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# Energy Transition: What Could Unfold?

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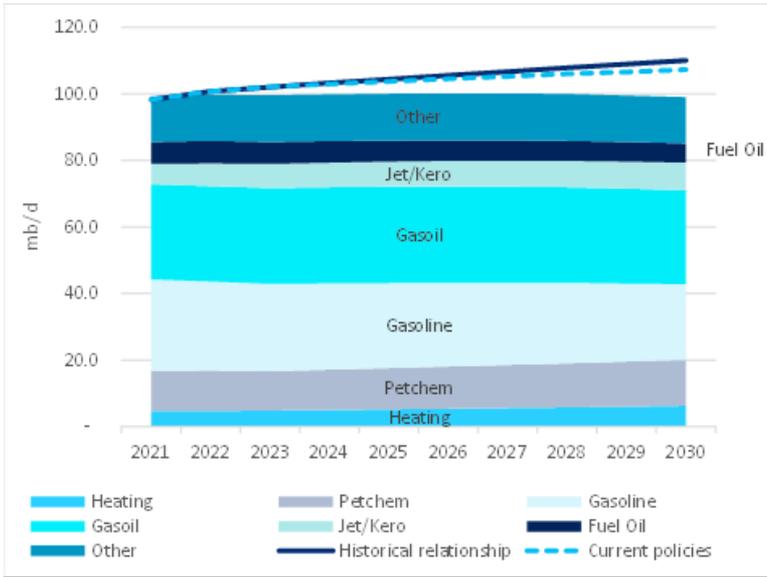
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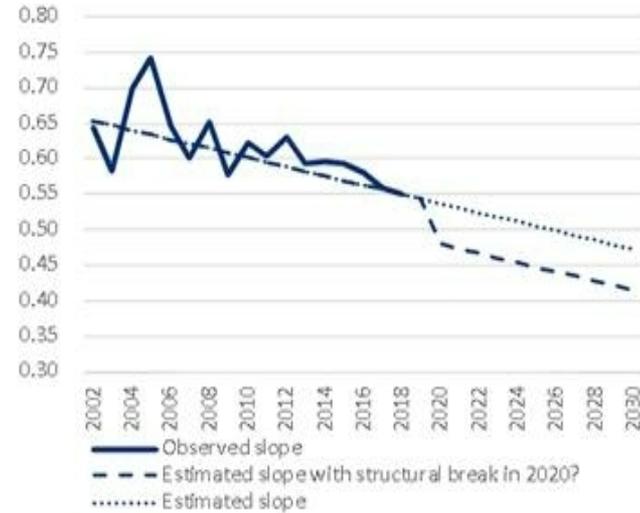
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# Oil demand should plateau over the decade after near-term recovery

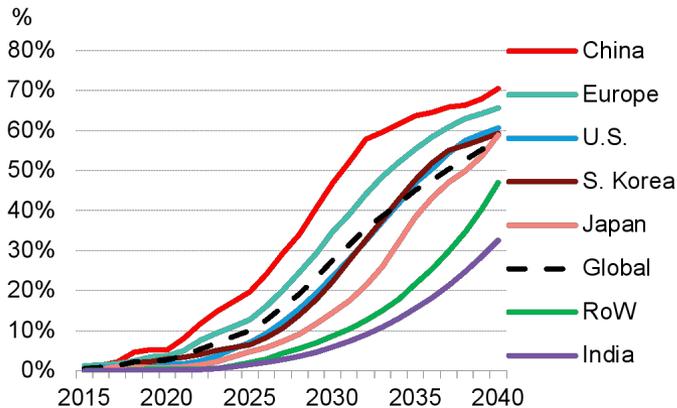
Global oil demand scenarios to 2030: (1) historical relationship, (2) current policies, and (3) energy transition with product breakdown



