U.S. Trade Policy Cost Implications for Clean Energy

A scenario analysis

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Overarching questions

1. How could U.S. trade, security and industrial policies accelerate or slow achievement of global climate goals?
2. Could defensive U.S. trade policies put the brakes on clean energy technology development and cost reductions?
3. Could such policies raise the cost of clean energy and slow decarbonization of U.S. power and transportation?

Three techs, three price scenarios

For each of three critical clean energy technologies driving decarbonization today – solar PV, onshore wind power, and lithium-ion batteries – BloombergNEF examined current and potential deployment costs through the use of three scenarios. The goal: to understand how trade and industrial policy actions could potentially impact equipment costs and ultimately the deployment of these technologies. For wind and solar, BNEF examined how levelized costs of energy (LCOE) associated with the technologies fluctuated to make the technologies more/less competitive vs. natural gas-fired power. For lithium-ion batteries, BNEF analyzed how trade policy actions related to such equipment could make a typical electric vehicle (EV) more or less cost-competitive on a "sticker-price" basis vs. an equivalent internal combustion energy (ICE) vehicle.

BNEF took current costs of these technologies as tracked in our regular market surveys and flexed them based on potential trade policy actions the U.S. might undertake. The "Open Markets" scenario envisioned the U.S. pursuing policies aimed at fostering maximum free trade. In the case of wind equipment and lithium-ion batteries, this meant no new tariffs or other actions to inflate costs. For PV, however, Open Markets assumed lower policy-associated costs because the U.S. currently imposes some tariffs on foreign-made solar equipment. At the other extreme, the "Controls/Local Content" scenario assumes maximum policy action on foreign-made equipment and the highest cost impact. The "Mixed" scenario represents a middle-ground policy regime. The potential cost changes associated with each of these scenarios are detailed in the table below.

Proposed change from current (2H 2020) pricing	Open Markets	Mixed	Controls/Local Content
Solar PV c-Si modules	-40%	0%	+10%
Lithium-ion batteries	0%	+7%	+20%
Wind turbines	0%	+7%	+20%

BNEF's analysis sought to assess not just the current cost impacts of policy actions but the long-term affects as well. In the case of the Mixed scenario, we assumed the cost premium seen in the immediate term will ultimately dissipate and converge to Open Markets pricing by 2035. For Controls/Local Content, we assumed the cost premium remained through the entire 2021-2035 period for all three technologies.

Methodology and main assumptions

- **Solar PV:** BloombergNEF's Levelized Cost of Energy Survey and model were used to calculate current and potential prices for PV. The current purchase price for a PV module in the U.S. is inflated by overlapping tariffs the U.S. now imposes on foreign-made equipment. The Open Markets scenario assumes those tariffs disappear. Meanwhile, the Mixed Scenario represents current module pricing, given existing tariffs. The Controls/Local Content scenario reflects the cost of a potentially more integrated value chain with more manufacturing on U.S. soil due to policy efforts to restrict imports or subsidize domestic production.
- **Lithium-ion batteries:** BNEF's Battery Price Index and Battery Cost Model were used to calculate current and potential prices for batteries. The Open Markets case is similar to current actual pricing based on imports from overseas suppliers, namely those based in South Korea or China. The Mixed Scenario is based on the difference between manufacturing battery cells and packs in the U.S. vs. making them in China and shipping to the U.S., assuming U.S. workers are paid a minimum wage of $15/hour. For the Controls/Local Content scenario, we assumed $30/hour.
- **Onshore wind:** For wind, BNEF again used its LCOE survey and model to calculate current and potential prices. Under the Open Markets scenario, wind costs are quite similar to current actual pricing. This reflects the existing strength of a U.S. manufacturing industry across all key components. While Chinese turbines are generally less expensive than U.S. turbines, they are very rarely installed on U.S. soil, primarily because Western banks will not finance them. As a result, we did not assume they would enter the U.S. market in greater volumes even with lower prices. The Mixed Scenario assumes tariffs of 15% on key wind turbine components: blades, gearboxes, and generators. The Controls/Local Content scenario assumes a higher tariff of 25% on these components.
- **The effects of current renewables tax credits were not included.** This analysis did not take into account the primary subsidies onshore wind and solar today receive in the U.S. – the production tax credit and investment tax credit, respectively.

