Magazine of EU-China Energy Cooperation Platform

EU-China Energy Magazine

2023 March Issue

About ECECP

EU-China Energy Cooperation Platform was launched on 15 May 2019, to support the implementation of activities announced in the 'Joint Statement on the Implementation of EU-China Energy Cooperation'.

The Joint Statement was signed during the 8th EU-China Energy Dialogue that was held in Brussels on 9th April between Commissioner for Climate Action and Energy Miguel Arias Cañete and the Administrator of the National Energy Administration of China Mr ZHANG Jianhua, back-to-back with the 21st EU-China Leaders' Summit on 9 April 2019 and was witnessed by Jean-Claude Juncker, President of the European Commission; Donald Tusk, President of the Council of Europe and Dr Li Keqiang, Premier of China.

The start of the implementation of the EU-China Energy Cooperation Platform (ECECP) was included in the EU-China Leaders Summit Joint Communique.

The overall objective of ECECP is to

'enhance EU-China cooperation on energy. In line with the EU's Energy Union, the Clean Energy for All European initiative, the Paris Agreement on Climate Change and the EU's Global Strategy, this enhanced cooperation will help increase mutual trust and understanding between EU and China and contribute to a global transition towards clean energy on the basis of a common vision of a sustainable, reliable and secure energy system.'

Phase II of ECECP is implemented by a consortium led by ICF, and National Development and Reform Commission - Energy Research Institute.

EU-China Energy Magazine

2023

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Dear All,

Welcome to March 2023 issue of the EU China Energy Magazine!

As the spring flowers come into bloom, it is a relief to see that the EU has managed to survive the winter in this energy crisis so well. Gas storage levels are above those of 2020, and the EU can breathe a sigh of relief for a short time. However, the turbulence on the energy market will be with us for some years to come. And it remains the case that, in addition to energy security and affordability, the aspect of sustainability is a key factor. This is reflected in the articles in this issue.

First, we delve into the future of long-term contracts in electricity market design, exploring how contractual arrangements are evolving to encourage investment and innovation in renewable energy. We then turn our attention to Germany, examining the country's shift away from coal and towards renewables, and sharing 11 key lessons from this ongoing transition.

Next, we explore how the combined influence of evolving consumer preferences, private sector investment readiness, and a supportive policy framework can create a tipping point to expedite building decarbonisation. This is followed by an in-depth analysis of the growing popularity of heat pumps in Europe, as consumers seek low-carbon alternatives to traditional heating systems in response to the continent's energy crisis.

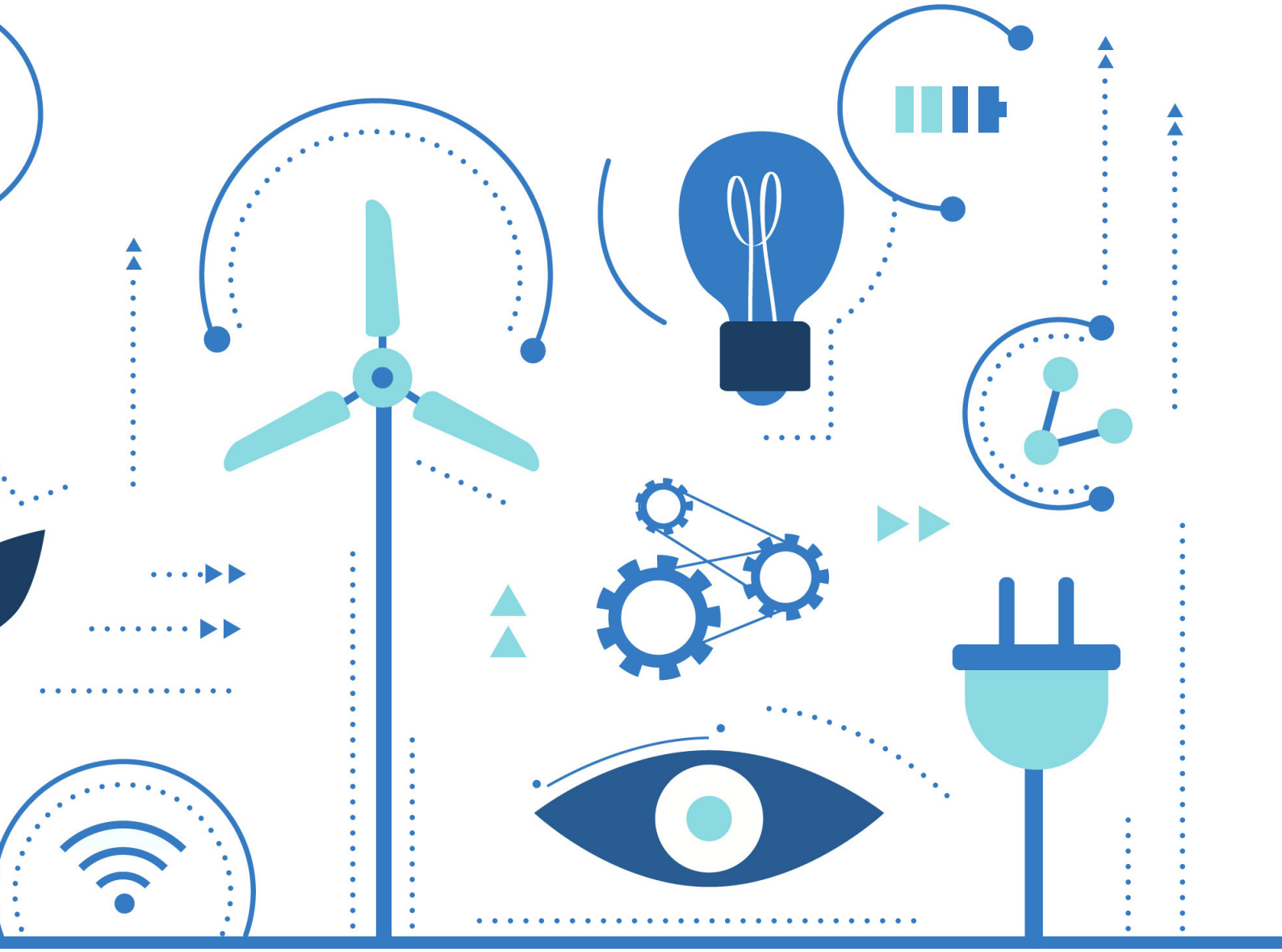
Finally, we look at sustainable aviation fuels in China, exploring the policy support needed to drive their adoption for the decarbonisation of the transport sector.

We hope you find this issue both informative and thought-provoking, and we invite you to join the conversation on these crucial topics.

Once again, I would like to say a big thank you to our editors Daisy Chi and Helen Farrell for their hard work in delivering this issue of the magazine under extreme pressure.

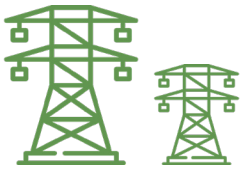
Flora Kan
ECECP Team Leader

Electricity market design:
What future for long-term contracts?



The European Commission recently closed its public consultation on the reform of the EU's electricity market design and is expected to table a proposal on March 16. In the version of the proposal that leaked this week, the Commission is taking measures to improve the PPA (Power Purchasing Agreement) and forward markets. Member States can make use of 'hybrid' market design to support new RES investments, but the Commission puts some requirement in place to protect the functioning of the spot market and preventing crowding-out of PPA markets: Support contracts need to be equivalent to two-way CfDs, which are more financial and keep short-term incentives intact, and governments should prioritise allocating CfDs to investors that have PPA contracts in place. The proposal leaves many design details unanswered and might not go far enough for some stakeholders who favour managed CfDs for all generation assets.

The fact that the European Commission did not originally consult on a well-defined set of measures for long-term contracts but instead considered a wide range of options, reflects the fact that there are major differences of opinion between member states. This is no surprise, as there already exists large national differences in the implementation of short-term markets, the role of capacity markets, the support schemes of RES, and regulation of the retail tariffs. Some fundamentals must be kept in mind when considering such schemes and as the final version of the Commision's proposal will soon be published and discussed at the Council and the European Parliament.



Improving the market for long-term contracts

We expect the use of long-term contracts by private parties will increase in the long run net zero scenario. Price volatility is expected to increase, government price guarantees for RES such as feed-in tariffs, will phase out, and the prudential regulation of the retailers will become stricter (CERRE, 2022, p.28).

We also expect innovation in energy contracts. Long-term contracts will need to go beyond standard forward contracts on the day-ahead market. Specific contracts, such as Power Purchasing Agreements (PPAs) are needed to target actors with different risk profiles (retailers, intermittent RES producers, storage operators, aggregators, conventional generators). Balancing contracting positions might require multilateral contracting (CERRE[1], 2022, p.96). For instance, a wind farm, a retailer, and a storage operator together might have a lower risk exposure than any two players together.

The market for corporate PPA is likely to mature further, but integrated companies with portfolio investments will remain important as well. Those could be in the form of classical utilities, but also in special purpose vehicles such as energy communities or integrated offshore energy hubs. Those structures can prevent hold-up in closely intertwined investments.

1. *Pollitt, M., von der Fehr, N., Banet, C., Le Coq, C., Willems, B., Bennato, A.R. and Navia, D., Recommendations for a Future-Proof Electricity Market Design, Centre on Regulation in Europe (CERRE), 2022. https://cerre.eu/wp-content/uploads/2022/12/CERRE_MarketDesign_Final.pdf*

Government intervention in long-term markets

There are good arguments for government intervention in the contracting market such as: regulating the risk of retailers, standardising contracts to simplify netting of positions, improving transparency, contracting on behalf of consumers to prevent future intervention by the government, and providing natural counterparties for some contracts. The lastcategory should cover activities that are heavily affected by regulation, such as the availability of transmission capacity and long-term carbon policies with long-term transmission rights and options on the CO_2 ETS price. However, a key role remains with private parties.

The existing market has worked well in providing consumers with the option to lock-in prices three to sometimes five years in the future, but consumer demand for those contracts was often limited. While producers might like longer-term contracts to reduce their capital costs, economists disagree on whether and how we should regulate hedging beyond this period, especially given the lack of consumer demand for longer term hedging. Some economists argue for more government intervention in the long-term contracting market and structural market design changes, in what is called a hybrid market design (See CERRE, 2022, p.101).

We believe that the subsidiarity principle should apply with respect to the implementation of organised long-term markets for two reasons:
There is no consensus among economists or industry participants on whether we need a large market reform based on long-term contracts. Member states also have different social contracts regarding the role of governments in steering markets, and their consumers have different risk-appetites across.

There are benefits from using organised long-term markets as they will lower capital costs for investors and hedge consumers against large price changes.

Government intervention for long-term contracts may make more sense for base-load producers (e.g., nuclear, and renewable energy suppliers) as they have large investment costs, and are less likely to be price setters, and therefore have higher risk exposure if private contracts do not provide sufficient hedging. For gas-fired power plants, the electricity price follows their input cost as they are often marginal, and their price risk is therefore lower.

Flexible energy sources such as storage and demand side management might find it hard to find long-term hedging contracts in organised futures market, but it is not obvious that targeted government-mandated contracts will be useful here. Governments might find it hard to quantify the portfolio benefits of different flexibility technologies and bilateral private contracts are likely to be more innovative than standardised government contracts. Moreover, portfolio investors might build a mix of renewable energy and storage facilities and internalise risk offsets within a company (ibid., p.97).

Many countries in Europe already have a form of hybrid markets as they are using distinctive styles of support schemes for renewable energy and capacity markets, next to a more harmonised wholesale market. Harmonisation at EU-level might help improving the efficiency of those schemes for renewable energy, capacity markets and potentially long-term contracts and allow for international trade. So, there is no need for a revolutionary new design to improve the role of long-term contracts.

Drawbacks of government-backed contracts

However, there are also drawbacks of government-backed long-term contracts, which might have implications for the internal market, and for which the European Commission might impose some minimal requirements at the central level:

- The contracted capacity might not fully take part in the short-term markets: day-ahead, balancing, and ancillary service market. This could reduce production efficiency and reduce spot market liquidity.
- There might be too little competition for long-term contracts, with insufficient cross-border participation as long-term transmission contracts do not exist and contracts are not sufficiently standardised between Member States.
- Format might suit one technology more than another. So, we might obtain an inefficient combination of production technologies. This might be in particularly valid for demand response, storage, and other forms of flexibility.
- Government-regulated contracts might crowd-out private PPAs and portfolio investments because the government could offer better contracting conditions and does not price the risk of different assets correctly.
- Energy prices might be too low, if a government exercises its monopsony power as a single buyer and extracts resource scarcity rents by signing long-term contracts at below the expected market rates and passes the lower contract price on to consumers. This could be a form of state-aid (ibid., p.98).

Empirical evidence on long-term contracts highlights some of those pitfalls. Chattopadhyay & Suski, (2022[2]) indicate that legacy long-term PPA contracts slow down innovation, reduce spot market liquidity and are often less competitive with higher prices. In CAISO and MISO, regulated planning processes, utility programs, and state-directed procurements for preferred resource types several years in advance have crowded out short-term capacity markets. Capacity markets were therefore not successful in attracting merchant investments and large quantities of low-cost capacity supply (Pfeifenberger et al. 2017[3]). In the Ontario market, the operational decisions of some assets (renewable, hydroelectric, and nuclear) do not respond to market prices, because they are subject to fixed price contracts independent on production levels (Pfeifenberger et al. 2017). The Colombian contract model did not provide enough incentives for intermittent RES (Olaya et al., 2016[4]). However, there are also many examples where government-mandated targeted long-term contracts have accelerated investments. For instance, in the UK, the Low Carbon Contracts Company has contract about 30GW of new capacity under Contract for Differences (CfDs).

