New Energy Outlook 2025

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Energy and climate scenarios that connect the dots.

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Executive summary

Summary findings

Investors and businesses navigating the energy transition face rising complexity and uncertainty against a backdrop of elevated policy risk and geopolitical tension. Yet key clean-energy technologies continue to enjoy strong fundamentals, with favorable economics and rising technology maturity driving adoption in diverse geographies across the globe. At the same time, accelerated growth in power demand from rising adoption of artificial intelligence presents both a challenge and an opportunity.

This report is BloombergNEF's latest global energy transition outlook to 2050. Here, we present a new, updated base-case scenario, mapping out how the transition might progress in a world where investment decisions are driven primarily by the need to meet rising energy demand with a cost-competitive mix of technologies – not by climate concerns. Through this 'Economic Transition Scenario', we explore how far and how fast the low-carbon transition can proceed based purely on competitive economics and existing short-term policy settings. In conjunction with our Paris-aligned Net Zero Scenario (published last year), we hope that this new work can support companies, financial institutions and policy professionals in developing resilient strategies to address energy security, economic development and climate-change mitigation.

Understanding this report

- For this edition of BNEF's New Energy Outlook, we have focused our efforts on updating the base-case Economic Transition Scenario (ETS), incorporating new analysis on data-center power demand, changed policy assumptions in some key geographies, and updated cost estimates for both clean and fossil energy. Most policy and cost assumptions date from late 2024.
- This year's report contains a substantial chapter focusing on the 10 years to 2035. These years will be make-or-break from a climate perspective, and the year 2035 specifically forms the focus of the third round of Nationally Determined Contributions (NDCs) under the Paris Agreement, which are due this year in advance of COP30 meeting in Brazil in November.
- Our ETS sees robust adoption of clean power and electrification in road transport in the coming decades, growth in natural gas demand, and long-term decline in coal and oil use. Emissions in BNEF's ETS fall 22% by 2050 (back to 2005 levels), a trajectory in line with global warming of 2.6C by 2100, with a 67% confidence interval.
- Our Net Zero Scenario (NZS) published in 2024 remains valid. The trajectory required for the world to achieve net zero by 2050 in line with the Paris Agreement has not changed, though there is less time than ever. We do not re-display that work in full in this publication, but we

do make important comparisons to it throughout and re-publish the scenario's full dataset in our *New Energy Outlook 2025: Data Viewer (web | terminal)*.

Growth, opportunity and data centers

- In the ETS, demand for electric power rises 75% by 2050 as economic development, electric vehicles (EVs), cooling needs and power demand for data centers push up electricity use. Growing economies in Asia, the Middle East and Africa account for a large portion of the increase, and it is here that the greatest opportunities for power infrastructure investment will lie. Across the wider energy economy, demand for 'useful energy' increases 32% by 2050 as populations and economies grow, but primary energy rises just 9%, as efficiency gains from electrification and renewables limit the growth of upstream energy production.
- Incremental electricity demand from data centers jumps to 1,200 terawatt-hours globally by 2035, and 3,700TWh by 2050. In total, data centers represent 4.5% of final power demand in 2035. That almost doubles to 8.7% in 2050. In all, this is still less than the demand from EVs (11.2% in 2050), but more than air-conditioning and heat-pump load, which reaches 7.1% in 2050.
- Estimates of future demand from data centers are somewhat uncertain and subject to revision, but it is clear they represent a substantial opportunity in the coming decade. We find that an additional 362 gigawatts of power plant capacity is required by 2035 to meet data-center demand. Renewables (47%) and storage (9%) together make up more than half of the needed capacity, but the remainder (44%) is fossil-based. However, when it comes to power generation, the balance is flipped. In aggregate, 64% of incremental generation to meet data-center demand comes from fossil fuels, and 36% from renewables.
- This last finding appears to run at odds with industry wisdom today that places solar and wind at the front of the queue when constructing new power capacity to meet data-center demand, in part due to a backlog in the availability of gas turbines. Our modeling supports the strong case for renewables and storage build to power data centers but also highlights the possibility that added data-center demand could help extend the life of existing coal and gas plants. Indeed, most of the incremental coal capacity and one-third of the gas capacity associated with data-center demand is from existing plants that avoid or delay retirement.

