Clean Energy Technology Trends

Testimony before the House Appropriations Subcommittee on Energy & Water
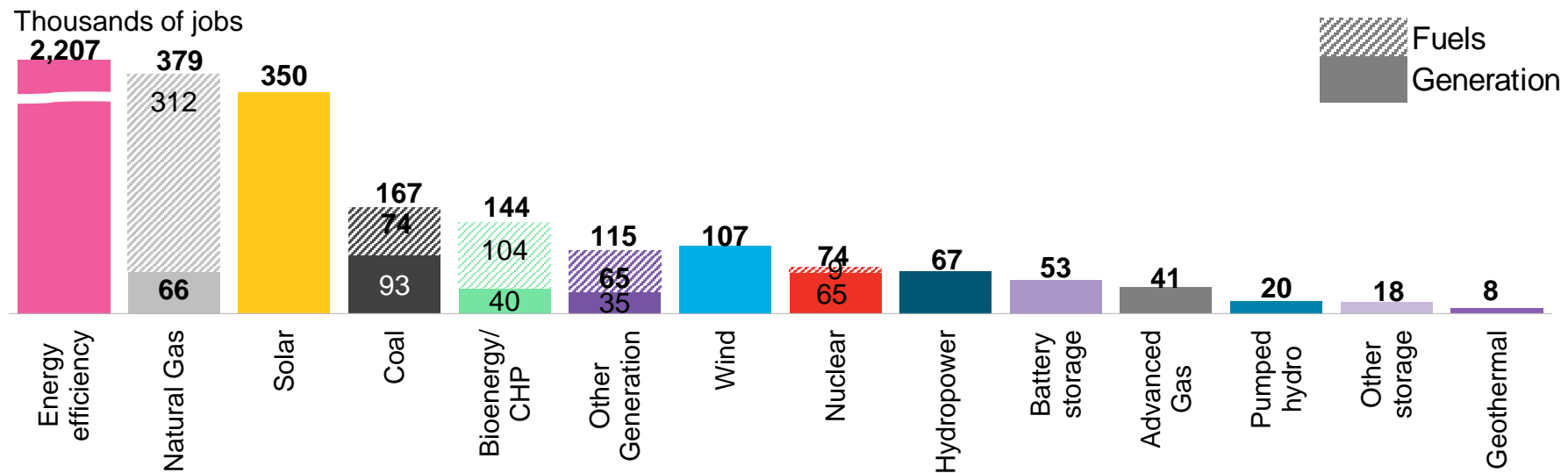
Ethan Zindler

February 07, 2019
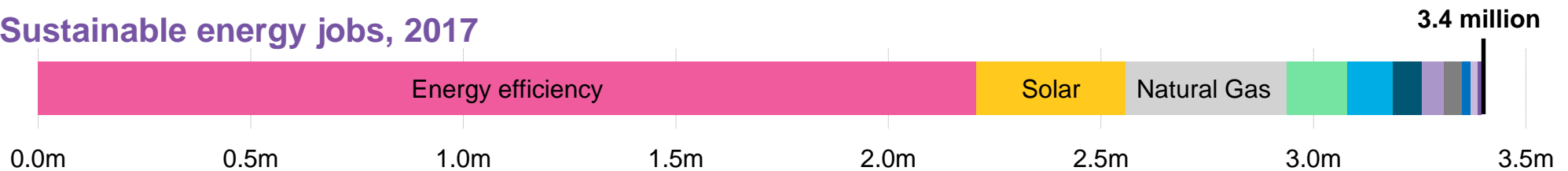
BloombergNEF

Jobs in select segments of U.S. energy
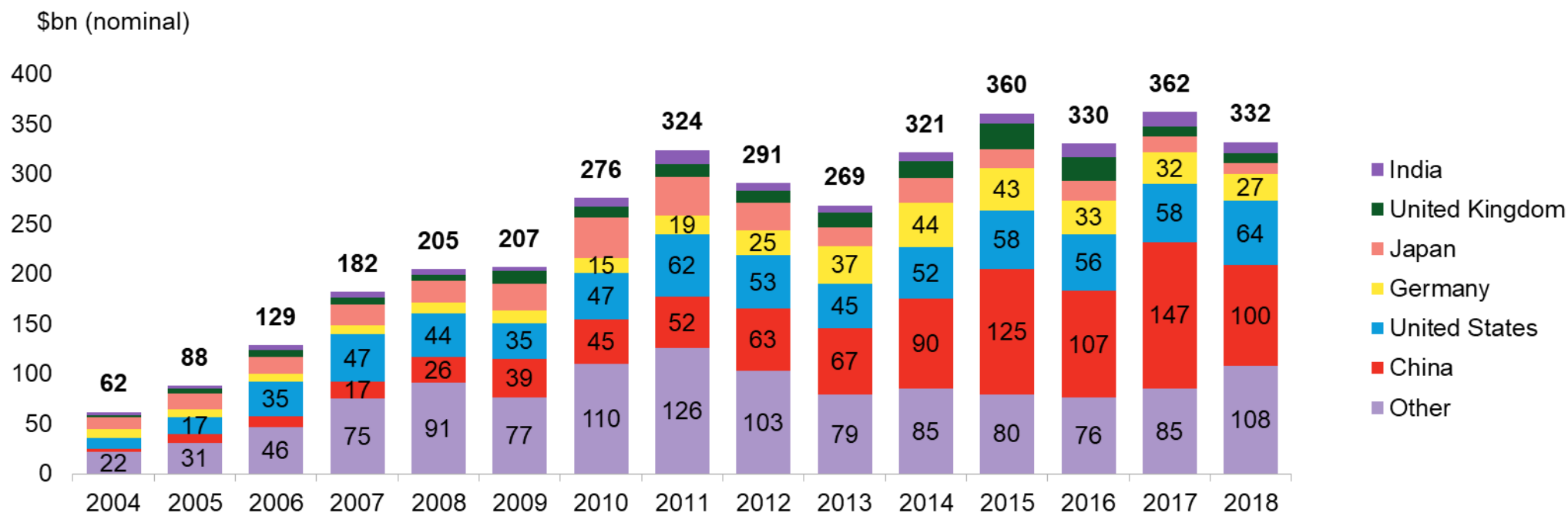
Jobs in select energy segments, 2017