2. *Chattopadhyay, D. and Suski, A.K. (2022), Should Electricity Market Designs Be Improved to DriveDecarbonization?, Policy Research Working Paper Series 10207, The World Bank.*
3. *Pfeifenberger, J., Spees, K., Chang, J., Aydin, M. G., Graf, W., Cahill, P., Mashal, J., & Pedtke, J. I. (2017), The Future of Ontario's Electricity Market A Benefits Case Assessment of the Market Renewal Project. The Brattle Group.*
4. *Olaya, Y., Arango-Aramburo, S., & Larsen, E. R. (2016), 'How capacity mechanisms drive technology choice in power generation: The case of Colombia', Renewable and Sustainable Energy Reviews, 56:563–571. https://doi.org/10.1016/j.rser.2015.11.065*

How to minimise these drawbacks?

The European Union might try tolimit the downsides of those effects by providing some guidelines on contract design, but those often increase the risk for investors as well. Examples of such measures are as follows:

- Make the contracts technology neutral and standardised to increase the number of bidders. Contracts could focus on hedging long-term price exposure of consumers, and less on the hedging needs of producers.
- Use an auction to determine the contract price, as this will create more competitive pressure.
- Allow portfolios of technologies to participate in the market for government contracts. For instance, a RES producer combined with a storage operator can sell a forward contract and manage risk internally. This reduces the need for the auctioneer to rely on availability and portfolio risk factors in the auctioning process or will allow at least some arbitrage between technology choices. This will require, however, more financial monitoring on the risk exposure of portfolio bidders.
- Allow contracts to be traded on secondary markets, so firms can reallocate contracts. This will allow inefficient generation capacity to exit the market, and retailers can adjust their contracting positions if they gain or lose customers. Secondary markets are important for firms to mothball technology in a timely fashion. To enable secondary markets, contracts should not be strictly bound to a particular asset. For instance, if an inefficient asset is under a long-term contract with historical favourable contracting conditions, it might not be in the firm's best interest to mothball the asset, unless the contractual obligations can be transferred to other assets.
- Turn physical contracts into financial contracts, such a Contract for Differences, where contract deviations are settled financially. This keeps incentives for availability and participation in the spot market. It requires liquid short-term markets to function well.
- Fix the contracted quantity ex-ante. Contracts should be based on deemed capacity and not available capacity. Take-or-pay clauses that are sometimes used for thermal generators eliminate their incentive to participate in spot markets and reduce liquidity. This is also the case for renewable energy production. Hence, the risk for unavailability must be with the seller of the contract.
- If resource scarcity rents are extracted, this should happen in a transparent way, and state aid concerns need to be addressed, when rents are reallocated.
- Allow cross-border participation in the auctions for long-term contracts, as this will increase competition. This will require long-term contracts for transmission capacity (CERRE, 2022, p.99-100).

Conclusion

The energy crisis has stirred up a discussion on whether (long-run) risks and incentives are correctly allocated between investors, consumers, utilities, and the government; especially considering a future net zero energy system. The lack of long-term contracts has exposed consumers to price spikes and created windfall profits for inframarginal production. Do Member States need more tools to promote long-term contracts in a so-called hybrid system?

Many Member States already supplement the short-term market with additional mechanisms, for instance to support renewable energy and nuclear, and capacity renumeration schemes. State-aid rules have explicit provisions for those contracts. Hence, Europe already has hybrid markets.

The current discussion allows the Commission to ascertain whether those hybrid markets need to become more harmonised to improve competition and prevent a fragmentation of the European energy market, and whether state-aid rules should be adapted to allow governments to intervene more explicitly in risk allocation and to prevent distortions of short-term markets. The precise design principles of the CfDs support program will determine whether they are beneficial for the energy market.

The crisis also shows that we need to step up the regulation and monitoring of risk in the energy sector. This takes many forms: energy procurement by individual retailers, margin requirements for financial contracts, the use of physical and financial collaterals, netting of contracts, the allocation of congestion risks, monitoring the liquidity and pricing of futures markets, and assessing systemic risks.

Since its inception, the European internal power market has been evolving continuously, and it will continue to do so. We have established a well-functioning set of short-term markets, cherished by most stakeholders. This has resulted in a European-wide well-integrated internal market, which benefited security of supply and competitiveness. We do not need a revolutionary new European-wide market design, but an improved regulatory framework for hybrid markets which Member States can apply based on national preferences, and better monitoring and regulation of risk.

By Bert Willems

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*This article is an edited and commented excerpt from CERRE's report '**Recommendations for a Future-Proof Electricity Market Design**'. For more, check out the report here.*

Renewables or coal?
11 lessons on Germany's changing energy mix?

Last year marked a turning point for the EU's energy policies. The dependency on Russian fossil fuels—gas in particular—had severe consequences for its member states and resulted in an energy supply crisis across the entire EU. In response, the EU put forward measures focusing on the promotion of renewable energy and energy efficiency as well as the diversification of gas supply. Germany adopted the most comprehensive policy programme to promote the expansion of renewables and energy efficiency.

However, Germany has chosen coal as a short-term emergency alternative to replace gas and secure sufficient energy supply during the energy crisis. Its plans to phase out coal, however, remain unchanged. Overall, the gas crisis is likely to lead to an accelerated energy transition both in Germany and in the rest of the EU. Germanwatch and adelphi analysed Germany's changing energy mix and presented the 11 identified lessons in this policy brief.

Europe's structural response to the gas crisis has been to focus on renewable energy, energy efficiency, and diversification of gas supply.

The year 2022 marked a turning point for European energy policies as the negative impacts of the EU's dependency on Russian fossil fuels – especially gas – were heavily felt. Before, Russia supplied the EU with about 40 per cent of its fossil gas, imported predominantly via Nord Stream I as the main network of gas pipelines running to Germany under the Baltic Sea. That pipeline network is no longer functional, the Russian government has reduced the flow of gas to Europe, and the EU has set itself the objective to stop importing Russian gas. Since the beginning of the conflict, the EU has successfully cut around 10 per cent of fossil gas demand in response to the invasion and in order to reduce dependency on Russian fossil fuels, with an overall reduction of 15 per cent being planned by March 2023.

As a response to the energy crisis the European Commission proposed the RePowerEU Plan in May 2022 with its three main objectives of saving energy, accelerating the production of clean energy, and diversifying energy supplies.

- To save energy, the plan proposes an updated target for energy efficiency, raised from 9 per cent to 13 per cent by 2030, compared to the projections of the 2020 Reference Scenario. Moreover, the Commission proposed a target to reduce overall electricity demand by 10 per cent, as well as an obligation for Member States to reduce demand during peak price hours by and additional 5 percent.

- The plan foresees a rapid rollout for renewables, proposing to increase the 2030 target for renewables from 40 per cent to 45 per cent (from 1067 GW to 1236 GW), supported by a faster permitting process for renewable installations and the introduction of the EU Solar Energy Strategy, which intends to double installed solar capacity by 2025 from current levels. The strategy aims to bring more than 320 GW of solar PV online, newly installed by 2025, and almost 600 GW by 2030.

- Moreover, the EU has taken measures to diversify its gas supply and entered international cooperation with several countries to this end. Next to increasing supply, the EU has also introduced measures to reduce gas demand by adopting the European Gas Demand Reduction plan, including the switch from gas to alternative fuels, incentives for reducing gas consumption, and reducing heating and cooling, to support Member States in reducing their gas demand by 15 per cent.

Germany has supported EU measures on gas reduction and aims to cut its gas consumption by 20 per cent between 1 August 2022 and 31 March 2023. In Germany, the reaction to the energy crisis has also translated into an enhanced focus on diversifying gas supplies, with plans to build a number of fixed onshore LNG terminals and five floating storage and regasification units, as well as pursuing contracts with additional suppliers. Some parts of the federal German government want support for the exploration of new gas fields abroad, but a number of ministries are trying to prevent this step. The situation has also led to postponing the deadline for nuclear phase-out by three-and-a-half months, and a temporary uptick in coal consumption.

Germany has passed the largest package of measures to accelerate the energy transition to renewable energy, and is developing further laws to speed up this process.

In spring of 2022, Germany announced its 'Easter Package', which included the most amendments to energy policies that Germany has seen in decades. The five laws that were amended in July 2022 all target the rapid expansion of renewable energies, ranging from an increase in renewable capacity expansion, faster permitting processes and grid expansion for an improved integration of renewable energies. The update of the country's Renewable Energy Act (EEG), for example, included new targets for renewable energies. The share of wind, solar, and hydropower in electricity consumption is set to increase to at least 80 per cent by 2030. Due to the new level of priority allocated to renewable energies, the planning and permitting processes of installation projects will be accelerated. This is especially important to speed up the expansion of onshore wind energy, which had been negatively affected by bureaucratic delays in the past. Wind power provided the largest contribution to electricity generation in 2021 (2021: 114.6 bn kWh; 2020: 132.1 bn kWh), yet its installed capacity has been growing only slowly (2021: +1.632 MW; 2020: +1.227 MW). In comparison to the slow expansion of installed wind power capacity, installed solar power capacity was expanded continuously: From 2016 to 2021, total installed capacity grew by 46 per cent from 40.700 MW to 59.400 MW. 2022 saw yet another increase in the rolling out of solar power, as net solar PV additions are estimated to have risen by 26 per cent, increasing the cumulative installed capacity to over 65 GW.

In addition, targets for offshore wind have also increased significantly with the Offshore Wind Act and the Offshore Realisation Agreement:Offshore wind capacity will be expanded from the current 8 GW to 40 GW by 2035 and 70 GW by 2045 (previous target: 20 GW by 2030; 40 GW by 2040).

In 2022, the share of renewables in German power consumption reached a new high, as renewables accounted for almost 46.9 per cent, an increase of 4.9 percentage points from 2021.

While renewables are widely considered to have the highest priority in the debate about energy security, energy savings and efficiency have been somewhat less prominent but no less crucial. A study by E3G found that investments in building efficiency alone could help Germany to save more gas than would be imported via any of the planned LNG terminals, saving EUR 200bn of gas imports. Germany introduced clear measures tackling energy efficiency and savings on the demand-side by approving two energy conservation ordinances in August 2022. The ordinances include enhancing the energy efficiency in public, private, and corporate buildings, e.g. by optimising of heating systems, as well as energy savings in companies, for which companies with an annual energy consumption of 10 GWh or more are required to implement energy efficiency measures. Moreover, Germany is working on two ambitious energy efficiency laws. So far, concrete legal targets include a reduction of final energy consumption by 500 TWh by 2030. Starting in 2024, the federal government is required to reach final energy savings of 45 TWh per year, while the German states must save 5 TWh annually.

At the end of January, due to the described measures and relatively mild temperatures, gas storage facilities are still full, prices have come down, and the problem of a gas crunch seems unlikely for the current winter season. However, next winter may still be a challenge, as – contrary to the first part of 2022 – no gas from Russia will be imported, China might export less gas due to stronger domestic demand, and mild temperatures are not guaranteed.

The German Energy Transition

The German Energy Transition (Energiewende) aims at restructuring the German energy system towards renewable energy sources and away from the use of nuclear power by 2023, from coal ideally by 2030, and from oil and fossil gas by 2045. The transition began as early as 2000 with the introduction of the Renewable Energy Act (EEG). Since then, the EEG has been revised several times, including a move from set feed-in tariffs to auctions for renewables. Germany aims to cut all greenhouse gas (GHG) emissions by at least 65 per cent by 2030 compared to 1990 levels, by 88 per cent by 2040, and to achieve GHG neutrality by 2045. Until recently, gas was regarded as a 'transition' fuel in the context of the Energy Transition, whereas coal and nuclear were being phased out. Consequently, Germany has shifted away from coal and nuclear energy over the past decade and turned towards renewables - and gas (Myllyvirta 2022).

The German coal phase-out was legally adopted in July 2020 and has been complemented by an Act on Structural Change in Coal Mining Areas to support structural changes in coal-producing regions, as well as plans to boost the expansion of renewable energy, especially wind and solar. The first coal-fired power plants were shut down in 2020 (BMUV n.a.).

In the power sector, additional unforeseen events – especially a nuclear power crisis in France - have exacerbated an extraordinary supply crisis.

Along with the high energy prices as a result of Russia's invasion of Ukraine, several other factors aggravated the energy crisis. France experienced a power crisis due to the weak nuclear output during much of 2022. By November, a record number of 26 out of 56 reactors was shut down. Moreover, the effects of the exceptional summer drought throughout the EU, which hampered hydropower generation in the South, put additional stress on the EU's electricity systems.

In this emergency, coal will play a role as a short-term alternative to gas in the power sector.

A particularly effective measure to reduce the total amount of gas consumed lies in curbing its use in electricity generation. However, while investment in renewable energies has been ramped up in Germany and across all of the EU, renewable energy capacities are not yet sufficient to cover for the current supply shortages in gas. It is now widely seen as a mistake that previous governments slowed down the expansion of renewable energy. While Germany used to be a pioneer in solar and wind power, changes to the Renewable Energy Sources Act, which resulted in reduced feed-in tariffs and fewer financial incentives for the industry, as well as additional regulations led to a slowdown in the expansion of installed solar power. More recent obstacles were a lack of skilled technicians and backlogs in the supply chain. In the case of onshore wind, long permitting procedures, minimum distances, local protests, and ideological blockages in some German states like Bavaria have hampered the expansion of wind infrastructure. Another problem is the transmission infrastructure that has not been developed fast enough in the past because of opposition from local municipalities in expanding an electricity line connecting the northern and southern grids. A majority of wind energy generation takes place in northern Germany while southern Germany is responsible for an outsize share of the country's total electricity demand. Furthermore, Germany has had to export large amount of electricity to France in 2022, where a large number of nuclear power stations were unable to run consistently.