Strong fundamentals underpin growth in renewables and EVs

- Renewables and electric vehicles play an expanding role in the Economic Transition Scenario, as ever-lower costs and maturing technologies drive faster adoption. While points of resistance have emerged in recent years, namely higher interest rates, volatile costs and rising trade barriers, these technologies continue to show advantageous and improving economics, which ultimately drive their adoption to unprecedented levels.
- Renewables generation increases 84% in the five years to 2030 and then doubles again by 2050. So, by mid-century, renewable sources serve 67% of the world's (much-expanded) appetite for electric power, up from 33% in 2024. The share of coal, gas and oil in the power system drops to 25% in 2050, from 58% in 2024. This results in a 21% reduction in absolute fossil-fired generation levels. Between now and 2035, some 6.9 terawatts of solar is constructed globally, alongside 2.6 terawatts of wind.
- Power system flexibility, meanwhile, increases markedly to ensure optimal grid operation and system stability, complementing the rise of variable renewables. In the year 2050, more than 4,300TWh of demand-side flexibility is enabled via smart EV charging and demand-response in the wider economy. Another 6,100TWh of flexibility comes from dispatchable technologies

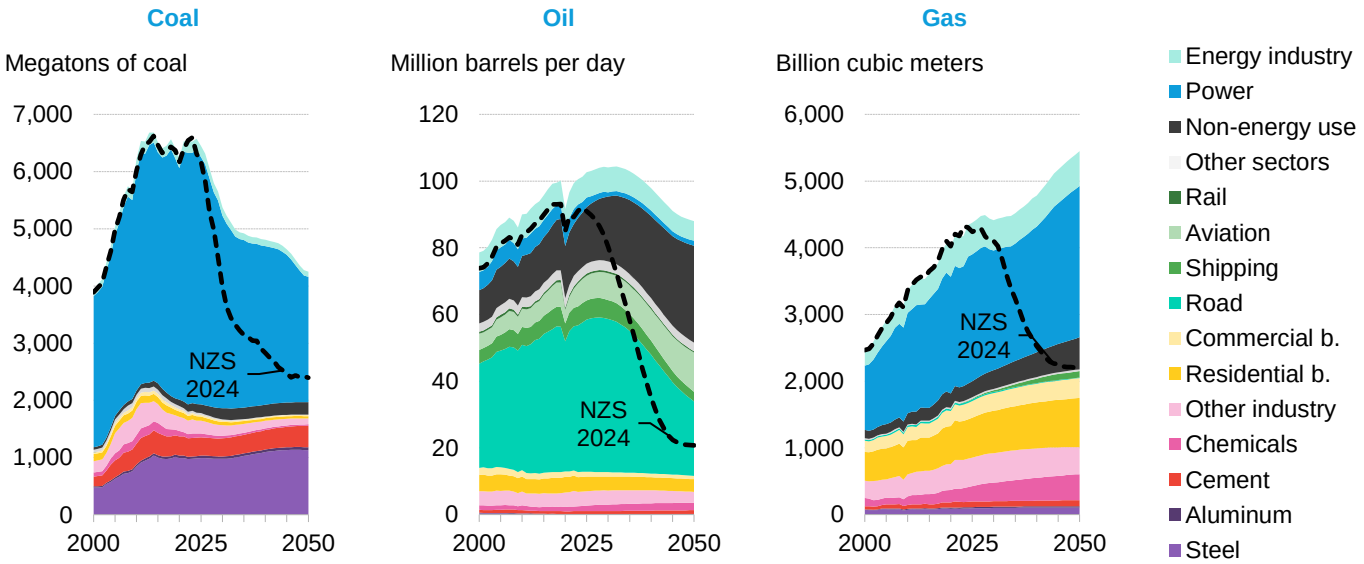
such as batteries, gas-peaker turbines and pumped hydro. Together, these sources are equivalent to 20% of global electricity demand by mid-century.

