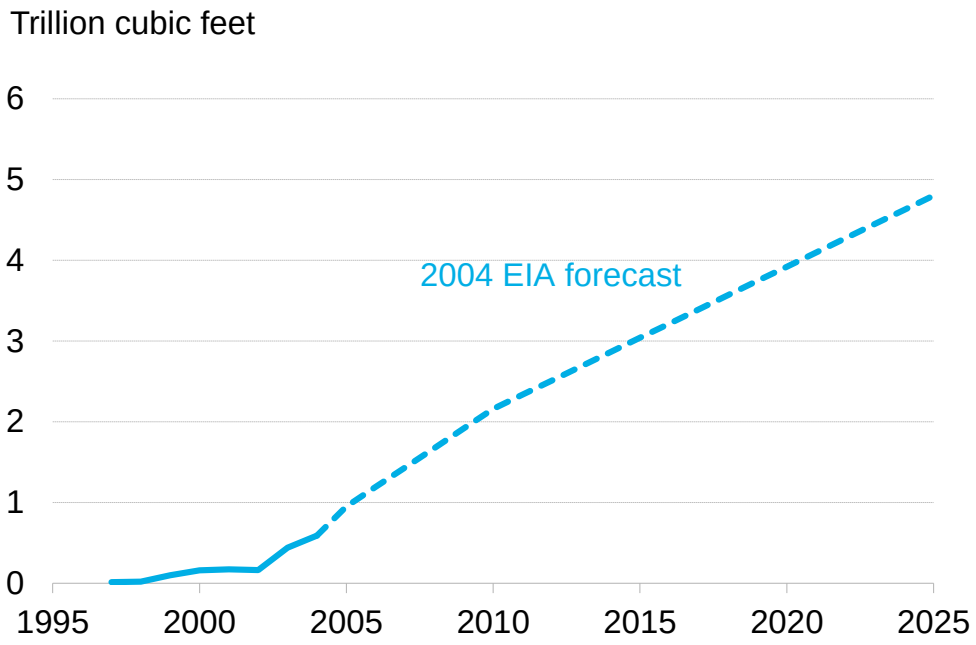
Source: NASA

U.S. faced gas scarcity

- Global gas price benchmarks, 1990-2004

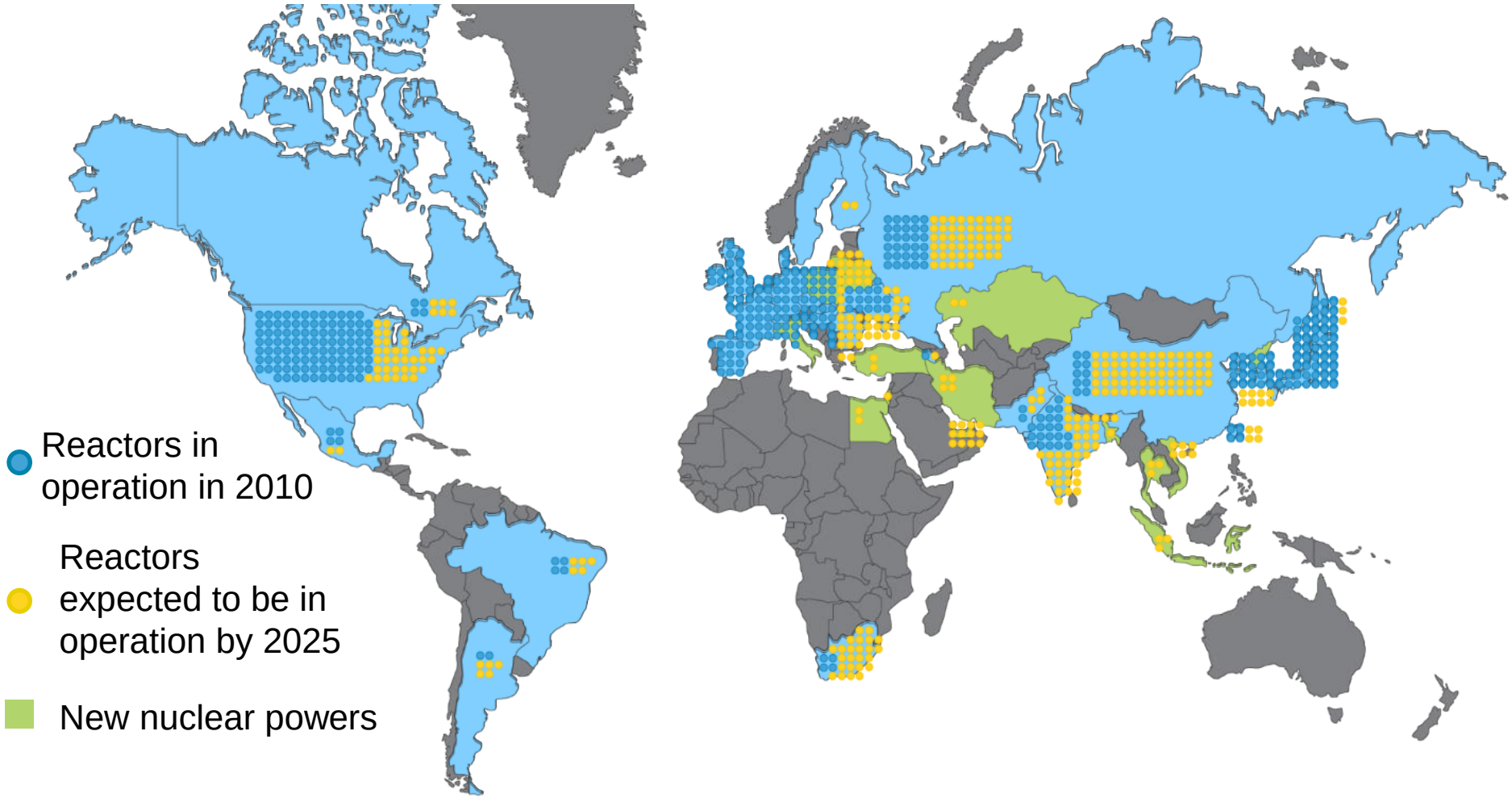


- Net U.S. LNG imports



- *Source: Bloomberg New Energy Finance*
- *Source: Bloomberg New Energy Finance, EIA*

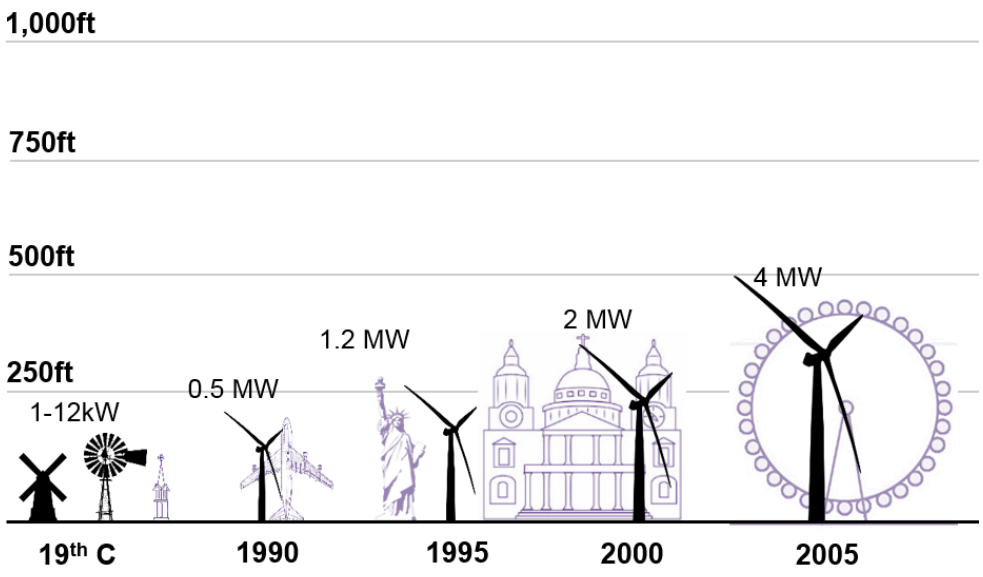
Impending nuclear renaissance



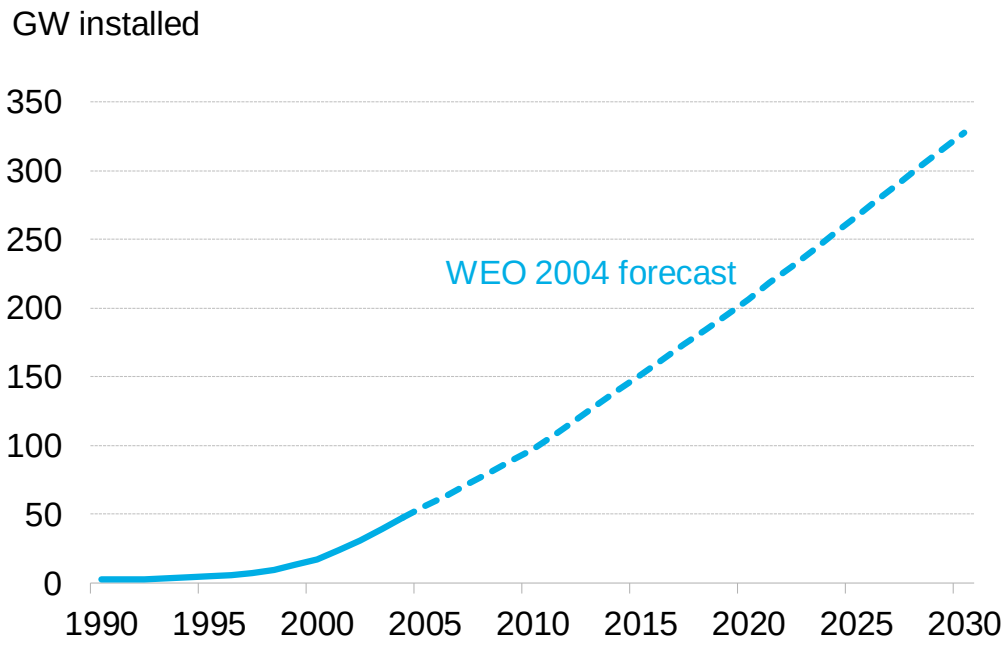
Source: International Atomic Energy Agency; Bloomberg New Energy Finance

Wind expected to increase

Wind turbine capacity



- Global cumulative wind installation



- *Sources: Various; Bloomberg New Energy Finance*
- *Source: Bloomberg New Energy Finance, IEA*

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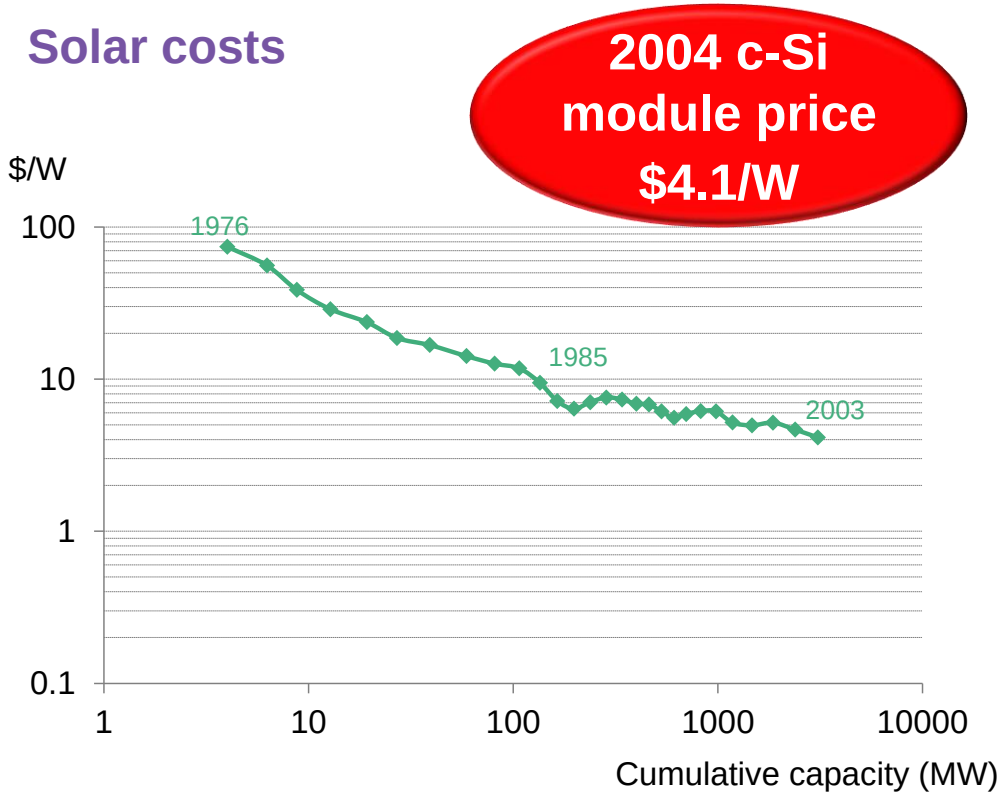
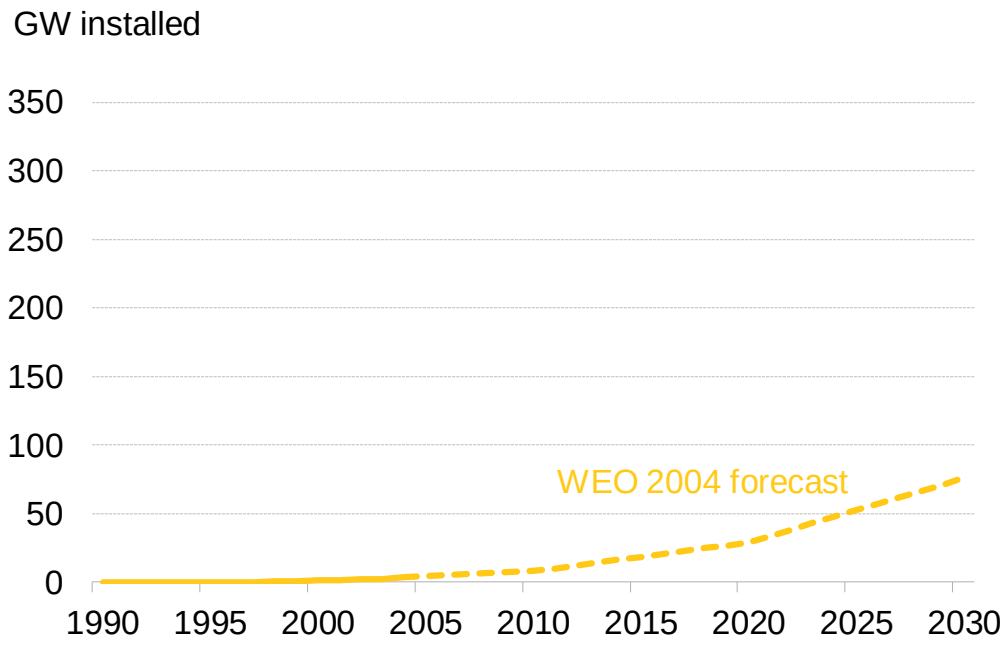
Solar expected to increase

Solar costs



Global cumulative solar installation



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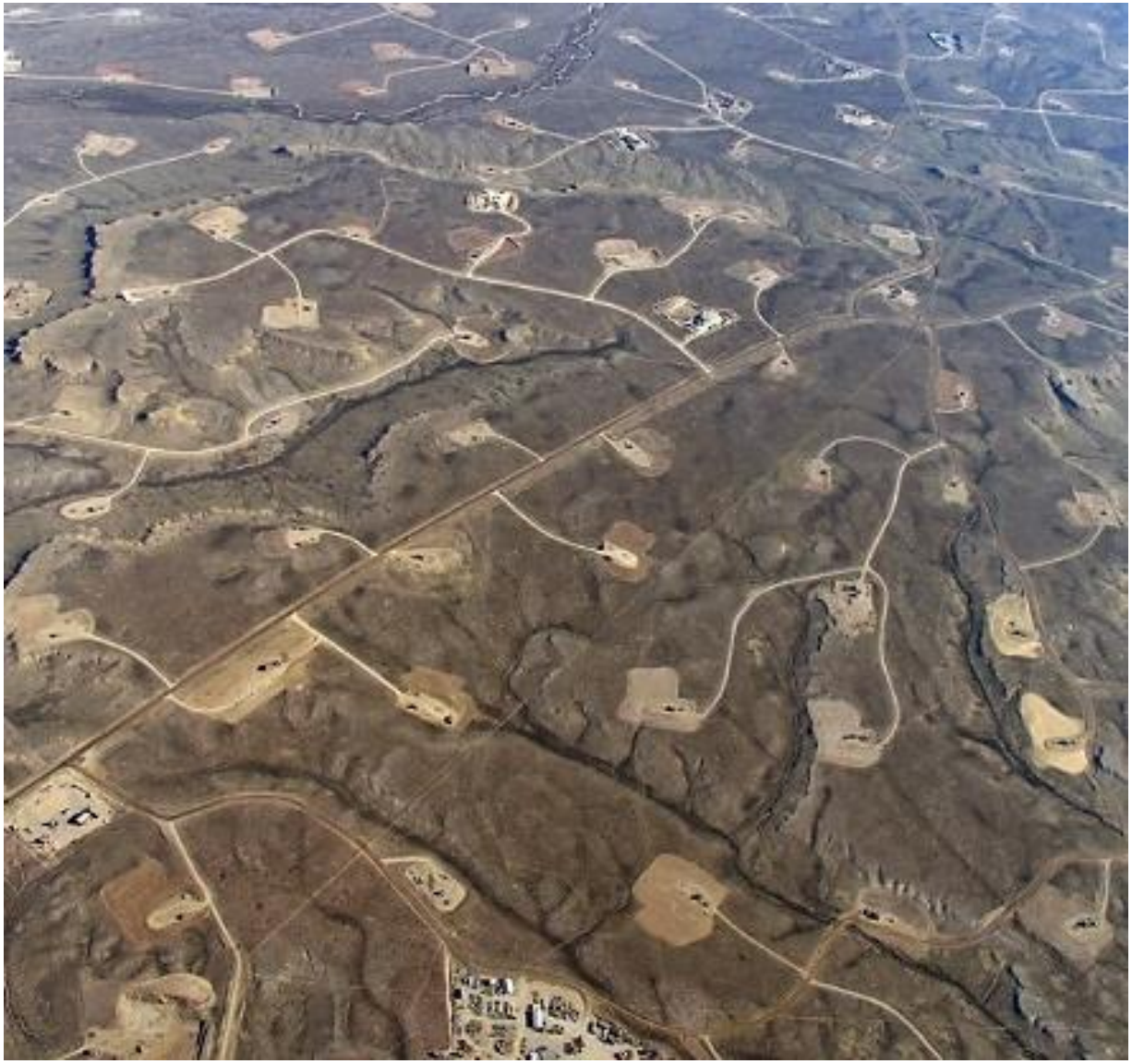
The world today…

Source: NASA

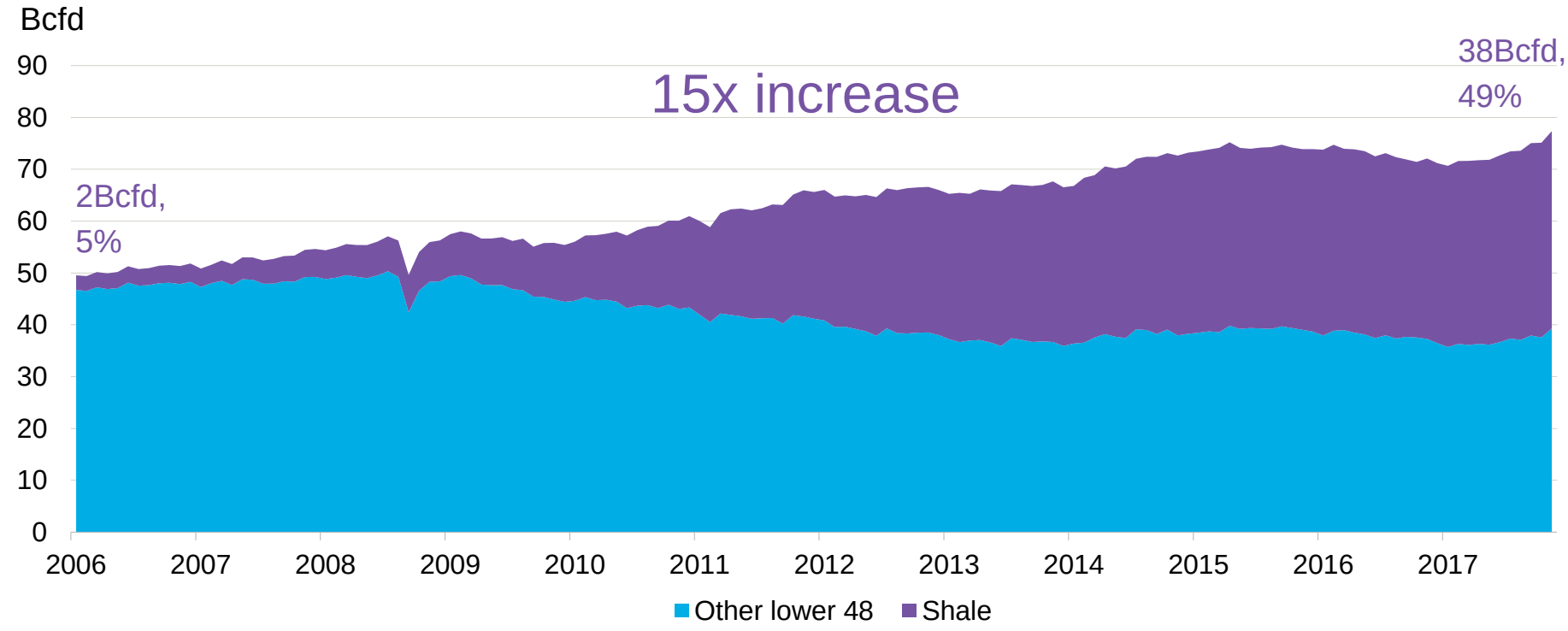
Shale changed the story on gas



- *Photos: Wikimedia Commons; DigitalGlobe; Pete Marovich/Bloomberg; KAL/Economist*

Shale production has boomed …

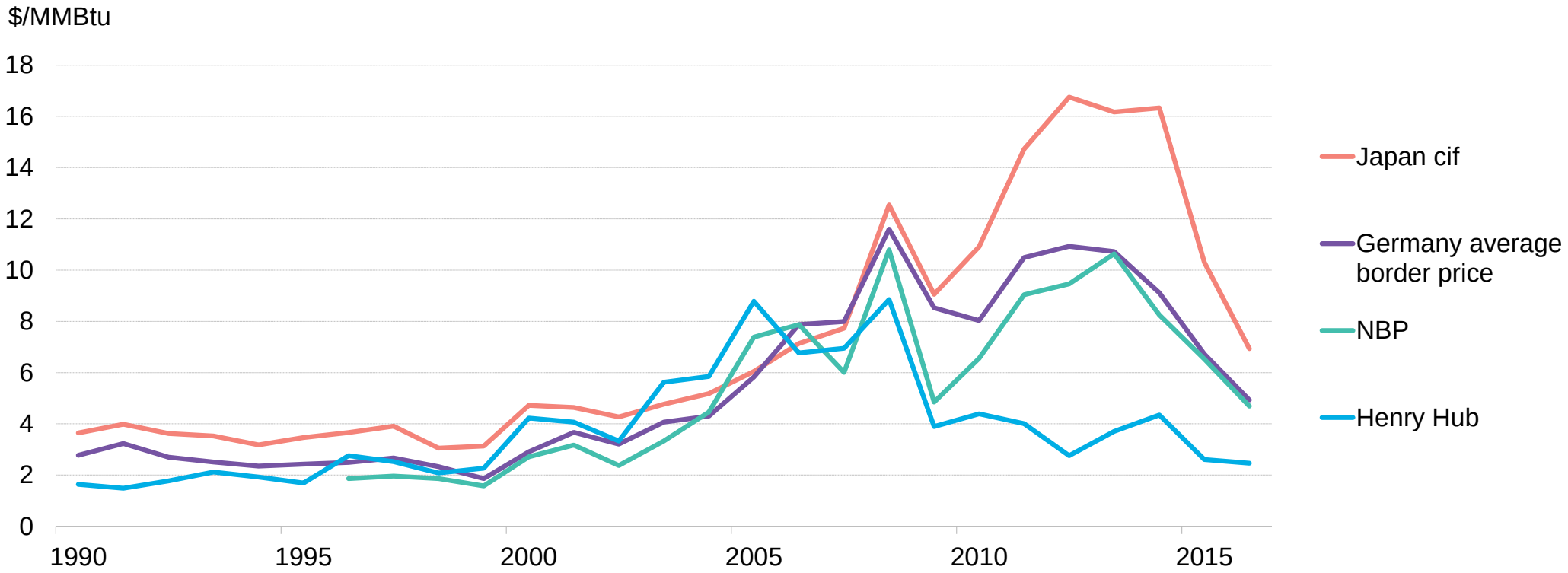
U.S. natural gas production



- *Source: Bloomberg New Energy Finance, EIA*

…And gas prices have fallen …

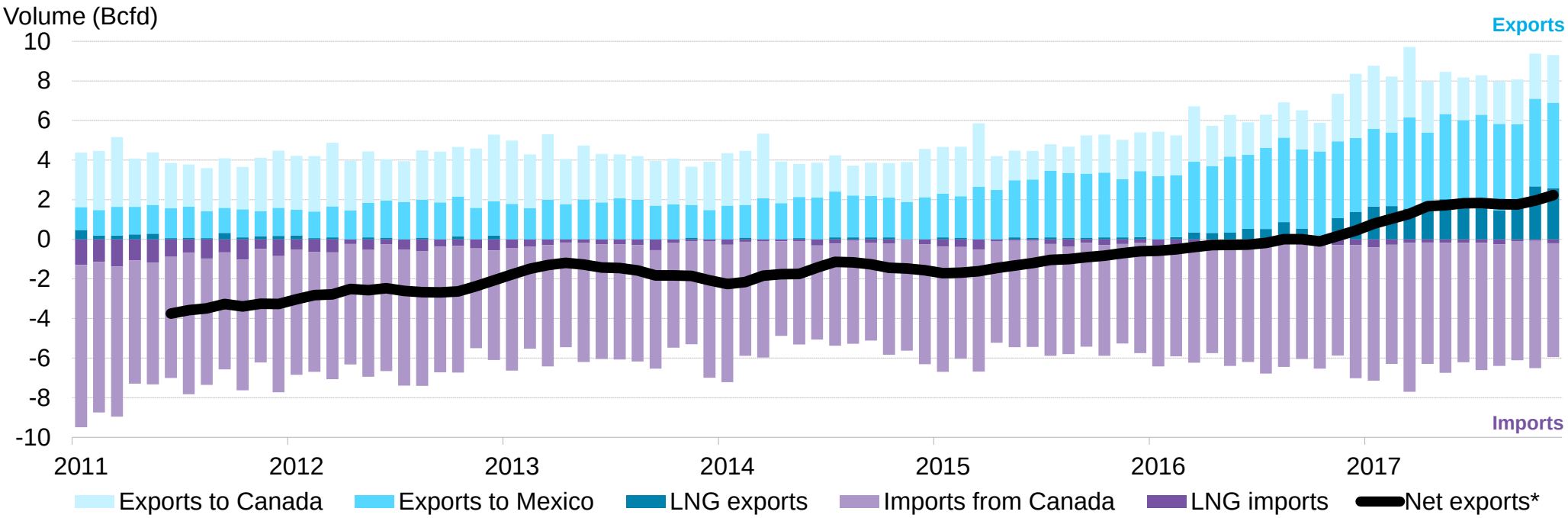
Global natural gas prices



- *Source: Bloomberg New Energy Finance, BP Statistical Review*

Turning the U.S. into a gas exporter

U.S. trade balance of natural gas

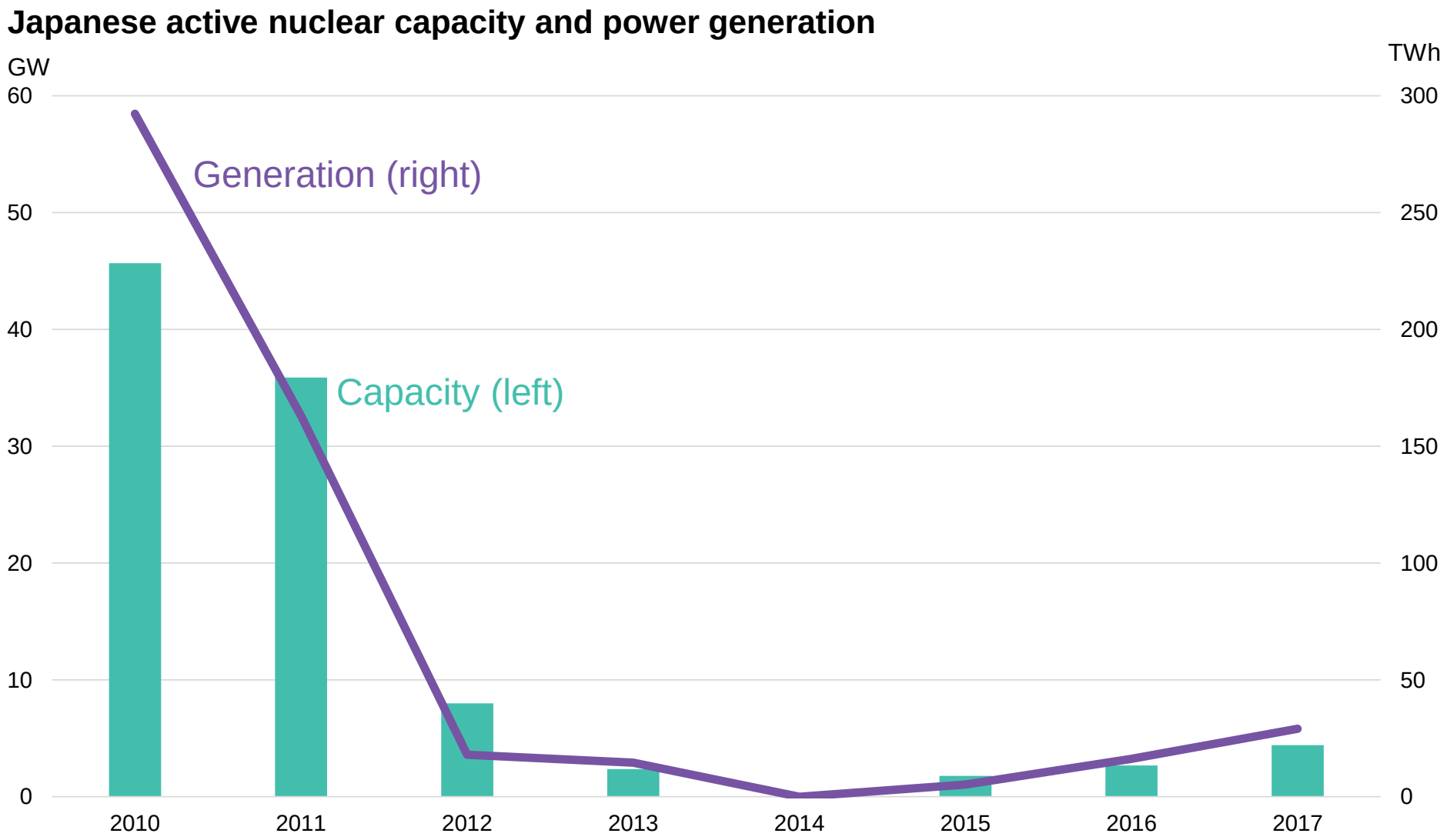


- *Source: Bloomberg Terminal, EIA Note: *Net export line shows the six-month rolling average.*

Nuclear growth never showed up

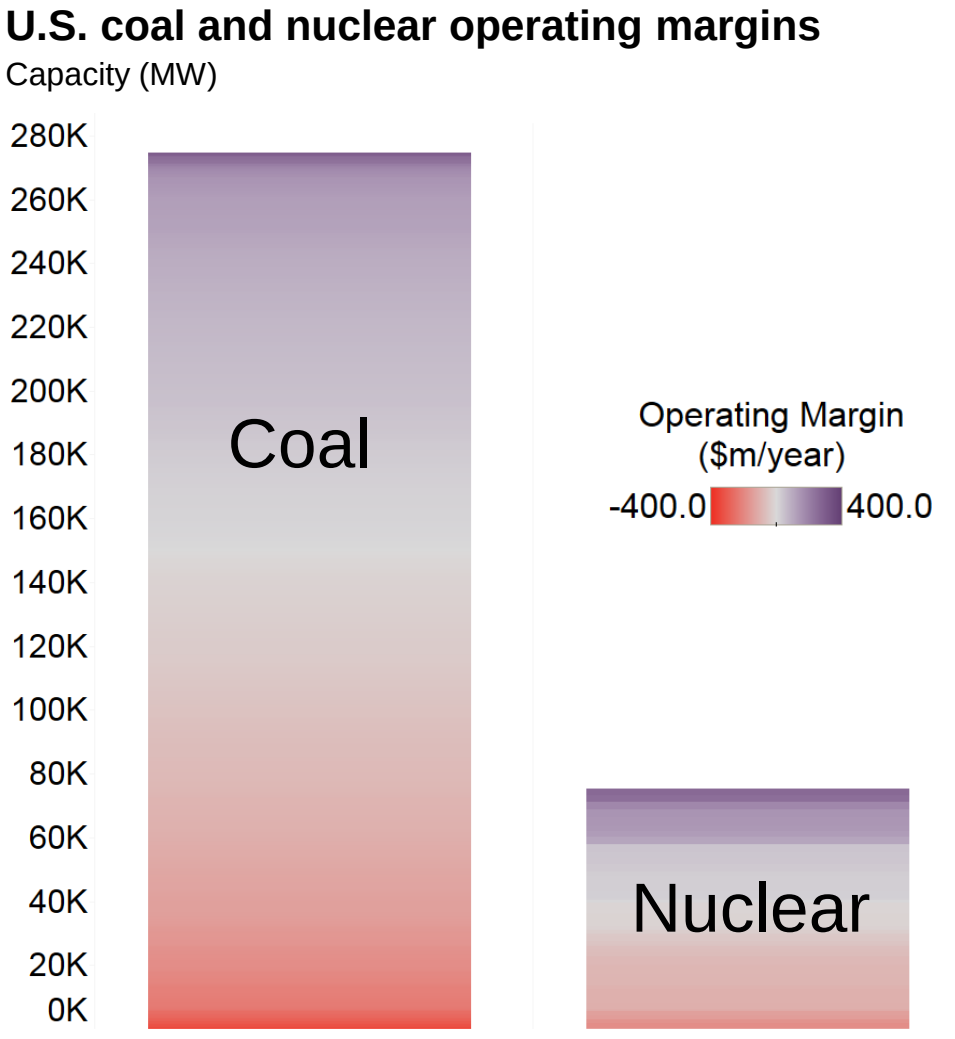
- *Photos: Wikimedia Commons; DigitalGlobe; Pete Marovich/Bloomberg; KAL/Economist*

Japan's nuclear power shut down



Source: Bloomberg New Energy Finance. Note: For generation output calculation, we assume 100% utilization ratio and an operation cycle of 13 consecutive months followed by a three-month shutdown for regular inspection.