Because of these shortcomings, coal-fired power plants have been chosen to substitute for fossil gas in the short term and serve as an emergency alternative to gas in the power sector.

Short-term plans for coal include the extension of the lifetime of existing plants for a few months or years coupled with higher operating hours.

Not only Germany, but several other EU Member States, such as Austria, France, and the Netherlands, have decided to extend the operation time of their coal-fired power plants, reopened them, or raised caps on operating hours. In Germany, the parliament passed the Substitute Power Plant Standby Act (EKBG) in July, which intends to secure energy supply and flexibility for the energy market during the energy crisis. In line with the EKBG, coal-fired power plants will be upgraded in order for them to re-enter production for the energy market at any time but only as a back-up option. The same goes for power plants that initially were supposed to be shut down in either 2022 or 2023, as well as for plants that have - until now - only served as grid reserves, or security reserves, the latter of which are supposed to restart only in extreme emergencies. For hard coal-fired power plants, the temporary comeback will apply until the end of March 2024 at the latest. For lignite, it will end even earlier on 30 June 2023.

The uptick in coal consumption has led to higher emissions in 2022, but the structural challenges for Germany to meet its climate targets lie elsewhere, in the buildings and transport sector.

Calculations by Agora Energiewende show that the reduction in CO_2 emissions required for achieving the German climate targets did not materialise in 2022 as Germany's GHG emissions stagnated at around 761 million tons of CO_2, missing the target of 756 million tons of CO_2. Emission reductions in 2022 compared to the reference year 1990 were only 39 per cent and, thereby, for the second time, lagging behind the 2020 climate target of 40 per cent. Although energy consumption fell to the lowest level measured since the country's reunification in 1990, the increased use of coal and oil nullified the emission reductions that were achieved through energy savings and lowered gas consumption. However, the use of coal in the power generation process was not the problem behind the failure to meet the climate targets, as the emission targets of the power sector were met. Rather, the transport and building sectors failed to meet their targets as the necessary structural changes for deep emissions reductions in those sectors have been delayed for years.

At the EU level, a study by Ember found that the short-term uptick in coal use will not have negative impacts on EU climate ambitions in the long term. Even if all the coal-fired power plants that are now on reserve across the EU were to operate at 65 per cent of their capacity, emissions in 2023 would increase by 30 $MtCO_2$, equalling 1.3 per cent of the EU's total CO_2 emissions in 2021 and 4 per cent of its annual emissions in the power sector.

The German government remains committed to its goal to end the use of coal ideally by 2030.

According to the German government, the increased coal use is only seen as a last resort and short-term back up to secure energy supply. Germany will not add any new coal capacity, and the government remains committed to phasing out coal ideally by 2030 and by 2038 at the latest, as mandated by German law.

The legal date for the end of lignite-based power production in Western Germany was recently moved forward to 2030 from 2038. While it is unclear to what extent this will lead to reduced emissions overall, it provides additional certainty that the age of coal is ending.

That Germany remains set on its plans to end coal use and accelerate its energy transition can be seen in the case of Western Germany, where the legal date for the coal exit has been accelerated. In the federal state of North Rhine-Westphalia (NRW), the end date for lignite in the Rhenish mining area has been moved forward by eight years to 2030. Two power plants that were meant to be shut down by the end of 2022 will remain connected to the grid until 31 March 2024, and all other lignite-fired power plants of RWE32 will retire by 2030. The implementation of this understanding between the BMWK, the Ministry of Economic Affairs, Industry, Climate Action and Energy of the State of NRW and RWE was anchored in law by adapting the Coal-fired Power Generation Termination Act. The government estimates that 280 million tons of coal are to remain in the ground as a result, saving up to 280 million tons of CO_2 that could have been emitted with a later phase-out in 2038. However, in a scenario modelled by Aurora Energy Research, which is based on the assumption that generating electricity from lignite would be unprofitable after 2030 - mainly due to the gradual normalisation of gas prices and rising prices in European emissions trading - the early phase-out of coal in the Rhenish mining area in 2030 would not have any meaningful emission-reducing effect. While it remains thus unclear to what extent this arrangement will reduce overall emissions, it highlights that the age of coal is ending in Germany.

Coal use in response to the crisis: Lützerath

Part of the compromise to re-activate two lignite power plants but move the date for coal phase-out forward by RWE has been the decision to destroy the German hamlet Lützerath. In some circles, its fate has taken on a symbolic significance, purportedly indicating whether Germany will act in keeping with the Paris agreement and the 1.5° goal. The hamlet consists of only a few houses and many of its previous residents have long sold their property and moved elsewhere. The ground now belongs to the energy company RWE, and clearing and demolition work started in 2020. Climate activists did occupy the site for about two years until January 2022 to prevent Lützerath's destruction but without success.

An anticipated exit from hard coal and from lignite in Eastern Germany s still under discussion.

Discussions about aiming for an earlier lignite exit in Eastern Germany are ongoing, but are more complicated due to stronger objections from local politicians. In

January 2023, Germany's Federal Minister for Economic Affairs and Climate Action, Robert Habeck, called on states in the east of the country to follow the agreement between NRW and RWE and move their respective coal exit to 2030 as well, warning that after 2030 coal-fired power generation in Germany will no longer be economically viable.

While a timely exit from lignite is the bigger challenge, Germany also has remaining hard coal-fired power plants that fully run on imported coal. They will be phased out through a combination of two approaches: Until June 2023, power plant operators can participate in several rounds of auctions to receive a payment from the state to close down their plants by 2026 at the latest. For the remaining plants, a phase out schedule will be set by the regulator, following a pathway defined by law. The end date of that pathway is also 2038 at the latest and would have to be brought forward for a complete coal exit by 2030.

The recent changes to the European Emissions Trading Scheme and the rapid growth of renewables are likely to make coal uneconomical by 2030 in Germany.

Overall, the German government has emphasised that emissions will only increase in the short term. In the long term, overall emissions will not surpass any planned targets because the cap on emissions from the power sector under the European Emissions Trading System (ETS) remains unchanged. With the recent deal on the European ETS from December 2022 that increases emission reduction targets to 62 per cent (from the current 43 per cent), the European coal phase-out could even be accelerated and take place before 2030, as coal usage becomes more and more unprofitable.

Overall, the gas crisis is likely to lead to an accelerated energy transition, translating into higher climate ambition. It will be crucial to reduce fossil lock-in in order to avoid stranded asset risks.

There are no relevant political voices that demand a lowering of German - or European - climate targets. If anything, ambitions seem to target an even faster transition towards clean energy, now that the problems of a fossil fuel-based energy system dependent on imports have manifested themselves as clearly as they have since the beginning of the war. The German coal exit is unquestioned and likely to be accelerated. The largest risk in the current changes to the German energy mix lies in the potential lock-in of new fossil fuel infrastructure related to LNG imports. Oversized LNG project could quickly turn into stranded assets as renewables expand rapidly, the carbon price increases and the political support for climate neutrality by 2045 in Germany and 2050 in Europe remains very high.

By **Lutz Weischer, Martin Voß, Zhibin Chen, Anastasia Steinlein, Magdalena Bachinger**

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REHeatEU:
A once-in-a-lifetime opportunity for energy security and climate protection

The war in Ukraine has increased the focus on the way we heat our buildings. Overnight, the EU's dependency on Russian energy threatened the economy at an unprecedented scale. It became urgent to decouple the EU economy from Russian energy supply. Of the Russian gas imported into the EU in 2021, 30 to 40 per cent was used to heat buildings. Equally worrying, 30 per cent of greenhouse gas emissions come from buildings. Today, this makes the replacement of fossil fuels in buildings by renewable solutions a top priority for energy security as well as for climate goals. Could the current crisis unleash a green swan that will exponentially transform the building sector in this decade? A green swan is an unpredicted event that positively transforms the economy. 'This extraordinary bird symbolises the potential for change and, in particular, for transformation.' [1]

1. *John Elkington (2020), Green Swans, the Coming Boom in Regenerative Capitalism*

The opportunity

Renewable solutions: The sales ratio of oil and gas boilers to hydronic heat pumps was 5:1 in 2021, but there has been a significant increase in the sales of heat pumps since then.[2] New heat pumps working with natural refrigerants can provide a higher output temperature which makes them suitable for the existing building stock—gone are the days when heat pumps were only suitable for new buildings. In fact, the green swan may very well be a heat pump. One goal at the EU level is to reach a share of 49 per cent renewables in buildings by 2030 compared to 24 per cent in 2020, including by installing 10 million new hydronic heat pumps by 2027 and 300 GW of photovoltaics (PV) on rooftops by 2030. The achievement of EU 2030 targets would lead to total annual heat pump sales of 7 million units (both hydronic and air-to-air solutions) and a savings of 21 bcm of gas by 2030—which is 'equivalent to almost 15 per cent of EU pipeline imports from Russia in 2021'.[3]

A strong European manufacturing base: With less than 10 per cent imports of heating appliances from third countries, the EU manufacturing base is strong. However, past years showed a worrying sign: the trade balance in heating deteriorated from 2015 to 2021. The EU–China trade balance went from a surplus of EUR 249 million to a deficit of EUR 390 million within five years.[4] Current disruptions of global supply chains and policies like the American Inflation Reduction Act are now putting additional pressure on EU manufacturers. This is where a strengthened industrial policy could really make a difference. It could alleviate the temporary threats and even strengthen the European manufacturing base.

Social acceptance and affordability: Already before the war in Ukraine, 35 million Europeans lived in energy poverty.[5] While the rising energy prices hurt people and the economy, they are a clear additional reason to speed up the energy renovation of buildings. Recent data show a tangible shift of consumer preferences towards renewable solutions, especially heat pumps, PV, and self-consumption models. The speed and scale of the shift depend on two issues: the upfront cost of heating systems, which is still three to four times higher for a hydronic heat pump than for a gas boiler, and their operating costs. A ratio of gas to electricity price between 1:2.5 and 1:3 per kilowatt-hour would ensure that the electricity bill remains acceptable compared to a conventional gas solution (see current price ratios on energypriceindex.com).

Speed and scale: The speed and scale of the market transformation on the supply side correlates with (1) manufacturing capacity and the availability of (2) supplies (material and components) and (3) installers. The achievement of EU targets requires a threefold increase of the existing heat pump manufacturing capacity and a parallel decrease of conventional combustion solutions. This is possible with a massive pan-European upskilling programme and job creation: Half of the 1.5 million installers need training and 750,000 more should be recruited.[6]

2. *EHI (2021), Heating Market Report*
3. *IEA (2022), The Future of Heat Pumps*
4. *Euractiv (May 2022), Battle for Dominance in Heat Pump Markets; Joint Research Center (2022), Heat Pumps in the European Union.*
5. *Data from Eurostat.*
6. *EHI (June 2022), Heating Systems Installers.*

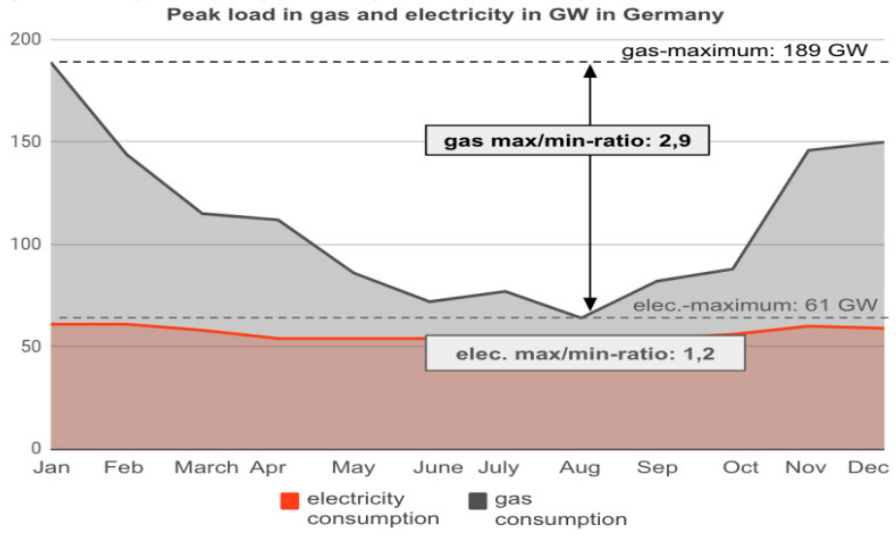
A heterogenous building stock with high peak demand in winter: Buildings are heterogeneous, meaning that a diversified mix of heating solutions is necessary to meet all heat profiles, including district energy. The European heating demand is on average three times higher during the winter than in the summer. The gas infrastructure is built in such a way as to meet this higher winter demand, but the electricity infrastructure is not yet equipped to meet it, as shown in the figure below. Gas properties make it a convenient energy carrier for storage over longer periods of time. Hybrid gas–heat pump solutions, including the hybridization of existing, already installed, gas boilers with heat pumps, can utilise this potential and address seasonality at lower system costs.

