*Magazine of EU-China Energy Cooperation Platform*

# EU-China Energy Magazine

2022 February 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

2022

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*Dear All,*

*Welcome to the first issue of EU China Energy Magazine in 2022, the year of the tiger. The tiger symbolises resilience and strength – resources we need in abundance as the world rebounds from the Covid pandemic.*

*We have several exciting articles in this issue. The future of the hydrogen economy is imagined with an invited article by Erik Rakhou, author of a newly published book 'Touching Hydrogen Future'. We also look at the benefits of open-source information, putting the spotlight on some of the EU Horizon 2020-funded research projects featuring open-source software models and tools that can assess the benefits, costs and trade-offs associated with the transition to climate neutrality. Not forgetting an analysis of the energy story behind the Beijing Winter Olympics 2022.*

*Our round up of energy news in the EU and China includes key stories that have hit the headlines over the past weeks, picked out by our ECECP editor, Daisy Chi.*

*We hope you will enjoy reading it.*

*Flora Kan*

*ECECP*
*Team Leader*

# Reflections on Energy Market Design

Energy markets are designed to achieve certain societal goals. When they don't achieve them, questions are naturally raised as to whether the market design should be changed. Recent high and sustained gas prices and associated very high prices for electricity have focused attention on the nature of gas and electricity markets in Europe and whether they are working in society's interest.

## What do we mean by market design?

When talking about energy markets we need to be careful to clarify what we are talking about. Are we talking about wholesale or retail markets? Gas or electricity? Or something else?

Also how would we judge if a market design is not working and needs to be changed? It would need to both be working in a way that could not have been predicted, and be capable of being changed into something that would work better.

High energy prices are not necessarily a failure of market design if energy is genuinely scarce. So far Europe's electricity and gas markets have delivered energy security. Gas and electricity supply

have not had to be curtailed in Europe.

Nor are high prices necessarily just a function of market design itself, they could be the result of a failure of market participants to correctly predict high prices and adequately invest and/or contract against them. Gas prices were very low in April 2021 and there seems to have been a general failure to foresee significant increases in the demand for gas coming.

## What have we (re-) learned about market design?

While markets may work in the long run (via high prices leading to investment and lower prices in the future), consumers live in the short run and may not be able or willing to wait for the long-run effects to come through, demanding regulatory action to bring forward lower prices.

However, we have learned several new things as a result of the prolonged high prices (at time of writing, we are now in our fifth month of very high prices).

First, Europe is very reliant on imported natural gas and exposed to both the behaviour of Russia and prices in the global liquefied natural gas (LNG) market. Natural gas prices continue to drive electricity prices in Europe in spite of the progress made with the roll out of renewables. As we move to net zero, sudden upswings in the demand for natural gas will become more, not less marked, even if average annual demand for gas declines.

Second, aggregate wind output can be low for a prolonged period and this now has a significant effect on the demand for natural gas for power generation. This necessitates a change to the contractual arrangements for natural gas to ones which are much more flexible (for example wind speed indexed gas contracts).

Third, retail business models have to be regulated more closely. We learnt in the financial crisis that anyone with a computer can make money in good times by buying short and selling long and undercutting more responsible players who match their buy contract lengths with their sell contract lengths. When the good times end it is society and/or more responsible buyers and sellers who have to make good on the losses that result from such irresponsible trading. National Regulatory Agencies (NRAs) have to regulate this more closely for households and for small and medium-sized enterprises (SMEs), who cannot be expected to pay attention to the financial soundness of energy retailer business models.

Fourth, we have been reminded once again how unusual electricity market design is. In spite of the fact that the underlying investments in generation and network assets are long term and substantially drive the true economic cost, wholesale electricity prices are determined

on the price of the marginal unit, which can be much higher than the average unit for prolonged periods. Even though consumers might be willing (and almost certainly are willing) to commit to paying prices which lock in longer run average costs, they are not able to commit to doing so under the current retail market design. While fossil fuel costs were a substantial part of long run total costs this might have been acceptable, but as fossil fuel costs decline as a share of average total costs, this payment model will seem increasingly bizarre to non-electricity intensive customers.

Fifth, general tightness of supply and demand creates opportunities for strategic residual monopoly behaviour as the market power of individual players behind constraints is increased. This could be occurring in local electricity congestion markets and in the European gas market as a whole. This is something that requires real time market monitoring and rapid intervention by NRAs and competition authorities. Political support for any market in a democracy is premised on appropriate regulatory oversight of anti-competitive behaviour.

Sixth, residential and small business price caps have been very controversial in the current crisis. The inability of prices to naturally adjust to higher wholesale gas and power prices has worsened the position of energy retailers. However, it has, in some cases, postponed large price rises. Clearly the way price caps are calculated has to reflect true underlying costs and should be robust to any change in cost during the price cap period. Regulators need to review the length and flexibility of price caps, and what price caps must imply for the contractual position of retailers. A six-month price cap based on forward wholesale prices could be ok if the retailer has also locked in wholesale costs for six months. The failure to let retail prices naturally rise has led to much higher demand than would have been the case if wholesale costs had been passed through more rapidly to final consumers, though it has no doubt protected poor and vulnerable customers.

Finally, there has been a resounding silence in the current crisis on the issue of demand-side flexibility. This crisis has been about the supply side. But what about the demand side? A big reduction in energy demand would have helped mitigate the price rises and reduced the financial burden of the crisis.

## So does market design need to be changed? And if so how and when?

We have the market design in Europe we see today because it does actually minimise the use of expensive fossil fuels. Efficiency in fossil fuel use was the whole idea behind creating wide area electricity and gas markets across Europe. Prolonged periods of high fossil fuel prices will surely prompt reduced fossil fuel use and investment in low-carbon alternatives, just as it did following the first and second oil shocks. Any gaming by fossil fuel producers in the current crisis is surely counterproductive in the long run.

Wide area electricity and gas markets in Europe also reduce the significance of the price impacts for individual jurisdictions that would be the worst affected by the shortage of gas. For instance, if Norway were not interconnected with the rest of Europe via electricity interconnectors, electricity prices would be even higher in the rest of Europe. Sharing the adjustment to underlying scarcity across Europe mitigates the worst local price rises and improves security of supply under stress conditions.

More renewables will not necessarily solve the ongoing issues with the current market design for the electricity market in Europe. The crisis has revealed that low renewables output might incentivise building more renewables but won't guarantee them being available more often. What will be increasingly difficult to explain to consumers as renewable capacities

increase is why the energy prices are still so linked to fossil fuel prices.

Energy market design cannot be changed quickly and should not be changed in response to a short run problem. The single markets in electricity and gas took almost two decades to develop and remain a work in progress. They have kept electricity and gas flowing in Europe and increasingly protect peripheral EU nations from the increased energy insecurity that they might otherwise experience.

However net zero seems set to make Europe increasingly reliant on the availability of European wind. What we need is an energy market design which can handle that wind-induced volatility. While we can hope for a global market permanently awash with cheap green hydrogen, that remains a distant dream. Thus short run price signals remain necessary and the contractual position that energy consumers are exposed to must be carefully considered. As the importance of capital costs rise in the energy system and fossil fuel price exposure reduces, how consumers pay for energy should change to reflect the capacity they create the need for.

There would therefore seem to be an increased role for longer term contracting within the European energy system where consumers are able to lock in a significant part of their energy costs at fixed prices. Contracts for Differences (CFDs) written by the government can help do this for low carbon generation, as can regulatory asset based funded investments in generation and network assets.

Better ways to induce demand-side flexibility, other than by sharp rises in prices, need to be investigated. More controlled shifting of device demand across the day could increase flexibility without the use of indiscriminate price based rationing. Deeper demand response can be complemented by increasing the availability of low carbon base load power (for example from nuclear, biomass, or hydrogen), which could be of increased value if intra-day demand side flexibility could be improved.

As we move to net zero, market design will need to evolve. What most energy customers will care about is not the design of individual wholesale markets but the retail market for energy. However, the nature of the retail market and its regulation will have implications for the design of wholesale markets.

*By Michael Pollitt*
*CERRE Academic Co-Director*
*University of Cambridge*
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# How will China control its methane emissions?

*The US–China joint declaration has given political impetus to controlling methane by 2030. The focus will be on monitoring and calculating emissions, and on policy measures.*

An open pit coal mine in Ejin Horo Banner, Ordos city, Inner Mongolia, China
(Image: Wang Zheng / Alamy)

A declaration made by China and the US at the COP26 climate summit has pushed methane into the limelight. Both countries have acknowledged the significant impact of emissions of the gas on rising global temperatures.

The US–China Joint Glasgow Declaration on Enhancing Climate Action in the 2020s, published last November, commits both countries to working together to bolster monitoring, management and research of methane emissions over the next ten years. China said it will produce a comprehensive and forceful national plan to control and reduce emissions, while the US had already announced its own emission-cutting action plan.

The latest official figures available show China released 55.3 million tonnes of methane in 2014. When converted to $CO_2$ equivalent, that is 10.4% of the country's total greenhouse gas emissions, second only to $CO_2$ itself (81.6%). The gas has a shorter 'lifespan' in the atmosphere – about 12 years, compared to over 100 years for $CO_2$. But methane's warming potential (the ability to trap heat in the atmosphere) is 80 times that of $CO_2$ over 20 years. Controls will therefore help to reduce near-term warming.

Last May, the Climate and Clean Air Coalition and UNEP (the United Nations Environment Programme) released a Global Methane Assessment, finding effective measures could cut anthropogenic methane emissions by 45% in the next 10 years. That would reduce the level of warming reached in 2045 by almost 0.3C. It might not sound like much, but global average temperature has already risen 1.3C since the Industrial Revolution. Avoiding 0.3C of warming could therefore see the world stay within the Paris Agreement's preferred warming limit of 1.5C.

In the past, far less attention has been paid to methane than to carbon dioxide. But methane controls will be a powerful tool for limiting warming. According to the US–China Joint Glasgow Declaration, China is to take a range of actions to cut methane emissions, both by building a system for monitoring, measuring, reporting and verifying emissions, and by developing policies, technologies and standards.

## The life and times of methane

Methane featured surprisingly heavily in the joint declaration.

In the run-up to COP26, the US and EU issued a Global Methane Pledge, with another 108 countries signing up during COP26, committing to reduce anthropogenic methane emissions by 30% by 2030 on a 2020 baseline. China did not join.

Methane, however, accounted for a sixth of the length of the joint declaration with the US, concluded in the latter half of the COP26 talks. This demonstrates China's determination to control methane emissions. The schedule set out in the declaration is clear: by this year's COP27 the two parties will 'develop additional measures to enhance methane emission control, at both the national and sub-national levels'. And China, in addition to its newly submitted NDC, 'intends to develop a comprehensive and ambitious National Action Plan on methane, aiming to achieve a significant effect on methane emissions control and reductions in the 2020s.'

China's circumstances drove the decision to not sign up to the Global Methane Pledge but to commit to action on methane in the joint declaration, experts told China Dialogue. Teng Fei, deputy director of the Institute of Energy, Environment and Economy at Tsinghua University, points out that methane emissions in the US and EU are concentrated in the oil and gas sector, whereas China's come mainly from coal mining. Tackling methane emissions from coal mines is harder and more costly, and the potential for reductions is less.

'Given the differences in the make-

up of methane emissions and ease of reduction, the targets proposed by the EU and the US are easier for them to achieve than for China. I think that's the reason China didn't sign up to the Global Methane Pledge.' Teng Fei told China Dialogue.

'But China is already aware of the potential of reducing methane emissions, and its importance to mitigating climate change,' he added. 'Now is the time to make realistic commitments, setting targets appropriate for China. That approach was the 'greatest common factor' that the two countries found in their joint declaration.'

Meanwhile, Ministry of Foreign Affairs spokesperson Wang Wenbin said at a press conference that developing nations commonly lack the basic data, monitoring technology and effective measures needed for controls of non-$CO_2$ greenhouse gases, and that needs to be remembered when setting ambitious targets.

