



ESG Outlook: Advancing Climate Innovation – The Road to 2050

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Executive Summary

Climate change is likely the largest investment opportunity this century and market-based solutions and public funding are essential to accelerating the transition to Net Zero

- Annual investment in clean energy and infrastructure needs to increase to \$4.3trn, which is more than 3x the current rate of \$1.4trn, reflecting a \$2.9trn annual investment gap for de-carbonization over the next three decades.
- While the majority of global reductions in CO2 emissions through 2030 will come from technologies readily available today, for 2050, half of the reductions will come from technologies that are currently at a proto-type phase.
- Early stage climate technology investment amounted to only \$87.5bn over the past 12 months.
- Public funding provides only 14% of current annual investments and this figure will need to grow almost two-fold to serve as a catalyst for private finance.
- Only \$438bn of the \$16.7trn COVID-19 recovery packages are likely to be directed to reducing greenhouse gas (GHG) emissions.

Our Climate Innovation Hype Cycle shows EV light duty passing an inflection point and gaining mainstream adoption

- We map key innovation products/concepts within electrification, power grid, agriculture, hydrogen and carbon capture - in total estimated to be able to abate 40% of GHG emissions by 2050 and attract \$2trn of capital per year by 2025 - to our Climate Innovation Hype Cycle to showcase relative development as well as the Climate Innovation Impact Matrix to classify innovation based on potential market impact and newness of technology.
- Only 3 out of 10 of the highest-emitting sectors - buildings, cars and power - possess the required technologies and business models to support the clean energy transition.
- EV light duty has passed a critical inflection point and leading adoption and investment with \$300bn+ investment in EVs globally.
- The global power grid is undergoing an upgrade to incorporate more distributed generation, digital tools and allow greater flexibility for a broader mix of baseload and storage resources.

Executive Summary

- Solar and Wind have reached the Plateau of Productivity on the Hype Cycle reflecting a dramatic decline in cost, with Solar showing greater potential than Wind.
- Hydrogen sits high on the innovation Hype Cycle and hype has turned to hangover with industry utilization likely to remain low at least until mid-decade but a growing spotlight on Ammonia is due to greater interest in transitioning to green H2.
- Alternative proteins could decarbonize agriculture and have moved past the peak of the Hype Cycle.
- Carbon Capture Use and Storage (CCUS) is minimal and nearing the top of the Hype Cycle.
- There has been mixed market performance for climate innovation sectors in 2021 with select categories in EV and distributed generation outperforming, but there has been material underperformance from Power and Hydrogen, while Solar outperformed Wind.
- The average size of early-stage climate tech deals has grown to \$96mn, more than 10 times the size of an average deal in 2013 and megadeals are also increasingly common, indicating a maturing asset class.

China emerging as a leader in clean energy innovation

- China is positioned to become one of the biggest winners of the clean energy transition, dominating not only the manufacturing of renewables but also the supply chain of critical transition.
- China is also the clear leader in global energy transition investment and innovation as measured by patents by a wide margin with inflows double those of the US; The clean energy sector delivered outsized returns in 2021.

Climate change is likely the largest investment opportunity this century and market-based solutions and public funding are essential to accelerating the transition to Net Zero

Climate Investment Need Estimates

	Annual need estimates	Comments
IEA	\$4.3trn	3x increase from \$1.4trn currently to achieve net zero by 2050
IPCC	\$830bn	6x increase in low-carbon energy technologies to limit warming to 1.5° C
McKinsey	\$9.2trn	Annual increase of \$3.5trn from today. Capital spending on physical assets for energy and land-use systems to achieve net zero by 2050
BNEF	\$1.3trn - \$5.8trn	\$92-\$173trn investment need to achieve net zero by 2050

Source: J.P. Morgan Strategic Research, IEA, IPCC, OCED, McKinsey, BNEF, February 2022

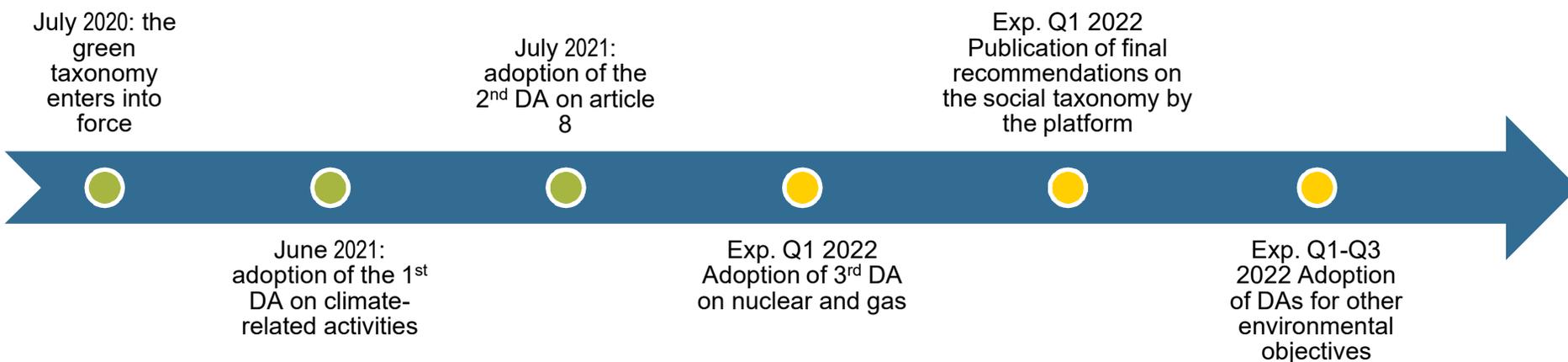
Rapid clean-energy transition offers \$26trn savings compared with today's energy system and \$9bn a year in the U.S.

