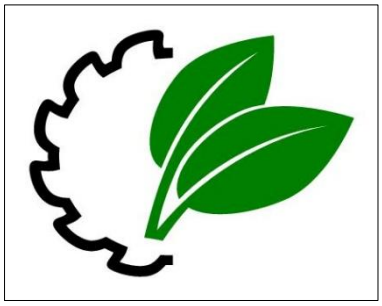
MANAGEMENT BOARD OF THE WIELKOPOLSKA REGION



STRATEGY FOR CLIMATE NEUTRALITY

EASTERN WIELKOPOLSKA 2040

Poznań, March 2021

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I. INTRODUCTION

1. CLIMATE NEUTRALITY : A NEED FOR NEW SOLUTIONS

The "Strategy for Climate Neutrality of Eastern Wielkopolska 2040" (hereinafter referred to as the "Strategy ..") defines **the policy of the Local Government of the Wielkopolska Region aimed at achieving the EU climate goals at the regional level**; these goals result directly from the EU documents, i.e. the new growth plan – the *European Green Deal, Clean Planet* and the *Hydrogen Strategy for a Climate Neutral Europe.*

The "Strategy..." was developed based on the assumptions adopted by the Management Board of the Wielkopolska Region in October 2020.[1], Resolution No. XXV/472/20 of December 21, 2020 of the Parliament of the Wielkopolska Region on the adoption of the Environmental Protection Program for the Wielkopolska Region until 2030[2] and Resolution No. 3157/2021 of the Management Board of the Wielkopolska Region of January 21, 2021 on the development of the draft Strategy for Climate Neutrality in Eastern Wielkopolska 2040.

Over the past decades and years, we have witnessed, and at the same time we have participated in and contributed to adverse climate changes progressing and noticeable worldwide. The constant human pressure on the natural environment results in global warming, extreme weather and climate events, and much more. The progressing climate change affects the living conditions of many millions of people, thus becoming a key factor to their survival and one of the most important challenges for the upcoming years, both for Poland, Europe and the whole world.

In order to avoid the catastrophic effects of climate changes being a consequence of anthropogenic emission of greenhouse gases into the atmosphere and the intensification of the greenhouse effect resulting in global warming, it is necessary to limit the increase in the global mean temperature to levels well below 2°C above pre-industrial level and to undertake efforts to lower global average temperature down to 1.5°C above pre-industrial level (Article 2 of the Paris Agreement)[3]. In this context, all measures aimed at reducing greenhouse gas emission and achieving climate neutrality have become priority.

The purpose of drafting the "Strategy ..." is to **adopt a new pro-climate approach to the development of the subregion** and **to show long-term action lines that will result in the**

[1]Information on the "Assumptions of the regional strategy for climate neutrality. Post-coal Eastern Wielkopolska 2040" of October 1, 2020.
[2]In the "Environmental Protection Program for the Wielkopolska Region 2030" (in chapter 5.1.4 "Regional strategic and program documents") the development and adoption of the "Strategy for Climate Neutrality in Eastern Wielkopolska 2040" are scheduled for the year 2021. The execution of the above resolution was entrusted to the Board of the Wielkopolska Region.
[3] https://eur-lex.europa.eu/legal-content/PL/TXT/?uri=CELEX:22016A1019(01)

reduction of greenhouse gas emission, improvement of air quality, development and increase in the use of renewable energy sources, reduction of demand for non-renewable primary energy and an increase in energy efficiency.

The essence of the "Strategy ..." is to **define** and **integrate the directions of social and economic development in terms of achieving the climate goals** indicated at the EU level. In order to stop the process of climate change and global warming, it is necessary to take measures to reduce the human impact on the climate at the supra-local and local level. It is assumed that the adoption of innovative, multi-faceted and complementary solutions, systemic in nature and territorially integrated in the area of Eastern Wielkopolska, by achieving synergy and economies of scale will lead to climate neutrality in 2040.

Therefore, it is indicated that the "Strategy ..." will be **implemented in accordance with the following principles:**

- **principles of partnership and just transition**[4]**:** it is assumed that the long-term integrated process of transformation and development of sustainable economy of Eastern Wielkopolska will be carried out in a transparent and participatory manner, with particular emphasis on the needs of social groups at risk of exclusion and marginalization, including as a result of (i) liquidation of enterprises and well-paid jobs, the activity of which is related to mining and processing of lignite, and (ii) the decline in communes' incomes; it is assumed that actions that are aimed at achieving climate neutrality and that serve the purpose of social inclusion will be complementary, with simultaneous active participation of local communities in the transformation process; in order to achieve climate neutrality, it is assumed that the tools and instruments of intervention will be chosen in terms of maximizing the positive impact on the community welfare, minimizing the risks leading to poverty (households) and lower tax revenues (communes and districts);

- **the principle of selectivity of challenges,** which means that the scope of the "Strategy ..." covers areas indicated as key to climate neutrality in the *European Green Deal* and confirmed in documents developed at the regional level (such as *Wielkopolska Region Development Strategy 2030, Spatial Development Plan for the Wielkopolska Region 2020+, Environmental Protection Program for the Wielkopolska Region 2030* and *Air Protection Program for the Wielkopolska Region*); diagnostic analyses, the main and key development challenges, and the program part are contextual in nature and regard issues necessary to achieve the adopted climate goals;

- **parameterization of goals**: it was assumed that in order to achieve climate neutrality in the long term (2040), it is necessary to indicate parameters to achieve goals in the mid-term

[4]A just transformation of Eastern Wielkopolska is understood as: "implementing structural changes in the subregion in a way that brings economic benefits and is environmentally sustainable, provides residents with an adequate standard of living and development conditions, and above all is socially acceptable, with a view to minimizing social and economic negative effects of transition towards climate neutral economy; based on the "Concept of Just Transformation of Eastern Wielkopolska". The Wielkopolska Valley of Energy. The Power of Eastern Wielkopolska".

perspective; the year 2030 was identified as a "milestone" on the path to climate neutrality, with target values adopted at the EU level;

– **integration of actions**: an integrated approach to the transformation process in order to achieve climate neutrality and integration of actions in the economic, social and environmental areas will help coordinate actions taken and achieve the synergy effect; at the same time, the territorial integration of actions undertaken in the area of Eastern Wielkopolska will help achieve economies effect.

- **European context**

The European Union's response to the challenges and threats related to climate change is the new growth plan called *The European Green Deal*; its assumptions lead to **Europe's achieving climate neutrality in 2050** and set the EU's climate goals for the next 10 years, by 2030. These goals include[5]:

– **reduction of greenhouse gas emission by 55.0%** (compared to the 1990 level),
– **increase in the share of energy from renewable energy sources in total energy consumption to 32.0%,**
– **increase in energy efficiency by 32.5%.**

The goals adopted by the EU in the *European Green Deal* are in line with the provisions of the Global Agenda 21[6] of 1992, the global program of actions for the environment and development and will contribute to the fulfilment of obligations under the Paris Agreement[7] and the implementation of The 2030 Agenda for Sustainable Development[8], adopted in 2015.

In order to achieve climate goals at the European level, 7 areas requiring intervention and transformation have been identified, namely:

1. **Clean Energy** area, where lowering the emissivity of the EU energy system is of pivotal importance to achieving climate goals; the priorities include: energy efficiency and developing the energy sector largely based on renewable sources, promoting innovative technologies and modern infrastructure, and counteracting energy poverty; the framework for the energy sector transformation towards clean energy is set by the *EU strategy for the Integration of Energy Systems with the Hydrogen Technology Sector*[9];
2. **Sustainable Industry** area, where the sustainable product policy was adopted based on the circular economy and being part of the green economic transformation; the following assumptions were made: supporting the development of climate-neutral and closed-loop products, lowering the emissivity and modernizing energy-intensive and resource-intensive

[5] https://ec.europa.eu/clima/policies/strategies/2030_en
[6]Global Agenda 21 was adopted at the United Nations Conference for Environment and Development in Rio de Janeiro on the so-called the 1992 Earth Summit.
[7]The Paris Agreement is a global plan to combat climate change by limiting global warming by well below 2°C; it was concluded at the Paris Climate Conference in December 2015 by 195 countries.
[8]The 2030 Agenda for Sustainable Development is a UN General Assembly resolution of September 2015 adopted by all member states in New York.
[9] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/clean-energy_en

industries[10], developing digitization to monitor pollution and optimize the use of natural resources; new directions of industry development are defined in *New Industrial Strategy for a Globally Competitive Green and Digital Europe*[11] and the *Communication from the Commission to the EP, the Council, the European Economic and Social Committee and the Committee of the Regions called The New EU Action Plan for the Circular Economy for a Cleaner and More Competitive Europe*[12];

3. **Construction and Renovation** area, aimed at improving the energy performance of buildings and reducing energy consumption; the following assumptions were made: supporting the design of buildings in accordance with the circular economy, the construction of energy-efficient and climate-resistant buildings, and increasing the level of digitization; priorities in this area are covered by the *Communication from the Commission to the EP, the Council, the European Economic and Social Committee and the Committee of the Regions* called *A Renovation Wave for Europe – greening the buildings, creating jobs, improving the quality of life*[13];

4. **Sustainable Mobility** area, where priority was given to: reducing transport emission faster, increasing the use of different modes of transport, increasing the supply of sustainable alternative fuels for transport, reducing pollution from transport sources and correlating the prices of various transport modes with their environmental impact; the related actions are mentioned in the *Strategy for Sustainable and Smart Mobility Third Mobility Package ("Europe on the Move"), Communication from the Commission to the EP, the Council, the European Economic and Social Committee and the Committee of the Regions called The New EU Action Plan for the Circular Economy for a Cleaner and More Competitive Europe*[14];

5. **Farm to Fork** area, where priorities include supporting organic farming, developing more efficient food production systems to provide Europeans with healthy, affordable and sustainable food while taking care of fair profits in the food chain, its storage and packaging, reducing food losses and waste, developing a more sustainable processing and transport industry in agriculture as well as promoting pro-ecological attitudes in the population; actions in this area are listed in the *Communication from the Commission to the EP, the Council, the European Economic and Social Committee and the Committee of the Regions called Farm to Fork Strategy for a Fair, Healthy and Environmentally Friendly Food System*[15];
6. **Biodiversity** area, which emphasizes the key role of (i) biological diversity and care for natural environment in the process of climate regulation and the fight against climate change and (ii) the need to increase the surface area and improve the quality of forests in Europe; the framework for actions to be taken in this area is provided by the *Communication from the Commission to the EP, the Council, the European Economic and Social Committee and the*

[10] In the case of the largest installations, by using the best available techniques and technologies (BAT).
[11] file:///C:/Users/agnie/AppData/Local/Temp/EU_industrial_strategy_pl.pdf.pdf
[12] https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0007.02/DOC_1&format=PDF
[13] https://eur-lex.europa.eu/resource.html?uri=cellar:0638aa1d-0f02-11eb-bc07-01aa75ed71a1.0018.02/DOC_1&format=PDF
[14] https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0007.02/DOC_1&format=PDF
[15] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_pl

Committee of the Regions called EU Biodiversity Strategy for 2030. Bringing Nature Back into Our Lives[16]*;*

7. **Pollution Elimination** area, which is aimed at eliminating air pollution and reducing the level of environmental pollution through protecting biodiversity and preventing contamination by microplastics, pharmaceuticals, and industrial pollution.

The areas indicated at the European level as key to limiting the negative human impact on the climate and improving climatic conditions worldwide provide the basis for contextual diagnostic analyses at the regional level for the Eastern Wielkopolska. The action lines under the "Strategy ..." correspond to the main and key development challenges of Eastern Wielkopolska in the context of climate change and securing space for human health and life in a clean environment, and thus they are in line with goals of the EU climate and energy policy.

At the same time, it should be noted that some of the key policies and instruments of the *European Green Deal* are still under development[17], and renewable energy and energy efficiency goals may be increased[18].

The "Strategy ..." is also consistent with the objectives of the EU Cohesion Policy for the years 2021 - 27 and is in line with the EU regulations, including:

- *Directive (EU) 2018/844 of the European Parliament and of the Council* of May 30, 2018 amending Directive 2010/31 / EU on the energy performance of buildings and Directive 2012/27 / EU on energy efficiency;
- *Directive (EU) 2018/2002 of the European Parliament and of the Council* of December 11, 2018 amending Directive 2012/27 / EU on energy efficiency;
- *Directive 2010/75 / EU of the European Parliament and of the Council* of November 24, 2010 on industrial emission (integrated pollution prevention and control);
- *Commission Recommendation (EU) 2020/1563* of October 14, 2020 on energy poverty.

[16] https://eur-lex.europa.eu/resource.html?uri=cellar:a3c806a6-9ab3-11ea-9d2d-01aa75ed71a1.0019.02/DOC_1&format=PDF
[17] World Bank.
[18] https://ec.europa.eu/info/news/review-renewables-and-energy-efficiency-directives-commission-launches-first-steps-process-2020-aug-04_en

- **National context**

Generally, the provisions of the "Strategy ..." are consistent with the provisions of documents at the national level that set out the state priorities in the field of providing ecological safety to Poland, reasonable management of environmental resources, shaping a sustainable and user-friendly transport system, and reducing the environmental impact of the energy sector; these documents include:

- *Poland's Energy Policy 2040 (PEP 2040)*[19]: it puts the emphasis on three pillars: just transformation, zero-emission energy system and good air quality; the purpose of the state's energy policy is energy security, while ensuring the competitiveness of the economy, energy efficiency and reducing the impact of the energy sector on the environment, with the optimal use of own energy resources; the goal achievement is measured by the share of coal in power generation in 2030 (not more than 56.0%), the share of renewable energy sources in the final energy consumption tax in 2030 (at least 23.0%), limitation of CO_2 emission by 2030 by 30.0% (compared to the level from 1990), an increase in energy efficiency by 23.0% by 2030 (compared to the forecasts of primary energy consumption from 2007), reduction of primary energy consumption by 23,0% by 2030 (compared to 2007 consumption forecast) and the implementation of nuclear energy technology by 2033;

- *National Plan for Energy and Climate for 2021-2030. Assumptions, Goals, Policies and Actions* (NECP)[20] refers to energy security, reduction in emission, energy efficiency, the internal energy market and innovation in the field of energy;

- *The National Environmental Policy 2030 – the Development Strategy in the Area of the Environment and Water Management*[21]: it shows the intensifying effects of climate change as one of the most important development challenges in the field of the environment and adopts climate change mitigation as one of the 2030 specific goals;

- *National Raw Material Policy*[22]: it includes the assumptions of the circular economy and indicates the need to take actions related to the acquisition of raw materials from waste, the development of substitutes for mineral resources and minerals, and the improvement of reclamation and remediation methods;

- *The Strategy for Sustainable Development of Transport 2030*[23]: it shows the special role of the transport system both in the process of building the competitive advantages of the economy as well as care for the natural environment; it also sets new challenges in this area, such as increase

[19]Project approved by the Council of Ministers on February 2, 2021.
[20]Drafted by the Ministry of State Assets, adopted in December 2019 by the Committee for European Affairs and submitted to the European Commission.
[21]Resolution No. 67 of the Council of Ministers of July 16, 2019 on the adoption of *The 2030 National Environmental Policy – the Development Strategy in the Area of the Environment and Water Management* (MP 2019, item 794).
[22]Document drafted by the Government Plenipotentiary for the State Raw Material Policy and the Interministerial Team for the State Raw Material Policy, Ministry of the Environment 2018.
[23]Resolution No. 105 of the Council of Ministers of September 24, 2019 on the adoption of *The Strategy for Sustainable Development of Transport 2030* (MP 2019, item 1054).

in the availability of transport services, reduction of costs and transport time, improvement of energy efficiency, decrease in emissivity indicators, and development of multimodality;

- *The Strategy for Sustainable Development of Rural Areas, Agriculture and Fisheries*[24] *2030* it provides for the development of alternative, emission-free heat sources, development of energy storage technologies, increase in the energy efficiency of buildings, support for the production of electricity and heat in combination as well as promotion of local projects in the field of energy production (clusters, energy cooperatives) with an emphasis on the development of renewable energy sources;

- *The National Strategy for Regional Development 2030. Socially Sensitive and Territorially Balanced Development*[25] puts the emphasis on the adaptation to climate change and limitation of environmental threats as one of the country's development challenges until 2030;

- *The National Waste Management Plan 2022*[26] provides for a decrease in the amount of generated waste, an increase in public awareness of proper municipal waste management, and an increase in the share of selectively collected waste;

- [27]*, The Polish Hydrogen Strategy 2030 with the 2040 perspective* provides for the implementation of hydrogen technologies in the power industry, the use of hydrogen as an alternative fuel in transport, support for industrial decarbonisation, hydrogen production in new installations, efficient and safe hydrogen distribution or creation of a stable regulatory environment;

- *The 2020 National Air Protection Program until 2020 (with the 2030 perspective until 2030):* [28] , based on the assumption that it is possible for certain substances in the air to be concentrated by 2030 at permissible and target levels indicated by the WHO and for new requirements resulting from legal regulations following the EU law to be met.

It is assumed that due to the fact that some of the above-mentioned documents may not make a real contribution to the achievement of the EU climate goals, the "Strategy ..." **provides for more ambitious goals and assumes full coherence with the EU climate goals by 2030 and achieving climate neutrality of the area already in 2040.**

- **Regional context**

The provisions of the "Strategy ..." are consistent with **the development goals of the Wielkopolska Region** listed in *The Development Strategy of the Wielkopolska Region 2030*[29], according to which the key factors for the Eastern Wielkopolska include (i) preparing a fair and inclusive *Plan for Economic and Energy Transformation* in line with the EU initiative to support

[24]Resolution No. 123 of the Council of Ministers of October 15, 2019 on the adoption of *The Strategy for Sustainable Development of Rural Areas, Agriculture and Fisheries 2030* (MP 2019, item 1150).
[25]Resolution No. 102 of the Council of Ministers of September 17, 2019 on the adoption of *The National Strategy for Regional Development 2030* (MP 2019, item 1060).
[26]Resolution No. 88 of the Council of Ministers of July 1, 2016 on the adoption of *The National Waste Management Plan 2022* (MP 2016, item 784).
[27]The was project developed by the Ministry of Climate and Environment, January 2021.
[28]adopted on September 3, 2015
[29]Resolution No. XVI/287/20 of the Parliament of the Wielkopolska Region of January 27, 2020 on the adoption of the *Development Strategy of the Wielkopolska Region 2030.*

mining regions, and (ii) carrying out a fair energy transformation at the lowest economic and social costs. The provisions of the "Strategy ..." are also in line with **spatial policy objectives** set out in *the Spatial Development Plan for the Wielkopolska Region*[30], according to which the goals of the Wielkopolska Region spatial development include creating new frameworks for the existing energy industry based on other energy carriers and shifting the economy to multifunctional activity profiles.

Also, the purposes of the "Strategy ..." are consistent with the provisions of regional documents, i.e. .:

- *Regional Innovation Strategy for the Wielkopolska Region 2030 (RIS 2030)*[31]*;*
- *Environmental Protection Scheme for the Wielkopolska Region 2030*[32]*;*
- *Waste Management Plan for the Wielkopolska Region for 2019-2025 along with Investment Plan*[33]*;*
- *The Wielkopolska Regional Action Plan for Sustainable Energy and Climate in the Field of Renewable Sources and Energy Efficiency with the 2050 Perspective*[34]*;*
- *Regional Action Plan called "Economic Transformation of Subregions in the Wielkopolska Region: the Hydrogen Mission" created as part of the INTERREG Relos3 project;*
- *Air Protection Program for the Wielkopolska Region;*
- *Air Protection Program for Ozone for the Wielkopolska Region;*
- *Resolution No. XXXIX /941/17 of the Parliament of the Wielkopolska Region of December 18, 2017 on the introduction in the Wielkopolska Region (excluding the City of Poznań and the City of Kalisz) restrictions or bans on the operation of installations where fuel is consumed.*

[30]Resolution No. V/70/19 of the Parliament of the Wielkopolska Region of March 25, 2019 on the adoption of the *Spatial Development Plan for the Wielkopolska Region* together with the spatial development plan of the functional urban area of Poznań.
[31]Resolution No. 3099/2020 of the Management Board of the Wielkopolska Region of December 29, 2020 on approval of the *Regional Innovation Strategy for Wielkopolska 2030*.
[32]Resolution No. XXV/472/20 of the Parliament of the Wielkopolska Region of December 21, 2020 on the adoption of the *Environmental Protection Scheme for the Wielkopolska Region 2030.*
[33] Resolution No. XXII/405/20 of the Parliament of the Wielkopolska Region of September 28, 2020 on the adoption of the *Waste Management Plan for the Wielkopolska Region for 2019-2025 along with Investment Plan.*
[34]Resolution No. 3113/2021 of the Management Board of the Wielkopolska Region of January 8, 2021 on approval of the document called *The Wielkopolska Regional Action Plan for Sustainable Energy and Climate in the Field of Renewable Sources and Energy Efficiency with the 2050 Perspective. Information for Local Governments and Residents of Wielkopolska* developed as part of the C-Track 50 project from the 2020 Horizon program to be disseminated among local government units and residents from the Wielkopolska Region.

2. CHARACTERISTICS OF THE EASTERN WIELKOPOLSKA AREA – KEY DEVELOPMENT CHALLENGES IN THE CONTEXT OF CLIMATE CHANGE MITIGATION

A special area in Wielkopolska Region, which requires implementation of climate neutrality measures, is **Eastern Wielkopolska**, where an extremely important industrial area in the region – Konin mining and power basin – operates on the basis of documented lignite deposits and developed technical infrastructure connected with power plant operation.

Administratively, Eastern Wielkopolska includes 5 districts, including 1 municipal district (Konin) and 4 country districts (Kolsk, Konin, Słupca, Turek), as well as 43 municipalities, including 4 urban, 11 urban-rural and 28 rural ones. Eastern Wielkopolska covers the area of 4,438 km2, which accounts for nearly 15.0% of the total area of the Wielkopolska Region. In 2019, the area was inhabited by slightly more than 433.2 k people or approximately 12.4% of the population in Wielkopolska. The percentage of population living in cities was at 39.5% (in Wielkopolska – 54.0%). The average population density in this area was 97.6 persons/km^2 (in Wielkopolska – 117.3 persons/km^2), with 919.2 persons/km^2 in urban areas (Wielkopolska – 1,222.1 persons/km2) and 61.7 persons/km^2 in rural areas (Wielkopolska – 56.9 persons/km^2).

The main city of Eastern Wielkopolska is Konin, in terms of population the largest urban centre in the area and the third in the region, with 73.5 k inhabitants, with its functional area[35] constituting the development core of Eastern Wielkopolska. The city is one of the four urban centres in the region, acting as sub-regional growth poles[36]. It concentrates a considerable economic potential and provides service functions of supra-local importance (including administration, university education and healthcare), and its influence covers a significant part of the region. Konin acts as an important communication junction and has good communication links with the remaining major urban centres of Eastern Wielkopolska, as well as with the region's capital and other metropolitan areas in the country, i.e. with Łódź and Warsaw.

In terms of **climatic conditions**, the area of Eastern Wielkopolska, like most of the region, lies in the Central Wielkopolska Region (XV), where very warm and cloudy weather without precipitation prevails (38.7 days in a year on average)[37].Polar-maritime air masses dominate here, resulting in cooler summers and milder winters compared to the eastern, more continental part of Poland. Cool fronts move most often over the region, which in the summer are often accompanied by thunderstorms, significant temperature fluctuations and increase in wind speed[38]. Westerly winds prevail. Mostly, there is a weak wind of 2.5-3.5 m/s.
The lowland character of the area allows for undisturbed flow of air masses, which improves **air quality** and prevents pollution from accumulating in one place[39]. In 2019, 10,897,868 Mg of gaseous substances and 1,929 Mg of particulate substances were emitted into the atmosphere

[35]Konin Functional Area comprises: the city of Konin, urban-rural municipalities of Golina and Ślesin, and rural municipalities: Kazimierz Biskupi, Kramsk, Krzymów, Rzgów and Stare Miasto; Source: "Local development plan for Wielkopolska Region."
[36]The plan indicates the following centres of sub-regional importance: Konin, Leszno, Gniezno and Piła.
[37]Basic ecophysiographic study for Wielkopolska Region – material for the change of the local development plan for Wielkopolska Region, Wielkopolska Planning Office in Poznań, 2014.
[38]Environmental protection programme for Wielkopolska Region until 2030.
[39]Environmental protection programme for Wielkopolska Region until 2030.

from the plants that are particularly burdensome in terms of air pollution in Wielkopolska Region, as recorded by the Central Statistical Office. **Greenhouse gas emissions** from Wielkopolska Region in 2019 totalled 12,163,380.707 Mg according to the KOBIZE national database, including:

- carbon dioxide CO_2 – 12 151 560. 750 Mg,
- hydrofluorocarbons HFCs – 25. 579 Mg,
- sulphur hexafluoride SF_6 – 0.016 Mg,
- methane CH_4 – 11 555.500 Mg,
- perfluorocarbons PFCs – 0.044 Mg,
- nitrous oxide N_2O – 238. 785 Mg,
- nitrogen trifluoride NF_3 – 0.030 Mg[40].

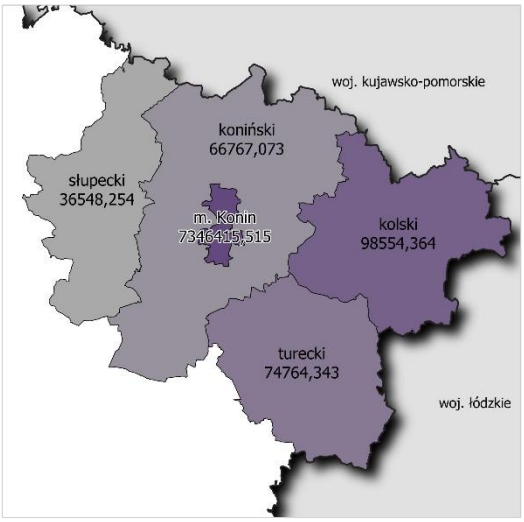
Compared to 2015, the emission of gaseous substances decreased by 33.17% while the emission of dust substances – by 60.52%. Most of the dust substances generated by the plants – as much as 99.7% – are stopped by the pollution control installations, mainly various types of dedusting devices. In 2019, 71.3% of gaseous pollutants (pollutants retained do not include CO2) were retained through pollution control devices[41]. The largest amounts of dust emitted into the air and the highest gas emissions come from Konin (36.08% and 66.06% respectively)[42].

In Wielkopolska Region, as in the whole of Poland, about 70.0% of gas and dust emissions to air comes from fuel and energy industry. In Wielkopolska, the plants emitting the most polluting substances are located in Eastern Wielkopolska[43].

Air quality in Eastern Wielkopolska and the whole Wielkopolska Region is determined by emissions from surface sources. A significant share of pollutants emitted to the air is represented by so-called "low emission," the source of which include: municipal and household sector, dumps, large-size plants or cities as a whole. Particularly high amounts of pollutants enter the air as a result of burning solid fuels in tiled stoves or household boilers in poor technical condition. Low emission from the municipal and household sector is a significant source of fine particulate PM10 emission and causes the permissible level to be exceeded. This problem is especially exacerbated during the autumn and winter[44].

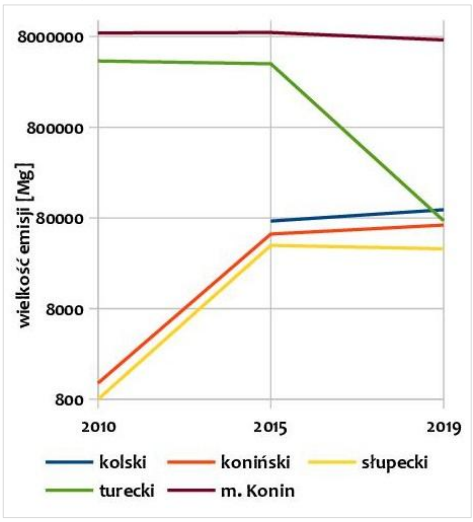
[40] as above.
[41] as above.
[42] as above.
[43] as above.
[44] as above.

Fig. 1 CO2 emissions in Eastern Wielkopolska districts in 2019. (Mg)



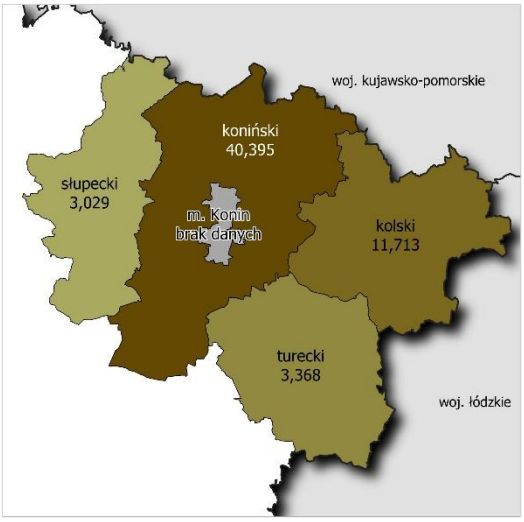
Source: WBPP own study based on KOBiZE data

Fig. 2 CO2 emissions in Eastern Wielkopolska districts in 2010 – 2015 – 2019. (Mg)



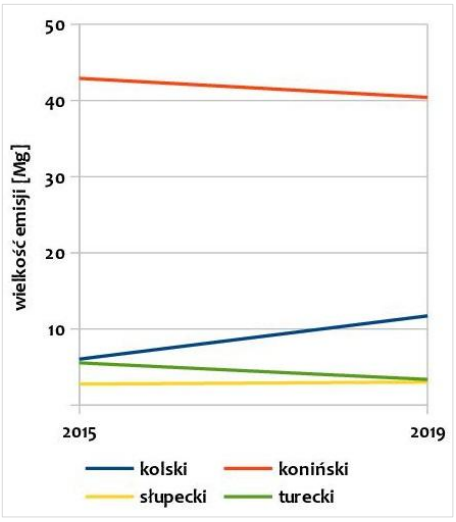
Source: WBPP own study based on KOBiZE data

Fig. 3 Methane emissions in Eastern Wielkopolska districts in 2019. (Mg)



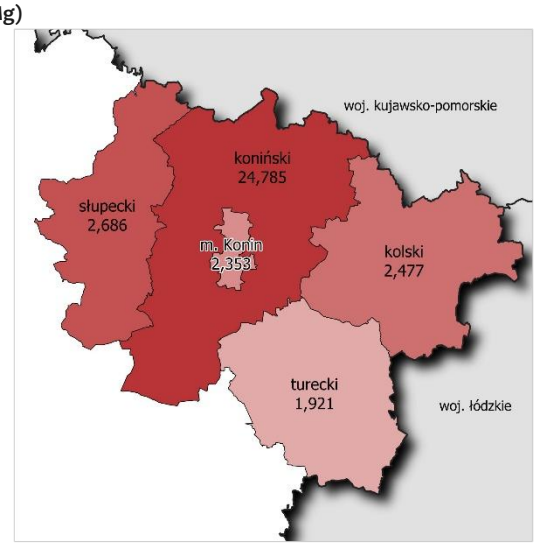
Source: WBPP own study based on KOBiZE data

Fig. 4 Methane emissions in Eastern Wielkopolska districts in 2015 – 2019. (Mg)



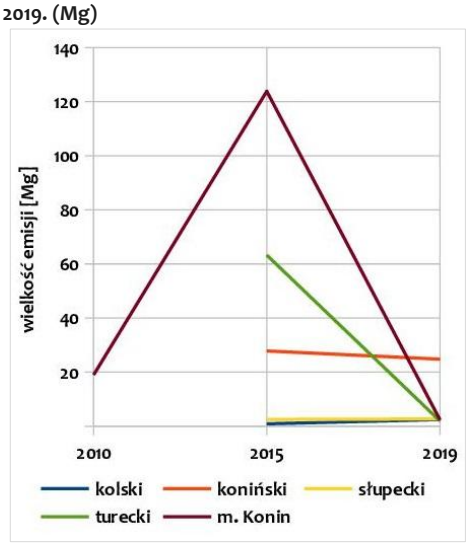
Source: WBPP own study based on KOBiZE data

Fig. 5 N2O emissions in Eastern Wielkopolska districts in 2019. (Mg)



Source: WBPP own study based on KOBiZE data

Fig. 6 N2O emissions in Eastern Wielkopolska districts in 2010 – 2015 – 2019. (Mg)



Source: WBPP own study based on KOBiZE data

In terms of **air quality assessment**, the area of Eastern Wielkopolska is located in Wielkopolska zone (PL 3001), covering the whole Wielkopolska Region except for the city of Poznań and the city of Kalisz. In terms of criteria defined for health protection in 2019, the resultant classes[45] for individual substances in Wielkopolska area were as follows[46]:

Table 1. Resultant classes of air quality results in terms of criteria specified for the protection of health for individual substances in Wielkopolska zone in 2019.

Name of zone	Symbol of resultant class for particular substances												
	NO_2	SO_2	CO	C_6H_6	PM 2.5 particulate matter	PM10 particulate matter	BaP	As	Cd	Ni	Pb	O_3	
												Target level	Long-term target level
Wielkopolska zone	A	A	A	A	A	**C**	**C**	A	A	A	A	A	**D2**

Source: Environmental protection programme for the Wielkopolska Region until 2030 on the basis of Annual assessment of air quality in Wielkopolska Region - provincial report for 2019, GIOŚ, RWMŚ in Poznań, 2020

In terms of criteria defined for plant protection for 2019, the resultant classes for individual substances in the Wielkopolska zone were as follows[47]:

Table 2 Resultant classes of air quality results in terms of criteria specified for the protection of plants for individual substances in Wielkopolska zone in 2019.

Name of zone	Symbol of zone class for particular substances			
	NO_X	SO_2	O_3	
			Target level	Long-term target level
Wielkopolska zone	A	A	**C**	D2

Source: Environmental protection programme for the Wielkopolska Region until 2030 on the basis of Annual assessment of air quality in Wielkopolska Region - provincial report for 2019, GIOŚ, RWMŚ in Poznań, 2020

Increasingly, climate change is the result of human activity and its negative effects are felt on a global scale. Emissions of greenhouse gases (including water vapour) and dust, especially in highly urbanized areas, lead to changes in the radiation balance and in the thermal balance of the earth's surface. The consequence of increasing greenhouse gas concentrations in the atmosphere is global warming and climate change resulting in, inter alia, an increase in the frequency and intensity of extreme weather events[48].

It is crucial for reducing greenhouse gas emissions and restoring high air quality in Eastern Wielkopolska to identify the needs in this respect in 6 areas with the greatest impact on climate, i.e.: **clean energy, sustainable industry and construction, sustainable housing, intelligent agriculture, sustainable mobility and biodiversity**.

[45] The result of the assessment, both for health protection and for plant protection criteria, for all substances subject to the assessment, is classifying the zone into one of the following classes*:
- class A – if pollutant concentrations in the zone do not exceed permissible levels and target levels respectively;
- class B – if pollutant concentrations in the zone exceed permissible levels, but do not exceed permissible levels plus margin of tolerance;
- class C – if pollutant concentrations in the zone exceed permissible levels plus margin of tolerance, and in case the margin of tolerance is not determined – the permissible levels and target levels;
- class D1 – if the level of ozone concentrations does not exceed the long-term objective level;
- class D2 - if ozone concentrations exceed the long-term objective level.

