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DEVELOPING COOPERATION BETWEEN SCIENCE AND THE ECONOMY IN THE AREA OF RENEWABLE ENERGY SOURCES BASED ON THE EXAMPLE OF THE DEENET NETWORK

Abstract
The aim of the paper is to analyze projects focused on decentralized energy supply systems, energy-optimized design and construction, as well as energy-efficient industrial processes and sustainable energy supply concepts. In view of the above, projects such as the following were analyzed: "Regiony w 100% Odnawialne" ("100% Renewable Regions), "KLIMZUG", "Zabytki i Energia" ("Monuments and Energy"), "Klimaregio", "Sieć elektroenergetyczna przyszłości" ("The Power Engineering Network of the Future"), "Polsko-niemiecki dialog klastrów" ("Polish-German Cluster Dialog"), "Energooszczędne budownictwo i mieszkanie" ("Energy Efficient Construction and Housing"), "dEcoSense", "Manager Energetyczny – IHK" ("Power Engineering Manager - IHK") d "Okrągły stół energetyczny Północnej Hesji" ("Northern Hesse Energy Round Table").

Key words
energy, energy supply systems, civil engineering, power engineering design, energy efficient processes, sustainable energy supplies

Introduction

The DeENet competence network (KompetenznetzwerkdezentraleEnergietechnologiene.V.) was established in 2003 following the initiative of industry insiders, trade associations, research institutes and local government units. Currently, there are over 120 entities in the network. In 2010, Germany's Ministry of Economy and Technology awarded DeENet the title of "2010 Competence Network in Germany". In October 2011, the network received the Brown Certificate of the European Cluster Excellence Initiative [1]. The main goal of the network is to jointly develop integrated system solutions in terms of energy supply. These in turn increasingly depend on decentralized structures based on the use of renewable energy and efficiency improvement measures. DeENet's business areas are decentralized energy supply systems, energy-optimized design and civil engineering, and energy-efficient industrial processes and sustainable energy supply concepts.

With an integrated approach, sustainable energy supply concepts and value-added chains are created. Their emergence is influenced by the continuous flow of information between members of the network, creating intangible values such as knowledge and ideas, and material value.

Struktura zewnętrzna – External structure; Kompetencje indywidualne – Individual competences; Struktura wewnętrzna – Internal structure; Transfer wiedzy, konwersja wiedzy – Transfer of knowledge, conversion of knowledge

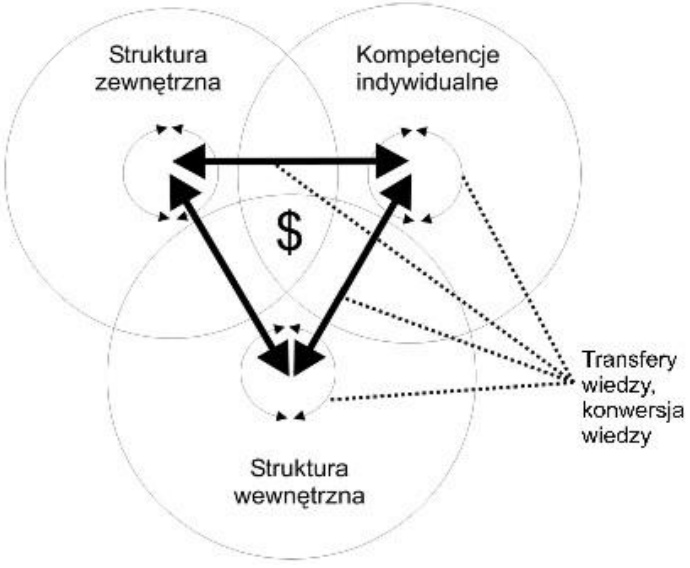
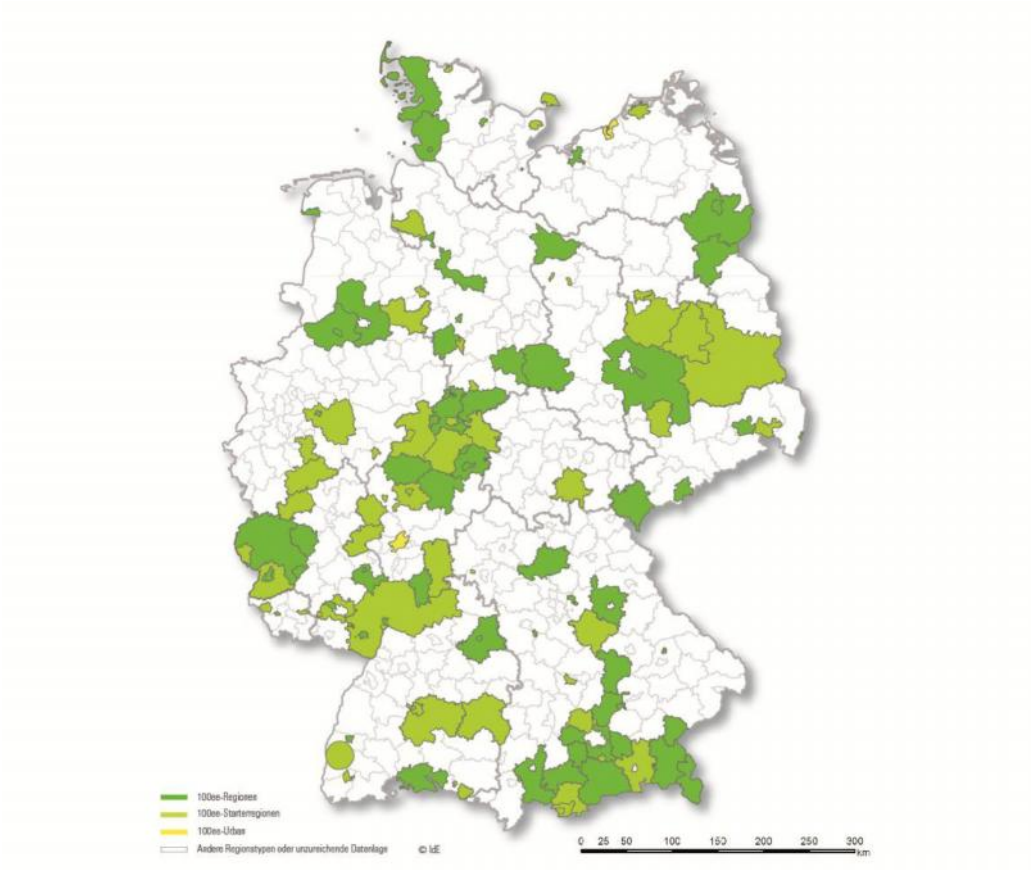


Fig. 1. An image of a company from a knowledge perspective
Source: own study based on [2]

The "100% Renewable Regions" project

This project aims to unite the regions (municipalities, cities) in Germany, which are, or in the next few years want to become, 100% self-sufficient in energy terms. There are currently over 130 counties, municipalities, towns and regional networks in Germany that have joined in to achieve this goal. The project supports the actors involved in the regions through appropriate communication, transmission and creation of service networks. The implementer of the project is the Institute for Decentralized Energy Technologies - IDE (operating in the DeENet network). The project is funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The technical consultancy provided within the project is offered by the Federal Office for the Environment (UBA). The IDE, along with the University of Kassel, conducted research into the optimization of the energy supply chain and the success factors for achieving 100% of energy independence across regions.

The first phase of the project was carried out from 2007 to 2010 and primarily covered research. The second phase, carried out between 2010 and 2013, focused primarily on promoting and implementing research results in regions that expressed their willingness to achieve energy independence but had not yet fully implemented that idea. The challenges facing individual regions are becoming increasingly complex. Therefore, they need complex social, legal, economic and technical solutions. The need for reliable information and support on the path to sustainable energy supply is becoming increasingly apparent. The added value of the project is the exchange of good practices between regions - the leaders in energy self-sufficiency and those who want to join the spearhead.



