

Decarbonization in China, Germany and California

Wilson Center Presentation

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BloombergNEF

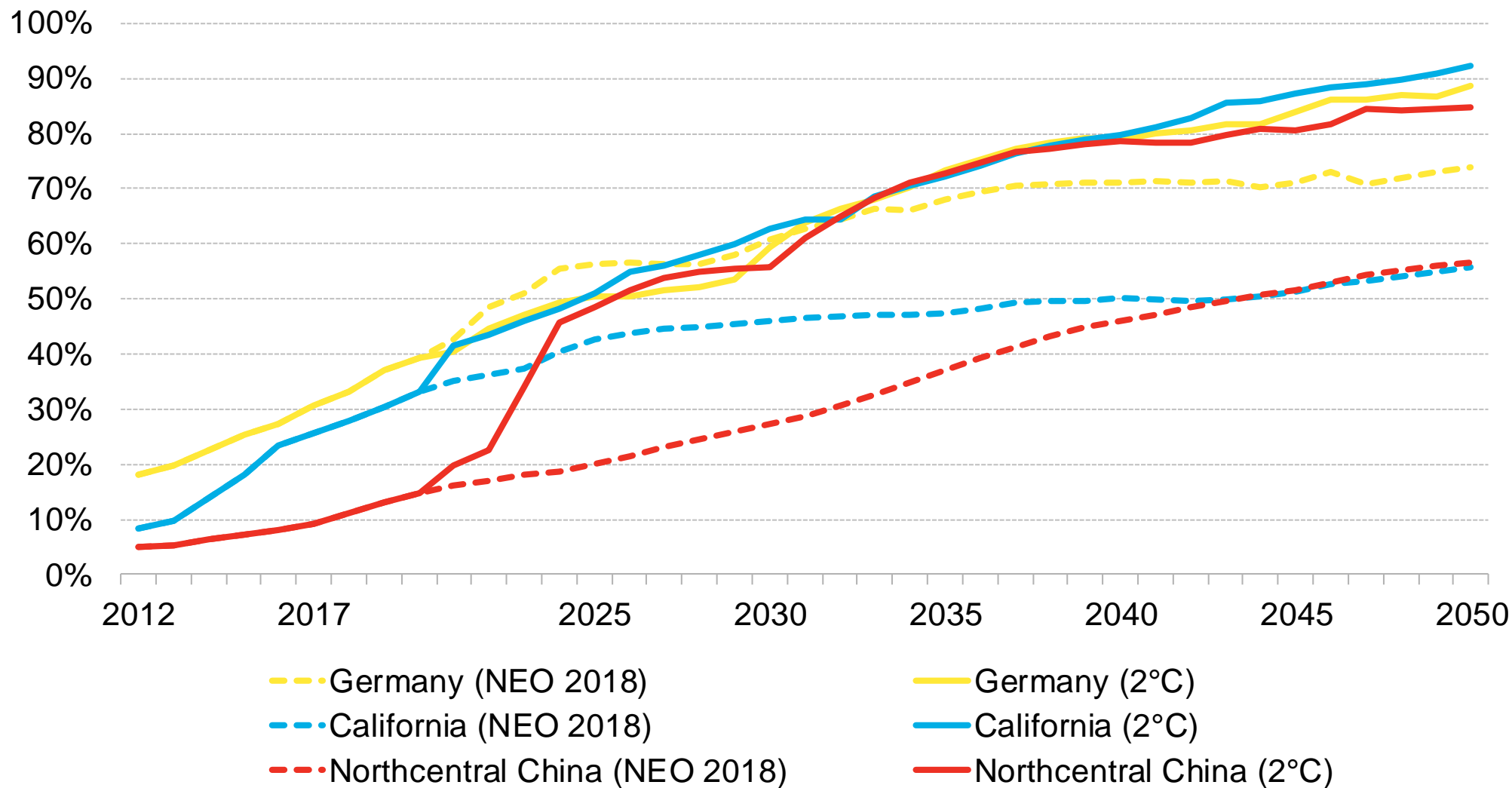
Introduction

- This presentation is based on BloombergNEF's November 27, 2018, analysis, "Can Wind, PV and Batteries Keep Us Within 2 Degrees?" by Jef Callens and Seb Henbest.
- We built 2°C pathways to 2050 for the power sector in three regions – Germany, California and Northcentral China – and modeled the generation mix, allowing renewables and batteries to meet as much demand as possible.
- We used International Energy Agency data on power sector emissions and annual changes in emissions.

Introduction (2)

- In this presentation, we compare our 2°C pathways to 2050 with BNEF's New Energy Outlook 2018 (NEO 2018), our proprietary annual long-term economic forecast of the world's power sector.
- Unlike NEO 2018, the 2°C pathways to 2050 in this presentation are not forecasts, are not intended for decision support and should not be interpreted as a measure of national effort.

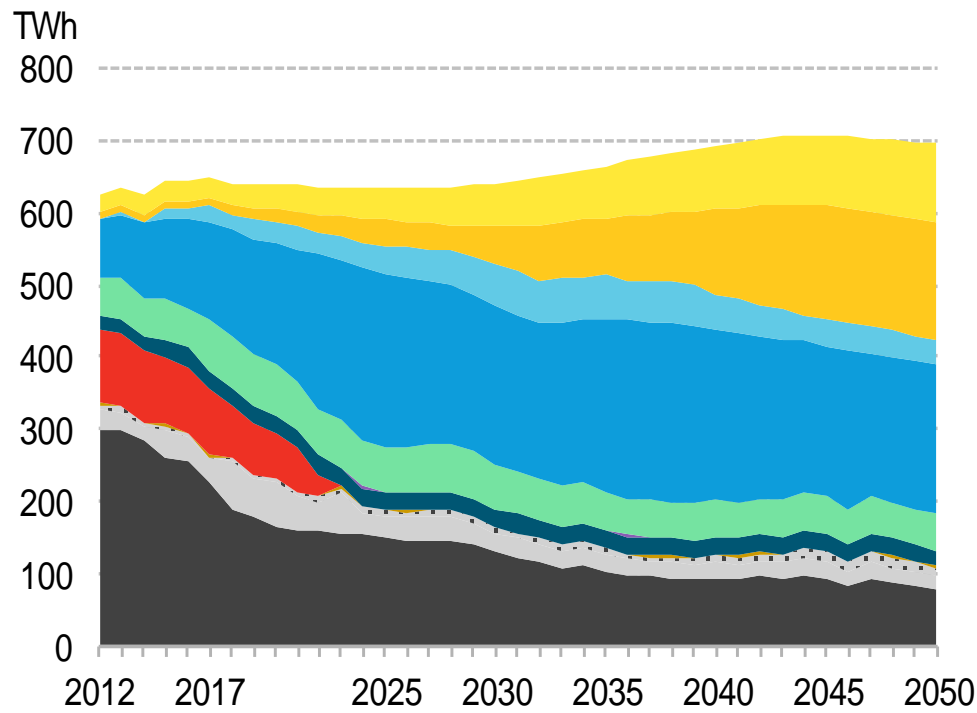
Wind and PV generation share, NEO 2018 vs 2°C pathway