High-level conclusions

The higher potential costs modeled in this exercise would probably not, on their own, materially delay clean energy adoption across the U.S. over the next few decades.

- **Onshore wind**: Low import tariffs will not materially delay the cost competitiveness of onshore wind projects vs. newly built combined-cycle gas turbine (CCGT) power plants. There is however up to a three-year delay in LCOE cost parity between wind and a new CCGT plant under a scenario with high import tariffs. When competing against *existing* CCGTs, wind is uncompetitive through 2035 under all scenarios, absent further policy support.
- **Solar PV:** Adding 10% to current PV prices delays the tipping point at which PV becomes more economical than new CCGT by just one year. It also delays cost parity between new tracking PV and existing CCGT plants by a year and PV becomes cost competitive vs. existing U.S. CCGTs by 2035. The U.S. in on track to achieve the Department of Energy's solar cost target of $30/MWh by 2025, BNEF projects.
- **Lithium-ion batteries:** A 20% increase in lithium-ion battery pack prices would delay by two years the point at which EVs would be cost-competitive with ICE vehicles on a sticker-price basis. This assumes no new additional policy support for EV purchases and is true in both the medium vehicle and SUV segments of the market.
- **U.S. clean energy goals:** Based on separate BNEF analysis, a U.S.-wide 100% clean energy goal by 2035 would spur the buildout of approximately 760GW of wind and solar between 2021 and 2035. However, China is projected to build over twice as much wind/solar capacity over that time.
- **Market size:** Under our three scenarios, U.S. manufacturing expansion will be driven by local demand growth. This will allow manufacturers to scale operations and cut per-unit production costs. The China market is expected to be substantially larger, however, meaning manufacturers there will achieve even greater scale and even lower per-unit prices. Competition to export to third-party countries will be fierce and U.S. manufacturers could struggle if that competition is waged purely on the basis of price. Cost premiums for components made entirely in the U.S. will prevail over time if the U.S. imposes controls or local content rules to shift all component manufacturing back onshore.

Sector sensitivities

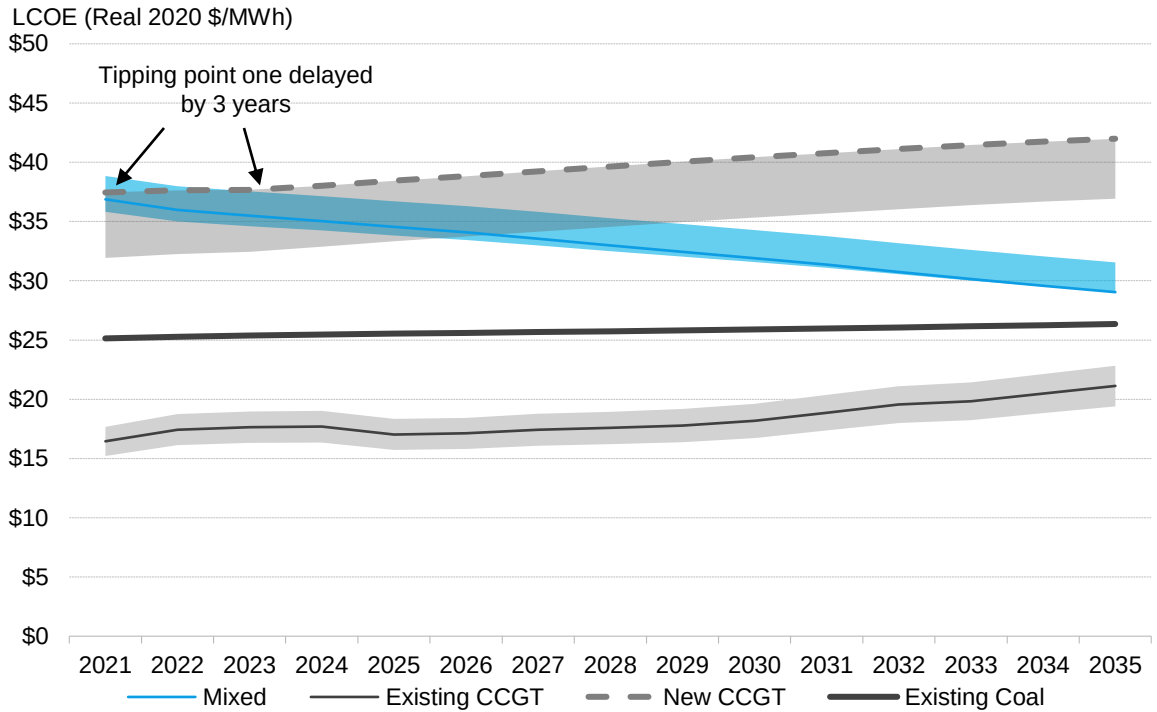
Wind, PV and EVs

Tipping points for renewables vs. new and existing fossil fuel power plants

To understand liminal moments when the energy transition has and will accelerate based purely on economics, BloombergNEF in this analysis focuses on two “tipping points”:

- **Tipping point one:** when new-build renewable power becomes cheaper than building and operating a new fossil-fuel power plant on a levelized cost of energy (LCOE) basis.
- **Tipping point two:** when it becomes cheaper to build new onshore wind or solar PV than to run an existing coal or gas plant that provides bulk electricity. Once the LCOE of solar or wind falls below the short-run marginal cost of an existing fossil-fuel plant, it makes economic sense to replace it with a new unit of renewables capacity, if it is not needed to ensure security of supply.
  - In practice, tipping point two is not a cliff face, and there are many reasons why deployment of renewables may fail to accelerate at this point, and existing fossil-fuel plants continue to generate. This includes uncertain market price signals for new renewables build, and the fact that gas and coal plants can operate at reduced output. However, a lack of run hours eventually forces such plants to retire unless alternative revenue streams are available to cover their fixed operating costs.
  - The minimum capacity factor for coal and gas plants will vary between markets, but the consequence of continued growth in renewables is the eventual retirement of fossil capacity. That may occur in chunks rather than following a smooth trend, leading to greater demand for new-build capacity, a further boost for renewables.

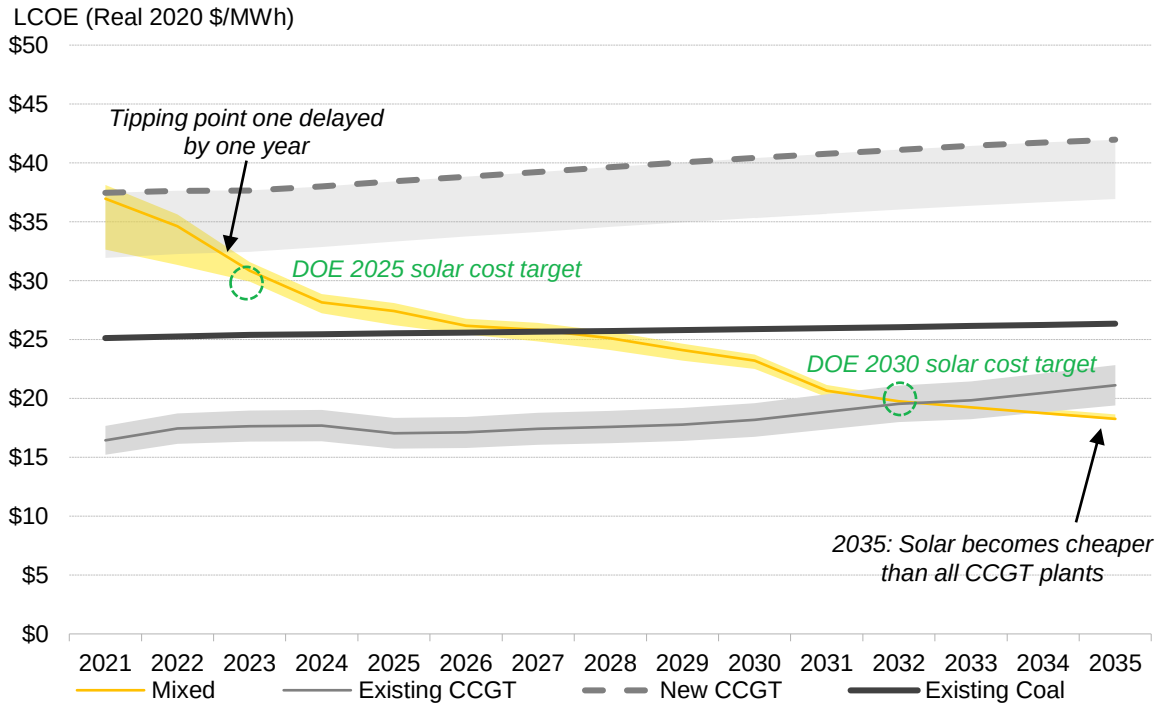
For onshore wind, higher tariffs would delay parity vs. gas by three years