Thousands of jobs

Legend: Fuels (hatched), Generation (gray)

Segment	Total	Fuels	Generation
Energy efficiency	2,207		
Natural Gas	379	312	66
Solar	350		
Coal	167	74	93
Bioenergy/CHP	144	104	40
Other Generation	115	65	35
Wind	107		
Nuclear	74	9	65
Hydropower	67		
Battery storage	53		
Advanced Gas	41		
Pumped hydro	20		
Other storage	18		
Geothermal	8		

Sustainable energy jobs, 2017

3.4 million

Energy efficiency | Solar | Natural Gas

0.0m   0.5m   1.0m   1.5m   2.0m   2.5m   3.0m   3.5m
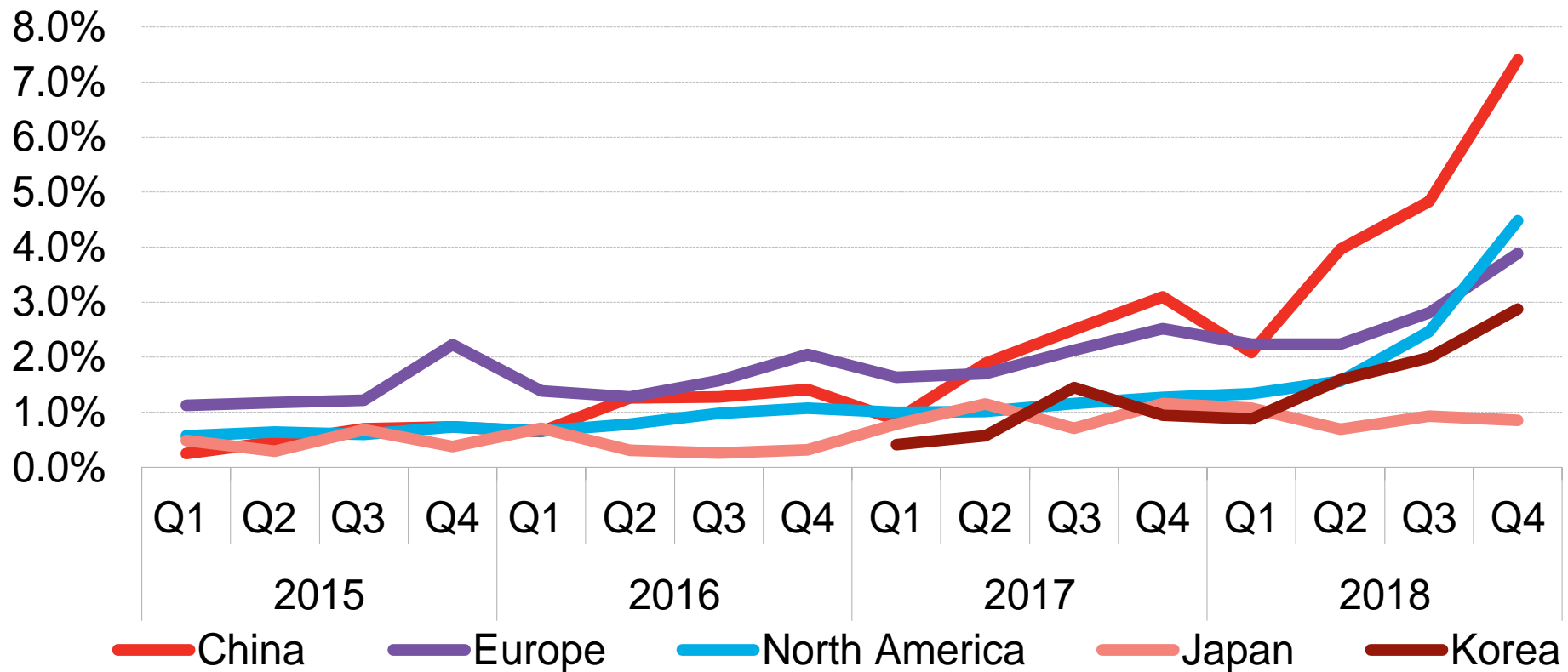
BloombergNEF

New investment in clean energy: >$3 trillion to date

$bn (nominal)

Source: BloombergNEF   Notes: Includes new investment in wind, solar, biofuels, biomass, waste, energy smart technologies (such as electric vehicles and lithium-ion batteries), and other renewables/low carbon services.

