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# Promotion of RES in a Technology Transfer Network. Case Study of the Enterprise Europe Network

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**Abstract:** The promotion of renewable energy is a key concept in the European Union for both environmental and economic reasons. It contributes to securing the objectives set out in the Kyoto Protocol. In addition, it brings various social and economic benefits, e.g., diversification of the energy offer, new jobs, improvement of regional and local development opportunities and building a solid national industry. The main purpose of the article is to contribute to the debate on the instruments promoting renewable energy sources (RES) by emphasizing its importance within the technology transfer network. The subject is an empirical study of an actual technology transfer network. Its international activity promotes RES among entrepreneurs. Data related to meetings as part of brokerage events (BE) and company missions (CM) were subject to statistical and visual analysis, based on the data obtained from the Enterprise Europe Network from the years 2017–2018. The presented results are the foundation for future theoretical and practical studies. One of the important aspects to be examined is the intensity of cooperation launched during CM and BE. It is related to the results of partnership agreements and the importance of increasing the knowledge flow and creating opportunities for partners to acquire foreign technologies.

**Keywords:** RES; company mission; brokerage events; cooperation; network

## 1. Introduction

In a situation where the advancement of new sustainable technologies is key to tackling the challenges related to the climate and environment in the 21st century, these technologies face significant development and implementation obstacles. One of the reasons is that technologies are usually associated with dominant business models, value chains, industry standards and certain institutions [1]. Therefore, the transition to more sustainable production methods often requires relatively long development periods. This is because technology-specific business networks, value chains, institutions, etc., must be introduced and adapted to the emerging technologies. This means that a sustained technological change can potentially be affected by a number of market, systemic and institutional

shortcomings [2]. This, in turn, requires adopting an innovation policy based on a blend of multi-faceted political interventions [3–5]. For example, it has long been known that to stimulate innovation, it is necessary to combine technology-driving and promotion instruments that attract demand.

Energy relates to both the political and economic elements of international business relations. Therefore, it is one of the basic instruments for launching, maintaining and strengthening the existing regional partnership programs [6]. The lack of information on mutual credibility and preferences significantly hampers cooperation [7,8]. In this perspective, seeking formal, semi-formal or informal cooperation with regional institutions of the partner countries is a practical way to reach improved energy integration. In order for the economy to develop, including the RES market, it needs an institutional environment that will enable and support market activities. Shirley [9] divides the institutions into two sets, not necessarily complementary. The first group includes the elements of support that facilitate market exchange by reducing transaction costs and increasing confidence. The second group were the elements that strengthen private ownership and individual freedom, rather than use and subordinate them to the centralized state power. In order for the process of economic development to be sustainable, political institutions must be transformed along with the socio-economic climate. Hence, the institutional support system for market processes plays an important role by inducing development and promotion of RES in the economy. Sanderink and Nasiritousi [10] have shown that institutional interactions can increase the effectiveness of institutional partnerships for renewable energy.

Progress trends in highly developed countries demonstrate that building [11] a competitive edge based on R&D research results and the exploitation of scientific and technical progress can guarantee long-term, sustainable development [12–14]. The high level of innovation in energy and environmental technologies improves the competitiveness of economies and minimizes the negative impact of man's activities on the environment, also by reducing emissions of greenhouse gases [15–18]. Therefore, achieving the sustainable development goals, i.e., a low-carbon and environmentally friendly economy, requires support of activities that popularize and promote energy technologies.

When the Directive 2018/2001 on the promotion of the use of energy from renewable sources (“RED II Directive”) entered into force, a new, prospective framework was established. Its purpose was to achieve the set target of at least 32% of RES energy in EU's total gross energy consumption by 2030. These new frameworks are based, e.g., on the commitment of Member States to use the 2020 targets as the foundation for their targets for the next decade. Other parts of the Clean Energy for All Europeans package complement the framework [19]. The European Union is also a leader in applying various renewable energy technologies in their supply chains. For some technologies, e.g., wind turbines, the EU producers represented at least 41% of the 2016 annual global installed capacity [20]. EU producers are also global leaders in the EU photovoltaic (PV) sector, with a 50% share of the market. The share of EU inverter producers in the global market exceeds 18% [21]. Through the financial mechanisms of the HORIZON 2020 program, the EU finances a number of projects aimed at developing and popularizing innovative RES solutions. For instance, FracRisk was an EU-funded project aiming at improving the understanding of potential environmental impacts of shale gas exploration by hydraulic fracturing [22,23].