U.S. nuclear and coal economics



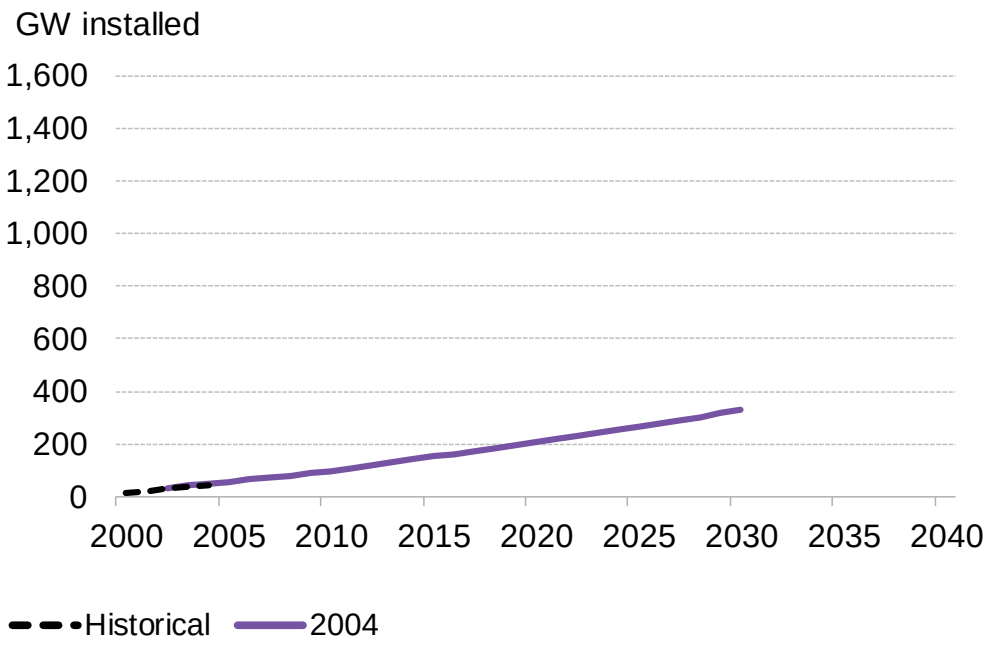
- *Source: BNEF. Coal covers historical 2012-2017 performance. Nuclear estimates based on Bloomberg Fair Value curves.*

Renewable growth accelerates

- *Photos: Wikimedia Commons; DigitalGlobe; Pete Marovich/Bloomberg; KAL/Economist*

IEA wind capacity forecast evolution

Global cumulative wind installations



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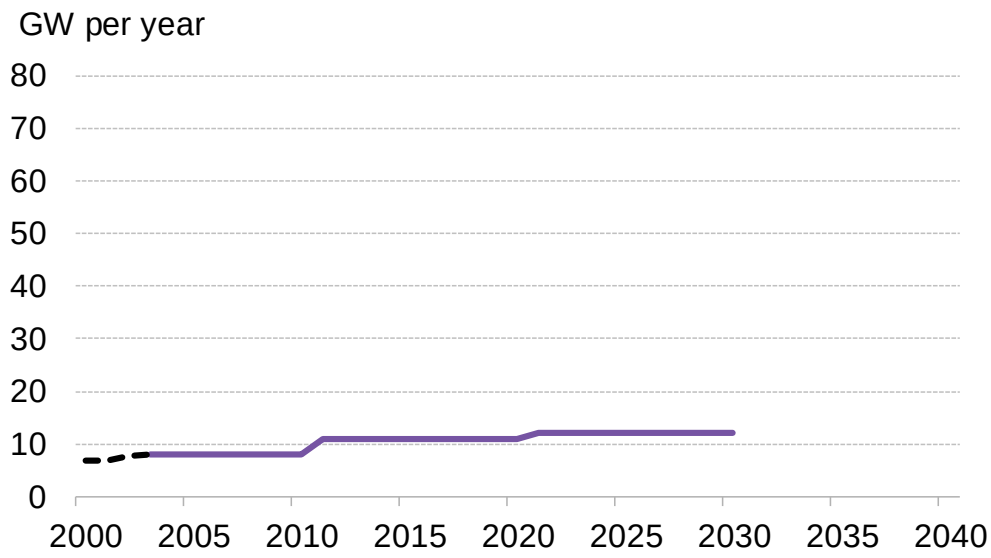

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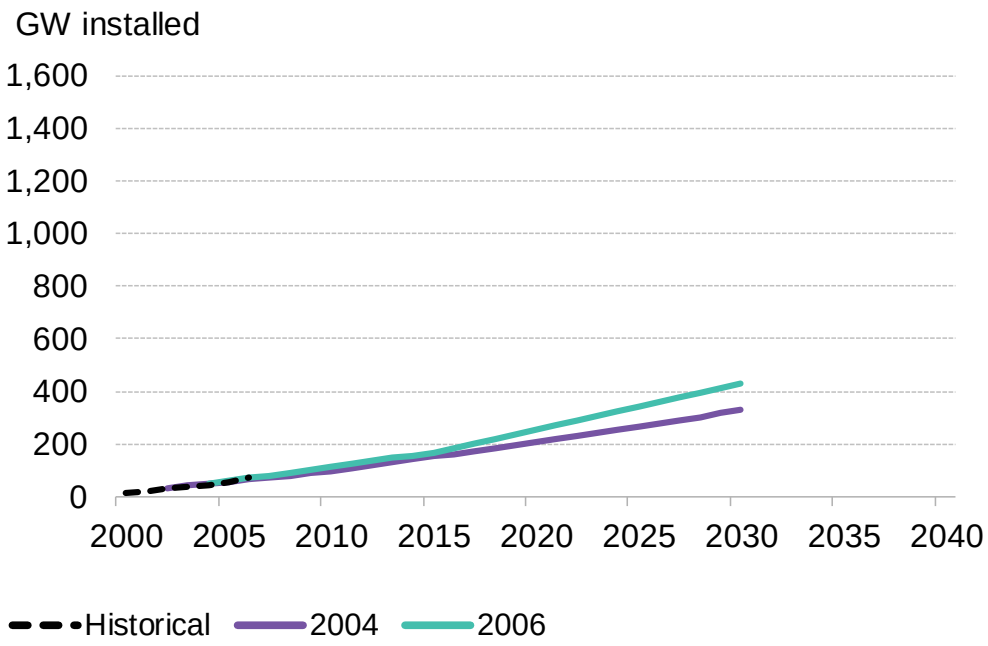

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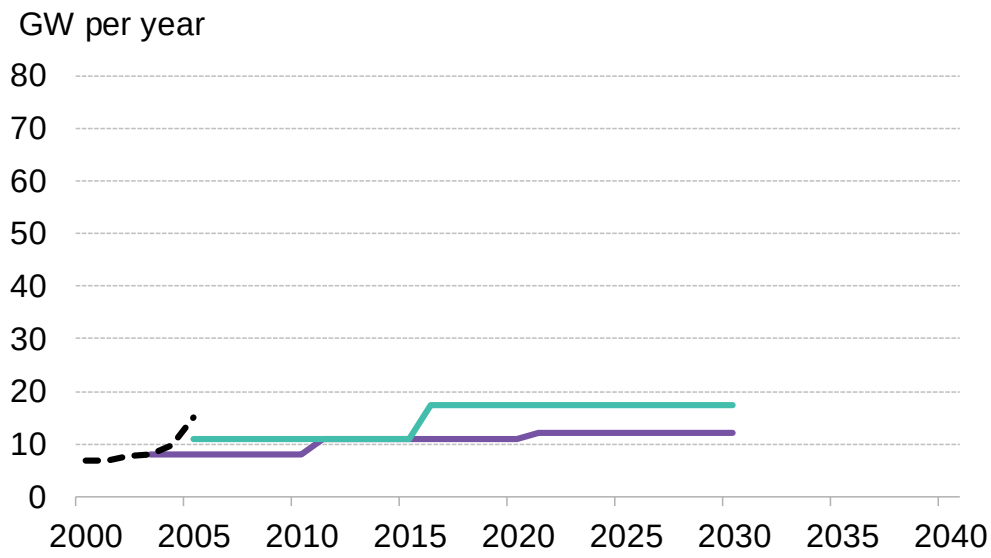

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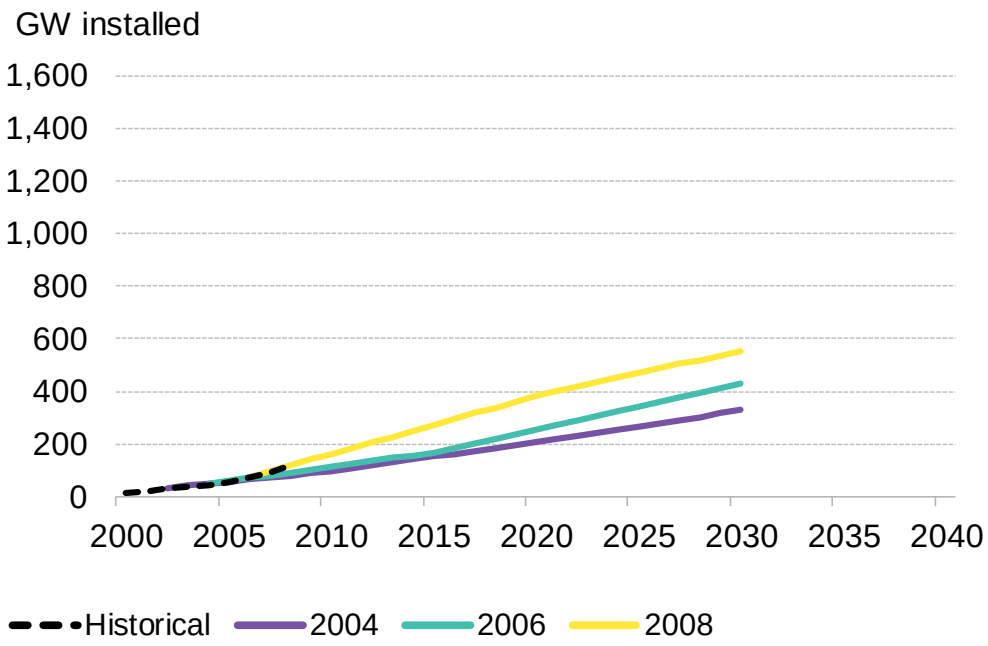

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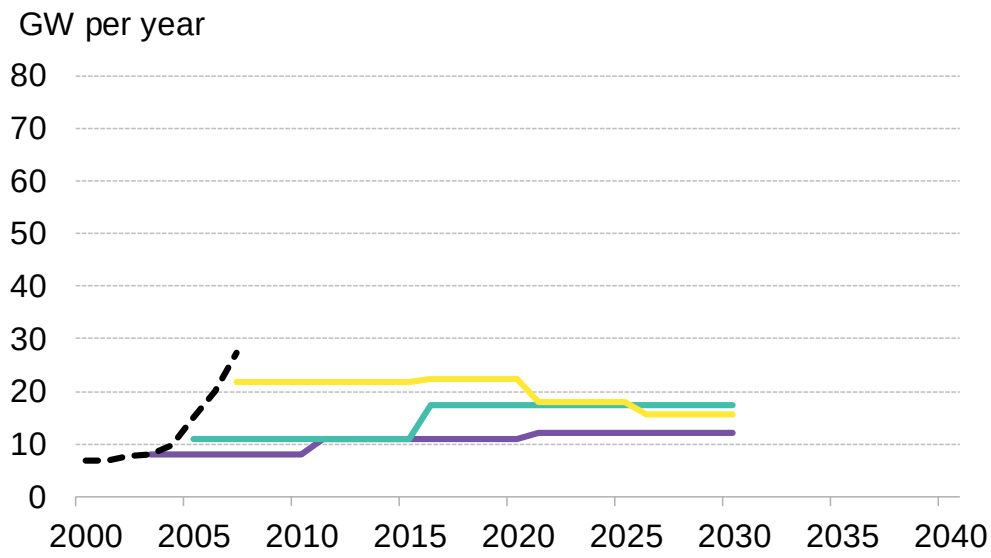

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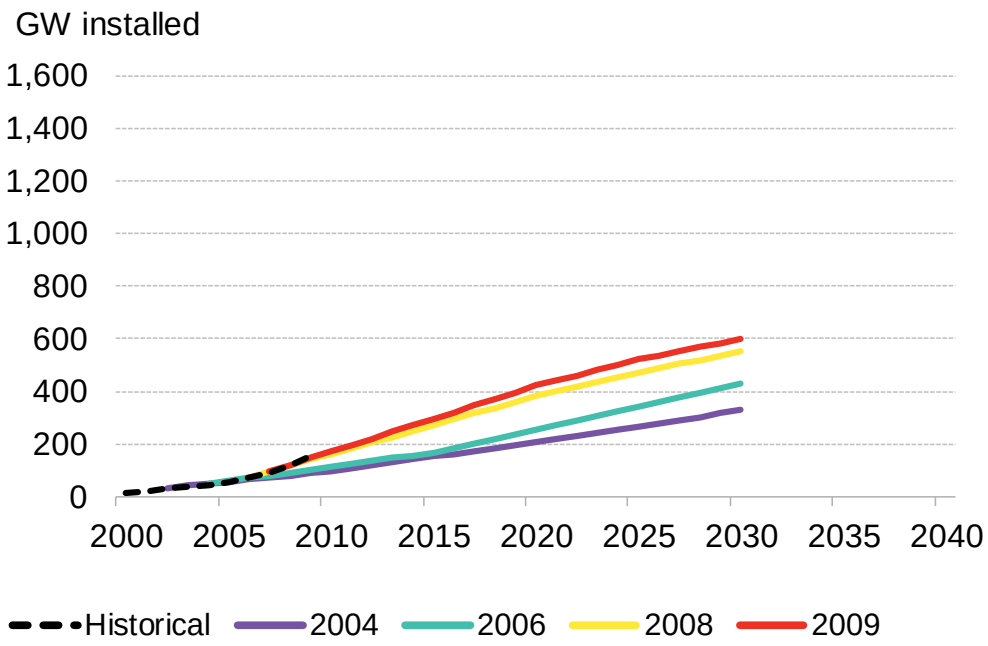

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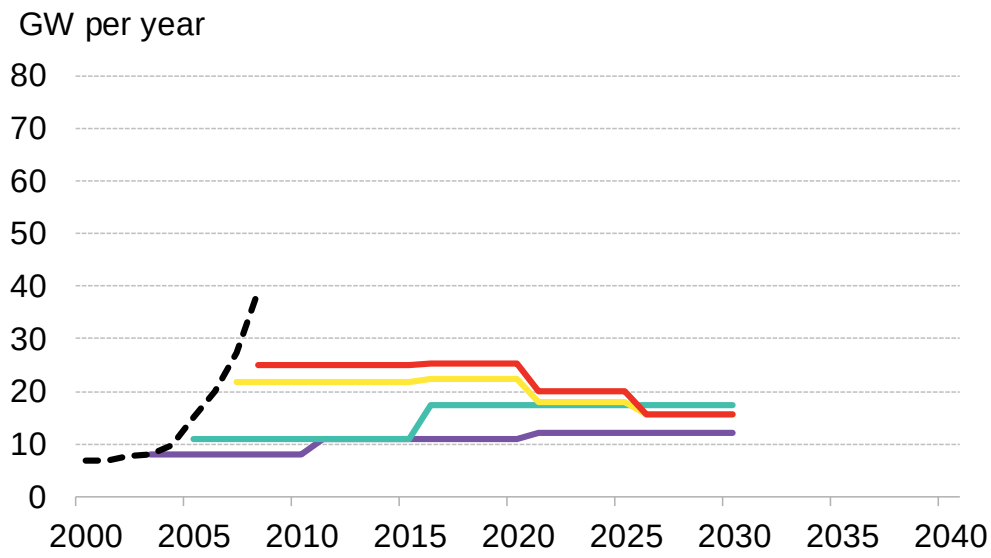

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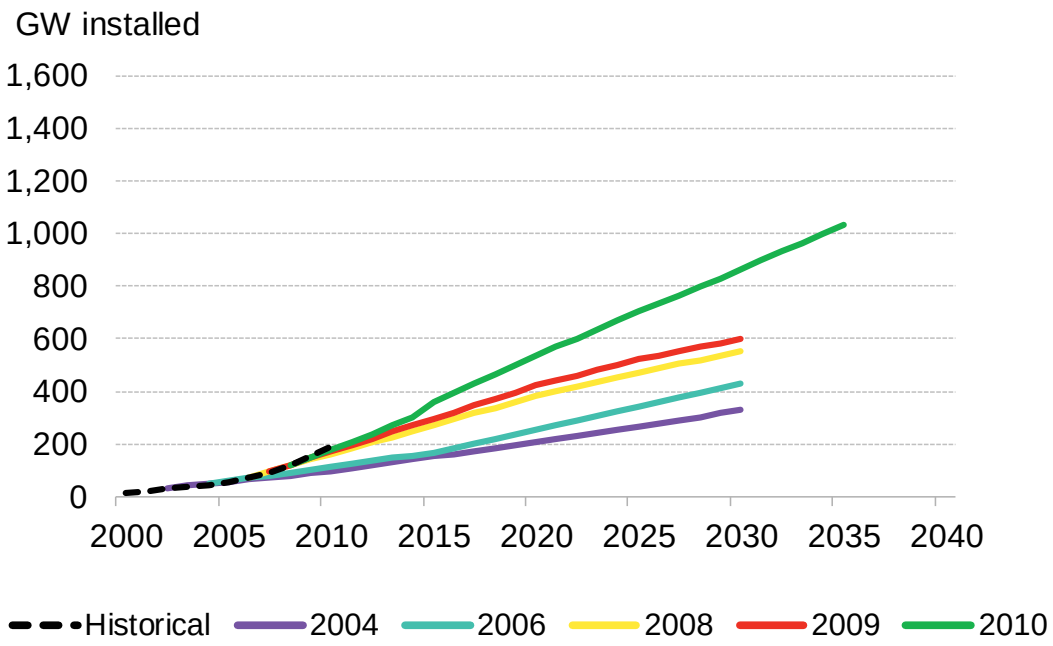

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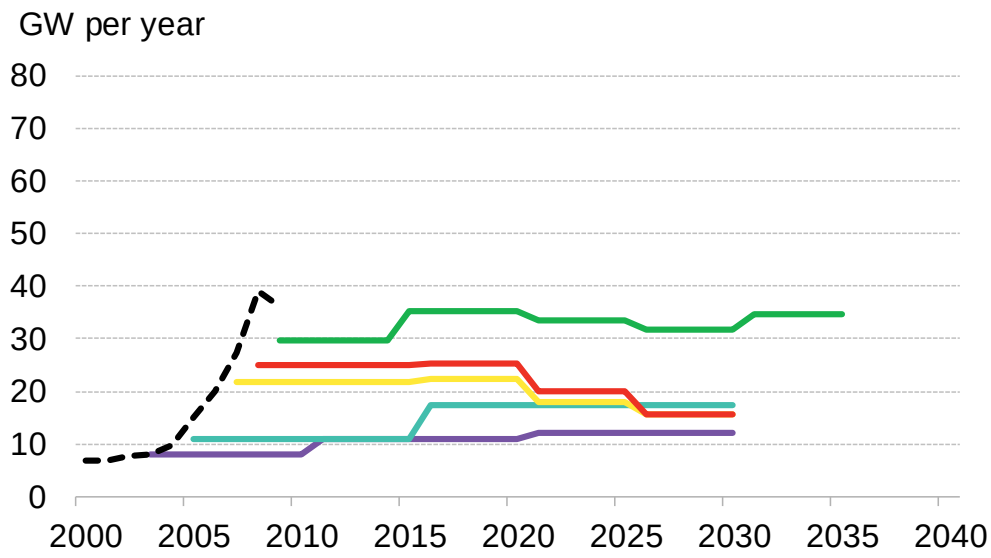

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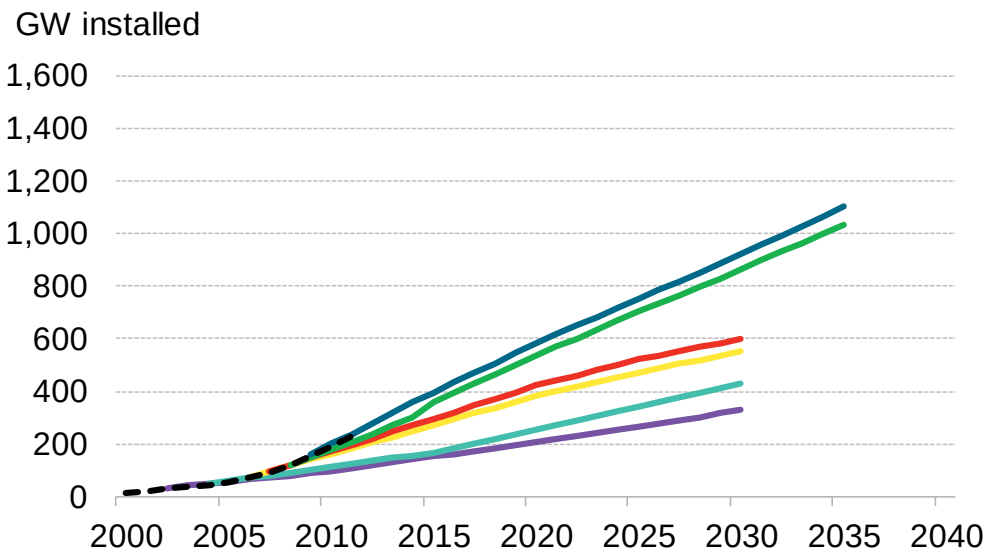

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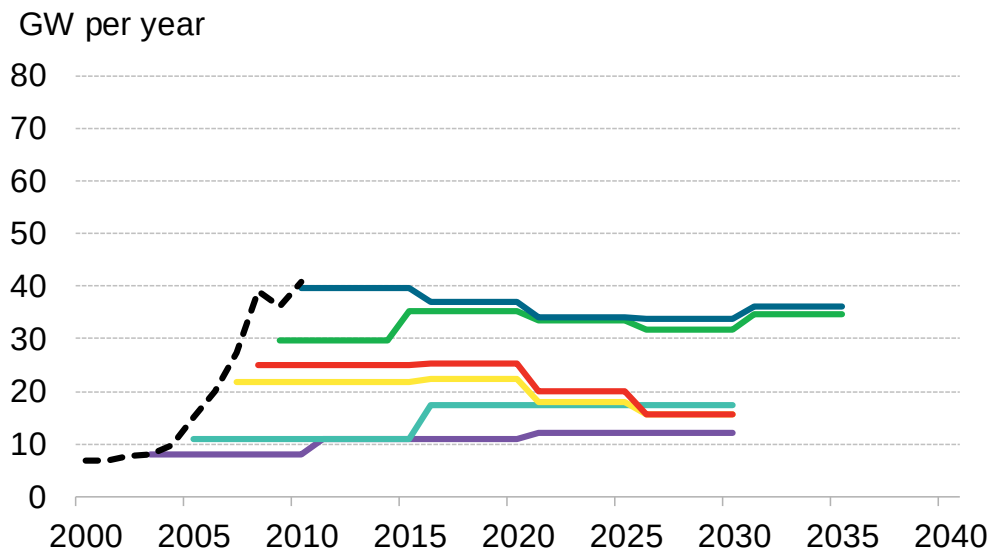

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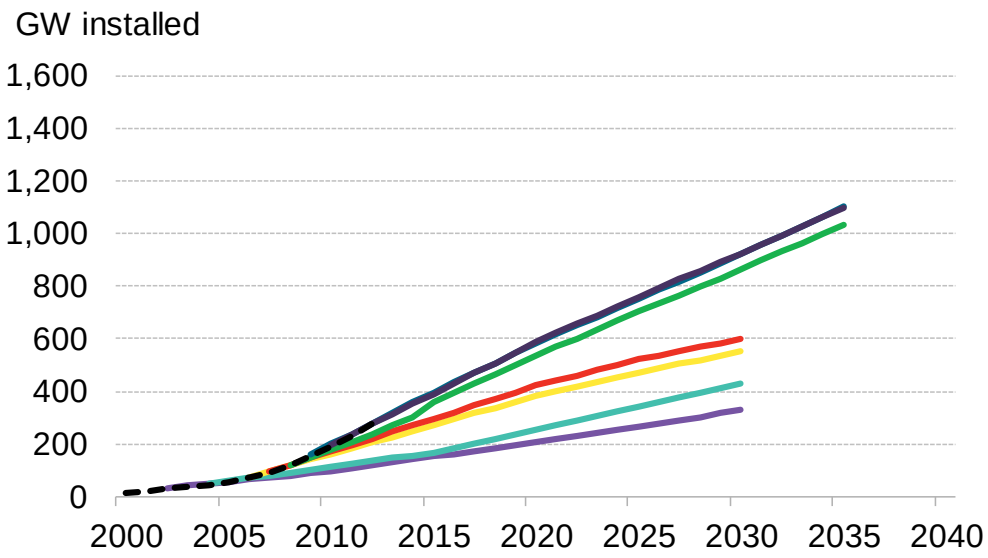

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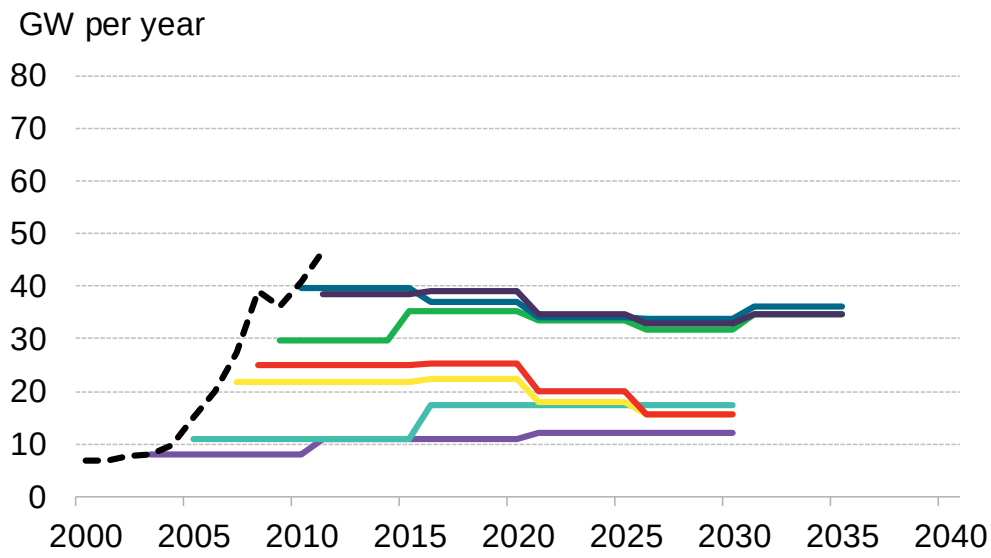

