

DEVELOPMENT AND INNOVATION STRATEGY BIOENERGY FOR THE REGION CLUSTER



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1. Introduction

1.1. SMART4NZEB project

The aim of the SMART4NZEB project is to boost competitiveness and support the scaling-up of 577 SMEs active in construction, energy efficiency and renewable energy sectors through strengthening capacity-building of 5 representative clusters as drivers of innovation in Central and Eastern Europe (Poland, Romania, Serbia and Slovenia) and facilitating trans-national exchanges and strategic partnerships with a focus on sharing experience between different practices, skills gaps, policies, target goals and level of engagement related to nearly Zero Energy Buildings (nZEB).

The main objective of SMART4NZEB is to create a sustainable collaboration, co-learning and capacity building between the involved partners - cluster managers and cluster members and relevant stakeholders representative for the nZEB market in the selected Central and East-European countries, with a view to develop the involved clusters management excellence and to support interregional partnerships to facilitate the development of competitive products and technological solutions intended for new and existing buildings, which will lead to market penetration of nearly zero energy buildings, related to their production, use and reuse. The objective is to drive clusters towards innovative and modern clusters being able to address cross-sectoral and cross border

1.1. Context of the Work Program

This document is developed within *WP4 Clusters' development and innovation strategies*. The main objective of this WP is to create transnational collaboration-based clusters' development strategies to boost competitiveness and support the scaling-up of SMEs active in construction, energy efficiency and renewable sectors through improved and tailored services offered by the clusters based on the specific needs of the involved SMEs. As a supplementary document, action plans for the participating clusters will be also developed, to ensure that the collaboration strategies in the field of nZEB are operational, functional and allow for progress monitoring. WP4 utilizes results of other technical workpackages (Figure 1). In particular, it uses results of the SWOT analysis from WP2, survey conducted among clusters members in WP3, and feedback from ClusterXchange study visits participants.

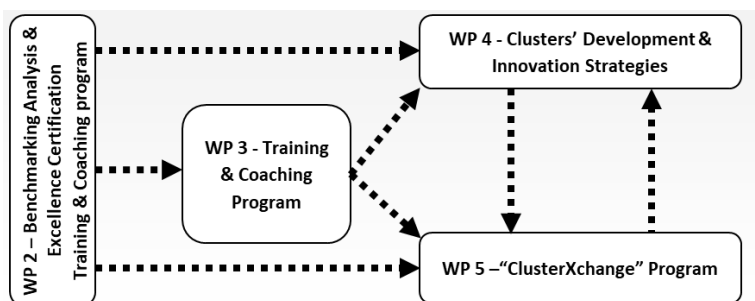


Figure 1 Workflow of SMART4NZEB project

1.2. Aim of the document

The aim of this document is to provide the Development and innovation strategy for the Bioenergy for the Region Cluster. The Strategy should be a comprehensive guidance for helping local stakeholders in regional development of nZEB through active engagement, cross-sectoral and transnational collaboration of clusters' members.

2. Global environment of the cluster

2.1. Global and European environment of the cluster

The main objective of the Bioenergy for the Region Cluster's activities is widely understood the development of renewable energy sources, supported by promotion of energy efficiency improvement. Renewable energy sources (wind, solar, hydroelectric, ocean energy, geothermal energy, biomass and biofuels) are an alternative to fossil fuels and contribute to reducing greenhouse gas emissions, diversifying energy supplies and reducing dependence on uncertain and unstable fossil fuel markets, especially oil and gas. Effective global action towards a safe and sustainable low-carbon and climate-resilient energy system is essential to tackling climate change and achieving the objectives of the 2030 Agenda, stated by the United Nations Department of Economic and Social Affairs. Central for such action is the provision of universal access to energy, wider deployment of renewable energy, increasing resilience of energy systems and improving energy efficiency. Progress toward the achievement of the UN the 7th Sustainable Development Goal (SDG7): ***Ensure access to affordable, reliable, sustainable and modern energy for all*** remains mixed and falls short of what is needed to reach the goal by 2030. Still more than a billion people, mostly in rural areas, live without the benefits of electricity, while about three billion people still lack access to clean and safe cooking fuels and technologies, with catastrophic consequences in terms 2 of over 4 million premature deaths due to indoor pollution affecting primarily women and children. While modern renewable energy is expanding rapidly in the electricity generation sector across the world, comparable progress has not occurred with renewable energy in the heat or transport sectors. Despite advancements in reducing energy intensity globally, progress is not yet sufficient to meet the energy efficiency target under SDG7. However, in opinion of The United Nations High-level Political Forum (HLPF), achieving SDG7 remains feasible. Despite the challenges, Forum emphasized that technological innovations, new business models and a growing number of best practices are bringing this goal within reach. To accelerate progress, they emphasized, among others, the need for:

- i. enabling environments including bold policies and stable regulatory conditions;
- ii. concerted action by public and private sectors to overcome financing challenges;
- iii. scaled up capacity building;
- iv. integrated, cross sectoral approaches to break the silos and operationally realize interlinkages;
- v. regional cooperation to promote harmonization, innovation and competitiveness.

On the European Union level, the EU legislation on the promotion of renewable energy sources and reducing energy consumption and energy losses has evolved considerably in recent years. In 2009, EU leaders set a target that by 2020, 20% of EU energy consumption should come from renewable sources, and the annual energy consumption should decrease by 20%. In 2018 *The Clean Energy for All Europeans* package was proposed. One of its purpose is to maintain the Union's position as a world leader in the field of renewable energy sources and, in a broader context, to help the Union meet its emission reduction commitments under the Paris Agreement. It sets a binding target that by 2030, final energy consumption in the Union should be obtained at least 32% from renewable sources, and a clause allowing this target to be increased by 2023. The energy efficiency target was set to decrease energy consumption by 32.5% by 2030. *The Clean Energy for All Europeans* legislative proposals covers energy efficiency, renewable energy, the design of the electricity market, security of electricity supply and governance rules for the Energy

Union. Energy efficiency measures are increasingly recognized as a means not only to achieve sustainable energy supply, reduce greenhouse gas emissions, improve security of supply and reduce import costs, but also to promote the Union's competitiveness. Energy efficiency is therefore a strategic priority of the Energy Union, and the EU promotes the principle of *energy efficiency first*. In addition, the Commission proposes a new way forward for Ecodesign as well as a strategy for connected and automated mobility. The package also includes actions to accelerate clean energy innovation and to renovate Europe's buildings. It provides measures to encourage public and private investment, promote EU industrial competitiveness and mitigate the societal impact of the clean energy transition.

	GREENHOUSE GAS EMISSIONS	RENEWABLE ENERGY	ENERGY EFFICIENCY
2020	-20%	20%	20%
2030	≤ -40%	≥ 32%	≥ 32.5%

Figure 2 Targets set by The Clean Energy for All Europeans package

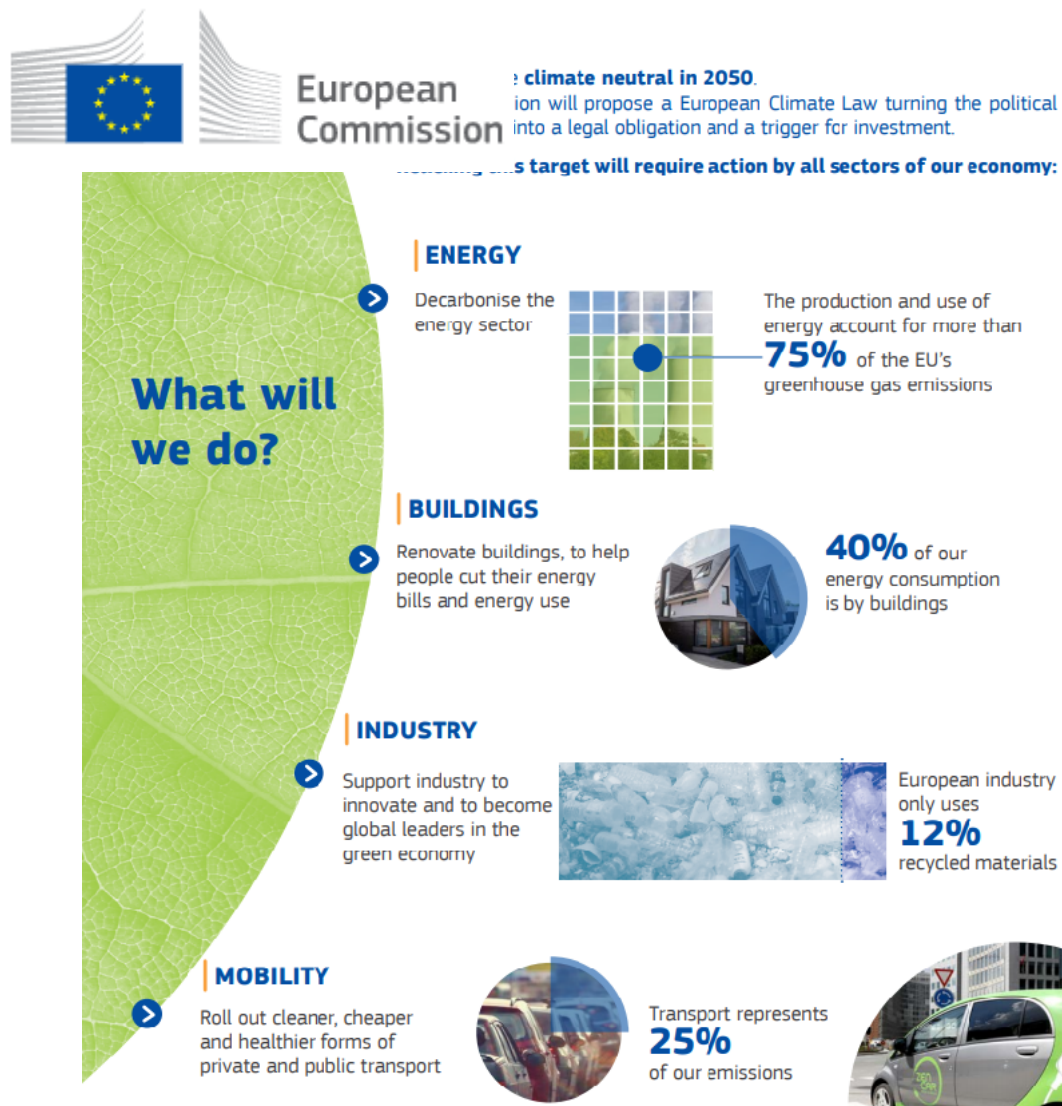
The European Commission promotes also increasing energy efficiency of the building stock. Buildings are the single largest energy consumer in Europe, as they are responsible for approximately 40% of EU energy consumption and 36% of CO₂ emissions. At present, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient. At the same time, only about 1% of the building stock is renovated each year. Renovation of existing buildings can lead to significant energy savings as it could reduce the EU's total energy consumption by 5-6% and lower CO₂ emissions by about 5%. Investments in energy efficiency stimulates the economy, especially the construction industry, which generates about 9% of Europe's GDP and directly accounts for 18 million direct jobs. SMEs in particular benefit from a boosted renovation market, as they contribute more than 70% of the value-added in EU's building sector. The Energy Performance of Buildings Directive (2010/31/EU - EPBD) updated in 2018 (2018/844/EU) requires that all EU Countries must establish a long-term renovation strategy to support the renovation of their national building stock into a highly energy efficient and decarbonised building. This is a one step forward the current target of all new buildings to be nearly zero-energy (nZEB) by 2020. **nZEB** have very high energy performance (in accordance with Annex I of the EPBD). The low amount of energy that these buildings require comes mostly from **renewable sources**.