The establishment of international climate policy facilitate decentralized energy production and constant growth of RES technology markets [24,25]. This market growth is supported, e.g., by international and EU policies on renewable energy production, EU directives on the growing competition in the electric power industry and the growing prices of fossil fuels. Local energy production increases energy efficiency due to lower transportation or transfer losses, as well as supports local business [26]. Production of energy from local waste reduces waste management costs, thus enabling other local businesses to emerge and offer new jobs. By reducing dependence on imports, local energy production also increases power and fuel security [27].

The promotion of renewable energy is a pivotal concept in the European Union both in terms of the environment, and economy. It supports securing the objectives set out in the Kyoto Protocol

and brings various social and economic benefits. These are, e.g., diversification of the energy offer, new jobs, improvement of regional and local development opportunities and building a solid national industry [28]. The carbon capture and storage (CCS) technology transfer model was described by Liu and Liang [29]. The authors built a four-stage model including physical transfer of non-confidential technologies, the financial mechanism, as well as building endogenous capacity and the mechanism of monitoring. Seres et al. [30] took up the topic of technology transfer in Clean Development Mechanism (CDM) projects, demonstrating that technology transfer is more common in larger projects and in projects including exchange of knowledge and technology with foreign partners. However, any technology transfer requires promotional activities to enhance its effectiveness. In the literature to date, the authors have identified a research gap in RES technology promotion within technology transfer networks, especially financed from public EU funds. The article in question fills the gap by analyzing independent actions, often dispersed, but undertaken for the same purpose, i.e., promoting RES among entrepreneurs.

The main purpose of the article is to contribute to the discussion of the instruments promoting renewable energy sources (RES) by emphasizing their importance within the technology transfer network.

## 2. Materials and Methods

The analysis presented in this paper is carried out by means of an actual technology transfer network. Its international activity promotes RES among entrepreneurs. The subject is the European Enterprise Network (EEN) created in 2008 by the European Commission. It can be seen as an instrument in EU's strategy for economic growth. The EEN is an EU initiative supporting business innovation in Europe's small and medium-sized enterprises (SMEs). The EEN is the largest global network supporting business and innovation. Currently, it comprises 625 partner organizations located in over 60 countries. Over 4000 internationalization experts and technology transfer practitioners offer a wide range of entrepreneurship support and innovation services for enterprises, including business missions (CM) and brokerage meetings (BE) [31,32]. Data related to meetings as part of brokerage events (BE) and company missions (CM) were subject to statistical and visual analysis, based on the data obtained from the Enterprise Europe Network (EEN) from the years 2017–2018.

One of the main anticipated results of the EEN is to increase the connectivity of SMEs to other entities across Europe for international business cooperation, technology and knowledge transfer, as well as innovation partnerships.

As a unique exchange platform for innovative technologies, CMs facilitate establishing direct contacts, initiating and establishing new, industry-specific business partnerships. CMs are the low-cost, direct form of reaching the right potential business partner in their natural environment and allow to get acquainted not only with their offer but also their immediate business and legal environment. In turn, a BM is a quick and direct form of seeking a cooperation partner. It provides an opportunity to exchange information on innovative technologies and new trends, as well as to search for business and technology partners. Prior to the event, BE participants choose their partners for direct B2B meetings, according to the type of cooperation sought [33–35]. Table 1 presents the CE and BE meetings carried out by the EEN between 2017 and 2018. The events were organized according to:

1. Keywords related to the technologies characterizing the event's theme.
2. The event's location (the spatial characteristics), with the country marked, but please note that the fair and exhibition events took place in large urban centers.

**Table 1.** List of company missions (CM) and brokerage meetings (BM) topics in respective countries in the years 2017–2018. Source: own study.