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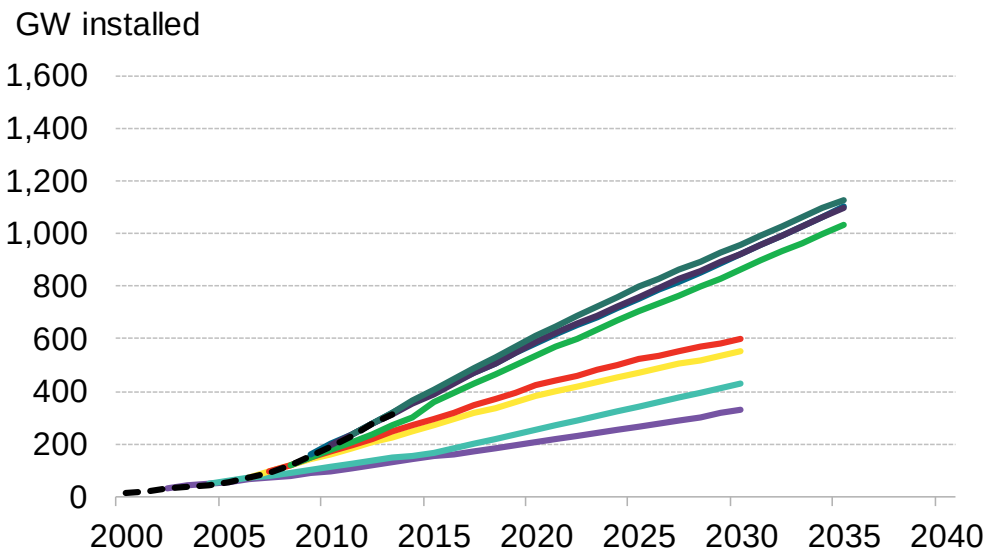

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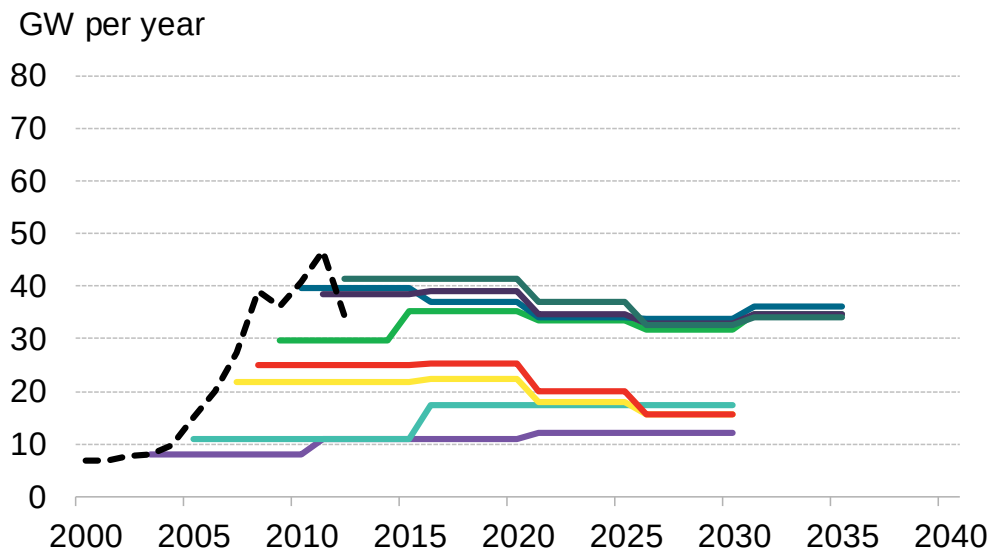

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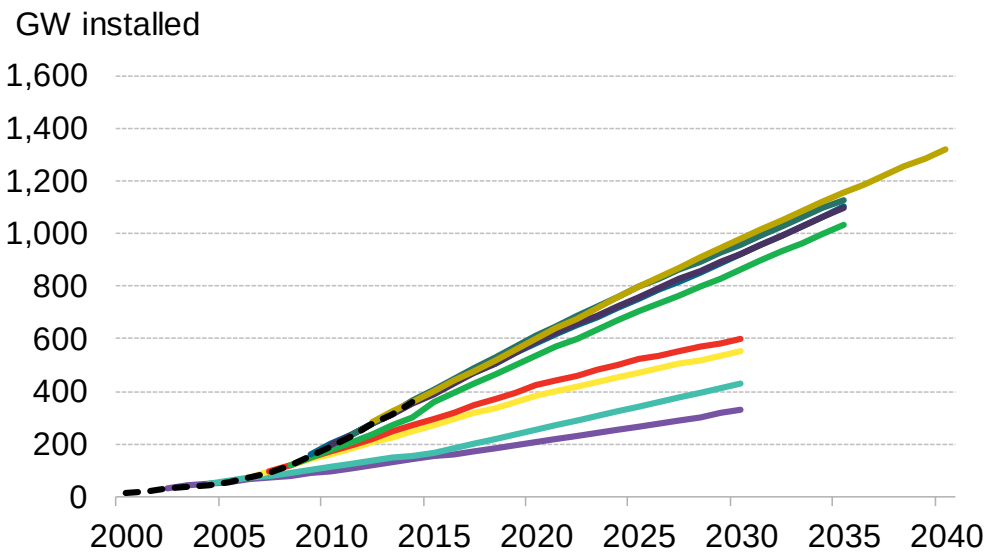

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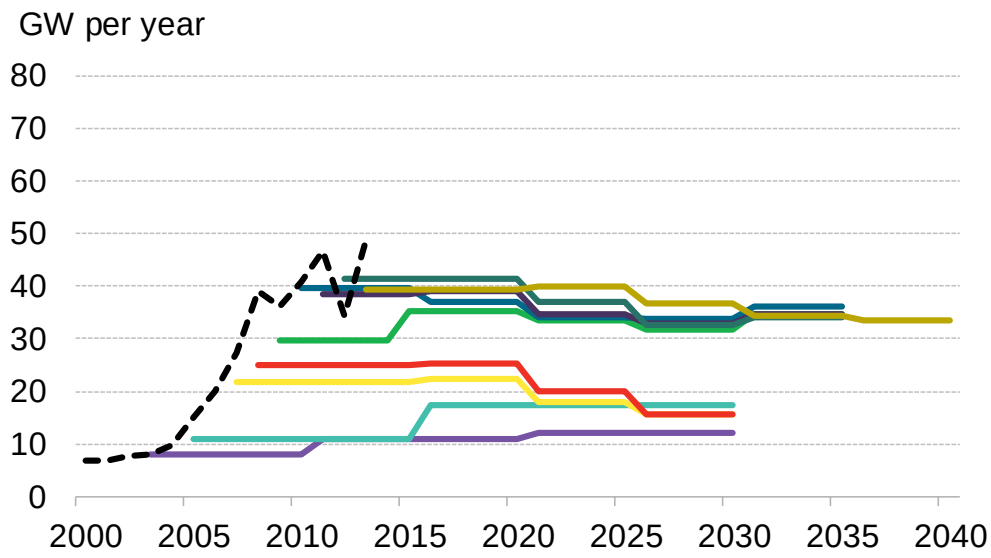

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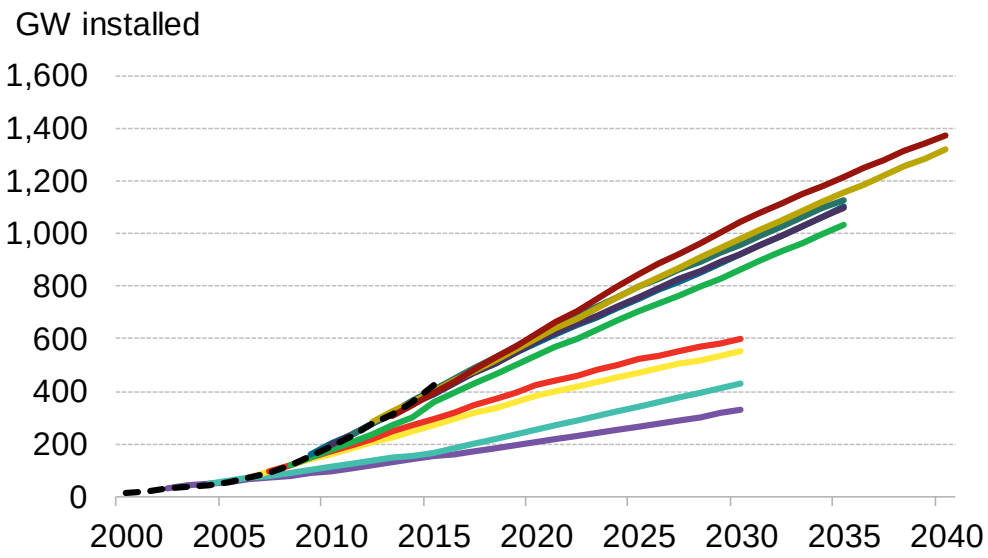

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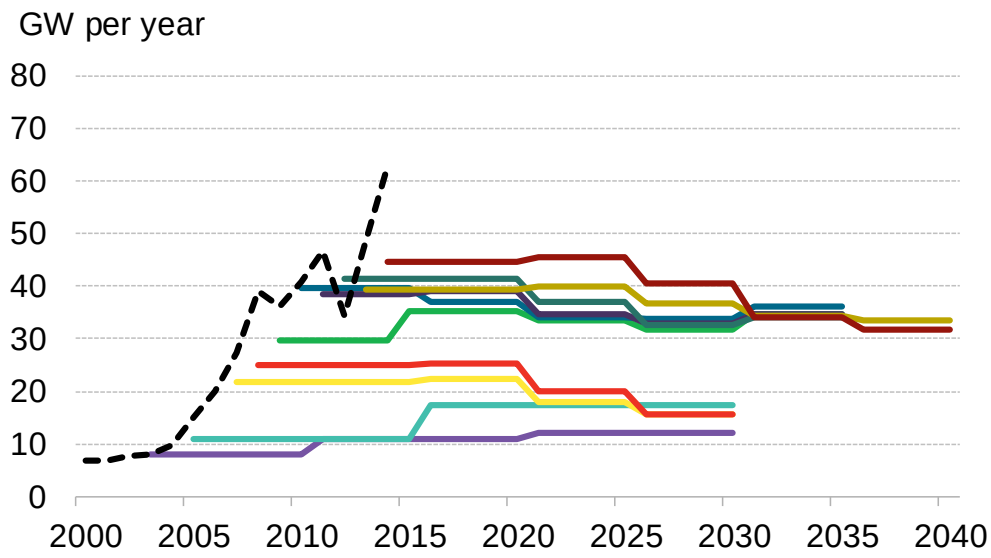

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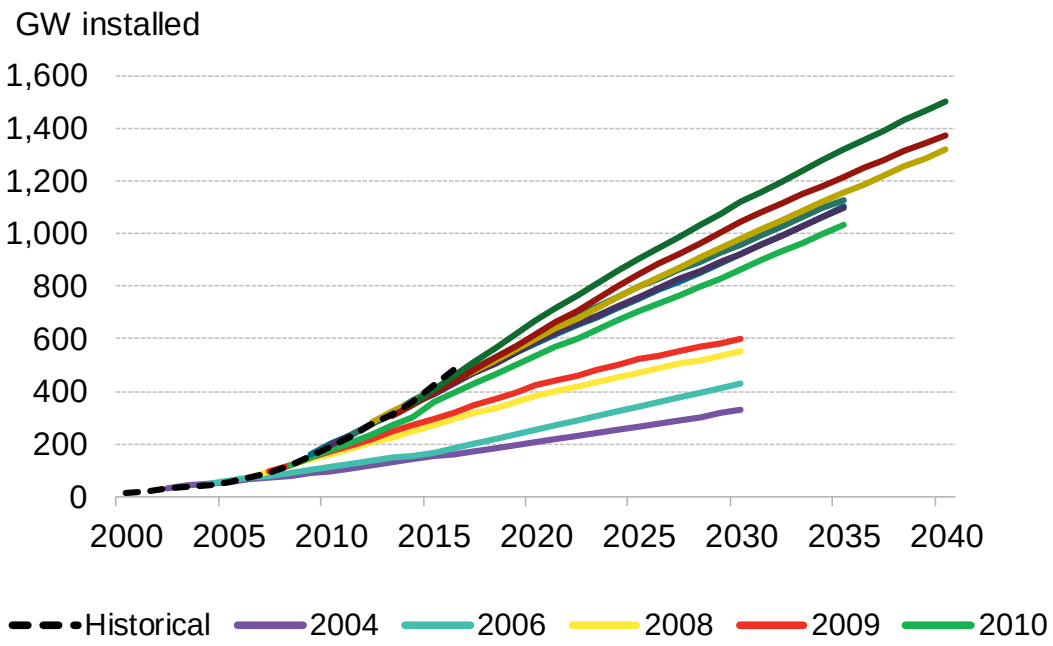

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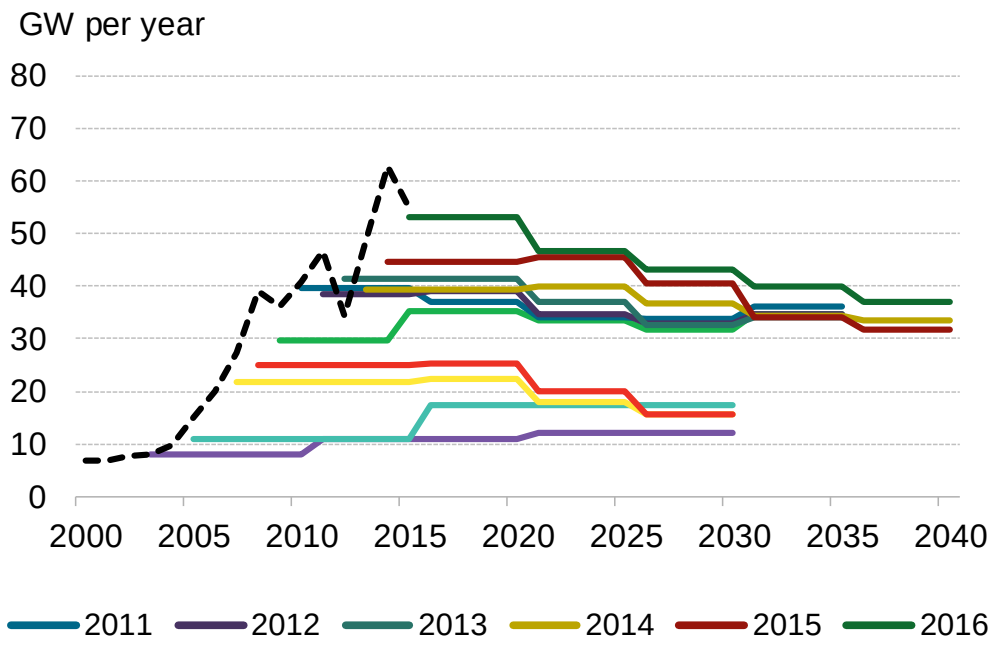

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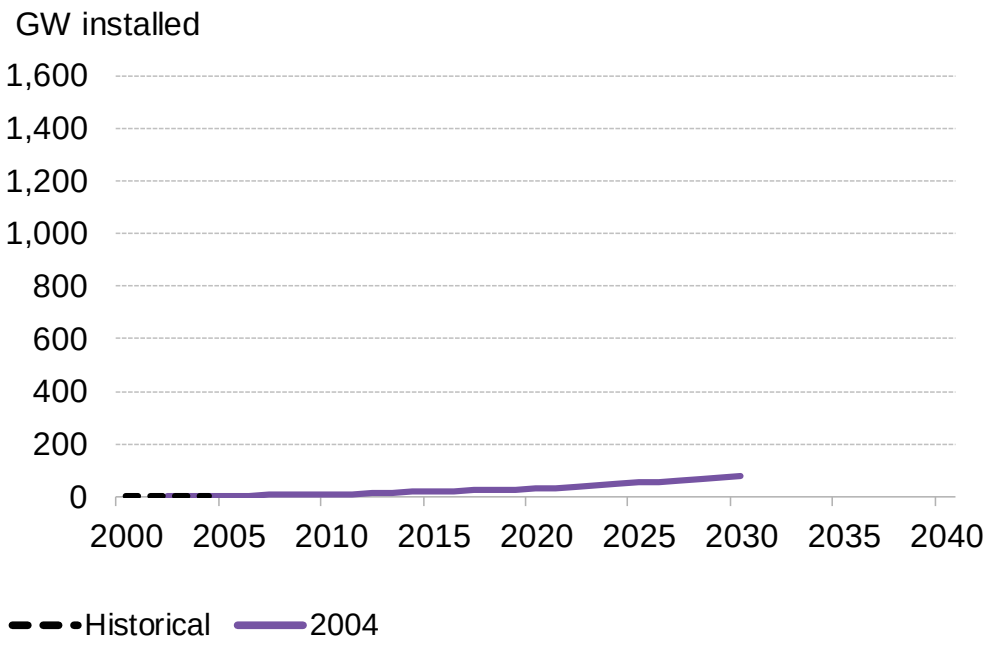

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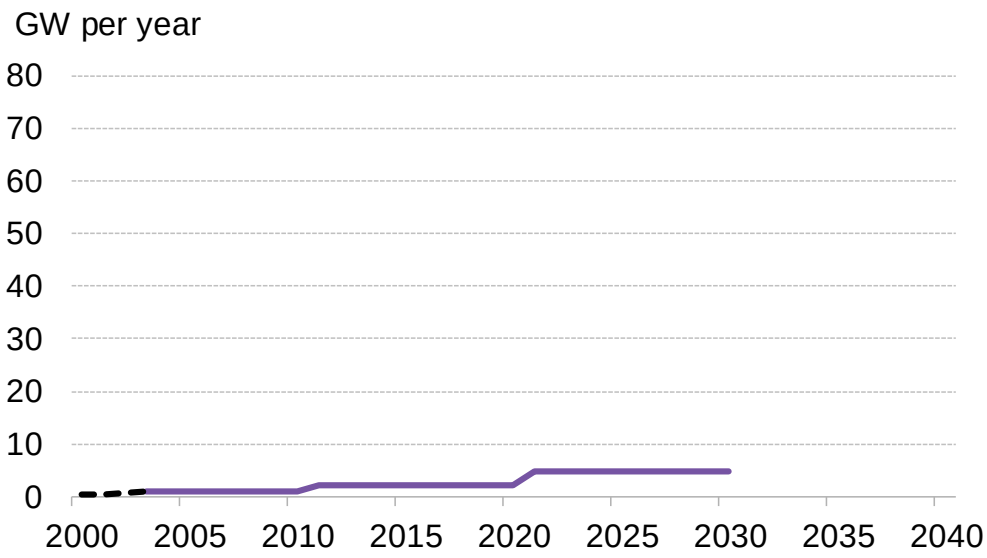

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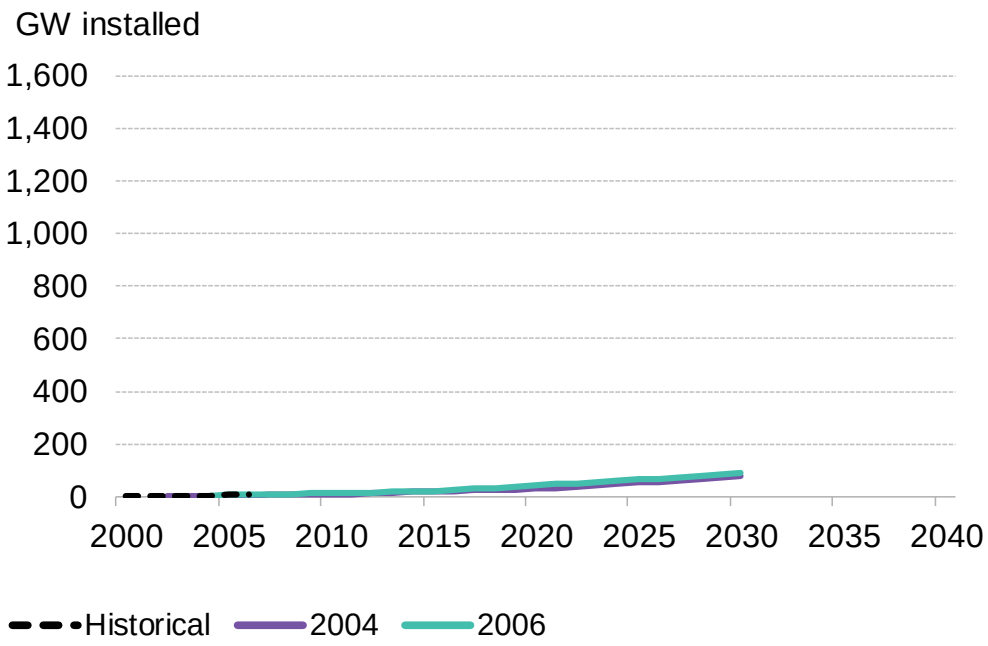

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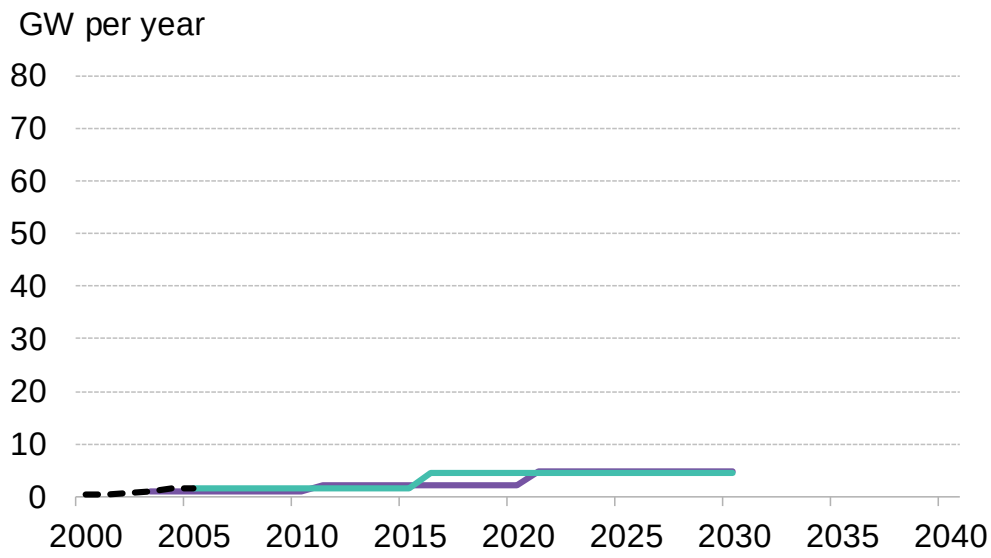

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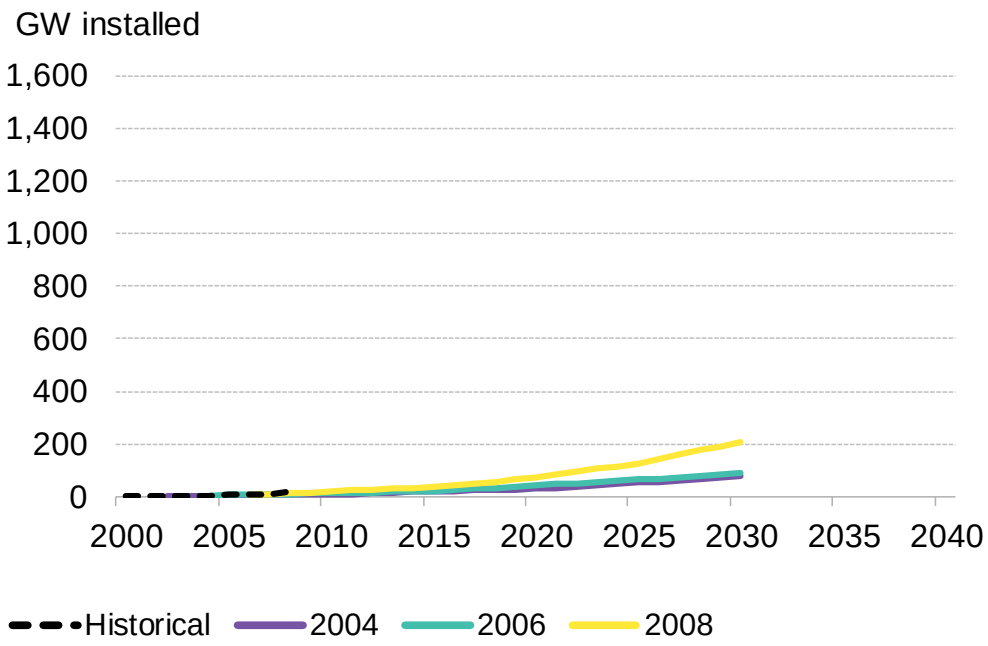

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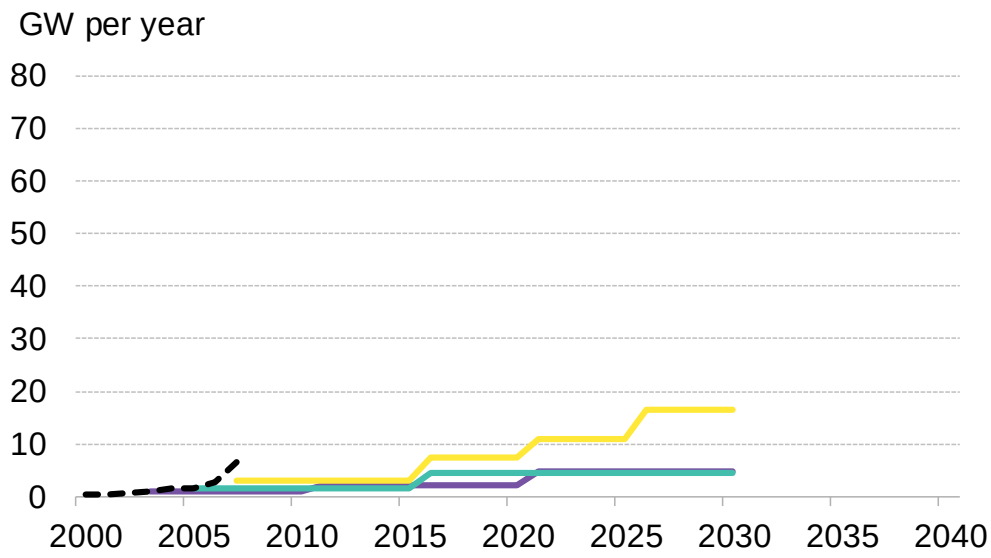

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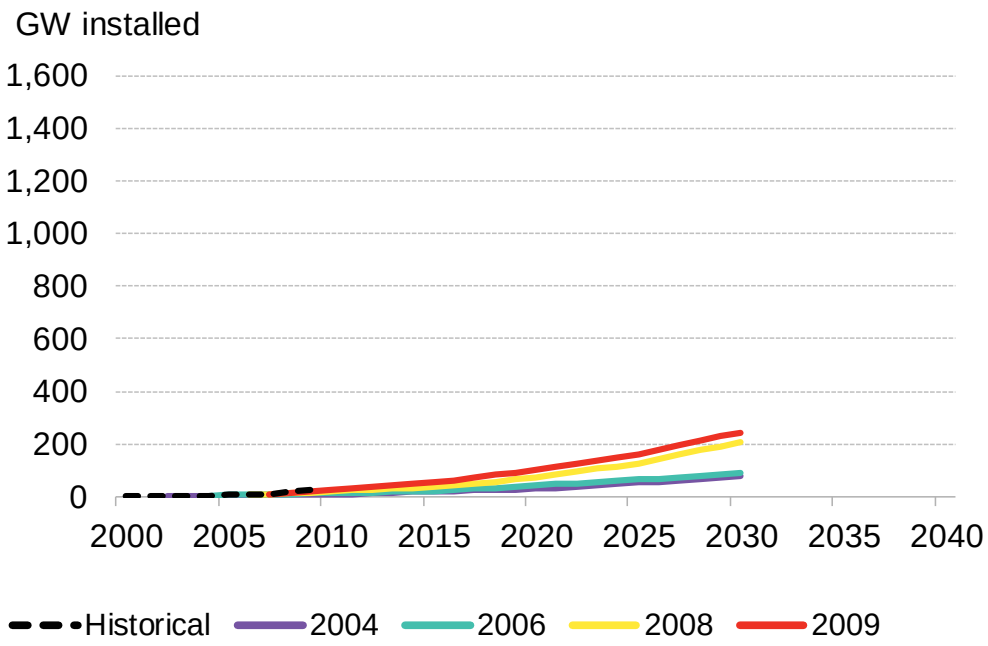

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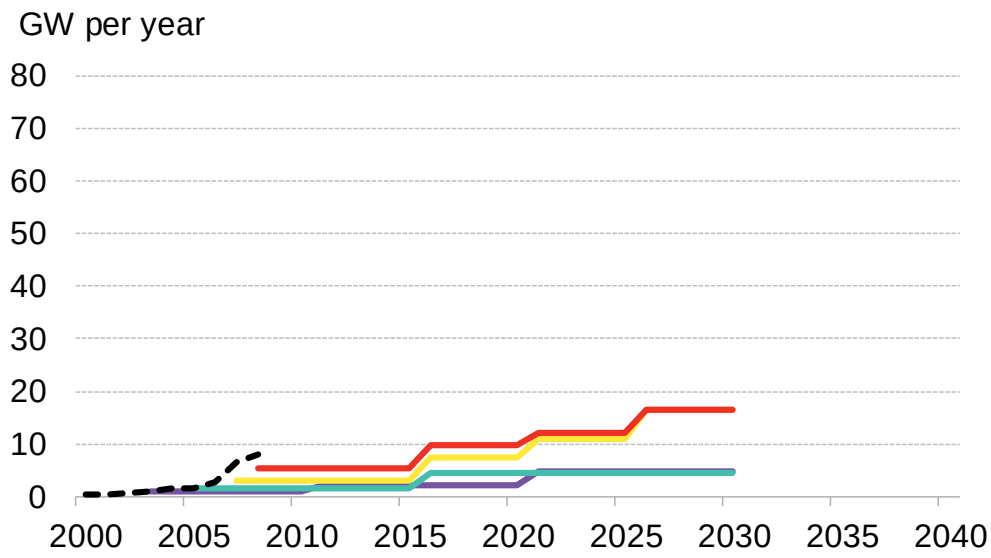

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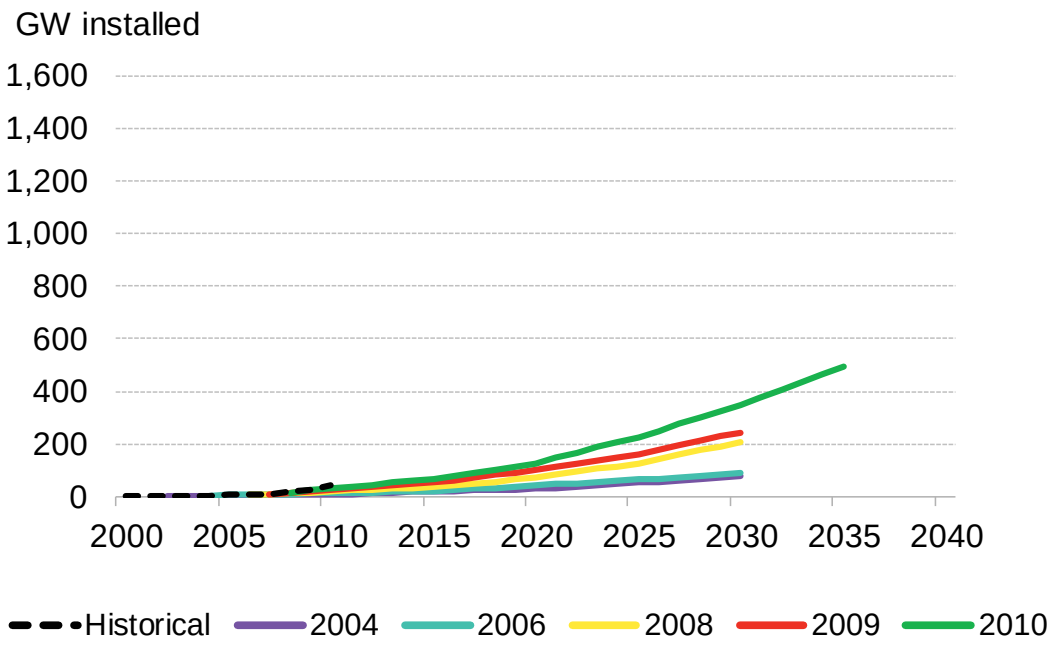