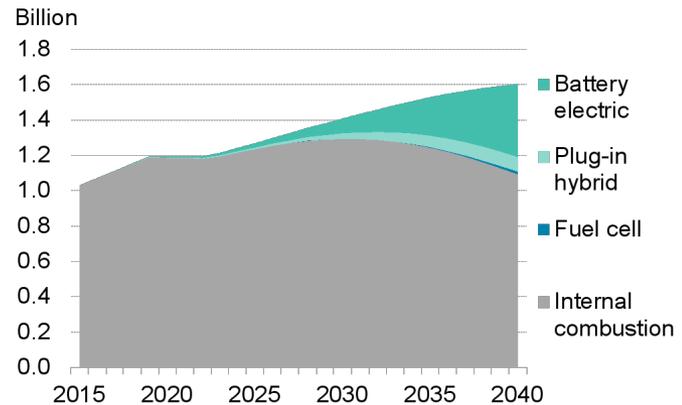
Oil demand sensitivity to macro drivers



EVs as % of vehicle sales (historical and projected to 2040, by major region)



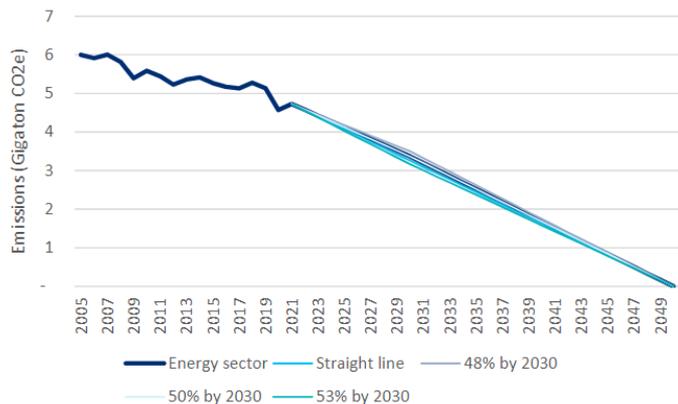
Projected global vehicle fleet by drivetrain (in billions of vehicles)



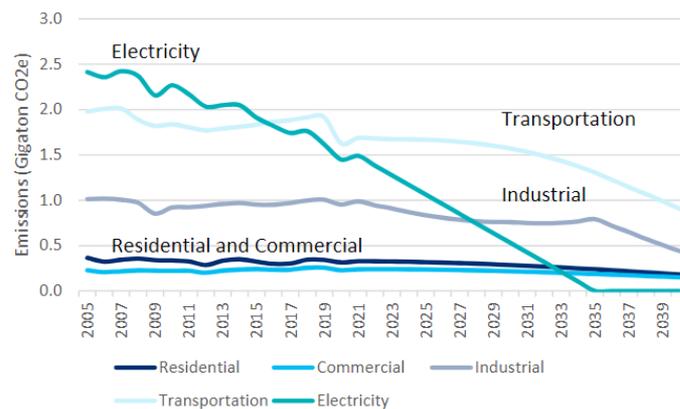
Source: EIA, IEA, BNEF, Citi Research

# US: The goal of cutting emissions by 50-52% by 2030 vs. 2005 is ambitious

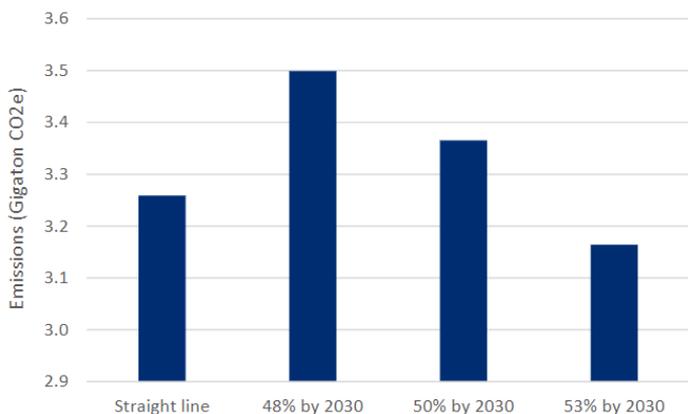
Emissions pathways to net-zero by 2050 (gigatons CO2e)



