Forum Energii

Analizy i dialog

Clean heat as an engine for the Polish economy

Why heating and construction sectors need a fresh impetus

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Forum Energii is a European, interdisciplinary think tank from Poland. Our team consists of experts in the field of energy, with experience in business, public administration, and science.

Our mission is to initiate dialogue, propose knowledge-based solutions, and inspire action for a just and effective energy transition leading to climate neutrality. We achieve this through analysis, opinions, and dialogue on the decarbonisation of key areas of the economy.

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Introduction

A new approach to heating is needed in Poland. It is currently a neglected area where the necessary changes and modernisation have been postponed for years. As a result, every winter we have the most polluted air in the European Union and the Polish district heating system is on the verge of collapse. The costs and scale of the investments needed are enormous, but further delays will lead to an even higher prices.

The challenges are tremendous, but we should not fear change. First, public (EU funds, revenues from the ETS system and other national sources) and private money have been allocated to the transformation. Secondly, there is no alternative, as much of the district heating plants and individual heating in buildings has reached the end of life, air quality is terrible, and CO_2 emissions remain at very high levels. Thirdly, transforming district and individual heating can contribute to the modernisation of domestic industry so that as much money as possible stays in the country.

This report focuses on the heating and construction sectors from an economic perspective - these are industries that can drive the national economy if the right policies are implemented. In the following chapters, we analyse how much we can gain in the 2050 horizon, which technologies are worth betting on now, and what should be the priority for public policy and financing in the upcoming years.

We are convinced that clean heat – defined as energy-efficient technologies in buildings, district and individual heating – can become a driver of the economy and a Polish export blockbuster. It will translate into a significant increase in added value and job creation.

The transformation of the heating sector and the modernisation of buildings should be treated as a post-pandemic reconstruction strategy for the Polish economy. Appropriate industrial policy is required to take advantage of this opportunity. We hope that our report will contribute to this.

We encourage you to read the report and are open to discussion.

Yours sincerely,
Dr Joanna Maćkowiak-Pandera
President of the Forum Energii

1. Key conclusions and recommendations

- The transformation of the Polish district and individual heating as well as construction towards low- and zero-emission solutions is inevitable for technological, economic and environmental reasons.
- The necessary changes imply significant investments. By 2050, as much as PLN 52.7 billion (on average) may be spent on heating sources, installations, networks and thermal renovation annually. Thanks to investments, we will also massively reduce the growing costs of fuels, CO_2 emission allowances as well as environmental and health protection expenses.
- It is the state's interest to ensure that as much as possible is supplied by Polish companies (maximizing the *local content*). The ability to produce goods and provide services means swift modernisation and a significant boost for the domestic economy and labour market.
- Poland is already one of the leading manufacturers of products used in the broadly defined heating sector, which is reflected by the fourth position of Polish exports in the EU (over 6 per cent share in EU total value in 2020). This result may significantly improve in the upcoming years thanks to a deliberate and consustent industrial policies.
- In the ambitious modernisation scenario, we expect Polish GDP to increase by over 2 per cent annually for 30 years and over 400,000 jobs per year to be created. Growing Polish enterprises will also be able to expand abroad effectively, increasing those benefits even more.
- The current situation of Polish manufacturing supplying heating and construction is diverse. High specialisation and robust financial position characterise particularly the producers of raw materials for thermal renovation. This increases the likelihood that the sector will make most of the opportunities arising from the energy transition. The situation is worse among manufacturers of heat pumps, where insufficient production capacity is currently observed. For Polish companies to benefit from the transformation, it will be necessary to increase efforts to rapidly increase capacity and acquire new competencies to meet the growing demand.
- Public policy should aim to provide secure and predictable conditions for the development of heating and construction companies - in particular, demand should be stabilised. This requires:
    - **Establishing the Clean Heat Strategy** – based on concrete and ambitious targets and prospective technologies.
    - **Correct investment incentives** – producers and consumers must be motivated to invest in clean technologies.
    - **Good regulations** – ones that create favourable conditions for investment.
    - **Effective support** for R&D and export activities.
    - **Climate and environmental awareness** – the state should educate citizens of all ages.
- A major challenge is ensuring a regular and transparent information flow between stakeholders responsible for developing these sectors (incl. central and local governments, business representatives, scientific institutions, and financial markets). A **sector deal for clean heat** can be an effective tool to achieve this goal. This report presents a proposal for such an agreement based on good national and foreign practices.

2. Context and objective

Heating, broadly defined as district heating and individual heating, consumes the most energy in Poland - accounts for over 1/3 of the domestic primary energy consumption. It is a large energy sector with a significant impact on the environment and climate, the country's energy balance, and our energy security.

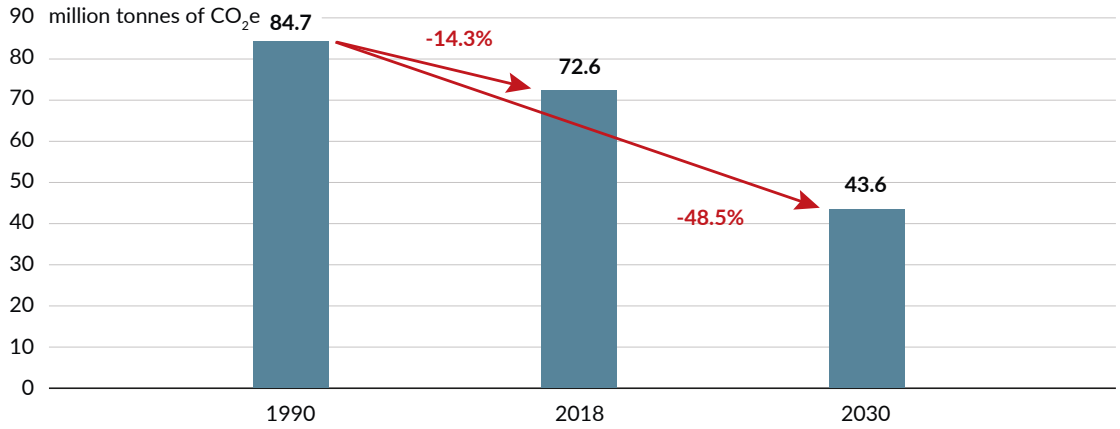
The heating sector, which has an installed capacity of 150 GWt of heating equipment and served millions of buildings in Poland, is also strongly linked to the domestic construction industry, manufacturing of heating and cooling equipment and construction materials. This is why one should view the transformation in the heating sector from a broader perspective – not only of the consumers but of the entire economy.

In upcoming years we will witness significant changes in the heating and construction sectors influenced by:

1. Obsolete infrastructure and the need for its modernisation.
2. Aim to reduce CO_2 emissions and air pollution levels.
3. Development of new low- and zero-carbon renewable technologies and pressure to improve energy efficiency.
4. Efforts to minimise heating costs.
5. The need to reduce Poland's dependence on fuel imports.

Heating and building sectors are highly emission-intensive and constitute Poland's second-largest source of greenhouse gas (GHG) emissions, after the electricity sector. Achieving climate neutrality by 2050 will require a significant or almost full reduction in CO_2 emissions. By 2030, GHG emissions from the heating sector should be reduced by nearly half[1] (Graph 1).

Graph 1. Reduction of GHG emissions from district and individual heating in Poland by 2030 consistent with a climate-neutral pathway



Source: A. Gawlikowska-Fyk, M. Borkowski, *How Poland can reach higher GHG emission reduction targets by 2030*, Forum Energii, 2020, https://forum-energii.eu/en/analizy/analiza-55ghg.

For these reasons, heavy investments will be made in the upcoming years – billions will be spent on heating equipment, construction materials, ICT and a wide range of services (from transport and installation to service and training).

1 J. Maćkowiak-Pandera, S. Buchholtz, T. Adamczewski, *The cost of carbon-free buildings and transport*, Forum Energii, 2021, https://www.forum-energii.eu/en/analizy/catm.

International technology transfer and drawing from the experience of other countries will be the foundation of Poland's energy transition. However, it is necessary to ensure that products and services are designed and manufactured locally, contributing to the development of the business sector and job creation.

The optimal solution is to increase domestic companies' share of production (local content) – provided that the products they offer are innovative and competitive. Even if the modernisation is carried out partially by subsidiaries of foreign entities, the benefit for the domestic economy remains significant, as a substantial part of the added value will accrue to Polish companies and consumers (salaries, reinvested profits and tax revenues[2]). Methods of organisation and management acquired from foreign corporations will be transferred to Polish companies, translating into increased productivity.

We are not starting from scratch in the race for the local content. Polish companies producing high-quality solar panels, photovoltaics or construction materials have already achieved international success. In their case, a good eye for trends and the ability to diversify have become critical success factors. Moreover, Poland has proven to be an attractive location for foreign investments in energy storage or wind turbine parts for, to name a few. Owing to access to skilled personnel, we are attracting highly specialised elements of supply chains (for example, R&D) more often.

We want the success of Polish companies to become the rule, not the exception. It will only be possible if public policy creates a coherent framework for the development of companies and provides them with support at critical moments. Three goals should guide it:

1. **The creation of stable domestic demand** – the certainty of demand from domestic entities will provide incentives for investment, cooperation and, as a result, the development of companies. In this context, it is worth noting that Poland is a large and unsaturated market, the stability of which will allow many entities to develop. Steady domestic demand is also a springboard for the foreign expansion of Polish companies.
2. **Support in increasing the share of production by domestic entities** – thanks to the favourable conditions for expanding the product range and attracting lucrative parts of supply chains of foreign companies to Poland, the scope of tasks to be performed in the country will grow, so the added value and workplaces. It will also enable the transfer of specialised knowledge to domestic entities.
3. **Support in the development of products and services related to clean heat** – stabilising domestic demand will help develop new niches. Advanced services that can be provided globally have particular potential.

For decades to come, climate and environmental policies will be a natural stimulus to develop heating and low-energy buildings. However, without adequate public policy, funds earmarked for the modernisation of the heat and building sectors will leak abroad, putting Polish entities in the position of technology consumers and reducing the positive impact of modernisation on the national economy. Therefore, before the EU budget is launched, the development of the domestic market should be stimulated through a clear strategy, coherent legal framework and business-friendly institutions. Allowing Polish entities to absorb co-financing may become a new engine for the economy.

We devote this report to clean heating as an economic sector. In particular, we answer questions on how much the Polish economy can benefit from such modernisation, which products and services have particular potential in the domestic and international markets, and how public policies should be shaped to facilitate these tasks. We formulate our recommendations in the form of nine challenges.

2 This money will be spent, among other things, on Polish goods and services, triggering subsequent spending.

Purpose of the report

In this report, we attempt to answer how the modernisation of the Polish heating and construction sectors can be combined with efforts to increase the competitiveness of the national economy and create attractive jobs. We aim to present the discussion on clean heat as an important element of Poland's industrial policy.

3. Outline of the methodology

The analysis answers vital questions about the economic benefits of modernising the Polish district and individual heating and low-energy construction. A brief description of the analytical strategies and research tools is presented further (for a full description, see the appendix).

How is the market for the district and individual heating and low-energy construction sectors developing in Poland? What role do domestic manufacturers and service providers play therein?

To answer this question, we perform a statistical analysis of key economic variables describing the functioning of these sectors (e.g., output, exports and imports) and the characteristics of producers and service providers (Chapter 4). By analysing their structure, we learn which areas Polish companies have conquered the domestic and foreign markets. Thanks to the trend analysis, we know how their role has changed over time. On this basis, we can also assess the maturity of markets. This information is necessary to determine the ability of domestic manufacturers and service providers to manage the demand resulting from the proposed modernisation programme. If their capacity is insufficient, it is essential to support the development of the domestic market even before investments are made – otherwise, modernisation will mainly benefit foreign players. We write about how to strengthen these sectors in Chapter 6.

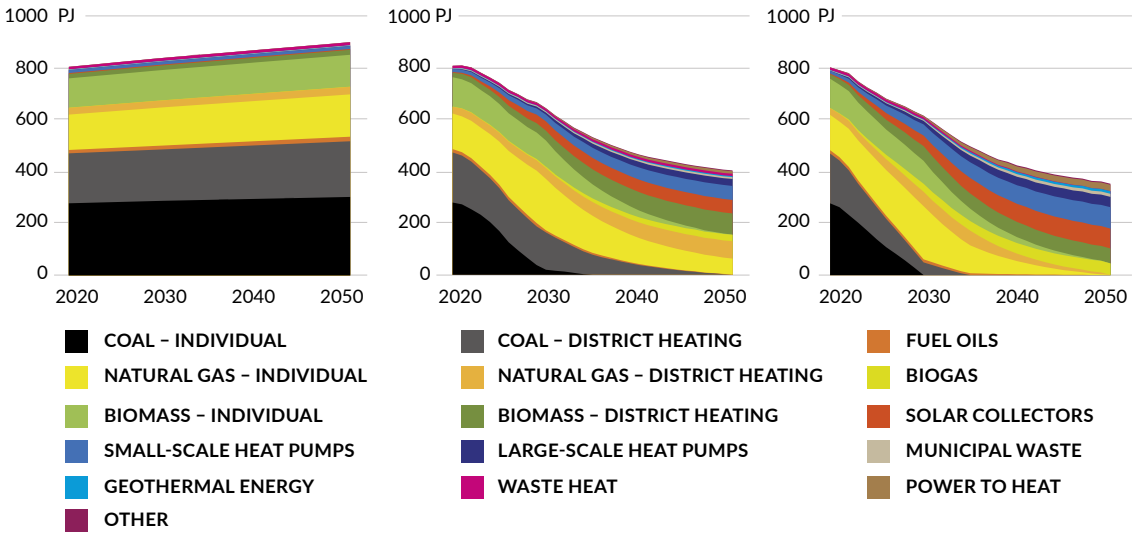
How will Polish district and individual heating and construction operate in 2050?

We do not know exactly, so we use projections – three scenarios of sector development by 2050 created on behalf of Forum Energii by the Polish National Energy Conservation Agency (*Krajowa Agencja Poszanowania Energii S.A.*, KAPE)[3]. The scenarios differ in terms of climate ambition, which manifests in different energy demand and energy mixes (Graph 2):

- **The reference scenario** (*status quo*, *business-as-usual*) assumes that the current mix of heat generation equipment and the current rate of thermal renovation in buildings will continue.
- **The low-emission scenario** assumes a massive programme of thermal renovation and gradual replacement of heat sources. It presupposes phase-out of coal by 2030 in individual heating and in 2040-2050 in district heating. Coal is replaced by RES and natural gas.
- **The zero-emission scenario** presumes a massive programme of thermal renovation, accelerated replacement of heat sources in district heating, and a phase-out of coal by 2035. In individual heating it will be eliminated by 2030, and gas in district and individual heating will cease to be used in 2050.

3 These are updated scenarios prepared for the report *Clean Heat 2030. Strategy for heating* (Forum Energii, 2019). Their update assumes the transition to have a delayed start (2021-2022) and accelerate later, as well as a more ambitious coal phase-out schedule in the zero-emission scenario (elimination of coal from individual heating in 2030 and 2035 for district heating). The faster phase-out of coal is due to greater pressure from climate policy in the last two years and slower than expected progress recorded in Poland.

Graph 2. Projected energy mix in district and individual heating by 2050



Source: Forum Energii, *Clean Heat 2030. Strategy for heating*, 2019, https://forum-energii.eu/en/analizy/czyste-cieplo-2030. Estimates by WiseEuropa Foundation based on KAPE analysis commissioned by Forum Energii.

What investments will be made by 2050?