*Environmental protection programme for Wielkopolska Region until 2030.
[46]Environmental protection programme for Wielkopolska Region until 2030.
[47]as above.
[48] Source: IPCC

- **Clean energy**

The fuel combustion sector plays a key role in the transition to a greenhouse gas neutral economy. In fuel combustion, which accounted for 92.3% of total CO2 emissions in Poland in 2018, the power industry had a share of 48.1%[49]. In order to mitigate climate change and achieve climate neutrality, it is necessary to work towards a zero net greenhouse gas emission energy system, while ensuring a secure and sustainable energy supply[50].

The most important **electricity producer** in Eastern Wielkopolska is Zespół Elektrowni Pątnów – Adamów – Konin (ZE PAK S.A). In 2019, in the structure of fuels and other primary energy carriers consumed for electricity generation by ZE PAK S.A., lignite accounted for 89.6% and renewable energy sources for 9.8%[51].

ZE PAK Group's lignite power generation operations consist of 3 active power plants[52]:

– Konin Power Plant[53], the oldest lignite-fired power plant in Poland, which also supplies heat to the city of Konin and surrounding areas. With 3 boilers operating, it has a nominal thermal capacity of 391 MWt, including a biomass boiler with a nominal capacity of 169 MWt and the others with 111 MWt each. Decommissioning of two coal-fired units is planned by December 31, 2022. After the planned rebuild of K-7 boiler is completed, the power plant will use biomass as the main fuel. According to the decision, 93 MW of installed capacity generated from the operation of the Power Station's coal-fired boilers will be shut down by June 2020;

– Pątnów II Power Plant[54] EP II is equipped with one power unit with nominal thermal capacity of 1080 MW, which is the first supercritical generating unit in the national power system. It is characterized by high efficiency of energy production, which is associated with lower fuel

[49] National Inventory Report 2020 (Synthesis Report) containing national greenhouse gas emissions data for 1988-2018 with a description of the methodology. Report based on data reported to the UNFCCC Secretariat on April 15, 2020.
https://www.kobize.pl/pl/fileCategory/id/16/krajowa-inwentaryzacja-emisji

[50]Commission Communication. A clean planet for all. A European long-term strategic vision for a prosperous, modern, competitive and climate-neutral economy; https://eur-lex.europa.eu

[51]https://www.zepak.com.pl/pl/o-firmie/struktura-paliw/ze-pak-sa.html

[52]Regional Development Agency in Konin.

[53]The installed power plant capacity for the above boilers is 198 MW. The Konin power plant is in the first part a collector power plant consisting of a set of power boilers and a set of condensing and extraction-condensing turbines with an open cooling system. The main fuel is lignite and the auxiliary fuel is mazout used to fire up the boilers. The power plant is equipped with a flue gas desulphurisation plant to which coal boilers are connected. In addition, the boilers are equipped with electrostatic precipitators.
The power boilers of the Konin Power Plant:
1. power boiler K5 (EKM No 85) OP130b with nominal thermal power in fuel 111 MW, the basic fuel is lignite, kindling fuel is mazout and light fuel oil,
2. power boiler K6 (EKM No 86) OP130b with nominal thermal power in fuel 111 MW, the basic fuel is lignite, kindling fuel is mazout and light fuel oil,
3. power boiler K7 OP230p with nominal thermal power in fuel of 231 MW, the basic fuel is lignite, mazout and light fuel oil are used as kindling fuels - currently the boiler is not in use - reconstruction of this boiler into a biomass boiler is planned.
4. energy boiler K12 – fluidised bed boiler with nominal thermal power in fuel of 169 MW, where only biomass is incinerated,
From July 1, 2020, the EKM boilers No. 85 and 86 in the Konin Power Plant changed their function to peak load/reserve (they will be operated no longer than until December 31, 2022). Therefore, the operating time of the EKM boilers, understood as the time of normal operation of their EK5 emitter, will be:
- during the period from 1 July 2020 to 17 August 2021 will be less than 1500 h/year,
- during the period from 18 July 2021 to 31 August 2022 will be less than 500 h/year,

[54] Pątnów II Power Plant consists of 1 power unit with installed capacity of 464 MW. Fuel combustion for electricity production is carried out in a power boiler with a thermal power of 1080 MWt connected to a wet flue gas desulphurisation plant separated for this boiler. In addition, a four-zone electrostatic precipitator is installed for dust removal from boiler flue gases and a flue gas denitrification system using primary methods and the selective non-catalytic reduction (SNCR) method.

consumption and reduced amount of post-production waste. It was also equipped with state-of-the-art atmospheric protection facilities – wet flue gas desulphurisation and reduction of nitrogen emissions. The Power Plant is scheduled to cease operations in 2030;

– Pątnów I Power Plant[55], the largest power plant in ZE PAK Group, equipped with 6 power boilers of 604 MWt nominal thermal capacity each. Boilers 3 and 4 were shut down in June 2020, boiler 6 was shut down in December 2020, while boilers 1, 2 and 5, according to the integrated permit, will be decommissioned by the end of 2030. Despite the possibility of operating some boilers until 2030. ZE PAK Group plans to terminate the Power Plant's operations in 2024.

At present ZE PAK S.A.[56] supplies approx. 4.0% of the domestic electricity, ranking 4th in the country. It is also Poland's second largest producer of electricity from lignite combustion. In 2019, the volume of energy produced reached 6.6 TWh, using 7.3 million tons of lignite. The amount of carbon dioxide (CO_2) emitted (in the process of energy production) to the atmosphere was 6.61 million Mg. Such significant emissions make the Group the largest source of CO_2 emissions in the region for years. In 2019, it accounted for over 60.0% of the region's CO_2 emissions and nearly 90.0% of its emissions in the subregion. Ending the operation of coal-fired boilers will therefore translate into a significant reduction in CO_2 emissions, which will make an important contribution to achieving the national CO_2 reduction target by 2030[57]

In the area of Eastern Wielkopolska there are 22 documented **lignite deposits** (including 2 off-balance deposits) which cover about 3.3% of the whole area[58]. In 2019, the balance resources of lignite in Eastern Wielkopolska were at 493,616 k tons, which represented almost 6.2% of the region's resources and 2.1% of the national resources. The largest balance resources are found in the deposits: Dęby Szlacheckie, (in the municipalities: Babiak and Koło), Piaski (in the municipalities: Rzgów, Rychwał, Grodziec, Zagórów), Grochowy - Siąszyce (in Rychwał municipality), Tomisławice and Mąkoszyn (in Wierzbinek municipality) and Ościsłowo (in the municipalities: Wilczyn, Skulsk, and Ślesin). Industrial lignite reserves decreased from 128,738 to 40,625 k tonnes, or 68.4%, between 2012 and 2019.

Currently, lignite is mined in two open-pit mines: PAK Kopalnia Węgla Brunatnego Adamów SA, which is in liquidation, and PAK Kopalnia Węgla Brunatnego Konin SA, which operates 4 open pits. In the case of the first of the above-mentioned mines, coal extraction from the Adamów open pit, the only open pit operated by this mine, will be ended in the first quarter of 2021. The Konin mine (supplying the Konin, Pątnów I and Pątnów II power plants) operates the Drzewce, Jóźwin and Tomisławice open pits. The area occupied by the open-pit operations, as well as those undergoing reclamation, covers nearly 7,500 hectares. Lignite resources in the mined-out open

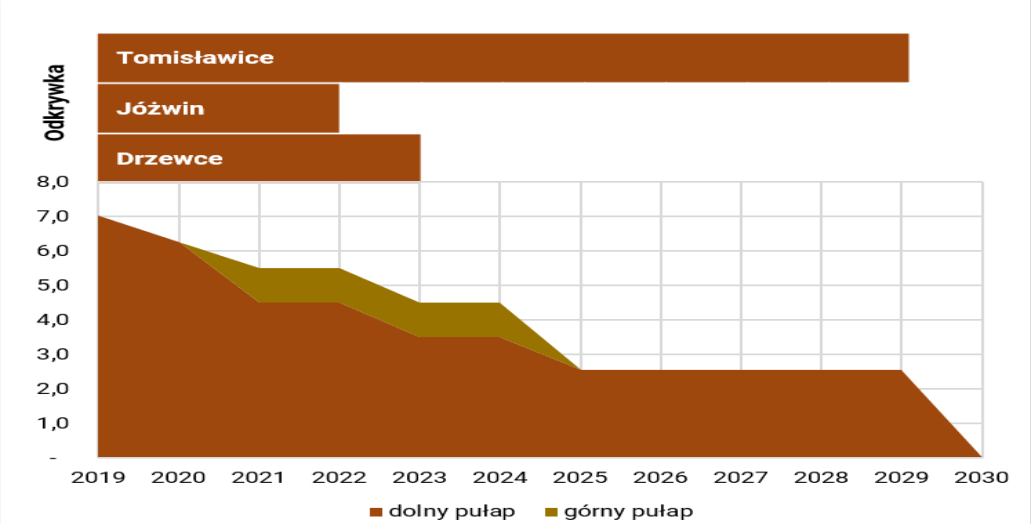
[55] Pątnów I Power Plant is a block power plant consisting of 6 power units. Lignite is the main fuel and mazout and fuel oil are auxiliary fuels used to fire up the boilers. The main fuel is burned in 6 power boilers. The thermal capacity of each boiler in fuel is 604.0 MWt. In Pątnów I Power Plant, two flue gas desulphurisation (FGD) installations were built in 2008. At present, FGD plants in Pątnów I Power Plant are based on the lime-gypsum method which treats flue gases from six boilers. Moreover, the boilers in Pątnów I Power Plant are equipped with three-field electrostatic precipitators.
[56] All the above installations are covered by integrated permits.
[57] Regional Development Agency in Konin based on data from ZE PAK, DSR, Instrat.
[58] Based on MIDAS database; PGI PIB, Balance of mineral deposit resources in Poland as at 31 December 2019.

pits will enable the mine to operate at current production levels until 2030 at the latest. The Jóźwin open pit will be closed in 2021, the Drzewce open pit will be closed by 2022 at the latest, and the Tomisławice open pit – by 2030 [59]. In 2019, lignite output for power plants was at 6,751 k tons, down nearly 50.8% from 2012 output.

Lignite mining is associated with a potential burden on the environment, which consist mainly of: complete transformation of land surface within the contour of the open pit under construction, hydrogeological and hydrological transformations related to the dewatering of the open pit (lowering of groundwater level, drying up of soils, impact on surface waters), geomechanical deformations on the foreground and slopes of the open pit and the external dump (subsidence and formation of landslides), problem of mining waste management[60].

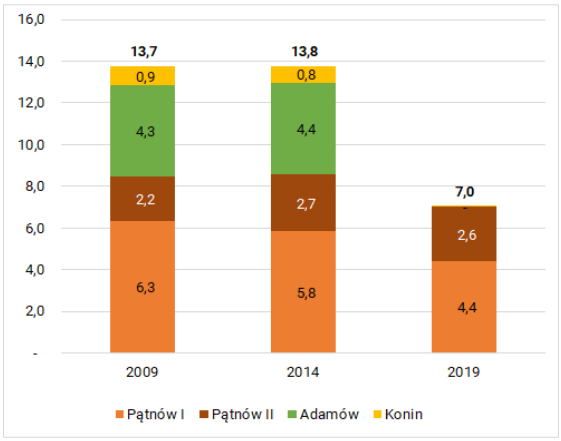
[59]Regional Development Agency in Konin.
[60]Environmental protection programme for Wielkopolska Region until 2030.

Fig. 7 Lignite output of KWB Konin from 2021 according to new ZE PAK strategy (m tons)



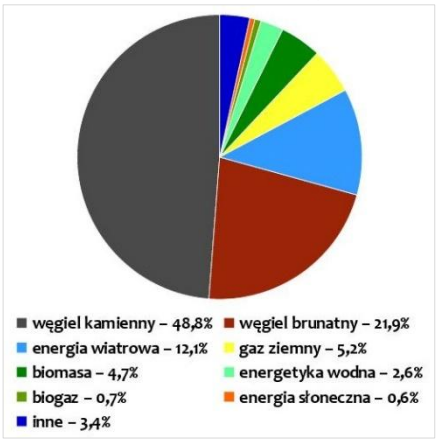
Source: Hetmański, M., et al. (2021). Economic analysis of Eastern Wielkopolska region in terms of the delivery of the fair transformation process, including energy transformation. Report by Instrat Foundation commissioned by ARR Konin, January 2021.

Fig. 8 Lignite consumption by ZE PAK power plants in the years 2009, 2014, 2019(m tonnes)



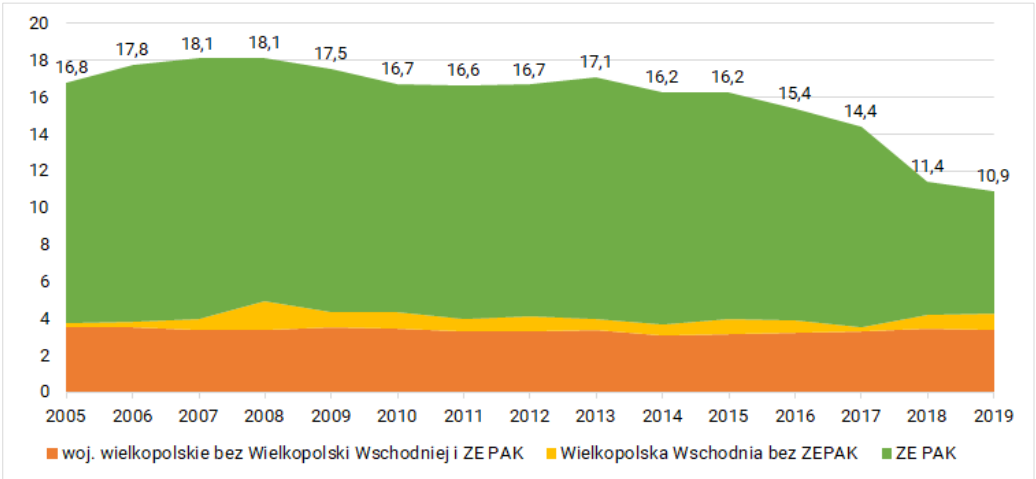
Source: Hetmański, M., et al. (2021). Economic analysis of Eastern Wielkopolska region in terms of the delivery of the fair transformation process, including energy transformation. Report by Instrat Foundation commissioned by ARR Konin, January 2021.

Fig. 9 Structure of fuels and other primary energy carriers used to generate electricity, delivered to consumers by the main distribution companies in Wielkopolska Region in 2018.



Source: Wielkopolska Regional Action Plan for Sustainable Energy and Climate in terms of renewable energy sources and energy efficiency with a 2050 perspective. Information for local governments and inhabitants of Wielkopolska

Fig. 10 CO_2 emissions from Wielkopolska Region in the years 2005-2019 - share of ZE PAK (m tonnes)



Source: Hetmański, M., et al. (2021). Economic analysis of Eastern Wielkopolska region in terms of the delivery of the fair transformation process, including energy transformation. Report by Instrat Foundation commissioned by ARR Konin, January 2021.

The energy generated from renewable energy sources (RES) includes electricity or heat from renewable sources, in particular from wind, photovoltaic, hydro, biogas, biomass and geothermal energy sources, as well as from solar thermal collectors[61] and concentrated solar power systems.

With 9.841 TWh of electricity produced in Wielkopolska region, 1.602 TWh of electricity came from renewable sources, which accounted for 16.3% of the total energy produced in the Wielkopolska region[62].

At the same time, in 2017, the share of renewable energy in gross final energy consumption in the country was at 10.9%, 0.4 p.p. lower than the share in 2016. Currently, the development of micro-installations is particularly visible, resulting from the available support programs for prosumer energy[63] [64].

In Eastern Wielkopolska, there are 110 installations for **energy production from renewable sources** with a total power of 227.2 MW, representing 24.0% of the power installed in Wielkopolska Region from RES. The largest number of installations producing energy from renewable sources is located in the districts of Konin and Koło, where wind farms account for the largest share.

Although the wind conditions in the area of Wielkopolska Region are not the best[65] for the development of wind power plants, they are relatively good in Eastern Wielkopolska. The average annual wind speed in the Wielkopolska region ranges from about 3.0 to about 3.5 m/s. The wind energy potential in the region is 4 GW, which gives it 7th rank in Poland[66]. In 2020, on the recultivated post-mining areas of the Adamów lignite open cast mine, a wind farm with a capacity of 31 MW was launched, supplying electricity to approximately 30,000 households. Wind power plants in Eastern Wielkopolska have a total capacity of ca. 162 MW, which constitutes 22.3% of installed wind power capacity in the region.

Sun conditions of Eastern Wielkopolska, like those of the Wielkopolska Region, are similar to those prevailing on the majority of the territory of Poland. With an optimally positioned solar absorbing plane, between 1150 kWh and 1185 kWh of heat energy can potentially be obtained per year from 1m^2 of absorbing surface in Wielkopolska, respectively in the southern and northern parts of the region[67]. In Eastern Wielkopolska, there are: 4 installations producing energy from

[61]Environmental protection programme for Wielkopolska Region until 2030.
[62]Annex to Resolution No. 3113/2021 of the Board of the Wielkopolska Region of 8 January 2021 Wielkopolska Regional Action Plan for Sustainable Energy and Climate in terms of renewable energy sources and energy efficiency with a perspective until 2050. Information for local governments and inhabitants of Wielkopolska; Poznań 2021.
[63]Indicators of green economy in Poland 2019, CSO.
[64]Annex to Resolution No. 3113/2021 of the Board of the Wielkopolska Region of 8 January 2021 Wielkopolska Regional Action Plan for Sustainable Energy and Climate in terms of renewable energy sources and energy efficiency with a perspective until 2050. Information for local governments and inhabitants of Wielkopolska; Poznań 2021.
[65] The climate change will have little impact on Europe's overall wind energy potential, with changes at the European level in the range of ± 5% in the 21st century. Several studies suggest an increased potential at the European level in winter, but a decrease in summer and autumn. Local and regional variations in annual wind energy potential can be up to ± 15%, with possible variations up to ± 30% for individual seasons. Most studies predict an increase in potential in the Baltic Sea countries and a decrease in Southern Europe, while both increases and decreases are predicted for the other regions. Source: Report 02/2019 of the European Environment Agency (EEA) "Adaptation challenges and opportunities for the European energy system. Building a climate-resilient low-carbon energy system."
[66]According to the data from the Institute of Renewable Energy.
[67]Environmental protection programme for Wielkopolska Region until 2030.

solar radiation with total capacity of 1.1 MW (in the municipalities of Dobra, Przykona and the city of Konin).

Wielkopolska has favourable conditions for the development of renewable energy from solid biomass, biogas and biofuels. The largest biomass resources are located in areas of intensive agriculture (southern as well as central and eastern part of Wielkopolska). Because of developed plant and animal production, Wielkopolska has a great potential for the development of agricultural biogas plants, which by using, among others: waste from animal production, waste from plant production, energy crops from purpose built crops and waste from food production as a raw material for biogas production, contribute to positive environmental, economic and social effects. In addition to agricultural biogas plants, biogas produced from sewage sludge in municipal sewage treatment plants, landfill gas from landfills and manure gas are sources of renewable energy[68]. In the area of Eastern Wielkopolska, there is an industrial power plant with a capacity of 50 MW in Konin, producing energy for heating purposes[69] with the use of biomass, as well as agricultural bioelectric plants in Konin and the municipality of Przykona (Psary). In addition, the Municipal Waste Management Plant in Konin generates electricity and heat of 6.7 and 15.4 MW, respectively, in the process of thermal processing of municipal waste.

Wielkopolska Region is counted among the most water scarce areas in Poland. The available water resources, in an average year, are at 3,753.71 million m^3. Most of the region falls into Categories I and II of the greatest needs in terms of small retention. The enormous water consumption by the lignite mining and power industry in Eastern Wielkopolska, as well as the observed climate changes, contribute significantly to the aggravation of the water deficit problem[70].

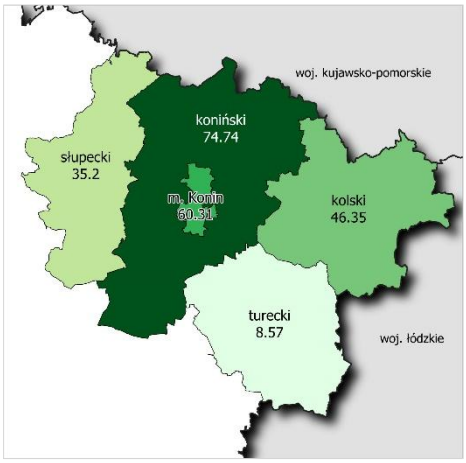
Wielkopolska Region is a region with significant and exploitable geothermal energy and water resources. The region has the largest, on the Polish Lowlands, amounts of accumulated heat per unit area with values ranging from 400 to over 500 GJ/m^2. The existing geothermal energy resources can be used not only to produce heat but also electricity[71]. In the area of Eastern Wielkopolska for the borehole "Koło GT-1," which explores thermal waters from formations of the Lower Cretaceous, exploitation resources were estimated at Q = 257 m^3/h.

[68] as above.
[69] https://zepak.com.pl/pl/elektrownie/elektrownia-patnow-konin/elektrownia-konin/blok-opalany-biomasa.html
[70] as above.
[71] as above.

Fig. 11 Share of RES in electricity production in Wielkopolska versus Poland in 2008 – 2018 (%)

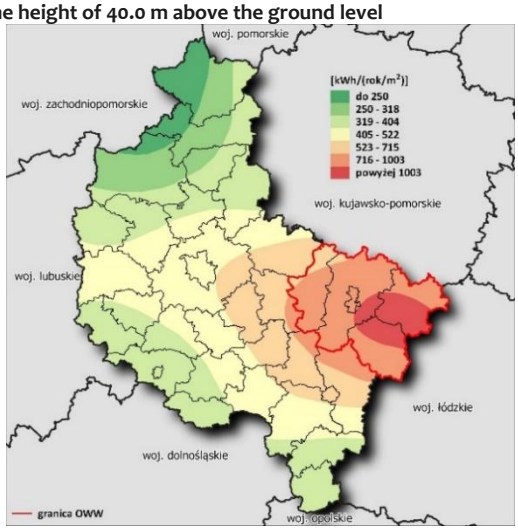
Source: energy.instrat.pl based on data from the Energy Regulatory Office.

Fig. 12 Total capacity of RES generation sources installed in the counties in Eastern Wielkopolska in 2019. (MW)



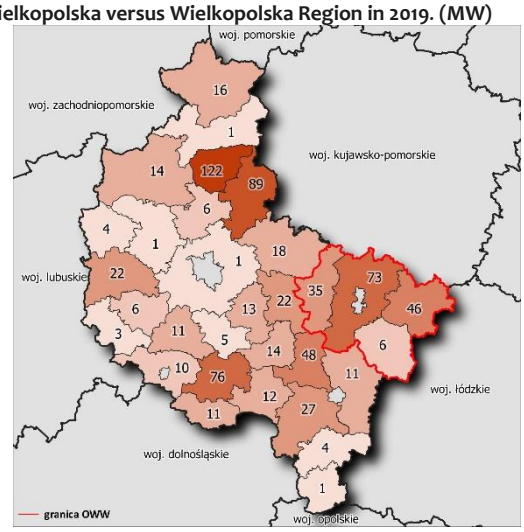
Source: own study by WBPP on the basis of Environmental Protection Programme for Wielkopolska Region until 2030

Fig. 13 Technical potential of wind energy in Wielkopolska Region at the height of 40.0 m above the ground level



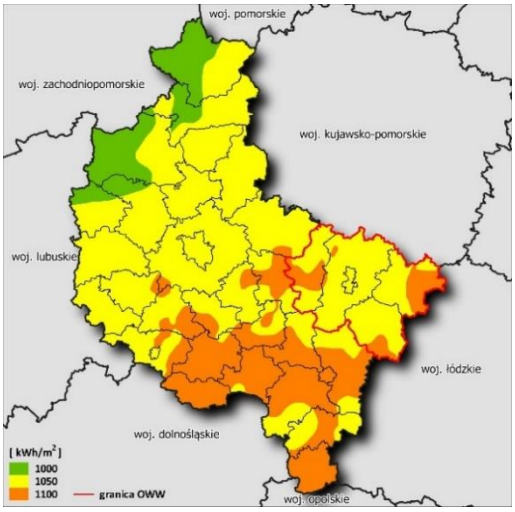
Source: Review of renewable energy resources in Wielkopolska Region

Fig. 14 Wind power capacity installed in districts of Eastern Wielkopolska versus Wielkopolska Region in 2019. (MW)



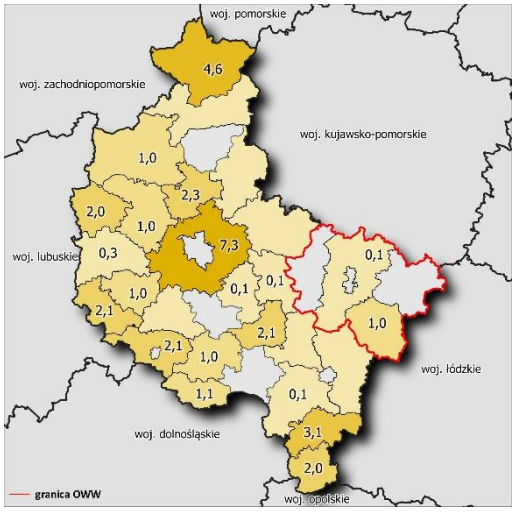
Source: energy.instrat.pl based on data from the Energy Regulatory Office.

Fig. 15 Annual energy of solar radiation per unit area in Eastern Wielkopolska versus Wielkopolska Region (kWh/m²)



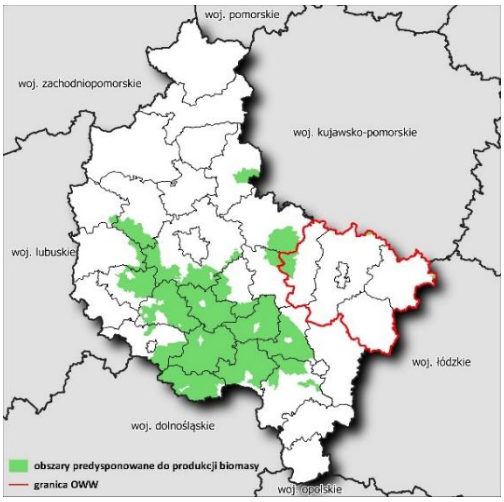
Source: Environmental Protection Programme for Wielkopolska Region until 2030 based on the Monograph Renewable energy sources as a chance for Wielkopolska, Scientific Publishing House of Mikołaj Kopernik University, Toruń, 2016

Fig. 16 Photovoltaic power installed in districts in Eastern Wielkopolska versus Wielkopolska Region in 2019. (MW)



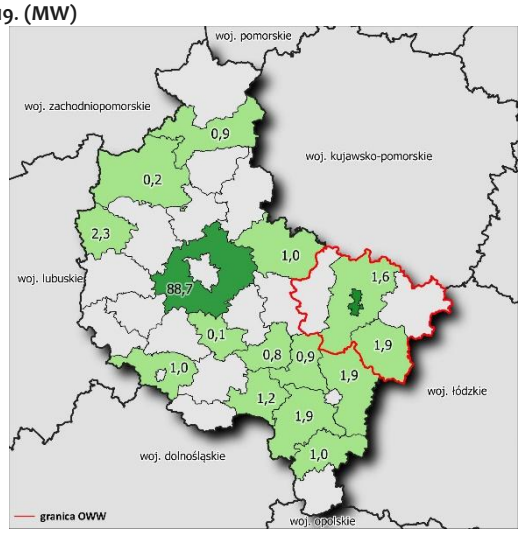
Source: energy.instrat.pl based on data from the Energy Regulatory Office.

Fig. 17 Areas predisposed to biomass production in Wielkopolska Region



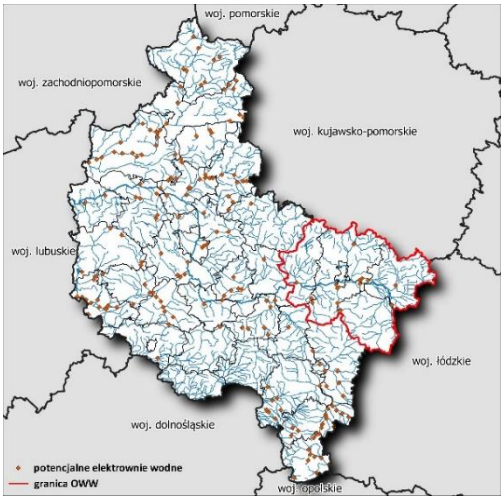
Source: Local development plan for Wielkopolska Region 2020+

Fig. 18 RES power from biogas and biomass installed in counties in Eastern Wielkopolska versus Wielkopolska Region in 2019. (MW)



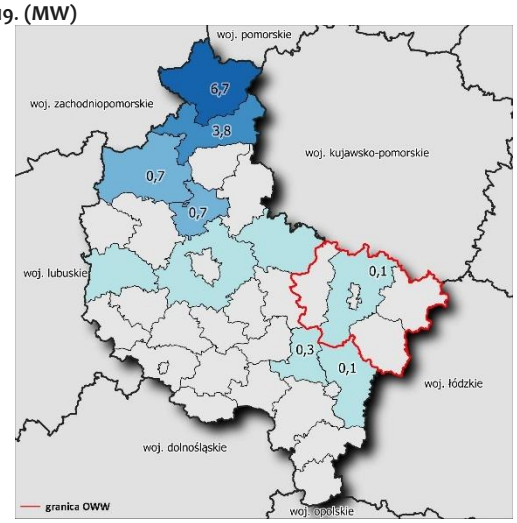
Source: energy.instrat.pl based on data from the Energy Regulatory Office.

Fig. 19 Location of potential hydroelectric power plants (after mills) in Eastern Wielkopolska versus Wielkopolska Region



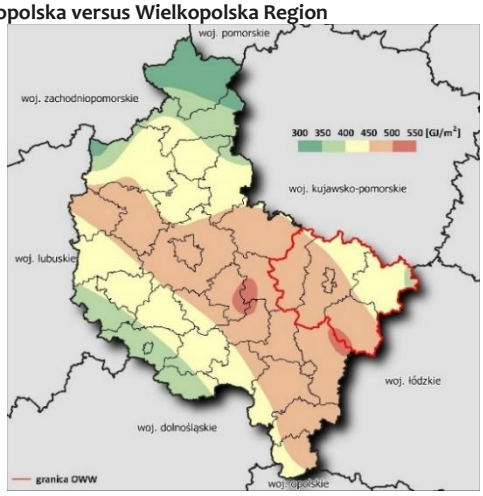
Source: Environmental Protection Programme for Wielkopolska Region until 2030 based on the Monograph Renewable energy sources as a chance for Wielkopolska, Scientific Publishing House of Mikołaj Kopernik University, Toruń, 2016

Fig. 20 Hydroelectric power capacity installed in districts of Eastern Wielkopolska versus Wielkopolska Region in 2019. (MW)



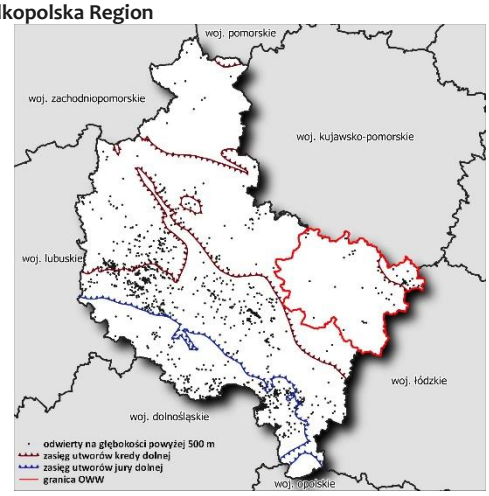
Source: energy.instrat.pl based on data from the Energy Regulatory Office.

Fig. 21 Available unit geothermal energy resources in Eastern Wielkopolska versus Wielkopolska Region



Source: WBPP's own study on the basis of Atlas of Geothermal Resources in the Polish Lowlands, Mesozoic Formations, Kraków 2006

Fig. 22 Geothermal water wells in Eastern Wielkopolska versus Wielkopolska Region



Source: Environmental protection programme for Wielkopolska Region until 2030.

Currently, due to its ecological nature, **hydrogen** is gaining more and more interest in Poland, which is seen as a new green fuel in the transport, electricity, industrial and heating sectors[72]. The initiator of activities for the development of power industry in the area of Eastern Wielkopolska based on modern hydrogen technologies and development of research in the field of implementation of modern technologies for production, distribution and storage of green hydrogen is the city of Konin[73]. The city will participate in the construction of a multimodal terminal where both locomotives and trucks will run on hydrogen[74]. It is also an important centre for promoting the hydrogen economy in the country[75]. Moreover, there are plans to create a **"hydrogen valley"** in Eastern Wielkopolska and to establish an energy cluster promoting the production of green hydrogen from renewable sources.

The process of implementing hydrogen technologies in Eastern Wielkopolska was started by ZE PAK S.A., where works related to three investment projects are being carried out: construction of a hydrogen production plant with accompanying infrastructure on the premises of the Konin power plant, construction of a hydrogen filling station on the territory of the town of Konin and autonomous supply of electricity and heat to a single-family house[76].

One of the most important projects currently implemented in Eastern Wielkopolska is the construction of a **hydrogen production plant with accompanying infrastructure** on the premises of the Konin power **plant.** Hydrogen will be produced by water electrolysis using PEM (proton exchange membrane) technology, which means that it will be created without harmful by-products[77].

The electrolysis process will use electricity generated in Konin Power Plant's biomass-fuelled generation units - RES units, including from a new biomass unit resulting from the conversion of a coal-fired boiler into a biomass-fuelled boiler. In the first stage of construction of the hydrogen plant, the demand for electricity will be at 2.5 MW and after equipping the module with a second 5 MW electrolyser, which will allow for production of 2 tonnes of hydrogen per day. One electrolyser will allow the operation of approximately 50 buses per day, each of which travels about 250 km per day[78].

Another investment related to hydrogen is the opening of a **hydrogen filling station in Konin**, scheduled for March 2021. The station will be able to fill up cars, buses and trucks[79].

[72]The concept of equitable transformation of Eastern Wielkopolska. Wielkopolska Energy Valley. Strength of Eastern Wielkopolska; project; Konin, October 2020.
[73]The City of Konin is a founding member of the Wielkopolska Hydrogen Platform.
[74]"The city of Konin as the leader in hydrogen projects and investments – we do rather than just talk," UM in Konin, January 2021.
[75]The analyses carried out as part of RIS 2030 allowed to identify the potential of Konin subregion to become an area related to subregional specialisations: "Renewable Energy Sources" and "Modern Energy Technologies."
[76]The planned H2Lab Hydrogen Application Centre.
[77] Production of hydrogen using this technology consists in the decomposition of pure demineralised water by means of electric current into hydrogen and oxygen, which takes place on the surface of special membranes enabling the catalytic process of water decomposition. The hydrogen generated in PEM with a pressure of about 30 bar is compressed to a pressure of about 350 bar (in the compression station) and pumped to mobile storage (via the filling station). The mobile storage facilities will allow hydrogen to be delivered to refueling stations for passenger vehicles and buses located in many places around the country. Source: Regional Development Agency in Konin.
[78] Source: Regional Development Agency in Konin.
[79]as above.

The project of **autonomous supply of electricity and heat to a single-family house** based on own sources of renewable energy using hydrogen as an energy storage and carrier assumes the development of a concept and technical selection of equipment for a self-sufficient autonomous system of supplying electricity, heat and domestic hot water to single-family houses with low energy consumption and passive houses[80].

