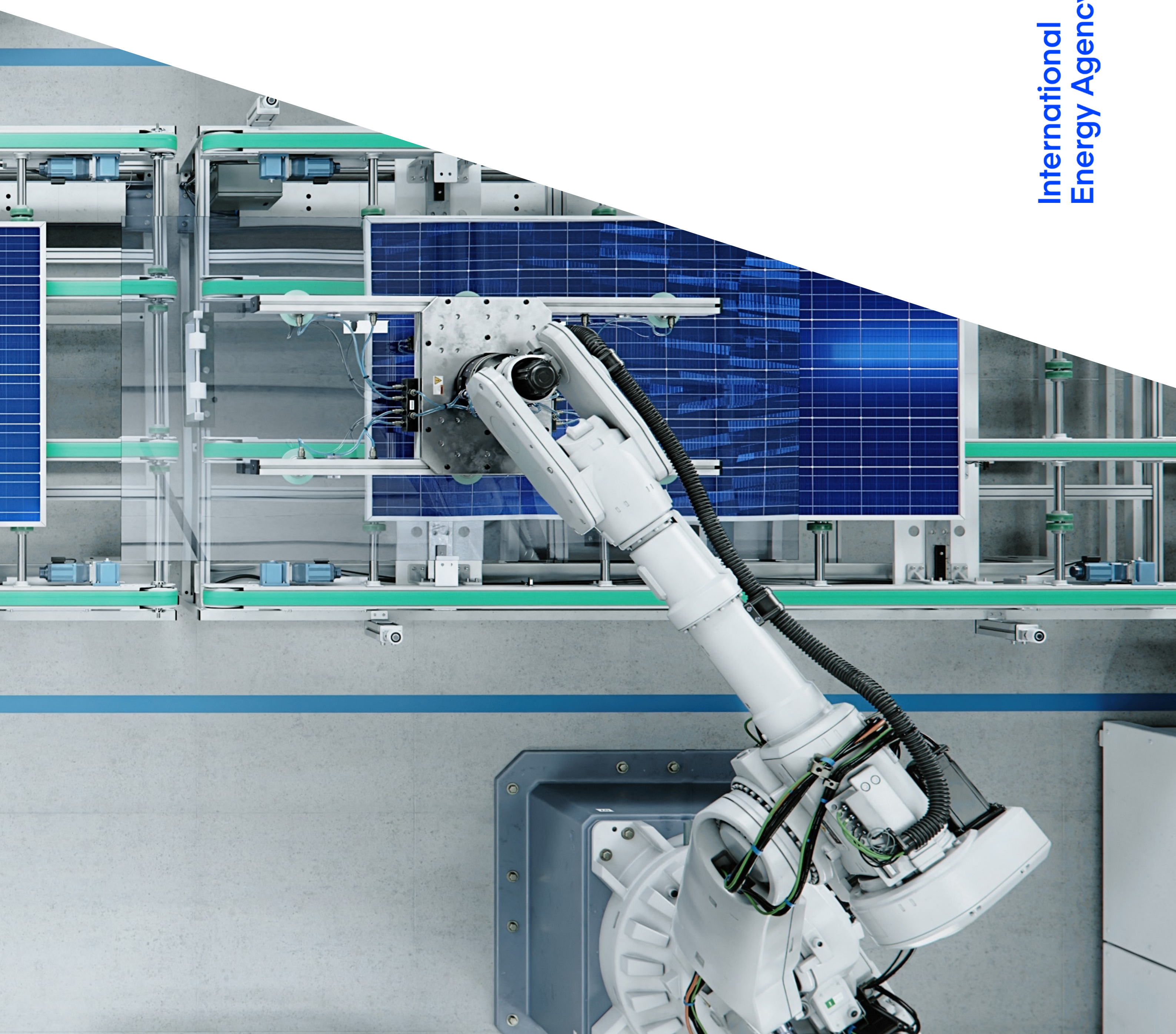
The State of Clean Technology Manufacturing

An Energy Technology Perspectives Special Briefing – November 2023 Update

International Energy Agency



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Key findings

- Clean energy technologies are foregrounded in the IEA's updated Net Zero Emissions by 2050 Scenario (NZE Scenario), which highlights impressive growth in solar PV installations and electric vehicles as one of the success stories of recent years helping to keep the net zero goal within reach.
- None of these advances would have been possible without growth in clean energy technology manufacturing, and manufacturing now needs to accelerate further in order to meet targets for 2030 deployment consistent with the net zero goal.
- This Energy Technology Perspectives Special Briefing provides a snapshot of the latest developments in manufacturing capacity across five key technologies: solar PV, wind energy, heat pumps, electrolysers and batteries.
- Announcements during just the middle two-quarters of 2023 – the analysis period since our last Special Briefing in May – account for nearly 40% of the total announced capacity for solar PV, 10% for batteries and 20% for electrolysers. However, the growth in announced capacity has been slowing. Globally, the average monthly rate of additions to the project pipeline during Q2-Q3 2023 has halved relative to the period examined in the May Special Briefing for solar PV, reducing by nearly two-thirds for batteries, and by nearly one-third for electrolysers.
- For the first time, announced projects for electrolyser manufacturing could meet deployment needs for the NZE Scenario in 2030. Almost 170 GW of installed manufacturing capacity could be expected by 2030, if all announced projects are realised. However, less than 10% of announced projects for electrolysers are committed – i.e. they have reached a final investment decision (FID) or are under construction. Meeting deployment needs for net zero will require all of these projects to move rapidly towards completion, backed by sustained and strong growth in demand for electrolysers, as well as a step-up in operations for already installed capacity.
- Solar PV manufacturing continues to surge ahead, with projected throughput of existing and announced projects now two-thirds higher than the level required to satisfy deployment needs in 2030 in the NZE Scenario.
- For batteries, the latest announcements continue to add to the huge increase in manufacturing capacity embodied by project announcements over the past year. If all announced projects are realised, total manufacturing capacity by 2030 would reach 7 500 GWh, almost five-times current installed capacity, which reached 1 550 GWh per year at the end of 2022. At the global level, announced battery manufacturing capacity would be sufficient to meet deployment needs for both mobility and stationary applications in the NZE Scenario in 2030.
- Heat pump manufacturing capacity additions tend to be less prominently announced than those for other technologies, but announcements have slowed down compared to 2022 in the face of uncertainty about demand. In some countries, this results from the

downgrading of subsidy schemes, or – conversely – from consumers postponing investment decisions in anticipation of forthcoming incentives. The downward trend could therefore be reversed in the near term.

- There has been very limited activity in the project pipeline for wind energy, and capacity remains significantly below the deployment levels required in the NZE Scenario. Newly announced facilities for manufacturing onshore wind components only just outweighed others that were cancelled.
- The successful completion of manufacturing capacity additions for offshore wind energy projects depends on the financial stability of original equipment manufacturers, which is itself strongly affected by the tendering and contracting process for new sites. Any delays or cancellations can therefore have a direct effect on manufacturing facilities.
- There is a strong degree of regional concentration in manufacturing for all five technologies considered here, and on the basis of project announcements, the same countries and regions will continue to dominate manufacturing through to 2030. The relative shares of the different countries and regions in capacity for each technology will nevertheless undergo a small shift.
- China is expected to continue to account for the majority of manufacturing capacity for wind, batteries, and especially solar PV, as well as for their key components. Announced projects suggest that the manufacturing base for heat pumps and electrolysers will broaden out slightly, with no country or region accounting for more than 50% of capacity.
- Ensuring that clean energy technology supply chains are secure and resilient are an important aim of public policy. Major policy announcements of recent years, including the US Inflation Reduction Act, the EU Net Zero Industry Act and India’s Production Linked Incentive scheme are already starting to ripple through the manufacturing sector.
- For some technologies – notably electrolysers in the United States and heat pumps in several European countries – ongoing policy changes have resulted in uncertainty and delays with regards to demand. To increase confidence in the reliability of future demand, it is essential to ensure that delays in policy implementation are minimised.

Part I: Introduction

Clean energy technologies are central to efforts to meet the world's climate, energy security and economic development goals. Increasing deployment at the pace needed to get on track for net zero emissions by 2050 will require a rapid step-up in manufacturing capacity for clean technologies.

This Energy Technology Perspectives (ETP) Special Briefing provides a targeted update on recent progress in clean energy technology manufacturing in key regions. Covering five technologies – solar PV modules,[1] wind turbines,[2] batteries,[3] electrolysers[4] and heat pumps[5] – that will be critical to the energy transition, the analysis is focused on the areas of supply chains that are showing the greatest dynamism in response to recent policy and industrial strategy developments. It contains data on the project pipeline for key technologies to the end of September 2023, and takes into account the latest updates to the IEA's Net Zero Emissions by 2050 Scenario (NZE Scenario), published in September 2023, to examine progress towards climate goals (see Box 1 for a description of the scenarios used in this Special Briefing).[6]

This analysis constitutes one of the deliverables requested by G7 leaders from the IEA: an update on clean technology supply chains to be provided ahead of COP 28, the next UN Climate Change Conference of the Parties, at the end of 2023. It follows a similar ETP Special Briefing published in May 2023 to support the deliberations at the Hiroshima Summit. These publications build on analysis conducted as part of the latest edition of the IEA's technology flagship publication, Energy Technology Perspectives 2023 (ETP-2023), published in January 2023.

This report also forms part of the IEA's support of the first global stocktake of the Paris Agreement, which will be finalised in the run-up to COP 28. Find other reports in this series on the IEA's Global Energy Transitions Stocktake page.

[1] Hereafter "solar PV", unless a particular component or intermediate step in production is specified.
[2] Hereafter "wind", with analysis based on aggregate or average quantities for nacelles, towers and blades as appropriate.
[3] Including both mobile and stationary applications and all battery chemistries.
[4] Including alkaline, proton exchange membrane, anion membrane exchange and solid oxide technologies.
[5] For buildings applications only.
[6] The updated Net Zero Roadmap highlights the growing role of electrification on the path to net zero emissions and cost reductions that have boosted take-up of technologies such as solar PV and batteries. The 2023 NZE Scenario therefore reflects these changes with updated deployment rates for key technologies. For example, solar PV and Electric Vehicles (EVs) take a more prominent role, whereas for wind and hydrogen, the deployment rate has been revised downwards, based on recent investment trends from manufacturers compared to other low-emissions alternatives.

