EU-CHINA ENERGY MAGAZINE

2024 OCTOBER ISSUE

Funded by the European Union

EU-China Energy *Cooperation Platform*

EU-CHINA ENERGY MAGAZINE

2024

About ECECP

EU-China Energy Cooperation Platform was launched on 15 May 2019.

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 I of ECECP (2018 – 2021) was implemented by a consortium led by ICF, with National Development and Reform Commission – Energy Research Institute and CECEP Consulting Company.

Phase II (2021 – 2023) was implemented by a consortium led by ICF, and with National Development and Reform Commission- Energy Research Institute.

Phase III (2024 – 2029) is implemented by a consortium led by GOPA Worldwide Consultants and with GIZ.

CONTENTS


ECEC

Dear All,

Welcome to the 2024 October issue of EU-China Energy Magazine! This month, we focus on two crucial topics - energy regulation and circularity - that are significantly influencing the evolution of our energy sector.

China is adjusting its legal framework to address the challenges posed by the increasing share of renewable energy in the new power system. On 11 October 2024, EU-China Energy Cooperation Platform (ECECP), the Sino-German Energy Partnership implemented by GIZ, and China Electricity Council (CEC) jointly organised an expert workshop to facilitate dialogue between Europe and China on the construction of a new power market and its corresponding electricity legal framework.

Building on the insights gleaned from this event, we present a featured article by Dr Rozeta Karova, international consultant on energy law and policy, who provided a comprehensive overview of the development of EU energy regulations governing the EU electricity markets, illustrating how they are implemented in Member States. We believe that sharing this EU expertise will provide valuable insights for Chinese policymakers.

The increasing role of LNG supplies to the EU has brought the emissions associated with LNG supply chains to the forefront of the energy and climate agenda. Our discussion on regulation continues with an article looking at the potential impact of the EU Methane Regulation on LNG imports. We also report on how Germany and Poland, the two largest coal consumers in the EU, are accelerating the transition away from coal by developing renewables, while navigating economic and social challenges during the shift to ensure justice and efficiency.

Shifting our focus to China, we spotlight the circularity within the renewable industry. China continues to lead in the manufacturing and deployment of EV batteries and PV panels globally, but the imminent retirement of these products highlights the urgent need for responsible end-of-life management. ECECP conducted on-site interviews with two Chinese companies specialising in battery and PV panel recycling, discussing the challenges they face and potential solutions.

In its inaugural issue published in December 2019, this magazine featured an article about innovative EU solutions in wind turbine blade recycling. Five years on, we are eager to explore recent developments in China in this field. Companies or institutions interested in participating in a follow-up interview are encouraged to contact us at magazine@ececp.eu.

We hope you enjoy this issue!

Dr. Flora Kan
ECECP Team Leader
28 October 2024

Understanding European Energy Law

Introduction

China is the biggest producer and consumer of energy in the world, and when in September 2020 it announced its intention to reach carbon neutrality by 2060, it set in motion the reform of its energy sector and the development of new climate policy. Substantial progress in greening its energy mix has been made over the last decade, and China remains a champion of both renewable energy production and investment in renewable projects. Its Electricity Law, adopted in 1995 and revised in 2009, 2015 and 2018, is to be amended again, together with the Renewable Energy Law. A new Energy Law was adopted on 8 November 2024, which will come into force on 1 January 2025. The objective of the reforms is not only to adapt the new legal framework to enable greater integration of intermittent renewable energy, but also to improve the regulation of the energy sector and the governance and functioning of the energy market.

On 11 October 2024, the EU China Energy Cooperation Platform (ECECP) together with the GIZ-implemented Sino-German Energy Partnership and China Electricity Council (CEC) organised an expert workshop providing a comprehensive overview of energy laws and regulations governing the EU electricity markets and their implementation in the EU and several Member States. The workshop was attended by Chinese officials from the National Energy Administration (NEA), the National Development and Reform Commission (NDRC), the National People's Congress (NPC), researchers from think-tanks and representatives from major power companies and European embassies. It included a presentation by international energy consultant Dr Rozeta Karova on the development of the EU's energy policy and legislation, which provides the basis for this article.

This article will provide an overview of the development of energy law within the EU, aiming to understand the way in which European rules are adopted by the EU institutions and then implemented by the EU Member States. It will include the

developments within its electricity market which have been impacted by the integration of increased volumes of decentralised, renewable sources, in line with the region's climate neutrality and decarbonisation objectives. A focus will be placed on the progress towards organised short-term electricity markets and their integration, with points of reference for the ongoing legislative reform in China.

European legal framework

The EU is made of 27 Member States and has an institutional setting allowing for decision-making and adoption of European law, known as acquis communautaire. EU integration was achieved through adoption of European treaties, which have supremacy over national law, while the Member States maintain their autonomy.

In addition to the provisions of the EU Treaties, European energy sector-specific law is adopted by the EU institutions in the form of regulations and directives, mostly using the so-called 'ordinary legislative procedure'. The European Commission submits a legislative proposal to the European Parliament (consisting of directly elected members) and the Council of the EU (consisting of representatives of all the EU Member States). They have equal say in the process, and after their agreement on the text of the legal act, it is published in Official Journal of the EU and becomes EU law.

The EU regulations are '*binding in their entirety and directly applicable in all Member States*'[1] meaning that the EU Member States do not need to transpose them into domestic law, and they can be enforced directly before the national courts. The directives, on the other hand, are binding upon the Member States as to the result to be achieved, but they need to be transposed into the domestic legal order in order to become national law.[2]

In addition to these legal acts, the cross-border electricity market transactions and system operations, alongside conditions for accessing the network for cross-border electricity exchanges, are governed by technical network codes and guidelines, which are adopted in the form of legally binding regulations. These are developed by the European

Network of Transmission System Operators (ENTSO-E)[3] and approved by the European Commission once the Agency for Cooperation of Energy Regulators (ACER) has recommended them for adoption.

1. Article 288 TFEU.
2. The Directives can also have direct effect if the Member States fail or refuse to implement them on time provided, they satisfy other conditions for direct effect (i.e. the provisions are clear and unconditional). C-41/74 Van Duyn v Home Officel [1974] ECR 1337.
3. Alone or in cooperation with the EU DSO entity.

Development of EU energy policy and law

The EU's threefold objectives of market liberalisation, enhancing the security of supply and sustainability underpin the policy and legislative developments in the EU. These objectives have to be kept in balance, but each of them may prevail at different points in time. While the liberalisation was a guiding principle throughout the '90s, the intention being to reform the national electricity markets, security of supply has risen up the European agenda over time as the markets become more international and exposed to cross-border trade. Needless to say, the sustainability objective has been a feature of all legal acts together with the commitments for decarbonisation and reaching climate neutrality by 2050 undertaken by the EU and its Member States.

It is important to bear these objectives in mind when looking into the development of the EU energy policy and law.

Energy has been an essential part of the integration process of the EU since the very beginning: two of the three European treaties signed in the 1950s[4] were specifically related to the energy sectors. By contrast, the Treaty of Rome, which established the European Economic Community (which later became the European Union), did not include any provision for a common energy policy. Nevertheless, the latter provided for establishment of a common market[5] which also covered the energy sectors. The Treaty on the Functioning of the European Union (TFEU),[6] introduced an energy article - Article 194 TFEU - stipulating the three abovementioned energy objectives.

Well before the specific energy article was introduced in the TFEU, the first sector-specific electricity

4. Treaty of Paris establishing the European Coal and Steel Community, Paris, signed on 18.04.1951, entered into force 25.07.1952 and expired 50 years later in 2002; Euroatom Treaty creating the European Atomic Energy Community, Rome, signed on 25.03.1957, entered into force on 01.01.1958 and was concluded for an unlimited period.
5. As defined in article 8(a) of the Single European Act [1987] OJ L169/1: "an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured".
6. Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union, Official Gazette of the European Union (2008/C115/01), 09.05.2008.

liberalisation Directive 96/92/EC was adopted in the '90s. Its objective was to open the electricity markets through the gradual introduction of competition, increasing the efficiency of the sector and the competitiveness of the European economy. Leaving a lot of freedom to the Member States, its implementation led to the development of different national electricity market designs, depending on the national energy mix and the sector's organisation. The European model started with a focus on the final goal of liberalisation, allowing transitional measures and more detailed legislation to be developed in the second legislative package when Directive 2003/54/EC was adopted together with the first Regulation 1228/2003/EC on cross-border exchanges in electricity.

The Third Energy Package from 2009, Directive 2009/72/EC and Regulation (EU) 714/2009, was focused on regional cooperation and completion of the internal energy market. In this package, ACER and ENTSO-E were established, the intention being to foster Europeanisation and cooperation between National Regulatory Authorities (NRAs) and Transmission System Operators (TSOs). Finally, the acts adopted within the Clean Energy Package for all Europeans, as part of the 'Fit for 55', Directive 2019/944/EU and Regulation (EU) 2019/943 were intended to align the climate and energy targets. Namely, under the European Climate Law, the Regulation (EU) 2021/1119, the EU Member States committed to reach climate-neutrality by 2050. The first intermediary target is to reduce net emissions by at least 55% by 2030, compared to 1990 levels. Those higher targets, including for renewable energy and energy efficiency, together with the electrification of the economy, required changes in the rules governing the electricity sectors and markets, more flexibility and new services being offered by local energy communities, better customer protection and improved longer-term forward markets.

The gradual and partial opening of the electricity markets started with the first electricity directive setting the conditions for transforming the electricity industries, from monopolistic to competitive markets, a process which was accelerated with the second package. The concept of unbundling, meaning that non-competitive activities (transmission and distribution of electricity) had to be separated from the competitive activities (production and supply of electricity), was introduced in the first directive requiring only management and accounting separation. The second electricity directive required establishment of a separate company, while the Third Energy Package also introduced separation in terms of ownership. Since non-competitive activities remained monopolistic activities, rules on access to the incumbents' networks, known as Third Party Access (TPA), were introduced. Those rules have also gradually been developed over time and now require

regulated TPA, i.e. access to the network subject to published and regulated tariffs, applied to all system users under non-discriminatory terms and conditions. National Regulatory Authorities, which are independent not only from industry but also from any other public or private entity, were established in each Member State and their role has increased over time, in particular in relation to market oversight and cross-border activities. Given the importance of electricity for people's daily lives, the attainment of the highest possible standards of public services has also been one of the primary objectives of the EU electricity acquis, which is reflected in provisions on ensuring public service obligation (PSO) and customer protection, including vulnerable groups and energy-poor customers.

National market reforms in the EU Member States have been introduced in parallel with integration of the national electricity markets and the establishment of regional markets, which has been a necessary step towards completion of the internal electricity market.

The security of electricity supply was not the focus at the start of market liberalisation. However, as the reforms moved from national level to establishing the EU electricity market and from state-driven to market-driven systems where electricity markets became more international, the EU dependence on imports, as well as its vulnerability to interruptions in supply, brought the security of supply to the top of the EU agenda. The adoption of a separate piece of EU legislation demonstrating the importance of this issue at the EU level came only in 2006, with the Electricity Supply Directive 2005/89/EC. This legal act has since been replaced by the Risk Preparedness Regulation (EU) 2019/941. The change of legal instrument from a directive, where implementation is left to the Member State, to regulation, which is directly applicable, demonstrates the Europeanisation of the security of supply topic. As a response to the global energy market crisis and the impact of the lower gas supply caused by the war in Ukraine, the REPowerEU Plan was

launched in May 2022, to facilitate energy saving, diversification of energy supplies and the production of clean energy. Three Council regulations were adopted in November 2022 under article 122 of the TFEU, designed for emergency situations.

In addition to the liberalisation legislation and the rules on security of supply, Regulation (EU) 2022/869 governs trans-European Networks for Energy (TEN-E), streamlining the permitting procedures and the cooperation for construction of cross-border energy infrastructure, enabling investments and access to funding. Directives have also been adopted at European level governing renewable sources and energy efficiency, which include interim 2030 targets.

The European electricity target model

The integration of European electricity markets requires both the development of the necessary energy infrastructure as well as alignment of legislation and regulation in the EU Member States by implementing the EU regulations and directives. The European electricity market consists of four different markets: two, short-term organised markets: Day-ahead Market (DAM) and Intraday Market (IDM); the forward long-term market; and the balancing electricity market.

An important element in the integration of electricity markets in Europe is so-called 'market coupling'. That means that bidding for network capacity is done implicitly through bidding for electricity in a single auction. The TSOs define the interconnection capacity for the next day and the national market operators (the power exchanges) take into account available cross-border capacity in the price calculation process, in order to minimise the price difference in different market areas. Before market coupling took place, cross-border capacity and electricity were purchased separately. The European experience has shown that market coupling maximises social welfare, avoids artificial splitting of the markets and sends transparent price signals that encourage investment in cross-border transmission capacities. Such short-term markets enable the integration of larger volumes of renewable energy sources and attract investments to speed up decarbonisation. Electricity prices are set according to the variable cost of the marginal plant (the most expensive plant needed to cover demand) and all generators receive (and buyers pay) the same price – known as the clearing price. The value of cross-border trade is calculated by ACER at EUR 34 billion, and its role in helping to mitigate price volatility in 2021 is acknowledged.[7]

Conclusions

This paper has provided an overview of the different European legal tools, the objectives behind them and the development of the European energy acquis. It has also presented an overview of the European electricity target model focusing on integration of short-term organised markets.

While individual EU Member States started with a variety of structures within their electricity sectors, and initially developed diverse electricity market designs, today, thanks to harmonisation of the legislative framework governing even the most technical details of the grids and the markets at European level, the EU has developed a workable unified solution and has established the world's largest integrated electricity market.

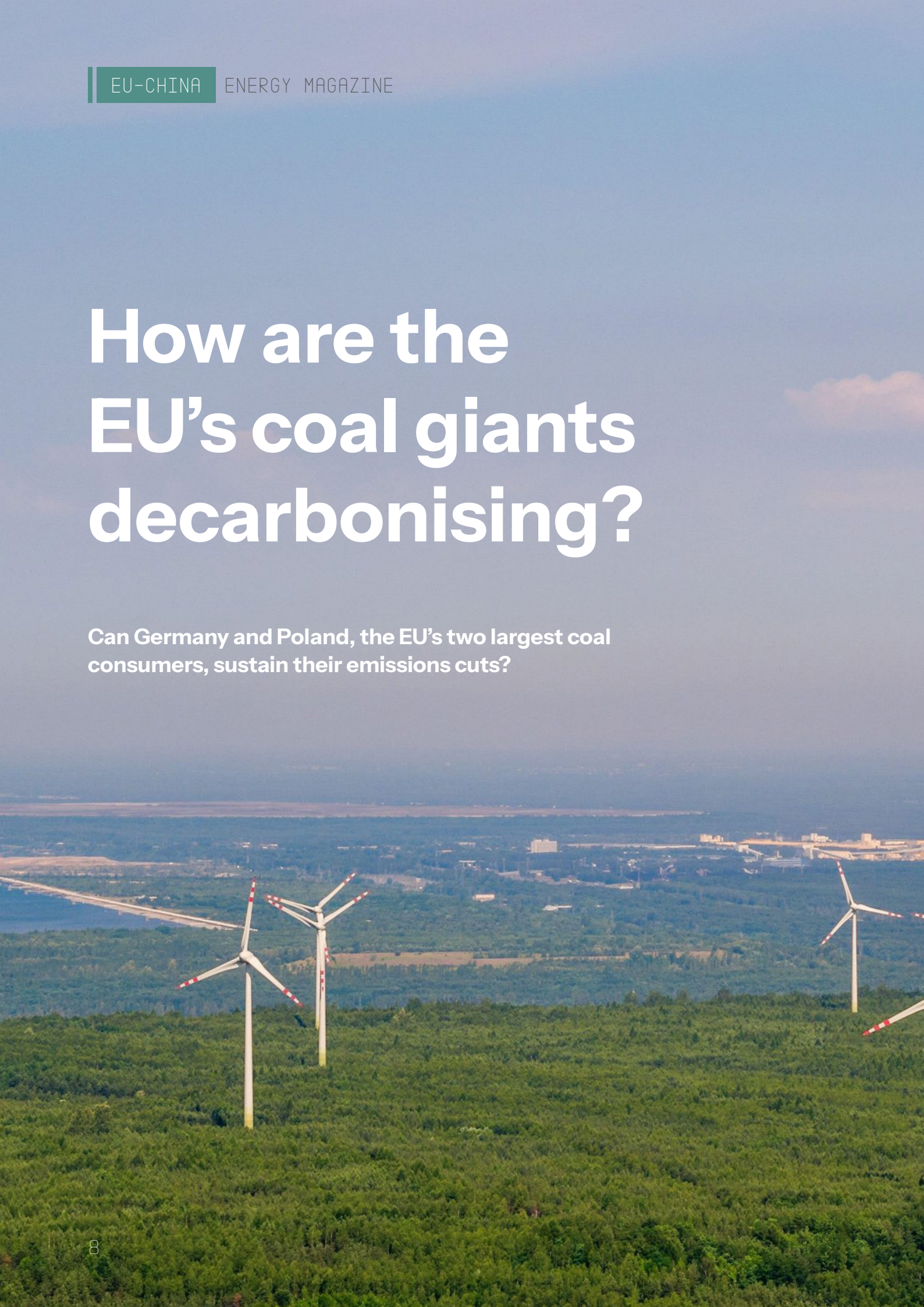
While legislative drafting is very different in the context of China, some useful lessons can be drawn from the European experience and further adapted to suit the national specificities. Opening the wholesale markets and developing a standardised market design coupled with strong regulation of monopolistic activities is one such example. Starting with wholesale competition before embarking on retail competition (if this is included in future plans) requires well-defined governance and the active participation of the relevant institutions in order to ensure transparency and non-discrimination and to avoid the abuse of market power by incumbent companies. Now that China has started implementing pilot spot electricity markets, further insights from the European market may also be helpful. Due to the size of the electricity market in China, the legal and regulatory framework will have to be carefully designed to define the details of solutions addressing both the local specificities and the establishment of a larger, liquid and transparent electricity market.