An important element in building a low-carbon and energy-efficient energy sector is modern and accessible electricity grids integrated with energy generating installations. In Eastern Wielkopolska, the derivation of electric power from power plants is enabled by an extensive **electric power system** consisting of: 2 400 kV power lines (Konin Power Plant - SNN Kromolice and Pątnów Power Plant - Konin Power Plant), 10 220 kV power lines , 44 110 kV lines and the highest voltage substations in Konin and Turek. High-voltage overhead lines and main supply points are of different ages and transmission capacities. Some of the medium and low voltage grids, including transformer substations, are heavily exploited. Increasing energy security and efficiency requires corrective actions to develop a modern transmission infrastructure system. Currently, the distribution network operators in the area of Eastern Wielkopolska start works related to reconstruction of power lines and their digitalisation and automation, which will provide the users with stable energy supply. Works are underway related to the construction of a new 400 kV line between Pątnów and Jasiniec or 110 kV line between Słupca and Powidz. New or reconstructed power lines of different voltages, through the Smart Grid[81], will enable integration with RES installations.

Reducing the emissions of the power system will be possible through introduction of new technologies related not only to production and transport of energy, but also its storage and development of energy clusters and cooperatives. In 2018, the Green Energy **cluster** in Konin[82] was established in Eastern Wielkopolska, whose main goal is, among others, to integrate the potential and entities related to the energy market and initiate cooperation to build a low-carbon economy and sustainable energy[83]. On the other hand, in the area of Turek district, there is the "CLEAN ENERGY" Turek Energy Cluster whose mission is to increase the share of renewable energy sources in the overall energy mix and to reduce low emissions, and in the long term – achieve energy self-sufficiency[84].

The key challenge for the transformation of the energy sector in Eastern Wielkopolska in the context of the fight against global warming and climate change is the decarbonisation of the energy sector.

[80] Source: Regional Development Agency in Konin.
[81] The distribution network and the related information and communication technologies, integrating the activities of energy producers, distributors and consumers in an intelligent way; the key element of the Smart Grid is the application of smart meters for measuring the consumed electricity in households in smart metering posts; by introducing the Smard Grid technology to the system, two-way flow of information and energy will be ensured, the costs related to the modernisation of the transmission network will be reduced and appropriate instruments for energy management in households related to its consumption will be provided; The Smart Grid will also contribute to the efficient use of distributed renewable sources, including photovoltaic panels that can be combined with heat pumps in residential buildings; the Smart Grid also enables an individual customer's micro-source to be connected to the power line.
[82] It was awarded the Pilot Energy Cluster Certificate by the Ministry of Energy as part of the Competition for Energy Clusters.
[83] http://www.mzgok.konin.pl/1/121/klaster_energii_%E2%80%9Ezielona_energia_-_konin%E2%80%9D
[84] https://media.energa.pl/pr/398865/energa-wspoltworzy-kolejny-klaster-energetyczny

The main challenges for Eastern Wielkopolska in the context of climate change and securing space for people's health and life in a clean environment are among others:

- **with regard to maintenance and development of the energy potential:**
  - the need to change the structure of energy management and the energy production process, including the transformation of the energy sector aimed at changing primary energy carriers to climate-neutral ones and reducing greenhouse gas emissions;
  - improving the energy efficiency of the energy sector;

- **for the mining sector associated with the exploitation of lignite deposits:**
  - complete abandonment of lignite mining;
  - complete abandonment of coal as an energy carrier in electric power and heating, both network and dispersed;
  - using the potential of post-mining areas to develop renewable energy sources, including wind farms, photovoltaic or sustainable biomass production;
  - the need to restore proper water relations and soil conditions disturbed by mining activities;

- **with regard to RES development:**
  - full use of the potential of Eastern Wielkopolska for the development of RES, including especially good wind conditions, geothermal water resources, favourable sunlight conditions and substantial biomass and biogas resources;
  - the need to shape pro-environment and pro-climate attitudes among the inhabitants;
  - the need to build a system conducive to the development of innovation, such as the relationships between business and science;

- **with regard to the electricity system:**
  - preventing the decapitalisation of electricity networks;
  - the need to prevent energy losses in transmission and distribution;
  - the need for an energy collection and storage system;
  - adapting the electricity system to the needs resulting from the progressive change in the structure of energy generation sources, including the development of RES and prosumer energy from micro-sources.

- **Sustainable industry and construction**

Making the environmental transition and achieving a climate-neutral Europe in 2050 requires technological change in carbon-intensive economic sectors, energy and resource-intensive industries and construction. Supporting the implementation of low-carbon technologies, investing in research and innovation and the creation of new and modern jobs in the green economy, while changing people's consumption-related behaviours towards, among other, giving up disposable or limited-use products, saving water consumption or preventing food waste, will be key to limiting climate change.

In the process of fuel combustion, which was responsible for 92.3% of total CO2 emissions in Poland in 2018, the manufacturing industry and construction (9.3%) had a significant share. Industrial processes and product use accounted for 5.8% of total CO2 emissions, with mineral products being the main source of emissions[85].

In 2018, **the number of business entities** in Eastern Wielkopolska was at 38,733, which represented 9.0% of the entities in Wielkopolska Region. Since 2012, the number of business entities in Eastern Wielkopolska has increased by 12.2% (in Wielkopolska – 10.7%). In 2018, 4,335 new businesses were registered, representing 11.2% of new businesses in the region. The largest economic centre of the area is the city of Konin, where 8 174 entities are located, i.e. 21.1% of all entities in Eastern Wielkopolska. A relatively large number of business entities also operate in Turek (2 747 entities), Koło (2 565), Słupca (1 804) and Stare Miasto (1 497).

The level of economic activity in Eastern Wielkopolska, counted by the number of business entities per 1,000 people at working age, was 145 in 2018 and was definitely lower than the average in Wielkopolska (203). The cities with the highest economic activity included: Słupca (221), Rychwał (207), Koło (200) and Konin (186).

In terms of **investment attractiveness**, the municipalities of Eastern Wielkopolska are very diverse. In 2017, according to a report from the Polish Investment and Trade Agency[86], the highest rated cities and areas included: Konin, Koło, Turek and Słupca, the urban-rural municipality of Kleczew and the rural municipality of Przykona. The potential for activities in the processing industry has been identified in the urban-rural municipalities Ślesin and Kłodawa and in the rural municipalities: Słupca, Ostrowite, Stare Miasto, Władysławów. On the national scale, the subregion of Konin[87] was indicated as being highly attractive for the industry (ranking 19th among 60 subregions in the country) and services (ranking 20th) as well as being of average attractiveness for the high-tech industry (ranking 35th)[88].
Although the structure of entities by sectors of economic activity in Eastern Wielkopolska is dominated by service entities (69.7%), the **industrial specialisation of** the area is proven by high share of business entities operating in the industrial and construction sector (28.4%),

[85] National Inventory Report 2020 (Synthesis Report) containing national greenhouse gas emissions data for 1988-2018 with a description of the methodology. Report based on data reported to the UNFCCC Secretariat on April 15, 2020.
https://www.kobize.pl/pl/fileCategory/id/16/krajowa-inwentaryzacja-emisji
[86] Investment attractiveness of regions 2017 Wielkopolska Region, collective work edited by H. Godlewska-Majkowska, report prepared for Polska Agencja Inwestycji i Handlu S.A. at the Institute of Enterprise, Warsaw School of Economics, Warsaw 2017.
[87] According to NUTS classification, Konin subregion consists of the following districts: Gniezno, Kolsk, Konin, Słupca, Turek, Września, City of Konin.
[88] IBnGR Report Investment attractiveness of regions and subregions of Poland 2016.

compared to the average for the region (23.6%). Between 2012 and 2018, this share increased by 4.7 p.p. At the same time, there is a significant increase in the share of new entities from the industrial and construction sector among the newly created entities in total. In 2018, it was at 41.8% and has increased by 14.2% since 2012. Most entities from the industrial and construction sector are located in the largest economic centres of the area: Konin (1,724) and Turek (520), as well as in the Ślesin municipality (473). At the same time, the share of this sector in many municipalities exceeds 40.0% of business entities, which proves their high economic specialisation. The areas with the highest share of entities operating in the industry and construction sector include: Wierzbinek municipality (ranking 2nd in the region), rural areas of Rychwał and Sompolno municipalities (ranking 5th and 6th among the regions) and Ostrowite municipality (ranking 7th).

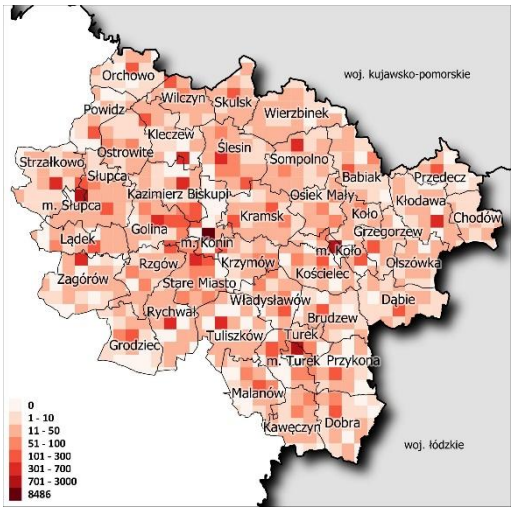
In 2018, according to the Polish Classification of Activities (PKD), the economic activity in the territory of Eastern Wielkopolska qualified to **the industry and construction sector** was conducted by entities representing five sections of PKD: "B" (mining and quarrying), "C" (manufacturing), "D" (electricity, gas, steam, hot water and air conditioning supply), "E" (water supply, sewage and waste management and reclamation activities) and "F" (construction). The most numerous groups, respectively 65.8% and 31.0% of the total number of the sector's entities, were constituted by enterprises in the field of construction and industrial processing, including: manufacture of fabricated metal products (20.7%), repair, maintenance and installation of machinery and equipment (12.1%), manufacture of wood and cork products (12.0%), manufacture of furniture (9.9%) and manufacture of food products (9.8%).

The analysis of the size of enterprises in terms of **headcount** showed that production activities in Eastern Wielkopolska are characterised by a significant share of small and medium enterprises. The largest companies, with more than 1,000 employees, include: 5 entities from the industrial sector and one from the construction sector. There are 15 industrial enterprises in the group of entities with headcount between 250 and 999 employees.

In the context of the need to transform the area's economy towards a low-carbon, energy- and resource-efficient **economy**, the development of **a closed-loop green economy** is of particular importance, including sustainable construction and industry, which, in the case of the largest installations, is required to continuously develop the technological process in a manner consistent with the best available techniques and technologies (BAT). The change of assumptions starting from the design phase, where all stages of the product cycle are indicated, through the process of sustainable production and rational use, will make it possible to minimize the generation of waste and to reuse it in the manufacturing process, which will lead to savings caused by the increase in productivity, reduction of pollution and, as a result, improvement of the condition and quality of the natural environment.

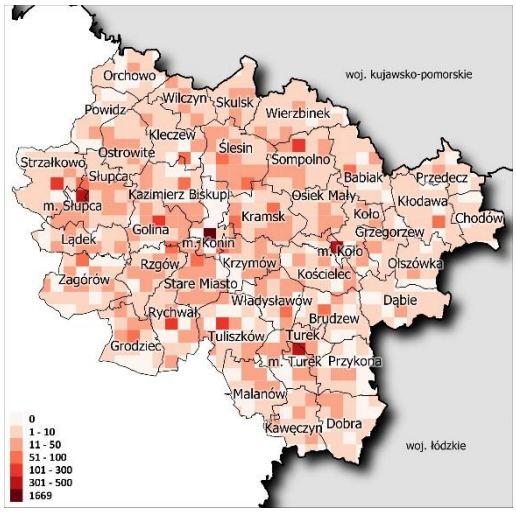
Fig. 23 Total number of national economy entities in Eastern Wielkopolska in 2018.

Fig. 24 The number of national economy entities from the sector "Industry and construction" in Eastern Wielkopolska in 2018.



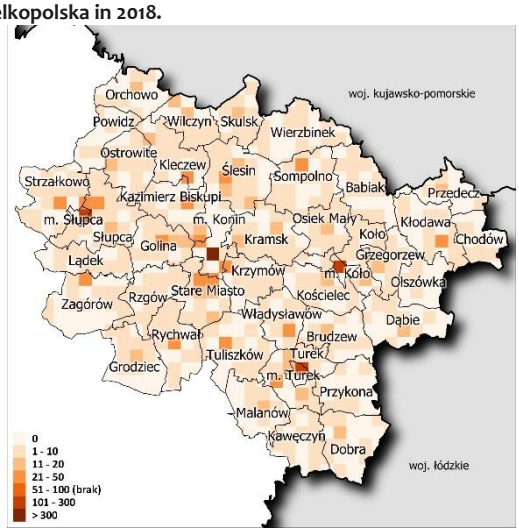
Source: WBPP own study based on CSO, BDL

Fig. 25 Number of business entities in the field of personalised furniture, design, smart technologies and materials in Eastern Wielkopolska in 2018.



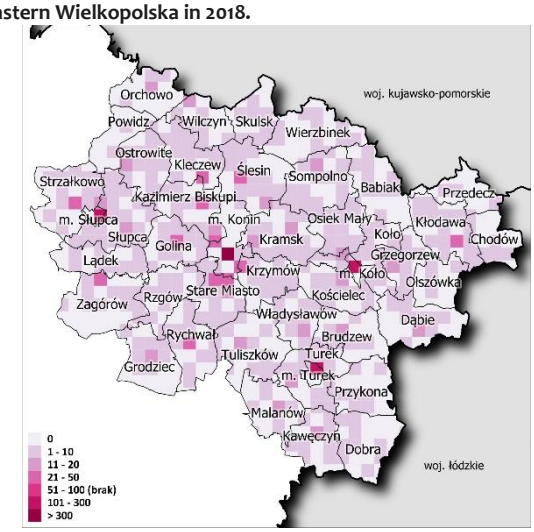
Source: WBPP own study based on CSO, BDL

Fig. 26 Number of business entities in the field of machinery and machine components, new technologies and materials in Eastern Wielkopolska in 2018.



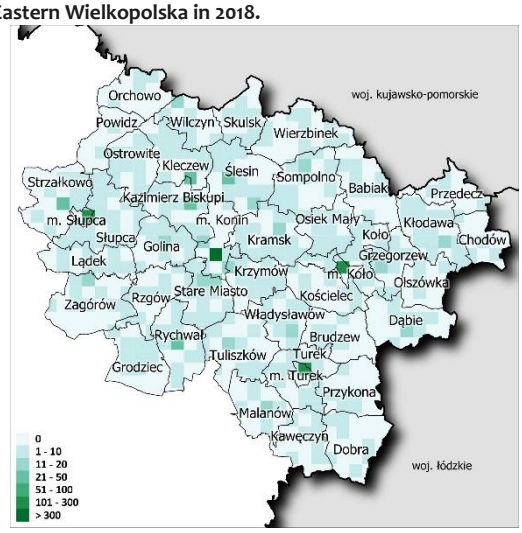
Source: WBPP own study based on BDL

Fig. 27 Number of ICT businesses for public services, technology development and infrastructure for data exchange and storage in Eastern Wielkopolska in 2018.

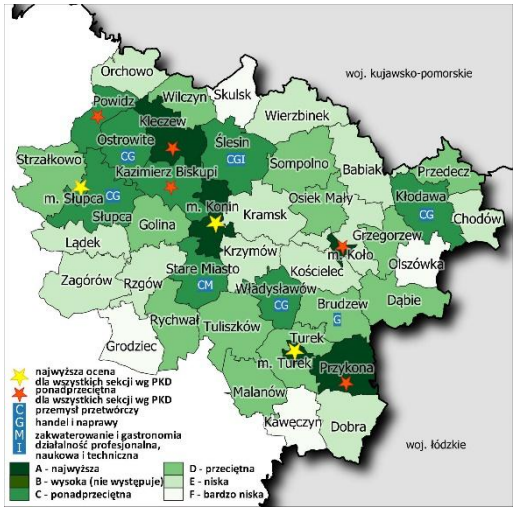


Source: WBPP own study on the basis of municipality SUiKZP, Land and Property Register

Fig. 28 Investment attractiveness of Eastern Wielkopolska municipalities



Source: WBPP own study based on BDL



Source: WBPP own study based on a report from the Polish Investment and Trade Agency

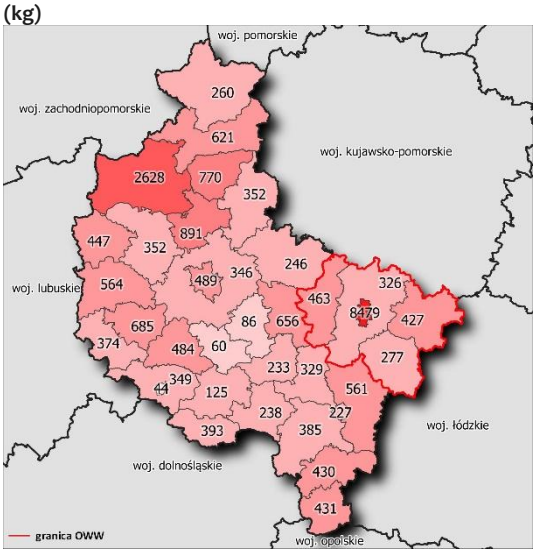
Production processes in industry are very complex and vary considerably in terms of the technologies or solutions used, therefore it is difficult to identify all directions of energy use. The primary energy uses include furnace heat, process steam, electric drives, heating and lighting[89].

In 2019, in Eastern Wielkopolska, there were 25 enterprises in high-emissions industries (other than electricity), employing ca. 4.8 k people[90]. The five largest companies account for more than three-quarters of revenue and half of employment. Therefore, counteracting the negative economic effects of decarbonisation outside the electricity sector in the region should focus on providing support to the employees of selected enterprises, including, for example, changing their business profile or retraining employees. The parts of the economy at risk include in particular the metal production sector, including metallurgy, and the ceramics sector with significant exposure to the cost of emission allowances. These industries have identified the need to switch sources of energy generation from fossil fuels to low- and zero-carbon fuels (including green hydrogen) and electrification and thereby create new jobs in the local value chain[91], including both those created in addition and those replacing current ones that will be eliminated[92].

The need to reduce the depletion of natural resources and climate change and to secure space for human health and life in a clean environment requires minimizing the generation of waste as well as creating an effective and sustainable management of the waste generated. **Sustainable waste management** includes to the greatest extent municipal waste, which is the most extensive group of waste that depends on the daily behaviour of residents. The mass of municipal waste collected in 2019 in the area of Eastern Wielkopolska was 127,766 Mg, of which 87.1% was household waste and 12.9% was waste from municipal services, trade, small business, offices, and institutions. Of the above mass of collected municipal waste, 82137 Mg was mixed waste (64.3%) and 45 629 Mg was selectively collected (Eastern Wielkopolska 35.7%, Wielkopolska 29.0%, Poland 31.2%)[93] [94]

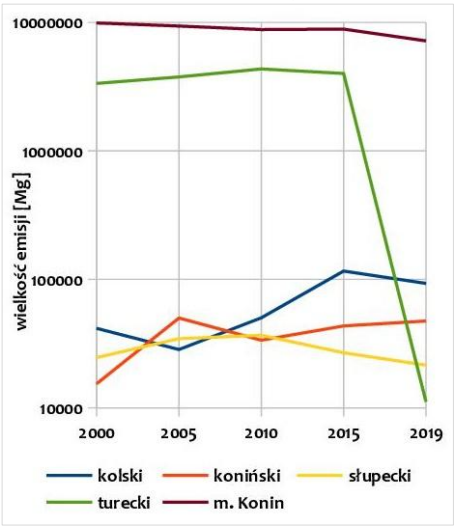
[89]after the National Plan for Energy and Climate
Source: Hetmański, M., et al. (2021). Economic analysis of Eastern Wielkopolska region in terms of the delivery of the fair transformation process, including energy transformation. Report by Instrat Foundation commissioned by ARR Konin, January 2021.
[91]as above.
[92]These issues need to be addressed at the company level.
[93]BDL, CSO 2019.
[94]Waste management plan for Wielkopolska Region for the years 2019-2025

Fig. 29 Emissions of the economy of Eastern Wielkopolska by districts versus Wielkopolska Region. CO2 emissions per capita in 2019 (kg)



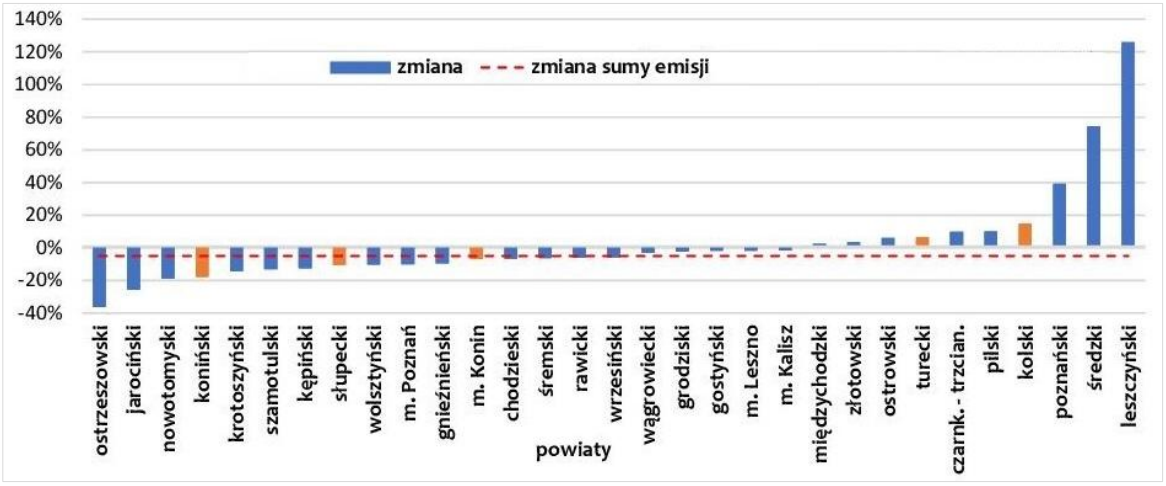
Source: UMWW Provincial Environmental Pollution Bank; own study by WBPP on the basis of Instrat Foundation materials

Fig. 30 The volume of CO2 emissions from plants particularly arduous for the environment in the districts of Eastern Wielkopolska in the years 2000 - 2019 (Mg)



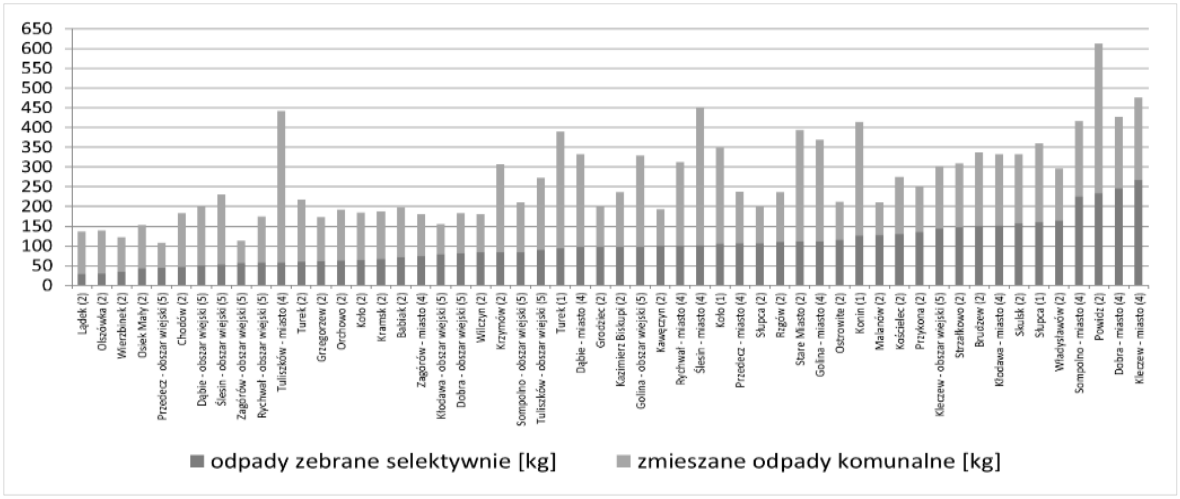
Source: WBPP own study based on CSO

Fig. 31 Emissions of the economy of Eastern Wielkopolska by districts versus Wielkopolska Region. Change in CO2 emissions in selected districts in 2019 compared to 2018r. (%); (2018 = 100.0%)



Source: WBPP own study based on CSO

Fig. 32 Mixed municipal waste and selectively collected waste per capita in urban and rural areas in Eastern Wielkopolska in 2019.



Source: WBPP own study based on BDL, CSO

The waste generated, excluding municipal waste, in Eastern Wielkopolska is mainly a group of waste connected with lignite mining industry, rock salt and the power industry (mineral waste, heaps and tailings ponds). Nevertheless, neither on the area of the whole region, nor on the area of Eastern Wielkopolska is it planned to establish mining waste treatment facilities. Currently, extractive waste or products resulting from the recovery of extractive waste as well as ash and slag constituting incineration residues are used for the production of cement, concrete and aggregates, replacing natural materials, in particular in construction projects, e.g. roads and land reclamation projects. Waste from thermal processes in the energy industry are generated in the process of burning lignite and as a result of exhaust treatment methods. The main types of waste generated include: ash-slag mixtures from wet furnace waste disposal, coal fly ash, mixtures of fly ash and solid waste from calcium-based flue gas desulphurisation methods and slags, bottom ash and boiler dust. The main direction for waste disposal is landfilling, nevertheless 30.0%-40.0% of the generated waste stream is recycled. In 2019, 1,558,100 Mg of non-municipal waste was generated, of which only 5.0% was recycled.[95] The amount of waste generated excluding municipal waste in the area has been steadily declining and has halved between 2012 and 2019[96].

Moreover, Eastern Wielkopolska is characterized by zero reuse of industrial wastewater[97] (0.04% for the region) and marginal use of sludge generated during the year from industrial wastewater treatment plants in agriculture and soil reclamation. In 2019, only 1.0% of sludge was used for agriculture in the area (Wielkopolska 20.1%), 0.02% for land reclamation, including land for agricultural purposes (Wielkopolska 0.4%), while 4.6% was thermally transformed (Wielkopolska 16.5%)[98].

[95] BDL, CSO 2019.
[96] In the same period, the area of unclaimed landfills for generated and landfilled waste increased by 6.6 ha. There are 7 industrial waste dumps In the area of Eastern Wielkopolska: Northern furnace waste landfill of Pątnów ZE PAK S.A. open pit in Goranin, Sławęcin, Sławęcin Lubomyśle, furnace waste storage yard of Gosławice open pit with evaporator Linowiec, ZE PAK S.A. in Wola Łaszczowa, Wieruszew, Maliniec Wola Łaszczowa, Wieruszew, Maliniec, western open pit combustion and solid waste storage facility with evaporator, so-called eastern open pit, Przykona ZE PAK S.A. in Żuki, Chlebów, Warenka, Olszowa, non-hazardous and inert waste landfill site with hazardous waste sections of ZUO Konin Sp. z. o. o, hazardous waste landfill located in Konin, landfill site for solid waste from Pątnów Ślesin open pit in Sławęcinek-Rębowo, landfill site for hazardous waste from construction, renovation and demolition of buildings and infrastructure in Konin; Information on the facilities for the treatment of main streams operating in Wielkopolska Region for waste from products, hazardous waste and other waste; status as at 31 December 2017.
[97] Nearly 94.0% of industrial wastewater generated in Eastern Wielkopolska is wastewater – cooling water (not requiring treatment) – discharged directly to water or to the ground.
[98] Source: BDL, CSO.

In the context of the necessity to change the economy, the **process of creation and implementation of innovations**, both in relation to products, technology and organisation, becomes particularly important. Wielkopolska Region, including Eastern Wielkopolska, is characterised by a low level of innovativeness, which results inter alia from insufficient innovative activity of enterprises. Both the percentage of innovative enterprises and enterprises co-operating in the field of innovative activity and the expenditures incurred by enterprises for the innovative activity are most frequently at the level lower than the average in the country[99]. As regards industrial property protection of utility models, the indicator is the level of protection rights granted in the Patent Office of the Republic of Poland (UPRP) per 100,000 people. In 2018, the index was 2.0 in the country, 1.7 in Wielkopolska Region, and 0.5 in Eastern Wielkopolska. Out of 95 utility designs submitted from the region, 3 were from Konin district and 1 from the city of Konin. Moreover, in 2018, 14 inventions from the Eastern Wielkopolska region (less than 4.0% of all applications from the region) were filed with the Patent Office and 10 patents were granted. Out of the inventions, 9 were filed by business entities (5.0% on a regional scale) and 5 by natural persons (10.0% on a regional scale). Most patents were granted to business entities (9, which constituted 6.0% of patents in this category in the region).

the development potential in the economic dimension and investment attractiveness increases thanks to investment areas with favourable conditions for running a business. The municipalities of Eastern Wielkopolska are situated in the area of influence of the Łódź Special Economic Zone (counties: Kolski, Konin, Turek, the city of Konin) and the Walbrzych Special Economic Zone "INVEST-PARK" (Słupca district). The Łódź SEZ offers attractive areas, especially for industrial investments and is oriented towards supporting manufacturing, modern **business** services (BPO, SSC, IT) and R&D operations. Also, **companies related to business services** support the business activity in the area. At the end of 2018, in Eastern Wielkopolska there were 6,657 entities providing services for enterprises and business[100] (including more than 30.0% in Konin), which constituted 6.4% of the entities located in the region. At the same time, business environment entities accounted for 17.2% of all entities in the area. The self-government authorities of Eastern Wielkopolska are actively involved in works aimed at increasing innovativeness. Representatives of the city of Konin and Agencja Rozwoju Regionalnego S.A. in Konin are members of the Wielkopolska Hydrogen Platform, one of the aims of which is to promote and implement rational European and national solutions related to the use of low- and zero-emission technologies, including hydrogen.

Also, Eastern Wielkopolska has: a **scientific and research centre** in Konin, **Turek Business Incubator** (an industrial park and incubator supporting micro, small and medium enterprises which provides comprehensive services for the business) as well as **OZE research and development centre** located in Konin.

[99] Wielkopolska Region Development Strategy 2030.
[100] Such as: banks, insurance institutions, consulting and advisory companies (PKD sections J, K, L, M, N).

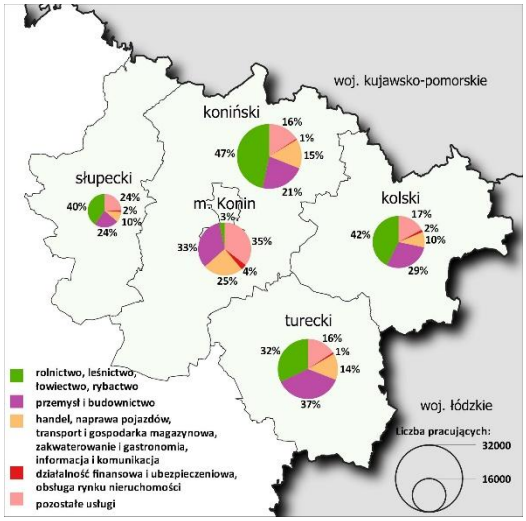
The process of transforming the economy is accompanied by a process of changes in the labour market. As of the end of 2018, there were[101] 126,468 people working in the Eastern Wielkopolska area. In comparison to the employment structure in Wielkopolska Region, the **local labour market** was characterised by a lower share of people working in services (11.4 percentage points less) and in industry and construction (3.7 percentage points) and a higher share of people working in agriculture, forestry, hunting and fishing (15.1 percentage points more). In Eastern Wielkopolska 37,150 people worked in industry and construction, which constituted 9.5% of the total number of employees in this sector in the region. The highest percentage of those employed in industry and construction was recorded in the district of Turek (37.0% of all employed).

An important element illustrating the attractiveness of the labour market is **commuting**. Analyses of population flows related to employment conducted in 2016 showed that the balance of circular migration in the Eastern Wielkopolska area prevailed in favour of leaving for work, which should be considered an unfavourable process. A total of 42,062 workers left the municipalities of Eastern Wielkopolska for work purposes, while 33,677 people came to work in local establishments. Movements of workers in both cases mostly took place within the area, but also concerned the inflow and outflow of population from other regions of Wielkopolska and Poland. The positive migration balance of daily shuttle trips to work, i.e. the advantage of arrivals over departures, was recorded in 8 municipalities of the area. The most attractive and absorbing local labour markets included: the city of Konin, (with 4 182 arrivals), the city and municipality of Koło[102] (2 652 arrivals), the city and municipality of Turek[103] (1 318 arrivals), the municipality of Powidz (868 persons), the municipality of Kleczew (579 arrivals) and the municipality of Zagórów (417 arrivals). At the same time, the municipalities with the highest number of arrivals include: Konin – 7 932 arrivals (23.6% of all commuters), Koło[104] - 4 766 arrivals (14.2%), Turek[105] - 4 399 arrivals (13.1%).

In 2018, in all districts of Eastern Wielkopolska, **the registered unemployment rate** exceeded the average level estimated for Wielkopolska Region, which was at 3.2%. The districts with the highest unemployment rate included the district of Konin (8.9%) and Słupca (7.7%). The **number of the registered unemployed people** was at 10,963 (21.6% of the total number of the unemployed in the region), of which over 56.0% were residents of Konin and Konin district. The analysis of the educational background of the unemployed showed that the majority of them have completed basic vocational education (28.5%), lower secondary education (24.5%) and post-secondary vocational education (23.0%). Persons with university-level education constitute 14.2% of all unemployed persons, while those with general secondary education - 9.7%.

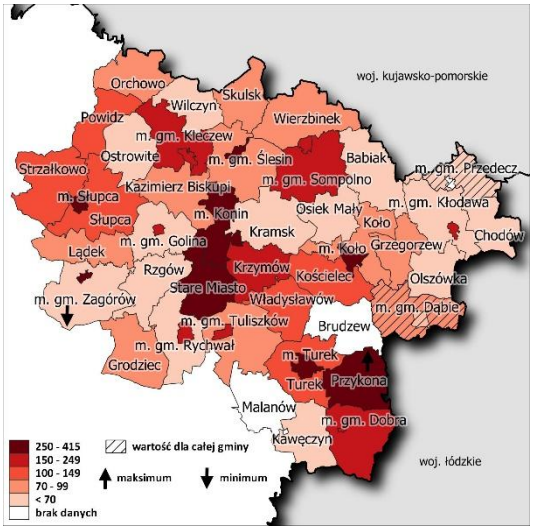
[101]Excluding business entities employing up to 9 persons, clergy and those employed by state-owned enterprises active in the field of national defence and public security. The data includes individual agriculture and employees of organisations, foundations, unions (SOF), by actual place of work and type of activity. Data on the number of persons employed in individual farms as at 31 December in 2002-2009 were estimated on the basis of the National Population and Housing Census and the Agricultural Census 2002 and in 2010 on the basis of the Agricultural Census 2010.
[102]for the purposes of the analysis, the urban and rural municipality was examined jointly.
[103]as above.
[104]as above.
[105]as above.

Fig. 33. Structure of employment in the districts of Eastern Wielkopolska in 2018.