The green swan

Changing consumer preferences, the investment readiness of the private sector, and the policy framework could constitute a critical mass for exponential change: the green swan of buildings decarbonization.

Consumers: Energy security concerns triggered by the war in Ukraine and the increasing salience of climate change is leading to a true awareness shock among consumers. Climate change is not a theoretical threat made by distant scientists anymore; its effects are tangible, salient, and immediate. In 2022 alone, over 15,000 people died in heat waves in Europe.[7] Movements such as Fridays for Future have been another eye opener for many. This awareness shock combined with rising energy prices is already translating into what could be the premise of the biggest market shift in decades. According to preliminary figures from the Association of the European Heating Industry (EHI), the sales of gas condensing boilers decreased overall by 8 per cent in 2022 vs 2021, and the sales of air-to-water heat pumps increased by 40 per cent, with big differences across member states. [8]

Figure 1: Challenges raised by seasonality of heating demand in buildings



Source: Frontier Economics (2021), *Die Rolle von Wasserstoff im Wärmemarkt*.

7. *WHO (November 2022), Statement – Climate change is already killing us, but strong action now can prevent more deaths.*
8. *EHI (November 2022), year-end forecast in 12 European countries. This report is not publicly available yet.*

Private sector: This awareness shock is equally tangible in the private sector. Heat pump targets at EU and national levels and possible bans of oil and gas boilers have given a strong market signal for investors. This has led to investment pledges amounting to EUR 4 billion in the heat pump ramp-up in Europe.[9]

Policies: It is likely that this shift will be maintained and accelerated by the implementation of the new EU energy and climate framework: REPowerEU and the Fit for 55 package—'fit' for a 55 per cent greenhouse gas reduction by 2030 compared to 1990 levels. The table below provides an overview of the potential transformative effect of the upcoming policy framework.

This table clearly shows the magnitude of the transformation that could be driven by policies. We should pay close attention to the EU, the UK, and those member states that are at the forefront of these policies (such as Germany, Netherlands, France, and Denmark), as they could become mainstream in the foreseeable future.

Market push via legal requirements	Market pull via subsidies, taxation, and transparency
Ban of, or restrictions on, new stand-alone oil and gas boilers in existing buildings EU: by 2029 via ecodesign DE: 2024 via the 65% renewable rule UK: 2035 NL: 2026 DK: 2028 AT: 2040	Subsidy schemes for buildings and individual heating systems DE: recovery plan led to +10% growth of heating market in 2021, +13% in 2020 IT: Superbonus scheme led to +20% market growth EU: large amount of funding (via EU recovery plan, EU budget, and revenues generated by strengthened emission trading scheme), and end date for subsidies targeting fossil-fuel heating systems by 2024/2025 via the Energy Performance of Buildings Directive (EPBD)
Phase-out of fossil fuels in heating, equivalent to a mandatory retrofit of existing installations by a sunset date EU: by 2040 via EPBD DE: gradual decrease of allowed use-phase via Gebäudeenergiegesetz DK: by 2035	Reduced VAT for green solutions EU level: reduction of VAT anywhere down to 0% allowed at national level for green products DE: 0% VAT for PV instead of 19%
Renovation requirements for least performing buildings EU: ca. 15% of existing buildings by 2033 via EPBD* NL, FR: similar incentives * Proposal of European Commission: nonresidential—class F in 2027 and at least class E after 2030; residential—class F in 2030 and at least class E after 2033.	Transparency, mandatory energy labels for end-users and reporting requirements for companies—via Energy Labelling Directive and Corporate Sustainability Reporting Directive
Renovation requirements for public buildings and social housing EU: 3% of public buildings >250 m2 per annum (potentially including social housing)	Extra subsidies for more environmentally friendly solutions DE: +5% on-top for heat pumps using natural refrigerants starting in January 2023; in future: extra subsidies for products with lowest environmental lifecycle footprints
PV (or renewable) requirements for new and existing buildings EU: PV deployment on all existing and new nonresidential buildings by 2027, by 2029 on all new residential buildings	Energy prices (including energy taxation, extension of EU Emission Trading Scheme to buildings and price caps) and Electricity Market Design: impacting relative total cost of ownership of products, profitability of selfconsumption models, and demand-side response

Source: Author's own compilation of existing legislations and ongoing revisions. Note: most policies listed in this table are still under discussion, either at the drafting or the negotiation stage, so changes are still very likely.

9. *IEA (2022), The Future of Heat Pumps, table 3.4; see overview of national heat pump targets in table 1.1 of the same report.*
10. *See for example: Ray Kurzweil (1999), The Age of Spiritual Machines.*

The speed and scale of the transformation is difficult to anticipate as the market has been relatively stable over the past decades. Change theory indicates, however, that technological change usually starts slowly then accelerates exponentially.[10]

Industrial policy

A green swan that keeps value creation, jobs, and sustainable growth in Europe will need a strong industrial policy. We are witnessing a paradigm shift in the design of industrial policy at EU and national levels, with proposals on the table that were unthinkable even two years ago, such as a European Sovereignty Fund or extra subsidies for clean technologies 'made in Europe'. Here is a list of six success factors for an effective industrial policy in heating.

- Ramp-up of EU manufacturing capacity via public support in R&D, capex (direct funding and accelerated depreciation), skills, and guarantees. It is possible to leverage existing instruments such as the EU Innovation Fund and the Temporary Crisis Framework for State Aid.

- Speed. Support measures, especially financial instruments, must kick in immediately, with faster lead-times. The approval duration of Important Projects of Common European Interests, for example, is inappropriate for the heat pump opportunity. Forced import of renewable solutions can be avoided by giving sufficient lead time to the European industry for the ramp-up of manufacturing capacities.

- Skills. Leverage the European Social Fund and other instruments such as the EU Pact for Skills to attract and train installers (see above).

- Regulatory certainty. The Fit for 55 package combined with national initiatives will be a strong driver for investments. A priority is to steer those investments and leapfrog into environmentally friendly, circular, and resource-efficient solutions. Most European heating manufacturers consider that there is no conflict between increasing production capacities to reach the 10 million heat pump target by 2027, and higher environmental goals, for example via the F-gas and REACH regulation.[11]

- Subsidies targeting end-users. A priority is to secure demand for low-carbon solutions until economies of scale and innovation further reduce their production costs. Behavioural economics shows that upfront costs have a greater impact on final consumer decisions than total cost of ownership; this has to be factored into the design of national subsidy schemes. Extra subsidies for products 'made in EU' would also be a strong pull for European-based manufacturing.

11. EHI (2022), position papers shared with EU policy makers.

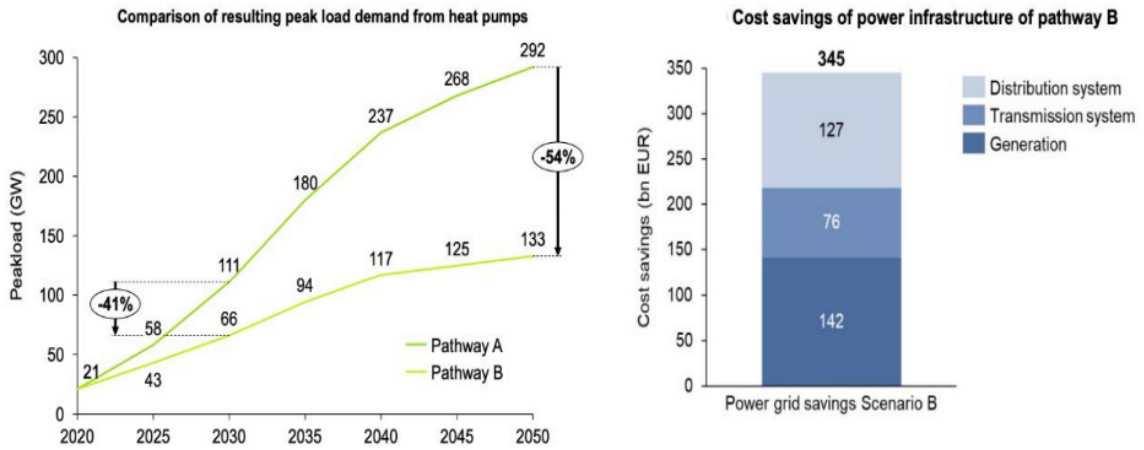
- Supply chains. Evaluate and support the European production and diversification of the supply of key components such as compressors, semiconductors, and power electronics—for example, with an extension of the framework set out in the European Chip Act to other critical clean technologies.

The long-term perspective

A green swan in buildings would unleash an exponential ramp-up of heat pumps by 2030, a giant renovation wave, and millions of prosumers (actors both consuming and producing energy) benefiting from self-consumption and selling flexibility to the grid. A question that remains open is the role of green gases in buildings.

A study was commissioned by EHI to compare a full-electric scenario (Pathway A) with a balanced-mix scenario (Pathway B) where the heating stock is fully carbon neutral by 2050. Its findings projected that, in the latter scenario, gas demand goes down to 460 TWh in 2050 vs 1280 TWh in 2020. Meanwhile, the peak load demand from heat pumps is 50 per cent lower, leading to EUR 345 billion of accumulated savings until 2050.

Figure 2: Cost savings resulting from lower peak load demand in a green gas scenario for a decarbonized building stock



Source: Guidehouse (2022), *Decarbonisation Pathways for the EU Building Sector.*

The availability of green gases for other hard-to-abate sectors is critical. Yet, the amount of green gases that will be available in 2050 and their costs are uncertain. Some evaluations send a positive signal, for example:

- Biomethane production potential in the EU has been estimated at 1,350 TWh.[12]
- Hydrogen production potential in the EU has been estimated at 1,710 TWh.[13]

Assuming that half of the 460 TWh gas demand for buildings is met by hydrogen, and the other half by biomethane, that would mean, in this estimation, that only 13 per cent of the available hydrogen supply would go to buildings.

Heating appliances are ready for green gases. Additional evaluations of the cost-efficiency of security of energy supply and resource adequacy are still needed to meet the seasonality of heating demand at the lowest costs possible.

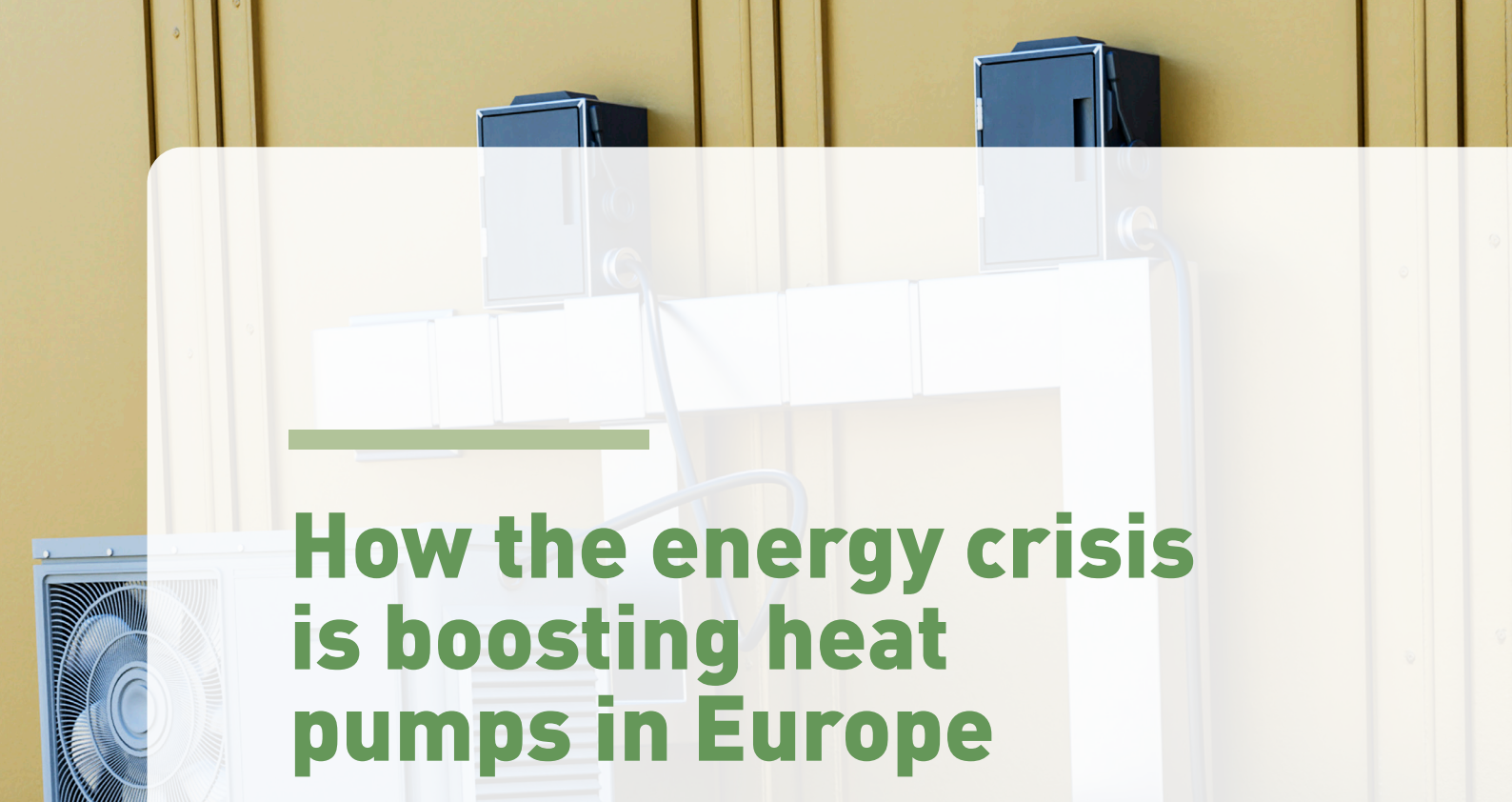
Conclusion

The decarbonization of the building stock is a unique opportunity to enhance both energy security and climate protection. Policies, evolving consumer preferences, and the private sector's willingness to invest indicate that we could see a green swan in buildings in this decade. That green swan could very well take the shape of a heat pump. In the words of Professor Martin Viessmann, 'This is a once in a lifetime opportunity to write climate history' for each and every one of us.[14] Maybe the EU energy security strategy adopted in the wake of the war in Ukraine should have been called REHeatEU instead of REPowerEU.