On December 2019 European Commission presented *The European Green Deal* – a roadmap for making the EU's economy sustainable by turning climate and environmental challenges into opportunities across all policy areas and making the transition just and inclusive for all. Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, Europe needs a new growth strategy that transforms the Union into a modern, resource-efficient and competitive economy where:

- there are no net emissions of greenhouse gases by 2050;
- economic growth is decoupled from resource use;

- no person and no place is left behind.

The European Green Deal provides a roadmap with actions to boost the efficient use of resources by moving to a clean, circular economy and stop climate change, revert biodiversity loss and cut pollution. It outlines investments needed and financing tools available and explains how to ensure a just and inclusive transition. *The European Green Deal* covers all sectors of the economy, notably transport, energy, agriculture, buildings, and industries such as steel, cement, ICT, textiles and chemicals.

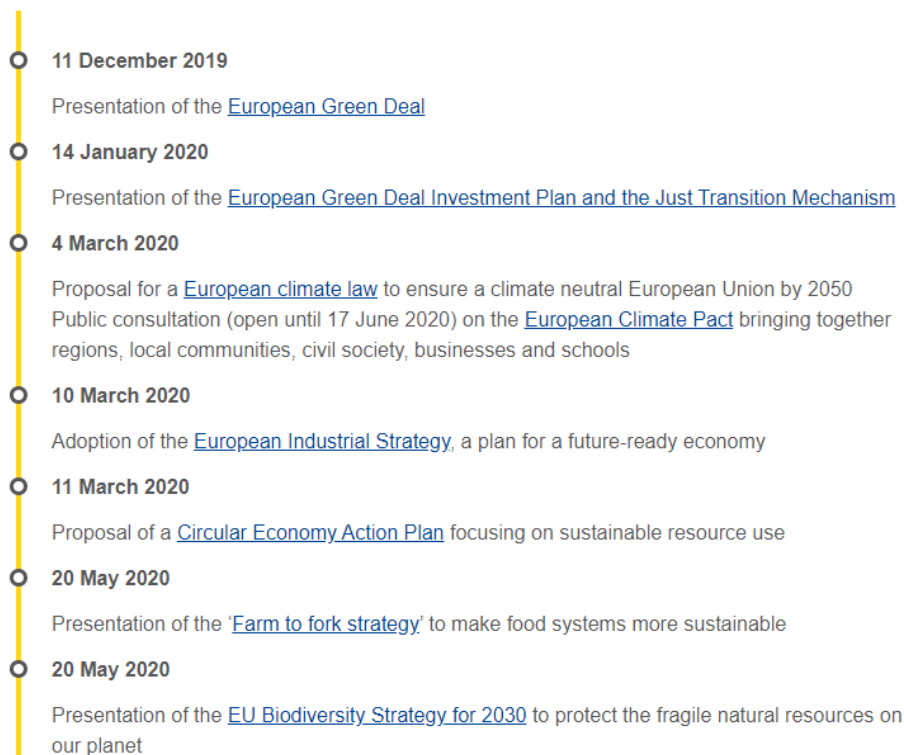


Source: What is the European Green Deal?,
https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6714

Meeting the objectives of *The European Green Deal* will require significant investment. Achieving the current 2030 climate and energy targets is estimated to require €260 billion of additional annual investment, representing about 1.5% of 2018 GDP. This investment will need the mobilization of the public and private sectors. The Commission will present in early 2020 a Sustainable Europe Investment Plan to help meet investment needs. At least 25% of the EU's long-term budget should be dedicated to climate

action, and the European Investment Bank, Europe's climate bank, will provide further support. For the private sector to contribute to financing the green transition, the Commission will present a Green Financing Strategy in 2020.

Timeline



Source: A European Green Deal. Striving to be the first climate-neutral continent.

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Bioenergy for the Region Cluster is one of the stakeholder of the global and European endeavors and participates in the global efforts related to renewable energy sources development together with the environmental protection actions, creating new economical resource management rules, and all kind energy production and the food processing as well as waste management technology development.

2.2. National context and policy framework

The specific objectives of Poland's energy policy focus on increasing the share of renewable energy in final energy consumption to 15.5% in 2020 (19.3% for electricity, 17% for heating and cooling, 10.2% for transport fuels). However, at the moment, Poland is one of the several member states of the European Union which probably will not meet its national target of 15% the share of renewable energy in 2020 on time. Achieving the 15% target renewable energy in the energy mix appears unreal: in 2018, this share was only 11.3%. The effects of renewable energy auctions organized in 2018-2020 are not enough to make up for this gap, especially since most of the new RES installations will be built after 2020. Therefore, in negotiations with the European Commission, the key year will be 2021, in which the Polish government will have to convince Brussels that Poland has permanently entered the path of real support for renewable

energy sources, and the acceleration in renewable energy development visible from 2018 will be continued. Poland should prove that, although we have not reached the threshold for 2020, we want to have a constructive share in the implementation of the EU goal for 2030. Such an approach will certainly meet with a positive reaction of the European Commission and may help to avoid penalties if the effects are visible. Otherwise, Poland will be exposed to a number of consequences.

In the context of energy efficiency, Polish goals have been set to reduce primary energy consumption in the years 2010-2020 by 13.6 Mtoe. This means that the absolute final energy consumption should not exceed 71.6 Mtoe, and primary energy consumption - 96.4 Mtoe in 2020. In the last decade the Polish government has established a set of programmes supporting energy efficiency improvement in all economy sectors, dedicated various bodies and industries, e.g. buildings, public bodies, SMEs, transport, power sector, and horizontal measures. These include e.g. energy efficiency obligation scheme (white certificates), energy audits and energy management systems in large companies, qualification, accreditation and certification schemes (energy performance of buildings certificate). In the context of buildings, in 2015 the Polish Government adopted the "The "National Plan aimed at increasing the number of nearly zero energy buildings". The document focuses on legislative changes necessary to increase the number of NZEB in Poland and indicates measures and programmes that can be used by bodies interested in the development of NZEB. Despite its name, the document does not include any action plan, understood as a set of tasks that should be performed, with timeline and responsibilities assigned. This resulted in poor recognisability of the NZEB concept in Poland.

The fact that Poland will not achieve the "3x20 Energy Policy" goals is due to the well-grounded energy mix and the lack of political decisions to change this mix. The fuel mix of electricity generation in Poland has been based predominantly on solid fuels for many decades. In addition, the generation power base is outdated. Many of the generating units are inefficient, uneconomic, and do not comply ecological standards, so they should be withdrawn from use in the near future. Poland, which consumes approximately 170 TWh of electricity, needs to determine the direction of the further development of the energy sector. The concepts of covering domestic demand for electricity were outlined by the government in the draft Energy Policy of Poland until 2040, where it was pointed out that the most important pillars of the Energy Policy should be the following:

- i. the energy security of the country,
- ii. competitiveness,
- iii. the improvement of the energy efficiency of the economy,
- iv. limiting the impact on the environment.

In line with the Paris Climate Agreement the governments of EU countries have declared coal phase-out by 2030. Poland is one of the few countries in which such a scheme is not considered. One of the most important documents resulting from the regulations and directives of the European Parliament and the Council, the *National Energy and Climate Plan for 2021–2030* and the *Energy Policy of Poland until 2040*, are currently in the discussion phase. The 6th goal of the Energy Policy until 2040 is the development of renewable energy sources thanks to:

- lowering the emission intensity of the energy sector and the diversification of energy generation;
- a 21% renewable energy sources (RES) in gross final energy consumption in 2030 in Poland is planned;

- 1–1.3% of annual consumption should increase in heating and cooling, maintaining the increase in the electricity sector;
- the implementation of offshore wind energy,
- 10% and 14% RES in transport in 2020 and 2030,
- development of distributed production renewable energy system,
- the possibility of RES balancing (storage sites, energy clusters, regulatory sources),
- financial support system dedicated to the renewable energy sources development.

'Bioenergy for the Region' is a co-operation platform of companies, research institutions, local administration and business support institutions. The main aim of our co-operation is sustainable energy development in Central Poland. In the context of the climate change, we promote innovative solutions in renewable power engineering in local and regional dimensions.

'Bioenergy for the Region' Cluster aims to achieve its purposes through:

- complex solution of issues concerning the regulation of the biomass market in Central Poland, in particular the methods of collection, processing and use as a RES;
- integration of members of the Cluster - businesses, researchers and local authorities in order to increase the share of solar and wind energy in the energy balance of the region;
- educational and information activities, promoting the use of renewable energy and energy efficiency.

2.3. Technology development trends in the energy efficiency and RES industry

Two basic trends in the development of energy technologies in Poland can be observed: the first concerns clean coal technologies, and the second - renewable energy technologies.

The lack of a clear national strategy in the field of renewable energy sources development and the lack of consideration in Polish industrial policy of the need to promote and shape the development of the RES production industry have slowed down the formation of larger RES production companies, which could become global or even EU or domestic market leaders in their areas. However, many companies have already been established that significantly meet the needs of the domestic market of RES and have made efforts for international expansion. The RES production sector is not monitored in Poland in a systematic and complete way, it is not included in national statistics. Domestic producers of renewable energy devices are also not widely represented in industry associations and chambers of commerce, which is why little is known about the problems and needs of device manufacturers. There is a noticeable tendency to increase in the share and number of companies of RES production specialization with multi-branch character, producing various components and devices not specific for renewable energy, and a trend to decrease in the number of companies specializing in the production of basic devices, key for a the renewable energy sources industry. Another observation shows that the RES company engage only around 20-40% of their technological capacity for the production. This trend has been continued for at least two decades and leads to unprofitability of the domestic RES industry and total dependence on the import of modern technologies for renewable energy source development.

The Polish renewable energy industry does not develop its own proprietary, exclusive technologies, but is based on solutions and technologies obtained from abroad. Components for the construction of solar farms and wind farms are imported. The main PVP suppliers are Chinese companies, like JA Solar, Trina Solar, JinkoSolar etc., while the largest producers of wind turbines are Danish Vestas, Danish-Japanese MHI Vestas, Siemens Gamesa, General Electric and companies from China. Wind power net capacity installed in Poland was 5.766.1 MW at the end of 2018, but electricity production from wind power in 2018 was 12.799 TWh and it was lower than in 2017 about 15%. Installed solar photovoltaic net capacity in Poland was 562.0 MW in the end of 2018 and it was doubled power comparing the PVP capacity to 2017 year.

Building energy efficiency technologies can be divided into two main categories: technologies improving energy efficiency of traditional buildings (both new and existing ones), and novel technologies of buildings construction.

The first group consists of solutions improving energy performance of a building, such as:

- insulation systems of the exterior surface (walls, ceilings), e.g. mineral wool, styrofoam,
- energy efficient windows,
- heat and power source: gas and biomass boilers, heat pumps, electric heating (e.g. electric mats),
- heating distributions system elements, e.g. thermostatic valves,
- LED lighting,
- ventilation systems, e.g. heat recovery systems,
- efficient pumps, insulation of pipes, effective and optimized control,
- energy management and control systems.

Most of these technologies that are applied in Poland are of foreign origin – they are imported to Poland and Polish companies only distribute and/or install them. There are however a few exceptions. Polish windows producers (Drutex, Oknoplast) have a strong position on both national and international market and provide high quality energy efficient windows solutions. The boiler market is dominated in Poland by domestic manufacturers, both large companies and SMEs. In fact, they are dynamically developing their businesses due to the coal ban introduced by many Polish municipalities in recent years – they shift from coal to biomass highly efficient biomass boilers.