Map 1. Regions participating in the project
Source: the author's own study.

The above map shows the regions that are participating in the project. The overwhelming majority are the areas that have reached 100% energy independence. The main objectives of the project are:

- the development study for reaching 100% sustainable regions;
- the identification of key challenges and success factors;
- the identification of examples of best practices;

- the support for regional/local activities to achieve energy independence;
- developing model strategies.

The objectives are achieved through the following activities:

- knowledge transfer to regions;
- exchange of experiences between regions;
- distribution of educational materials;
- the newsletter and website: www.100-ee.de;
- workshops and conferences.

Photo 1. Logo of the project before the access road to the commune affiliated in the "100% Renewable Regions"
Source: taken from [3]

One of the key aspects of the "100% Renewable Regions" project is the public acceptance of the RES technology. If there is no acceptance, it is impossible for the commune to build any installation. It is therefore important to demonstrate the value chain resulting from the proposed RES project. One of the most important arguments is economic benefits. If it is thought out well in economic terms, a project plan can be the key to achieving a high level of acceptance. The inhabitants of a commune can accept any adverse effects if there is a financial compensation for it, such as making a profit according to their stake in the project or getting work in service of the project. Engaging local businesses in the investment process is also important. These problems equally affect the Federal Republic of Germany and Poland. During the implementation of the project "100% Renewable Regions", the idea of organizing an annual congress under the same title as the project cropped up. In 2012, its fourth edition had already taken place. Over four years, the event had grown to become one of the most important conferences in Germany devoted to renewable energy sources and energy independence. The congress brings together key decision makers, both on local level as representatives of communes and regions, and on a state level with the Ministry of Environment, Nature Conservation and Nuclear Safety, Ministry of Economy and Technology. Congress participants can learn about the latest developments in RES development and case studies, and exchange views on numerous discussion forums. The paths to energy independence of the regions are also presented. The main organizer is the DeENet network in cooperation with the UBA (German Environment Agency), the German Association of Cities and Communes and the Agency for Renewable Energy.

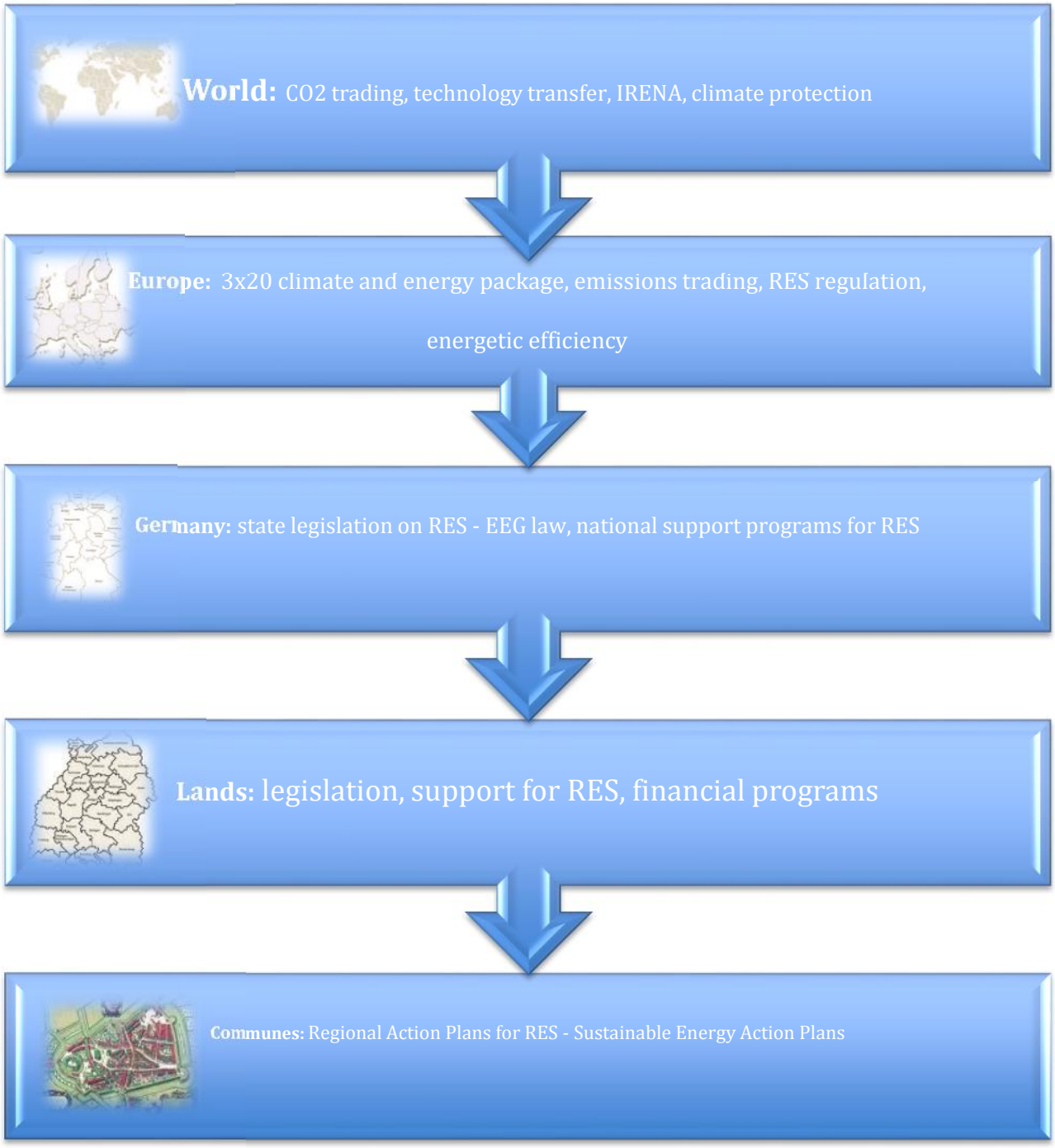


Fig. 2. Impact of the project on different planes
Source: the author's own study.

The "KLIMZUG" project - halting climate change in the northern Hesse region

Climate change is one of the most important dilemmas of the modern world. In the coming decades, it will play a very important role in the life of Germany. Regions must prepare for potential impacts on life and the economy in changing climatic conditions. The Institute for Economic Research in Germany has surveyed around a thousand entrepreneurs in terms of the exposure of their businesses to climate change. Approximately 20% of the surveyed companies indicated indirect or direct negative impacts of climate change on their business. It is expected that this percentage will consistently increase. In 2030, more than 60% of businesses may feel the effects of global warming. That is why the Federal Ministry of Education and Research responds to climate change by proposing the "KLIMZUG" project. North Hesse was chosen as the pilot region for the project. The budget is 80 million Euro.

Photo 2. Heavy rain and a tornado in Western Germany
Source: taken from [4]

The main aim of the project is to stop climate change, in this case in the Northern Hesse region, by developing a model of the right strategy and implementing the recommendations resulting from it. The design consortium consists of research institutions, enterprises and regional authorities. All partners are located in the Hesse region. The aim is to develop a shared view and overcome the challenges associated with the growing problem of adverse environmental changes. It is important to anchor climate change awareness in society. The project is divided into 18 research sub-projects and 9 implementation sub-projects. Each sub-project is involved in the study of a separate topic, including low emission transport, agriculture, sustainable tourism, education, law, economics, and politics. Scientists from the field of social sciences are tasked with highlighting the importance of RES in the context of halting climate change and determining a shared view on the issue by all parties. Within fundamental innovations, transfer of developed solutions to companies in regional clusters, as well as to local authorities, is offered. For this purpose, managers and climate change officials will be appointed. Project results are also disseminated through training and conferences under the Climate Adaptation Academy (CAA). The International Partner of the project is the Waldviertel region in Austria.