By **Alix Chambris**

This article was originally published on Issue 35 of Oxford Energy Forum and republished with permission from Oxford Institute for Energy Studies.

12. *IEA (2020), Outlook for Biogas and Biomethane.*
13. *Guidehouse (2019), Gas for Climate Study.*
14. *Viessmann (2022), speech delivered during the visit of Chancellor Olaf Scholz in the factories of the Viessmann Group on 9 August.*



How the energy crisis is boosting heat pumps in Europe

Heat pumps are widely seen as the most important technology when it comes to decarbonising heating. Organisations including the International Energy Agency and McKinsey see heat pumps providing most of our heating needs in the future, on the path to net-zero emissions.

Until recently, heat pump sales had been struggling to take off, but this is changing rapidly. In a previous Carbon Brief guest post we reported double-digit growth in 2021.

Since then, Russia's invasion of Ukraine, the resulting energy crisis and related policy interventions have boosted installations in Europe even further, to unprecedented new highs.

For the first time in 2022, heat pump sales in Europe reached 3m, up 0.8m (38%) from a year earlier and doubling since 2019. Sales doubled in a single year in Poland, Czech Republic and Belgium.

One main driver is cost: gas and oil prices skyrocketed in 2022 and even though electricity prices also increased sharply in many countries, running costs tipped in favour of heat pumps.

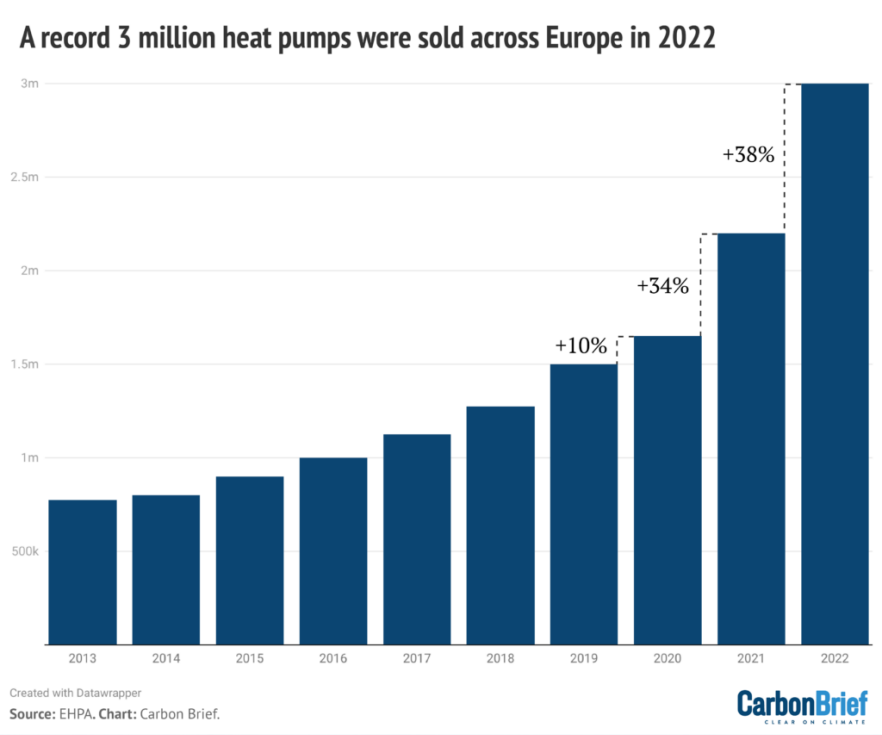
With further policy changes likely to continue supporting the rollout of heat pumps, we look at their current and potential future adoption across Europe.

Expanding markets

Initial figures for Europe show that 3m heat pumps were installed in 2022, up 38% year-on-year. This builds on a 34% increase in 2021, which was, in turn, much higher than the previous norm of around 10% per year. This acceleration is shown in the figure below.

Within the total for Europe, national heat pump markets can be grouped into three categories: mature heat pump markets, emerging heat pump markets and dormant heat pump markets.

Mature markets in Europe, where heat pumps have been installed in large numbers for a long time and annual growth tends to be lower, include the Nordic countries, Switzerland and France.

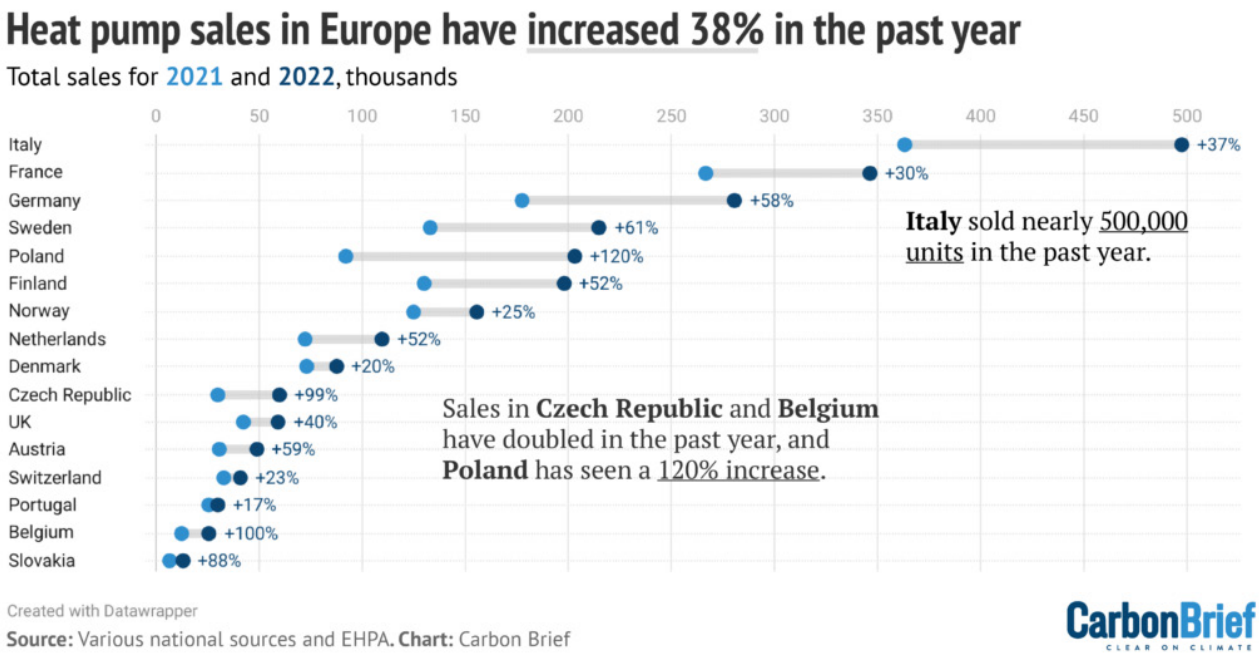


Annual heat pump sales in Europe, 2012-2022. Source: EHPA. Chart by Carbon Brief using Datawrapper.

Countries with emerging markets, showing more recent and rapid growth in large numbers, include Germany, Poland and the Netherlands. Dormant heat pump markets include Ireland (where no data is available for 2022), Portugal and the UK.

Most notable about 2022 is the rapid growth in both mature and emerging market segments, and the signs of awakening in dormant markets, such as the UK.

This is shown in the figure below, where heat pump sales in 2021 (light blue circles) and 2022 (dark blue) are shown for a selection of European countries. The percentage growth in sales between the two years is indicated at the end of each bar.



Growth in European heat pump markets in 2022, by country, in terms of the number of units sold and the percentage increase. Source: EHPA for all countries except those with the following national sources, SULPU, UNICLIMA, BWP, Duurzaam Verwarmd, NOVAP, PORT PC, SKVP, FWS. Chart by Carbon Brief using Datawrapper.

Even the very mature market in Finland experienced extraordinary growth in 2022, with heat pump sales up 50%. The Finnish government gives grants of up to EUR 4,000 to replace oil-fired heating.

Similarly, Norway already has the highest heat pump penetration in the world. Around two-thirds of households now use the technology, which accounts for almost all new heating systems. Yet Norway still saw 25% growth in heat pump sales in 2022.

Despite having installed heat pumps for a long time and having a very mature market, Switzerland also saw 23% growth in 2022. Two-thirds of all heating systems sold in the country in 2022 were heat pumps. To level the playing field for clean heating technologies, Switzerland implemented a carbon tax on heating fuels in 2008, which is currently set at around EUR 120 per tonne of carbon dioxide (CO_2). This is coupled with a federal grant programme administered by the cantons.

For a mature heat pump market, Sweden also recorded impressive growth of 61% in 2022. Sweden's carbon tax, which has been in place since the 1990s and reached EUR 115/ tCO_2 in 2021, has been a primary driving force behind its heat pump market.

Doubling sales

While mature, established European markets recorded surprisingly strong sales growth in 2022, the most rapid increases were found in emerging heat pump markets.

In three European countries – Belgium, Czech Republic and Poland – the heat pump market roughly doubled in a single year.

Poland has long been seen as a laggard when it comes to climate policy. Yet its heating market is changing fast and nearly a third of all new systems are now served by heat pumps.

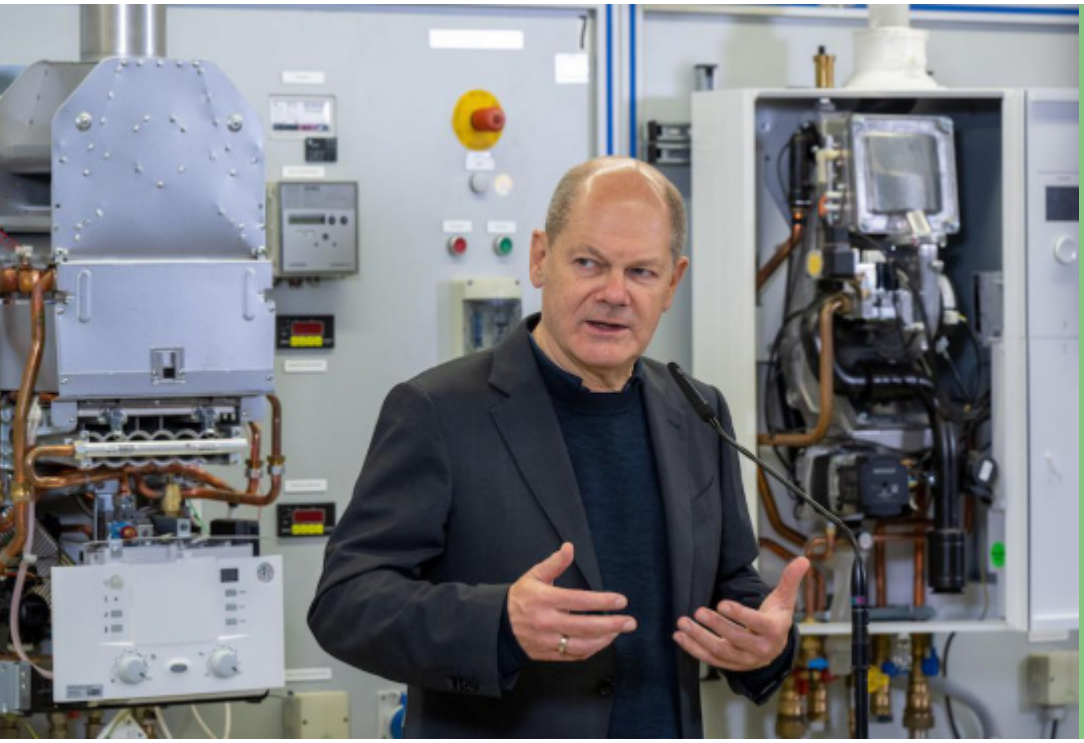
Moreover, Polish heat pump sales more than doubled in 2022, with growth of 120% year-on-year, possibly the fastest growth ever seen for the technology.

To put this in context, Poland also saw the second-greatest increase in 2022 when measured in terms of the numbers of heat pumps sold, behind only Italy, and beating out larger economies with more established markets for heat pumps such as France, Germany and Sweden.

A reform of Poland's Clean Air Programme in 2018 provided increased support for heat pumps. At the same time, their running costs have become much more economically attractive, thanks to rising fossil fuel prices driving up the cost of alternatives.

Another major mover in 2022, Belgium, has been a heat pump laggard, with some of the lowest installation rates in Europe. Yet in 2022 the market doubled, with around 13,000 additional units sold. Similarly, the Czech heat pump market grew to reach 60,000 units sold, up from 30,000 in 2021.

Elsewhere, Slovakia experienced record growth of 88% in 2022. According to Vladimir Orovnický, the president of the Slovak Association for Cooling, Air-conditioning and Heat Pumps, this was mainly driven by energy security concerns rather than government policy, although the nation's Green Houses Program continues to offer grants of up to EUR 3,400 for heat pumps.