Novel building technologies include mainly prefabricated components (e.g. façade panels) and buildings. They are offered usually by SMEs (often start-ups). Prefabrication can reduce construction time significantly, and can provide higher energy performance standard, due to limited risk of human mistake at a construction site. Companies offering this type of buildings often advertise their products as highly efficient, zero- or even plus-energy constructions. This market is developing, however still quite small. Example of companies: Budihome, Box Haus, Solace house, Ecologic.

2.4. Market trends in the energy efficiency and RES industry

After two years of stagnation, total RES capacity in Poland grew by 6% in 2019, reaching 9106 MW (Figure 3). The highest share in this growth had photovoltaics (331 MW, 64% of the total increase), followed by biomass (130 MW, 25%). Despite the recent inhibition in the wind energy sector, it stays the largest RES branch in Poland with the capacity of 5916 MW (65% of share). It is followed by biomass (1492 MW, 16.4%) and water (973, 10.7 MW). All these three subsectors (wind, water, biomass) are a part of the power system in Poland, providing electricity on a large scale. This is reflected in the size of an average installation – for biomass it is 28.7 MW (usually biomass boilers in power and CHP plants), for wind turbines – 4.9 MW, and for water – 1.3 MW (Figure 5). On contrary, PV installations are rather small – 400 kW on average. They are developed both by large companies, SMEs and private consumers. The largest PV plant of a capacity of 3.77 MW is located in Czernikowo (WNP 2019), and is owned by Energa, a state-owned large energy supplier and distributor. The PV market is driven by small customers, buying installations for their own needs. In 2019 the total number of PV prosumers in Poland (usually households possessing small PV installation) increased almost threefold, from 51 thous. to 149 thous. This is mainly due to governmental programme “Mój Prąd” (My electricity) providing up to 5000 PLN (~1200 EUR) donation for households for small scale PV installations (2-10 kWp), but also decreasing prices of PV and rising electricity costs. Small installations have a share of 70% of a total PV capacity in Poland (IEO 2020). It is expected that by the end of 2020 the total PV market in Poland will reach PLN 5 billion (IEO 2020).

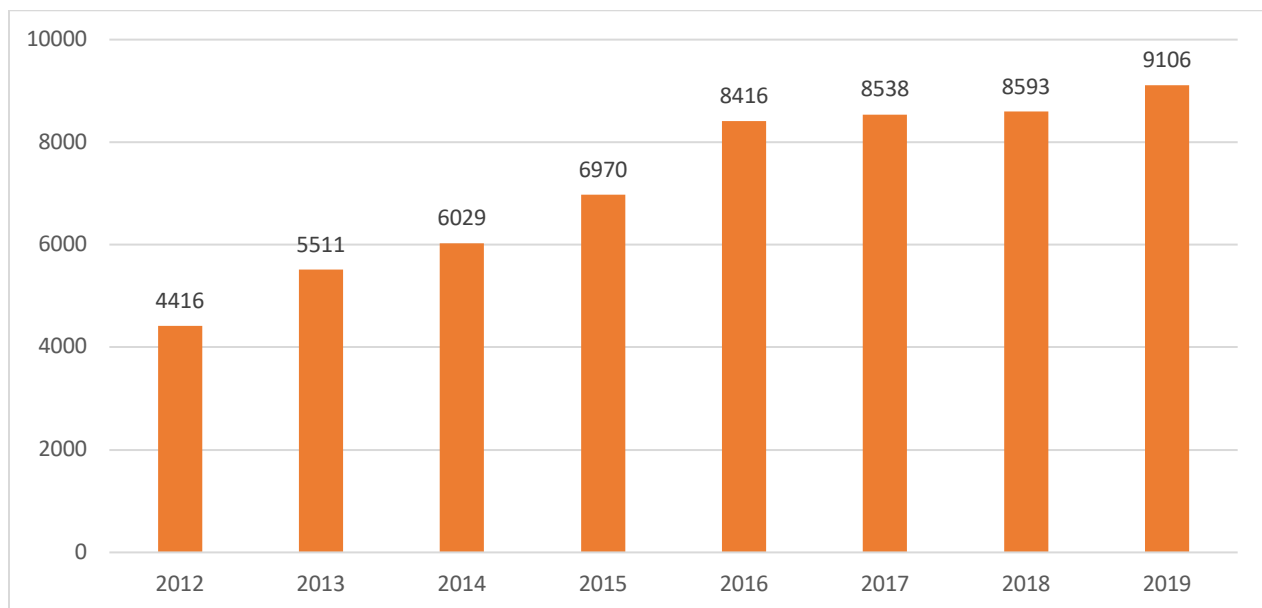


Figure 3 RES capacity in Poland, 2012-2019 (MW) (Rynek Elektryczny 2020)

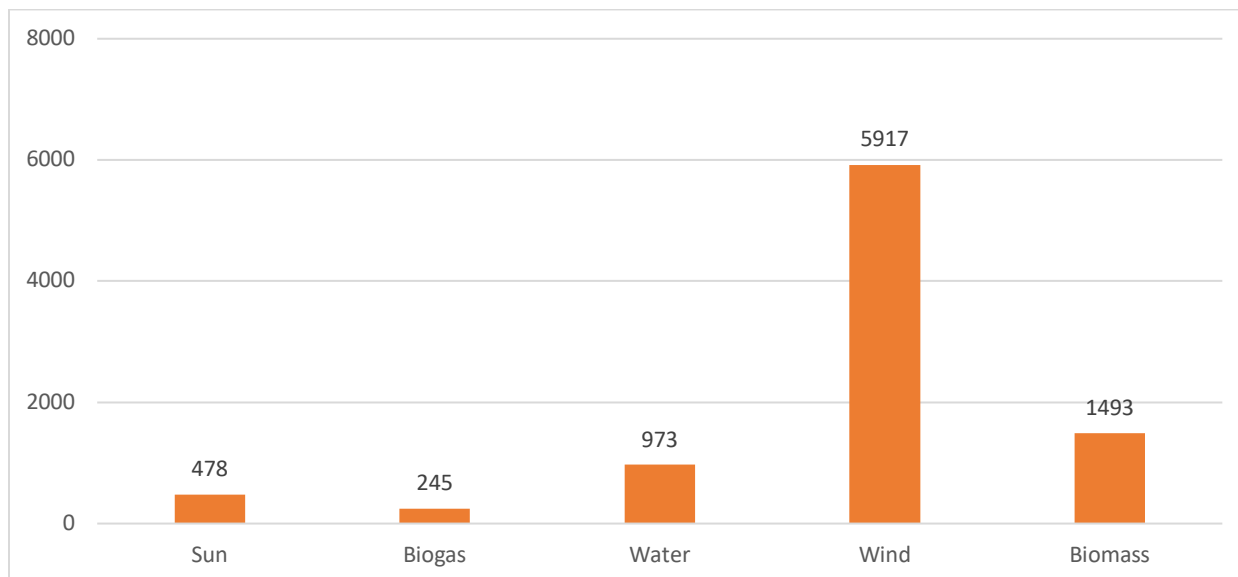


Figure 4 RES structure in Poland, 2019 (MW) (Rynek Elektryczny 2020)

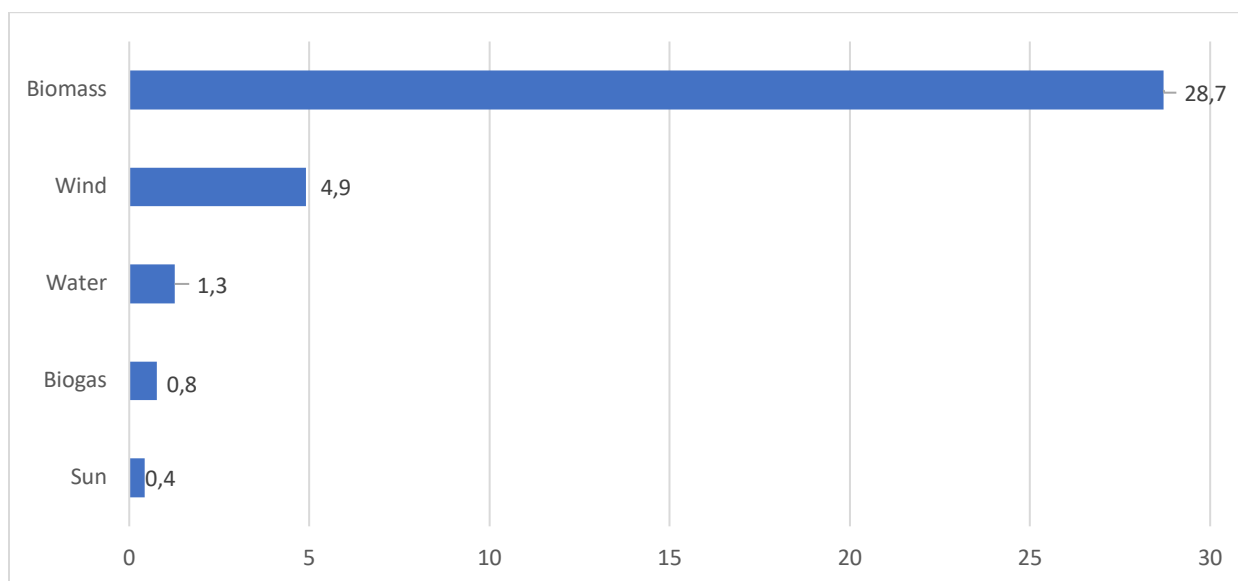


Figure 5 Average capacity of RES installations, 2019 (MW)

Energy efficiency market in Poland is focused on two main sectors: industry and buildings. Large companies are obliged by the Energy efficiency act to conduct an energy audit every 4 years unless they implemented an energy management system or environment energy system (EMAS). The first due date was set to 1 October 2017 and effected in a massive demand for services of energy auditors in 2017. Similar wave is expected in 2021. The building energy efficiency market is more stable, however it is also driven by governmental and local policies. Following regulations of the Environment Protection Act, since July 2018 it is not possible to sell a solid fuel boiler of a class lower than 5, according to PN-EN 303-5. In fact, in many municipalities burning solid fuel is illegal, according to “ani-smog acts”. Households are

encouraged to install ecological heating sources, in particular district heating, heat pumps and gas boilers. This is supported by the governmental programme “Clean Air” (Czyste Powierze) providing grants for owners of private residential buildings for a thermal modernization of a building and exchange of a heating source. It is possible to get up to 30,000 PLN in case the modernization includes a heat pump and PV, or 20,000 PLN for only a heating source exchange. Total budget of the programme is PLN 103 billion and is implemented between 2018 and 2030 (NFOŚiGW n.d.). It is expected that this programme will boost the ecological heating sources market.

Gas boilers are still the most popular heating source in single-family buildings. 47% of newly sold heating devices were gas boilers (Figure 6). Heat pumps have the smallest share, but this market has been continuously growing in recent years. It is estimated that there are already 128,000 heat pumps installed in Polish households. They are used for space heating and domestic hot water heating. In 2019 it increased by 37% and considering only heat pumps dedicated to central heating systems – by 64%. This translates to 42,800 heat pumps sold. The market leader are air-to-water heat pumps – their sales raised by 91% in 2019, compared to 2018, reaching 20,000 units. Since the “Clean Air” programme launching, almost 18,000 heat pumps have been installed thanks to this grant. It is expected that by 2030 there will be between 1.09-2.09 mln heat pumps installed in Polish households, reaching 10-22.8% share of the heating sources (Port PC 2020).