Given China's stance on controls of non-$CO_2$ greenhouse gases in recent years, the prominence of methane in the US–China Joint Glasgow Declaration could have been predicted.

In 2016, 'Controlling non-$CO_2$ greenhouse gases' was included in the the 13th Five Year Plan (2016-2020) outline. Then, last March, the 14th Five Year Plan (2021-2015) outline went further, saying China would 'strengthen controls on other greenhouse gases such as methane, hydrofluorocarbons and carbon tetrafluoride'.

But how will that be done? At a seminar on methane held in March 2021, Li Gao, head of the Ministry of Ecology and Environment's Department of Climate Change, explained that the 14th Five Year Plan period will see China produce action plans for controlling methane, with new policy, technology and standards introduced in sectors including oil and gas, coal and waste. Market mechanisms will also be used to encourage emissions cuts.

## More accurate data needed

A lot of work is still needed on the basics. The priority areas will be monitoring, calculating, reporting and verifying methane emissions in key sectors, such as energy, agriculture and waste.

Globally, methane data is obtained more by calculation than by actual measurement. Sample monitoring is carried out at emission sources, with the data obtained used to calculate average 'emission factors', and then national methane emissions. This is known as bottom-up calculation. Top-down calculations, on the other hand, use satellites, airplanes, drones and vehicles to monitor methane at the country, regional or facility level.

But research shows that neither method is adequate, and there is room to improve the quality and coverage of data.

Between 90% and 95% of China's methane emissions in the energy sector come from coal mines. For the 2014 National Greenhouse Gas Emissions Inventory, the most recent to be made public, China used default emission factors provided by the IPCC in 1996 to calculate methane emissions from open-air coal mines. To calculate emissions from abandoned mine shafts, China used the IPCC's simplest methodology and simplified assumptions. But Teng Fei says these factors and methodologies may not be suitable in China – and any inaccuracies will have a big impact on the overall data.

The US may have the same problem. Research between 2012 and 2018, headed up by the Environmental Defense Fund, a US environmental organisation, measured 13 million tonnes of methane emissions throughout the oil and gas industrial chain – 60% higher than the figure calculated by the Environmental Protection Agency using emissions factors. Calculation methods need to be improved globally, with more

on-site methane monitoring to make inventories more accurate and support localisation of emission factors.

Teng Fei highlighted abandoned mine shafts: 'China has been shutting down small mines, and the number of working shafts has plummeted. The majority are no longer in use. But China doesn't have a handle on the associated geological and methane emissions data.' He thinks there should be more on-site monitoring and establishment of emission factors suited to China.

There are also limits to 'top-down' monitoring. Thick clouds can interfere with spectral imaging by satellites, reducing accuracy. And not all the methane in the atmosphere is from human activity – there are other sources, such as wetlands. 'When processing data, researchers need to carefully account for the background concentrations of methane in the atmosphere and sources of interference,' said a Chinese research paper published in 2021.

The research added that both methods have problems. China, along with the rest of the world, needs to combine both approaches, merging the data to obtain a better picture of what is actually happening.

## The industrial emissions problem

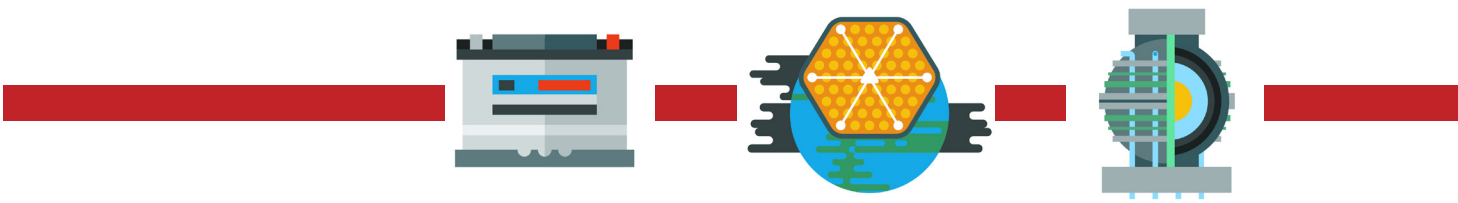
At a late November press conference, the Ministry of Ecology and Environment's Department of Climate Change said China will also: research controlling methane emissions; produce an action plan for the gas; encourage trials of methane emission reductions; and increase international cooperation.

Currently, China has few rules on emissions of methane. Those it does have are focused on emissions from urban water-treatment plants. The biggest emitters – coal mines, oil and gas facilities – aren't subject to any binding standards, although some firms are looking at the problem and carrying out monitoring.

The lack of policy guidance or economic reward means companies aren't motivated to tackle those emissions.

According to a report in China Energy News last April, the coal industry releases methane during extraction, processing, transportation and consumption, and reducing those emissions will cost. 'Companies are unlikely to spend more, unless it's due to safety concerns or to harness a profitable source of coalbed methane,' the reporter suggested.

There are policies in place encouraging the harvesting of methane gas where its concentration is over 2% by volume, and in particular over 8%. But 80% of emissions are from sources where methane is less than 1%. That's very hard to make commercial use of, so the gas is allowed to enter the atmosphere. Han Jiaye, head of the Ministry of Emergency Management's Energy Safety Institute, said in an interview with China Energy News that even demonstration projects for use of



*Designed by macrovector / Freepik*

methane had been paused because they were uneconomic. 'Making use of methane where possible [to incentivise the capture of it] is essential to cutting those emissions.'

China's methane action plan, announced in the US–China Joint Glasgow Declaration and due by COP27, may help.

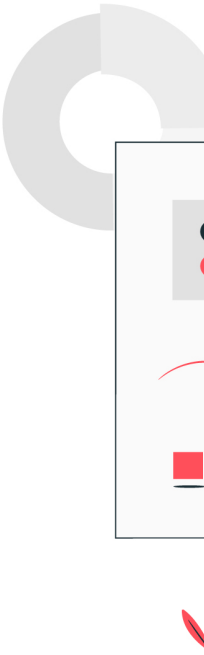
Teng Fei thinks China needs to decide whether to use sticks such as binding emissions standards or carrots such as subsidies. 'It costs companies to recover methane. If there's neither reward for doing that, or punishment for failing to, policy targets will be hard to deliver.' He says the government should consider complementary financial measures when setting targets, and strengthen coordination between these carrot and stick policies.

Some oil and gas firms are already acting. In June, China Gas signed up to the UNEP-led Oil and Gas Methane Partnership (OGMP), becoming its first Chinese member. The OGMP aims to help member firms understand and manage their methane emissions and promote information and technology sharing. Other members include 66 big energy firms from around the world, not least Shell, BP and Total. And in May, seven Chinese energy firms, including the China National Petroleum Corporation and Sinopec, formed the China Oil and Gas Methane Alliance, with an aim of reducing methane emissions intensity during natural gas production to below 0.25%. In October, the Hong Kong and China Gas Company headed up ten Chinese coal gas suppliers signing up to a methane initiative, indicating they too are on board with cutting emissions.

As China begins to draw up its plans for methane emissions control for the next decade, such moves by its industries are welcome signs of momentum in acting on this potent greenhouse gas. But the intention to act must now be met with effective implementation to ensure the chances of successful mitigation by 2030 – and the broader warming goals of 2050 – remain alive.

*By Gao Baiyu*





# Open-source data joins the battle against climate change

Global challenges require global solutions. Yet in a world where competition has long been lauded as the route to riches, companies and countries are too often averse to opening up their wealth of knowledge and experience to others for the common good.

The common goal, of limiting global warming to well below 2˚C, requires a level of cooperation that the world has never seen before. Is it right for companies and nations to profit from their climate successes, and so hold back the progress towards climate neutrality?

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Rather, they have an obligation to share the progress they have made, so the collective movement towards net zero can be accelerated.

The EU is committed to becoming climate-neutral by 2050 to fulfil its commitment to the Paris Agreement. It recently published the results of 14 research projects that have developed models and tools that can assess the benefits, costs and trade-offs associated with the transition to climate neutrality. Many of them feature open-source software that has the potential not only to benefit nations and companies who are planning their own routes to climate neutrality, but can also be developed and improved in the years ahead by subsequent research from around the globe. Funding for the projects has come from the Horizon 2020 research and innovation funding programme.

Open-source tools are software tools that are freely available without a commercial licence. These tools are built to retain data, are low cost, and facilitate monitoring and the gathering of data. In the private sector, there is a noticeable change in companies' attitudes when it comes to applying an open-source philosophy. For example, Elon Musk has made Tesla's patents open-source, rendering the technology readily usable by anyone to spur innovation in the development of electric vehicles. ECECP looks now at some of the research topics that the EU has funded and whose results will be available to climate scientists around the world.

## Identifying regions at risk

The COACCH team – CO-designing the Assessment of Climate Change Costs – set out to identify regions most at risk from climate change, and to provide indicators for policy action. It has developed focused assessments of the risks and costs of climate change in Europe.

What is unique about their approach is their 'inverted approach' to analysis. The team started from local social and economic shocks, such as localised production losses, price increases or job losses, and then worked their way backwards, to assess the climatic conditions that led to these shocks. That approach helped them to identify the root causes of local climate events, such as flooding in homes and business premises.

The COACCH project includes an open-source web interface which will allow anyone access to the project data, assumptions and results, so that researchers can download and explore all of COACCH's results. The hope is that this publicly available data will help research communities to improve their models and result in more effective mitigation and adaptation policies.

If subsequent researchers do, as anticipated, tap into the data compiled, then the project will become a building block in the global search for effective models and ways to mitigate the impact of climate change.

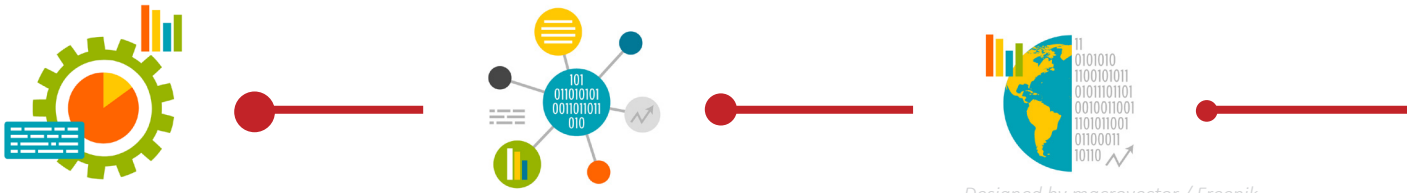
**Website:** www.coacch.eu

## How do individuals fit into the battle against climate change?

'Net zero' is a phrase that is flung around with abandon by politicians and journalists alike. But what will people's lives and jobs look like in a world with net zero carbon emissions? The EU-funded EUCalc project has built an interactive pathways explorer to show how the Paris Agreement objectives will affect citizens around the world.

The project offers policy makers, business owners, scientists and everyday citizens access to interactive charts and information on the work under way to achieve climate neutrality. They can see how actions taken in Europe benefit the world as a whole, and they can compare scenarios where the rest of the world does, or does not, follow suit.

The EUCalc team of 13 institutions, coordinated by the Potsdam institute for Climate Impact



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Research in Germany, has designed the model and tools so they can be accessible to as many people as possible. It looks not only at the impact of technology, but also lifestyle changes. 'We know that technological progress alone is not sufficient to reach net zero in 2050, so EUCalc systematically considers the role of lifestyle changes in supporting the decarbonisation of Europe,' explains project coordinator Juergen Kropp.

The idea is that an individual can see how their own efforts can contribute to the global effort to reduce emissions. The tool looks at terms such as distance travelled each year, type of transport, or amount of food wasted. It aims to show that significant lifestyle changes, if widely adopted, could result in emissions savings of 60% by 2050.