The assumed scenarios differ in climate ambition, which translates into different scale, structure and timing of the investments carried out. Generally, the more ambitious the scenario, the larger and faster the investment effort. Low- and zero-emission scenarios are associated with higher demand for heat pumps, solar collectors, biogas and biomass CHP plants at the expense of lower demand for natural gas solutions (Graph 4). Therefore, thermal renovation takes place in this case about four times faster than in the reference scenario.

What benefits can we expect from the transformation of the sector by 2050?

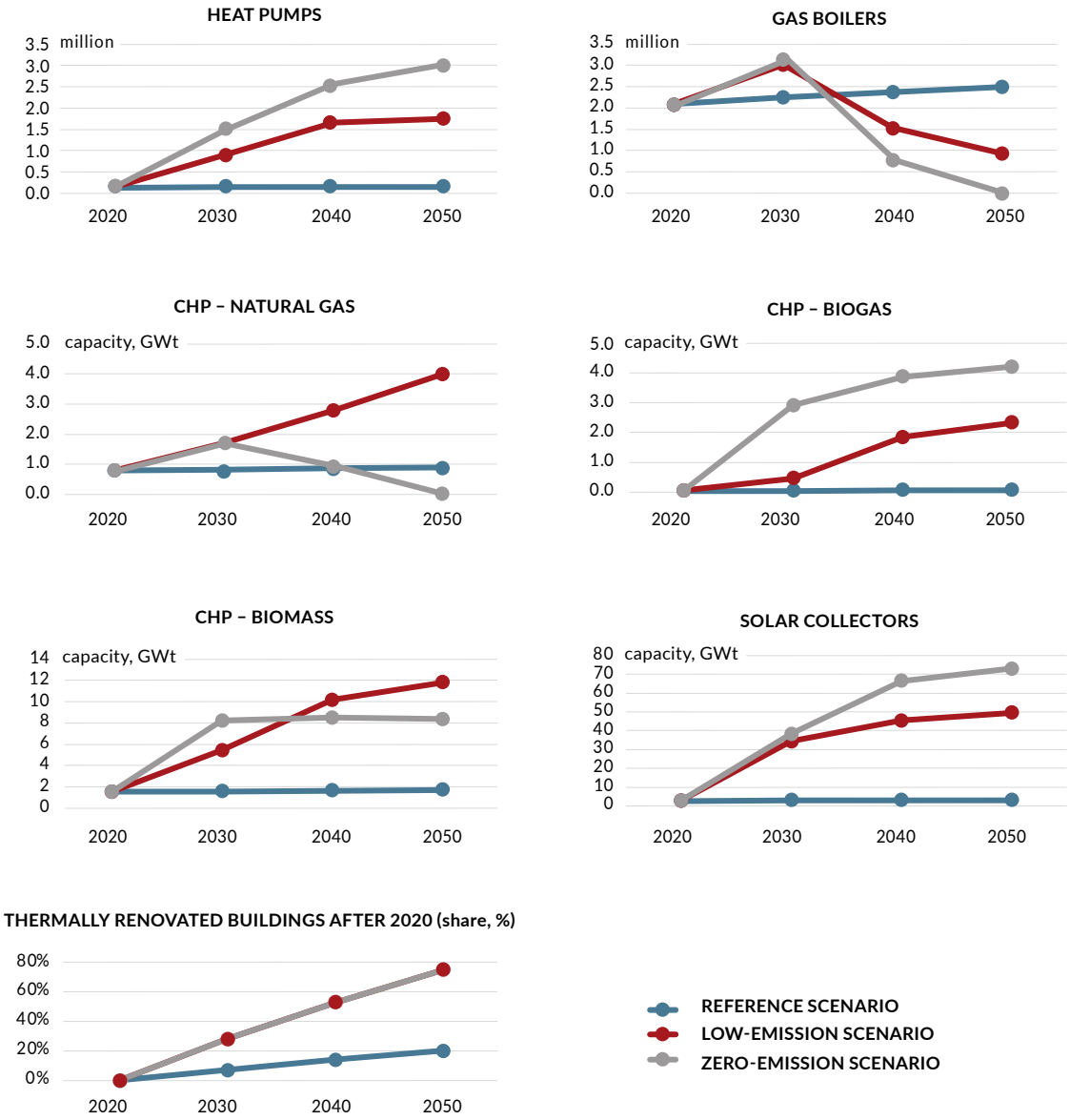
We measure the benefits to the Polish economy from the sector's modernisation through its contribution to GDP and employment. We do so by year, economic sector (agriculture, industry, construction, services) and investment type (heat sources – district heating and individual, district heating networks, thermal renovation). For this purpose, we use macroeconomic modelling. It is a multi-stage analytical method involving the following sequence of events:

1. The level of climate ambition described by the scenarios defines the demand for technologies and fuels.
2. Modernisation creates direct demand for equipment and services (Graph 3). Their production and the provision of services trigger indirect demand – along with the supply chain.[4] We analyse how direct demand translates into supply chains using input-output analysis.
3. Domestic suppliers will meet part of the direct and indirect demand, the rest will be imported. The shares of domestic production for particular types of investments have been assumed at levels similar to other large European economies.
4. The interest in domestic heat and retrofit products and services triggers demand for employees in line with regional specialisations.

Estimates of the economic and labour market benefits of modernisation are presented in Chapter 5.

4 For example, purchasing a window generates demand for the design of a specific product, the manufacture of the glass and other raw materials needed in the industry, the storage and transport of the finished product, and then its installation.

Graph 3. Assumptions on demand for heating appliances and thermal renovation by 2050



Source: Forum Energii, *Clean Heat 2030. Strategy for heating*, 2019, https://forum-energii.eu/en/analizy/czyste-cieplo-2030. Estimates by WiseEuropa Foundation based on KAPE analysis commissioned by Forum Energii.

How do we measure benefits from sector modernisation?

Two benefits measured directly are additional added value and employment. Furthermore, there are benefits in terms of lower costs: fuel, CO_2 emissions and health costs – for the sake of fairness, these are on the cost side.

In this report, we use the category of added value. Gross Domestic Product (GDP) is the sum of the added value produced over a year in a country. In other words, if the scenario involves an increase in added value, this translates into an increase in GDP. Summing up the added value from successive years is possible thanks to measuring GDP in real terms (i.e., unaffected by the inflation).

Modernising the economy increases demand for many new goods and services while reducing it for raw materials and declining products (e.g., coal or coal-fired boilers). We analyse the net effect to capture the balance of this two-way relationship.

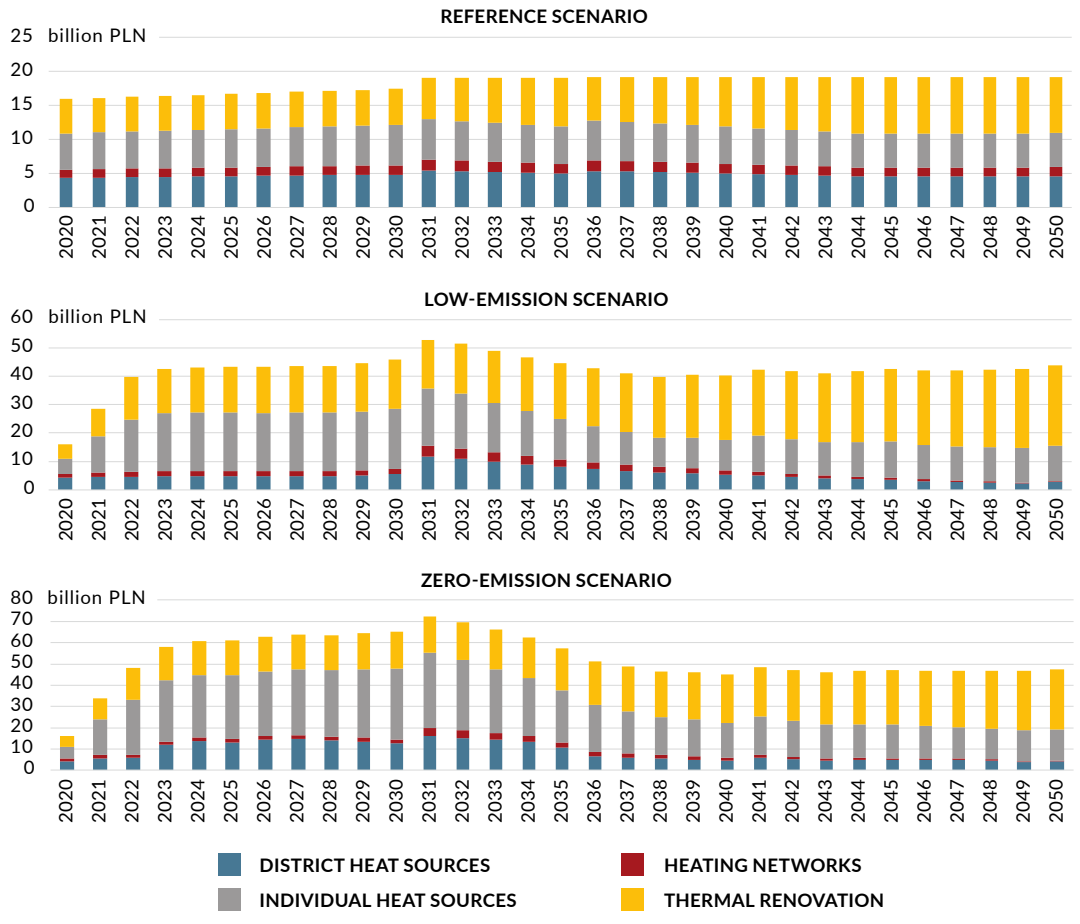
In our analysis, we also refer to employment. Unlike GDP, one should not add up figures from consecutive years. If 200,000 jobs are created annually, it does not mean that 2 million jobs will be created in 10 years. The way to think about it is that each year, employers decide how many jobs they need to create or replace based on productivity and demand for products and services.

How do we measure costs related to sector transition?

Cost accounting includes:

- investment costs in heating sources, networks, and thermal renovation – implementation of the low-emission scenario entails annual investments of PLN 42.1 billion, while the zero-emission scenario – PLN 52.7 billion, as compared to PLN 18.3 billion in the reference scenario (Graph 4),
- fuel costs – falling as renewable solutions replace coal and gas technologies,
- the cost of emission allowances – although a single allowance will become more expensive over the 2050 horizon, the total cost of allowances will fall if retrofitting leads to the phase-out of fossil fuels,
- health costs – by moving away from polluting fuels, it will be possible to significantly reduce the cost of healthcare or untapped human potential.

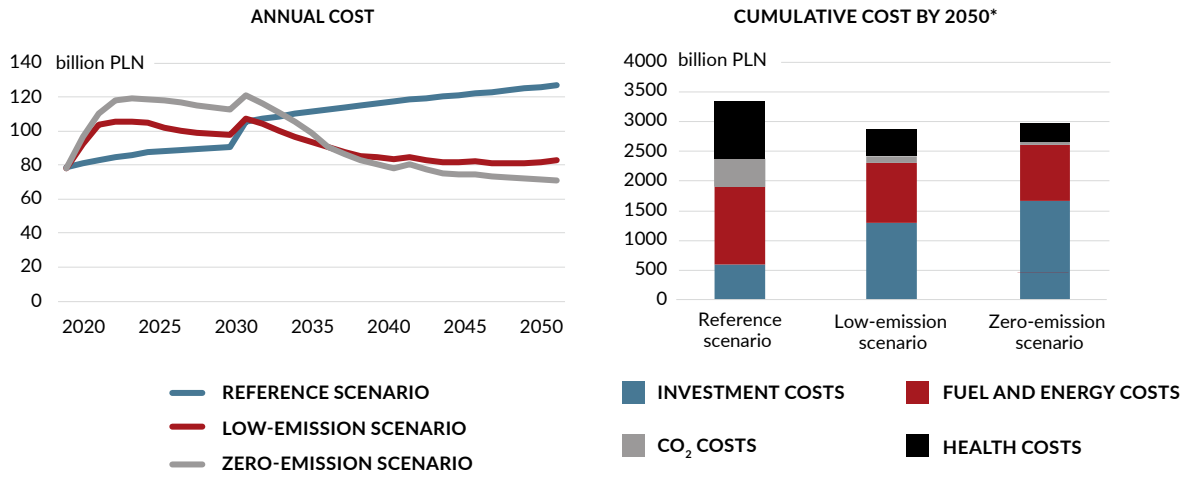
Graph 4. Investments in heating by 2050 by scenarios



Source: Forum Energii, *Clean Heat 2030. Strategy for heating*, 2019, https://forum-energii.eu/en/analizy/czyste-cieplo-2030. Estimates by WiseEuropa Foundation based on KAPE analysis commissioned by Forum Energii.

The scenarios differ in the time profile of costs incurred (Graph 5). In the low- and zero-emission scenarios, initial costs are high (due to investment mobilisation) but start falling clearly in the early 2030s. In contrast, in the reference scenario, costs rise over time. This rising cost profile creates the temptation to defer investment – but there is no doubt that by 2050 investment costs will be recouped in lower fuel and energy expenditure, falling CO_2 allowance costs and better health. Higher than projected growth in allowance prices will increase the advantage of the zero-emission scenario over the low-emission and reference scenarios.

Graph 5. Forecast total costs by scenario



* Assumed gradual increase in CO_2 costs to EUR 100 per tonne in 2050 and inclusion of individual heating in ETS after 2030.

Source: Forum Energii, *Clean Heat 2030. Strategy for heating*, 2019, https://forum-energii.eu/en/analizy/czyste-cieplo-2030. Estimates by WiseEuropa Foundation based on KAPE analysis commissioned by Forum Energii.

How do we identify the challenges facing Polish public policy?

Sector transformation is an endeavour involving different areas of public policy. To identify key areas of intervention, we use qualitative research methods such as group and individual interviews with experts. They aim to identify barriers to sector modernisation. The experts' voices complement the opinions of business representatives of the analysed sectors who assessed the attractiveness of the (public) policies pursued so far.

What experiences are worth transferring to Poland for the transition of the sector to be effective and cost-efficient?

In the areas of climate and environmental policy, industrial policy or social dialogue, Poland should learn from the knowledge and experience of other countries. We have reviewed existing strategies, programmes and tools to show that many solutions are ready to adapt to the national environment. We are reaching for proven solutions from Denmark (heating), Germany (industry) and the United Kingdom (sector deals), among others.

4. Condition of key sectors' producers

4.1. Poland's position in the EU manufacturing of heating appliances

The starting point for analysing the strength and potential of the Polish manufacturing for heating sector is its position among EU producers of selected product groups. Due to the limited data availability, the reference point is Poland's share in the total output of EU manufacturing (about 5 per cent).

Poland's specialisation (at minimum 10 per cent share) is recorded both among large product categories (windows and doors, plastic pipes, polystyrene) and relatively small ones (steam turbines, non-electric heaters). We have a strong position in the production of thermal insulation products and a somewhat weaker position as a manufacturer of heating system components and equipment (Graph 6).

Polish manufacturers are doing well in district heating sources (steam turbines, steam and water boilers), while a slightly higher than average share characterises some types of equipment for individual heating (heat storage or radiators and boilers). Poland's marginal role in heat pump production and its weak position in water heater production must both be noted.

In recent years we have noted an increase in the share of the majority of the analysed product categories (sometimes a solid one – e.g. products for thermal renovation or copper pipes). It shows a favourable demand environment and competitive advantages of domestic manufacturers, which are being utilised more effectively.

4.2. Foreign trade

As data from 2015-2020 shows, exports of the analysed product groups grew significantly faster than imports, resulting in a growing foreign trade surplus (Graph 7). It more than quadrupled during this period (to EUR 2.2 billion). Over 75 per cent of this volume was generated by products for retrofitting (especially windows and doors, which have been one of Polish export blockbusters for many years).