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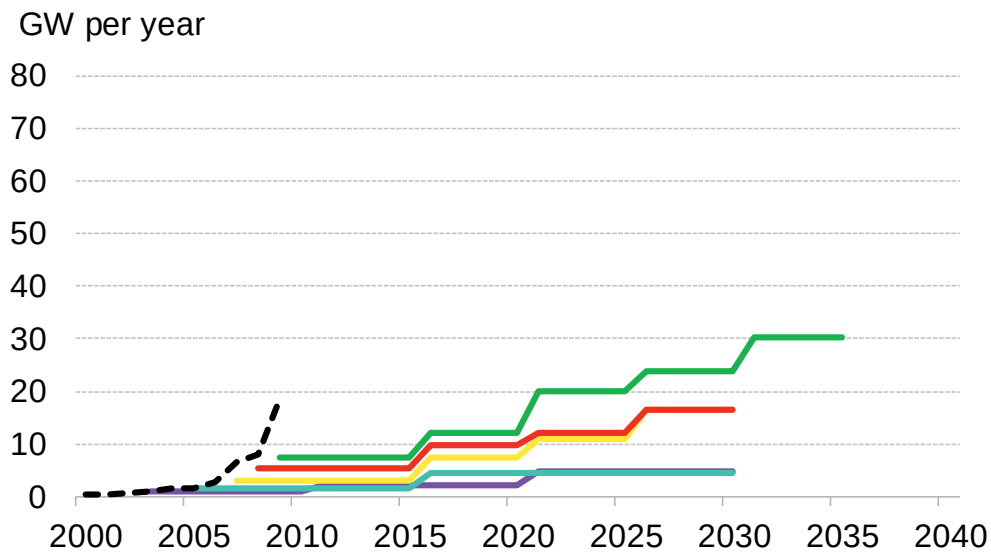

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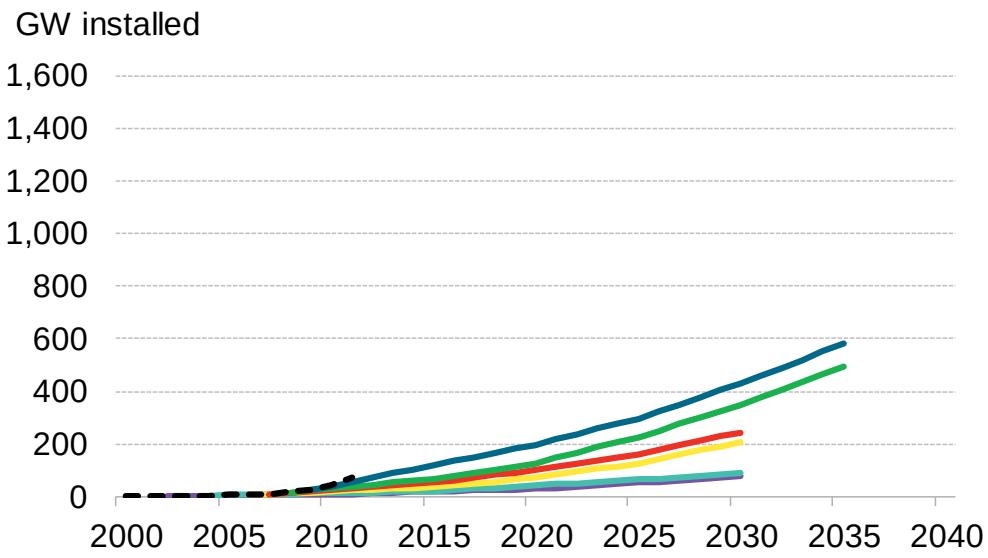

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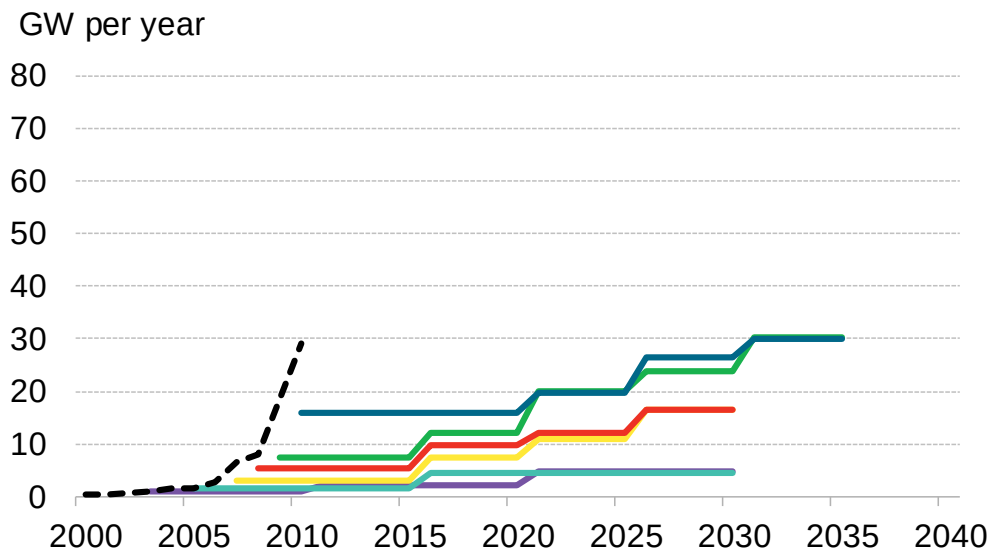

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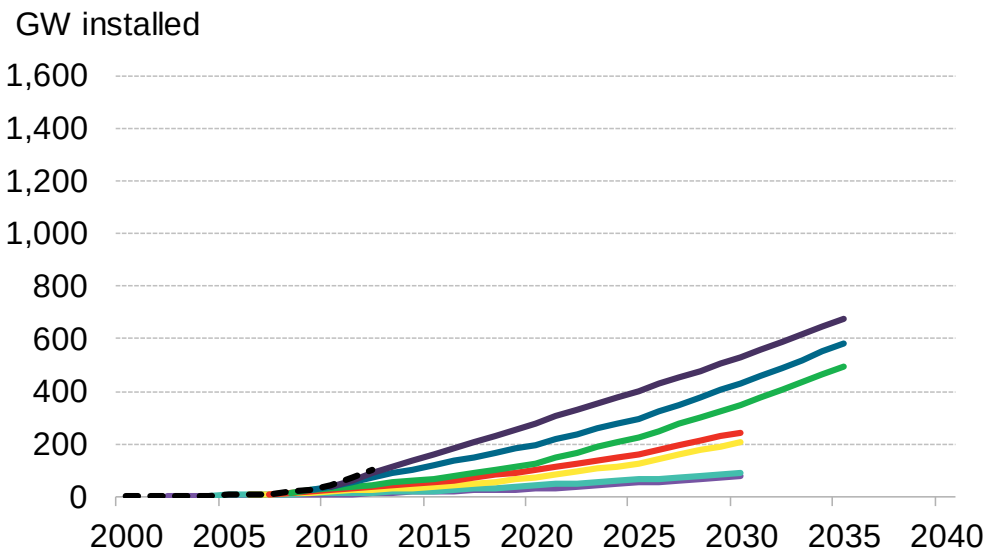

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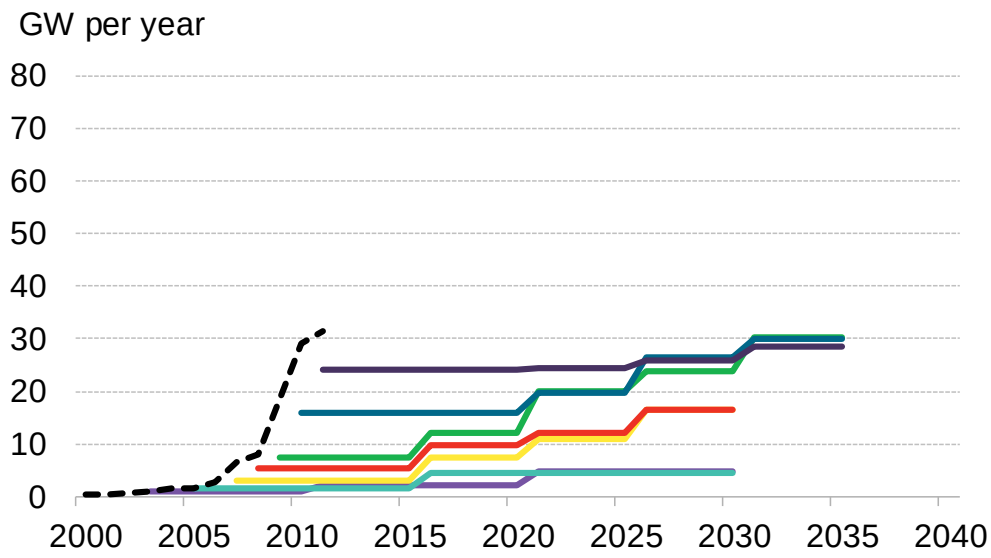

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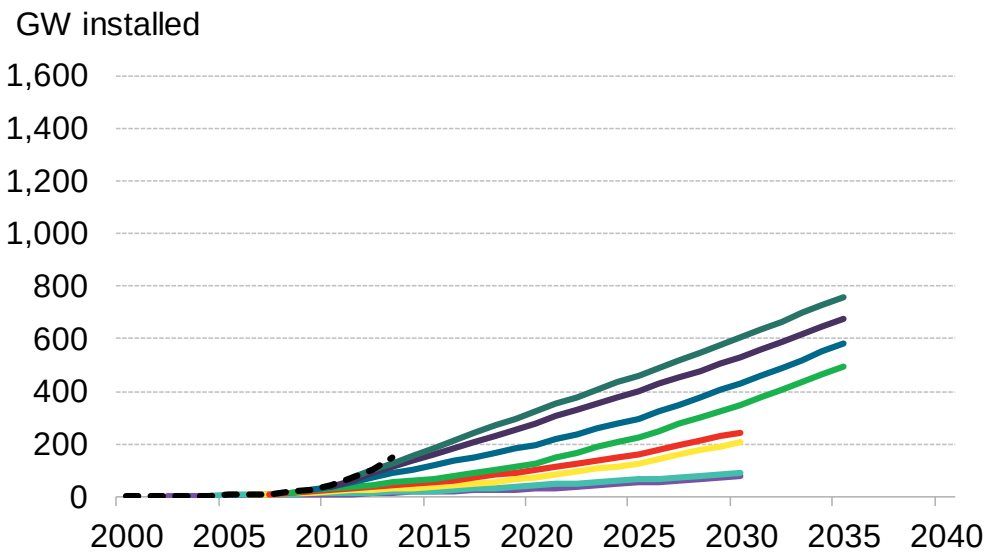
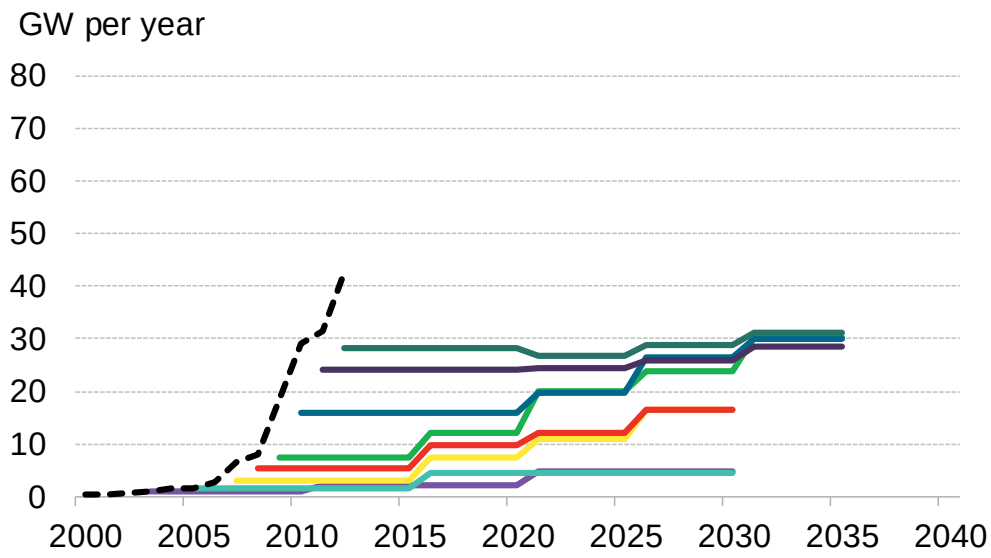
Global cumulative solar installations



Annual solar additions



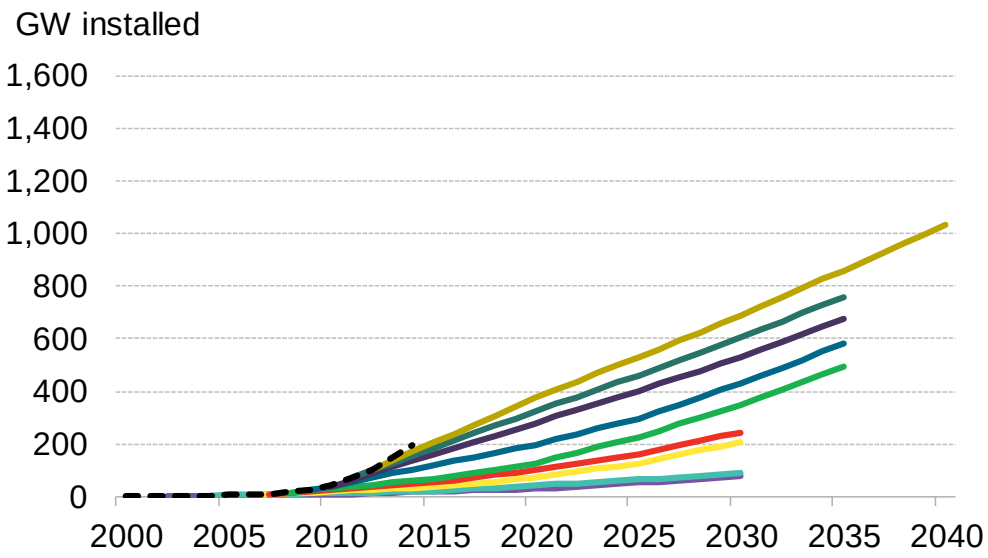
Historical 2004 2006 2008 2009 2010 2011 2012 2013

Note: 2004-2009 Reference, 2010-2016 New Policies Scenario

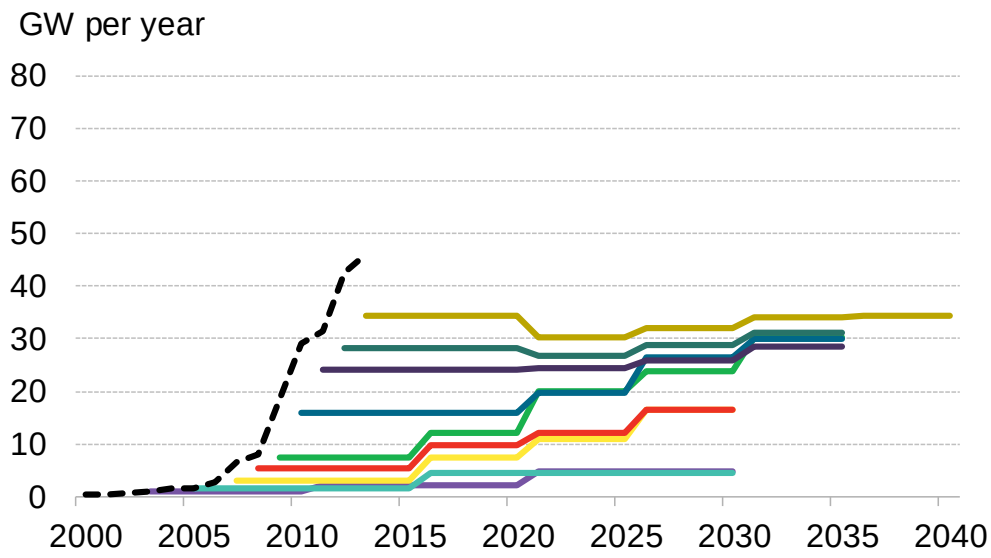
Source: IEA World Energy Outlook

IEA solar capacity forecast evolution

Global cumulative solar installations



Annual solar additions



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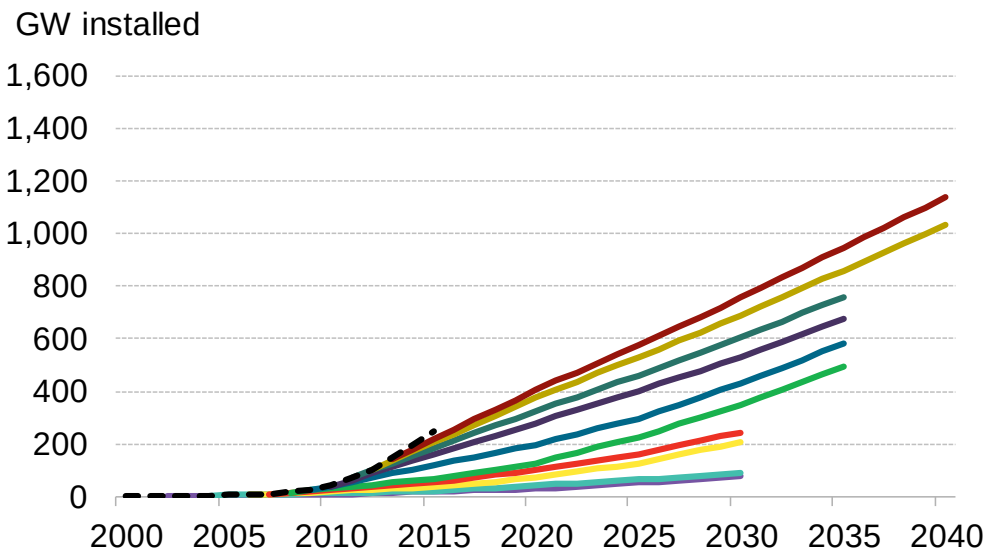
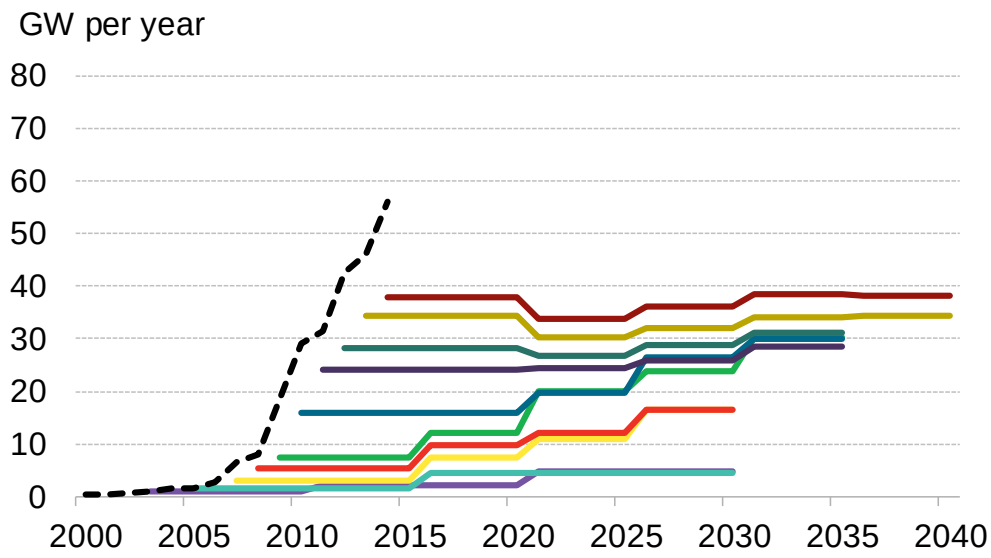


Annual solar additions



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Note: 2004-2009 Reference, 2010-2016 New Policies Scenario

Source: IEA World Energy Outlook

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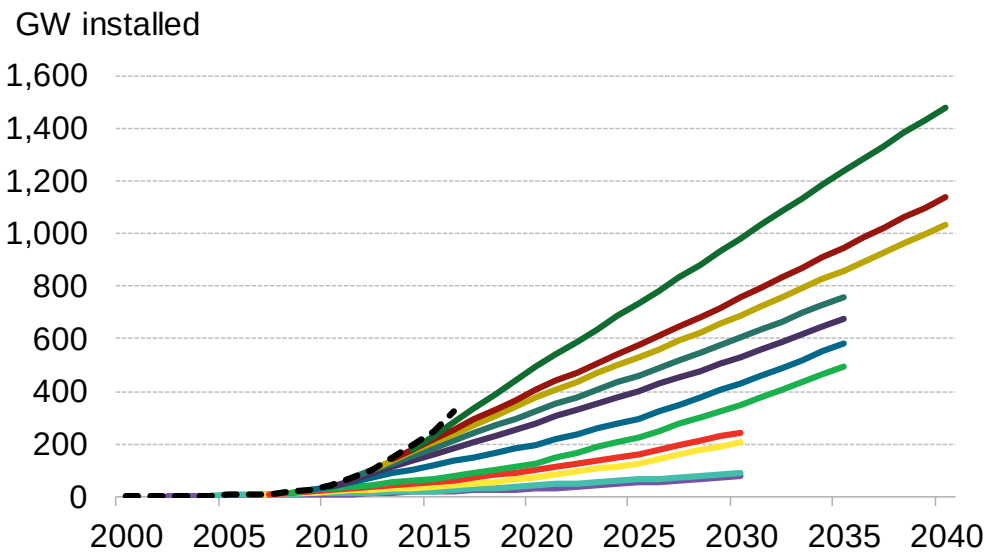
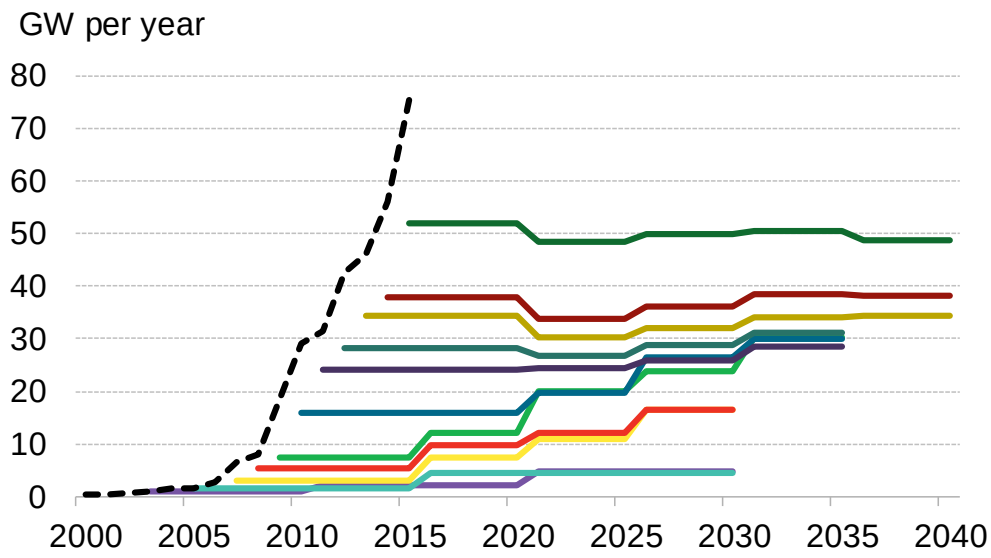


Annual solar additions



Historical 2004 2006 2008 2009 2010 2011 2012 2013 2014 2015 2016

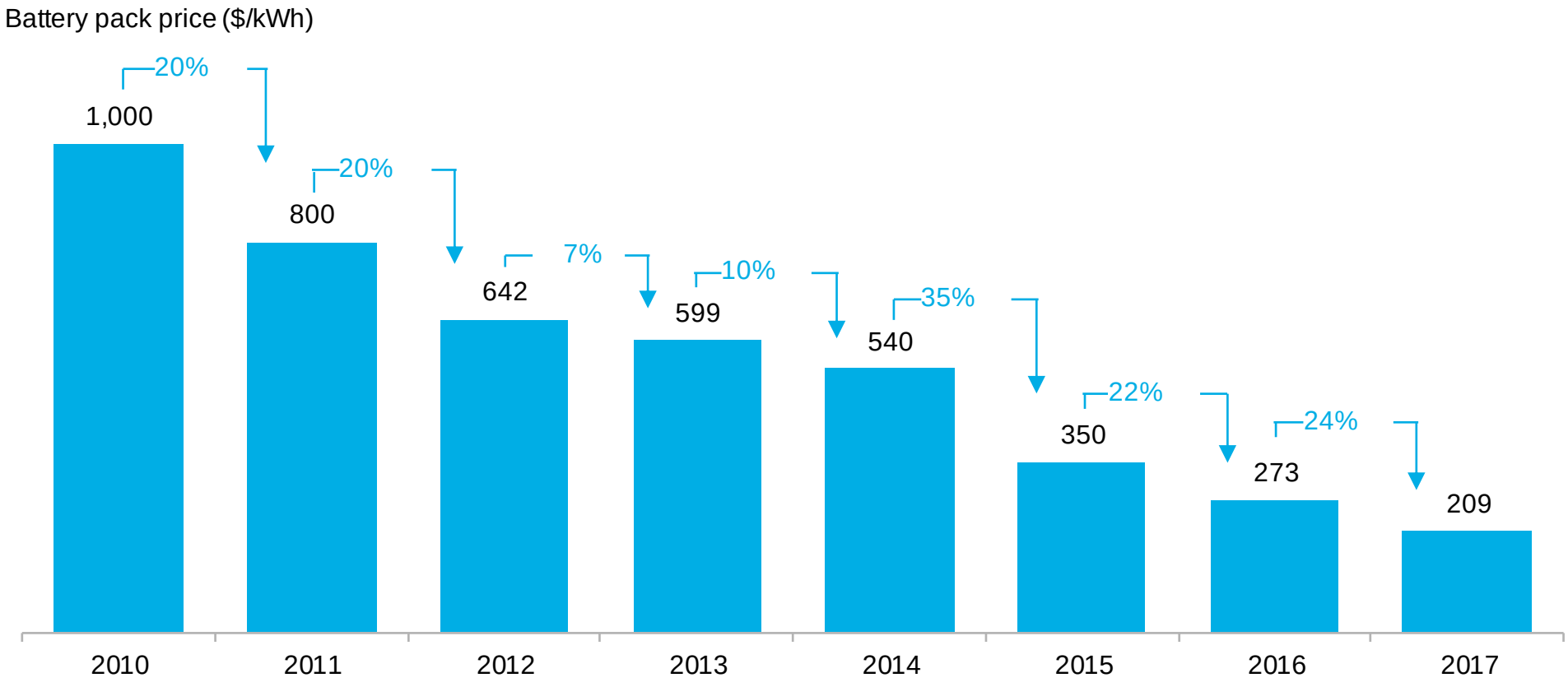
Note: 2004-2009 Reference, 2010-2016 New Policies Scenario

Source: IEA World Energy Outlook

Curve Ball: Batteries

Photos: Wikimedia Commons; DigitalGlobe; Pete Marovich/Bloomberg; KAL/Economist

BNEF EV lithium-ion battery pack price survey results



Source: Bloomberg New Energy Finance

Electric vehicle sales are accelerating

Time to sell one million electric vehicles

Source: Bloomberg New Energy Finance

Electric vehicle sales are accelerating

Time to sell one million electric vehicles

Source: Bloomberg New Energy Finance

Electric vehicle sales are accelerating

Time to sell one million electric vehicles

Source: Bloomberg New Energy Finance

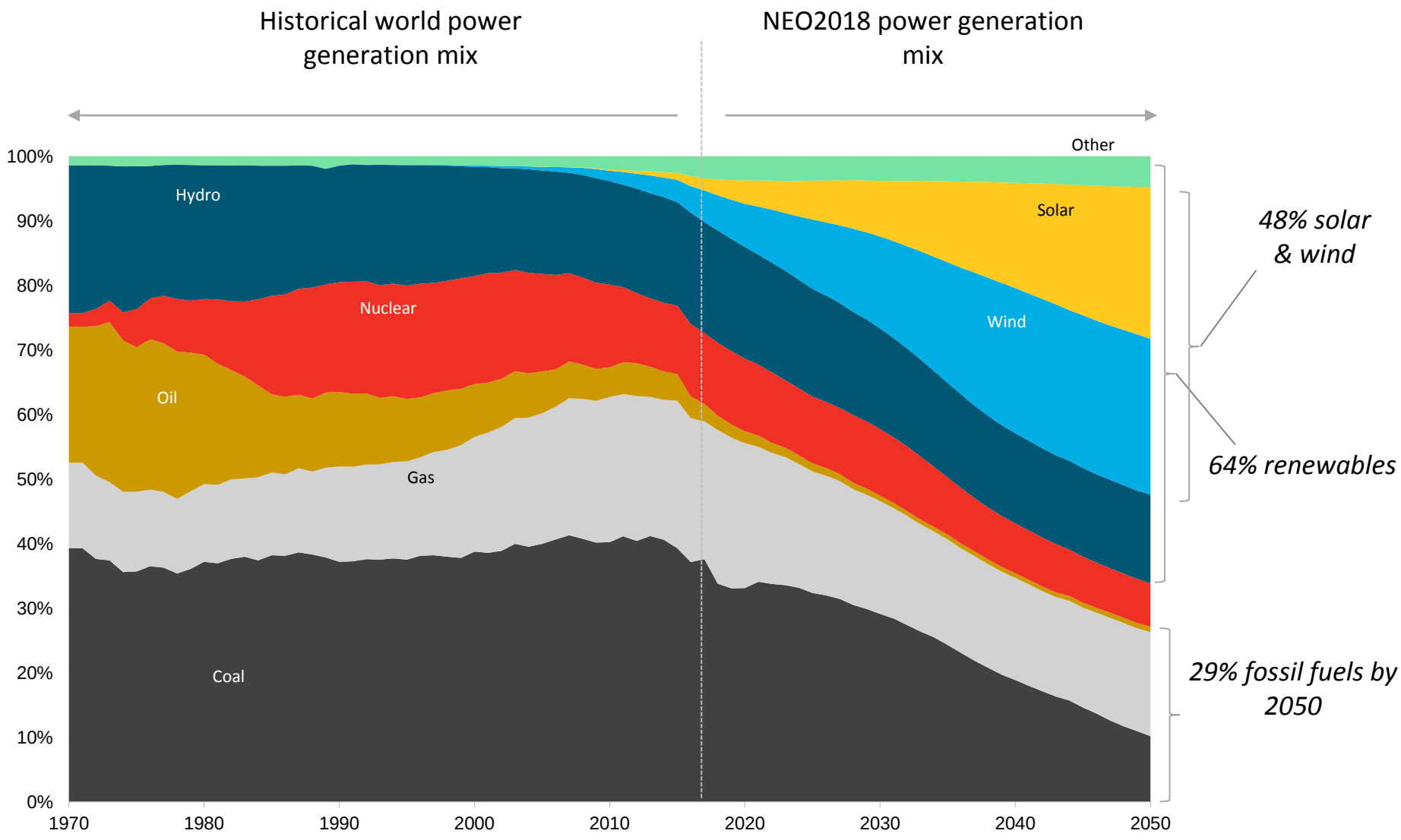
The world tomorrow?

