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Energy Transition Enhancement in Emerging Economies: EU's and Japan's Strategies for Central Asia

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Abstract: The paper operationalizes the notion of strategy for energy transition enhancement (SETE) as a specific set of energy transition diplomacy (ETD) instruments tuned to a particular external/ third country or region/ context. The paper shows that the ideational parameters and structural components of a (supra)nation's energy transition strategy influence its ETD. Being a geographically specific form of a (supra) nation's ETD, SETE is susceptible to the shifts in global, (supra)national, and third country/ region contexts. The paper examines the European Union (EU)'s and Japan's approaches to fostering energy transition in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan). Central Asian economies' robust renewable energy (RE) development potential is barely tapped due to technological, financing, and institutional constraints. The EU and Japan pursue energy transition security, possess certain technological advantages, and seek greater normative power in global decarbonization. The study argues that these aspects make cooperation among the EU, Japan, and Central Asian economies feasible and mutually attractive.

Keywords: energy transition, enhancement strategy, EU, Japan, Central Asia

1. Introduction: Conceptualization of Strategy for Energy Transition Enhancement (SETE)

Energy transition is a conversion towards decentralized system driven by renewable energy (RE) sources, resulting in the advent of a new energy regime [1], with justice being one of its key components [2].

SETE – as designed by an advanced economy and applied in an emerging economy – is a central concept of this paper. What is SETE and how does it relate to other concepts in energy transition studies?

Energy security is one of the most crucial elements of a national security; it is safeguarded with the instruments of energy diplomacy [3–7]. National (or supranational, as is the case of the European Union (EU)) energy diplomacy embraces meetings, negotiations, agreements, and embedded diplomatic practices [8]. Energy transition undermined the significance of power relations centered on conventional hydrocarbons, setting in motion the incumbent geopolitical configurations [9–11] and stirring novel arrangements between the players across increasingly diverse segments of energy transition supply chains [12, 13]. Energy transition diplomacy (ETD) is inspired by the ideas, values, beliefs [14] and driven by norms [15, 16] endorsed in a national energy transition strategy (NETS), but it is also shaped by the geopolitical environment [17, 18]. The accelerating securitization of energy transition legitimized the de-risking and friend-shoring principles in advanced economies' ETDs [11]. These nations increasingly employ ETD modes to enhance their normative and soft power [19]. The instruments for transplanting NETS are sundry; they include international partnerships (at large and focusing on critical raw materials (CRM), batteries, hydrogen, ammonia, and others), energy dialogues, research and innovation collaborations, enhancement of supply chains, mobilization of green financing, development and empowerment of human resource, and promotion of sustainability, inclusiveness, equity, and justice [20].

In this study, SETE is operationalized as a combination of ETD's select instruments and communication modes tuned to fit the context of a specific host country or region (Figure 1).

The nations' motivations for cooperation in energy transition can be versatile [21]. While the theory of cooperation offers general insights [22], there is a growing body of literature focusing specifically on cooperation in energy transition [23–26]. Kawabata [24] demonstrates the expanding intensity of cooperative networks for energy transition. Before 2020, RE was at the core of bi- and multilateral agreements. Major geopolitical shocks in the aftermath of Russia's invasion of Ukraine in 2022 ushered in a new wave of securitization of energy, shifting focus to energy transition resources and technologies, in particular, hydrogen and critical minerals. China leads by far in RE, with the EU ranked second and Japan a few places down. The EU and Japan have dense cooperation networks (surpassed only by the US) in hydrogen and critical materials. Japan leads by far in carbon dioxide capture, utilization, and storage (CCUS), followed by the US and the EU. In addition to the EU's strong performance, the individual results of the EU member states (Germany, France, Denmark, and the Netherlands) are also solid, making the group of European actors the most proactive players in the global energy transition. Through energy transition cooperation, importers of conventional energy seek to become

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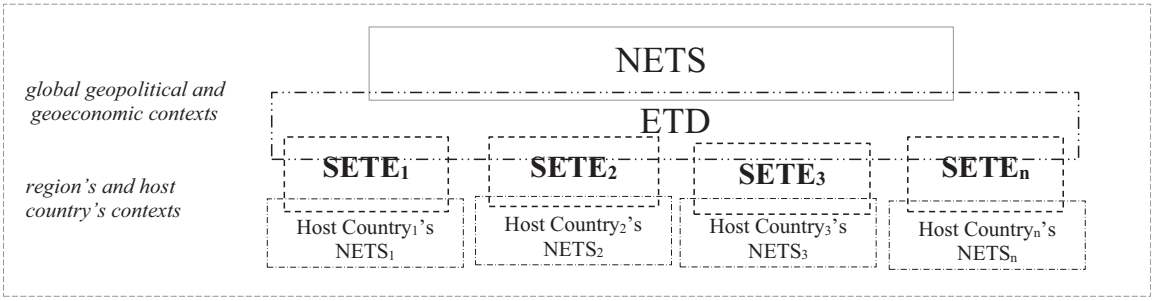
Figure 1
General concept map



Note: NETS – national energy transition strategy; ETD – energy transition diplomacy; SETE – strategy for energy transition enhancement.

green energy exporters or secure energy transition supply chains. In turn, the exporters of conventional energy pursue diversification, greening their energy product portfolios in response to the international pressure to decarbonize [24].

In line with Müller et al. [27], cooperation for energy transition between a country-owner of SETE and an emerging economy (an object of a respective SETE or a host country) can be voluntary. For example, a donor country seeks to secure access to resources and an emerging economy is eager to attain lacking fundamentals for energy transition, such as technology or capital. For emerging economies, energy transition is often part of greater aspirations, such as sustainable economic development. Cooperation can also be imposed, when a host country faces adversarial effects of changes in the international regulatory environment initiated by advanced economies, such as the Carbon Border Adjustment Mechanism (CBAM). Designed in such a context energy transition is likely to focus on the most vital for the emerging economy export-oriented sectors and, thus, be of a niche mode. In case a host country confronts serious lock-ins (institutional, structural, or other) the removal of which necessitates profound reforms and, hence, creates risks to destabilize the incumbent political regime, the host state is also likely to adopt a niche format cooperation, limiting the SETE owner's engagement to such areas as financing and technology. To ensure the longevity of the incumbent political regime, the emerging state often prioritizes its economic interests. This focus frequently leads to the continuation of carbon-intensive practices, even after setting goals and aspirations for decarbonization and climate change adaptation and mitigation. Seeking to secure additional aid less wealthy host state is more likely to delegate a broader mandate to the SETE owner. In such a scenario, dependence on certain technologies and suppliers arises, ultimately reducing the sustainability of the solutions for the host nation [27, 28].