BloombergNEF

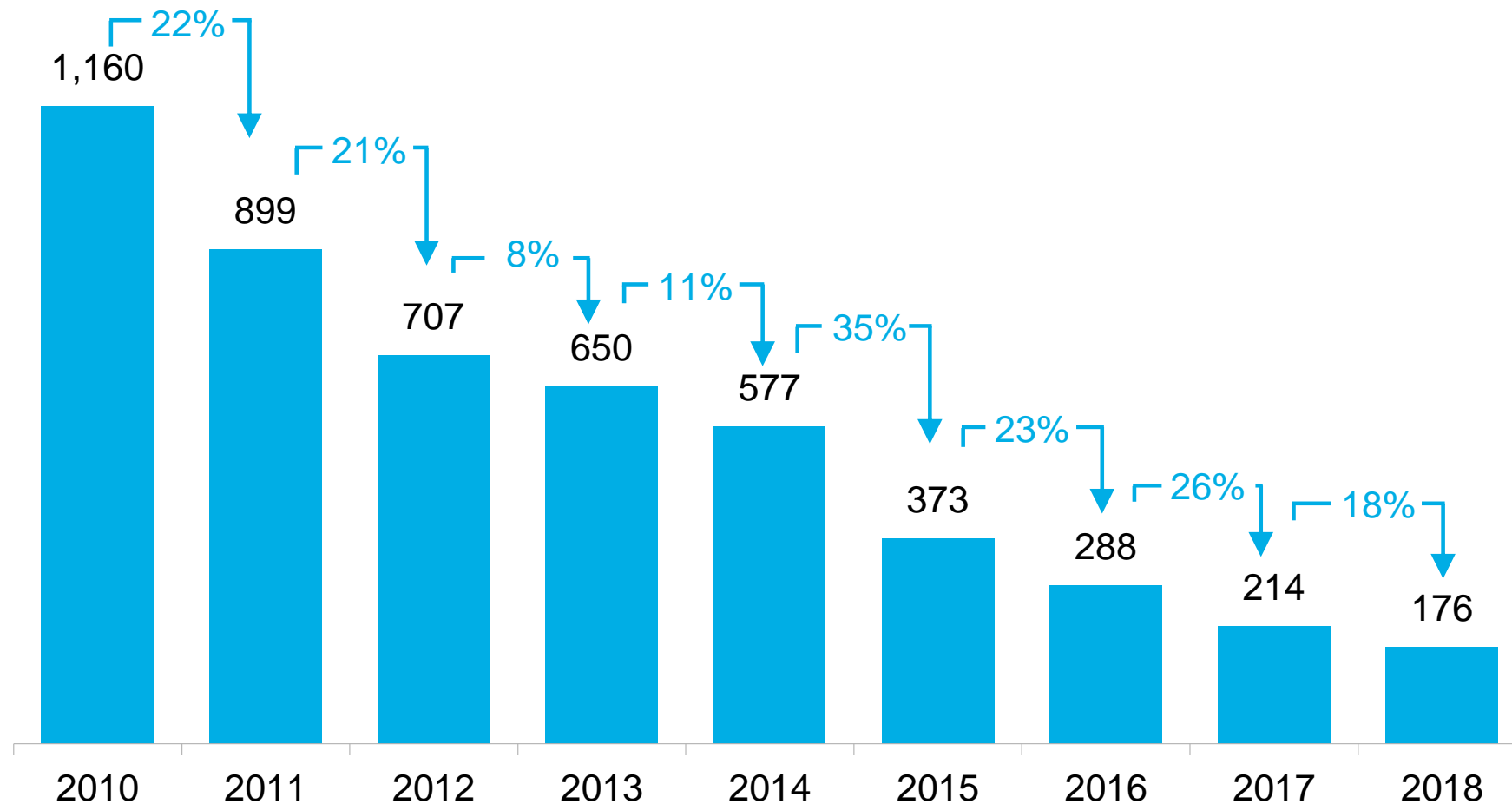# Electric vehicle sales: accelerating

EV share of overall passenger vehicle sales

Legend: China, Europe, North America, Japan, Korea

X-axis: Q1 Q2 Q3 Q4 (2015), Q1 Q2 Q3 Q4 (2016), Q1 Q2 Q3 Q4 (2017), Q1 Q2 Q3 Q4 (2018)