By **Rozeta Karova, Ph.D.**
International Consultant on Energy and Climate Law and Policy 8 November 2024

7. ACER's Final Assessment of the EU Wholesale Electricity Market Design, 2022.

How are the EU's coal giants decarbonising?

Can Germany and Poland, the EU's two largest coal consumers, sustain their emissions cuts?



In the EU, coal consumption rebounded in 2021 and 2022 as the economy recovered from the Covid-19 pandemic and an energy crisis escalated by Russia's invasion of Ukraine prompted some countries to fire up coal power plants. In China, the media and public began to question Europe's climate commitments.

But gas and coal use across the EU fell significantly in the second half of 2022, a Dialogue Earth analysis showed. Coal burning continued to decline in 2023, with coal-power generation hitting new lows, dropping 26% in a year to account for only 12% of the bloc's electricity mix, according to energy think-tank Ember.

The EU has long been a leader in global climate governance. Its European Green Deal, published in late 2019, aimed to bring about 'climate neutrality' by 2050, meaning net zero emissions of all greenhouse gases, not just CO_2. In February of this year, the European Commission set an intermediate goal on that pathway – to reduce emissions by at least 90% by 2040, against a 1990 baseline. This would mean coal being 'almost completely phased out' by 2040, according to an impact assessment report.

In Poland a wind farm stands before Europe's largest coal-fired power plant, Bełchatów

(Image: Łukasz Szczepanski / Alamy)

Pieter de Pous, who leads the Coal to Clean Programme at UK-based think-tank E3G, said Germany and Poland's continued efforts are particularly important when it comes to the EU targets because despite falls in coal power generation in both countries in 2023, the two still account for 71% of the bloc's coal generation.

Experts interviewed by Dialogue Earth believe Europe's two largest coal consumers are accelerating the deployment of renewables to reduce their reliance on coal, but still face challenges around economic development and ensuring a just transition.

Could Germany phase out coal by 2030 rather than 2038?

Germany's carbon emissions have been in general decline since 1979. Last year, they reached their lowest levels since the 1950s, with coal-power generation dropping by a quarter compared to 2022, from 180 gigawatts to 135 gigawatts, and coal's share of the energy mix down to 26.8%, Ember found.

In January 2020, Germany passed a law requiring coal-fired power stations to be completely phased out by 2038, and published a detailed timetable. The government also committed to ending nuclear-power generation within two years, leading to concerns over power shortages.

When the 2022 energy crisis led to shortages of natural gas, the shutdown of the last three nuclear power plants had to be delayed; they were finally wound down in April last year. But fears that coal generation would pick up the slack proved unfounded, with fossil-fuel generation falling at the same time.

So Germany was able to cut coal generation while shutting down nuclear power and weathering natural gas shortages. This achievement was, at least in part, thanks to a rapid expansion of renewables.

Reforms designed to speed up the energy transition were announced in 2022. These included faster planning and approvals processes for renewables, and a requirement for 2% of all land to be reserved for wind power by 2032.

In 2023, Germany for the first time generated more than half of its power from renewable sources (excluding nuclear), Ember data shows. Last year also saw wind power overtake coal as the country's largest single source of power, at 27.2% of the mix. The data also shows that together, wind and solar power accounted for 39% of all power generated, three times the global average of 13%.

However, a fall in electricity demand from industry, which saw reduced output last year, also helped cut emissions. Some are therefore worried about the relationship between economic performance and emissions. Agora Energiewende, a German think-tank, calculated that only 15% of Germany's 2023 carbon cuts were permanent in nature, that is, achieved by adding new renewable energy, boosting energy efficiency or switching to lower-carbon fuels. Half of the cuts came from falling power demand and other short-term impacts; Reuters has reported a 5.3% drop in load on public power networks in 2023, reflecting that drop in demand. Germany's economic slowdown has a range of causes including the war in Ukraine, high

interests rates and deficits in skilled labour. When the expected recovery from these issues occurs, some emissions reductions gains are likely to be lost, Agora warns.

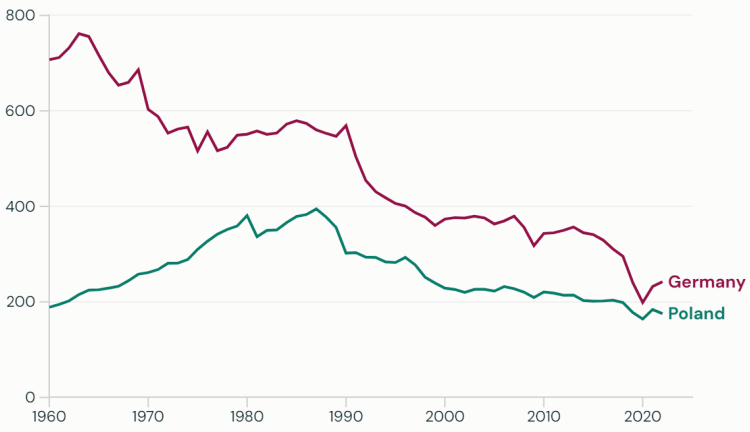
De Pous says the German government has set ambitious targets related to renewables, such as for at least 15 million electric vehicles to be on the roads by 2030. The associated growth in power demand has been factored into planning for renewable-energy construction, he adds. The question is, can Germany keep on expanding renewables to meet post-coal power demand?

The government seems confident. In fact, action at the state level indicates that the coal power shutdown may indeed come earlier. In late 2022, North Rhine-Westphalia – a centre for coal mining and heavy industry in the west of Germany – announced that coal generation would be phased out by 2030. States in the east of the country are making similar noises.

'Of course, Germany still has a lot of work to do,' said de Pous. 'As in most countries rolling out renewable energy, the big task is construction and digitalisation of the power grid. Alongside that, Germany is also developing flexible energy tech, such as hydrogen power. I'm cautiously optimistic that Germany is on the right track with its energy transition. If the government's renewable-energy plans come to fruition, a 2030 coal phase-out is feasible.'

Germany and Poland's changing CO2 emissions from coal

Annual emissions 1960–2022, in million tonnes



Data source: Our World in Data • Graphic: Dialogue Earth

Poland, an emerging decarbonisation 'leader'?

Last year was a record-breaking one for Poland too. The country increased its wind and solar power generation by 7 terawatt hours, with their share of the energy mix up from 16% to 21%. Coal generation, meanwhile, fell by 22 terawatt hours, with its share of the energy mix dropping from 70% to 61%.

But unlike Germany, Poland's annual emissions have remained steady over the last 25 years or so. However, a Polish politician speaking off the record told Dialogue Earth that while Poland's emissions look high, the economy grew 2.5 times between 2000 and 2020, while emissions held steady. In other words, carbon intensity – meaning emissions per unit of GDP – more than halved. 'That means that Poland, one of the world's fastest growing economies, is already undergoing a sustained transition and has, for 25 years, been a leader on decarbonisation,' he said.

Poland's journey away from coal can be traced back three decades. Between 1990 and 2020, output of hard coal, or anthracite, dropped 63%, while mining sector jobs fell 80%, from 390,000 to 80,000. However, this was an inevitable outcome of economic trends and the

switch from a planned to a market economy, rather than a deliberate energy transition strategy by government, according to Resources for the Future, a US-based research institute.

Poland is now making plans for decarbonisation, but it is more reliant on coal than Germany and so faces bigger challenges. In 2020, the government and union representatives agreed on an end to coal mining by 2049. The deal gave miners the right to transfer from closed mines to those still operating, or to get an early retirement package of 80% of their salaries.

The government also sought EU permission to provide state aid 'for financing the current production, in order to ensure the stability of the hard-coal mining companies'. The EU regulates state aid provided by its member states, and experts think it unlikely that Poland will be allowed to keep funding coal mining.

Aleksander Śniegocki, CEO of the Reform Institute, a Polish think-tank, told Dialogue Earth that it remains to be seen how the new administration, which came to power in December, will manage that commitment, but it's clear that the government cannot keep supporting loss-making mines. Western Europe once had many coal mines too, but at a certain point, the mining stops making economic sense, Śniegocki said.

Seeking to secure power supply security following the energy crisis, in October 2023 the EU suspended until the end of 2028 a requirement for power stations to stay within certain CO_2 emissions limits in order to qualify for state aid. That effectively allowed member states to subsidise coal- and gas-power generation. In March this year, Poland's top energy-security official told Reuters the country would need the suspension extended beyond 2028, until its first nuclear power plant comes online next decade.

Under the EU's Emissions Trading System (ETS), certain industries must keep their CO_2 emissions within a quota or buy additional allowances. De Pous said that, like Germany, Poland will speed up its coal phase-out in response to the tightening of ETS quotas as well as to the economic attractiveness of renewables. But unlike Germany, Poland is putting its hopes in new nuclear power stations. This is risky as nuclear power construction can be slow and expensive. In such a scenario the country may be left no choice but to burn coal and natural gas to bridge the gap, which would inevitably slow the energy transition, de Pous added.

Justice and efficiency

In 2021, Poland approved an energy policy framework running up to 2040. Known as PEP2040, the framework was roundly criticised for its lack of ambition. For example, its target to install 10-16 gigawatts of solar power by 2040 was met just two years later. And last year, renewables accounted for 27% of Poland's energy mix – already approaching the 2030 target of 32%.

Śniegocki points out that, unlike Germany, Poland has no energy-transition roadmap or methodical top-down planning and implementation. The government's thinking seems to be that an active approach, with forward planning and targets for an ambitious roll-out of renewables, would be a clear signal that demand for coal is going to fall. Such a communication would make the government unpopular with the mining unions. 'Sometimes, Poland's energy transition seems like a silent revolution,' he said.

After all, Poland is one of the EU's fastest growing market for solar power. In 2018, heat pumps had 10% of the heating installation market. By 2023 that share had risen to 40%. And the country is set to become a major player in offshore wind, with a target of at least 3.4 gigawatts of generating capacity by 2030.

The Polish politician Dialogue Earth spoke to said the new administration is expected to boost ambition for both offshore wind and nuclear power. The closure of mines, he stressed, won't just result in miners losing their jobs. There will also be grave consequences for their families and communities. Just transition policies need to be in place for them, he said, as well as solutions to ensure energy security. 'It's a sustained process, and we aren't going to give up,' he said.

Ensuring a just transition for workers and communities reliant on the coal industry, while keeping the lights on in homes and factories, is a challenge for all decarbonising countries, not just Germany and Poland, he said.

In Germany, the far-right Alternative for Deutschland (AfD) party, which is opposed to a coal phase-out, garnered strong support in the east of the country in recent European elections. Some worry its influence will reduce the government's climate ambition. In 2020, EUR 40 billion was promised in structural funding to reduce the impact of job losses, but eastern state leaders have again warned that ensuring a just transition will be key in keeping voters away from extremist parties.

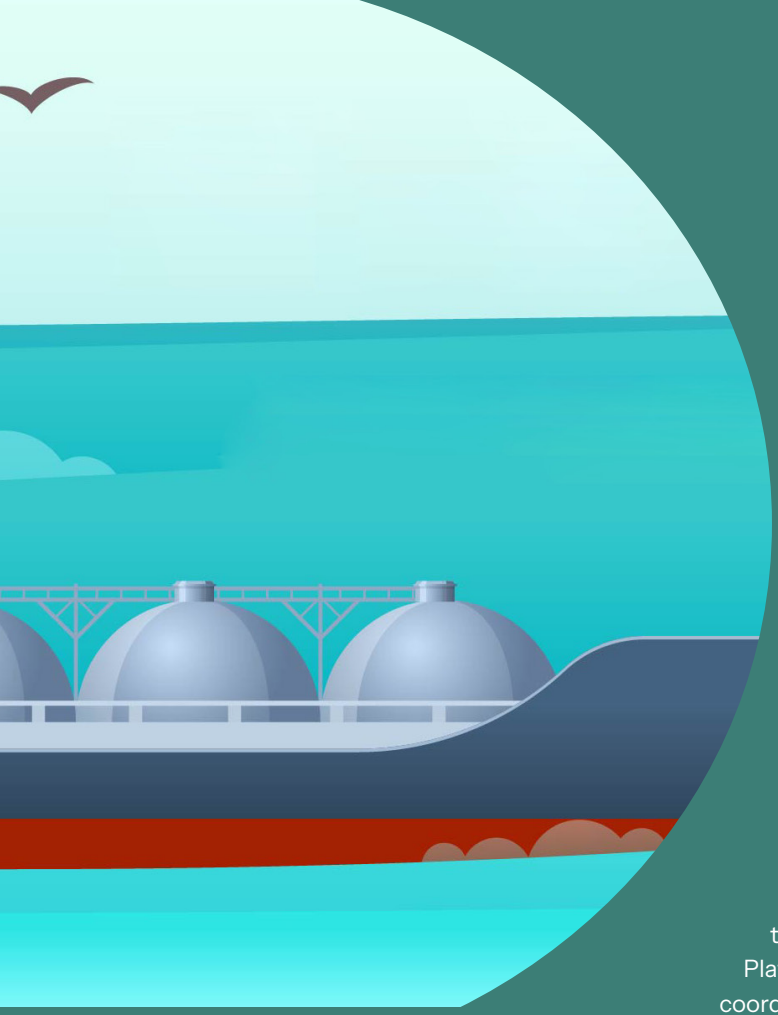
In three eastern state elections in early September, the AfD received the most votes in Thuringia and came a close second in neighbouring Saxony. Reflecting on these results, de Pous told Dialogue Earth: 'An earlier coal phase out in eastern Germany is just as likely to happen following these election results as before,' but with state government intervention less likely to play a part. The earlier phase out is now more likely to be 'entirely driven by market forces,' he said.

De Pous believes that a just transition and industrial competitiveness will in fact be best achieved by speeding up renewable-energy development, and that this process should not be slowed by a minority seeking to keep their jobs a little longer. 'In Europe, the debate about a just transition has often become instrumentalised,' he said. 'We've already wasted a lot of time, which is preventing more people from enjoying the social and economic benefits of a transition to sustainable energy.'

By **Niu Yuhan**

The EU Methane Regulation – What will be the impact on LNG imports?

Over the past two years, liquefied natural gas (LNG) has mostly been discussed in the context of security of supply. Europe's increased reliance on LNG provided the supplies needed to replace Russian pipeline gas in the aftermath of the invasion of Ukraine. But as the security crisis recedes and the gas market reaches a new equilibrium, discussions on decarbonization and the greenhouse gases associated with, particularly LNG supply chains, have again begun to attract increasing attention. Hence, the question arises: will its new global role enable the EU to impose stricter environmental standards on LNG market players and specifically, the standard proposed in the new Methane Regulation?



EU as the major LNG importer

The 2022-23 energy crisis transformed the role of the European Union (EU), from a global gas balancing market via LNG to becoming the largest global importer of LNG with nearly 97 million tonnes (Mt) or roughly 134 billion cubic meters (bcm) of imports (121 Mt if the rest of Europe is included) in 2023.[1] The EU's surge of LNG imports requiring the development of significant new infrastructure was an aggregation of individual countries' decisions rather than a coordinated EU crisis response.

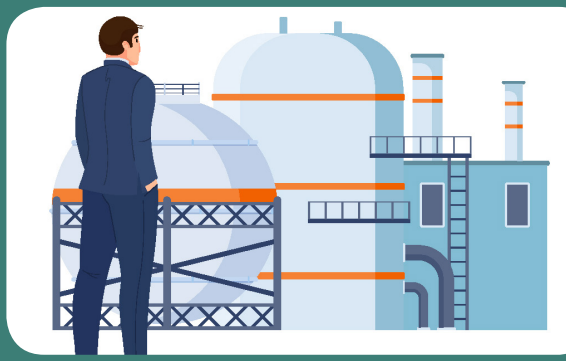
While the EU Commission tried to promote greater coordination, e.g. through the establishment of the joint purchasing platform (AggregateEU), a recent report by the European Court of Auditors (ECA) concluded that the Platform's impact alongside the EU Commission's efforts to coordinate international outreach to global gas producers could not be demonstrated.[2]

Being a major gas importer is one thing, being able to use this leverage is another. The ECA found that the Commission lacks the tools and legal competences in international affairs to achieve these objectives. This situation illustrates a tension within the EU between long-term sustainability objectives set at the EU level and short-term security of supply concerns of member states.