German Chancellor Olaf Scholz makes a statement at an assembly wall on which various heating burners are installed for training purposes during his visit to the Chamber of Crafts' training center on October 22, 2022. Credit: Peter Kneffel / dpa / Alamy Stock Photo

In Germany, one of Europe's largest markets for heating systems, heat pump sales grew by a record 53% in 2022. One important driver was the announcement that all newly installed heating systems will need to run on at least 65% renewable energy by 1 January 2024 – two years earlier than initially planned. Rising gas and oil prices probably also contributed to the increase.

In 2021, Germany had implemented a carbon price on gas and oil used for heating, which will rise from EUR 30/tCO_2 today to EUR 45/tCO_2 in 2025. This is likely to support further growth for heat pumps.

Finally, France, historically one of Europe's largest markets, set a new record for sales of air/water heat pumps in 2022. Sales of these devices grew by 30% to reach around 346,000 units, up from 267,000 in 2021.

Correspondingly, 2022 marked a sharp decline in the French fossil fuel boiler market, with sales of gas and oil condensing boilers falling 30%. France provides generous grants to install heat pumps, with larger sums available to lower-income households.

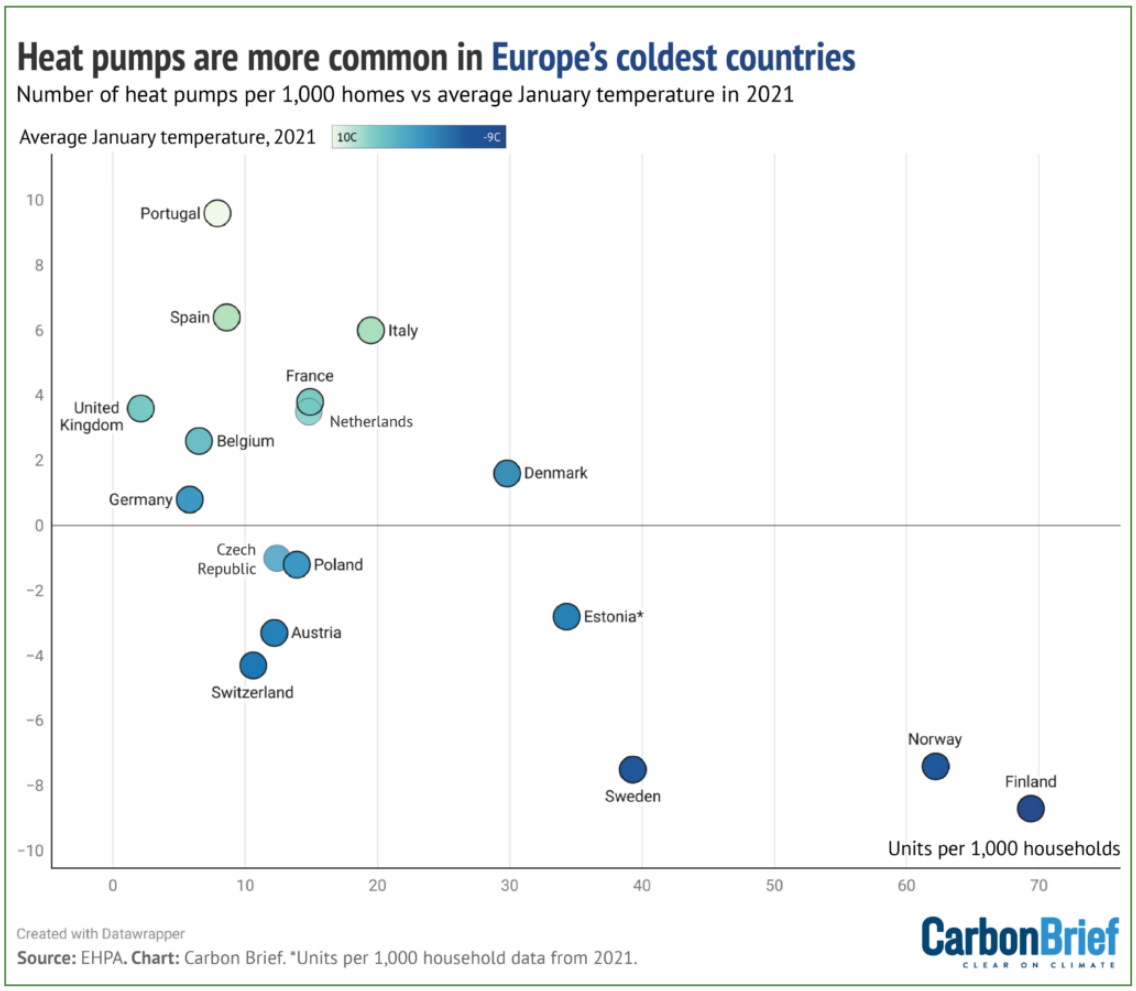
Cold climates

In addition to the growth rates in 2022, it is also interesting to look at the geographical distribution of sales. Indeed, the shift to heat pumps is not just happening in warmer countries. On the contrary, the highest penetration of heat pumps can be found in the coldest climates

In Europe, the four countries with the highest number of installations of heat pumps per 1,000 households in 2022 are Finland, Norway, Sweden and Estonia. These four countries also face the coldest winters in Europe, as shown in the figure below (y-axis and darker blue shading).

Evidence disproves the oft-heard allegation that heat pumps are unable to work in cold climates. Although heat pumps are less efficient when it is coldest, performance does not suffer drastically.

Data from field tests in Germany show that air-to-water heat pumps still produced more than two units of heat for each unit of electricity when the outside temperature was -3.6C. (In technical terms, their average 'coefficient of performance', or COP, was 2.3.) Even at temperatures below -10C, the heat pumps were operating with a COP of 1.6. Similarly, in Finland, tests of air-to-air heat pump systems from various manufacturers resulted in COPs of 3 at -10C and 2 at -20C.



Number of heat pumps sold per 1,000 households in 2022 versus average January temperatures. Source: EHPA. Chart by Carbon Brief using Datawrapper.

Outlook for heat pumps

High fossil fuel prices have changed the economics of heat pumps, often making them cheaper to run than gas- or oil-fired heating. While prices for oil and gas have fallen from last year's record highs, it is unlikely that the coming years will see a return to previously low levels.

Meanwhile, the EU's Emission Trading System (EUETS) is due to start putting a price on carbon from heating fuels from 2027, which will further advance the economics of heat pumps.

Several countries have announced phaseout dates for fossil fuel heating, although it remains to be seen how exactly this will be implemented. The European Commission has also mentioned a possible phaseout date for the sale of fossil fuel heating systems by 2029 and, if adopted, this could trigger an even bigger shift to heat pumps in EU member states.

Novel policy instruments such as clean heat standards, that may require a specific quantity of clean heating systems to be installed, are currently being discussed in the US and the UK. In addition to the existing policies and regulations, such clean heat standards could play an important role in scaling up Europe's heat pump market in the coming years.

Finally, reforms to the EU renewable energy directive (RED) might also provide countries with the incentive to deploy heat pumps. The RED sets targets for growing the use of renewable heating and cooling, yet the current version encourages inefficient uses of renewables in buildings.

It incentivises the use of less-efficient technologies, such as biomass boilers, and does not consider the use of electricity for heating and cooling. The European Parliament and Council are currently considering revisions to the RED, which may consider counting the electricity used to run heat pumps towards the target. If adopted, this could provide another boost to heat pumps as countries use them to increase their shares of renewables in heating and cooling.

By **Jan Rosenow,** director of European programmes at the Regulatory Assistance Project.
Duncan Gibb, senior adviser at the Regulatory Assistance Project.
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Policy support needed to boost sustainable aviation fuels in China

China's aviation sector needs sustainable fuels to lower its carbon footprint, but support is needed to reduce costs and increase production.

Used cooking oil (left) and aviation fuel derived from cooking oil (right) as shown by a scientist from SINOPEC Research Institute of Petroleum Processing (Image: Alamy)

The aviation sector must overcome some major challenges in the coming decades if it's to reach its 2050 net zero target. By then, the International Air Transport Association (IATA) estimates airlines will be carrying 10 billion passengers a year, more than double the pre-pandemic high of 4 billion in 2019. The industry is pinning its hopes largely on the development of sustainable aviation fuels (SAFs) to reach the net zero target, with IATA expecting such fuels to provide 65% of the sector's carbon reductions by 2050.

China's aviation market is second in size only to that of the US. According to analysis published by the International Council on Clean Transportation (ICCT), Chinese flights emitted 103 million tonnes of CO_2 in 2019 – 13% of the global aviation total. Although aviation accounts for 1% of the country's total emissions, its share is expected to grow as emissions from heavy industries, such as steel and cement making, fall in the next decade. A research paper published before the pandemic predicted that China's civil aviation emissions will reach 516 million tonnes by 2050 – five times the 2019 amount.

China's production of SAFs is just getting started. In late 2022, the Institute of Energy at Peking University published a report finding huge potential for sustainable fuel production in China, with significant feedstocks available, such as used cooking oil, forestry waste and food waste from cities. But there is no top-level policy to develop the sector nor functioning market to promote SAF production. Meanwhile, there are significant obstacles to investment and expansion of capacity, commercialisation of SAF production technologies, and reduction of costs.

What is sustainable aviation fuel?

SAFs are liquid fuels produced from sustainable feedstocks (biological or synthetic) that can replace fossil fuels in commercial aircraft. They can reduce emissions by 80% or more compared to conventional fossil fuels, depending on the technology and feedstock, and how the SAF is transported. Currently, SAFs are mixed with conventional fuels (usually at a ratio of no more than 50%), although there is no technical barrier to the exclusive use of SAFs. No major changes to airport infrastructure or aircraft are needed to enable fuel switching.

Standing-setting body the American Society for Testing and Materials International (ASTM) has approved nine SAF production processes. Existing and planned production in China uses the well-established hydroprocessed esters and fatty acids (HEFA) method, which refines animal and plant oils and recycled oils into an aviation fuel. This is how most of the world's SAF is produced.

The Gasification/Fischer-Tropsch (G+FT) process has also been a focus of the world's major fuel suppliers. The technology has been applied in large natural gas liquefaction and coal liquefaction facilities. Considering sustainability, using the process to produce SAF products requires that the raw materials should not be fossil fuels, but biomass, municipal solid waste or industrial waste.

However, the Power-to-Liquid (PtL) process has the greatest potential to reduce aviation emissions. Hydrogen is extracted from water by electrolysis and combined with carbon dioxide to produce hydrocarbons. The process can be powered by renewables and the carbon dioxide sourced from carbon capture technologies. In theory, this process could deliver 99–100% reductions in emissions across the fuel lifecycle, but it's new and commercial-scale application is still far off.

The IATA has estimated that 449 billion litres (358 million tonnes) of SAFs will be needed to meet 65% of the sector's fuel requirement in 2050. Production in 2020 was a mere 50,000 tonnes, just 0.01% of the 2050 target.

Although the target is ambitious, IATA admits the aviation industry won't be able to completely eliminate emissions at source and will need to mitigate the rest using a variety of offsetting mechanisms. The International Civil Aviation Organization adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in 2016. Airlines will have to buy emissions reduction offsets from other sectors to compensate for any increase in their own emissions above the 2020 level. Alternatively, they can use lower carbon 'CORSIA eligible' fuels.

However, the effectiveness of CORSIA has been heavily doubted, as there is no guarantee that the carbon credits purchased by airlines to offset their emissions would be of a high quality. An investigation in 2021 found that the forest protection carbon offsetting market used by airlines had a significant credibility problem, with experts warning the system is flawed and can produce credits with no climate benefit.

IATA envisages that as new technologies, including those to produce SAF, become widespread, the need for offsets will diminish. However, 65% of the net zero goal needs to be achieved by using 380 million tons of sustainable aviation fuel, while CORSIA does not have a solid plan to promote sustainable fuel. There are multiple challenges to scaling the production of SAFs.

In 2017, Hainan Airlines became the first Chinese airliner to make an international flight using a mix of conventional aviation fuel and fuel derived from used cooking oil (Image: Alamy)

High costs

One of the biggest barriers to SAF production is cost. According to the ICCT, the various processes cost two to six times as much as conventional jet fuel. Fuel costs account for 25–40% of airline operating costs, so switching to sustainable alternatives will have a significant impact. Airlines may prefer to offset carbon emissions rather than reduce them.

Besides, the airline industry is still recovering from the impact of Covid-19, which cut passenger numbers. In 2021, the Chinese aviation sector saw 440 million journeys made – up 5.5% on 2020, but still down 33% on 2019. Airlines are facing enormous pressure to survive, deterring investment and promotion in SAFs.

Environmental costs are also an issue. Sticking to the technical requirements of the ASTM alone does not ensure sustainability. SAFs need industry-recognised sustainability certification, such as that offered by the International Sustainability & Carbon Certification System or the Roundtable on Sustainable Biomaterials, which look at overall carbon emissions across the product lifecycle.

Beijing Daxing International Airport opened in September 2019. It is designed to handle 300 takeoffs and landings per hour. China's civil aviation emissions may quintuple between 2019 and 2050. (Image: Alamy)

An ICCT report shows that production costs are lowest for the hydroprocessed esters and fatty acids (HEFA) route, but not all HEFA products actually cut emissions. Feedstocks can have a huge impact on emissions outcomes: fuel made from sugarcane or palm oil are more expensive than traditional jet fuels and produce more lifecycle greenhouse gas emissions, the report states. And the direct use of plant oils as feedstock can affect food security and cause changes in how land is used – potentially giving rise to deforestation and higher lifecycle emissions.

