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Renewable energy as a connecting spot between China and Central and Eastern European countries: status, directions and perspectives

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Abstract

Background Considering energy- and climate-related policies adopted, the European Union and the People's Republic of China are expected to be on the same trajectory of reducing pollution, aiming for carbon neutrality in 2050 and 2060, respectively. However, although they share a common goal of more sustainable development, their targets and means often collide. The main objective of the study is to identify the main similarities and differences in approaches to energy and climate policies in the European Union and the People's Republic of China, with special attention given to the scope, past, present, and future of Chinese investments in renewable energy projects in the countries of the Central and Eastern European region, and to reveal the prevailing factors of the (un)successful renewable energy projects in those countries eventually. The methods used are literature review and qualitative content analysis of the European Union's and the People's Republic of China's energy- and climate-related policies according to the prescribed indicators (from 2005 onwards) and in-depth exploratory desk research of cooperation in renewable energy projects between the People's Republic of China and 14 Central and Eastern European Countries (from 2014 onwards).

Results The study showed that despite the significant alignment of the European Union's and the People's Republic of China's energy- and climate-related policies on a normative level, renewable energy cooperation between the People's Republic of China and Central and Eastern European countries on a practical level is moderate. This *state of play* mainly results from political factors, such as rising levels of Sino-scepticism and the overall deterioration of the European Union–People's Republic of China relations.

Conclusions The study showed that political rather than economic or legal factors had a great impact on the Chinese presence in the domain of renewable energy in the countries of the Central and Eastern European region. However, the significant alignment of the European Union's and the People's Republic of China's energy- and climate-related policies and dedication to common energy transition targets offer room for improving renewable energy cooperation. Overcoming political and economic divergences imposes a condition for achieving better cooperation in the renewable energy domain.

Keywords Renewable energy, European Union, People's Republic of China, Central and Eastern European Countries, Energy- and climate-related policies, Sino-scepticism

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Background

With the post-pandemic environment and, more recently, the warfare started by the Russian invasion of Ukraine, the energy transition on both global and regional scales started to take the connotation of urgency. Decarbonisation is a complex and long-term development process where a significant role belongs to renewable energy sources (RES), making them one of the main pillars of sustainable growth in the future. Increased interest in their usage, especially after 2022, resulted in gaining the status of a new geopolitical asset and one of the crucial tools in the new energy competition, so they could be observed as “a game changer for interstate energy relations” [1], presenting thus one of the most exploited themes not only in the domain of energy and industry but also in political and security context [2]. Within this context, one cannot disregard the geopolitical repercussions of the energy transition—critical materials that run renewable energy infrastructure (rare earth materials, nickel, cobalt, lithium, etc.) become a source of rivalry among powers. As Criekemans [3] stated, “cooperation is possible, but never a given”.

However, although having a strong international competition impetus, some studies have shown that renewable energy sources have a solid potential to “de-geopoliticalise international relations and allow states to transcend the ‘zero-sum’ thinking in their pursuit of energy security” [4]. In this context, traditionally marked as colliding, the European Union–People’s Republic of China (EU–PR China) energy-based relations started to emerge as aligning with each other due to significant commitments to renewable energy (RE) and energy transition targets. As stated in Liu et al. [5], the EU and PR China are responsible for approximately one-third of global greenhouse gas (GHG) emissions together, which makes their partnership one of the most important in the ongoing energy transition, with consequences of global importance. Since both actors are among the key players in contemporary energy and climate global governance and are undergoing the energy transition, analysing their relationship in these areas from diverse perspectives becomes very important.

Renewable energy sources have been increasingly used since the launch of the Paris Climate Agreement in 2015. While RES in power generation took 2.8% of global energy consumption in 2015 [6], they reached almost 13% in power generation in 2021 [7]. Within this context, PR China remained the main driver of solar and wind capacity growth during 2021, accounting for about 36% and 40% of the global capacity additions, respectively [7]. On the other hand, the share of renewable energy more than doubled between 2004 and 2021 in the EU, reaching 21.8% of energy consumed in 2021 [8]. More significant

is that RES generated 38% of the EU’s electricity in 2020, overtaking fossil-fired power generation for the first time, which fell to 37% [9]. With a 20% fall in coal power generation and a 4% fall in gas power generation in 2020, Europe’s electricity was 29% “cleaner” than in 2015 [9]. This renewable energy source’s rise in electricity production was mostly powered by wind or solar energy. In addition, European policies see RES as mutually beneficial: while presenting one of the primary tools in energy transition and a goal per se, they are also seen as one of the mechanisms to guarantee the security of supply in the context of dwindling reserves of fossil fuels [10, 11] which gained added value in the context of the ongoing Russia–Ukraine conflict. Bearing in mind its ambitious climate agenda, where the status of the first carbon-neutral continent by 2050 is one of the most critical goals, the recent integration of the EU’s energy and climate policies should be considered as a result of the evolution of the EU’s actions aimed at achieving energy transition goals [12]. Nevertheless, it is not negligible that certain European countries historically, as one of the leaders of the industrial revolution, contributed most to the GHG emissions and continue to be among the biggest emitters at present [13].

PR China had long based its policy on the developing country card and “right to develop” regarding GHG emissions [13]. However, domestic pollution from industry activities was the main reason for PR China to redirect its activities towards greener options [14]. Already high levels of urbanisation, rapid economic development, and PR China’s opening to the world, brought environmental issues very high on the agenda. When observing data on the global level, PR China has the most extensive carbon dioxide emissions coming from the energy sector, generating almost more than 31% of all global emissions in 2021 [7]. On the other hand, PR China is the most prominent leader in RE investments. In 2022, PR China invested 546 billion dollars in clean energy, far surpassing the EU with 180 billion and the United States of America (USA) with 141 billion dollars [15]. Within the 2014–2022 period, PR China invested 121.3 billion dollars in renewable energy projects, as stated in China Global Investment Tracker (CGIT) [16], which made it one of the global leaders in the domain of RE investments.

Since the USA’s withdrawal from the Paris Agreement, the burden of the fight against climate change has been transferred to the EU and PR China as powers with significant economies and ecological footprints. Energy transition and renewable energy are seen as integrative tools for the future reconstruction of sectoral politics, and there are obvious aspirations in the EU and PR China to push the energy transition through other departments, such as industry, transport, construction, food,

etc. Bearing this in mind, the common denominator of the EU's and PR China's XXI century energy policies became a low-carbon future or, more precisely, carbon neutrality, with the EU aiming to reach it by 2050 and PR China by 2060. Besides, their mid-term goals showed significant commitments towards energy transition—both the EU and PR China plan to increase the share of renewable energy in total energy consumption to 45% and 25%, respectively, by 2030 [17]. Nevertheless, the energy transition and proposed targets are facing many challenges. Significant reliance on imported fossil fuels, further complicated by the ongoing Russia–Ukraine conflict and polarisation of the world when it comes to this issue, questioned the planned dynamics of the energy transition of both actors. Within this context, energy and climate cooperation between the EU and PR China could be observed as a challenging but mostly desirable type of cooperation with significant potential to contribute to mitigating geopolitical tensions as it is based on a common goal of reducing GHG on a global level.