While these tensions may reduce as more LNG becomes available, the post-crisis response showed that member states, not the European Commission, have the leading role in negotiating with gas producing countries with gas procurement treated mostly as a national affair. Despite this situation, the recently adopted EU Methane Regulation puts the Commission at the helm of the negotiations on measurement, reporting and verification (MRV) equivalence with exporters of crude oil, gas and coal into the EU.

The EU Methane Regulation

On 27 May, the Council approved the EU Methane Regulation, which will come into force over summer 2024.[3] The regulation imposes obligations on oil and gas operators, coal mine operators, importers and member states with regard to monitoring, measurement reporting and independent verification of methane emissions.



1. ACER, 'Analysis of the European LNG Market Developments. 2024 Market Monitoring Report'.
2. European Court of Auditors, 'Special Report: Security of the Supply of Gas in the EU'.
3. Maria Olczak, Andris Piebalgs, and Jonathan Stern, 'Analysing the EU Methane Regulation'. OIES (2024).

The EU is the first jurisdiction to set requirements for fossil fuel imports, which will be implemented gradually from 2025-30. The table shows this process will begin with information provision, followed by demonstrating MRV equivalence, then reporting, and finally ensuring that imports stay below maximum methane intensity thresholds. While the legal requirement to comply with these requirements is on EU importers, they will need to work with producers and exporters to provide CAs in Member States with information required under the Regulation. Measurement will then need to be subjected to verification by qualified and nationally accredited bodies which will report to the CAs.

The Regulation clearly aims at ensuring that companies exporting fossil fuels to the EU face the same MRV and mitigation requirements as EU operators. Companies failing to comply will face financial penalties set by member states and reputational damage with customers.

The final version of the Regulation is considerably less ambitious than what was proposed in the Methane Strategy, which the EU published in 2020, and will take longer to achieve. Key methodologies and metrics defining equivalence and intensity have yet to be established and will require secondary legislation in the form of delegated and implementing acts (see table). Nevertheless, despite some disappointment, the EU has achieved a comprehensive regulatory framework for methane. Implementation is the next challenge.

TIMELINE	REQUIREMENTS	WHAT IF AN IMPORTER FAILS TO COMPLY?
By 04/2025	All contracts: Importers provide to competent authorities (CAs) information on methane emissions monitoring and mitigation measures set out in Annex IX	- Justify to CA and specify the actions undertaken - Financial penalty - Reputational damage
From 2027	New/renewed contracts*: Importers demonstrate and report to CAs that the imported coal, crude oil and gas is subject to equivalent MRV measures at the level of producer	- Financial penalty - Reputational damage
	Existing contracts: 'importers shall undertake all reasonable efforts',e.g.contract amendment	- Justify to CA and specify the actions undertaken - Financial penalty - Reputational damage
By 2028	New/renewed contracts*: EU producers and importers report the methane intensity of the production of crude oil,coal and natural gas	- Financial penalty - Reputational damage
	Existing contracts: 'importers shall undertake all reasonable efforts'	- Financial penalty - Reputational damage
By 2030	All contracts concluded/renewed after Q2 2030: EU producers and importers demonstrate that the methane intensity of the production<the maximum methane intensity values	- Financial penalty - Reputational damage

**new and renewed contracts are those concluded after the entry into force of the Regulation. CA = competent authority Source: Olczak, Piebalgs and Stern, 'Analysing the EU Methane Regulation'.*

DELEGATED ACTS	IMPLEMENTING ACTS
Art. 22(3) restrictions on **venting methane from ventilation shafts** for coking coal mines [2027]	Art. 12(4) **MRV reporting templates**
Art. 27(1) further information to be required from importers, **amending Annex IX**	Art. 14(7) **Minimum detection limits and detection techniques for LDAR surveys**, the thresholds applicable to the first step of LDAR surveys [2025]
Art. 29(4) the **methodology** for calculating, at the level of producer, the **methane intensity values** associated with imports [2027]	Art. 28(6) **MRV equivalence for third countries**: a) procedure and evidence requirements for establishing equivalence, b) decisions establishing/revoking equivalence
Art. 29(6) **maximum methane intensity values and classes** for crude oil, natural gas and oil	
Art. 32 EU COM can establish **mandatory standards or technical prescriptions** concerning e.g. measurement and quantification, LDAR	

LNG shipping emissions are covered under the EU ETS and FuelEU Regulation

What may come as a surprise is that the Methane Regulation does not cover emissions associated with LNG shipping. As of 1 January 2024, maritime transport emissions, including these associated with LNG shipping, were incorporated under the EU's cap-and-trade program – the Emissions Trading System (EU ETS).[4] As a result, shipping companies using European ports have to monitor and report their emissions and purchase and surrender EU allowances (EUAs) for each tonne of reported carbon dioxide (CO_2) emissions. From 1 January 2026, this obligation will be extended to two short-lived GHGs – methane (CH_4) and nitrous oxide (N_2O). The ETS will cover 100% of emissions for domestic voyages, but only 50% of those associated with international voyages.

There are two important differences between the approach in the Methane Regulation and EU ETS. In contrast to the Regulation, shipping companies covered by the EU ETS can choose between the calculation approach (methods A, B and C) and measurement approach (D). So far, the calculation approach was the default choice of the companies covered by the EU ETS. In case operators fail to comply with the MRV or surrender obligations, the company will face not only financial penalties and reputational damage but may be denied access to the EU market.

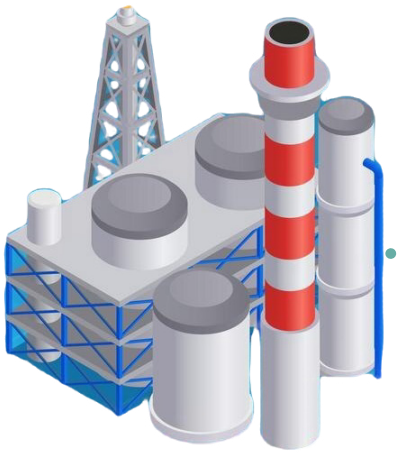
Moreover, as of the 1 January 2025, shipping companies will also need to comply with the FuelEU Maritime Regulation, whose main objective is to promote the use of renewable and low-carbon fuels in maritime transport.[5] Although LNG has become an alternative marine fuel of choice for the sector, FuelEU specifies that the GHG intensity (CO_2, CH_4 and N2O) of fuels used on board ships will need to gradually decrease by 2% in 2025, to 80% in 2050, below the baseline 91.16 g CO_2 eq per megajoule (MJ) (2020 fleet average GHG intensity of energy used on board ships)

4. Maria Olczak and Andris Piebalgs, 'The Decarbonisation of Maritime Transport'. OIES (2023).
5. Regulation (EU) 2023/1805 of the European Parliament and of the Council of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC (Text with EEA relevance). URL: <http://data.europa.eu/eli/reg/2023/1805/oj/eng>.

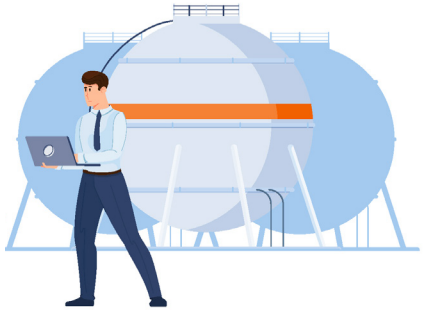
Crucial role of EU member states

This new wave of EU regulation targeting emissions associated with LNG will roll forward with revisions of both the Maritime Transport and EU Methane Regulations in 2028. Returning to our earlier question of whether its new role will enable the EU to impose stricter environmental standards globally: paradoxically, the energy crisis put the EU in a better position as the leading LNG importer, but as the competence of the EU is limited, it will require member states to play a more active role in the implementation and enforcement of the EU legislation and the outreach activities.

The fact that member states are mostly responsible for the implementation and enforcement of EU regulations and directives will be crucial for the success of the EU Methane Regulation. Hence, the effectiveness of policies will depend on how states implement them. For some governments it may give an opportunity to protect their domestic industries. And as revenue from the financial penalties associated with EU ETS and EU Methane Regulation stays largely in the member states, it may be considered by some governments as a potential source of additional revenue.



Energy (in contrast to e.g. competition policy) is an area of shared competence between member states and the European Commission. The latter's competence in international affairs, e.g. with regard to negotiations with non-EU countries, is even more limited. While the European Commission will be leading negotiations with gas producers and governments on how to define and achieve MRV equivalence under the EU Methane Regulation, it is clear that member states will have a major impact on how (and to what extent) its provisions will be implemented. Very important will be the institutions which states designate as `competent authorities' to carry out many of the key MRV tasks. While national energy regulators may seem to be the obvious choice, many have little or no environmental competence and may require a substantial increase in qualified staff. Alternatively, states may designate more than one competent authority with tasks shared between energy and environmental regulators.



Priorities for the new EU Commission

Regulation of methane fills an obvious gap in EU climate policies, but it remains to be seen how high this will be on the list of priorities for the new EU Commission and member states. Methane emissions reduction – a highly complex and technical topic – is not part of mainstream political discussions in Brussels and national capitals. If LNG demand remains strong in Europe and is seen as endangering EU climate objectives or the EU's image as a climate leader, more regulations and more assertive national and EU policies can be expected, as long as these measures are not seen by member states as compromising security of gas supply.

By **Maria Olczak** and **Jonathan Stern**

Republished with permission from Oxford Energy Forum

Building a healthy circular economy for electric vehicle batteries

A golden opportunity is emerging for investors into recycling who want to capitalise on China's upcoming wave of depleted electric vehicle batteries. But those investors are being greeted by market chaos: lack of regulation has sparked numerous illegal battery processing facilities, which are having a knock on impact on the market. ECECP discussed the current chaos and potential solutions with experts at Botree Recycling Technologies, a Chinese recycling solution provider of critical battery materials.

The looming wave of spent EV batteries

China's new energy vehicle (NEV) market has witnessed exponential growth in recent years, with the number of NEVs on the road reaching 20.41 million by the end of 2023. Typically, EV batteries come with an eight-year manufacturer's warranty. When their capacity falls below 80% of the original level, they would normally be due for replacement, or the entire car would be scrapped. Given that 2014 is widely regarded as the inaugural year for substantial NEV development, the batteries of the first NEVs to hit the market have reached or even exceeded their warranty period, potentially launching an entire new battery recycling industry.

According to data released by the China Automotive Battery Recycling and Utilisation Industry Collaboration Alliance (CABRCA)[1], 168 000 tons of depleted EV batteries were generated in China in 2023, a year-on-year increase of 78.3%. By the end of 2023, the total amount of depleted EV batteries had reached 449 000 tons. It is estimated that by 2030, China will be generating over one million tons of depleted EV batteries each year.

With these looming volumes in sight, the effective recycling and processing of these batteries has become a pressing issue for the automotive industry. Failure to manage this situation properly could result in a tsunami of environmental and safety concerns, in addition to the waste of valuable resources.

As a core component of electric vehicles, power batteries are made up of critical minerals such as lithium, nickel, and cobalt, and therefore normally account for 40% of the value of an electric vehicle. However, the geographical distribution of these minerals means that China relies heavily on imports to access these key resources. It is reported that China's reserves of lithium, nickel, and cobalt constitute 6%, 3%, and 1% respectively of the world's total. Yet, as the world's largest battery producer, China consumes more than half of the world's production of these minerals.[2]

Tapping into the 'urban mine' of spent EV batteries for safe and compliant disposal and recycling, as well as utilisation, is not only crucial for securing the supply of critical raw materials for the future, but also for reducing the need for new extraction of virgin minerals, thereby lowering the environmental footprint of EVs.

Dr Liu Gangfeng, chief technology officer at Botree Recycling, outlined the issues to ECECP. 'According to our calculations, producing EV batteries using recycled materials can reduce the lifecycle carbon footprint by more than 30% compared with using virgin materials. Whether from the perspective of environmental protection or circular economy, the proper management of EV batteries is a critical mission that holds benefits for both the present and the future.'

1. https://mp.weixin.qq.com/s/HRl2Li2QqAQCuUeSjsF3TQ
2. https://tv.cctv.cn/2024/08/24/VIDETy3rqDjP9vREwivU3PbO240824.shtml

Reuse or recycle? That is the question

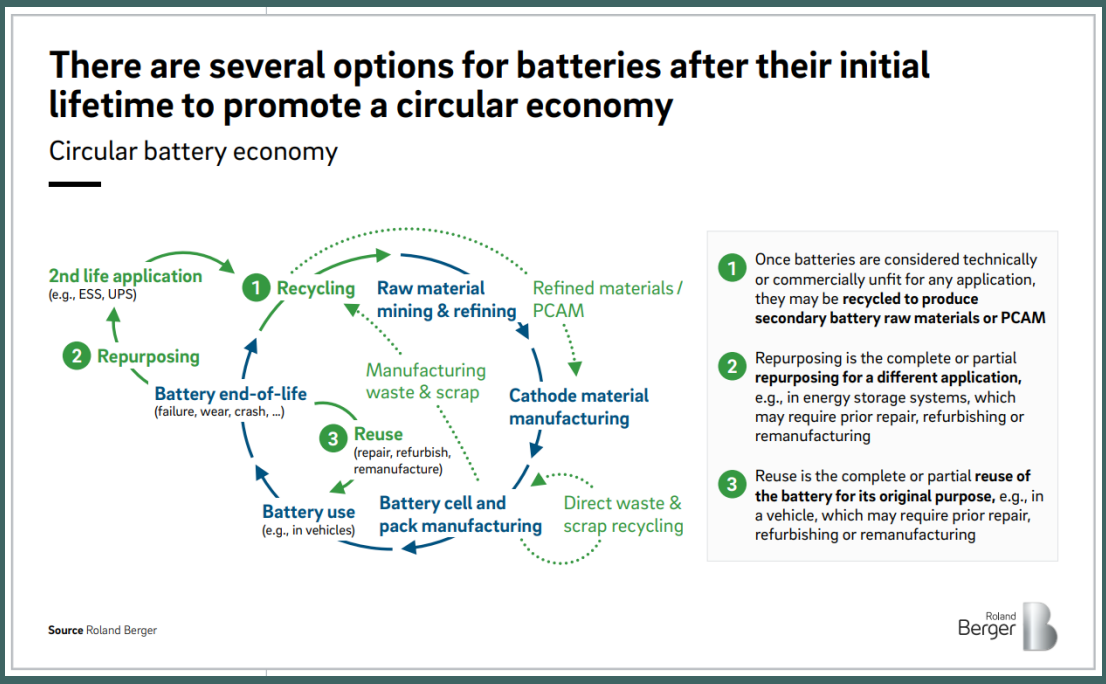
How are these spent batteries normally handled? Generally, when a battery is 'retired' from service in EVs, it does not mean the end of its life. Even after its capacity falls below 80%, it can be repurposed for use in other applications once it has gone through a series of processes including safety tests and evaluation, sorting, screening, and regrouping. For example, spent batteries can be reused in both stationary and home energy storage applications as well as in other motor vehicles. In China, this approach is usually referred to as 'cascade utilisation'.

Once the reuse value of these used batteries has been exhausted, their ultimate destination is a recycling facility. After they have been disassembled, crushed and sorted, and undergone chemical treatment, any recyclable materials, such as the minerals, can be extracted and recovered, and eventually used to produce new batteries.

According to Liu Gangfeng, there is still much debate on how best to handle spent batteries, especially regarding the safety and economic viability of their reuse. He stresses that repurposing these batteries for reuse not only prolongs the battery life and maximises its value, but also encourages the sustainable use of these assets. However, because the journey of cascade utilisation involves multiple stakeholders and a complex network of interests, it is difficult to monitor effectively and is prone to regulatory loopholes.

As a matter of fact, the absence of state-of-health (SOH) testing, evaluation, and standardisation for second life batteries poses numerous safety risks in practical applications. 'Many of the reported accidents involving thermal runaway fires at energy storage power stations and in electric bicycles are more or less related to non-compliant use of second life batteries,' says Liu Gangfeng.