No.	Country	Technology Keywords of the Studied Company Missions	Technology Keywords of the Studied Brokerage Meetings
1.	Austria	Renewable sources or energy; solid biomass; biogas and anaerobic digestion; bio-refineries for energy	Low, zero and plus energy rating; energy management
2.	Belarus		Energy management
3.	Belgium	Energy efficiency; renewable sources of energy	Energy efficiency; renewable sources of energy; wind energy; installations related to construction (energy, lighting); solar/thermal energy
4.	Bosnia and Herzegovina		Renewable sources of energy; geothermal energy; wind energy; biomass; hydropower; energy from wastewater; energy production, transmission and conversion; photovoltaics; solar/thermal energy
5.	Brazil		Energy management
6.	Bulgaria	Energy conservation related; alternative energy	
7.	Chile	Energy production, transmission and conversion;	
8.	China	Waste to energy-other; biomass and biofuels; energy efficiency	Renewable sources of energy; alternative energy
9.	Croatia	Energy production, transmission and conversion	Energy management; energy efficiency; clean production/green technologies;
10.	Cyprus	Energy efficiency	
11.	Czech Republic		Energy efficiency
12.	Denmark	Energy efficiency	Combined heat and power (CHP) (Co-generation); Other alternative energy; CHP engines; renewable sources of energy; energy supply system; energy production, transmission and conversion
13.	Finland		Photovoltaics; marine energy
14.	France	Solar/Thermal energy; renewable sources of energy;	Energy efficiency; wind energy; waste to energy/resource; waste to energy-other; geothermal energy; clean production/green technologies; solid biomass; energy from wastewater; photovoltaics; integrated waste-energy processes;
15.	Germany	Solar/Thermal energy; energy management; renewable sources of energy; other energy topics; energy production, transmission and conversion	Energy management; wind energy; renewable sources of energy; chemical technology and engineering; other energy topics; energy efficiency;
16.	Greece	Energy production, transmission and conversion	
17.	Iceland		Energy efficiency; geothermal energy
18.	India	Renewable sources of energy	

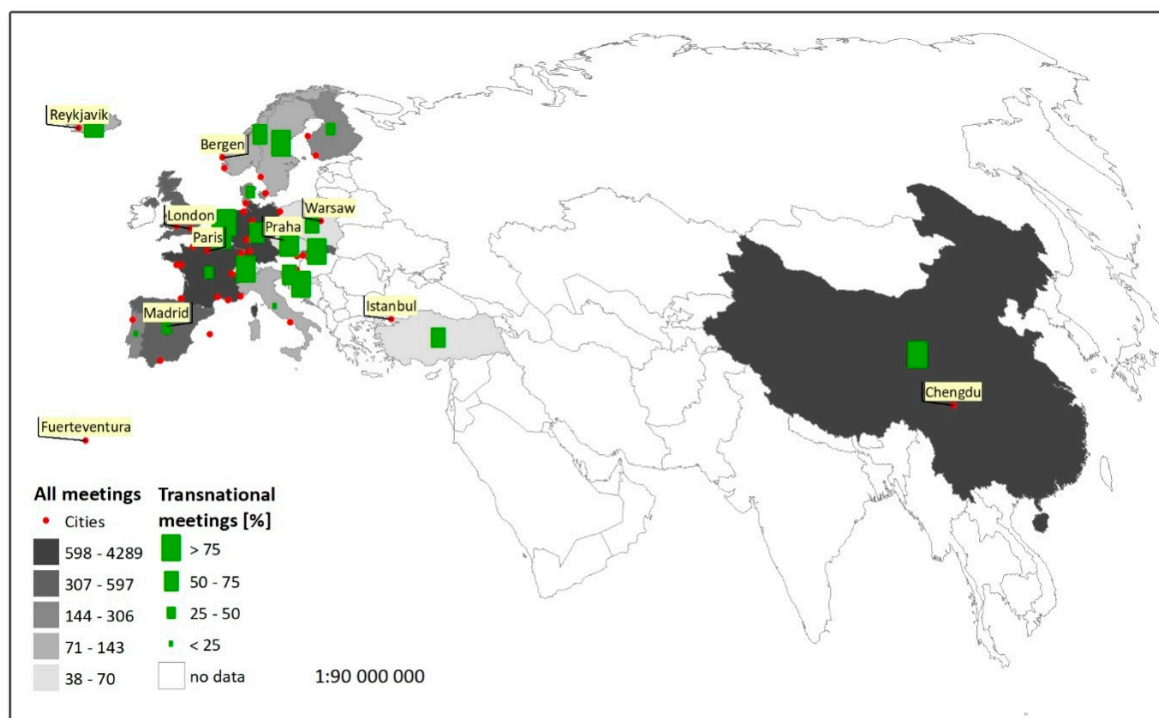
Table 1. Cont.