This powerful tool does an impressive job given the amount of data it is able to process. To the average citizen, the wealth of information may be overwhelming and to be honest, it is not in fact easy to see the effect of an individual's lifestyle changes, only the overall impact of general lifestyle change on a sector. However, it is a welcome step towards involving the general public in the climate discourse, which is all too often conducted at many removes from the average citizen.

**Website:** tool.european-calculator. eu/intro

## Open-source modelling

Access to reliable and practical modelling systems that can asses the feasibility, effectiveness, costs and impacts of different policy actions is vital if companies and governments are to reach informed decisions about the most appropriate pathways to climate neutrality.

The LOCOMOTION (Low-carbon society: an enhanced modelling tool for the transition to sustainability) project, coordinated by the University of Valladolid in Spain, is compiling an open-source software in Python which will offer an improved model that draws on other models such as World6, LEAP, GCAM and C-Roads, with an increased level of detail and greater geographical coverage. It has created a new worldwide multiregional model with seven global regions and the integration of the 27 EU Member States.

The project will end in 2023, but the project's findings will be available to scientists and modelling experts in future, with a second interface aimed at non-scientists to provide a user-friendly decision support tool for policy makers.

**Website:** locomotion-h2020.eu

## Low Carbon Transition Pathways

The shift towards renewable and

clean energy sources is set to be supported by an EU-funded Open ENTRANCE project – an open-source platform for assessing low-carbon transition pathways.

This four-year project, coordinated by Sintef Energi in Norway, has developed four scenarios for low-carbon energy futures at a pan-European and national level, covering subsequent 1.5˚C and 2.0˚C global temperature increases.

It includes case studies on topics such as how energy flexibility in households will impact investment needs at a European level and how optimal use of energy among communities will impact the overall load profile.

The information is to remain available in an open-source format for the next 10 years. This way, the platform can be reused and further developed by the scientific community, and the datasets used in other carbon transition research. The project is due to finish in 2023.

**Website:** openentrance.eu

## Sustainable Energy Transitions Laboratory

Another modelling solution featured in the CORDIS Results Pack is the SENTINEL project, which has taken a modular approach to energy modelling. 'Policy makers need to know the economic, social and environmental implications of the difference choices that they face today,' explains Anthony Patt, professor of Climate Policy at the Swiss Federal Institute of Technology Zurich, which coordinates the project. 'We focus on answering these questions not with a single model that is so large and complicated as to be a mysterious black box, but rather by pulling together a set of small, transparent, open-source models and data that can precisely meet their needs.'

The team aims to make these models available for download with clear instructions on how to use them in combination.

Once again, the online platform will remain available after the end of the project's funding period and will remain as a hub for community users who will help to improve the tool by sharing feedback and data. The aim is for SENTINEL to develop as a widely used resource for decades to come.

**Website:** sentinel.energy

According to research published by Sky and the UK-based Behavioural Insights Team (BIT) in November 2021, 70% of people across Europe are willing to change their behaviour to address the climate crisis.

Yet without access to information about what changes are necessary, and what impact they will have, that willingness may vanish into a sea of apathy. The same applies to companies: there is a general acceptance of the need to implement climate-friendly changes to current practice, but how are start-ups and SMEs to find out about and choose between the technologies on offer? How are they to learn what grants, incubators and policy support exist to support them? And when technology is protected by patents, how can that encourage widespread adoption of that technology?

Governments bear a heavy responsibility to reach out to individual consumers, climate innovators and investors, and create policies that will support action to reduce carbon emissions.

By funding these projects, many of which advocate and espouse open-source data, the EU shows that it is happy to contribute to the development of a global understanding of the challenges ahead, and aware of the need to cooperate and share information in order to avert a climate disaster.

*The projects highlighted here are part of the CORDIS Results Pack, a suite of 14 research projects funded by the EU through its Horizon 2020 programme, which have developed a suite of models and tools that are able to assess the benefits, costs, risks, trade-offs and synergies with other policy objectives of strategies and investments associated with the transition to climate neutrality. For more information about these and the other projects in this Results Pack, please follow this link.*

https://cordis.europa.eu/article/id/418144-climate-neutrality-pathways-for-achieving-european-green-deal-objectives

*By Helen Farrell*
*ECECP English Editor*

## Examples of open-source solutions that changed the world

**Penicillin** – The most efficacious life saving drug in the world and one of the first medications that were effective against bacterial infections. The group of antibiotics were discovered by Alexander Fleming, who chose not to patent the drug: 'I did not invent penicillin. Nature did that. I only discovered it by accident.'

→ *Learn More*

**World Wide Web (WWW)** – The information system that provides web resources with an individually authenticatable address, also known as Uniform Resource Locators (URLs) and transferred via Hypertext Transfer Protocol (HTTP). The code of the WWW was written by Sir Tim Berners-Lee, a British computer scientist who wanted to make it open accessible to all: 'Had the technology been proprietary, and in my total control, it would probably not have taken off. You can't propose that something be a universal space and at the same time keep control of it.'

→ *Learn More*

**Linux** – The collaborative open-source operating system was first developed by Linus Torvalds, a leading supporter of open-source software. In an article about Linus Torvalds from 2003, Wired magazine wrote: 'He posted it on the Internet and invited other programmers to improve it. Since then, tens of thousands of them have, making Linux perhaps the single largest collaborative project in the planet's history.'

→ *Learn More*

**Ubuntu** – The project was founded by Mark Shuttleworth, who wanted to create an easy-to-use Linux desktop operating system. A combination of commercial teams and a volunteer community collaborate to create high quality releases on a predictable cadence.

→ *Learn More*

**Microsoft** – The global leading provider of computer software and hardware is not the first to come to mind when thinking about open-source. Since Microsoft began experimenting with 'shared source' in 2002, it has become an enthusiastic supporter of Linux and has built up a powerful open-source strategy. In 2018, Microsoft joined the Open Innovation Network and has cross-licensed 60,000 patents with the open-source community.

→ *Learn More*

*Summarized by Helena Uhde, ECECP Junior Postgraduate Fellow*

# How China is powering the Winter Olympics 2022 in Beijing

*China is branding the Winter Olympics 2022 in Beijing as the first 'green' Olympic games, including the first games to run on 100% renewable electricity.*


中航技

In a new analysis for Carbon Brief, we show that the desire of China's leadership to showcase clean energy development and make it a part of the country's international image, while important in itself, is backed by real developments on the ground.

Zhangjiakou, the mountain city in China's Hebei province that is hosting the skiing events of the games, has renewable energy capacity exceeding that of most countries in the world – and a pioneering 'Zhangjiakou Green Electric Grid' built to deliver power from the city to neighbouring Beijing.

Moreover, the pilot renewable power grid is a scale model of a much larger plan that the Chinese government is rolling out nationwide, as it aims to peak carbon dioxide ($CO_2$) by 2030 and reach carbon neutrality by 2060.

## Olympic 'green' power supply

From the start of the preparations, in mid-2019, to the end of the games, the venues will require about 400 gigawatt hours (GWh) of electricity, according to the organisers. This is equal to the annual electricity consumption of approximately 180,000 Chinese households.

By the end of 2021, the installed capacity of wind and solar power in China was more than 600 gigawatts (GW), with both technologies crossing the 300GW mark last year. Including hydro power, a total of 2,480 terawatt hours (TWh) of renewable electricity was generated in 2021 in China. China's plentiful renewable energy capacity can, therefore, easily cover the Olympics electricity use.

However, instead of simply purchasing renewable electricity on paper, via the trading mechanism, the government has used the games to pioneer a dedicated renewable power grid.

To fulfil the announced 100% renewable electricity target, the government is using the cross-regional 'green power trading'

mechanism, which allows large consumers to buy renewable electricity generated anywhere in the country. The games have been given priority in the trading platform, with venues able to buy renewable electricity at a lower price.

State Grid Beijing Company manages the renewable electricity electricity trading for the games. This electricity mainly comes from 11 wind and solar power generation companies located in Zhangjiakou. The organisers report having purchased 171GWh of 'green' electricity – wind and solar by 30 October 2021 and 237GWh by the end of 2021. These numbers imply that the electricity use at the venues during the Olympics themselves will be around 160GWh.

The winter Olympic games has accelerated the construction of the Zhangbei renewable energy flexible direct current (DC) grid. The Beijing 2022 games rely on this newly-built infrastructure in Zhangjiakou City, a $2bn project launched in June 2020 to distribute wind and solar power, with pumped hydro storage to regulate the variations in output.

*A wind farm in Hailiutu township of the county of Zhangbei in Zhangjiakou, Hebei Province, China.*

*Credit: Oriental Image.*

## Zhangjiakou: the wind power capital of China

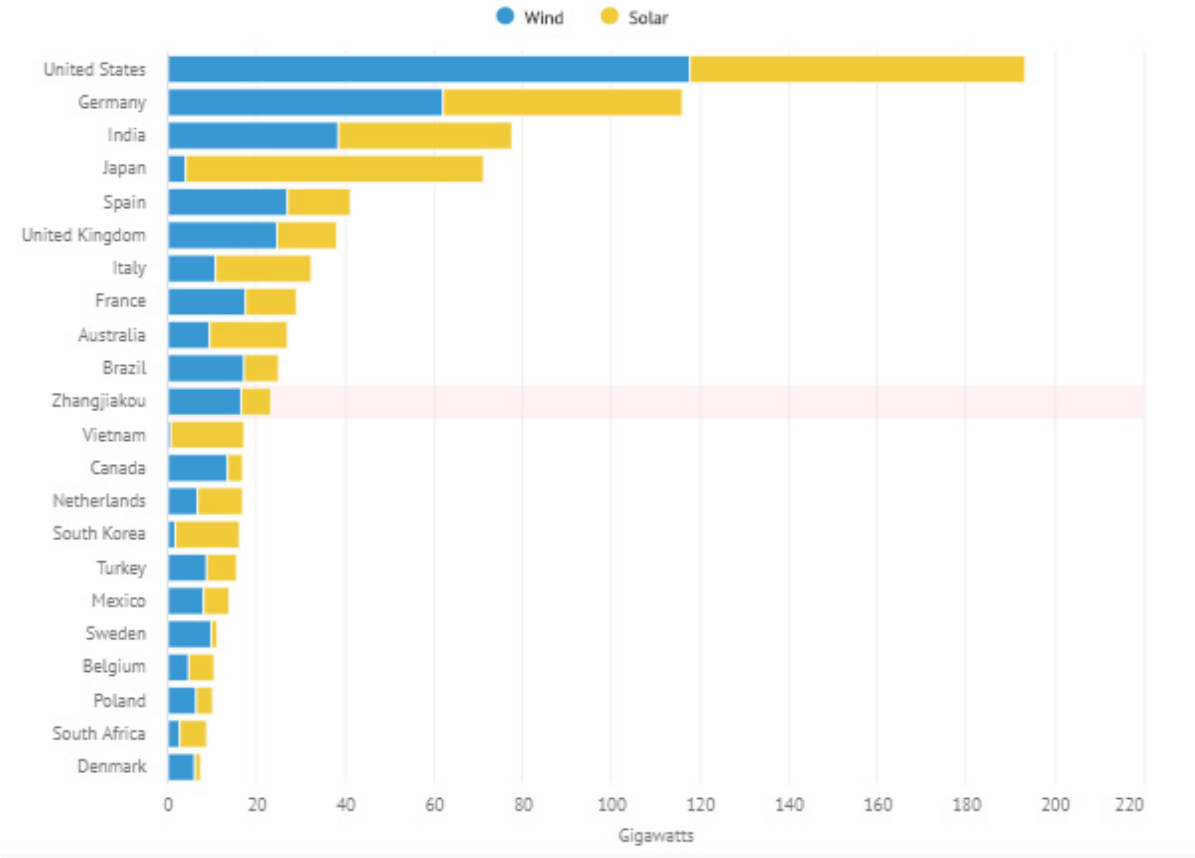
Wind and solar power installations in Zhangjiakou were accelerated as well, with capacity hitting 23.4GW, breaking down into 16.4GW wind and 7.0GW solar. If the city was a country, its combined wind and solar capacity would be the twelfth largest in the world, as shown in the chart below, behind Brazil but ahead of Vietnam.