Source: NASA

Renewable Energy

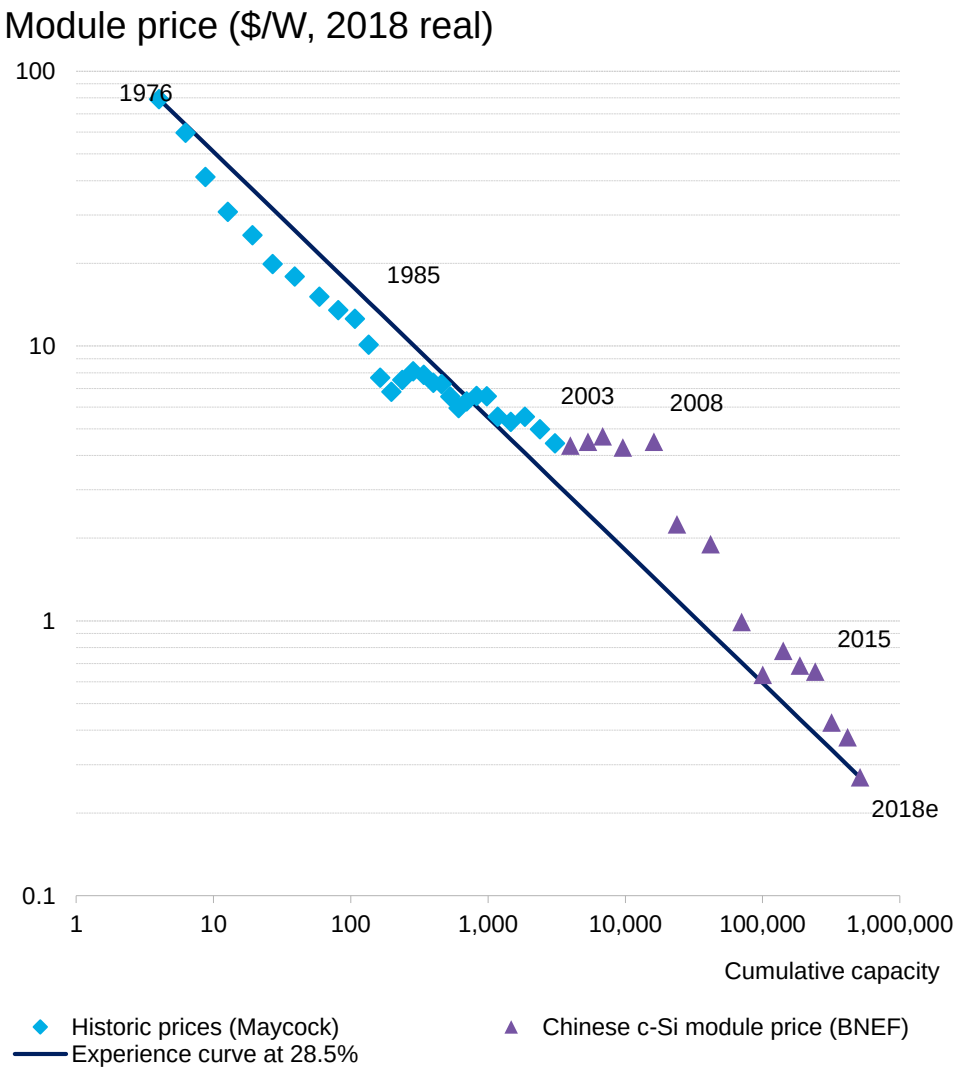
Higher cost efficiency for wind and solar

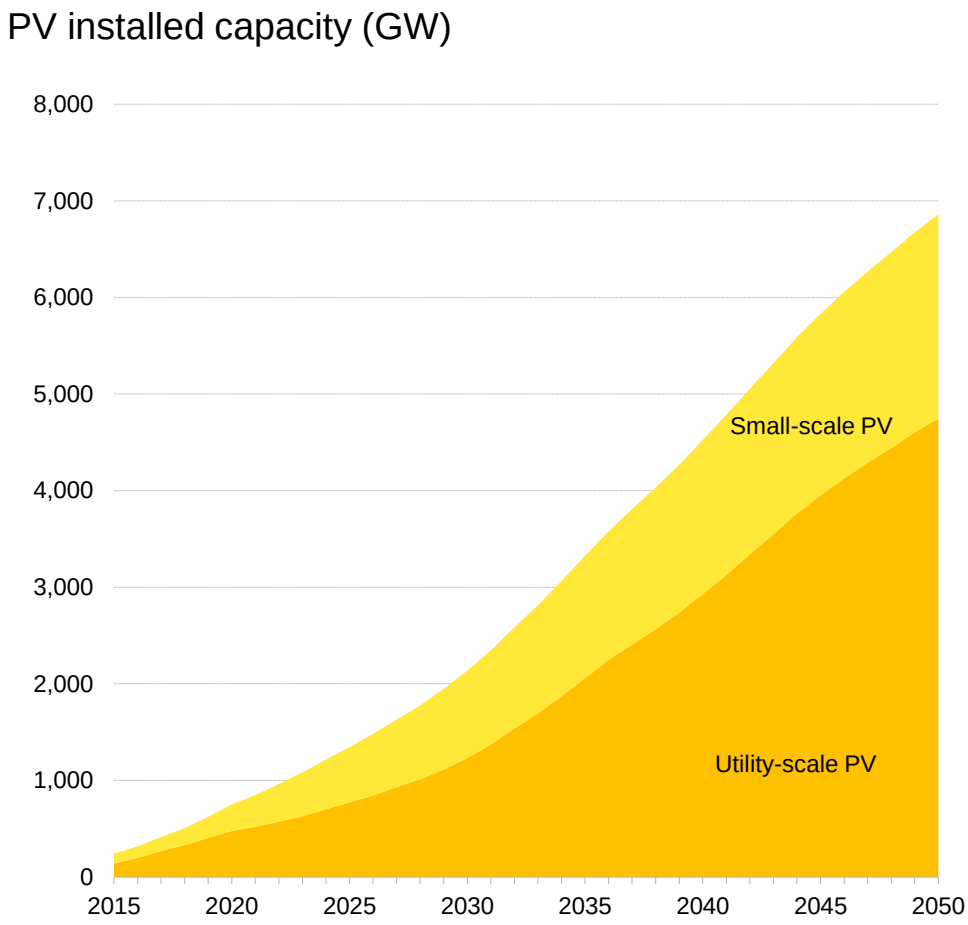
Accelerating renewable growth



BloombergNEF

Falling solar prices drive adoption

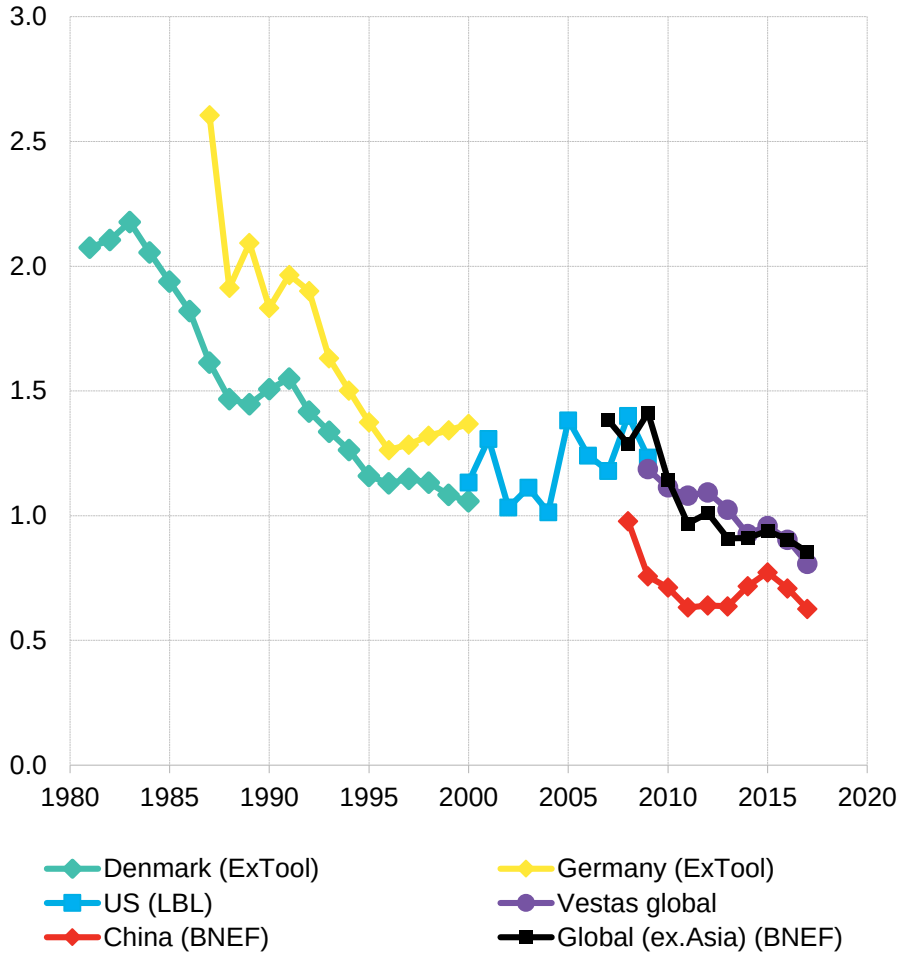




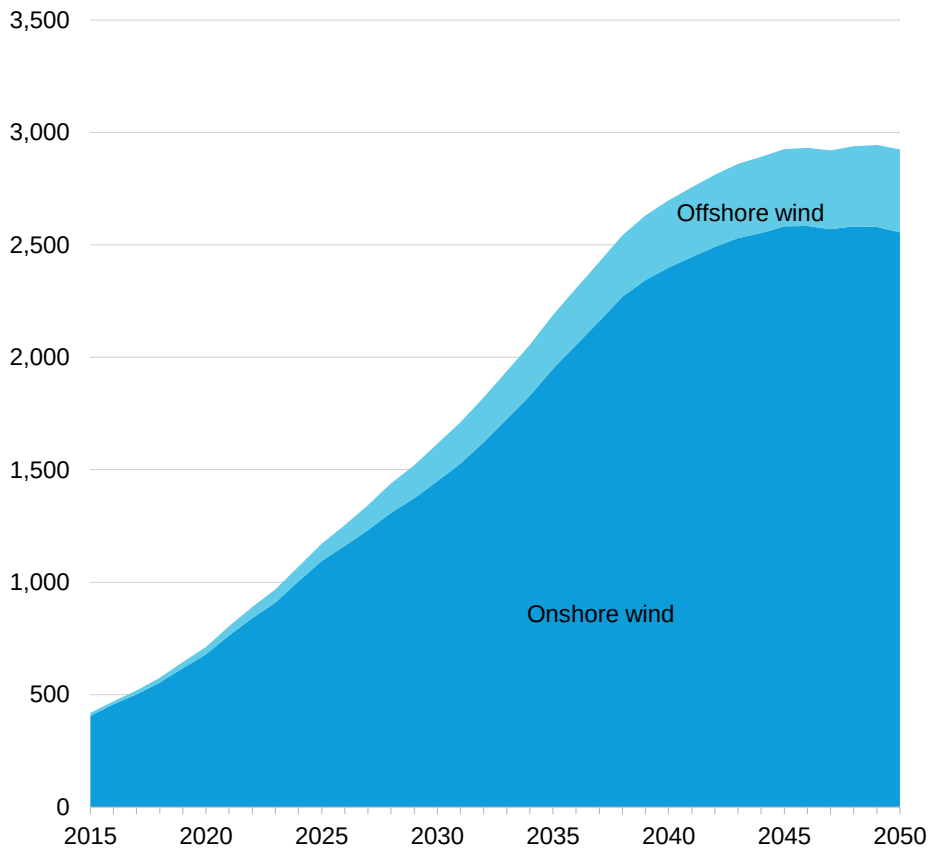
BloombergNEF

Wind follows similar trend

Wind turbine price (mEUR/MW, 2017 real)

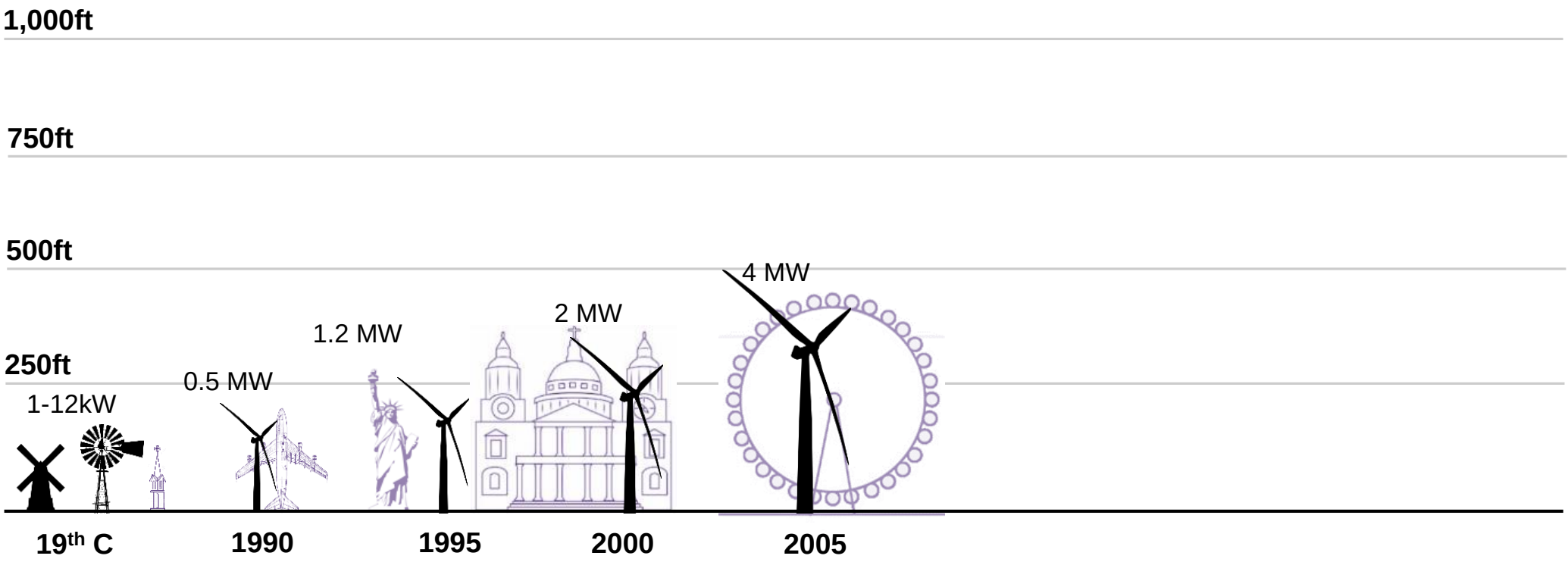


Wind installed capacity (GW)



Efficiency in wind

Evolution of wind turbine heights and output

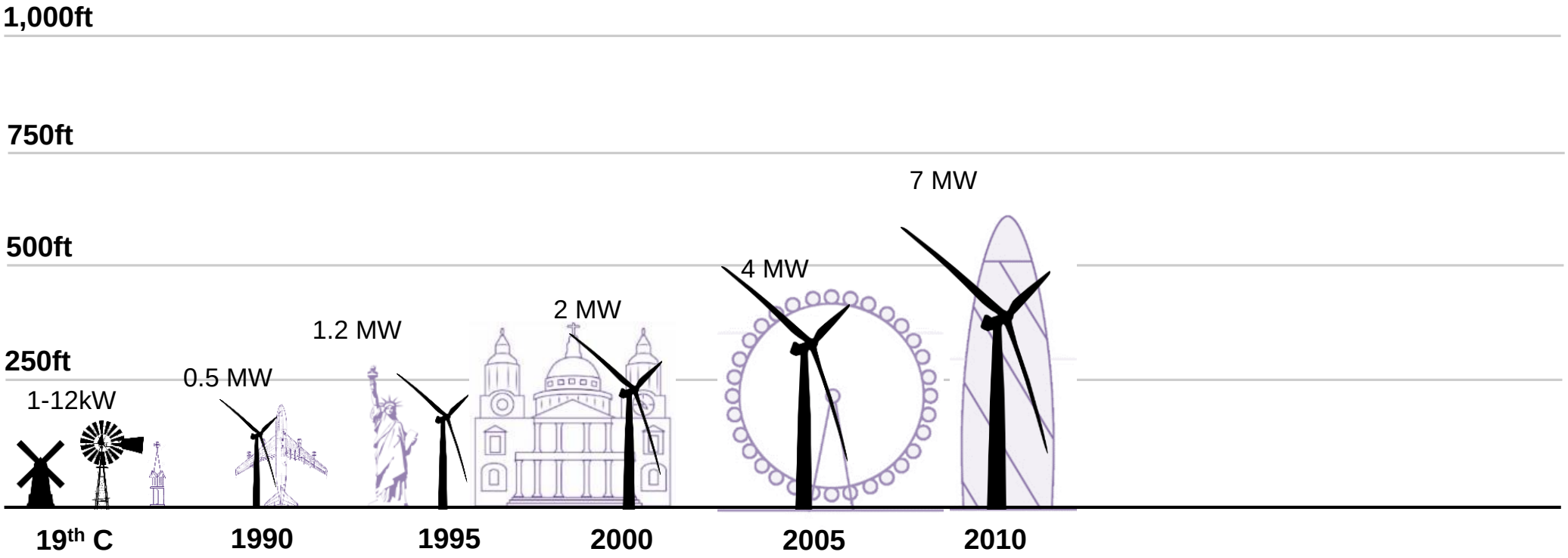


Sources: Various; Bloomberg New Energy Finance

Efficiency in wind

Evolution of wind turbine heights and output

75% increase



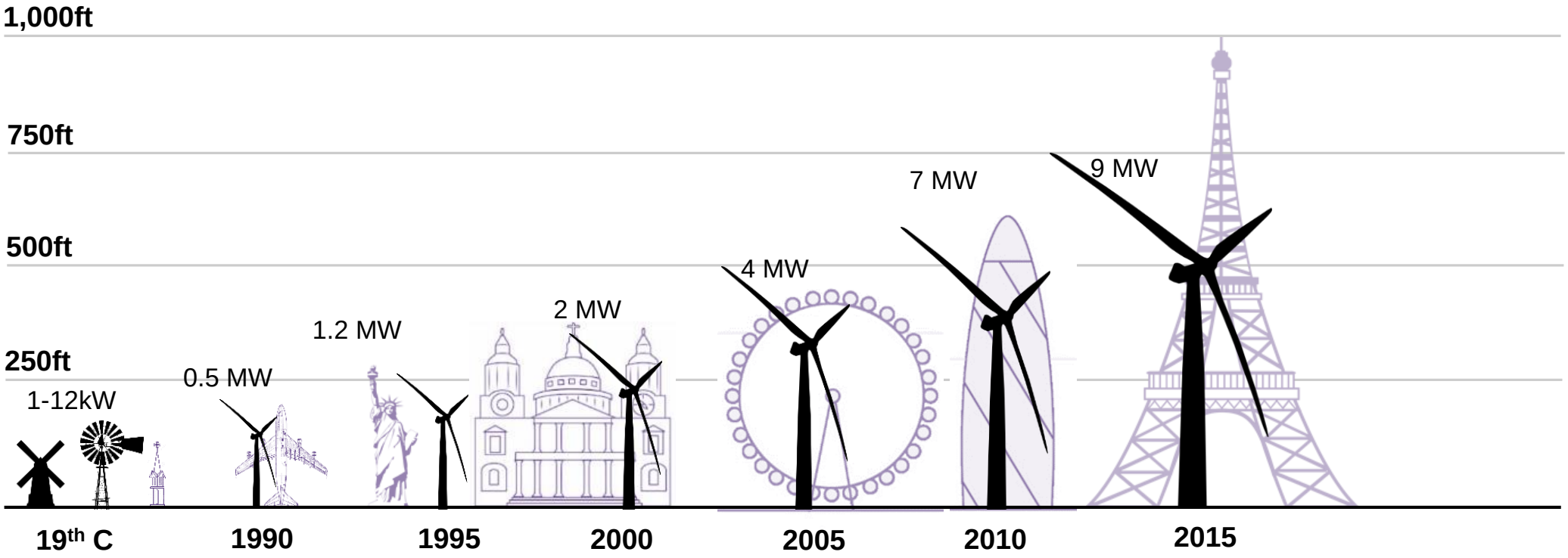
Sources: Various; Bloomberg New Energy Finance

BloombergNEF

Efficiency in wind

Evolution of wind turbine heights and output

29% increase

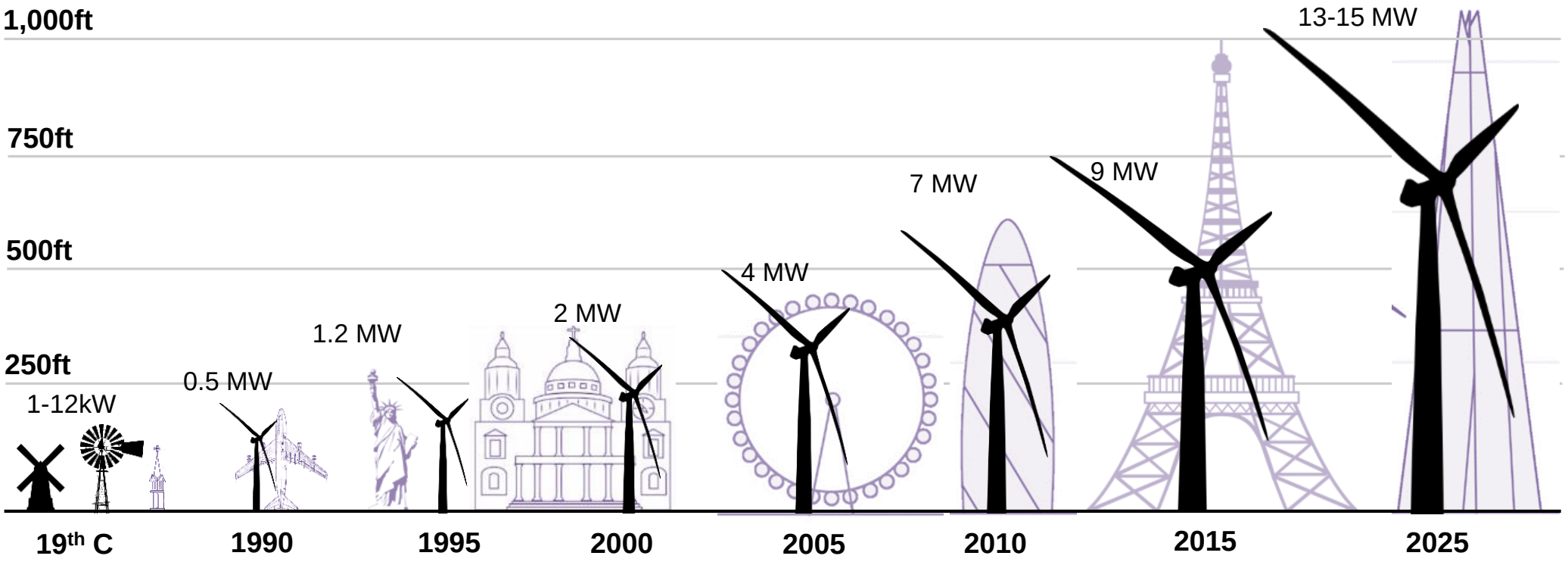


Sources: Various; Bloomberg New Energy Finance

Efficiency in wind

Evolution of wind turbine heights and output

56% increase

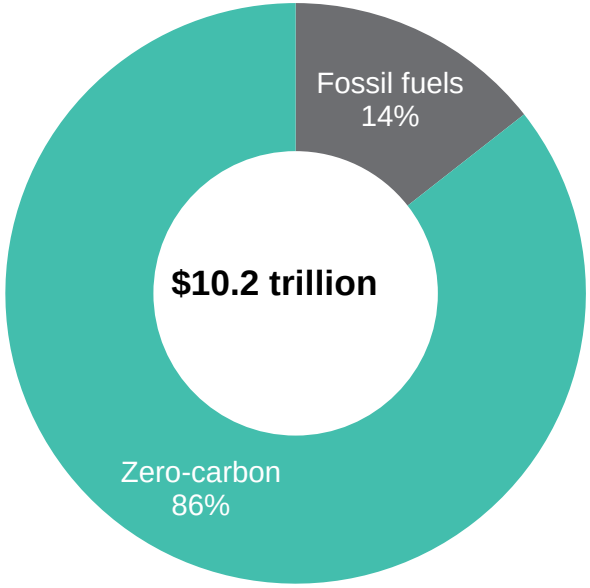


Sources: Various; Bloomberg New Energy Finance

BloombergNEF

Solar and wind attract 60% of new investment in power generating capacity

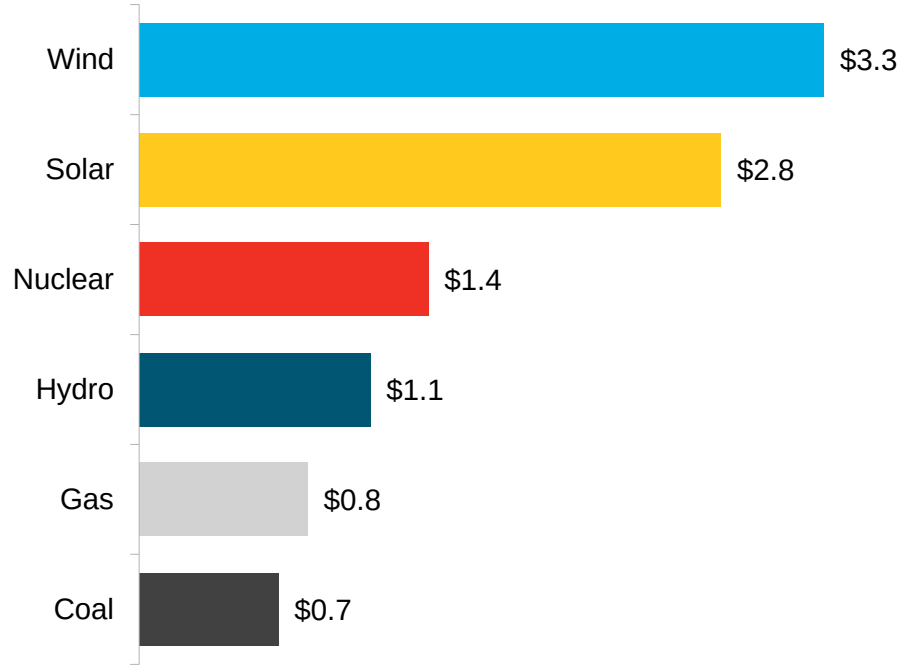
Investment, by technology, 2017-2040



Source: Bloomberg New Energy Finance New Energy Outlook 2017

Investment, by technology, 2017-2040

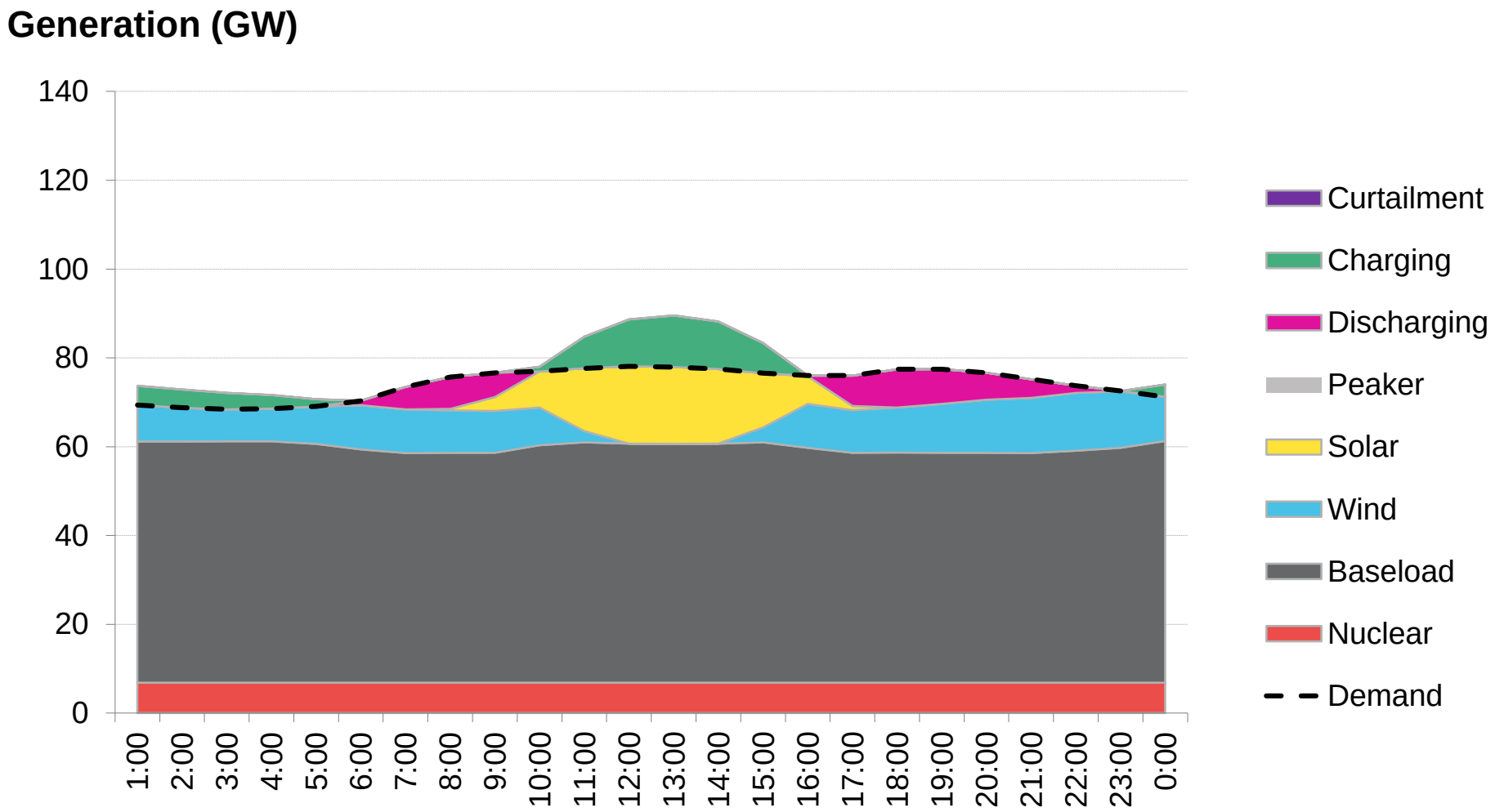
($ trillion - 2016 real)



Source: Bloomberg New Energy Finance New Energy Outlook 2017

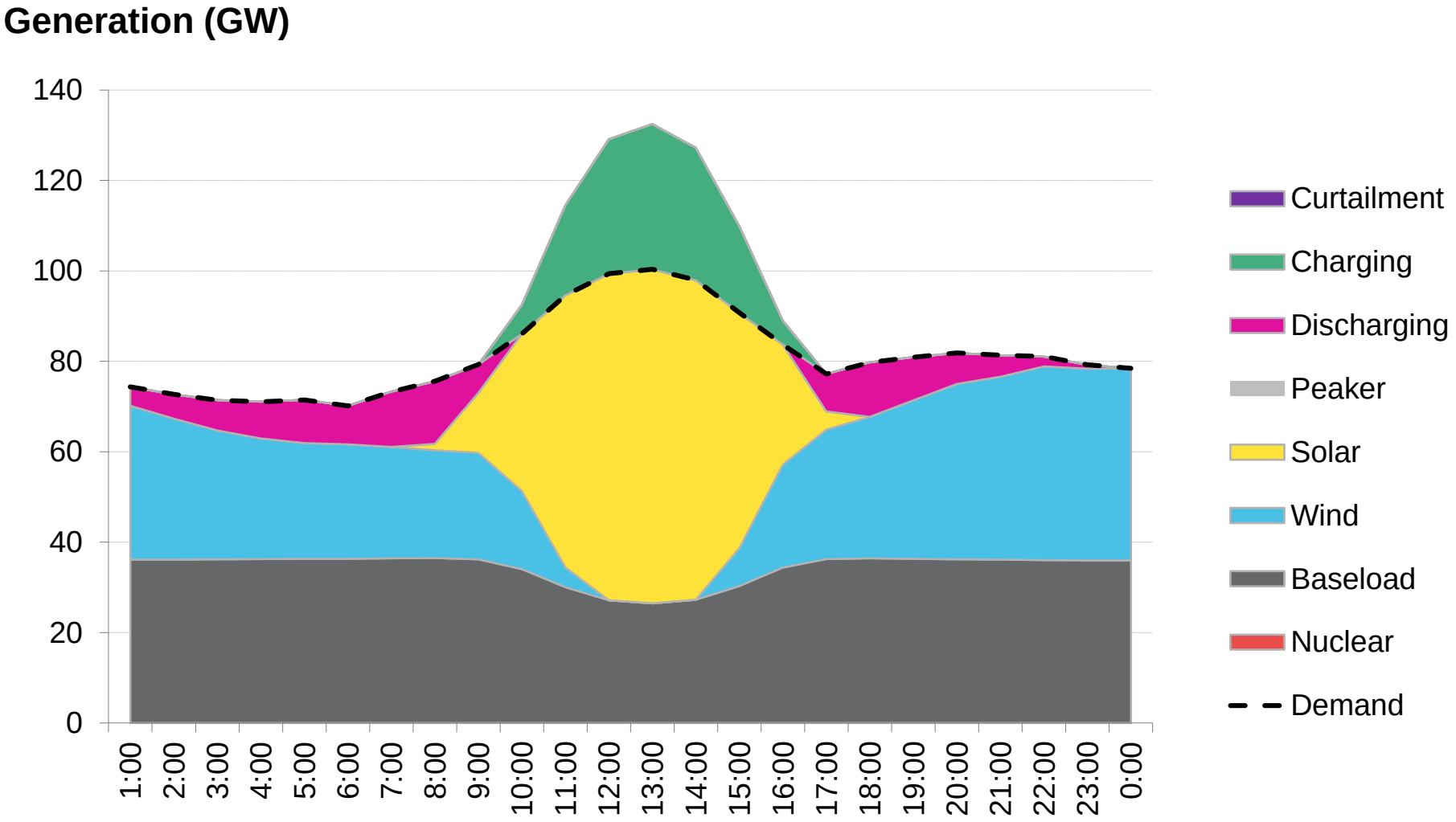
How does this change power?