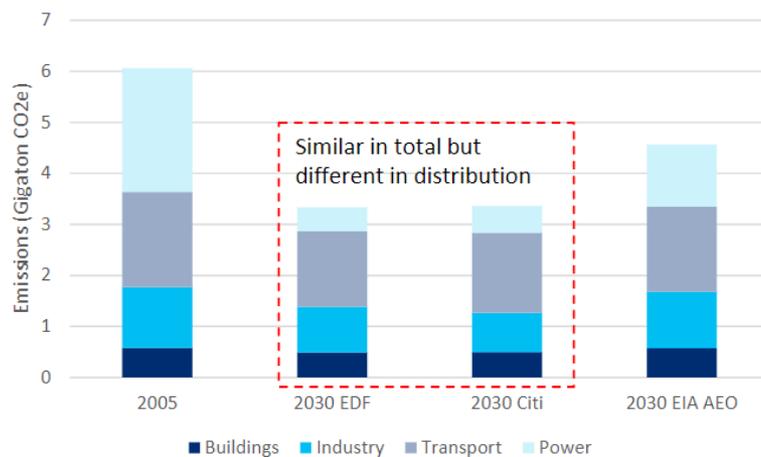
Emissions in gigatons in CO2-equivalent by sector (shown individually; actual up to 2020; projections between from 2021 to 2040)



Differences in energy sector emissions in 2030 (in gigatons CO2e), if 2030 emissions were cut by 48%, 50% or 53% vs. 2005 levels



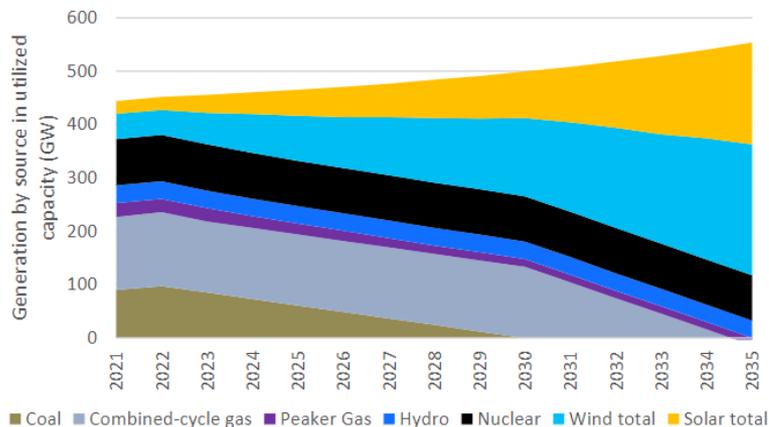
Total emissions in CO2e by 2030 based on analyses by EDF, Citi and the EIA



