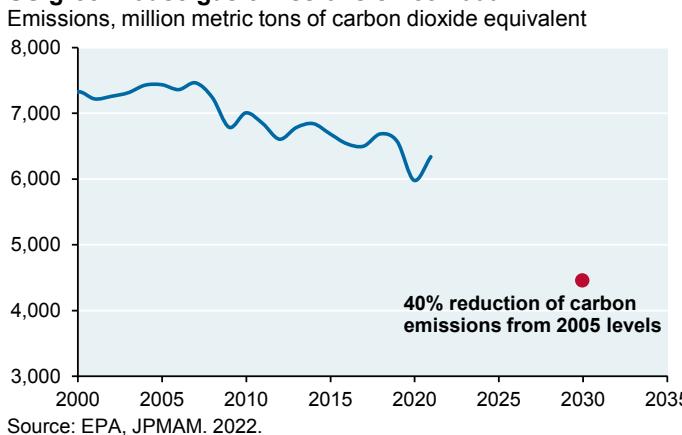




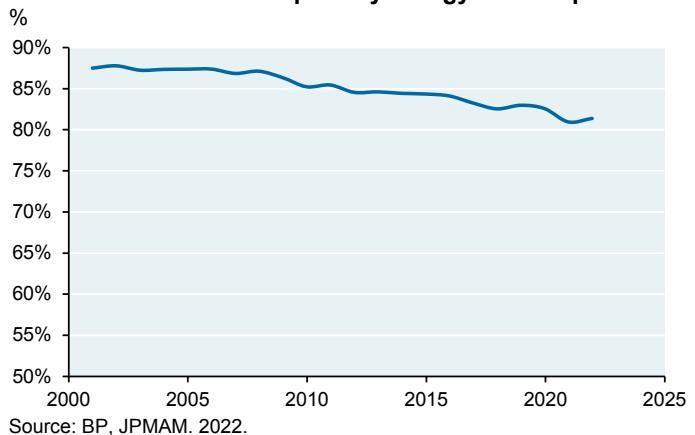
The second gear of the Manchin-Schumer bill

Whenever there's a tax/spending bill passed by Congress, the Congressional Budget Office "scores" the bill with respect to its impact on deficits, debt and GDP. The guts of the CBO process require dynamic scoring models that estimate the tax impact of every provision in the bill, and everyone sees the detailed results. While the Manchin-Schumer bill would accelerate the US energy transition, there was no CBO-style analysis released by the bill's principal authors to support the assertion of a 40% decline in GHG emissions by the year 2030. Such analyses reportedly exist; the questions on the next page are what I would ask about them.

US greenhouse gas emissions since 2000



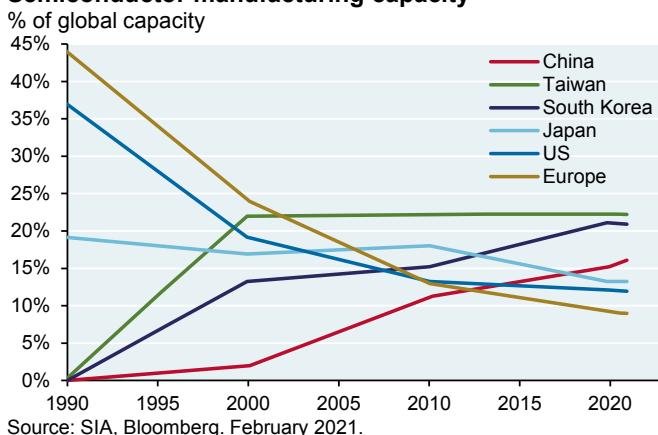
Fossil fuels share of US primary energy consumption



To be clear, the stated target entails a 30% decline in emissions from 2021 since 2030 targets typically use 2005 as a reference point. The Manchin-Schumer bill is mostly focused on tax credits to incentivize decarbonization; less is dedicated to more challenging siting, scale, geological, chemical, policy and regulatory obstacles we discussed in this year's energy piece. **My best guess is that the bill would shift the US renewable transition from first to second gear, but that the GHG decline by 2030 would be nowhere near the 40% decline cited.**

There may be a separate bill coming this fall (negotiated by Manchin as a quid pro quo) to simplify permitting and siting issues. I will believe it when I see it given the history of judiciary decisions reaffirming state's rights and rejecting Federal eminent domain assertions. But if this siting bill materializes, combined with provisions Manchin has required for oil/gas development, battery and rare earth supply chain development and passage of the CHIPS bill¹, Democrats will have constructed a new industrial policy, something which seemed out of reach a few weeks ago. I wish I knew how much it is all really going to cost.