Intraday power generation by source: Germany 2020



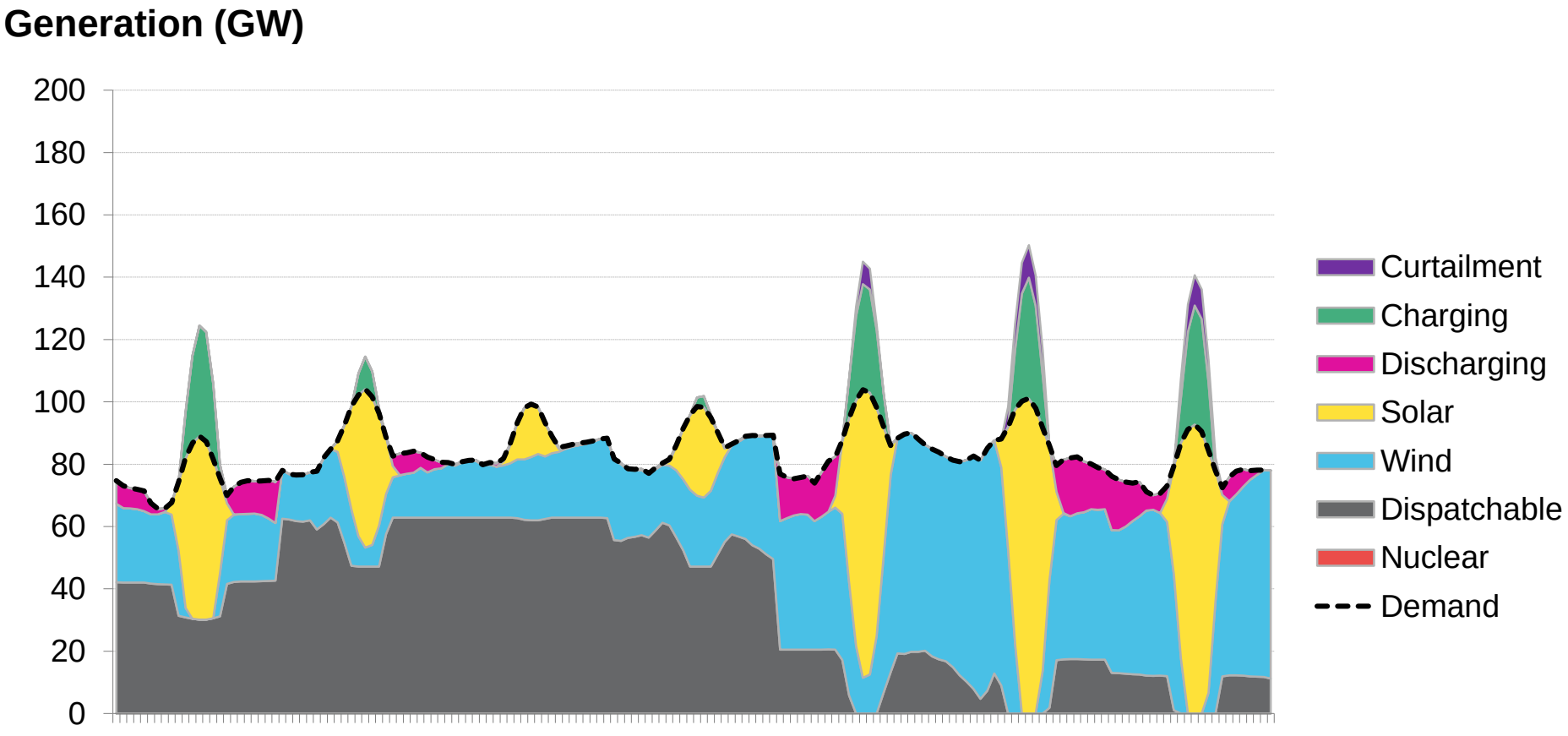
How does this change power?

Intraday power generation by source: Germany 2040



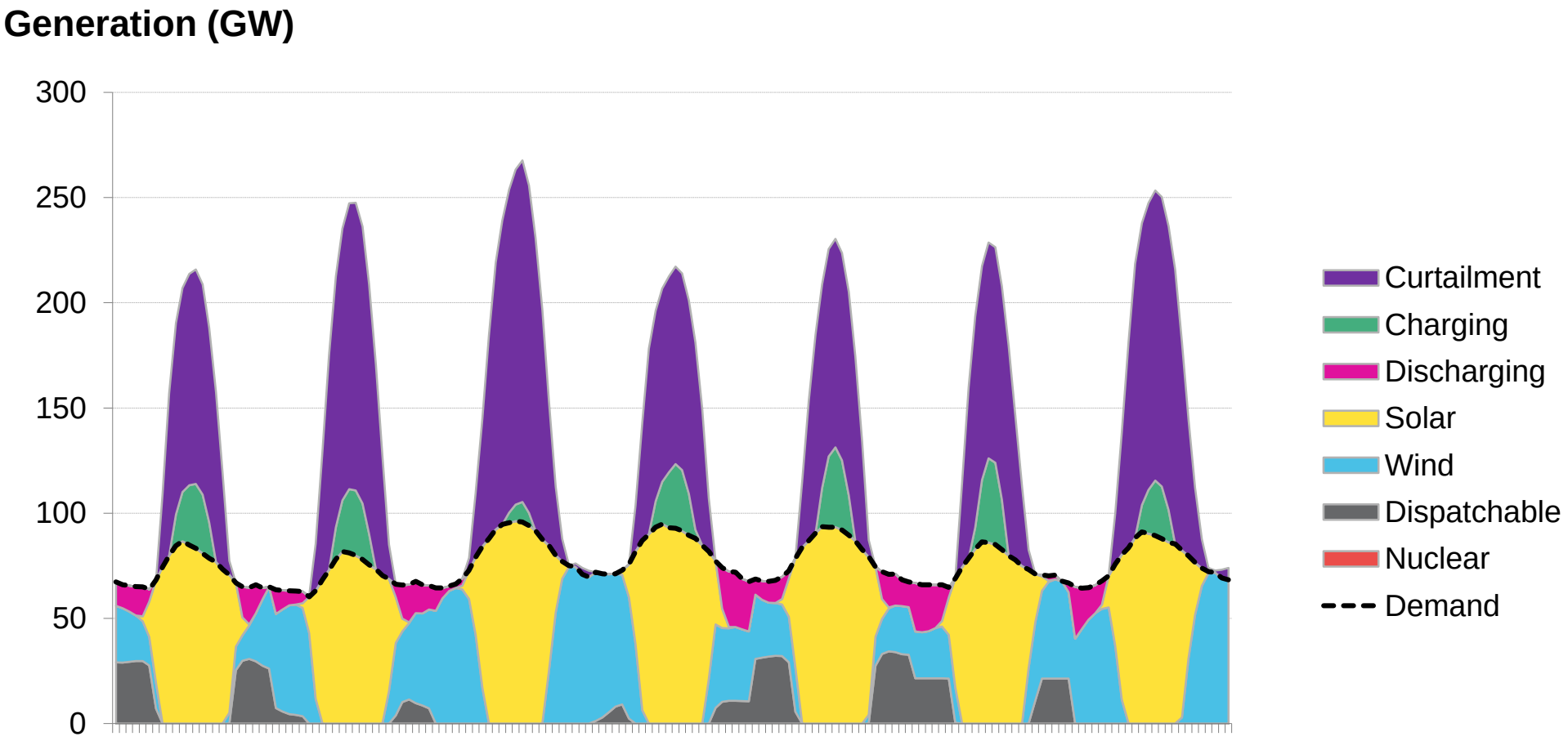
What about for a week?

Germany low renewable generation week, 2040



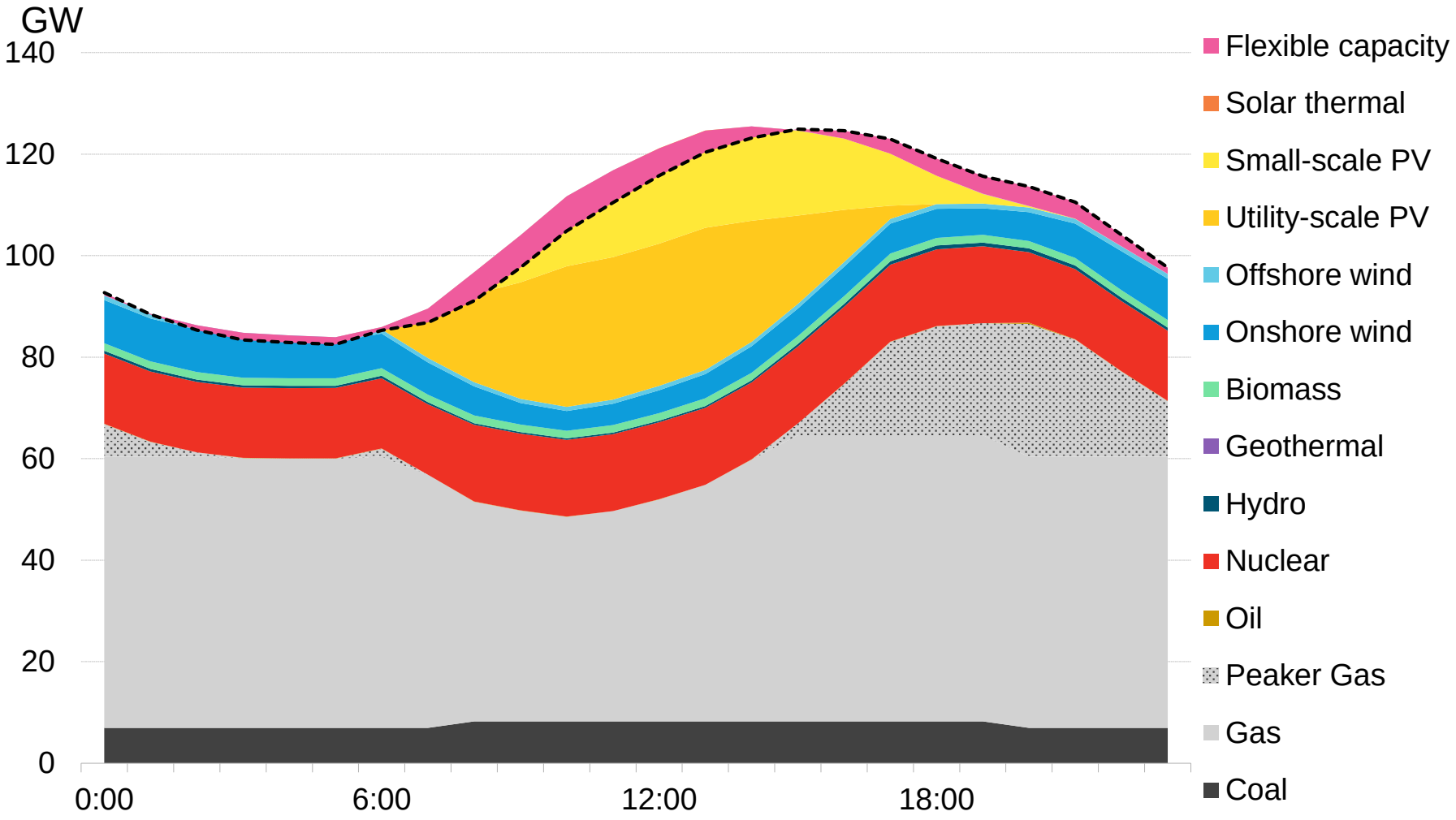
What about for a week?

Germany high renewable generation week, 2040



How about for the US?

Daily dispatch, PJM 2040

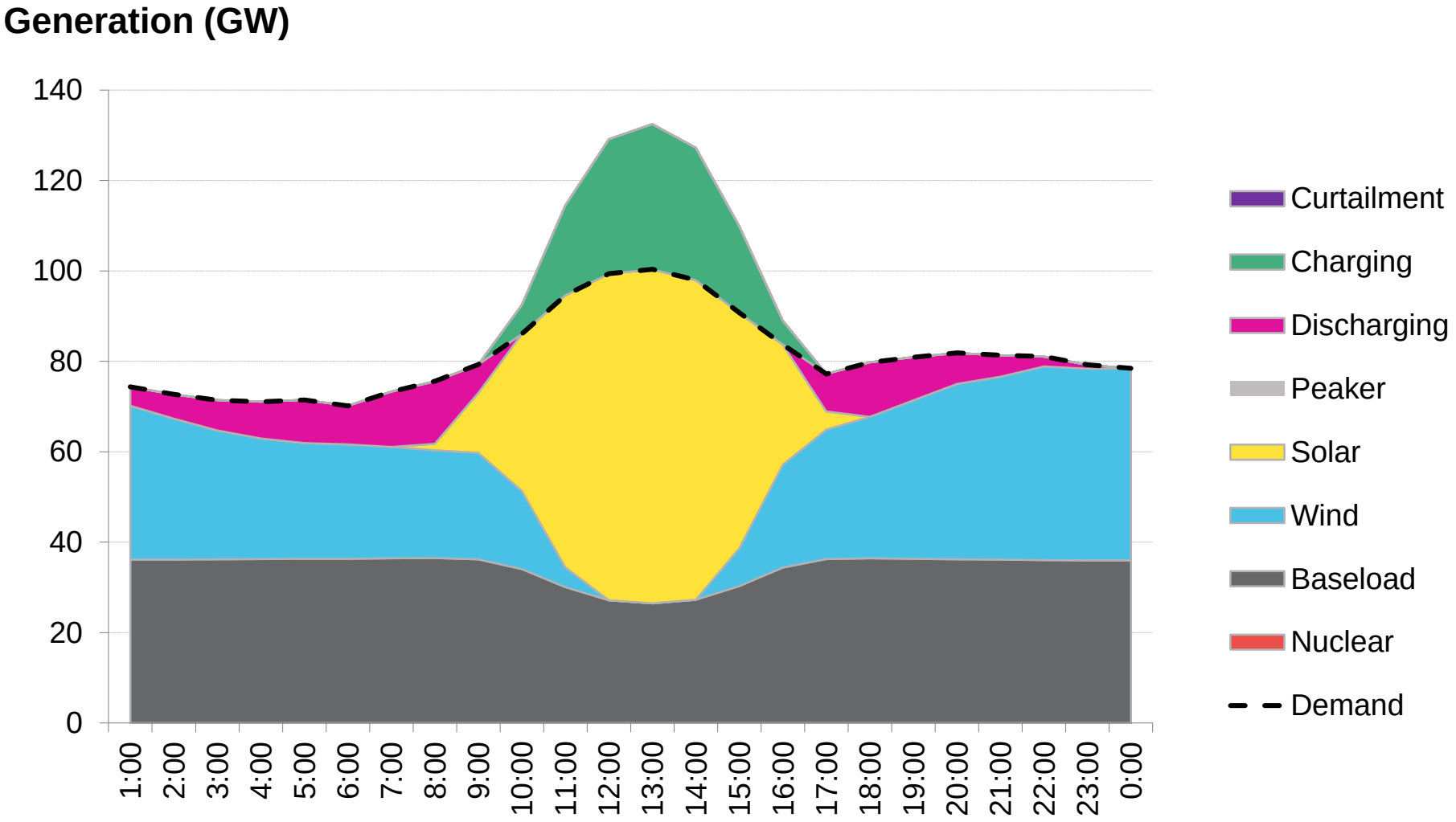


Energy Storage

Taking advantage of fluctuating generation

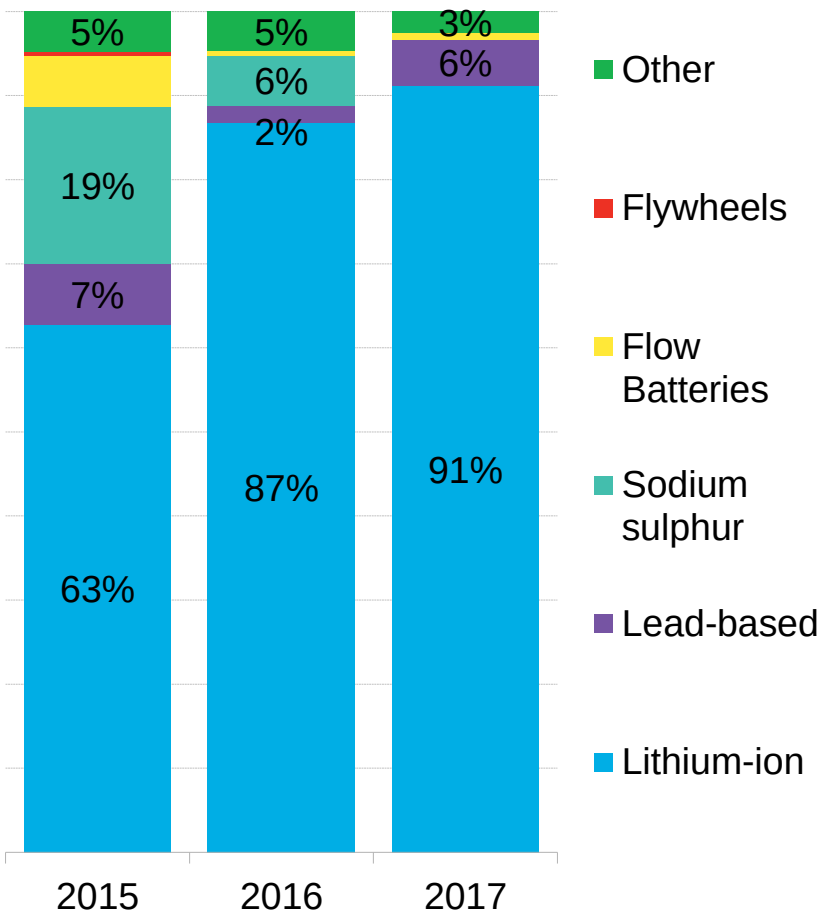
How does this change power?

Intraday power generation by source: Germany 2040

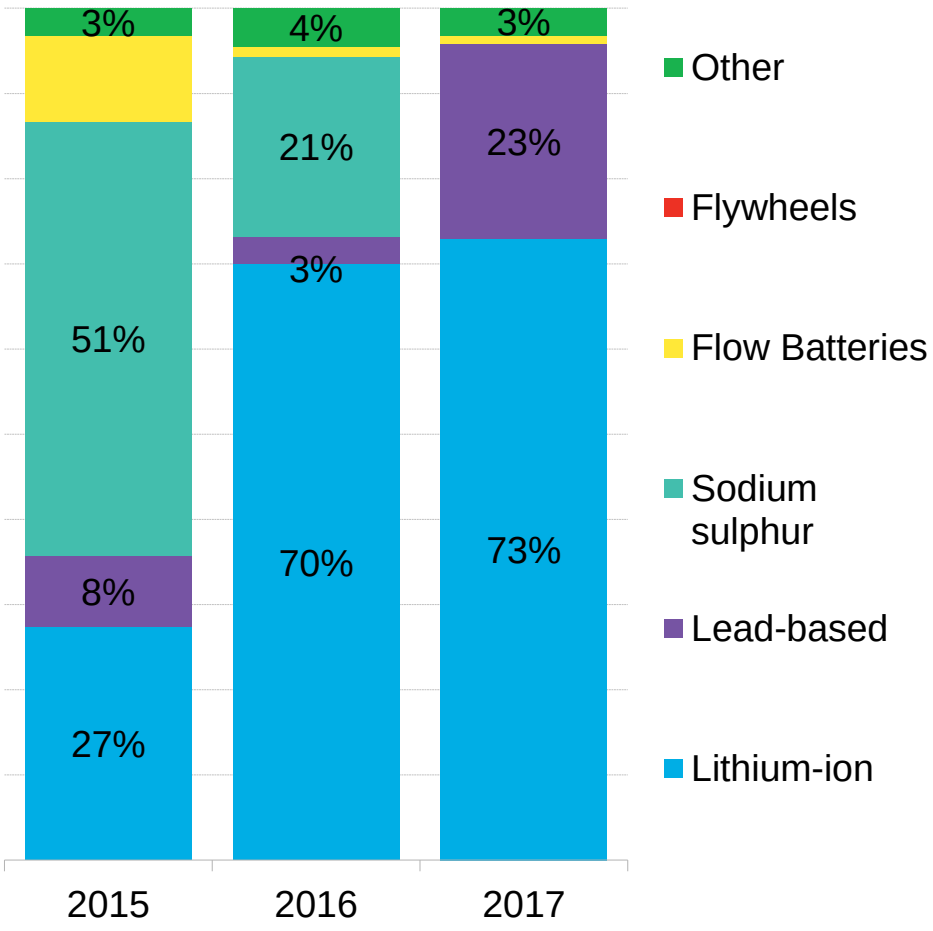


Energy storage tech breakdown

Storage % by power output (MW)

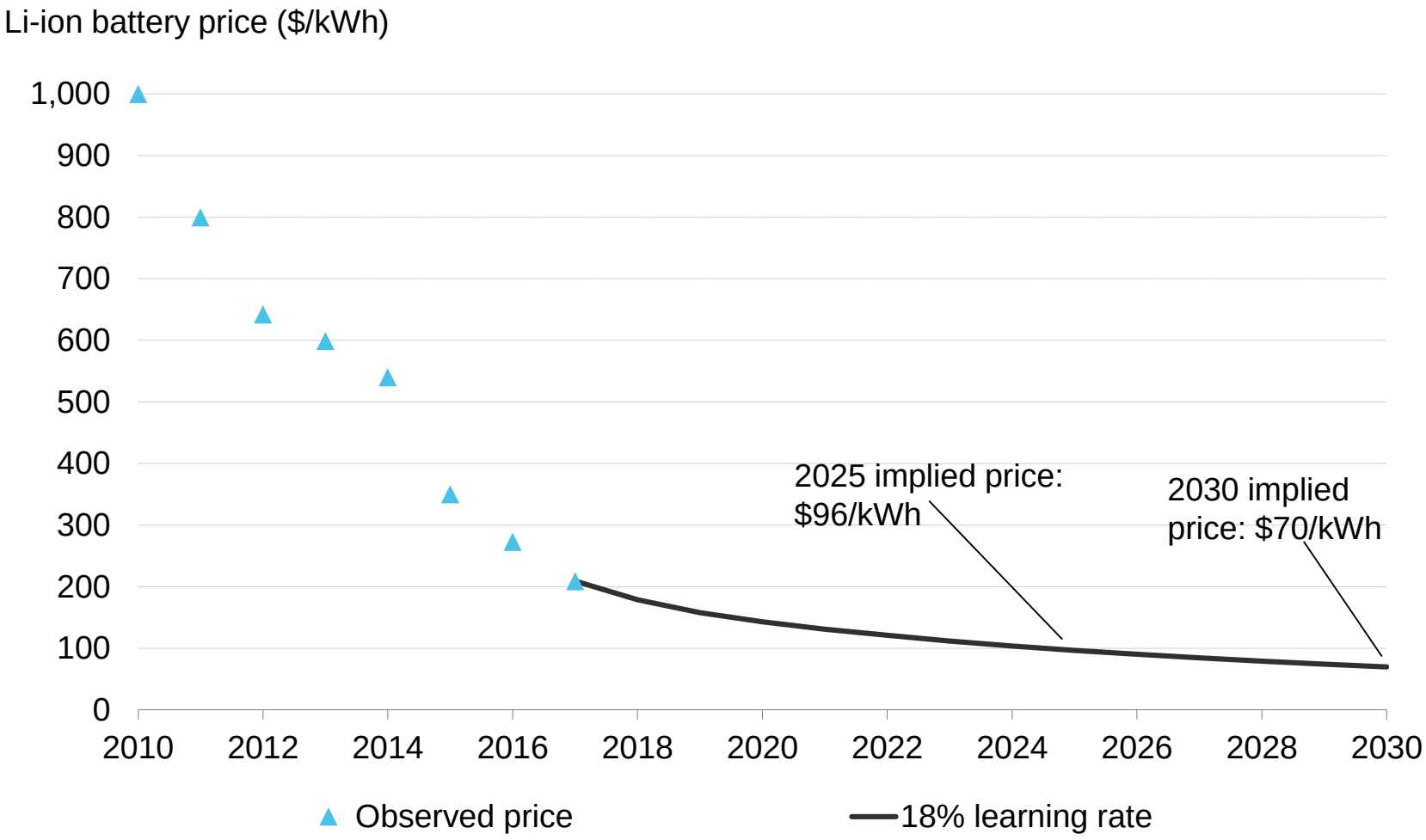


Storage % by energy capacity (MW)