Clean Energy Transition Savings		
Source	Estimated Savings	Notes
INET Oxford	\$26trn	Rapid clean energy transition savings as compared to today's energy system
RMI	\$9bn/yr	BBB clean energy incentives are estimated to save utility companies and customers \$9bn per year in the U.S.

Source: RMI, INET Oxford

Global standards for ESG will further aid and accelerate progress and adoption

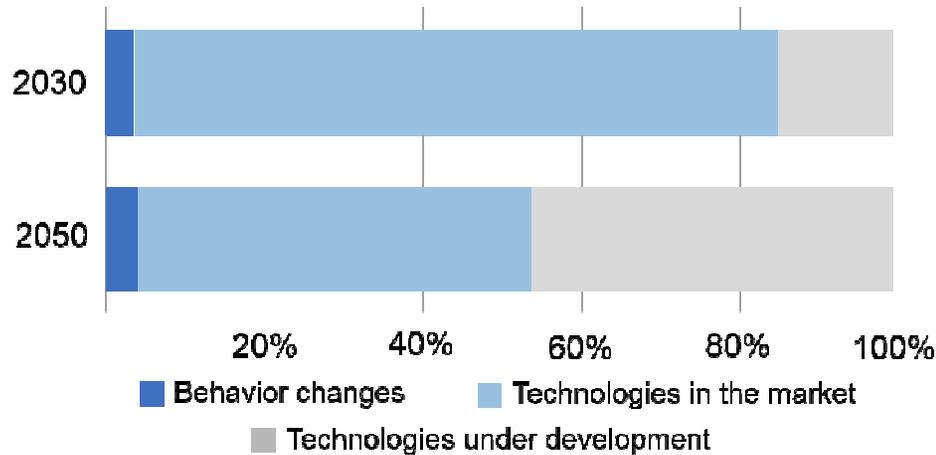
Milestones & Next Steps of the EU Taxonomy Regulation



Source: J.P. Morgan based on the EU Commission. Green circles represent past milestones while orange circles represent next steps.

Climate innovation will play a vital part in bending the curve and half of the global CO₂ reductions for 2050 will come from technologies that are currently in a prototype phase