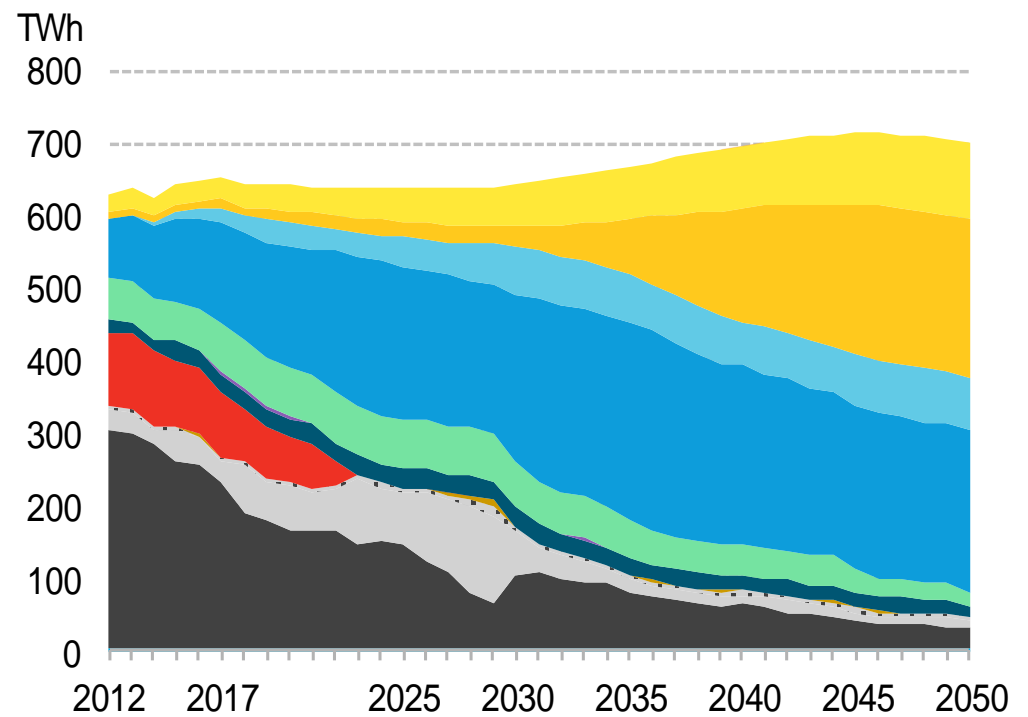
Source: BloombergNEF Note: "Northcentral China" encompasses the cities, provinces and region (Inner Mongolia) with the country's largest electricity demand.

Germany generation to 2050

NEO scenario



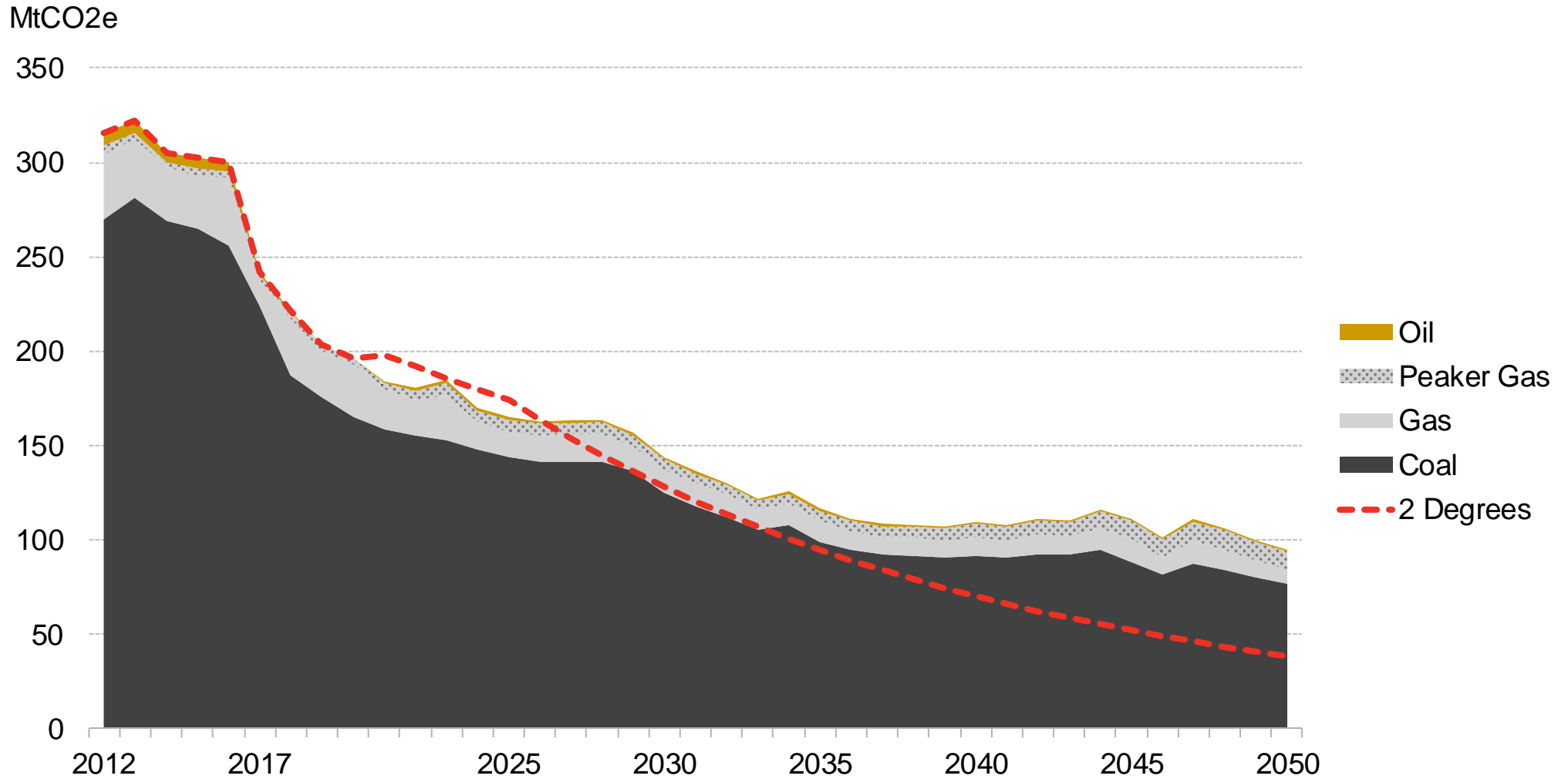
2°C pathway



- Coal
- Gas
- Peaker Gas
- Oil
- Nuclear
- Hydro
- Geothermal
- Biomass
- Onshore wind
- Offshore wind
- Utility-scale PV
- Small-scale PV
- Solar thermal