Semiconductor manufacturing capacity



¹ \$52 billion for US semiconductor R&D, \$24 billion for US semiconductor plant tax credits, \$200 billion in science and technology research funding



What we need to know to assess the 2030 GHG target

- What percentage of new car sales and what percentage of the total fleet would be electrified by 2030 given the new incentives?²
- What kind of gasoline savings are assumed for HEVs, given how sensitive outcomes are to driver behavior?³
- The bill contains provisions requiring that rising shares of EV battery components and rare earth metals be sourced in the US or from its allies by 2024 in order for buyers to be eligible for the \$7,500 tax credit at point of sale. **These provisions could dramatically reduce the availability of the EV tax credit unless there is a complete and unprecedented shift in related manufacturing processes from China back to the US⁴**
- What is the assumed penetration of sustainable aviation fuels and hydrogen/battery long-haul trucks by 2030? Both of these technologies do not exist yet in any meaningful way⁵
- What kind of heat pump penetration is assumed to result by 2030 compared to current levels? Will homeowners retain backup thermal systems for very cold days or not?⁶
- How much more quickly can wind and solar power really be built compared to current levels? For the last few years, new US wind/solar capacity has increased its share of US electricity generation by ~1.2% per year. Grid interconnection challenges and interstate transmission siting (see our energy paper this year) are more binding as constraints than a lack of capital or cost of capital. Btw, China reliance is massive here as well⁷
- What kind of grid expansion is assumed to take place to accommodate more electrification of transportation and winter heating? For the last decade, the grid has only been expanding at 0.5%-1.0% per year, and most decarbonization plans with 40% assumed GHG reductions require 5%-8% annual grid expansion
- Press articles mention incentives for geothermal. How much is geothermal assumed to contribute in 2030? Today it's a rounding error, accounting for just 0.1% of US primary energy consumption
- What is assumed by 2030 regarding the amount of US CO₂ emissions that are geologically sequestered, used for enhanced oil recovery or converted into fuels? Are tax credits ranging from \$60 to \$85 per ton of CO₂ enough to cover capital, maintenance and return requirements? Based on currently operating CCS facilities plus those planned and permitted, just 1%-2% of US emissions are on track to be sequestered in 2030

² JP Morgan's Commodity Research Team models oil demand using automaker commitments that 25%-50% of sales will be EVs by 2030, up from 9% in 2021 and 12% in June 2022 (these figures include HEVs with very small batteries charged only by regenerative braking). Even if these EV sales targets are met, given current vehicle average lives of 12 years, **only 1 out of 6 passenger cars in the US fleet would be electrified by 2030**

³ The most recent data we have seen cite **20%-30% declines in lifecycle GHG emissions for HEV and PHEV vehicles** based on actual driver behaviors. This compares to 65%-80% GHG declines for battery electric vehicles

⁴ According to the bill: the "critical mineral" minimum percentage for US/FTA countries is 40% for 2024, 50% in 2024, 60% in 2025, 70% in 2026, and 80% beyond that. For battery components: 50% in 2024, 60% in 2025, 70% in 2026, 80% in 2027, 90% in 2028, and 100% thereafter. **Current US/FTA shares for battery components and critical minerals are in single digits**

⁵ In 2019, US sustainable aviation fuel production (from plants, agricultural waste, sewage, cooking oil) was just **3 million gallons out of 26 billion gallons** of jet fuel consumed. On hydrogen trucks: start with 1 kWh of green electricity from wind/solar. By the time this energy is converted into hydrogen via electrolysis and converted by a fuel cell back into electricity to power the truck's motor, **around 70%-75% of the original energy is lost**

⁶ Currently, just 6% of US residential space heating is produced by heat pumps. As discussed in this year's energy paper, **if heat pumps replace on-site combustion of fossil fuels without backup thermal power, generation capacity and transmission would have to be built for the handful of coldest days when electrified heating would skyrocket**, creating load demand which could double vs current levels. There are a lot of policy issues to tackle before assuming seamless electrification of residential and commercial winter heating.