Annual CO₂ emissions savings in the net zero pathway, relative to 2020

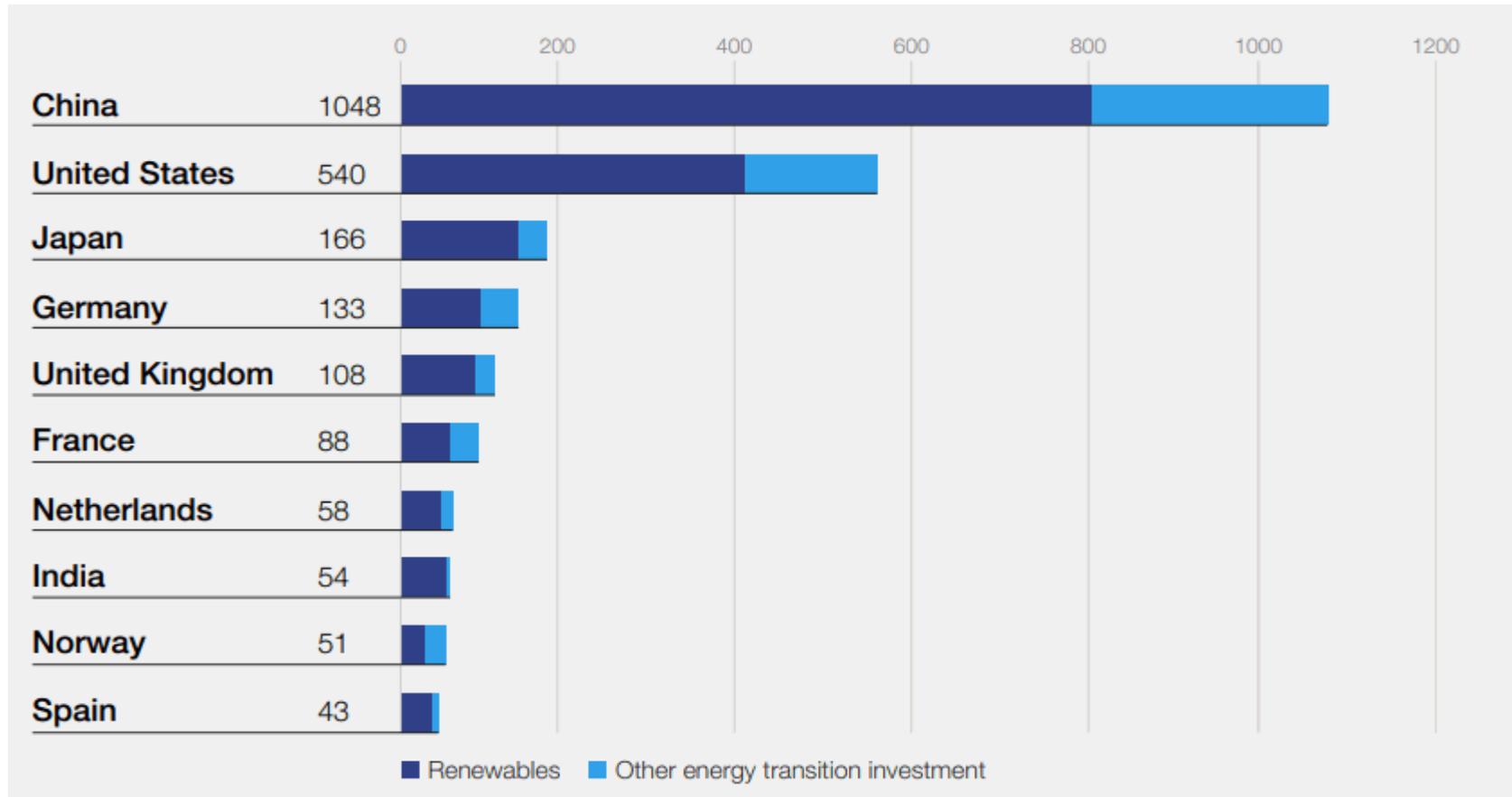


Source: IEA

China is the clear leader in global energy transition investment with inflows double those of the US and also leads in climate innovation as measured by patents

Global energy transition investment: 2016-2020

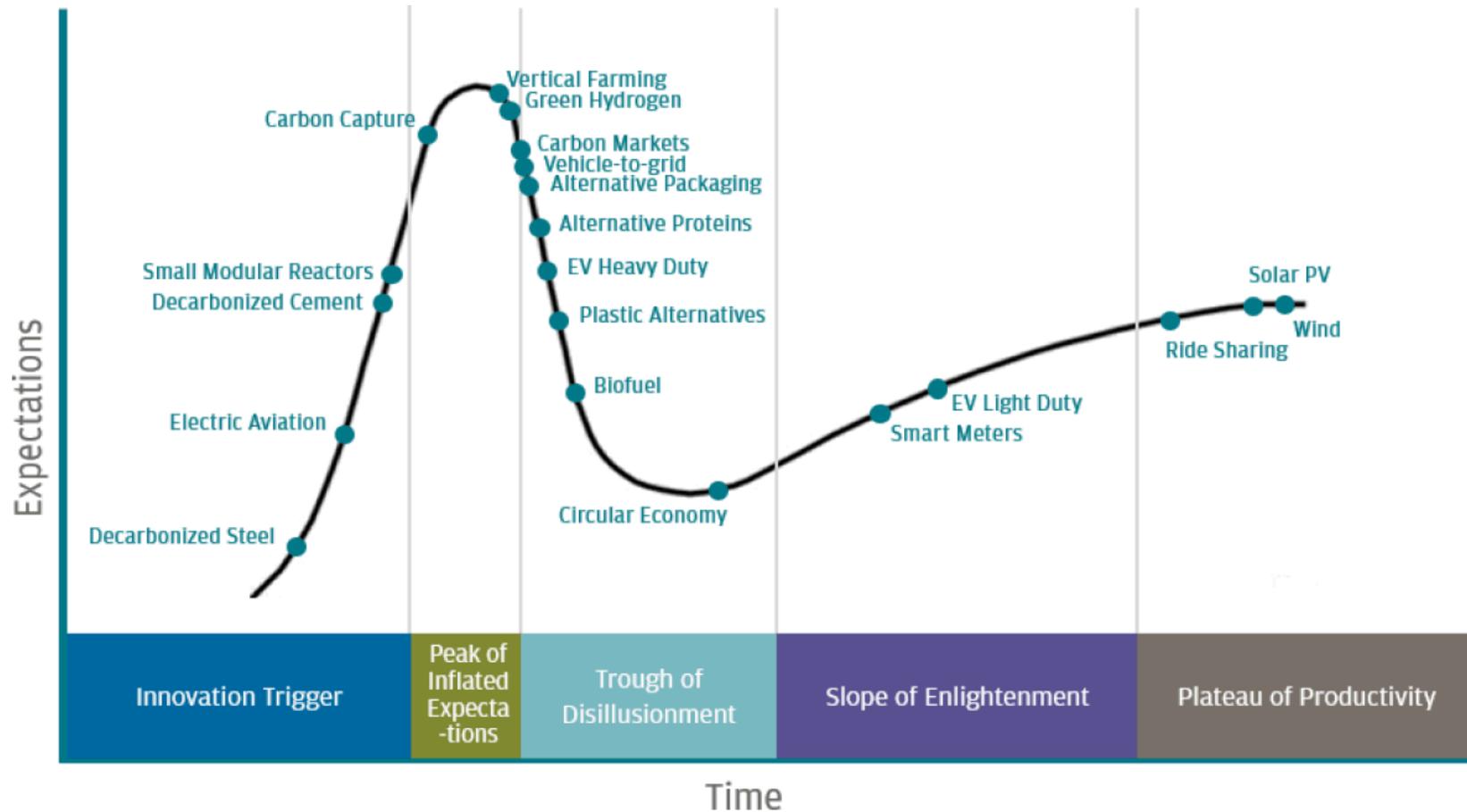
(\$ billions)