Box 1 Scenarios used in this Special Briefing

Analysis in this Special Briefing is underpinned by global projections of clean energy technologies derived from the IEA's Global Energy and Climate (GEC) model, a detailed bottom-up modelling framework composed of several interlinked models covering energy supply and transformation, and energy use in the buildings, industry and transport sectors. The modelling framework includes 29 regions or countries covering the whole world.

The most recent year of complete historical data from the GEC model is 2022, to which year-end 2022 manufacturing installed capacity data have been added as part of the analysis for this Special Briefing. Data for Q3 2023 are available for some technologies. For projected values to 2030, we make use of two IEA scenarios produced using the GEC model that describe possible energy system pathways:

The Net Zero Emissions by 2050 Scenario (NZE Scenario) is a normative scenario that sets out a pathway to stabilise global average temperatures at 1.5°C above pre-industrial levels. The NZE Scenario achieves global net zero energy sector CO_2 emissions by 2050 without relying on emissions reductions from outside the energy sector. In doing so, advanced economies reach net zero emissions before developing economies do. The NZE Scenario also meets the key energy-related UN Sustainable Development Goals, achieving universal access to energy by 2030 and securing major improvements in air quality.

The Announced Pledges Scenario (APS) assumes that governments will meet, in full and on time, all the climate-related commitments they have announced, including longer-term net zero emissions targets and Nationally Determined Contributions (NDCs), as well as commitments in related areas such as energy access. It does so irrespective of whether these commitments are underpinned by specific policies to secure their implementation. Pledges made in international fora and initiatives on the part of businesses and other non-governmental organisations are also taken into account wherever they add to the ambition of governments.

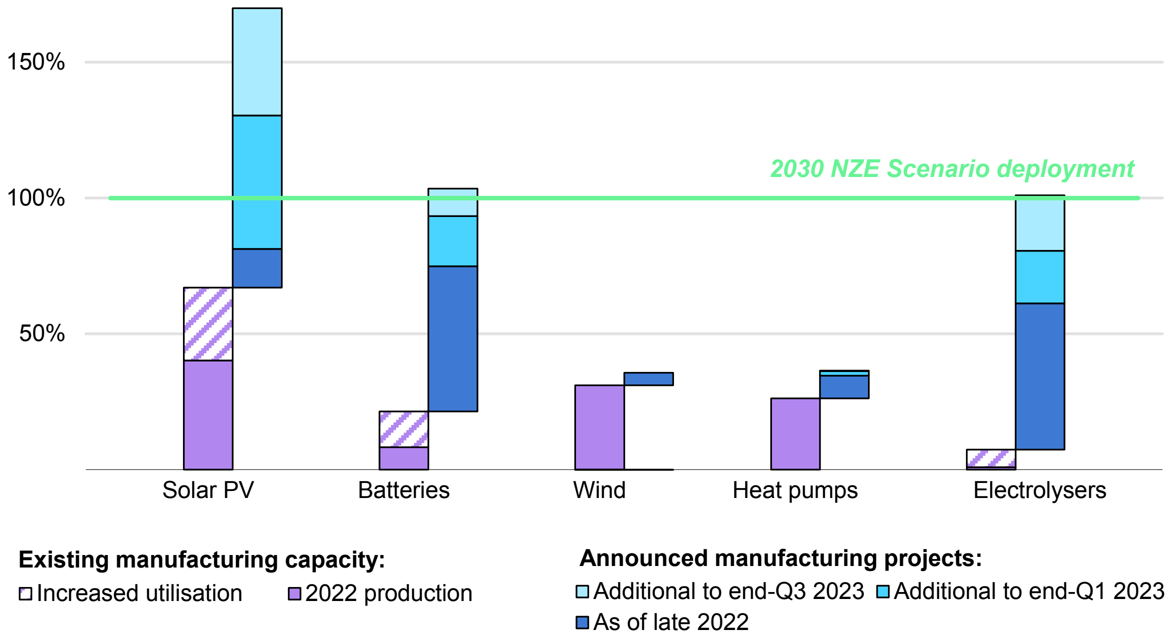
Neither scenario should be considered a prediction or forecast. Rather, they are intended to offer insights into the impacts and trade-offs of different technology choices and policy targets, and to provide a quantitative framework to support decision-making in the energy sector, and strategic guidance on technology choices for governments and other stakeholders. The scenarios and results are consistent with those presented in the World Energy Outlook 2023.

Part II: Analysis

A snapshot of the latest developments

The updated project pipeline to the end of September 2023 (end-Q3 2023) shows that the number of announced projects for manufacturing clean technologies has continued to rise, albeit at a more moderate pace. The announcements during just the middle two-quarters of 2023 (Q2-Q3 2023) – the analysis period since our last Special Briefing in May – account for nearly 40% of the total announced capacity for solar PV, 10% for batteries and 20% for electrolysers. However, the growth in announced capacity has been slowing. Globally, the average monthly rate of additions to the project pipeline during Q2-Q3 2023 has halved relative to the period examined in the May Special Briefing for solar PV, reducing by nearly two-thirds for batteries, and by nearly one-third for electrolysers.

Figure 1 Projected throughput from existing and announced manufacturing capacity relative to Net Zero Emissions by 2050 Scenario deployment needs in 2030



Note: NZE Scenario = Net Zero Emissions by 2050 Scenario. 2022 production values reflect estimates of actual utilisation rates. Increased utilisation refers to the gap between 2022 production levels and existing capacity being utilised at 85%. A utilisation rate of 85% is used for both existing and announced manufacturing capacity in 2030.

Source: IEA analysis based on data from InfoLink, BNEF, WoodMac, EV Volumes, BMI, UN Comtrade and announcements by manufacturers and personal communications.

If all announced projects go ahead, manufacturing for solar PV, batteries and electrolysers will be able to accommodate deployment needs consistent with the latest update to the NZE Scenario by 2030. This is despite the fact that in this latest scenario update, 2030 solar PV and battery deployment is higher than it was in the previous edition of the NZE Scenario used for the comparison in the May edition of this Special Briefing. For the first time, announced projects comprise sufficient capacity for 2030 electrolyser deployment needs as well, in part due to lower levels of deployment in the updated NZE Scenario, relative to the previous edition. In addition, for solar PV, batteries and electrolysers, the utilisation rates of existing manufacturing capacities are low, indicating that there may be overcapacity at present – but also that production could quickly ramp up.

In contrast, the wind manufacturing industry has seen negligible changes to the project pipeline in the past 6 months, with newly announced facilities for onshore wind components only just outweighing other projects that were cancelled. Announcements for manufacturing of heat pumps have slowed in the face of uncertainty about future policy support and thus consumer demand. The relatively short lead times required to bring new manufacturing capacity for wind and heat pumps online mean that bridging the gap to NZE Scenario levels by 2030 is possible, but will require dedicated policy support.

There is a significant split between announced projects that are committed – i.e. they have reached an FID or are under construction – and those that remain at a preliminary stage in their development. For example, less than 15% of announced projects for electrolysers are committed. This requires sustained attention to ensure that announced projects materialise.

Box 2 Categorisation of manufacturing data

In this Special Briefing the manufacturing data for the focus five clean energy technologies can be categorised as follows:

“**Installed manufacturing capacity**” refers to the maximum rated output of facilities for producing a given technology. Capacity is stated on an annual basis for the final product and does not refer to the capacity for any intermediate products or components. Where available, manufacturing capacity for key components is provided separately. Annual manufacturing “**throughput**” is a fraction of the installed manufacturing capacity. Throughput depends on the utilisation rate of production capacity, for which 85% is a typical annual average target level under normal operation. However, utilisation rates for clean technology manufacturing facilities tend to be much lower on average today, reflecting significant degrees of overcapacity globally. 2022, the base year for the analysis in this Special Briefing, is the most recent year for which installed manufacturing capacity data has been collected.

"**Announced projects**" refers to the aggregate stated capacity – or estimated throughput of that capacity (assuming a default utilisation rate of 85%) – of potential manufacturing facilities that have been announced. This includes projects for building new facilities or expanding existing ones that are at different stages of development. 'Committed' projects includes projects that have already reached an FID, or are under construction, whereas 'preliminary' projects include those that have not yet reached an FID. Wherever data is available, we refer to these milestones in project development. Unless otherwise stated, the announced projects dataset assembled for this Special Briefing comprises announcements dated up to and including the end of the third quarter of 2023.

External data providers include InfoLink, Thomson Reuters, Bloomberg New Energy Finance, Wood Mackenzie, EV Volumes, and Benchmark Mineral Intelligence.

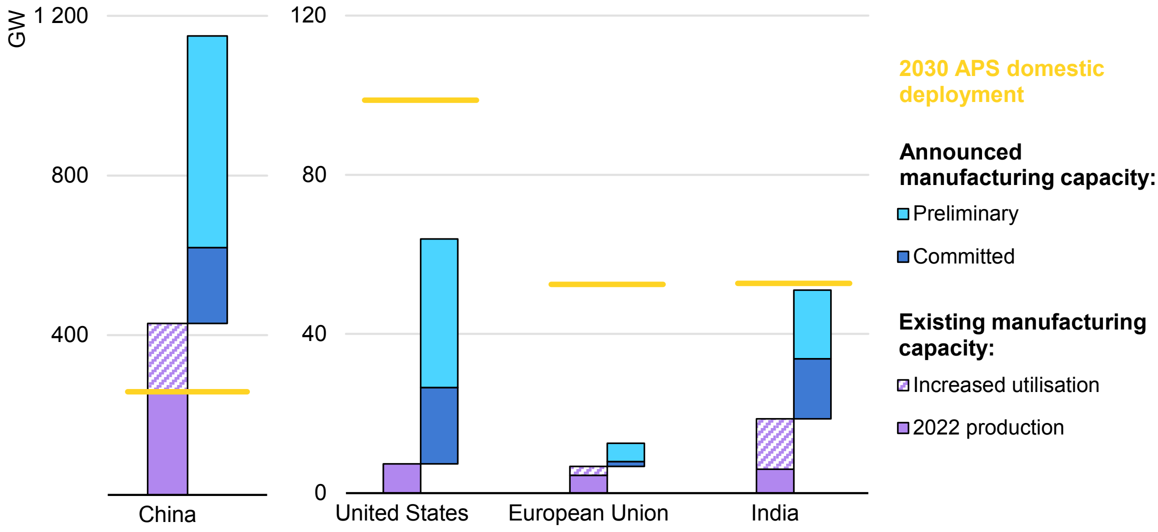
Announced manufacturing capacity for solar PV doubles again in 2023

Announcements for solar PV module manufacturing projects continue to surge ahead, with the additional manufacturing capacity announced having approximately doubled since late 2022. Over 380 GW of capacity have been announced in the past six months alone, which would be sufficient to accommodate the entire 2022 module production, bringing the total throughput from announced and installed capacity to around 1 650 GW by 2030. The vast majority of new projects announced, i.e. around 85%, are based in China, which is also seeing the fastest rate of installations globally, with almost half of total global capacity additions in 2022 (i.e. 45%) taking place in China.