The European Union revised its Renewable Energy Directive in 2018 to phase out palm oil by 2030, along with most first-generation food-based biofuels. In response to the economic fallout from the EU's move, top palm oil producers Indonesia and Malaysia have pushed for increasing exports to India and China. In 2022, China's state-owned companies invested 6 billion Malaysian Ringgit (around US$1.35 billion) to produce hydro treated vegetable oil and sustainable aviation fuel in Malaysia.

Incomplete industrial chains

The report from Peking University's Institute of Energy estimates that China can currently produce 150,000 tonnes of SAF via the HEFA route every year. But the country consumed 26.47 million tonnes of aviation fuel in 2021. The supply of SAFs is nowhere near adequate if airlines are to cut their emissions as planned.

However, it is not easy to produce SAF. Sinopec Zhenhai Refining & Chemical Company (Zhenhai Refining) was the first in China to look seriously at developing and producing SAFs. It first produced one in June 2022 and its equipment can process 100,000 tonnes of used cooking oil every year. Huang Aibin, Zhenhai Refining's technical chief, said that production costs remain high, feedstock supplies are unstable, and demand is variable.

The best feedstock for the HEFA process, in terms of sustainability, is used cooking oil. The fuel produced is lower cost and meets sustainability requirements. There are no issues with competition for food supplies or water, and there are no deforestation or biodiversity issues.

China's larger and more advanced factories generally pre-process used cooking oil and then export it to the EU. A previous China Dialogue article explained that the high costs of transportation and processing mean that biodiesel made from used cooking oil costs more than standard diesel. If the government does not subsidise it, there is no incentive for fuel makers to buy it. That's why apart from some limited applications as a fuel or feedstock in industry, most of China's biodiesel is exported to the EU.

Chinese companies that produce biodiesel (especially HVO, hydrotreated vegetable oil, also known as second-generation biodiesel) can also transition to SAF production. The report estimated that the country's total production capacity will reach 2.05 million tons by 2025 if China's existing and planned production capacity for HVO is retrofitted to produce SAF, combined with the existing SAF capacity. By then, total SAF supply will account for 4.5% of China's total aviation fuel consumption.

However, China exempts biodiesel that conforms to national standards from consumption taxes and grants a refund of 70% of value-added tax to encourage biodiesel producers. By contrast, no targeted support measures have been instituted in the SAF industry. Companies lack incentives to transition to SAF production.

According to Huang Aibin, used cooking oil is expensive to transport, which makes local utilisation more attractive. Sinopec is planning to set up regional plants, but further investment will depend on market demand: 'The equipment only becomes profitable when we are getting regular ongoing orders from the airlines.'

And while the Civil Aviation Administration of China (CAAC) has set a target for cumulative consumption of SAFs of 50,000 tonnes by 2025, there is no sign yet of how the airlines plan to achieve this. As the report says: 'China's airlines are mostly state-owned and will only act on SAFs in response to central government policies and plans.'

To date, Air China, China Eastern and Hainan Airlines have carried out test flights using a blend of conventional fuel and SAFs. But these have not led to their use on commercial flights. Hong Kong's Cathay Pacific has been more proactive, saying 10% of its aviation fuel will be sustainable by 2030.

Nikola Xing, head of climate action for the airline, said at the launch of the Peking University report that the premium which airlines pay for SAFs could be partially passed on to customers – in particular, big corporate customers signed up to the Science Based Targets initiative. The SBTi helps companies set carbon targets and then monitors performance. As its aviation guidance shows, commercial travel is the biggest source of emissions for financial and professional services firms. The guide suggests cutting down on travel, using alternative modes of transportation, such as high-speed rail, and taking flights using sustainable fuel. Companies may be willing to pay extra for greener flights.

SAF policy needed

The aviation sector needs urgent policy interventions to establish a market for SAFs, and incentivise investment in SAF production at scale and the commercialisation of processes such as non-waste oil derived SAFs.

In the EU and US, governments have set specific blending mandates. For example, the ReFuelEU Aviation Initiative is expected to require all flights taking off from EU airports to use a certain percentage of SAF: 2% in 2025, rising to 5% in 2030 and 63% in 2050. A new SAF policy from the Biden Administration will support producers with the aim of raising output to at least 3 billion gallons a year (about 4 million tonnes) by 2030.

In China, there are no comprehensive top-level policies to support SAFs. Dr Yang Fuqiang, a research fellow at Peking University's Institute of Energy, told China Dialogue that the Civil Aviation Administration of China (CAAC) should set a requirement – even if it is just that 1% of aviation fuel be sustainable – to get the industry moving. That could be gradually increased to further cut emissions. He suggests the extra costs could be accounted for by increasing the price of tickets on popular routes or for business-class travel.

Considering the limited supply of feedstocks, the overall production capacity of the HEFA route cannot meet the demand. In contrast, The G+FT process uses agricultural and forestry waste, municipal solid waste, and industrial waste as raw materials, while the PtL process hardly needs to worry about raw material issues. They are expected to grow in the long term, due to their cheap and diverse raw materials.

Yang added that in the long-term the PtL route has huge potential and is free of feedstock concerns, and China has plenty of natural resources to develop renewable energy. With policy support, economies of scale and technological advances, PtL costs could be reduced significantly, making this pathway the best solution for cutting aviation emissions.

He also expects the aviation industry to be included in China's national emissions trading system (ETS), incentivising airlines to reduce emissions by switching to low-carbon sustainable fuels. In 2011, China's regional carbon emission trading systems were launched in seven provinces and cities, among which Shanghai is the only one to have included the aviation sector. The national ETS, which entered into force in 2021, so far only includes the power sector. A document issued by the National Development and Reform Commission in 2016 proposed that the first phase of the national ETS will cover key emission industries such as aviation. However, the Chinese government has not yet announced the implementation specific measures of the above plan.

By **Niu Yahan**

Monthly News Round-Up

ECECP highlights the key energy news headlines from the past month in the EU and China

EU manufacturing to be boosted by Net-Zero Industry Act

On 16 March 2023, the EU Commission unveiled its legislative proposal for the Net-Zero Industry Act, which aims to create a regulatory framework to boost EU manufacturing of clean technologies to reach at least 40% of the bloc's needs by 2030. The 40% target is a political objective, not a legally binding goal.

The proposed law aims to speed up permitting and increase access to finance for clean tech. Supported technologies include solar, wind, batteries and storage, heat pumps and geothermal energy, electrolysers and fuel cells, biogas/biomethane, carbon capture, utilisation and storage, and grid technologies. Under the law, each of these should aim to have two fifths of their production in the EU by 2030, although this will not be a legal obligation.

The proposal sets an EU objective to reach an annual 50 Mt injection capacity in strategic CO_2 storage sites by 2030. European Hydrogen Bank is also set to be established, which will support the uptake of renewable hydrogen within the EU as well as imports from international partners.

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Commission proposes plan for power market reform

The European Commission published its proposal to reform the EU electricity market on 14 March 2023. It aims to counter volatile gas prices by offering consumers more protection, boosting renewables and supporting demand-side measures. The proposal includes measures enabling EU citizens to become more active players in the energy market, granting them a wider choice of contracts and clearer information. It also proposes introduction of a peak shaving product to stimulate demand-side flexibility, making the market more adaptable to supply-demand changes. It advocates long-term instruments such as power purchase agreements (PPAs) and two-way contracts for difference (CfD) to help protect consumers from volatile prices.

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EU mandates 11.7% cut in energy use by 2030

EU lawmakers have agreed to introduce mandatory energy savings of at least 11.7% (or an average of 1.5% per year) across the bloc by 2030. The Energy Efficiency Directive also makes provision for a robust monitoring and enforcement mechanism to make sure Member States deliver on their national contributions to this binding EU target.

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Emergency measures set to keep squeeze on gas demand

The EU Commission wants to continue emergency measures to reduce European gas demand by 15% for another 12 months. The existing regulation, which generated savings of 19% between July 2022 and January 2023, is set to expire at the end of March 2023. Commission analysis shows that it is important to continue this provision for another year in order to avoid security of supply issues next winter as global gas markets are expected to remain tight. The decision will be discussed by energy ministers at the Transport, Telecommunications and Energy Council (TTE) Council on 28 March 2023.

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EU agrees world's first bond issuance rules to combat greenwashing

The EU has achieved a world first, with agreement on a set of comprehensive rules for issuing green bonds to meet the bloc's net zero goals. The rules establish unified standards for Member States, although compliance will be on a voluntary basis. The effect will be to enable Members States to identify high quality green bonds and companies, thereby reducing greenwashing or exaggerated environmentally-friendly claims.

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European Commission relaxes state aid rules for clean tech

On 9 March 2023, the European Commission adopted a Temporary Crisis and Transition Framework that further relaxes state aid rules for clean technologies. The new decision gives Member States more flexibility to design and directly implement support measures in strategic sectors in the clean transition, including investment support for the manufacturing of strategic equipment such as batteries, solar panels, wind turbines, heat-pumps, electrolysers and carbon capture usage and storage, as well as for production of key components and production and recycling of related critical raw materials. The new rules will apply until the end of 2025.

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11 EU countries launch alliance for nuclear power in Europe

Energy ministers from 11 European countries (Bulgaria, Croatia, Czechia, Finland, France, Hungary, the Netherlands, Poland, Romania, Slovakia and Slovenia) gathered in Stockholm in March 2023 to announce a strengthening of European cooperation across the entire nuclear supply chain. They also promoted common industrial projects in new generation capacity as well as new technologies like small reactors. Their joint declaration acknowledges the role of nuclear in reaching net zero and undertakes to take greater account of nuclear in all legislative texts being discussed in EU institutions.

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UK government announces GBP 205 million of renewables funding for next CfD round

The UK government has earmarked GBP 205 million (EUR 234.39 million) for the fifth annual flagship Contracts for Difference (CfD) renewables auction in its 2023 Spring Budget. The allocation includes GBP 170 million for established technologies such as offshore wind, and GBP 10 million for tidal stream technologies. CfD is a government scheme that aims to improve the UK's energy security by supporting new domestic low-carbon electricity generation projects. Due to its price guarantee mechanism for the power produced by a project, the scheme has helped bring nearly 27 GW of low-carbon capacity to the grid to date. The Spring Budget also heralded a GBP 20 billion investment in carbon capture and the launch of a state-owned company Great British Nuclear (GBN) to support new nuclear builds.

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Europe's largest battery energy storage system launched in the UK

A GBP 75 million battery energy storage system – the largest in Europe – has been officially opened in the UK by Harmony Energy Income Trust Plc. The Pillswood project is located next to the National Grid's Creyke Beck substation, which is also the connection point proposed for phases A and B of Dogger Bank – the largest offshore wind farm in the world – set to go live in the summer of 2023. The battery energy storage system can store up to 196 MWh of electricity in a single cycle, which is enough to power around 300 000 homes in Yorkshire for two hours. The energy storage facility uses Tesla Megapack technology to maximise the efficiency of wind farms by reducing the time it needs to be switched off (curtailed) because of supply and demand imbalances or network limitations.

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Spain takes first steps towards offshore wind power

Offshore wind is finally on the horizon for Spain. After more than four years of work, the Spanish government has given the go-ahead for the development of offshore wind farms by confirming where wind farm developments can take place. The plan aims to enable optimal use of marine space off the Spanish coastline, reducing conflicts and promoting the coexistence of other stakeholders in the maritime sector such as fisheries and tourism. This clears the way for the development of further sources of renewable energy. In total, around 5 000 square kilometres have been set aside for offshore wind development.

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Danish parliament adopts new rules to support geothermal

Denmark's parliament has adopted a new law that effectively exempts geothermal heat projects from the current price regulation. Instead, pricing will be determined through a contract between the district heating company and the geothermal operator, thus placing a ceiling on the costs consumer will pay for the geothermal heat. The new law is expected to further encourage the development of geothermal heating projects in Denmark

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Germany in talks to merge grids operators

Germany's government is accelerating efforts to merge the country's four main high-voltage grid operators because it believes this is the quickest way to modernise power lines ready for an influx of renewable energy. The government is in talks for a EUR 20 billion takeover of Dutch grid operator Tennet, and is negotiating with 50 Hertz Transmission GmbH, Transnet BW GmbH and Amprion GmbH, with the eventual goal of forming a single privately owned unit. The administration has slammed former Chancellor Angela Merkel's decision to privatise and split the grid, holding this responsible for splintered management responsibilities, slow expansion and sluggish modernisation. The estimated price for expanding the transmission system alone is about EUR 50 billion, according to the nation's energy agency dena.

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France to drop legal limit on nuclear in energy mix

French lawmakers have voted in favour of abolishing the 50% legal limit on nuclear in the country's energy mix, signalling a stronger-than-ever willingness to boost nuclear power across the country. The 50% limit set in 2015 was originally intended to diversify energy supply and promote renewables. However, the recent energy crisis and conflict in Ukraine have brought nuclear back to the fore as a reliable, controllable and low-carbon source of electricity. The decision is part of France's broader legislative package to build six new nuclear reactors, the first of which is expected to come online in 2035.