Y-axis: 0.0% to 8.0%

BloombergNEF
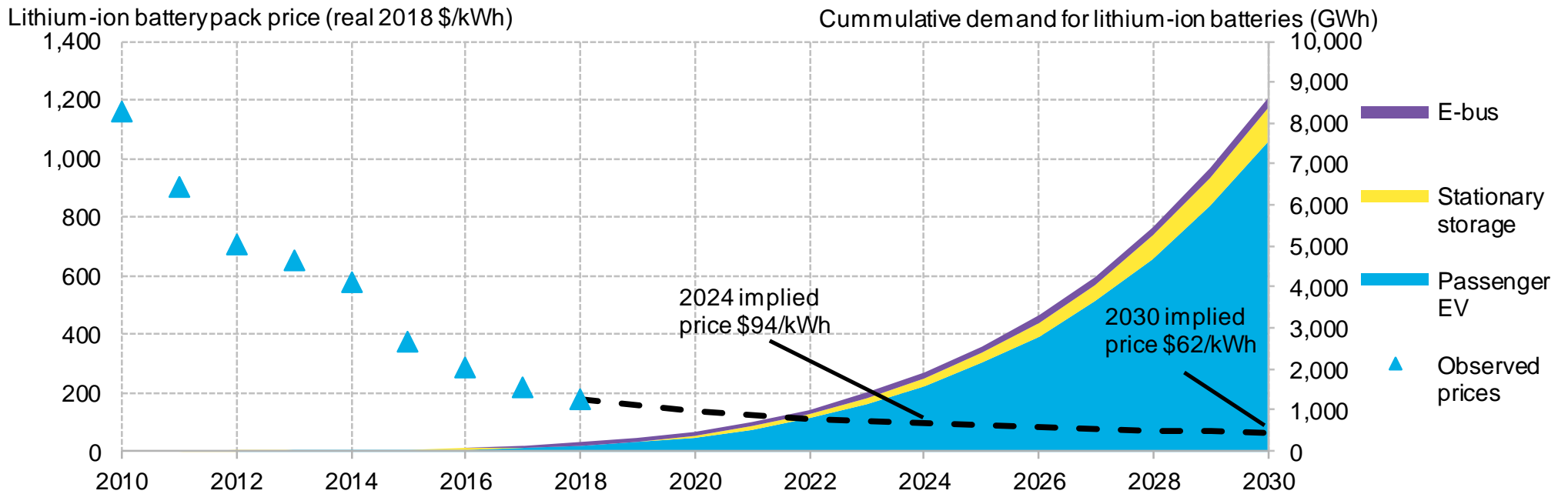
Lithium-ion battery prices: down another 18% in 2018

Battery pack price (real 2018 $/kWh)

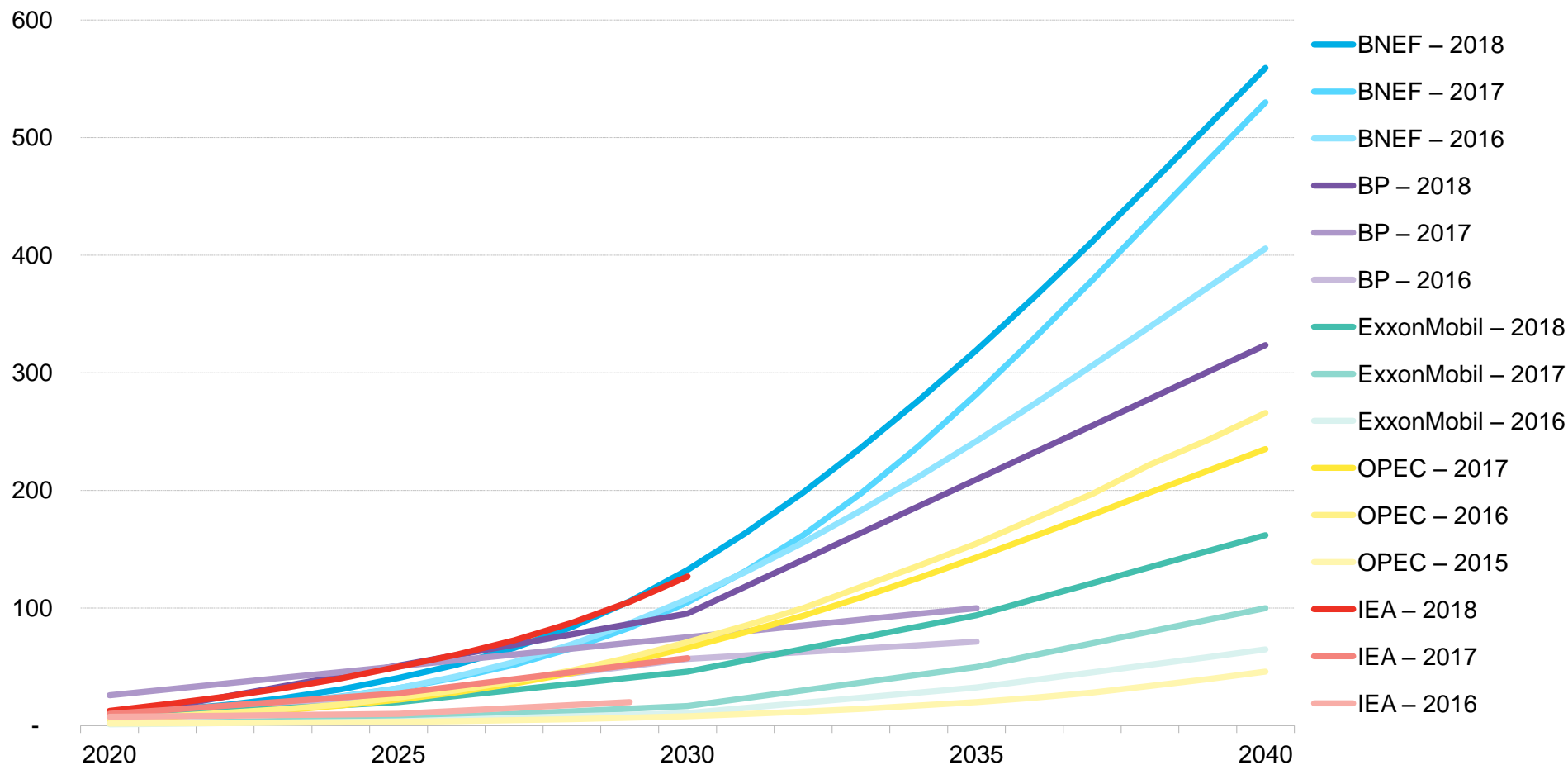Source: BloombergNEF. Based on confidential survey of buyers/sells or li-ion batteries conducted annually by BNEF.