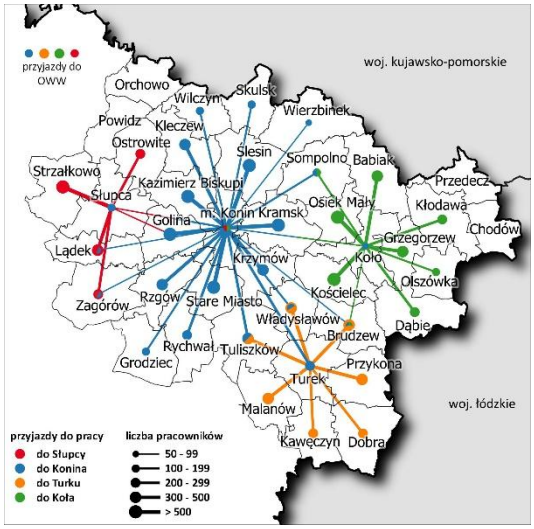
Source: WBPP own study based on CSO, BDL

Fig. 34. Number of employed persons per 1,000 inhabitants in municipalities of Eastern Wielkopolska in 2018.



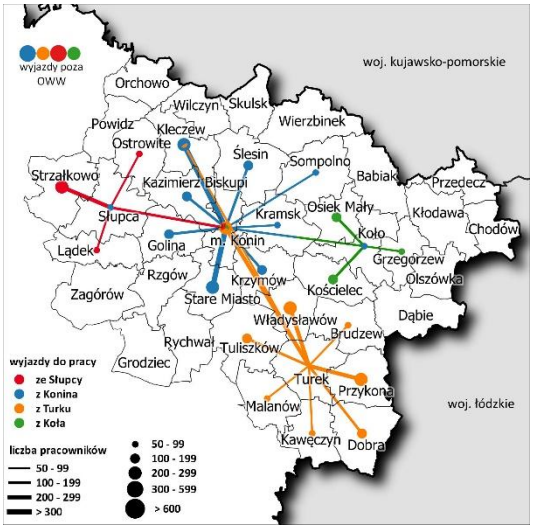
Source: WBPP own study based on CSO, BDL

Fig. 35. Arrivals to work in Eastern Wielkopolska in 2016.



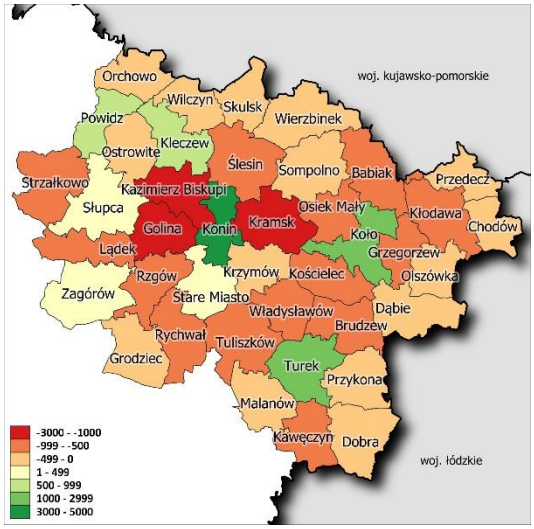
Source: WBPP own study based on CSO

Fig. 36. Departures to work in Eastern Wielkopolska in 2016.



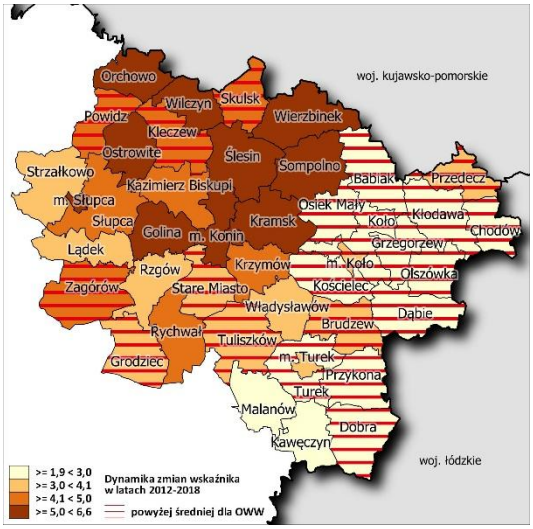
Source: WBPP own study based on CSO

Fig. 37. The balance of commuters in municipalities of Eastern Wielkopolska in 2016.



Source: WBPP own study based on CSO, BDL

Fig. 38. Number of unemployed persons per 100 persons of working age in municipalities in Eastern Wielkopolska in 2018.



Source: WBPP own study based on CSO, BDL

Taking actions to mitigate the effects of the transition towards climate neutrality is also important from the perspective of ZE PAK Group and the labour market in which the Group plays an important role (the transition to climate neutrality will involve both job losses and the need to retrain employees). At the end of 2019, the ZE PAK Group employed over 4,600 people (of which 9.0% were women). 98% of employees came from the area of the subregion, including 48% from Konin, 32% from Konin district, and 16% from Turek district[106]. The largest number of ZE PAK Group employees was employed in Konin (28.4% of the total ZE PAK Group workforce), Turek (9.8%) and the municipalities of Kazimierz Biskupi (9.2%), Kleczew (8.8%) and Ślesin (7.5%). Almost two-thirds of the Group's employees reside in the aforementioned municipalities, while further 18% of its employees live in the next five municipalities (Wierzbinek, Sompolno, Kramsk, Golina, Wilczyn)[107]. In the case of the smaller municipalities of Eastern Wielkopolska, the employees of ZE PAK Group constituted a large percentage of the working population (employed and residing in a given municipality). This percentage is particularly high in the municipalities of Kazimierz Biskupi (almost 40%), Wilczyn, or Wierzbinek (ca. 30%). Taking into account the fact that the employees of ZE PAK group are 91% men, this percentage for working men only is almost twice as high, at 75%, 66% and 48% respectively. In other words, about half of the men living in a given municipality are employees of the Group - this shows the dominant position of this company as a local employer[108].

The **challenge for the labour market** will be to provide the staff for the transport, forwarding and logistics industry and manufacturing industries. Among the most sought-after workers on the labour market in Eastern Wielkopolska[109] are: electricians, electromechanical technicians, electrical fitters, mechanical technicians, fitters and operators, welders, electronic technicians, automation and robotics specialists, truck and tractor drivers, construction engineers, construction installation fitters, industrial designers, earth-moving equipment operators and technicians, construction finishers, bricklayers and plasterers, construction workers, production organisation specialists, database designers and administrators, programmers, practical vocational training teachers and vocational subject teachers. In most districts, threats arise from the phenomenon of aging of staff in many professions and lack of replacement staff. A frequent obstacle to taking up employment is, inter alia, the lack of appropriate qualifications or skills necessary for the professional performance of a given profession. Potential employees with vocational training are often required by employers to have work experience and practical skills, but also to be familiar with modern technologies[110].

An important factor testifying to the competitiveness of a given region is the status of entrepreneurship; as the level of entrepreneurship improves, the economic attractiveness of an

[106]Calculations were based on employment as of November 2020.
[107]It is estimated that by 2024, 25% of ZE PAK Group's employees will be entitled to pension, while by 2026, 35% of the workforce - a percentage that is several to a dozen percentage points higher if you look at the subgroup of employees entitled to a miner's pension.
[108] Hetmański, M., et al. (2021). Economic analysis of Eastern Wielkopolska region in terms of the delivery of the fair transformation process, including energy transformation. Report by Instrat Foundation commissioned by ARR Konin, January 2021.
[109]On the basis of analyses carried out by District Labour Offices.
[110]Regional Labour Office in Poznań. 2018. Occupational barometer 2019.

area increases. In 2018, **the level of entrepreneurship** in Eastern Wielkopolska, measured by the number of people running a business per 100 people of working age, was lower than the provincial average and amounted to 11.7 (Wielkopolska 14.8). The change in this respect between 2012 and 2018 amounted to 1.7 and was slightly higher than in the region (1.5). The highest level of entrepreneurship was characteristic for: Rychwał (17.0), Słupca (16.9), Ślesin (15.6) and Koło (15.3) as well as Stare Miasto Municipality (16.5). The picture of low entrepreneurial activity of inhabitants of the area is complemented by much lower number of entities with foreign capital participation than in the region – 1.8 entities per 10 thousand inhabitants (Wielkopolska Region 6.6)[111].

The key challenge for transforming the economy in the context of combating global warming and climate change is the equitable transformation of the economy towards a zero-carbon economy – without the use of transition fuels (coal-to-clean).

The main challenges of the economy for Eastern Wielkopolska in the context of fighting climate changes include:

- the need to increase levels of productivity and innovation;
- reducing resource and energy intensity;
- reducing greenhouse gas emissions;
- the need to exploit the economic potential for the development of a closed loop economy (CLE);
- the need to direct the waste management system towards a circular economy;
- the need to increase the level of awareness of the local community, including businesses, in the area of CLE;
- the transformation of the labour market, including the use of the competences of the existing workers for creating new jobs;
- the need to adapt employee qualifications to the needs of the changed labour market.

[111] BDL, CSO

- **Sustainable housing**

A very important element of the *European Green Deal* is **modern and energy-efficient construction**. Energy- and resource-intensive construction processes have a high impact on the environment and its resources. In 2017, buildings generated 40.0% of energy consumption in EU countries[112]. At the same time, the municipal and household sector, emitting harmful dusts and gases from low-efficiency household heat sources, is responsible for low emissions, along with transport. In addition, housing conditions are an important factor in determining the attractiveness of an area and the standard of living of its residents.

In 2018, **residential development areas** in Eastern Wielkopolska covered an area of 3,990.0 hectares, accounting for 0.9% of its total area (Wielkopolska 1.2%). Residential buildings in the towns of Eastern Wielkopolska constituted in total 8.4% of their area, while in rural areas 0.6% (Wielkopolska 10.9% and 0.7%, respectively). Since 2012, the residential areas of Eastern Wielkopolska increased by 686.0 ha or 21.0%, and the percentage share of residential areas in the total area increased by 0.2 p.p. The spatial distribution of residential areas was highly differentiated and the share of residential development in the total area ranged from 2.3% to 19.0% in cities and from 0.01% to 2.0% in rural areas.

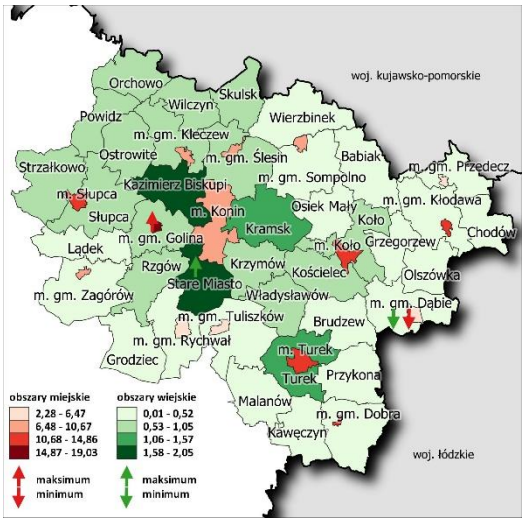
The **population density of settlement areas**, defined as the number of people per 1.0 ha of residential land and indicating the degree of intensity of their use, was relatively high and in 2018 in Eastern Wielkopolska was at 108 people/ha (Wielkopolska 95 people/ha). The intensity of use of land occupied by residential functions, both in towns and in rural areas, was highly diversified and totalled 111 persons/ha and 108 persons/ha respectively (Wielkopolska region: 113 persons/ha and 81 persons/ha respectively). Between 2012 and 2018, the population density of settlement areas in both urban and rural areas decreased (by 9.0% and 32.0% respectively).

In 2018, the **housing stock of** the Eastern Wielkopolska area consisted of 141 214 dwellings (including 46.6% in cities and 53.4% in villages), constituting 11.5% of Wielkopolska Region's stock and 0.9% of the national stock, with a total usable space of 11 767 922 m^2. Compared to 2012, Wielkopolska's housing stock increased by 5,892 dwellings (4.3%, Wielkopolska 8.2%, Poland 6.5%), including 1,543 dwellings in cities (2.4%, Wielkopolska 7.1%, Poland 6.6%) and 4,349 dwellings in rural areas (6.1%, Wielkopolska 10.0%, Poland 6.3%). The indicator showing the number of new dwellings completed per 1,000 inhabitants in 2018 in Eastern Wielkopolska in total amounted to 2.4 and was much lower than the average for Wielkopolska (5.7) and the average for Poland (4.8). At the same time, it should be noted that the situation in this respect varied considerably in individual municipalities (from no new housing resources to 9.6 new dwellings per 1,000 inhabitants).

Fig. 39. Share of residential development land in total area in urban and rural areas in Eastern Wielkopolska in 2018 (%)

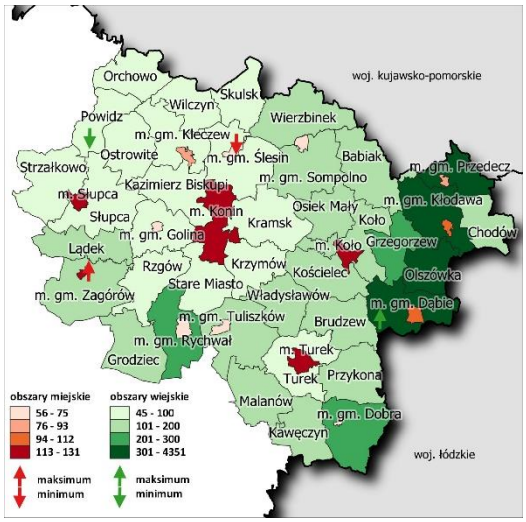
Fig. 40. Population density of settlement areas in urban and rural areas in Eastern Wielkopolska in 2018 (persons per 1 ha of residential area)

[112] Source: Eurostat, Energy balances, 2019 edition, final energy consumption in 2017, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu_pl



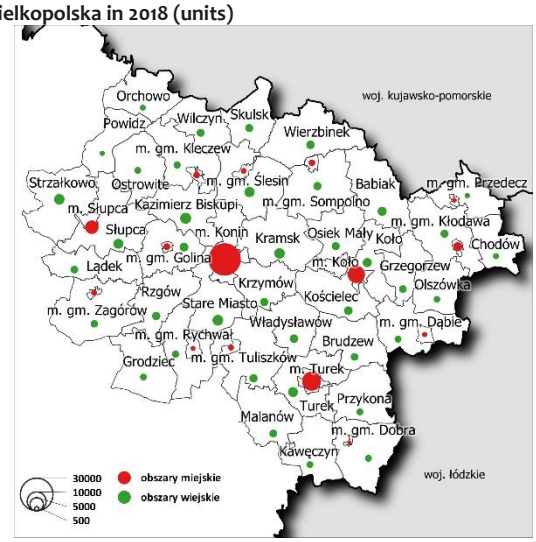
Source: WBPP own study based on Land and Property Register

Fig. 41. Number of dwellings in urban and rural areas in Eastern Wielkopolska in 2018 (units)



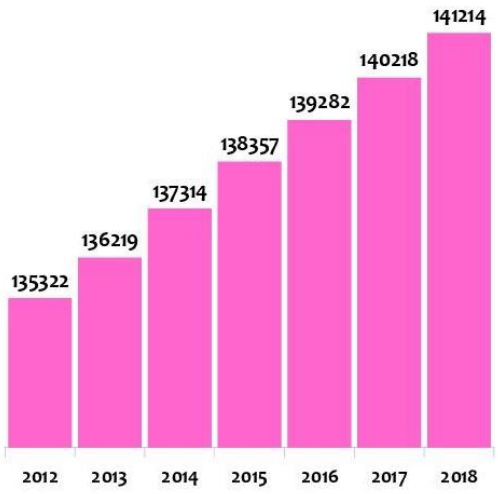
Source: WBPP own study based on CSO, BDL, Land and Property Register

Fig. 42. Total number of dwellings in Eastern Wielkopolska in 2012 - 2018 (units)



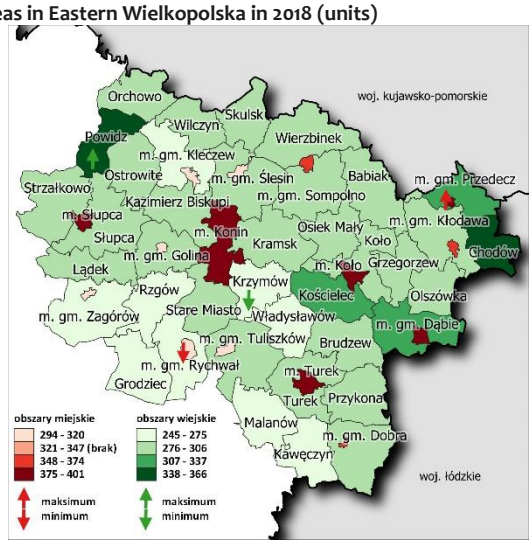
Source: WBPP own study based on CSO, BDL

Fig. 43. Number of dwellings per 1,000 people in urban and rural areas in Eastern Wielkopolska in 2018 (units)

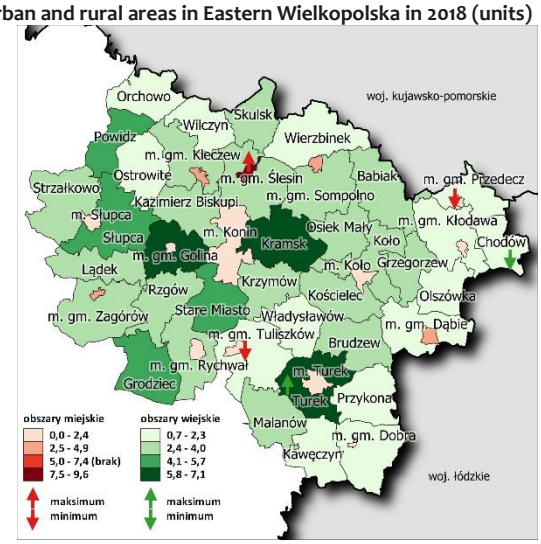


Source: WBPP own study based on Land and Property Register

Fig. 44. Number of dwellings completed per 1,000 people in urban and rural areas in Eastern Wielkopolska in 2018 (units)



Source: WBPP own study based on CSO, BDL



Source: WBPP own study based on CSO, BDL

In terms of **the age of the resources**[113], the largest number (76,276 i.e. 61.6%) of inhabited dwellings in Eastern Wielkopolska were built in the years 1945 - 1988, of which over 25.2% (20,028) were located in Konin, where they accounted for 72.9% of the city's total housing resources. The oldest housing resources, built before 1970, constituted 38.9% of the total housing resources of Eastern Wielkopolska (Wielkopolska 43.2%, Poland 44.2%), while dwellings built before 1945 constituted 12.3% of the total number of inhabited dwellings. 15.0% of the housing stock came from the period 1989 – 2002, 4.0% was built in 2003 – 2007 and 2.6% in 2008 – 2011 (Wielkopolska 3.9%, Poland 3.6%). It should be noted that the share of the youngest housing resources higher than the average for Eastern Wielkopolska was characteristic only for the districts of Konin (4.2%) and Słupca (3.0%). Additionally, 4.5% of the stock consisted of dwellings of undetermined construction period. From 2010 to 2018, i.e. since the introduction of regulations on the energy performance of buildings requiring the use of architectural and installation solutions that meet the requirements of energy efficiency principles in the construction project, 7,757 dwellings have been added in East Wielkopolska, which accounted for 5.8% of the total housing stock.

An important element of building climate neutrality and protecting the natural environment is the development of energy and resource-efficient construction and equipping dwellings with **pro-environmental sources of energy and heat**. In Poland, the fuel most often used for heat production is coal and its derivatives as well as post-coal waste, which has an impact on air pollution and CO2 emission levels. The municipal and household sector is responsible for the so-called low surface emission of fine particulate matter and B(a)P. The emissions of these substances is connected primarily with the combustion of solid fuels (including coal) in low-efficiency boilers and adversely affects human health and life and reduces air quality. In Wielkopolska zone, about 2.97 million inhabitants are exposed to elevated concentrations of carcinogenic B(a)P, and 385.0 thousand to elevated concentrations of fine particulate matter PM10 and PM2.5. The elderly over the age of 65 account for over 15.0% of the zone's population, while children under the age of 5 account for 5.5%. Therefore, in total, in the Wielkopolska zone the share of population particularly exposed to air pollution is over 20.0%. In the case of Eastern Wielkopolska about 10 k people are exposed to negative influence on health and life due to exceeded permissible levels of fine particulate matter PM 10 and PM 2,5, and practically all inhabitants are exposed to the impact of B(a)P on their health and life.

Results from cohort studies indicate that particulate pollution actually contributes to reduced life expectancy in exposed populations. Mortality in the population is the result of a number of different factors, among which air pollution is one of the important causes[114]. According to model data, in 2018, 1,600 people died from cardiovascular disease and 250 people died from respiratory disease in Eastern Wielkopolska[115].
Taking the above into account, it is reasonable and necessary to achieve by 2030 the admissible (PM10 and PM2.5) and target levels of B(a)P in the air. Among the most important corrective actions planned for the next few years in Eastern Wielkopolska, the need to replace over 90 k

[113] Source: Census 2011.
[114]The "attributable fraction" (AF) methodology provides an opportunity to estimate the magnitude of this impact. The AF factor is determined as the fraction of all deaths in the considered area attributable to long-term exposure to air pollutants.
[115]Source: POP WLKP

inefficient, obsolete heat sources fuelled by solid fuels in housing and almost 3 thousand of such sources estimated in communal resources. On the other hand, it is estimated that 33 k buildings should undergo thermal modernisation[116].

In 2018, the producers of thermal energy sources in Eastern Wielkopolska included: Miejskie Przedsiębiorstwo Energetyki Cieplnej (MPEC) – Konin Sp. z o.o., Miejski Zakład Energetyki Cieplnej Sp. z o.o. in Koło, Miejski Zakład Energetyki Cieplnej Sp. z o.o. in Słupca and Przedsiębiorstwo Gospodarki Komunalnej i Mieszkaniowej in Turek (Heat Engineering Department).

MPEC Konin Sp. z o.o. used three heat sources: Konin Power Plant – Zespół Elektrowni Pątnów - Adamów - Konin S.A., Municipal Waste Thermal Treatment Plant - Miejski Zakład Gospodarki Odpadami Komunalnymi Sp. z o.o. in Konin and Gosławice Sugar Factory Boiler Room.

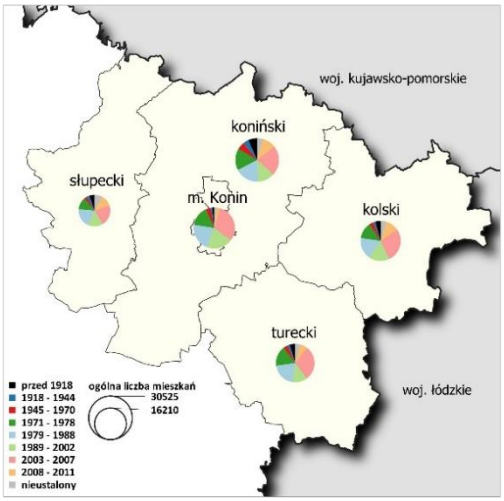
In 2018, Konin Power Plant generated heat from: biomass (63.4%), lignite (36.3%), other (0.3%), Municipal Waste Thermal Treatment Plant: mixed municipal waste and other waste from mechanical waste treatment (100%), while Gosławice Sugar Factory Boiler Room - hard coal and eco pea (100%). MZEC Sp. z o.o. in Koło produced heat from various types of installations, while the share of heat generated from RES was only 14.8% and the share of heat generated from solid fuels was 85.2%.

A total of 200 boiler houses were in operation in Eastern Wielkopolska in 2018, of which 147 were in urban centres and 53 in rural areas. Since 2012, the number of boiler houses increased by 103, including: in the city of Konin 21 (525.0%), Kolski district 44 (220.0%), Konin district 34 (189,0%), Turek district 9 (53.0%). Only in Słupca district the number of boiler houses decreased: 5 boiler houses were decommissioned (13,0%).

In terms of the length of the **transmission and distribution heating network** in 2018, the Eastern Wielkopolska area had a grid of 181.4 km, of which 171.3 km were located in cities and 10.1 km in rural areas. 113,190 dwellings, or 80.0%, were provided with central heating. This value was similar to the average for Wielkopolska Region, which was at 84.0%. In 2018, in the cities of Eastern Wielkopolska, dwellings equipped with central heating systems in the number of total dwellings constituted 89.2% (Wielkopolska 86.7%, Poland 87.7%), while in rural areas 72.3% (Wielkopolska 79.2%, Poland 72.0%).

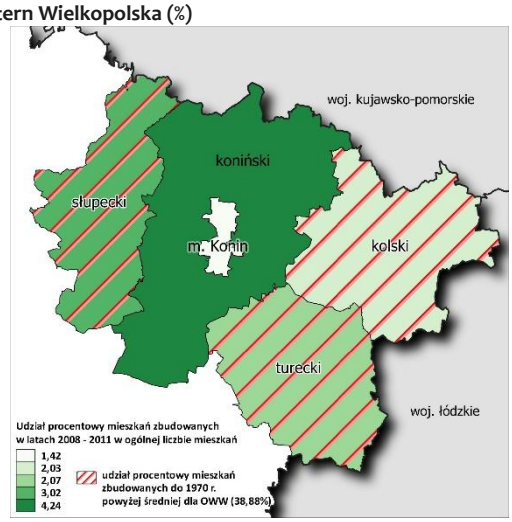
[116] Source: POP WLKP

Fig. 45. Dwellings occupied by period of construction in districts pf Eastern Wielkopolska (units)



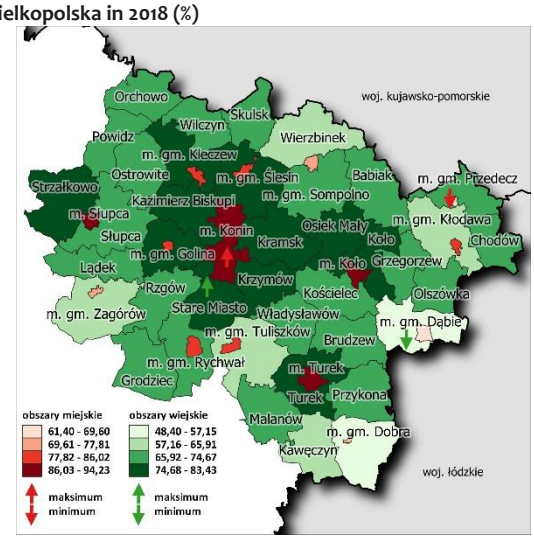
Source: WBPP own study based on CSO, NSP 2011

Fig. 46. Structure of housing stock by age in the districts of Eastern Wielkopolska (%)



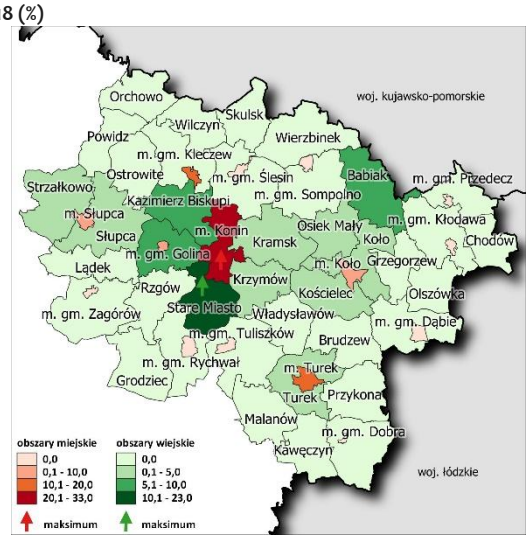
Source: WBPP own study based on CSO, NSP 2011

Fig. 47. Share of dwellings provided with central heating versus the number of total dwellings in urban and rural areas in Eastern Wielkopolska in 2018 (%)



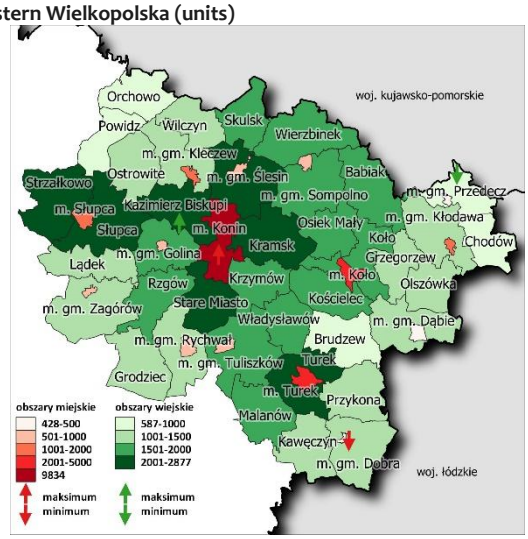
Source: WBPP own study based on CSO, BDL

Fig. 48. Share of dwellings provided with gas in the number of total dwellings in urban and rural areas in East Wielkopolska in 2018 (%)



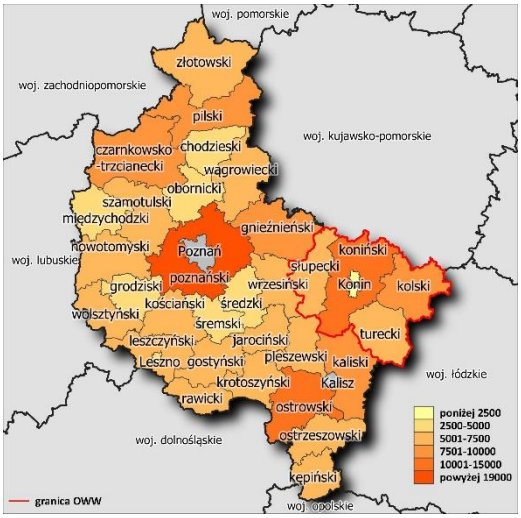
Source: WBPP own study based on CSO, BDL

Fig. 49. Number of inefficient heat sources in individual buildings to be replaced by 2016 in towns and rural areas in Eastern Wielkopolska (units)



Source: WBPP own study based on DSR UMWW

Fig. 50. Estimated number of buildings scheduled for thermomodernisation until 2030 in districts of Wielkopolska zone



Source: WBPP own study based on POP WLKP 2020

In 2018, the active **gas transmission and distribution** grid in Eastern Wielkopolska was 776.0 km long and has been extended by 228.0 km since 2012 – an increase of 42.0%, but it should be noted that it is not well developed. The length of the active transmission and distribution gas grid in urban areas was 319.0 km and increased by 65.0 km, (26.0)% since 2012, while in rural areas it was 457.0 km and increased by 163.0 km (55.0%) since 2012. In 2018, only 9.9% of all dwellings (14,002 dwellings) were equipped with grid gas (Wielkopolska 52.2%, Poland 55.5%), including 18.8% in cities and 2.1% in rural areas. In 27 municipalities the housing stock was not equipped with grid gas.

The challenge of equipping the housing stock with modern and pro-environmental installations is related to the problem of **energy poverty**. Achieving higher energy efficiency is an opportunity to create a fair and equitable energy transition for economically disadvantaged residents in need of greater support. According to the data of the Institute for Structural Research (2016), the rate of energy poverty in single-family houses of Wielkopolska Region was higher than the average in Poland, at 16.4% and included more than 100 k energy-poor households. This phenomenon is primarily experienced by households with 5 or more people. Of all Wielkopolska households in energy-poor single-family houses, almost 60.0% made a living from farming or hired labour. About 2/3 of these buildings were built more than 40 years ago, and only 1/6 of homes had access to the gas grid[117]. In Eastern Wielkopolska, fuel poverty was estimated to affect 18 – 20 k households.

The quality of housing resources of Eastern Wielkopolska is also evidenced by the actions to be implemented as part of the **revitalisation programmes**[118] prepared by the municipal local governments[119]. A total of 105 projects were identified, 73 of which served to improve the technical condition and energy efficiency of buildings, including residential buildings, and 32 to improve environmental quality standards. The most frequently undertaken measures included: installation of window and door woodwork with high insulation coefficient, replacement of roof covering, replacement of electrical, water and sewage systems, insulation of walls and roofs, increasing the environmental awareness of residents concerning correct waste segregation, limiting low emissions, as well as revitalisation of green areas.

In the context of housing development in Eastern Wielkopolska, **the planning policy of local governments** defined in the studies of conditions and directions of spatial development of municipalities is extremely important. The large area of land designated for development, which gives potential investors considerable freedom of execution, is simultaneously associated with an increase in the intensity of environmental transformations, leading to the dispersion of development and spatial chaos, and contributing to an increase in investment, transport and environmental costs. Urbanization is dynamically attacking environmentally valuable areas, e.g. lake shores, land adjacent to areas under legal protection, or natural forest complexes.

[117]Diagnosis of the socio-economic and planning situation of Wielkopolska Region in 2019; Poznań, September 2019.
[118]The main objective of revitalisation processes is social-economic activation and solving problems such as low entrepreneurship, unemployment, poor condition of local enterprises, poverty or low level of social capital. Negative social and economic phenomena are accompanied by environmental, spatial-functional and technical issues affecting the living conditions.
[119]In Eastern Wielkopolska 32 municipalities (i.e. 74.0%) have developed revitalisation programmes, with programs of 31 municipalities being entered in the List of revitalisation programs in municipalities of Wielkopolska Region, which allowed their self-governments to apply for EU grants dedicated to revitalisation activities as part of the Wielkopolska Regional Operational Programme 2014+.

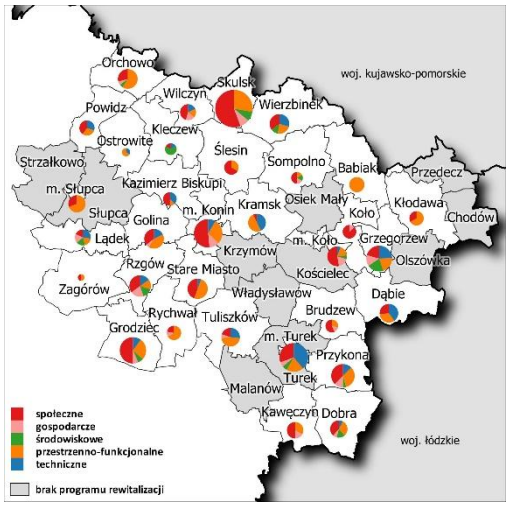
Biodiversity protection, which should above all be treated as an element of sustainable development and a tool helping to combat climate change, is in practice often perceived by investors as a kind of obstacle to economic activity[120].

Urbanization processes undoubtedly have a significant impact on the level of low emissions and air quality, and thus on the climate. At present, the existing built-up areas in Eastern Wielkopolska occupy an area of over 7,520 ha, which is about 1.7%[121] of the total area. The target areas indicated in the municipalities' studies for the development of residential, service and economic functions in total cover an area of almost 61,000 ha (14.0% of the total area). In relation to the existing development, the area of target built-up areas designated in municipal studies has increased by an estimated 810.0%.

In the era of progressing climatic change resulting in, among others, increased frequency and intensity of heat waves, droughts and torrential rains, it is extremely important to **shape and develop green areas** constituting an integral part of urban areas. Promoting the retention functions of urban green space will promote the mitigation of the effects of rainfall. These areas, through their beneficial influence on the city's microclimate, will also mitigate the negative effects of heat waves. A larger area of parks, greenery and housing estate green areas means a greater capacity of the land to regenerate the environment. Green areas also act as ventilation corridors allowing natural filtering, ventilation and regulation of air temperature. Thus, they improve the quality of the environment and living conditions. The degree of coverage of urban and rural areas of Eastern Wielkopolska with green areas (parks, green areas and housing estate green areas) was very diverse, but much higher in cities than in rural areas, and ranged from 0.0 to 25.0% of the total urbanised areas. At the same time, it should be noted that the degree of preservation of areas free of development, calculated as the share of the area of forest land, agricultural land (excluding developed agricultural land) and surface waters in the total area, is slightly higher in towns than in the region (Eastern Wielkopolska 62.9%, Wielkopolska 62.3%), while lower in rural areas (Eastern Wielkopolska 91.0%; Wielkopolska 92.8%).