The "Monuments and Energy" project

"Climate protection must respect and preserve the cultural heritage." This was the statement issued by the German Minister for Culture at the start of a conference in April 2010 [5]. This statement therefore puts the issues of protection of monuments on par with the objectives of environmental and climate protection. Since the repository of historical monuments constitutes an average of 3% of sites in the Federal Republic of Germany, it should be ensured that measures to reduce carbon emissions will not cause damage to monuments in the building monuments of cultural heritage. Experts recommend acting in small steps: "A large part of energy costs can be avoided by optimizing home heating and rationally using energy. The principle should be to complement the protection of monuments and protect the climate, because the repurposing and the further use of historical structures leads to saving energy needed to produce new building materials. Thanks to its longevity, historical objects conserve resources and protect the climate." They also appeal to federal ministers to sensitize, for example, energy advisors on the matters of conservation and preservation of monuments, to support research in this area, and to popularize constructive solutions for internal thermal insulation.

In Kassel, there are about five thousand historic buildings, and over two thousand of those are cultural monuments. Most of these buildings are used daily and have specific energy needs. Considering the increase in energy costs of more than 30%, there is a decline in the demand for rental housing and stagnation in the residential and developer market. Many owners of old buildings observe this situation with concern. The desire to preserve the historic buildings in their original state and form makes the energy efficiency of the facility suffer. Typically, these buildings are highly energy absorbent. However, rapid development in the field of new energy systems and ensuring the highest energy efficiency makes it possible to reduce the energy demand in old residential and historic buildings. At present, complex energy advice is provided to building owners and audits are carried out to determine the actual state of the building, including its energy consumption, potential for renewable energy use and improved energy efficiency.

Photo 3. The Orangerie Castle in Kassel
Source: taken from [6]

The "Monuments and Energy" project comes across these expectations. It proposes the cooperation of specialists who deal with monuments together with engineers dealing with the topic of modern power engineering technologies. In Germany, the DeENet Network was the first to launch the project. This pilot project is intended to carry out research and then to implement their results in old residential buildings and monuments in Kassel. One of the aims is to create an energy advisory center where facility owners can get advice on how to improve energy efficiency in buildings, organize energy supply chains, and install micro renewable energy sources. A model of cooperation between building owners, monument experts, energy technology engineers, property owners and historic buildings will be created. This structure is to be an example for other cities and monument conservationists on how to solve the energy problems of old buildings and cultural monuments. The main aim is also to develop a method of designing energy systems in such a way that they do not interfere with the appearance of the monuments, thus contributing to the implementation of the German sustainable development policy, considering the increasing share of RES and increasing energy efficiency.

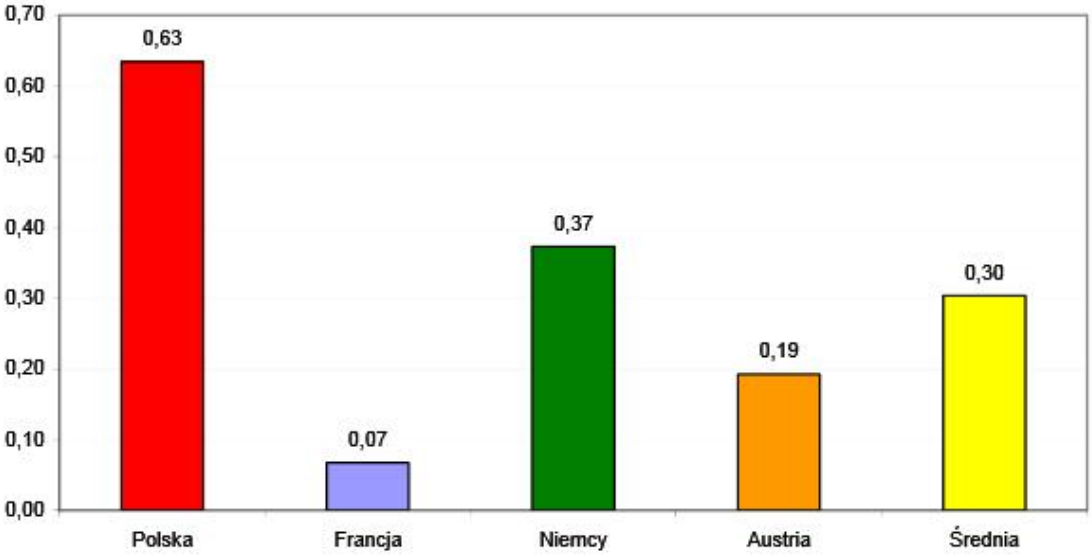
In the long term, the project, through ongoing research and project implementation, stimulates the local economy to develop. The DeENet network will focus on the energy analysis of the selected buildings and will propose comprehensive solutions to optimize energy efficiency. There is a special unit within the project that not only informs property owners about the potential of energy savings and the possibility of cost reduction through efficient resource management, but also about the possibility of obtaining financing for these investments. Thanks to the innovative concept of the project, experts predict that savings of 50% -80% on the current costs associated with the energy consumed by the building will be possible.

The "Klimaregio" project

The cliché that there are no "free lunches" is popular in journalism circles [7]. This statement was popularized in 1966 as the acronym TANSTAAFL in a paper on the effects of the unbalanced economy, by R.A. Heintlen. The phrase "There is No Such Thing as a Free Lunch" is the title of M. Freedman's 1975 book, and is still used in common parlance. This phrase means that every human action entails certain costs. Environmental-related activities were often correlated with high costs, but their influence and importance for the development of the national economy were rarely discussed. Concrete action in the scope of energy efficiency, climate change, or investment in environmentally-friendly energy, however, entails specific costs.

The chart below presents a simulation of the likely costs that Poland and other EU countries will have to bear in terms of CO_2 emissions reduction. The share of spending on CO_2 emission reduction in national income will be the largest in Poland. In Germany, this share will amount to about 58% of the Polish share, while in Austria it will be 30% and in France only about 11%.

Polska – Poland; Francja – France; Niemcy – Germany; Austria – Austria; Średnia - Average



Graph 1. Share of the costs of reducing CO_2 emissions in national income in 2030. (in %)
Source: own study based on [8]

An analogous debate on climate change is taking place in Germany. Communes and counties in Hesse are playing an increasingly important role in climate protection. Approximately 32% of CO_2 emissions in Hesse are generated by residential buildings, while about 37% of the emissions come from the transport sector. The emphasis is therefore placed on counties and cities, as well as on local communities, to present best practices to them using the so-called lighthouse projects (model solutions with the possibility of recreation in other municipalities), regarding the use of RES and energy efficiency to combat the negative effects of climate change.

The "KlimaRegio" project provides for counteracting climate change by setting up local investment projects that consider the reduction of CO_2 emissions. During the pilot phase the Darmstadt-Dieburg-Odenwaldkreis and Giessen regions are supported. Those interested in investing in new technologies, including reducing carbon emissions, are encouraged by the potential for funding. A refund of €25 to €100 per ton of documented CO_2 emission reductions is offered. The maximum amount of funding is 75,000 Euro.

The "Power Engineering Network of the Future" project
A power grid is a collection of power cables and devices linked in functional terms and electrically connected, intended for the transmission, processing and distribution in a given territory of electricity generated from power plants and for the supply of power to the receivers [9].