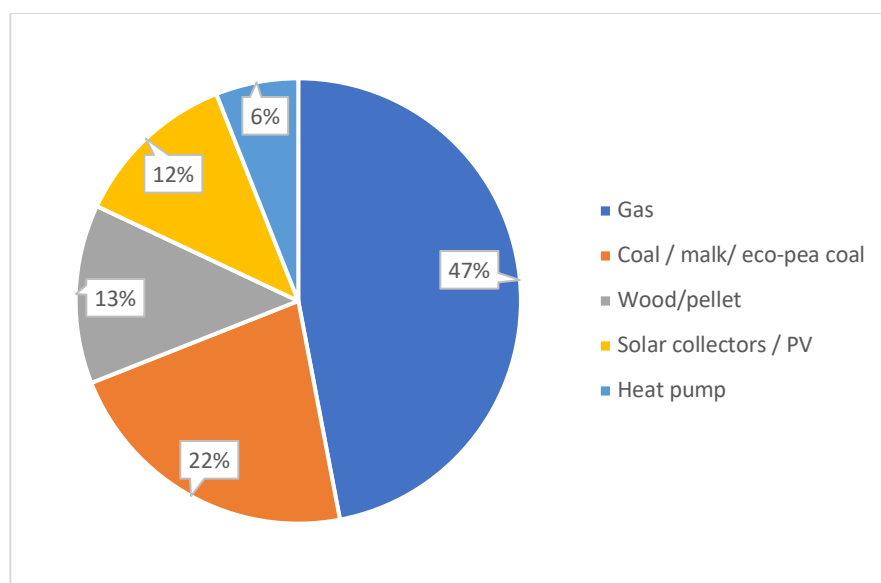


Figure 6 Sales of heating devices by fuel type/medium in 2019 (SPIUG 2020)

2.5. External resources available for the cluster development

The first cluster in Poland started its activity in 2003. Since then, over 150 clusters representing 28 branches have been established. Since the beginning they have been funded and developed thanks to work and donation of their members. In 2011 the Ministry of Economy and Polish Agency for Enterprise Development inaugurated a working group for cluster policy. In 2014 the working group recommended that the main goal of cluster policy should be to strengthen the innovation and competitiveness of the Polish economy based on the intensification of cooperation, interaction and knowledge sharing within

clusters, and to support the development of strategic economic specializations. In fact, the suggestion was that the financial support should be available only for Key National Clusters (Krajowy Klaster Kluczowy, KKK).

National Key Cluster (KKK) is a cluster of significant importance for the Poland's economy and high international competitiveness. KKKs are identified at national level, based on the following criteria: critical mass, development and innovation potential, existing and planned cooperation, experience and potential of the cluster coordinator. KKKs are selected in an open competition organised by the Ministry of Entrepreneurship and Technology in cooperation with the Polish Agency for Enterprise Development. As of July 2020, there are 15 KKKs.

Direct public support for clusters is available from Smart Growth Operational Programme and Eastern Poland Operational Programme:

- Internationalization of the KKK - an instrument dedicated directly to clusters (EUR 33.25 million);
- Preferences for projects submitted by members of the KKK (additional points for membership in the KKK granted at the stage of proposal evaluation);
- Support for supra-regional cooperation links (EUR 100 million).

3. Cluster overview

3.1. History of the cluster

The Bioenergy for the Region Cluster (B4R) has been established in April 2007 as a bottom-up initiative of companies, local authorities and research institutions based in Łódź Voivodeship. It is an open cooperation initiative, which in the mid-2020 brought together 53 SMEs, 3 large enterprises, 7 research institutes, 11 public authorities and 6 business environment institutions, a total of 80 entities operating in renewable energy sources and energy efficiency area. The cluster's goal is to work for the sustainable bioenergy development of the Central Poland in the context of the European Commission's policy in the field of energy and climate change.

3.2. Cluster coordinator

Research and Innovation Centre Pro-Akademia (RIC Pro-Akademia) is the first professional non-governmental public benefit research organization in Poland, established in Lodz in 1996. In its scientific and research activities, the organization focuses on interdisciplinarity, multi-sectoral and international cooperation. RIC Pro-Akademia employs 20 permanent experts and collaborates with over 150 external professionals in the field of technology, economics and social science. The main source of financial income of RIC Pro-Akademia are project grants (~60%), followed by direct contracts with SMEs and public authorities for conducting tailored research actives (~35%).

3.3. Cluster activity and technology background

As of June 2020, the cluster is composed of 80 members (Table 1), excluding the coordinator. The cluster is balanced in terms of the members structure, since it associates all type of entities. Most of the members are SMEs (53), followed by Public authorities (11) and Research and education institutions (7) (Figure 7). Core activity of the cluster members is related to biomass energy, energy efficiency and other renewable energy sources, in particular solar and HVAC installations. Members dealing with biomass cover the whole

value chain: production of energy plants (e.g. Gospodarstwo Rolne Tomasz Maciaszczyk), production and sales of fuels from biomass (e.g. Pellet Energy Sp. z o.o., Firma Handlowo Usługowa Krzysztof Kłys), production of energy (e.g. BIOENERGY PROJECT Sp. z o. o.), manufacturing of machines and tools for the biomass industry (e.g. EKO-MAX Sp.z o.o), as well as R&D in the field of biomass cultivation (e.g. Instytut Ogrodnictwa). Members working in the field of energy efficiency focus on providing advisory services, including energy audits and energy management (e.g. Agencja Użytkowania i Poszanowania Energii Sp. z o. o., Projekt Grupa Witold Kurczyński). This group consist of also construction companies providing passive and energy efficient buildings (e.g. INWESTOR Janusz Mostowski, Przedsiębiorstwo "MAGNUS" Arkadiusz Muszyński). Companies from the solar energy sector deliver mainly PV installations, sometimes combined with heating systems and smart building systems. 11 members and the coordinator provide research and education services, in particular in RES and energy efficiency fields. Key R&D&I players are RIC Pro-Akademia which initiates most of the joint research projects among cluster members, but also Łódź University of Technology, Instytut Energetyki and Instytut Ogrodnictwa.

Examples of already implemented projects:

- Testing and implementation of a pilot service in the field of management of energy efficiency in an enterprise – RIC Pro-Akademia conducted a series of free-of-charge energy audits of SMEs that resulted in increasing their energy efficiency.
- Construction of a Technology Transfer Center in the field of Renewable Energy Sources – The main goal of the project was to increase the innovativeness of enterprises associated in the Bioenergy for the Region Cluster by providing a common laboratory area that would be used for development of innovative products and services.
- Sustainable Energy Action Plan for Konstancin Łódzki– RIC Pro-Akademia developed a SEAP for Municipality of Konstancin Łódzki. The plan sets energy efficiency, RES and CO2 emissions targets, as well as an action plan.
- Efficiency of energy clusters in the Visegrad Region – RIC Pro-Akademia conducted a research on the effectiveness of Polish energy clusters, in particular in the view of the cluster policy at the central level in Poland and provided conclusions for the final report on the cluster policy of the Visegrad Group.

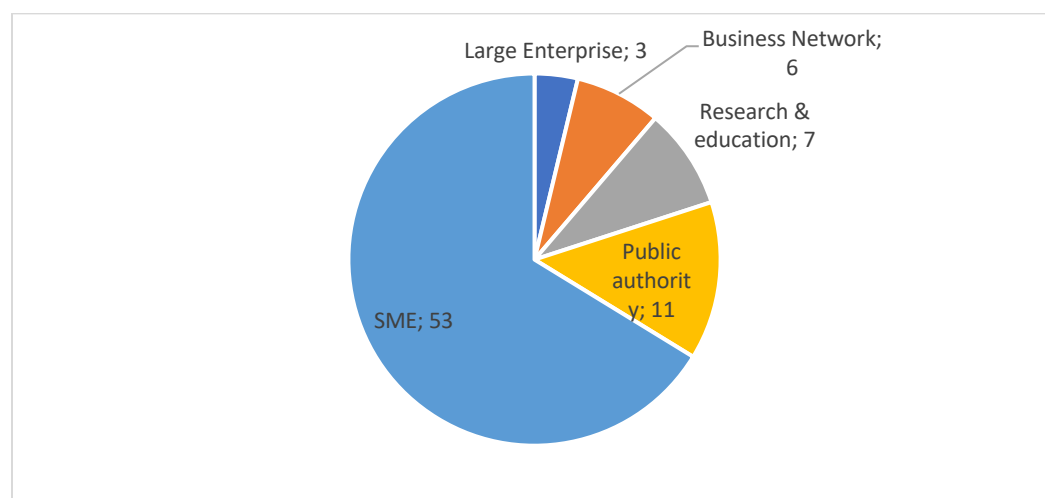


Figure 7 Structure of the cluster's members

Table 1 Cluster members as of 20 July 2020

N	Name	Type	Field of expertise	website
1)	Agencja Użytkowania i Poszanowania Energii Sp. z o. o.	Business Network	Energy efficiency advisory services. Energy audits, economic analysis of fuel efficiency. Supporting ecological activities.	http://www.auipe.pl
2)	ALLMENDINGER Sp. z o. o.	SME	Supplier of individual, energy-saving solutions for the construction industry	http://www.allmendinger.pl
3)	BIOENERGY PROJECT Sp. z o. o.	SME	Production of bioenergy using plant substrates. Owner of an agricultural biogas plant.	http://bep.net.pl
4)	Biomass Training Research Szymon Szufa	SME	Advanced services in the field of innovative methods of biomass processing.	-
5)	Bracia Kolanowscy Ogrody Marcin Kolanowski	SME	Production of energy plants, services in the field of biomass cultivation. Modern and energy-saving technologies for individual recipients and projects.	http://kolanobros.pl
6)	BRANDEKO A. Dębski	SME	Heating, gas and air conditioning installations	http://www.brandeko.pl/
7)	CELMIT Sergiusz Janowski	SME	Wholesale of frozen fruit and vegetables, herbs, concentrates, sugar, fats, oils and vegetable meals with the management of organic waste for energy purposes.	http://www.celmit.pl
8)	Centrum Transferu Technologii Uniwersytetu Łódzkiego	Business Network	Education, training and consulting in the field of innovative ideas in the scientific, business and public sphere. Technology transfer from universities and research units to enterprises.	http://www.ctt.uni.lodz.pl/
9)	CONSENSUS Rafał Klimaszewski	SME	Services in the field of effective energy management in real estate.	http://www.consensus.net.pl/
10)	CWD Sp. z o.o.	SME	Production, sale and export of innovative biomass boilers.	http://grupa-cwd.pl/
11)	EGC Sp.z o.o	SME	Consultation services for cluster members in the preparation of grant applications for projects related to renewable energy.	http://www.egc.pl/
12)	EKO-CAL BIS Sitarek Spółka Jawna	SME	Production of energy-saving central heating boilers.	-
13)	EKO-MAX Sp.z o.o	SME	Production of granulators for pellets from agricultural biomass and low and medium power boilers for efficient and energy-efficient heating of houses and industrial facilities.	-
14)	EKO-PLAN Krzysztof Łudczak	SME	Energy assessments of flats, buildings, single-family houses, terraced houses and all building structures, as well as certification of entire housing estates. Energy certificates and energy audits.	http://www.eko-plan.com.pl
15)	EKO-RABEX Sp.z o.o	SME	Wholesale of fuels and related products.	-
16)	ELBIS Sp.z o.o.	SME	Contract project manager in the implementation of investment in wind park projects.	https://elb2.pl/
17)	Energia Słońca - QEko	SME	Photovoltaics	https://energiaslonca.pl
18)	ERGOM Sp. z o. o.	SME	Supplier of electrical equipment for energy, automotive, telecommunications and RES.	https://www.ergom.com/
19)	Ericpol Sp.z o.o.	Large Enterprise	Professional ICT products for the needs of renewable energy project management, energy control in buildings, increasing energy efficiency.	https://www.ericpol.pl/
20)	Europejskie Centrum Gospodarcze Sp. z o.o	SME	Agricultural production. Management of agricultural, organic waste for energy production in a biogas plant.	http://www.ecg.net.pl/