- Sales of passenger electric vehicles increase to 42 million in 2030, from 17.2 million in 2024, and almost double to 80 million in 2050. By mid-century, about two-thirds of the 1.5 billion passenger vehicles on the road are electric, up from 4% today. This electrification is one of the most important drivers of emissions reductions in the Economic Transition Scenario and helps deliver a 40% reduction in oil consumed in the transport sector by 2050.

Oil and coal face decline, though the speed is uncertain

- Overall oil demand peaks in 2032 at 104 million barrels per day, with road fuel peaking a few years earlier. Demand ultimately drops to 88 million barrels per day by 2050 – a significant decline from today, but far from what is required to get on track for net zero. Outside of road transport, oil consumption remains resilient in the ETS, with a doubling of demand for aviation and strong growth in petrochemicals through 2050.
- Coal demand drops rapidly in the ETS as cost-competitive renewables and gas displace its use in the power sector. Between today and 2035, global coal consumption drops 25%. In the immediate future, we estimate that coal demand may drop 2% year-on-year in 2025, with most of the reduction driven by China. While this outcome will rest on numerous factors such as the country's economic growth and renewables production (including hydro), it is possible that China's coal-based emissions may now be in decline.
- For both oil and coal, a long-term decline is expected in both our ETS and our Net Zero Scenario. Investment is thus likely to fall in these sectors, whether policy makers pursue an economics-led transition or a Paris-aligned one, albeit at different times and at different speeds. The same cannot be said for gas, where our two scenarios highlight starkly divergent futures.

Figure 1: Fossil-fuel demand by sector, Economic Transition Scenario



Source: BloombergNEF. Note: 'NZS 2024' is the Net Zero Scenario from NEO 2024. Megatons are metric and assume a 6,000kcal/kilogram energy content. 'b.' refers to buildings. We have revised upward historical oil demand in NEO 2025 compared to NEO 2024 scenarios, as we now account more accurately for oil use for non-energy purposes outside the petrochemical industry.

Growth in gas demand highlights divergent futures

- Gas now plays a larger role in our Economic Transition Scenario, due to lower long-term fuel-price expectations and higher electricity demand from data centers. Global natural gas demand increases 25% from 2024 to 2050, reaching 5,449 billion cubic meters. Much of this growth occurs after 2035, as the years up to 2034 are characterized by renewables displacing the use of gas in the power sector. But after 2035, power-sector gas consumption kicks in again, led mainly by the US, where favorable economics support investment in gas-fired generation. Gas use also continues to grow in industry and buildings globally, where cost-competitive low-carbon solutions are lacking.
- This outlook contrasts sharply with our Net Zero Scenario, which sees gas demand dropping steeply in the near term and roughly halving by mid-century. There are thus highly divergent futures possible for natural gas, and its role in the energy transition will look very different depending on which kind of transition trajectory is in play in a given region.