Source: [World Economic Forum](#)

The Climate Innovation Hype Cycle cautions concepts high on the curve such as hydrogen and carbon capture; EV light duty has passed the critical inflection point

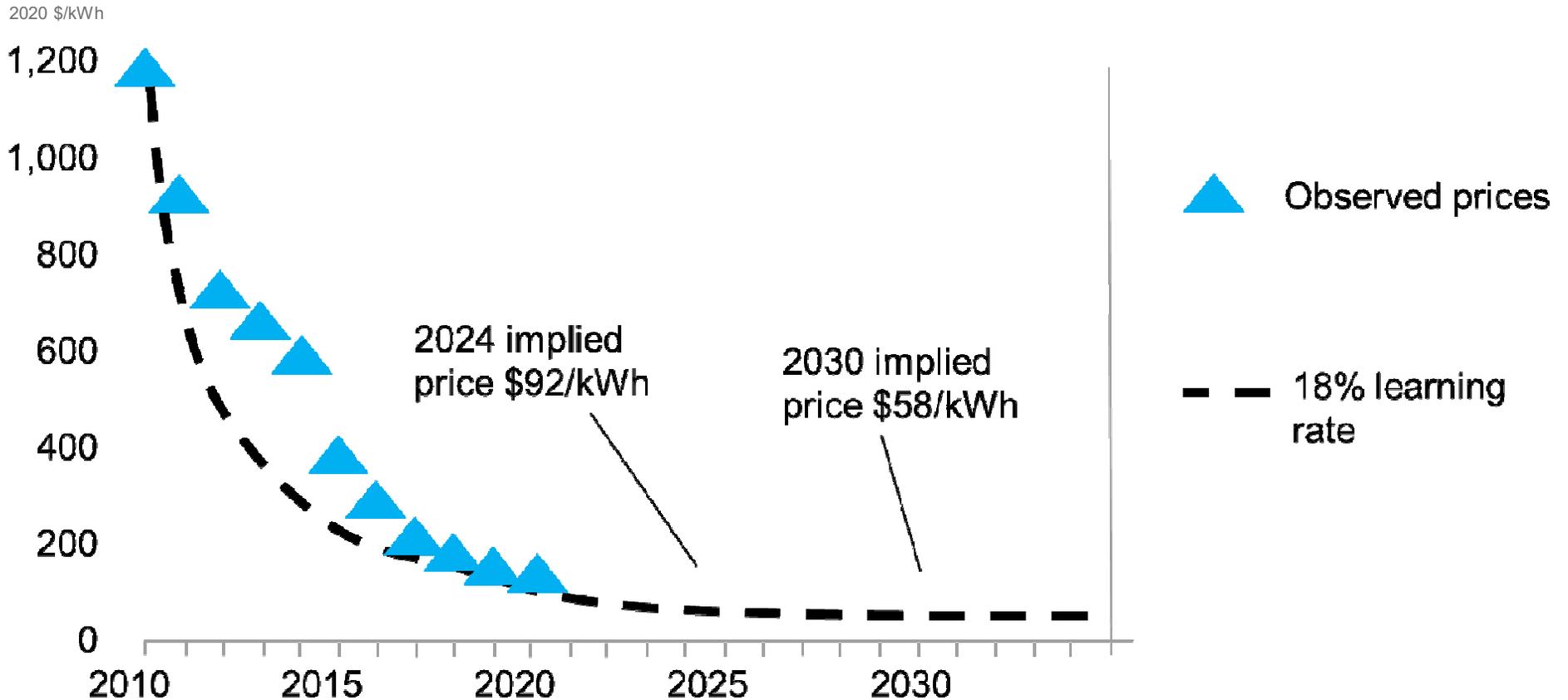
Climate Innovation Hype Cycle



Source: J.P. Morgan Strategic Research, February 2022.