No.	Country	Technology Keywords of the Studied Company Missions	Technology Keywords of the Studied Brokerage Meetings
19.	Italy	Renewable sources of energy;	Renewable sources of energy; energy production, transmission and conversion; energy efficiency;
20.	Lithuania	Renewable sources of energy; solar/thermal energy	Renewable sources of energy; energy production, transmission and conversion;
21.	Luxembourg		Renewable sources or energy; energy production, transmission and conversion;
22.	Moldova		Renewable sources or energy; energy production, transmission and conversion;
23.	Netherlands	Solid biomass; bio-refineries for energy; photovoltaics; waste to energy	Photovoltaics; solar/thermal energy; wind energy
24.	Norway	Fuels and engine technologies; hydropower; energy efficiency;	Renewable sources or energy
25.	Poland	Photovoltaics; renewable sources or energy; energy efficiency	Renewable sources or energy; energy production, transmission and conversion
26.	Portugal		Renewable sources or energy; energy production, transmission and conversion
27.	Romania	Solid biomass; biogas and anaerobic digestion; integrated waste-energy processes;	Renewable sources or energy; geothermal energy; other energy topics; solar/thermal energy;
28.	Russia	Renewable sources or energy; other energy topics; energy efficiency;	
29.	Serbia	Renewable sources or energy;	
30.	Slovakia	Renewable sources or energy	Renewable sources or energy
31.	Slovenia	Energy efficiency; fuels and engine technologies; geothermal energy; energy management; wind energy	Energy efficiency; fuels and engine technologies; geothermal energy; energy management; wind energy
32.	Spain		Renewable sources or energy; other energy topics; energy efficiency
33.	Sweden		Renewable sources or energy; biogas and anaerobic digestion (AD); energy production, transmission and conversion; energy efficiency
34.	Switzerland		Renewable sources or energy
35.	Taiwan	Photovoltaics	
36.	Turkey	Renewable sources or energy	Fossil Energy Sources; renewable sources or energy; other energy topics; biogas and anaerobic digestion (AD); energy production, transmission and conversion; energy efficiency
37.	Ukraine		Renewable sources or energy
38.	United Kingdom	Wind energy	Renewable sources or energy

The table is a point of reference for the analysis, which aims to fully illustrate the qualitative variables, i.e., the factors determining the selection of RES promotion tools by the centers of the Enterprise Europe Network. The EEN centers choose the topics of their meetings independently,

according to the needs of their clients. As demonstrated in Table 1, topics related to RES are very popular among entrepreneurs, which prompts the event organization. The proximity of international trade fairs also has a huge impact on the organization of BM, as they are usually organized as accompanying events. Every year, EEN centers report on their activities, e.g., on the number of BM organized, their participants (clients), the number of meetings held by these clients and the number of partnership agreements (PA) signed as a result of the BM. The above are the foundation of the MB effectiveness assessment, and a potential follow-up in the future.

The maps visualizing the results were created with the ESRI software ArcGIS 10, the graphs-in-Microsoft Excel program. Maps present simple cartograms of all analyzed meetings (all brokerage events and company missions). Meetings of the same type and taken place in the same country, were summed up and divided into 5 classes. The classes were calculated with the quantile method, i.e., each class included an equal number of objects in one class (meetings), and no class was empty. This visualization method was used due to the large linear dispersion of the data. Moreover, the transnational meetings of each type were presented as a percentage of all meetings and divided into 3 or 4 classes, manually, with the use of the expert method, in the way for the best presentation of the data. Both figures show the Euroasian continent but on the Figures 1 and 2, Chile is in the large scale map as the only country outside Euroasia where meetings took place. The cartographic method aims only to visualize data, this is not a statistical or analytical method. However, it is proved that visualization, except the obvious benefits also helps the interpretation of data. This is also the case here.