Thus, SETE is developed by countries with competitive advantages[1] in the energy transition, driven by their pursuit of energy security. The latter can be safeguarded through various means, including access to energy transition resources, the promotion of normative power within international legal frameworks, and the strategic use of soft power to influence other nations' visions of energy transition. However, SETE cannot merely be transplanted into a host country's context. Generally, a host country with greater financial and technological autonomy is more likely to initiate certain adjustments to the SETE.

[1]Typically, SETE owners were advanced economies, like in the case this paper discusses. However, more recent aspirations to conduct SETE are revealed by China, Saudi Arabia (SA), and the United Arab Emirates (UAE).

2. Energy Transition in Central Asia

Central Asian countries are at the early stage of RE adoption [29, 30]. Interestingly, hydrocarbon-rich economies in the region are more active in developing RE [31, 32]. Kazakhstan commenced RE endeavors nearly a decade earlier than the rest of its regional peers, introduced more comprehensive RE policies, and more effectively communicated its vision for the role of RE domestically and abroad. Kazakhstan views RE as a driver for modernizing the national economy and as a trade and investment link to advanced economies. Uzbekistan exhibits the importance of the domestic institutional environment for RE development. In the aftermath of the country's post-2016 political transformation, institutional and regulatory reforms markedly facilitated the inflow of foreign capital and innovations, enabling the adoption of RE. Uzbekistan is growing increasingly ambitious to re-establish itself as a regional energy hub. The modernization of the Central Asian Power System (CAPS) and the deliberated gas union with Russia and Kazakhstan can be interpreted as steps in the same direction. Kyrgyzstan appears to have finally shifted from relying passively on international financial and technical assistance for RE development to a more proactive approach, including cooperation with Kazakhstan in green energy financing. The most reclusive nation in the region Turkmenistan has eventually commenced RE development. Unlike other Central Asian countries, Turkmenistan prefers cooperation with a small circle of nations with similarly authoritarian systems. The country seems to be facing a dilemma of preserving its political regime intact or reforming its politico-economic institutions to make them more fit for harnessing international advances and expertise. Finally, in Tajikistan, RE development has taken a slower pace. Small-scale RE projects are implemented with the support of international organizations, while there are no significant regulatory and institutional efforts to enhance greater RE diffusion. For a long time, Tajikistan was locked in a belief that hydropower alone could secure necessary electricity generation for rising domestic demand and exports.

Do Central Asian countries need the energy transition? There are several reasons to affirm this necessity [21]. First, despite having relatively developed energy infrastructure inherited from the socialist past, inadequate investment in modernizing the existing facilities and constructing the new ones has exacerbated such problems as high energy intensity, energy losses in transmission and distribution systems, and electricity shortage. To a varying degree, all Central Asian economies experience scheduled electricity rationing and emergency blackouts. Second, as developing economies, Central Asian nations are witnessing

population and economic growth exceeding the global average rates. This translates into a significant rise in energy and electricity demand, forcing Central Asian economies (except Turkmenistan) to import electricity from within the region or from outside (Russia). Third, although Central Asian countries contribute relatively small amounts to global emissions, they are among the most carbon-intensive economies in terms of CO_2 per unit of GDP and CO_2 per capita. The capital cities suffer from severe pollution during winter when coal usage increases and the rural areas have pronounced problems with access to clean energy for cooking. Furthermore, climate change threatens some nations' traditional reliance on hydropower (Kyrgyzstan and Tajikistan), as water becomes increasingly scarce in the entire region and requires sustainable intraregional management. Fifth, as Central Asian countries are integrated into global supply chains mainly as exporters of hydrocarbons or carbon-intensive goods, they face the risk of losing competitiveness in international trade once carbon pricing is enforced in one or another way. Central Asian economies can hardly attain systematic solutions to the incumbent problems by continuing the niche-mode development of RE. They need a comprehensive energy transition facilitated by access to cutting-edge technology, specialized expertise, and substantial financial resources – much of which can be garnered or facilitated only through international collaboration.

There are many non-regional actors engaged in the development of RE in Central Asia. After China incorporated the "green" component into its grandiose Belt and Road Initiative (BRI), it has become an even larger player equipped with a multifaceted policy toolbox. Following the outbreak of the Ukrainian war, the geopolitically tuned heavyweight aid provider US has activated efforts to increase its presence in Central Asia, pursuing RE as one of the important elements of its strategy in the region. Turkey, which has been assertively promoting the idea of shared Turkic values, has also engaged in cultivating RE cooperation in Central Asia. And still more, SA and the UAE have grown ambitious in transplanting their early RE achievements into Central Asian economies [21].

Why does the paper focus on the EU's and Japan's strategies for the region? We argue that through closer cooperation with the EU Central Asian countries can pursue a more comprehensive mode of the just energy transition underpinned by market-driven decarbonization and intraregional connectivity. By cooperating with Japan, Central Asian economies can tap into the experience of a high-quality standard of large-scale infrastructural project implementation. The combination of these virtues is unique and beneficial to Central Asian developing economies. What are the motivations of the EU and Japan to foster their roles in energy transition across Central Asia? One primary reason is that these advanced economies envision their missions as proactively contributing towards a global just energy transition. In the aftermath of Russia's invasion of Ukraine in 2022, the calculations of security of alternative (non-Russian) conventional energy supply and access to energy transition resources have additionally elevated the importance of Central Asia for both the EU and Japan. As discussed further, the EU and Japan have been retrofitting their energy strategies to respond to geopolitical perturbations and adjusting SETEs for Central Asia to secure their interests in the region.

The paper examines how the EU's and Japan's SETEs in Central Asia compare and if they have a synergy potential. The rest of the paper is organized as follows. First, the overview of the theoretical underpinnings involving ETD and SETE is provided. The next section outlines the data and methodology used in this research. Then, the evolution of the EU's and Japan's (supra)national energy transition pathways is characterized to explain the background for their ETD. Next, the interests, priorities, and institutional frameworks (collectively referred to as the ETD) employed by the EU and Japan in their external engagements are discussed. In the next stage, the paper looks at the EU's and Japan's specific initiatives and mechanisms for facilitating energy transition in Central Asia (referred to as SETE). The paper uncovers the linkage between the characteristics of a (supra)nation's energy transition pathway and the levers of the SETE, rendering the latter its flexibility and adaptability. The next section summates the comparative observations on the EU and Japan's SETEs and speculates on the dimensions for collaborative bilateral and multilateral efforts involving Central Asia, the EU, and Japan. The final section presents the implications and outlines the limitations of the study.

3. Data and Methodology

The paper covers the EU and Japan as the developers of SETE and five Central Asian countries as the hosts thereof. It employs an integrative and critical literature review approach [10] to comparatively analyze the EU's and Japan's SETEs for Central Asia. Comparative policy studies face several methodological challenges [33, 34], with the conceptualization of the policy output being the most fundamental [27, 35–37]. Studies on policy output are diverse; some focus on identifying policy means versus its ends [38], others focus on policy diffusion, change, and growth over time, across policy fields and cross-nationally [39], and still others on the types of policy instruments that characterize the density and the intensity of the policy portfolio [40].