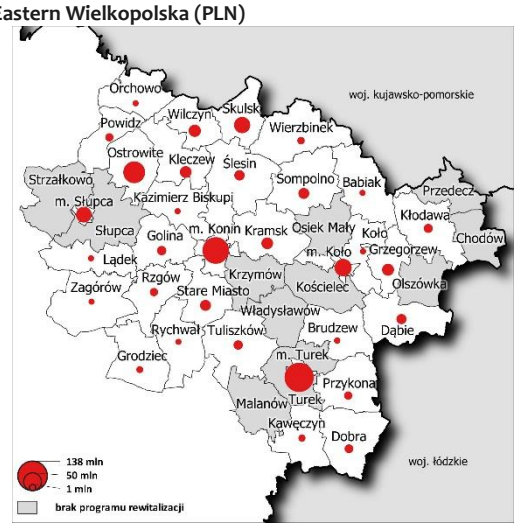
[120]Raszko, 2005.
[121]According to the Land and Building Register.

Fig. 51. Types of undertakings indicated in revitalisation programmes in the municipalities of Eastern Wielkopolska



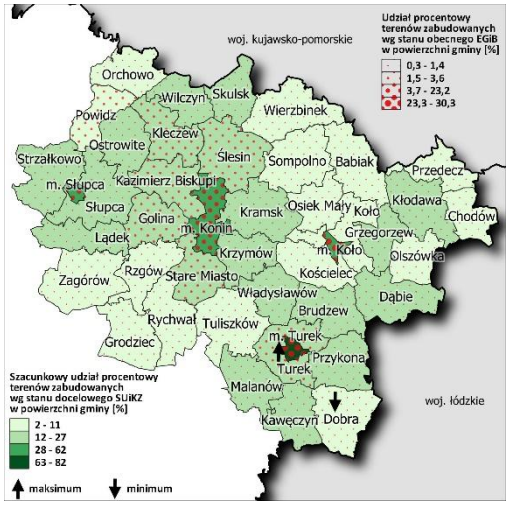
Source: WBPP own study based on revitalisation programmes

Fig. 52. Estimated financial resources allocated to undertakings indicated in the revitalisation programmes in the municipalities of Eastern Wielkopolska (PLN)



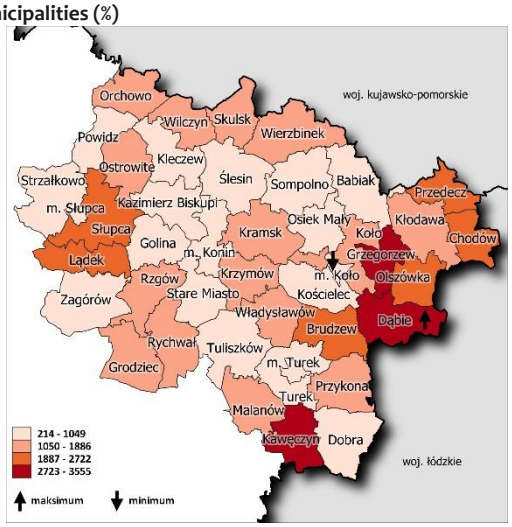
Source: WBPP own study based on revitalisation programmes

Fig. 53. Estimated share of existing and target development areas in the total area in the municipalities of Eastern Wielkopolska (%)



Source: WBPP own study on the basis of municipality SUiKZP, Land and Property Register

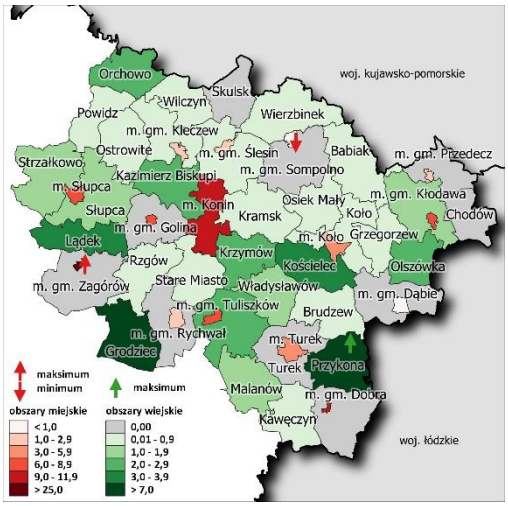
Fig. 54. Estimated increase of the area of land allocated for building development in relation to the existing development according to the planning study for Eastern Wielkopolska municipalities (%)



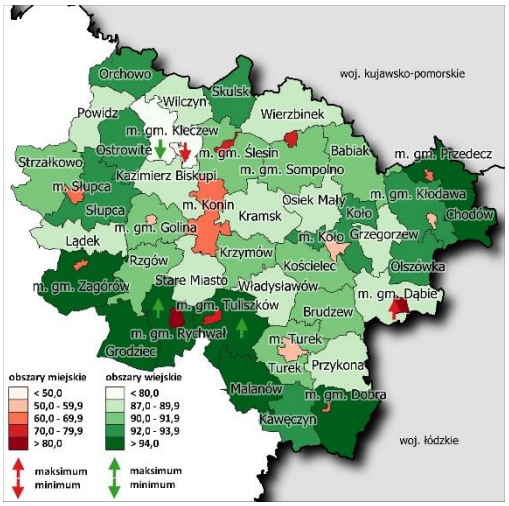
Source: WBPP own study on the basis of municipality SUiKZP, Land and Property Register

Fig. 55. Share of the area of parks, green areas and residential greenery in the area of urbanised areas of cities and rural areas in Eastern Wielkopolska in 2018 (%)

Fig. 56. Share of forest land, agricultural land and surface water in total area in urban and rural areas in Eastern Wielkopolska in 2018 (%)



Source: WBPP own study based on CSO, BDL



Source: WBPP own study based on Land and Property Register

The key challenge for housing development in the context of combating global warming and climate change is the improvement of the existing housing stock and the development of new housing stock towards zero carbon and energy efficient construction.

The key challenges in this area include:

- the need for architectural solutions that meet the requirements of energy efficiency principles,
- the need to apply modern, pro-environmental installation solutions, including replacement of old, inefficient heat sources with new pro-environmental installations or connection to grid heat systems,
- the need to use environmentally friendly building materials,
- the need to use modern technologies to improve the energy performance of buildings,
- development of intelligent buildings,
- counteracting energy poverty and reducing its scale,
- preventing dispersion of development and forming green areas free of development,
- the popularisation of energy consulting.

- **Smart agriculture**

In the context of the need to reduce greenhouse gas emissions, one of the key areas in fighting the climate change is agriculture and agricultural/food processing, requiring technological changes and the implementation of innovative solutions, taking decisive action aimed at optimised use of pesticides and fertilisers, as well as changing production and consumption processes towards a circular economy. Creating new opportunities in this area and building a sustainable food chain will contribute to reducing the environmental and climate footprint and ensure food security. The new, intelligent agriculture and agri-food processing, aimed at producing high-quality food in a way that is compatible with a circular economy and environmentally and climate friendly, fits in with the expectations of potential customers and the preferences of environmentally conscious consumers[122,123].

At the same time, the progressing climate change is worsening the environmental conditions for food production, reducing access to water and energy, and threatening the biological balance[124].

Eastern Wielkopolska has a relatively large share of **agricultural** land in the total area of 73.1%[125] (Wielkopolska Region 64.7%). The highest share of agricultural land is in Konin district (34.9%). Arable land accounts for 78.5% of agricultural land (81.5% in Wielkopolska Region), while grassland (meadows and pastures) account for 17.1% (14.3% in Wielkopolska Region). In general, the land resources on the area of Eastern Wielkopolska used for agricultural purposes remain at a constant level.

The highest **potential of agricultural production area** was characteristic of Koło district, where the valorisation index was at 65.5 points (Wielkopolska Region - 63.4 points). Unfavourable natural conditions affecting agricultural production, and thus the lowest value of valorisation index for agricultural production area (50.8 points), characterised the Turek district.

In terms of **soil quality**, Eastern Wielkopolska was dominated by the poorest arable land of VI soil quality, which constituted 42.0% of all arable land. The weakest soil conditions were in Konin and Turek districts, while the best ones in Koło district. Soil quality is strongly influenced by the level of acidity. The need of liming agricultural soil in Eastern Wielkopolska are diversified. The highest, covering 49.0% of agricultural land, occurs in Turek district, while in Malanów municipality it is for 58.0% of agricultural land. In Koło district, 33.0% of agricultural land require liming (mainly in the municipalities: Grzegorzew (44.0%) and Olszówka (49.0%). In Konin municipality, this process concerns 27.0% of land, while the greatest needs in this respect occur in the municipalities: Rychwał (47.0%) and Stare Miasto (51.0%). In Słupca municipality, only 16.0% of land requires liming and the greatest need in this respect is in the Zagórów municipality (50.0%).
In the context of the planned reduction in the use of fertilisers at the European level (by at least 20.0% by 2030), a disadvantageous phenomenon in Eastern Wielkopolska is the **deficiency of mineral components in soil**. Proper plant growth, crop height and crop quality are influenced by

[122]Strategy of sustainable development of rural areas, agriculture and fisheries 2030.
[123] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_pl
[124]as above.
[125]CSO, BDL, Geodetic area of the country 2014.

adequate levels of phosphorus in the soil. In Eastern Wielkopolska the phosphorus content of agricultural land soils is low. The highest share of soils with low phosphorus content is in the Turek district (39.0%), followed by Koło district (38.0%) and in Konin district (34.0%). Moreover, 23.0% of the soils in the Słupca district is characterised by low phosphorus content. Potassium plays a key role in the development of plants and is responsible for their water balance. Plants with abundance of potassium can better withstand periods of drought. Unfortunately, the whole area of Eastern Wielkopolska is characterised by a large share of soils with low and very low potassium contents, amounting respectively to: Turek 83.0%, Konin 69.0%, Koło 60.0% and Słupsk 43.0%. Moreover, soils of Eastern Wielkopolska are also poor in magnesium, which affects, among others, the resistance of plants to diseases. The highest share of magnesium-deficient soils is found in the district of Turek (51.0%).

Plant growth and development conditions are very much affected by **drought**. Agricultural drought, resulting from soil drought, causes, among other things, crop losses and limits the choice of plants in crop rotation, which has a significant impact on reducing farm income. The greatest danger in terms of occurrence of agricultural drought (3rd degree of danger on a 4-grade scale) in Eastern Wielkopolska concerns the municipalities: Zagórów, Strzałkowo, Lądek and Grodziec in the Słupca district and the municipalities: Dobra, Tuliszków, Turek, the town of Turek, Kawęczyn, Malanów in Turek district[126].

Drought risk assessment carried out for all municipalities in Poland[127] has shown that in all municipalities of Eastern Wielkopolska the drought risk index is high[128]. Over the period 2007 - 2018, municipalities in the northern part of the area and two municipalities, located in the southern part, were affected by drought every year: Dobra and Malanów. The remaining municipalities experienced drought during 8 - 9 years[129]. An analysis of the moisture index[130] from May 2019 to May 2020 showed that soil moisture is highest from October to March, exceeding 50% in all districts of Eastern Wielkopolska, and lowest (less than 25%) during the summer months (late July - August).

In order to minimize the effects of drought, it is necessary to apply appropriate agrotechnical procedures and use irrigation. Water reclamation should be aimed at increasing overall water resources[131]. Ditches and drainage increase the possibility of rational cultivation and play a role in protecting farmland from flooding. Water melioration devices consist of: drainage ditches (Słupca district: 672,793 km[132], Konin district: 194,402 km[133], Kolsk district: 263.3 km[134]), pumping

[126] RZGW Poznań, Drought control plan for the Warta river water region.
[127] The expert opinion titled "Determination of areas at different degrees of drought risk in Poland for the purpose of implementing the operation "Modernization of agricultural holdings" of the Rural Development Programme 2014 - 2020," the Institute of Soil Science and Plant Cultivation - National Research Institute in Puławy, July 2019.
[128] The assessment of the risk of drought was conducted for a selected group of crops including: ground vegetables and strawberries, fruit bushes and trees, hops, potatoes and legumes.
[129] Option 1. The number of years in which drought occurred [2007-2018] in at least 1 reporting period on at least one of the listed crops.
[130] Based on EUMETSAT H-SAF satellite data for two layers: 7-28cm and 28-100cm. Based on the data acquired once a day from the Metop satellite sensor, the soil moisture in the surface layer is determined and further used in a model that calculates the moisture index for different depths, with a spatial resolution of 25km.
[131] Draft Drought Mitigation Plan, 2019.
[132] Environmental Protection Programme for Słupca district for 2017-2020 with the perspective until 2021-2025.
[133] Environmental Protection Programme for Konin district for 2017-2020 with a perspective until 2024.
[134] Minutes No. 22/2018 of the meeting of the Committee on Environmental Protection, Agriculture and Forestry held on 14 March 2018.

stations, retention reservoirs, and damming structures. The construction of damming facilities makes it possible to accumulate considerable water reserves, which naturally raise the groundwater level. These reserves can be used for irrigation, mainly of grasslands. Moreover, in agricultural areas, all types of mid-field ponds play an important role in water management of areas used for agricultural purposes and constitute an important element of the so-called small retention[135].

In 2010, in the area of Eastern Wielkopolska there were 30,703 farms above 1.0 ha[136], which constituted 89.0% of the status from 2002[137]. The largest number of farms was recorded in Konin district (39.1% of all farms in the area) and Kolsk district (22.3%). Agricultural activity was conducted by 98.9% of farms. The average **area of a farm** was 6.8 ha of arable land (AL) and was much lower than the average in the region (11.0 ha AL). Farms with the area of 5.0 - 10.0 ha AL (21.8% of all farms) and small farms below 1.0 ha AL (12.3%) were predominant. Farms with more than 50.0 ha of arable land constituted only 0.7% of farms. The greatest fragmentation of farms concerned the city of Konin and Konin district, while the largest farms were in Słupca district.

The number of people working on farms engaged in agricultural activities in 2010 amounted to 83,548 people[138], which constituted 23.4% in the region. The highest number of people working in agriculture was recorded in Konin county (8.9% of those working in agriculture in the region). Per 1,000 inhabitants, 189 people worked on farms in Eastern Wielkopolska, which is much higher than the average value for Wielkopolska (101).

Analysis of the **equipment of farms with fixed assets** has shown that the best equipped with tractors were the municipalities of Turek district (9 units /100 ha of arable land). It should be added that the largest share of tractors with engine power over 60 kW was in the Słupca district (20.0%).

The main branch of plant production in Eastern Wielkopolska was **cereal production**. Cereal prevailed in the structure of crops, with the share of 74.9%[139] (Wielkopolska 73.4%). Among cereals, rye had the largest share (32.3%).

The share of **industrial crops** (7.3%) was much lower than in the region (12.4%), with rapeseed and colza dominating (80.5%). **Fodder** crops constituted 13.5% in the structure of crops and were higher than the average for the region (9.0%). The structure of crops was dominated by leguminous crops (44.7%) and maize for forage (39.8%).
The area of cultivation of **fruit bushes, berry plantations** and **strawberries** in Eastern Wielkopolska constituted 25.2% of production in Wielkopolska. The highest share of these crops was in Koło district (52.4%), with currants dominating (30.8%). The area of **fruit trees** cultivation in the farms of the area amounted to 3,850 ha, which constituted 19.7% of crops in the region. Eastern Wielkopolska was mainly characterised by cherry trees, which accounted for 31.9 % of fruit tree cultivation in Wielkopolska, and plum trees (31.5 %). Among the cultivated trees, the

[135]Draft Drought Mitigation Plan, 2019.
[136]CSO, BDL, General Agricultural Census 2010.
[137]GUD, BDL, General Agricultural Census 2002.
[138]GUS, BDL, General Agricultural Census 2010.
[139]BDL, CSO, General Agricultural Census 2010.

largest area was occupied by apple trees (50.0%). Orchards are most numerous in Konin district (57.1% of the area for fruit trees in Eastern Wielkopolska), especially in Sompolno municipality, which is a region with strong vegetable and fruit growing traditions. **Mushrooms** and **oyster mushroom** production is also prominent in the processing industry, with production facilities located in Słupca, Turek, Kolsk, and Konin districts.

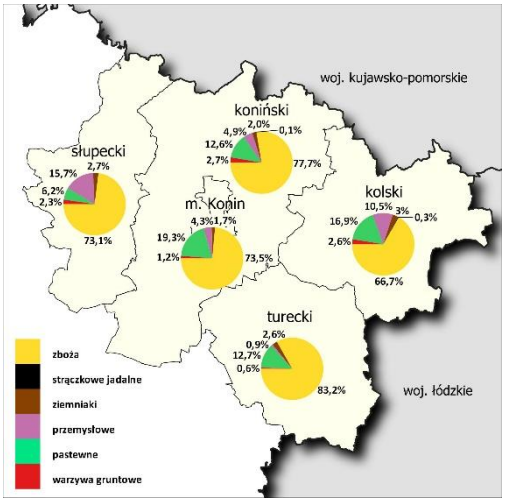
Apart from that, in Kolsk and Konin districts there are **organic farms** that specialise in e.g. fruit and ground vegetable production. At the European level, it is assumed that organic farming will be promoted and that the area of agricultural land used for organic farming will increase to 25.0% in 2030.

In Eastern Wielkopolska, the **livestock density** was lower than in the region and was characterised by a different level of livestock production. The production level for poultry was definitely lower than the regional average (493 pcs./100 ha of AL; Wielkopolska 1605 pcs./100 ha AL) and pigs (80 pcs./100 ha AL; Wielkopolska 269 pcs. /100 ha AL). The density of cows was slightly higher (18 pcs. per 100 ha AL; Wielkopolska 17 pcs. /100 ha AL). The highest livestock density was recorded in the Słupca district, which was also characterised by the highest production of poultry in the region (923 pcs. per 100 ha AL), pigs (151 pcs. per 100 ha AL) and sheep (3 pcs. per 100 ha AL). Cattle production was the highest in the following districts: Koło (63 pcs. per 100 ha AL) and Turek (62 pcs. per 100 ha AL)[140]. The latest data indicate that Koło district stands out in terms of dairy cow breeding as compared to the region[141]. There are 98 dairy cow farms in the district, which together produced 8,801 kg of milk in 2019, ranking the district 16th in the region.
Developed animal breeding is the basis for the development of agri-food processing. The predominant share of agri-food enterprises are those specialising in slaughtering and the processing of meat and meat products[142]. These are mainly small businesses, employing up to 9 people. Large industrial plants (employing more than 250 people) engaged in agri-food processing are located in the following districts: Koło, Konin, Słupca and Turek.

In addition, in the districts of Koło and Słupca there are organic farms specialising in poultry production and breeding of young beef cattle.

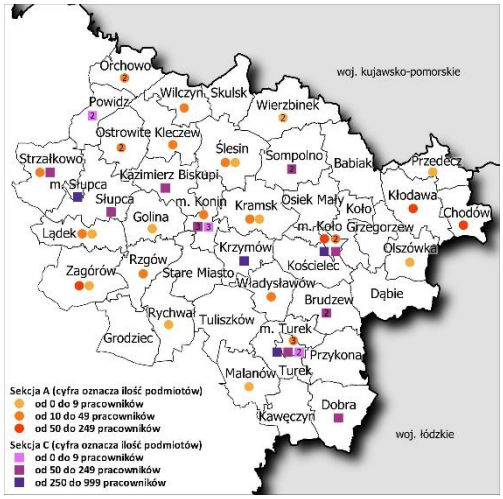
[140]CSO, BDL, General Agricultural Census 2010.
[141]Evaluation and breeding of dairy cattle, Polish Federation of Cattle Breeders and Milk Producers, 2019.
[142] Regon 2019

Fig. 57. Structure of sown area in districts in Eastern Wielkopolska (%)



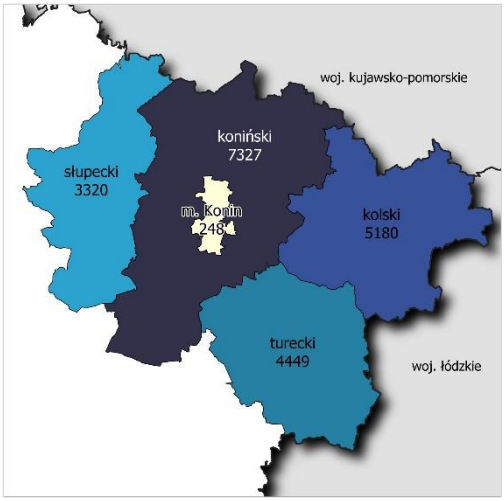
Source: WBPP own study based on BDL, CSO, Agricultural Census 2010

Fig. 58. Number of enterprises from sections A and C by employment size in municipalities of Eastern Wielkopolska



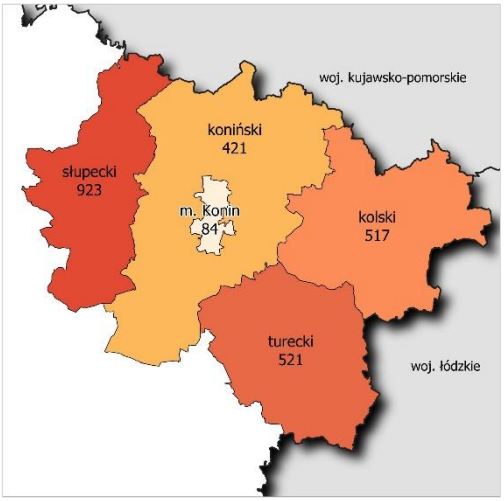
Source: WBPP own study based on Regon 2019

Fig. 59. Number of farms with tractors in the districts of Eastern Wielkopolska (pcs.)



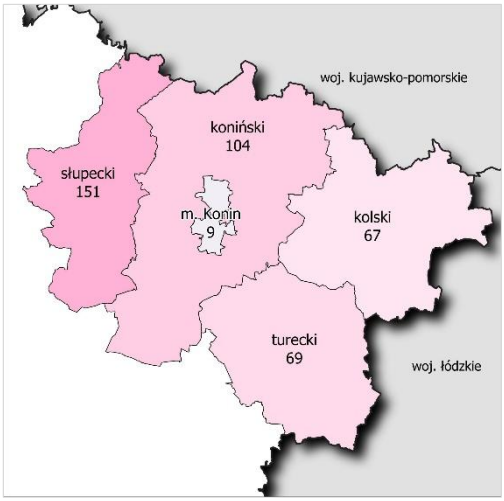
Source: WBPP own study based on BDL, CSO, Agricultural Census 2010

Fig. 60. Livestock density per 100 ha of arable land – poultry in the districts of Eastern Wielkopolska (pcs.)



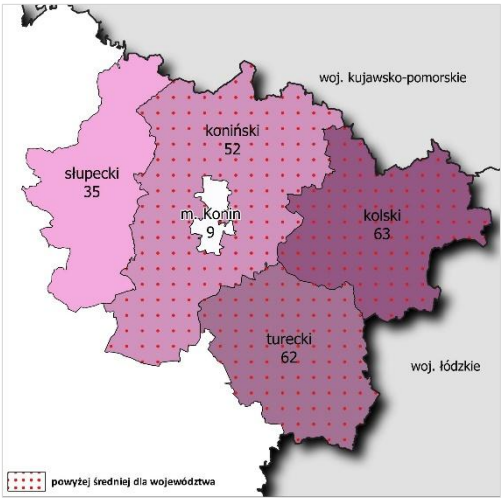
Source: WBPP own study based on BDL, CSO, Agricultural Census 2010

Fig. 61. Livestock density per 100 ha of arable land – pigs in the districts of Eastern Wielkopolska (pcs.)



Source: WBPP own study based on BDL, CSO, Agricultural Census 2010

Fig. 62 Livestock density per 100 ha of arable land – cattle in the districts of Eastern Wielkopolska (pcs.)



Source: WBPP own study based on BDL, CSO, Agricultural Census 2010

Eastern Wielkopolska is also distinguished by well-developed **breeding of thermophilic fish**. The breeding ponds are primarily located in close proximity to the power plant discharge canals, which are characterized by elevated temperature waters from the cooling of the power plant turbines. Fish farms operating in Eastern Wielkopolska deal mainly with breeding of consumer fish (mainly sturgeon) and stocking material and are among the largest ones in Poland.

Agricultural and food processing potential of Eastern Wielkopolska is a basis for the development of **bioeconomy**. There are currently two biogas plants in operation here. Cychry Biogas Power Plant is located in Konin, which uses waste to produce biogas used as fuel in the generator to produce electricity and heat. Przykona Bioelectric Power Plant operates on the territory of Turek district, in the town of Psary. Substrates for the biogas plant come from local field crops, processing plants and animal husbandry. The construction of agricultural biogas plants is connected with limiting the negative impact of agriculture on the environment, and thus on climate change. The function of agricultural biogas plants, in addition to the production of energy from renewable sources, is also the management of organic residues generated by agriculture and agri-food industry and the production of fertilizer.

During 2018 - 2020, the planning and investment processes for large-scale biomass projects and related installations were carried out in Eastern Wielkopolska. The environmental impact assessment process shows that these projects are beneficial in terms of natural environment impact. Some of these installations will be new, while others will be thoroughly modernized, such as the boiler at ZEPAK, which will be adapted to burn biomass. It is assumed that such an installation fuelled with biomass will contribute to the reduction of the existing emissions of dust and gas substances by several dozen percent (e.g. SO_2 by 70%, dust by 30%). However, an additional effect of replacing lignite with biomass is the fact that biomass is a renewable fuel and in CO_2 emission settlements it is treated as a fuel that does not contribute to the emission of greenhouse gases. Also within ZEPAK group, the planned hydrogen plant project will use electricity from biomass combustion[143].

The key challenge for transforming the economy in the context of combating global warming and climate change is the equitable transformation of the economy towards a zero-carbon economy – without the use of transition fuels (coal-to-clean).

The key challenges in this area include:

- the need to conduct a broad information campaign among potential beneficiaries of the future Common Agricultural Policy on the mechanisms of the *European Green Deal* introduced in the new financial perspective;
- the need to implement solutions facilitating and enabling maximum use of EU funds from the Reconstruction Fund, the Common Agricultural Policy and funds to be used in the transitional period from the financial perspective 2014 - 2020;

[143] Source: Environmental impact report in terms of issuing a decision on environmental conditions for the undertaking consisting in the construction of a hydrogen production plant with accompanying infrastructure on the premises of Konin Power Plant, on plot no. 1209/17 precinct Gosławice in Konin

- the need for modern agriculture to implement production and processing technologies based on low-emission technologies through the application of precise doses of plant protection products and precise demand-adapted doses of mineral and natural fertilizers;
- promoting rural employment, economic growth including bio-economy and sustainable agriculture and forestry;
- promoting social inclusion and local development in rural areas;
- the need to implement livestock rearing and breeding technologies in conditions which maximally reduce the emission of harmful substances into the environment, as well as those which reduce water intake and ensure access to pasture for animals;
- the need to implement modern technologies in processing and production of plants, fruit and vegetables and animals based on innovative methods of "Agriculture 4.0" (artificial intelligence in applications for agriculture);
- the need to develop and promote organic farming.

- **Sustainable mobility**

Implementation of the objectives of the *European Green Deal*, particularly those concerning zero-emission and climate change mitigation and improved air quality, requires action to reduce the environmental impact of **transport** in its broadest sense.

In 2017, transport was responsible for 25.0% of EU greenhouse gas emissions[144] and the mode of transport contributing most to these emissions was road transport (71.7%)[145]. It was also one of the main sources of air emissions in Poland. According to data from the National Centre for Emissions Balancing and Management (KOBIZE) , the share of the total transport sector in total greenhouse gas emissions in Poland in 2018 was at 15.8%, including 97.8% for road transport[146]. This is due to the ever-increasing number of individual vehicles, as well as the development of the logistics industry, whose main means of transport are motor vehicles.

The road transport system of Eastern Wielkopolska is a key element which affects the social and economic development. Communication service of the area, its internal cohesion as well as good external accessibility in the regional and supra-regional scale are provided by a developed network of public roads of national category (A2 motorway, DK roads No.: 25, 92 GP class, DK No.: 72, 83 G class) and regional (DW No. 260, 262, 263, 264, 266, 269, 270, 443, 466, 467, 470, 471, 473, 478 G class). The road system is complemented by district and municipality roads, whose task is first of all to provide internal communication services in Eastern Wielkopolska.

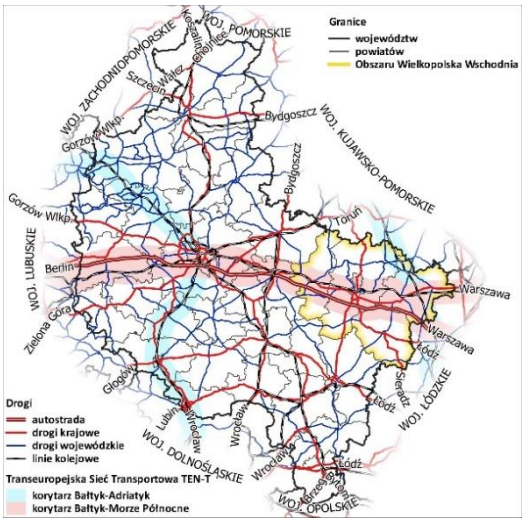
The relatively high road accessibility of the area and its transit character in east-west connections cause a **significant load on the road network**. In 2018, the number of cars registered in Eastern Wielkopolska was 294,900, an increase of 21.7% since 2012. There has also been a steady increase in the number of cars per 1,000 residents over recent years, from 550.8 in 2012 to 678.2 in 2018. (Wielkopolska 671.2).

The highest traffic intensity[147] on national roads, exceeding the average for Wielkopolska Region (12,171 vehicles/day)[148], occurred on the A2 motorway which is a part of the international route E-30 and on single sections of national roads No. 72 and 92. The highest vehicle traffic amounting to 24,991 vehicles per day was recorded on the A2 motorway section between Sługocin interchange and Modła interchange. Trucks had a significant share in the average daily traffic on national roads. According to 2015 GTS, this share was close to 32.0%, and on the A2 alone it was over 39.0%. For the regional roads, the highest average daily traffic of over 5,000 vehicles/day (Wielkopolska 4,250 vehicles/day) was recorded on the sections running in whole or in part through district towns and on DW 264.

Fig. 63. External transport connections of Eastern Wielkopolska in comparison to Wielkopolska Region

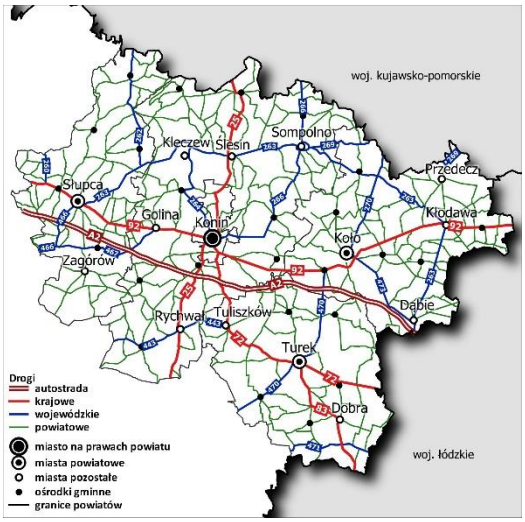
Fig. 64. Road system of Eastern Wielkopolska

[144]Source https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu_pl
[145]Source: as above
[146] National Inventory Report 2020 (Synthesis Report) containing national greenhouse gas emissions data for 1988-2018 with a description of the methodology. Report based on data reported to the UNFCCC Secretariat on April 15, 2020.
https://www.kobize.pl/pl/fileCategory/id/16/krajowa-inwentaryzacja-emisji
[147]Vehicle traffic intensity on national and provincial roads is measured in 5-year cycles within the General Traffic Survey (GTS) by the General Directorate for National Roads and Motorways. The survey does not include sections of national and provincial roads within the borders of cities with district rights, including the city of Konin in Eastern Wielkopolska. The current GTS dates back to 2015.
[148]Average daily annual vehicle traffic in 2015 according to 2015 GTS.



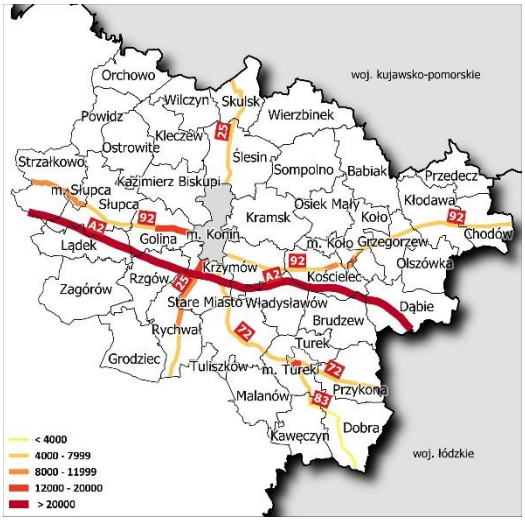
Source: WBPP own study based on BDOT data

Fig. 65. Total traffic intensity on national roads in Eastern Wielkopolska



Source: WBPP own study based on BDOT data

Fig. 66. Total traffic intensity on regional roads in Eastern Wielkopolska

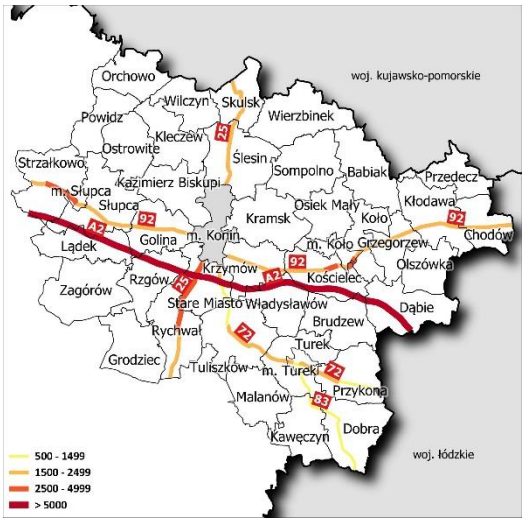


Source: WBPP own study based on 2015 GTS

Fig. 67. Truck traffic intensity on national roads in Eastern Wielkopolska

Source: WBPP own study based on 2015 GTS

Fig. 68. Truck traffic intensity on provincial roads in Eastern Wielkopolska



Source: WBPP own study based on 2015 GTS

Source: WBPP own study based on 2015 GTS

The level of harmful substances emissions to the air is influenced by the **quality of cars**. It can be determined, among other things, by the age of the cars and the type of fuel used. The level of emissions of harmful substances by cars is defined by the European Emission Standard – Euro 1 – Euro 6 Standards[149].

In 2018, the largest age group of passenger cars in Eastern Wielkopolska were vehicles 16-20 years old (22.9%). The newest cars represented only 3.4%. Since 2015, there has been an increase in the number of new cars (those up to 3 years old) and the oldest cars (those 21 years old and older), reflecting the increasing life of vehicles. It is estimated that about 24.0% of cars do not meet any of the Euro emission standards, and the latest Euro 5 and 6 standards are met by just over 9.0% of cars registered in Eastern Wielkopolska.

The most common fuel used in cars is gasoline. In 2018, there were 49.8% of gasoline-powered cars in Eastern Wielkopolska, but since 2015 their share in total cars has declined from 52.8%. Cars using diesel as a fuel in 2018 accounted for 32.3% and since 2015, the share of cars of this type has increased from 29.2%. LPG gas is also a popular fuel for cars. The share of passenger cars using this fuel has remained at around 17.0% since 2015. Alternative-drive cars, including all sorts of hybrids and electric cars, accounted for only 0.9% in 2018.