Whether a spent battery is better suited for reuse or recycling depends on a series of complex factors, as illustrated by research published by Roland Berger GmbH[3]. Spent batteries designated for reuse often employ older technologies and



Circular battery economy. *Source: Roland Berger GmbH*

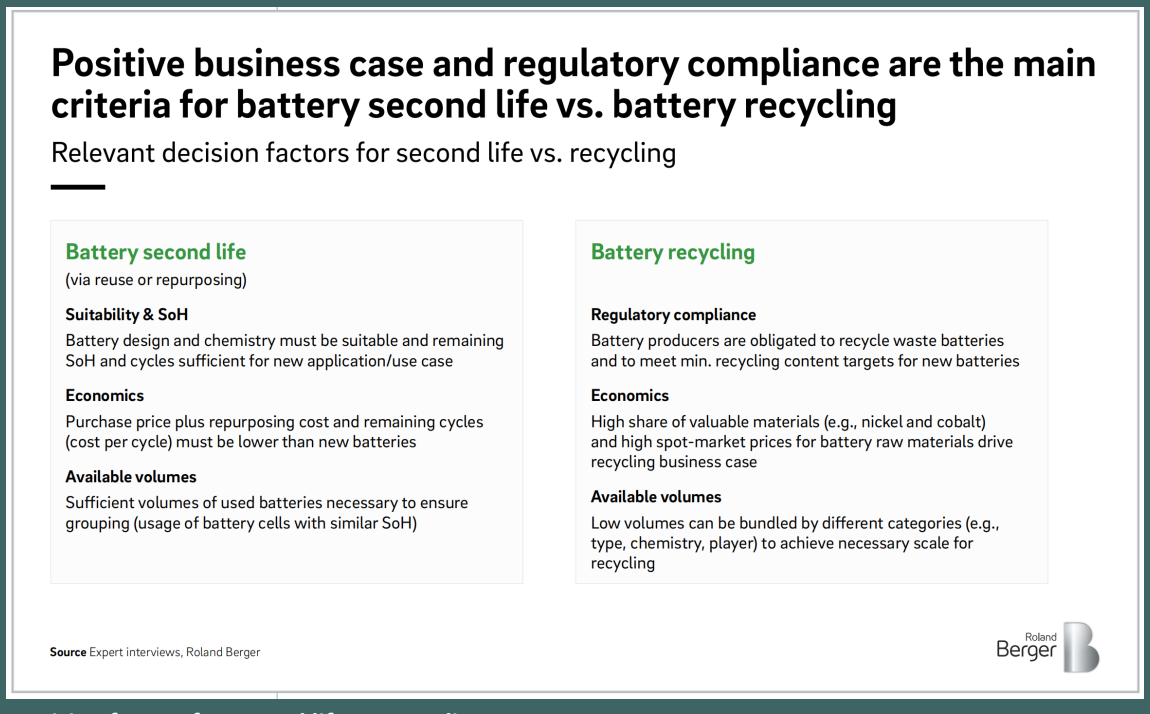
have various origins. Therefore, establishing their health status can pose challenges, as well as potential safety risks. In addition, repurposed batteries must compete against cutting-edge purpose-built new batteries. With continuous technological advancements, the cost of the new batteries is declining significantly. In some cases, purchasing new batteries may even be cheaper than buying repurposed ones, which means repurposing is not always economical. Moreover, the batteries that are now entering the reuse and recycling industry are typically not designed for reuse or repurposing. Coupled with the incomplete standards and lack of interoperability, the business case for high volumes of reused batteries is not an easy one to make. In Europe, repurposing is not currently widespread[4] as the systems for evaluation and market trading of spent batteries have yet to be established.

In a bid to address safety and reliability concerns, in 2023 China's National Energy Administration[5] issued new requirements for battery implementation, stating that 'large and medium-sized energy storage facilities should utilise batteries with mature technology and high safety performance, and should approach the use of second-life power batteries with caution'. In a similar vein, the newly released mandatory national standards[6] for electric bicycles in 2024 explicitly prohibit the use of second-hand lithium batteries in electric bicycles. Zhang Weikai, head of Botree Recycling's Dingzhou subsidiary, anticipates that as policy supervision strengthens, alongside the improved performance and declining prices of new batteries, the market share of reused batteries in the battery recycling market may well contract.

The battery recycling process

There is no doubt that regardless of whether a battery is reused or repurposed, it will eventually end up as waste and need to be recycled. This final stage represents the 'last mile' of the battery industry chain and is key to closing the loop in the battery circular economy.

Battery recycling typically follows three primary technical pathways: pyrometallurgy, hydrometallurgy, and direct recycling. When evaluating these methods based on technical maturity, environmental impact, required



Decision factors for second life vs. recycling. *Source: Roland Berger GmbH.*

3. Repurpose, reuse or recycle? What battery producers and users need to know? https://content.rolandberger.com/hubfs/23_2064_ART_Battery_Second_Life-04.pdf
4. Managing waste batteries from electric vehicles: the EU and Japan, Institute for European Environmental Policy (2023). https://ieep.eu/wp-content/uploads/2023/05/Managing-waste-batteries-from-EVs-JP-and-EU-May-2023.pdf
5. 《防止电力生产事故的二十五项重点要求》（2023), China NEA, March 2023.

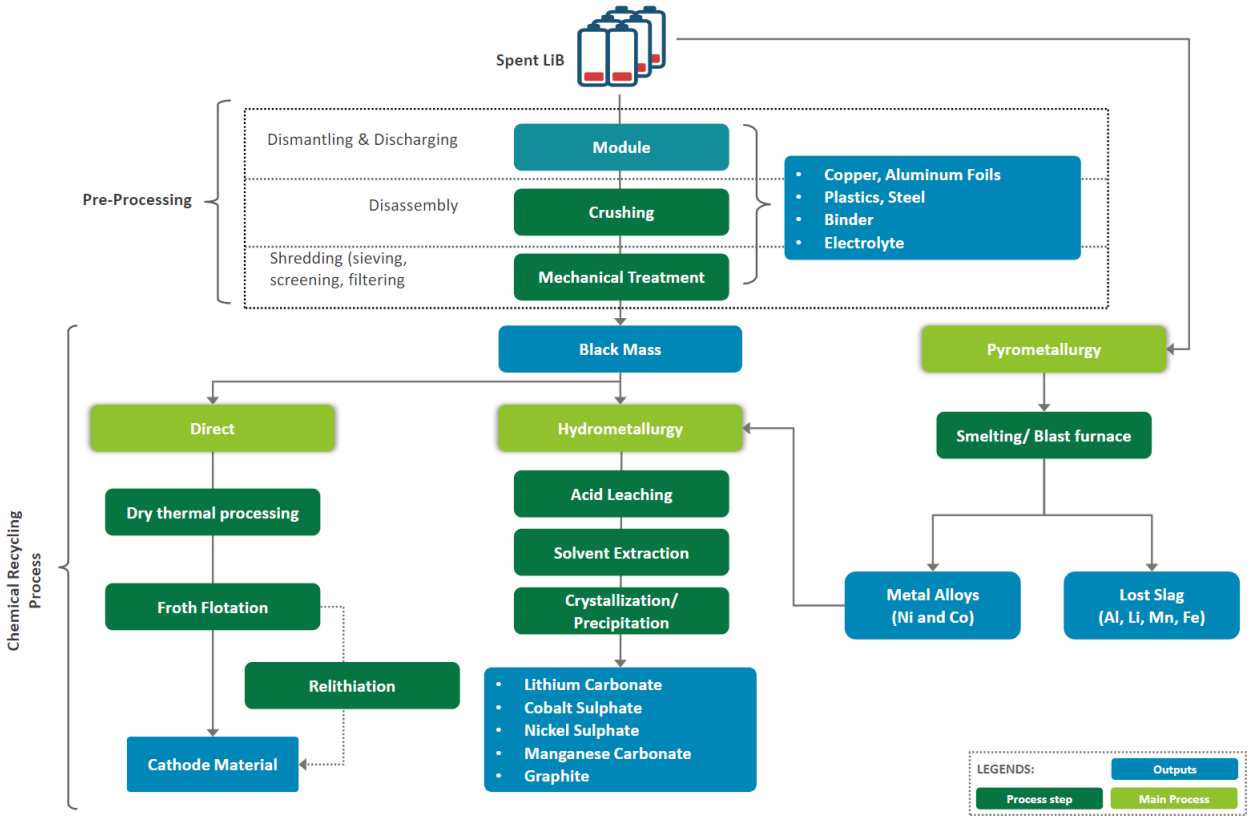
capital investment, and energy consumption, hydrometallurgy emerges as the preferred option for recycling battery materials. This process not only boasts a higher recovery efficiency but also effectively retrieves a variety of materials, including copper, aluminum, cobalt, nickel, and lithium.[7]

According to Liu Gangfeng, China tends to use the hydrometallurgical method for battery recycling. Batteries first undergo pre-treatment of disassembly and mechanical processing, shredding them into little pieces to obtain black mass (cathode material). They are then sent for chemical recycling (hydrometallurgical) for refining and recovery of materials that can be used in new batteries.

Chaos in the battery recycling market

The battery recycling market is sensitive to spot-market prices for battery raw materials because these are the main drivers for the recycling business . In China, the market price of lithium carbonate, a raw material for batteries, soared from CNY 50 000/ton in 2020 to CNY 600 000/ton in 2022. This price surge prompted a 'gold rush' into the battery recycling sector.

Data from Qichacha, an enterprise information query platform, indicates that there are currently 141 900 registered enterprises engaged in EV battery recycling-related businesses in China, numbers having increased exponentially over the past two years. There are noticeable signs of overheating in the battery recycling market. Issues such as the emergence of a grey business, overcapacity, and price inversions are impeding the healthy development of the EV battery recycling market.



Workflow of LiB Recycling Processes *Source: GIZ Battery Ecosystem Report*

6. 《电动自行车用锂离子蓄电池安全技术规范》（GB 43854—2024）

The grey business of the small workshops

In order to set benchmarks for the battery recycling business, China has announced five successive batches of 'white-listed' enterprises that are compliant with the 'Industry Norms and Conditions for Comprehensive Utilisation of New Energy Vehicle Power Batteries', totalling 156 companies. These companies are selected for their adherence to higher standards and are equipped with the appropriate equipment, technology, and environmental protection facilities that are sought by EV original equipment manufacturers (OEMs) and battery producers when selecting their recycling partners.

Beyond the 156 white-listed companies, a significant number of enterprises and private workshops engage in rudimentary processing and illegal disposal of batteries, without regard for safety and environmental requirements. Chinese media[8] have reported repeatedly on illegal 'small workshops' that do not meet the formal requirements. The images are alarming: a few workers can be seen disassembling scrapped batteries with their bare hands in makeshift warehouses, with no protection measures in place. The waste liquid generated during battery processing is often discharged indiscriminately, posing significant safety and environmental hazards.

According to Liu Gangfeng, the majority of these small workshops are engaged in the upstream mechanical pre-treatment business, due to the relatively low entry barriers. Very few companies engage in the resource regeneration process, which involves chemical metallurgy and requires more specialised expertise.

'Battery recycling and processing is a highly specialised task that requires knowledge of mechanics, metallurgy, chemistry, and more. If not handled properly, it can easily lead to fires and explosions. A battery's electrolyte contains hazardous components that are harmful to our health and to the environment, so specialised technology and equipment is a must. Legal recyclers spend a lot on safety and environmental protection—between 30% and 40% of their total costs. This means they cannot compete with small recycling workshops on price,' says Liu Gangfeng.

He further notes that even though some compliant companies have acquired the necessary qualifications and possess the required environmental protection equipment, they still choose to outsource processing to illegal workshops to cut down on operational costs. 'For some companies, survival is obviously more important than being punished for violations,' he says.

In addition, due to their low operating costs, these small workshops can usually offer higher prices or spent batteries, while compliant companies find it challenging to secure a steady supply. The result is that high-quality recycling capacity sits idle. Industry statistics[9] show that less than 25% of spent batteries currently reach white-listed companies, while 75% end up in small workshops and companies. There is a glaring need for strengthened regulation and law enforcement in the battery recycling sector.

Overcapacity intensifies market chaos

Meanwhile, the status of recycling capacity in China is just as chaotic. Statistics from the Ministry of Industry and Information Technology[10] reveal that in 2023, reuse and recycling of NEV batteries amounted to 225 000 tons. However, media reports[11] suggest that the nominal recycling and processing capacity of the existing 156 'white-listed' enterprises exceeds 3 million tons per year, indicating severe overcapacity issues. It is widely acknowledged that China's current battery recycling capacity is sufficient to support the volumes of spent batteries that are projected for 2030. Although the price of lithium carbonate has now dropped significantly, this excessive recycling capacity is

7. Battery Ecosystem: A Global Overview, Gap Analysis in Indian context, and Way Forward for Ecosystem Development. https://changing-transport.org/wp-content/uploads/GIZ_Battery-ecosystem-report.pdf
8. https://capital.huanqiu.com/article/4CcSEYrF3q9
9. Ibid.
10. http://www.scio.gov.cn/live/2024/33205/tw/
11. https://tv.cctv.cn/2024/08/24/VIDETy3rqDjP9vREwivU3PbO240824.shtml

already well established across the nation. Such a severe mismatch between the current limited supply of depleted batteries and excessive recycling capacity foreshadows intense market competition, which in turn has caused an price inversion, so that the materials from used batteries and recycled products are now more expensive than imports of unprocessed raw materials. This situation is putting significant pressure on battery recyclers.[12]

Zhang Weikai further notes that some scrap battery dealers and small pre-treatment workshops even pose as cascade utilisation companies so that they can stockpile end-of-life batteries and black mass (the intermediate product after pre-treatment) -- to sell at a profit when market conditions are right. This practice is inflating battery recycling costs and hindering the flow of scrapped materials into the crucial hydrometallurgical recycling phase, so disrupting the market cycle.

'Battery recycling should be about doing good for the environment and not just making a quick buck. That's the bottom line,' adds Liu Gangfeng. 'When everyone jumps in just to make money, things get messy. It's like a gold rush, and that's not how it should be.'

How to get battery recycling back on track

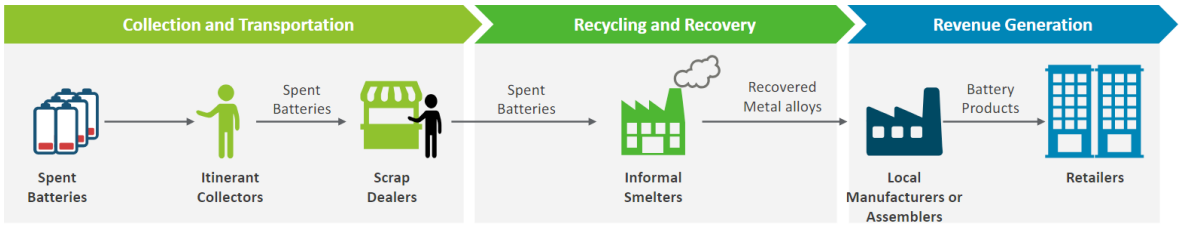
As the wave of spent batteries approaches its peak, how can the current chaotic market be brought back on track to create a healthy circular economy for power batteries? Measures such as strengthening environmental law enforcement, further raising the industry entry threshold, making a clear and logical plan for capacity distribution, and establishing and improving relevant standards are all necessary steps. However, the most pressing measure is to establish a well-regulated and well-organised recycling system that ensures used power batteries are directed into formal recycling channels, thereby breaking the cycle of the grey market.

Since used batteries in China can be bought and sold freely like any other commodity in the open market, recycling companies are inevitably in a bidding war to acquire them, which can easily lead to market disorder. This brings us to the question: could legal regulation of these market transactions end this chaos for good?

Many players in the recycling industry suggest that a more reasonable approach would be to follow the EU's approach. Its policy is to ensure strict implementation of Extended Producer Responsibility (EPR), whereby battery producers are held responsible for managing the batteries once they are depleted, so that the financial burden is shouldered by the entities generating the waste[13]. Liu Gangfeng believes that in China, too, battery producers should take battery disposal and recycling into consideration during the initial manufacturing process, with funding set aside to subsidise the final recycling efforts. However, China still lacks explicit guidelines for enforcing EPR in the battery sector, and the specifics of how to implement such a system are not well-defined.

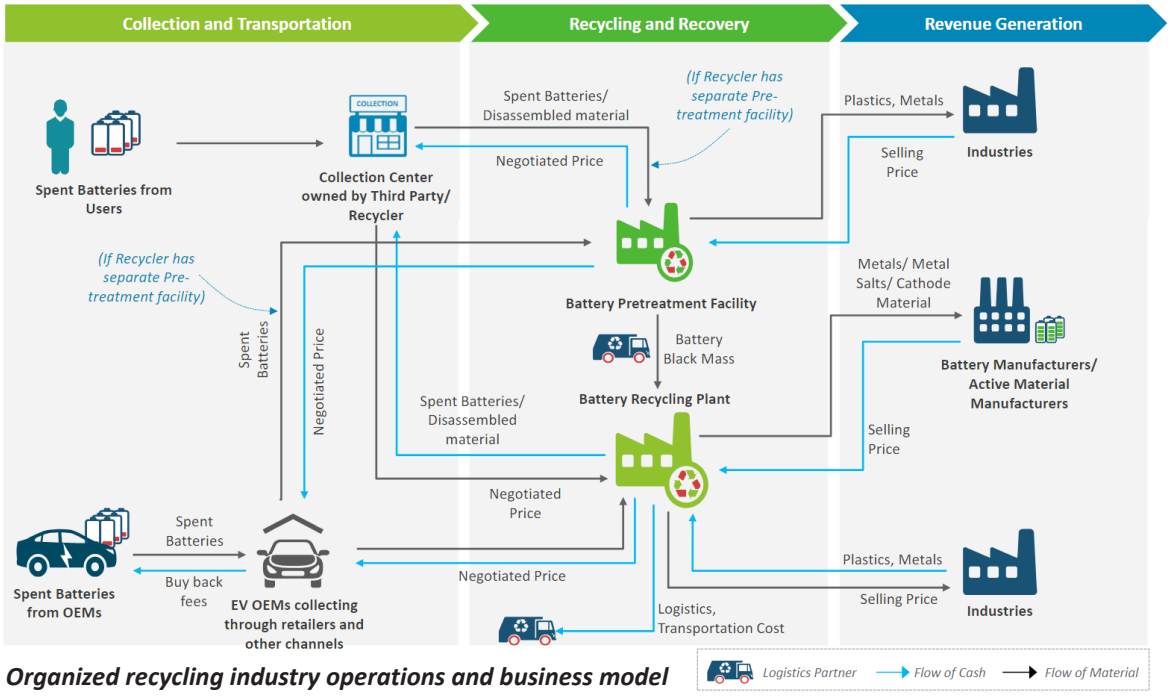
The EU got off to an early start in implementing EPR. Battery producers are made responsible for the collection and recycling of the batteries they sell and for the associated costs[14], no matter what their chemical composition, condition and brand, or where they are sourced. Car OEMs, retailers, and EV users all have to return used batteries to the battery producers, who are then responsible for ensuring they are recycled by designated specialist companies. This system ensures a steady and reliable stream of used batteries back into trustworthy recycling channels.