Limited inroads on hydrogen, carbon capture, and hard-to-abate sectors

- Not all clean energy technologies are ready to stand on their own two feet. Unlike renewables and EVs, hydrogen, carbon capture and storage, clean fuels and low-carbon industrial processes all struggle to make an impact in the Economic Transition Scenario, which assumes that policy makers offer no new financial support for low-carbon technologies.
- In the aviation sector, the high cost of sustainable aviation fuels limits their role to just 6% of final energy use by 2035, and 7% by 2050. Fossil kerosene demand jumps 63% by 2050 to meet rising aviation demand, with a commensurate rise in emissions. Shipping fares better, with emissions falling nearly 30% by 2050, due to a combination of optimized operations, liquefied natural gas (LNG) uptake, and some progress on methanol and ammonia.
- In the industrial sector, low-carbon technologies and processes make little impact by 2050. Energy-related emissions from industry increase a modest 6% globally by 2050, reaching almost 7GtCO2 (or 9.5GtCO2 if process emissions are included). Demand for industrial materials such as steel, aluminum, cement and petrochemicals increases at a slower rate than seen in the last two decades, but the lack of technology transition means that emissions continue to rise gradually. By 2050, fossil fuels provide 88% of the energy used to produce steel – which is similar to today's levels. Unabated fossil fuels account for more than 96% of global cement production by mid-century. And petrochemicals demand rises 79%, with little to show in the way of low-carbon transformation.
- Residential and commercial buildings see a 37% increase in final energy use through 2050, in the wake of rising population, higher household incomes and increased business activity – including data centers, which are considered within commercial buildings. Just under half of the increase occurs in the residential sector, with a doubling in air-conditioning demand and growth in other energy uses too. Cooling needs and data centers drive a 68% increase in electricity demand in commercial buildings. Heat pumps are a critical tool for decarbonizing building heat, but their high upfront cost restricts their role to just a quarter of primary heating units in cold-climate households by mid-century in the ETS. Despite the rise in energy demand, a combination of electrification, cleaner power and energy efficiency gains together hold emissions increases in the buildings sector to just 4% by 2050.
- These findings contrast strongly with our Net Zero Scenario, which sees a large role for heat pumps in buildings, clean fuels for heavy transport, and hydrogen, carbon capture and electrification in industry. The NZS maps out credible decarbonization pathways for each of these so-called hard-to-abate sectors – but robust, long-term policy support would be needed to close the gap between the base case in this report, and the path to net zero.

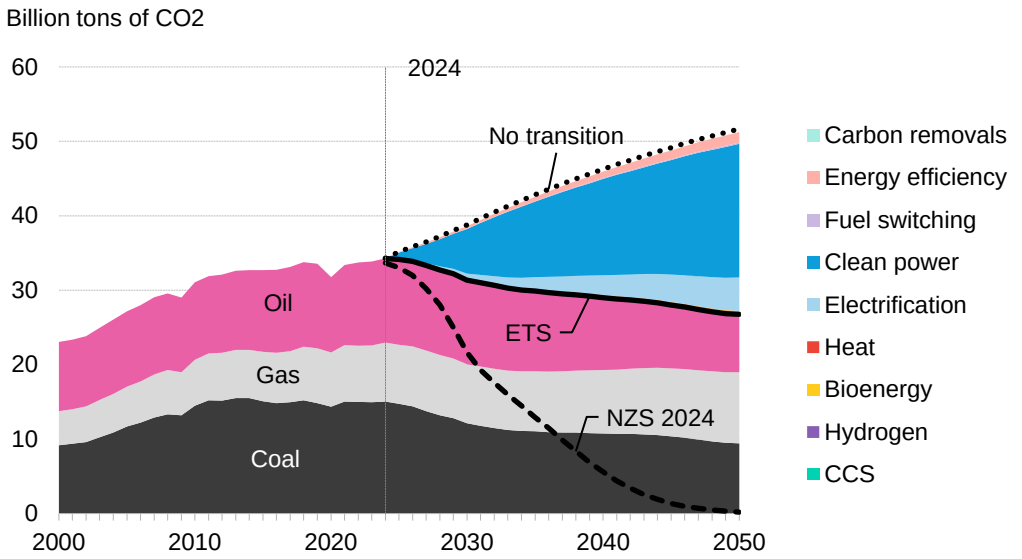
The US energy transition does not derail