⁷ China makes 97% of solar wafers, 85% of solar cells, 79% of polysilicon and 75% of solar panels

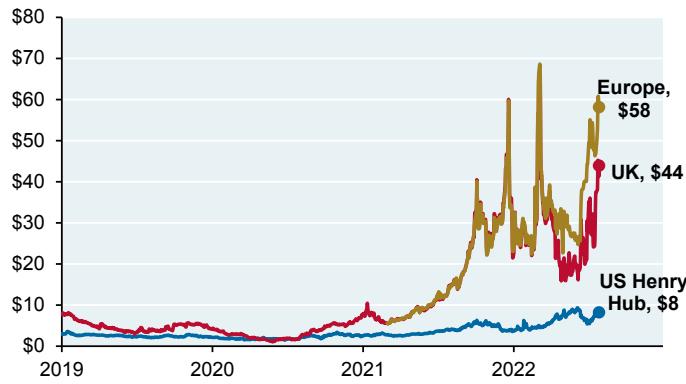


- What kind of continued improvements in energy efficiency per unit of GDP are assumed for 2030, given greater incentives for home improvement and insulation?⁸
- Does any serious person really believe that advanced nuclear or direct air carbon capture⁹ will have a material impact on US GHG emission declines by 2030?

Bottom line. The Manchin-Schumer bill would accelerate the renewable transition and be the most aggressive climate action taken to date by Congress. It certainly will enrich and sustain a lot of business models in the renewable energy space that are reliant on subsidies; many of them are rallying already. But let's not delude ourselves about the pace or the high cost of this transition¹⁰, or delude ourselves about the need for a lot of natural gas along the way. The US already faces unprecedented challenges regarding its electricity grid, and any steps that reduce dispatchable power such as natural gas could lead to "disastrous results".¹¹ I have not even addressed the US natural gas expansion required to rescue Europe from its energy disaster; European natural gas and electricity prices are 5x-7x higher than US levels, which is nothing short of terrifying from an economic and political perspective.

The US-Europe natural gas gap

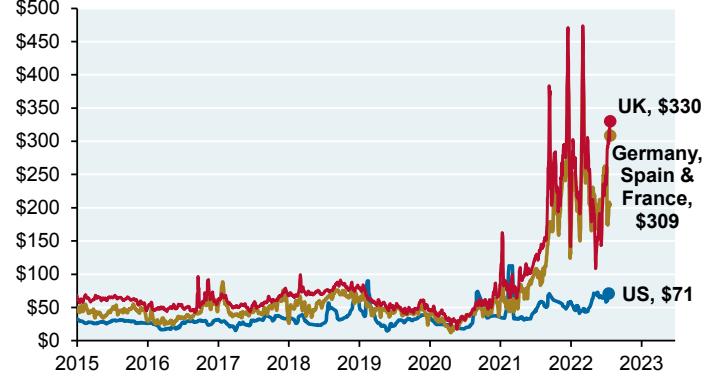
Wholesale natural gas price, US\$ per MMBTU



Source: Bloomberg, JPMAM. July 29, 2022.

The US-Europe electricity gap

Wholesale electricity price, US\$/MWh, 7 day average



Source: Bloomberg. July 29, 2022. Dots represent latest daily price.

⁸ US energy intensity per unit of GDP has declined by almost 30% since the year 2005 due to more efficient machines, turbines, motors, buildings etc. However, over that same time frame, overall exajoules of energy use are roughly constant given rising energy demand which offsets improving efficiency.

⁹ Some highly profitable technology companies are price-inelastic when it comes to a zero carbon footprint, and are **reportedly paying \$1,200 per ton** to startups that capture minuscule amounts of carbon from ambient air. This is irrelevant in the big picture: direct air carbon capture is "an energetically and financially costly distraction in effective mitigation of climate changes at a meaningful scale" [*"Unrealistic energy and materials requirement for direct air capture in deep mitigation pathways"*, Chatterjee and Huang, Nature Communications, 2020]

¹⁰ Example: if wind developers pay "prevailing wages" and include enough domestic manufacturing content, **the subsidy they receive rises by 10x from \$0.03 per kWh to \$0.31 per kWh**. Same kind of provisions for solar subsidies. It does not take a lot of analysis to see that this could quickly become a substantial source of inflation when assessing the true economic cost of wind and solar power.

¹¹ *"Fossil Resources Still Needed for Reliability in a Transitioning Grid"*, North American Electric Reliability Corporation, July 26, 2022

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