The same acceleration is also observed in the upstream parts of the PV supply chain, with manufacturing capacity announcements for solar cells increasing by around 210 GW and for wafers by around 260 GW. Announced additions to polysilicon capacity were smaller over Q2-Q3 2023 than in Q1 2023, but still totalled just under 100 GW. Solar PV installations grew to reach 220 GW in 2022, with the rate of capacity additions increasing by 35% over the previous year. China's share of the global total grew from 39% in 2021 to 45% in 2022 – reaching 100 GW – with China's share expected to increase further in 2023.

Despite the utilisation rates of solar PV manufacturing facilities being relatively low on average globally (around 60%), recent excess supply in China is likely to have created a large backlog of modules in Europe (estimated at 60-70 GW), according to Chinese exports and global installations data.

Figure 2 Current and projected throughput for solar PV manufacturing capacity and deployment in the Announced Pledges Scenario



Note: APS = Announced Pledges Scenario. 2022 production values reflect estimates of actual utilisation rates. Increased utilisation refers to the gap between 2022 production levels and existing capacity being utilised at 85%. A utilisation rate of 85% is used for both existing and announced manufacturing capacity in 2030.
Source: IEA analysis based on data from InfoLink and BNEF.

The projected throughput of the existing and announced projects is now two-thirds higher than the level required to satisfy deployment needs in 2030 under the NZE Scenario. Activity on announcements for modules manufacturing is also visible outside China, particularly in the United States and India, but respective capacity for upstream components such as wafers and polysilicon is still lagging behind in these two regions. Overall, solar PV module manufacturing is the clean technology manufacturing activity with the most surplus capacity compared to the global NZE Scenario needs. It is possible that this will lead to greater market consolidation over the coming years, with the least competitive facilities ceasing operations and the most speculative announcements failing to materialise.

Indicative of the momentum in solar PV manufacturing is the fact that there are currently five announcements for facilities that are each capable of producing 30 GW or more of modules per year, which was the size of the largest facility identified in our Special Briefing published in May this year. This has now been surpassed with a 56 GW capacity addition announced by Jinko Solar.

Table 1 Major solar PV manufacturing facilities operating or near completion

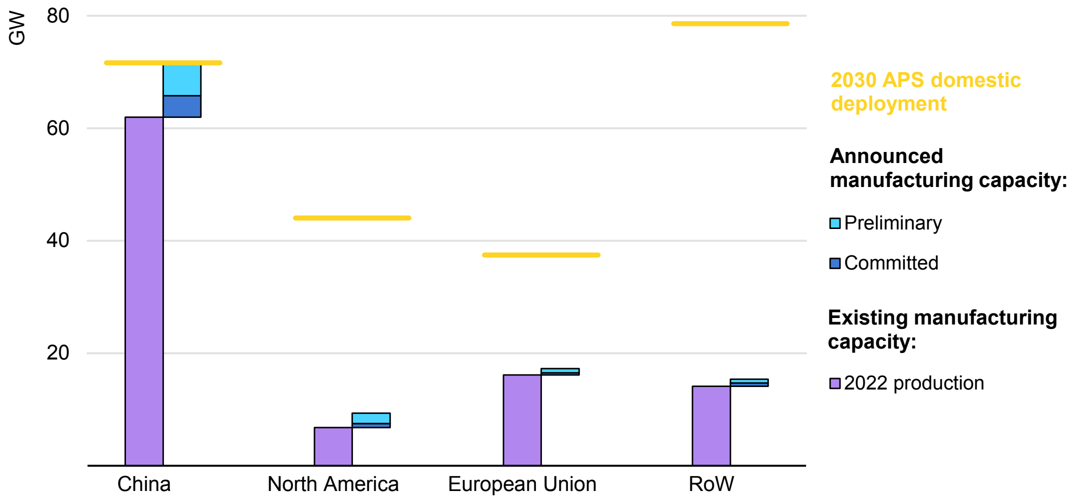
Company	Location	Country	Production capacity	Projected completion year	Projected year at maximum
Jinko Solar	Shanxi	China	56 GW	2024	2025
Jinko Solar	Zhejiang	China	40 GW	2024	2026
GCL	Jiangsu	China	35 GW	2023	2024
GCL	Anhui	China	30 GW	Operating	2025
SOLAR-GRIDS	Zhejiang	China	30 GW	2023	2026

Source: IEA analysis based on data from InfoLink.

Wind manufacturing beset by delays and cancellations despite record installations

Newly grid-connected wind capacity in 2023 is expected to rebound to the record levels of 2020, reversing the trend of decreasing installations during 2021-2022. The ratio of onshore to offshore installed capacity remains broadly constant at approximately 6:1. Despite this projected return to growth, there has been very limited activity in the project pipeline for facilities manufacturing wind energy components, with capacity remaining significantly below NZE Scenario deployment levels. Since the beginning of 2023 there has been a small increase in the share of offshore wind facilities that can be considered committed, but for onshore wind components, newly announced capacity only just offset the quantity that was cancelled.

Figure 3 Current and projected throughput for wind manufacturing capacity and deployment in the Announced Pledges Scenario



Notes: APS = Announced Pledges Scenario; RoW = Rest of World. Manufacturing capacity is calculated as an average of nacelle, tower and blade capacity. 2022 production values reflect estimates of actual utilisation rates. A utilisation rate of 85% is used for both existing and announced manufacturing capacity in 2030.

Source: IEA analysis based on data from Wood Mackenzie.

Almost all offshore wind manufacturing capacity formerly assessed as preliminary and now considered committed is located in China. The country was also responsible for half of global annual capacity additions in 2022. Further projects have moved from preliminary to committed status in North America, while other announced investments this year have been revised. A number of offshore projects were halted in Europe, casting doubt on the likelihood of several other project announcements materialising.

The limited activity in manufacturing project announcements is partly due to under-utilisation of existing capacity and the fact that final investment decisions are only taken after tenders are awarded, which has repercussions throughout the supply chain. Furthermore, slow and complex permitting for both onshore and offshore wind projects is delaying future investment decisions by manufacturers. In 2022 around 80 GW of wind installation projects in Europe were stuck in permitting procedures.

Several offshore wind projects have been delayed or cancelled since the beginning of 2023, including the Norfolk Boreas project off the coast of the United Kingdom, and Ocean Wind 1 and 2 in the United States. Developers have linked cancellations to rising costs due to inflation and high commodity prices, as well as supply chain bottlenecks. Some manufacturers have also had problems with components of wind turbines, notably Siemens Energy, which reported a loss of EUR 2.9 billion in its Q3 earnings release, partly due to technical problems with rotor blades for its onshore turbines, together with rising costs.

A shortage of suitable installation vessels recently led to a project in China Taipei being halted, and a lack of vessels is looming as a potential future barrier to the scale-up of installations in line with countries' climate ambitions. This issue is further exacerbated by the increasing size of wind turbines in recent years, requiring ever bigger vessels and associated adaptations at ports. Offshore wind turbine rotor diameters have grown from around 120 to 200 metres since 2010 (compared to for onshore turbines), posing challenges for turbine manufacturers who have to invest in upgrades to equipment and testing facilities and undergo new certification procedures in order to bring new designs to market and retain a competitive edge. The disruptions to installation projects that stem from these complications can have direct repercussions for manufacturing facilities.

Box 3 How the offshore tender design and contract award process can impact manufacturing capacity for wind energy

The successful completion of manufacturing capacity additions for wind energy projects is dependent on the financial stability of original equipment manufacturers (OEMs), which is deeply intertwined with the design of tenders.

Manufacturing capacity for wind is hard to measure, as facilities announcements and final investment decisions are made only after a site is awarded by governments, meaning that any project cancellations or delays have a direct knock-on effect on manufacturing facilities and the financial stability of OEMs. In light of this, delays and cancellations may also endanger future investments into manufacturing, or into new sites. This can result in under-investment across the supply chain and reductions in overall global manufacturing capacity.

The design of tenders for wind needs to be carefully considered to ensure that they receive strong proposals, and that winning projects have the best possible chance of being realised on time and on budget. In many instances, auctions for wind are based largely on price, which can lead to negative bidding and a race to the bottom. When the contract prices on offer are considered too risky, the result can be auctions not receiving any bids, as was the case for the United Kingdom's latest offshore wind auction.