- BNEF's outlook for energy transition in the US will evolve in the coming months as more policy clarity emerges from a fluid and fast-moving picture in Washington today. The updated US base case presented in this report incorporates a lowered EV forecast that assumes weaker fuel-economy standards and the removal of purchase tax credits. We also factor in lower natural gas price assumptions, updated project pipelines and cost estimates for clean energy technologies, as well as increased data-center demand. Most of these assumptions were settled at the end of 2024 but remain valid as of April 2025.
- Compared with our 2024 base case, the US transition is slowed but not derailed. Importantly, emissions continue to fall, dropping 16% by 2035 (as compared to 24% in last year's base case), and 29% by 2050 (versus 41% last year), as renewables and EVs continue to roll out. When compared to last year's outlook, most of the increase in emissions in the coming decade is due to road transport and fuel refining, with some impact from increased gas burn in the power sector.
- For clean power technologies in the US, the future remains bright in the next ten years. The ETS sees installed wind capacity double by 2035 to 321 gigawatts, and solar more than triples to 692GW. The installed base of battery storage rises from 29GW in 2024 to 175GW by 2035.
- Compared to last year's Economic Transition Scenario, our new base case sees 15% less wind capacity in the US by 2035, reflecting the administration's actions on permitting and seabed leases, as well as lower assumed onshore wind capacity factors in our modeling. In contrast, lower solar and battery costs have led to increased deployment for these two technologies. Solar capacity is up 7%, or 43GW, in 2035 compared to our previous ETS, and battery storage is up 11%, or 17GW. Policy changes – both those that have been enacted and those that are still to come – can and will affect the pace of the transition in the US, but clean energy technologies will continue to gain ground based on economics.
- Note that the US scenario presented in this report does not account for the new 'reciprocal' tariffs announced on April 2. These tariffs, if implemented in full, are likely to raise the costs of key clean technologies in the US. BNEF has previously run a scenario in which the US pursues full onshoring of battery cells and solar polysilicon-to-modules and found that the resulting higher costs led to 27% less stationary-storage build to 2050, and 7% less solar PV.

Global emissions set to begin their long descent

- Energy-related CO2 emissions have risen globally in most years since the 1950s, but clean energy additions appear finally to have caught up with energy-demand growth. Our modeling indicates that 2024 may have been the peak year for emissions, meaning that 2025 could be the first year of *structural* emissions decline (excepting unusual years such as 2020 or 2009). While many individual advanced economies have already seen structural emissions declines induced by the growth of clean energy, this would be the first time such a moment has been observed at the global level.
- Only time will tell if 2024 was truly the peak but, in any case, BNEF's Economic Transition Scenario puts emissions on a declining trajectory in the coming years. By 2030, we find emissions have fallen 9%, and by 2035 the drop is 13%. By mid-century, global energy-related emissions are down 22%, with three-fourths of the emissions avoidance coming from deployment of clean power technologies. A further 15% of abatement comes from electrification of end uses including transport, and 7% from improving energy efficiency in buildings and industry and energy savings elsewhere.

Figure 2: CO2 emissions reductions from fuel combustion by measures adopted, Economic Transition Scenario versus 'no-transition' scenario and Net Zero Scenario



Source: BloombergNEF. Note: The 'no-transition' scenario is a hypothetical counterfactual that models no further improvement in decarbonization and energy efficiency. In power and transport, it assumes that the future fuel mix does not evolve from 2023 (2027 in shipping). 'Clean power' includes renewables and nuclear, and excludes carbon capture and storage (CCS), hydrogen and bioenergy, which are allocated to their respective categories. 'Energy efficiency' includes demand-side efficiency gains. 'NZS 2024' is the Net Zero Scenario from NEO 2024.