At an average operating rate for January-February, wind and solar power generation in Zhangjiakou during the 17 days of the games will be around 2,300GWh, about 10 times the projected electricity consumption of the Olympic venues during this time.

The city's installed coal-fired power capacity, at 5.9GW, is dwarfed by the renewables installations. We estimate that more than 60% of electricity generation in the city in January-February will be derived from wind and solar power, as shown in the chart below. Output from wind and solar would also exceed Zhangjiakou's total consumption during the period.

This 60% share for wind and solar stands out particularly strongly from the rest of Hebei province and from Beijing, where fossil fuels generate 90% of all electricity at this time

**Olympic city Zhangjiakou has more wind and power capacity than most countries**




*Wind and solar capacity, gigawatts, of Zhangjiakou city in China (highlighted) compared to the countries with the largest combined capacity in the world. The chart does not show the total for China, which passed 600GW in 2021. Source: IRENA. Chart by Carbon Brief using Highcharts.*

of the year. The average for the whole country is approximately 75% (rightmost column).

## Flexible grid

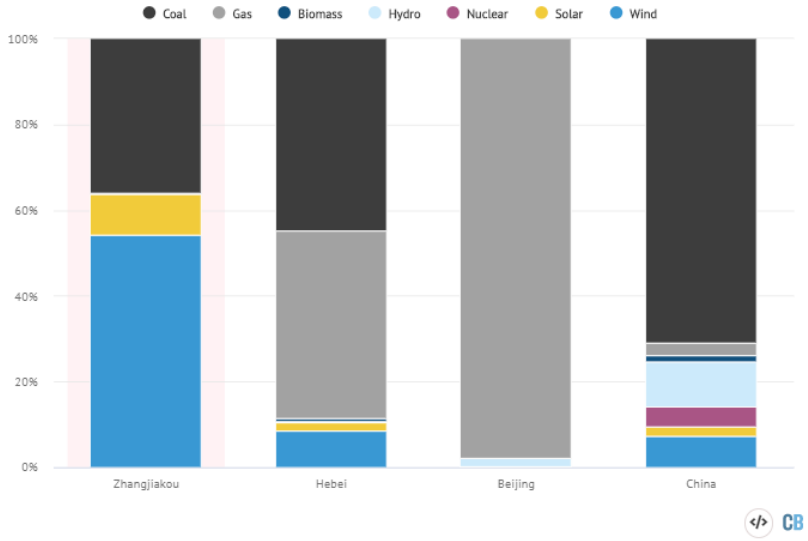
The 'flexible green electricity grid' in Zhangjiakou is the first of its kind to use direct current, a technology much better suited for very long-distance transmission than alternating current.

Besides wind and solar generation capacity, the grid is connected to the Fengning pumped storage plant, which can store renewable electricity to be dispatched later, shown in the map below.

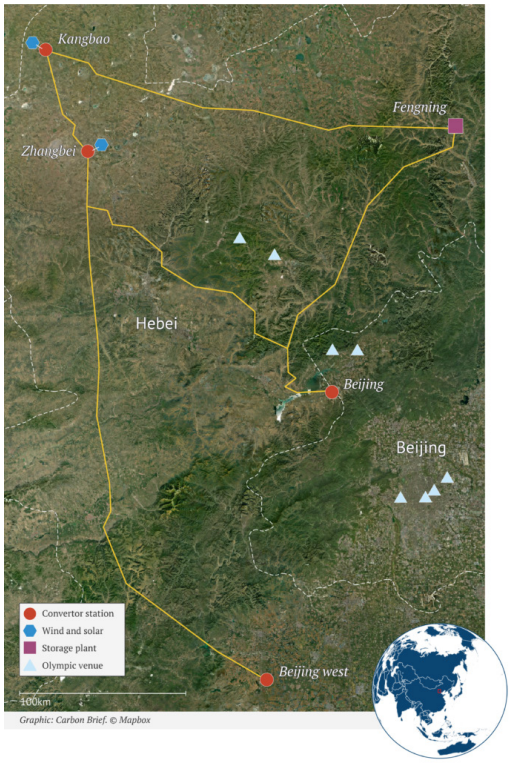
In addition to the grid linking Zhangjiakou to Beijing, the city's renewable energy installations feed a direct long-distance transmission line built to power the new city of Xiong'an, China's 'city of the future', being built outside of Beijing.

A long-standing challenge with China's long-distance transmission lines has been their inflexible operation, which has meant that much of the power dispatched through the lines has been generated from coal. The Zhangjiakou project is about pioneering a new institutional set-up that is required for the power grid to absorb high shares of intermittent generation, at least as much as new hardware.

**Zhangjiakou will get more than 60% of its power from wind and solar during the Olympics**




*Estimated power generation mix, %, in Zhangjiakou city, Hebei province overall, Beijing and China. Source: The mix is calculated based on the latest reported generating capacity from the National Energy Administration – except for Zhangjiakou city, which uses news reports – and the average capacity utilisation for the January-February period over the past five years. Hebei averages are applied to Zhangjiakou. Chart by Carbon Brief using Highcharts.*




*An approximate map of the green electricity grid connecting wind and solar power in the western part of Zhangjiakou to the Fengning pumped storage station and to a converter station near Beijing. There are two converter stations with dedicated wind and solar capacities in Zhangjiakou. The locations of the Olympics venues are shown as well. Source: Project maps for the Zhangjiakou green grid and the Zhangbei-Xiongan UHV line.*

## Continued reliance on coal

However, the measures that coal-fired power plants report taking to ensure stable power supply during the Olympics highlight that China's power grid is still highly reliant on coal.

State-owned power generation groups ordered their plants in the Beijing-Tianjin-Hebei area to stockpile enough coal – more than 30 days – and carry out their maintenance before the end of 2021, so that they are all available to generate during the games.

Coal deliveries are being given priority in rail and road freight. The government's requirement to increase coal stockpiles in the provinces that have an important role in power supply for the Olympics has triggered a recent coal price increase.

As if to highlight the continued reliance on coal-fired power, a new 2,000 megawatt coal-fired power plant was approved in the relatively wealthy coastal province of Zhejiang during the first week of the games.

In addition, the Ministry of Industry and Information Technology and Ministry of Ecology and Environment jointly published a 'notice on peak shifting production for the iron and steel industry in Jingjinji areas in the winter heating season of 2021-2022' to reduce air pollution.

In spite of impressive gains, this shows that short-term measures are still required to ensure acceptable air quality during nationally important events.

## After the Olympics

Zhangjiakou's wind and solar can currently generate about 44TWh per year. The city's own consumption is about 19TWh, leaving about 25TWh for exports.

After the athletes go home, the 'green grid' is projected to transmit about 14TWh of renewable energy from Zhangjiakou to Beijing every year, equivalent to approximately 10% of the electricity consumption of China's capital, leaving a lasting legacy from the games.

Another 7TWh per year will be transmitted to Xiongan, China's 'city of the future', being built outside of Beijing. The transmission to Xiongan takes place through the dedicated Zhangbei ultra-high voltage transmission line.

Meanwhile, Zhangjiakou is aiming to more than double its wind and solar capacity from current levels, to reach a combined 50GW by 2030.

On an even larger scale, China's central planner the National Development and Reform Commission (NDRC) has recently announced the first batch of projects and plans for China's 'clean energy bases' in the west around the Gobi desert, with a capacity of 100GW, and is reportedly finalising the second batch, with 400GW of capacity to be installed by 2030. The bases will be a vast regional network of wind and solar power installations designed to transmit power to the demand centres in the east.

At the same time, fossil-fuelled power generation continued to grow in 2021 and $CO_2$ emissions from the sector are only due to peak late this decade. Investments in new coal-fired and gas-fired power plants continue, increasing 19% on year in the first 11 months of 2021.

This might appear paradoxical, as renewable energy has a clear cost advantage against new coal power, especially after the increases in tariffs paid to coal power plants late last year. In response to the coal shortage and power crisis, the government allowed tariffs paid to coal plants to rise up to 20% above the province-specific benchmark prices.

This means that coal-fired plants are paid more for their power output than new wind and solar power projects, whose tariffs are pegged to the benchmark price for coal power.

Besides opposition from vested interests, the key issue determining the pace of China's transition is the confidence of decision makers that clean electricity can keep the lights on without further additions of coal-fired capacity.

Pioneering regional grids with a high share of renewable energy – and especially a grid that powers the top decision-makers' own offices in Beijing – has broader national significance in this context.

*By Lauri Myllyvirta and Xing Zhang*



*A photovoltaic power plant on the north mountain of Caozhuangzi Village in the Xuanhua district of Zhangjiakou, Hebei Province, China.*

*Credit: Oriental Image.*

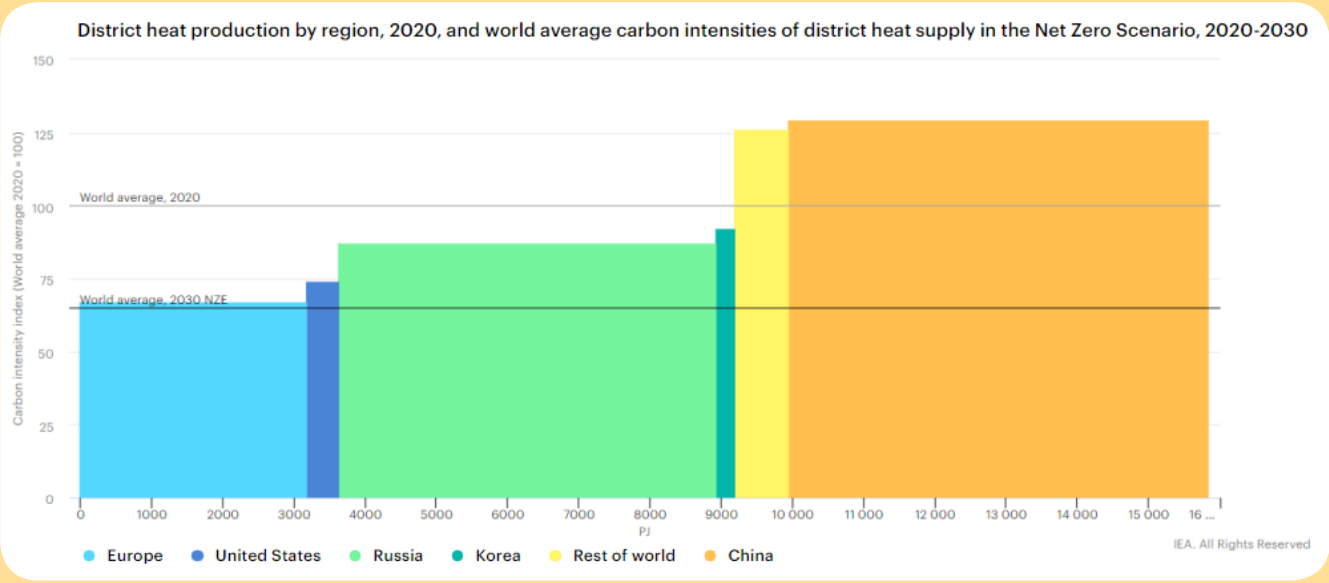
# District Heating:
# **policies for cutting emissions need work says IEA**