Source: BloombergNEF

- A typical U.S. onshore wind project today sources 57% of the its components (by dollar value) domestically. However, the industry still imports key products from a diverse set of countries and relies on China for specific components.
- Wind is represented in the shaded blue at left with the Controls scenario serving as the upper bound and the Open Markets scenario at the bottom. The Mixed scenario is the darker blue line.
- Wind can already produce at lower cost than the average new CCGT plant in the U.S. under both Open Markets and Mixed scenarios. The Controls scenario essentially delay by three years the point at which the first tipping point is reached.

For solar PV, trade barriers would not materially delay tipping points



Source: BloombergNEF

- Under the Open scenario where the U.S. removes all existing trade tariffs, solar becomes cheaper than new CCGT generation just one year earlier (2022) vs. the Mixed and Controls scenarios (2023).
- BNEF projects PV to undercut existing CCGTs on cost by the mid-2030s. By then, the effect of more or less trade policy action would largely have dissipated.
- The U.S. Department of Energy aims to achieve a cost reduction target for solar of $30/MWh by 2025 and $20/MWh by 2030. Under the Open scenario, where the U.S. lifts all tariffs on solar, the 2025 target would be achieved two years earlier. The 2030 target would be marginally missed by one year under the Open scenario and by two years under the others.

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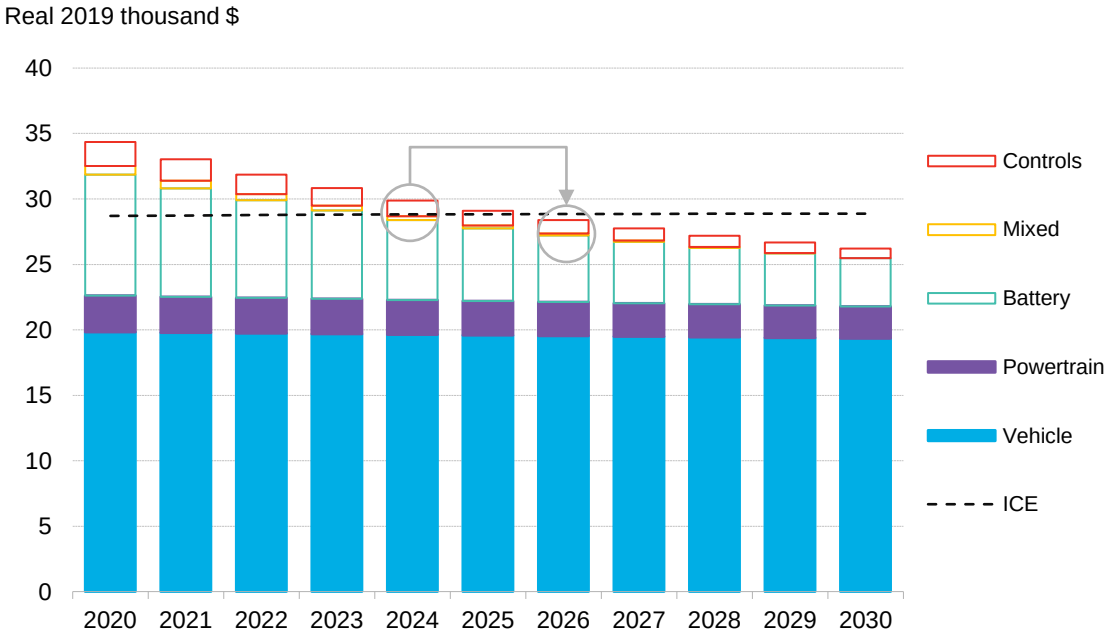
For medium EVs, a 20% battery pack price would delay sticker parity to 2026



Source: BloombergNEF

Medium vehicle segment

- BNEF compared sticker prices for a medium electric vehicle (EV) vs. a similar internal combustion engine (ICE) car. Medium EVs include the Tesla Model 3 and the Nissan Leaf, two of the most popular electric cars. The goal was to estimate when EVs would reach price parity against ICE vehicles, and whether boosting battery pack prices would delay that potentially important tipping point.
- This chart stacks the main EV cost components with the battery cost at top. The Mixed and Controls boxes represent the potential cost premiums on the battery that would occur under those modeled scenarios.
- In an Open Market scenario, EVs reach price parity in 2024. The Controls scenario boosts by 20% battery pack prices and delays parity between EVs and ICEs by two years, until 2026.