Source: BloombergNEF

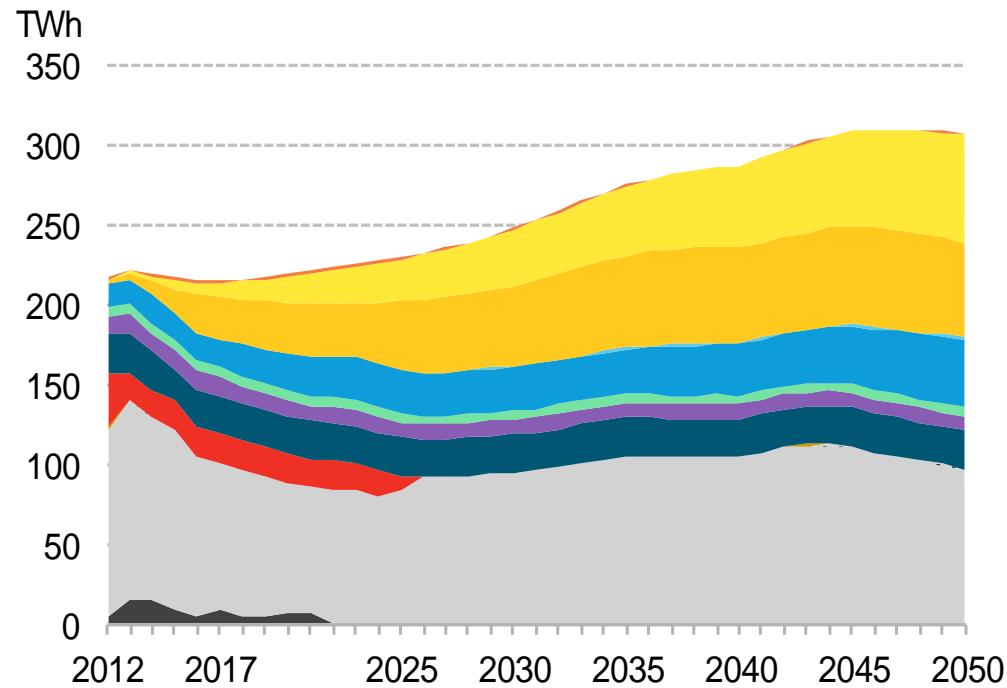
Germany emissions to 2050



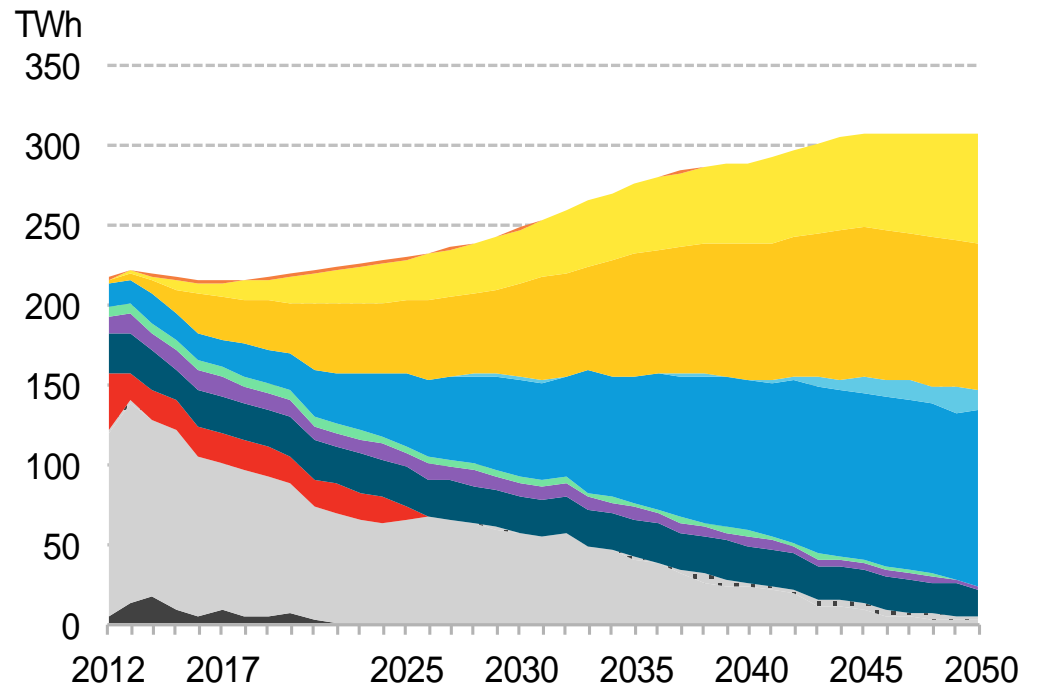
Source: BloombergNEF

California generation to 2050

NEO scenario



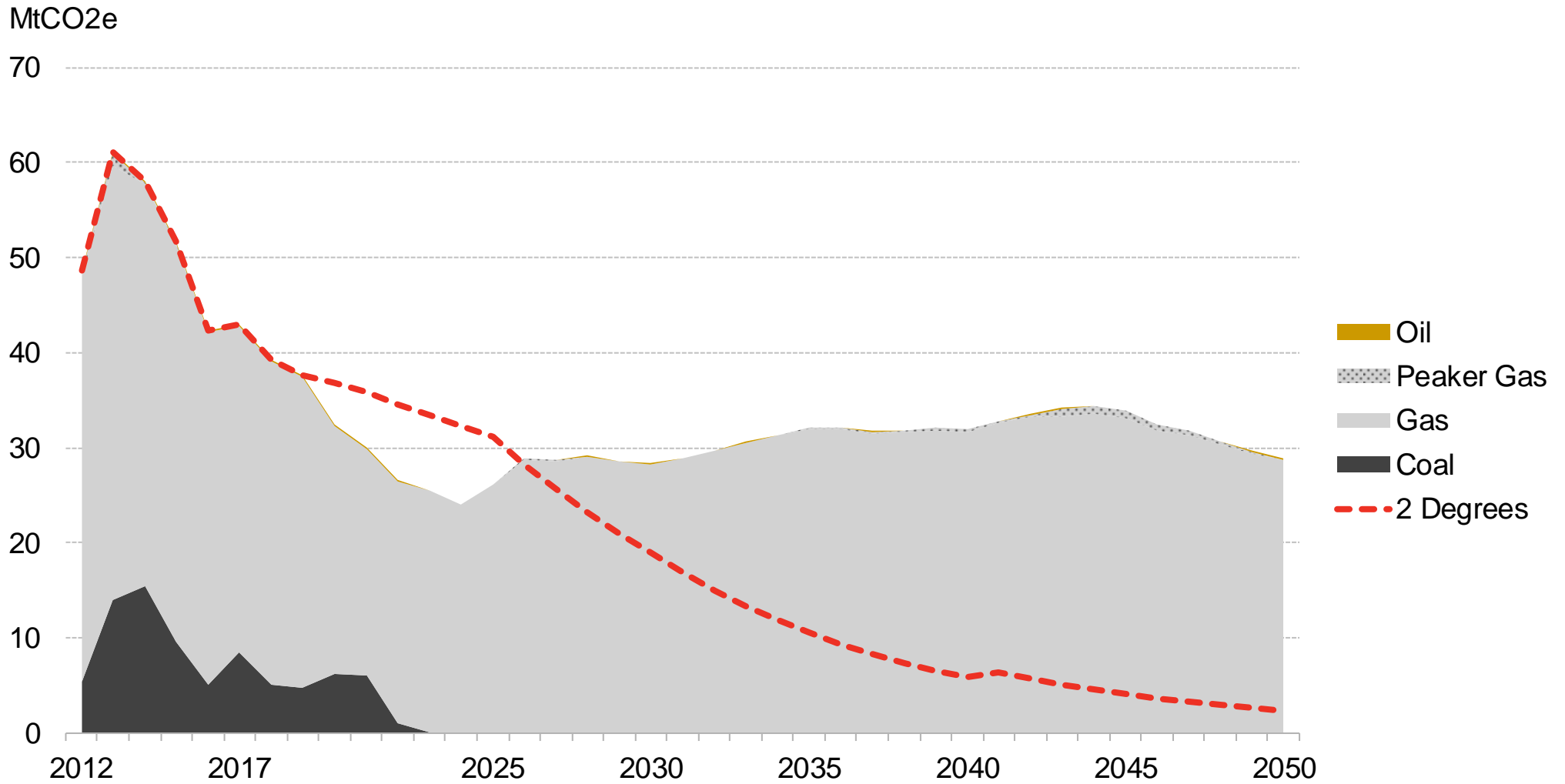