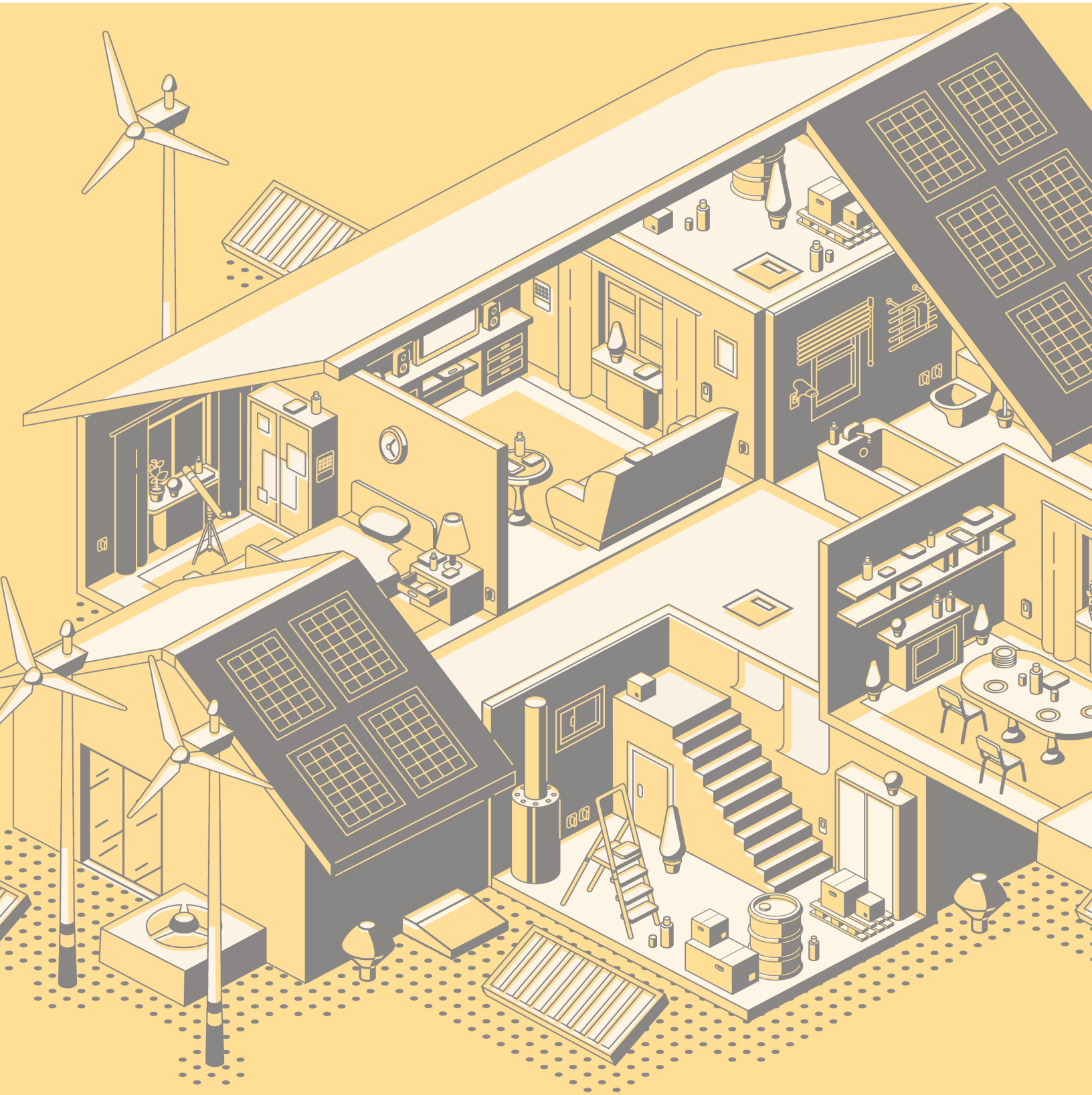
*District Heating policies need urgent attention according to the IEA so here in Europe it's a good moment to examine what the 'Fit for 55' package means for the sector's future development. Providing excellent background to the discussion, Chiara Delmastro at the IEA explains below how and why progress on district heating is not on track to reach its net-zero goals. District heating is a favoured solution for efficiency gains and emissions cuts because the heat is generated centrally rather than in individual buildings. This is a very popular heating solution especially in chillier climes such as Sweden, Denmark and countries like Poland where 6,000,000 homes are connected directly to heating networks. Globally, district heating today supplies only 8.5% of heat used in buildings. And nearly 90% of that heat is produced from fossil fuels: coal (45%), natural gas (40%) and oil (3.5%). What are the challenges and opportunities for District Heating?*

District heating systems are an important part of heating sector decarbonisation, as they allow for the integration of flexible and clean energy sources into the energy mix, which could be challenging at the individual building level in urban dense areas. However, although many cities are already implementing low carbon district heating solutions, around 90% of global district heat production today still relies on fossil fuels.

## Net Zero Emissions by 2050 Scenario

In the Net Zero Emissions by 2050 Scenario, the combined share of renewable sources and electricity in global district heat supplies together rises from 8% today to about 35% in the current decade, helping





to slash heat generation carbon emissions by more than one-third.

## Tracking progress

District heating systems have been in operation since the late 1870s, mostly in densely occupied areas with high and consistent heat demand. Many buildings and industrial sites rely on district heating, ranging from large urban networks in Beijing, Seoul, Milan and Stockholm to smaller networks such as university and medical campuses.

District heating systems are important solutions for decarbonising the heating sector in the Net Zero Emissions by 2050 Scenario. Modern networks with low operating temperature can integrate 100% renewable sources to supply energy-efficient buildings, especially in areas where decentralised solutions would not allow the direct integration of available clean energy sources or efficient operations, for example due to space or infrastructure constraints.

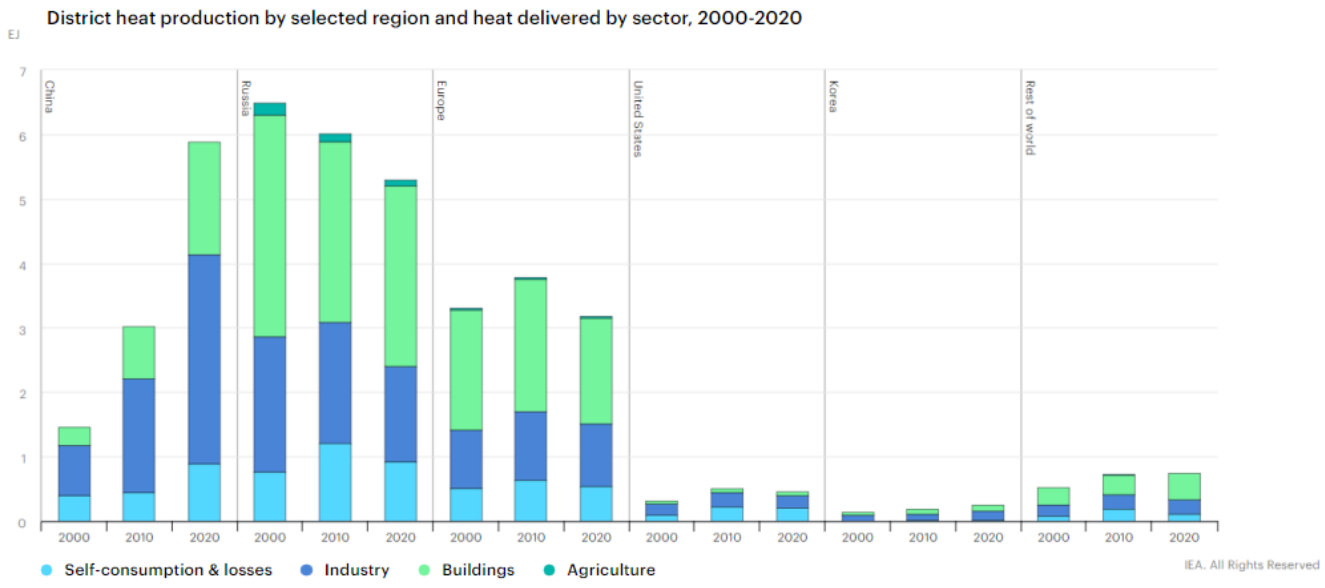
District heating networks operated with electricity could also offer electricity grid flexibility services through demand-response.

Despite these advantages, however, low carbon district heating potential remains largely untapped and future systems need to be redesigned to adapt to a different heat supply mix and meet new conditions for heat delivery.

## The global district heating market is growing

Global district heating production was 16 EJ of heat in 2020, jumping 30% from the 2000 level at an annual compound growth rate of ~1.3% (or 2.4% if normalised for climatic conditions). The impressive 2.3% increase from 2019 to 2020 was spurred mainly by China and partially by Korea (7% growth each).

China, Russia and Europe are responsible for more than 90% of global district heat production, and therefore critically influence the average carbon intensity of district heating. China had the greatest growth since 2000, with it more than quadrupling by 2020, and is the world's largest producer (responsible for more than 35% of global district heat production).



The sector is also growing in the United States and Korea. In the latter, district heat production has expanded rapidly, nearly doubling since 2000.

Before its delivery, part of the heat produced is lost during the distribution process. Many networks operating today distribute heat by pipe through pressurised water at supply temperatures of over 80°C, with losses ranging from 10% to 30% or more in the most inefficient systems. The renovation of existing networks towards lower operating temperatures, improved piping insulation and integration of digitalisation solutions, reduces heat losses significantly- and targets values are below 10%.

Nearly 40% of the heat generated globally in district heating plants goes to the industry sector, which also impacts a network's ability to reduce distribution temperatures, as industrial users often require high temperature heat. Using heat pumps to increase temperatures at local substations can offer solutions in such cases. China leads, with more than 50% of global district heat consumed in its industry sector in 2020, up from around 34% in 2010. By contrast, this share fell to 24% in Russia, down from more than 40% in 2010.

Globally, district heating supplies a relatively small share of heat used in buildings, at only 8.5% of the sector's heat consumption – a share that has remained impressively constant since 2000, considering that floor area increased 65% at the same time. However, although the global average share is low, district heat does cover a high portion of heat delivered in buildings in some European countries, such as Denmark and Sweden (above 45%), as well as in Russia (~45%) and China (~15%).

Despite market growth, the potential of low carbon district heating remains largely untapped

One of the main strengths of district heating systems is their capacity to integrate several energy sources, including waste heat and renewables. Nevertheless, in 2020 nearly 90% of heat globally was produced from fossil fuels, prevalently coal (45%), natural gas (40%) and oil (3.5%), down from 95% in 2000.

The share of coal used to generate district heat globally jumped from 35% in 2000 to 45% in 2020 owing to China, which consumes nearly 70% of coal used for district heating globally and accounted for all coal-based growth since 2000. 2020 was no exception, with coal use rising 1.3%.

Meanwhile, the share of natural gas in district heat generation dropped from 51% in 2000 to 40% in 2020, and oil use declined from 9% to 3.5%. The use of electricity for district heating is still low, at below 0.3% in 2020. Interestingly, Helsinki is currently using its wastewater to run a heat pump for the city's district heating network; and Vienna uses a power-to-heat plant to convert electricity from wind turbines into district heat for 10,000 homes.

## The share of renewables and electricity together should quadruple by 2030

Renewables are already being integrated into the district heating generation mix, but not in large enough quantities. They made up 8% of energy inputs for district heat production in 2020 (mainly as bioenergy), which is similar to 2019 but is an increase from the share in 2015 (7%) and 2000 (less than 4%). The primary renewable resources with potential to be employed in district heating systems are solar thermal, geothermal and bioenergy. Europe leads in the use of renewables for district heating, accounting for most global solar thermal and geothermal use and 75% of bioenergy-based production.