**Figure 1.** All brokerage event meetings, in a global perspective, including transnational.

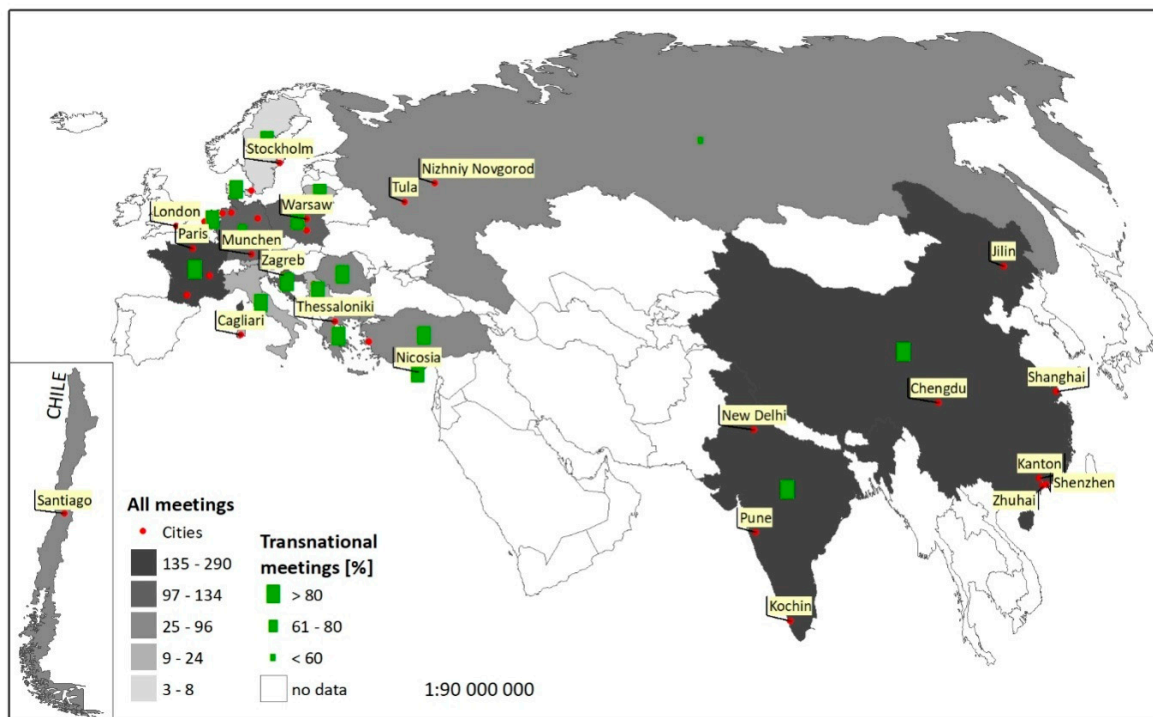


Figure 2. All company mission meetings, in a global perspective, including transnational.

### 3. Results and Discussion

In the course of the research it was found that in the analyzed period there were 12,769 BE meetings and 1922 CM meetings, taking place in 47 and 36 cities around the world, respectively. In some cases, these meetings were held at the same time in two or several cities. For example, the Smart cities trade delegation took place at the India–UK Tech Summit, in New Delhi, Pune and Kochi (India), or the French SMEs Delegation to China took place in Shanghai, Chengdu, Shenzhen, Canton and Zhuhai. Apart from European countries, these meetings took place in Chile, China and India, as illustrated in Figures 1 and 2.

Most of the meetings, both BE and CM, were international (63% and 89%, respectively). Thematic maps with bar diagrams in Figures 3 and 4 also present the percentage of transnational meetings (in the total number of meetings), per every country where they took place. These data are highly dispersed (greater for BE) and range from 12% to 100% for BE and 50% to 100% for CM. Most BE meetings took place in France (4289). They were associated with energy efficiency; waste to energy; low, zero and plus energy rating and environmental engineering (wind, marine and alternative energy). Also, many took place in Germany (2814) and Belgium (1437). The fewest meetings were held in the Czech Republic (38), Croatia (44), Switzerland (45), Poland (70) and Turkey (70). CM meetings took place mostly in the United Kingdom (439) and France (290). They were associated with energy conservation and wind energy in the UK, as well as with PV/thermal energy, energy for transport, pollution and recycling, oil and gas exploration and production in France.