2°C pathway



- Coal
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Source: BloombergNEF

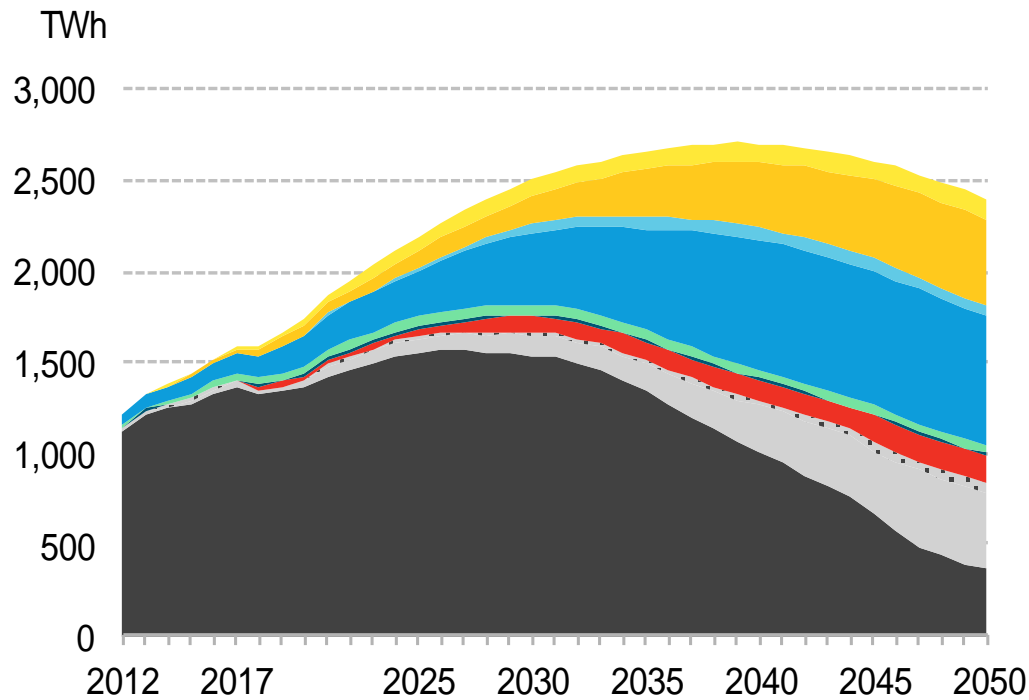
California emissions to 2050



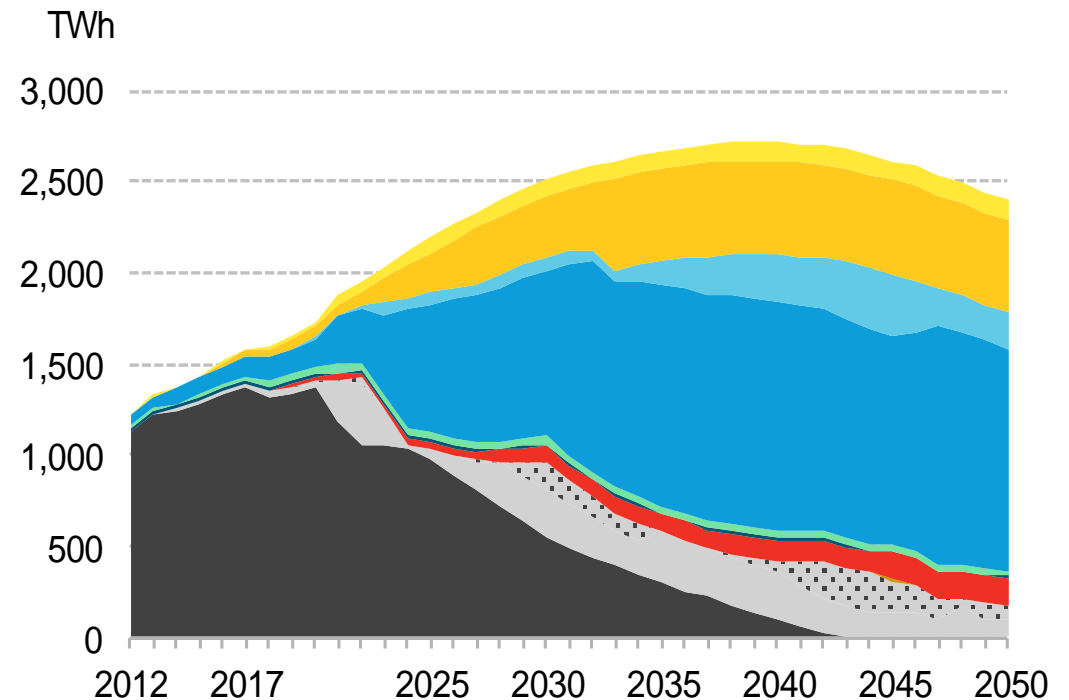
Source: BloombergNEF

Northcentral China generation to 2050