21)	Firma Handlowo Usługowa FUNZON Marek Tworek	SME	Distributor of ecological motor vehicles and electric bikes.	https://funzon.pl/
22)	Firma Handlowo Usługowa Krzysztof Kłys	SME	Sales of energy fuels	http://opaltuszyn.pl/
23)	Gmina Daszyna	Public authority	Supporting local enterprises for activity in the field of renewable energy sources and focusing on the development of the commune on renewable energy sources. The BdlaR cluster projects were implemented in the Daszyna commune.	http://www.daszyna.4bip.pl
24)	Gmina Konstantynów Łódzki	Public authority	Supporting local enterprises in the field of renewable energy sources and focusing on renewable energy sources.	https://www.konstantynow.pl
25)	Gmina Lipce Reymontowskie	Public authority	Supporting local enterprises operating in the field of renewable energy sources, especially solar energy and biomass plants.	http://www.lipcereymontowskie.pl
26)	Gmina Miasto Łęczyca	Public authority	Supporting the development of enterprises running a business in the field of renewable energy sources and focusing on the city's development on energy efficiency, low-emission transport and renewable energy sources.	https://leczyca.info.pl
27)	Gmina Wodzierady	Public authority	Supporting the development of enterprises in the field of renewable energy sources, especially wind energy.	https://wodzierady.pl/
28)	Gospodarstwo Rolne Tomasz Maciaszczyk	SME	Production of energy willow plants on the area of 5 hectares.	-
29)	HIACYNT Jacek Duda M	SME	Wholesale trade services of fruit and vegetables. Organic waste management for energy purposes.	-
30)	HPI Polska	SME	Distributor of car modeling. Owner of the track for racing car models using renewable energy.	https://hpi.pl/
31)	Instytut Energetyki - Instytut Badawczy	Research & education	R&D in the field of biomass cultivation and processing, selection of the right types of energy plants and algae for natural conditions, research on remediation of degraded soils through biomass cultivation and cultivation of plants fertilized with sewage sludge.	https://www.ien.com.pl/
32)	Instytut Ogrodnictwa	Research & education	R&D in the field of biomass cultivation and processing, selection of the right types of energy plants and algae for natural conditions, research on remediation of degraded soils through biomass cultivation and cultivation of plants fertilized with sewage sludge.	http://www.inhort.pl/
33)	Instytut Szkoleń i Doradztwa Sp. z o.o. (poprzednia nazwa: Ustronna Media Sp. z o.o.)	SME	Training and consulting company offering services in the field of obtaining external financing, among others, for investments in renewable energy.	http://isid.pl/
34)	Instytut Technologiczno - Przyrodniczy	Research & education	Expertise on biofuels, solar and geothermal energy.	https://www.itp.edu.pl/
35)	INWESTOR Janusz Mostowski)	SME	Construction company interested in developing passive technologies.	http://www.inwestor.lowicz.pl/
36)	ISO Studio	SME	Design and graphic services for companies operating in the renewable energy area, as well as active activity for sustainable bioenergetic development of the Lodz region.	https://iso100studio.com

37)	JANIS Sp. z o.o. Sp. K.	SME	Wide range of services, including innovative finishing of fabrics with silver nanoparticles.	http://www.janis.pl/
38)	Kral Sp. z o.o	SME	Recycling services in the field of building materials.	http://www.kral.lodz.pl
39)	KROBAN	SME	Medical devices in the area of neonatology produced with environmentally friendly methods.	https://www.kroban.pl/
40)	Łódzka Rada Federacji Stowarzyszeń Naukowo-Technicznych - NOT	Business Network	Supporting enterprises in solving specific technical and economic issues.	http://not.lodz.pl/
41)	Łódzki Ośrodek Doradztwa Rolniczego	Business Network	Development and innovation in the field of ecology and environmental protection	https://lodr-bratoszewice.pl/
42)	Łódzki Regionalny Park Naukowo-Technologiczny Sp. z o.o	Business Network	R&D in the field of modern technologies. Public aid for SMEs interested in laboratory research and implementation of innovative technologies. Research services in the fields of biochemistry and bioprocesses.	http://bionanopark.pl/
43)	M7 GRUPA Sp. z o.o	SME	Floor panels, skirting boards and doors used, among others, in homes and energy-saving facilities.	-
44)	Madej Wróbel Sp.z o.o	Large Enterprise	Oriented to modern technologies of energy processing of animal biomass waste and reducing the cost of the technological processes through the use of renewable energy sources.	http://www.madejwrob.el.pl/
45)	Mariusz Zatylny Architekt	SME	Designing energy-efficient buildings, passive architecture, Interest in the subject of available social bio-building and sustainable social development	-
46)	Miasto Bełchatów	Public authority	Supporting local of enterprises conducting business activities in the field of renewable energy sources, energy mix and waste recycling and waste transformation for energy purposes.	https://www.belchatow.pl/
47)	Międzynarodowe Centrum Ekologii PAN	Public authority	R&D in the field of aquatic ecosystems, broadly understood hydrology and early warning systems for floods.	https://instytucja.pan.pl
48)	Municipality of Parzęczew	Public authority	Municipality interested in development of RES	http://www.parzeczew.pl
49)	Neostar Green Energy sp. z o.o	SME	Energy consulting with particular emphasis on renewable energy and environmental issues.	-
50)	P.P.H. MAWi Mariola Zięba	SME	Services in installation of combined heating systems, including floor heating, solar systems and other elements using renewable energy.	https://mawi.com.pl
51)	P.P.H.U. LUKAN Export-import Anna Klimek	SME	Production process of outerwear with energy from renewable sources.	http://lukan.com.pl/
52)	Pellet Energy Sp. z o.o.	SME	Production of ecological solid fuel - pellets, as well as a provider of comprehensive energy solutions using biofuels.	https://www.pelletenergy.pl/pl/
53)	PERLIPOL K.Kuśmierk, G.Derlatka, J.Benben spółka jawna	SME	Production of perlite.	https://www.perlipol.com.pl/
54)	PHU Dytrych Sp. z o.o.	SME	A construction company focusing mainly on the revitalization of post-factory and residential buildings, including energy-efficient technologies and renewable energy.	http://www.dytrych.pl/
55)	PHU Lider-S	SME	Solar power plants built based on polycrystalline modules.	-

56)	PolContact Krzysztof Śniegula	SME	Electric heating systems, PV, smart building systems	https://polcontact.pl
57)	Politechnika Łódzka Instytut Architektury i Urbanistyki	Research & education	R&D in the field of energy efficiency of buildings and eco-design.	http://www.bais.p.lodz.pl
58)	Politechnika Łódzka, Wydział Inżynierii Procesowej i Ochrony Środowiska	Research & education	R&D in the field of energy processing of biomass and organic waste, including the use of sewage sludge.	http://www.bais.p.lodz.pl
59)	Politechnika Łódzka, Wydział Mechaniczny	Research & education	Research on energetics and energy mechanics.	https://www.mechaniczny.p.lodz.pl/
60)	Politechnika Łódzka, Wydział Organizacji i Zarządzania	Research & education	R&D in management processes in the production and services sector on the renewable energy market.	https://www.p.lodz.pl/wydzial-organizacji-zarzadzania
61)	Polska Izba Biomasy	Business Network	Support in the creation and implementation of biomass and biogas investments.	http://www.biomasa.org.pl/
62)	Projekt Grupa Witold Kurczyński	SME	Energy audits services.	http://projekt-grupa.firmy.net/
63)	Przedsiębiorstwo "MAGNUS" Arkadiusz Muszyński	SME	All-year wooden and summer houses made of logs - with thermal isolation and closed frame construction built with renewable energy.	-
64)	Przedsiębiorstwo Gospodarki Komunalnej Daszyna Sp. z o.o	Public authority	Development of renewable energy sources in the Daszyna area.	http://www.pgkdaszyn.a.pl
65)	Przedsiębiorstwo Innowacyjne VIRTECH	SME	Photovoltaic, wind and water power plants.	https://virtech.pl
66)	Przedsiębiorstwo Instalacyjno-Budowlane INSBUD Krzesińscy sp.j.	SME	Energy-saving construction using renewable energy	-
67)	Przedsiębiorstwo Produkcyjne MDEkoPower Sp. z o.o	SME	Innovative technologies - renewable energy sources and thermo-modernization	-
68)	Przedsiębiorstwo Wielobranżowe ANPOL Rajmund Andrych	SME	Company trades and produces biomass	http://anpol-biskupice.pl
69)	PWPUIH "Inter Solar" Sp. z o.o.	SME	Manufacturer of traditional food interested in implementing renewable energy technologies. Potential investments in the area of photovoltaics, production of biofuels based on algae and wind energy.	http://intersolar.com.pl
70)	SAM-ROL Sp.z o.o	SME	Trade agency, machines for cultivation of energy plants.	http://www.sam-rol.pl
71)	Starostwo Powiatowe w Poddębicach	Public authority	Supporting the local enterprises conducting business activity in the field of renewable energy sources and focusing on the development of the area for renewable energy sources, especially solar energy and geothermal energy.	https://www.poddebicki.pl
72)	Starostwo Powiatowe w Skierniewicach/ Powiat skierniewicki	Public authority	Supporting the local enterprises conducting business activity in the field of renewable energy sources and focusing on the development of the area for renewable energy sources, especially solar energy and geothermal energy.	http://powiat-skierniewice.pl
73)	SUNRISE Adam Świerczyński	SME	Electrical and photovoltaic installations.	http://sunrisefotowoltaika.pl
74)	Sylwan Ewelina Chlebowska	SME	Modern solutions in the field of generating energy from a renewable source – wind.	-

75)	Tanieogrzewanie sp. jawna	SME	Services; maintenance of renewable energy devices.	https://tanieogrzewanie.pl/
76)	TEX INWESTYCJE Sp. z o.o.	SME	Heating, gas and air conditioning installations	-
77)	Trimen Chemicals S.A.)	SME	Synthetic and analytical services for biochemical, biotechnology, pharmaceutical companies	https://www.trimen.pl/
78)	Veolia Energia Łódź S.A.	Large Enterprise	Energy audits, implementation of a media consumption optimization plan, modernization of energy equipment, systems encouraging energy savings.	https://www.veolia.pl/
79)	WI-BUD Witold Janczak	SME	Ventilation installations with heat recovery (recuperation), solar systems and the provision of advisory services related to the energy efficiency of buildings.	https://centrumrekuperacji.pl/
80)	WIND-HYDRO Grzegorz Łukasiewicz	SME	Technical consultancy, engineering and design in the field of water management techniques.	https://windhydro.pl/

3.4. International orientation and positioning of the cluster

The development of renewable energy sector is a global challenge that goes beyond a single region or country. That is why the Bioenergy for the Region Cluster actively collaborate with international partners. The aim of this collaboration is:

- improvement of the image of Poland as an attractive economic partner in the field of renewable energy and a place to establish valuable business contacts and conducting environmentally friendly business activities,
- foster the international knowledge and experience exchange in the field of renewables,
- promote international partnerships of members of the Bioenergy for the Region Cluster.

To this end, the Bioenergy for the Region Cluster is a part of the following international networks:

⇒ **European Cluster Collaboration Platform**

The European Cluster Collaboration Platform is a service facility aiming to provide cluster organisations with modern tools allowing to

- make efficient use of networking instruments (search/find potential partners and opportunities)
- develop collaboration trans-nationally (within Europe) and internationally (beyond Europe)
- support the emergence of new value chains through cross-sectorial cooperation
- access the latest quality information on cluster development
- improve their performance and increase their – as well as their members' – competitiveness.