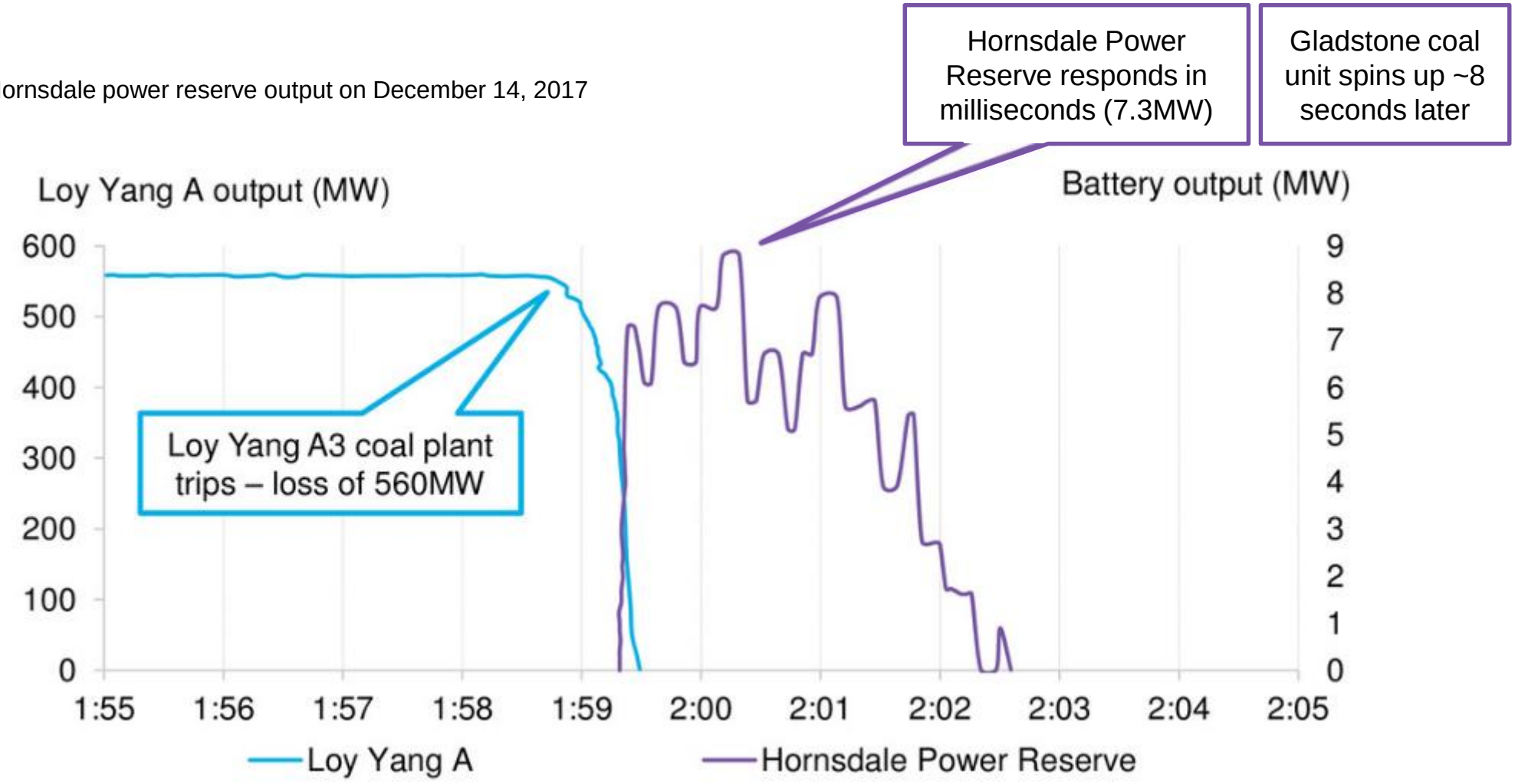
Note: excludes pumped storage

Battery price declines



Flexibility in electricity grids

Hornsdale power reserve output on December 14, 2017

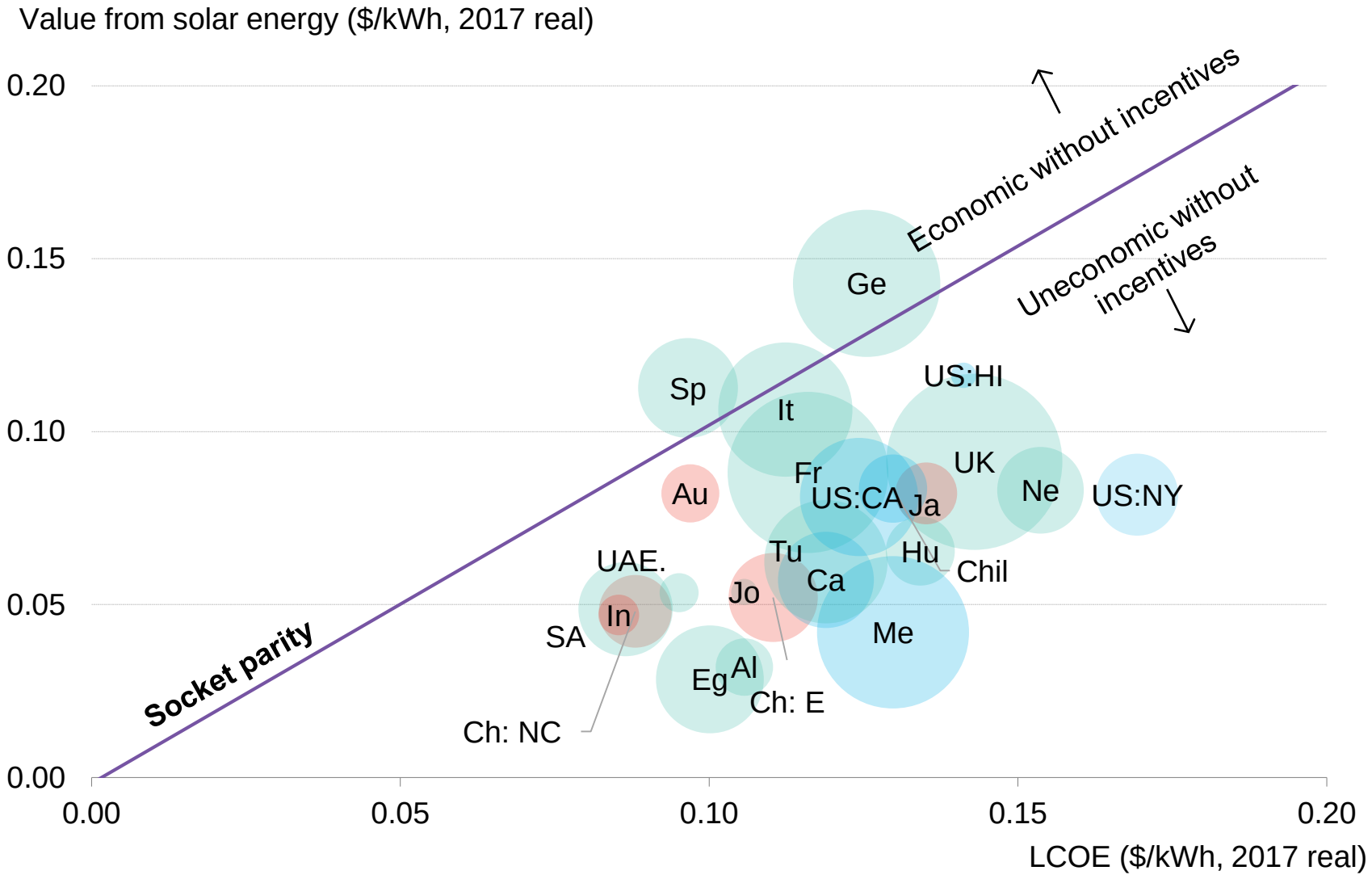


Source: Australian Energy Market Operator, Bloomberg New Energy Finance

Decentralized Energy

Stepping away from the grid

Residential socket parity, 2018



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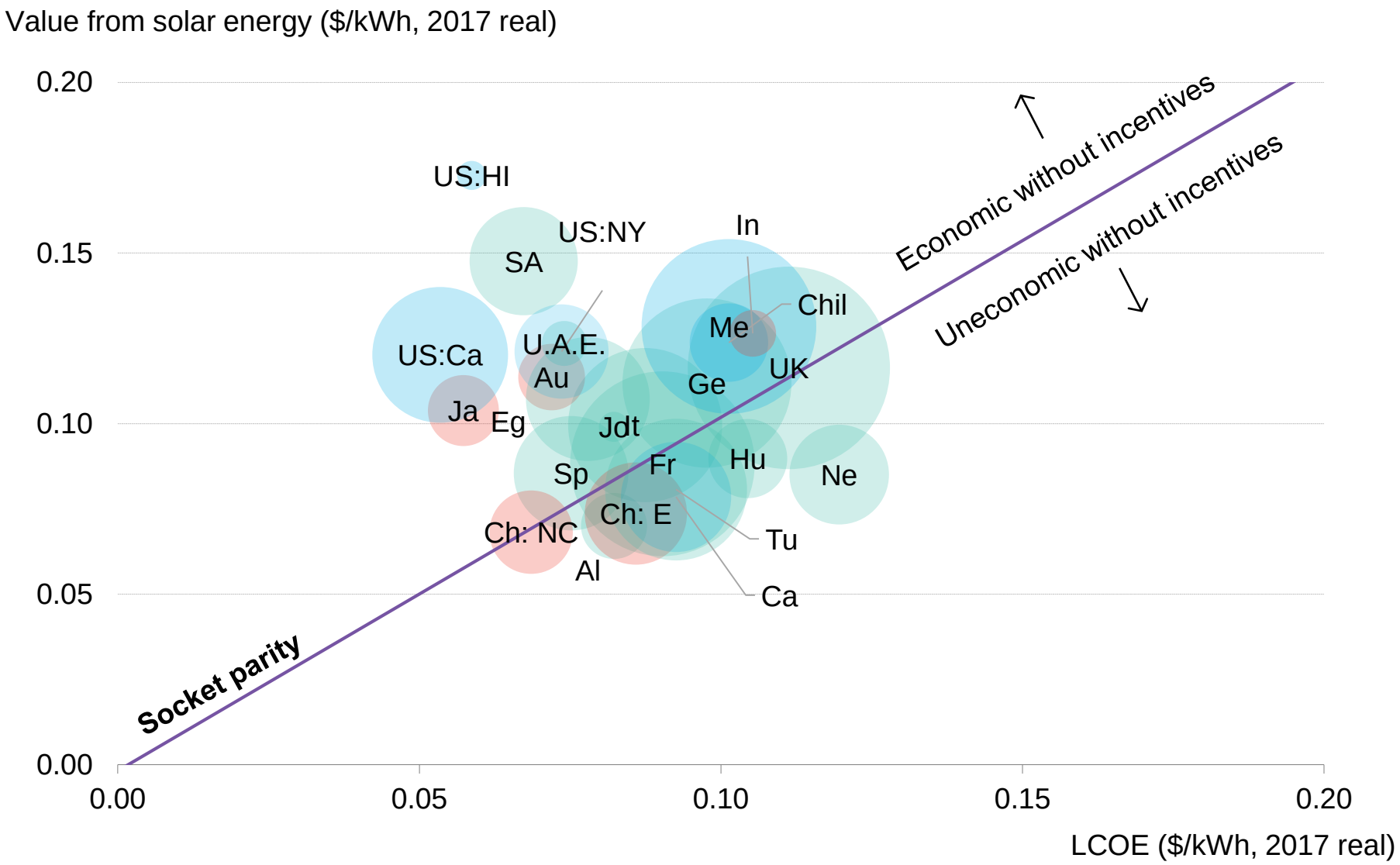
Residential socket parity, 2035



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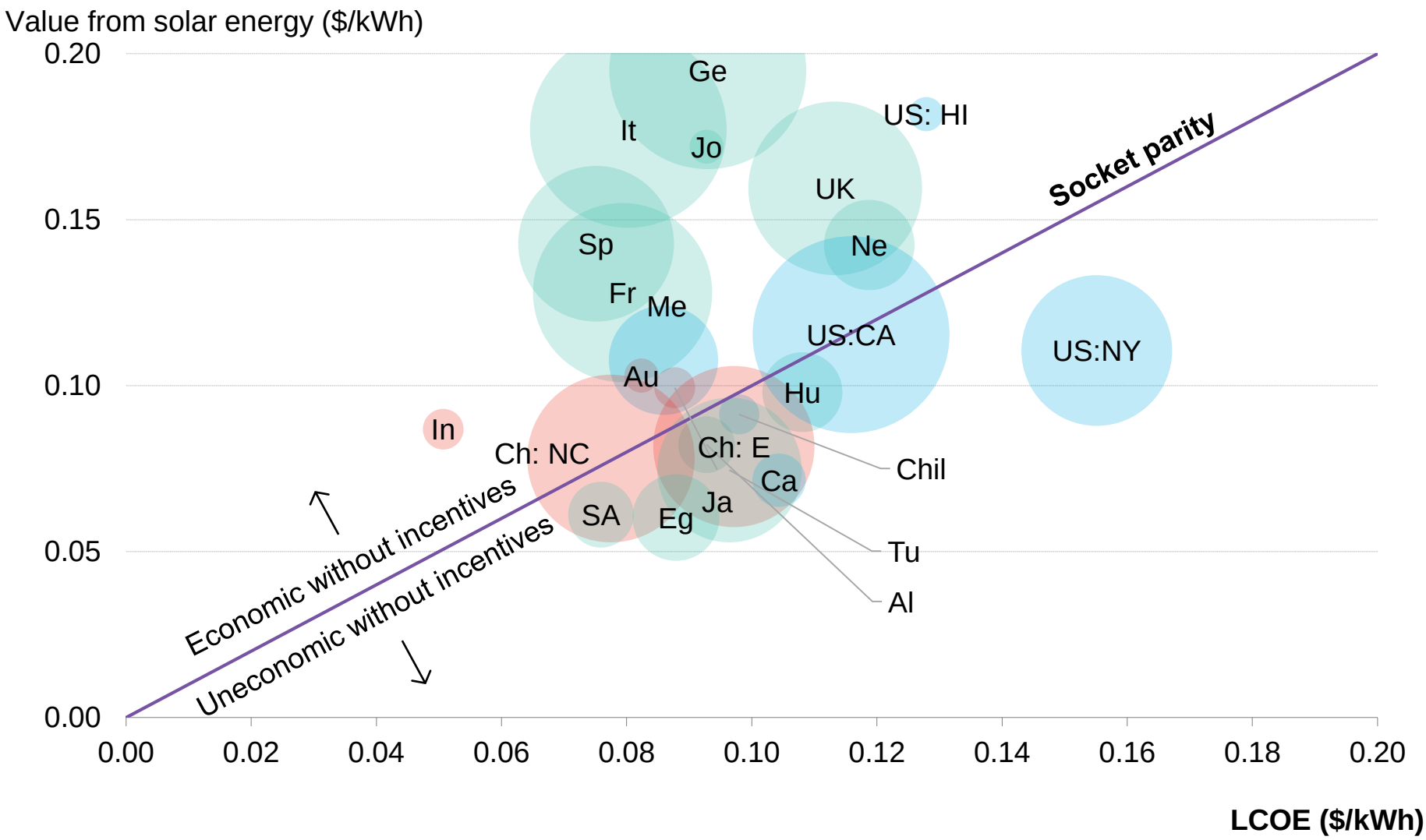
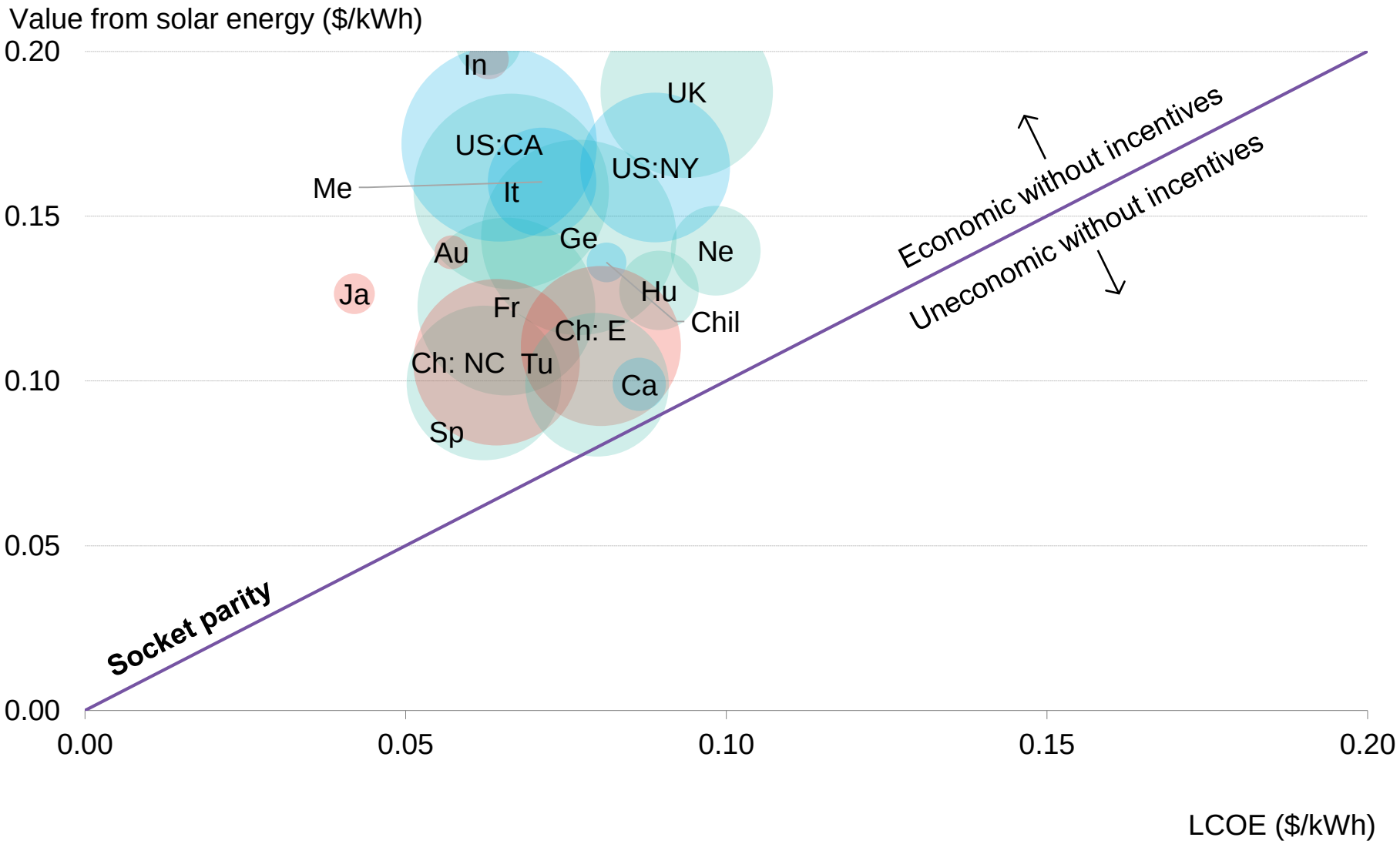
Commercial socket parity, 2018



Commercial socket parity, 2035



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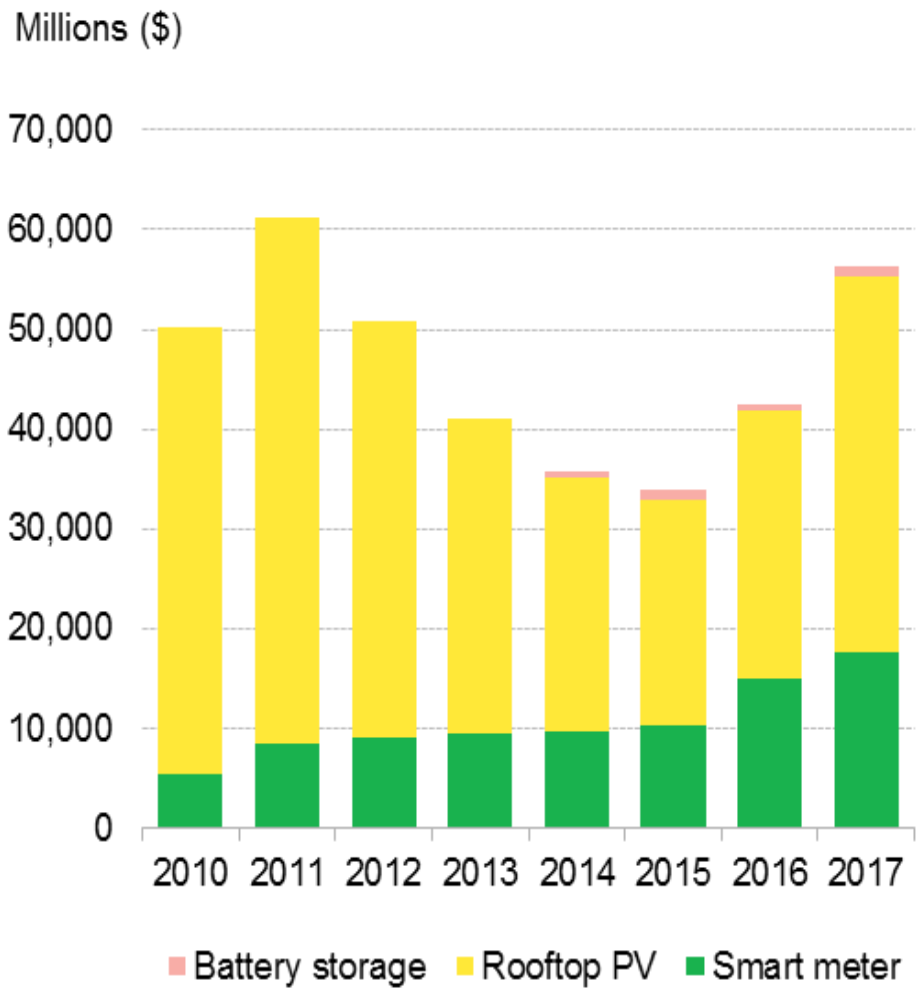
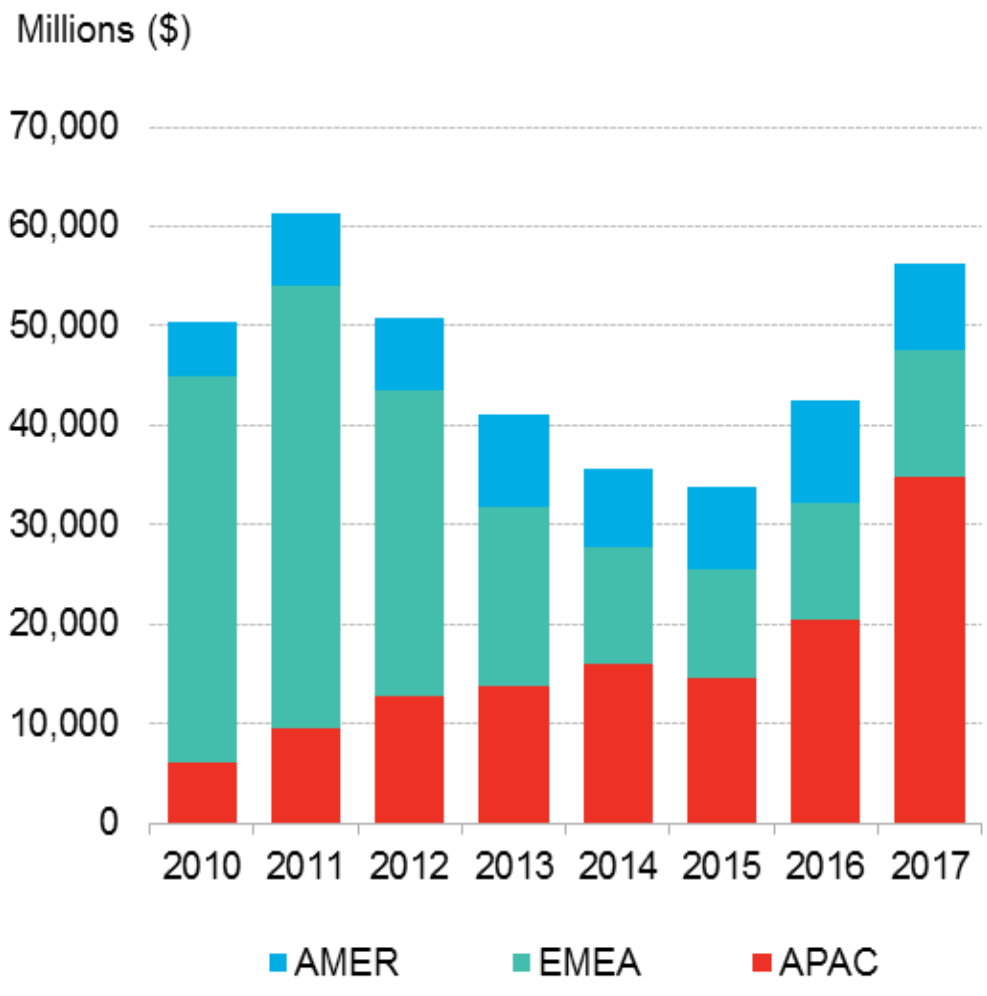
Decentralized energy investment

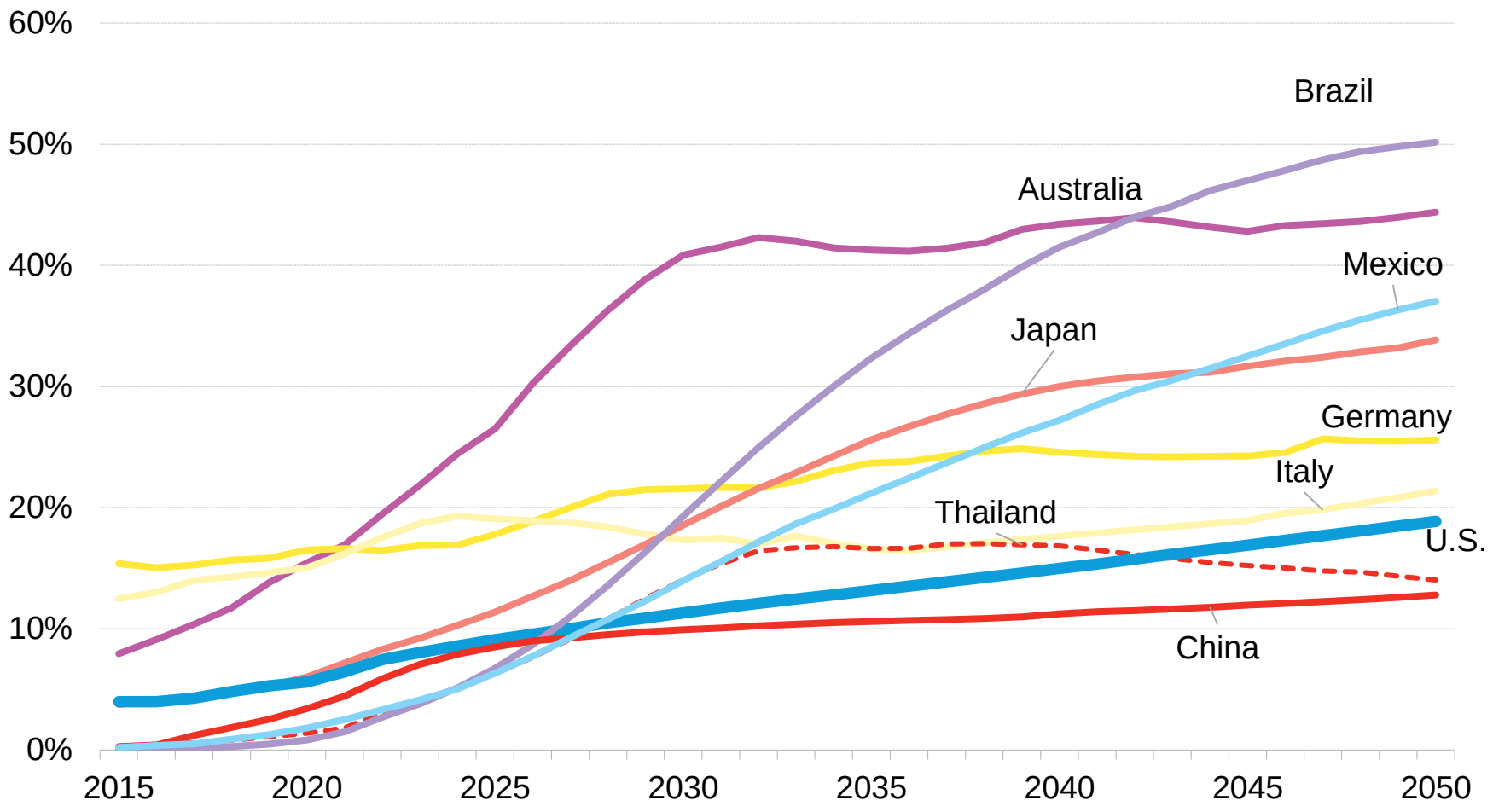
Breakout by technology and region





Decentralization ratio

Fraction of capacity behind the meter



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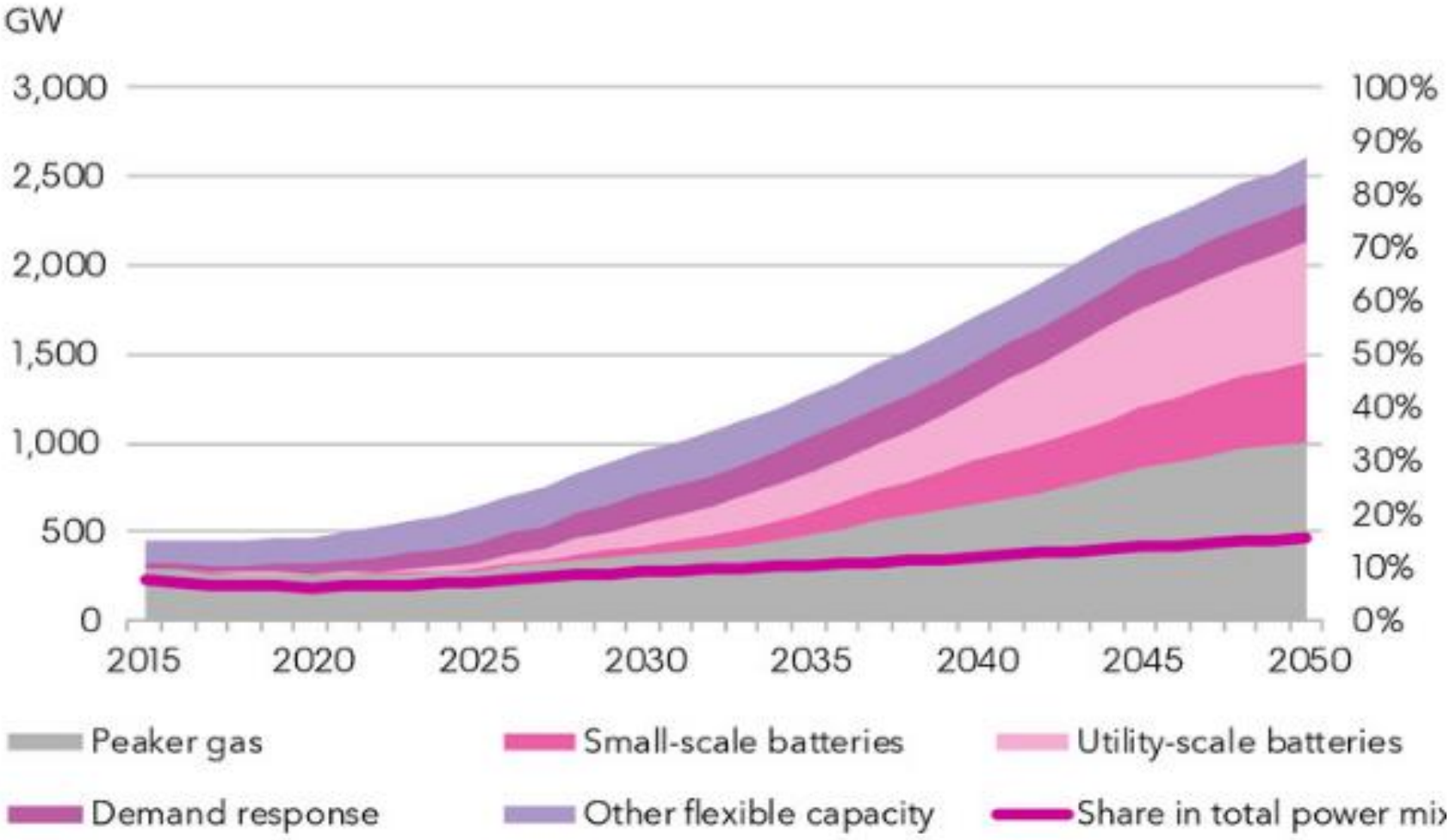
Global flexible capacity



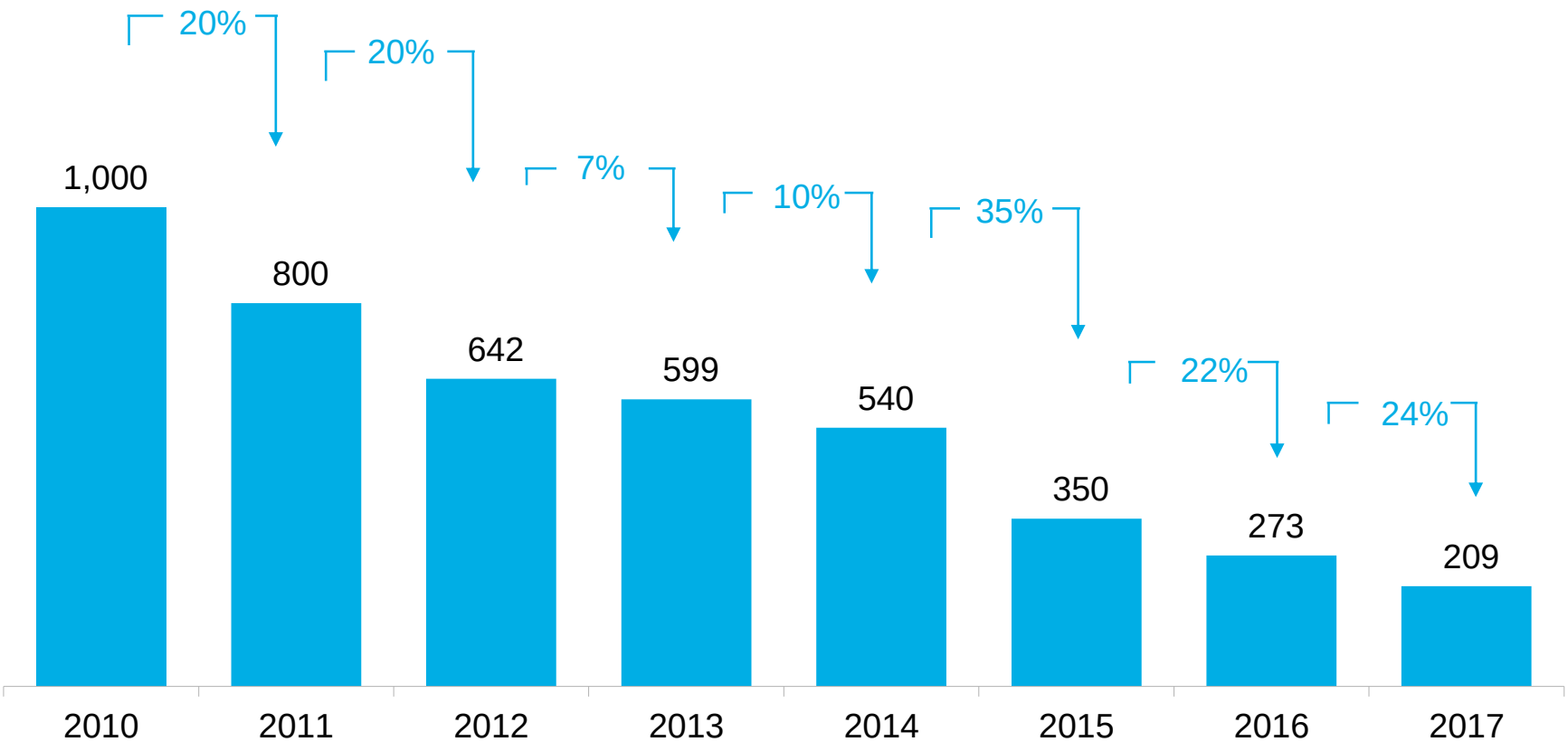
Source: Bloomberg NEF

Electric Vehicles

How far will they take us?