In each of five analysed areas, Poland had a foreign trade surplus in 2020. Statistically, the situation improved the most in district heating installations, where foreign trade deficit had been recorded until recently. However, this was primarily due to a significant improvement in the segment of automation, also used outside of heating. Therefore, one can assume that district heating installations are an area where domestic companies do not satisfy local demand fully. However, the dynamic development of exports in automation creates an opportunity to use the experience and knowledge gained for the heating sector's future needs.

Graph 6. Poland's share in EU production of goods used in the heating and construction

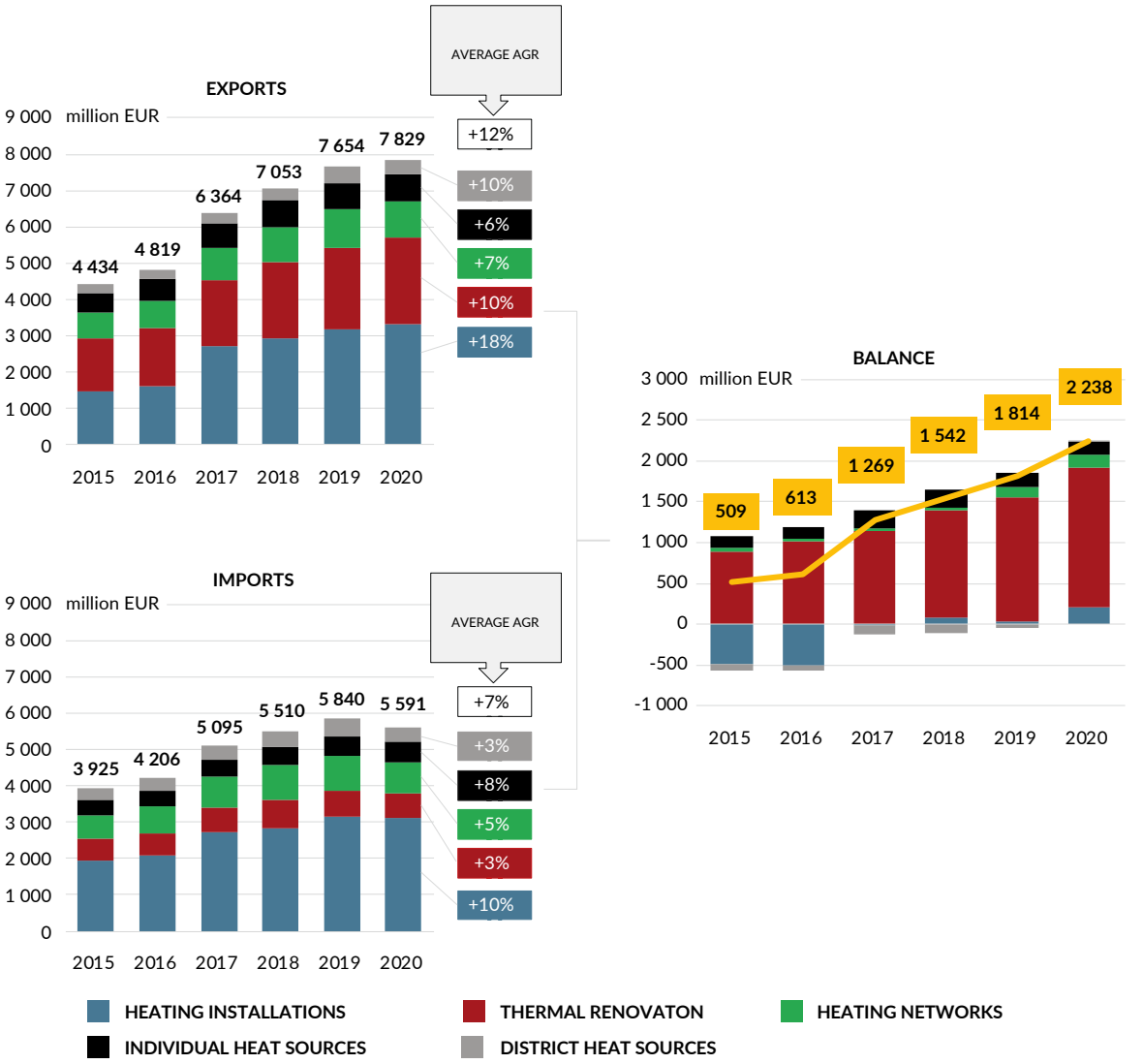
AREA/PRODUCT GROUP		2020	CHANGE VS 2015 (PP)	NOTES
Heating installations	Non-electric radiators	14.2%	2.8	
	Heat exchange units	4.8%	0.4	
	Automation*	4.0%	nd.	Data for an incomplete product group (approx. 93% of EU production in 2020)
	Pumps	1.7%	0.2	Data for 2019, for an incomplete product group (approx. 74% of EU production in 2019)
	Valves**	1.4%	-0.6	Data for an incomplete product group (approx. 82% of EU production in 2020)
	Heat meters	1.3%	0.4	Data for an incomplete product group (approx. 78% of EU production in 2020)
	Parts for taps, cocks, valves	1.1%	-0.3	
	Electric radiators	nd.	nd.	Unreliable data
	Other***	nd.	nd.	Unreliable data
Heating networks	Plastic tubes and pipes	10.1%	0.7	Data for an incomplete product group (approx. 95% of EU production in 2020)
	Copper tubes and pipes	4.7%	2.1	
	Steel tubes and pipes	2.7%	-0.3	Data for 2018, for slightly extended product group (NACE 24.20)
Thermal renovation	Styrofoam	12.3%	1.3	Change vs 2016
	Windows and doors	9.9%	1.6	Data for 2019
	Other	5.4%	3.0	Data for 2019
	Mineral wools	nd.	nd.	Unreliable data
Individual heat sources	Heat storage	7.0%	0.5	Change vs 2016
	Stoves and boilers	6.2%	-0.2	Data for 2019, change vs 2016
	Water heaters	3.5%	0.2	
	Heat pumps	1.2%	0.8	Change vs 2016
District heat sources	Steam turbines	16.0%	7.4	
	Steam and water boilers	7.7%	nd.	Data for an incomplete product group (approx. 69% of EU production in 2020)
	Gas turbines	nd.	nd.	Unreliable data

- SHARE SIGNIFICANTLY ABOVE (>2 PP) MANUFACTURING AVERAGE
- SHARE SLIGHTLY ABOVE (0-2 PP) MANUFACTURING AVERAGE
- SHARE SLIGHTLY BELOW (0-2 PP) MANUFACTURING AVERAGE
- SHARE SIGNIFICANTLY BELOW (>2 PP) MANUFACTURING AVERAGE

* Thermostats, manostats, smart devices, etc.
** Hydraulic and pneumatic, pressure reducing, control and safety, controlling technological processes (gate valves, globe, ball, butterfly, membrane).
*** Flow meters, pressure gauges, etc.

Source: Forum Energii calculations based on Eurostat data.

Graph 7. Foreign trade in production of goods used in the heating and construction, 2015-2020



Source: Forum Energii calculations based on Eurostat data.

Other areas, in which Polish exports expanded dynamically (average annual growth rate of 10 per cent) in recent years, were products related to thermal renovation and district heating sources. In turn, the fastest-growing areas of imports in 2015-2020 were district heating installations and individual heat sources (10 and 8 per cent, respectively).

In nearly half of the product categories exports exceeded imports and at the same time the surplus increased between 2015 and 2020 (Graph 8). Windows and doors recorded the most significant export advantage (exceeding EUR 1.7 billion) and strongest improvement in the trade balance (exceeding EUR 750 million). The trade surplus in automation equipment also rose by around EUR 500 million in this period.

Categories characterized by a large and growing foreign trade surplus include plastic tubes and pipes, non-electric heaters, steam turbines, and mineral wools. At the other end of the spectrum are product groups with an import advantage (mostly increasing) – in particular, heat pumps, steel tubes and pipes, pumps and other parts of heating installations or gas turbines. Polystyrene foam is a special case – despite the very high share in EU production, local demand remains largely unsatisfied (negative foreign trade balance in 2020 of the order of EUR 250 million).

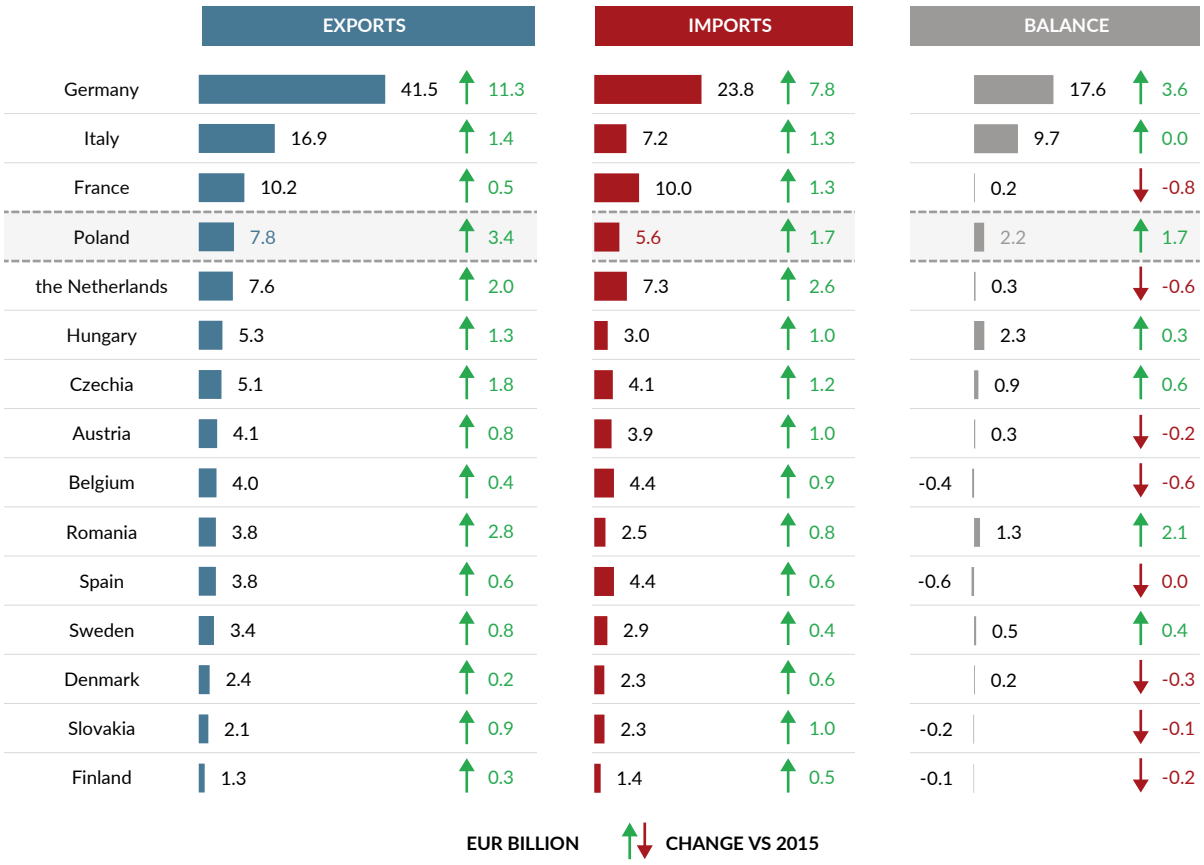
Graph 8. Foreign trade balance of goods used in the heating and construction*

AREA/PRODUCT GROUP		TRADE BALANCE (MILLION EUR), 2020	CHANGE VS 2015 (MILLION EUR)	DESCRIPTION
Heating installations	Automation	168	+472	Increasing surplus
	Non-electric radiators	135	+70	Increasing surplus
	Heat exchange units	101	nd.	Increasing surplus
	Valves	65	+41	Increasing surplus
	Heat meters	-10	+1	Decreasing deficit
	Others	-14	+16	Decreasing deficit
	Electric radiators	-14	-1	Increasing deficit
	Pumps	-100	-17	Increasing deficit
	Parts for taps, cocks and valves	-118	+23	Decreasing deficit
Heating networks	Plastic tubes and pipes	332	+127	Increasing surplus
	Copper tubes and pipes	-41	-1	Increasing deficit
	Steel tubes and pipes	-135	-15	Increasing deficit
Thermal renovaton	Windows and doors	1742	+752	Increasing surplus
	Mineral wools	224	+80	Increasing surplus
	Other	-17	0	Decreasing deficit
	Styrofoam	-247	-15	Increasing deficit
Individual heat sources	Heat storage	155	+61	Increasing surplus
	Stoves and boilers	53	-7	Decreasing surplus
	Water heaters	46	+1	Increasing surplus
	Heat pumps	-98	-51	Increasing deficit
District heat sources	Steam turbines	112	+55	Increasing surplus
	Steam and water boilers	27	+47	Increasing surplus
	Gas turbines	-129	-10	Increasing deficit

* Extended description of individual product categories as for Graph 6.
Source: Forum Energii calculations based on Eurostat data.

A comparison of the value of exports and imports in the broadly understood heating sector (Graph 9) shows that Poland is one of the most active players in this field in the EU market. It ranks fourth in the EU with respect to the total value of exports and fifth in imports; it also achieved the fourth highest trade surplus in this area. Despite the uneven situation, domestic heating products industry is one of the leading ones in Europe, which should not be surprising given the size of the economy and the climate conditions.

Graph 9. Foreign trade of goods used in the heating and construction in the leading EU economies, 2020



Source: Forum Energii calculations based on Eurostat data.

A picture of German dominance emerges from the comparison (Graph 10). German companies supply many products necessary for the successful transformation of the Polish heating sector. Still, they are also major competitors of Polish manufacturers in domestic and foreign markets. Germany is responsible for about 1/3 of EU exports, being the leader in foreign sales in as many as 15 product groups – their dominance is evident in district heating installations, which in turn is quite poorly developed by Polish manufacturers. In all other groups, they rank in the top three.

Poland reaches the EU exporters' podium in 7 of 23 product categories. It is the leader in three groups of products (windows and doors, mineral wools, non-electric heaters). It is also the EU's second-largest exporter of steam turbines and third-largest exporter of plastic and copper tubes and pipes (with a substantial distance to Germany and Italy) and domestic heat storage equipment. Poland's share in EU exports is in double digits in almost all the product categories mentioned. A relatively high percentage (8 per cent and fourth position) is also recorded in water heaters as well as steam and water boilers. It shows a considerable export potential.

Graph 10. Top five exporters of goods used in the heating and construction, 2020

AREA/PRODUCT GROUP		#1	#2	#3	#4	#5	Poland**
Heating installations	Automation	43%	8%	7%	7%	5%	#6 4%
	Valves	35%	22%	7%	6%	5%	#6 4%
	Pumps	28%	15%	13%	12%	6%	#9 2%
	Heat exchange units	27%	20%	8%	8%	5%	#7 4%
	Parts for taps, cocks, valves	34%	18%	9%	5%	4%	#10 3%
	Heat meters	48%	10%	7%	7%	4%	#8 3%
	Electric radiators	34%	16%	7%	5%	5%	#13 3%
	Non-electric radiators	18%	17%	14%	12%	10%	#1 18%
	Other	53%	11%	9%	5%	3%	#5 3%
Heating networks	Plastic pipes and tubes	32%	13%	10%	6%	6%	#3 10%
	Steel pipes and tubes	32%	19%	7%	5%	5%	#8 4%
	Copper pipes and tubes	34%	30%	7%	5%	4%	#3 7%
Thermal renovaton	Windows and doors	26%	20%	8%	6%	5%	#1 26%
	Styrofoam	20%	17%	13%	12%	8%	#6 6%
	Mineral wools	24%	17%	14%	8%	7%	#1 24%
	Heat storage	43%	15%	7%	6%	6%	#6 4%
Individual heat sources	Stoves and boilers	20%	19%	13%	12%	8%	#7 5%
	Heat pumps	21%	19%	19%	9%	6%	#11 2%
	Water heaters	22%	16%	9%	8%	7%	#4 8%
	Heat storage	20%	16%	13%	6%	6%	#3 13%
District heat sources	Gas turbines	26%	22%	14%	11%	9%	#7 2%
	Steam and water boilers	18%	17%	14%	8%	7%	#4 8%
	Steam turbines	25%	20%	12%	11%	8%	#2 20%
Σ	Total goods used in heating and buildings	33%	13%	8%	6%	6%	#4 6%

* Extended description of individual product categories as for Graph 6.
** The black circles indicate Poland's position in EU exports.