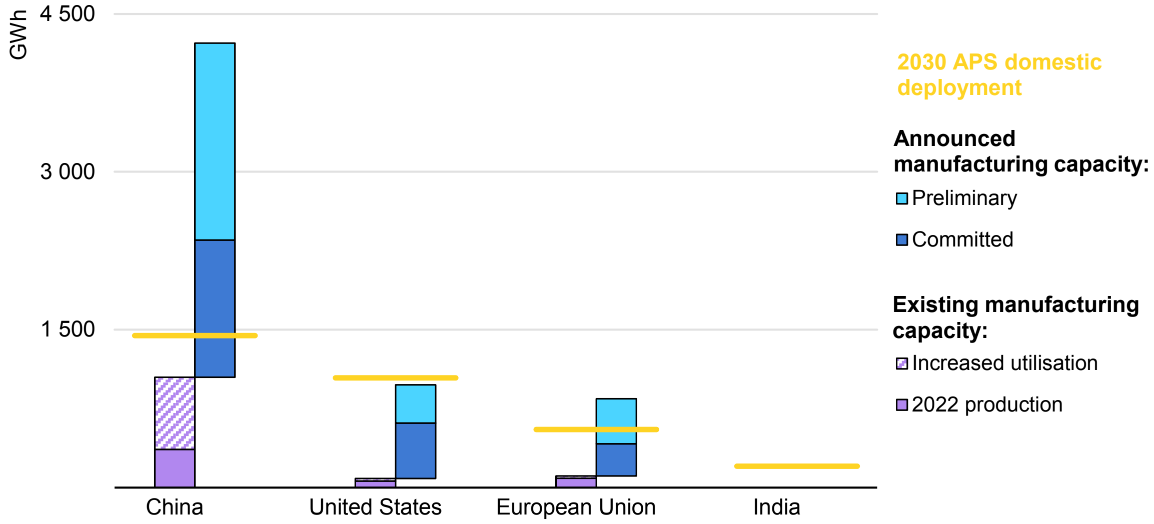
In the context of rising costs for wind developers, action to index prices can ensure that future inflation has less of an impact on profitability. Where available, environmental assessments and site surveys carried out prior to the announcement of tenders can also help potential bidders to accurately assess likely investment needs.

Battery manufacturing continues to expand

Battery manufacturing project announcements have continued throughout the first three quarters of 2023, backed by strong uptake of electric vehicles (EVs) supported by policy incentives in several major regions.

Looking at the pipeline of announced manufacturing projects during Q1-Q3 2023, 1 160 GWh of capacity has been added, with 730 GWh added in the latter two quarters alone. This growth nevertheless constitutes a deceleration relative to the same period in 2022 (equal to approximately 60% of the growth in Q2-Q3 2022), suggesting that manufacturers are now shifting their focus to securing funding and building or expanding previously announced plants rather than planning new installations. If all announced projects are realised, total manufacturing capacity by 2030 would reach 7 500 GWh, almost five-times currently installed capacity, which reached 1 550 GWh at the end of 2022.

Figure 4 Current and projected throughput for battery manufacturing capacity and deployment in the Announced Pledges Scenario



Notes: APS = Announced Pledges Scenario. 2022 production values reflect estimates of actual utilisation rates. Increased utilisation refers to the gap between 2022 production levels and existing capacity being utilised at 85%. A utilisation rate of 85% is used for both existing and announced manufacturing capacity in 2030. For battery manufacturing specifically, 'committed' refers to projects that are currently under construction or expansions of current plants, with all other announcements being categorised as 'preliminary'.

Source: IEA analysis based on data from BMI, BNEF and EV Volumes.

Global battery manufacturing capacity announcements, if completed in full and on time, would be sufficient to meet deployment needs in the NZE Scenario in 2030. However, less than half the capacity embodied by these announced projects is under construction, including expansions of existing manufacturing facilities.

Bringing battery manufacturing facilities online requires significant investment and access to a skilled workforce, without which announced projects might be delayed or fail. This is especially true in regions that today have limited experience in battery manufacturing at scale. The collapse in 2023 of UK battery manufacturer Britishvolt, whose plans for a gigafactory in the north-east of England failed to secure investment, illustrates the challenge of establishing new manufacturing facilities.

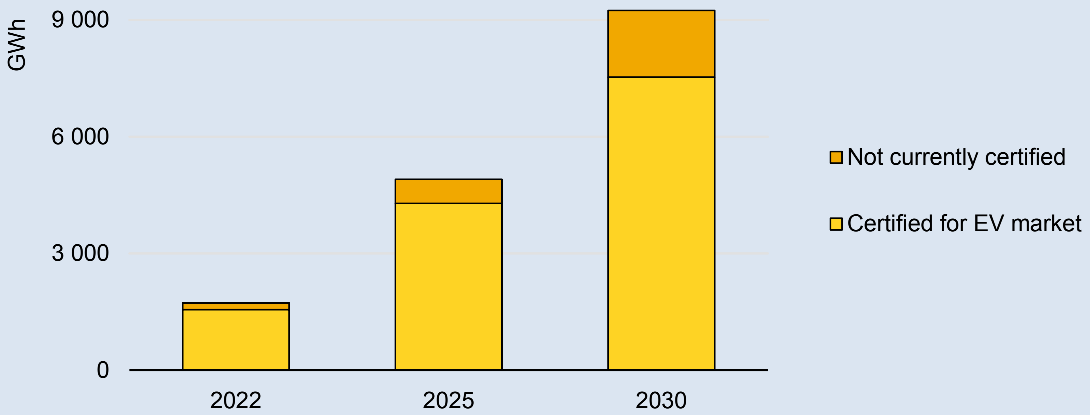
In addition, the global average utilisation of battery manufacturing capacity is estimated at around 35%, assuming no stockpiling. This indicates significant surplus capacity compared to current demand, but also suggests manufacturers are prepared to respond to the widely expected increase in demand in the coming years.

The projected throughput from existing and announced battery manufacturing capacity in China in 2030 is expected to be three times the country's domestic demand in the Announced Pledges Scenario (APS).[7] If announced projects all materialise, production in Europe is set to be sufficient to satisfy domestic demand under the same scenario, and production in the United States will almost meet domestic demand. Domestic battery production of other important regions, notably India, is set to be insufficient to cover its APS deployment needs by 2030.

Box 4 Even more batteries on the horizon

Today, there are a number of early-stage battery manufacturing companies in China, Europe and the United States that are either building their first plants or already serving non-EV related markets, including those for stationary and portable batteries. The ultimate goal of many of these companies is to build up the expertise, funding and machinery, as well as the certifications required, to eventually serve the EV market. If these early-stage manufacturers – some of which are backed by important automakers such as Volkswagen, Renault and Stellantis – are successful in meeting this aim, battery manufacturing capacity could be even higher than described above.

Preliminary, committed and early-stage battery manufacturing capacity across all lithium-ion battery markets, 2022-2030



Note: Companies that are certified to produce batteries for the EV market can also serve the stationary storage market, but not vice-versa.

Source: IEA analysis based on data from BMI.

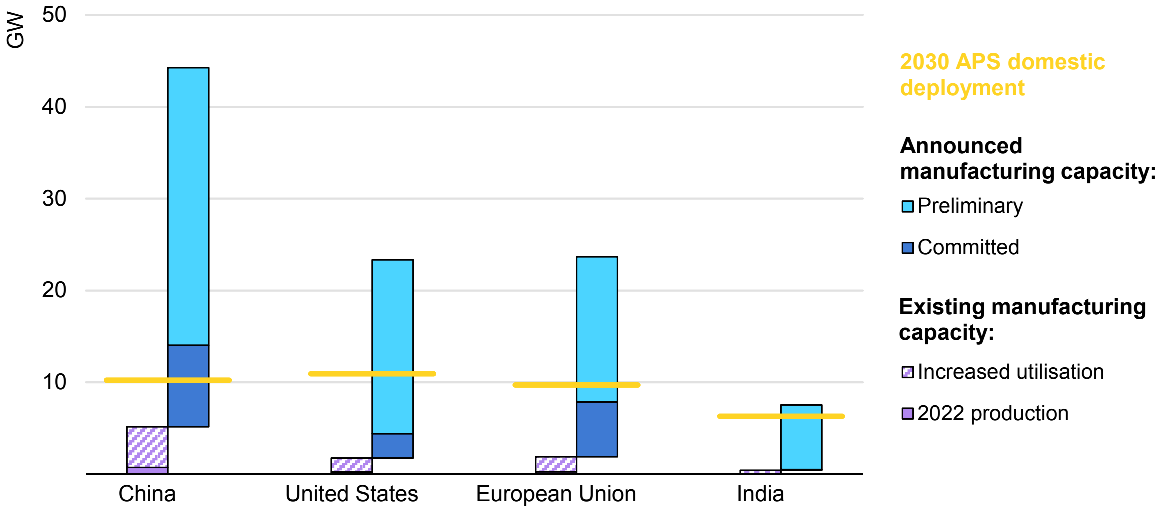
[7] Assuming an average utilisation factor of 85%.

A leap in announced electrolyser manufacturing capacity closes the gap with NZE Scenario deployment

Announced manufacturing capacity for electrolysers continues to increase, backed by strong political momentum around low-emissions hydrogen which is boosting expansion ambitions among manufacturers. If all announced projects were realised, almost 170 GW of manufacturing capacity could be installed by 2030, which for the first time means that the current project pipeline is sufficient to meet the 2030 deployment needs of the NZE Scenario.

China accounts for the majority of total capacity announced in 2023 (23 GW), followed by the United States (16 GW) and Europe (13 GW). The United States has seen the biggest increase in announcements in 2023, more than double those of 2022, boosted by the effect of financial incentives for low-emissions hydrogen. For example, in October 2023, John Cockerill announced the construction of a new manufacturing site in Baytown (Houston) close to one of the selected regional hydrogen hubs that will receive funding from the US Department of Energy. 20% of the capacity of the project pipeline – 30 GW – has been announced with no specified location, meaning that the regional distribution of announcements is subject to significant change as policy incentives evolve.

Figure 5 Current and projected throughput for electrolyser manufacturing capacity and deployment in the Announced Pledges Scenario



Notes: APS = Announced Pledges Scenario. 2022 production values reflect estimates of actual utilisation rates. Increased utilisation refers to the gap between 2022 production levels and existing capacity being utilised at 85%. A utilisation rate of 85% is used for both existing and announced manufacturing capacity in 2030.

While this progress is encouraging, there are three reasons to be less sanguine. Firstly, current utilisation rates are extremely low, with just over 1 GW of electrolyser production from 13 GW of stated capacity in 2022. While it appears feasible that production could scale quickly if orders were to surge as a result of generous incentives on offer – notably those in North America and Europe – accounts from manufacturers suggest that a significant fraction of this capacity is not yet fully operating, or still undergoing a phased ramp-up.

Secondly, many of the announced factories are assembly facilities that will require a supply of components (membranes, cathodes, anodes, bi-polar plates, power electronics, etc.) to produce the electrolyser stacks and the final electrolyser system. Reaching the capacity expansion envisaged by announced projects will depend on the scale-up of manufacturing capacity of all these components in parallel, to prevent bottlenecks occurring in certain parts of the supply chain.