NEO scenario

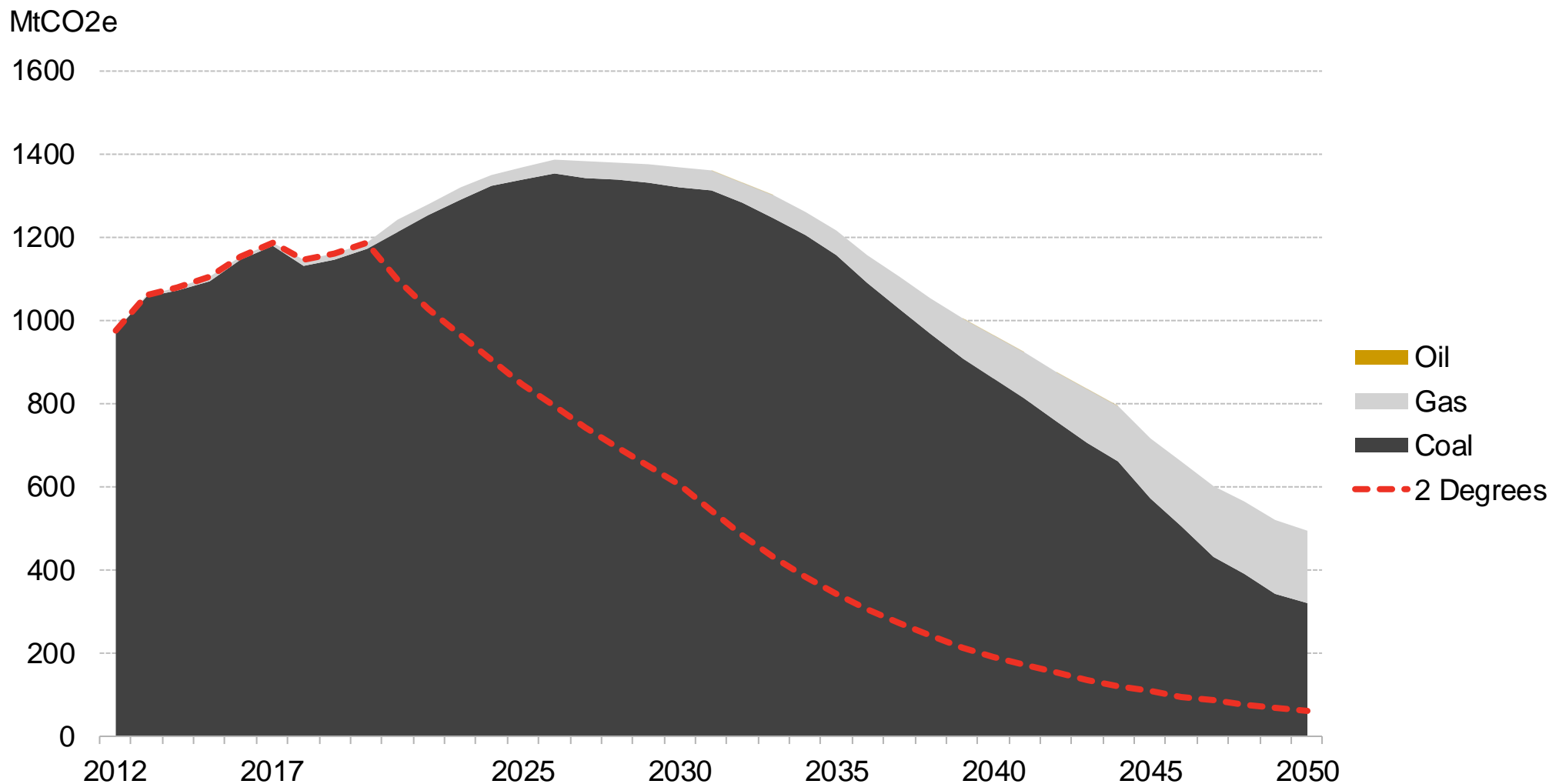


2°C pathway



Source: BloombergNEF Note: "Northcentral China" encompasses the cities, provinces and region (Inner Mongolia) with the country's largest electricity demand.