12. https://www.cnfin.com/dz-lb/detail/20240708/4072366_1.html
13. https://www.thepaper.cn/newsDetail_forward_29088358
14. Managing waste batteries from electric vehicles: the EU and Japan, Institute for European Environmental Policy (2023). https://ieep.eu/wp-content/uploads/2023/05/Managing-waste-batteries-from-EVs-JP-and-EU-May-2023.pdf



Unorganized recycling industry operations

Source: GIZ Battery Ecosystem Report



Organized recycling industry operations and business model

Source: GIZ Battery Ecosystem Report

In Liu's view, Europe has a relatively well-established recycling system with mature practices regarding collecting and sorting waste from the outset, and has clearly defined the responsibilities of various stakeholders. Moreover, the EU has introduced incentive mechanisms such as deposit-refund schemes, which maintain the price margin for recycling. All these measures lay the foundations for a more effective battery recycling and reuse industry.

In addition, Europe is taking steps to update its waste management policies, specifically by revising its waste list[15] to enhance control over the export of black mass and lithium battery cathode materials, in a bid to keep the valuable materials derived from waste batteries within the EU and so support supplies of key raw materials in the region[16]. This is expected to boost local recycling capabilities significantly within the EU.

'As a technology-driven solutions provider, we are very optimistic about the European battery recycling market,' remarks Liu Gangfeng. 'Europe is building its own EV battery industry including closing the loop on recycling. They need mature industrial-scale battery recycling technologies. China, on the other hand, has developed a complete industrial chain of battery recycling, and has gained extensive technological knowledge validated by years of industrial experience in processes such as shattering, segregation, and extraction and purification. There's a great opportunity for both regions to work together in the future.

15. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14016-Waste-treatment-Amendment-to-the-European-List-of-Waste-to-address-waste-batteries-and-wastes-from-treating-them_en
16. https://mp.weixin.qq.com/s/WaChjJeaQEpnuQlQ6tw7tw

Implications of the EU's New Battery Regulation

Separately from the EPR, the EU's New Battery Regulation[17] came into effect on 17 August 2023, and aims to ensure the sustainability and safety of batteries placed on the EU market throughout their life cycle. The regulation not only establishes specific recovery targets for batteries and key metals like nickel, cobalt, and lithium, but also requires that new batteries include a minimum percentage of these metals sourced from recycled waste batteries. Liu Gangfeng believes this minimum recycled content requirement will further boost market tolerance of recycled materials, which will benefit the battery recycling industry.

Moreover, the New Battery Regulation strengthens existing mandates requiring disclosure of battery information. Batteries exported to Europe must have a 'Battery Passport' that meets specific criteria. Battery producers are required to record the use of materials in the production process, as well as battery state-of-health (SOH) and historical information, which allows for better management of the battery's quality and carbon footprint throughout its lifecycle. This supports the implementation of EPR and clarifies the rights, responsibilities, and interests of each party in the battery industry chain. The new regulation is widely seen as a significant step towards greater sustainability and accountability in the battery industry, despite the immediate challenges it may present to battery producers. In the long run, it will help to formalise the battery recycling system as well as lifecycle and carbon footprint management[18], thus contributing to the healthy and green transformation of the battery industry chain.

Progress underway in China

The Chinese government has recently introduced a series of intensive measures to rectify EV battery recycling industry chaos and create a healthy battery recycling ecosystem, and as a result the overall regulation framework on battery recycling and utilisation is gradually improving.

In terms of policy, in August 2024, China Ministry of Industry and Information Technology issued the 'Draft industry standards for integrated utilisation of used NEV batteries (2024 edition)'[19]. This document proposes higher and more detailed requirements relating to the responsibilities, site selection, traceability management, comprehensive utilisation capabilities, environmental protection, and R&D investment for battery cascade utilisation companies and battery recycling companies, which will further raise the industry's entry barriers. Additionally, the document sets minimum recovery rates for valuable metals in the metallurgical process: lithium at no less than 90%, and nickel, cobalt, and manganese no less than 98%. These standards are expected to create improved policy conditions for the battery recycling market and stimulate its growth.

In terms of traceability, the national EV battery whole lifecycle traceability management platform[20], launched in 2018, is continuously being revised. As of October 2024, more than 100 different pieces of traceability information can be found on the platform, covering battery production, sales, use, disposal, retirement, and recycling and utilisation. This is to ensure that 'the source channel can be traced, the destination can be tracked, the process can be controlled, and accountability is assured', laying a solid data foundation for the battery circular economy.

17. https://eur-lex.europa.eu/eli/reg/2023/1542
18. https://baijiahao.baidu.com/s?id=1803965804522460442&wfr=spider&for=pc
19. https://www.miit.gov.cn/cms_files/filemanager/1226211233/attach/20248/d0f33b478b4244249772958ae7e4580d.pdf
20. https://evmam-tbrat.com/

In terms of law enforcement, local market supervision departments have recently carried out a series of cleanup operations to investigate and crack down on illegal small workshops involved in power battery recycling, further safeguarding market fairness.

In a further significant recent move, China Resources Recycling Group Co. Ltd, a centrally administered state-owned enterprise, was officially established in Tianjin[21] on 18 October 2024. This new entity has been given the crucial role of developing a national platform focused on the recycling and utilisation of a wide range of resources, including the recycling and secondary use of NEV power batteries. The establishment is expected to strengthen the current battery recycling network, optimise battery collection channels, and enhance the infrastructure supporting the circular economy.

Local initiatives are also making significant strides. Botree Recycling has assisted the city of Dingzhou, Hebei Province, in creating the country's first city-level battery asset management platform. This platform streamlines the battery recycling sector by eliminating intermediaries, reducing the cost of acquiring scrapped materials. The initiative records important events and data of a battery throughout its life cycle, creating a digital battery passport that provides insights into the battery's manufacturing site, production techniques, and carbon emissions during manufacturing. In addition, capitalising on Dingzhou's proven track record in resource recycling, Botree is building a hydrometallurgical pilot processing line in the city with an annual capacity of 20 million tons for black mass treatment.

'Battery recycling is really the final link in the entire battery industry chain,' comments Zhang Weikai.

Botree battery recycling line. *Source: GIZ Battery Ecosystem Report*

'To fix deeper issues, we need to look at the whole picture. Only by building a strong foundation for transparent information disclosure, with better traceability and carbon footprint management, can we get the battery recycling sector moving in the right direction. This will help us truly close the loop and create a healthy, circular battery economy.'

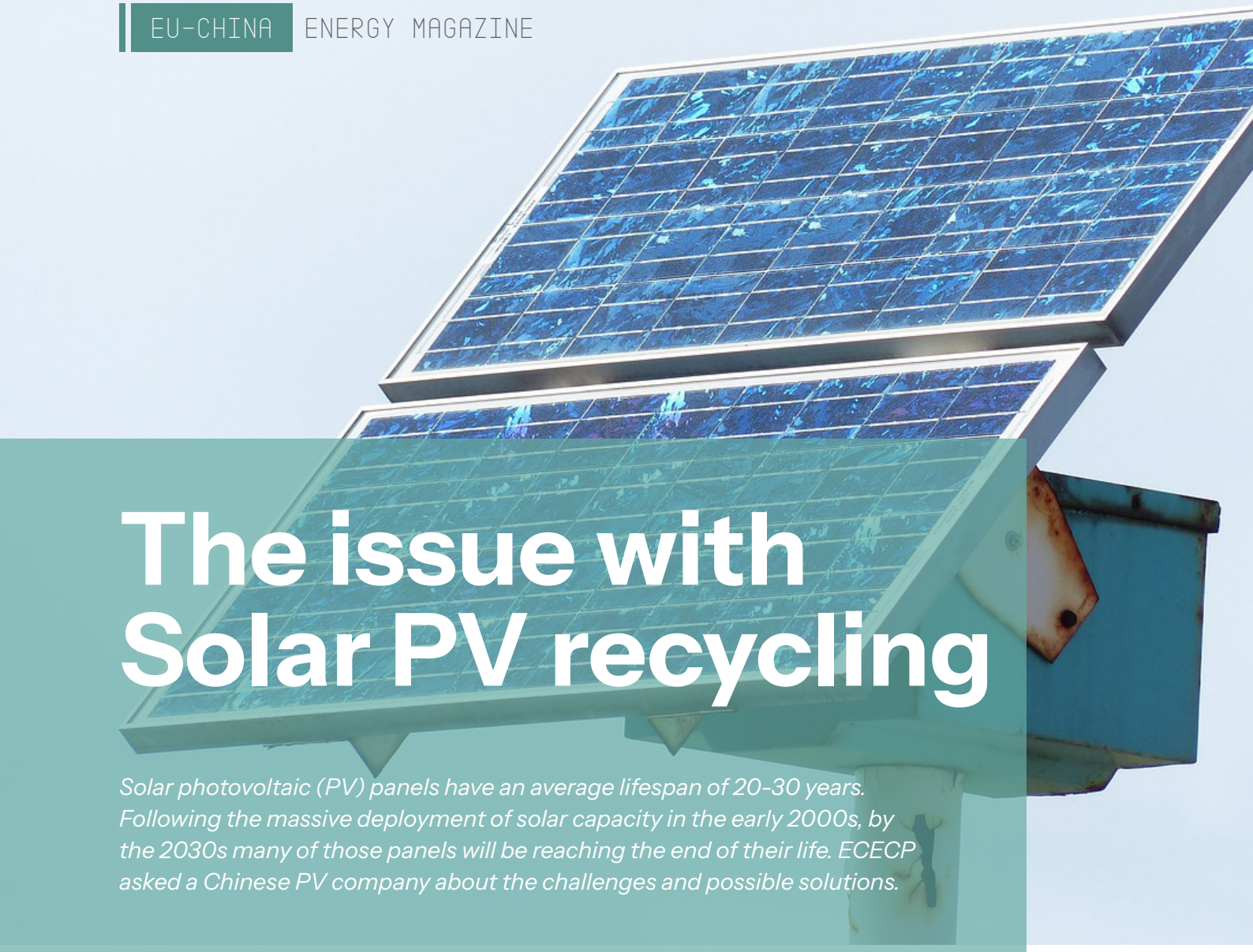
By **Daisy Chi**
Editor in Chief of EU-China Energy Magazine

About Botree Recycling

Botree is a complete solutions provider for the recycling of critical battery materials, enabling battery manufacturers, battery operators, automotive manufacturers, energy storage enterprises, and recyclers to streamline their recycling processes. The company has completed 45+ industrial and large-scale applications across the world for lithium battery recycling, from pre-treatment and hydrometallurgical recycling to material regeneration. It has established a complete life cycle assessment (LCA) system for EV batteries complying with international standards and helps customers to build systems for responsible sourcing.

www.botree.tech

21. https://www.bjnews.com.cn/detail/1729848453129061.html



The issue with Solar PV recycling

Solar photovoltaic (PV) panels have an average lifespan of 20-30 years. Following the massive deployment of solar capacity in the early 2000s, by the 2030s many of those panels will be reaching the end of their life. ECECP asked a Chinese PV company about the challenges and possible solutions.

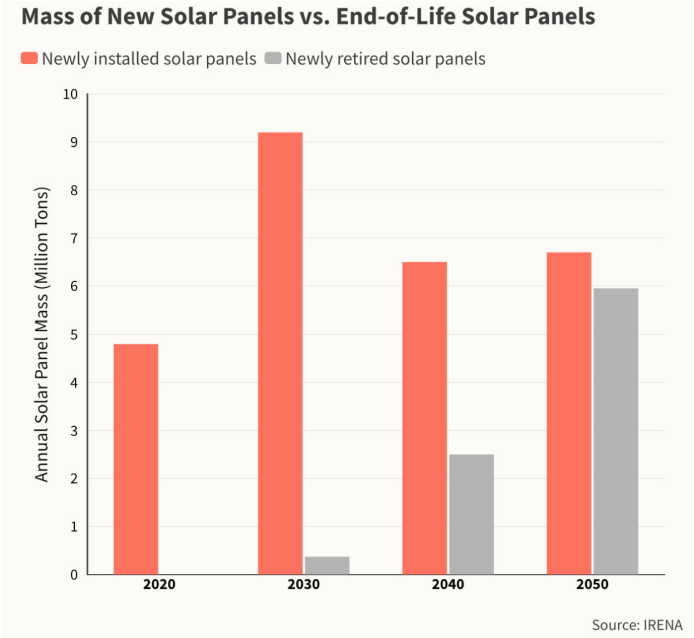


Figure 1. *Source: IRENA (2016) via YaleEnvironment360*

How circular is the economy around solar energy production? Ask a solar PV manufacturer in China, Europe, or the US, and the answer will likely be similar: not as much as it could be. In fact, as deployment of solar capacity keeps growing, so does the potential amount of solar waste (i.e. solar PV panels reaching end-of-life). As early as 2016, the International Renewable Energy Agency (IRENA) was warning that by 2050 the amount of solar waste would be almost as much as new installed capacity (Figure 1). More recent estimates suggest that by 2030, there will be approximately 8 million tonnes of solar waste globally, with this figure soaring to 80 million tonnes by 2050.

Owing to its massive deployment of PV installations, China is set to represent almost a quarter of global solar waste, generating around 1.5 million tonnes of end-of-life solar panels by 2030 and 20 million tonnes by 2050[1]. This is more than double the amount generated by the second and third largest producers together (the US and Japan, respectively), and almost five times the solar waste generated by Germany, the largest European producer (Figure 2).

Globally, only a small proportion of end-of-life panels is actually recycled. Many observers[2] have highlighted the need to scale up solar PV recycling to meet the challenge, yet the industry is still in its infancy. From an economic point of view, solar recycling looks promising: according to data provided by China's Yingli Group, the value of recovered materials globally is projected to exceed USD 450 million by 2030, potentially reaching USD 15 billion by 2050 as recycling practices develop. This comes on top of the environmental benefits – to send billions of tonnes of solar waste into landfill doesn't sound really 'green' – and even geopolitical rationales: in a world rushing for critical raw materials, recycling materials can mitigate demand for further supplies and reduce dependencies on external providers.

The anatomy of a solar PV panel

So, given the benefits of recycling end-of-life solar panels, why are so few panels recycled? Let's start with the basics – or rather, the silicon solar cells at the root of solar technology. Disclaimer: if you're already a solar energy geek, you may already be familiar with most of the content of this Energy 101 class.