Countries face different trajectories, and need to make their NDCs count

- While we are at or near peak global emissions in the energy sector, the same is not true for every country. Our analysis indicates that important economies like India, Vietnam and Indonesia are set to continue increasing their greenhouse gas emissions, while a large group of other markets, including the Middle East and Africa, Latin America and other parts of Asia, could see a long plateau in emissions. The global decline in emissions is largely driven by reductions in leading economies including China, the US and Europe.
- This year, parties to the Paris Agreement are due to present their third set of Nationally Determined Contributions (NDCs) – emissions pledges to 2035. Many have yet to do so, and our analysis provides an indication of the emissions reductions that would be needed for them to get on track for 'well below two degrees' of warming. For example, our NZS indicates that the EU, Australia and South Korea would each need to target roughly a 70% reduction in emissions by 2035 (from different base years; see table). India could commit to a 27% rise in emissions from a 2005 base and remain on track for BNEF's Net Zero Scenario.
- For the few countries that have already submitted a third NDC, our scenarios allow us to assess their level of ambition. Both Brazil and the UK have set 2035 targets that outperform our Net Zero Scenario on emissions reductions, while Japan's commitment is more ambitious than the ETS base case but falls short of the NZS. The US has submitted a 2035 NDC that falls in line with our NZS but is considered defunct given the change of government.

Table 1: Tier 1 country and EU-27 Nationally Determined Contributions 2030 and 2035 emissions targets and ambition levels compared to BNEF's Net Zero Scenario trajectory

			2030 implied emissions change		2035 implied emissions change	
Market	Target type	Base year	NDC	NZS	NDC	NZS
Brazil	Absolute emissions reduction	2005	-53%	8%	-59% to 67%	-20%
UK	Absolute emissions reduction	1990	-68%	-58%	-81%	-73%
France	Absolute emissions reduction	1990	-51%	-45%	Pending submission	-65%
Germany	Absolute emissions reduction	1990	-66%	-64%	Pending submission	-78%
EU-27 *	Absolute emissions reduction	1990	-55%	-54%	Pending submission	-70%
US	Absolute emissions reduction	2005	-50% to -52%	-54%	-61% to -66%	-74%
Australia	Absolute emissions reduction	2005	-43%	-48%	Pending submission	-71%
Japan	Absolute emissions reduction	2013	-46%	-55%	-60%	-73%
South Korea	Absolute emissions reduction	2018	-40%	-50%	Pending submission	-71%
India	Emissions intensity	2005	+153%	+103%	Pending submission	+27%
Indonesia	Baseline scenario	2020	+74%	+3%	Pending submission	-35%
Vietnam	Baseline scenario	2020	+81%	+1%	Pending submission	-20%
China	Emissions intensity	2005	+179%	+5%	Pending submission	-43%

More ambitious than NZS | In line with NZS | More ambitious than ETS | Less ambitious than ETS

*Source: BloombergNEF, ClimateWatch, Nationally Determined Contributions from the UN Framework Convention on Climate Change. Note: NZS is Net Zero Scenario. Applies parties' economy-wide, unconditional, greenhouse gas reduction targets for 2030, apart from China, which only has a CO2-related target. Where the target is a range, the most ambitious figure is used in the rating. NDC ambition assessments consider the absolute difference in emissions, crossover points and overall trajectory. * Includes EU-27 for reference, with 'Europe ex UK' as a proxy for the NZS trajectory. Europe ex UK includes Norway and Switzerland. France and Germany's targets are based on a weighted average contribution to the sectors covered by the EU Emissions Trading System and their national-level effort-sharing targets. For countries with emissions intensity or baseline scenario target, we estimated their 2030 absolute emissions targets. Markets are listed in order of 2030 targets most to least in line with the NZS.*

The Economic Transition Scenario won't materialize by itself

- Although we describe the ETS as our 'base case', the levels of solar, wind and storage deployment seen in the scenario are not the same as the 2035 forecasts presented in our sectoral Market Outlooks. The ETS modeling at the heart of this report assumes that policy makers put in place the conditions for cost-optimal levels of clean energy deployment, whereas our sectoral forecasts must account for real-world policy, regulatory and practical challenges, while factoring in some probability that these barriers are lifted in future years.
- As a result, our sectoral Market Outlooks forecast much less wind and storage deployment by 2030, and slightly less solar, than modeled in the ETS. This is because there are still substantial barriers to clean energy deployment in a number of markets around the world, which may prevent wind, solar and storage from reaching the 'economically optimal' levels described in the ETS. These can include market access and market design, fossil fuel subsidies, permitting/planning challenges, grid infrastructure limitations and lack of experience. Some markets have long-term contracts for fossil generation that protect these plants from being displaced by cheaper clean energy. All these challenges need to be