EV light duty is leading adoption as growth in EV sales accelerates and the cost of EV battery will fall below \$100/kWh mid-2020s

Battery price forecast

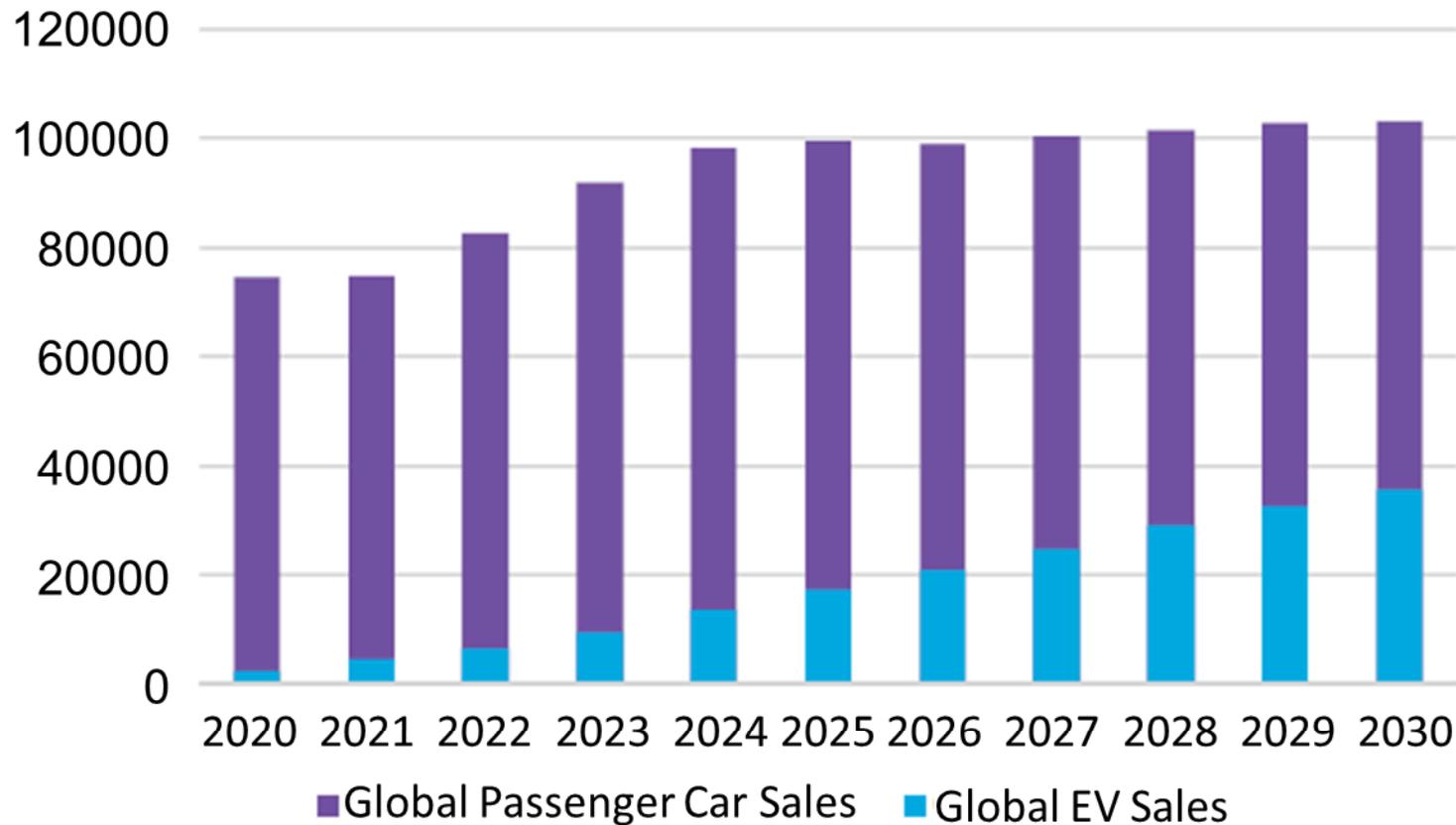


Source: Bloomberg Finance L.P., New Energy Finance (BNEF)

EV light duty is leading adoption as growth in EV sales accelerates and the cost of EV battery will fall below \$100/kWh mid-2020s

Global EV new passenger vehicle sales versus total global passenger vehicle sales