Source: Forum Energii calculations based on Eurostat data.

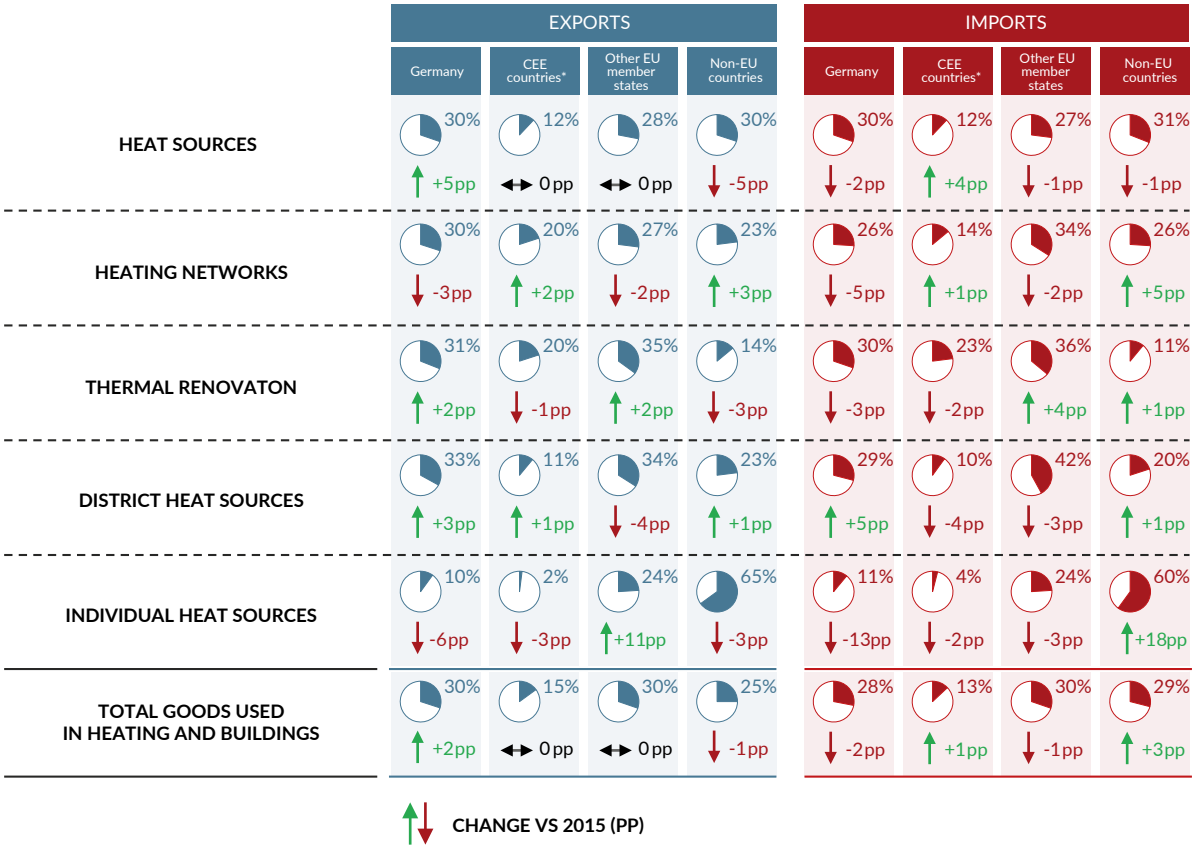
Poland's exports of heat sources – e.g., heat meters, electric heaters, spare parts and other elements of measuring equipment – remains relatively low. One should also emphasise the marginal role played by Poland in the EU export of heat pumps (less than 2 per cent and a place only in the second ten of the list). Poland also occupies a distant position in exports of steel tubes and pipes or gas turbines.

The second most important exporter of products used in the broader heating sector is Italy (13 per cent share in 2020). They can be seen as an alternative to German suppliers in most areas. In several product categories, countries of our region also hold a relatively strong position: Czech Republic (e.g., automation, valves, non-electric heaters, plastic tubes and pipes, steam turbines), Hungary (e.g., automation, heat exchangers, gas turbines), Romania (automation) and Slovakia (radiators and boilers).

The geographical structure of Polish exports and imports of products used in the broadly defined heating sector is quite diverse, stable and similar in both cases (Graph 11). Germany has the largest share in the trade of these products – in the last five years its share in exports has slightly increased and to a similar extent decreased in imports (mainly to non-EU countries).

As an export market, Germany plays a crucial role in all areas, except for individual heat sources. In the structure of imports, this country looms large particularly in district heating and thermal renovation. EU member states from our region play a relatively minor role in Polish exports and imports (especially in thermal renovation materials).

Graph 11. Geographical structure of Polish exports and imports of goods used in the heating and construction, 2020



* Central and Eastern Europe (CEE): Czech Republic, Hungary, Slovakia, Romania, Bulgaria, Croatia, Slovenia, Lithuania, Latvia, Estonia.

Source: Forum Energii calculations based on Eurostat data.

The share of other EU member states is proportional to the overall foreign trade volumes (30 per cent). The most important ones are the Benelux countries, Italy and France. Trade is primarily in thermal renovation materials and district heating sources, although materials used in heating networks also account for a significant proportion of imports.

Non-EU countries account for approximately a quarter of Polish exports from the analysed goods group. The importance of these markets is very high in the exports of individual heat sources (as much as 65 per cent in 2020). USA, Russia and United Kingdom are important and developing export markets (5, 4 and 3 per cent, respectively). In imports, third countries account for 29 per cent of the total, with a clear upward trend observed in recent years. The Asian direction prevails – especially deliveries from China, which in 2020 accounted for approx. 12 per cent of Polish imports of products used in the heating sector (the second most important source of imports after Germany). The share of these countries in imports is exceptionally high for individual heat sources (as much as 60 per cent share and 18 pp of growth in 2015-2020).

4.3. Financial situation of manufacturers and contractors for construction

The ability to meet increased demand from the heating sector is highly dependent on the financial standing of producers. Their financial performance shows significant variation. The structurally strong industries, with simultaneously robust revenue growth, above-average profitability, a healthy debt and liquidity situation and high investment activity, include above all:

- manufacturers of plastic plates, sheets and tubes,
- manufacturers of (wooden, metal and plastic) joinery.

This positive picture is correlated with strong international position of domestic companies from this sector. Producers of heating radiators and boilers also have a relatively good financial situation (Table 1).

By contrast, there are sectors with a large share of companies experiencing considerable difficulties – especially sustained low profitability, poor revenue growth rate, and limited liquidity. This may translate, among other things, into their low investment activity. This group includes in particular:

- industries producing basic metal products (steel and copper tubes and pipes),
- manufacturers of pumps and compressors,
- manufacturers of steam generators,
- manufacturers of plugs and valves.

The analysed sectors are mostly export-oriented and thus are familiar with the rules of functioning in foreign markets. A particularly high share of exports in revenues (over half) applies to producers of heating systems equipment and components, a slightly smaller percentage – producers of copper products and plastic products for the construction industry, which include, for example, manufacturers of the plastic door and window joinery.

The analysis of financial data of selected NACE from the construction sector (Table 2) shows that their financial condition is generally good. Activities directly related to construction are characterised by very high profitability (low percentage of companies reporting a loss) and an outstanding debt and liquidity situation (overall debt and quick liquidity ratios are usually significantly better than the average for the entire construction sector).

Table 1. Financial standing of selected NACE classes covering manufacturers of goods used in the heating *

	Indicator	2813 Pumps and compressors	2814 Taps and valves	2521 Radiators and boilers	2530 Steam generators	2221 Plastic plates, sheets, tubes and profiles
Development	Average annual revenue growth 2015–2019	6.7%	0.2%	3.3%	-1.9%	5.3%
	Revenue growth 2020 vs 2019	-37.5%	-1.1%	13.7%	4.1%	13.0%
Profit margin	Net profit rate** A - 2015-2019 average B – 2020	A: 4.1% B: 3.5%	A: 2.1% B: 4.1%	A: 9.3% B: 8.8%	A: 0.2% B: -8,2%	A: 5.9% B: 8.6%
	Return on equity*** A - 2015-2019 average B – 2020	A: 6.6% B: 5.1%	A: 3.2% B: 8.2%	A: 26.3% B: 22.7%	A: 0.2% B: -25.4%	A: 13.0% B: 16.4%
	Share of companies reporting a gross loss**** A - 2015-2019 average B – 2020	A: 15% B: 14%	A: 28% B: 26%	A: 21% B: 21%	A: 22% B: 25%	A: 13% B: 16%
Debt and liquidity	Gross debt ratio***** end of 2020	40%	44%	46%	65%	38%
	Quick liquidity ratio****** end of 2020	0.90	0.95	1.27	1.11	1.41
Investment activity	Investment rate******* 2018-2020 average	0.68	1.00	1.58	1.03	1.45
Foreign market presence	Export share in revenues 2018-2020 average	73%	52%	59%	62%	35%
	Share of exporters 2018-2020 average	79%	87%	77%	64%	81%

	Indicator	2420 Tubes and pipes of steel	2444 Copper production	1623 Builders' carpentry and joinery	2223 Builders' ware of plastic	2512 Doors and windows of metal
Development	Average annual revenue growth 2015–2019	4.7%	-2.4%	6.7%	8.0%	10.1%
	Revenue growth 2020 vs 2019	3.6%	-13.0%	0.9%	-0.8%	12.6%
Profit margin	Net profit** A - 2015-2019 average B – 2020	1.3% (A) 2.0% (B)	2.2% (A) -1,3% (B)	5.3% (A) 8.1% (B)	5.3% (A) 8.5% (B)	9.0% (A) 12.1% (B)
	Return on equity*** A - 2015-2019 average B – 2020	3.2% (A) 4.6% (B)	5.8% (A) -2.9% (B)	11.5% (A) 14.0% (B)	13.1% (A) 22.5% (B)	20.0% (A) 27.0% (B)
	Share of companies reporting a gross loss**** A - 2015-2019 average B – 2020	31% (A) 42% (B)	29% (A) 40% (B)	20% (A) 14% (B)	17% (A) 12% (B)	17% (A) 10% (B)
Debt and liquidity	Gross debt ratio***** end of 2020	45%	45%	37%	45%	40%
	Quick liquidity ratio****** end of 2020	0.78	0.80	1.18	1.14	1.09
Investment activity	Investment rate******* 2018-2020 average	0.68	0.48	1.70	1.52	2.18
Foreign market presence	Export share in revenues 2018-2020 average	37%	48%	37%	46%	39%
	Share of exporters 2018-2020 average	87%	100%	70%	78%	69%

INDICATOR MORE FAVOURABLE THAN MANUFACTURING AVERAGE
INDICATOR LESS FAVOURABLE THAN MANUFACTURING AVERAGE

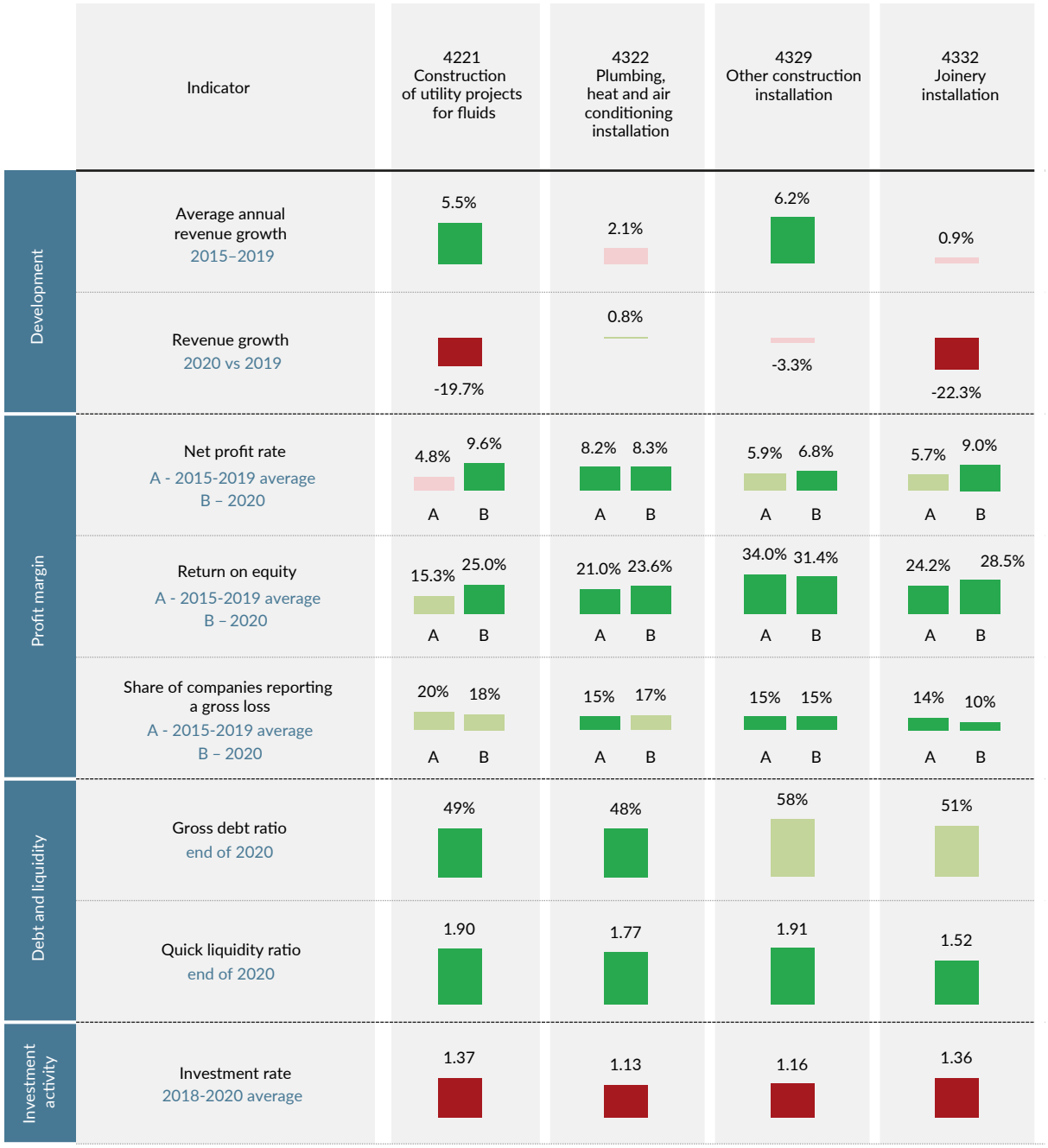
* Data for companies with 10 or more employees and completing F-01 reports.
** Net profit – revenues ratio.
*** Net profit – equity ratio.
**** Companies reporting a gross loss – total number of companies ratio
***** Liabilities and provisions – total assets ratio.
****** Current receivables and investments – current liabilities ratio.
******* Investment – depreciation ratio.

Source: Forum Energii calculations based on data prepared by Pont Info.