This study follows the logic of the conceptual framework outlined in the introduction. First, it characterizes the NETS of the EU and Japan. Then, it examines the ETDs of both parties. The analysis of the EU's and Japan's SETEs for Central Asian countries begins with an exploration of their respective bi- and multilateral frameworks. The EU's and Japan's SETEs in Central Asia are compared across several elements, including ideational components, institutional evolution, technological priorities, and green financing capabilities.

The critical analysis involved the work with the programmatic and policy documents of the EU, Japan, and Central Asian countries, regulatory acts in the realm of their energy transition, as well as the features of the concerned parties' diplomatic exchange. Policy data were retrieved from publicly accessible databases on RE, including the IEA/ IRENA Joint Policies and Measures database, Global-Climatescope, Bloomberg NEF, and the Regulatory Indicators for Sustainable Energy RISE. Additional information was adopted from annual reports such as the REN 21 Global Status Reports, the World Energy Outlooks, and IRENA's publications. When these sources proved incomplete for some Central Asian countries, individual countries' RE legislation was explored.

The study incorporates a wide range of macrodata, such as those produced by international organizations, regional development banks, and national statistics agencies, as well as microdata released in companies' reports and surveys by the United Nations Development Programme, Asian Development Bank (ADB), and Central Asian Barometer, to name but a few.

4. (Supra)National Energy Transition Strategy and Diplomacy

4.1. EU

The EU has developed the densest legislative and policy framework to promote energy transition. A large body of research

explores various aspects of the energy transition in the EU [41–44]. Only the most critical elements related to the theme at hand are addressed in this section.

In November 2018, the EU pledged to become climate-neutral by 2050. Since energy accounts for 2/3 of overall EU greenhouse gas (GHG) emissions, energy transition is at the core of the EU's decarbonization strategy. The energy transition was addressed in the Clean Energy for All Europeans and the European Green Deal added impetus to forming more comprehensive policy and responsible action of member states. In 2021, the European Climate Law set the intermediate target of reducing net GHG emissions by at least 55% by 2030, compared to 1990 levels to ensure the fulfillment of the 2050 climate neutrality. Also in 2021, the EU adopted the Fit for 55 Package containing legislative proposals to enable a 55% emissions reduction by 2030. The proposals included the Renewable Energy Directive, the Energy Efficiency Directive, the Energy Performance of Buildings Directive, the Energy Taxation Directive, the Social Climate Fund Regulation, and the gas and hydrogen package with some proposals adopted relatively swiftly, others being under longer deliberations and new proposals added.

The Russian war in Ukraine triggered energy crisis in the EU. Adopted in May 2022, REPowerEU signified the securitization of energy transition. The plan centered on the importance of energy security, the necessity of higher energy self-sufficiency, and the need to boost RE. REPowerEU, among other strategies, proposed the external energy engagement strategy, the solar energy strategy, the save energy plan, the biomethane action plan, the hydrogen accelerator, and an EU energy platform for voluntary common purchases of gas, liquified natural gas (LNG), and renewable hydrogen. The endorsed energy union and climate action governance framework envisions long-term national energy and climate plans prepared by the member states to ensure their contribution to EU energy and climate objectives. REPowerEU increased the 2030 targets for the share of RE from 40% to 45% and voiced an intention to raise the 2030 GHG reduction target from 55% to 57%. Endorsed in 2023, A Green Deal Industrial Plan for the Net-Zero Age and the Net-Zero Industry Act provided the vision and policy measures for the EU's industrial restructuring amidst the aggravated energy security concerns.

Section 3 of the Green Deal outlines the EU's ambitions as a normative power, pledging "to develop a stronger 'green deal diplomacy' focused on convincing and supporting others to take on their share of promoting more sustainable development", to ensure that "... products that are placed on the European market [...] fully comply with relevant EU regulations and standards..." and to "...use its expertise in 'green' regulation to encourage partners to design similar rules that are as ambitious as the EU's rules, thus facilitating trade and enhancing environment protection and climate mitigation..." in trading partners. A part of REPowerEU, the EU External Energy Engagement in a Changing World aims to accelerate the global green and just energy transition, building long-lasting international partnerships and promoting the EU clean energy industries across the globe. Partnerships are encouraged for securing access to energy transition materials and improving technological advantages. Another group of partnerships is envisioned for emerging countries, traditionally for the EU – Africa, but also East Neighborhood nations, especially those affected by the Russian aggression in Ukraine. The EU External Energy Engagement in a Changing World also pledges to support the green transition in Central Asia through a Regional Team Europe Initiative on Environment, Energy, and Water.

The EU's ETD is underpinned by the Global Gateway Strategy (2021), Just Energy Transition Partnerships (JETPs)[2] and Critical Raw Materials Act (2023). The EU contributes to the Green Climate Fund (GCF), which is the arm of the United Nations Framework Convention on Climate Change. GCF is tasked to support developing countries' efforts to fulfill their pledges for the emissions cuts set in nationally determined contributions (NDC). The EU (together with the member states and the European Investment Bank, EIB, and the European Bank for Reconstruction and Development, EBRD) is the main provider of public climate finance to developing countries and the largest provider of official development assistance (ODA).

4.2. Japan

Decarbonization was not Japan's policy focus until 2020 [45–47]. Yet, since the 1970s Japan has been among the most coherent followers of energy efficiency action [48]. Before 2020, a substantial portion of this effort was in the form of soft law – corporate governance and stewardship centered on incentivizing energy efficiency at large corporations. Such initiatives include the Top Runner Programme, the Cool Biz, and the Zero Energy Buildings, to name but a few.

In October 2020, Japan pledged to reach net zero carbon emissions by 2050. In April 2021, the government tightened the intermediate goal, announcing a 46% cut in emissions by 2030 vis-a-vis the 2013 levels. In December 2020, the government adopted the Green Growth Strategy through Achieving Carbon Neutrality in 2050 (Strategy 2050) outlining national industrial policy aimed at spurring economic growth in the process of decarbonization. The Strategy 2050 formulates five cross-sectoral policy tools (grants, tax incentives, measures of financial policy, regulatory reform, and international collaboration) and action plans for 14 growth sectors (energy industries, transport/ manufacturing industries, and home/ office industries).