When discussing the potential alignment of the EU's and PR China's energy- and climate-related policies and strengthening their cooperation based on RES, it is worth noting that PR China develops relations with the EU as a supranational organisation but also with its individual member states. One of the possible ways to map PR China's cooperation based on RES with individual European states is to analyse their relationships within the PR China–Central and Eastern European Countries (CEEC) cooperation framework, which was established by PR China in 2012. Namely, this cooperation framework should be understood as a part of a broader Chinese pragmatic strategy [18] aimed at achieving Chinese economic and environmental goals while simultaneously presenting a group of EU Member States or candidate states, meaning they are functioning (or tend to do so) according to the EU energy *acquis communautaire*. Thus, this cooperation framework could serve as a solid background for questioning the current *state of play*, challenges, and perspectives of PR China–CEEC renewable energy cooperation and, consequently, cooperation on Chinese renewable energy projects across Europe.

Official documents and statements recognise the importance of a mutual Sino-European relationship [19–21], with the area of renewable energy included in this notion. However, this normative cooperation seems far from the one in practice. Therefore, this article aims to explore the current *state of play* and challenges in the EU's (CEEC) and PR China's renewable energy cooperation at present and in the future. A review and comparative analysis of the EU's and PR China's energy and climate-related policies should serve as a base for concluding whether their policies tend to align on a

renewable energy basis, observing from this normative level. On a practical level, this alignment will be tested on the PR China–CEEC cooperation framework.

Methods

The study is focused on two research questions regarding the (potential) normative alignment of the EU's and PR China's energy- and climate-related policies in the domain of RE and its influence on the renewable energy cooperation between PR China and CEEC on a practical level. Since the aim of the study demands different methodological tools to answer two research questions, the main methods of data collection and analysis used are literature review, qualitative content analysis, and in-depth exploratory desk research of cooperation in renewable energy projects between PR China and CEEC.

Literature review and qualitative content analysis refer to the analysis of the contemporary EU's and PR China's energy- and climate-related policies to identify their possible alignment on the normative level, led by several indicators: targets of the energy transition process, energy transition deadlines, the role of renewable energy sources in energy transition, and methods of achieving energy transition targets. The concept of alignment in this study should be understood as a rather content-neutral concept that does not “prejudge conceptually the type of cooperation involved”, i.e. as “an all-encompassing ‘umbrella’ concept” [22] that offers an analytical environment for studying different types of cooperation.

Considering the specific scope and aim of this study, the alignment, in this particular case, entails renewable energy cooperation between PR China and CEEC on two levels. On a normative level, this cooperation was assessed by analysing the EU's and PR China's energy- and climate-related policies to reveal the main similarities and differences in their renewable energy approaches through prescribed indicators. On a practical level, the renewable energy cooperation was evaluated by conducting an in-depth case study on PR China's renewable energy investments in Central and Eastern Europe (CEE) region. This region was chosen as a case study for two main reasons. Firstly, PR China established the PR China–CEEC cooperation framework in 2012 as a prominent part of its geo-economic strategy of being more present in this part of Europe. Secondly, the CEE region comprises the EU Member States, as well as candidate states, that base their national legislation and policy approaches on the EU energy *acquis communautaire*, so the EU's energy approach is considered a prevalent context within which the CEEC and other external actors interact. This diversity of European countries, which exists within the same or approximately similar energy context under the EU energy and climate umbrella and

simultaneously belongs to the PR China–CEEC cooperation framework, were the main reasons to question the scope, past, present, and future of PR China–CEEC renewable energy cooperation.

The second method refers to the case study based on in-depth exploratory desk research on PR China–CEEC renewable energy cooperation. To answer the second research question, Zakić and Šekarić study on Chinese energy investments in CEEC [18] was updated and subsequently subjected to a qualitative, descriptive analysis to discuss the results of Chinese renewable energy investments in CEEC. This study thus follows a hypothetico-deductive pathway arguing that dedication towards energy transition targets and alignment of strategies based on RES should bring higher levels of practical cooperation between PR China and CEEC. As already stated, PR China–CEEC cooperation is chosen as a case study due to CEEC's diverse structure, comprising EU Member States and candidate countries, so any change in PR China's involvement in renewable infrastructure investments towards these two groups could be empirically evaluated.

For the first research question, a review and comparative analysis of the contemporary EU's and PR China's energy- and climate-related policies¹ were conducted and existing cooperation mechanisms were tackled to identify potential alignment according to the prescribed indicators. The first step was to target the main strategic documents regarding energy and climate issues, as believed that they could describe mid- to long-term commitments in the best way due to their strategic nature. Since the end of the 1990s and the beginning of the XXI century, together with the Kyoto Protocol (1997), the Stern Review on the Economics of Climate Change (2007), and the Paris Agreement (2015), which marked the promotion of RES as the main tool in achieving energy transition, this period is considered in the context of the EU's and PR China's energy- and climate-related policies.

More precisely, the analysis covered the period from 2005 onwards, as the first concrete activity in this area—the Joint Declaration on Climate Change—has formally marked the EU–PR China relationship in the domain of global climate governance. The cooperation between the EU and PR China in this domain started with a sectoral energy dialogue in 1994. However, it was in 2005, after the 8th EU–China summit meeting, that the dialogue was institutionalised with the establishment of the EU–China Partnership on Climate Change. Besides,

concrete energy- and climate-related policies undertaken by both individually were those starting from the years mentioned.

Secondly, an analysis was conducted to trace the representation of “renewable energy sources/renewable energy/renewables” within those documents, particularly in connection with the external dimension of their policies. By searching for similarities, potential differences and points of contention were also explored in order to map the main challenges in cooperation between these two subjects in the domain of RE.

After a brief historical overview of the development of their policies and cooperation, the study focused on the main similarities between the EU's and PR China's contemporary energy- and climate-related policies in order to identify possible points of alignment.

For the second research question, PR China–CEEC cooperation in the domain of energy infrastructure investments was examined, with a particular focus on RE investments. This analysis covered a 9-year-long research period—from 2014 (when the PR China–CEEC cooperation framework started to operate) to 2022. Collected data were sourced using relevant national and international sources, and the research sample consists of 14 states in the CEE region—the Republic of Albania, Bosnia and Herzegovina, the Republic of Bulgaria, the Czech Republic, the Republic of Croatia, Greece, Hungary, Montenegro, the Republic of North Macedonia, Poland, Romania, the Republic of Serbia, the Slovak Republic, and the Republic of Slovenia. It should be noted that the Baltic States withdrew from this cooperation framework and were not included in this research. Although Greece was not part of the original PR China–CEEC cooperation framework, there are many projects in the renewable energy field on which the Greece and PR China cooperated, which put Greece into the analysis.

The starting point for the analysis was CGIT, a database founded by the American Enterprise Institute and the Heritage Foundation on Chinese investments abroad. However, it is important to highlight certain database limitations for objective reasons. First of all, since the CGIT has flaws and does not register all transactions, a new database that will be more precise and cover even smaller RE investments was proposed (see “Appendix”). In addition, the background of every disputable or failed RE project was investigated to identify the causes of such outcomes, where applicable. In conducting research, all available primary, and secondary sources (official announcements from different governments, media reports in local languages and English, scholarly articles, and existing databases) were used to ensure the accuracy of the analysis.

¹ Regarding PR China's energy- and climate-related policies, due to the language barrier, it should be stated that the analysis of those documents that did not contain the English version was conducted relying on secondary data and a literature review with reference to primary documents.