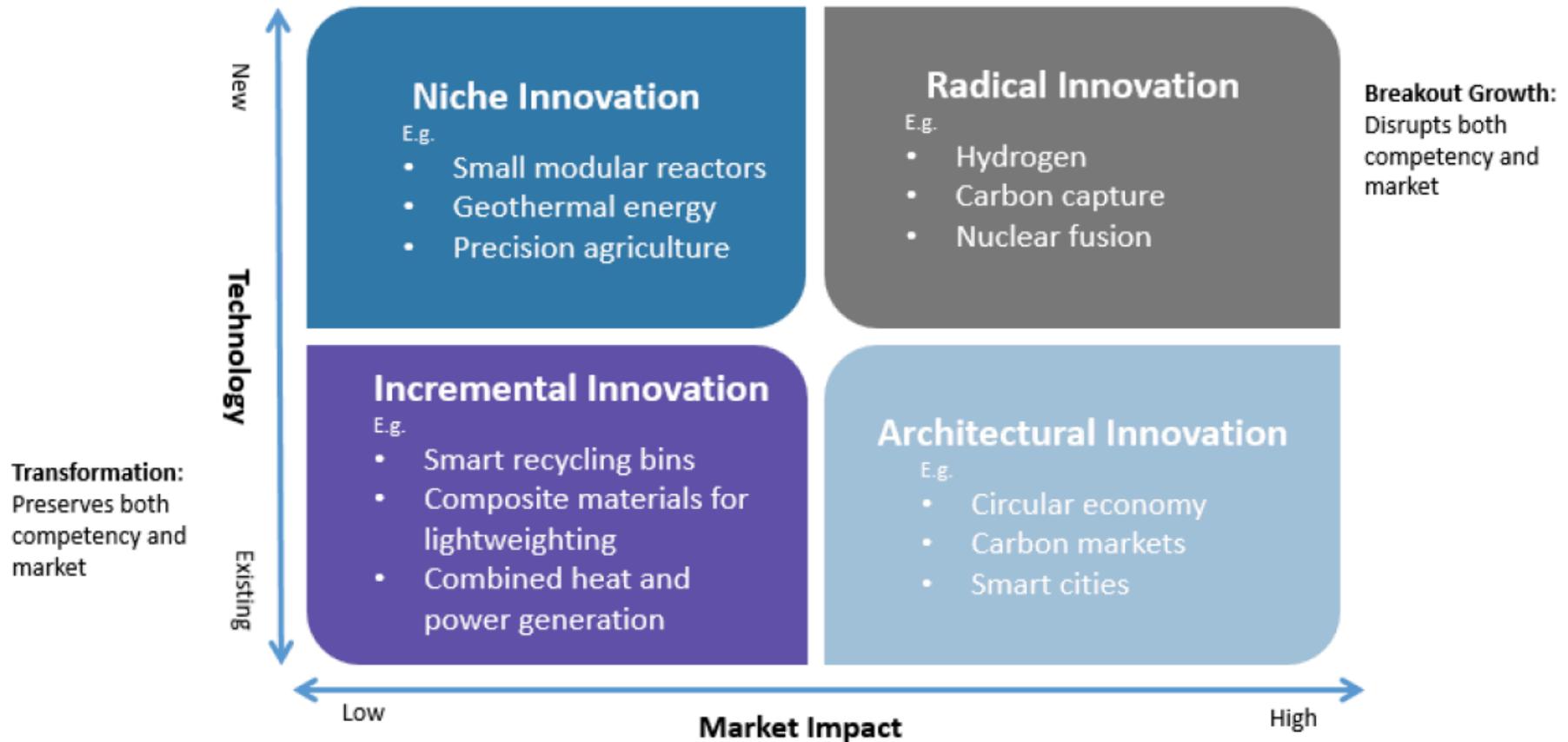
Units in Thousands



Source: IHS October 2021 Update

The Climate Innovation Impact Matrix classifies innovation by inventiveness of technology and magnitude of impact in accelerating transition to Net Zero