Adopted in 2021, the current Sixth Basic (Strategic) Energy Plan[3] was not particularly envisioning energy transition. However, a massive number of programmatic visions, strategic documents, legislative acts, and initiatives have been announced afterward. Putting this in context, the following documents have been developed to add momentum to the energy transition in Japan: Long-term Growth Strategy under the Paris Agreement (October 2021), Clean Energy Strategy (May 2022), New Form of Capitalism (part 2, Green Transformation, GX) (June 2022), Towards Accelerating Japan's Green Transformation (May 2023), Strategy for Promoting Transition to a Decarbonized, Growth-Oriented Economic Structure (aka GX Promotion Strategy) (July 2023), GX Transition Bonds (February 2024), to name the major ones. By March 2025, Japan aims to adopt the Seventh Basic Energy Plan and a new Green Transformation 2040 Vision. In 2026, the full-scale launch of emissions trading is expected. In the fulfillment of GX, Japan became the world's first country to issue Climate Transition Bonds" (aka GX Bonds) in February 2024 to finance its commitments to reducing GHG emissions by 2030 and achieving carbon neutrality by 2050.

The Strategy 2050 underlines the importance of an integrated domestic and international industrial policy, stating that the

[2]Since COP26 in 2021, JETP has emerged as a new plurilateral financing cooperation mechanism to help emerging economies accelerate the phase-out of fossil fuels (especially coal) and ensure their just energy transition. JETP is designed to be owned and led by a respective developing country; mobilize private finance; and enable the attainment of a country's ambitious NDCs.

[3]A new Strategic Energy Plan is endorsed every four years.

Japanese industry should strive to capture the advantage of economies of scale in overseas markets, including emerging economies. To this end, collaboration on innovation and technology development with the US and the EU in priority areas, including in third countries and more specifically emerging countries, was highlighted as essential. The strategy envisions Japan's aspirations to deepen its engagement in rule-making for the promotion and standardization of technologies in priority fields and the removal of trade barriers. It identifies several areas (in addition to RE) as intended for focused effort, such as CCUS, nuclear power, hydrogen, ammonia/ hydrogen co-firing, and biofuels. The document also stresses the importance of large-scale conventions to improve Japan's communicative outreach internationally and enable the exchange of ideas, norms, and values involved with the energy transition.

Japan's Strategy 2050 highlights the importance of cooperation with the US and the EU, and among emerging economies – with Asian countries. In the latter, Japan primarily focuses on the ASEAN. In May 2021, Japan launched the Asia Energy Transition Initiative (AETI) centering around its traditional 3Es concept (Energy security, Environment, and Economic growth) to provide a practical roadmap towards decarbonization and leverage Japanese technology, systems, and know-how. In 2021, Japan established the Asia Green Growth Partnership Ministerial Meeting (AGGPM) under the auspices of the Ministry of Economy, Trade and Industry. The pivotal elements of the AETI and the AGGPM are cooperation for CCUS and carbon dioxide capture and storage (CCS) technologies, which Japan has a competitive advantage at and, hence, seeks wider commercialization of CCS/ CCUS business in ASEAN economies and beyond. Also, in 2023 Japan initiated the Asia Zero Emission Community (AZEC) embracing ASEAN countries (except Myanmar) and Australia. By May 2024, Japan had about 350 Joint Crediting Mechanism (JCM) projects under the AZEC initiative. Japan contributes to the GCF and finances the GCF projects via the Japan International Cooperation Agency (JICA) and the ADB.

Japan is particularly active in international green technology cooperation upon the JCM[4] following, however, its traditional geographical preference for development aid directed to the ASEAN countries. In April 2024, Japan joined the G7 Ministers' Meeting on Climate, Energy, and Environment pledging to broaden cooperation with emerging economies.

Through its recent actions, Japan has been demonstrating an interest in scaling up particular technologies, such as hydrogen and CCUS, hosting, for example, the Hydrogen Energy Ministerial Meeting, joining the International Partnership for Hydrogen and Fuel Cells in the Economy and launching the Asia CCUS Network.

Since 2020, Japan has held an annual large-scale Tokyo Beyond Zero (Tokyo GX) Week umbrellaing a wide range of events themed for enhancing cooperation in energy transition and decarbonization.

In emerging economies, Japan pursues a cooperation model different from that of Western economies [49]. As a nation that achieved great success in economic development, Japan excelled in creating normative power upon the notion that it has experience, knowledge, and expertise, all readily available for the developing nations [50, 51]. In communicating its development diplomacy, Japan has been using nuanced value-oriented rhetoric. Instead of emphasizing its geopolitical priorities and stipulating development financing upon the recipient nations' adherence to Western democratic values and norms, Japan has been welcoming transformations towards free and open economies [49]. It has been pragmatically allocating development financing to the spheres essential for economic development (infrastructure, human resource development, etc.), assuming that all the virtues of democracy come into place naturally with a developing nation's economic progress [49].

When pursuing cooperation with developing economies, Japan relies on a model centered on Japanese state-led initiatives and institutionalized government-business collaborations underpinned by ODA mainly in the form of tied aid and loans enabling Japanese manufactured exports. The Japanese government has traditionally preferred to see the state or state-linked entities among the Japanese companies' counterparts, only recently having somewhat loosened this approach by endorsing public-private partnerships (PPP).[5]

Since about 2010, Japan has been increasingly focused on infrastructure exports fulfilling its aspirations envisioned in respective policy documents: the Package-Type Infrastructure (2010), the Infrastructure System Export Strategy (2013), and the Infrastructure System Overseas Promotion Strategy 2025 (ISOPS) (2020) [52]. The infrastructure projects are seen to assist infamously risk-averse Japanese businesses in supplementing their supply chains and incorporating Japanese businesses into greater value chains [53]. Japan has been seeking to advance infrastructure exports by pursuing twin goals: revitalizing domestic economic growth and leveraging China's surging regional influence [53]. The inauguration of the BRI and Asian Infrastructure Investment Bank (AIIB) in 2013 enhanced China's competitive position [54]. In response, Japan endorsed the Partnership for Quality Infrastructure and adopted the ISOPS. Thus, Japan has established novel normative principles for quality infrastructure system exports and succeeded in promoting them as global norms in respective documents of the G7 (2016), APEC (2018), and G20 (2019) [52, 55]. Faced with the heightened security risk for energy transition resources in the aftermath of the Russian-Ukrainian War, Japan initiated the institutionalization of international supply chain risk management. In 2023, Japan and other G7 members signed the Resilient and Inclusive Supply chain Enhancement (RISE) initiative. With financial and technological assistance from the World Bank Group (WB), the International Monetary Fund (IMF), ADB, and developed economies, RISE aims to help integrate CRM-rich emerging economies into the global supply chains.