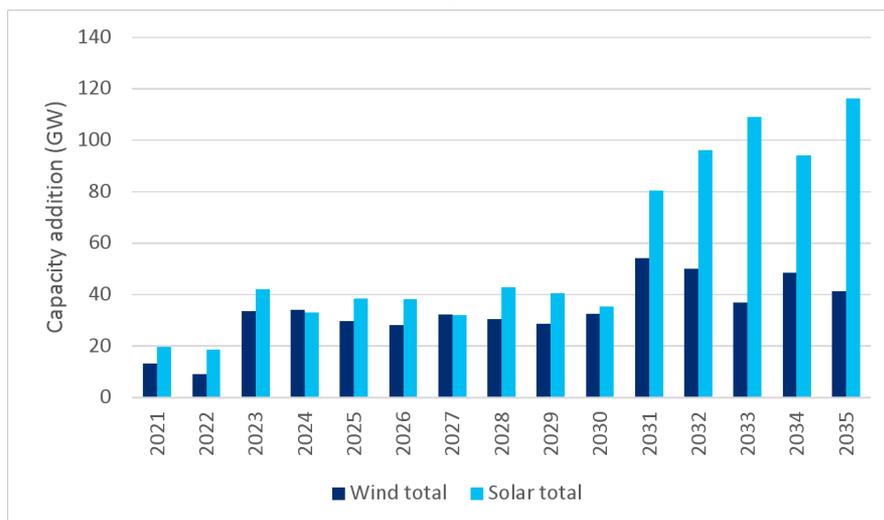
Source: EIA, EDF, Citi Research

# Power sector would drive much of initial emissions cuts pre-2030

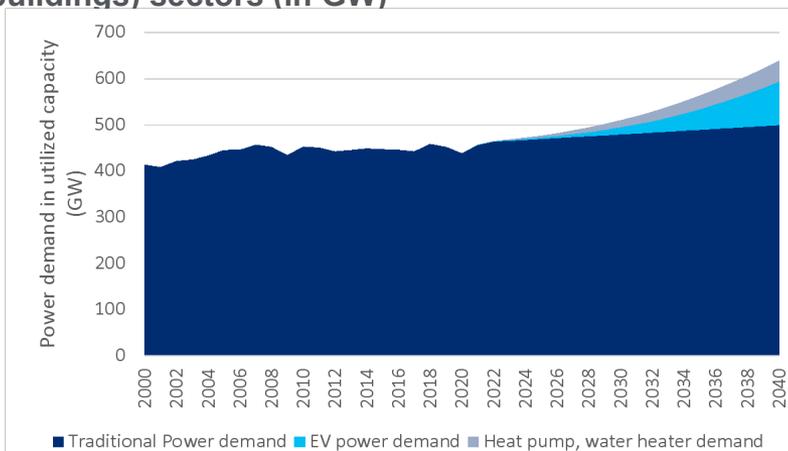
## Generation mix required to reach net-zero in 2030 (in GW)



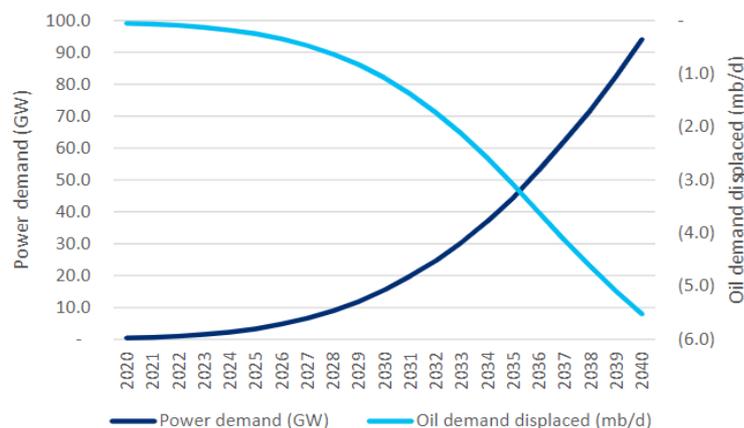
## Wind and solar capacity additions (in GW)



## Power demand growth with electrification in the transportation and residential/commercial (buildings) sectors (in GW)



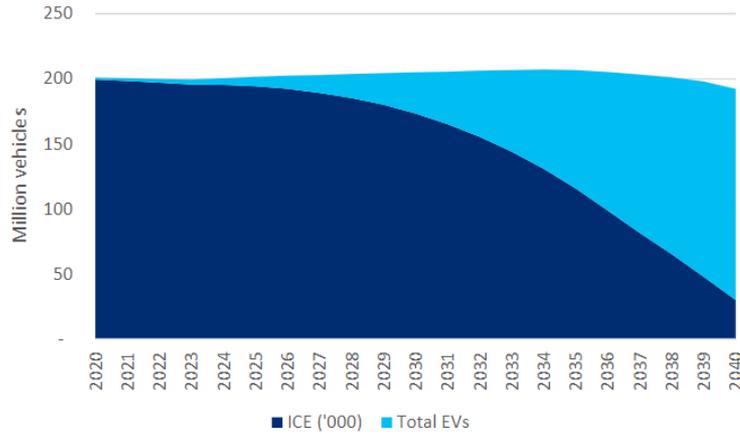
## Potential power demand growth (in GW) and oil demand displaced (in mb/d) from now to 2040