Lithium ion battery price declines

Li-ion battery pack price ($/kWh, nominal)



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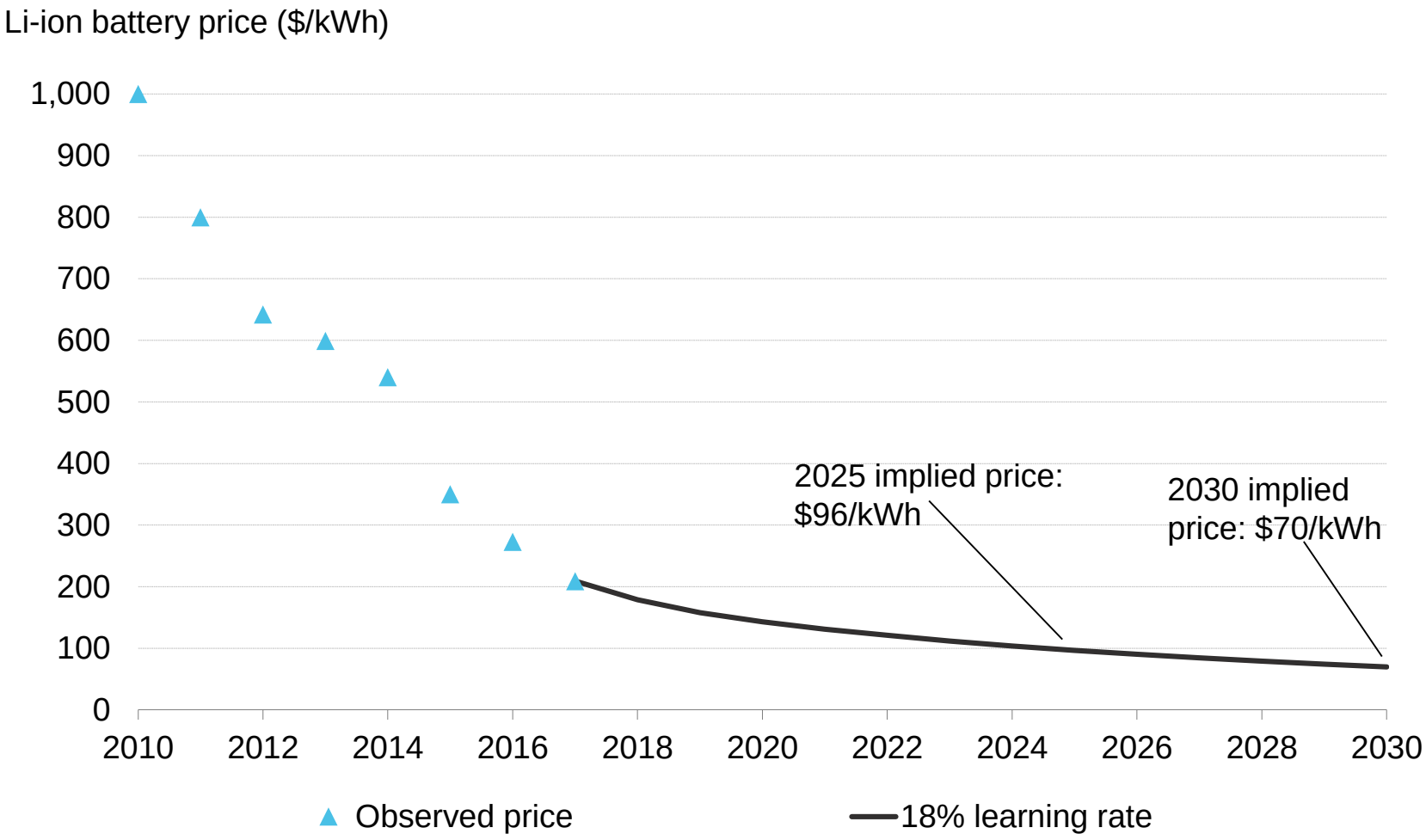
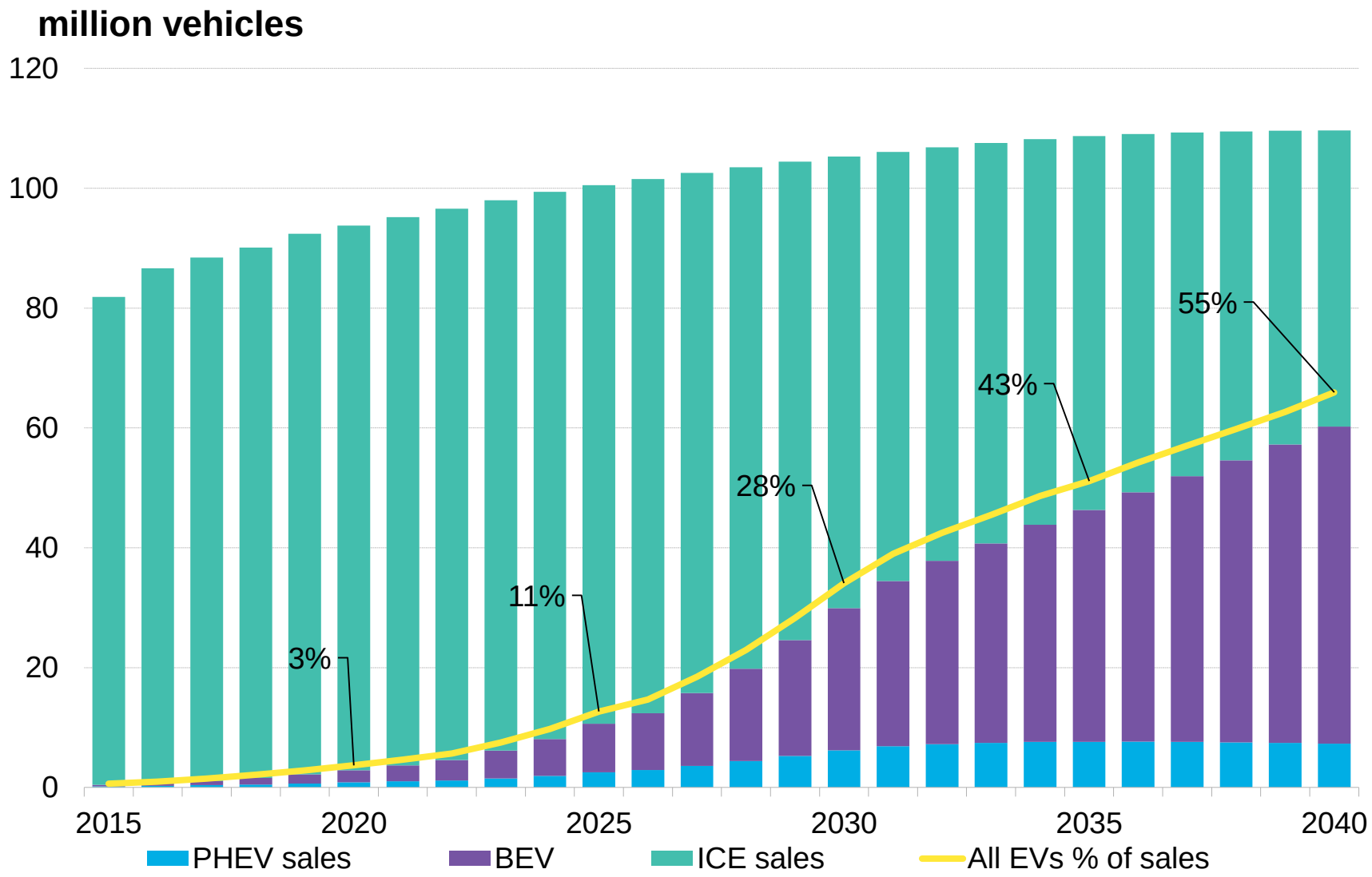
Battery price declines



Global electric vehicle sales



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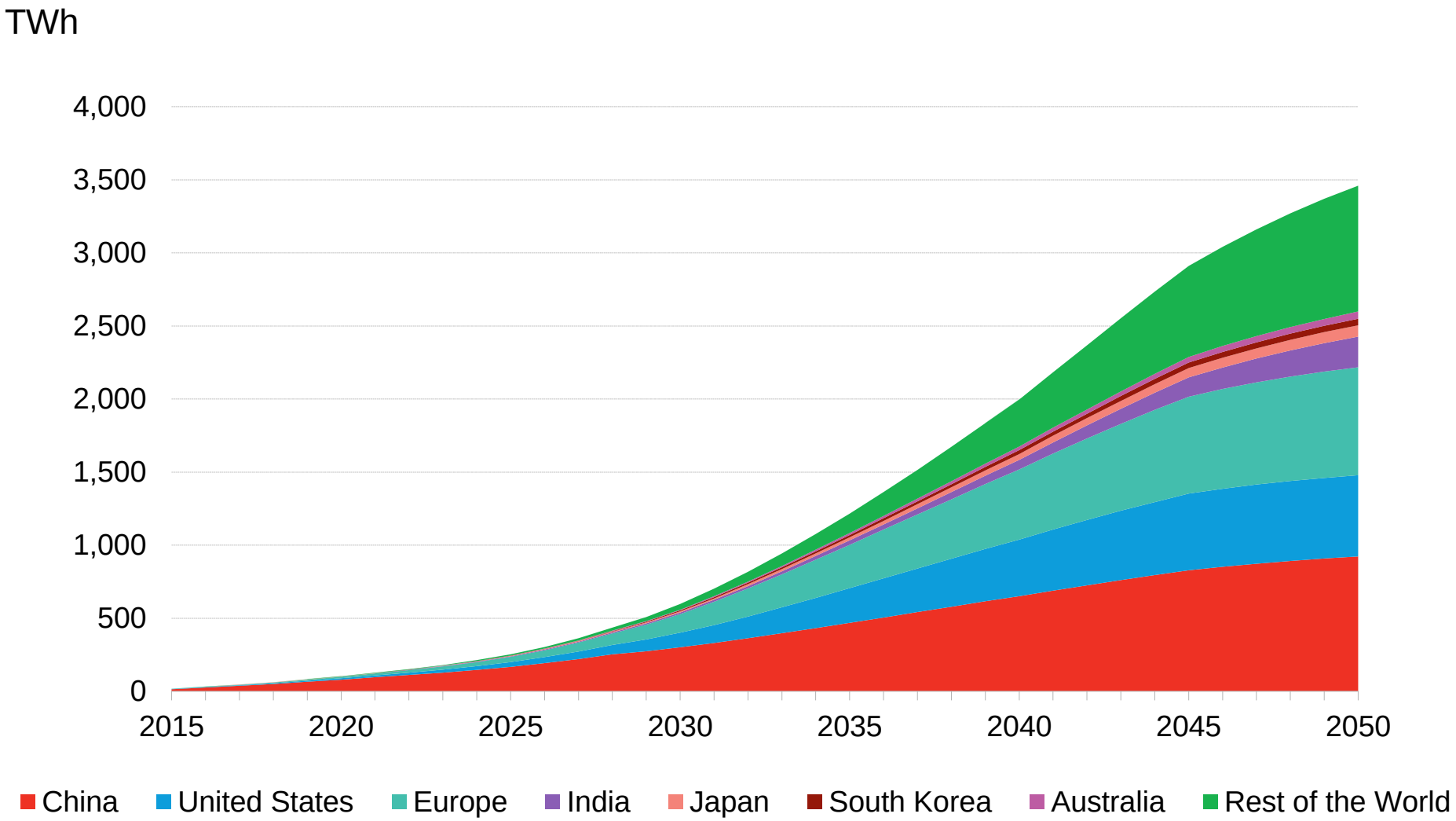
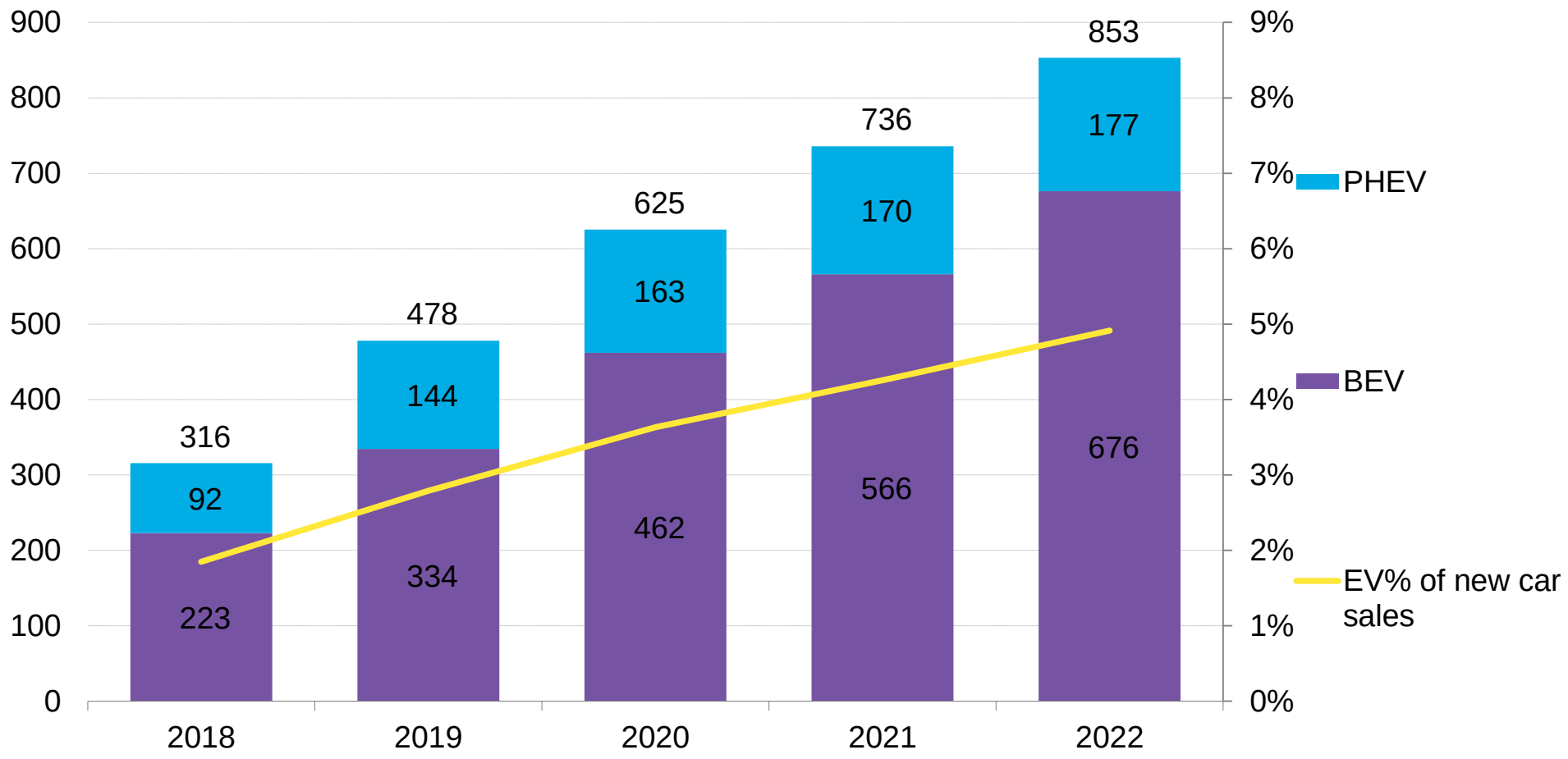
EV electricity demand by region



Annual U.S. EV sales forecast

thousand EVs per year



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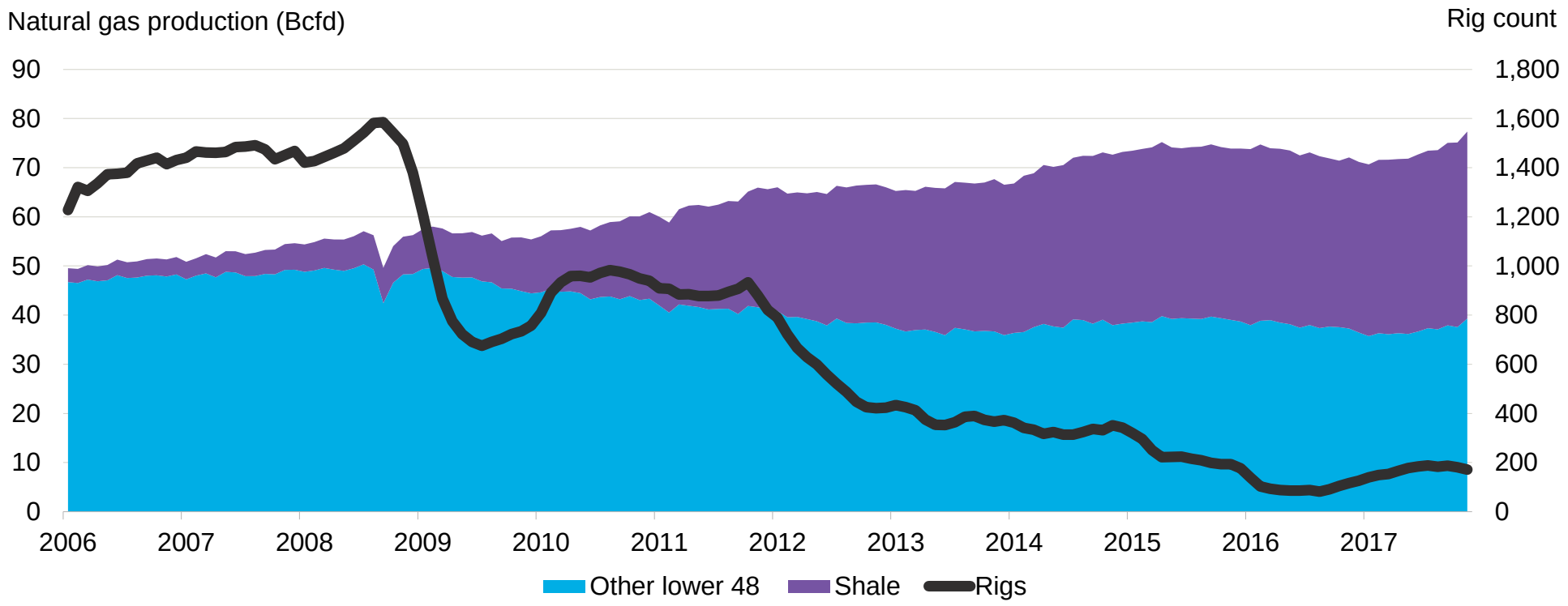
Natural Gas & LNG

Improving flexibility, connecting markets

Increasing production with fewer rigs…

U.S. natural gas production and rig count



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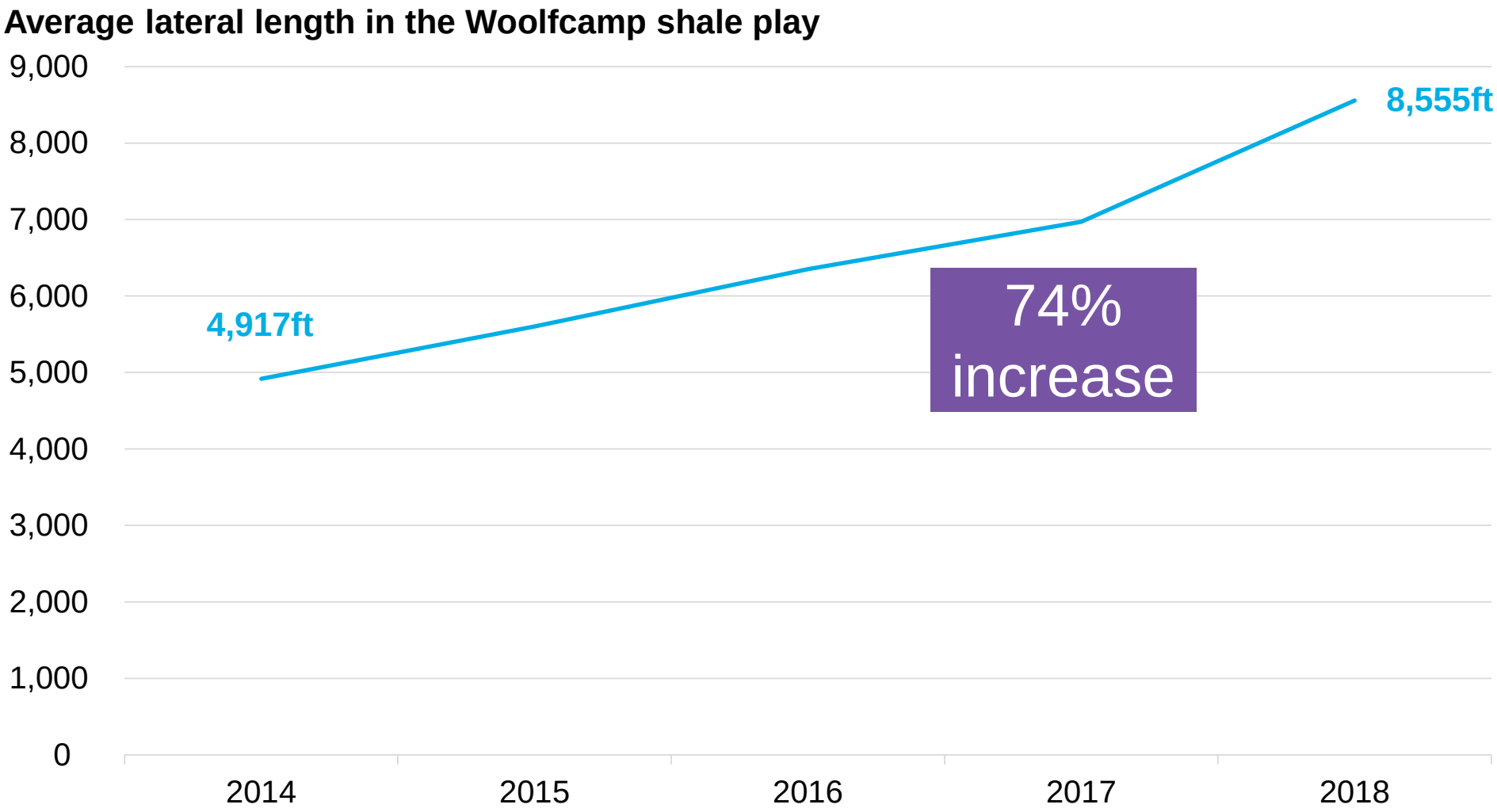
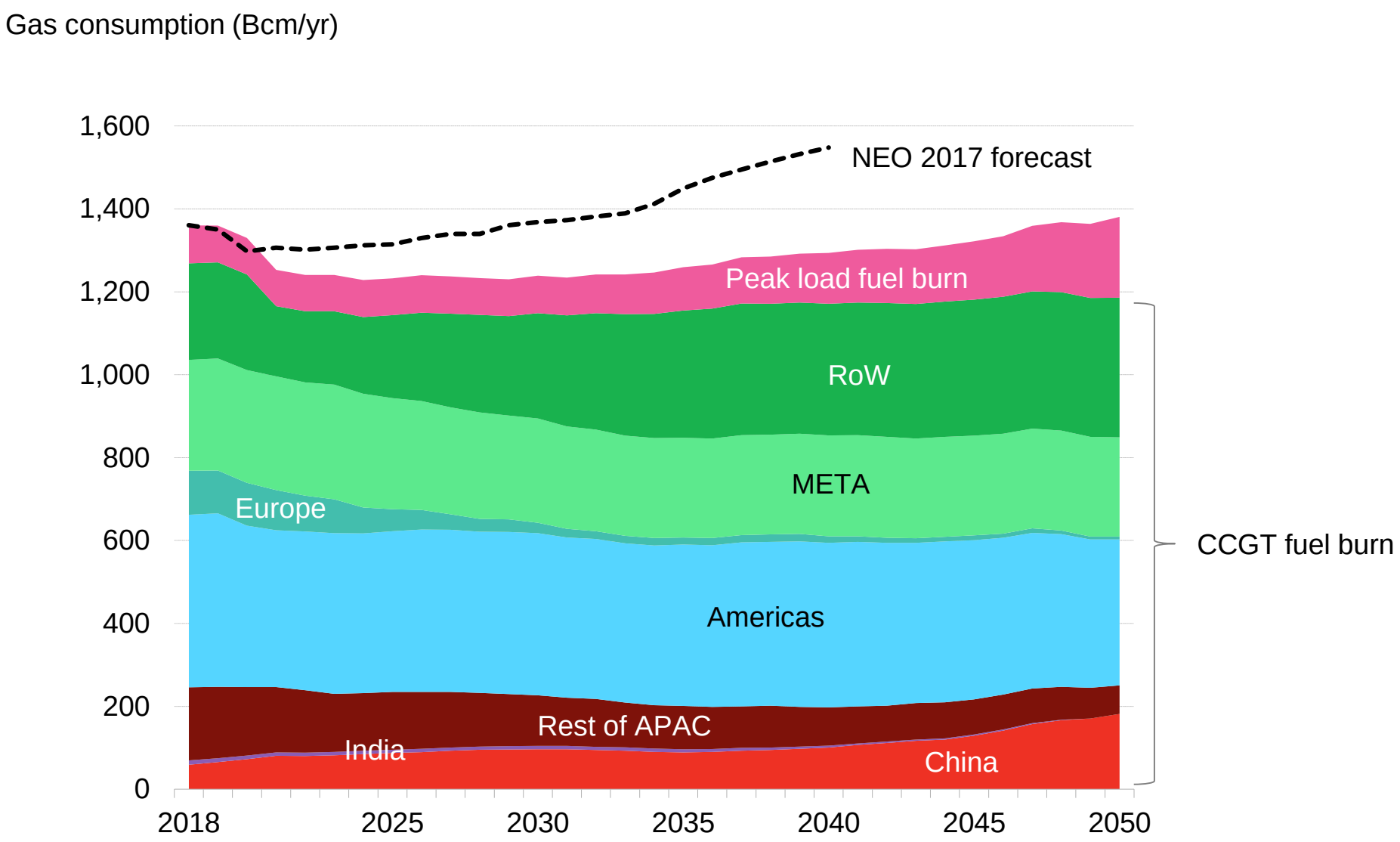
Efficiency in oil and gas



Source: DrillingInfo, Bloomberg estimates

Gas burn levels out



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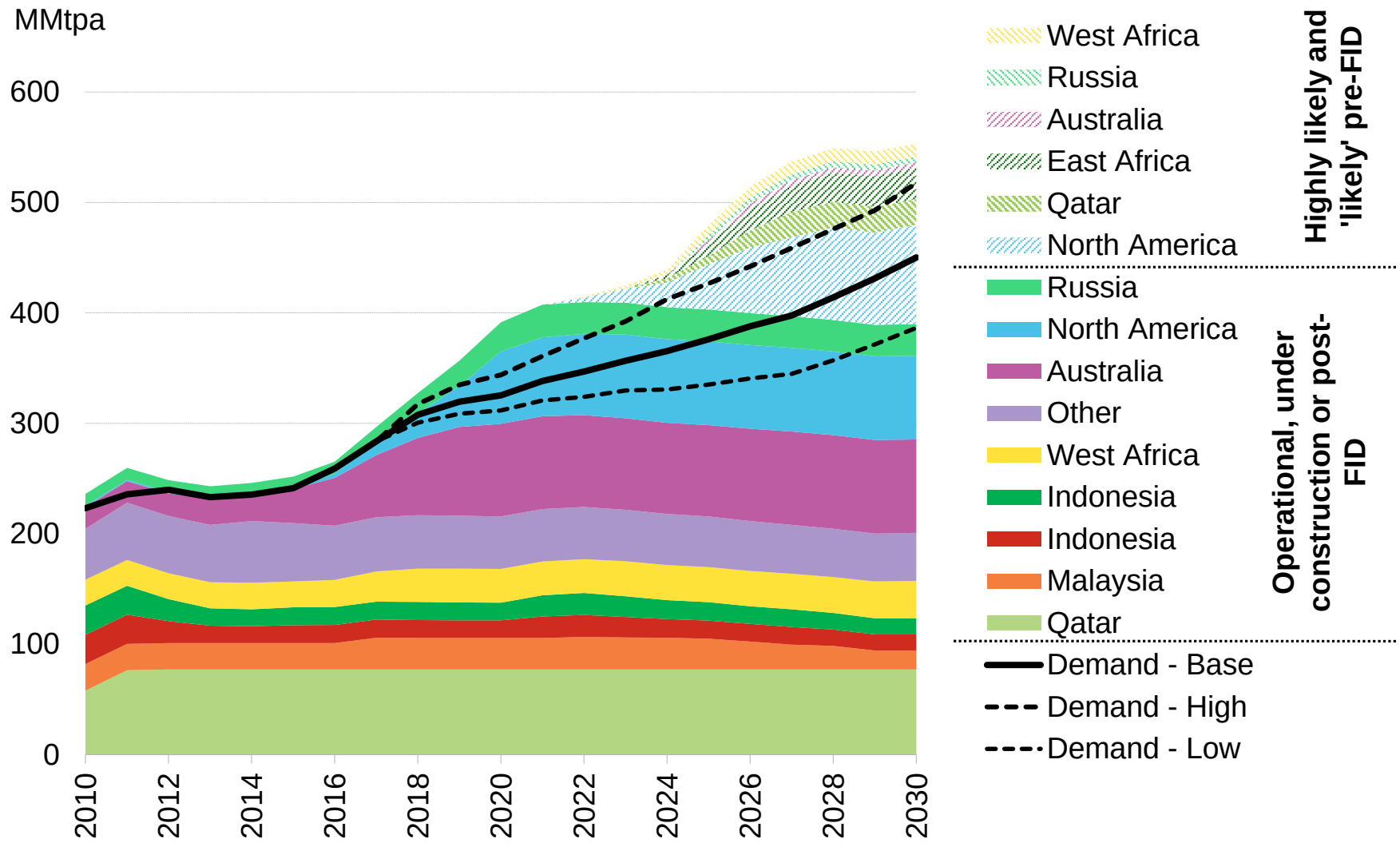
Expansion of global LNG trade



In Summary…

Key takeaways from the outlook

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