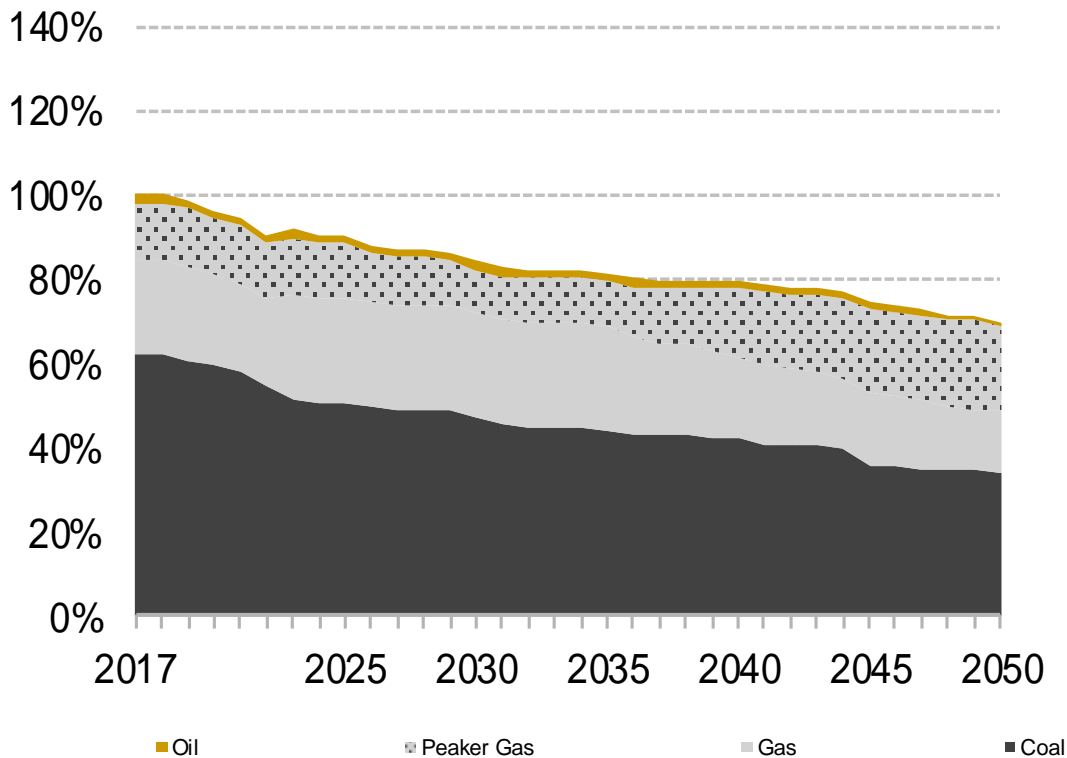
Northcentral China emissions to 2050



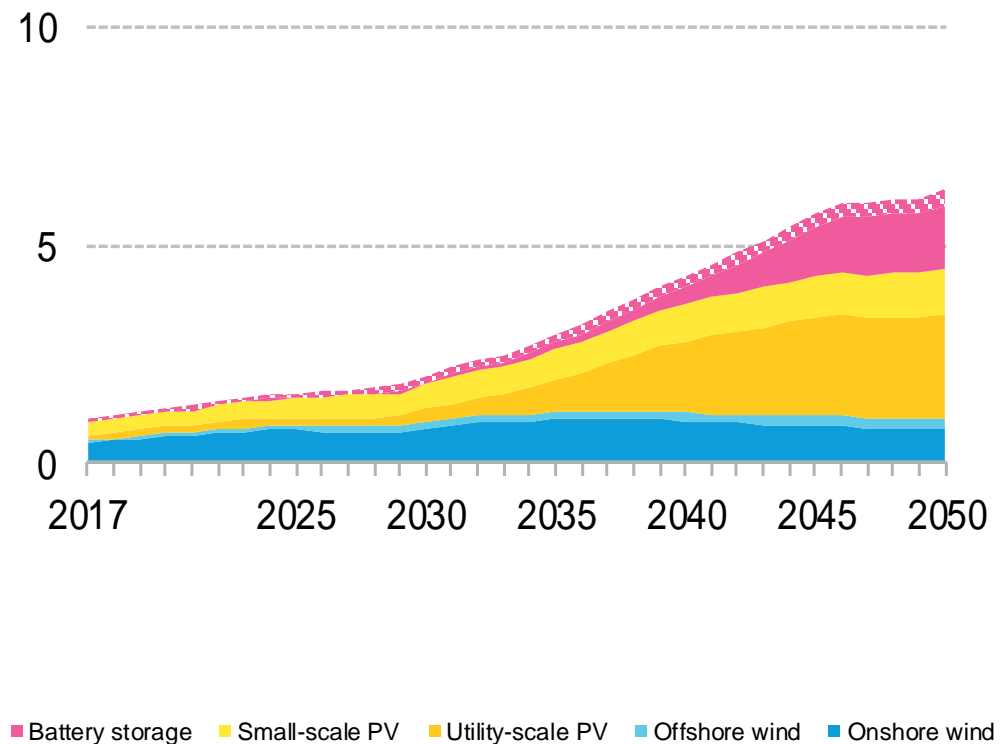
Source: BloombergNEF Note: "Northcentral China" encompasses the cities, provinces and region (Inner Mongolia) with the country's largest electricity demand.

Germany capacity to 2050

Fossil (2017=100%)



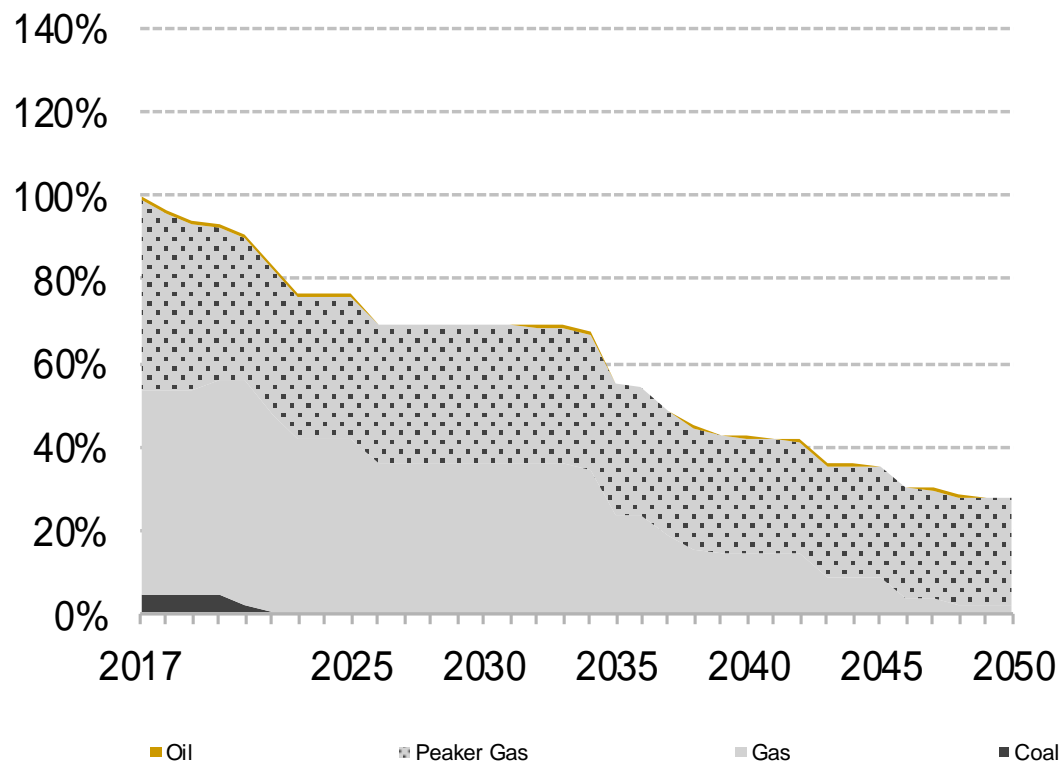
Renewables (2017=1x)