Table 1 Relevant EU’s and PR China’s energy- and climate-related policies in the context of renewable energy (2000–2022)

Year	EU’s RE policies	PR China’s RE policies
2000	European Climate Change Programme (ECCP)	2000–2015 Main Points of Development Planning of New Energy and Renewable Energy Industry
2005		Renewable Energy Law
2006	Green Paper—A European Strategy for Sustainable, Competitive and Secure Energy	a) 11th FYP for National Economic and Social Development b) Medium and Long-Term Plan of Renewable energy (2007) c) Revision of the Renewable Energy Law (2009)
2008	2020 climate and energy package	
2009	Directive 2009/28/EC on promoting the use of RES (EU target of 20% RES by 2020)	
2011	Energy Roadmap 2050	a) 12th FYP for National Economic and Social Development
2013	Green Paper: A 2030 framework for climate and energy policies	b) Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating the Construction of Ecological Civilisation (2015)
2015	Energy Union	
2016	Clean Energy for all Europeans	13th FYP for National Economic and Social Development
2018	Revised Renewable Energy Directive (32% RES target by 2030)	
2019	European Green Deal	
2021	a) Fit for 55 b) The 2030 targets: EC proposal to raise target for 2030 to 40% RES in the EU’s energy mix	a) 14th FYP for National Economic and Social Development b) Draft of the Energy Law
2022	REPowerEU Plan: EC proposal to raise target for 2030 to 45% RES in the EU’s energy mix	

Source: authors

Results

Renewable energy in the EU’s and PR China’s energy- and climate-related policies

Considering the first research question regarding the (potential) normative alignment of the EU’s and PR China’s energy- and climate-related policies in the domain of RE, this subsection is dedicated to presenting results from a conducted literature review and qualitative content analysis of their policies and cooperation mechanisms.

The literature has offered significant insights into existing and future cooperation between the EU and PR China when it comes to the RE sector. Some authors stated that common elements of the EU’s and PR China’s environmental policies are determined by international processes, acknowledgment of the necessity of dealing with global environmental issues, and international contracts; still, the main differences come from the social and economic development circumstances [23]. In a similar manner, Altun and Ergenc [24] describe Sino-European relations in the renewable sector as a dialectical “collaboration–competition nexus” consisting of both consensus and contention. For Dupont [25], Sino-European relations are deeply grounded in “climate geopolitics” and are determined by the “rhetoric of competition”.

While some authors emphasised irreconcilable differences in their philosophies and political approaches [26, 27], others highlighted the necessity of fostering EU–PR China energy and climate cooperation [17]. Liu et al. [5],

thus, see the necessity of stronger energy cooperation between the EU and PR China in the future “for meaningful climate change mitigation and adaptation”, regardless of the many political and economic differences. In addition, Stensdal and Heggelund [28] see energy and climate as two main opportunities for increased cooperation between the EU and PR China. While the above-mentioned differences arguably cannot be neglected, the latter views generally rest on the benefits of the energy transition and common interests that go far beyond any particular or (supra)national interest.

A summary of the main EU’s and PR China’s energy- and climate-related policies historically (starting from 2000) as one of the outcomes of this study could be seen in Table 1.

As could be seen, starting in 2005, the EU and PR China have adopted relevant policies in connection with RE almost simultaneously. This is somewhat expected due to their commitments contained in international agreements in the RE field. However, this renewable energy policy development was not linear from the beginning. While the official start of the development of the EU’s climate-related policies could be traced back to the 1970s (though with very limited concrete objectives and mechanisms to achieve them [29]), the beginning of the XXI century was significant for PR China in the context of the rapid development of renewable energy policies. Although some rudimentary forms of renewable energy could be traced back to the early 1950s with the

development of the first small hydropower plant (HPP), there were no systematic renewable energy policies in PR China until the late 1990s, when PR China's renewable energy policies started to make "some long-term plans, and to formulate specific development goals" [30]. Severe floods that hit PR China in 1998 in the Yangtze River basin, for instance, were an "urgent call" to protect the natural environment and to undertake necessary measures [31].

With the arrival of the XXI century, encouraging messages on the usage of RES within several politics have been replaced by concrete actions towards achieving a greater share of RES in PR China's industry. More specifically, with the "10th Five-Year Plan for the Development of New Energy and Renewable Energy Industry" released in 2002 and with the introduction of the Renewable Energy Law in 2005 (and its revision in 2009), PR China progressively undertook supporting policies and measures in order to achieve sustainable development in years to come [32]. This Renewable Energy Law made RES a priority from the legal standpoint, made renewable energy a "preferential area for energy development" in PR China [33], and is very often marked as an initial step of the upcoming period of rapid development of Chinese renewable energy policies [30].

Ecological civilisation philosophy, introduced in 2007 by President Hu Jintao, became one of the leitmotifs of Chinese environmental policies in the upcoming period. The Chinese government's "Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating the Construction of Ecological Civilization" from 2015 put the philosophy concept into concrete actions and integrated it into all sectors of society [34]. In 2020, the National Energy Administration (NEA) released a draft of the Energy Law of the PRC that should establish a legal base for the development of PR China's energy sector towards more green and low-carbon options. However, this draft has been largely criticised due to its non-transparency of the data used, its long-term preparation (13 years at the moment of its release), and its unclear outlook towards the future of fossil fuels [35]. Through these legislative frameworks, combat against climate change, energy transition, and sustainable growth have been given national priority.

Some studies showed the significant impact of domestic policies on external actions linked to energy and climate issues [36, 37]. As the Chinese energy- and climate-related policies entered a new development stage after 2005, the two five-year plans (FYP) for National Economic and Social Development that followed showed the importance of RES for energy transition in PR China, with profound consequences for its external energy and climate actions. The first one was the 11th FYP

(2006–2010), with objectives of reducing energy intensity and achieving a greater share of RES in energy consumption objectives. The second one was the 12th FYP (2011–2015), which imposed a reduction of carbon intensity per capita GDP as a binding target for PR China's economy. As an instance, in 2019, CO₂ emissions per capita GDP were reduced by 48% from 2005 levels; for the same period (2005–2019), coal consumption dropped from 72.4% to 57.7%, while non-fossil fuels in primary energy rose from 7.4 to 15.3% [34]. Since then, each subsequent FYP has had to include this target as the number one priority. The 13th FYP (2016–2020) followed previous ones in energy conservation and carbon reduction targets and established vast tax and financial incentives for environmental actions. The so-called "Goal 3060", aimed at peaking CO₂ emissions before 2030 and becoming a carbon-neutral country by 2060, was the latest ambitious goal launched in 2020 by Chinese President Xi Jinping as part of updated Nationally Determined Contributions (NDC). This is often called a "new normal" era in PR China's development [5] that relies on more sustainable growth. In addition, the 14th FYP (2021–2025), released in March 2021, set the goal of reducing 18% of carbon dioxide emissions per unit of GDP by 2025 [38]. However, it is important to stress that this new plan has no targets for a coal phase-out. It clearly states that it will promote "the replacement of coal with electricity" and "reasonably control the intensity of coal development" [38] but without a clear statement for coal phase-out.

Shortly after, at the 76th Session of the United Nations General Assembly in September 2021, the Chinese President promised that "China will step up support for other developing countries in developing green and low-carbon energy and will not build new coal-fired power projects abroad" [39]. Yet, at the COP26 in November 2021, PR China stirred up the public with its protesting against the term "phase out" and advocating the term "phase down" carbon emissions [40], which explicitly reflected its national interest in gradual energy shifts. In a similar manner, PR China's "14th Five-Year Plan for a Modern Energy System", released at the beginning of 2022, is sending mixed messages—while promoting renewable energy development, it clearly states the importance of coal in ensuring its energy security in the following years. As believed, this springs from "the government's attempts to find a balance between ensuring short-term supply security and laying the foundation for the longer-term transition" [41].