BloombergNEF

As battery prices fall, EV sales will rise

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

Source: BloombergNEF. Note: Prices have been changed to real 2018 dollars

BloombergNEF

Electric vehicle forecasts: trending upward

EV fleet size (millions)

Legend:
- BNEF – 2018
- BNEF – 2017
- BNEF – 2016
- BP – 2018
- BP – 2017
- BP – 2016
- ExxonMobil – 2018
- ExxonMobil – 2017
- ExxonMobil – 2016
- OPEC – 2017
- OPEC – 2016
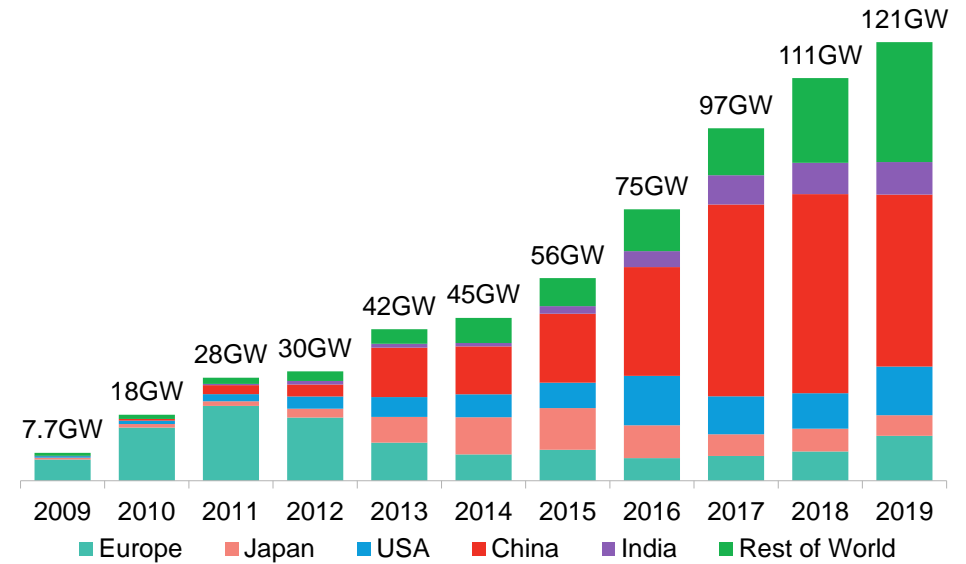- OPEC – 2015
- IEA – 2018
- IEA – 2017
- IEA – 2016

Source: BloombergNEF, organization websites. Notes: BNEF-2016, BNEF-2017, and BNEF-2018 represent our revised annual forecasts. Some data points for BP, ExxonMobil and the IEA are estimated based on organization charts, reports and data (estimates assume linear growth between known data points). Outlook assumptions and methodologies vary. BP only forecasted through 2035 in its 2016 and 2017 outlooks. The IEA only forecasts through 2030. The IEA forecasts multiple scenarios (base case values are shown here). ExxonMobil and IEA forecasts prior to 2018 included BEVs, PHEVs and FCVs; all other forecasts include just BEVs and PHEVs. See organization websites for authoritative viewpoints.