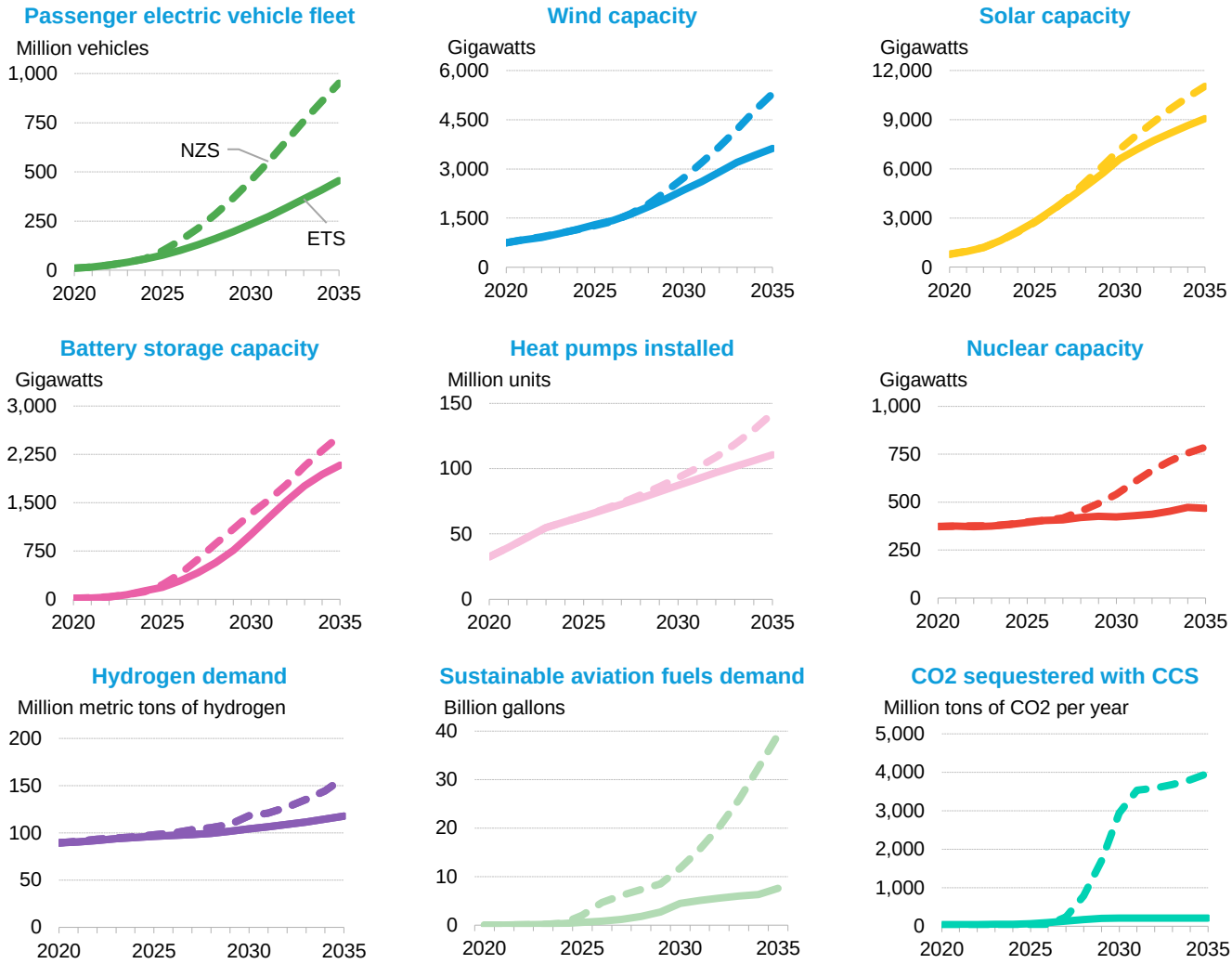
addressed if clean power is to reach its economic potential. Policy makers must take responsibility for creating the conditions for clean power to flourish.