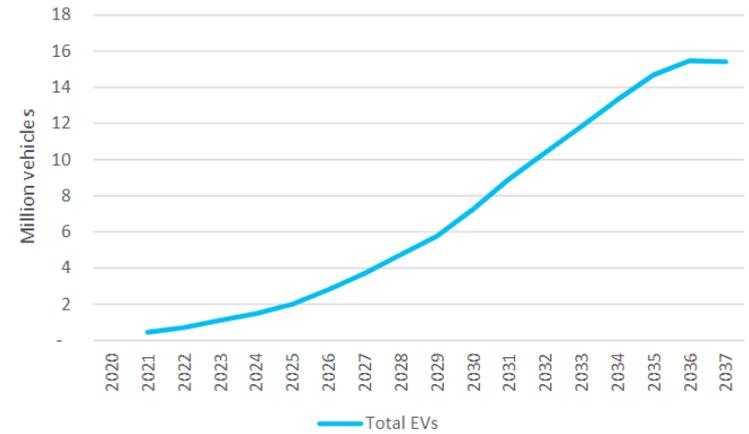
Source: EIA, Citi Research

# Transport, building sectors should ramp up carbon cuts but more so post-2030

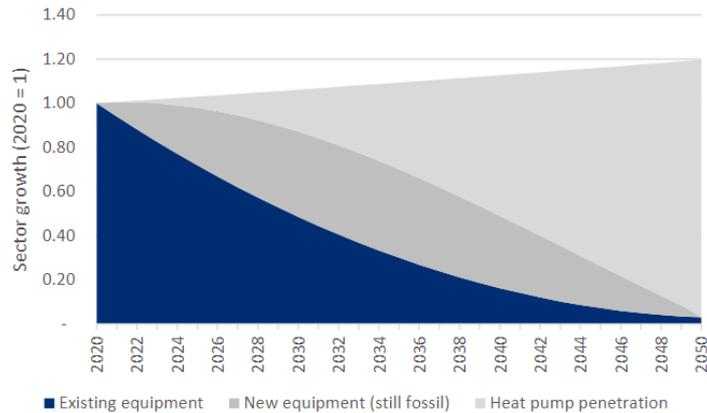
Relative size of ICE and EV fleets (in million vehicles)



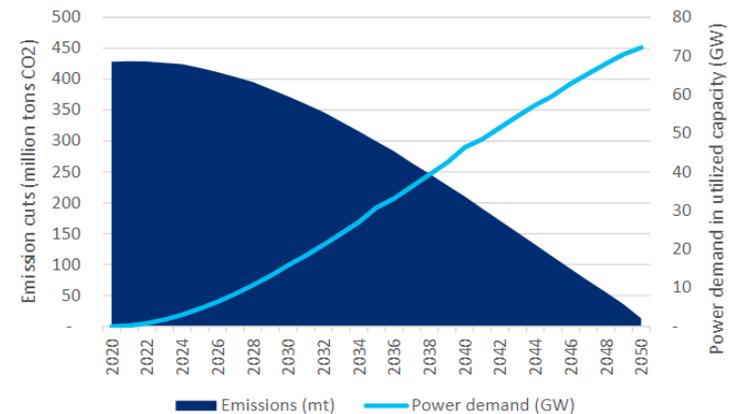
Potential EV sales over time (in million vehicles)



Share of existing vs. new equipment in illustrating the opportunity for replacement of fossil-fuel powered furnaces with heat pumps (indexed to 1 in 2020, with projections out to 2050)