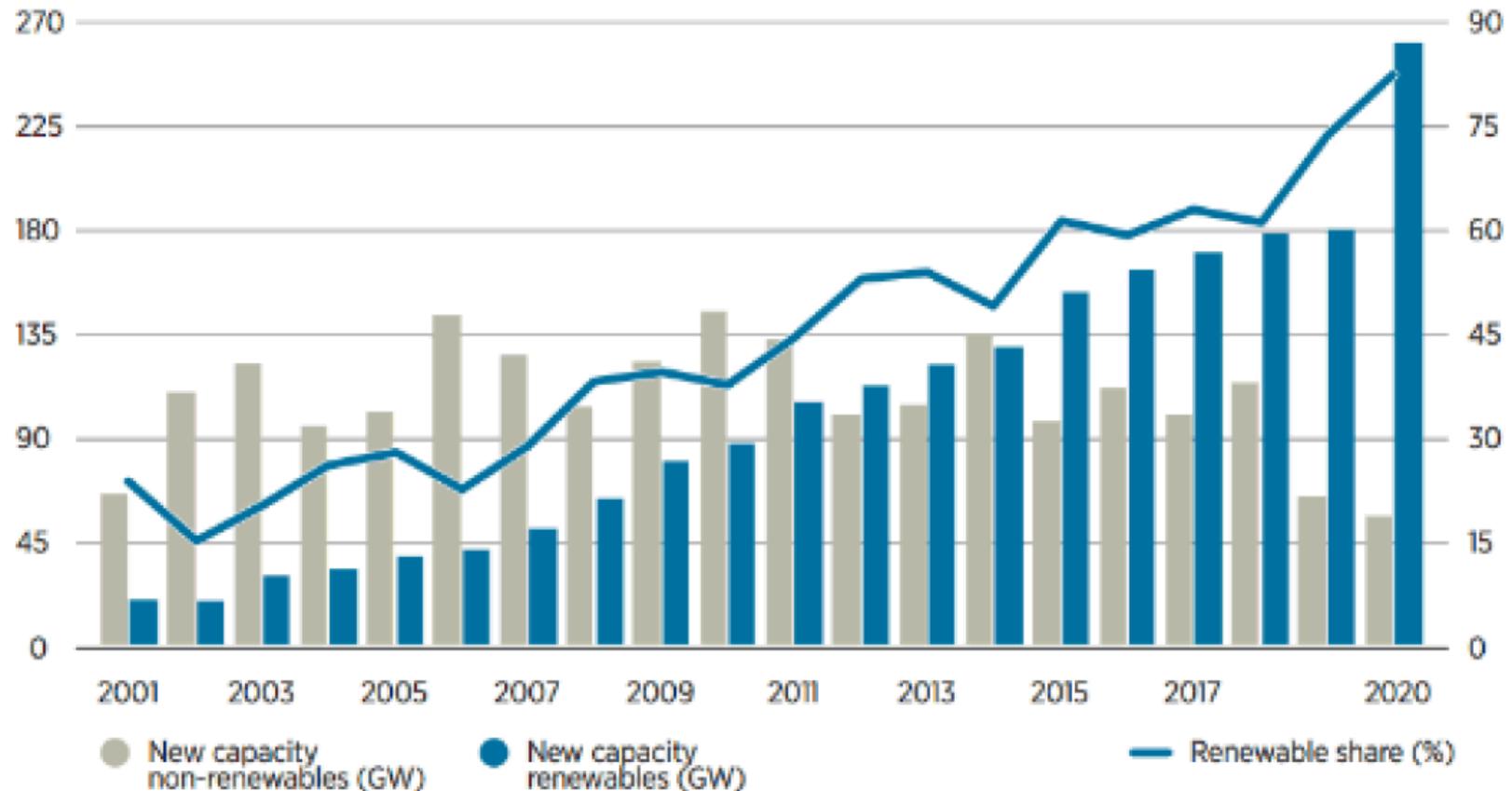
Climate Innovation Impact Matrix



Source: J.P. Morgan Strategic Research, February 2022.

Since 2012 fossil fuels have seen less investment than renewables, which is expected to continue