BloombergNEF

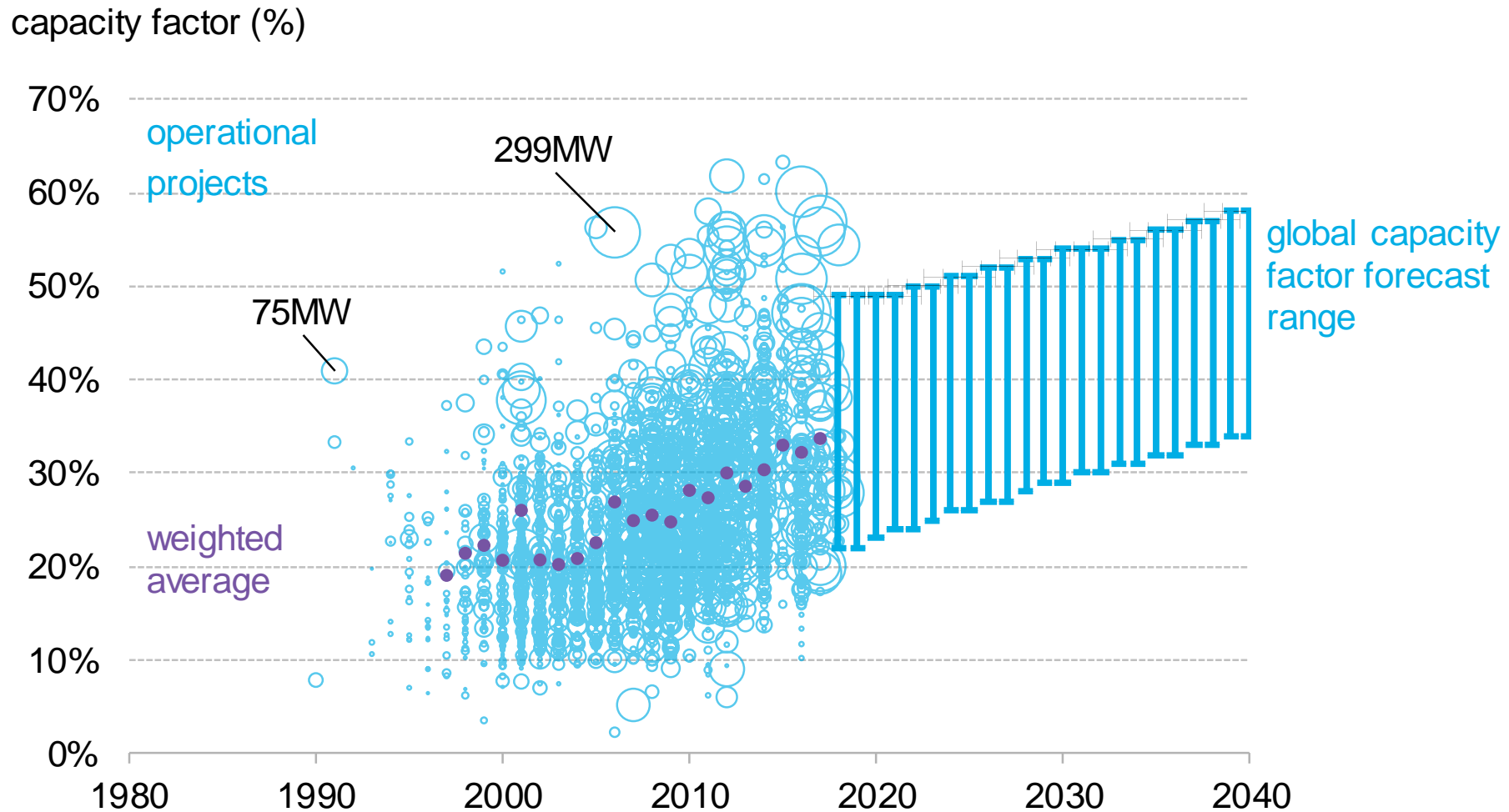# Solar: costs keep dropping, build keeps surging

Residential solar costs

Total photovoltaic build

$/W(DC)

Legend (Residential solar costs): Germany — California — Japan — Chinese multi module — Australia (4kW) — Vivint — Sunrun — U.S.

Legend (Total photovoltaic build): Europe — Japan — USA — China — India — Rest of World

Build values: 7.7GW (2009), 18GW (2010), 28GW (2011), 30GW (2012), 42GW (2013), 45GW (2014), 56GW (2015), 75GW (2016), 97GW (2017), 111GW (2018), 121GW (2019)
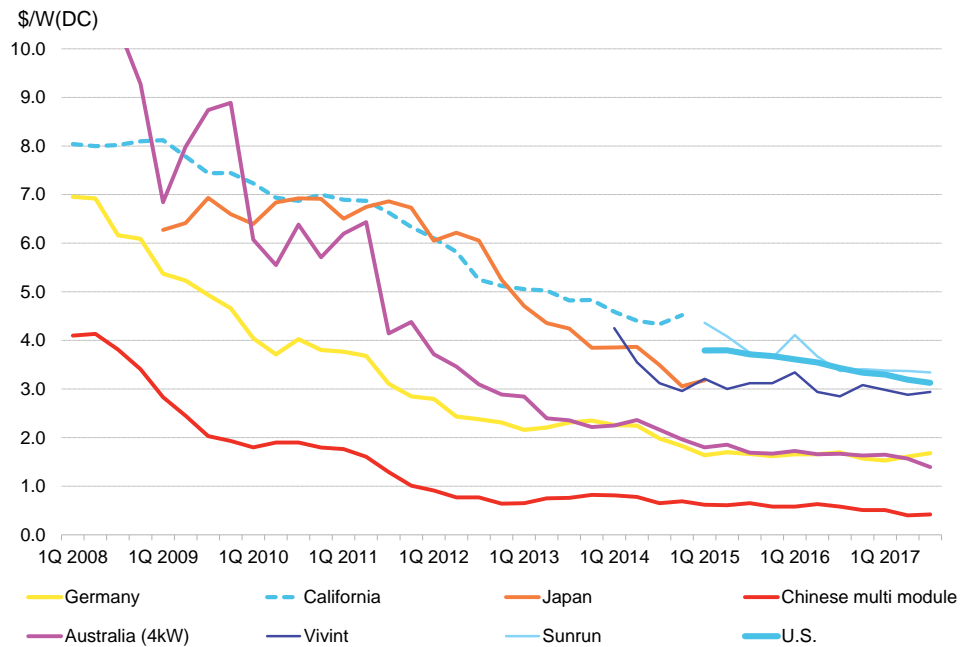
Source: BNEF. Data potrayed for residential solar on a $ per installed Watt basis. Build figures are given in gigawatts.