There are four qualifications: (1) insufficient interest, no further contact is planned; (2) very informative, but no cooperation is planned; (3) cooperation is possible; and (4) cooperation has already been agreed. Upon analyzing the charts, it can be observed that the largest percentage of BE meetings concluded with the lack of further contact in Switzerland (27%) and the lack of further cooperation in Croatia (23%). However, countries such as Switzerland, Croatia, Sweden, Slovenia and Poland considered further cooperation possible in over 30% of cases. Finland was the only country that agreed to cooperate on a larger scale (11%). CM meetings were characterized by a significantly higher percentage of no further cooperation, as well as of possible cooperation, or agreed cooperation.

For example, in the UK, “Insufficient interest” or “No further contact planned” were indicated in 72% of cases, while in Chile—30%. A high percentage of “No cooperation planned” responses was also noted for Denmark—67%, Sweden—50%, Chile—42%, Romania—41%, Cyprus—38%, Poland—29%, Greece—29%, UK—28%, and “Further cooperation is possible” was indicated by Denmark in 33%, Italy—42%, Serbia—54%, Croatia—56% and Romania—58%. In Serbia, 25% of meetings ended with a consent for further cooperation and in Sweden, as much as 50%. Please note that the participants of CM and BE were both representatives of the public administration, as well as business, especially the micro, small and medium-sized sector. The percentage of answers regarding possible cooperation and consent for further cooperation confirms the active search for new partners in enterprises operating in the RES sector, as well as the access to knowledge and necessary technologies.

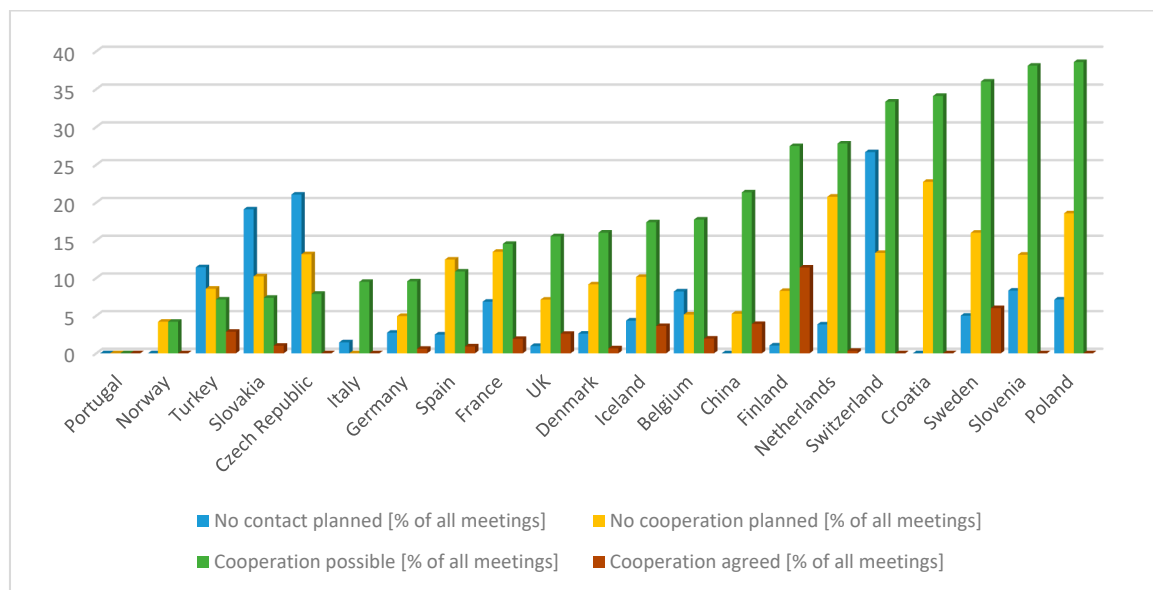


Figure 3. Further cooperation possibilities following brokerage events, in all countries.