Compared to the average for the construction industry, the investment activity of the analysed segments is relatively low. It is partly related to the specific nature of their actions (low capital intensity and low investment requirements of the specialised construction sector compared to other construction categories). However, some of the discussed segments of the industry experienced a substantial decline in revenues in 2020.[5]

5 It should be emphasised that the presented data give only a partial market view of the mentioned activities. As a rule, considerable fragmentation is observed (domination of micro-companies), and the available financial data refer only to entities employing at least 10 employees and completing F-01 reports.

Table 2. Financial standing of selected NACE classes covering manufacturers of goods used in the construction *

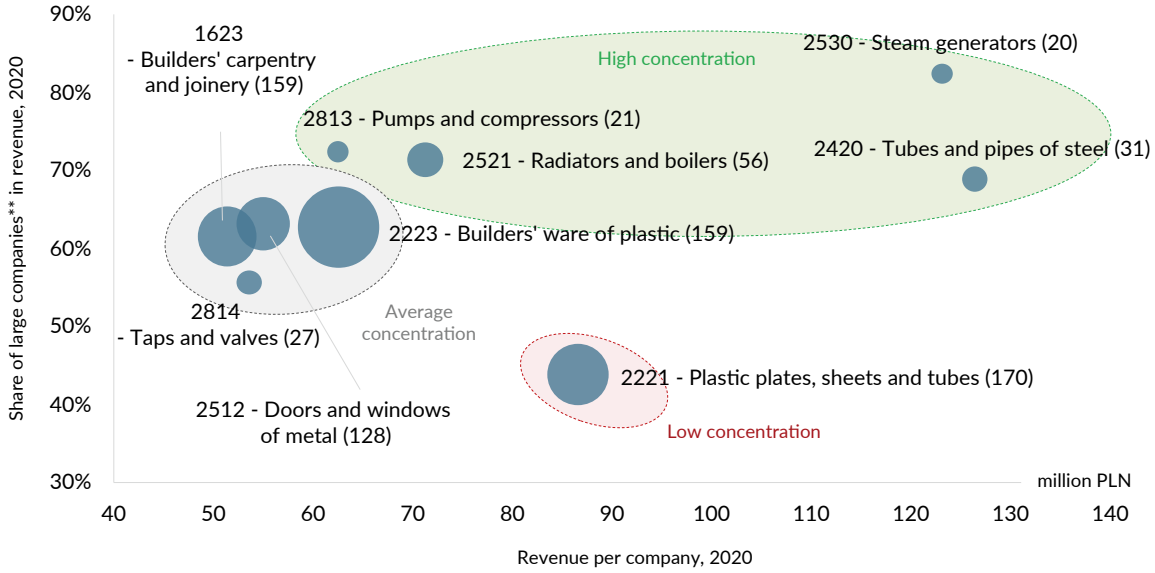


* Data for companies with 10 or more employees and completing F-01 reports. Detailed description of indicators as for Table 1.
Source: Forum Energii calculations based on data prepared by Pont Info.

4.4. Competitiveness

Larger companies are much better prepared to meet the growing expectations of the domestic market and expand into foreign markets. The differences between the sectors are quite distinct. The share of large companies in total revenue (excluding micro-firms) ranges from 44 per cent (in the case of the most fragmented sector of plastic plates, sheets and pipes production) to even over 80 per cent (in the case of steam generator production). Three other categories – pumps and compressors, heaters and boilers, as well as steel tubes and pipes – also reach 70 per cent (Graph 12). In other cases, the share of large companies is closer to 60 per cent. High concentration level also characterises the copper processing sector – it is not included due to statistical confidentiality.

Graph 12. Competitive situation in selected NACE classes covering manufacturers of goods used in the heating and construction, 2020.



* Data for companies with 10 or more employees and completing F-01 reports. Country size and numbers in parentheses reflect the total number of entities in 2020.
** With 250 or more employees.
*** The chart does not include the NACE 2444 – copper processing (no data on revenues of large companies due to statistical confidentiality). A high level of concentration characterises this sector.

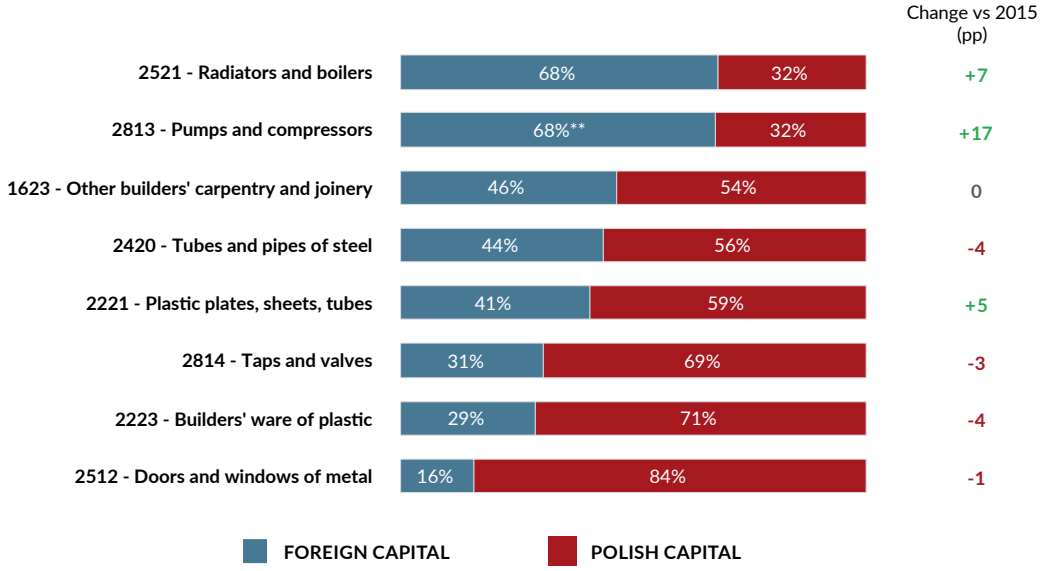
Source: Forum Energii calculations based on data prepared by Pont Info.

In manufacturing, the share of large companies in the sector's total revenues amounts to about 73 per cent. Therefore, most of the analysed sectors are characterised by at best an average level of concentration and consequently still have a high potential for consolidation. Accordingly, with few exceptions, the revenues generated by a single entity are also relatively low on average. In the entire manufacturing sector (small, medium and large companies completing F-01 reports) the average slightly exceeds PLN 100 million. This criterion is met only by two of the analysed sectors (the production of steel tubes and pipes and steam generators), while for the rest, the revenue per single entity is in the range of PLN 50-70 million. Strong fragmentation of the analysed types of activity is undoubtedly barrier to development, especially to any acceleration of foreign expansion.

The presence of foreign capital varies between sectors (Graph 13). In the analysed industries, the share of companies controlled by foreign capital is between 16 and 68 per cent. As a rule, the percentage of local content in the discussed part of the Polish industry is relatively high.

For comparison: in the entire manufacturing companies with domestic capital account for around half of the total revenue of small, medium-sized and large entities. Where companies are small, there is also little foreign capital. This may indicate the relatively low attractiveness of these industries from the point of view of foreign investors (limited competitive advantage) and, on the other hand – the scale of success of family businesses in selected sectors (e.g., woodwork). It is also the precise reason that the energy transformation in the Polish heating sector is a significant development opportunity for many entities with dominant domestic capital.

Graph 13. Competitive situation in selected NACE classes covering manufacturers of goods used in the heating and construction, 2020 vs 2015*



* Data for companies with 10 or more employees and completing F-01 reports.
** Data for 2019.
Source: Forum Energii calculations based on data prepared by Pont Info.

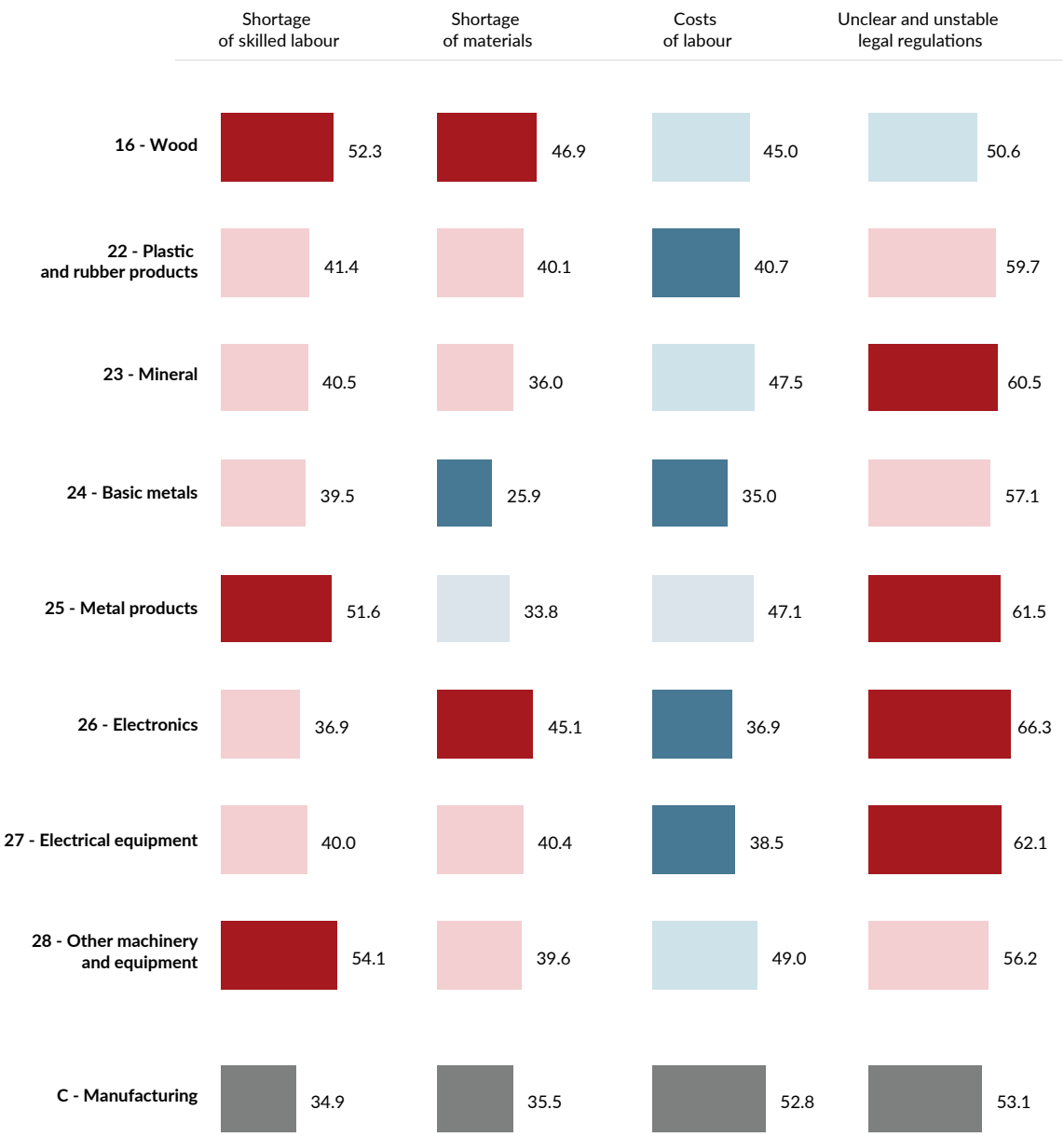
4.5. Key business barriers

There are many challenges for sectors that produce heating equipment. These are structural (e.g., unfavourable demographic trends and associated wage pressures, high energy intensity with rising energy costs) and short-term (e.g., pandemic woes). The industry also faces a shortage of skilled workers to an above-average degree (Graph 14). This seemingly contrasts with the low share of companies indicating employment costs as a barrier. Still, these are fairly heavily automated sectors, and a much bigger challenge is the workforce's skills. Machinery and equipment manufacturers, metal processors and wood product manufacturers point to this problem.

In pandemic conditions, these sectors also face a shortage of raw materials. This is due to disruptions in global supply chains and general supply inefficiencies in economies during periods of marked economic recovery. The problem has reached unprecedented levels in many sectors, such as wood, electronics, electrical appliances, plastic products or machinery. Another barrier is the uncertainty of the economic situation (with wood manufacturing as an exception), partly due to these sectors' high sensitivity to pandemic difficulties.

Assuming a gradual recovery from the crisis caused by the COVID-19 pandemic, the last two barriers can be expected to be short-lived. However, the duration of the current disruption is still uncertain.

Graph 14. Factors limiting activity in selected manufacturing NACE classes – share of companies declaring barriers, 2020

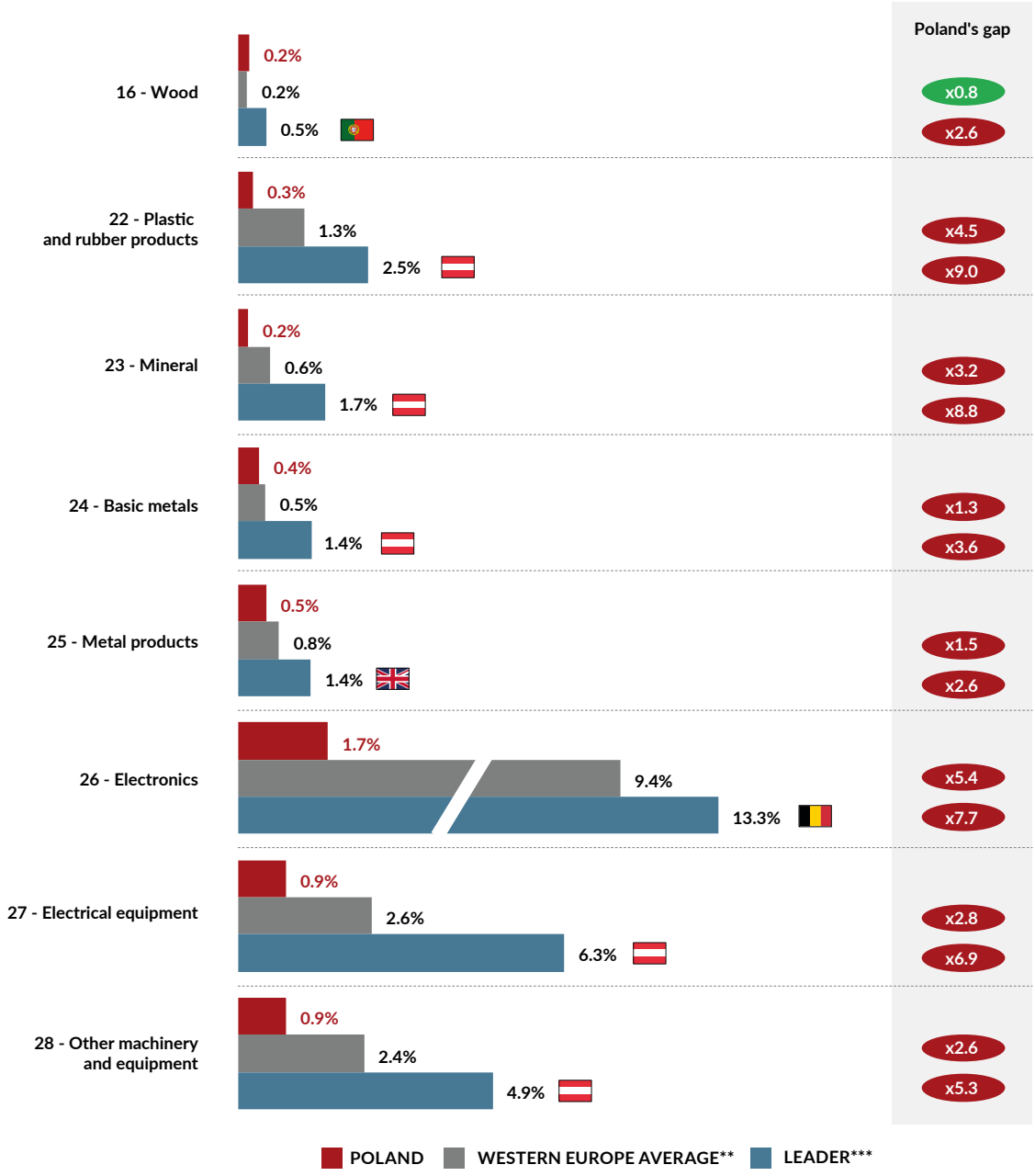


Source: Forum Energii elaboration based on Statistics Poland data.