- In addition, markets with hourly wholesale trading could see power price erosion that harms the economics of renewables, and ultimately storage (even if price arbitrage becomes economic for storage in some markets at certain times). This cannibalization effect is strongest for solar but holds true for all zero-marginal-cost technologies. Wholesale power prices will not be sufficient to drive investment levels consistent with our ETS, and so other market mechanisms will continue to be needed.
- While the ETS sees more solar than our sector forecast to 2030, it actually drops below the forecast thereafter. By 2035, solar accounts for 23.5% of power generation globally – enough to trigger the cannibalization effect described above in many markets. After this point, further growth in solar deployments depends on demand growth and higher levels of storage and flexibility on the grid.

Decisive action is needed to get on track for net zero

- Our base case scenario falls short of the Paris Agreement goals, with emissions falling only 22% by 2050 – a far cry from net zero – and is consistent with 2.6C of global warming by 2100. This shows that deploying only economically competitive climate solutions will not be enough to avert climate disaster. Policy makers must not only grasp the easiest opportunities – renewables, storage and EVs – but also tackle harder solutions such as low-carbon heat, industrial decarbonization, carbon capture, hydrogen and clean transport fuels. Only with this wider range of solutions can the physical impacts and economic damage wrought by climate change be brought under control.
- In our Net Zero Scenario, all of these clean technology sectors grow faster than in the ETS. By 2035, there are 16 terawatts of wind and solar installed globally, versus 12.6TW in the ETS. The passenger EV fleet is twice as large by 2035, at 952 million vehicles on the road. Nuclear power capacity rises above 750GW, hydrogen to 159 million metric tons, and demand for sustainable aviation fuel jumps to nearly 40 billion gallons, as multiple sectors race to decarbonize faster.
- Aligning to net zero would require more investment than for the Economic Transition Scenario, but the difference is smaller than one might expect. In the ETS base case, global investment and spending on energy technologies and infrastructure totals $76 trillion in the years to 2035, including both fossil and clean energy spending, while the Net Zero Scenario requires only 19% more investment (a total of $90 trillion) over the same period.
- When considering the full horizon from 2025 to 2050, cumulative investment in the ETS rises to $185 trillion, while the Net Zero Scenario only requires 15% more funding, at $213 trillion. The difference lies in where the investment goes, with clean technologies such as renewables, EVs, heat pumps, carbon capture and enabling grid infrastructure driving much of the NZS total. Our analysis shows that aligning the energy system to net zero is a question of policy and regulation that creates incentives to divert investment flows from traditional energy processes to new clean energy technologies – not n order of magnitude step-change in costs. Market incentives and regulations that attract private sector capital into clean technologies will be critical to unlock the needed investments. There is little time left to get on track for a Paris-aligned climate outcome, but through a combination of ambitious new NDCs and decisive policy action to support clean energy transitions at the national and sub-national level, global leaders still have a chance to avert the worst impacts of climate change.

Figure 3: Key technology drivers in the Economic Transition Scenario, 2020-2035



Source: BloombergNEF. Note: ETS is Economic Transition Scenario, NZS is Net Zero Scenario. Wind includes offshore and onshore. Solar and storage include small-scale and utility-scale. CCS is carbon capture and storage, the ETS shows project pipeline forecast as of November 2024. Heat pumps included for China, Japan, Germany, France, UK and the US. Power grids are a mature technology solution but were not updated for this report. For more, see New Energy Outlook 2024: Grids (web | terminal).

Table of contents in the report

List of figures

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N E
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