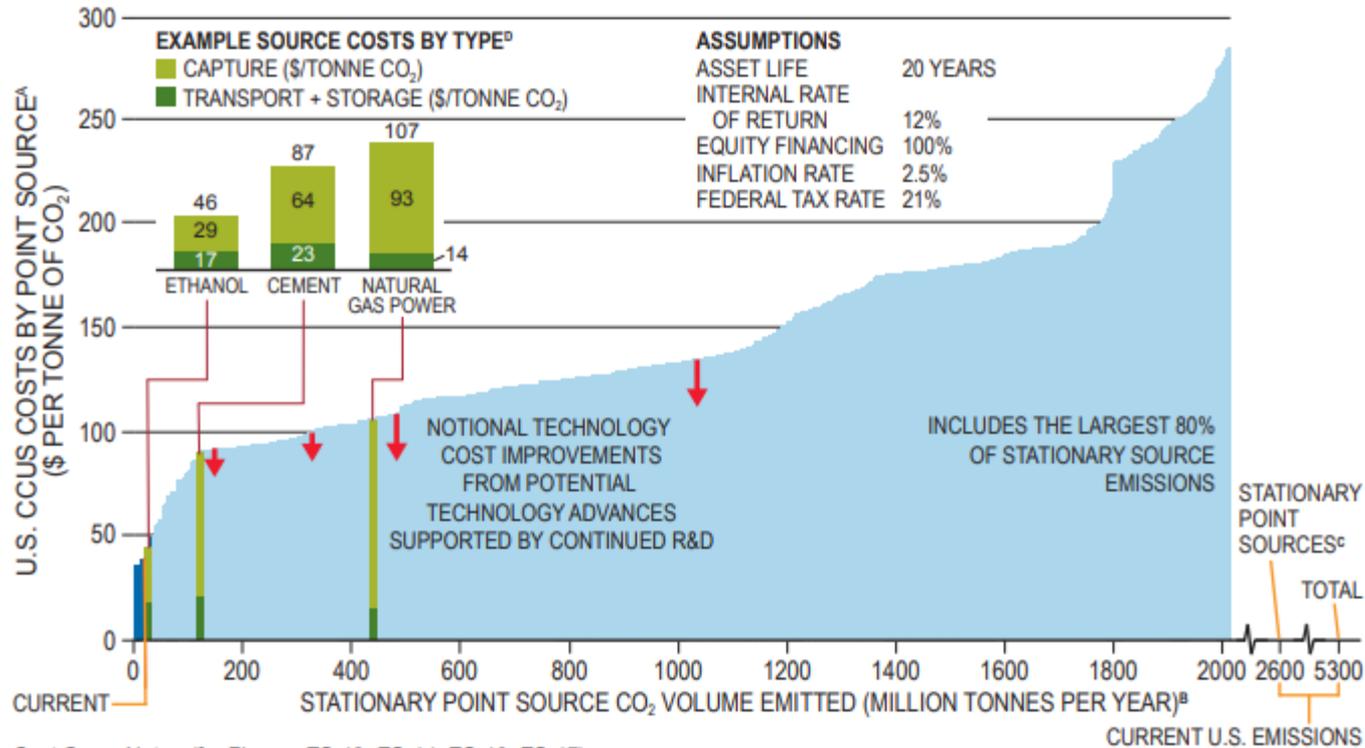
Emissions (in million tons CO2e) should fall more consistently post 2030 toward zero in 2050



Source: BNEF, EIA, Citi Research

# CCUS could become an option for very hard to abate sectors

US CCUS cost curve showing capture, transport, and storage costs (US\$/ton of CO<sub>2</sub>) for the largest 80% of US 2018 carbon dioxide stationary source emissions