Quite the opposite, the EU was one of the pioneers in the domain of renewable energy policies; as stated in the literature, the EU Member States "have historically been at the forefront of climate policy initiatives" [25], and today they are among the leaders in renewable

technology development—according to the UNCTAD report [42], seven European countries were among the 20 top countries with the most foreign direct investment (FDI) outflows in renewable energy in 2021 and 2022. Namely, the EU started to develop its environmental legislation during the 1970s. At the same time, the protection of the natural environment was also the subject of the EU's fundamental treaties. As stated in the literature, before the 1990s, the promotion of RES came mainly “from national programmes in a few pioneering EC countries”, such as Germany, Denmark, and the Netherlands [43]. The following period was shaped by many contextual factors that paved the way for developing the EU's energy- and climate-related policies, including global order shifts and the securitisation of many issues. Thus, the beginning of the 1990s saw greater concerns over climate change, resulting in more promotion of RES on a supranational level. A key turning point in the evolution of EU renewable energy policy was the release of the 1996 Commission Green Paper on RES, followed by a White Paper in 1997 entitled “Energy for the Future: Renewable Sources of Energy” [43], by setting the first goals and mechanisms for introducing RES into different sectoral politics.

In years to come, especially from the 2000s onwards, the rise in oil and gas prices, increased energy dependence, and securitisation of climate change have brought RES as a response to those challenges and set safeguarding environmental sustainability as one of the primary targets. One of the first EU's strategies that introduced a new perspective on European energy security was “Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy”, which stated that sustainable development should be one of six key areas that require necessary actions toward the challenges the EU faces [10]. For the EU, RES has begun to be seen as a tool for an “integrated European energy market and a common EU voice in international relations” [44], strengthening its energy- and climate-leader role in international relations. Between 2008 and 2021, the EU adopted three packages or frameworks for climate and energy policy [45]. The so-called “2020 climate and energy package” (2008) pressured the EU to achieve a 20% cut in GHG emissions (from 1990 levels), 20% of energy from RES, and a 20% improvement in energy efficiency. Those targets were supplemented to reduce GHG emissions to 80–95% below 1990 levels by 2050, set by the “Energy Roadmap 2050” [46], with mid-term goals oriented towards reducing GHG emissions up to 40% by 2030 and achieving a share of RES of around 30% at the same time [47].

As could be seen, the last two decades resulted in a significant increase in RE policies in the EU as climate issues

started to be an issue of global concern,² culminating with the 2019 European Commission's European Green Deal as an overarching set of measures aiming to reduce net EU emissions to zero by 2050 and to reduce emissions from 1990 levels by 55 percent by 2030, as set by “Fit for 55” [48]. The subsequent European Climate Law (2021) made energy transition targets mandatory. In addition, the REPowerEU Plan, launched in 2022, aims to end the EU's energy dependence on Russian fossil fuels and address the transition to clean energy as one of the priorities [49]. A series of directives that the EU has adopted during this period, addressing diverse sectors of society and specific time objectives show its long-term dedication to renewable energy development. As stated in the literature, the EU has progressed during this period from idea-driven leadership to a more pragmatic leadership role [45].

The EU's and PR China's roles in combating climate change evolved through the years and became even more critical with the USA's withdrawal from the Paris Agreement in 2017. While the EU and Chinese officials have been meeting for annual energy dialogues to cooperate on energy issues at the ministerial level since 1994, the EU and PR China have strengthened energy and climate cooperation in several rounds from 2005 onwards: in 2010, they established a ministerial dialogue mechanism and EU–China Environmental Governance Program; in 2012, the EU–China Environmental Sustainability Program; in 2015, the “EU–China Joint Statement on Climate Change”; in 2016, the “EU–China Roadmap on Energy Cooperation (2016–2020)”; and in 2018, the “China EU Leaders' Statement on Climate Change and Clean Energy”. In 2019, the EU–China Energy Cooperation Platform was established to enhance energy cooperation between the two and contribute to the global transition to clean energy, respectively. Within this period, they agreed to expand cooperation in areas such as low-carbon development, protecting the environment, addressing climate change, and encouraging clean energy development [50]. Established cooperation mechanisms thus helped to deepen Chinese presence in the EU's energy sector.

While some studies have shown the attractiveness of the EU's market for PR China's energy investments in terms of gaining access to the EU energy companies' know-how, technologies, and running operations [51], others have revealed increased flows of renewable investments into the EU, mainly in the solar and wind sectors

² Besides climate changes, the security of supply, actualized by the 2005/2006 and 2008/2009 gas crisis between the Russian Federation and Ukraine, and the 2014 Ukraine crisis, became an additional issue in combating energy threats and challenges in the EU.

in recent years, with Germany being the most popular destination for those investments [52].

So far, the EU has achieved targets set in the 20–20–20 package in the form of reduced GHG emissions, an increased share of RES, and improved energy efficiency [53]. The EU, thus, imposed itself as a normative leader in the energy transition with strict objectives to follow, so it served as a good role model for PR China on how to work on the issue of climate change and energy transition in terms of creating policies and technology improvement [54]. However, it is important to note that the EU's 2030 renewable energy target is at risk “due to low ambition in Central and Eastern European countries” [55]. On the other hand, PR China was acting more flexibly during this period. In this context, the literature highlights the pragmatism of PR China's external politics (and thus actorhood related to energy and climate) over revisionism and the wish for changing the established order [56], its gradual energy policy shifting towards environmental stewardship [36], which made it wholeheartedly accept the carbon neutrality target as a “new source of performance legitimacy” [37].

Although largely imposed by international agreements, energy transition targets for PR China were adopted when they were publicly perceived to significantly impact the domestic level. China thus emphasised its partiality towards “a voluntary climate regime that respects state sovereignty and different pathways towards tackling climate change and climate (in)justice” [13]. Nevertheless, it seems that it went through the path of changing identities from being a “developing country” to “a leading developing country”, admitting the necessity of reducing carbon emissions and the importance of the ecological civilisation concept as well [28] which, inevitably, mirrored in its energy- and climate-related policies from being responsible for major GHG emissions to being a more ecologically responsible country. In other words, the last two decades showed a gradual shift in PR China's perception from a country focused solely on economic growth towards more sustainable development. In that sense, China's energy- and climate-related policies could place it among environmentally aware countries—for illustration, PR China took second place among the 20 top countries with the most FDI outflows in the renewable energy sector in 2021 and 2022, right behind the USA [42].

The review and comparative analysis of the current EU's and PR China's climate- and energy-related policies resulted in some similarities: both recognise the profound role of RES in the energy transition process; both are undoubtedly dedicated towards energy transition and reducing carbon emissions by the similar deadlines; mid-term policies aim at similar targets; both recognise similar challenges in the energy transition such as energy

dependency from third countries and the necessity of a greater share of RES in energy consumption; both recognise the necessity of international cooperation in contribution to global energy transition. In addition, some of the established cooperation mechanisms exist, and there is room for improvement in their cooperation, normatively speaking.

In contrast, the review and comparative analysis of their policies and previous actions showed some differences. Despite being the leader in the field of RE investments, PR China still heavily relies on coal in its energy consumption, with no official goal of cutting down coal-fired power plants, domestically or abroad. Additionally, the general impression is that the EU is oriented towards simultaneous processes of cutting off fossil fuels and increasing its share of RES, while PR China tends to establish renewable energy systems before the total phase-out of coal and other hydrocarbons. In this context, it could be said that PR China's national interests are reflected mainly in its external dimension. The main points of contention thus spring from different perspectives when it comes to environmental responsibility. While the EU calls for an urgent reaction, prioritising green financing and a total phase-out of carbon emissions, PR China's camp stands for a more nuanced approach towards ambitious energy transition goals that will favour national needs of a country.