⇒ **Cluster-Dialogue Germany-Poland**

The main goal of the network is to initiate joint economic and research projects between clusters from Poland and Germany. The "Cluster-Dialogue Germany-Poland" network includes:

- deENet Kompetenznetzwerk Dezentraler Energietechnologien e.V.
- East-West-Science Center - University of Kassel
- Dr. Grundmann Consult
- Bioenergy Cluster for the Region

⇒ **TREC Danube**

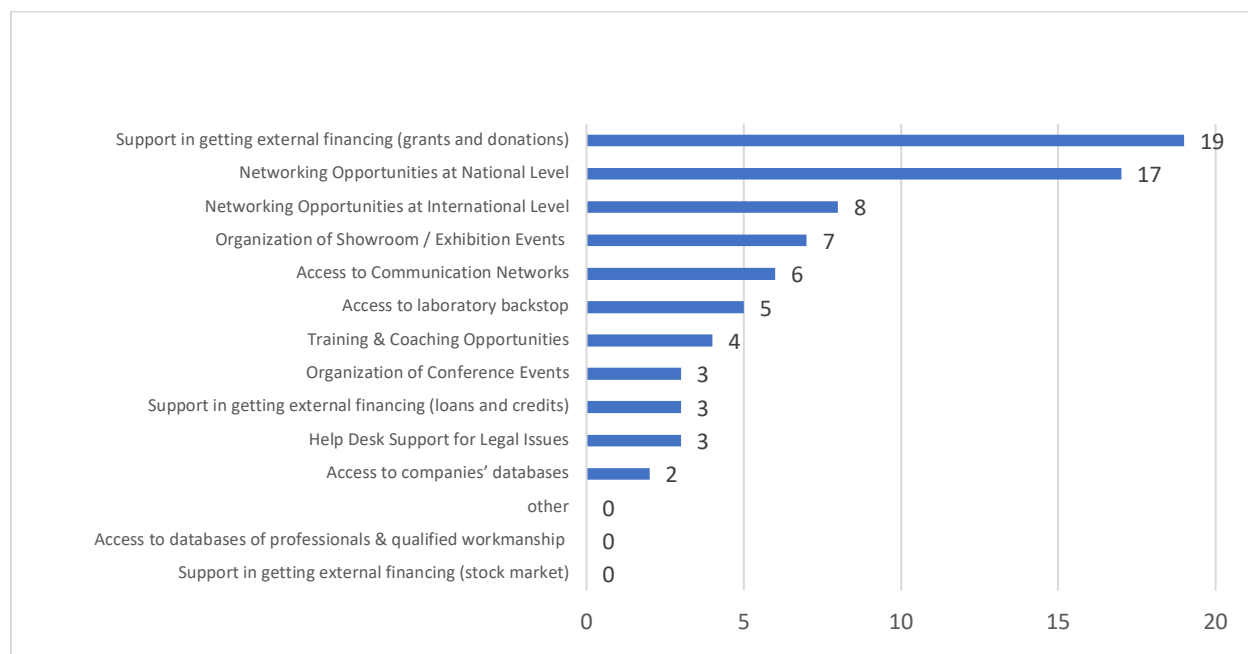
The Transnational Renewable Energy Cluster of the Danube Valley is a transnational network of regional clusters in the field of renewable energy, energy systems and bioeconomy. The cluster connects networks, business partners and research and development organizations from the Danube region and Central Europe. TREC is a platform initiating international R&D projects and innovations in the field of energy and environmental technologies.

3.5. Cluster members' needs

In July 2020, the cluster coordinator conducted a survey among cluster members about their needs and expectations regarding the cluster activities. 21 out of 80 cluster members provided their answers.

- 1) *The list below indicates activities / types of services that can be provided by a cluster. Please mention which of them would be mostly relevant / of interest for your Organisation? (multiple choice)*

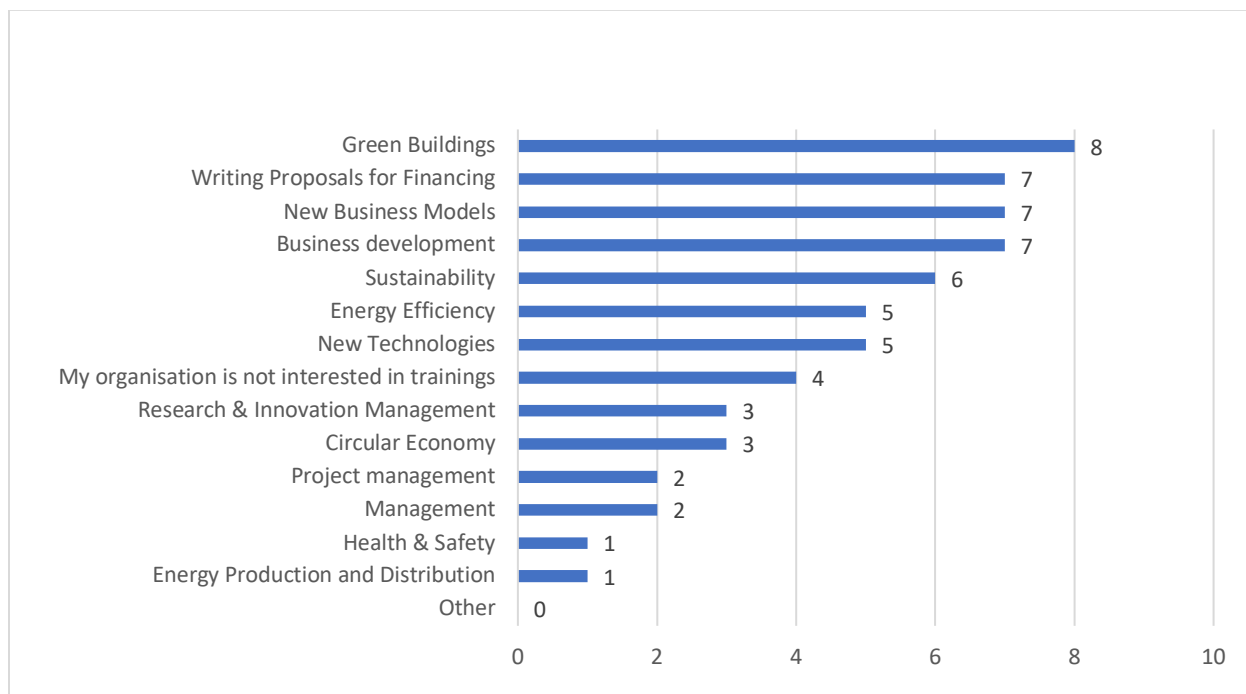
Cluster members are mostly interested in getting support in an acquiring grants and donations for their projects (19 answers) and extending their networks on national level (17). Less popular, but still interesting, is supporting them by the cluster in networking on international level (8). Organisation of showroom of products offered by the cluster companies enjoys rather moderate concern (7), similarly to providing access to communication networks (6), laboratory backstop (5) or training and coaching opportunities (4). Interestingly, external financing schemes such as loans or stock market are not popular.



- 2) *In your opinion, which are the most relevant topics for training the staff of your Organisation? (multiple choice)*

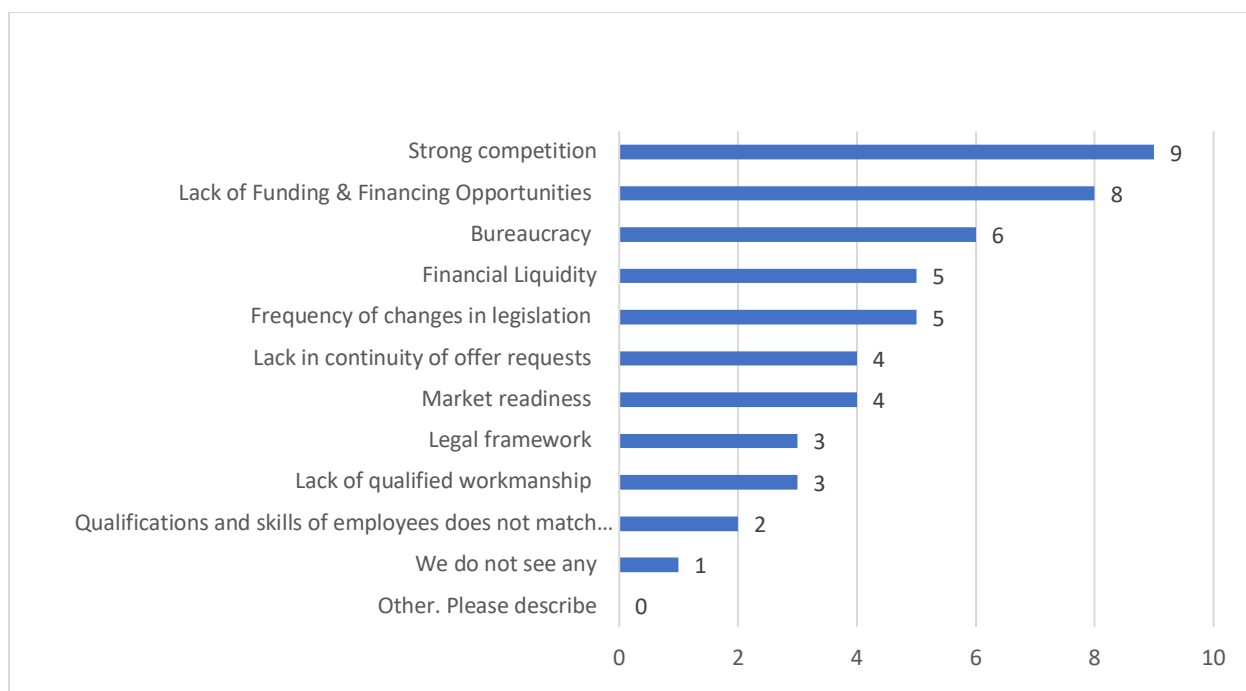
Regardless rather moderate interest of cluster members in trainings offered by the cluster, there is a clear preference on certain topics. Green buildings is the most interesting field (8), followed by Writing proposals for financing, New business models, and Business development (7 answers for each). This suggests that cluster members would like to learn new skills that would help them in development of their organisations. Courses on specific technical fields, such as sustainability (6), energy efficiency (5) and new

technologies (5) are also popular. On the other hand, courses on energy production and distribution, health and safety, management or project management are of interest of single members.