BloombergNEF

Bigger wind turbines are making more productive use of wind

capacity factor (%)

operational projects

299MW

75MW

weighted average

global capacity factor forecast range

BloombergNEF

Natural gas and renewables will dominate U.S. power generation

Generation (TWh)

Legend:
- Solar thermal
- Small-scale PV
- Utility-scale PV
- Offshore wind
- Onshore wind
- Biomass
- Geothermal
- Hydro
- Nuclear
- Oil
- Peaker Gas
- Gas
- Coal
- Renewables share
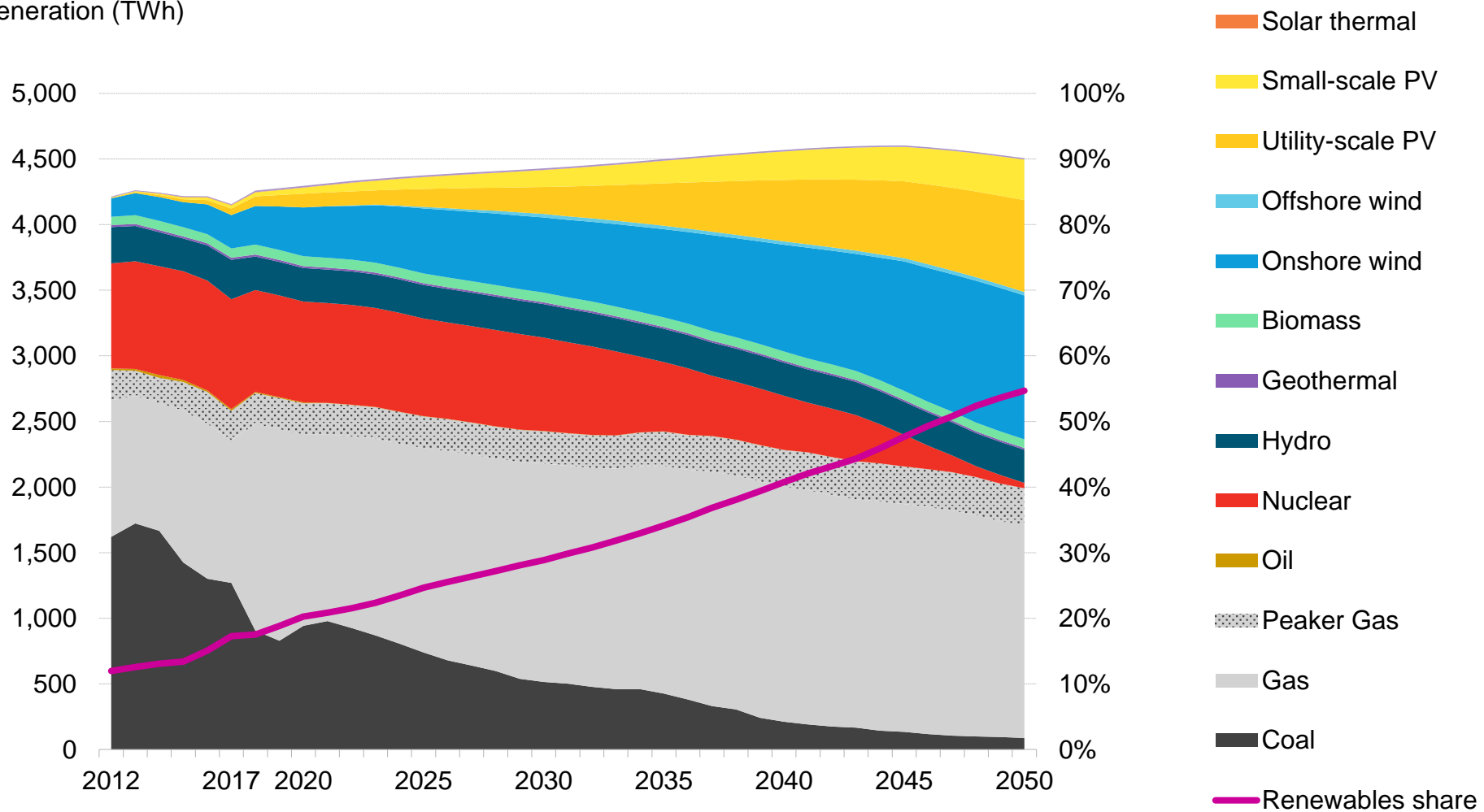
Source: BloombergNEF New Energy Outlook projection to 2050.