PR China's renewable energy investments in CEEC: state of play and future considerations

Since the analysis of the EU's and PR China's energy- and climate-related policies showed significant alignment in the RE domain, it was necessary to examine how this normative alignment reflected on a more practical level. The analysis of Chinese renewable energy investments in CEEC was thus chosen as a case study. In light of PR China's speedy progress in its renewable energy investments both at home and internationally [57], the need to examine if this trend is mirrored in the CEEC example has emerged as significant. For this purpose, desk research on the example of 14 countries of the CEE region was conducted. The results of this work are presented in Tables 2 and 3, while “Appendix” provides a comprehensive table with extensive data (see “Appendix”). One of the most challenging aspects of this research was obtaining financial details about each project, which resulted in some transactions being labelled as N/A (non-available).

Table 2 presents the number of projects in different RE fields in order to see in which RES subsectors PR China had the most success. Based on the data collected, the solar energy subsector has emerged as the leading subsector with 12 projects. The wind energy subsector follows closely behind with nine projects, while the hydro

Table 2 Number and status of the Chinese RE projects in CEEC

RES subsector	Number of projects	Status
Wind energy subsector	9	7 finished/finalised, 1 active 1 negotiation ongoing
Solar energy subsector	12	6 finished/finalised, 5 actives 1 N/A
Hydro energy subsector	4	3 actives, 1 on hold
Geothermal energy subsector	1	1 finished
Gas cycle power plant	1	1 finished
Water pipeline—linking thermal and heating power plant	1	1 active
Acquisition of alternative energy distributor	1	1 finalised

Source: authors

Table 3 Structure of the Chinese RE projects within CEEC

Country	Number of projects	Type of RE projects
Bosnia and Herzegovina	6	2 wind, 1 solar, 3 hydropower plants
Czech Republic	1	1 solar
Croatia	2	2 solar
Greece	2	1 wind, 1 solar
Hungary	5	4 solar, 1 geothermal
Montenegro	2	1 wind, 1 hydropower plant
Poland	5	3 wind, 1 solar, 1 acquisition of alternative power provider
Romania	3	3 winds
Republic of Serbia	3	1 wind, 1 gas cycle plant, 1 water pipeline

Source: authors

energy subsector has four major projects. If one takes into account each small hydro energy project separately instead of lumping them together with larger projects, such as the three small HPPs on the River Drina and the three small HPPs on Bistrica in Bosnia and Herzegovina, the number would be even higher. While there were occasional transactions in the geothermal energy subsector or gas cycle power plant, there were no regularities to report.

The structure of RE projects in CEEC in which PR China invested is shown in Table 3. Countries not listed in this table, such as Albania, Bulgaria, North Macedonia, Slovakia, and Slovenia, did not have any RE projects so far. Bulgaria is the exception in this group because it had one project in the making, in which Dongfang Electric was one of the partners. That was the construction of a refuse-derived fuel plant that uses waste, and as such, it can be considered as an RE project. However, the Bulgarian Supreme Court recently annulled this project [58]. It is also worth noting that, currently, there are no Chinese-funded RE projects in either Poland or the Czech Republic, and all past investments, rights, and acquisitions have been sold.

When analysing the number of active or completed projects, Bosnia and Herzegovina is the leader in this field of RE cooperation, with six of them. Following closely behind are Poland and Hungary, with five projects each, while Romania and the Republic of Serbia have three. Greece, Montenegro, and Croatia have two projects each, and the Czech Republic has one. So far, Bosnia and Herzegovina and Poland have achieved the most diversified cooperation results.

When looking at the value of realised/active projects, the results are slightly different. Despite having only two projects, Greece has the highest value of approximately €1.74 billion, which ranks it first. Bosnia and Herzegovina come in second with a total project value at around €1.1 billion. Since values are not available for all projects in Poland and Hungary, they could not be ranked. Therefore, according to available data, the Republic of Serbia is ranked third.

Chinese companies were involved in most of the RE projects, either as investors or construction and design companies (see “Appendix”). Only two projects were financed by Chinese loans: the hydropower plants on the Drina River in Bosnia and Herzegovina, worth 460

million euros, and in the Republic of Serbia, the construction of a hot water pipeline linking the Obrenovac thermal power plant and the Novi Beograd heating plant, worth 165 million euros. An additional project in Bosnia and Herzegovina, which may also be partially financed by a Chinese loan, is currently under negotiations. This is the case for three small-scale HPPs on the Bistrica River, worth 103 million euros. Comparing these findings with the Zakić and Šekarić study [18], it was noted that coal-related projects in the traditional energy sector in CEEC were all financed by loans in previous years, while most RE projects were not. Thus, it appears that Chinese financing patterns in the traditional and renewable energy sectors in CEEC differ.

When analysing RE projects in CEEC that involve Chinese investments, there have often been examples of negotiated projects that failed before the construction began. Because of this, it was important to investigate the background of each project because the reasons behind the successful and unsuccessful examples were often more related to politics than to sustainable development issues. In this sense, the concept of Sino-scepticism was a helpful tool in mapping political reasons for collapsing relations established and/or closing down agreed projects between PR China and a specific country from the CEE region. This is due to the general rise of negative sentiment toward PR China across Europe in recent years [59], which resulted in Lithuania, Latvia, and Estonia stepping out of the framework in 2021 and 2022 and, in certain cases, worsening of bilateral relations with PR China [60]. For that purpose, the data and information surrounding each project were analysed to identify factors contributing to its outcome. Specifically, CEEC was divided into three groups according to the number of realised and unsuccessful RE projects: those with no projects currently, those with a moderate level of cooperation (1–3 projects), and those with a high level of cooperation (more than three projects).

Countries with no Chinese RE projects

Currently, the following 7 countries do not have RE projects connected to PR China: Albania, Bulgaria, the Czech Republic, North Macedonia, Poland, Slovakia, and Slovenia. Within this group, Bulgaria tried, and Poland succeeded in establishing cooperation, but that was not the case with the rest of the group. Poland is a specific case amongst studied countries because it started the RE cooperation strongly and had several successful projects and transactions before it all suddenly stopped. Chinese companies sold all of their RE portfolio in 2021, and this situation coincided with the rise of Sino-scepticism in Poland [61, 62] provoked by several factors: the EU's worsened political relations with PR China [63], the

pandemic, limited economic results in cooperation with PR China [64, 65], bilateral diplomatic tensions and the latest one was Chinese relations with the Russian Federation in the context of the ongoing warfare in Ukraine [63]. PR China tried several times to conduct RE projects in Bulgaria [66, 67] with no results, and no particular or out-of-the-ordinary reasons for those failures could be found. The Czech Republic had just one successful Chinese-financed project. After that, mainly due to political changes in this country (ruling parties) and the rise of Sino-scepticism [64] as a result of PR China's domestic human rights issues and the PR China–Taiwan dispute [68], almost all cooperation ceased. Slovakia is a country in which the same process (the rise of Sino-scepticism) and results (or lack thereof) can be interpreted as in the case of Poland and the Czech Republic. In this case, the only difference is that PR China negotiated with Slovakia to construct one HPP (on the river Ipel), and that one was unsuccessful [64]. On the other hand, in the case of Slovenia, official information about possible cooperation in RES was not available, so a definite conclusion about the reasons for the lack of cooperation in this field could not be reached. Albania, as a country dedicated to its EU path, regardless of good diplomatic relations with PR China, did not want to jeopardise its potential EU membership and its relations with the USA, so it chose not to interact with PR China in the field of investments [69]. Similarly, North Macedonia was not open to cooperation with PR China, especially since governmental changes in 2017 [58].