In the context of the sector's ability to respond to the demand associated with the planned transformation of the heating sector, their innovativeness must also be taken into account. Indeed, the transformation of the domestic industry will be based on modern and low-emission technologies contrasting with many traditional solutions. Taking advantage of the opportunities will require an attractive range of products and an appropriate level of technology. In this context, the relatively low activity in R&D remains a considerable challenge for the domestic industry.

In practically all NACE sections analysed, R&D outlays expressed as the share of production or revenue diverge significantly from Western European competitors. Here, those leaders show several times higher levels of expenditure (Graph 15). This is partly due to the high fragmentation of Polish companies. If the energy transition is to be implemented with the active participation of domestic suppliers, this sphere will require major changes.

Graph 15. R&D expenditures to production ratio by NACE sections, 2020 – Poland compared to the Western Europe*

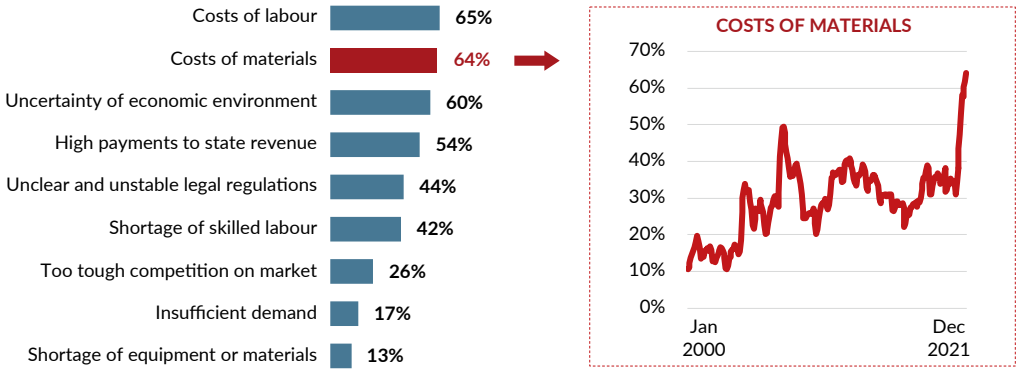


* The latest available comparable data is from 2017 and 2018.
** Belgium, Denmark, Germany, Spain, France, Italy, Austria, Portugal, Finland, Sweden, United Kingdom.
*** Country in the analysed group with the highest ratio of R&D expenditures to production.
Source: Forum Energii calculations based on Eurostat data.

The domestic construction sector is also experiencing specific problems, struggling with a structural shortage of labour, especially skilled labour (the employment gap is estimated at 150,000 people). In the November 2021 business tendency survey, this barrier was declared by approx. 42 per cent of companies (Graph 16), which was the highest result among all major sectors of the Polish economy. Consequently, there is wage pressure in the sector – high employment costs were singled out by about 65 per cent of the surveyed companies.

From the perspective of modernizing the heating sector, current problems in the construction sector could give rise to significant supply-side challenges – especially as we are currently experiencing unprecedented cost pressures from rapidly rising prices of construction materials. The share of companies identifying the cost of raw materials and their availability as a barrier to doing business was around 64 per cent in November 2021, the survey's record high. The current problems of the sector cannot be underestimated in the context of the investment potential of the economy in the coming years.

Graph 16. Factors limiting activity identified by construction companies (November 2021)



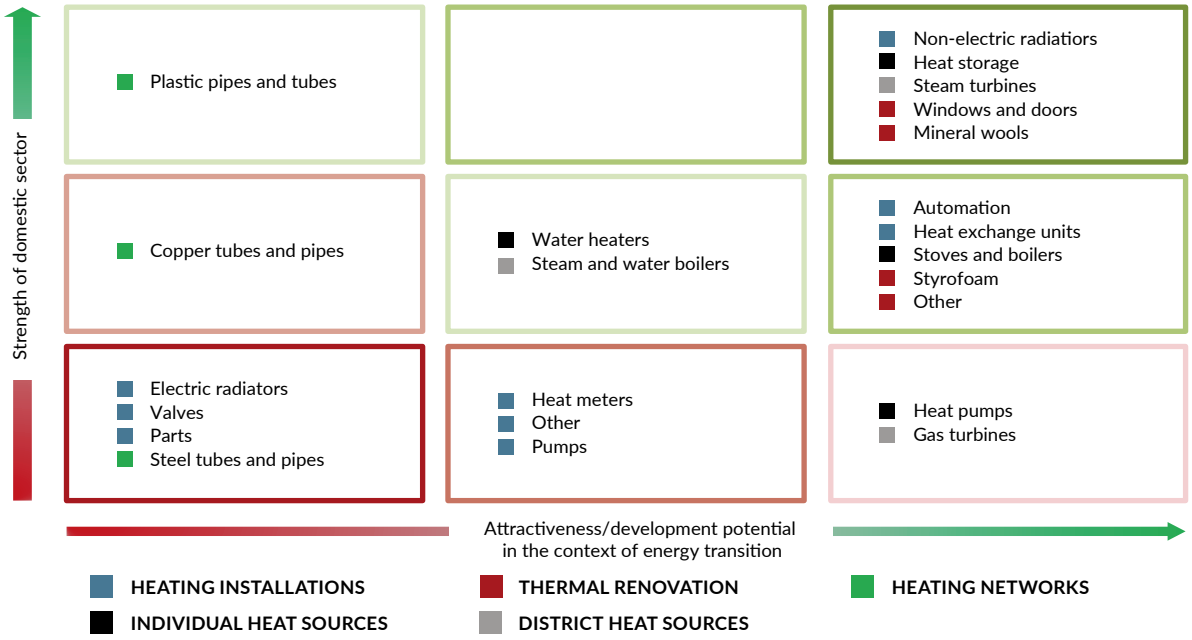
Source: Forum Energii elaboration based on Statistics Poland data.

4.6. The strengths of the Polish manufacturing capacity

The following picture of the domestic heating manufacturing industry emerges from the analysis:

- Poland is one of the leading producers of products used in the broadly defined heating sector. This is best reflected by its high fourth position among EU exporters (over 6 per cent share in the total exports of EU countries in 2020).
- The level of specialisation among Polish companies and their position in the domestic and European markets varies greatly between sectors. In the area of products related to thermal renovation, the situation is very good. In contrast, in the case of products used in heating installations and some heating sources (especially heat pumps), local production capacity is underdeveloped.
- Their generally sound financial situation further strengthens the potential of some heat-related industries. For others, permanently weak financial indicators are an additional burden, confirming their structural weakness.
- Relatively strong fragmentation of industries and, consequently, limited scale of activity of many entities might be a barrier to wider foreign expansion of companies. In this context, their more substantial consolidation could prove to be desirable.
- The crucial structural challenges of the industries discussed above in the context of their ability to take advantage of business opportunities related to the transformation of the heating sector are: (1) deteriorating situation in the labour market (access to qualified labour, wage pressure) and (2) low innovativeness (minimal R&D activity). Under current conditions, these are reinforced by pandemic challenges (shortage of raw materials and their rising costs, as well as general uncertainty of the economic situation, which may negatively affect, among other things, investment activity). There is a risk of various supply tensions, potentially slowing down and affecting the cost side of many heat projects in the coming years. Strengthening R&D among domestic producers is very important in preparing the Polish industry to meet the growing needs of the heat sector.

Graph 17. Polish industrial capacity vs. attractiveness/development potential of selected product categories related to the energy transition of heating*



* Extended description of individual product categories as for the Graph 6.
Source: Forum Energii elaboration.

- Some of the product categories, in which the position of Polish companies is solid, are also very attractive in the context of the ongoing transformation of the heating sector. These include products such as windows and doors, mineral wools, steam turbines, heat storage devices, and non-electric heaters. These are areas in which there is a high probability of the Polish industry making optimal use of opportunities related to the green transformation of the heating sector.
- In some promising market segments, the position of Polish companies is so weak that there is a risk of losing business opportunities due to low competitiveness. These include heat pumps and gas turbines. In these areas, the domestic market is likely to develop with the significant participation of foreign suppliers. Taking advantage of these opportunities by Polish companies (if at all possible) will require increased efforts to build competencies and production capacities.
- Support for the local industry may also be required in other attractive areas, where the market position and strength of Polish companies should be assessed as average (e.g., automation, heat exchangers, stoves and boilers, as well as retrofit materials).

5. Expected benefits of modernising heating and buildings by 2050

5.1. Economic impact

Modernisation of the sector will bring tangible benefits to the Polish economy. Even the minimum investments described by the reference scenario make it possible to generate a GDP contribution (added value) in the order of PLN 766 billion (approx. PLN 25 billion on average annually) by 2050. The implementation of the transformation scenarios means a multiplication of this impact. The added value in the low-emission scenario reaches PLN 1.8 trillion, while it exceeds PLN 2 trillion in the zero-emission scenario. Thanks to in-depth investments in the heating sector and buildings, the Polish economy may increase its GDP by 50-65 billion PLN per year on average over the next 30 years (Graph 18).

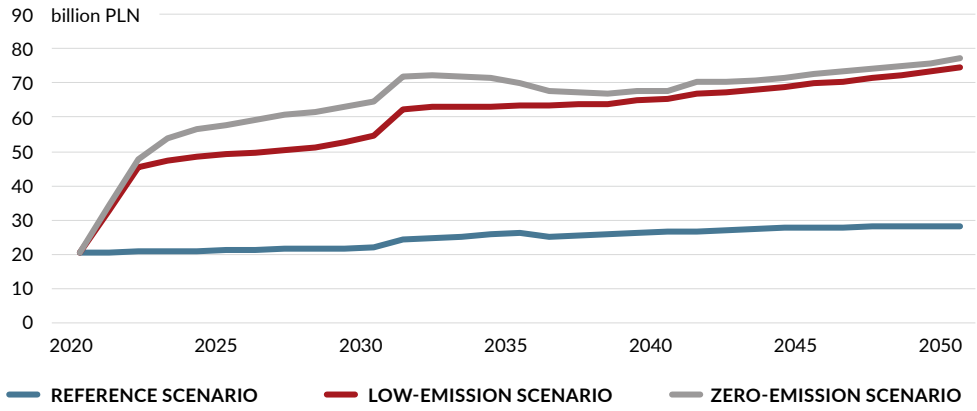
Graph 18. Economic impact of heating transformation by 2050

	ZERO-EMISSION SCENARIO	LOW-EMISSION SCENARIO	REFERENCE SCENARIO
total contribution to GDP by 2050	over PLN 2 trillion	1.8 trillion	less than PLN 0.8 trillion
annual average (approx.)	PLN 65 billion	PLN 50 billion	PLN 25 billion

Source: WiseEuropa Foundation calculations for Forum Energii.

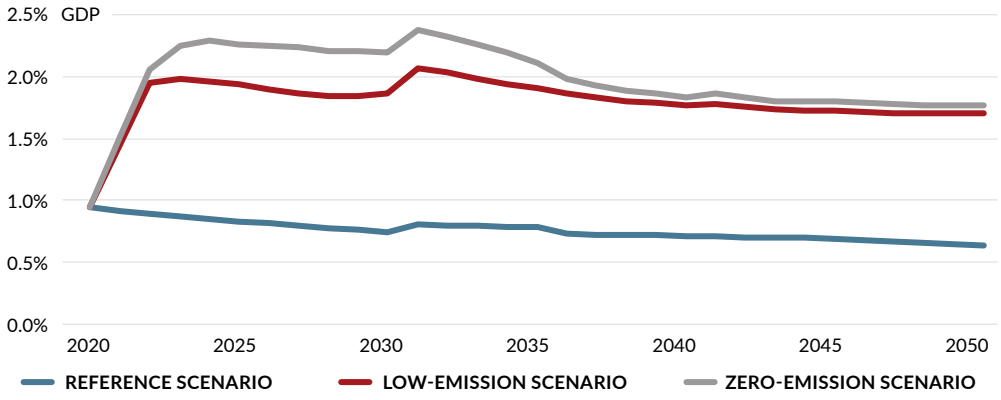
An ambitious transformation programme creates demand for more goods and services, boosting the domestic parts of the supply chain. Added value is growing in line with the investment trajectory. We record linear growth in added value, excluding two periods of acceleration: by 2023 (initial mobilisation) and 2030-2035 (cumulative investment in heat sources).

Graph 19. Added value resulting from the modernisation process



Source: WiseEuropa Foundation calculations for Forum Energii.

Graph 20. Added value resulting from the modernisation process as a share of GDP

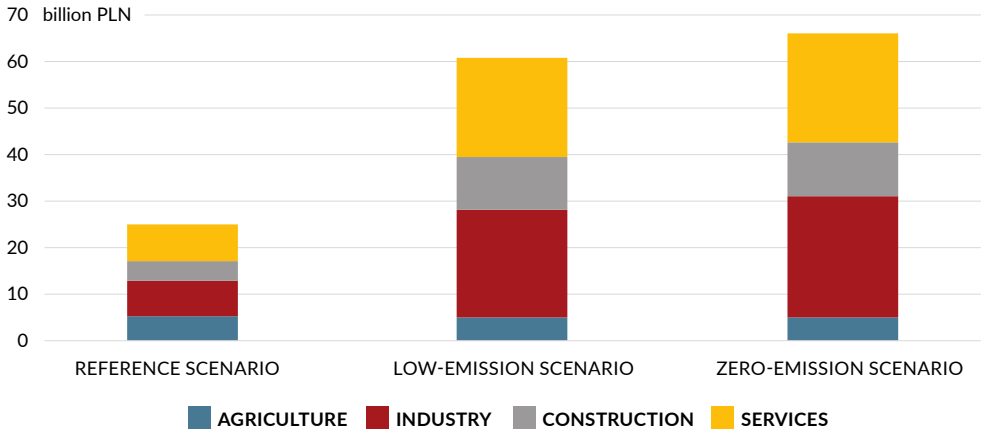


Source: WiseEuropa Foundation calculations for Forum Energii.

As Poland gets richer, the added value from modernisation will represent a decreasing share of GDP[6] (Graph 20). From this perspective, it is worth looking at the transformation scenarios as a tool permanently immunising households to higher heat prices and incentivising companies to develop lucrative market niches. In the low-emission scenario, GDP will rise by around 2 per cent annually from 2022 onwards. In the zero-emission scenario, GDP will temporarily rise by up to 2.4 per cent thanks to additional investments until the mid-2030s.

Modernisation creates a clear impetus for industry, services and construction development. By 2050, added value will increase about three times compared to the reference scenario (Graph 21). The scale of the impact results not only from the gradual development of the domestic industrial base in response to the emergence of stable demand but also from the distribution of expenditure. Expenditure includes not only the delivery of finished equipment and the accompanying production of components but also construction work, subcontracting services and after-sales services (which are characterised by high local content). For this reason, industry, construction and service sectors benefit from the transformation. In comparison, the value added in agriculture remains similar in all variants.

Graph 21. Average annual added value by 2050 resulting from the modernisation process by sector



Source: WiseEuropa Foundation calculations for Forum Energii.