BloombergNEF

Technology alone won't save the day

Global power sector CO2 emissions (MtCO2)
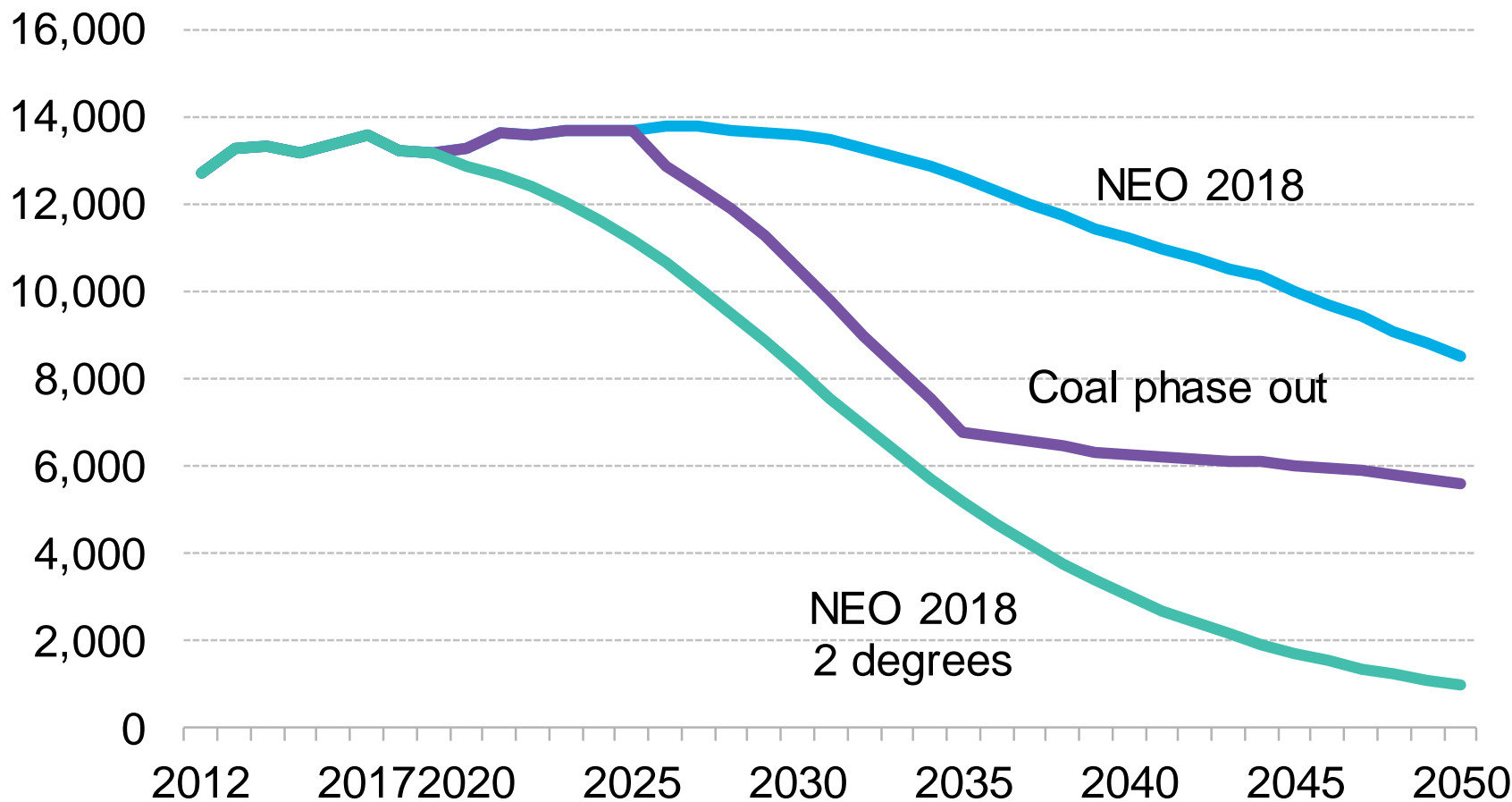
Source: BloombergNEF 2018 New Energy Outlook (NEO). Blue line represents BNEF central scenario for global CO2 emissions. "Coal phase out" scenario depicts emissions if all coal-fired power plants are brought off line in 10 years. "NEO 2018 2 degrees" shows the level of CO2 emissions reduction required of the power sector to keep global temperature rises within 2 degrees C.

BloombergNEF

Copyright and disclaimer

BloombergNEF

Bloomberg NEF (BNEF) is a leading provider of primary research on clean energy, advanced transport, digital industry, innovative materials, and commodities.

BNEF's global team leverages the world's most sophisticated data sets to create clear perspectives and in-depth forecasts that frame the financial, economic and policy implications of industry-transforming trends and technologies.

BNEF research and analysis is accessible via web and mobile platforms, as well as on the Bloomberg Terminal.

Coverage.

Clean energy
Advanced transport
Commodities
Digital industry

BloombergNEF

Get the app
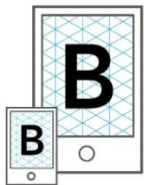
On IOS + Android
about.bnef.com/mobile

Client enquiries:

Bloomberg Terminal: press <u><Help></u> key twice
Email: <u>support.bnef@bloomberg.net</u>

Learn more:

about.bnef.com | @BloombergNEF