Countries with a moderate level of cooperation with PR China in RE projects

Several countries have had moderate levels of cooperation with PR China in the RE field, including Montenegro, Croatia, Greece, the Republic of Serbia, and Romania. Montenegro, so far, has only one Chinese project that it has finalised until the present day, with one project (an HPP) on hold. Montenegro was not motivated to pursue joint projects in the RE field due to complicated PR China–Montenegro relations regarding the loan and construction of the high-speed road between Bar and Boljare in Montenegro, for which Montenegro had to ask the EU to help it in restructuring it, so that it could pay the loan [70].

Croatia realised two projects in the solar energy field, which took some time for legal reasons [71], but in the end, they were successful. However, due to Croatia's limited engagement with PR China and the absence of official information regarding further cooperation in RES, it was not possible to definitively ascertain the reasons for the halt in cooperation. Although their good diplomatic relations are not strained, Croatia, in this instance, is

following the EU example of keeping good relations but with a limited number of Chinese investments.

According to the number of Chinese RE projects, Greece has a medium level of cooperation, but according to their values, it is in the lead. The main reasons for this were the acquisition of 75% of wind farms within the company Copelouzos, worth 1.45 billion euros, and the construction of the MINOS concentrated solar power plant, worth 286 million euros [18]. Greece has very diversified cooperation with PR China in general. PR China is very interested in cooperation in the RE field because Greece, as an EU country, could apply for many RE funds to increase carbon neutrality, which is attractive to Chinese investors.

As a non-EU Member State, the Republic of Serbia pursued intensive cooperation with PR China, mainly in infrastructure. Until recently, RE projects were not at the top of the Republic of Serbia's agenda regarding Chinese investments, and if that were the case, the number of projects would be much higher. Interestingly, PR China proposed many RE projects, but the Republic of Serbia was not interested in them, mainly because of other infrastructural and fossil fuel priorities, as clearly seen by the volume and number of those kinds of projects for which the Republic of Serbia applied [14, 18]. Chinese private companies have been joining forces with the EU companies for RE projects in the Republic of Serbia, such as solar park Agrosolar [72], which is currently under construction, and the wind farm Maestrle Ring and the wind park Vetrozelena [73, 74] where the construction process will start in 2024.

The last country in this group is Romania, which has had three smaller solar projects since 2014, and in times before that, it cooperated with PR China mainly in the wind energy field. Romania's relations with PR China have been restrained for various reasons, including constant changes of ruling political parties and the increased level of Sino-scepticism surrounding leading politicians, similar to those in the Czech Republic.

Countries with a high level of cooperation with PR China in RE projects

The final group is the one in which PR China developed the most diversified RE cooperation (with more than three projects), including Hungary and Bosnia and Herzegovina. Even though both countries successfully cooperate with PR China, their ways of cooperating and the projects on which they are working are different.

For example, Hungary introduced legislation in 2016 that prohibits the installation of wind turbines within a 12-km radius of populated areas [75], which meant there was no space for building new wind farms, so PR China could only invest in solar and geothermal energy projects

in Hungary. However, there has been no news about new Chinese RE projects in Hungary since 2021, which could indicate that these two countries are pursuing collaboration in other fields. Despite the above, PR China is heavily investing in the production of lithium batteries in Hungary, to be worth around 9 billion euros in the upcoming years [76, 77], so it probably means that PR China is re-focusing its attention on more lucrative RE-related projects in Hungary.

In Bosnia and Herzegovina, PR China was focused on pursuing HPP projects. However, there are legal problems that are putting those projects on hold. For example, in the case of an HPP on the River Bistrica, according to the plans, the PR China National Aero-technology International Engineering Corporation is in charge of constructing three small HPPs. Still, the work was stopped due to annulled construction permission issued by a local court in the city of Banja Luka [78]. The main problem was the expired environmental permit for construction, which is obligatory for projects that have an invasive impact on the environment. Legal issues surrounding the work on HPPs on the River Buk Bijela keep the project in the early stage of construction, even though it began in 2019. Furthermore, the legal framework surrounding RE projects in Bosnia and Herzegovina is susceptible to illegal actions, which is demonstrated in practice through many suspicious transactions [79]. Among many other problems, companies that want to be involved in solar or wind energy projects can only be concessionaires for a limited period, and the law forbids them to be the owners. As a result, many projects changed the concession rights several times, and usually, the first holder of these rights gets concession rights at a relatively low price, but subsequent buyers pay those rights at several times higher prices [79].

Discussion

Based on data collected from the 14 countries of the CEE region, the study showed that political factors had a greater impact than economic and legal ones regarding the Chinese presence in CEEC in the RE field. This is in line with the findings of Sattich et al. [4] that "increasing recourse to policy choices based on national priorities today creates obstacles to further cooperation" regarding the EU's and PR China's energy- and climate-related policy alignment. In addition, the context of the current Chinese presence in CEEC in the RE field is shaped by the overall stagnation of the EU-PR China partnership due to increased Sino-scepticism in Europe, the harmful effects of PR China's security policies on European companies in PR China, and PR China's neutrality over Russia's invasion of Ukraine, among other factors [63].

To prove such conclusions, narratives surrounding the political orientation of CEEC towards PR China along the spectrum of Sino-scepticism vs. Sino-optimism were further explored. During the 11 years of the PR China–CEEC cooperation framework, the battle of Chinese *versus* Western narratives was stark concerning the reasons for PR China's rapid and intense economic and political involvement in the CEEC. PR China [80–82] considers this move a pragmatic way to deepen primarily economic cooperation. As Liu [81] pointed out, it was part of circumstances shaped by, at that time, the situation both in PR China and CEEC:

“Presented with favourable chances, such as the lack of time for the core European countries to take care of the CEE region, and the CEE countries wishing to develop more extensive foreign cooperation in order to overcome economic difficulties, China seized the opportunity of this time frame to develop cooperation with CEE countries and successfully initiated the China–CEEC cooperation”.

On the other hand, the Western countries view this situation differently. Analysing frequently used Western narratives associated with the PR China–CEEC cooperation framework, Mitić [83] concluded that narratives are mostly negative, viewing this cooperation framework as part of PR China's geopolitical strategy. Without going too deep into this significant topic, it should be stated that views and opinions regarding this cooperation are stark on both spectrums (positive vs. negative), with a small number of those trying to take moderate positions.

For the purpose of this analysis, CEEC was divided into four groups according to the level of Sino-scepticism/Sino-optimism (Fig. 1). This categorisation helps demonstrate each country's prevailing narratives and political opinions regarding cooperation with PR China. Since this study employed exploratory in-depth desk research of the outlined case study, diverse textual sources referring to each concrete project were analysed in order to reveal possible reasons for their (un)success. In other words, the categorisation of CEEC according to the level of Sino-scepticism/Sino-optimism results from the authors' opinions shaped by the literature review and media article analysis,³ and data collected over several years of research on PR China, and it should be approached cautiously, as it is based on the authors' interpretations of empirical data.

When comparing the results of cooperation in the RE sector within the PR China–CEEC cooperation framework (Tables 2 and 3 and Fig. 1), it becomes clear that the negative vs. positive orientation of CEEC towards cooperation with PR China significantly affected the success

of RE projects. Political factors, such as the rising level of Sino-scepticism due to PR China's domestic human rights and disputes regarding Taiwan, followed by strained EU–PR China relations, were among those that proved to be the most severe obstacles. Owing to PR China's extensive experience in renewable energy and competitive project prices, economic factors were not an obstacle to cooperation in most cases. Legal procedures related to environmental factors only affected small HPPs, and those were found only in Bosnia and Herzegovina. Therefore, the level of CEEC's Sino-scepticism/Sino-optimism seriously affected the results of PR China–CEEC RE cooperation.