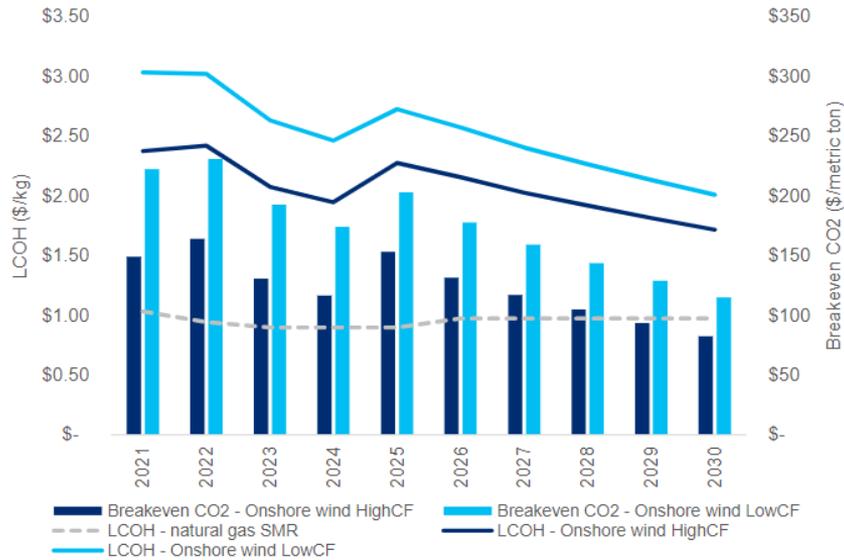


Cost Curve Notes (for Figures ES-13, ES-14, ES-16, ES-17):

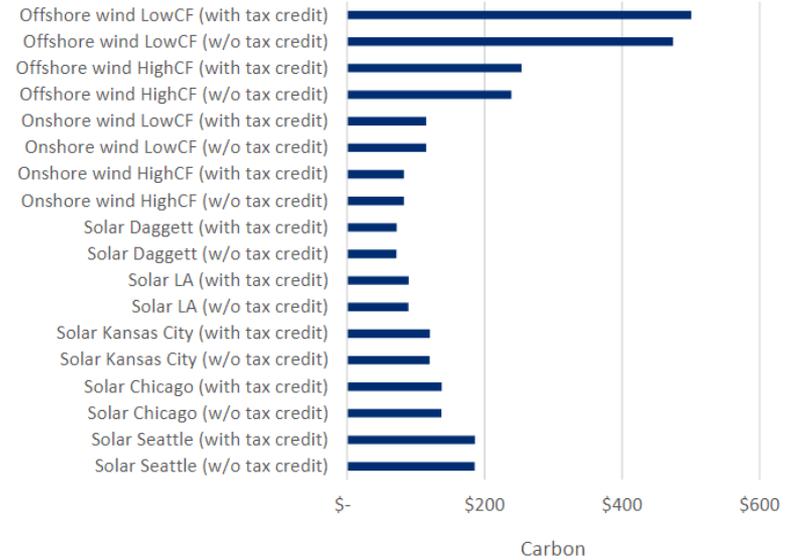
- Includes project capture costs, transportation costs to defined use or storage location, and use/storage costs; does not include direct air capture.
- This curve is built from bars each of which represents an individual point source with a width corresponding to the total CO<sub>2</sub> emitted from that individual source.
- Total point sources include ~600 Mtpa of point sources emissions without characterized CCUS costs.
- Bar width is illustrative and not indicative of the volumes associated with each source.

# Green hydrogen can also be used for refining, ammonia and steel production

**Breakeven carbon prices (\$/ton) in the US to make green hydrogen at cost parity (in \$/kg) with grey hydrogen (SMR) from 2021 to 2030\***