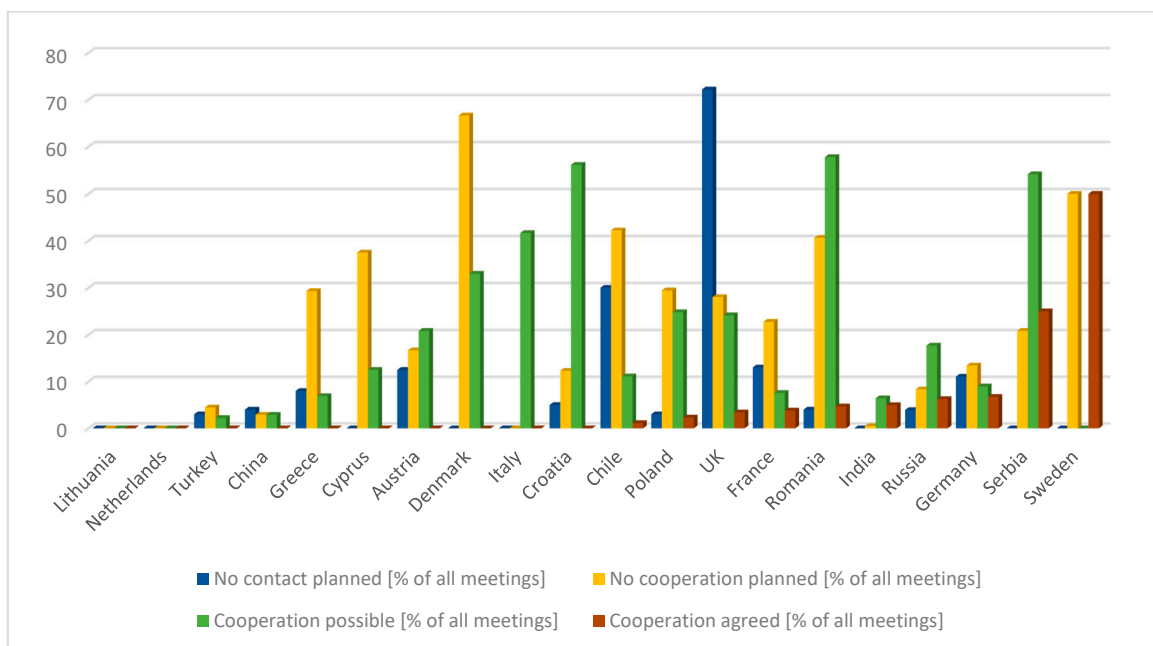


Figure 4. Further cooperation possibilities following company missions, in all countries.



According to Eurostat [36], in 2018 Denmark achieved a 36.1% RES share of its national energy mix, exceeding its national target for 2020 by 6.1 percentage points. Lithuania was in a similar situation, reaching 24.4% against the national target of 23%. Austria achieved a 33.4% RES share in its national energy mix in 2018 against a 34% target for 2020. In 2018, Luxembourg came very close to its target set at 11%, increasing the share of RES from 6.4% to 9.1% in the years 2017–2018. However, the country's authorities have already started negotiations with e.g., Lithuania, from which they want to buy back the missing “virtual” volume of green energy in order to fulfil their commitment for 2020. Spain was 2.6 percentage points short of its 20% target in 2018, while in Ireland the situation was much worse, with 11.1% of the national target of 16% achieved.

Upon analyzing the range of technologies presented during BE and CM, it has been deemed necessary to demonstrate the associations and cooperation between the host countries. At the initiative of Lithuania, and with support of Poland, Latvia, Austria, Estonia, Greece, Luxembourg and Spain, the countries have appealed to the European Commission to take action to achieve the sustainable development objectives set out in the so-called European Green Deal [37]. Renewable energy sources, especially wind- and sun-based, will play a key role in achieving EU's climate neutrality. It has been pointed out that one of the most important tasks will be to build the main elements of this system (including the supply system) in Europe. This will not only achieve the climate goals, but will also bring economic benefits to the Old Continent. The signatory states postulate that wind and sun, as well as green energy storage technologies should become the main investment elements of European green governance.

Increased investment in sustainable energy sources is also the result of China's active participation in international life. As a signatory of the 2016 Paris Agreement, China has committed to increase the share of sustainable energy in the overall consumption model to 20% by 2030 [38]. Joining the agreement has forced China mainly to re-evaluate the current model of energy economy and introduce significant changes. Apart from investments, China is also looking for foreign markets for “green” technologies. Europe's potential partner may be Central Asia, which lacks sufficient infrastructure, despite a huge potential related to its geographical conditions. The Chinese have become leaders in the world's solar panel production as early as the last decade. What is more, the 2016 export of RES technologies reached USD 83 billion, which exceeds 24% of the global market share [39].