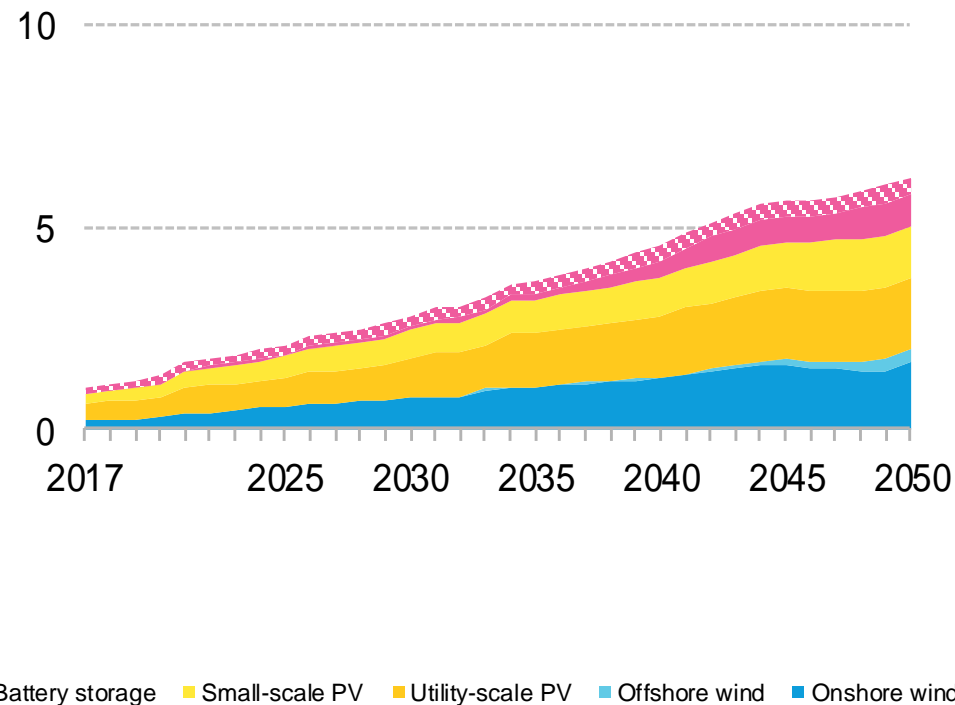
Source: BloombergNEF

California capacity to 2050

Fossil (2017=100%)



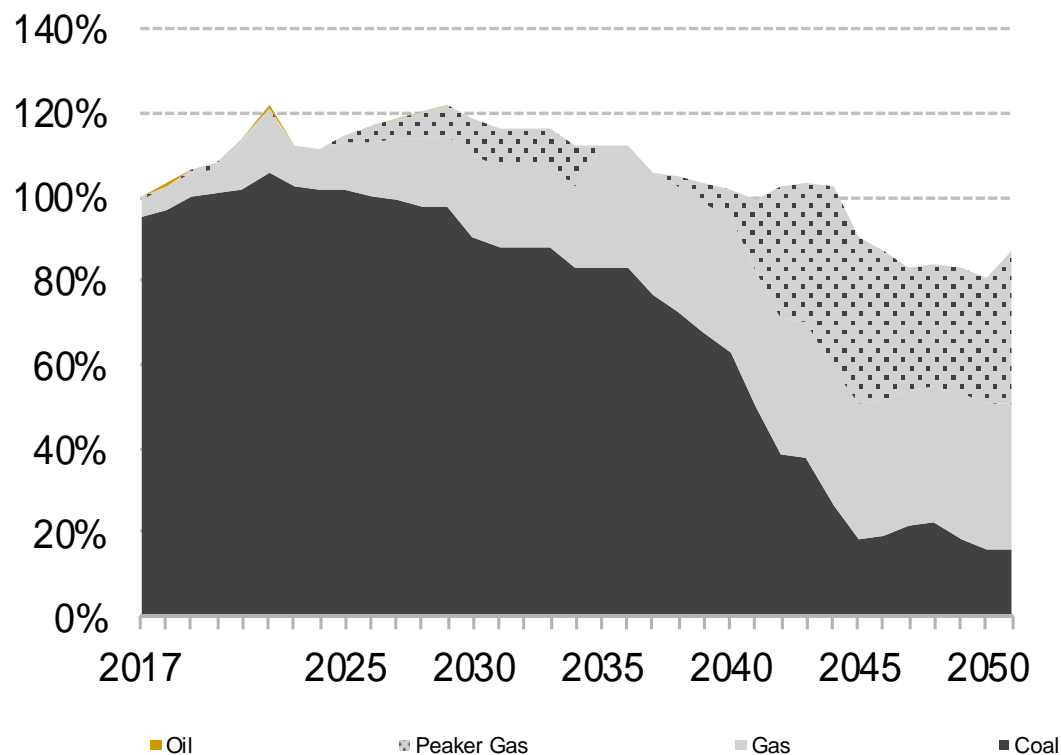
Renewables (2017=1x)



