Global Clean Energy Outlook

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| November 10, | 2022 | · · · | • • • | • | · · | | • | · · | - | • | · · | • | • • | - | • | • | · · | | • | • | • | • | | / |



BNEF coverage

Strategies for a cleaner, more competitive future



Renewable energy investments have risen, barring some hiccups...



Source: BloombergNEF

2 November 10, 2022

...and capacity additions have grown continuously

Annual renewable energy investments and capacity additions



Source: BloombergNEF

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Renewables capacity growth aided by cost declines...

Global solar PV capex benchmark

\$/W(DC)(Real 2021)



Source: BloombergNEF

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...and by rising efficiencies

Onshore wind capacity factors



Battery energy density



Source: BloombergNEF Note: NMC is Nickle, Manganese & Cobalt, NCA is Nickel, Cobalt & Aluminum, LFP is Lithium, Iron & Phosphate and LMO is Lithium Manganese Oxide.

Source: BloombergNEF

...translating into lower power generation costs

Global levelized cost of electricity (LCOE) benchmarks



Source: BloombergNEF. Note: The global benchmark for PV, wind and storage is a country-weighted average using the latest annual capacity additions. The storage LCOE is reflective of a utility-scale Li-ion battery storage system with four-hour duration running at a daily cycle and includes charging costs.

...leading to higher share in the global power mix

Share in global power generation



Source: BloombergNEF Note: renewables include large hydro and biomass.

However, renewable energy capex have risen for the first time in decades

Benchmark U.S. onshore wind capex



Source: BloombergNEF. Note: Capex chart is by financing year.



However, renewable energy capex have risen for the first time in decades

Global solar PV capex benchmark



\$/W(DC)(Real 2021)

Source: BloombergNEF

But costs expected to decline again as supply chain constraints ease

Benchmark U.S. onshore wind capex



Source: BloombergNEF. Note: Capex chart is by financing year.



But costs expected to decline again as supply chain constraints ease

Global solar PV capex benchmark



Source: BloombergNEF

Renewables will continue to grow rapidly in an Economic Transition Scenario...



Source: BloombergNEF

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But for net zero, we need to decarbonize everything (not just the power sector)...

Energy emissions and carbon budget, by sector



Source: BloombergNEF

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Rising investments in other forms of known clean energy raises hopes...

Global new investment in energy transition by sector



Source: BloombergNEF Note: CCS is carbon capture & storage. Start-years differ by sector. However, all sectors are present from 2019 onward; see Appendix for more detail.

...but investments need to scale rapidly

2021 energy transition investment versus required investment to reach net-zero



Source: BloombergNEF Note: Green scenario sees higher share of electricity in energy mix and growth for renewable power, carbon capture and storage (CCS) grows significantly in the gray scenario, high electrification and growth of nuclear power drive the red scenario.

...but investments need to scale rapidly

2021 energy transition investment versus required investment to reach net-zero



Source: BloombergNEF Note: Green scenario sees higher share of electricity in energy mix and growth for renewable power, carbon capture and storage (CCS) grows significantly in the gray scenario, high electrification and growth of nuclear power drive the red scenario.

Net-zero commitments are a good to have...

Status in G-20 countries

Share of global emissions by status



Source: WRI CAIT, BloombergNEF. Note: Includes land use, land-use change and forestry, 2018

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Inflation Reduction Act (IRA) a potential game changer

Estimated 2022-31 energy transition spending in 2021-22 laws



Source: EIA, EPA, Joint Committee on Taxation, BloombergNEF. Note: Not comprehensive



... IRA can help accelerate clean power

U.S. annual solar PV build



U.S. annual wind power build



U.S. battery storage build 2022-30



Source: BloombergNEF

...IRA also brings promise to carbon capture and hydrogen

Effect of production tax credits on US LCOH₂



Source: BloombergNEF. Note: This modeling uses project level assumptions available in BloombergNEF's H2val. Green hydrogen calculation assumes production tax credit of \$3/kg taken over equal production in each year. Blue hydrogen calculations assume projects choose 45Q credit.

Nth-of-a-kind capture costs with previous and new 45Q credit levels



Source: Great Plains Institute, BloombergNEF. Note: Petrochem is petrochemicals, which are used to make plastics.

...and IRA can help other clean fuels too

Renewable diesel production capacity

Million tons



Global sustainable aviation fuels demand



RNG supply and demand outlook in U.S.



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Multiple options for oil & gas firms to invest in the energy transition



Source: BloombergNEF

Leading to diverging strategies emerging

Cumulative low-carbon investment, 2015-2021



Source: BloombergNEF. Note: Since the previous update, hydrogen investment has been moved to "core aligned". Janus is the rom an god of beginnings, usually depicted with two faces, one looking into the past and the other into the future. Logarithmic scale used.

Still, low-carbon investment of oil & gas firms are at an all time high

Low-carbon investment for oil and gas



Low-carbon %

The share of low-carbon expenditure from the 41 oil and gas companies analyzed has reached 6.6% of capex, a new high in 2021.

2021 saw over **\$21 billion** invested. compared to about \$14 billion across all of 2020, and almost \$17 billion in 2019.

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Source: BloombergNEF, Bloomberg terminal, company announcements

24 November 10, 2022

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Feedback:

Ashish Sethia (<u>asethia5@bloomberg.net</u>) Brent Smelter (<u>bsmelter@bloomberg.net</u>)

Client enquiries:

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

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