The development of a modern public passenger transport system, including **bus transport**, is of significant importance for the reduction of pollutant emissions. In 2019, there are 137 vehicle passenger transport providers in Eastern Wielkopolska. This number has increased by 12.3% since 2012.

In 2018, there were 1,122 buses registered in Eastern Wielkopolska. Compared to 2015, their number increased by 7.6%. In the Eastern Wielkopolska region, there were 2.6 buses per 1,000 inhabitants in total (Wielkopolska 2.5), however it should be noted that significant differences in access to bus transport, especially of local importance, occur at the district level. The highest number of buses per 1,000 inhabitants was recorded in Konin (4.5) and the lowest in Koło district (1.7).

In the last few years, due to the lack of a stable legal situation for carriers, there has been a process of aging of the existing bus fleet and the service life of vehicles has increased. In 2018, in terms of vehicle age, more than 26.6% of the bus fleet in Eastern Wielkopolska was made up of buses 31 years old and older. The least numerous group were the newest buses in the age range of 1-5 years (3.7%).

The quality of the rolling stock is also indicated by the type of fuel used. In 2015, just under 94.0% of vehicles used diesel fuel in Eastern Wielkopolska, which was similar to the level for Wielkopolska Region (94.0%). However, over the last few years there has been a noticeable trend away from the most harmful diesel fuel. In 2018, the share of this type of vehicles in the bus fleet of Eastern Wielkopolska was 81.3% (Wielkopolska 77.8%).

[149]The first standard was introduced in 1993 and the latest in 2014. At present, Euro 6 standard is undergoing further modifications, which will further tighten actual emissions and force passenger car manufacturers to introduce an increasing range of environmental solutions, including electric, hybrid and hydrogen drives.

At the same time, the share of green-powered buses, including but not limited to hybrid and electric buses, has increased since 2015, reaching 14.0% in Eastern Wielkopolska and 17.4% in the region in 2018. However, it should be stated that the ongoing changes aimed at the modernization of the bus fleet are not sufficient and have not significantly improved its quality. New buses do not replace decommissioned vehicles to a suitable degree. As part of the smart specialisation "Industry of tomorrow," RIS 2030 distinguishes the area of "Eco-innovative means of car and air transport and public transport vehicles and systems" setting the direction for further modernisation of means of transport.

Road freight transport is very important in terms of environmental and climate risks**.** Its share in the amount of transported cargo is constantly growing. In Poland, 1,873,022 k tonnes of cargo, or 85.5%, was transported by road in 2018. Compared to 2012, cargo tonnage increased by 324,911 k tonnes and the share of domestic road transport increased by 1.5 p.p.

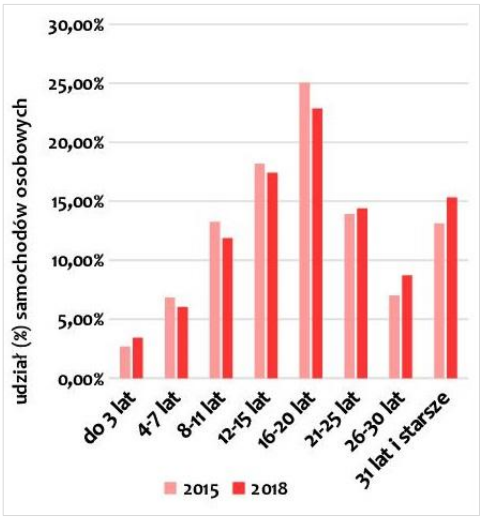
In terms of road transport, Wielkopolska belongs to the regions that serve the greatest mass of freight. In terms of tonnage of incoming and outgoing cargo, Wielkopolska has been ranked 3rd in the country for years.

Freight transport in Eastern Wielkopolska is predominantly car transport, which is influenced by good transport accessibility of the area favourable for the development of **logistic activity** (e.g. in RSI 2030 it is the area "Specialised supply chains," "Optimisation and decision-making support tools in logistic processes"). Moreover, logistics was indicated as one of the four smart specialisations of the Konin sub-region[150]. In 2018, the number of business entities entered to the REGON register in section H in Eastern Wielkopolska was 182 and accounted for 8.7% of the logistics entities in the region (2,089). Compared to 2012, this number increased by 44.4%, indicating the dynamic growth of the industry. Since 2001, in Eastern Wielkopolska, Wielkopolska Logistics Centre (WCL) has been operating, bringing together Stare Miasto municipality and the city of Konin, as well as private entrepreneurs, offering areas prepared for the needs of logistic companies.

In the context of the environmental impact of road freight transport, it should be noted that the structure of fuels used in trucks and truck tractors in 2015 was definitely dominated by diesel fuel (74.7%), the combustion of which emits the most pollutants into the atmosphere. In 2018, this share fell slightly to 69.3%.

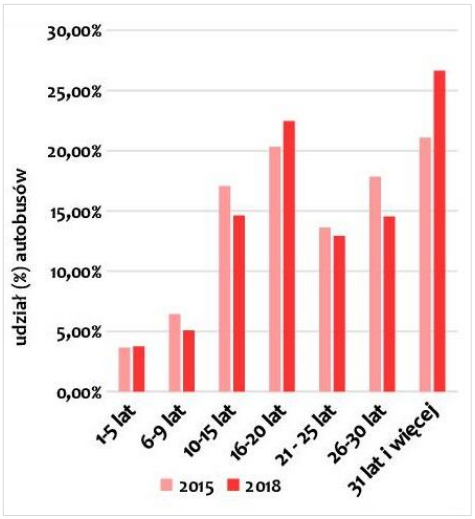
[150]Other smart specialisations of the Konin subregion are: Renewable Energy Sources and modern energy technologies including hydrogen; Tourism; Healthy food production.

Fig. 69. Share of cars by age group in 2015 and 2018; (%)



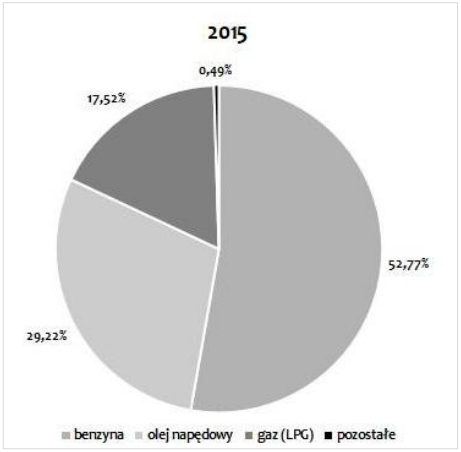
Source: WBPP own study based on BDL CSO

Fig. 70. Share of buses by age group in 2015 and 2018; (%)



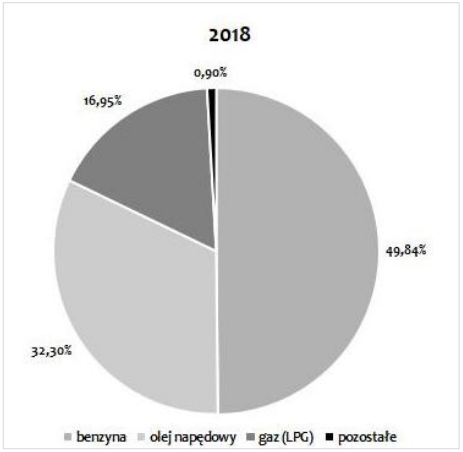
Source: WBPP own study based on BDL CSO

Fig. 71. Share of cars in Eastern Wielkopolska by type of fuel used in 2015; (%)



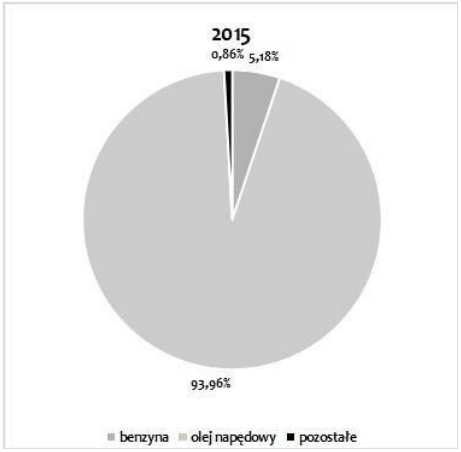
Source: WBPP own study based on BDL CSO

Fig. 72. Share of cars in Eastern Wielkopolska by type of fuel used in 2018; (%)



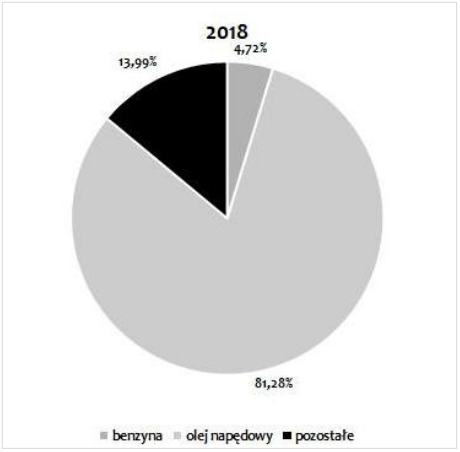
Source: WBPP own study based on BDL CSO

Fig. 73. Share of buses by type of fuel used in 2015; (%)



Source: WBPP own study based on BDL CSO

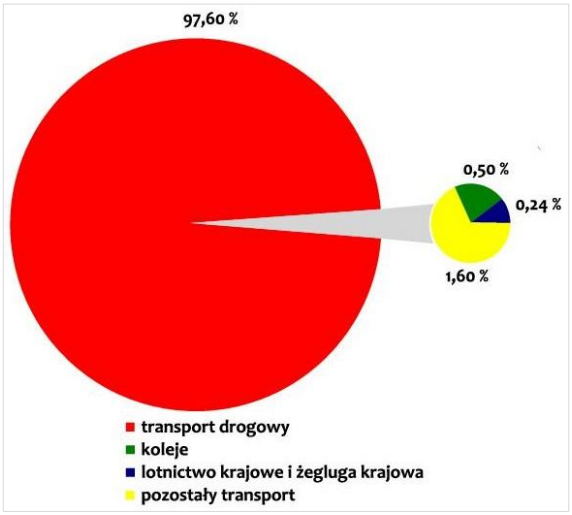
Fig. 74. Share of buses by type of fuel used in 2018; (%)



Source: WBPP own study based on BDL CSO

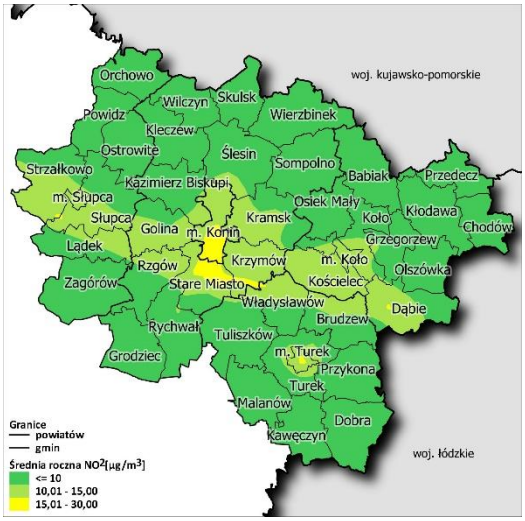
The dynamic development of road transport, both for passengers and freight, based on conventional fuels (petrol, diesel), adversely affects the environment and contributes significantly to climate change[151]. **Pollution from road transport** is mainly of a linear nature and is greatest along major traffic routes and in larger cities where there is the greatest traffic density. The most exposed city to pollution caused by congestion in Eastern Wielkopolska is Konin. A high level of pollution is also noted in larger cities of Eastern Wielkopolska, i.e. Turek, Koło, or Słupca. On the other hand, the highest linear pollution intensity occurs along the A2 motorway, where the highest traffic intensity in the entire area is recorded, and on the remaining national, regional and other roads, especially within the larger towns and traffic junctions generating heavy traffic. The 2018 annual assessment of air quality in Wielkopolska Region[152] showed that road transport, in the *Wielkopolska zone*[153] covering the area of Eastern Wielkopolska, had the largest share in the balance of nitrogen oxide emissions (47.3%) among all the sectors studied[154]. The share of road transport in the balance of particulate matter PM10 and PM2.5 emissions was also pronounced (5.6% and 6.3%, respectively). An opportunity to reduce emissions of harmful gases into the atmosphere may lie in the increased emphasis on the development of electromobility, which has been identified as a component of the "Industry of the Future" specialisation in RIS 2030, as well as the takeover of transit traffic by rail transport.

Fig. 75. Share of the individual transportation subsector in emissions from IPCC sector 1.A.3 in 2016. All greenhouse gases converted to CO2 equivalents are included



Source: Climate for Poland Poland for climate, KOBIZE 2018

Fig. 76. Average annual spatial distribution of NO_2 pollution in Wielkopolska zone



Source: Spatial distribution of selected pollutants in the area of Wielkopolska Region - results of mathematical modelling of PM10, PM2.5, SO_2, NO_2, B(a)P and ozone concentrations for the annual air quality assessment for 2017 /according to GIOŚ

[151]Emissions from motor vehicles can be classified into 3 main groups: exhaust emissions, abrasion emissions and vapour emissions. Exhaust emissions are related to the combustion of fuels (petrol, diesel, natural gas, liquefied petroleum gas - LPG) in the engine compartment, resulting in pollutants entering the air in the form of: nitrogen oxide, carbon monoxide and dioxide, hydrocarbons and particulate matter. Abrasion emissions are responsible for e.g. mechanical abrasion of tires, brake pads, clutch, or road surface, which emit mainly PM into the air. Vapour emissions, on the other hand, occur as a result of vapours escaping from the vehicle's fuel system.

[152]Annual assessment of air quality in Wielkopolska Region. Regional report for 2018, GIOŚ, Department of Environmental Monitoring, Regional Department of Environmental Monitoring in Poznań, April 2019.

[153]The report determines the level of pollutant emissions in terms of health and plant protection. All municipalities in Eastern Wielkopolska are within the scope of the *Wielkopolska zone*, which covers the area of the region that is not included in agglomerations and towns with population over 100 thousand.

[154]Sectors: utilities, road transport, point and other.

Eastern Wielkopolska is characterized by limited internal accessibility to **rail infrastructure**. The area is crossed by two double-track, electrified trunk railway lines of national importance: line No. 3 West Warsaw – Kunowice, located in the corridor of the Trans-European Transport Network TEN-T North Sea - Baltic and line No. 131 Chorzów Batory – Tczew, located in the corridor of the Trans-European Transport Network TEN-T Baltic – Adriatic. The district without direct access to railway infrastructure is Turek district, with no railway lines.

The quality of railway lines is gradually improving. In the years 2017 – 2022, the project is being implemented: *Works on railway line E 20 at section Warsaw – Poznań – remaining works, section Sochaczew – Swarzędz*[155] co-financed from EU funds under the "Connecting Europe" facility (CEF). These works will result, among other things, in increasing the capacity of the line, shortening the time and increasing the safety of travel. Railway traffic will be carried out at a maximum speed of up to 160 km/h in passenger traffic and up to 120 km/h in freight traffic. The investment is planned for completion by the end of 2022. The modernised line is also to function as the so-called railway communication spoke No. 10, which is planned within the railway programme for the Central Communication Port. It will allow for a direct connection with the largest airport in Poland in the future.

The remaining railway infrastructure in Eastern Wielkopolska has the status of sidings. The former railway line No. 388 since 2014 operates as a siding line Konin – Pątnów, track 1P. It connects industrial areas and Pątnów power plant in the northern part of Konin with railway line No. 3 and is occasionally used for freight traffic. Among larger sidings is also the one between Strzałkowo and Powidz, connecting the railway line No. 3 with the airport in Powidz. Moreover, in Eastern Wielkopolska there was a narrow-gauge railway, but at present it is not in use and is in a bad technical condition.

Railway passenger transport in Eastern Wielkopolska on railway line no. 3 has regional, national and international character, but in the context of mobility of the area's inhabitants and accessibility to the capital of the region, the most important are regional transports served by Koleje Wielkopolskie (KW), which is owned by Wielkopolska Region. In 2016, the number of passengers served by KW on the Poznań Główny – Kutno line was at 2,769,232 and in 2019 it will be at 3,404,933. However, it should be noted that in 2017 and 2018 there was a modernization of the railway line No. 3, during which a substitute communication was provided using bus transport. As a result, in the second half of 2018 and into 2019, the rail carrier has been taking steps to recover its passengers. Railway line no. 131 is of marginal importance in passenger traffic and has no connections of regional character.

Railway lines are also used for **freight transport**. There are 5 loading points located near railway line No. 3: Słupca, Cienin, Konin, Koło, Barłogi. The 2 loading points are also a big advantage: Dąbie n/Ner, and Zaryń, located in the vicinity of railway line No. 131 used mainly for freight transport. Construction of an intermodal terminal is planned in place of the loading point in Konin.

[155]Source: http://www.poznan.uw.gov.pl/system/files/zalaczniki/wielkopolskie_inwestycje_kolejowe_stan_na_31.12.181_0.pdf

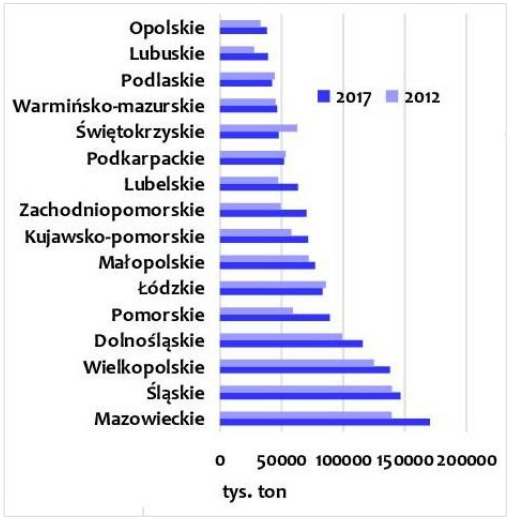
Fig. 77. Railway network used for passenger transport in Eastern Wielkopolska

Source: WBPP own study

Fig. 78. Railway network used for freight transport in Eastern Wielkopolska

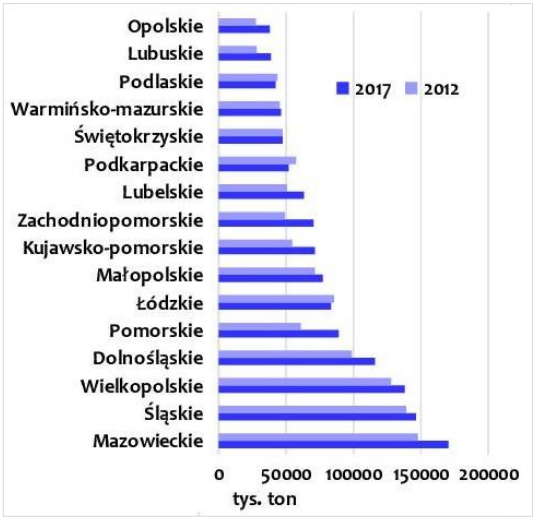
Source: WBPP own study

Fig. 79. Cargo shipped for transport by region in 2012 and 2017



Source: CSO

Fig. 80. Cargo accepted for transport by region in 2012 and 2017



Source: CSO

Table 3. Number of stops, use of loading tracks in 2014-2019

Station	line number	2014	2015	2016	2017	2018	2019
BARŁOGI	3	0	0	0	0	0	0
CIENIN	3	0	0	0	0	0	0
KOŁO	3	74	95	51	144	68	38
KONIN	3	35	58	92	78	50	32
SŁUPCA	3	117	236	189	151	0	3
DĄBIE N/NEREM	131	6	5	2	1	36	6
ZARYŃ	131	8	0	3	5	20	0

Source: PKP PLK S.A. Railway Traffic Management Centre

The key challenge associated with the dynamic development of transport in the context of combating global warming and climate change is to transform the transport sector towards zero-emission transport.

The key challenges in this area include:

- **with regard to road transport:**

– the need to increase the share of modern cars using low and zero emission drive systems;
– the need to renew the aging bus fleet and increase the share of eco buses, including hybrid, electric and clean energy sources and carriers, e.g. hydrogen;
– the need to improve the transport offer of the collective road transport and to increase the degree of integrating the various modes of transport;
– the need to integrate the different modes of freight transport and to take over transit freight transport by rail;
– joining the system of international supply stations with new clean energy sources and carriers, e.g. hydrogen;
– changing travel behaviour towards greater preference of public transport;

- **for the rail transport system:**

– the need to develop the railway infrastructure;
– increasing the share of new-generation rolling stock using new clean energy sources and carriers, such as hydrogen.

- **Biodiversity**

Biodiversity, taken as diversity in the species of plants, animals, fungi and all microorganisms on Earth, is particularly threatened by climate change. Loss of biodiversity is the greatest threat to the proper functioning of life on Earth.

Drought is a phenomenon that has a particularly negative impact on the maintenance and shaping of biodiversity. Eastern Wielkopolska in its whole area is threatened, to a moderate and significant degree, with the occurrence of **atmospheric drought** and, in consequence, **soil, hydrological and hydrogeological drought**. The phenomenon of drought can cause irreversible changes in aquatic ecosystems and many economic losses. For the biodiversity of aquatic and forest ecosystems, for meadows and pastures, drought may mean the extinction of many species of moisture-loving fauna and flora inhabiting them.

Wielkopolska Region, including Eastern Wielkopolska, is characterized by definitely low **surface water resources**. This problem results, inter alia, from: climatic conditions, unfavourable water balance, limited hydrogeological retention possibilities of catchment areas, low retention level and the share of forests and woodlands in the land use structure, as well as the generally occurring phenomenon of drought.

The river network of Eastern Wielkopolska is relatively well developed. The main river of this area is the Warta River, which is also the right, longest tributary of the Odra River. The valley of this river is an ecological corridor of national importance and is the main axis of the natural system of Wielkopolska. Rivers and smaller watercourses of Eastern Wielkopolska and their valleys create ecological corridors which enable movement of living organisms on a local, regional and national scale. In the valleys of these rivers many valuable marsh, peatbog and forest ecosystems have been preserved under legal protection. Rivers are vulnerable to the occurrence of drought, which in extreme cases is manifested by a significant reduction in water flow, local changes in biophysical parameters in the river course and the condition of habitats, which may prevent their proper functioning. The resilience of a river ecosystem to drought is greater the more diverse the hydromorphology of the watercourse is. River valleys, in turn, promote the cyclical recovery of plant communities and also delay the effects of drought. Therefore, in order to counteract the effects of drought, it is particularly important to take actions aimed at restoring proper (original) space to rivers, mitigating and reducing surface runoff, or sustainable flood management[156].

Lakes and artificial water reservoirs are an important hydrographic element of Eastern Wielkopolska, because their number and capacity determines the retention abilities of the area. The total area of standing waters in Eastern Wielkopolska is over 8 k ha[157]. The key ones include: Powidzkie, Gosławskie, Pątnowskie, Mikorzyńskie, Brdowskie, Wilczyńskie or Gopło lakes.
Rivers, lakes or reservoirs that function naturally overgrow much more slowly, providing fresh water storage through so-called small retention. Thus, water is retained in the natural

[156] Bryl M., Łyczkowska G., 2019, Wody powierzchniowe w Wielkopolsce – gospodarowanie zasobami, ochrona i zagrożenia wynikające ze zmian klimatycznych i działalności człowieka (Surface waters in Wielkopolska - resource management, protection and threats resulting from climate change and human activities) (in:) Choiński A., Wody Wielkopolski (Waters of Wielkopolska), Wydawnictwo Naukowe UAM, Poznań.
[157] Database of Topographic Objects (BDOT), 2014.

environment, which directly translates into the characteristics of the local climate (e.g. increased humidity, reduced air temperature).

The preservation of wetlands is extremely important in mitigating the effects of drought. On the one hand, they are vulnerable to water shortages, but on the other, they have high retention capacities, which reduce the effects of floods. Wetlands, and **peatlands** in particular, are highly productive ecosystems (accumulating organic carbon) and provide rich habitats for flora and fauna. They retain water in the environment, recharge groundwater by capturing significant amounts of water from flowing streams or precipitation during floods. The ecosystem services provided by wetlands are highly dependent on their degree of degradation. These ecosystems are particularly threatened by water shortages in dry periods and are additionally subject to strong anthropopressure. Therefore, in order to preserve their ecosystem functions, it is necessary to protect non-degraded objects and reclaim degraded areas. Particular attention should be paid to undegraded peatlands, which show great potential for accumulating organic carbon by withdrawing CO_2 from the atmosphere, thus also having a significant impact on the climate.

Within the borders of Eastern Wielkopolska almost 3,700 ha of land ecosystems have been identified[158] remaining in dynamic relations with groundwater and surface waters (so-called wetlands[159]). Water-dependent ecosystems usually occupy depressions and are often used as meadows and pastures. The area of meadows and pastures in Eastern Wielkopolska covers ca. 78 k ha[160]. Wetlands play an important role in water retention in the catchment area, improve the water balance in the catchment and increase water resources. They are a refuge for wild animals and plants. At the same time, undegraded peatlands, as natural reservoirs of organic carbon stored in peat deposits and withdrawn from the atmosphere in the process of photosynthesis, slow down the rate of increase of atmospheric CO_2 concentrations, having a negative impact on the intensification of the greenhouse effect in the troposphere. Maintenance and protection of non-degraded peatlands and restoration of degraded peatlands will increase the potential for carbon accumulation in peat deposits and will have a beneficial effect on biodiversity. Restoring degraded wetlands, maintaining the natural character of watercourses and their floodplains is the most effective way of increasing "small retention," much more beneficial to nature and the environment than the construction of artificial water reservoirs. Unfortunately, the area of wetlands in Eastern Wielkopolska is gradually decreasing. Between 2014 and 2019, the greatest decrease in wetland area occurred in Konin district (12.1%), followed by Turek district (4.0%), Słupca district (3.5%), and Kolsk district (1.0%). Only in the city of Konin an increase of wetland area by 19.2% was recorded.

The most common threat to the biodiversity of aquatic ecosystems is the **eutrophication process**, which affects both flowing and still waters. The main cause of eutrophication of reservoirs is the excess of nitrogen and phosphorus, which increases water fertility. These elements largely come from agricultural sources, i.e. fertilizers and animal excrements. One of

[158] BDOT, 2014.
[159] For practical reasons, the term *wetlands* is used interchangeably to describe *land ecosystems in dynamic relationship with groundwater and surface water*.
[160] BDOT, 2014.

the negative aspects of agricultural activity is water pollution due to surface runoff of nutrients from fields and improper storage of fertilizers and plant protection products.

Forests and wooded areas are extremely important ecosystems for climate protection and biodiversity. They play an important role in the general water balance of the catchment area[161], including among others: provide high retention capacity, influence the amount and frequency of precipitation, prevent excessive decrease of water level in rivers during droughts and also limit soil erosion and decrease the amplitude of air temperature, which indirectly translates into climatic conditions. Forests play an important role in climate change mitigation as they absorb carbon dioxide from the atmosphere.

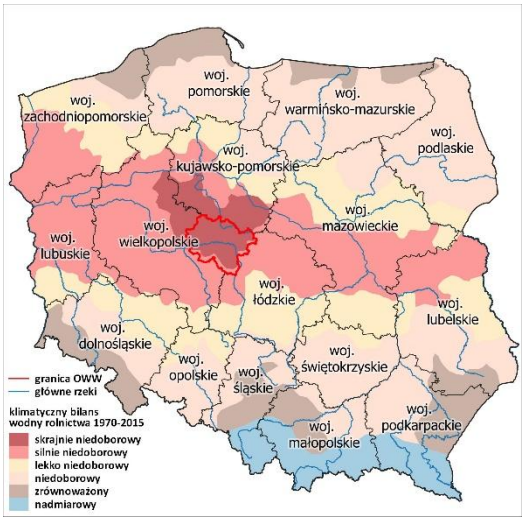
In 2019, the forest area in Eastern Wielkopolska was over 74.8 k ha[162] and the forest cover was at 16.8% (Wielkopolska Region 26.5%). The highest share of forests in the total area was found in Turek district (24.7%). In the districts of Konin, Słupca and Koło, the forest cover was at 16.7%, 15.6% and less than 12.0%, respectively. Konin had the forest cover of 3.2%. A slight increase in the area's forest cover of 0.1 p.p. was recorded between 2012 and 2019, with the highest in Konin district (0.45 p.p.).
Expanding forest area is a popular way to combat the climate crisis. Unfortunately, the compensation of natural forests with new plantations and plantings, although desirable, represents a different value for water management, for the water cycle in nature and for the climate, due to the differences in the structure of these ecosystems[163]. An additional element of shaping biodiversity, simultaneously affecting the improvement of humidity conditions and reduction of area contamination, are **strip plantings**, shrubs and tree clumps introduced in agricultural areas.

In the fight against climate change, it is also important to specifically protect areas of outstanding biodiversity, especially in the context of possible investments. This includes areas already covered by **forms of environmental protection** or to be created in the future. In Eastern Wielkopolska, the areas covered by legal protection (together with Natura 2000 areas) occupy the total the area of[164] 202.8 k ha. These include: nature reserves (Bieniszew, Pustelnik, Mielno, Złota Góra, Rogoźno, Kawęczyńskie Brzęki, Sokółki), landscape parks (Nadgoplański Tysiąclecia Park, Powidzki Landscape Park, Nadwarciański Landscape Park), protected landscape areas (Goplański-Kujawski, Złotogórski, Uniejowski, Powidzko-Bieniszewski, Pyzdry), a documentation site (Pink Salt Profile), ecological grounds, natural monuments (213), Natura 2000 areas (Bzura-Neru Proglacial Valley, Gniezno Lake District, Bieniszewski Forest, Ostoja Nadwarciańska, Gopło Lake, Central Warta Valley, Jeziorsko Reservoir, Warsaw-Berlin Proglacial Valley, Ostoja Nadgoplańska).

Fig. 81. Climatic water balance in the years 1970 - 2015 for Eastern Wielkopolska versus Poland

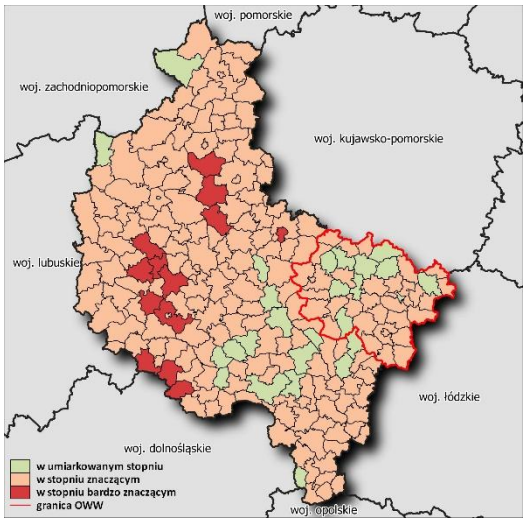
Fig. 82. Municipalities threatened by drought in Eastern Wielkopolska versus Wielkopolska Region

[161]Kowalczak P., 2008, Zagrożenia związane z deficytem wodę (Threats Related to Water Deficit), Wydawnictwo Kurpisz, Poznań.
[162]CSO, BDL.
[163]Kowalczak P., 2008, Zagrożenia związane z deficytem wodę (Threats Related to Water Deficit), Wydawnictwo Kurpisz, Poznań.
[164] Area under legal protection, counted without duplicating the area of overlapping forms of environmental protection.



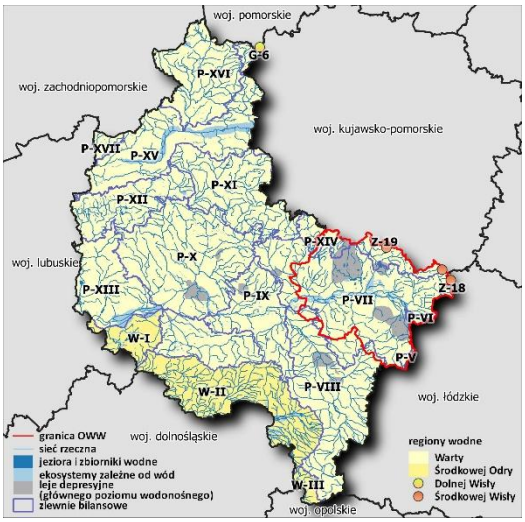
Source: WBPP own study on the basis of Environmental Protection Programme for Wielkopolska Region until 2030, after SOR 2017

Fig. 83. Surface water resources in Eastern Wielkopolska versus Wielkopolska Region



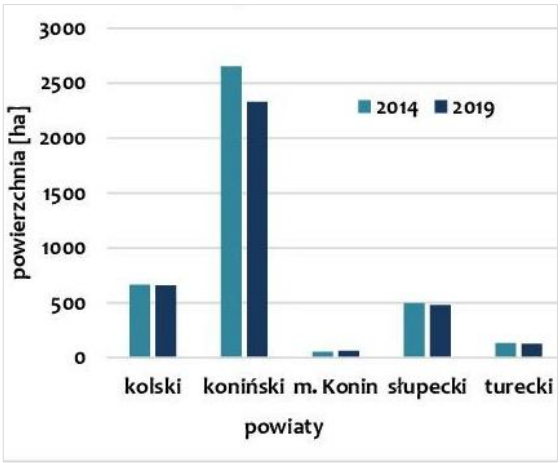
Source: WBPP own study based on KZGW

Fig. 84. Change in wetland area in districts of Eastern Wielkopolska between 2014 and 2019 (ha)



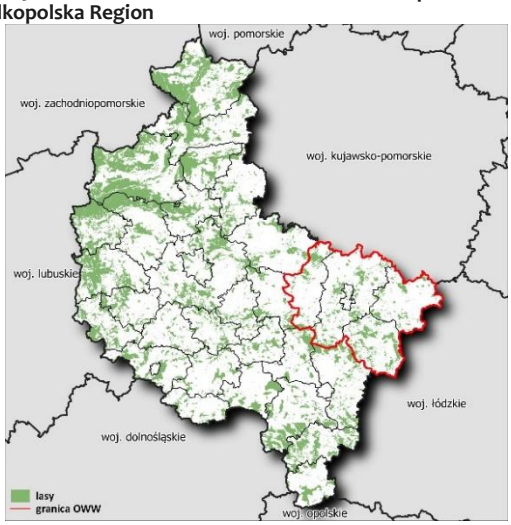
Source: WBPP own study based on Hydrographic Map of Poland 2019

Fig. 85. Forest resources in Eastern Wielkopolska versus Wielkopolska Region

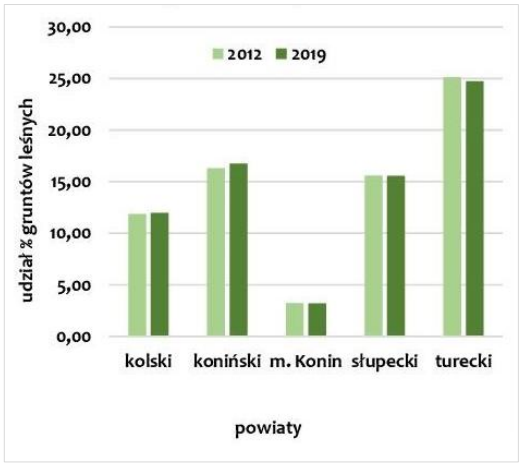


Source: WBPP own study based on BDOT 2014, 2019

Fig. 86. Forest cover in Eastern Wielkopolska districts in 2012 - 2019 (%)



Source: WBPP own study based on Forest Data Bank 2016



Source: WBPP own study based on CSO, BDL

The key challenge for shaping biodiversity in the context of fighting global warming and climate change is to maintain biodiversity at the genetic, species and ecosystem levels.