There are nine different types[3] of solar PV panels, but those that are silicon-based are the most widespread thanks to the higher returns on investment and efficiency yields (around 20%-25%). Hence, this type of panel is the main focus when it comes to recycling – as well as in this article. Figure 3 shows the anatomy of a solar PV panel. Think of it as a sandwich, where different layers are placed one above the other until you reach the filling – the solar cells – in the middle. As a

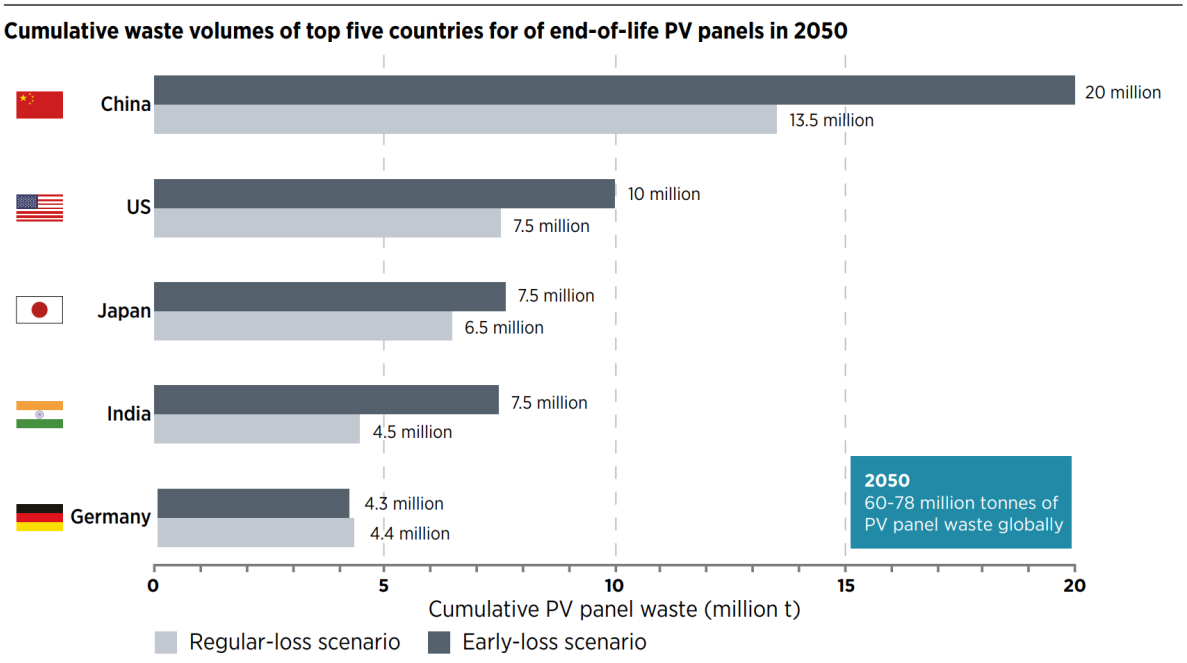


Figure 2. *Source: IRENA, "End-of-life Management: Solar Photovoltaic Panels" (2016)*

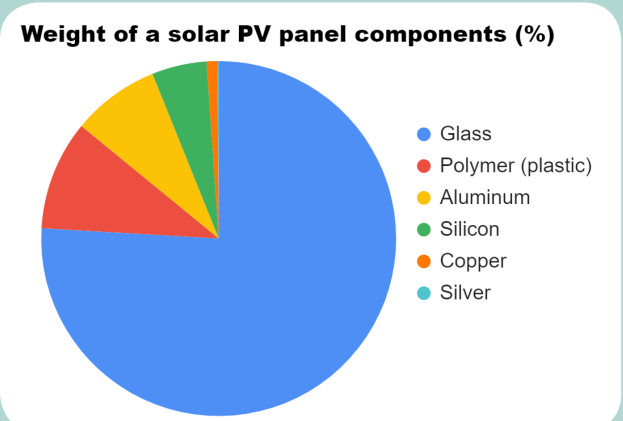
1. Figures provided by Yingli Energy Group
2. See, for instance, Harvard Business Review, June 18, 2021, link: https://hbr.org/2021/06/the-dark-side-of-solar-power ; World Economic Forum, October 10, 2022, link: https://www.weforum.org/agenda/2022/10/solar-panel-recycling-is-here-and-now-is-the-time-to-scale-up/
3. For a broad overview, see https://theecoexperts.co.uk/solar-panels/solar-panels-types

matter of fact, most of the layers (aluminium frame, glass cover, encapsulants) are responsible for shielding and sustaining the thin layer of solar cells, which is where the magic happens and sunlight is transformed into a stream of electrons. Yet, the external protective layers are also the heaviest parts – just like the bread in cheap sandwich kiosks – making up the bulk of a solar panel's mass: the glass alone accounts for roughly three quarters of a PV panel's weight. Add the aluminium frame, which shields the panel from external bumps, and the weight reaches well over 80% of the total. Figure 4 highlights the weight of the different components (the exact amounts vary according to different manufacturers).

A further 10% of the weight is plastic. This is mostly composed of ethylene-vinyl acetate (EVA), a polymer serving as an encapsulant to sustain and isolate the solar cells. This is where the trouble begins: during the manufacturing process these layers are pressed and blended together to such an extent that makes it difficult to separate and recycle them after a PV panel reaches end-of-life. As such, common recycling methods involve warming up the EVA layers in a furnace-like machine, to burn the plastic and free the solar cells inside. Finally, we reach the ham of our PV sandwich: the solar cells. This thin layer is made primarily of chemically-doped silicon – essential to absorb light and convert it into moving electrons – and thin silver-made conductive lines, which form a grid that captures and transports the electrons.

This initial partition highlights a first, crucial aspect of PV recycling. The thin layer of solar cells only accounts for a small fraction of the whole panel, yet it is also the most valuable part. Silver, in particular, only accounts for a tiny 0.1% of a panel's mass, but it constitutes almost half of the total value of recycled materials (Figure 5). Add silicon, and the figure touches 60%. In other words, the real value of PV recycling lies in the solar cells, but they are also the most complex parts to separate. The bulk of a PV panel (with the exception of the aluminium frames and copper-made cables) has little market value, which makes the profit margins from recovered materials less appealing from a recycling company's point of view. Furthermore, solar cells require special treatments to attain a certain level of purity and increase their market value, and these methods are often more complex and expensive,

Figure 4: The typical crystalline silicon solar panel is made of about 76% glass, 10% plastic polymer, 8% aluminum, 5% silicon, 1% copper, and less than 0.1% silver and other metals. *Source: Institute for Sustainable Futures. Image: ECECP*



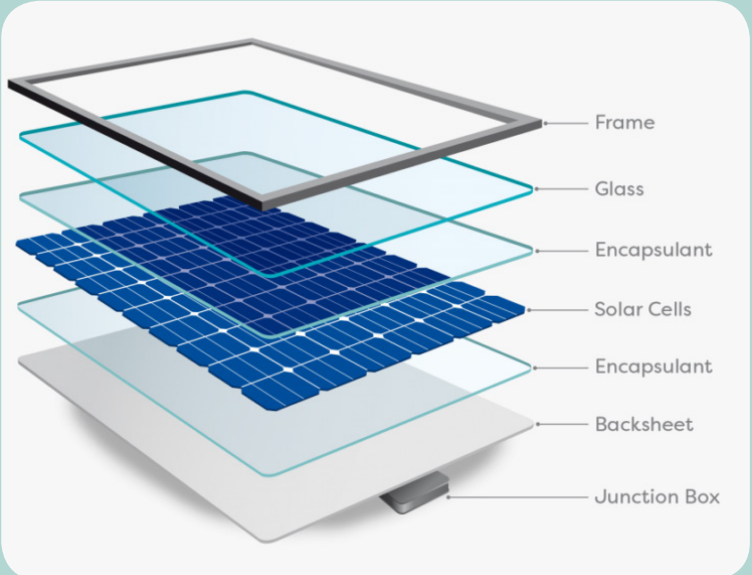


Figure 3.The anatomy of a solar PV panel. *Source: SolarPower Beginner*

further pushing up costs. According to US estimates[4], recycling costs fluctuate between USD 20 to USD 30 per panel, whereas it only costs around two dollars to throw end-of-life panels in landfill. If the recovered materials are not valuable enough to cover the expensive recycling costs, it makes no sense for companies to invest in recycling. Therefore, a first important issue is how to make an economic case out of recycling end-of-life panels, allowing the sector to become lucrative enough to scale-up and attract private investments.

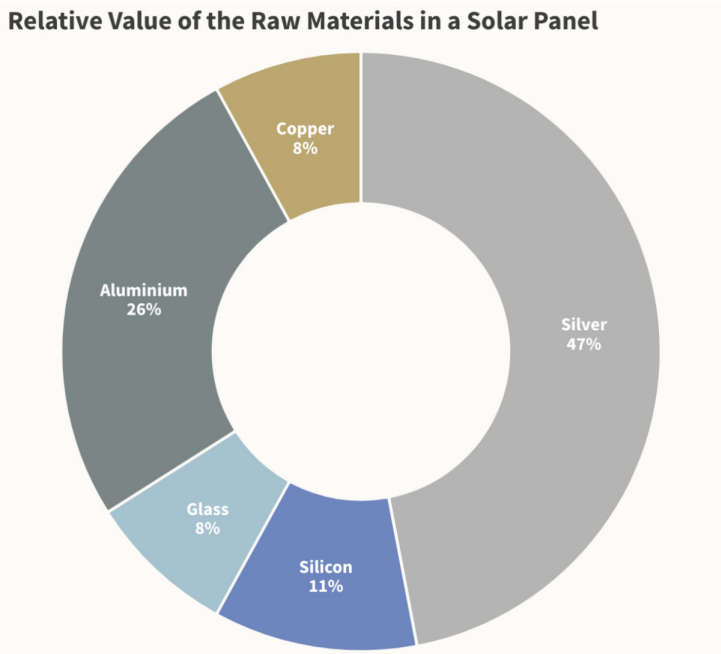


Figure 5. *Source: IRENA via YaleEnvironment360*

The technology of PV panel recycling

An important aspect of PV recycling concerns the maturity of the technology involved. At present, three main processes dominate the scene: mechanical, thermal, and chemical. Of these, mechanical recycling is the most widely used because it is the most cost-effective: the technology employed only involves basic machinery separating the different layers. Think of a recycling line where a machine cuts the cables: one removes the junction box, another dismantles the aluminium frame, and so on, until the final layer of solar cells is shredded and the different materials are separated (Figure 6). The process is relatively simple and cheap, although it also presents some limitations. Parts of the PV panels such as

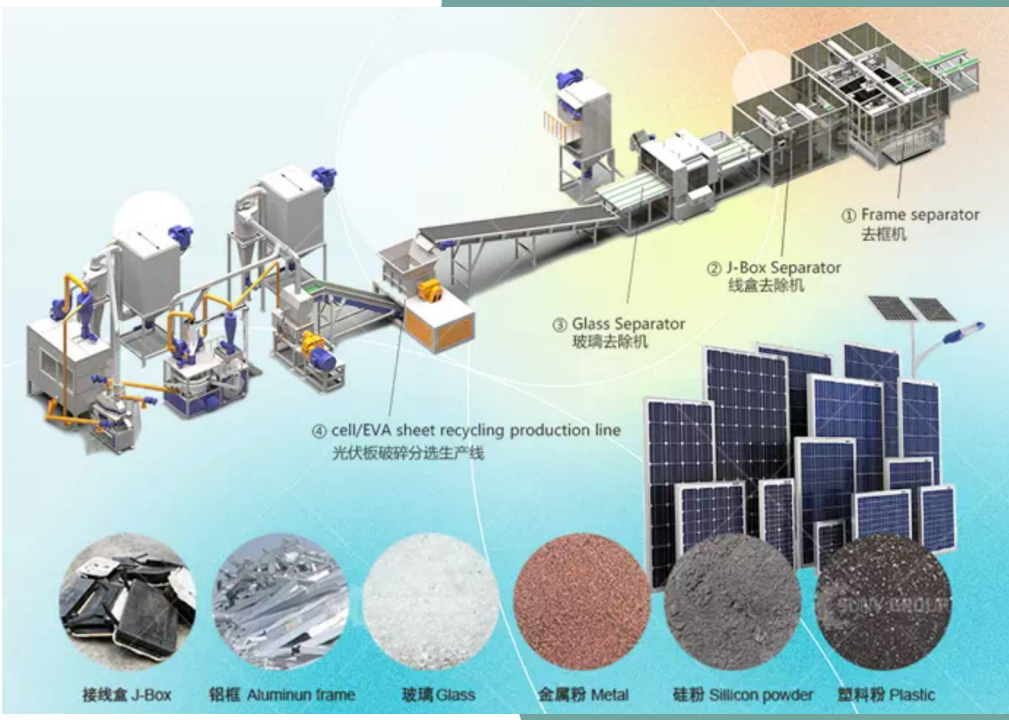


Figure 6. Example of a machine for mechanical recycling. *Source: SUNY Group*

4. PV Magazine, "Solar panel recycling in the US — a looming issue that could harm industry growth and reputation", December 3, 2020, available at: https://pv-magazine-usa.com/2020/12/03/solar-panel-recycling-in-the-us-a-looming-issue-that-could-harm-growth-and-reputation/

the EVA and the solar wafers are hard to separate mechanically, as they are usually blended together during the production. Hence, the material recovery – especially for silicon and rare metals – is limited, often requiring supplementary processes. Moreover, the silver and silicon recovered through mechanical separation have lower levels of purity, resulting in lower selling prices, and cannot be reused to manufacture new PV panels. Nonetheless, they contribute to enhancing the circular economy: their reuse reduces demand for input materials in other sectors where they can be used, such as construction or transportation.

Thermal processing, on the other hand, burns off the polymers by using high heat (generally between 400°C to over 1000°C, depending on the specific technology), and it allows for a more accurate separation of the solar cells from the encapsulants. The high temperatures decompose the EVA and other plastic components, thus enabling the recovery of higher-purity silicon and metals. Nonetheless, there are downsides: thermal methods are more expensive, require lots of energy to run the furnaces, and generate CO_2 emissions during the recycling process. Supporters of these methods claim that the emissions created are significantly lower than those needed to produce silicon from scratch, whereas critics point to other less energy-intensive methods to recover high quality materials.

Finally, chemical processes (such as acid leaching) use chemicals to dissolve specific components, particularly metals like silver, copper, and tin. In short, the solar cells are immersed into chemical liquids that separate the different parts. The metals are then filtered out and, if necessary, subjected to further refining. The advantage is that materials can reach a high level of purity: the silver recovered usually ranges from 95% to 99.9%, whereas the silicon spans from 98% to 99.5% (albeit far from the 99.9999% purity required for PV manufacturing). But once again there are disadvantages. The process is complex and expensive, requires a highly qualified workforce (given the chemicals involved), and produces hazardous waste, which can pose environmental threats – such as water contamination – if not properly treated.

The key message is that there is no 'one-fits-all' approach when it comes to solar waste management. Given that each method has distinct advantages and trade-offs, PV recycling companies usually adopt a combination of different techniques according to their business models. However, despite the general consensus on the importance of PV recycling and the common knowledge on recycling methods, there are significant obstacles that hinder the scaling up of the industry, explains Chinese company Yingli Group, which has been involved in PV business for more than 30 years.

The challenges behind solar PV recycling

To better understand the reality of solar waste management, ECECP visited the green recycling base run by Yingli Group in Baoding (Hebei), a pilot project funded by the Chinese government to promote solar recycling. Here, there was an opportunity to gain some first-hand knowledge of the day-to-day challenges faced by operators in the solar recycling sector.

One aspect that does not provoke much anxiety is whether there is a lack of capacity to manage solar waste in the coming decades. In fact, the plant in Baoding is struggling to operate at its full capacity of 4 000 tonnes a year. In China, the feeling is that if more capacity is required, then more will be built.

The key concern is cost: recycling solar panels is not economically profitable. The system in China works in such a way that end-of-life panels are awarded to recyclers through public tenders: recycling companies participate in auction-like bids to get deliveries of decommissioned panels. Most retired solar panels come

from power plants in regions like Shandong, Hebei, Jiangsu, and Xinjiang, which are managed by state-owned enterprises (SOEs). These SOEs are responsible for the PV panels' afterlife and account for the lion's share of solar waste, whereas private consumers only represent a small fraction. According to Yingli, the price of end-of-life PV panels through public tenders usually ranges between CNY 30 and CNY 60 per unit. The company has to pay transport costs on top, to fund shipping of the dismantled panels to the recycling base in Baoding. These range from CNY 2 to CNY 5 per unit. Finally, operational fees are roughly CNY 10 per unit. Total costs are therefore between CNY 42 and CNY 75 per unit. However, the revenue from each recycled PV panel (after selling all the different materials) is roughly CNY 60. This is why, without government subsidies, facilities like Yingli's green recycling base would struggle to function.

The relatively low selling price is also connected with the recycling method employed: Yingli uses a mechanical process to recycle PV panels, which is less expensive but yields lower material purity. Chemical methods would yield a higher selling price, but they must comply with more stringent environmental requirements: operations must be carried out within a chemical park, where specific facilities allow for the wastewater to be concentrated for treatment, thus ensuring that it does not pollute the environment. These chemical-processing companies are usually located in selected industrial areas, and the operations to recycle PV panels are typically clustered with other processes requiring chemical treatment (such as lithium battery recycling). The high specialisation and concentration of different recycling chains allows these companies to scale up operations and reduce costs. Companies like Yingli, that use mechanical recycling methods, can get higher returns by selling the laminated component (Figure 7) to these companies rather than recycling it themselves. Moreover, as the largest and heaviest parts have already been removed, transportation costs plummet, because more units can be stored during the shipment.

Finally, there are hundreds of illegal companies in the PV recycling sector[5]. These 'shadow' firms usually operate by extracting valuable materials and reselling them on secondary markets, without observing environmental protection regulations. This leads to two main consequences: firstly, they cause environmental harm, as the panels are not dismantled in line with environmental standards and the remaining parts – after valuable materials are recovered – are sent to the nearest landfill facility (if they reach a landfill at all). Secondly, they create market distortions: illegal companies compete with legal ones for the basic materials – decommissioned PV panels. However, because their costs are typically lower (they do not incur the costs linked with meeting environmental standards), they have a higher profit margin. As a result, they are a key cause for the low profit margins faced by legal companies, which face higher prices to buy end-of-life panels.