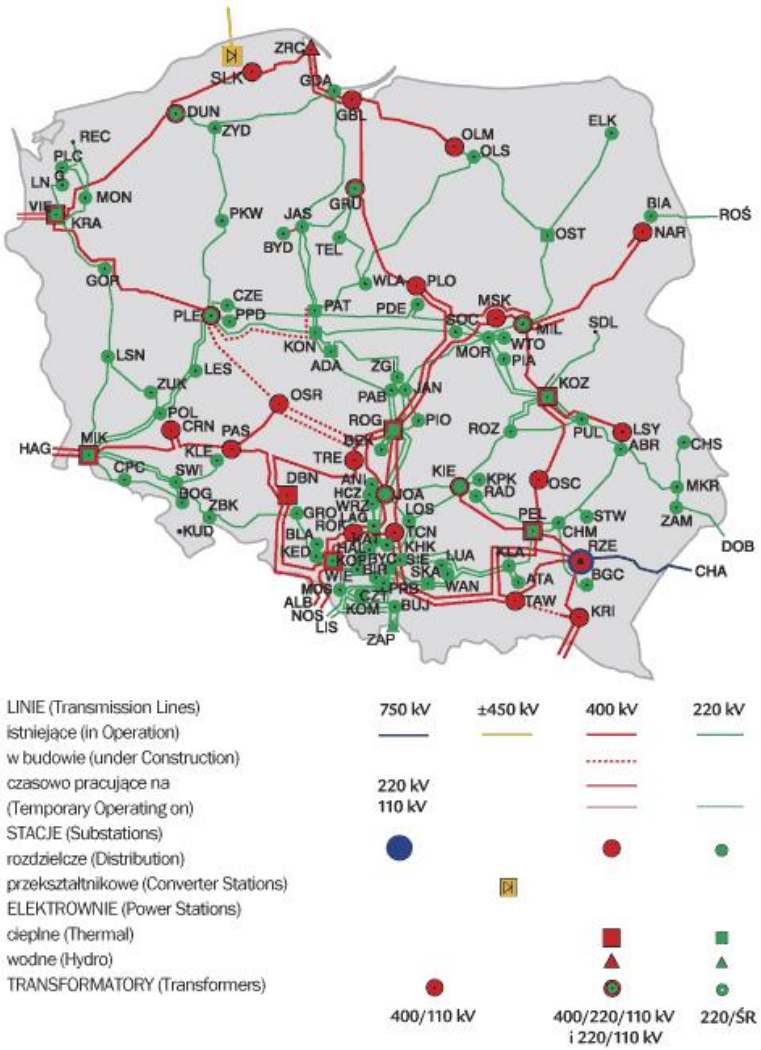
Power grids are divided into:

- type of current: AC (most) and DC current (see Fig. HVDC);
- voltage level: low voltage (lv) <1kV, medium voltage (MV) <60 kV, high voltage (HV) ≤ 220 kV and highest voltage (HV) ≥ 400 kV;
- grid layout: TN-C, TN-S, TN-CS, TT, IT

You can distinguish in it elements such as:

- transmission network - high-voltage network and highest-voltage network;
- distribution network - medium voltage network and low voltage network [10].

In Poland, the business involving transmission of energy is conducted by the company PSE Operator S.A. Below is the distribution of the transmission network in Poland and its power.



Map 3. The transmission system in Poland
Source: PSE Operator SA

The "Power Engineering Network of the Future" project aims to develop and test the regional energy system of the future. The need for further development of a decentralized energy supply chain, to which new and renewable sources of energy will be connected, poses many challenges for the persons in charge. The problems encountered by both investors in Poland and Germany are:

- Lack of a uniform position on the distribution of costs associated with connection to the grid;
- "Blocking" of connection capacity by developers who do not intend to build new capacities, but only conduct the obtained conditions of connection (e.g. of wind farms) to the power grid.

Another common problem, especially in Poland, is the lack of transmission capacity and the possibility of introducing power into the existing power grid. All these problems are countered by the "Power Engineering Network of the Future" project. The project proposes solutions related to the terms "smart grids" and "smart metering". Smart energy networks are networks designed to ensure efficient communication between energy market participants, using available ICTs, to make more efficient use of the energy resources available in a combined system.

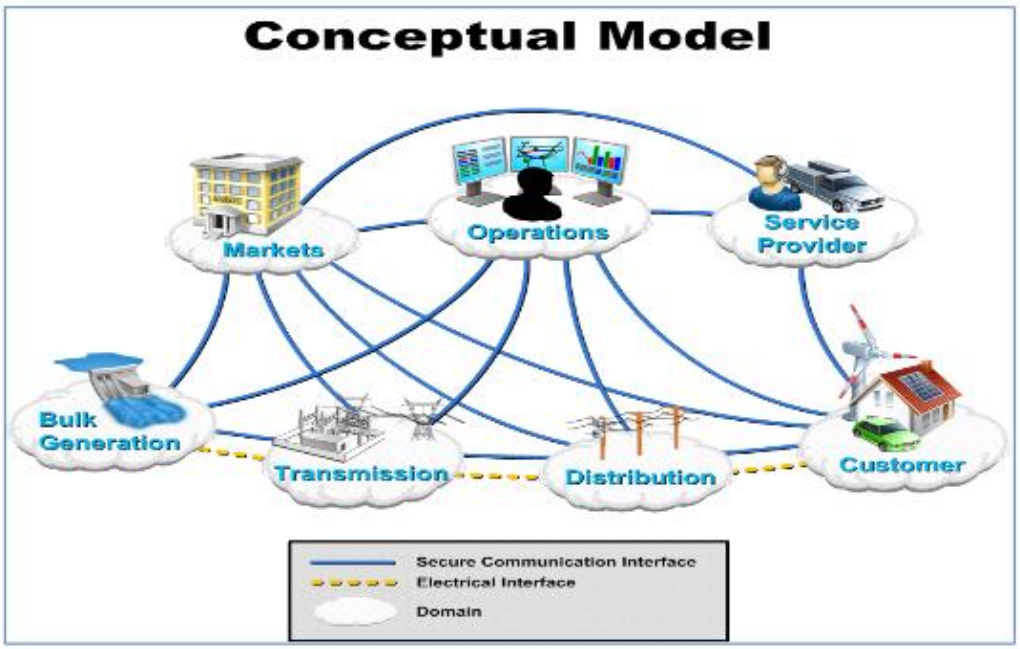


Fig. 3. Diagram of the conceptual model of intelligent grids
Source: [11]

The Company E.ON Mitte, in cooperation with the Hessian municipalities and the DeENet network, intends to develop a model of regional energy supply systems that will address the challenges of the future. The municipalities with which the company cooperates are selected by way of a competition.

The main objectives of the project are:

- development of "smart networks" and "smart metering";
- development of a regional energy system with a high share of RES;
- taking into account local opportunities in terms of energy efficiency potential;
- development of business models to generate added value.

The partners in the project are:

- E.ON Mitte - power engineering services provider,
- The DeENet competence network,
- Fraunhofer Institute IWES - conducting research on wind energy and energy systems,
- Fraunhofer Institute IBP - conducting research on sustainable civil engineering,
- SMA - a global tycoon in the field of inverter production.

All participating municipalities can present their energy performance results at an annual conference and then publish them in a special bulletin. Angelburg is an excellent example of a community involved in the project. With 4,000 inhabitants living in an area of 17 km^2, local authorities have long been involved in investments related to renewable energy sources and energy efficiency. Their main goal is to reduce the demand of the municipality for resources, including energy. Local decision makers have decided to invest in the modernization of street lighting to increase energy efficiency and to improve the comfort and safety of the inhabitants. In addition, according to German regulations from 2015, there will be a ban on the use of mercury lamps. The partner contracting the investment was E.ON Mitte.