4.3. Japan-EU energy transition cooperation

Japan's Strategy 2050 and the EU's Green Deal aiming at carbon-neutral growth, green jobs, and competitiveness laid the foundation for establishing the Japan-EU Green Alliance in May 2021 [56]. The stepping stones for the Alliance were the EU-Japan Energy Dialogue, the Economic Partnership Agreement (2018), the EU-Japan Strategic Partnership Agreement (2019), and the Partnership on Sustainable Connectivity and Quality Infrastructure (2019). Several partnerships, such as the Japan-EU Digital Partnership (2022), were concluded following the Green Alliance.

Institutionally, the EU-Japan Centre for Industrial Cooperation, the EU-Japan Business Round Table, the Japan Business Council in Europe, and the European Business Council in Japan are channeling the inter-governmental initiatives into technological business collaboration to ensure energy transition and carbon neutrality.

[4]The Kyoto Protocol outlines various mechanisms to facilitate cooperation between developed and developing countries in addressing climate change. One such mechanism is the Joint Implementation (JI) and another is the Clean Development Mechanism (CDM), governed by Article 6 and Article 12, respectively, of the Kyoto Protocol. Under JI, if a country finances a decarbonization project in another nation, the resulting reduction in CO_2 emissions can be credited to the financing country. CDM allows a developed economy to undertake decarbonization projects in a developing country. The developed country then accounts for the resulting CO_2 reductions. Both JI and CDM play pivotal roles in promoting sustainable practices and fostering international collaboration to combat climate change.

[5]JICA considers the inauguration of the guaranteeing mechanisms for enhancing private business engagements in developing economies in 2025.

Given that Japan is one of the EU's closest like-minded partners, the spectrum of technological cooperation is naturally broad to include LNG, renewable (in particular, offshore wind) generation, energy systems integration, energy markets reform, smart grids, energy storage technologies, batteries, renewable and low-carbon hydrogen, industrial decarbonization, CCUS, but also fusion energy, and nuclear safety, decommissioning and innovation. Green financing is also among the areas where the two seek enhanced cooperation.

Additionally, the Japan-EU Green Alliance envisions cooperative schemes for energy transition in third countries. Such schemes imply non-discriminatory participation in low-carbon projects undertaken by Japan and the EU in Asia, Africa, and Latin America. The 2019 Partnership on Sustainable Connectivity and Quality Infrastructure broadened the geography for Japan and EU collaboration to include Central Asia among other regions.

Japan and the EU share energy security concerns, prioritize similar technological solutions for energy transition, and seek greater involvement in energy transition in third countries. Central Asia is a region where the EU and Japan demonstrate an interest in advancing energy transition initiatives.

5. EU and Japan in Central Asia

5.1. EU in Central Asia

The Central Asian countries were not identified in the EU's European Neighbourhood Policy and the Eastern Partnership established for the post-Soviet states. However, the EU effectively extended these frameworks to include them in the concept of Wider Europe launched in 2003. The ground for the EU relations with Central Asia as a region was established in 1995 upon the adoption of a document titled "Towards a European Union Strategy for Relations with the Independent States of Central Asia". In 2007, the EU Strategy for Central Asia emphasized the insecurity and instability in the region and the importance of the EU's aid for the sake of the region's socio-economic progress. The 2007 Strategy also envisioned cooperation in the energy sector and environment. Adopted in May 2019, a new Strategy for Central Asia yet again characterized Central Asia as a fragile region and outlined the EU's mission as the support of the region's development and resilience. The 2019 Strategy titled New Opportunities for a Stronger Partnership outlines the scope of cooperation until 2027, envisioning strengthening regional cooperation in such critical areas as energy, environment, climate change, water, and socio-economic advancements. Following the adoption of the 2019 Strategy, the European Union-Central Asia Platform on Environmental and Water Cooperation was established. In Central Asian countries, the EU has 15 regional initiatives in the areas of environment, biodiversity, climate change, disaster risk reduction, water resources, and sustainable energy and runs 20 bilateral projects.

The EU has been promoting RE investments and facilitating energy transition in Central Asia [57]. Among the recent initiatives by the EU is the Sustainable Energy Connectivity in Central Asia (SECCA) 2022–2026 project. The project is guided by the European Green Deal and the EU's 2019 Strategy for Central Asia and seeks to contribute to strengthening the region's energy resilience, help achieve climate goals, and enhance sustainable development.

Before 2022, the EU positioned itself as pursuing no geopolitical interests in Central Asia [58–60] and focusing on the normative change and transfer of expertise [61]. In the aftermath of the Russian war in Ukraine, the EU started viewing Central Asia geopolitically, seeking to counter-balance other regional players (most of all, Russia and China) and enhance Central Asian regionalism. In October 2022, the EU and Central Asian countries held the first leaders' meeting (an analogue to CA + formats established by Japan, the US, and China). Additionally, CA + Germany summit was launched in September 2023. In January 2024, the European Parliament admitted that its strategy for Central Asia is no longer comprehensive in the face of dramatic geopolitical transformations stirred by Russia's war in Ukraine, increasing securitization of relations with China and other shifts, and outlined an updated vision (Vision) for its new strategy for the region. Central Asia was characterized as a region of strategic interest to the EU in terms of security, connectivity, energy, and resource diversification, among other things. The establishment of efficient trade and energy corridors bypassing Russia is a novel element of the EU's Vision for Central Asia. Additionally, the Vision highlights the significance of individual Central Asian countries for strategic partnerships in the field of CRM, batteries, and renewable hydrogen.

In Central Asia, the EU is most actively engaged in cooperation with Kazakhstan. In 2020, Kazakhstan was the first in the region to conclude the Enhanced Partnership and Cooperation Agreement (EPCA) with the EU. With other Central Asian countries, the EU concluded Partnership and Cooperation Agreements (PCA) in 1999 (Uzbekistan and Kyrgyzstan) and 2010 (Tajikistan). PCA with Turkmenistan was concluded in 1998 but it has not been ratified due to the country's poor human rights records. Joint climate action, cooperation on clean energy, sustainable modernization, and enhanced connectivity are the key areas of the partnerships. With Kazakhstan as a nation possessing substantial deposits of CRM, the EU established additional provisions, such as the Memorandum of Understanding on Strategic Partnerships on Sustainable Raw Materials, Batteries, and Renewable Hydrogen Value Chains (2022).

The EU has been the largest provider of financial assistance, technical expertise through various programs and initiatives, and investment and aid facilitator via the EBRD and the EIB. The EU established closer diplomatic and official contacts with the countries where the European companies had greater business engagement, mainly in extractive sectors. Russia's aggression in Ukraine heightened the EU's security concerns and made Central Asian countries valuable partners. By engaging with the region through the supranational institutions, the EU aims to advance cooperation, including efforts for a green transition. The EU has been fostering the vision for Central Asian regional cooperation [58, 61–63].