Finally, the share of manufacturing projects in the pipeline that are firmly committed remains small. Only around 10% of current announcements in capacity terms have reached FID. This reflects continuing uncertainty around demand for low-emissions hydrogen, and other barriers to scale-up, such as increasing costs, which are delaying equipment orders that could provide a clear signal to manufacturers to commit to investments in announced capacity. However, just the committed capacity in China is sufficient to fulfil domestic deployment needs of the APS in 2030, and the European Union is quite close to being in the same position.

Announcements for heat pump manufacturing have slowed down, reflecting uncertainty about demand

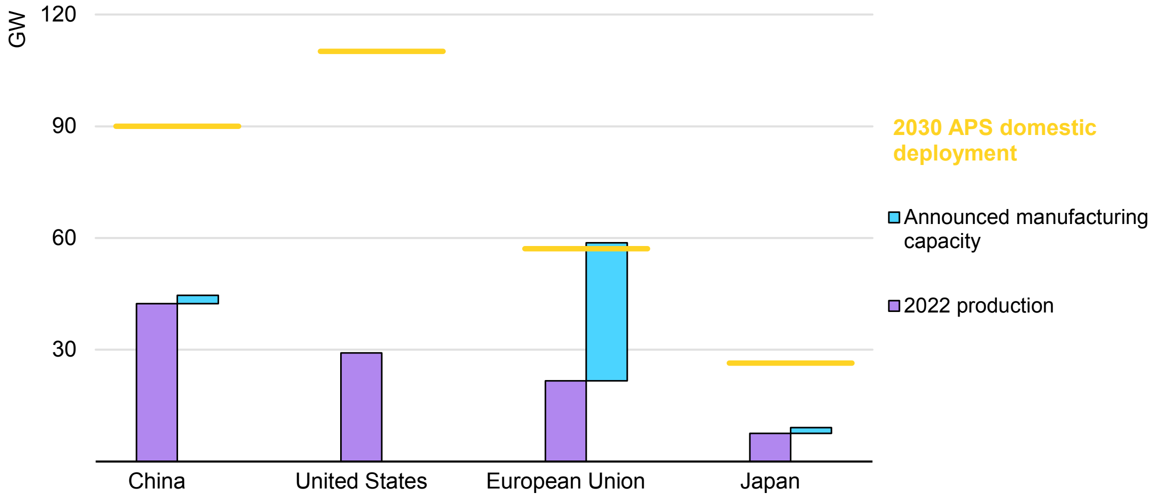
Announcements of manufacturing projects for heat pumps have slowed relative to 2022, with only a few announcements taking place since the beginning of 2023. Manufacturers are uncertain about the prospects for short-term demand amidst the scaling back of installation incentives in key markets, resulting in a slowdown in manufacturing announcements. Additions to the project pipeline during the period Q2-Q3 2023 were limited to some announcements of small amounts of capacity in the European Union totalling around 1 GW.[8]

Announced manufacturing projects for heat pumps currently meet around 35% of deployment needs in the NZE Scenario in 2030. However, manufacturing capacity expansions for heat pumps typically follow near-term demand trends, meaning additions could ramp up quickly. In addition, heat pumps tend to be part of a wider manufacturing portfolio, and are therefore not as prominently announced as for other technologies, especially outside of Europe. The slowdown in manufacturing

[8] Q4 2023 has already seen two large announcements in the European Union, with Bosch investing more than a USD 100 million in a heat pump factory in Portugal by 2026, and Groupe Atlantic announcing plans for an investment of more than EUR 150 million in France, as well as developments in the United States, where the Department of Energy awarded USD 169 million for 9 projects to expand manufacturing capacity for heat pumps, including compressors and low-carbon refrigerants.

– and the gap to deployment levels consistent with the NZE Scenario – may therefore be less pronounced than it appears.

Figure 6 Current and projected throughput for heat pump manufacturing capacity and deployment in the Announced Pledges Scenario



Note: APS = Announced Pledges Scenario. 2022 production values reflect estimates of actual utilisation rates. A utilisation rate of 85% is used for both existing and announced manufacturing capacity in 2030.
Source: IEA analysis based on data from UN Comtrade.

In the United States, even though shipments of heat pumps were down by around 10% by mid-2023 relative to the same period the previous year, they are still performing better than their fossil fuel counterparts, such as natural gas furnace sales, which were down by around a quarter. The forthcoming introduction of the rebates for heat pumps as part of the Inflation Reduction Act (IRA) may be contributing to the current slowdown, as consumers wait for the scheme to be introduced before making a purchase.

The European heat pump market has more than doubled in size since 2019, growing at record-high levels of over 35% per year during 2021 and 2022. However, early 2023 market data indicates a slowdown, with some major markets such as Italy, Finland and Poland witnessing double digit drops in installation rates. Considering existing manufacturing expansion plans in Europe, this trend could drive the market into a state of overcapacity in the short term.

In Germany, a new heating law was passed in September 2023 setting out the technology pathways and support mechanisms for the years to come. However, many homeowners have postponed investment decisions as the increased financial incentives will only become available in 2024, while other uncertainties remain. A shortage of skilled installers continues to be a major bottleneck. In Italy, the downgrading of the Superbonus 110 tax credit scheme for homeowners in Italy (from a credit of 110% to 90%) and uncertainty about tax credit transfers also seem to be behind the slowdown in heat pump sales.

In the United Kingdom, the Boiler Upgrade Scheme was revised in October 2023, increasing the grants to cover part of the cost of replacing fossil fuel heating systems with an air source or ground source heat pump to GBP 7 500. However, the decision to relax the terms of a fossil fuel boiler phase-out has been criticised by manufacturers for damaging confidence in heat pumps and increasing uncertainty for investors and consumers.

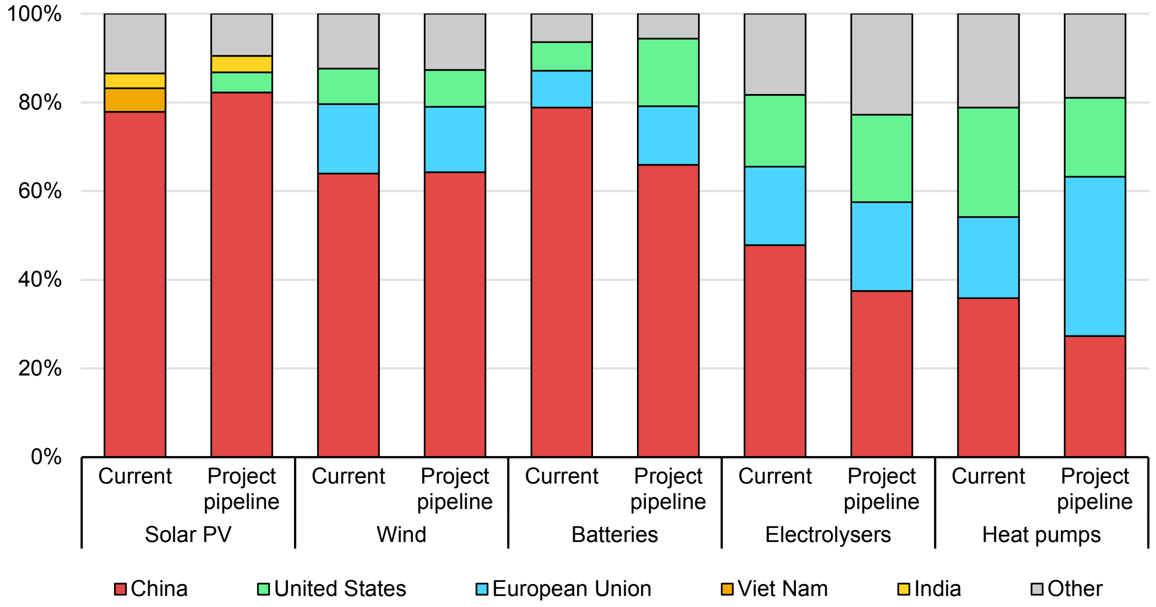
Elsewhere, in Japan, heat pump water heater sales – the fastest growing market segment in the past few years – were almost 10% down by September 2023 compared to the same period in 2022, a trend which seems principally driven by an increase in material cost which has driven up equipment cost. This segment had previously experienced seven consecutive years of positive market growth (8% year-on-year on average).

Regional concentration

On the basis of announced projects, four countries and the European Union will continue to account for around 80-90% of manufacturing capacity for all of the five technologies considered in this Special Briefing. However, the shares of each country or region for different technologies undergo a small shift.

China is expected to continue to account for the majority of manufacturing capacity for wind, batteries, and – especially – solar PV. If all announced projects go ahead, the manufacturing base for heat pumps and electrolysers will become slightly broader, with no country or region accounting for more than 50% of capacity.

Figure 7 Geographical concentration of current and announced manufacturing capacity



Notes: Wind refers to onshore wind nacelles in this analysis. For electrolysers, the analysis only includes projects for which location data was available. Shares are based on manufacturing capacity. 'Current' refers to installed capacity data for 2022. "Project pipeline" refers to the sum of current installed capacity and all announced manufacturing capacity additions (as of end-Q3 2023) through to 2030. "Other" refers to the aggregate of all capacity outside of the top three countries/regions for each technology and timeframe.

Source: IEA analysis based on data from InfoLink, BNEF, WoodMac, BMI and UN Comtrade.

Already strong concentration in solar PV manufacturing could grow further to 2030

Solar PV manufacturing is the most regionally concentrated of all the key technologies we focus on in this Special Briefing, with just under 80% of capacity located in China, which enjoys relatively low production costs across the supply chain. On the basis of announced projects, this share for modules manufacturing is expected to grow to slightly over 80%, whereas for wafers and polysilicon China's share will be close to 95%.

The share of global solar PV manufacturing located in the United States is set to grow to 5% if all announced projects go ahead, with the addition of over 65 GW, of which one-fifth can be considered committed – compared to around 8.5 GW of existing capacity in the country. While efforts to incentivise domestic manufacturing for solar PV through the US IRA have not resulted in a similar increase in share of global capacity to that seen for battery manufacturing, these additions represent a significant step-up. The United States is expected to become the second-largest manufacturer of solar PV, with 75 GW of capacity, followed by India with 60 GW, far overtaking Viet Nam as the current second-largest producer.