The "Polish-German Cluster Dialog" project

The internationalization of clusters aims is a current trend that aims to provide access to markets and knowledge. There is also an effort to increase the importance of clusters and their impact on funding.

The overall benefits of the internationalization of clusters for an enterprise participating in the cluster structure provide access to knowledge that can be used in new products and services, new markets, key infrastructure elements, and new international partners [12].

Fig. 4. The process of internationalization of clusters
Source: taken from: [13]

The "Polish-German Cluster Dialog" project was launched in 2008 during a meeting of the project group of the POLEKO trade fairs in Poznań. Partners from Germany and Poland participated in the project.
On the German side, the project partners were:

- The DeENet competence network,
- OWWZ – Centrum Badań nad Wschodem i Zachodem (Center of Research on the East and the West),
- Center for Energy Technologies - Brandenburg,
- The Power Engineering Institute in Leipzig,
- The Fraunhofer Institute MOEZ,
- The German Biomass Research Center.

The Polish partners of the project were:

- The Bioenergy for the Region Cluster
- The Innovative Silesian Clean Coal Technologies Cluster,
- Warsaw University of Life Sciences,
- Wroclaw Research Center EIT+,
- The Jan Kochanowski University.

The main objective was to initiate joint research and development between clusters and units from Germany and Poland. A series of workshops and matchmaking meetings took place on both sides of the border. One of the meetings took place on 25.03.2010 at the Faculty of Electrical Engineering, Electronics, Computer Science and Automation of the Łódź University of Technology. The topics covered were photovoltaic panels, their application spectrum, technological trends, practical use in enterprise, small municipalities, and farms. Topics pertaining to Polish, German and EU sources of financing of investments related to renewable energy sources,

with a special focus on solar energy, were also covered. Participants discussed the opportunities for cooperation in the economic context, and in scientific development, consortium formation, transfer of scientific and technical knowledge, and exchange of experience.

The conference was divided into three thematic panels:

- Photovoltaic cells - production technologies and research;
- Renewable energy at the municipality level;
- Photovoltaic cells - financing opportunities.

Members of the German clusters and representatives of the University of Kassel attended the conference , specializing in research on solar technologies and photovoltaics. The Polish side was represented by members of the Bioenergy for the Region Cluster and the authorities and employees of the Łódź University of Technology, entrepreneurs, employees of research centers, business environment institutions, local government units and entities interested in joining the Cluster.

Photo 4. V Forum of the Bioenergy for the Region Cluster as part of the *Polish-German Cluster Dialog* Project
Source: taken from: [14]

The project was financed by the German Ministry of Education and Research under the "Germany - Land of Ideas" programme, which promotes innovation and internationalization in the economy.

The "Energy Efficient Construction and Housing" project

According to the European Commission's 2009 report titled "ICT for a Low Carbon Economy. Smart Buildings" [15], 40% of final energy consumption in EU countries comes from buildings. This percentage indicates how much the residential construction impacts the country's energy economy and it allows for related assessments of opportunities and threats. It is therefore particularly disturbing that there is a lack of an integrated approach to building design, based on sustainable development principles. It would minimize the harmful impact of human activities related to the design and construction of buildings on the environment. The concept of sustainable development is used when the present needs are satisfied and the opportunities for satisfying the needs of future generations are not compromised.

In the construction industry, it is manifested in the form of care for the environment and economical management of raw materials throughout the construction cycle; from the project, through the construction, operation of the building, up to its demolition.

Środowisko – The environment; Ochrona ekosystemu planet I bogactw naturalnych – Protection of the planet's ecosystem and natural resources; ograniczenie zużycia surowców – limiting the use of resources; korzystanie ze źródeł energii odnawialnej – utilizing renewable energy sources; minimalizacja odpadów I zanieczyszczeń – minimalization of waste and pollution; ograniczanie zużycia energii pierwotnej – limiting the use of pro Energy; Społeczeństwo – The socjety; Wysoka jakość środowiska wew. – High quality of internal environment; odpowiedni mikroklimat – proper microclimate; komfort akustyczny i wizualny – acoustic and visual comfort; jakość wody pitnej i powietrza – quality of drinking water and air; Wartości funkcjonalno – estetyczne – Functional and aesthetic values; efektywne wykorzystanie powierzchni – efficient use of space; brak barier i dostęp publiczny – no barriers and public access; Ekonomia – Economy; trwałość budynku – building durability; niski koszt budynku w cyklu życia – low building cost within the life cycle; dochód generowany podczas istnienia – income generated during existence; elastyczność dopasowywania się do coraz nowszych celów, jakim ma służyć – flexibility in adaptation to the subsequent purposes it is supposed to serve;

Fig. 5. Three aspects of sustainable construction
Source: the author's own study.

An analysis of the literature on the subject and the results of numerous thematic conferences shows that the opinions of experts on eco-friendly and energy-efficient construction differ from time to time. There is, however, a convergence of beliefs about the requirements that such buildings must fulfill. First, they should limit their consumption of raw materials, including water. Second, they should limit emissions of harmful gases into the atmosphere and minimize their negative impact on local ecosystems. Third, they should have optimum indoor environment parameters in terms of air quality, thermal comfort, lighting and noise. Finally, the architectural quality should be high [16].

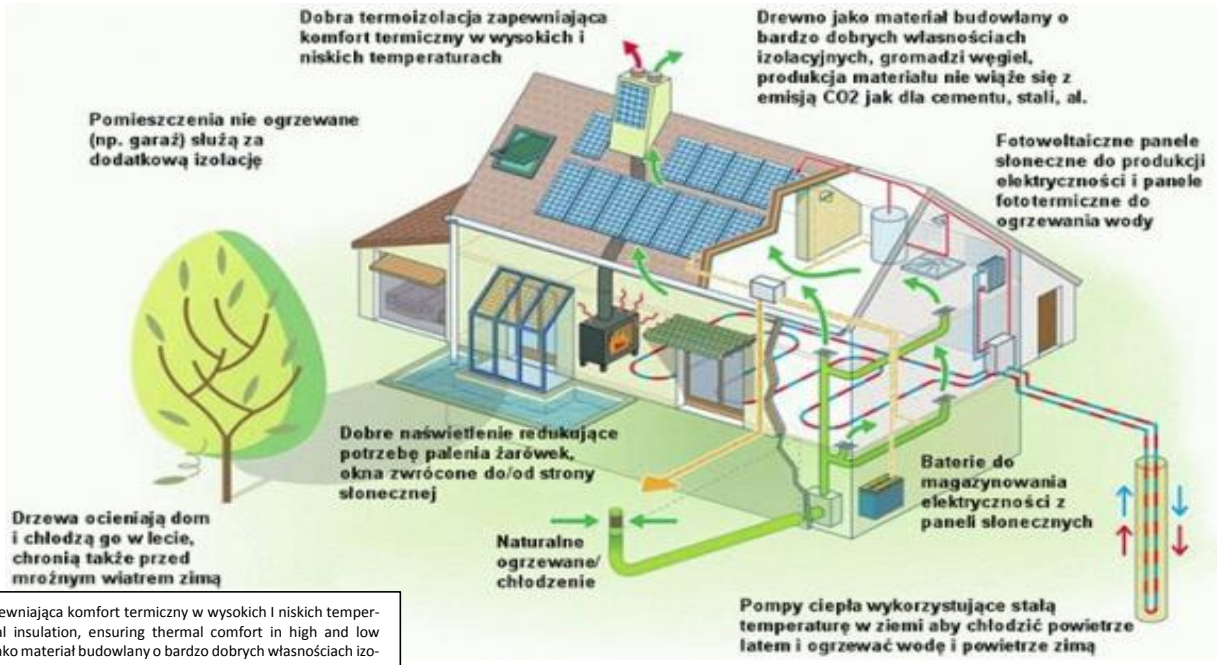


Fig. 6. Characteristics of a passive house
Source: taken from: [16]