5.2. Japan in Central Asia

Launched in 1996, the Silk Road Diplomacy was Japan's "discursive strategy of engagement that largely exists in the realm of narration" [64]. In 2006, Japan adopted the concept titled Central Asia as a Corridor of Peace and Stability, seeing Central Asia as a part of a greater region encompassing the Middle East. In 2004, Japan initiated the Central Asia Plus Japan Dialogue, becoming the first non-regional player to institutionalize cooperation with the entire region. The Dialogue format embraces foreign ministers' meetings, senior officials' meetings, expert meetings, business dialogues, and symposiums (Tokyo Dialogues). As the importance of energy transition and decarbonization agenda has risen, Japan and Central Asian countries held the First Ministerial Economic and Energy Dialogue in September 2023. The Joint Statement highlighted the importance of the energy transition and carbon neutrality agenda for bilateral cooperation, envisioning a role for JCM and PPP in financing the decarbonization projects.

In 2024, Japan concluded the Intergovernmental Memoranda on Energy Transition with Kazakhstan, Uzbekistan, Turkmenistan,

and Kyrgyzstan. Similar accord is considered with Tajikistan. Bilateral cooperation involves available energy sources and technologies, including energy conservation, RE, hydrogen, ammonia, e-fuels, CCUS/ carbon recycling, and high-efficiency power generation technologies. JCM is specified as a framework for implementing bilateral energy transition projects. The JCM under Article 6 of the Kyoto Protocol is the instrument fitting both sides' decarbonization aspirations and contributing towards attaining the NDCs. Japan concluded the JCM projects with Uzbekistan (October 2022), Kyrgyzstan (July 2023), and Kazakhstan (October 2023). Through JCM, Japan improves its NDCs credentials, while Central Asian countries gain access to Japanese decarbonization technologies.

In Central Asia, Japan runs a range of regional and bilateral projects, offering loans, grants, technology transfer, and technical assistance through its national agencies like JICA, Japan Bank for International Cooperation, New Energy and Industrial Technology Development Organization, Japan Organization for Metals and Energy Security, Japan External Trade Organization, Japan Association for Trade with Russia and NIS, to name some. Although the absolute value of Japanese development financing in Central Asian countries is not significant, Japan has been the key donor to Central Asian states from the outset of their independence [65]. Initially, Japan has focused on contributing to the socio-economic development of Central Asian countries [66]. In 2015, the visit of then-Prime Minister Abe signaled the beginning of Japan's resource diplomacy toward the region envisioning resource procurement and infrastructure exports. Responding to the traditional for such scenario government's guarantees and incentives, Japanese businesses activated their engagement in the fossil fuel sector, uranium, and rare earth metals projects. Most recently, Japan has been seeking to join the development of the Central Asian RE sector, providing financing, physical capital, and technological solutions.

Compared to their European counterparts, Japanese companies have been less involved in the hydrocarbon sector in Central Asia. The growing RE sector in Central Asia presents Japanese businesses with the opportunity to excel in green technologies, expand export of equipment with low-carbon footprint, as well as secure a spot in the emerging regional hydrogen industry and CRM supply chains.

6. Comparing EU's and Japan's SETE in Central Asia

6.1. Ideas and norms

At the outset of the Central Asian countries' challenging post-Soviet transformation, the EU had justified concerns about security in the region. The ODA was employed to alleviate the populace's dearth of essentials and suffering amidst the collapsing obsolete socio-economic order. As hydrocarbon exports started fueling economic growth in Kazakhstan and Turkmenistan, the EU refocused its ODA programs to less prosperous Tajikistan, Kyrgyzstan, and Uzbekistan.

The Green Deal ushered in new ideas for the EU's cooperation with Central Asia, emphasizing *justice* as a norm to govern the EU's SETE in the region. The 2021 Global Gateway highlighted the EU's new ideas for better *connectivity* and mapped Central Asia as a new geographical priority. The idea of improved intraregional connectivity resonates well with Central Asian countries. While they face energy shortage, electricity trading across the Soviet-era CAPS covers only around 2.5% of the concerned countries' electricity demand and equals about 40% of the CAPS capacity.

Similar to the EU, Japan's inroads into the region began with the ODA, with the focus shifting over time to lower income Tajikistan, Kyrgyzstan, and Uzbekistan. Resource-rich Kazakhstan absorbed the majority of Japanese FDI. Following the adoption of decarbonization agenda domestically, Japan turned energy transition into a core element of its aid and resource diplomacy. This shift provided Japan with the opportunity to advocate the *quality* and *security* of energy transition resources as the new norms underlying energy transition cooperation.

The ideas and norms underpinning the EU's and Japan's domestic energy transition reveal certain complementarity. In their own right and together, the EU and Japan encourage greater intraregional cooperation and interconnectivity across Central Asian energy systems. Central Asian governments need to address a raft of social, economic, technical, technological, and environmental aspects of energy transition, and they are interested in supplementing national capabilities and resources with those offered by the EU and Japan.

6.2. Institutions

Energy transition in Central Asia is enhanced by these countries' engagement with global, multilateral, and bilateral institutions. Central Asian countries exhibit commitment to the pursuance of energy transition; they refine their RE policies and tighten NDCs (Table 1).

In addition to global frameworks, such as the Kyoto Protocol and the Paris Agreement (Table 2), Central Asian countries join specific frameworks. In 2023, Kazakhstan, Kyrgyzstan, Turkmenistan, and Uzbekistan signed the Global Methane Pledge promising a 30% methane emissions reduction from 2020 levels by 2030. A coal-dependent Kazakhstan also voiced its intention to join the JETP framework targeted at the provision of financing for coal-dependent emerging economies. Decarbonization priorities have also been exhibited at the company level: KazMunaiGas and Uzbekneftegaz, Kazakhstani, and Uzbek state-owned companies, respectively, joined the Oil and Gas Decarbonization Charter at the COP28 in 2023.

The EU and Japan established frameworks to engage Central Asian countries in cooperation for the energy transition. In comparison, the EU has a more pronounced regional approach and potentially stricter environmental conditions. The EU promotes the development of regulatory frameworks and policies conducive to a just energy transition, aligning them with its supranational energy policies and directives and attaching stricter environmental requirements to the aid. The decarbonization agenda is embedded in the logic of the EU's EPCAs/ PCAs with the Central Asian countries.

Both the EU and Japan pursue energy transition agenda for Central Asia upon a two-tier – intraregional and bilateral – institutional network. Spheres for intraregional cooperation for energy transition are inspired by the EU's 2021 Global Gateway Strategy and detailed by the Team Europe Initiatives on Water, Energy, and Climate Change. The content of bilateral climate and energy cooperation with each Central Asian country is formed by a respective Multiannual Indicative Programme 2021–2027. Other frameworks vary by country and include what the EU calls flagship initiatives. Among country-specific energy transition frameworks, there is a Strategic Partnership in the Field of CRM, Batteries, and Renewable Hydrogen with Kazakhstan, which is signed by both the EU and Japan. The EU and Japan have a history of cooperation with hydrocarbon-rich Kazakhstan and smaller scope of involvement in similar sectors in Uzbekistan and Turkmenistan. The European and Japanese companies' engagement in conventional energy in these countries adds momentum to modern decarbonization-centered cooperation.