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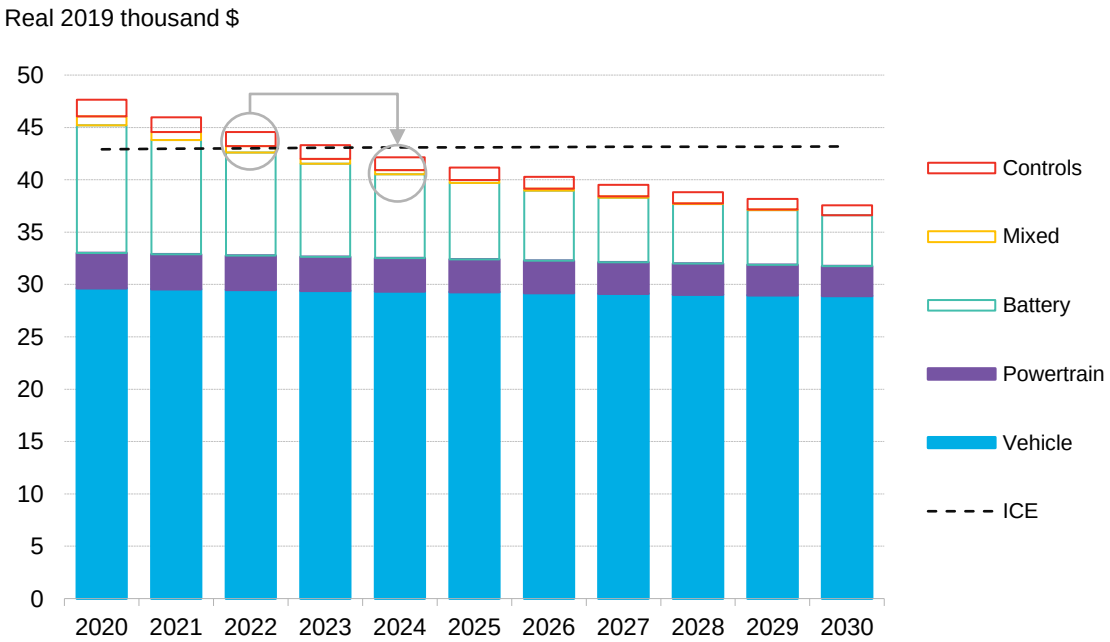
For electric SUVs, a 20% battery price hike would delay parity to 2024



Source: BloombergNEF

SUV segment

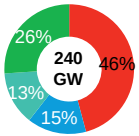
- BNEF also compared sticker prices of electric SUVs vs. ICE SUVs. Again, the goal was to estimate when EVs would reach price parity against ICE vehicles, and whether an increase in battery pack prices would delay the tipping point.
- This chart stacks the main EV cost components with the battery at the top. The Mixed and Controls boxes represent the potential battery cost increases that would occur under those scenarios.
- In an Open Market scenario, electric SUVs reach price parity in 2022. A 20% battery pack price increase under the Controls scenario delays parity between electric and ICE SUVs by two more years, until 2024.

The U.S. market in context

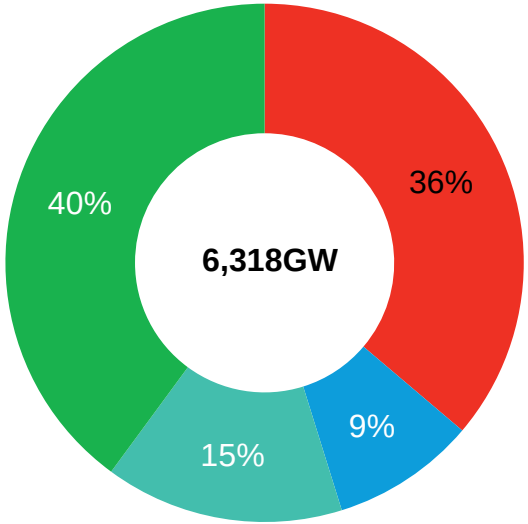
Growth drives certainty and cuts prices, but China remains much larger

China will remain a much larger domestic market for PV and wind

Wind/PV installed in 2020



Projected 2035 cumulative wind/PV



China U.S. Europe Rest of World

Source: BloombergNEF, 2020 New Energy Outlook Economic Transition Scenario. Note: Not to scale.