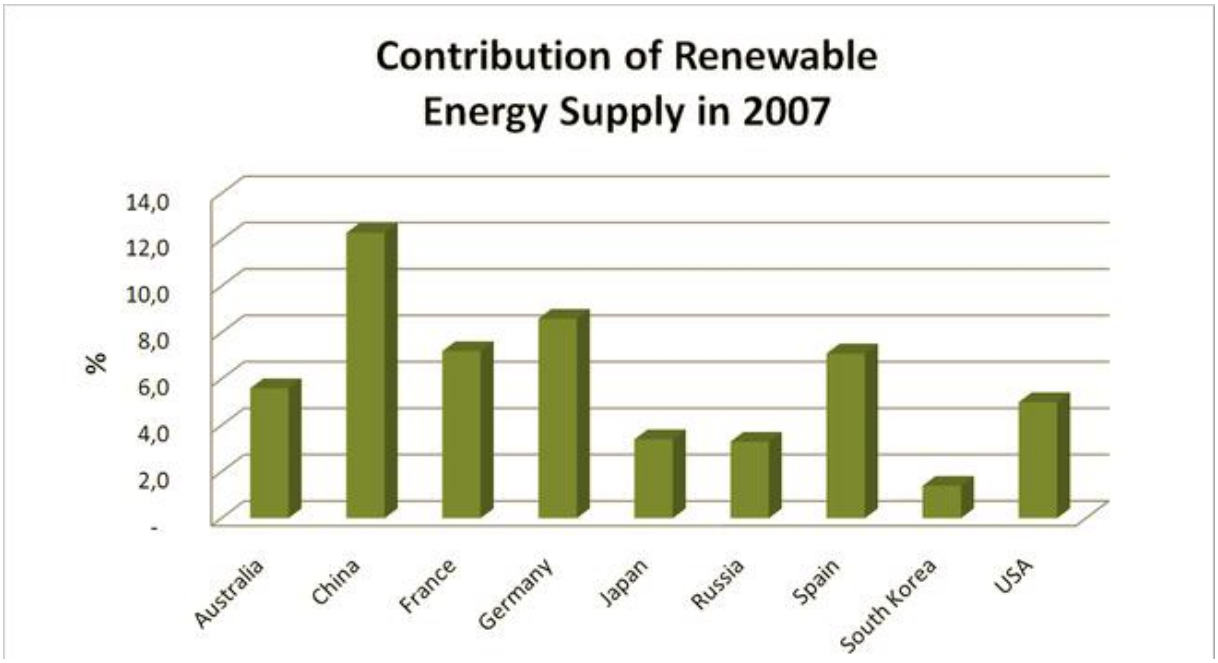
Dobra termoizolacja zapewniająca komfort termiczny w wysokich I niskich temperaturach – Good thermal insulation, ensuring thermal comfort in high and low temperatures; Drewno jako materiał budowlany o bardzo dobrych własnościach izolacyjnych, gromadzi węgiel, produkcja materiału nie wiąże się z emisją CO2 jak dla cementu, stali, al. – Wood as a building material with very good insulation properties, it accumulates coal, production of the materia lis not associated with CO2 emission unlike for cement, steel, aluminium; Fotowoltaiczne panele… - Photovoltaic solar panels for the production of electricity and photothermal panels for heating water; Bateria do magazynowania… - Battery for storage of electricity from the solar panels; Pompy ciepła wykorzystujące… - Heat pumps utilizing the constant temperature in the soil to cool the air in the summer and heat water and air in the winter; Naturalne ogrzewanie/chłodzenie – Natural heating/cooling;Dobre naświetlenie… - Good solarization, reducing the need to switch on light bulbs, windows directed towards/away from the sunny side; Drzewa ocieniają… - The trees provide shade for the house and cool it in the summer, they also protect against cool wind in the winter; Pomieszczenia nie ogrzewane… - Unheated rooms (e.g. garage) serve the purpose of additional insulation;

This project is a joint venture of the city of Baunatal and the DeENet competence network. It is financed by the Hessian Ministry of Environment, Energy and Economy. The main assumption of the project is the intention to demonstrate the benefits through incentives, such as subsidies or low interest loans, coming from low-energy consuming construction. The intent is not to force owners of potential buildings or potential investors to build passive buildings by applying restrictions or penalties. The aim is to show potential investors the benefits and advantages of energy-efficient construction.

Within the project, there are consultations with energy auditors before the commencement of construction works, and there is the option to have flexible financing of investments, such as interest-free loans and grants. There are also training and workshop opportunities.

The "dEcoSense" project

The Republic of Korea has been one of the fastest developing countries in the world in the last decades. Fifty years ago, the South Korean GDP per capita was comparable to the GDP of poorer countries in Africa and Asia [17]. While West Germany proclaimed an economic miracle (1948), resulting in monetary reform, taxation and price liberalization, South Korea was still one of the poorest countries in the world. Currently, the GDP of South Korea per capita is nine times higher than in India, 15 times higher than in North Korea (using the Purchasing Power Parity, PPP calculation method) and comparable to the GDP in less developed Western European countries. In the years 1963-1997, the GDP growth rate was 8.5% per year.



Graph 2. The structure of the RES share in the energy balance of individual countries
Source: based on OECD data

The DeENet competence network also employs South Korean scientists in its team. Dr. F. Jaeckel, a molecular biology specialist, proposed the creation of a joint research project between the Republic of Korea and the Federal Republic of Germany. With the economic development of Korea, the country's demand for energy is increasing. Domestic energy resources only meet the needs to a negligible extent. As a result, South Korea is heavily dependent on imports of crude oil, coal and uranium. The authorities in Korea have been searching for years for a proper model of decentralized energy supply. They are most likely to copy solutions from foreign partners. In 2009, a new energy strategy was announced in Korea, which plans to invest up to $40 billion by 2013 in renewable energy and energy efficiency measures.

The DeENet competence network has therefore proposed cooperation within the "dEcoSense" project to offer best practices in the sustainable energy supply chain. The project was to create structures and supply chains similar to those existing in Germany. Activities were implemented at the level of both municipalities and enterprises. In addition, matchmaking meetings were organized for German and Korean companies operating in the RES sector. German companies, as part of the concept of internationalization already presented, are keen on

moving outside, not just outside their borders, but also outside the EU. The Korean market is one of the most promising in the world, especially considering the members of the deENet network having extensive experience in both research and implementation works. The project also implements energy analysis and development forecasts for the metropolitan area of Seoul and the industrial zones surrounding the city. Everything will be based on a highly participatory model of providing energy supplies that are part of the South Korean tradition.