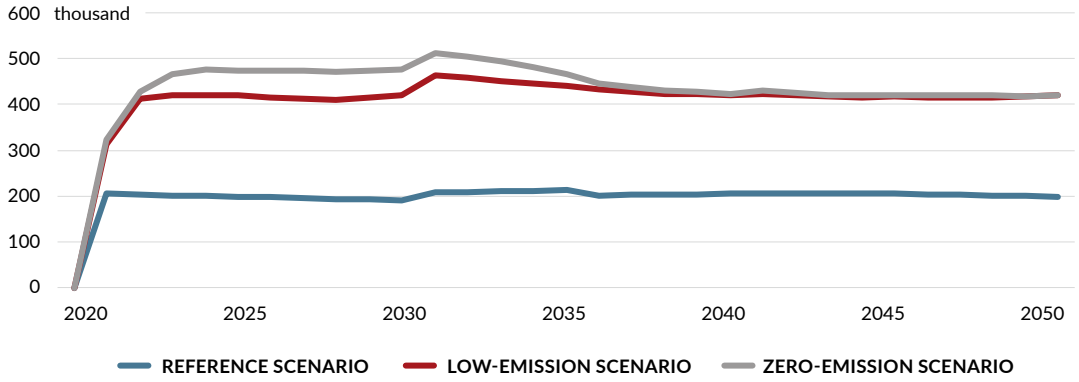
6 In practice, the fraction's denominator will grow faster than the numerator. It is economically justified for several reasons: heat modernisation will not be the only investment programme, the Polish economy will have an increasingly diversified mix of goods and services, prices of services will rise faster than prices of industrial goods and energy, and production processes will become more efficient.

5.2. Impact on the labour market

The demand for employees follows investment. Even with low ambitions (reference scenario), about 200 thousand jobs will be created (Graph 22). In the transformation scenarios, demand rises to 400 thousand jobs per year on average by 2050. Such a high impact on the labour market is due to the scale of investments, the absorption capacity of the national economy (local content) and the relatively high labour intensity of the production processes in district heating networks and thermal renovation of buildings.

While in the reference scenario, the impact of investment on the labour market is constant over time, modernisation increases demand and differentiates it over time. Demand grows rapidly in the programme's first years and then piles up again in the 2030s to stabilise at around 430,000 in both scenarios. This smoothing results from higher demand for low-carbon solutions accompanied by gradual increases in production efficiency resulting from knowledge accumulation.

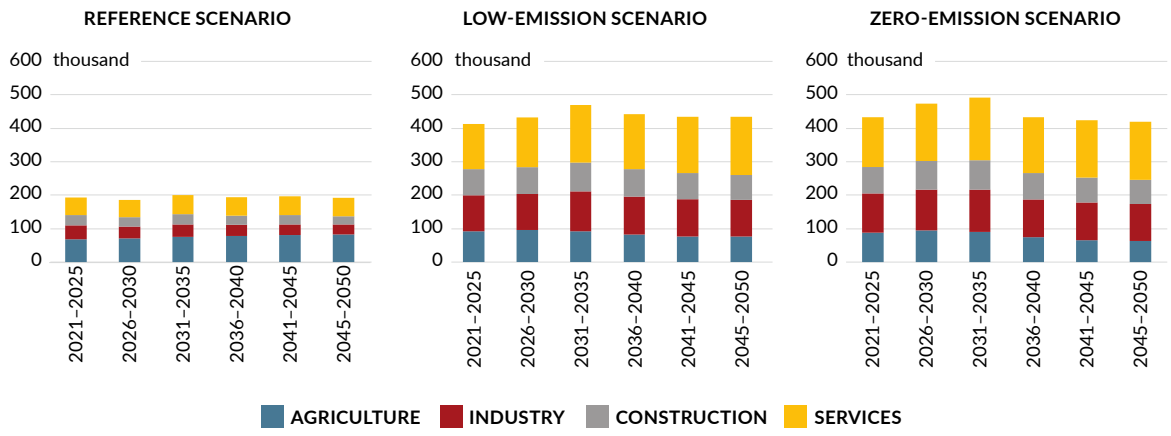
Graph 22. Net number of jobs created as a result of the modernisation process



Source: WiseEuropa Foundation calculations for Forum Energii.

The reference scenario increases the demand for biomass, which will translate into higher employment in agriculture and forestry, where labour productivity remains low (Graph 22). In addition, the negative pressure on biodiversity will increase, with significant and long-term negative consequences for society. The implementation of more ambitious transformation scenarios will additionally create around 110,000 highly productive jobs in industry (production of technical solutions), 160,000 in services (incl. design, sales, and maintenance) and about 80,000 in construction (Graph 23).

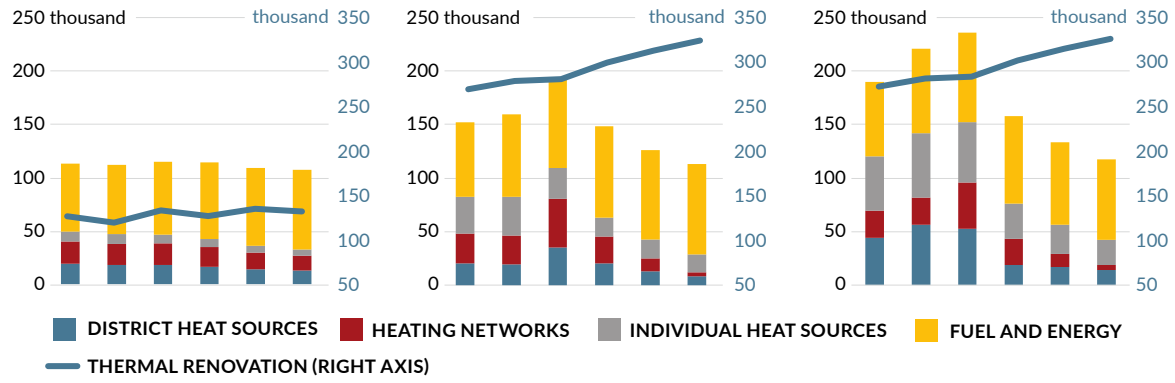
Graph 23. Net number of jobs created through heat upgrading by sector



Source: WiseEuropa Foundation calculations for Forum Energii.

In the transformation scenarios, most jobs will be created by widespread thermal retrofitting, followed by investments in sources and networks in district heating (Graph 24). There is additional value in jobs created due to the massive installation of individual heat sources. The low-emission option also assumes an additional demand stimulus in the labour market between 2031 and 2035 due to investment in district heating networks, while the zero-emission option assumes a positive stimulus between 2021 and 2035 as a result of the installation of district heat sources.

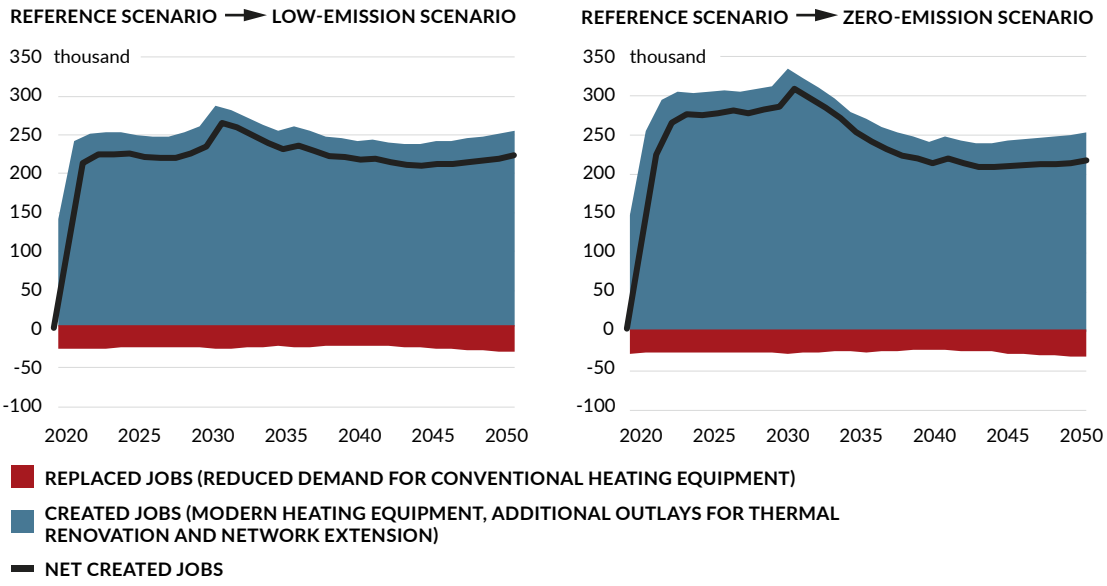
Graph 24. Net number of jobs created as a result of heat modernisation by delivery area



Source: WiseEuropa Foundation calculations for Forum Energii.

Modernising district heating and buildings will create many more jobs than will be lost due to moving away from conventional heating sources. In other words, the net effect on the labour market is unequivocally positive. In the low-emission scenario, an additional 245,000 jobs will be created annually on average, and in the zero-emission scenario, an additional 270,000. In both scenarios, fewer than 30,000 jobs will be lost – between 25,700 and 34,300, depending on the year – with the highest number in the last five years. It means that for every 10 jobs lost, 74 or 82 new ones will be created (depending on the scenario). Such a proportion provides significant room for retraining employees.

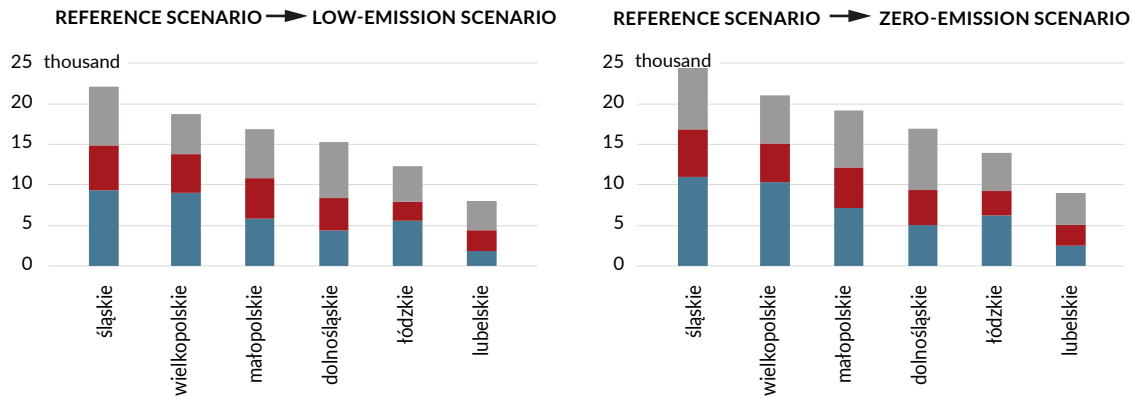
Graph 25. Jobs created and replaced in the shift from reference to transition scenarios



Source: WiseEuropa Foundation calculations for Forum Energii.

Creating jobs will play a key role in the regions transitioning away from coal. In the modernisation scenarios, almost 60 per cent of jobs will be created in the six post-coal regions (most in Silesia). Adopting a more ambitious modernisation path would entail creating an additional 93,000 or 104,000 jobs there (in the low- and zero-emission scenarios, respectively) over and above those in the reference scenario (Graph 26). Approx. 38 per cent of jobs will be created in the industry, and about 25 per cent in construction. The exact distribution will depend on the specialisation of regions.

Graph 26. Jobs created when switching from the reference to the transformation scenarios by regions – annual average by 2050



Source: WiseEuropa Foundation calculations for Forum Energii.

Will the modernisation of heating reduce the distance between the Polish economy and Western Europe?

The implementation of the transformation scenarios is a process of comprehensive modernisation of Poland's residential and public buildings, spread over three decades. From an economic perspective, it is a continuous investment impulse in heating and retrofitting with a noticeable impact on the national economy.

According to the estimates, implementation of the zero-emission scenario will boost Poland's GDP by 1.2 pp on average per year, while the low-emission scenario – by 1 pp. The cumulative growth resulting from the realisation of modernisation ambitions by 2050 will be around half of the 2020 GDP. This is undoubtedly a factor allowing Poland to catch up with Western Europe (convergence) by 2050.

Accompanying the investments, an increase in employment of 250,000 jobs could raise the number of employed to over 16.6 million in the short term. Given the current population size, this would increase the employment rate by 1.1 pp, i.e., to around 73 per cent. For comparison, in Western Europe, the rates are currently about 76-80 per cent.

In 2050, with a smaller population, the projected increase of 220,000 jobs will raise the employment rate even higher – to about 1,9 pp. Thus, implementing the transformation scenarios offers an opportunity to create stable and well-paid jobs, contributing to closing the employment gap between Poland and the most efficient EU labour markets. Attractive jobs will bring further benefits in the form of socially acceptable transformation, smooth changes in career paths and higher tax revenues for the state.

Source: Forum Energii elaboration.

6. Key challenges for public policy

6.1. Vision for public policy

A vision of clean heat in 2050

Modernisation of the heating sector leads to clean and affordable heat for citizens and benefits domestic companies in the heating, construction and related sectors. Polish companies in these areas are becoming exporters to the global market with modern and highly competitive products and services.

Industrial policy will play a key role in implementing this vision. By industrial policy, we mean a set of coherent measures to improve the competitiveness of the industry, enhance production capacity of domestic entities in this sector, and promote demand-responsive transformation. Importantly, this does not mean hampering activities in other sectors (meaning that the effect of the policy is to be positive for the entire economy).

These objectives will be achieved through the following:

- correct identification of technologies and solutions that will evolve due to so-called megatrends,
- creating good conditions on the supply side (production of heating equipment and services for the heating and building industry) and formulating the objectives to be achieved,
- use of regulatory tools to ensure stable demand,
- supporting the flow of information and coordination between the state and private actors.

In other words, it is about supporting the stable development of the market for materials, equipment, and services – growing production that finds buyers. Expanding the market will improve technology and reduce costs, leading to economies of scale.

An essential part of industrial policy is identifying areas with high growth potential. The development of such industries means a better allocation of capital and labour (from less to more productive uses) and responds to the need for transformation.

It is nowadays assumed that high development potential is linked to the ability to export because then the usefulness of the product or service is confronted by a diverse range of customers. From the producers' perspective, selling in a highly competitive global market helps exporters achieve the appropriate scale of production. In addition, benefits increase through close cooperation with companies in neighbouring industries (clustering).

The low-emission transition is one example of a challenge which industrial policy is committed to address. Achieving climate neutrality by 2050 requires a rapid reduction of CO_2 emissions in all areas of the economy. However, not all solutions that lead to its achievement are known and sufficiently mature in Poland. It means market competition does not guarantee the emergence and implementation of the necessary technical innovations and organisational changes. This opens the field for public action, including a policy of supporting demand for desired goods or financing research and development activities.