#### 4. Conclusions

Renewable energy is one of the key interdisciplinary issues included in EU policies. The European Union and its Member States have become a global leader in the development and implementation of RES. As a result, RES and their support under EU policies are strongly anchored in development strategies, goals and priorities, as well as in binding regulations.

RES are a key element of EU's sustainable development. Their goal is to obtain energy from natural, repetitive processes and thus limit the exploitation of conventional sources, i.e., using non-renewable resources. In addition, due to their positive impact on the natural environment, RES are one of EU's priorities in terms of energy policy. Thus, having a wide range of instruments to support the promotion of RES, EU popularizes these technologies, also through technology transfer networks.

The article demonstrates the importance of transnational technology transfer networks in the promotion of RES during company mission and brokerage events. It has been demonstrated that the discussed events, organized at the initiative of the EEN are becoming a platform for the exchange of experiences and contacts, as well as signing contracts for RES. Different levels and types of institutional interaction can affect efficiency in different ways, with the sharing of procedural information and coordination mechanisms being considered most fruitful for increasing efficiency.

Electricity is an important part of the economic development of each country, with a steadily growing demand. In recent years there has been a sharp increase in the share of renewable energy in total energy production [40] and in the light of the numerous regulations, directives and laws created in Europe, its importance will further increase in the near future. At the same time, the share of nuclear

energy and coal is decreasing and that of oil and gas from conventional and unconventional deposits is increasing. In this context, the existing trend of increasing the importance of electricity production from renewable sources seems irreversible. However, this does not mean that the introduction of large anthropogenic objects into the environment is not opposed. This is why an international discussion seems so important, to introduce numerous mechanisms and instruments leading to promoting RES by emphasizing their importance within the technology transfer network, as well as to build international networks, such as the Enterprise Europe Network.

Apart from the environmental aspects, energy (including renewable energy) covers both the political and economic aspects of international business relations as an important aspect of sustainable development. According to Sustainable Development Goals, energy is a subject of the 7th goal, but also a part of the 17th goal. The concept of sustainable development is laudable, as it is based on counteracting the broadly understood degradation of the Earth's natural and cultural environment and on harmonious business activity. Thus, it has found many supporters virtually all over the world, and its implementation is financially supported by numerous private institutions and international organizations. The Enterprise Europe Network is an example of an institutional network promoting technology transfer for sustainable development of renewable energy.

Sustainable development is a multidimensional idea which, apart from the natural, economic and social aspects of man's environmental behavior, also means the institutional, spatial, moral and spiritual aspects of life related to its quality, although not necessarily considered as material goods. This concept is universally desirable because its main premise is progress, and this gives an opportunity for proper, sensible spatial planning and management [41]. This seems all the more important as the exploitation of natural resources (including fossil fuels) often remains uncontrolled. Many locations experience a significant environmental imbalance caused, on the one hand, by increased consumption and, on the other hand, by a lack of compensation for the environmental and social losses. Probably not many researchers already doubt whether Naveh was correct [42] in saying that the sustainability revolution in all spheres of life should be a key element of further research. With no understanding of the need for a systemic and multidimensional approach to human-environmental relations, the idea of sustainable development will be doomed to failure. This approach requires the implementation of numerous political, legal and economic solutions in the functioning of many local, national or even international institutions [43–45].

The presented results are the foundation for future theoretical and practical studies. One of the important aspects to be examined is the intensity of cooperation launched during CM and BE. It is related to the results of partnership agreements and the importance of increasing the knowledge flow and creating opportunities for partners to acquire foreign technologies.

To summarize the conclusions:

1. Institutions operating within transnational technology transfer networks have an important role to play in RES technology transfer.
2. BEs and CMs have become a platform for the exchange of experience and contacts, as well as for signing transfer and diffusion contracts on RES innovations. The nature of BE and CM and the possibility to organize meetings in a virtual company is of particular importance during the COVID-19 pandemic period.
3. The types of institutional interactions can significantly influence the efficiency and effectiveness of RES technology transfer.
4. When creating the next EU energy policy program framework, introduction of numerous mechanisms and instruments leading to the promotion of RES should be considered, with emphasis on their importance in technology transfer networks. Building international networks should also be taken into view, following the example of the Enterprise Europe Network.
5. Building transnational partnerships aimed at the exchange of experience and knowledge on the development and improvement of RES efficiency has become necessary, based on geographical and regional conditions.

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