The key challenges in this area include:

- the need for legal protection of the most valuable areas in terms of nature and landscape;
- taking into account in the spatial planning the environmentally valuable areas which are not subject to legal protection;
- the need to increase the area of forests, reconstruction of tree stands[165] and creation of mid-field afforestation in agricultural landscape and post-mining areas;
- the need to protect lakes and other water reservoirs (especially mid-field and mid-forest ones) and wetlands (especially undegraded peatbogs) against pollution and decrease of water level;
- undertaking restoration activities, restoring the optimum water level and condition of lakes and wetlands;
- reclamation of mined areas taking into account the possibility of the presence of as many native taxa as possible;
- the necessity to apply technologies and solutions in the economy, minimising the negative impact of human activity on natural environment;
- delivery of investments taking into account protection of natural resources;
- implementing programmes for renaturalisation of water and wetland ecosystems (in particular peatbogs) and protection of endangered plant and animal species;
- supporting monitoring of nature and environment and scientific research (in particular research on the impact of climate change on the functioning of ecosystems and the greenhouse gas balance);
- the need to increase the level of awareness among the local community regarding nature protection and promotion of pro-environmental behaviour.

[165] https://journals.pan.pl/Content/114863/PDF/24_Las_Przebudowa.pdf?handler=pdf

II.VISION OF DEVELOPMENT

Due to its specificity and exceptional character, the area of Eastern Wielkopolska is particularly predisposed to undertake integrated and comprehensive actions aimed at limiting human impact on the climate. The "Strategy for Climate Neutrality East Wielkopolska 2040" adopts the following vision of the development of Eastern Wielkopolska. It is a response to the key and main development challenges and creates an image of the area in the next 20 years:

EASTERN WIELKOPOLSKA 2040 AS A LEADER IN DEVELOPMENT OF INNOVATIVE, RESOURCE EFFICIENT AND ZERO-EMISSION ECONOMY THAT PROVIDES NEW ATTRACTIVE JOBS AND A GOOD PLACE TO LIVE

It is assumed that in 2040 Eastern Wielkopolska will be a national leader in the green economy. The circular economy in the Region has been dynamically developing with use of the competences and skills of the population and local production capacities in line with the identified areas of smart specialization in Wielkopolska, especially those based on environmentally friendly technologies.

The dominant branch of the economy is the **resource-efficient, zero-emission and energy-efficient industry**, including the fuel and energy sector, using innovations and advanced technologies and providing attractive jobs. The former lignite mining region has transformed into a leading **producer of green energy from renewable sources** and a **producer and exporter of hydrogen.** The power industry that uses solar, wind and geothermal energy in addition to biomass, biogas and hydrogen and also involves new forms of energy communities, provides the basis for a new energy system that includes individual energy sources.

The transformation of the economy of Eastern Wielkopolska and the **implementation of systemic changes for the circular economy** led for the creation of new jobs and minimized the negative impact of humans on the environment. Pro-ecological and pro-climate solutions applied in enterprises from all sectors of the economy resulted in a neutral impact on the climate. Reclamation of post-mining areas, where energy from renewable sources is produced, contributed to the improvement of water relations, thus providing a good example of deep changes.

An efficiently functioning economy is enhanced by **well-developed communication infrastructure** – road, rail, and water transport – that is **adapted to the needs of low-emission transport**. The most harmful combustion vehicles have been replaced with low-emission electric

or hydrogen-powered cars. The enhanced railway network and waterway infrastructure helped launch alternative modes of transport. Individual car transport has been largely replaced by road and rail public transport, and freight transport uses low-emission vehicles and multimodal terminals that increase opportunities to transport a variety of loads.

The community of Eastern Wielkopolska is known from their **high level of ecological awareness**, which, combined with the use of the latest technologies, led to the **reduction of greenhouse gas emission and restoration of clean air**, thereby making Eastern Wielkopolska a friendly place to live, where the environment and climate are respected.

III.OBJECTIVES AND ACTION LINES

1. STRATEGIC GOAL

EASTERN WIELKOPOLSKA REGION AS AN AREA OF JUST TRANSFORMATION NEUTRAL FOR THE CLIMATE IN 2040

Goal description

Climate changes being a consequence of human activity have led to changes in the natural environment and living conditions worldwide. **Limiting climate change is the most important global challenge in the upcoming years and achieving climate neutrality is the key to the future of next generations.** At the same time, achieving climate goals set by the EU requires transforming many areas of life. It is said that intensification of measures to reduce human impact on the climate in Eastern Wielkopolska will help achieve climate neutrality of the Region as early as in 2040 and thus the EU's obligations and main climate goal will be met faster[166].

It is assumed that the **strategic goal of the climate policy for Eastern Wielkopolska is the climate neutrality of the area in 2040, achieved in the process of just transition with particular emphasis on the needs of social groups at risk of exclusion and marginalization.**

It is mentioned that **targeted and coordinated actions** will be taken to enhance energy efficiency, increase the use of climate-neutral energy carriers, transform the economy into a circular economy, develop a modern bioeconomy sector and clean mobility, which will result in **reducing CO2 emission in the electricity sector by at least 90 - 95% by 2030, and by approx. 80 - 90% in other sectors by 2040**[167]. At the same time, measures will be implemented to increase the absorption of CO2 by ecosystems through, for instance, afforestation in the area, reconstruction of tree stands, peatland protection and restoration and urban green growth. In addition to the above actions, some other dust and gas emission (e.g. PM10 and B(a)P, NO_x, SO_x) will be limited. It is assumed that by the end of 2030 the permissible level of PM10 and PM2.5 and the target level B(a)P in the air will be achieved.
It is believed that the multi-faceted actions will result in the **transformation of Eastern Wielkopolska into a climate-neutral area** by 2040 with a developed zero-emission economy, with particular emphasis on hydrogen, zero-emission transport as well as modern and energy-saving construction. Moreover, it is assumed that green investments will become a factor to boost the local economy, affect its competitiveness and entrepreneurship, and provide new attractive jobs, so important in the face of the closing of the mining sector. The innovative activity of enterprises

[166] They result from European documents regarding the new perspective, such as: *Clean Planet, European Green Deal, Communication of the European Commission, Hydrogen Strategy for a Climate-Neutral Europe, Reconstruction Plan for Europe and the 2030 Digital Competence Development Program.*
[167] According to the assumptions of the European Commission, the base year is 1990.

will develop, with particular emphasis on modern solutions in the area of ICT, Industry 4.0 and other leading technologies[168]. At the same time, it is assumed that the rapid technological changes and progress are constantly monitored in the context of the level of availability of new technologies (resulting from the costs of a given technology) and an increase in the possibility of their common use. The directions of economic transformation will become **permanent factors of sustainable socio-economic development** of Eastern Wielkopolska.

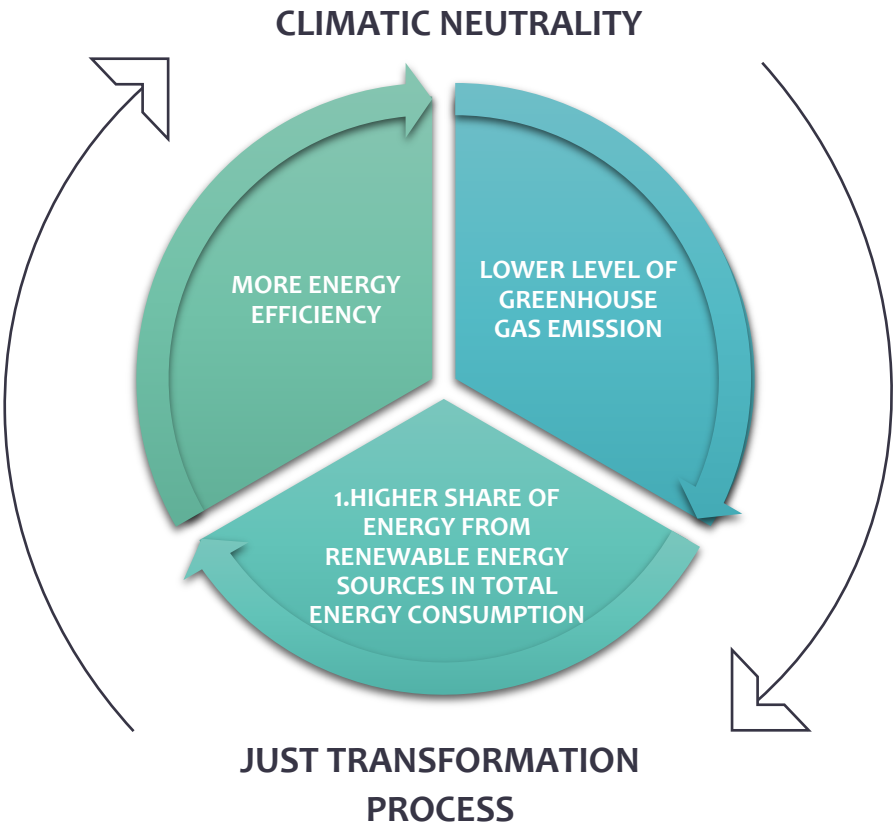
It is assumed that just transformation of the area will be targeted at the development of inclusive economy and will be carried out with the participation of and support from the state and budgetary resources, based on the principles of social solidarity. The long-term **integrated process of transforming and building sustainable economy of Eastern Wielkopolska** will be carried out in a transparent manner, with respect for the partnership principle, with particular emphasis on people affected by the twilight of coal-fired power generation or the needs of social groups at risk of exclusion and marginalization. It is assumed that actions aimed **at social inclusion** will be undertaken, including **the use of competences of currently employed employees** when creating new jobs in the public and private sectors and **adjusting employees' qualifications to the needs of the changed labour market**. At the same time, creating **new jobs in the green economy** and the development of **the SME sector** will contribute to **professional activation** of the population. The emphasis will be put on **vocational education** and **training courses** that meet the requirements of the future labour market. Well-developed **system of lifelong learning,** aimed at acquiring new skills and professions, will allow employees to continuously improve their skills, thus increasing their chances to enter the labour market.

[168]In accordance with the provisions of the Regional Innovation Strategy for the Wielkopolska Region 2030 (RIS 2030). Horizontal goal. Sustainable development of the region. Strategic goal 1. Increase in innovative activity in Wielkopolska. Strategic goal 1.1. Development of zero-emission economy with particular emphasis on hydrogen. C1.2. Development of innovative activities of enterprises, with particular emphasis on supporting and implementing modern ICT solutions, Industry 4.0 and other leading technologies and C2. Development of the regional innovation ecosystem. Strategic goal C4: Modern economy personnel.

2. SPECIFIC GOALS

It is assumed that the **process of achieving climate neutrality** in Eastern Wielkopolska will focus on three complementary detailed goals and will take place in two stages, for which the years 2030 and 2040 will be the dividing line. The specific goals include[169]:

1. **Greenhouse gas emission lower by at least 55.0% in 2030**
2. **Share of energy from renewable energy sources in total energy consumption increased to at least 32.0% in 2030**
3. **Energy efficiency higher by at least 32.5% in 2030**



The specific goals of the "Strategy ..." to be achieved in the first stage of transformation, i.e. by 2030, result directly from and are consistent with the European Union's climate objectives. Thus, the year 2030 becomes a "milestone" on the way to achieving climate neutrality of Eastern Wielkopolska in 2040. It is assumed that it will also be the year of verification of the adopted action lines in terms of achieving the strategic goal and imposing the development vision if reasons for updating the "Strategy ..." do not previously occur.

[169] According to the assumptions, the base year is 1990.

In order to achieve the specific goals in 2030 and the strategic goal in 2040, the following directions of action are defined:

Strategic goal

EASTERN WIELKOPOLSKA IS A REGION OF JUST TRANSFORMATION NEUTRAL FOR THE CLIMATE IN 2040

Specific goal 1	Specific goal 2	Specific goal 3
GREENHOUSE GASES EMISSION LOWER BY AT LEAST BY 55.0% IN 2030	**SHARE OF ENERGY FROM RES IN TOTAL ENERGY CONSUMPTION INCREASED TO AT LEAST 32.0% IN 2030**	**ENERGY EFFICIENCY HIGHER BY AT LEAST BY 32.5% IN 2030**
Action lines	Action lines	Action lines
1.1. Development of a low-carbon energy sector using climate-neutral energy carriers	2.1. Development of the power industry using wind and solar energy, geothermal waters, biomass and biogas	3.1. Development of energy-efficient building industry
1.2. Development of a zero-emission economy	2.2. Development of smart energy networks for the purposes of renewable energy sources	3.2. Development of energy-efficient industry
1.3. Development of a modern bioeconomy sector	2.3. Development of energy communities	3.3. Development of energy-efficient transport
1.4. Development of low-emission building industry	2.4. Development of the renewable energy industry	
1.5. Low-emission transport		
1.6. Shaping the entrepreneurial environment for the development of an innovative green economy		
1.7. Increase in the green space and tree planting		

- **Specific goals for 1.**

GREENHOUSE GAS EMISSION LOWER BY AT LEAST 55.0% in 2030

Goal description

Reducing emission and limiting the negative impact of greenhouse gases on the climate require adopting new priorities and implementing specific solutions. It is assumed that in the upcoming years, the area of Eastern Wielkopolska will experience **green economic transformation**, which will result in limiting the adverse human impact on the climate, including significant reduction in greenhouse gas emission. Innovative and modern technologies will be introduced in the industry and the construction industry, which will enable the economy to go through technological re-engineering and move towards **the circular economy**. It is believed that the measures taken will be comprehensive and will apply to all sectors of the circular economy, i.e. **sustainable industrial production, sustainable consumption, development of bioeconomy, new business models** and a **system to monitor** the environmental and climate impact [170]. The implementation and use of closed-loop and climate-neutral products, the modernization of energy- and resource-consuming industries, and the simultaneous development of digitization will help optimize the use of natural resources. On the other hand, rational and economical management of resources and the maximum use of all raw materials, products and waste from the mining industry, industrial processing as well as energy production and supply, in line with the zero waste philosophy, will contribute to the reduction of greenhouse gas emission and the adverse human impact on the climate.

In Eastern Wielkopolska, the mining and energy sector based on lignite resources has a significant share in greenhouse gas emission. It is said that by 2030 at the latest, **lignite opencast mines will no longer be exploited, and lignite will not be used as an energy carrier in the electricity and heating sectors (grid and individual) in favour of climate-neutral carriers**. The priority is to diversify the sources of obtaining energy, including **the development of the energy sector based on renewable sources, i.e. wind, solar and geothermal energy.** For the purposes of energy production, the **bioeconomy** using the agricultural potential of the area and its abundance in biomass, will develop. The application of new technologies will contribute to the development of energy based, for instance, on **hydrogen**.

Other key actions aimed at climate neutrality will included promotion and implementation of innovative technologies and the development of modern energy infrastructure. It is assumed that **new solutions related to the production, storage and transport of energy** leading to reduction in the energy system emissivity will be implemented. The **power management optimization** will also be an important factor affecting the reduction of greenhouse gas emission.

The **construction industry** is a sector that greatly affects the climate and air quality**.** Building processes, which require significant amounts of energy and raw materials, and the production of building materials (such as cement) generate significant amounts of greenhouse gases. It is

[170] https://www.gov.pl/web/rozwoj-praca-technologia/rada-ministrow-przyjela-projekt-mapy-drogowej-goz

believed that in the upcoming years the construction sector will be transformed towards the production and use of environmentally friendly materials that contribute to an increase in the energy efficiency of buildings.

As part of **modern, low-emission housing economy**, actions will be taken to ensure the energy efficiency of the existing housing stock, low- or zero-emission of new housing development and the effectiveness of technical infrastructure systems that support it. An important element to reduce the emission of pollutants is providing the existing and planned residential buildings with **modern systems of technical infrastructure**. The modernization of the heating system, including its expansion, decentralization, cogeneration and better access to heating grids and devices, will play a key role. In the municipal and housing sector, which is responsible for the so-called low surface emission of fine dust and B(a)P, in accordance with the air protection programs applicable in the Region and the so-called anti-smog resolutions, comprehensive measures will be taken **aimed at replacing old, ineffective heat sources with new environmentally friendly installations**, including those using renewable energy sources (e.g. wind, sun, geothermal waters). The use of modern ventilation and HVAC[171] technologies allowing the heat and cold to be recovered will also be promoted.

Smart construction equipped with integrated systems for managing installations to minimize operating costs and reduce the emission of harmful pollutants will be supported. **Counteracting energy poverty**, which prevails especially among residents of single-family houses in cities with less than 100,000 people and is determined by low income and high energy expenditure[172], will be one of the key areas where actions will be taken. Advisory support and social assistance will be provided to entities taking actions aimed at thermal modernization of buildings and replacement of low-efficiency heating installations.

Priority will also be given to **modern architectural design and rational spatial planning** that is based on the use of local terrain conditions to improve climatic conditions and application of construction solutions limiting human impact on the climate. It is assumed that natural solutions will be used on a large scale, such as well-planned urban greenery, green roofs and walls that provide buildings with insulation and shading, reduce the need for heating and cooling and improve the energy performance of buildings, thus contributing to reduction of energy demand.

such actions will be aimed at **developing dense settlement structures, intensifying and adding to the existing building development and preventing the dispersion of buildings**. Rational shaping of space will help maintain proper relations between built-up and undeveloped areas.

The **production of high-quality food conducted in accordance with the principles of the circular economy and the development of organic farming** will considerably contribute to the green economic transformation process. It is believed that measures will be taken to increase efficiency

[171] Heating, ventilation, and air conditioning.
[172] Source: RESEARCH REPORT 01/2018 Structural Research Institute, K. Sałach, P. Lewandowski „Pomiar ubóstwa energetycznego na podstawie danych BBGD – metodologia i zastosowanie".

of the systems of food production, storage, packaging and transport to reduce waste and to develop sustainable food processing. It will help limit food losses, thus fighting climate change and global warming. Actions related to preventing food waste and identifying its amount will be of key importance. These actions will contribute to reducing food waste in the stream of unsorted (mixed) municipal waste.

In order to reduce food waste, food banks redistributing food to people in need will be developed.

The **sustainable consumption and municipal waste management** are one the key sectors of the circular economy. According to the *Waste Management Plan for the Wielkopolska Region for 2019-2025 along with Investment Plan*, actions will be taken to intensify the prevention of generation of significant amounts of waste and promote its recycling, reuse, and usage for the production of heat and electricity in the high-efficiency cogeneration units. The circular economy package comes with an obligation to increase the level of preparation for reuse and recycling of municipal waste to 55 % by 2025. It is forecasted that the stream of separately collected waste will increase significantly, on average by 15.0% annually for the years 2021-2025 and 5.0% for the years 2026-2030. In addition, solutions extending the product life are also expected, e.g. restoration of products to their original function (e.g. through repairs), exchange of utility items between interested parties or transfer of used and other items that their holder would like to get rid of, to interested parties, including appropriate organizations, to distribute them among people in need, charity institutions or the so-called free shops.

It is assumed that in order to limit climate changes and slow down the global warming, it is necessary to **reduce the emission of harmful substances coming from transport**. In this regard, all modes of transport will be transformed into an environmentally friendly transport system and measures will be taken to stimulate integration and use of various modes of transport, increase the supply of sustainable alternative fuels for transport, develop low-emission modes of transport and modern transport infrastructure.

The development of **environmentally friendly public collective transport** will be an important element of changes. It is believed that a modern low-emission bus fleet will be introduced, including zero-emission vehicles, such as electric and hydrogen-powered buses. The development of new railway connections adapted to the needs of residents and the use of modern low- and zero-emission rolling stock, including hydrogen trains, are expected to happen. Apart from replacing the means of transport with ecological ones, **modern forms of public transport organization will be introduced** as part of the passenger transport development. The key issue is the inter-mode integration of public transport, also with individual transport, which will result in limiting individual car traffic and reducing traffic intensity, thereby minimizing the negative impact of transport on the climate. It is said that the introduction of such improvements as kiss &r ide and park & ride car parks will increase the accessibility and comfort of using public transport, especially in the largest cities of the area. The construction of modern interchange nodes will also increase the comfort of travellers using two means of public transport (e.g. rail and bus). Attractive public transport will also develop a result of introducing additional discounts

and improvements for passengers, including a uniform ticketing system for various means of transport in the entire area of Eastern Wielkopolska. It is also extremely important to promote **pro-ecological transport behaviour of the population** (i.e. the idea of sharing or renting various ecological means of transport for a specified period, encouraging people to use collective transport).

In order to eliminate or minimize the negative impact of car transport on the natural environment and climate, it is also advised that measures will be taken to gradually **introduce a modern low-emission truck fleet**. It is assumed that there will be a dynamic leap into the era of electromobility, which will help eliminate vehicles using traditional fuels. New forms of infrastructure, such as e-motorways[173], will develop, thereby giving hybrid trucks supplied with electricity a range far into non-electrified areas. In addition to the replacement of the truck fleet, it is assumed that the **share of means of transport other than road ones in freight transport** will increase. The most serious unused alternative is rail transport, which, along with the development of the local network, may significantly increase its share not only in passenger but also freight transport. In addition to improving the transport infrastructure and introducing low-emission vehicles, it is also necessary to **develop integrated intermodal nodes** allowing different modes of transport to be connected. It is assumed that intermodal reloading terminals will be created, connecting rail and road transport, including the terminal in Konin, which will increase the importance of rail transport. It is also expected that the existing railway infrastructure in the form of loading points will be modernized, which will increase the transport capacity and encourage the interested parties to use this form of transport. The new railway infrastructure will help diversify transport costs and use various distribution channels in the field of freight transport, thereby increasing the attractiveness of the existing and new investment areas and significantly contributing to the reduction of negative impact of transport on the environment and climate.
Economic transformation requires shaping an **innovative and modern entrepreneurial environment**, responding to new needs and development challenges. The research and development sphere and business environment institutions are expected to grow. The creation of a **digital platform for entrepreneurs** will contribute to the development of **cluster initiatives**. In addition, it is assumed that the development of **cooperation** between entrepreneurs and business environment institutions and the R&D centres will contribute to fully benefiting from the endogenous potential of the area for achieving climate neutrality in 2040.

In addition, it is said that an increase in the level of CO_2 absorption and reduction of air pollution will also be the result of reclamation of some of the post-mining areas towards **greater afforestation** as well as the permanent preservation and enlargement of new green areas in urban centres and rural areas. In order to limit the effects of climate change, the so-called blue and green infrastructure in communes will be promoted, biodiversity in environmentally valuable areas will be protected and increased, the hydrographic network of the area will be recreated, and proper water relations will be restored. Shaping the elements of **green infrastructure** will contribute to the reduction of low emission, thereby bringing economic, social and environmental benefits.

[173] the so-called eHighway, an electrically-augmented road with overhead electric lines adapted to handle freight transport.

A new approach to the economy and the development of a circular economy will be possible thanks to the **adoption of proactive and pro-ecological attitudes of entrepreneurs, residents and local authorities of** Eastern Wielkopolska. Information campaigns will be conducted, and educational programs will be developed to promote new patterns of behaviour in line with the principles of the circular economy. These actions will result in an increase in environmental awareness and a change in consumer and transport attitudes, such as giving up disposable products, minimizing food losses and waste, developing renewable energy sources, and reducing individual car transport in favour of collective ecological means of transport. Social campaigns to be conducted will be aimed at emphasizing the role of spatial planning in mitigating climate change, including the meaning of urban and rural solutions for improving air quality in urban and rural areas. It will also be critical to conduct training and educational campaigns for designing residential areas in a holistic way, including the promotion of rational and deliberate maintenance and design of new areas capable of filtering pollutants, ventilating and regenerating the air.

The above-mentioned measures will result in the reduction of greenhouse gas emission by at least 55.0% in 2030, the achievement of the climate goal set by the European Union[174] and achievement of climate neutrality in 2040. Also, creating and introducing innovative technologies and organizational solutions in the power industry, economy and transport will contribute to the growth of entrepreneurship and an increase in the attractiveness of Eastern Wielkopolska for future investors and its competitiveness in the country and internationally.

[174]According to the assumptions of the European Commission, the base year is 1990.

Directions of actions

1.1. Development of low-emission energy sector using climate-neutral energy carriers, including hydrogen, through:

- departure from coal combustion in the power and heating industry by 2030;
- diversification of power sources;
- certificate for generation of green hydrogen;
- development of renewable energy sources using wind, solar and geothermal energy, biomass and biogas;
- implementation of low-emission and energy-saving energy generation technologies, including those using hydrogen;
- development of smart, low-emission power grids to which new power from RES can be connected;
- integration of power systems;
- implementation and development of innovative solutions in the field of energy collection and storage;
- construction, expansion and modernization of smart grids and gas storage facilities that enable decarbonised gases such as hydrogen, biomethane, etc. to be gradually transmitted at all types of pressure in the future;
- implementation of modern solutions for power management optimization;
- adjustment of employee qualifications to the needs of the changed labour market, including comprehensive support for employees from industries affected by the decarbonisation process.

1.2. Development of a zero-emission economy through:

- transformation towards a circular economy, including the development of new closed-loop products and climate neutral;
- promotion and support of the entire value chain of the hydrogen economy;
- development of strong regional competences in manufacturing products and performing services from the supply chain of the hydrogen economy;
- construction of regional hydrogen infrastructure for the development of hydrogen economy business applications;
- supporting low-emission economic activities;
- supporting the development of the tourism industry in compliance with low- and zero-emission solutions;
- promotion and implementation of innovative and low-emission technologies in the construction industry and in other sectors, including ceramics and wood industry;
- implementation of economically and ecologically effective solutions to reduce food waste at the stage of production, storage, packaging and transport;
- promotion of and support for the development of investment projects and products with a low environmental and carbon footprint;
- promotion of selective collection of municipal waste, recycling and reuse processes;

- implementation of economically and ecologically effective waste recovery and waste treatment technologies, including waste and/or heat-to-energy conversion;
- promotion of products manufactured from waste materials and by-products;
- implementation of digital air quality monitoring systems;
- shaping pro-innovative and pro-ecological attitudes of entrepreneurs;
- creation of new jobs in the green economy;
- development of a modern SME sector;
- support provided to local government units in the preparation of investment areas for entrepreneurs operating in low- and zero-emission industry;
- using the competences of currently employed staff when creating new jobs in the public and private sectors;
- development of vocational education and courses responding to the needs of the new labour market;
- promotion of lifelong learning;
- shaping ecological awareness of residents and promotion of sustainable consumption.

1.3. Development of the modern bioeconomy sector through:

- increase in the potential of agricultural production in Eastern Wielkopolska, with the use of biomass for bioeconomic purposes;
- supporting sustainable food processing;
- promotion of organic farming and organic food producers, including the promotion of agricultural and food products manufactured in compliance with the principles of ecology and reducing CO2 emission;
- promotion and support for the development of investment projects and products with a low environmental and carbon footprint;
- supporting precision farming (also known as "precision agriculture" or "smart farming"[175];
- development of research and innovation in technology, knowledge transfer and new skills in bioeconomy;
- creating a cluster ecosystem in bioeconomy;
- strengthening inter-cluster cooperative ties – building integrated value and supply chains for various sectors related to the bioeconomy.

1.4. Development of low-emission construction through:

- the use of environmentally and climate neutral building materials;
- replacement of heat sources with pro-ecological and environment-friendly ones, including those using renewable energy sources, especially in residential buildings;
- implementation and promotion of the use of hydrogen technologies in the building industry;

[175]The concept of modern farming that uses digital techniques to monitor and optimize agricultural production processes. Source: Rolnictwo precyzyjne a przyszłość rolnictwa w Europie Prognoza naukowa; EPRS | The European Parliamentary Research Service; December 2016

- the use of modern technologies for heat recovery;
- implementation and promotion of smart building industry;
- promotion and support for the development of investment projects and products with a low environmental and carbon footprint;
- counteracting energy poverty;
- shaping functional and spatial structures aimed at counteracting climate change;
- conducting social campaigns for the importance of spatial planning in mitigating climate change;
- promotion of enterprises operating in the construction sector and using low- and zero-emission technologies.

1.5. Aiming for low-emission transport through:

- development of external and internal rail connections using low- and zero-emission rolling stock, e.g. hydrogen trains;
- development of a system of bicycle trails connected with the local bicycle pathway and development of bicycle and pedestrian trails;
- development of public collective transport based mainly on low- and zero-emission means of transport, including railway and bus rolling stock;
- integration of various modes of transport, including the development of integrated interchange nodes and multimodal terminals;
- development and implementation of modern transport technologies, including hydrogen-based technologies;
- development and use of low- and zero-emission means of transport;
- development of grids supplying environmentally friendly means of transport;
- promotion and support for the development of investment projects and products with a low environmental and carbon footprint;
- implementation of digital air quality monitoring systems;
- shaping pro-ecological transport attitudes among people.

1.6. Shaping entrepreneurial environment for development of innovative green economy through:

- development of the R&D sector;
- development of business environment institutions;
- strengthening the adaptability of entrepreneurs and employees to green economy;
- development of connections between the R&D sector, enterprises and business environment institutions;
- support for measures based on the Quadruple Helix model[176];
- development of digital platforms for entrepreneurs;

[176]Quadruple helix model (Arnkil, Järvensivu, Koski, Piirainen 2010; Carayannis 2014, 2015) - an element of the user-centred innovation system (user-centred model, user-oriented model), based on the society and institutions representing the society, such as non-governmental organizations and innovation end-users, i.e. citizens; it favours the inclusion of society in the innovation system, which leads to the emergence of their new forms and a new way of arranging the network of connections between various stakeholders. Source: citing J. Morawska-Jancelewicz: „Model poczwórnej helisy jako narzędzie wdrażania strategii inteligentnych specjalizacji", p 110; Studia i Prace WNEIZ US No. 46/1 2016; https://wnus.edu.pl/sip/pl/issue/229/article/3238/

- development of cluster initiatives;
- support for companies operating on foreign markets, including the possibility of presenting pro-ecological innovative solutions at international trade fairs and other promotional business events as part of smart specializations: "Bio-based raw materials and food for informed consumers", "Industry of tomorrow", "ICT-based development" and "Specialized logistics processes";
- support for and promotion of foreign cooperation of companies, business environment institutions and research and development institutions in the R&D sector regarding pro-ecological innovative solutions, including specially dedicated financial instruments.

1.7. Green space development through:

- revitalization and restoration of degraded forest areas and wetland ecosystems (in particular peatlands);
- reclamation of some post-mining areas towards reforestation;
- conservation and shaping of biodiversity in environmentally valuable areas;
- shaping and protection of greenery in cities and rural areas;
- recreation of the hydrographic network of the area, restoration of transformed watercourses and proper water conditions;
- increase in water retention;
- providing environmentally valuable areas with forms of nature protection;
- afforestation of land with barren soil;
- roadside and mid-field forestation.

The indicated action lines under goal 1. are in line with the idea of shaping a climate-neutral circular economy and have become an inherent part of the Regional Innovation Strategy for Wielkopolska 2030 and the following areas of the action plan for EU growth called *The European Green Deal:*

1. the "Clean Energy" area related to the lowering of the energy system emissivity (priority action line 1.1., 1.3.),
2. the "Sustainable Industry" area supporting green transformation (1.2., 1.3., 1.6.),
3. the "Field to Fork" area referring to the production of safe and healthy food and the development of organic farming (1.3.),
4. the "Construction and Renovation" area focused on improving the energy performance of buildings (1.4.),
5. the "Elimination of Pollution" area, which is an action plan for the elimination of pollution, including air pollution(1.2., 1.4.);
6. the "Sustainable Mobility" area aimed at reducing emission and transport-related risks (1.5.),
7. the "Biodiversity" area that shows the need to protect and shape ecosystems contributing to the climate regulation (1.7.).

- **Specific goal 2.**

THE SHARE OF ENERGY FROM RENEWABLE ENERGY SOURCES IN TOTAL ENERGY CONSUMPTION INCREASE TO AT LEAST 32.0% IN 2030

Goal description

Decarbonization of the energy sector will create a carbon gap and the need to fill it with new **green energy investment projects**. It is assumed that the system reorientation of the fuel and energy sector in Eastern Wielkopolska will be the fastest in the country and will contribute to the development of a scheme of technical solutions to be adopted in other post-mining areas.

In 2017, 17.5% of gross energy consumption in the EU came from renewable energy sources. In Poland, it was only 10.9%. In Eastern Wielkopolska, further development of **renewable energy sources** is expected based on 4 basic pillars: **wind energy, solar energy, biomass and biogas as well as geothermal energy**.

It is assumed that the maximum intensification of actions and technologies for RES will result in the optimization of the use of wind energy potential, post-mining areas and post-mining water reservoirs for the purpose of photovoltaics development. A significant increase in power coming from wind energy and photovoltaics will allow **Eastern Wielkopolska** to **lead in the field of energy from renewable sources in Poland.**

The recovery of lands degraded by mining facilities and mine heaps will allow energy crops to develop and the **biomass** to be acquired. Additionally, through the development of modern bioeconomy sector, the agriculture and industry will be the source of biomass and biogas. It is assumed that **Eastern Wielkopolska will be a pioneer in the use of biomass and biogas in CHP (Combined Heat and Power, or cogeneration) plants and in heat engineering.** At the same time, when it comes to the development of renewable energy from solid biomass, it is necessary to take a methodical approach to managing resources, including the water-energy-land connection, as it draws attention to the complex, related and limited nature of resources used to achieve competitive goals, especially in the context of water deficit.

The use of alternative fuels and **geothermal energy** as well as the shift from the centralized energy production system to the allocation one will help create an image of the region as an area safe for the natural environment and climate-friendly. It is worth paying attention to the fact that eastern part of the Wielkopolska Region has very favourable conditions for using geothermal water. These areas are located in the Szczecin-Łódź-Miechów synclinorium and are known for the best recognized and the shallowest aquifers in the Lower Jurassic and Lower Cretaceous formations. **Geothermal water in this area is characterized by large resources and high temperatures, even exceeding 90°C.**

Transformation in the commercial power industry will contribute to the formation of new forms of energy communities, i.e. **energy clusters and energy cooperatives** , which will allow **the energy sector to develop locally and regionally.**

At the same time, distributed generation and the integration of dispersed energy resources as part of an **intelligent power grid** will increase the energy security of the region and the country.

The measures taken will result in an increase in the share of energy from renewable energy sources in total energy consumption to at least 32.0% in 2030, in line with the climate target indicated by the European Union, and in achieving climate neutrality in 2040. The development of green energy will contribute to the improvement of air quality and an increase in the attractiveness of the area as a good place to live. Moreover, it may also stimulate employment growth in the region by creating jobs in the sector of new green technologies.