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Greece: new law to allow relocation and reuse of older wind turbines

Greece's Ministry of Environment and Energy has proposed an extensive new energy law which includes a rule on reusing old wind turbines whose models are no longer manufactured. The proposal gives second life to smaller turbines (between 60 kW and 1 MW) by moving them from mainland wind farms to isolated islands to boost renewable energy production. Those systems that are still within the 20-year period of serviceable use will continue to get compensated under existing remuneration mechanisms, although additional requirements will need to be met to ensure they are viable for their remaining life expectancy.

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BP launches plans for 2 GW green hydrogen cluster in Spain

Oil and gas giant BP has launched plans for a 2 GW green hydrogen cluster, dubbed HyVal, at its Castellón refinery in the Valencia region of Spain. The public-private initiative foresees the phased development of up to 2 GW of electrolysis capacity by 2030 to produce green hydrogen at the BP refinery. Anticipated to be operational in 2027, the first phase of development will see at least 200 MW of capacity installed at the refinery, producing up to 31 200 tonnes of green hydrogen per year. The second phase could be complete by 2030.

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China launches pilot scheme to boost rural clean transition

China has launched a pilot scheme to support the energy transition in rural areas, according to an action plan released by the National Energy Administration on 23 March 2023. The main idea is to accelerate the rural clean transition through innovative development of distributed renewables. The plan also calls for the local development and utilisation of renewable energy, a further boost to electrification in rural areas, and the more diversified use of renewables including applications that do not involve electricity. According to the plan, each provincial government will need to identify one potential pilot county. The objective is for renewable energy to account for over 30% of total primary energy consumption in the pilot counties by 2025, with more than 60% of incremental primary energy consumption coming from renewable sources.

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China to push for integrated development of oil and gas with renewables

China's National Energy Administration has issued an action plan that aims to accelerate the integration of oil and natural gas development with renewable energy from 2023-25. China plans to use renewable energy sources such as wind and solar to provide onsite green power for enhanced oil and gas recovery techniques. Gas output could be increased by 3 bcm/yr through pressure-boosted mining techniques, while crude oil production could be raised by more than 2 mt/yr by using renewable-powered CO_2 flooding and thermal recovery techniques. In addition, the NEA proposes further exploration for both onshore and offshore oil and gas deposits that would also draw on renewable power sources.

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China to formulate national standards for Virtual Power Plants

Virtual power plants (VPPs) have an ever increasing role to play in providing power system flexibility, and there is huge potential for large-scale applications. Recently, the National Standardisation Management Committee approved the establishment of a unified standardized management system for VPPs. This includes two national standards: one will specify the management of VPPs, and the other will establish technical specifications for resource allocation and evaluation of VPPs. China's VPP development is still at an early stage: it is primarily led by national and local government administrations and implemented by grid companies. The move will standardise the interpretation of VPPs and their implementation, further promoting their participation in the power market.

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Solar power capacity exceeds 400 GW in China

China's total installed power capacity reached 2.6 TW at the end of February 2023, an increase of 8.5% year-on-year. Of this, the installed capacity of solar power reached 410 GW, comparable to that of hydropower. The 2023 National Energy Work Conference predicts that the country's solar power capacity will reach around 490 GW in 2023. In the first two months of the year, investment in solar power generation reached CNY 28.3 billion (EUR 3.8 billion), nearly three times higher than in the same period in 2022.

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China's economic recovery to drive 40% of global oil demand growth

China's post-Covid return to full economic activity is the single biggest driver for the recovery in global oil demand in 2023, accounting for roughly 40% of the global 2.6 million barrels a day increase, according to Wood Mackenzie's new analysis. The firm anticipates that private consumption will account for most of the surge in China's oil consumption. However, under its high-growth scenario, the figure may be even higher.

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China to allow negative power prices in solar-rich province

Power traders in China's Shandong province can now ask to be paid to accept electricity as the province's growing rooftop solar capacity threatens to overwhelm the grid. The official lowest price on its spot market has been set at below zero, according to a draft rule released by the Shandong Development and Reform Commission. Negative prices are common in advanced power markets, encouraging generators to switch off. The new move represents another step forward in China's slow march towards liberalisation of its power sector.

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New move to encourage utilisation of used EV batteries

With China's new energy vehicles stock now reaching around 14 million, proper handling of used batteries is now a major concern for the industry. According to forecasts, by 2025 there will be up to 137.4 GWh of used EV batteries in China, requiring 900 000 tons of recycling capacity. The State Administration for Market Regulation and the Ministry of Industry and Information Technology intend to introduce a certification system for used EV batteries that will encourage regions to use the residual capacity in used batteries in state infrastructure, key projects, and municipal public projects. The notice also calls for an improved insurance and financing environment that can accelerate innovation to allow the recycling of used batteries.

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Sinopec launches massive integrated green hydrogen demo project

An integrated wind-solar demonstration project for green hydrogen production recently launched in Ordos, Inner Mongolia. The project, developed by Sinopec Group, is the largest green hydrogen coupling coal chemical project in the world. The project is intended to make full use of locally rich wind and solar resources, with designed installed capacities of 450 MW and 270 MW respectively, as well as 288 000 cubic metres of hydrogen storage capacity. It is expected to produce 30 000 tons of renewable hydrogen as well as 240 000 tons of clean oxygen per year, which will be used to reduce carbon emissions at a nearby coal processing pilot project.

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Goldwind tops the global wind turbine maker list in 2022

Chinese wind turbine manufacture Goldwind edged out Vestas as the world's top wind turbine supplier in 2022, the first time a Chinese manufacturer has held the position, according to BloombergNEF. Goldwind supplied 12.7 GW to projects in 2022, while Denmark-based Vestas came in second with 12.3 GW. Of the top ten wind turbine manufacturers worldwide, six are Chinese. Analysts warn that global commissioning of new wind turbines fell by 15% to 86 GW in 2022 due to the economic slowdown in the US and China. This is largely due to supply chain constraints and uncertainty around state subsidies which has hit project development.

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Mingyang launches recyclable large-scale wind turbine blade

China's Mingyang Smart Energy has launched a large-scale blade made from recyclable materials, achieving over 95% blade material recyclability. The blade's performance meets certification requirements without changing the original production process. A new chemical degradation recycling method means that Mingyang can separate and recycle resin, fibers and core materials, so they can be reused in other industries.

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China and Russia to boost energy cooperation

China and Russia have agreed to develop their existing energy cooperation partnership, with Moscow ready to scale up natural gas exports and provide uninterrupted oil supplies to China, according to a joint statement released in March 2023. During President Xi Jinping's visit to Russia, the two country leaders discussed in detail Power of Siberia-2, a proposed pipeline which could deliver up to 50 bcm of Russian gas to China via Mongolia each year. However, analysts comment that China may not need additional gas imports until after 2030.

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China to establish benchmark for quality carbon emission monitoring data

China has launched the 'Key Measurement Technologies and Standards for Carbon Emission Monitoring Data Quality Control' project as part of its national key research and development plan. The project aims to establish a greenhouse gas benchmarking system and a value transfer system, in order to establish a measurement basis to ensure the authenticity, accuracy, and consistency of carbon emission monitoring data, and to promote the standardisation of relevant processes. The move is crucial for evaluating the progress in achieving carbon peaking and carbon neutrality targets and formulating effective emission reduction control strategies. The project will be led by the Aerospace Information Research Institute at China's Academy of Sciences.

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Assessment of China's CO_2 sequestration potential to be made public in 2023

At the 7th International Forum on CCUS held on 17 March 2023, Li Jifa, director of the China Geological Survey of the Ministry of Natural Resources, revealed that there is huge geological carbon sequestration potential in China's offshore areas with a predicted capacity of 258 trillion tons. This is approximately 224 times China's CO_2 emissions in 2022. The results of an assessment of onshore geological carbon sequestration potential are to be released later this year.

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Featured Publication

Demand-side data and energy efficiency indicators

Energy efficiency indicators are key to tracking energy efficiency progress for a variety of purposes, ranging from policy making, monitoring targets, making energy projections, developing scenarios and planning, and benchmarking. This IEA guide offers professionals and decision makers options and examples of good practice across the world on collecting energy end-use data and the development of energy efficiency indicators at the national level. This is a strategic document looking at the whole value chain in the development of efficiency indicators, from the initial point where the need for data and indicators arises, to the subsequent dissemination and use of data, providing a useful resource for practitioners across the globe.

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Embracing the new paradigm of green development

China Carbon Neutrality Policy Framework research report

China's commitment to become carbon neutral by 2060 is a signal not only of its determination and ambition to switch away from fossil fuels but also its readiness to embrace a new model of modernisation that can benefit both China and the wider global community. This report, published by Grantham Research Institute on Climate Change and the Environment, includes contributions from experts in China and the UK who offer different options for the Chinese government to turn its new growth model toward green development. It sets out the guiding principles for this new development model and defines the actions required to reshape key sectors. It also considers China's role in leading and promoting global carbon neutrality governance mechanisms and opportunities for international collaboration to realise a mutually advantageous, sustainable future.

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Net-Zero Roadmap for China's Steel Industry

This joint study by Lawrence Berkeley National Laboratory and Global Efficiency Intelligence aims to develop a roadmap for deep decarbonisation of the Chinese steel sector, based on an analysis of the current status of and challenges faced by the industry. In considering the five major decarbonisation pillars (demand reduction; energy efficiency; fuel switching, electrification and grid decarbonisation; technology shift to low-carbon steelmaking; and the adoption of CCUS), the study illustrates different decarbonisation scenarios for 2050 that could substantially reduce CO_2 emissions from China's steel industry. The report argues that although meeting the Net-Zero Emissions scenario requires unprecedented uptake of low-carbon technologies, the primary goal should be to phase out carbon-intensive Blast Furnace-Basic Oxygen Furnace (BF-BOF) steelmaking.

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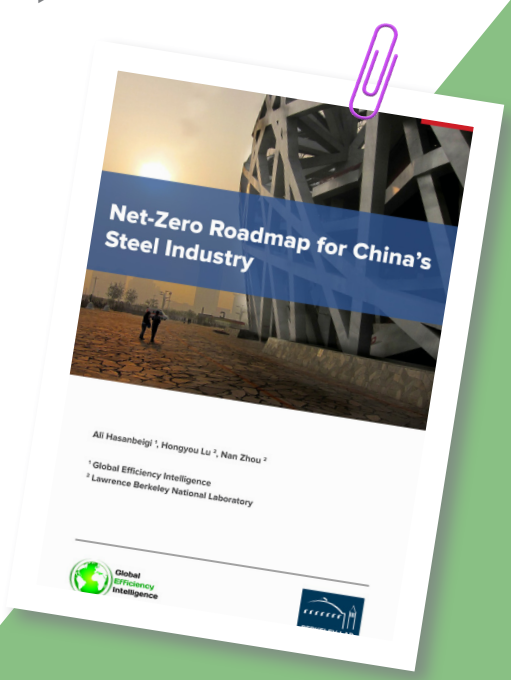
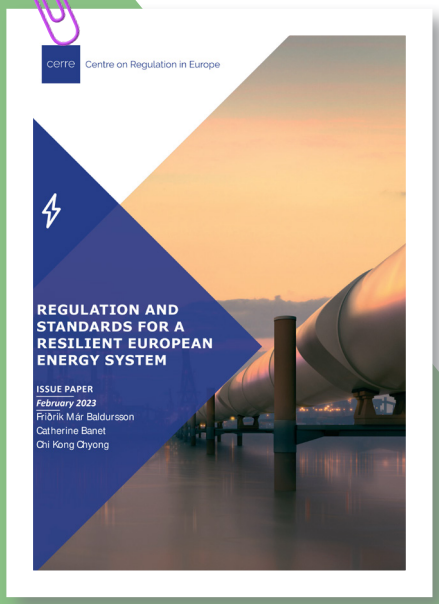


Regulation and Standards for a Resilient European Energy System



Ensuring and building energy system resilience to overcome extreme events requires structural adaptations. This paper from the Centre on Regulation in Europe explores new EU regulatory and legislative approaches that could increase infrastructure resilience. The study delves into the regulatory regime for gas and/or electricity system operators and their relationship with other actors, reflecting on the allocation of responsibilities among actors and cross-sector coordination for ensuring system resilience. It identifies regulatory pathways for fostering a resilient energy system through proper regulation of operators. Incentives for enhancing resilience to disruptive events are mapped and analysed from legal and economic perspectives.

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Assessing China's power sector low-carbon transition: a framing paper

China's low-carbon energy transition depends on the power sector taking the lead. Prepared by Oxford Institute for Energy Studies, this paper seeks to assess some key issues that are fundamental to the clean transformation of this crucial sector, including changes to the power mix and progress on electrification, as well as the role of power market reforms in driving the clean transition. The paper also notes that international cooperation on power sector research has long focused on evaluating the potential benefits of the target market model in accelerating the adoption of clean energy, electrification and renewables. The authors identify some other micro aspects such as EV charging, distributed energy, and green power markets, where greater international joint research and cooperation could be beneficial.

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Decoding China's Energy Transition

China has a key role in the global net-zero transition, given its share of global CO_2 emissions and its leadership in low carbon technology innovation and market deployment. China is also the country where the most aggressive steps are being taken to enable energy transition, under the government's '1+N' policy framework. However, the complexities of China's energy transition can be hard to grasp, especially for those outside China.

The blueprints for most of China's 14th Five-Year Plan were published during 2022. Throughout the year, senior researchers from Beijing Energy Club and PKU Energy Institute published weekly English-language reports to 'decode' China's energy transition, each focusing on a specific subject. This publication is a compilation of those reports, providing a highly comprehensive and detailed picture of what is going on in the world's largest energy market.

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