Table 1
Key parameters of decarbonization policies in Central Asian countries

Country and year of most recent NDC submission	Version of NDC	Period	Emission reduction target by 2030	Base year	Renewable energy target	Scope of document
Kazakhstan	2nd, 27/06/2023	2021–2030	15%^{u} 25%^{c}; carbon neutrality by 2060	1990	RE electricity 15% by 2030; with hydropower & nuclear 30% by 2030 & 50% by 2050	comprehensive & concise (15-page document analysis by sector; nexus approach; link to SDGs; R&D, gender, vulnerable groups' aspects; etc.)
Kyrgyzstan	2nd, 09/10/2021	2017–2050	15.97%^{u} 43.62%^{c}; carbon neutrality by 2050	2017	10% of total final supply (year unspecified); development of solar and wind is mentioned to reduce emissions	comprehensive (43-page document, analysis by sector; nexus approach; link to SDGs; technology, gender, vulnerable groups' aspects; etc.)
Tajikistan	2nd, 12/10/2021	2021–2030	30–40%^{u} 50–60%^{c}, carbon neutrality by 2037	1990	10% in generation by 2030; development of solar is mentioned as a priority	comprehensive (37-page document, analysis by sector; nexus approach; treatment of waste; gender aspects; etc.)
Turkmenistan	2nd, 30/01/2023	2021–2030	20%	2010	benefits of RE are mentioned vaguely	verbose (70-page document lacking concreteness)
Uzbekistan	2nd, 30/10/2021	2021–2030	35% GDP's emission intensity by 2030; carbon neutrality by 2050	2010	40% (small-scale hydropower plants included)	comprehensive (31-page document; link to SDGs; etc.)

Note: Superscripts u and c stand for unconditional and conditional NDCs, respectively; SDG – Sustainable Development Goals adopted by the United Nations member states in 2015.

6.3. Technological cooperation

The EU and Japan offer technological transfer and capacity-building programs to enhance local capabilities for sustainable energy development in Central Asian countries. Yet, the level of technological advancement is one of the most serious impediments to energy transition in Central Asian countries (Table 3).

Central Asian economies depend on what can be broadly defined as technology transfer [67]. This situation might potentially shape certain technological lock-ins, such as dependency on specific technological processes, technical solutions, equipment, and spare parts, and, hence, it could weaken national technological security. To enhance their technological capabilities, Kazakhstan and Uzbekistan have endorsed local component requirements (LCRs). However, in addition to contradicting the World Trade Organization principles, LCR proved to be difficult to attain in practice. For instance, Kazakhstan enacted the LCRs for PV solar projects seeking to boost the participation of a domestic solar PV module manufacturing facility. However, the national undertaking was futile for domestic components were unable to compete with Chinese modules despite the state's stimuli [68].

Among many important elements, energy transition requires specifically trained human resources. The Central Asian education systems reveal the symptoms of the "carbon lock-in and stranded skill sets" [69]. In this regard, the creation of Japan Digital University (JDU) in Uzbekistan in 2020 is an innovative move. Not only does the JDU offer a fully online IT-centered study program to over 600 students in Uzbekistan but also it breeds students through hands-on training during the study and on-the-job training in Japan after graduation.

While the EU's and Japan's technological priorities reveal a certain degree of compatibility for hydrogen and CRM, the Central Asian countries are well poised to be integrated into energy transition resources value chains (Tables 4 and 5) [70, 71]. Also, carbon-intensive Central Asian countries, particularly Kazakhstan, are interested in Japanese CCUS technologies.

6.4. Energy transition financing

As developing economies, Central Asian countries have a shortage of domestic financial resources to spur energy transition. At the same time, they are ranked lowly in terms of their attractiveness for RE investment (Table 6). Therefore, development financing has been one of the major levers to fund RE projects in the region.

The EU and Japan are employing the ODA mechanisms to finance Central Asian green projects. The CDM under the Kyoto Protocol is another financing tool. For Japan, JCM remains one of the major tools for green financing of emerging economies. As discussed above, ASEAN countries remain a geographical priority for Japanese green development financing and only recently has Japan signed JCMs with Uzbekistan, Kyrgyzstan, and Kazakhstan. However, the CDM lost its appeal to the European companies after the EU decided to stop accepting CDM emission reduction certificates for the European Trading System. Also, Japan and the EU utilize the GCF framework, although it is criticized for its modest role in green financing [72]. The EU and Japan typically operate through EBRD, EIB, ADB, JICA, and other entities when providing grants, direct capital investments, concessional debt, and guarantees.

The EU and Japan are already partnering in several JETPs. The JETP seems to be a viable framework to combine the EU and Japan's green financing efforts. Given that Central Asia was listed among the

Table 2
Central Asian countries' engagement with global climate change institutions

	Kyoto protocol		Paris agreement	
	Signed	Ratified	Signed	Ratified
Kazakhstan*	12 March 1999	19 June 2009	2 August 2016	6 December 2016
Kyrgyzstan		13 May 2003	21 September 2016	18 December 2020
Tajikistan		29 December 2008	22 April 2016	20 March 2017
Turkmenistan	28 September 1998	11 January 1999	23 September 2016	20 October 2016
Uzbekistan	20 November 1998	12 October 1999	19 April 2017	9 November 2018

Note: * Kazakhstan applied to be added to Annex I of the Kyoto Protocol in 2000, but the approval is pending. Kazakhstan pledged to cut emissions by 5% by 2020 from their 1990 levels.

Table 3
Frontier technology readiness index, score/ rank, 2023

	Kazakhstan	Kyrgyzstan	Tajikistan
Total	0.6/ 68	0.3/ 113	0.2/ 149
ICT	0.5/ 82	0.4/ 107	0.1/ 160
Skills	0.7/ 36	0.4/ 103	0.3/ 118
R&D	0.3/ 69	0.1/ 119	0.1/ 140
Industry Activity	0.6/ 69	0.5/ 111	0.4/ 138
Access to Finance	0.5/ 124	0.5/ 113	0.4/ 151

Note: There is no data for Turkmenistan and Uzbekistan.

Table 4
Central Asian countries' hydrogen production potential

	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Production Potential by 2040, Mt/ y	2.56	0.15	0.20	5.76	2.09
Optimal Technology	SMR + CCUS, electrolysis + RE	electrolysis + RE	electrolysis + RE	SMR + CCUS	SMR + CCUS, electrolysis + RE

Note: SMR – steam methane reforming; CCUS – carbon capture, utilization, and storage.