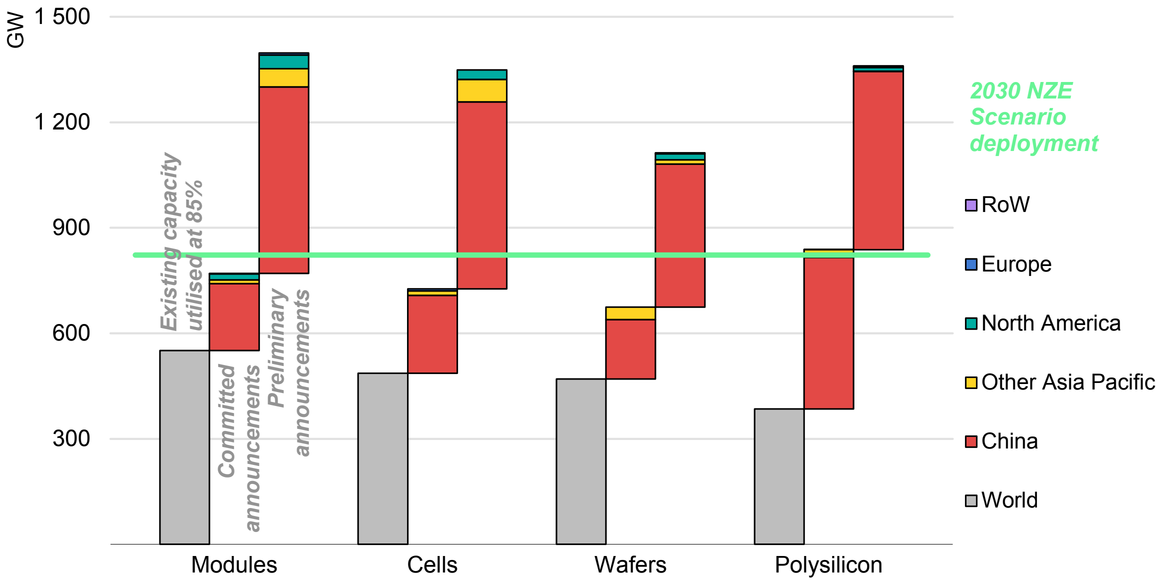
While Viet Nam is still expected to see some increase in its current manufacturing capacity, the growth seen in recent years has started to decelerate as the solar PV manufacturing industry has been hit by infrastructure gaps and curtailments in the past year, as well as a cap on Feed-in-Tariffs for solar power that were in place between 2017 and 2021. Reduced demand from a key export market – the United States – is likely to be an even more significant factor. The efforts underway to boost domestic supply chains for solar PV and other clean technologies in the United States embodied in the Inflation Reduction Act are soon going to be accompanied by anti-circumvention measures with respect to Chinese companies with assembly operations in Viet Nam and other countries in Southeast Asia.

In India, efforts to promote the development of domestic PV supply chains appear to be bearing fruit, with 60 GW of announced capacity expansions for modules, compared to current levels of 22 GW. Apart from the increase in module capacity, significant presence is also anticipated for the upstream components of solar PV where the capacity was previously less than 6 GW for PV cells and non-existent for wafers and polysilicon manufacturing.

Concentration in solar PV component manufacturing also increases

The full supply chain for solar PV modules is characterised by a strong degree of concentration. The components of a solar PV module are related to each other in series: for crystalline silicon modules (which currently represent 98% of the market), polysilicon is an input (or precursor) for wafers, which make up the cells, which are then assembled into a solar PV module. A solar PV manufacturing facility rarely comprises all of these steps, but each is necessary for the final module. Projected throughput from announced manufacturing capacity, together with that from existing installations, comfortably exceeds the global deployment needs for 2030 in the NZE Scenario at each step in the supply chain.

Figure 8 Projected throughput from existing and announced solar PV component manufacturing capacity and Net Zero Emissions by 2050 Scenario deployment in 2030

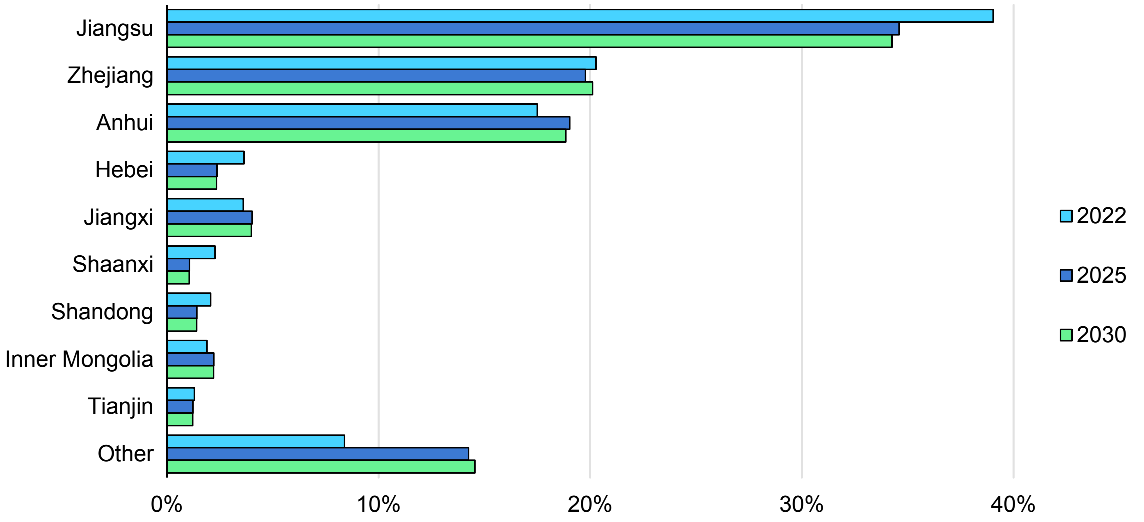


Note: NZE = Net Zero Emissions by 2050 Scenario; RoW = Rest of World.
Source: IEA analysis based on data from InfoLink.

At the end of 2022, China accounted for between 79% and 96% of installed capacity for all of these components, and this level of concentration looks set to increase on the basis of announced projects. If all projects come to fruition, China's share of module manufacturing is expected to grow, albeit marginally, from 79% to 82%. For wafers, the current share of Chinese manufacturing is 96%, with no significant change expected, and for polysilicon the share of manufacturing located in China – already at 85% – is expected to become even larger, as more and more companies expand vertically upstream. Just one decade ago, a significant share of global manufacturing capacity for polysilicon was located in Europe and North America, but by 2022 this had dwindled to 10% for the two regions combined.

On a subnational level, 80% of module production based in China (i.e. two-thirds of global production) is based in just three provinces – Jiangsu (with 40% of production), Anhui, and Zhejiang (each with approximately 20%), all in the densely populated East. The picture is different for upstream PV components, with more than 50% of manufacturing capacity for polysilicon found in the inland provinces of Xinjiang and Inner Mongolia, driven by low energy costs, whereas for wafer manufacturing, Inner Mongolia alone accounts for almost 40% of the capacity. In addition to PV module exports to Europe and to countries other than the United States, Chinese manufacturers also export solar PV components to other countries in South-East Asia – where about 10% of their total capacity for manufacturing modules and cells are located – that are not subject to the same export restrictions in global markets.

Figure 9 Distribution of existing and announced solar PV manufacturing capacity by province in China



Note: "Other" includes all Chinese provinces that currently have a capacity less than 1% of the total.
Source: IEA analysis based on data from InfoLink.

Battery manufacturing capacity set to spread, while component manufacturing becomes more concentrated

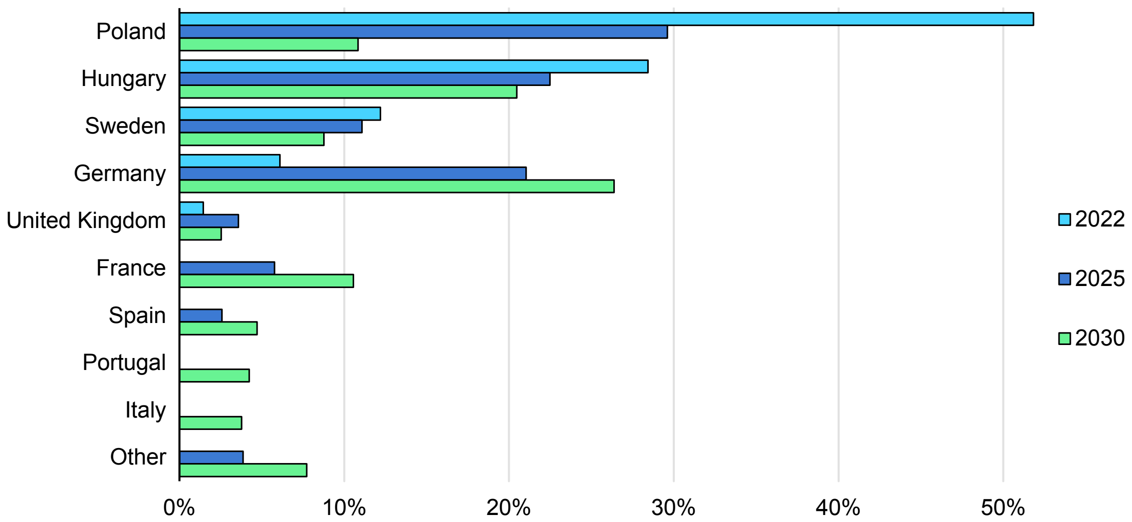
Battery manufacturing today is strongly concentrated in China, where almost 80% of production capacity is located. Yet if all announced projects are realised, this share is set to fall to 66% in 2030, mainly thanks to significant investment in the other two key battery markets: Europe and the United States.

There is significant variation in the share of announced capacity expansions in each of the major markets that can be considered committed. In Europe, 40% of announced plant capacity either constitutes an expansion of an existing facility or a new facility that is under construction – the remaining 60% of the announced capacity is considered preliminary. In the United States, the share of preliminary announcements is lower, at 40%, indicating greater likelihood that a higher share of the announcements will materialise. In China, the preliminary share is estimated to be around 60%, albeit of a much larger quantity of capacity in absolute terms.