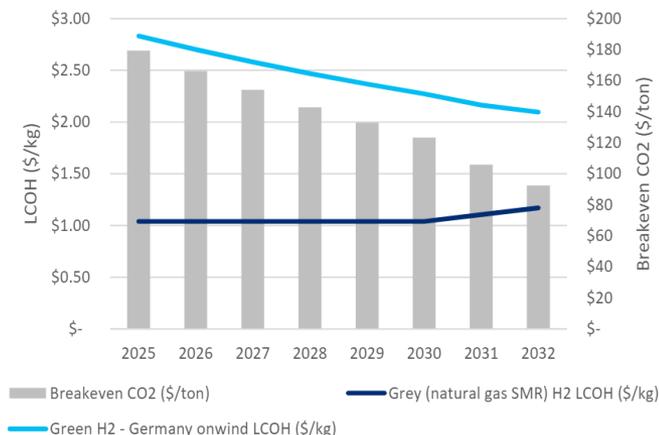
**Breakeven carbon prices (\$/ton) assuming different renewable sources, locations/power hubs in 2030**



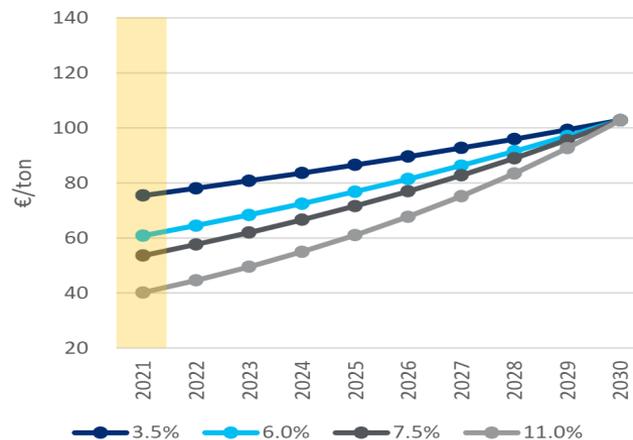
Source: NREL, Citi Research (\*CF = Capacity Factor)

# EU: The role of green hydrogen within the carbon emissions pricing framework

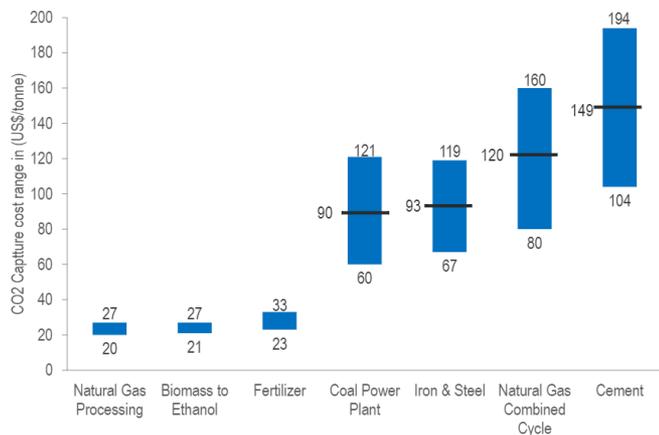
## Breakeven carbon prices in Europe to make green hydrogen at cost parity with grey hydrogen (SMR)



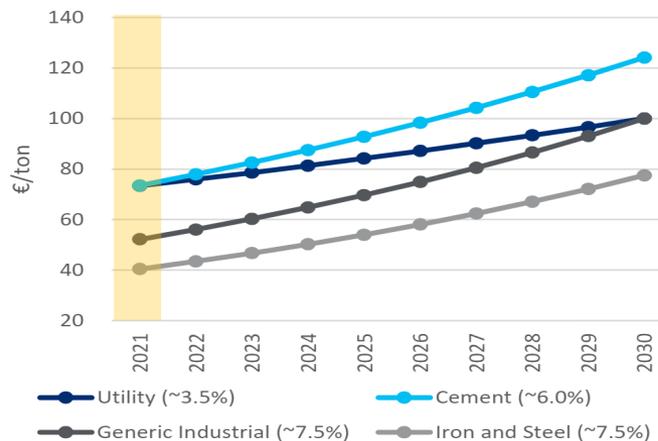
## PV EUAs assuming the cost of grey hydrogen at par with green hydrogen in 2030



## CCUS costs vary across industries, with midpoints identified



## PV EUAs assuming parity with CCUS in 2030 based on different industrials' CCUS midpoints and WACC



## Appendix A-1

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