Many networks have successfully integrated renewable energy sources. For instance, Silkeborg, Denmark, has 110 MWth of installed solar thermal capacity, sized to

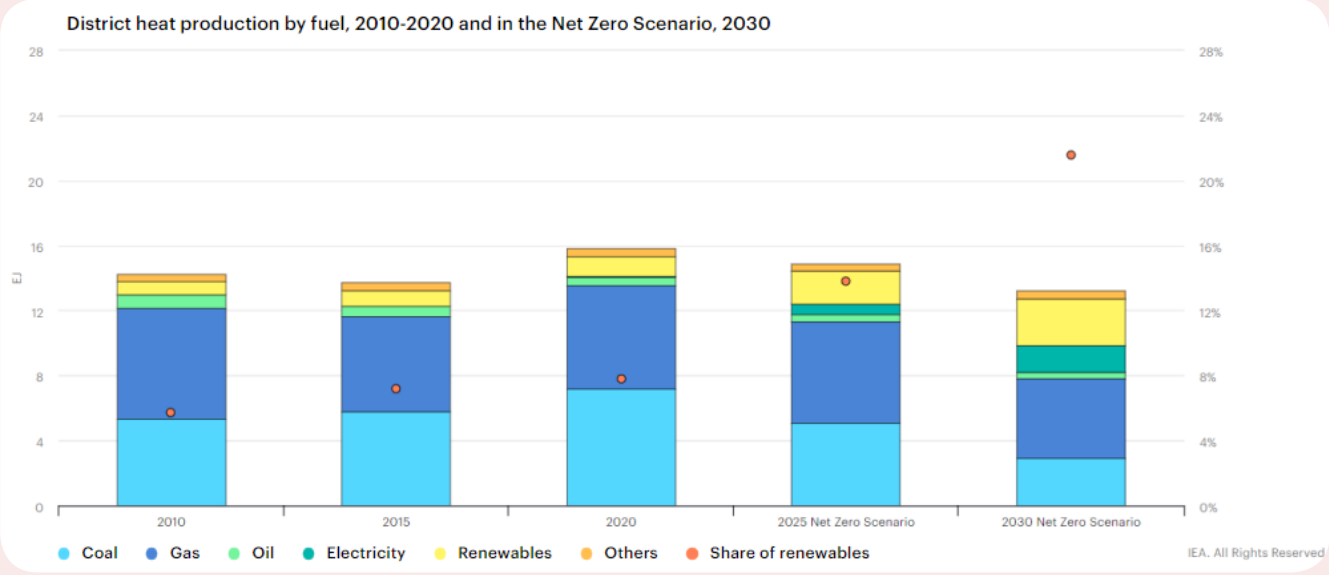
supply around 20% of district heating capacity in 2017, while Munich has several geothermal plants in operation (the first since 2004) for a total of 40 MWth, and it aims to shift to 100% renewable district heating by 2040. A total of more than 260 large-scale solar-based district heating systems were in operation in 2020. Denmark has more than 120 of these systems, followed by China with 18.

Bioenergy currently accounts for the largest share of renewable district heat supplies, especially for use as a conversion fuel in old plants or in areas with high biofuel availability (e.g. biomass-rich mountain areas). For instance, district heating plants were converted to use biomass and waste in Copenhagen (covering more than 95% of all heat generated) as well as Vilnius, Lithuania (supplying 45% of heat produced in 2018).

Annex TS5 of the Technology Collaboration Programme on District Heating and Cooling (DHC TCP) – Integration of Renewable Energy Sources into Existing District Heating and Cooling Systems – is exploring technical solutions to integrate renewable energy sources into both existing and modern district heating systems.

Excess heat is also an important resource that can be exploited by district heating networks. Excess heat can be recovered from industrial facilities and data centres, but also from unconventional sources such as supermarket refrigeration, sewage and wastewater. Ongoing projects are filling the knowledge gap to better understand the potential of this resource. For instance, the MEMPHIS project (DHC TCP) focused on a methodology to map and identify low-grade excess heat at the local level and the ReUseHeat project showcases replicable models enabling the recovery and reuse of waste heat available at urban level.

In the Net Zero Emissions by 2050 Scenario, the combined share of renewables and electricity used in district heat quadruples by 2030: renewable production jumps to more than 20% in 2030, nearly tripling today's level. The share of electricity (using electric heat pumps) also grows to around 12%, while fossil fuel use decreases by more than 40% compared with 2020. For Net Zero alignment, the average carbon intensity associated with district heat production must drop by more than one-third in the next decade.



## Innovative systems are emerging, and their potential must be exploited

More heat source diversification (especially through shifting from fossil fuels to renewables, electricity and excess heat) and the integration of large-scale heat pumps will propel the transition towards lower-temperature and more flexible district heating networks – a progression from third-generation to what is called fourth-generation district heating.

Meanwhile, the concept of fifth-generation district heating, which arose in 2015, refers to combined district heating and cooling networks operating at ambient temperature and using distributed heat pumps. In addition to network adjustments, the deployment of low-temperature district heating networks must be co-ordinated with energy efficiency improvements of buildings, however, as better energy performance of buildings are compatible with low temperature heat supply.

Modernisation of existing networks is also key to reduce losses and inefficiencies and to enable the shift to new-generation district heating systems. For this reason, the KeepWarm project, founded by the EU Horizon 2020 programme, aims to accelerate the modernisation of district heating systems in Eastern Europe and provides several case studies in the region. Similarly, the REWARDHeat project aims to demonstrate a new generation of low-temperature district heating and cooling networks, which will be able to recover renewable and waste heat, available at low temperature in urban environments.

Next generation district heating systems are expected to contribute to the integration of variable renewables in power systems by increasing flexibility resources through the use of large scale electric heat pumps and demand-response, enabled by heat storage capacities.

Automated controls can also be employed for peak-shaving, reducing installed capacity requirements and optimising overall network operations. For example, as part of its modernisation process the district heating system of Bolzano, Italy, introduced a control system that reduced overall energy losses by up to 5%.

Innovative concepts are also being tested to fully exploit waste heat, deep geothermal technologies, and the integration of heating and cooling networks. For instance, recovering heat from metro stations has been explored in London and Turin. New deep geothermal solutions are also emerging, such as the Eavor closed-loop system, which do not require a permeable aquifer. Solutions to integrate district heating and cooling networks are also appearing. Oil-free compressors in heat pumps and chillers make these technologies more competitive for such applications.

The Global District Energy Climate Award has been in place since 2009 to identify best practices and innovations in district energy. Among the 2019 recipients were a system in Braunschweig, Germany, which was given the New Scheme award for using waste heat from a data centre; a system in Kaunas, Lithuania, which received the Modernisation award for modernising the network; and the Barredo Colliery district heating system in Mieres, Spain, which was granted the Emerging Markets award for having introduced innovations in geothermal energy use. Applications for 2021 are still available.

## Policy support and initiatives vary significantly by country

District heating deployment is often spurred by the benefits it can offer (energy efficiency, reduced pollution, etc.) and by national/local policy frameworks.

National policies are fundamental to extend district heating system deployment and support local government actions. Policies that

prompt greater district heating penetration and modernisation have been linked to: grants, subsidies and incentives for renewables (as in the European Union); fossil fuel, polluter and carbon taxes (diffused in Nordic countries and China); energy and heating plans/strategies (such as the EU Energy Roadmap 2050); the integration of district heating into energy standards for buildings (as per the zero-carbon-ready buildings concept); tariff regulation (as in Armenia and Denmark); and renewables targets (as in Finland).

In China, the Clean Winter Heating Plan in Northern China (2017-2021) defines measures that also impact district heating production. In June 2020, Denmark signed a Climate Plan for a Green Waste Sector and Circular Economy to regulate how wastes would help meet the goal of reducing GHG emissions 70% below the 1990 level by 2030. As a Covid19 crisis recovery measure, Denmark also introduced funding to renovate social housing, which includes replacing old oil-fuelled boilers with district heating systems or heat pumps.

Meanwhile, in 2021 Canada initiated a National Infrastructure Assessment consultation to compare the status of its infrastructure with the country's key priorities. It also introduced a new standard for thermal energy meters in 2021 (CSA C900:21) to regulate thermal meter design. In the United Kingdom, the government has proposed a Green Network Fund to help new and existing networks adopt low-carbon technologies during 2022-2025.

Harmonising national and local policies is also necessary to advance district heating. Local policies can involve advance planning to integrate and co-ordinate infrastructure investments (for instance in Bergen, Norway) or synchronise building renovations with district heat expansion (as in Hong Kong). Other examples include targets for renewables or excess heat (as in Copenhagen), goals for district heating expansion (as in Helsinki), connection policies (as in Flanders, Belgium) or broader targets for reducing carbon emissions or fossil fuel consumption (as in Vienna).

In addition to policy support for district energy systems, several associations, programmes and initiatives are also working to promote their expansion. For instance, the DHC TCP has led research in the field since the 1980s and now comprises 13 members from major district energy markets. Likewise, the District Energy in Cities Initiative, a multi-stakeholder partnership co-ordinated by UN Environment, helps local and national governments enlarge their investments in district energy.

In Europe, Euroheat & Power connects several district energy stakeholders to create momentum for sustainable heating and cooling. As part of Euroheat & Power, the DHC+ Technology Platform enables further networking and organises several events to promote district energy and increase awareness of technology options. Meanwhile, the Celsius Initiative (created from the Celsius Project concluded in 2017) is a collaboration hub that helps cities exchange information on innovations, best practices and policies to develop their heating and cooling networks.

Furthermore, founded in the United States and now comprising more than 2,400 members, the International District Energy Association (IDEA) works to connect, inform and expand the district heating industry. In China, the China District Heating Association supports the nationwide deployment of district heating.

**Recommended actions…**

Implement policy targets to support the establishment of district energy markets

Together with broader policy goals, targets related specifically to district heating (e.g. goals for district heating penetration, objectives for integrating renewable energy sources, and waste heat recovery

subsidies) are important to drive the transition to efficient networks.

To set such targets, an awareness of current and future heat demand and resources is fundamental to assess district heating potential. Energy mapping is key, and projects such as Heat Roadmap Europe provide valuable knowledge to support heat strategies and define national targets.

In addition, building capacity for energy and infrastructure mapping at the local level would allow advanced urban planning practices to integrate energy, infrastructure and land planning. For instance, excavation costs for district energy systems could be shared with other infrastructure construction projects, and district heating expansion could be co-ordinated with building renovations.

## Accelerate innovation to modernise district heating

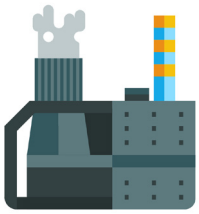
RD&I of innovative technologies (such as innovative deep geothermal wells, new pipeline designs, advanced control and measurement systems, insulation materials and optimisation solutions for heat pump systems) for low-temperature district heating is crucial to exploit its full potential. Research at the demand level (buildings) is also needed to further integrate local renewables-based heat production and increase the efficiency of building substations, heat exchangers and distribution systems.

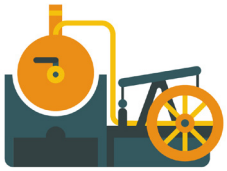
Financial and legal schemes to support the deployment of low carbon district heating as effectively as possible are also needed.

## Enhance system integration opportunities

Demonstration project development can be useful to define configurations for assessing flexibility options. Digitalisation can be a useful tool for this process, not only because it can optimise network operations and maximise the integration of renewables, but also because it facilitates system maintenance. Broader diffusion of heating system connected meters and data-driven advanced control systems helps to balance generation and consumption patterns.

Storage is also necessary to enable both short- and long-term flexibility. It is worthwhile to exploit the storage potential of the network itself, as well as decentralised storage at the consumer level. By decoupling the availability of renewable energy from the time when it is needed, thermal energy storage enables sector coupling between electricity and heating/cooling.





*Designed by macrovector / Freepik*

To take full advantage of cross-sector (buildings, industry, and heat and power generation) and cross-service (heating and cooling) synergies, integrated infrastructure planning as well as interoperability need to be developed and tested. Improved collaboration, transparency and communication between stakeholders from different energy sectors is an essential condition to make all the sectors develop towards higher integration, through, for example, standardised monitoring systems, data sharing protocols and collaborative platforms.