Figure 7. Solar PV panels after mechanical removal of the heaviest parts. *Source: SENS eRecycling*

5. For more coverage (in Mandarin) see: https://tv.sohu.com/v/dXMvMzM1OTQwNDA2LzUyMDU5MDEyNC5zaHRtbA==.html?key=/v/dXMvMzM1OTQwNDA2LzUyMDU5MDEyNC5zaHRtbA.html&vid=520590124

Public policies can facilitate solar PV recycling

Governments, in China and elsewhere, have a number of options available to help the industry develop. According to Yingli, public authorities can intervene in several different ways to encourage PV recycling and, while some are specific to the Chinese context, others are universally applicable. Not surprisingly, the first interventions to be mentioned are subsidies (which make the solar recycling industry profitable in its initial stages), and more law-enforcing measures to fight illegal activities. These two steps would impact the paramount issue of cost: they would put some money on the table, ensure fair competition, and allow private companies to blossom like flower buds in springtime. Additionally, public funds could be redirected towards Research and Development (R&D) projects to increase the efficiency of recycling processes, sharing best practices to abate costs. These ideas are not new, yet, as evidenced by Yingli's green recycling base in Baoding, they could offer the most immediate solutions to help develop an industry that is still in its infancy.

Standardisation is also a key move that could benefit the solar recycling industry. '[Standardisation] holds great significance to the industry in terms of improving efficiency, environmental protection, building market trust, and international cooperation,' says Tammy Wang, who leads Yingli's recycling business and heads its Zero Carbon Research Institute. 'By getting a standards system in place for recycling solar panels, we can make sure this industry keeps moving forward in a way that's both sustainable and high-quality. It's all about being part of the bigger picture, creating a greener economy in the solar industry'. China today produces about 90% of PV panels worldwide: as a result, standardisation in China could potentially set global standards for the recycling industry – like the 'Brussels Effect', but with Chinese characteristics.

Finally, regulators can ensure that PV panels are recycled using extended responsibility mechanisms. This is already the case in the European Union, where solar waste has been

6. More information available at the following link: https://environment.ec.europa.eu/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en

regulated since 2012 under the Waste Electrical and Electronic Equipment (WEEE) Directive[6]. In particular, the Directive enforces an Extended Producer Responsibility (EPR) approach, mandating that PV manufacturers take responsibility for financing the collection, treatment, and recycling of solar panels when they reach their end-of-life. China, by contrast, does not yet have a specific EPR system in place.

Nonetheless, policy discussions to tackle the issue are underway. Sustainable management of wind and solar waste was highlighted in the 14th Five-Year Plan (2021-25), and in August 2023 the National Development and Reform Commission (NDRC) published guidelines on 'Recycling of Decommissioned Wind Power and Photovoltaic Equipment'[7]. Indeed, one of its key provisions is 'to establish a responsibility mechanism for handling decommissioned equipment' for enterprises. Moreover, the NDRC guidelines include tasks such as 'promoting green designs' and supporting PV manufacturers in 'establishing a distributed recycling system', thus further tilting the balance towards manufacturers. However, as these guidelines are not legally binding, there is still uncertainty as to how they will be implemented.

In conclusion, solar PV recycling is set to become a key issue in the coming decades, and the sector holds the promise of significant economic returns. Nevertheless, to become profitable and attract investments, various obstacles remain to be overcome, the most significant being the current high costs and low returns. China, in particular, will represent a large share of global solar waste, and is in a position to set the pace and the agenda for responsible recycling of this huge energy resource. This is an opportunity for cooperation and collaboration between China and Europe as millions of solar panels reach end-of-life, and the issue of solar waste takes centre stage.

By **Andrea Montanari**
Junior Postgraduate Fellow of ECECP

Established in 1987, Yingli Group is a Chinese private pioneer whose business covers the entire PV value chain. This includes the production of high-efficiency PV modules and photovoltaic green building integrated photovoltaics (BIPV), solar power station development, smart operations and maintenance, multi-scenario applications of PV products, and the recycling of PV modules. The company boasts four national-level R&D platforms, including the National Energy Photovoltaic Technology Key Laboratory and the National Key Laboratory for Photovoltaic Materials and Cells.

http://www.yingligroup.com/

7. " 国家发展改革委等部门关于促进退役风电、光伏设备循环利用的指导意见 ", 17 August 2023, available at the following link: https://www.ndrc.gov.cn/xxgk/zcfb/tz/202308/t20230817_1359879.html

Event highlight

Legislating for a New Electricity System Integrating a High Proportion of Variable Renewable Generation

As the share of renewable energy in power grids continues to rise, the revision and modernisation of electricity laws is crucial so that they can underpin a stable, efficient, and sustainable energy future. NEA recently initiated a revision to China's Electricity Law to accommodate the country's renewable energy-dominated new power system.

On 11 October 2024, EU-China Energy Cooperation Platform (ECECP), the GIZ-implemented Sino-German Energy Partnership, and China Electricity Council (CEC) jointly organised an expert workshop to provide a comprehensive overview of energy laws and regulations and EU electricity markets and to illustrate how they are implemented in selected Member States. The aim of this workshop was to facilitate dialogue between Europe and China on the

construction of a new power market and its corresponding electricity legal framework, particularly in light of the challenges posed by the increased role of renewable energy within the energy transition.

The workshop brought together 47 on-site attendees and included representatives from the NEA, National People's Congress, National Development and Reform Commission (NDRC), Ministry of Justice, policy officers from the European Union Delegation to China, representatives from the German Embassy and the Danish Embassy, as well as delegates from key Chinese energy companies and think tanks.

WORKSHOP HIGHLIGHTS

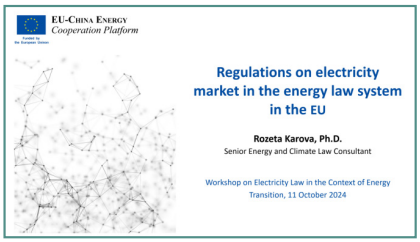
In his opening remarks, Liang Zhipeng, deputy director general of the NEA's Department of Legal Reform, highlighted that China's Electricity Law came into force nearly three decades ago, and was revised in 2018. He noted that the country is now undergoing a significant energy transition. He pointed out two primary challenges that China's power system is facing: the generation mix needs to absorb an increasing proportion of renewable energy, which is expected to account for around 80% of new power systems, and the entire system needs to shift towards decentralised power supplies alongside large-scale systems. Therefore, the Electricity Law needs to be further revised. China intends to strengthen its communication and cooperation with the EU and its Member States in the energy sector.

Mr Zeno Reichenbecher, First Counsellor and Economic Affairs Coordinator at the German Embassy in Beijing, highlighted the crucial role that robust legal and regulatory frameworks have played in safeguarding the success of Germany's energy transition. In order to achieve global climate neutrality, exchanges and cooperation between China and the EU are essential as China seeks to improve its legal systems and market mechanisms, as well as renewable energy consumption and grid integration.

Professor Wang Peng from North China Electric Power University provided a comprehensive overview of the legislative background and current status of China's Electricity Law, emphasising the pressing need for legislative revision to align with the evolving new realities of the ongoing power market reform and green transition.

PPT Download

Dr Rozeta Karova, energy and climate law advisor to the United Nations Office for Project Services and the World Bank, gave a presentation on EU electricity regulations that highlighted the EU's aim to create a free and integrated internal market, ensuring energy supply security and promoting sustainable development. Since the first EU Energy Package in 1996, market liberalisation has been central to new legislation. Subsequent legal packages in 2003, 2009, and most recently the Clean Energy Package (2019) and 'Fit for 55' package (2024), have been designed to upgrade the internal electricity market to meet decarbonisation requirements.



PPT Download

Benedikt Guenther, senior policy advisor at the German Federal Ministry for Economic Affairs and Climate Protection, outlined the policy and regulatory adjustments that Germany has introduced to facilitate the energy transition. These include: implementing capacity-based investment plans for renewable energy projects to ensure reliable power supply during peak hours; introducing 'location signals' to guide investment into energy facilities where they are most needed; and launching a 'Flexibility Agenda' to remove barriers and enhance consumer-side resilience in response to fluctuating electricity prices.

PPT Download

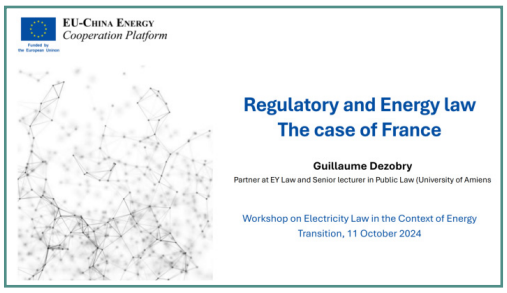
Flemming G Nielsen, chief advisor at the Global Cooperation Centre of the Danish Energy Agency, provided insights into Denmark's electricity market reforms with a focus on the measures and lessons learned when integrating and balancing the high share of variable renewable energy. This has been achieved thanks to strong grid connections with neighbouring countries, greater system flexibility offered by district heating, deployment of large heat pumps and power-to-X solutions, and participation in the Nordic Electricity Market, or Nord Pool, which facilitates cross-border trading.

PPT Download

Ermin Kloppenborg, policy advisor at the Dutch Ministry of Climate and Green Growth, explained how the Netherlands addresses the grid congestion issues caused by rapid development of renewable energy and industrial electrification. Grid expansion remains a priority, but is not a quick process: in the meantime, the country is exploring instruments that incentivise generators and users to make more efficient use of the existing grid, rewarding them for matching supply and demand locally.

PPT Download

Guillaume Dezobry, a partner at EY Law and senior lecturer at the University of Amiens, provided an in-depth analysis of recent reforms to regulations governing France's nuclear fleet. With a unique power generation mix that includes a strong nuclear component, France has introduced price and tariff reforms to preserve the benefits of its nuclear power investments and make sure costumers can benefit from stable prices that are in line with electricity generation costs in France. He also discussed ongoing reforms to the French capacity mechanism to meet the new challenges posed by increasing renewables and to ensure the reliability and security of the electricity supply.



PPT Download

The discussion session included questions from delegates on topics such as the transmission and distribution tariffs for centralised and distributed power sources, strategies to prevent grid congestion caused by renewable integration, and the aggregation of distributed renewable energy resources.

Liang Zhipeng, deputy director general of the NEA's Department of Legal Reform, noted in his closing remarks that China, Germany, and the EU face common challenges in the context of the energy transition, construction of new power systems, and the development of renewable energy. He emphasised that deepening cooperation between the two sides in relation to legislation on power systems and the construction of power markets will help to improve legal frameworks in the energy sector, promoting a green and low-carbon transition as well as sustainable development.

News in Brief

Click on the headlines to learn more.

ECECP highlight some recent key energy news headlines in the EU and China

Europe News

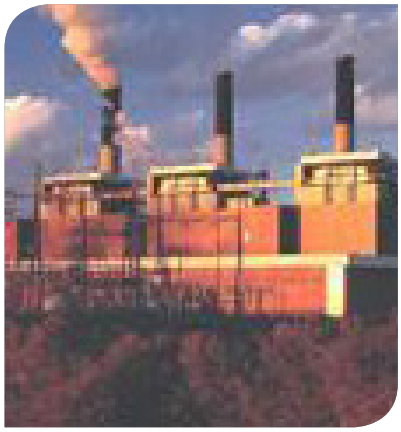
Policy Initiatives

EU: Commission issues new guidance on renewable energy and efficiency directives

The four guidance documents, covering heating and cooling, energy system integration, and renewable fuels of non-biological origin (RFNBOs), offer clarification on complex elements of the new legislation and support national administrations in transposing these directives into national law.

EU: Offshore ships to be included in the emissions monitoring system

The new delegated act clarifies that as of 2025, emissions from ships designed or certified to perform service activities offshore or at offshore installations (including offshore support vessels, pipe layers or drilling ships) will now be covered by the Monitoring, Reporting and Verification (MRV) Regulation.



EU: Adoption of EU ETS Monitoring and Reporting Regulation

Key revisions allow zero-rating of emissions from specific low-carbon fuels such as renewable non-biological and synthetic fuels, and improve rules for biomass and sustainable aviation fuels. They also ensure compliance with sustainability standards and avoid double emissions counting.
Rules are also clarified on transferring CO_2 and emissions permanently bound in products, and monitoring and reporting requirements for non-CO_2 effects from the aviation sector.

EU: New guidance on phasing out financing for new fossil fuel boilers by 2025

The European Commission has released its first guidance for EU nations when implementing the revised Energy Performance of Buildings Directive. From 1 January 2025, publicly-funded financial incentives for new stand-alone fossil fuel boilers will be prohibited. However, pre-existing incentives can remain in place for fossil fuel boilers, and incentives will be available for hybrid systems with a significant renewable energy share.

EU: New energy labelling rules to improve quality of information for consumers and companies

From 22 October 2024, all suppliers must undergo digital identity verification when registering their product models in the European Product Registry for Energy Labelling (EPREL). The new requirement is mandatory for all energy-labelled products entering the EU market. Suppliers that have not yet registered are invited to visit the Energy Efficiency Products Portal to complete their registration on the EPREL database.

Greece: Revised NECP targets 81% of renewables in its power mix by 2030
Under its revised National Energy and Climate Plan (NECP), Greece is aiming for renewables to cover 67% of energy consumption in the building sector by 2030, while the share of heat pumps in residential and tertiary buildings is to double between 2022 and 2030. In transportation, renewables are targeted to reach 14% by 2030 and 91% by 2050.

UK: National Energy System Operator established
Officially launched on 1 Oct 2024, this new independent body is responsible for whole system planning to deliver full decarbonisation by 2050. It is also tasked with delivering clean power by 2030. NESO will have strategic oversight of both the electricity and gas systems, to ensure that Great Britain's energy infrastructure is secure, resilient, flexible, and future proof.

Market & Business

EU: Greenhouse gas emissions down by over 8% in 2023
According to the 2024 Climate Action Progress Report, this is the largest annual drop in decades, with the exception of 2020 when COVID-19 significantly impacted gas emissions. Net GHG emissions are now 37% below 1990 levels, while GDP grew by 68% over the same period, evidencing the continued decoupling of emissions and economic growth.

EU: Power export capacity to Ukraine is boosted
European TSOs have boosted the capacity of power interconnectors to Ukraine by 400 MW. Up to 2.1 GW of power can flow to Ukraine at a given instant during this winter, according to ENTSO-E. The new limit will apply from 1 December 2024 and is intended to protect the beleaguered country's electricity supply.

Eurostat: EU imports of green energy products down in 2023
Latest data show that the value of EU's imported solar panels, liquid biofuel and wind turbines saw reductions of 12%, 22% and 66% respectively in 2023. While China remains the primary source for solar panels and liquid biofuels imports, India is the main supplier of wind turbines. Conversely, the export value of these green energy products has surged by 19%, 36% and 49%, respectively.

Spain: Government abandons permanent windfall tax on energy firms
Spain introduced a windfall tax in the winter of 2023 to reduce the impact of inflation on Spanish citizens by funding subsidies for fuel and public transport. The government had signalled that it would make the tax permanent, prompting oil and gas majors to threaten to halt their green hydrogen investments. This policy reversal is expected to prompt a revival of those plans.

Germany: Long-duration energy storage auctions to be held in 2025 and 2026
The Ministry for the Economy and Climate Change (BMWK) has opened a public consultation on new frameworks to procure energy resources for the proposed Power Plant Safety Act, including 12.5 GW of new power plants and 500 MW of long duration energy storage (LDES). BMWK is planning to require LDES technologies to provide up to 72-hour discharge duration with a minimum 1 MW power rating.

European firms to produce green ammonia in Morocco
European companies TE H2, Copenhagen Infrastructure Partners (CIP) and A.P. Møller have been selected for the first land allocation under Morocco's green hydrogen initiative, known as the 'Moroccan Offer'. In the initial phase, these companies aim to use 1 GW of solar and wind power for electrolysis of desalinated seawater to produce hydrogen, which will then be transformed into ammonia for the European market, providing 200 000 tons per year.

UK: Coal era ends as last coal-fired power station shuts down
The UK's last coal-fired power plant, Ratcliffe-on-Soar, closed at the end of September 2024. The closure marks a crucial step in the country's efforts to reduce its reliance on fossil fuels and lower emissions. With the closure, the UK has become the first G7 nation to end coal-fired power generation.

Technology & Innovation

EU: EUR 19.6 million WEDUSEA project gets go ahead
Co-funded by the EU Horizon Europe Programme and by Innovate UK, the WEDUSEA project will demonstrate a grid-connected 1 MW OE35 floating wave energy converter in Scotland's waters, representing the world's largest capacity floating wave energy device. The project is a collaboration between 14 partners across the UK, Ireland, France, Germany and Spain, and is coordinated by Ireland's OceanEnergy.

Germany: Global leader in cleantech development
A study by the European Patent Office (EPO) and the United Nations Environment Programme (UNEP) has shown that Germany registered more climate-friendly technology in 2023 than any other nation. Around 80% of European climate-protection innovations have been developed by Germany, France, Italy, Sweden, Spain and the UK.