Although previous analysis showed significant alignment of the EU's and PR China's energy- and climate-related policies on the basis of RES, case study analysis within the PR China–CEEC cooperation framework proved that this alignment did not always lead to successful results in reality. Accordingly, as Gippner and Torney [36] highlighted, policy alignment of two actors “is a necessary but not sufficient condition for stimulating Chinese investment in EU clean technology sectors”. Therefore, overcoming political and economic divergences imposes a condition for achieving better cooperation in the renewable energy domain.

Conclusions

This study questioned the normative alignment of the EU's and PR China's energy- and climate-related policies in the domain of RE and its influence on the renewable energy cooperation between PR China and CEEC on a practical level. More specifically, it tested the hypothesis that dedication towards energy transition targets and alignment of strategies on the basis of RES should result in higher levels of practical cooperation.

According to the conducted analysis, Sino-European relations in this area are intertwined in several domains: first of all, they are both core actors in climate and energy-related issues with the same goal of reaching carbon-neutral status; second, their core energy-related policies became the basis for other climate actions; third, PR China develops relations with the EU as a supranational organisation but also with its individual member states. In this context, the review and comparative analysis of contemporary the EU's and PR China's energy- and climate-related policies indicate a significant level of policy alignment on the basis of RE. The main connecting spots thus spring from:

- mutual recognition of the significant role of renewable energy sources in the energy transition process,
- similar deadlines for achieving energy transition targets,

³ Textual sources that were analysed could be found in the References section.

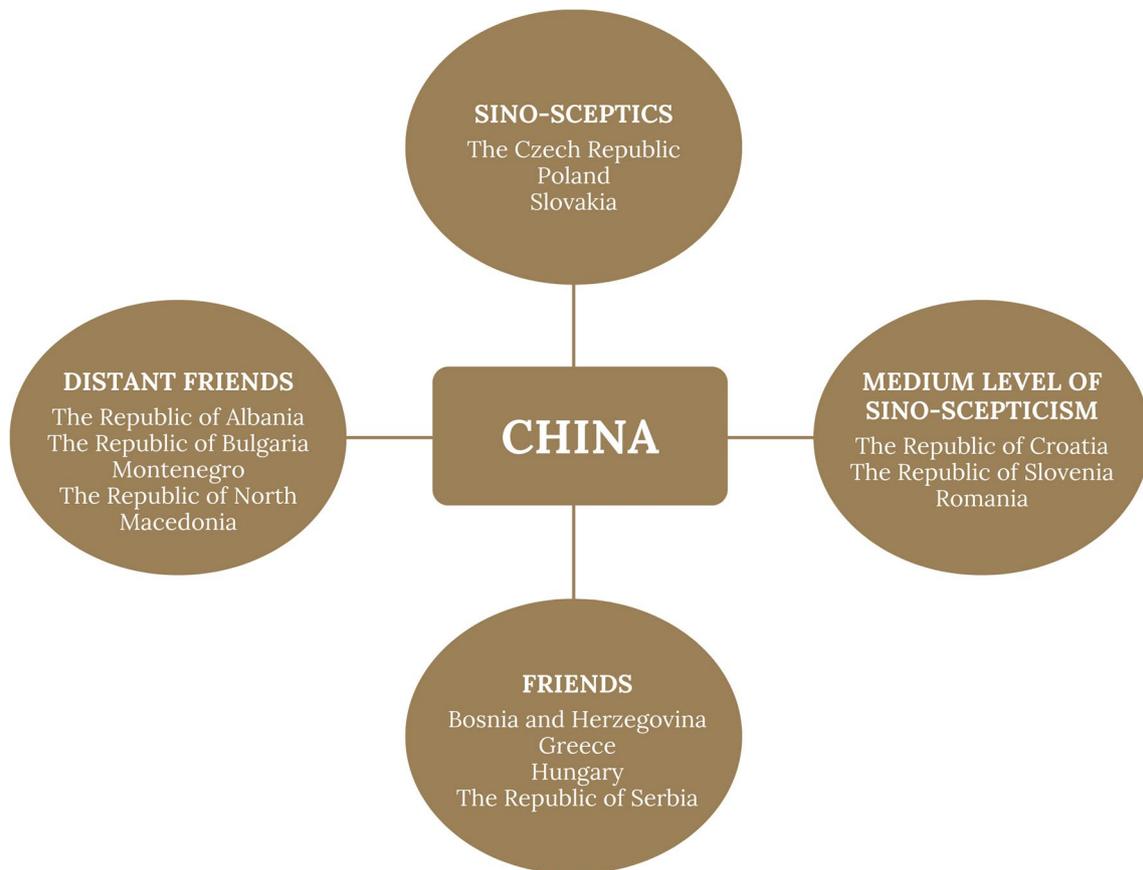


Fig. 1 PR China and CEEC: levels of Sino-scepticism (Sino-optimism). Source: authors

- similar goals of their mid-term policies,
- recognition of similar challenges in the energy transition, and
- the necessity of international cooperation in contribution to the global energy transition.

The critical point of contention, however, comes from different perspectives regarding environmental responsibility. While the EU calls for an urgent reaction, prioritising green financing and a total phase-out of carbon emissions, PR China’s camp stands for a more nuanced approach towards ambitious energy transition goals that will favour the national needs of a country.

The case study of PR China–CEEC RE cooperation was conducted to test if the alignment of the EU’s and PR China’s energy- and climate-related policies was reflected on a practical level. This region, comprising 14 countries, was chosen as a case study for two reasons. Firstly, it is part of the PR China–CEEC cooperation framework, presenting a prominent part of PR China’s geo-economic

strategy. Secondly, this region has a diverse structure comprising European Union Member States and candidate countries that interact with other external actors within the context of the prevailing European Union energy approach.

The study has shown moderate results of Chinese investments in RE projects in CEEC. Solar and wind energy projects are still leading, while hydropower plants have the biggest potential, especially in the Western Balkans. The main reasons for unsuccessful projects were political, stemming from rising levels of Sino-scepticism. Legal reasons, such as the specific legal procedures and norms for RE projects, were also a factor, followed by economic reasons, such as project costs. Those were found in a minority of cases. However, one should not forget the numerous upcoming RE projects involving Chinese and European companies in joint work, which will come to fruition in the next couple of years, thus suggesting that cooperation can be improved.

The transnational nature of climate change consequences requires unity to answer this challenge. This becomes especially important in the context of an unstable geopolitical environment. Once achieved, energy transition goals bring common benefits, global cooperation, and shared action imposed as a necessity in this process. The question is whether the speed of accomplishing the energy transition goals will be a priority over the political and economic differences between the EU and PR China. Sino-European cooperation in the domain of renewable energy has evolved in the XXI century, and a normative basis for its strengthening certainly exists. However, the effectiveness of achieving targeted energy and climate goals depends mainly on overcoming barriers on both political and economic levels. Besides, the two are expected to reach their renewable energy targets as leaders of the energy transition process, so there is a pressure to act accordingly.