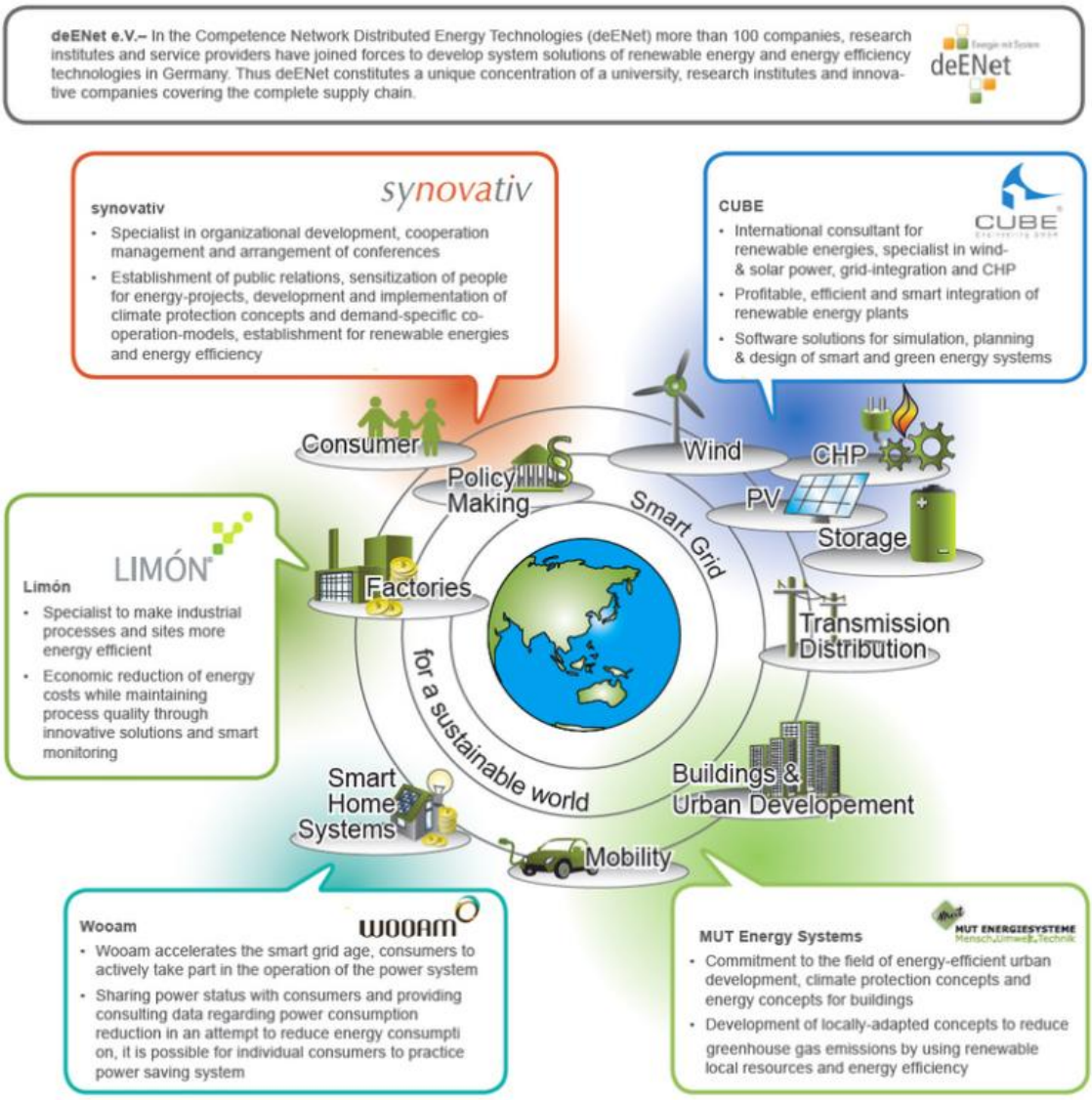


Fig. 7. Design consortium
Source: [18]

The "Power Engineering Manager - IHK" project

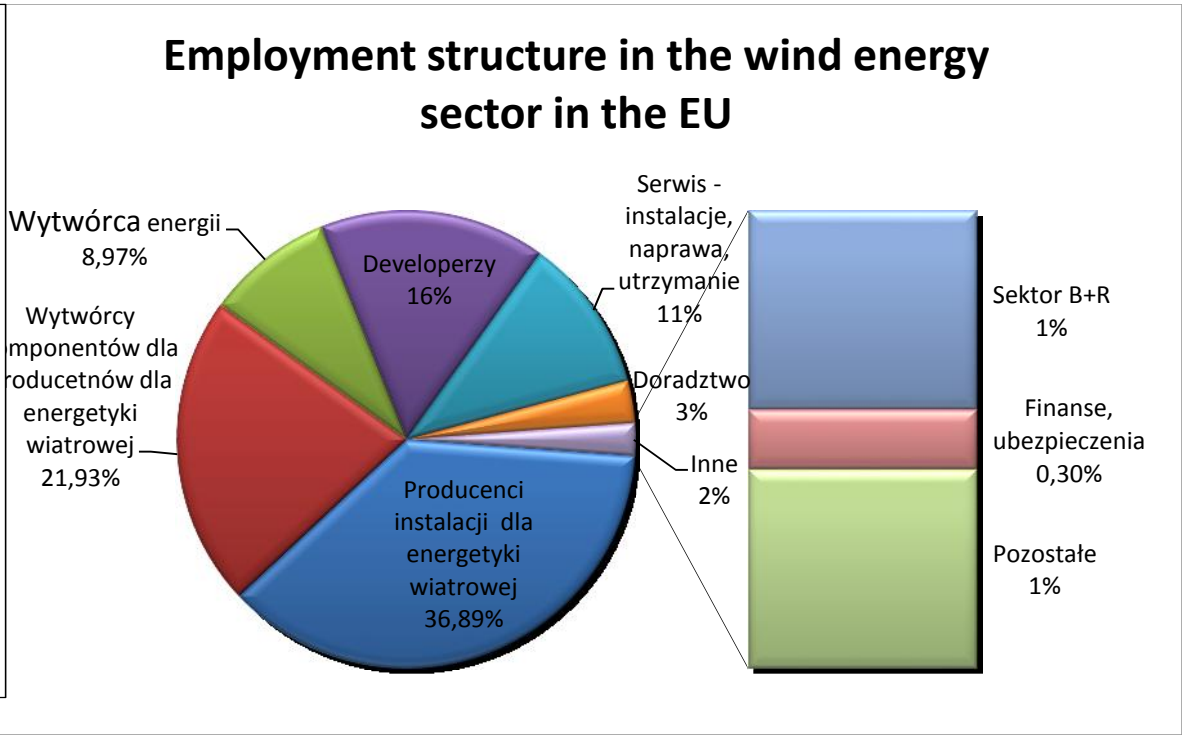
In August 2012, the German Ministry of Environmental Protection announced that in the first half of 2012, the share of renewable electricity in the German energy mix increased to 25%. It is 4% more than in the previous year and more than 2.5 times more than in 2005 [19]. One of the brightest sides of unconventional energy development, besides respect for the environment, is creating an enormous number of jobs in this sector. In the 27 EU Member States, renewable energy and related sectors employ almost 1.5 million people. Compared to 2009, a growth of 25% in the number of people employed in the RES sector was recorded. The turnover generated in this sector in 2010 is estimated at 127 billion Euros.

Germany is the European country that comes to the fore, both in terms of jobs and turnover. The requirements that apply to Poland's climate and energy package force the need to invest in renewable energy. With this process, many jobs related to sustainable energy technologies will emerge. Among other things, in such areas as

planning, implementation, design of RES systems, their operation and maintenance of infrastructure. Thus, a huge sector is being created, which in the future will provide the Polish economy with thousands of new, well-paid jobs.

Research by the Fraunhofer Institute ISI shows that people employed in the renewable energy sector are very often from the sectors of the economy where they have lost their jobs, mainly due to unfavorable economic conditions. These are branches such as shipbuilding, the steel industry, slaughterhouses or agricultural professions. The chart below shows the structure of employment in the wind energy sector in the EU.