*By Chiara Delmastro*

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# Hydrogen:
# the buzz word for the 2020s

*Which country will lead the hydrogen economy of the future? This year's publication of a new book 'Touching Hydrogen Future' is sparking renewed discussion about hydrogen's global prospects.*

The buzz around hydrogen is gathering at a phenomenal pace, as noted by mainstream global media[1] and by international energy experts in IRENA[2] and IEA[3]. Hydrogen is an abundant element and an ideal carrier of renewable energy. The basic concept now featuring in energy sector and wider policy discussions is that clean hydrogen[4] has the potential to be a key part of the toolkit when considering pathways to the energy transition. For some, it is the 'battery' that could power the switch from fossil fuels to renewable energy.

1.See e.g. Hydrogen — Fantasy or fuel of the future? Financial Times

2.See https://www.irena.org/publications/2022/Jan/Geopolitics-of-the-Energy-Transformation-Hydrogen

3.The IEA's 2019 report, The Future of Hydrogen, found that a growing number of countries have policies that directly support investment in hydrogen technologies, along with the sectors they target. There are around 50 targets, mandates and policy incentives in place today that directly support hydrogen, with the majority focused on transport. When the report was published, only France, Japan and Korea had strategies for the use of hydrogen. By October 2021, when the IEA's Global Hydrogen Review 2021 was released, 17 governments had released hydrogen strategies, while more than 20 governments had publicly announced they were working to develop strategies. Numerous companies are seeking to tap into hydrogen business opportunities. Such efforts are timely: hydrogen will be needed for an energy system with net zero emissions. In the IEA's Net Zero by 2050: A Roadmap for the Global Energy Sector, prepared for the COP26 summit in Glasgow, hydrogen use extends to several parts of the energy sector and grows six-fold from today's levels to meet one tenth of total final energy consumption by 2050.

4.Clean hydrogen can be formed using various energy resources. Green and blue hydrogen are currently the most prominent as clean hydrogen production methods. Pink hydrogen, is produced using nuclear energy and electrolysis. Green hydrogen is generated from renewable energy sources Grey hydrogen is produced from hydrocarbons. Blue hydrogen is produced from hydrocarbons, with most carbon captured.

## How is this relevant to global economies?

Many, if not all, major industrial sectors across the world, including in China and Europe, use energy for heating, cooling, manufacturing, transportation, power generation and ammonia (fertiliser). A number of these sectors use energy sources like oil and natural gas that are heavy 'emitters', contributing to global $CO_2$ emissions. In the course of the manufacturing process, industries create $CO_2$ emissions for which the world as yet has little use (albeit the market for $CO_2$ is growing). It is important that the carbon generated is captured and, where possible, stored, as we see from debates in Glasgow on carbon capture and carbon credit mechanisms.

An important option for decarbonising the global economy, including in China and Europe, is to use clean hydrogen as an energy carrier; a hydrogen economy has the potential to decarbonise industries, increase energy access, and reduce the amount of $CO_2$ emitted into the atmosphere.

## How will clean hydrogen affect the energy landscape in 2030-50?

Erik Rakhou's new book, 'Touching Hydrogen Future: Tour Around the Globe', sets out the changes we can expect if the hydrogen projects currently under consideration are implemented. Each of the book's 27 chapters focuses on a specific country, providing a snapshot of hydrogen-powered life over the next 20 years. Starting in the Netherlands, the book's 'hydrogen tour' covers countries across six continents including China, the US and Europe, with insights from experts from every corner of the globe.

Almost 150 years after Jules Verne first envisaged a world powered by hydrogen, this book maps out the changes it will enable within our lifetimes. Through the eyes of today's energy leaders, it paints a picture of a transformed world powered by hydrogen alongside other energy transition vectors, and invites readers to help build it.

While it is pitched at energy professionals and students with an interest in energy and sustainability, it is freely available for all, and is intended to educate and inspire the next generation to embrace and help develop hydrogen technology.

The accounts in the book are fictional, but the hydrogen technologies they reference are based on existing strategies and hydrogen projects that are already in the planning stages. Hydrogen powered flights, shipping, road vehicles and factories are envisaged

across the world, contributing to the fight against climate change. As a decarbonisation tool, hydrogen has the potential to contribute materially to a reduction in the total carbon footprint of the 27 countries covered by the book, which together account for 66% of global emissions (2020 data[5]).

This publication features 28 chapters, each of which is written by energy experts and leading authorities on the energy transition from academia, business and policy. A third of the authors are female, representing the shift expected from the current 22% female representation in the oil and gas sector towards a more gender-balanced workforce within the hydrogen sector[6]. Contributors include the Center on Global Energy Policy's Anne-Sophie Corbeau, who envisages hydrogen use in the US in 2035, and Joachim von Scheele, of Linde plc, the world's largest industrial gas company, who writes about China in 2030.

The foreword is by Andris Piebalgs, who served as the EU's Commissioner for Energy and Commissioner for Development. He welcomes the book's accessibility and contribution to a paradigm shift in the way we look at energy systems. 'There are immense opportunities for the global community in clean hydrogen development, with production potential far exceeding estimated global demand. Nevertheless, we must take pause and acknowledge the difference between what we can envisage, and what we know and see.

'The book allows us to understand the gravity and complexity of the task in hand, with each country bringing its own opportunities, constraints, and positionality. Although the transition will be far from simple, requiring unprecedented efforts from governments, industry, and citizens, the tour shows the reader the truly exciting opportunities hydrogen offers for all nations. It is not just a fuel replacement, it is a paradigm shift in the way we look at energy systems, with co-benefits across a number of Sustainable Development Goals.'

Readers can download and read '***Touching Hydrogen Future: Tour around the globe'***, at https://europeangasmarket.eu/downloads/ – freely available in all e-book formats. The book is edited by Erik Rakhou and Rosa Puentes.

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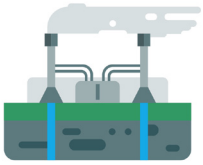
5. See EU Joint Research Centre Emissions Database for Global Atmospheric Research (EDGAR) 2020.

6. Women in Green Hydrogen study, published in 2021, on the percentage of women working in the energy sector.

# NEWS IN BRIEF

## EU Taxonomy set to include gas and nuclear



Designed by macrovector / Freepik

The European Commission presented its Taxonomy Complementary Climate Delegated Act on climate change mitigation and adaptation on 2 February 2022. Under strict conditions, gas and nuclear activities are recognized as sustainable, subject to phase-out periods. The move acknowledges the role of gas and nuclear in the shift from more polluting energy use, such as coal-fired power.

According to the document, gas and nuclear activities may be backed by private investment across the EU, provided they contribute to the transition to net zero. Nuclear projects will have to meet new environmental safety requirements; while gas projects must either contribute to the transition away from coal to renewables or clean gases, or keep the lifecycle emissions below 100g $CO_2$e/kWh, among other specific limits. Furthermore, there is a set of new rules on disclosure in the interests of transparency.

The European Commission stressed that the newly released Taxonomy is a financial tool that aims to draw on all possible options to ensure they make a contribution to the climate neutrality objectives, rather than dictating the energy mix of Member States.

The new document will be formally adopted when the text has become available in all EU languages.

***+ more***

## EU set to adopt Sustainable Products Initiative

The EU Sustainable Products Initiative is scheduled to be adopted on 30 March 2022. It establishes comprehensive requirements to ensure that all products in EU market are more durable, reusable, repairable, recyclable, and energy-efficient.

The Sustainable Products Initiative will make producers responsible for providing more circular products, either by providing products as services or by ensuring the availability of spare parts.

Following on from the Ecodesign Directive, which mainly focuses on energy-related products, the Sustainable Products Initiative extends to a broader range of goods. It is reported that the initiative will also take a lifecycle approach, inspired by the new Batteries Regulation announced in December 2020. It will consider not just environmental but also social supply chain issues. In addition, it is anticipated that there will be a Digital Product Passport, with mandatory information on the product's components and recyclability potential.

***+ more***

## Biomethane breaks records in Europe in 2021

Europe witnessed a record breaking year for biomethane deployment in the year 2021. According to European Biogas Association (EBA) and Gas Infrastructure Europe (GIE), Europe has 1 023 biomethane production facilities, with 300 added in the past 18 months. France saw the largest growth with 123 new plants entering operation in the first 10 months of 2021, followed by Italy and Denmark.

About 87% of the present active biomethane plants in Europe are connected to the gas grid. EBA stressed that plans for gas infrastructure development should include adaptations to enable biomethane to enter the distribution grids.

EBA estimates that sustainable biomethane could meet between 30% and 40% of the EU's gas consumption by 2050, with an estimated production of at least 1 000 TWh.

***+ more***

## **Germany:** boost to solar thermal systems as gas shortage bites

The installation of solar thermal systems in Germany is expected to accelerate in 2022, driven by the recent sharp increase in gas and carbon prices.

According to statistics provided by the German Solar Association (BSW) and the Federation of German Heating Industry (BDH), the country installed about 81 000 solar thermal systems in 2021, reaching an accumulated installation of roughly 2.5 million systems.

A recent survey by Germany's Renewable Energy Agency (AEE) revealed that about 1.9 million residential consumers in Germany are planning to purchase solar systems in the next three years, giving a substantial boost to the market.

To promote the transition to solar heating, the government provides subsidies that cover up to 45% of the costs for the purchase and installation of a solar system.

***+ more***

## **France** allocates funding to decarbonise industry

France plans to invest EUR 5.6 billion in industry decarbonisation as part of its 2030 plan, French Prime Minister Jean Castex disclosed on 4 February 2022.

EUR 5 billion will be used for the deployment of new technologies on industrial sites, while the remaining EUR 610 million will be used to support innovation and research for a low-carbon industry.

A further EUR 1 billion will support the deployment of mature technologies such as renewable heat 'for the benefit of all companies', declared Castex.

The measure supports the decarbonisation roadmaps prepared by industrial sectors such as steel, cement, chemicals and metallurgy.

***+ more***

## China maps out a smart PV industry ecosystem

China is set to create a smart PV industry ecosystem by speeding up the industry's integration with innovative information technologies, according to the Action Plan for Innovation-Driven Development of Intelligent Photovoltaic Industry (2021-2025) issued jointly by five government departments on 4 January 2022.

The new document addresses the detailed objectives and action priorities required to deliver a smart PV industry that includes smart manufacturing, application, operation and maintenance, and dispatch. It also includes proposals for various actions and measures to promote the cross sector deployment of the PV industry, including hydrogen coupling.

The action plan calls for carbon footprint evaluation standards across the PV sector, including an overall carbon emission control plan and a life-cycle approach. In addition, the plan provides for a boost to innovation and industrialised PV module recycling.

***+ more***

## China pushes to deepen power market reform

On 28 January 2022, China's top economic planner National Development and Reform Commission (NDRC) and the National Energy Administration (NEA) released the 'Guidelines for accelerating the development of a unified national power market mechanism', a move crucial for decarbonisation of the power sector and promotion of large scale consumption of renewables by means of market mechanisms.

The Guideline aims for an improved power resource allocation and better stability and flexibility in the power system. It sets out plans to establish a preliminary national power market by 2025 that will allow power markets, large and small, to operate collaboratively, and will cover medium and long term trading, spot power trading and ancillary services trading. The country also aims to establish a national trading system by 2030, which would include all renewable power producers. The new system is set to boost market-based cross-regional and cross-provincial trading of renewable generation across the country.

The document includes plans for a national power exchange, subject to the preparedness of infrastructure networks and connectivity between provincial power exchanges and local grids. In addition, a renewables-based power market will be developed with further linkage to the emissions trading system.

***+ more***

# Peak carbon emissions target pushed back for China's steel industry

The deadline for the steel industry to reach its carbon peak has been pushed back from 2025 to 2030, following a new guiding opinion paper on the development of the steel industry issued on 7 February 2022 by three Chinese government departments.

Addressing long standing issues such as overcapacity and low level of green transformation of the sector, the paper calls for increased efficiency and lower emissions, highlighting especially the need to accelerate the ultra-low emission retrofit of existing production capacity, to ensure the sector – the country's second-largest emitter of carbon dioxide– reaches peak emissions by 2030.