- In 2020, the world installed 240GW of new wind and PV capacity. Almost half was built in China (left figure).
- The U.S. had 217GW of solar and wind capacity online as of year-end 2020. Under BNEF's forward-looking Energy Transition Scenario, which assumes no new policy supports, it installs 351GW of new solar and wind 2021-2035.
- By 2035, China will have 2,287GW of solar and wind online, or over a third of the total global capacity installed (right). It is expected to add 1,732GW 2021-2035. The U.S. will represent less than 1/10th total commissioned capacity in 2035.
- Chinese manufacturers will have a much larger domestic market to absorb their products, potentially allowing them to scale faster while continuously reducing costs. This will make it very challenging for producers from other markets to compete strictly on a cost basis.

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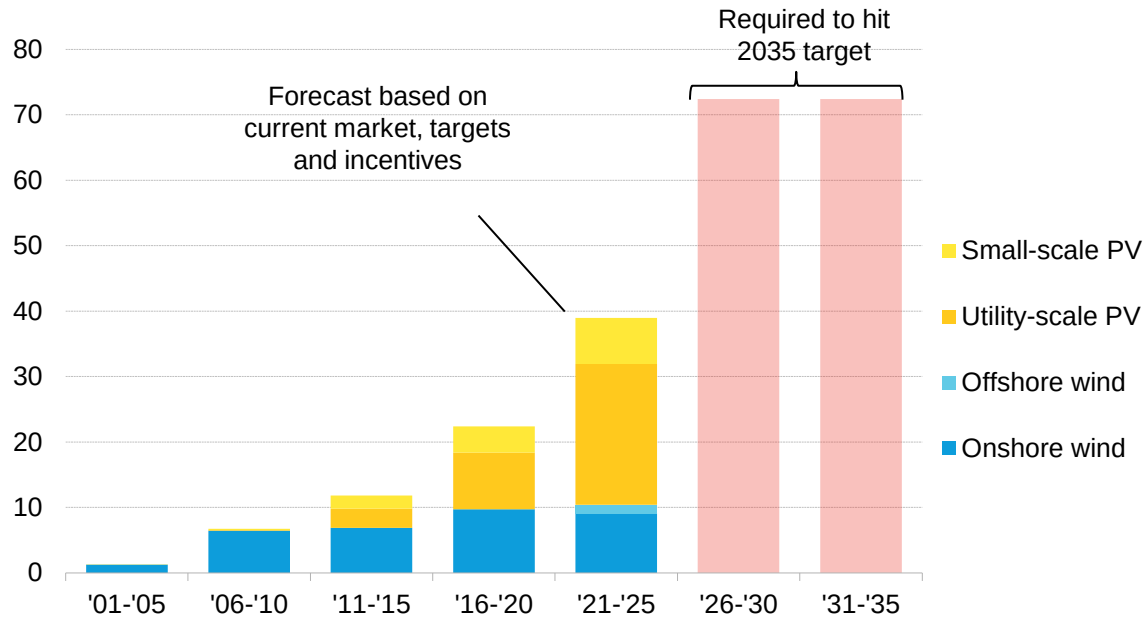
A 100% U.S. clean energy goal is not enough to reach Chinese build levels

Average annual build of U.S. wind and solar (GW)



Source: BloombergNEF

- For wind and solar to fulfill their potential in displacing gas from the power system, annual capacity additions from 2025 to 2035 will need to be on the order of ~70GW, a doubling of current levels.
- A total 763GW of solar and wind would potentially be built between 2021-2035 under Biden's clean energy goal. China is projected to add over twice as much wind and solar during the same period under BNEF's current base projection.
- Even in a bullish scenario for wind and solar build in the U.S., Chinese manufacturers will continue to have a much bigger domestic market to serve.
- This raises the prospect that U.S. wind and solar manufacturers will continue to produce at slightly higher costs than their Chinese competitors – but will have the opportunity to serve a growing domestic market.

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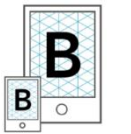

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