Germany: Car battery recycling factory to facilitate raw material reuse
Mercedes-Benz has opened a battery recycling facility in Baden-Württemberg, southwestern Germany, aimed at recovering key raw materials like lithium, nickel, and cobalt from used EV batteries. The plant is the first in Europe to employ a integrated mechanical-hydrometallurgical process, which delivers a recycling rate of over 96%.

Iceland: First space-based solar power to be delivered by 2030
UK-based solar power pioneer Space Solar and Iceland's Transition Labs are partnering to deliver the first solar power from space to Reykjavik Energy, in southwest Iceland, by 2030. The first space-based solar power receiving station will have an initial capacity of 30 MW.

Sweden: Old wind turbines could be 'tiny houses' of the future
Vattenfall has turned a decommissioned wind turbine into a tiny house, in a concept that the Swedish group claims could offer a new lease of life to thousands of machines as they reach the end of their working life. The house, designed by Superuse and executed by Blade-Made and Woodwave, is one of several wind-related concepts on display for Dutch Design Week.

Projects & Investments

EU to invest EUR 4.8 billion of ETS revenues to support innovative net-zero projects

The EU has announced its largest investment from the Innovation Fund since its launch in 2020. It has selected 85 projects across 18 countries, aiming to bring cutting-edge clean technologies into action across Europe. These projects will support industrial innovation, focusing on cleantech manufacturing, energy-intensive industries, industrial carbon management, renewable hydrogen and net-zero mobility.

Second auction announced for renewable hydrogen production

A second auction will open on 3 December 2024 and will award up to EUR 1.2 billion support to renewable hydrogen producers located in the European Economic Area (EEA).

European Energy Efficiency Financing Coalition welcomes 49 new members

Forty-nine public and private financial institutions, such as banks and their representative associations, investment firms, and development banks, have joined the 27 EU Member States as members of the European Energy Efficiency Financing Coalition. The new members will now engage directly with the Commission and EU countries to help mobilise private financing for energy efficiency.

France: Priority areas for offshore wind identified

The French government has published a map of priority areas for the development of offshore wind power by 2035 and 2050, in preparation for the launch of a new round of tenders for offshore wind projects set to begin in early 2025. The new tender (AO10) is expected to offer new capacity of 9.2 GW, distributed among five wind projects along the French coast.

Germany: Government approves EUR 18.9 billion Hydrogen Core Network

The project includes 9 040 km of hydrogen transport lines, with approximately 60% to be converted from existing gas lines to hydrogen and 40% to be newly constructed. The first lines will be converted during 2025, to be gradually brought into operation by 2032. The network will connect future hydrogen clusters throughout Germany, as well as with neighbouring countries.

Denmark: Tender materials published for new CCS fund

Denmark has launched a DDK 28.7 billion fund (USD 4.2 billion) that is intended to cover the costs of capture, transportation and geological storage of fossil, biogenic or atmospheric CO_2 over a 15-year contract period. It has been estimated that the Fund will reduce Denmark's annual carbon emissions by 2.3 million tonnes from 2030, equivalent to almost 5% of Denmark's total annual emissions. The commissioning of the first CCS facility must take place in 2029, with full capture and storage from 2030.

UK: 'Cap and floor' scheme to encourage investment in LDES

A new scheme guarantees a minimum income for developers while capping their revenue to ensure profits exceeding a certain level must be shared with consumers. This approach is designed to stimulate investment in long duration energy storage projects (LDES), including pumped storage, which up to now have been held back by high initial costs. Ofgem will serve as regulator and delivery body, and the scheme's first application round will begin in 2025.

China News

Policy Initiatives

China to expand national ETS to cement, steel and aluminum in 2024

On 9 September 2024, China's Ministry of Ecology and Environment unveiled a draft plan to expand the national Emissions Trading System (ETS) to include the cement, steel, and aluminum industries. The first compliance deadline is scheduled for 2025. The expansion will bring an additional 1 500 companies into the ETS, covering an extra 3 billion tons of CO_2e, roughly 5% of global emissions.

China doubles down efforts to boost renewable energy consumption

A comprehensive action plan, jointly issued the National Development and Reform Commission and five other departments, aims for China's renewable energy consumption to reach 1.1 billion tonnes of standard coal equivalent in 2025 and 1.5 billion tonnes by 2030. The initiative emphasises improving the capability of renewable substitution and increasing renewable energy deployment across industries, transportation, buildings, agriculture, and infrastructure to stimulate demand for renewable energy.

China to promote nuclear technology

According to a recent action plan jointly released by China Atomic Energy Authority and 11 other departments, China aims to support the development of the nuclear technology industry over the next three years, targeting a 400 billion annual output value by 2026. The plan is to boost independent nuclear innovation, and to identify new areas where nuclear technology can help modernise traditional industries.

China rolls out measures to promote green finance

Chinese authorities have jointly released a guideline promoting the development of green finance. Its 19 measures are designed to bolster support for key sectors and enhance the ability of financial institutions to offer green financial services, as well as to diversify their product and service offerings. Focusing on key areas such as the green transformation of industries and ecological conservation and restoration, China aims to establish a project library, effectively enabling the precise targeting of financial support.

MIIT moves to introduce standardisation in the solar PV industry

A new guide from the Ministry of Industry and Information Technology outlines the framework for a PV industry standards system, covering nine clusters: general requirements, equipment, materials, cells and modules, components, systems, applications, smart solutions, and green practice. The goal is to improve the linkage between standards and technological innovation within the PV industry by 2026, establishing more than 60 new national and industry standards.

NEA unveils new draft rules to reshape distributed solar market

The new draft rules replace an earlier version published in 2013 and represent a significant regulatory shift. The three grid connection models – full grid feed-in, self-use, and self-use with surplus feed-in – remain, but large-scale commercial and industrial projects will be restricted to full self-use with anti-reverse flow systems. The 2024 draft also introduces a green certificate system, allowing all distributed solar projects to participate in electricity market trading.

NEA proposes basic rules for the power auxiliary service market

Designed to regulate operations and protect the rights of market participants, the proposed draft rules reflect the principle of 'the service provider profits, the service user pays'. If adopted, the new rules will refine the pricing mechanism for auxiliary services and establish a robust cost conduction system. The rules outline the duties of various parties, including service provision by operators, support from grid companies, and service procurement by power dispatch agencies. These rules are applicable to auxiliary service markets at the provincial level and above.

New work plan to create carbon emissions accounting system

The NDRC has announced a new work plan that aims to strengthen the basic systems for controlling carbon emissions and to develop a system that will track and calculate emissions and so underpin efforts to measure progress towards decarbonisation. The plan maps out 23 specific tasks across eight key areas, focusing on improving carbon emission accounting and standards at various levels. The data will support local carbon emission assessments, industrial carbon emissions control, company level carbon management, project level carbon impacts assessment, and tracking of carbon footprints for individual products.

Market & Business

China launches inter-provincial electricity spot market

China's inter-provincial electricity spot market has officially begun operations, extending the scope of the country's power market. This market facilitates real-time power pricing and enables optimal allocation of power resources on a larger scale. It is expected to deliver significant improvements to the uptake of new energy. In the initial eight-month trial period this year, the utilisation rate of new energy increased by 1 percentage point thanks to the inter-provincial spot market.

New joint venture giant to enhance China's role in lithium chain

China Minmetals, a state-owned metals giant, is acquiring control of Qinghai Salt Lake Industry Group to establish the region as a key salt lake mineral extraction hub. China will hold a 53% stake in the new joint venture, QingHai Salt Lake Industry Co. Ltd, with a registered capital of CNY 10 billion. The remaining share will be held by Qinghai provincial government entities. This strategic initiative will underpin the supply of critical materials such as potassium and lithium.

China Resources Recycling Group officially launched in Tianjin

This newly established state-owned enterprise, with a registered capital of CNY 10 billion, will focus on resource recycling and creating a national platform for resource reuse. The state-owned Assets Supervision and Administration Commission and several major corporations hold stakes in the company. The group will set up subsidiaries for various recycling activities, such as scrap steel, electronics, new energy vehicle batteries, retired wind turbines, PV products and more.

Energy storage industry sees rapid development in 2024

At a press conference on 31 October 2024, China NEA highlighted the recent rapid development of new energy storage. By September 2024, installed capacity of new energy storage reached 58.52 GW (0.128 TWh), which has surged 86% since the end of 2023. Jiangsu, Zhejiang, and Xinjiang have led the expansion. Dispatch efficiency is also improving, as indicated by the average utilisation hours at 620 hours in the first eight months of 2024.

Solar industry reaches consensus to curb excessive competition

The China Photovoltaic Industry Association (CPIA) held a symposium of 16 major market players in October 2024 to address the issue of 'involution-style' competition in the solar industry. The solar companies agreed to work together to prevent price wars and strengthen self-regulation. Measures were also agreed to improve market mechanisms by rewarding stronger performers and softening the impact of closure of outdated production capacity. The CPIA has set a benchmark price of CNY 0.68/W, and bids below that minimum may be deemed illegal.

China wins 70% of new orders for green vessels

Latest data from China's Ministry of Industry and Information Technology show that China has secured over 70% of global orders for green vessels in the first three quarters of 2024, encompassing all mainstream ship types. Chinese shipbuilders have made significant strides in incorporating green technologies, such as methanol, ammonia and hybrid powering systems. Driven by surging global market demand, shipyards across China have already exceeded their business targets for 2024.

Technology & Innovation

CNOOC, Air Liquide pioneer long-distance liquid hydrogen transport

A vessel carrying specialised insulated tanks containing liquid hydrogen arrived at Yantian Port in the south China metropolitan of Shenzhen, after a 20 000 km voyage from Rotterdam. The pioneering long-distance delivery was carried out jointly by the China National Offshore Oil Corporation (CNOOC) and French industrial gases giant Air Liquide, marking a significant milestone in global hydrogen transportation.

World's largest flywheel energy storage connects to grid

China's first large-scale standalone flywheel energy storage project has been connected to the power grid in Shanxi Province's city of Changzhi. The Dinglun Flywheel Energy Storage Power Station has a power output of 30 MW and is equipped with 120 high-speed magnetic levitation flywheel units. Flywheel energy storage technology works by accelerating a rotor (flywheel) to a very high speed and maintaining the energy in the system as kinetic energy. Compared to other mechanical energy storage technologies such as pumped hydro and compressed air, it has higher energy and power density, higher efficiency, and rapid response.

Chinese firm succeeds in mass-producing all-solid-state battery

LiPure Energy, a Beijing-based company, has announced the successful launch of China's first mass production line for all-solid-state lithium batteries. With a target production capacity of 200 megawatt-hours, the line can charge 200 000 electric scooters simultaneously. Once it reaches full capacity, it is expected to churn out thousands of such batteries each day, which can be used in various sectors including energy storage and electric two-wheelers. All-solid-state batteries offer higher energy density and safety and are associated with lower costs than Li-on batteries, making them a potentially game-changing technology.

Projects & Investments

China Three Gorges to invest CNY 71.8 billion in a 16.5 GW hybrid power project

A massive hybrid power base project in the Taklamakan Desert in southern Xinjiang province will feature 8.5 GW of solar PV, 4 GW of wind power, coupled with 6 units of 660 MW coal-fired units, and 5 GWh new energy storage systems. The project is expected to be completed within three to four years. It will be able to produce over 36 TWh of electricity annually, to be transmitted to Sichuan and Chongqing via long-distance power lines once completed.

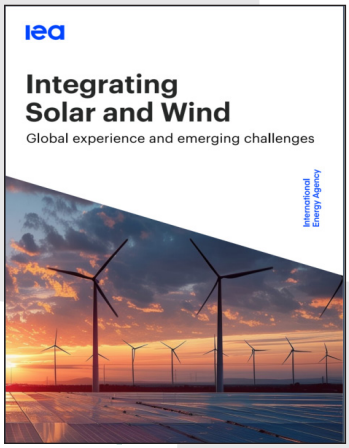
World's first commercial-scale hydrogen-powered project launched in Beijing

The demonstration project, capable of generating 1 million kWh of electricity annually and reducing carbon emissions by 800 tons per device per year, features Deutz's 7.8L hydrogen engines. These zero-carbon-emissions engines offer long service life, quick response, and high reliability, and could use industrial by-product hydrogen, marking a significant advancement in thermal efficiency, emission control, and stability. It holds strong potential for future commercial use in new energy applications.

China's first privately invested nuclear plant connects to grid

The Sanao Nuclear Power Station, located in Cangnan County, Wenzhou City, is a key national energy project and the first civil nuclear power project in China to involve private capital investment. The project will include six Hualong-1 power units, each with a capacity of 1.2 GW, which will be completed in three phases, with a total installed capacity of 7.2 GW. Once fully operational, it will provide approximately 54 billion kilowatt-hours of clean energy annually and reduce carbon dioxide emissions by over 44 million tons.

FEATURED PUBLICATION



Integrating Solar and Wind: Global experience and emerging challenges

This recent report published by the International Energy Agency (IEA) highlights the critical need for the timely integration of solar and wind power generation: their share in global electricity mix almost doubled between 2018 and 2023. Failure to take action may result in the loss of up to 15% of their generation in 2030, which could endanger the global decarbonisation goals. The report is the first global stock take of Variable Renewable Energy (VRE) integration measures across 50 power systems, which account for nearly 90% of global solar and wind power generation. It identifies proven measures to facilitate VRE integration as well as challenges faced by systems at various phases of VRE integration. Strategic government action, infrastructure enhancement, and regulatory reforms will be crucial to ensure the successful large-scale integration of solar and wind, in order to achieve global energy transition targets.

→ *More*

Coordinated energy infrastructure (CEI): Planning for a decarbonised system

The analysis from European Technology and Innovation Platform Smart Networks for Energy Transition examines the necessity and scope of a coordinated energy infrastructure planning approach that aligns with European policy objectives and legislative requirements. Central to this is setting up a consolidated vision and related scenarios to guide the integration of electricity, natural gas, and hydrogen sectors as well as wider energy sectors. The document discusses the requirements, attributes, and challenges to CEI planning, and suggests possible ways to address these challenges, taking consideration of disruptive technologies, R&D pathways, models and methodologies, legislation and standardisation to facilitate CEI planning.

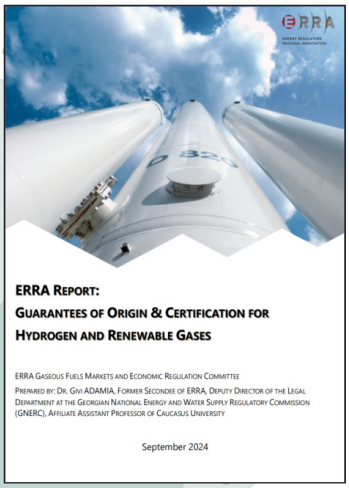
→ *More*

Securing Europe's Net Zero Path with Flexible LNG

The 2021-23 energy crisis underscored the high costs associated with energy shortages and the related challenges to decarbonisation efforts. This new report from the Centre on Regulation in Europe (CERRE) explores the strategies Europe can employ to ensure energy security while achieving its decarbonisation goals. It highlights the economic value of flexible LNG contracts that are aligned with the Paris Agreement's 1.5°C target and that can help mitigate price spikes and reduce consumer costs during periods of energy crunch. It also underscores the importance of robust market integration and enhanced transatlantic cooperation to ensure energy security as Europe moves towards carbon neutrality by 2050. The report suggests that addressing methane emissions and implementing comprehensive greenhouse gas pricing across the import chain could help drive global decarbonisation and provide long-term signals for investors.

→ *More*

Guarantees of Origin & Certification for Hydrogen and Renewable Gases



Hydrogen is playing a growing role in the global energy transition. This report from the Energy Regulators Regional Association (ERRA) highlights the transformative potential of hydrogen and the crucial role of certification mechanisms like the Guarantees of Origin (GOs) in fostering a transparent, credible, and efficient hydrogen market. The report identifies four critical attributes of GOs: traceability, ensuring that hydrogen's origin and production details are accurately tracked; tradability, allowing GOs to be bought and sold independently of the physical hydrogen; transparency, providing clear information about hydrogen's environmental credentials; and credibility, maintaining rigorous standards and independent verification.

→ *More*

Analysis of novel EV battery technologies, with a focus on tech transfer and commercialisation

Recent advances in battery technologies are outlined in this report from the European Commission's Joint Research Center (JRC), with a focus on both mainstream Li-ion and next-generation batteries for mobility applications. Based on comprehensive interviews with 17 key stakeholders across the EU battery value chain, the research identifies major barriers to development from lab to market. These include the need to scale up Europe's battery manufacturing industry, secure adequate funding, navigate unpredictable permitting processes, and address limited citizen acceptance of new factories and electric vehicles in general. The report also proposes solutions to overcome these challenges..

→ *More*

info@ececp.eu

Unit 1201A, Tower D1, DRC Liangmaqiao Diplomatic
Office Building, 19 Dongfang East Road,
Chaoyang District, Beijing, People's Republic of China

www.ececp.eu

Editor-in-chief: Jieqiao Chi

English editor: Helen Farrell

Feedbacks and Contributions: magazine@ececp.eu

EU-China Energy Cooperation Platform Project (ECECP) is funded by the European Union.

Funded by
the European Union