Clean Energy Outlook

Federal Reserve Bank of Dallas

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Falling technology costs are key to the decarbonization of power and transport

Solar module price ($/W)
XP Curve = 28.8%

Wind turbine price ($/W)
XP Curve = 7.1%

Batteries pack price ($/kWh)
XP Curve = 18%

Source: BloombergNEF
PV is increasingly efficient

Average year-end PV module efficiency

Source: BloombergNEF  Note: 2017 multi module efficiency was adjusted downwards from the 2018 PV manufacturing overview to reflect the industry average instead of pure survey results.
Wind capacity factors are on the rise

Wind capacity factors by technology

Onshore wind

Offshore wind

Source: BloombergNEF
Lithium-ion battery pack energy density is improving (as is cycle life)

Lithium-ion battery pack energy density

Source: BloombergNEF
Wind and PV are among the cheapest forms of generation in the U.S.

**United States levelized cost of electricity**

$/MWh (nominal)

Source: BloombergNEF. Note: LCOEs exclude tax-credits (ITC & PTC) and curtailment. The LCOE range represents a range of costs and capacity factors. Battery storage systems (co-located and stand-alone) presented here have four-hour storage. In the case of solar-and wind-plus-battery systems, the range is a combination of capacity factors and size of the battery relative to the power generating asset (25% to 100% of total installed capacity).
Wind and PV grow to 56% of global electricity generation in 2050

Global electricity generation

Source: BloombergNEF, IEA
PV, wind and energy storage is a least-cost combination to 70-80% renewables

Share of wind and solar as % of total annual generation

Source: BloombergNEF
In the U.S., renewables and gas have thrived over the last decade at the expense of coal.

Net U.S. power generation additions (GW)

Source: BloombergNEF
Coal and nuclear continue to struggle based on economics alone

Coal and nuclear capacity retirements, United States

Source: BloombergNEF
Wind, solar and gas (in the 2020s) continue to thrive

U.S. power generation capacity additions (GW)

Source: BloombergNEF
Renewables overtake gas as the leading source of generation in 2041

U.S. gross generation (TWh)
Wind and solar make up some 60% of total installed capacity in California in the ETS

Installed power generation capacity (GW) in California, Economic Transition Scenario

Source: BloombergNEF  Note: ETS stands for Energy Transition Scenario
Meeting California state goals requires much more capacity (solar+storage)

Installed power generation capacity (GW) in California, Renewable Portfolio Standard Scenario

Source: BloombergNEF
U.S. federal policy changes could be similarly impactful

Net-zero pledges of top global economies

1. United States  
2. China  ✔️
3. Japan  ✔️
4. India  ✗
5. Germany  ✔️
6. United Kingdom  ✔️
7. France  ✔️
8. Italy  ✔️
9. Brazil  ✗
10. Canada  ✔️
11. Russia  ✗
12. South Korea  ✔️

Source: Bloomberg
The U.S. currently lags behind Europe and China in terms of EV sales

Passenger electric vehicle sales (millions)

Source: BloombergNEF. Includes BEVs and PHEVs
Transitions are slow, right up until they’re not

Policy

Performance

Corporate actions

Source: Jean Chung/Bloomberg

Source: Tomohiro Ohsumi/Bloomberg

Source: Volkswagen
Passenger vehicles electrify quickly from the mid-2020s based on economics

Electric vehicle share of global new vehicle sales

Source: BloombergNEF
Two ways to think about O&G transition strategies

1. Shareholder pressure and ESG considerations
2. Disclosure requirements
3. Alignment to political goals in home markets
4. Social license to operate

The business rationale for investing in new and clean energy
We believe we can be the largest electricity power company in the world in the early 2030s.

*Maarten Wetselaar, Integrated Gas & New Energies Director, Shell*
Interested in learning more about BNEF?

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