Directions of actions

2.1. **Development of the power industry using wind and solar energy, geothermal water, biomass and biogas**, through:

- introduction of regulations supporting fast investment path;
- introduction of mechanisms of support and preferences for the development and use of renewable energy sources;
- development of education and consultancy in the scope of RES use;
- computerization of the renewable energy sector;
- creation and development of digital databases about areas that can be used for investment projects in the field of renewable energy;
- strengthening the cooperation between state and local government and organizations and institutions dealing with renewable energy;
- strengthening local energy potential in the field of renewable energy sources;
- introduction of the principle of priority of providing transmission services in the national power system for sources using wind and solar energy;
- increasing the role of prosumers in the RES development process;
- the use of certificates of origin confirming that certain amount of electricity covered by the certificate was generated from renewable energy sources;
- the use of substitution fees based on colour certificates, resulting from an obligation to purchase electricity from renewable sources;
- indication of new locations for wind and solar farms;
- development of maps of low geothermal power potential and maps showing areas where hydrogeological and geo-environmental hazards occur on a local scale for the area of Eastern Wielkopolska;
- introduction of geothermal heating project management models in conjunction with existing grids and heat demand;
- enabling the electricity production with the use of geothermal waters in binary systems (especially the use of geothermal resources in the vicinity of Konin, Koło and Turek);
- use of geothermal waters for heating purposes;
- bringing forward a proposal for establishing geological risk insurance funds;
- involvement of farm production capacity in the sustainable production of biomass and biogas;

- implementation of technologies and opening pilot facilities for sustainable biomass production and the use its end products, including biogas and hydrogen;
- reclamation of degraded areas towards energy crops providing biomass;
- promotion of and support for the development of investments and products with low environmental and climate footprint.

2.2. Development of smart grids for the purposes of renewable energy sources through:

- prevention of decapitalisation of grid assets;
- modernization of power grids towards fully automated ones, dynamically responding to the demand for electricity;
- efficient management of distributed generation;
- increased activation of consumers (power management and consumption planning) and the possibility of connecting small energy sources to the grid;
- development of smart distribution grids involving information and telecommunications technologies;
- installation of smart measuring and automation devices, including smart meters;
- implementation of IT systems for grid management.

2.3. Development of energy communities through:

- creating and applying distributed energy support system where it is necessary and justified;
- stimulating the development of production sources;
- construction of local electricity storage facilities at renewable energy sources and development of storage technologies;
- development of a pilot program based on energy self-sufficiency of settlement units based on renewable energy sources;
- development of the activity of energy clusters, including the "Green Energy - Konin" and the "CLEAN ENERGY" energy cluster in Turek;
- promotion of distributed energy and energy clusters.

2.4. Development of the renewable energy industry through:

- indicating preferences as to the location of enterprises from the renewable energy sector producing equipment necessary for the construction of photovoltaic, geothermal, biogas installations and wind farms;
- construction of enterprises and plants producing industrial, battery and hydrogen energy storehouses;
- promotion and support for the development of investment projects and products with a low environmental and carbon footprint;

- intensification of efforts for the creation of a cluster and a research enter for solar + storage and wind + storage systems (photovoltaic and wind power plants cooperating with battery energy storage);
- creation of a cluster and a research centre for microgeneration technology based on fuel cells used in the power industry;
- establishment of the H2Lab Hydrogen Application Centre (Centrum Zastosowania Wodoru);
- strengthening the research sector for the use of hydrogen technologies, including in the power industry and transport;
- formulation of strategy of hydrogen technology development in Eastern Wielkopolska and its implementation in the power industry as well as road, rail and water transport;
- promotion of hydrogen as a future energy carrier with great potential for clean, efficient power in transport applications;
- creation of a cluster of producers of hydrogen to be used as fuel and development of safe technologies for its storage, transport and distribution;
- stimulating the development of new technologies in the renewable energy sector;
- stimulating employment growth by creating jobs in the sector of new green technologies.

The above-mentioned action lines under goal 2. are consistent with the idea of shaping a climate-neutral circular economy. They have become an inherent part of the smart specialization identified in the Wielkopolska Region, i.e. "Industry of Tomorrow", and have a potential to become sub-regional specializations, i.e.: "Renewable Energy Sources" and "Modern Energy Technologies"[177] and are in line with the following areas of the *European Green Deal:*

1. the "Clean Energy" area relating to the development of the energy sector based on renewable energy sources (priority action line 2.1., 2.2., 2.3.),
2. the "Sustainable Industry" area supporting green transformation (2.4.),
3. the "Field to Fork" area referring to the production of safe and healthy food and the development of organic farming (2.1.),
4. the "Sustainable Mobility" area aimed at reducing emission and transport-related risks (2.4.)

- **Specific goal 3.**

ENERGY EFFICIENCY HIGHER BY AT LEAST 32.5% IN 2030

Goal description

Modern and energy-efficient construction plays an extremely important role in the process of increasing energy efficiency, thus limiting human impact on the climate. In 2017 in the EU

[177]The action lines are consistent with the provisions of RIS 2030. Horizontal goal: Sustainable development of the region. Strategic goal C1: Increase in innovative activity in Wielkopolska. Operational goal C1.1: Development of zero-emission economy with particular emphasis on hydrogen. Strategic goal C2: Development of the regional innovation ecosystem.

countries, buildings generated 40.0% of energy consumption[178]. In Poland in 2018, the share of households in total energy consumption was 17.6%, while in the Wielkopolska Region it was 21.5%. The priority is to reduce the building development demand for heat and electricity, and to minimize heat and energy loss. In this area, it will be important to follow the principle of energy efficiency first[179].

In order to increase the energy efficiency of buildings, with particular emphasis on residential buildings, the **sustainable construction** is expected to develop in Eastern Wielkopolska. It is assumed that the development, implementation and application of new technologies, building materials, innovative solutions and products will contribute to the improvement of the energy performance of buildings and the reduction of energy consumption, thus reducing the environmental impact.

The priority is to erect **energy-efficient buildings designed in accordance with the principles of the circular economy.** It is recommended to use environmentally friendly methods of energy production, including combined heat and power (cogeneration), renewable energy sources or hydrogen cells. Actions taken in the field of **thermal modernization of facilities** will contribute to the reduction of demand for energy by **existing building development.** In order to minimize heat losses and energy consumption, the existing residential buildings will have to be comprehensively renovated and the new building development will have to be holistically performed. The energy-saving and rational construction will use materials with high thermal insulation parameters and recycled materials.

It is expected that by 2030, both in Eastern Wielkopolska and the entire region, the permissible levels of fine particle dust and B(a)P in the air will be achieved. In Eastern Wielkopolska, over 90,000 low-efficient solid fuel heat sources will be eliminated in individual farms and 2,800 in communal municipal facilities. On the other hand, nearly 33,000 buildings from Eastern Wielkopolska will go through the thermal modernization processes.

It is assumed that the integration of renovation and modernization actions with the use of modern construction technologies and renewable energy installations will not only help achieve economies of scale, thus significantly increasing the energy efficiency of existing buildings, but will also ensure cost reduction.

It is indicated that in order to manage energy consumption in buildings, the use of **automatic building control systems** will develop and become popular. **The development of passive construction as well as smart and zero energy buildings (ZEB)** , which seem to be the most optimal solution in terms of energy saving, will be **promoted and supported**.

[178] Source: Eurostat, Bilanse energetyczne, wydanie z 2019 r., zużycie energii końcowej w 2017 r., https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu_pl

[179] "Energy efficiency first" means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decisions (Article 2 (18) of the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action).

To improve energy efficiency, **long-term strategies for comprehensive refurbishment and modernization of buildings in energy-poor households are expected to be swiftly implemented, in addition to complementary social measures for people experiencing energy poverty**. According to data of the Institute for Structural Research (2016), the energy poverty rate in families living in individual houses in the Wielkopolska Region was 16.4% and covered over 100,000 energy poor households. Moreover, it is pointed out that achieving higher energy efficiency will provide the foundation for creating just and fair energy transition for people in difficult financial situation and in need of more support. This goal will be achieved primarily through active participation of local government units and their subordinate units in the Priority Program Clean Air of the National Fund for Environmental Protection and Water Management and the STOP Smog program.

It is believed that Eastern Wielkopolska will be a leader in creating **energy microgrids,** which represent a significant potential for improving energy efficiency and security of energy supply, while providing independence and more favourable financial conditions for obtaining energy.

The development of distributed energy, in particular **renewable energy sources, including local resources and the potential of local energy,** will create optimal conditions for implementation of the latest technologies and innovative solutions, and above all it will increase the competitiveness and energy and economic efficiency of the local economy. **Consumers are expected to play a key role** in future electricity structures, e.g. by increasing the alignment of their energy demand profile with the profile of energy generated in distributed sources, mainly renewable sources.

It is assumed that model solutions **using highly efficient cogeneration and distributed renewable energy** will be implemented in public buildings. This will **affect energy performance,** contribute to **rational power use and management and to improvement of local energy security and air quality**.

The key to increasing better energy management is both the innovation growth and the creation of conditions for conducting and developing innovative business activity efficiently. It is assumed that **energy efficient use in industry** will increase through **high-efficiency cogeneration in energy production** and **effective power management system to allow waste energy from technological processes to be re-used.**

The transport sector is planned to be **converted into an energy-efficient and low-emission one**. The energy efficiency in the transport sector will be improved through **planning and coordinating traffic management and transport infrastructure** and **using energy-efficient means of transport**. It is assumed that **the systems for sustainable and efficient use of fuels in transport, including alternative fuels[180],** will be promoted and **the share of public transport** will increase.

[180]Alternative fuels (as defined in Directive 2014/94/EU) means fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. They include: –electricity,– hydrogen,– biofuels1– synthetic and paraffinic fuels,– natural gas CNG or LNG,– liquefied petroleum gas (LPG).

It is also assumed that the share of electric vehicles in the fleet of vehicles used in state administration units and local government units or other entities providing services in the field of passenger transport will increase. The use of rail transport and transformation of bus fleet into clean vehicles (hybrid, electric, fuel cell vehicles) will grow, urban traffic is expected to be efficiently managed and energy-efficient means of transport as well as education of the population will be promoted. Moreover, in order to reduce the consumption of primary energy (fuels) and emission from individual transport vehicles, people will be encouraged to use bicycle and pedestrian infrastructure in urban and suburban centres. In addition, the communication infrastructure is expected to develop and the **transport and energy systems** , such as intelligent charging and refuelling stations (e.g. electric and hydrogen) will be combined, thus supporting regional, interregional and cross-border transport services. These actions will lead to **clean, safe and integrated mobility**.

In order to save energy, improve energy efficiency and reduce emission, actions in the freight transport sector will be optimized, including **efficient management of supply chains to avoid empty vehicle runs, integration of different modes of transport, use of green corridors and development of IT systems in logistics.**

These measures will result in an increase in energy efficiency by at least 32.5% in 2030, which will help achieve climate neutrality in Eastern Wielkopolska in 2040. In addition, the development of modern and sustainable construction industry and transport will contribute to an increase in the attractiveness of the area as a friendly[place to live in.

Directions of actions

3.1. Development of energy-saving construction industry through:

- application of the energy rating system for residential buildings;
- development of long-term strategies for comprehensive energy refurbishment of buildings in households affected by energy poverty;
- diagnosis of the needs for thermal modernization of existing buildings through thermal imaging;
- modernization and thermal efficiency improvement of existing buildings, especially residential, service and public buildings;
- implementation and development of technologies to improve energy efficiency of buildings;
- promotion of rational use of energy in households;
- promotion and development of passive construction industry as well as smart and zero energy buildings;
- supporting prosumer power industry;
- promotion of and support for the development of investment projects and products with a low environmental and carbon footprint;
- introduction of digital energy monitoring systems.

3.2. Development of energy-saving industry through:

- implementation of environmental management systems, such as ISO[181] and EMAS[182];
- implementation and intensification of energy-saving technologies for the production and use of energy;
- introduction and intensification of energy recovery technologies along with the system of using energy from technological processes;
- implementation and intensification of energy-saving technologies in industry;
- energy-related improvement of buildings in enterprises;
- promotion of and support for the development of investment projects and products with a low environmental and carbon footprint;
- shaping pro-environment attitudes among entrepreneurs;
- review of integrated permits for enterprises in terms of the use of the best available techniques and technologies (BAT[183] in connection with the IED directive[184]);
- active participation of enterprises in managing energy demand.

3.3. Development of energy-efficient transport through:

- use and development of energy-efficient means of transport;
- implementation of modern forms of public transport organization;
- implementation and development of smart transport systems;

[181] https://www.iso.org.pl/uslugi-zarzadzania/wdrazanie-systemow/zarzadzanie-jakoscia/iso-9001/
[182] https://emas.gdos.gov.pl/co-to-jest-emas
[183] https://ippc.mos.gov.pl/ippc/?id=33
[184] https://www.ochronaklimatu.com/slownik-rynku-emisji/402-dyrektywa-o-emisjach-przemyslowych-ied

- introduction, application and intensification of smart solutions and information systems in logistics;
- promotion and support for the development of investment projects and products with a low environmental and carbon footprint;
- introduction of digital energy use monitoring systems;
- shaping pro-environment transport attitudes aimed at using alternative means of transport, especially in areas with public urban transport;
- expansion of local personal transport systems, e.g. city bike;
- shaping urban space in a way that makes it attractive to pedestrians.

The described action lines have the potential for becoming sub-regional specializations, i.e.: "Renewable Energy Sources" and "Modern Energy Technologies"[185] , are in line with the idea of shaping a climate-neutral circular economy and have become an inherent part of the following areas of the *European Green Deal:*

1. the "Construction and Renovation" area focused on improving the energy performance of buildings (priority action line 3.1.),
2. the "Clean Energy" area related to an increase in energy efficiency of the energy system (3.2.),
3. the "Sustainable Industry" area supporting the green transformation (3.2.),
4. the "Sustainable Mobility" area aimed at reducing emission and transport-related risks (3.3.).

[185]The action lines are consistent with the provisions of RIS 2030. Horizontal goal. Development of smart regional and sub-regional specialization areas. Horizontal goal: Sustainable development of the region. Strategic goal C1: Increase in innovative activity in Wielkopolska. Operational goal C1.1: Development of zero-emission economy with particular emphasis on hydrogen. Strategic goal C2: Development of the regional innovation ecosystem.

IV. IMPLEMENTATION SYSTEM

In order to achieve the set climate goals in an effective and efficient manner, the basis for the "Strategy ..." implementation system is provided, including the main implementation instruments, strategic goals monitoring processes and evaluation.

In addition, it is mentioned that the effectiveness of the implementation system will be affected by external, national, international or even global conditions (e.g. economic, climatic, systemic conditions deriving from national and EU policies). At the local and supra-local level, full commitment of communal and district local government units, active participation of local communities and proactive attitudes of individual residents and entrepreneurs of Eastern Wielkopolska will be of vital significance to the "Strategy ..." adoption.

1. THE SYSTEM OF POLICIES AND INSTRUMENTS SUPPORTING THE "STRATEGY ..." IMPLEMENTATION

The purpose of the "Strategy ..." is to directly implement the priorities set out by the *European Green Deal* by coal phase-out coal by 2030 (to meet the provisions of the Paris Agreement) and emission limitation from other sectors with a view to achieving climate neutrality by 2040.

Implementation of the investment plan for the *European Green Deal*[186] will depend on a part of the EU budget for the years 2021-2027; this budget will be spent on investment projects related to climate and environment protection under various programs (such as the European Regional Development Fun, , the Cohesion Fund, the Horizon Europe program and the LIFE program, the European Agricultural Fund for Rural Development, , the European Agricultural Guarantee Fund).

At the same time, it should be noted that the key policies and instruments of the *European Green Deal* are still being developed and in the future they may form the basis for the verification of the "Strategy ..." findings. For this reason, it is assumed that monitoring of the implementation of the "Strategy ..." will also include continuous monitoring of the implementation of the *European Green Deal* policies and periodic reviews in terms of their impact on the goal and action lines outlined in the "Strategy ...".

[186]Communication from the Commission to the European Parliament, the European Council, the Council, the Economic and Social Committee and the Committee of the Regions The European Green Deal. European Commission, COM (2019) 640 final, Brussels 11/12/2019.

On the one hand, the "Strategy ..." is a way to achieve climate neutrality in 2040, and on the other hand, it is a condition for obtaining support under the LIFE IP LIFE AFTER COAL program and funds for Eastern Wielkopolska from the Just Transition Fund[187].

The LIFE IP LIFE AFTER COAL program will be implemented at all levels, i.e. regional (districts and communes), interregional (in cooperation with other coal regions in Poland), national (in cooperation with the Ministry of Climate) , and internationally.

The system of policies is a set of interrelated program instruments (documents such as strategies, programs, plans), in a hierarchical arrangement and based on the principles of subsidiarity. The LIFE Program goal and the related goals of the "Strategy ..." should be consistent with the objectives of strategic documents at the national, regional and local level. In accordance with the provisions of *Poland's Development Management System* and the *Wielkopolska Region Development Strategy 2030*, the "Strategy ..." includes goals set forth in higher-level documents, while the goals of "Strategy ..." are included in equivalent or lower-level (local) documents. The action lines and actions indicated in the "Strategy ..." may be elaborated in directional documents in a given sector, including through action plans with specific investment tasks.

The main directions of the region's development are set out in the *Wielkopolska Region Development Strategy 2030*. This document contains a set of undertakings on which the achievement of development goals depends, but it does not exhaust the scope of effective operational management, in particular in relation to specific areas of the region and areas of strategic intervention, including Eastern Wielkopolska. Among the regional documents, the "Strategy for Climate Neutrality in Eastern Wielkopolska 2040" will be considered as a sector/domain document, in which operational objectives and directions of intervention of the *Wielkopolska Region Development Strategy 2030* will be elaborated. Maintaining the coherence of strategic documents will allow actions to be concentrated in such a significant area as Eastern Wielkopolska in order to achieve jointly set goals and the synergy effect.

[187]Regulation of the European Parliament and of the Council establishing the Just Transition Fund. European Commission proposal, COM (2020) 22 final, Brussels, January 14, 2020.

2. MONITORING AND EVALUATION SYSTEM

In order to provide information on how the set specific climate goals of Eastern Wielkopolska are reached to achieve climate neutrality in 2040 in an effective and efficient manner, the basic system for the implementation of the "Strategy ..." is adopted, including the goals monitoring and evaluation. Systematic observation of changes taking place in Eastern Wielkopolska will help quickly respond to changing conditions and effectively spend funds.

- **Monitoring system**

The Management Board of the Wielkopolska Region is responsible for monitoring the "Strategy ..." implementation. The monitoring-related tasks will be performed, based on mutual cooperation, by the representatives of: Regional Development Agency SA in Konin, the Wielkopolska Office of Spatial Planning in Poznań and the relevant organizational units of the Marshal Office of the Wielkopolska Region, including: Department of Environment, Department of Regional Policy, Department of Agriculture and Rural Development, Department of Economy, Department of Infrastructure, Department of Transport.

The purpose of monitoring is to analyse how the "Strategy ..." is implemented, mainly in relation to the values of the adopted indicators (Table 4). Due to the great importance of external conditions for the implementation of the "Strategy ...", the problems and threats to the achievement of specific goals and climate neutrality that result from factors at the national and local level, must be identified and monitored on an ongoing basis. Both systematic monitoring of changes in indicators and learning about the reasons for the occurrence of unfavourable phenomena that make it difficult to achieve the goals will provide the basis for adopting counter-measures adequate to the situation.

The implementation of the "Strategy ..." will be monitored on an ongoing basis, through reporting in a three-year cycle. A set of indicators related to specific goals, information on ventures and projects (infrastructural and non-infrastructural) involving the most important program and financial instruments and conclusions resulting from the current strategic dialogue under the Regional Forum of Eastern Wielkopolska will be used to monitor whether and how the "Strategy ..." goals are achieved. The report on the "Strategy ..." implementation in the form of a report will contain 4 elements:

1) basic conclusions from strategic dialogue, information exchange (social consultations, public debates, teams and working / thematic groups, etc.) under the Regional Forum of Eastern Wielkopolska, in which various stakeholders, including foreign partners, will be involved. The conclusions will concern the identification of phenomena, problems as well as threats and their scale affecting the implementation of the "Strategy ...";
2) analysis of indicators showing the level of achievement of the "Strategy ..." goals in relation to the area of Eastern Wielkopolska;
3) information on ventures and projects that affect the achievement of the "Strategy ..." goals;
4) periodic review of EU policies aimed at achieving climate goals indicated in the *European Green Deal* in terms of updating the goals or action lines adopted in the "Strategy ...".

The report on its implementation will be submitted every 3 years to the Steering Committee for Eastern Wielkopolska; if necessary, the Committee will set forth counter-measures for more efficient and effective achievement of the "Strategy ..." goals, including, for example, the document update. The first report on the "Strategy ..." monitoring will be submitted in 2024 and the first reporting period will cover the years 2021, 2022 and 2023. It is assumed that the next report (for the years 2024, 2025 and 2026) will be compiled in 2027.

In accordance with the provisions of the *Wielkopolska Region Development Strategy 2030*, regional documents must be in line with its goals monitored with the use of strategic indicators. Actions taken under the "Strategy ..." should primarily affect the "share of renewable energy in electricity production" indicator. In addition, the expected results of Eastern Wielkopolska development defined in the "Strategy ..." provide the values of indicators used to assess the level of achievement of specific goals.

A set of indicators to track changes at the action level will be the subject of the "Strategy ..." monitoring and one of the elements of the report on its implementation. Indicators should demonstrate most important results of the performance of individual actions and should be easy to manage. Official statistics and information on completed projects and undertakings assigned to goals specified in the "Strategy ..." will be a source of indicators. The relevant units from the Marshal Office, local government organizational units and companies in the Region will provide information for the purpose of detailed monitoring (involving identification of individual projects). The EU policies will be periodically reviewed based on materials and reports prepared by EU institutions.

The monitoring system will include data, conclusions and recommendations from expert opinions, research and thematic analyses either carried out by an evaluation unit and the Wielkopolska Regional Territorial Observatory Network (i.e. entities operating as part of the Department of Regional Policy of the Marshal Office) or commissioned to external entities. It will also be possible to perform in-depth analyses, carry out studies or compile technical reports that will help clarify a detailed scope of actions to achieve the set climate goals by 2030 and climate neutrality in 2040. These analyses, studies and reports will help adopt optimal solutions at each stage of the "Strategy..." implementation.

Table 4. Indicators for monitoring the level of achieving specific goals of the "Strategy ..."

Strategic goal	Specific goals[188]	Indicator	Unit of measure	Base value 2019*	Change 2030	Change 2040
THE Eastern Wielkopolska A JUST TRANSFORMATION AREA NEUTRAL TO THE CLIMATE IN 2040	Specific goal 1. LOWER LEVEL OF GREENHOUSE GAS EMISSION BY AT LEAST 55.0% IN 2030	1) Total emission of gaseous pollutants from particularly burdensome plants (according to the CSO),	t/year	7,373,084	decrease	decrease
		including:	t/year	4,339	decrease	decrease
		sulphur dioxide	t/year	7,265	decrease	decrease
		nitrogen oxides*	t/year	1,417	decrease	decrease
		carbon monoxide	t/year	7,359,959	decrease	decrease
		carbon dioxide	t/year	0	---	---
		methane	t/year	0	---	---
		nitrous oxide				
		2) Emission of dust pollutants from particularly burdensome plants (according to the CSO)	t/year	834	decrease	decrease
		3) Devastated and reclaimed degraded land (according to the CSO, data for the NUTS2 level)	ha	289	increase	increase
		4) Waste generated during the year subject to recovery (according to the CSO)	thousand t	77.4	increase	increase
		5) Average employment in section B - Mining and quarrying (according to PKD) (according to CSO)	person	3,831	decrease	decrease
		6) Number of jobs created thanks to the financial support provided	pcs	0	increase	increase
		7) Number of subsidized enterprises tanks to the financial support provided	pcs	0	increase	increase
	Specific goal 2. INCREASED IN SHARE OF ENERGY FROM RES IN TOTAL ENERGY CONSUMPTION TO AT LEAST 32.0% IN 2030	8) Number of newly built RES electricity generation units thanks to the financial support provided				
		9) Additional production capacity in the field of renewable energy (including electricity, heat) thanks to the financial support provided	pcs	0	increase	increase
		10) Digital management systems of smart energy systems thanks to the financial support provided	MW	0	increase	increase
			pcs	0	increase	increase
	Specific goal 3. ENERGY EFFICIENCY GREATER BY AT LEAST 32.5% IN 2030	11) Number of flats / buildings with improved energy performance thanks to the financial support provided	pcs	0	increase	increase
		12) Number of purchased units of low- or zero-emission passenger rolling stock in public collective transport thanks to the financial support provided				
		13) Number of newly registered low- or zero-emission passenger cars	pcs	0	increase	increase
			pcs	2,121	increase	increase

***** if more detailed data is available, baseline indicators may be updated

****** compared to 2030

[188] According to the assumptions of the European Commission, the base year is 1990.

- **Evaluation system**

Each strategic document should be comprehensively evaluated by comparing final results with initial goals and intentions. The evaluation should include and be based on analyses, syntheses, generalization and conclusions. Evaluation is a practical process; it takes several forms depending on various stages of the strategy implementation (before - *ex-ante* , during - *mid-term*/*on-going* and after - *ex-post*).

An *on-going* and *ex-post* evaluation are going to be made for the "Strategy ..."; the first one should be carried out in the middle of the period intended for achieving goals and climate neutrality, i.e. for the year 2030. The evaluation will be made by an external entity, while the Department of Regional Policy of the Marshal Office will be responsible for the substantive scope of the evaluation. It is assumed that the *on-going* evaluation carried out in 2030 will relate to the years 2021-2029 and will replace the report on the "Strategy ..." implementation for the period covering the years 2027, 2028 and 2029.

The purpose of evaluation will be to measure the level of achievement of goals at individual stages of the "Strategy ..." implementation and identify factors affecting the success or failure. An *on-going* evaluation makes it possible to correct and improve actions affecting the final effects of implementation.

The evaluation report on the first stage of the "Strategy ..." implementation will be submitted to the Steering Committee for Eastern Wielkopolska. The recommendations developed as part of the evaluation will largely complement the ongoing monitoring and reporting on the "Strategy ..." implementation. If necessary, the Committee will set forth counter-measures for more efficient and effective achievement of the "Strategy ..." goals, e.g. the document update.

The purpose of *ex-post* evaluation will be to summarize the effects of actions undertaken as part of the intervention, draw conclusions and come up with recommendations useful for future actions.

- **Interactive information platform**

In order to ensure efficient monitoring and evaluation, it is assumed that an interactive digital platform will be created, allowing the actions taken to be continuously presented and analysed in terms of final results and the level of achievement of the target indicator values.

V. SOURCES AND TOOLS OF FINANCING

The system of financing the "Strategy ...", due to the wide scope of the planned intervention, will use funds from various sources and diverse support tools. The financial framework were established mainly by identifying potential sources of financing and key instruments to carry out the transformation.

It is assumed that the performance of actions indicated in the document will be paid from public and private funds and program instruments available at the European, national, regional and local levels, including:

- public funds, i.e.:
  - budget of the Wielkopolska Region,
  - budgets of local governments at district and commune level,
  - budgets of local government organizational units, including funds under territorial agreements,
  - national budget and state special funds,
  - Energy Consulting Program called "Nationwide advisory support system for the public and housing sector and enterprises in the field of energy efficiency and renewable energy",
  - the "My Electricity" Program for 2019 - 2025,
  - the "Sunny Roofs" Program,
  - the "Clean Air" Program,
  - the "Stop Smog" Program,
  - other instruments based on public funds, e.g. instruments of Bank Gospodarstwa Krajowego as part of an offer of the Polish Development Fund Group;
- funds from the EU budget, i.e.:
  - Regional Program European Funds for Wielkopolska 2021-2027[189],
  - the Just Transition Fund (as one of the pillars of the Just Transition Mechanism, which is a part of the European Green Deal Investment Plan),
  - the InvestEU Program, including loan facility (2 other pillars under the Just Transition Mechanism),
  - LIFE IP LIFE AFTER COAL Program,

[189]The goals under the "Strategy ..." may be achieved through the use of structural and investment funds from the EU budget, under the cohesion policy adopted in the Wielkopolska Region in the financial perspectives 2007-2013 and 2014-2020, including funds taken from financial engineering instruments in the period 2007-2013, financial instruments and repayable aid in the period 2014-2020 must be re-used in the form of repayable support.

- the Reconstruction Fund (Next Generation EU) with its largest part, i.e. the Recovery and Resilience Facility (RRF), the funds of which will be invested under the National Plan for Reconstruction and Increasing Resilience,
- the REACT-EU package, which is a part of the Next Generation EU recovery fund, the purpose of which is to focus on supporting the resilience of society (labour market, SMEs, low-income families), digital and green economy transformation and sustainable socio-economic recovery,
- national programs supporting specific goals and action lines,
- the Modernization Fund, established along with the reform of the European emission Trading System (EU ETS) to support renewable energy, improve energy efficiency, modernize the grid and energy storage, and support fair transition in coal-dependent regions,
- the European Program for Employment and Social Innovation (EaSI) that supports high-quality and sustainable jobs, combating social exclusion and poverty and improving working conditions,
- Common Agricultural Policy,

- other foreign funds, i.e.:
  - funds from the European Investment Bank (also under the InvestEU Program),
  - Norwegian Financial Mechanism,

- private funds, especially when it comes (i) providing co-financing to projects that received EU funds or (ii) implementing projects in the public-private partnership formula,

- participatory funds, which would include local government units from the subregion and the Local Government of the Wielkopolska Region, aimed at implementing projects that would greatly affect and extend beyond the administrative boundaries of individual communes,

- commercial loans for investment purposes offered by commercial banks, e.g. Bank Ochrony Środowiska, through such instruments as: ECOcredit for photovoltaics, ECOloan "Our water".

The funds for the "Strategy ..." implementation will not constitute a separate financial resource, because different financial sources are dedicated to different goals. Individual program instruments will have specific amounts of funds for the "Strategy ..." implementation.

Table 5. Potential outside sources of financing in relation to the specific goals of the "Strategy ..."	
Detailed goals of the "Strategy ..."	Potential outside sources of financing
Specific goal 1. **LOWER LEVEL OF GREENHOUSE GAS EMISSION BY AT LEAST 55.0% IN 2030**	Just Transition Fund Regional Program: European Funds for Wielkopolska 2021-2027 Continuation of national programs, i.e.: OP EI, OP SG 2021-2027, RDP, OP DP, POWER LIFE Program Funds of the Regional Fund for Environmental Protection and Water Management in Poznań and the National Fund for Environmental Protection and Water Management Labour Fund National Training Fund European Globalization Adjustment Fund EU Program for Employment and Social Innovation Common Agricultural Policy National Reconstruction Plan
Specific goal 2. **SHARE OF ENERGY FROM RES FROM IN TOTAL ENERGY CONSUMPTION INCREASED BY AT LEAST 32.0% IN 2030**	Just Transition Fund Regional Program: European Funds for Wielkopolska 2021-2027 Continuation of the national OP EI LIFE Program National Reconstruction Plan
Specific goal 3. **ENERGY EFFICIENCY HIGHER BY AT LEAST 32.5% IN 2030**	Just Transition Fund Regional Program: European Funds for Wielkopolska 2021-2027 Continuation of national programs, i.e.: OP EI, OP DP Local Government Roads Fund the "Bridges for Regions" Program Railway Fund Program to Supplement the Local and Regional Railway Infrastructure Rail + National Reconstruction Plan

VI. INSTITUTIONAL SYSTEM

Institutional instruments are used to coordinate actions for the "Strategy ..." implementation, but these instruments vary in terms of their formality. The instruments include both administrative units, entities established for the purposes of effective implementation as well as agreements, networks and cooperation platforms, etc. The use of institutional instruments is based on the principle of multi-level management and partnership, because only with the cooperation of many entities involved in the achievement of goals will it be possible to provide a clear a system for the flow of information and conclusions from the performance of actions or implementation of projects. Such involvement should also help public institutions operating independently in various areas to make the right decisions.

In the institutional system of the "Strategy ...", the Local Government of the Wielkopolska Region, as the basic entity creating regional policy, acts as an entity managing the transformation processes towards climate neutrality of Eastern Wielkopolska within the scope of its direct competences, and the Management Board of the Region is responsible for the day-to-day management of the "Strategy ..." implementation. These actions are performed in close cooperation with the key entity, which is Regional Development Agency SA in Konin.

The Steering Committee for Eastern Wielkopolska operates at the Marshal of the Wielkopolska Region and will manage the process of the "Strategy ..." implementation. The Committee will consist of the following representatives:

- Marshal of the Wielkopolska Region – Chairman of the Committee;
- Regional Development Agency SA in Konin;
- ministry responsible for funds and regional policy;
- Governor of the Wielkopolska Region;
- other entities indicated by the Chairman of the Committee.

Other entities may join the Steering Committee, depending on the needs. Its tasks should primarily include:

- coordinating the "Strategy ..." implementation, including taking measures to achieve strategic goals and perform actions financed from various sources;
- coordinating actions taken by entities involved in the "Strategy ..." implementation;
- making recommendations on how to modify the available instruments to perform planned actions;
- ongoing monitoring and reporting the "Strategy ..." implementation;
- recommending evaluations, analyses and reports on the socio-economic situation;
- analysing conclusions developed within the Regional Forum of Eastern Wielkopolska and taking actions on this basis.

Other stakeholders in the "Strategy ..." implementation will participate in a periodic event called the **Regional Forum of Eastern Wielkopolska**, which may take place as part of the Wielkopolska Regional Territorial Forum (WRTF), a part of the institutional system of the *Wielkopolska Region Development Strategy 2030*. On the one hand, the Forum would be an advisory body to the Steering Committee, while on the other hand it provides a platform for strategic dialogue and information exchange which will involve local government authorities at all levels of management, public institutions, including universities and academia, R&D institutions, business environment institutions, entrepreneurs, social organizations, associations and non-governmental organizations, including those working for the climate, as well as residents and local communities of Eastern Wielkopolska and foreign partners. The purpose of the Forum would also be the ongoing monitoring of the needs and potential of Eastern Wielkopolska for achieving climate neutrality.

Both the Steering Committee and the Regional Forum are part of the Wielkopolska Regional Territorial Forum referred to in the *Wielkopolska Region Development Strategy 2030*. The WRTF is a group of entities providing advice to Local Government of the Region. The Forum acts for the development of the Region by monitoring public policies, conducting debates, issuing opinions and recommendations for Local Government. The Forum gives opinions during social consultations, participates in teams and working groups established as part of program and/or implementation works. Cooperation and dialogue within the WRTF allows Local Government of the Region to acquire and update knowledge about the dynamically changing environment.

The "Strategy ..." implementation and the achievement of EU climate goals will require international cooperation. It will be particularly important to establish cooperation with countries that are successfully transforming their coal-based economy as well as with those that in the future may become a market for zero-emission economy chain products and services from Eastern Wielkopolska. Supporting business in the Region, including in particular attracting investments for the development of zero-emission economy or opening new prospective sales markets, requires searching for partners worldwide. In addition, the purpose of international cooperation, including with partner regions of Wielkopolska Region from the European Union, is to exchange information, experience and good practices regarding the performance of actions towards climate neutrality, economic development, regional development, environmental and power industry protection, agriculture and rural development, transport and spatial planning, social, labour market and educational policy[190]. International cooperation will help better identify ever-changing conditions, problems, barriers and threats on the way to climate neutrality of Eastern Wielkopolska. It will also improve and speed up actions taken to achieve this goal.

The institutional system will be additionally supported by entities involved in cooperation with direct beneficiaries of programs financed under the Just Transition Fund or other funds and programs (e.g. Regional Program, Clean Air Program) supporting the process of achieving climate neutrality in Eastern Wielkopolska. These actions will mainly involve expert advice on

[190]The presented scope of cooperation is in line with the priorities of foreign cooperation of the Wielkopolska Region, as set out in the Attachment to Resolution No. XXXVII/739/13 of the Regional Parliament of September 30, 2013 on the adoption of "a document called "Priorities for international cooperation of the Wielkopolska Region".

how to obtain funds from various sources, assistance to non-governmental organizations and educational support that will entail building social awareness and improving skills and competences of coal industry employees.

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