Historical Deployments of Renewables and Fossil Fuels

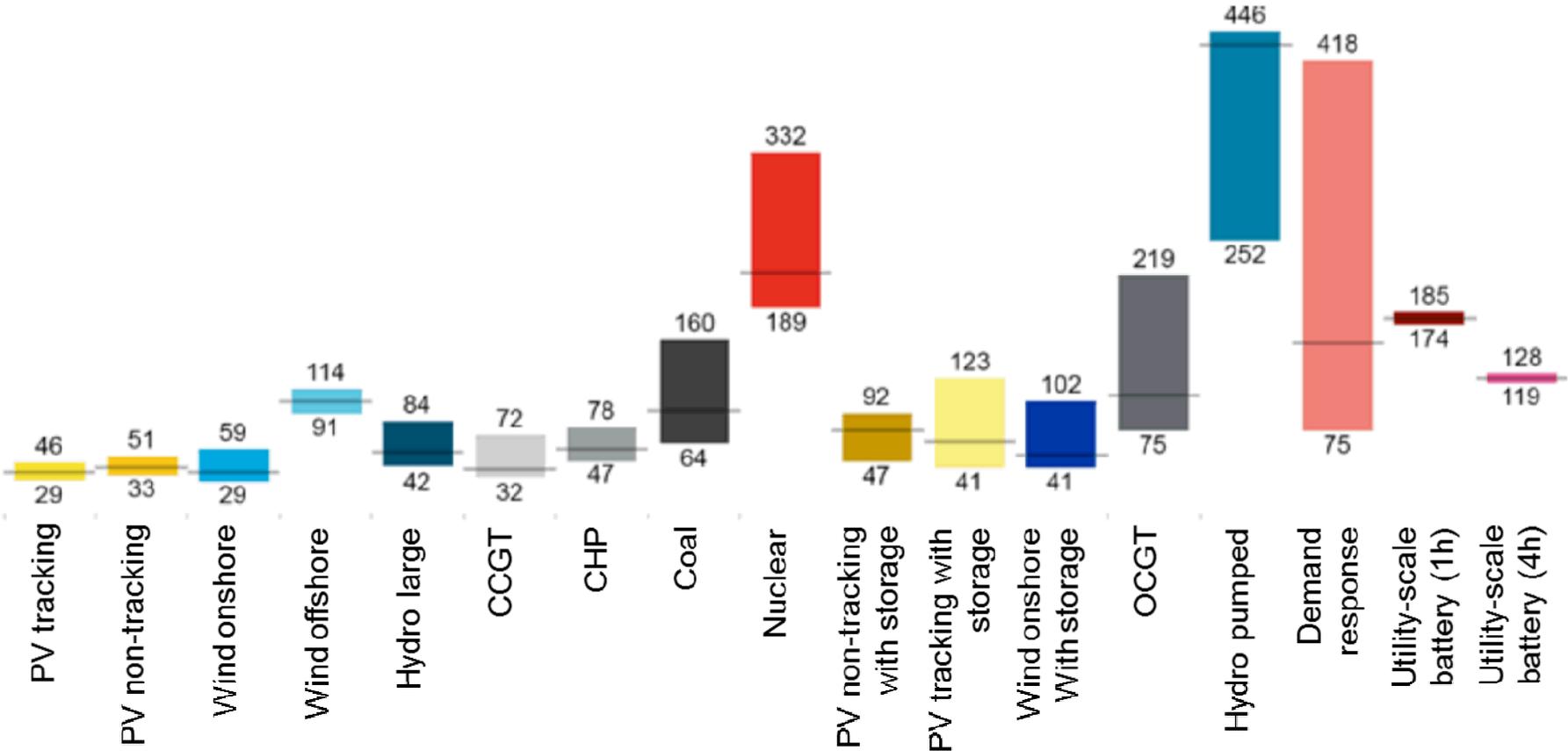


Source: International Renewable Energy Agency. Left axis shows GW of capacity. Right axis shows share percentage.

Solar and Wind have reached the Plateau of Productivity on the Hype Cycle reflecting a dramatic decline in cost, with Solar showing greater potential than Wind

Wind and solar are now routinely the lowest cost energy sources in the U.S.

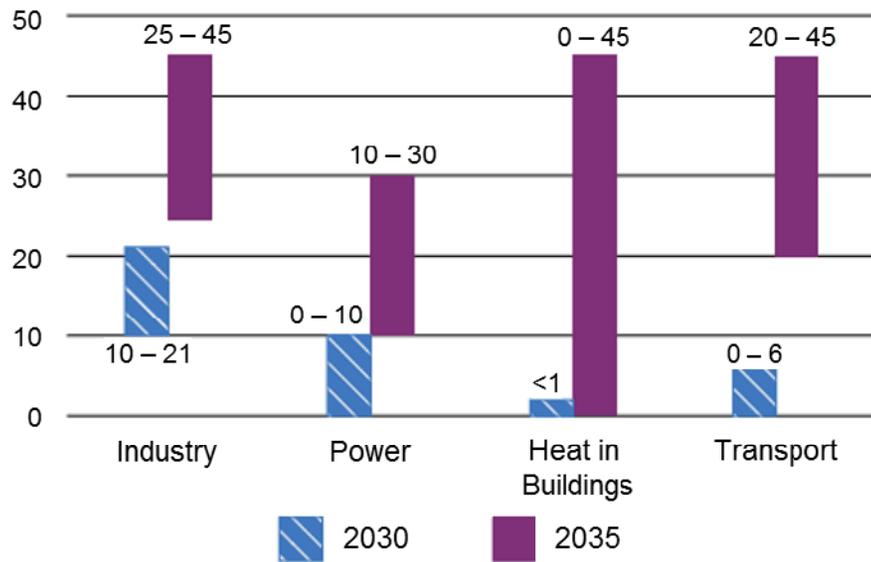
Levelized cost of electricity in \$/MWh



Source: Bloomberg Finance L.P.

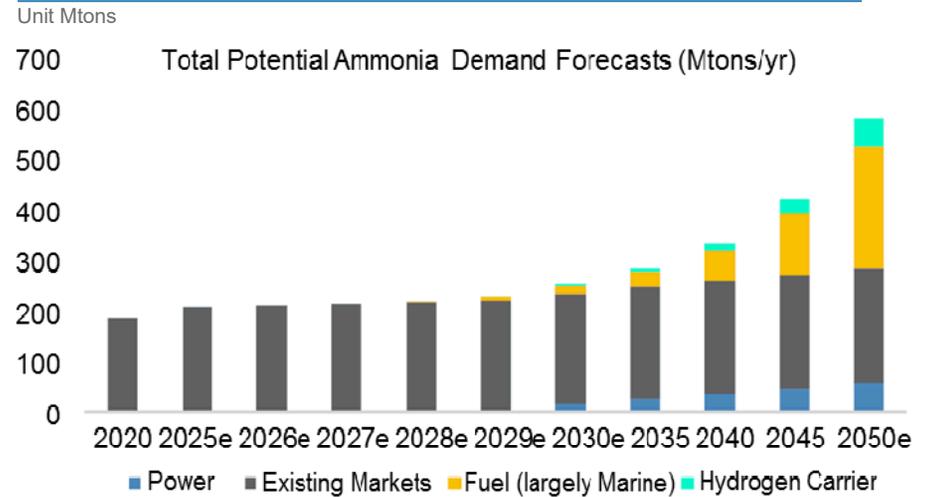
Radical innovation such as Hydrogen that sits high on the innovation Hype Cycle is still early stage with industry utilization likely to remain low at least until mid-decade

Illustrative hydrogen demand in 2030 and 2035 (in TWh)



Source: BEIS analysis. Note: figures do not include blending into gas grid

Potential Ammonia Demand



Source: J.P. Morgan research estimates

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