In the post-pandemic environment and especially with the start of the conflict between the Russian Federation and Ukraine, energy transition became the *raison d'être* of

the EU's energy operations, as it has stopped relying on its main external energy partner. The EU's ambitious energy transition targets reflect its urgent need to be energy independent. On the other hand, PR China, burdened with its own energy and environmental requirements, also strives for sustainable growth based on energy transition. This mutual need should be utilised in a manner that will bring the parties closer to achieving renewable energy targets.

Considering the importance of the EU and PR China in the mitigation of climate change, energy transition success will greatly affect the global level. Significant challenges in this cooperation, in turn, could slow down the process of energy transition. As for future sustainability concerns, the worth of the notion is the fact that the cooperation on climate and sustainability is seen as one of the priority areas for EU–PR China relations in the forthcoming decade. Looking to the future, it is important to be aware of the capacity for strengthening Sino-European cooperation in the domain of renewable energy.

Appendix: Chinese renewable energy projects in CEEC, from 2014–2022 (million €)

Country	Project	Chinese partner/ investor	Type of project	Renewable energy subsector	Status	Value
Bosnia and Herzegovina	Ivovik wind farm, 84 MW	China National Technical Import & Export Corporation, Powerchina Resources LTD	Greenfield (concession 30 years)	Wind	Active	€133 mn
	Vlašić, 50 MW and Galica wind farms 50 MW, in the Central Bosnia Canton	China Machinery Engineering Corporation (CMEC), Tomix Kneževa, TLG Travnik	Joint venture	Wind	Negotiations ongoing	€140 mn
	Dabar hydropower plant, 159 MW	China Energy Gezhouba Group	Design, construction and commissioning	Hydro	Active	€222.8 mn
	Hydropower plants on river Drina 1. Buk Bijela, 39 MW 2. Foča, 44 MW 3. Paunci, 43 MW	China National Aero-technology International Engineering Corporation (AVIC-ENG), Elektroprivreda Republike Srpske + Elektroprivreda Srbije	Loan and construction	Hydro	Active	€460 mn (220 + 119 + 125)
	Three small-scale hydropower plants Bistrica River, 39 MW	China National Aero-technology International Engineering Corporation (AVIC-ENG), Hidroelektrana Bistrica Elektroprivreda Republike Srpske	N/A (possible partial loan)	Hydro	On hold/ Active	€103 mn
	Bileća solar power plant, 450 MW	Dongfang Electric Corp. + EFT	Construction	Solar	Active	€43.5 mn
The Czech Republic	Energy 21, solar power company, 61 MW	China—CEE Fund	Acquisition	Solar	Finalised/ Sold	N/A

Country	Project	Chinese partner/ investor	Type of project	Renewable energy subsector	Status	Value
The Republic of Croatia	Wind farm in Senj, 156 MW	China North Industries Corporation (Norinco)	Investment and construction	Wind	Finished	€230 mn
	Energija Projekt power company	Norinco	Acquisition of 76% of company	Wind	Finalised	€32 mn
Greece	4 wind farms 78.2 MW Organis, Grammatikaki, Megavouni and Korfovouni (Thrace, Trikorfo, Mani, Crete)	China Energy Europe Renewable Energy S.A.(CEERE) (Shenhua Group)	Acquisition of 75% of wind farms within company Copelouzou	Wind	Finalised	€1454 mn
	MINOS 50 MW Concentrated Solar Power Project (Crete) – sun tracking mirrors + molen salt circuit	China Gezhouba Group International Engineering Co., Ltd. under China Energy Engineering Corporation and Zhejiang Supcon Solar Technology Co., Ltd	EPC contractor	Solar	Active	€286 mn
Hungary	40 MW geothermal power station in the Pest County town of Tura developed by KS ORKA	Zhejiang Kaishan Compressor Co	Construction and project development	Geothermal	Completed	€141 mn
	Kaposvar solar power plant, 100 MW	China National Machinery Import & Export Corporation (CMC), a subsidiary of China General Technology (Group) Holding Co., Ltd (Genertec)	Greenfield project	Solar	Completed	€100 mn
	Two solar projects with capacity of 13.9 MW and 2.15 MW, respectively	ReneSola	N/A	Solar	Finalised	N/A
	Tiszaszolos solar power plant 11.6 MW	Unisun Energy	N/A	Solar	N/A	N/A
	Solar power plant in north Hungary	Shanghai Electric Power Co Ltd (previously owned by Chint Solar Hungary)	Construction and commission	Solar	Active	N/A
Montenegro	Wind park on Mt Možura, 46 MW	Shanghai Power Electronics, Enemalta plc	Construction of wind turbine	Wind	Completed	€87 mn
	Hydropower plant on Morača River	Norinco	Construction and concession	Hydro	On hold	€500 mn
Poland	Polenergia	China–CEE Fund	Acquisition of 16% of Polenergia	Alternative energy provider, distributor and sale of electricity	Finalised/Sold	€45 mn
	Wroblew 36 MW and Project 2 wind farms 214 MW	China–CEE Fund and Enlight Renewable Energy	Joint venture	Wind	Finalised/Sold	N/A
	Zopowy wind farm, 30 MW	China–CEE Fund and GEO Renewables	Joint venture	Wind	Finalised/Sold	N/A
	Korytnica 1 (3.3 MW) and Korytnica 2 (50.4 MW) wind farm	China–CEE Fund	N/A	Wind	Finalised/Sold	N/A
	Solar auction bids to 26 utility projects of 1 MW total	ReneSola	N/A	Solar	Finalised	N/A

Country	Project	Chinese partner/investor	Type of project	Renewable energy subsector	Status	Value
Romania	Ratesti solar park in 154 MW	CHINT Solar and INTEC Energy Solutions	Design, engineering, procurement, construction, and high voltage grid connection of the solar park	Solar	Active	€100 mn
	Solar plant in Timiș, 21.4 MW	Jiangsu Zhongli and ReneSola Energy	Ownership	Solar	Sold	€1.86 mn
	Ucea De Sus solar farm, 82 MW	Jiangsu Sunshine Group	Ownership	Solar	Finalised	€100 mn
The Republic of Serbia	Pančevo combined cycle power plant, 189 MW	Shanghai Electric Group	Construction	Gas and water	Finalised	€180 mn
	Construction of hot water pipeline linking Obrenovac thermal power plant and Novi Beograd heating plant	Power Construction Corporation of China	Loan	Hydro and coal	Active	€164.7 mn
	Construction of solar park Agrosolar in Kula	Power China (for MK Group and Fintel Energy)	Construction	Solar	Active	€340 mn

This table contains seven rows of information on each RE project, including country, project (hydropower plant (HPP), solar park, wind park, etc.), Chinese partner/investor in the project (and, in some cases, information about a local partner), type of the project (e.g., FDI, loan, construction, design, etc.), renewable energy subsector (in which it was invested), status of the project (active, on hold, finalised, etc.) and the project's value (million €).

Abbreviations

CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CGIT	China Global Investment Tracker
EU	European Union
FDI	Foreign direct investment
FYP	Five-year plan
GHG	Greenhouse gas
HPP	Hydropower plant
NDC	Nationally Determined Contributions
NEA	National Energy Administration
PRC	People's Republic of China
RE	Renewable energy
RES	Renewable energy sources
UNCTAD	United Nations Conference on Trade and Development
USA	United States of America

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Author contributions

NŠS and KZ prepared concept of the study, analysis, and interpretation of the results. NŠS was the major contributor in the literature and renewable energy policies review. KZ was a major contributor in data collection and formulation of the database. Both authors participated in manuscript editing and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article and its "Appendix".

Declarations

Ethics approval and consent to participate

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Consent for publication

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Competing interests

The authors declare that they have no competing interests.

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