The United States is currently home to around 6% of global battery manufacturing capacity (accounting for around 100 GWh), but this share is set to jump to 15% in 2030 (1 150 GWh) on the basis of announced projects. This has increased from 700 GWh (representing 13% of 2030 global manufacturing capacity at the time) prior to the announcement of the US IRA. The relatively small increase in the United States' 2030 share, even following the introduction of the IRA, gives a good indication of the scale at which battery manufacturing is expanding worldwide.

Within Europe, battery manufacturing capacity is currently concentrated in Poland – where the LG Energy Solution plant accounts for half of all EU capacity – followed by Hungary, where Samsung SDI and SKI are already operating gigafactories and CATL is scaling up. If all announced projects are realised, Germany will become the leading EU battery manufacturer by 2030.

Figure 10 Distribution of existing and announced battery manufacturing capacity by country in Europe

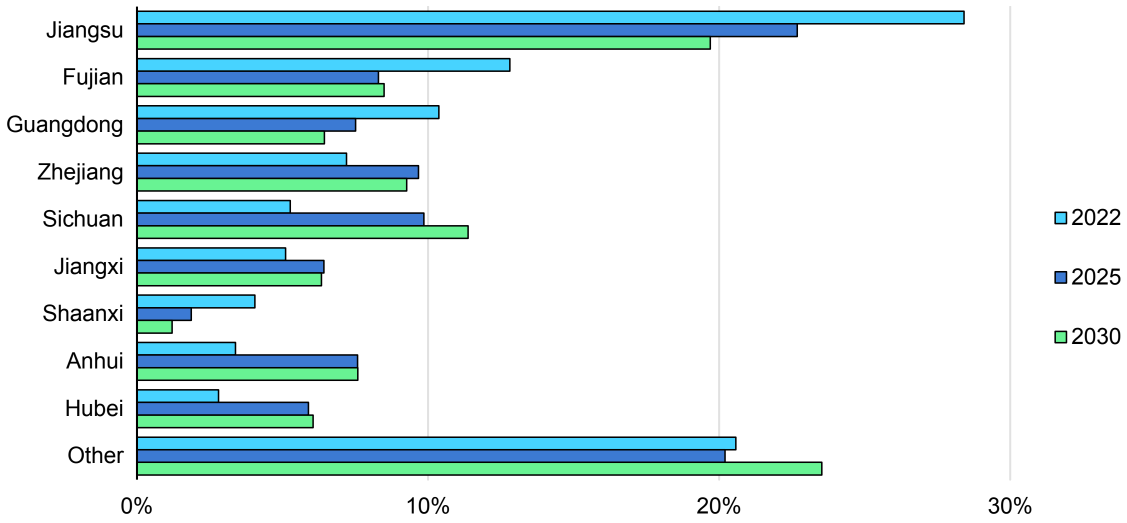


Note: "Other" includes all European countries with announced capacity additions to 2030.
Source: IEA analysis based on data from BMI.

Today, battery manufacturing in Europe and North America is dominated by manufacturers headquartered in Asia, and will remain dependent on East Asian companies in the coming years. Manufacturers headquartered in China, Korea or Japan are projected to own over 60% of manufacturing capacity in both Europe and the United States by 2030 based on current announcements.

Within China, battery manufacturing capacity is today largely concentrated in the coastal provinces of Jiangsu – which in 2022 accounted for around 22% of global battery manufacturing capacity and in 2023 introduced new measures to support clean technology exports – Fujian, and Guangdong, but further development in other regions is expected through 2030.

Figure 11 Distribution of existing and announced battery manufacturing capacity by province in China



Note: "Other" includes all Chinese provinces with announced capacity additions to 2030.
Source: IEA analysis based on data from BMI.

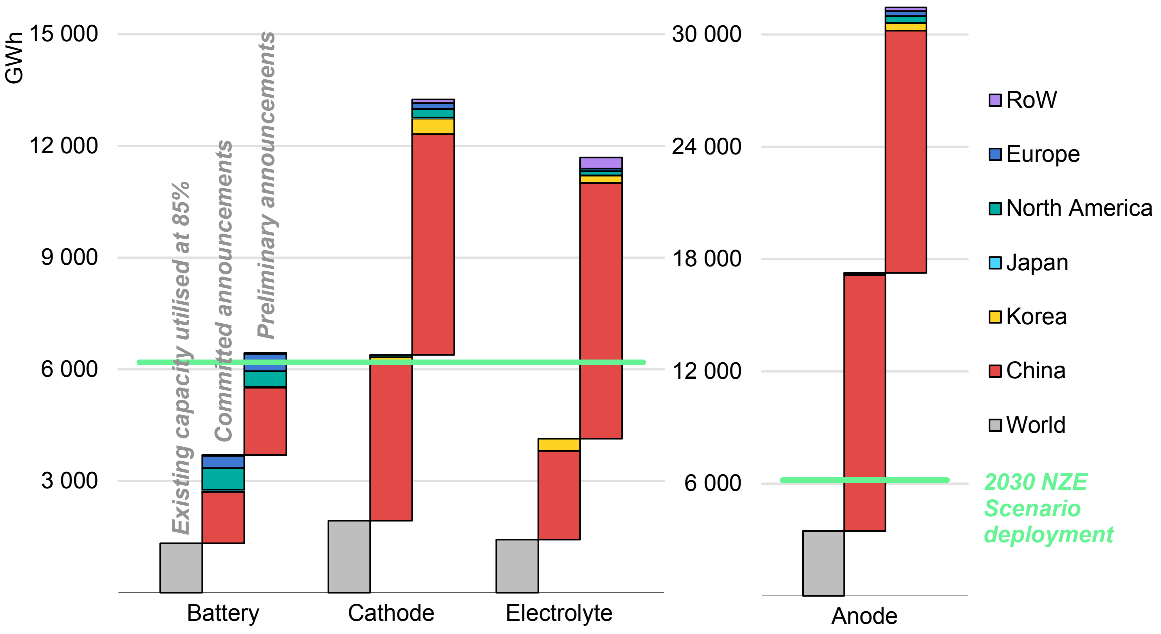
Manufacturing of key battery components is becoming increasingly concentrated

Lithium-ion batteries are composed of a series of cells, each one made up of three essential components: the cathode, anode and the electrolyte, which together allow the batteries to be charged and discharged. Manufacturing cell, cathode, anode and electrolyte materials requires different expertise and machinery, calling for dedicated facilities within the same company, joint ventures, or outsourcing to specialised manufacturers.

Battery component manufacturing is strongly concentrated in China, which currently accounts for more than 85% of capacity. Whereas the outlook for cell manufacturing suggests the manufacturing base will broaden, the pipeline for component manufacturing shows that existing concentration in China is set to remain, even as production steps up elsewhere. China's share of manufacturing capacity for cathode, anode and electrolyte in 2030 is expected to be equal to or greater than 90%. If all announced plants are built in full and on time, and even when accounting for all announced battery manufacturing plants (Box 4), cathode and electrolyte manufacturing capacity will be larger than battery manufacturing capacity by 70% and 50%, respectively. Anode manufacturing capacity will be four times larger than battery manufacturing capacity. While part of the graphite production could be used for applications other than batteries, most of the planned manufacturing expansions aim to serve the battery market, leading to the risk of significant unutilised capacity.

This level of surplus capacity, almost entirely located in China, raises questions about the financial prospects of some of these plants, and could pose serious challenges to new actors seeking to enter these markets. In other key regions (Europe, North America, Japan and Korea), if all announcements are completed in full and on time, cumulative cathode and anode manufacturing capacity will represent more than half of battery manufacturing capacity. This share would decrease to less than 40% in the case of electrolyte. Among those regions, Korea is set to have a significant role and export capabilities to serve part of the other key markets outside China for all battery components.

Figure 12 Projected throughput from existing and announced battery component manufacting capacity and Net Zero Emissions by 2050 Scenario deployment in 2030



Notes: RoW = Rest of World. A utilisation factor of 85% is assumed for all years and regions. Calculations for cathode, anode and electrolyte capacity assume a cathode and anode energy density of around 600 and 1 500 Wh/kg, respectively, and 1 g of electrolyte (solvent + salt) per ampere hour (Ah) and a nominal cell voltage of 3.5 V. For battery and battery components manufacturing specifically, 'committed' refers to projects that are currently under construction or expansion of current plants, with all other announcements being categorised as 'preliminary'.

Sources: IEA analysis based on data from BMI and BNEF.

Building resilience across the full supply chain for batteries will require close attention to levels of concentration in the manufacturing of key components. One recent example expected to boost cathode production in Europe is the July 2023 announcement of a EUR 1.7 billion investment in a plant in Poland by IONWAY, a new joint venture between Umicore and Volkswagen. Nonetheless, action is needed to avoid a scenario in which the foundation of the entire battery industry, i.e. the production of cathodes, anodes and electrolyte, could reach levels of concentration on a par with solar PV manufacturing.

Manufacturing capacity base for electrolysers is likely to broaden, though uncertainty remains

Today, China is home to the largest share of global electrolyser manufacturing capacity, with around half of existing capacity. Europe is in second place, closely followed by the United States. If all announced projects reach completion, together with those already operating today, China's share is likely to fall to just under one-third of global capacity (31%), with Europe accounting for 21% and the United States for 16%.

However, 18% of announced projects have no specified location, meaning that the global distribution could shift significantly to 2030 depending on where project announcements are pursued through to operation. If only announcements that are committed are considered alongside projects already operating today, China's share of manufacturing capacity could reach 47% by 2030, Europe's 33% and the United States' 15%.

China will maintain a large share of global manufacturing capacity in all potential outlooks, but this does not necessarily mean that Chinese electrolysers will find a big export market, as product standards differ. The Chinese market for electrolysers is also growing simultaneously, so it is likely that electrolyser manufacturers will find markets domestically, at least initially. There may also be opportunities for joint ventures between Chinese manufacturers and manufacturers in other regions in order to enter different markets.

The European Union gains a greater share of heat pump manufacturing

Heat pump manufacturing is currently less geographically concentrated than that of the other technologies considered here. Announced additions to manufacturing capacity suggest that the balance will shift in the coming years towards a greater share for EU manufacturers, accompanied by a slight decrease in the shares accounted for by China and the United States. No notable changes are expected outside of these regions.