Wytwórca energii – Power manufacturer; Wytwórcy komponentów dla producentów dla energetyki wiatrowej – Manufacturers of components for the producers in the wind energy industry; Developerzy – Developers; Serwis – instalacje, naprawa, utrzymanie – Service – installations, repair, maintenance; Doradztwo – Consulting; Inne – Other; Sektor B+R – R&D Sector; Finanse, ubezpieczenia – Finances, insurance; Pozostałe - Other



Graph 3. The structure of direct employment in the wind energy sector in the EU in 2008.
Source: own study based on EWEA data (2009).

The chart is a confirmation of a very positive and, above all, diversified, employment situation in the wind energy sector in the European Union. Wind power provided over 154,000 jobs in 2007. It can also be seen that employment was very diverse. It concerned both the producers and manufacturers of components, the service and the research sector. Research conducted by the EWEA assumes that by 2020, 325,000 jobs will be created in wind energy. Likewise, the situation will be shaped in other RES sectors like solar, hydro, biomass and waste energy. There is no skilled labor force in Poland that could meet the needs of this sector, highlighting the importance of acquiring skills that will enable employees to move freely in the sector of renewable energy and related services [20].

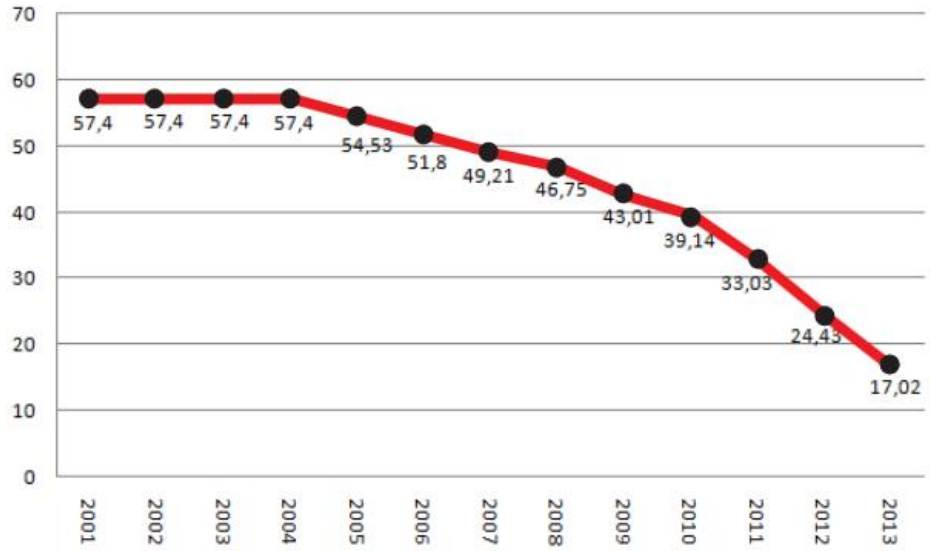
The "Power Engineering Manager" project is run by DeENet's competence network in cooperation with the Chamber of Commerce and Industry in Leipzig. It is a series of trainings, covering the issues associated with energy efficiency, new RES technologies, and the electricity market.

The project is designed for supervisors and managers of RES installations, technicians, production managers, energy service providers dealing with the issues of effective energy management in practice on an everyday basis. Training covers 80 hours of classes, both in the form of workshops and e-learning. The project ends with an exam, and in the case of a positive result, the issuance of a Power Engineering Manager certificate by the Kassel Chamber of Commerce and Industry.

The "Northern Hesse Energy Round Table"
Smart use of energy will become one of the key factors for business competitiveness in the future. Effective use of ventilation, cooling, heating in the current electricity market situation will reduce costs and, as a result, increase the company's income. The DeENet competence network research commissioned by the Federal Ministry

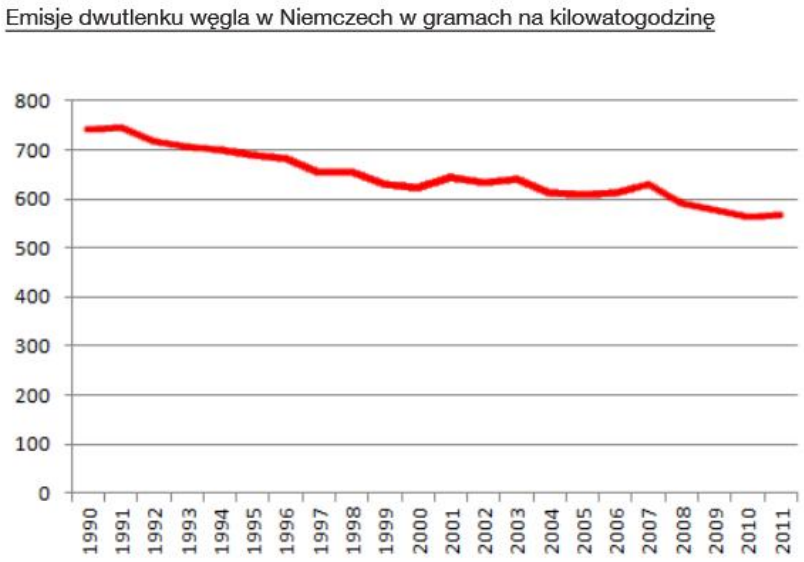
of Economics and Technology has shown that there is still a deficit of knowledge in implementing effective energy policy in German companies. It is predicted that next year will bring a spike in electricity prices in Germany. Unfortunately, in part, it is also because more and more RES is attached to the energy mix. Such a significant increase in the role of renewable energy in the German energy mix, especially in the case of hitherto relatively expensive photovoltaics, has an impact on electricity prices.

In October 2012, network operators have announced an increase in the cost of financing the development of renewable energy (the so-called Umlage) from 3.59 euro cents to 5.28 euro cents per kilowatt-hour. This means that about 20% of the electricity price paid by the average German citizen is used to finance the development of renewable energy. Large and energy-intensive businesses are exempt from this payment, which results in a situation where the German "Energiewende" costs are borne mainly by private consumers and small businesses.



Graph 4. Fixed rates for photovoltaics in Germany (Eurocent/Kwh)
Source: own study based on [21]

To increase its competitiveness, a group of companies from Northern Hesse decided to cooperate with the DeENet competence network. Cooperation mainly involves organizing cyclical "round table" meetings and exchanging views on possible improvements in production companies regarding energy efficiency. Energy experts, local authorities and business representatives are invited to the meetings. Apart from discussing current RES-related initiatives, best practices and examples of the implementation of efficient energy supply chains and energy-efficient systems in enterprises are also presented.



Graph 5. Carbon dioxide emissions in Germany in grams per kilowatt-hour
Source: own study based on: [21]

Conclusion

To conclude, it should be indicated that the DeENet competence network is one of the most well-developed cooperative relationships in Germany. This is evidenced by having over 120 members, but also by the huge number of projects that are undoubtedly one of the best practices in developing cooperation between science and technology in the field of renewable energy sources. The German models, both in terms of research and implementation in the field of cooperation between science and the economy, are among the best and most desirable in the world. These are ready examples of projects to be implemented in the Republic of Poland. It should be noted, however, that the active role of the DeENet cluster is possible thanks to the systematic support of its actions by state institutions, both at the regional/local level and at the ministerial level. Similar support cannot be observed in Poland. However, it should be noted that the Ministry of Economy has noticed this problem, and as such has created a special work group for cluster policy.

The aim of the establishment of the Work Group is to develop directions and assumptions for the Polish cluster policy up to the year 2020, based on the following:

- the conclusions and recommendations resulting from the current policy implemented in areas influencing the development of clusters in Poland, described in the Opening Report on the Polish Cluster Policy, considering the recommendations of the European Commission, as well as the experiences and good practices from abroad;
- the needs and determinants of cluster development and objectives for cluster policy;
- the dissemination of the cluster perspective in policy planning, affecting the development of clusters/cluster initiatives in the financial perspective 2014-2020.

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