The paper proposes a ban on construction of new steelmaking facilities and mandatory production control. It also encourages mergers and restructuring of steel enterprises as a way to accelerate the upgrading of facilities.

Some targets are proposed in order to achieve a highly-developed steel industry by 2025:

- at least 15% of crude steel produced by electric arc furnaces.
- digitalisation rate of production equipment to reach 55%.
- over 80% of the production capacity to achieve ultra-low emissions.
- reduce energy consumption per ton of steel production by more than 2%.
- cut water consumption by more than 10%.

*+ more*

# **Measures** announced to boost China's green energy transition

A green development plan for the energy sector was released by China's NDRC and NEA on 11 February 2022. The document serves as an important supporting scheme of the '1+N' policy framework for meeting the dual carbon targets, according to NEA officials.

It aims to establish a clean, low-carbon, safe, and highly-efficient energy system while deepening reforms of mechanism and innovation in the energy sector. By 2030, a system of energy production and consumption will be formed with non-fossil energy that can both meet the increase in energy demand and replace fossil energy stocks on a large scale.

These overall objectives are supported by detailed measures relating to ten different aspects. These measures include:

- diversifying the financing channels for renewables by introducing more market-oriented mechanisms.
- setting up a unified green product certification and labelling system.
- boosting renewable development by speeding up construction of large-scale wind and solar power bases in desert regions.
- a further push for clean coal consumption.

***+ more***

## **Shell** starts up its first commercial hydrogen project in China

Shell has started up a 20MW commercial power-to-hydrogen electrolyser in Zhangjiakou City, Hebei Province, in a joint venture between Shell China and Zhangjiakou City Transport Construction Investment Holding Group Co. Ltd, formed in November 2020.

Using the abundant local onshore wind power resources, the project is initially supplying green hydrogen to fuel a fleet of more than 600 fuel cell vehicles at the Zhangjiakou competition zone during the 2022 Winter Olympic Games, and after the Games will be used for public and commercial transport in the Beijing-Tianjin-Hebei region. The project will be scaled up to 60 MW over the next two years through partnerships with local government and businesses.

***+ more***

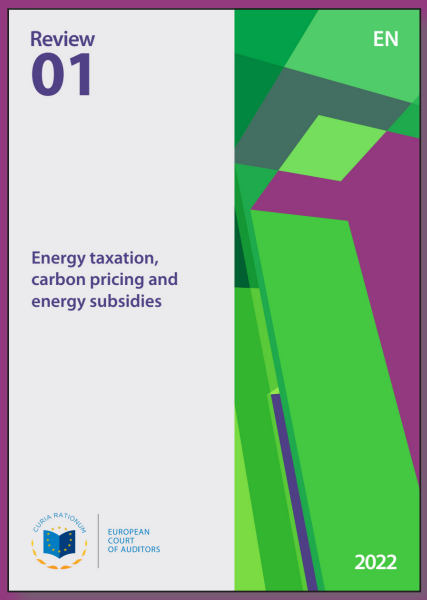
## **BASF** and Heraeus to launch precious metal recycling business in China

German companies BASF and Heraeus have agreed to form a joint venture to recover precious metals from spent automotive catalysts, according to a joint press released on 11 February 2022. The new company, named BASF HERAEUS (China) Metal Resource Co., Ltd will be based in Pinghu, China. Construction of the new recycling factory is scheduled to begin in 2022 and begin operations in 2023.

China's relies heavily on imports of platinum group metals, as domestic resources of these materials are limited. According to the press release, the joint venture will bring a world-class circular economy solution that can reuse precious metals, helping China to build up a local supply. The recycled metals can be used to make new products for the automotive, chemical, electronics and green hydrogen industries, and have a 90% lower carbon footprint than primary metals from a mine.

***+ more***

# Reports Recommendation




## Energy taxation, carbon pricing and energy subsidies

This review by the European Court of Auditors assesses how energy taxes, carbon pricing and energy subsidies fit into EU climate objectives. It reveals that while energy taxation has the potential to support efforts to combat climate change, current tax levels do not reflect the extent of pollution caused by different energy sources. The challenges faced by policymakers seeking to update energy taxation and subsidies policies include: ensuring energy taxation consistency across sectors and energy carriers; reducing fossil fuel subsidies; and reconciling climate objectives with social needs.

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## Fueling the Transition: Accelerating Cost-Competitive Green Hydrogen

Green hydrogen is critical for decarbonisation of some of the most problematic industrial sectors, such as shipping and steel production. This 2021 report from the US-based Rocky Mountain Institute (RMI) analyses the cost reduction opportunities and the critical enabling tools required to bring cost-competitive green hydrogen to market this decade. It shows that green hydrogen production costs could fall below USD 2 per kilogram in many locations in the next five years.

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## ▲ Seizing Business Opportunities in China's Transition Towards a Nature-positive Economy

China has an opportunity to achieve its economic and social ambitions and the vision of an ecological civilization by 2030 while creating millions of sustainable jobs, if it transforms three systems at the heart of its economy, according to the January 2022 report in the World Economic Forum's New Nature Economy Report series.

This new analysis finds that two thirds (65%) of China's total GDP is at risk of disruption from nature loss.

By urgently making 15 nature-positive transitions across three socio-economic systems, China could add USD 1.9 trillion in annual business opportunities and create 88 million sustainable jobs by 2030. For each of the transitions required, the report sets out recommendations for business- and government-driven action, highlighting progress to date and case studies.

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## ▲ European Electricity Review 2022

UK-based Ember's sixth annual report on EU electricity trends compares 2021 to benchmark pre-pandemic levels in 2019, providing an initial insight into how the gas crisis is affecting the region's power sector as national economies recover from the pandemic.

Key findings:

- Soaring gas prices meant that renewables replaced gas rather than coal, in an interruption to the previously steady phase-out of coal.
- Emissions fell at half the rate required if the 1.5˚C climate target is to be met.
- Contrary to reports, wind and solar power set new records during 2021, for the first time generating more power than gas.

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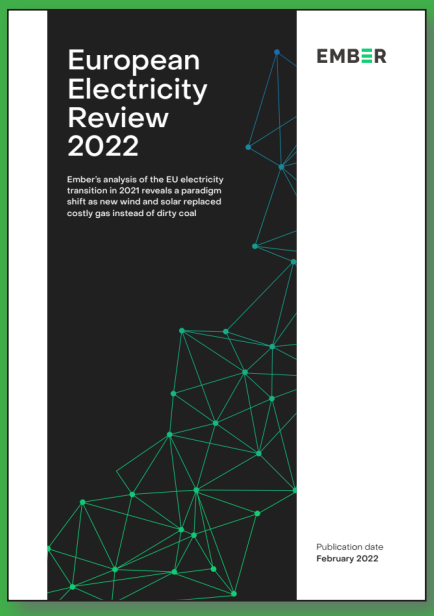

## ▲ Achieving a carbon-neutral energy system in China by 2060


Shell's 2021 Scenario sketch develops a possible pathway for China to achieve a carbon-neutral energy system by 2060. The document sets out a deep and rapid decarbonisation pathway that relies mainly on electrification with low and zero carbon power generation, while the remaining hard-to-electrify energy needs are met by low-carbon fuels, such as hydrogen and advanced bioenergy, and technologies such as carbon capture, utilisation and storage.

There are eight main identified areas of action over the next 40 years:

- Triple electricity production for end users.
- Quadruple the size of the electricity system and hydrogen production.
- Increase wind and solar's share of the energy mix to 80%.
- Raise hydrogen's share of final energy consumption from near zero today to 16% by 2060.
- Increase the use of bio resources for energy eightfold and increase the commercial use of biomass.
- invest in energy-efficiency to halve the energy intensity of the economy.
- Ramp up the government-led carbon price at least fourfold between 2030 and 2060.
- Scale up CCUS capacity at least 400-fold.

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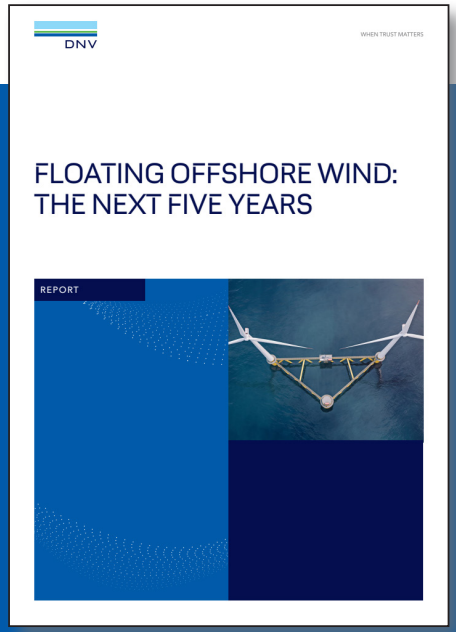
## ▲ Floating Offshore Wind: The next five years




Norwegian DNV's latest report predicts that by 2050, floating offshore wind will generate 264 GW worldwide, or 15% of all offshore wind energy, equivalent to a development of 15,000 individual turbines. The quality assurance and risk management company's report aims to make sense of the growing market for floating offshore wind. It brings together the most relevant findings from the company's forecasts and explores the technology innovation, cost challenges and investment and policy decisions that are needed in the next five years to make commercialised floating offshore wind a reality. It estimates that the levelised cost of offshore wind could drop 70% to USD 40 per MWh by 2050.

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## China Power Industry Statistics 2021

| | | 2021 | |
|---|---|---|---|
| | | | Year-on-Year Change (±, %) |
| **Electricity Consumption** | TWh | 8 312.8 | 10.3 |
| ---- Primary Industry | TWh | 102.3 | 16.4 |
| ---- Secondary Industry | TWh | 5 613.1 | 9.1 |
| *Including: Industrial* | TWh | 5 509.0 | 9.1 |
| ---- Tertiary Industry | TWh | 1 423.1 | 17.8 |
| ---- Residential | TWh | 1 174.3 | 7.3 |
| **Installed Capacity of Power Plants** | GW | 2 376.92 | 7.9 |
| ---- Hydro | GW | 390.92 | 5.6 |
| ---- Thermal | GW | 1 296.78 | 4.1 |
| ---- Nuclear | GW | 53.26 | 6.8 |
| ---- On-Grid Wind | GW | 328.48 | 16.6 |
| ---- On-Grid Solar | GW | 306.56 | 20.9 |
| **Average Coal Consumption of Power Plants of 6000kW and Above** | g/kWh | 302.5 | -2.4* |
| **Line Loss Rate** | % | 5.26 | -0.34▲ |
| **AUHs of Power Equipment of 6000kW and Above** | Hour | 3 817 | 60* |
| ---- Hydro | Hour | 3 622 | -203* |
| ---- Thermal | Hour | 4 448 | 237* |
| **Power Generation Projects Investment** | Billion RMB | 553.0 | 4.5 |
| ---- Hydro | Billion RMB | 98.8 | -7.4 |
| ---- Thermal | Billion RMB | 67.2 | 18.3 |
| ---- Nuclear | Billion RMB | 53.8 | 41.8 |
| **Power Grid Projects Investment** | Billion RMB | 495.1 | 1.1 |
| **Newly Installed Generation Capacity** | GW | 176.29 | -7.9 |
| ---- Hydro | GW | 23.49 | 79.0 |
| ---- Thermal | GW | 46.28 | -18.2 |
| ---- Wind | GW | 47.57 | -34.0 |
| ---- PV | GW | 54.93 | 14.0 |
| **Newly Added Substation Equipment Capacity of 220kV and Above** | GVA | 243.34 | 9.2 |
| **Newly Added Transmission Circuit Length of 220kV and Above** | km | 32 220 | -8.0 |

*Source: China National Energy Administration*
*Note: * absolute amount; ▲change in percentage points.*


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