In spite of the broader geographical spread of heat pump manufacturers, more than 90% of compressors, a key component, are currently imported from the Asian market.

Little change to the manufacturing base for wind, which typically serves nearby markets

Wind equipment manufacturing plants tend to be located close to demand centres, given the challenges of producing and transporting the sizeable components involved. A large share of demand is therefore met by domestic production.

The majority of global manufacturing capacity for key wind energy components – blades, nacelles and towers – is currently located in China, followed by the European Union. For the more easily traded components – nacelles and blades – China accounts for 64% and 69% of capacity, respectively, whereas the European Union accounts for 16% and 18%.

There has been a small increase in offshore component manufacturing in China since the beginning of 2023, with new facilities coming online. Additional facilities for onshore component manufacturing also came online in the United States and China.

Across all wind energy components, there is a huge gap to the deployment levels consistent with the NZE Scenario.

Box 5 Broadening the base of clean technology manufacturing

Given the need to massively scale up clean technology manufacturing in line with net zero goals, the significant degree of concentration seen in clean technology manufacturing is increasingly becoming a topic of concern for business and policy.

Reliance on any single country, manufacturer or trade route can leave supply chains vulnerable. In contrast, supply chains characterised by greater diversity are more resilient to potential disruptions or unforeseen changes. Broadening the base of clean technology manufacturing has therefore become a key objective of policies to accelerate manufacturing and shore up energy security, such as the US IRA or EU NZIA.

This goal is relevant to all aspects of the clean technology supply chain – from raw materials and mining, to processing and production of components, as well as to the equipment required for manufacturing. Diversifying clean technology manufacturing will be the focus for an IEA Energy Technology Perspectives Special Report to be published in 2024 following a request from G7 Leaders following their 2023 Summit in Hiroshima, Japan.

For manufacturers, the main driver of expanding into a new location or scaling up existing production tends to be the potential for growth. Other factors such as access to a skilled workforce, existing infrastructure, energy prices, CAPEX requirements, proximity to suppliers, economic and political stability and ease of installation also come into play, as do any incentives available. The weight of different push or pull factors of this kind in informing expansion decisions depends on the specific technology concerned, as well as the region, sector and application.

Policies designed to boost clean technology manufacturing and broaden the manufacturing base can make use of a portfolio of options. This includes direct incentives such as subsidies, as well as measures designed to encourage consumer demand and create an enabling environment for manufacturing, such as legal and regulatory frameworks. Public funding can help to de-risk projects and incentivise greater investments from the private sector, particularly for projects with substantial CAPEX needs. The cost of capital can also be an issue for expanding manufacturing, particularly in the context of inflation. These concerns are especially relevant for emerging markets and developing economies (EMDEs), where additional risks have a greater impact on investment. International collaboration will be needed to ensure that EMDEs can move up the value chain within clean technology manufacturing.

Importantly, in order to be efficient, any policy measures need to provide clear signals on the desired direction of travel: uncertainty and backtracking on policy measures can lead to hesitation among potential consumers of clean technologies, with knock-on effects for manufacturers. Regulations relating to clean energy technology manufacturing also need to be coherent, a task that can be especially complex where very large projects are concerned, or when there are trade-offs between different objectives.

The importance of trade as a driver of market growth (and thus manufacturing expansion) should also not be forgotten. Many recent trade agreements relating to clean technologies have been bilateral and have relied on traditional partnerships rather than opening up new possibilities. International trade could help create new markets and boost manufacturing, creating opportunities for a wider group of countries to benefit from the emerging clean energy economy. However, it must be pursued in a fair, rules-based manner. Trade in clean technologies also raises questions about common principles for identifying the environmental and social attributes of different products, and the need for standards and traceability to ensure a level playing field between manufacturers.

Given the urgency of addressing climate change, policies to broaden the manufacturing base will need to be pragmatic, and encompass learning-by-doing and close engagement with industry as the manufacturing base develops.

Note: See IEA (2023), IEA workshop focuses on priorities for diversifying clean technology manufacturing.

Part III: Recent policy developments

The past few years have witnessed the introduction of several major policy initiatives intended to incentivise domestic manufacturing of key clean energy technologies, boost demand and broaden the base of the supply chain. The global energy crisis has only served to intensify the urgency of these aims. As these policy initiatives move from announcements to implementation, attention is shifting to how the finer details will affect manufacturers.

United States

For some technologies, the past six months have been marked by the release of additional guidance on key provisions in the Inflation Reduction Act, and for others, by the anticipation that such guidance will soon be released.

While efforts to scale up domestic manufacturing for EV batteries have resulted in significant investments, there remain open questions about potential trading partners, and “Foreign Entities of Concern” (FEOC). Depending on how FEOC is interpreted, use of batteries and components from some foreign countries could leave manufacturers ineligible for IRA tax incentives. Joint ventures and investments by foreign companies in US manufacturing could also be at risk.

A final determination of circumvention inquiries of solar PV cells and modules from China was announced by the US Department of Commerce in August 2023. The department concluded that some Chinese manufacturers are carrying out minor processing operations in countries in Southeast Asia – Cambodia, Malaysia, Thailand, and/or Vietnam – in an attempt to avoid paying antidumping and countervailing duties that would be levied if the solar PV modules were exported directly from China. These duties will begin to be collected in June 2024.

With regards to electrolyser manufacturing, there is still uncertainty around the implementation of the Production Tax Credit (PTC), which is delaying investment decisions in low-emissions hydrogen production projects and, therefore, in electrolysers. Further details are expected in the coming months.

In contrast, the Home Energy Rebates Programs Guidance issued in late July 2023 put an end to uncertainty about potential subsidies for heat pump installation. Subsidies of up to USD 8 000 will be available to consumers in late 2023 or early

2024, suggesting that the slowdown observed in heat pump demand so far this year could be reversed once rebates are available.

European Union

The Net-Zero Industry Act is now moving towards implementation following endorsement by the European Parliament's Committee on Industry, Research and Energy in October 2023.

Earlier this year, in March 2023, the European Commission adopted today a new Temporary Crisis and Transition Framework that permits state aid for investments into key clean energy technology manufacturing sectors, including batteries, solar panels, wind turbines, heat pumps and electrolysers, as well as for the production and recovery of related critical raw materials for these technologies, until the end of 2025.

National schemes within EU member states are also ramping up to support manufacturing of key technologies. At the end of June, the Dutch Government announced a EUR 312 million subsidy and a EUR 100 million loan for the SolarNL project, a collaboration between industry and research institutes which aims to develop large-scale production of solar cells and panels in the Netherlands. The programme represents a total investment of EUR 898 million, of which EUR 586 million is financed by industry.

In June 2023 the Dutch government also launched a consultation on a potential subsidy for manufacturers in the hydrogen supply chain, including for electrolysers, with a total budget of EUR 838 million. In October 2023, the European Commission approved a EUR 100 million scheme in Italy for grants for electrolyser manufacturing.

Box 6 Manufacturers of electrolysers and other technologies sound the alarm over proposed ban on fluoropolymers in Europe

Manufacturers representing several key clean energy technology sectors, notably hydrogen, wind and batteries, have recently raised concern over proposed restrictions on per- and polyfluoroalkyl substances (PFAS) presented to the European Chemical Agency (ECHA). Fluoropolymers (a type of PFAS) are used in the manufacturing of electrolysers and fuel cells, as well as in components for numerous other technologies and manufacturing machinery. For some of these technologies, there is currently no alternative to fluoropolymers, meaning that a full ban could put a halt to manufacturing activities in the region. Manufacturers have therefore proposed the introduction of exemptions for those products in which PFAS cannot be replaced. ECHA's scientific committees are now evaluating the proposed restriction, following a consultation.

Battery manufacturers may be affected by an ongoing anti-subsidy investigation launched by the European Commission in October 2023 into EV imports from China. The investigation aims to determine whether EV manufacturers in China benefit from illegal subsidisation, and to assess the effects for EU manufacturers. Based on the findings, the European Union will decide whether to impose tariffs above the standard 10% EU rate for cars.

In France, starting from October 2023, EV purchase subsidies available to consumers will be linked to vehicle life cycle analysis rather than emissions from use. Other countries around the world, including Canada, are said to be considering similar approaches. Such policies will favour vehicles manufactured in jurisdictions with access to clean energy, particularly low-emissions electricity, to power their facilities.

Looking forward, the adoption of the revised Renewable Energy Directive (RED) will make permanent measures adopted in the emergency regulation in December 2022 to simplify and shorten permitting procedures for renewables. This directive will shorten permitting times for wind energy installations (to one year for onshore projects and two years for offshore, with an extension of up to six months) and limit the grounds of legal objections to new installations. This is expected to provide greater certainty to manufacturers and to overcome delays that can affect manufacturing (see Box 4).

Moreover, the European Wind Power Action Plan was proposed in October to support European competitiveness in the wind industry. The plan tackles faster permitting for renewable energy projects by focusing on digitalisation and encouraging government pledges on wind and long-term planning. A key pillar of the plan is improved auction design, as well as improved access to finance, monitoring unfair trade practices and skill development. The European Commission will also set up a digital platform to publish the auction plans of member states and provide greater visibility on the project pipeline.

Other economies

In October 2023, the Ministry of Commerce and General Administration of Customs in China announced that certain graphite products – including those using battery-grade graphite – would require export permits from 1 December 2023, in order to protect national security. Depending how this policy is implemented, it may have a limited impact on battery anodes manufacturers, most of whom already have the required export licences, but it could potentially threaten global supplies.

In India, following the approval in March 2023 of incentives for solar PV module manufacturing under Tranche II of the Production Linked Incentives (PLI) scheme, concerns have been raised about the likelihood of manufacturers being able to compete across all key components quickly, and meet efficiency targets. And following the introduction of the Advanced Chemistry Cell PLI scheme in 2021, in July 2023 the government launched a new consultation to re-open bids for 20 GWh of unutilised capacity. More recently, in October 2023 the Minister of Power, New & Renewable Energy announced that the government will bring out another PLI scheme for batteries.

In June 2023 India announced the implementation of tenders to support 15 GW of electrolysis manufacturing capacity in the country, with a first call (for 1.5 GW) launched in June 2023. The deadline for submissions has been extended until the end of October.

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