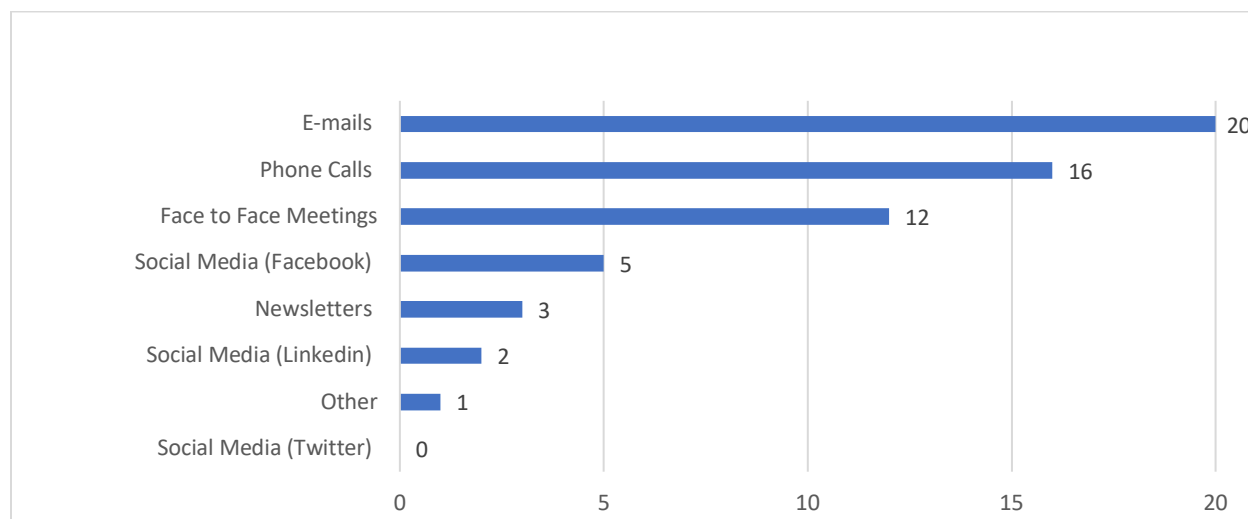
3) What are the most relevant issues in your Organisation's activity? (multiple choice)

Issues impacting on financial flows are the most meaningful issue for cluster members: strong competition (9), lack of funding and financing opportunities (8), financial liquidity (5). Barriers implied by external entities, such as bureaucracy (6) and frequent legislation changes (5) are also significant obstacles.



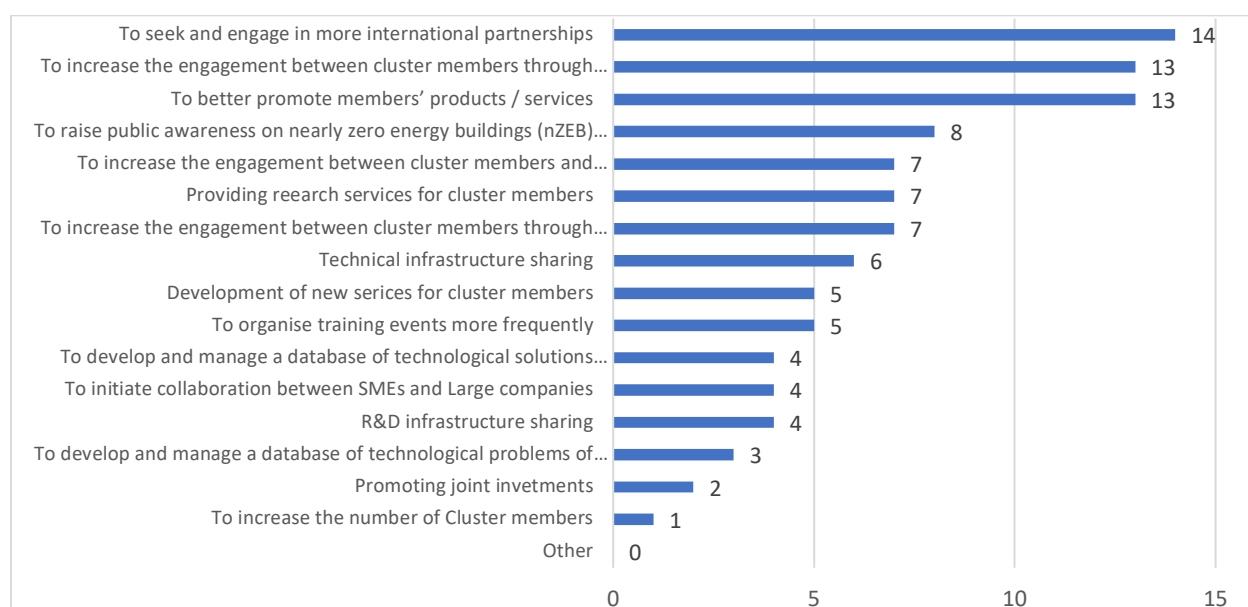
4) *What are your preferred ways to stay in touch with partners? (multiple choice)*

Email (20) and phone calls (16) are the most proffered communication channels of cluster members. Direct face to face contact (12) is also popular. Social media such as Facebook (5) or LinkedIn (2) are chosen by some members only. Twitter is not used.



5) *In your opinion, what should be the most important objectives for our Cluster? (multiple choice)*

Enhancing and supporting partnerships, both international (14) and national (13), in particular within the cluster, are the most important objectives for cluster members. Other significant objective should be promoting cluster members' products and services (13). Raising awareness on nearly zero energy buildings (nZEB) / energy efficiency / sustainability is considered as relevant for 8 members. Other significant objectives include providing research services for cluster members by the coordinator and increasing the engagement between cluster members and public authorities. On the other hand, increasing the number of cluster members or promoting joint investments was not considered as essential for the cluster.



3.6. SWOT analysis of the construction sector in Poland in the context of the nZEB development

The „National plan aimed at increasing the number of NZEB buildings” was adopted in Poland in 2015. The aim that this document sets is to create an environment that by 31 December 2020 all new buildings are nZEB. It focuses on legislation adjustment and indicates which legal acts should be amended or updated. No action plan is included. The plan contains a proposal of a definition of nZEB. The proposal however has not been further proceeded, which means that there is no binding NZEB definition in Poland. In fact, the “nZEB” term is not really used. More popular are “deep renovation” or “passive standard” ones. Funding agencies providing support for improving building energy performance do not require NZEB standard. More popular is requiring a given decrease of energy consumption (e.g. 55%).

Furthermore, the energy performance of the building stock in Poland is relatively low. Over 70% of residential building in Poland have been constructed before 1988, and their demand for primary energy varies from 160 to 350 kWh/m²a and higher. Most buildings do not meet modern requirements, in particular those regarding thermal insulation of walls, roofs and windows. In the coming years, a significant number of buildings will need a modernization, in particular in terms of improving their energy performance. Households in Poland consume 20% of final energy (excluding transportation fuels). The majority of energy (72%) is used by households for heating purposes, and this need to be improved, since according to the recommendations of the International Energy Agency, it should be 35%. Thus, there is room for construction companies for development in this market segment.

The biggest strength of the construction sector is the large number of construction materials and products manufacturers of on the Polish market, including large Polish companies providing their products worldwide (e.g. Drutex – windows producer, Blachy Pruszyński – roof and elevation steel claddings, Wienerberger – bricks and tiles). They act not only on national market, but also go abroad. In 2019 27% of construction companies exported their products or services (Rozkrut, Kowalczyk, & Boguszewski, 2020). They also develop their innovativeness— in 2017 91% of construction companies declared that they have introduced innovations in their activities (Madyda, 2018). Companies are supported by R&D institutes in the field of construction and construction materials, e.g. Institute of Ceramics and Building Materials, Instytut Techniki Budowlanej (Building Research Institute). On the other hand, 83% of Polish construction companies find limited access to financing this as a barrier for introducing innovations (Madyda, 2018). Other weakness is lack of experience in constructing nZEBs of the Polish construction market. There is also lack of cross-sectoral links between companies providing complementary solutions for nZEB, e.g. with energy efficiency or RES industries. An important opportunity for the market is a high demand for new buildings. There are 371 dwellings per 1000 citizens in Poland, while the OECD average is 460-480. 40% of Polish citizens live in overcrowded dwellings (Business Insider Polska, 2019; EUROSTAT, 2020). Furthermore, there is observed rising awareness of Polish citizens in terms of energy consumption in buildings, in particular related to air quality, and rising demand for ecological heating sources and small-scale renewable energy sources, PV in particular. 88% of Polish citizens would decide to build an energy-saving home (Danfoss, H+H, Rockwool, 2019). Demand for renewables is supported by the governmental programme “Mój prąd” (“My electricity”) offering a donation of up to 5000 PLN (~1150 EUR) for installation of PV in households. Significant R&D and innovation funding is also available (e.g. Smart Growth Operational Programme - ERDF). Significant threat for the market is related to rising costs of construction materials, fuels and land decrease investment potential of citizens. (Alebank.pl, 2019; Gazeta Prawna, 2019). Furthermore, lack of qualified and experienced staff in constructing highly energy efficient

or nearly-zero energy buildings may also be a barrier for the sector. Finally, the COVID-19 pandemic crisis may affect investment decisions negatively (Polski Związek Pracodawców Budownictwa, 2020).

4. Cluster strategy

4.1. Mission

The Bioenergy for the Region (B4R) Cluster is a cooperation platform for competitors whose mission is to increase competitiveness through technology transfer for the emerging regional renewable energy industry by developing innovative and environmentally friendly energy products and services, through building links between small and large enterprises, science and the economy, local governments and foreign partners.

4.2. Vision

In 2025, the Bioenergy for the Region Cluster will be a leading Central European cooperative, possessing:

- 1) own energy specializations combined with the energy efficiency solutions for buildings, industry and transport, together with waste management specialization,
- 2) patented and introduced on the European market innovative products and services,
- 3) a laboratory base dedicated to cluster's specializations,
- 4) a network of business and research partners around the world.

4.3. Strategic objectives

- ⇒ Strategic Objective 1: Improvement of cluster management excellence.
- ⇒ Strategic Objective 2: Improvement of innovation level, marketing and sales skills of cluster members.
- ⇒ Strategic Objective 3: Development of new services within the B4R cluster specialization for the cluster members aimed at boosting their competitiveness on national and European level.
- ⇒ Strategic Objective 4: Facilitating strategic and sustainable partnering in the EU of the cluster members.
- ⇒ Strategic Objective 5: Building up cross-sectoral and trans-national synergies and value chains with construction, energy efficiency, waste processing and renewable energy sources industries.
- ⇒ Strategic Objective 6: Increasing the recognition of the cluster.

4.4. Operational objectives

- ⇒ Strategic Objective 1: **Improvement of cluster management excellence.**
 - Operational objective 1.1: Implementation of the best management practice and systems in the field of cluster management
 - Operational objective 1.2: Upgrading the cluster website as a two-sided mobile communications platform of services and knowledge in scope of the cluster specialization,
 - Operational level 1.3: Implementation of the CRM Collaboration Project Management application for facilitating the contacts of the cluster members like Bitrix24 or similar,
 - Operational level 1.4: Implementation a system of fees of selected services provided by the cluster coordinator.
- ⇒ Strategic Objective 2: **Improvement of innovation level, marketing and sales skills of cluster members.**
 - Operational objective 2.1: Increasing awareness of the open innovation approach and developing specific skills of knowledge sharing within the cluster

- Operational level 2.2: Developing competency of technology, knowledge and best practices transferring and exchanging,
 - Operational objective 2.3: Strengthening the capacity of the join R&D project realization,
 - Operational objective 2.4: Implementation the standard procedure of join market activity.
- ⇒ Strategic Objective 3: **Development of new services for the cluster members aimed at boosting their competitiveness on national and European level.**
- Operational objective 3.1: Regular trainings and workshops regarding increasing competency of technology, knowledge and best practices transferring and exchanging,
 - Operational objective 3.2: Regular invitations to implementation of joint R&D projects, co-financed by external sources; especially by the European Commission.
- ⇒ Strategic Objective 4: **Facilitating strategic and sustainable partnering in the EU of the cluster members.**
- Operational objective 4.1: Stimulating the participation of cluster members in R&D activities on the national and EU level,
 - Operational objective 4.2: Supporting interdisciplinary, cross-sectoral and trans-national partnering of the B4R Cluster members.
- ⇒ Strategic Objective 5: **Building up cross-sectoral and trans-national synergies and value chains with construction, energy efficiency, waste processing and renewable energy sources industries.**
- Operational objective 5.1: Regular match-making cross-sectoral meetings on the cluster platform in order to prepare joint R&D projects,
 - Operational objective 5.2: Regular match-making trans-national meetings on the cluster platform in order to prepare joint R&D projects.
- ⇒ Strategic Objective 6: **Increasing the recognition of the cluster.**
- Operational objective 6.1: Rising the communication and the ICT quality level of the cluster website,
 - Operational objective 6.2: Annual meetings of the member and stakeholders of the cluster.