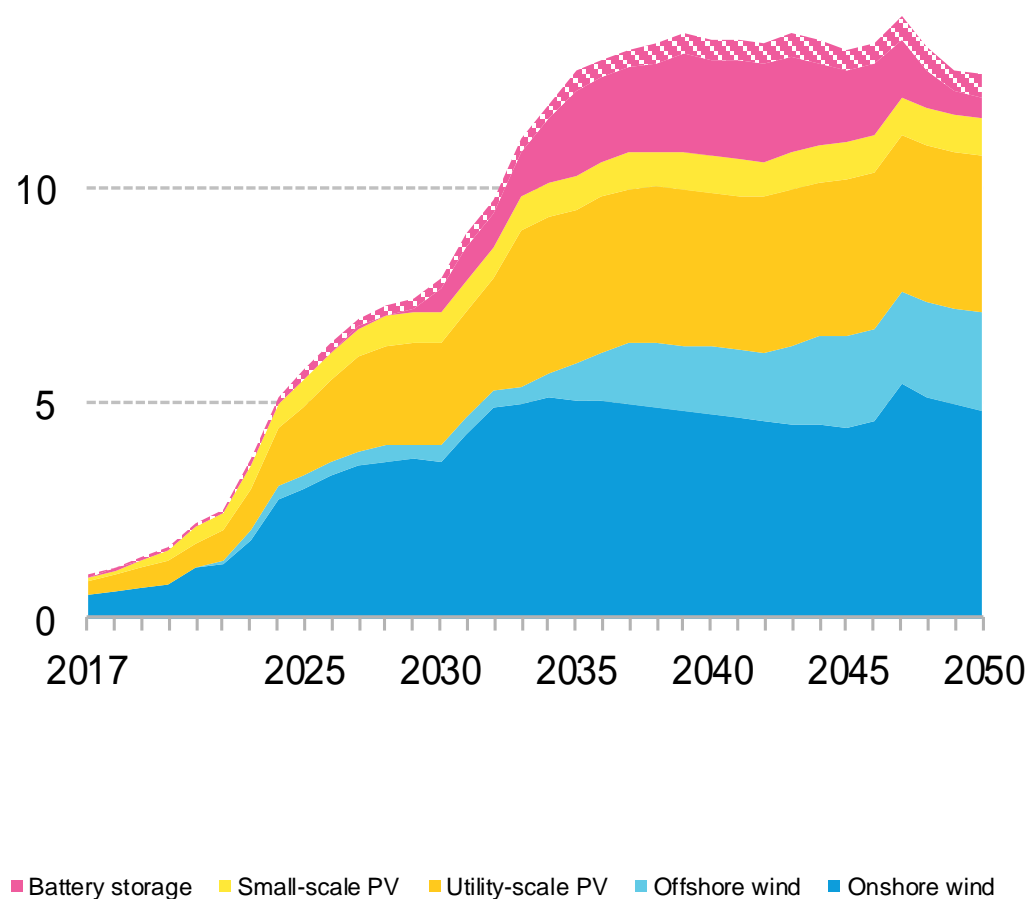
Source: BloombergNEF

Northcentral China capacity to 2050

Fossil (2017=100%)



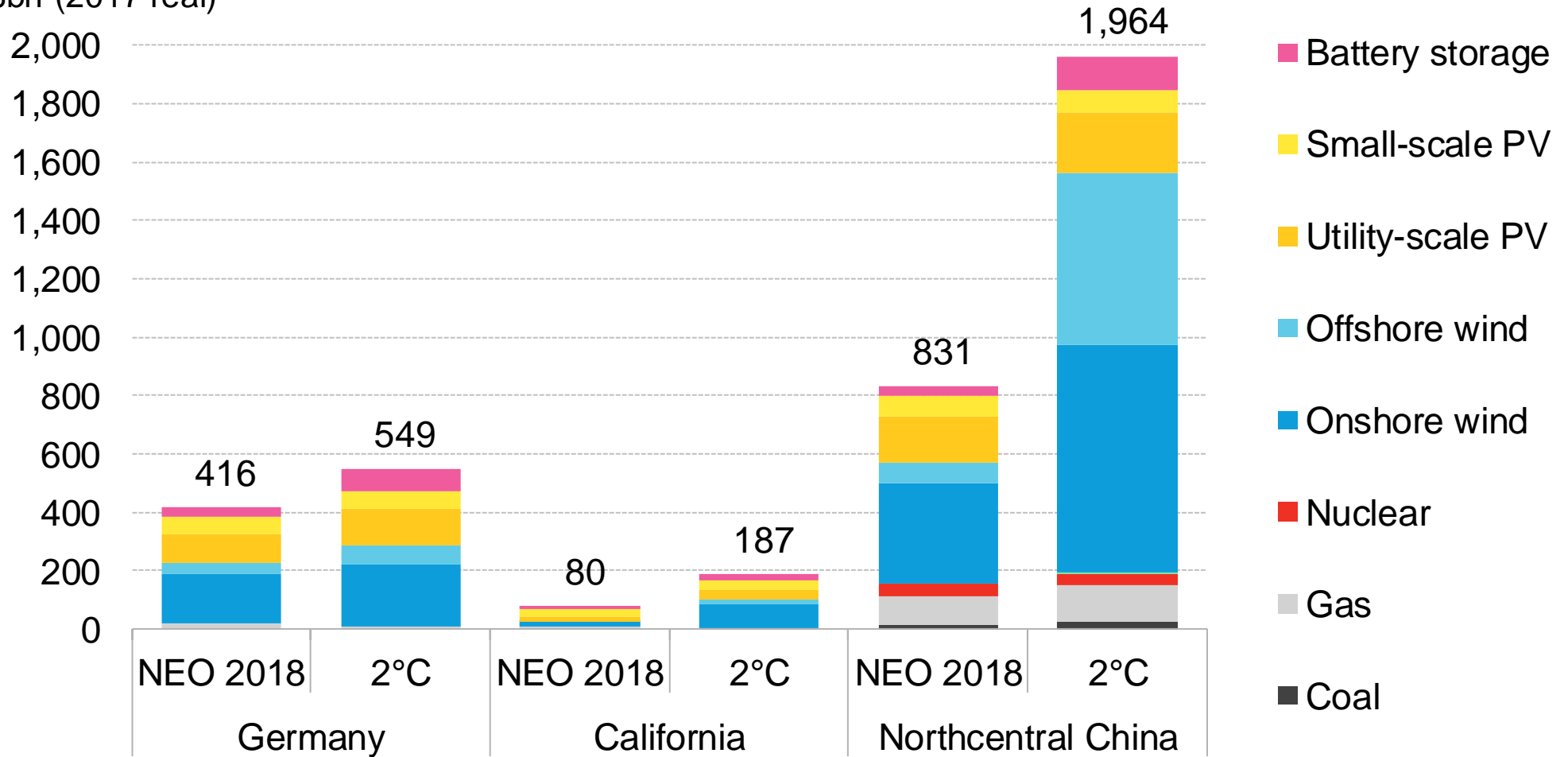
Renewables (2017=1x)



Source: BloombergNEF

Investment in generation capacity by region, 2018-2050

\$bn (2017 real)



Source: BloombergNEF

Conclusions

- To keep global warming within 2°C, power systems around the world need to decarbonize rapidly over the next 30 years. The required investment ranges from 30% more than NEO 2018 in Germany to 230% in California to 240% more in Northcentral China.
- To achieve our 2°C pathways would require a rapid build-out of renewable energy, at around 44GW per year in Northcentral China, 16GW in Germany and 5GW in California. That's 81%, 21% and 106% more build than in our NEO 2018 analysis.
- Battery storage capacity must surge to integrate such large amounts of intermittent clean energy.

Conclusions (2)

- These 2°C pathways face high barriers left unaddressed here.

Examples are:

- Market design and price formation
- Land availability for so much low-density renewable capacity
- Availability of raw materials for solar, wind and power storage
- Grid technology for managing intermittency and frequency variation

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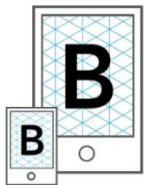
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