Table 5
Critical raw materials endowment in Central Asia

Type of critical material	Primary use in clean energy technologies	Central Asian countries' reserves	Share in global reserves, %	Central Asian countries' production	Share in global production, %/ rank
manganese	wind, EVs	Kazakhstan, Tajikistan	38.6	Kazakhstan	3.16/ 9
chromium	CSP & wind	Kazakhstan	30.1	Kazakhstan	12.73/ 2
zinc	wind, solar & CSP	esp. Kazakhstan, Tajikistan	12.6	Kazakhstan, Tajikistan, Uzbekistan	5.71/ 6
aluminium	electricity networks	esp. Tajikistan, Kazakhstan	5.8	Kazakhstan (bauxite) Kazakhstan, Tajikistan (aluminium)	1.87/8 0.57/ 22
copper	solar, CSP & wind, EVs, battery storage	esp. Kazakhstan, Uzbekistan, Kyrgyzstan	5.3	Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan	4.29/7
silver	solar	esp. Tajikistan, Kazakhstan, Uzbekistan	1.2	Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan	4.98/ 7
cobalt	EVs	esp. Kazakhstan	5.3		
nickel	wind, EVs	esp. Kazakhstan	1.2		
lithium	EVs, battery storage	esp. Kazakhstan, Kyrgyzstan	0.4		
graphite	EVs, battery storage	esp. Uzbekistan, Kazakhstan	0.3		

Note: CSP – concentrated solar power; EVs – electric vehicles.

Table 6
Attractiveness for RE investment

	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Total score (5 max)/ Rank (out of 105)	2.47/ 11	1.44/ 90	1.33/ 95	0.54/ 105	1.86/ 59
Fundamentals	3.46	2.07	2.19	0.80	2.22
Experience	1.24	0.90	0.05	0.00	2.16
Opportunities	1.73	0.74	0.88	0.57	0.86

prospective regions for the EU-Japan energy transition cooperation, it appears rational for the parties to step up their effort towards JETP with the countries in the region. Heavily coal-depended Kazakhstan is poised to be the first candidate for the JETP in Central Asia.

Regional green financing has only started developing in Central Asia with the support of the international development banks (EBRD and ADB, in particular). The forerunner here was Kazakhstan. It founded the Green Finance Centre (GFC) at the Astana International Finance Centre in 2018 to foster green financing domestically and regionally. The GFC is the first company in Central Asia accredited by the International Capital Markets Association. In 2020, the first two green bond issuances were placed on the Astana International Exchange and Kazakhstan Stock Exchange. The GFC facilitated the creation of the Bishkek GFC and the issuance of the first green bonds in Kyrgyzstan in 2023. Uzbekistan placed its first green Eurobonds on the London Stock Exchange in late 2023. Importantly, when developing a regulatory environment for green financing, Central Asian countries refer to the EU's experience. Such are the examples of green taxonomies adopted in Kazakhstan and discussed in Kyrgyzstan and Uzbekistan, and reporting on environmental, social, and governance impacts enacted in Kazakhstan and Kyrgyzstan.

7. Conclusions, Policy Implications, and Limitations

The ETDs of the EU and Japan reveal similarities. As formulated in respective programmatic documents, their ETDs endorse such objectives as ensuring economic growth, industrial revival, and securitization of energy transition resources. While the EU and Japan possess competitive advantages in decarbonization technologies and financing, they lack energy transition resources. Consequently, both have been mastering relevant ETD tools.

The EU and Japan acknowledge the potential of normative power and attempt to promote their respective ideas into the international norms to influence the global energy transition pathway and secure their businesses' positions in the global economy. Examples of such EU's initiatives for setting international norms include such regulations as the CBAM, the Methane Emissions Reduction Regulation, the Regulation on Deforestation-Free Products, the Corporate Sustainability Reporting Directive, the Corporate Sustainability Due Diligence Directive, etc. [15]. Also, the EU eloquently defends the incorporation of the norm of justice, advocating just energy transition as one of the democratic values. In turn, Japan concentrates on promoting two ideas traditionally important for the domestic and international contexts – quality and risk management. Japan succeeded in promoting these ideas into respective international norms for high-quality export infrastructure projects and international supply chain risk management. Importantly, the two parties demonstrate mutual support for each other's norm-creating efforts.

The EU's and Japan's ETDs are influenced by their ODA models and have clear geographical foci on their former colonies. In specific economic and geopolitical contexts in third countries, the EU's and Japan's ETDs transform into specific SETEs adhering to promoted ideas and norms, multi-level institutions, prioritized green technological solutions, and employed green financing mechanisms.

The EU and Japan share similar challenges in energy transition and decarbonization and reveal a growing complementarity of their visions for energy transition [73, 74], including cooperation in Central Asian countries. While the EU's normative power exercises through the calls for democratic transformations in Central Asian countries are not well-received by the regional political regimes, Japan's pragmatism-driven approach is appealing to Central Asian governments, who value the virtues of (neo)Confucian capitalism and find relevant the conceptions of developmental state. Coordinated efforts in Central Asia may serve the interests of all sides.

This study produced evidence of the existing and increasing synergy of the EU's and Japan's ETDs and SETEs for the case of Central Asia. The principal policy implication is that energy transition becomes one of the key spheres for bi- and multilateral cooperation among nations belonging to the so-called Global North and Global South groups, aiming towards efficient institutions and effective technological and financing solutions.

This paper's contribution is two-fold. First, it proposed the concept of SETE and applied it to a relatively under-researched theme of energy transition facilitation by advanced economies in emerging economies. Second, the study focused on the case of the EU's and Japan's activities in Central Asia, thus, contributing to research on a comparatively unexplored but increasingly important region of Central Asia.

The limitations of this study originate from a generic approach to Central Asia. While the proposed concept of SETE possesses explanatory power, it may be more effective when applied to "a country-owner of SETE – a country-host of SETE" framework as opposed to "a supranational SETE – a region host of SETE" scope. As the Central Asian countries' energy transition pathways are dissimilar [21, 31, 32], more nuanced research on individual states' energy transition cooperation with the EU and Japan separately can generate more practically valuable policy insights.

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Conflicts of Interest

The author declares that she has no conflicts of interest to this work.

Data Availability Statement

The data that support the findings of this study are openly available in United Nations Climate Change at https://unfccc.int/NDCREG, in United Nations Climate Change at https://unfccc.int/node/61095, in

United Nations Trade and Development Data Hub at https://unctadstat.unctad.org/datacentre/dataviewer/US.FTRI, in Climatescope by Bloomberg NEF at https://www.global-climatescope.org.

Author Contribution Statement

Elena Shadrina: Conceptualization, Methodology, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition.

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