4.5. Key Performance Indicators

Table 2 Key Performance Indicators (KPIs) of the strategy implementation

No.	Objective	KPI	Baseline		Target	
			Value	Year	Value	Year
1.1	Implementation of the best management practice and systems in the field of cluster management	Implementation of ISO 9001:2015 standard	0	2020	1	2022
1.1	Implementation of the best management practice and systems in the field of cluster management	Obtaining the Bronze Cluster Management Excellence label	0	2020	1	2021
1.2	Building the two-sided mobile communications platform of knowledge in scope	Cluster website http://www.bioenergiadlaregionu.eu/centrum-transferu-technologie-oze/ctt-oze/ expanded with new functionalities for knowledge sharing	0	2020	1	2022

	of the cluster specialization					
1.3	Implementation of the CRM Collaboration Project Management application for facilitating the contacts of the cluster members like Bitrix24 or similar	Cluster website http://www.bioenergiadlaregonu.eu/centrum-transferu-technologie-oze/ctt-oze/ equipped with the application Bitrix24 or similar	0	2020	1	2022
1.4	Implementation a system of fees for selected services provided by the cluster coordinator.	Preparation a draft of fee regulations, submission it to open on-line discussion and approval by cluster members	0	2020	1	2022
1.5	Implementation a system of fees of selected services provided by the cluster coordinator.	Cluster website http://www.bioenergiadlaregonu.eu/centrum-transferu-technologie-oze/ctt-oze/ equipped with the accepted and quarterly updated fee regulations	0	2020	1	2023
2.1	Increasing awareness of the open innovation approach and developing specific skills of knowledge sharing within the cluster	Cluster website http://www.bioenergiadlaregonu.eu/centrum-transferu-technologie-oze/ctt-oze/ equipped with the podcasts presented good practices of open innovation approach	0	2020	1	2022
2.2	Developing competency of technology, knowledge and best practices transferring and exchanging	Organization on-line workshops, dedicated to increasing competency of knowledge and best practices transferring and exchanging	0	2020	6	2023
2.3	Strengthening the capacity of the join R&D project realization	Organization face-to-face or on-line meetings with the selected member of the cluster, accordingly to new calls for proposals and potential to be a partner of the join R&D project	5	2020	15	2023
2.4	Implementation the standard procedure of join market activity	Preparation a draft of the standard procedure of join market activity, submission it to open on-line discussion and approval by cluster members	0	2020	1	2022
2.4	Implementation the standard procedure of join market activity	Cluster website http://www.bioenergiadlaregonu.eu/centrum-transferu-technologie-oze/ctt-oze/ equipped with the accepted and quarterly updated procedure of join market activity	0	2020	1	2022
3.1	Regular trainings and workshops regarding increasing competency of technology, knowledge and best practices transferring and exchanging	Organization on-line trainings, dedicated to increasing competency of knowledge and best practices transferring and exchanging	0	2020	6	2023

3.2	Regular invitations to realization of join R&D projects, co-financed by external sources, especially by the European Commission	Cluster website http://www.bioenergiadlaregionu.eu/centrum-transferu-technologie-oze/ctt-oze/ equipped with the updated information regarding new calls for proposals appropriate for the members of the cluster	0	2020	15	2022
4.1	Stimulating the participation of cluster members in R&D activities on the national and EU level	Personalized mailing of information regarding interesting R&D activities on the national and EU level	0	2020	150	2023
4.2	Supporting interdisciplinary, cross-sectoral and trans-national partnering of the B4R Cluster members	Cluster website http://www.bioenergiadlaregionu.eu/centrum-transferu-technologie-oze/ctt-oze/ equipped with the matchmaking room	0	2020	1	2022
5.1	Regular match-making cross-sectoral meetings on the cluster website in order to prepare the join R&D project	Organization the match-making cross-sectoral meetings on the cluster website in the matchmaking room	0	2020	6	2023
5.2	Regular match-making trans-national meetings on the cluster website in order to prepare the join R&D project.	Organization the match-making trans-national meetings on the cluster website in the matchmaking room	0	2020	6	2023
6.1	Rising the communication and the ICT quality level of the cluster website	Upgrading the user-friendly functionalities of the cluster website	0	2020	1	2023
6.2	Annual meetings of the member and stakeholders of the cluster	Organization once-a-year meeting of the member and stakeholders of the cluster	0	2020	3	2023

5. Action plan

5.1. Aim of the action plan

The aim of the action plan is to support implementation of the cluster's strategy and provide operational guidelines for the cluster managers for reaching strategic and operational objectives.

5.2. Actions

Action 1 Conducting the ESCA Evaluation for Cluster Management Excellence certification

- Description: The Bioenergy for the Region coordinator will conduct the ESCA Evaluation for Cluster Management Excellence process aimed at obtaining Bronze Label.
- Related operational objectives: 1.1: Implementation of the best management practice and systems in the field of cluster management
- Responsible person / body for the implementation: Ewa Kochańska– Leader of the Cluster, Katarzyna Łopalewska - Marketing Officer
- Start: Q2 2020, End: Q1 2021
- Key Performance Indicators: ESCA Evaluation Report, ESCA Bronze label

Action 2 Upgrading the cluster website as the main channel of communication, knowledge sharing, networking and services distribution

- Description: The B4R coordinator together with the ICT officer and subcontractors will improve the cluster website and equip it with some new advanced functionalities
- Related operational objectives: 1.2, 1.3, 1.4, 2.1, 2.4, 3.2, 4.2
- Responsible person / body for the implementation: Ewa Kochańska, Katarzyna Woźniak - ICT Officer
- Start: Q1 2021, End: Q4 2022
- Key Performance Indicators: Reports/ Protocols of acceptance of the work performed on the website

Action 3 Development of new services for the cluster members aimed at boosting their competitiveness on national and European level

- Description: The B4R coordinator together with the broker of innovation and ICT officer will implement new services for the members of the B4R Cluster
- Related operational objectives: 1.5, 2.2, 2.3, 2.4, 3.1, 5.1, 5.2
- Responsible person / body for the implementation: Ewa Kochańska, Dariusz Zych – Broker of Innovation, Katarzyna Woźniak
- Start: Q4 2020x, End: Q4 2022
- Key Performance Indicators: Reports of implementation of new services within the B4R Cluster

Action 4 Increasing the recognition of the cluster

- Description: The B4R coordinator together with the Scientific Board of the B4R Cluster will stimulate the dissemination and recognition of the Cluster
- Related operational objectives: 4.1, 6.1, 6.2
- Responsible person / body for the implementation: Ewa Kochańska, Katarzyna Łopalewska
- Start: Q4 2020, End: Q4 2020
- Key Performance Indicators: List of new stakeholders of the B4R cluster

Table 3 Activities overview

No.	Action	Related operational objectives	Dimension <i>National / International</i>	Implementation timeline													
				2020		2021				2022				2023			
				Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.	Conducting the ESCA Evaluation for Cluster Management Excellence certification	1.1	National														
2.	Upgrading the cluster website as the main channel of communication, knowledge sharing, networking and services distribution	1.2, 1.3, 2.1, 2.4, 3.2, 4.2	National/ International														
3.	Development of new services for the cluster members aimed at boosting their competitiveness on national and European level	1.5, 2.2, 2.3, 2.4, 3.1, 5.1, 5.2	National/ International														
4.	Increasing the recognition of the cluster	4.1, 6.1, 6.2	National/ International														

5.3. Resources

Table 4 Overview of resources necessary for the action plan implementation

#	Name	Description	Type <i>Human/ Financial / Technical/ Other</i>	Availability <i>yes/ partially/ no</i>
1.	Professional cluster coordinator	A leader, supported by a team who will be responsible for the cluster coordination, the action plan implementation and monitoring	Human/ Financial	Yes/ No
2.	ICT officer	A person, supported by a team who will be responsible for the upgrading of cluster website	Human/ Financial	Yes/ No
3.	Broker of innovation	A person, supported by a team who will be responsible for creation and implementation of new services	Human/ Financial	Yes/ No
4.	Marketing Officer	A person, supported by a team, who will be responsible for communication within the cluster and with all stakeholders of the cluster	Human/ Financial	Yes/ No

5.4. Procedure of monitoring and implementation plan progress assessment

Monitoring is an essential part of action plan implementation. If it is held regularly, it allows for a real-time control of completing the planned tasks and implementing corrective actions, if tasks are not bringing the estimated results. The action plan implementation is foreseen for 3 years and should be monitored on semi-annual basis. During the action plan completion monitoring, the effects of activities taken so far should be assessed and, unless they are satisfactory, the strategic goals, priorities and measures should be updated.

The action plan completion and its monitoring is recommended to be based on the tool called the Deming cycle: Plan-Do-Check-Act (Figure 8), as described, for an instance, in PN-EN ISO 50001.

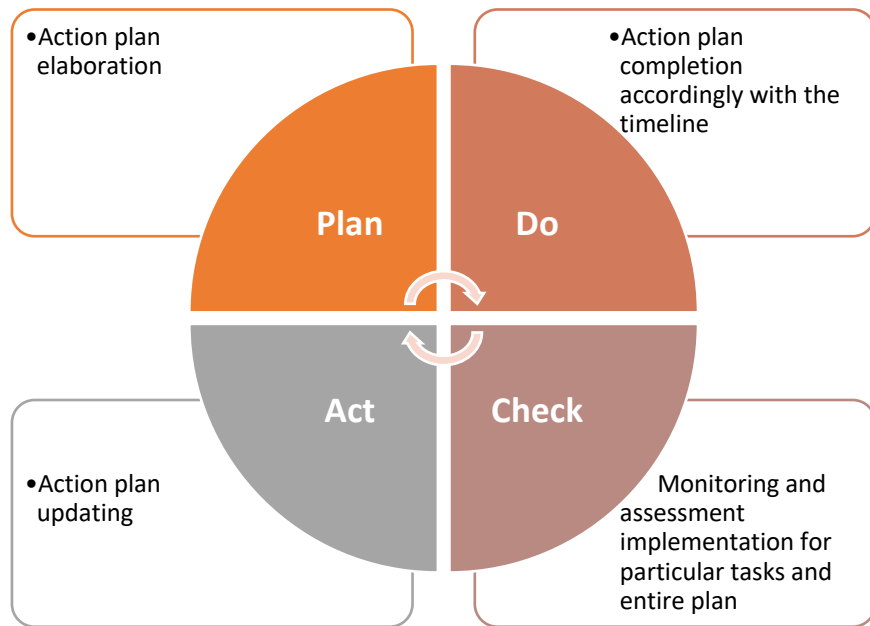


Figure 8 Action plan completion and implementation monitoring procedure based on the Deming cycle

The „Plan” part consists of development of an action plan and is being completed during the preparation of this document. The „Do” stage concerns the implementation of the particular activities and the whole plan, i.e. completion of the planned tasks. The „Check” stage, which means the action plan completion monitoring, should concern simultaneously each task separately (checking if the tasks are completed accordingly with the schedule and if the indicators have been achieved) as well as the overall plan (to what extent the plan goals have been achieved). Meanwhile, the „Act” part concerns the action plan updates and the corrective action implementation which allows to reach the previous indicators if it turns out on the previous stage that they are doubtful, or widening the plan with the new tasks and setting new indicators if the ones planned previously turn out to be completed.