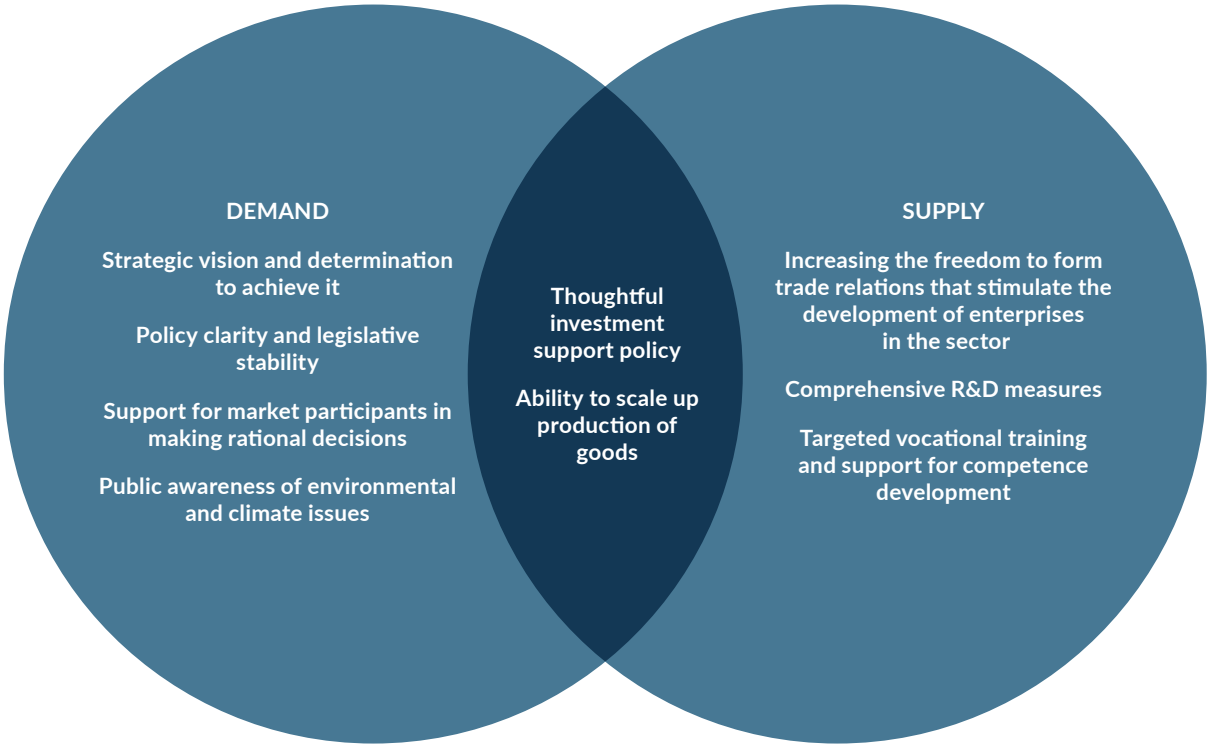
Climate neutrality will create demand for yet unknown products and services. Still, just as importantly, it will reward emission reductions in the production processes of all goods and services, including familiar ones. Companies planning for growth need to consider this, and policymakers should shape policies that make this possible.

6.2. Mapping clean heat challenges

Various factors underlie the challenges heating transformation is facing in Poland. First and foremost, we are starting from a distant starting position, one of a significantly carbonised economy, a system not adapted to modern needs and existing infrastructure approaching obsolescence. At the same time, Polish public policy (particularly industrial policy) fails to create the right conditions for the modernisation process to become a springboard for developing heat-related niches at the global level.

In the following section of the report, we describe in more detail the nine challenges that need to be addressed for the heat transformation in Poland to benefit citizens and the economy. These current problems are hindering both demand (stable and high demand) and supply (domestic production capacity) in the market for goods and services for heating and construction.

Graph 27. Challenges in maximising the economic benefits of modernising, heating and construction



Source: Forum Energii elaboration.

Challenge 1

Strategic vision and determination to achieve it

Problem 1: The state lacks a stable strategic vision in the field of heating and buildings

- Permanently outdated overarching strategic documents (*Energy Policy of Poland until 2040*[7] – PEP2040, *National Energy and Climate Plan for 2021-2030*[8] – NECP):
  - Documents do not take into account the objective of climate neutrality,
  - The diagnoses are no longer valid,
  - The actions are reactive and inadequate to the challenges ahead;
- Gaps in the strategic vision:
  - *Bottom-up* design (trend extension) instead of *top-down* design (ambitious goal confronted with objective barriers),
  - No critical milestones (e.g., phasing out coal in district heating) or visions lacking ambition (the target of modernising heating in rural areas by 2040, while in urban areas by 2030),
  - No operationalisation in sectoral strategies, meaning that existing programmes (e.g., Stop the Smog, Clean Air) do not fit into the broader context and their rules are unpredictable,
  - No links between climate-environmental objectives and economic (including industrial) policy limits the benefits of the transition – the economic context is not included in the national climate-environmental strategies, while the Polish white paper *(Poland's Industrial Policy)* remains incomplete in the area of modern energy technologies,[9]
  - Failure to link climate targets with social policy, increasing the risk of energy poverty and lack of acceptance of the energy transition;

7 Ministry of Climate and Environment, *Energy Policy of Poland until 2040*, 2021, https://www.gov.pl/web/klimat/polityka-energetyczna-polski.
8 Ministry of Climate and Environment, *National Energy and Climate Plan for the years 2021-2030*, 2019, https://www.gov.pl/web/klimat/krajowy-plan-na-rzecz-energii-i-klimatu.
9 Ministry of Development, Labour and Technology, *Poland's Industrial Policy*, 2021, https://www.gov.pl/web/rozwoj-technologia/polityka-przemyslowa-polski.

How late are Polish strategic documents in relation to European trends?

1. ***Long-term Renovation Strategy***[10] – The 2018 EU Energy Efficiency Directive stipulates that member states should adopt long-term building renovation strategies containing an action plan until 2050. Poland should have presented its strategy to the European Commission by March 2020. The document was issued in February 2022.

2. **Heating Strategy** – work on the strategy (including working group meetings) has been ongoing since October 2018. In October 2020, it was announced that the strategy would appear in the 1st quarter of 2021. In May 2021, the document was expected to be released after intra-ministerial consultation. In December 2021, it was reported that the strategy (including Fit for 55 commitments) would be publicly consulted by the end of the year. However, the date of its publication is still unknown.

3. ***National Energy and Climate Plan for the years 2021-2030*** – the current version of the NERP from the end of 2019 is heavily outdated (cf. decrease in emissions in ETS areas, the share of RES in gross final energy consumption). In addition, heating is viewed exclusively through district heating (representing only 1/3 of the heat supply area). The larger segment, i.e., individual heating, is completely ignored. The document is currently outdated and is not due to be updated until 2024.

4. ***Poland's Energy Policy until 2040*** – PEP2040 is still outdated, incomplete (too short time horizon), and does not respond to climate challenges, energy security and economic potential. It sets unambitious and vague targets for energy efficiency. The document also fails to recognise the benefits of electrification of heat, and many of the targets remain undefined. The update of PEP2040 is scheduled for 2023 at the latest.

Source: Forum Energii elaboration.

- Petrification of an outdated heating market model[11]:
  - Rewarding the volume of sales (which increases with the volume of emissions) instead of the quality of service,
  - The lack of adequate incentives for heat producers to reduce emissions,
  - Legislative actions focused on patching up the defects of the old model instead of developing a new one;
- Low priority for district heating in the public debate:
  - Heating and buildings have so far received little attention in the public debate, the only exception being the context of smog which appears seasonally,
  - On all-encompassing view because the area of heating is shared by different ministries, with none of them feeling fully responsible for this area,
  - On interdisciplinary body supporting the decision-making processes and directions of modernisation regularly and transparently, representing various circles (cf. Good practices).

10 Ministry of Development, Labour and Technology, *Long-term Renovation Strategy. Supporting the Renova*tion of the National Building Stock, 2021, https://www.gov.pl/web/rozwoj-praca-technologia/dlugoterminowa-strategia-renowacji.

11 This issue is discussed in detail in the report *The district heating company of the future. A new business model* (Forum Energii, 2021, https://www.forum-energii.eu/pl/analizy/nowy-model-biznesowy).

Problem 2: The lack of political determination to achieve climate neutrality

- Lack of cross-party consensus – the volatility of positions and the interplay of interests reduce the time consistency (and therefore cost-effectiveness) of actual actions,
- No complementary documents:
  - The lack of coherent programme for the district and individual heating sector, putting elements of already known projects into a broader context,
  - The lack of effective planning tools at the local level – in particular, reliable local heat, electricity and gas supply plans (although municipalities are obliged to prepare such 15-year plans once every three years, their quality and pass-through into decisions leave much to be desired),
  - Local spatial development plans are not sufficiently used in shaping the heating and environmental policy at the municipality level due to too much freedom in the choice of heat sources – by shifting the decision to the investor (who only considers their project), the municipality loses the chance, for example, to build a local heat network or to impose the minimum share of RES;
- Inconsistency of public action with strategic objectives – support for outdated technologies (e.g., 5th class coal-fired boilers in the Clean Air Programme until 2021) and low-quality coal for individual heating by the current fuel quality regulation[12], which conflicts with the climate neutrality objective,
- No tools to foster effective implementation of the strategies – no measurable objectives or indicators to monitor their progress.

Rationale for changes

Strategic coherence of policymakers and their determination to deliver will accelerate the transformation of heating and construction and increase the resulting economic and social benefits:

- strategies signal the priorities of the state, which over time become embedded in the public consciousness,
- strategic documents are a kind of map leading to climate neutrality; they set the direction and pace of changes in the economy expected by the state,
- strategies are a kind of commitment that, once a direction is chosen for many years, the state will support it, which increases the propensity for individual investment,
- cross-party consensus on clean heat increases the likelihood that sudden changes driven by political factors will not torpedo achievements to date or increase the cost of reform,
- regulatory certainty reduces the cost of borrowed capital, increasing the propensity for individual investment,
- strategies contain information on product and service standards for the market, which enable companies to assess the potential of the national market and adapt their business activities to it,
- incompatibility with EU targets and global megatrends for businesses in Poland is a source of considerable uncertainty and technological lag and thus makes it difficult to benefit from production scalability,
- a reasonable timetable for implementing change allows all market players to adapt, reducing risks arising from the supply constraints[13] or monopoly, while increasing demand,

12 *Regulation of the Minister of Energy of 27 September 2018 on quality requirements for solid fuels* (Journal of Laws 2018, item 1890).

13 he impact of supply constraints could be seen in the boom in road investments before Euro 2012. The backlog of orders resulted in limited access to materials and services, raising their prices.

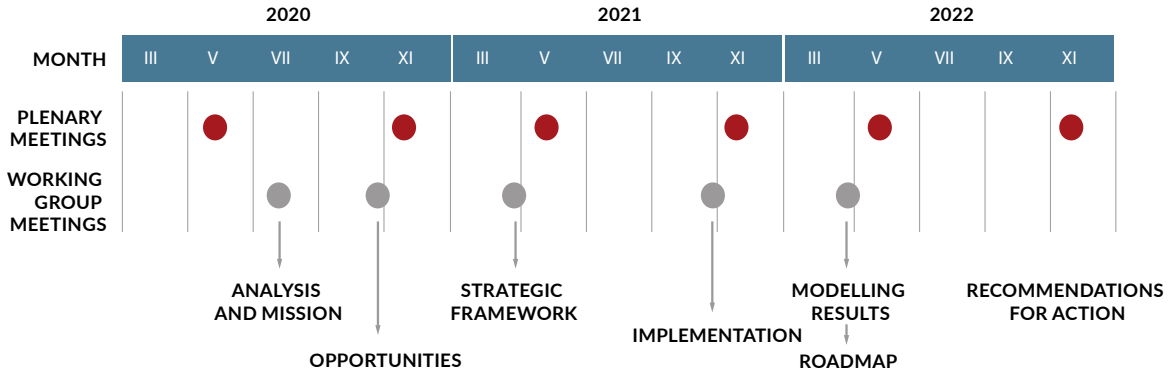
- the presence of strategies and programmes helps to focus stakeholders on the need for change,
- social dialogue supports the process of conducting public policy – it enables constant access to current signals and information from the market, which reduces uncertainty regarding the shape of future legislation, and consensually worked-out solutions favour their smooth implementation.

Good practice: energy efficiency strategy in Germany – an example of transparent stakeholder dialogue

In December 2019, the German Ministry for Economic Affairs and Energy (BMWi) published its Energy Efficiency Strategy 2050. One of the three pillars of the strategy is implementing the dialogue process "Energy Efficiency Roadmap 2050". Its development is based on regular, transparent stakeholder dialogue. It is assumed that energy efficiency – as a multi-faceted topic – requires the involvement of different perspectives (businesses, civil society representatives, science and ministries) and the assessment of the impact on various actors (consumers, suppliers, decision-makers).

To merge these perspectives, six plenary sessions and five meetings of each of the six working groups (three sectoral groups: buildings, industry, and transport; free cross-sectoral groups: education, digitalisation, and systemic issues) were scheduled between March 2020 and December 2022. The timetable and thematic scope of the sessions have been announced in advance (Graph 28). Even despite pandemic restrictions, they took place on time.

Graph 28. Work sequence on energy efficiency targets by 2050 in Germany



Source: Bundesministerium für Wirtschaft und Technologie, *Roadmap Energieeffizienz 2045*, https://www.bmwi.de/Redaktion/DE/Dossier/Energieeffizienz/roadmap-energieeffizienz-2045.html.

All relevant information is published on a dedicated website[14]. This includes periodic reports published by the German government. They are a compendium of knowledge and illustrate the current status of the Roadmap. Measures and recommendations developed in the ongoing dialogue are summarized there. This is an important signal for the German market and allows it to stay updated on developments. For example, the June 2021 report refers to the new Climate Protection Act (presented in May 2021), shortening the climate neutrality perspective from 2050 to 2045 and tightening the reduction targets for the 2030 horizon.

14 Bundesministerium für Wirtschaft und Technologie, https://www.bmwi.de/Redaktion/DE/Dossier/Energieeffizienz/roadmap-energieeffizienz-2045.html.

Challenge 2

Policy clarity and legislative stability

Problem 1: Inadequate legislation for the challenges of transformation

- The excessive inclination of national administrations and companies to make use of derogation opportunities:
  - Deferring decisions on necessary investments, increasing the risk of stranded assets[15],
  - The need to cover the rising cost of business as usual (expressed in the EUA price),
  - Looking for further loopholes, for example, trying to avoid including small heating plants in the EU-ETS by their boilers output[16],
  - The delay in creating an industrial base to meet domestic and foreign demand for heating products;
- No clear legislative priorities:
  - The lack of statutory operational support for green heating (analogous to green electricity), which could increase demand for goods in the sector,
  - An obligation to purchase green heat with options to protect outdated district heating operators;
- The lack of relevant definitions and legal frameworks:
  - The lack of definitions hinders the development and hampers the development potential of manufacturing (as in the case of the lack of definition of cppa[17] hindering the electrification of heat and domestic production of heat pumps),
  - Imperfect legal framework which hinders the organic development of solutions favouring the modernisation of district and individual heating, such as energy clusters (e.g., through overly complicated settlements between its participants).

Problem 2: Low quality of legislation

- A sub-optimal sequence of works – the scale of many current investments in district heating may turn out to be wrong if deep retrofit of existing buildings drastically reduces energy demand and thus increases the popularity of other heating technologies (e.g., heat pumps and RES or waste energy),
- Inequality in the light of law:
  - In the district heating, the external costs of CO_2 emissions are taken into account only for large heat plants above 20 MW, while in the individual heating, heat pumps are covered by the ETS (through the cost of CO_2 emissions added to the price of electricity), but gas and coal boilers are not – those who do not bear this cost therefore still have little incentive to reduce emissions and energy consumption,
  - The costs of air pollution in Poland are not included in the heating bill, although their scale is significant[18] (cf. the good practice).

15 The International Energy Agency defines stranded assets as "those investments which have already been made, though at a point in time prior to the end of their economic life (as assumed at the investment decision point), are seen to no longer earn economic returns".

16 In light of the *Fit for 55* package proposals, such action will not prevent it from being covered by the ETS.

17 *Corporate Power Purchase Agreement* – a long-term renewable energy purchase agreement concluded directly between an energy producer and consumer.

18 Forum Energii, *Clean Heat 2030... op. cit.*, Figure 6.10.

Rationale for changes

Adequate and well-structured legislation creates the correct incentives for low-carbon transformation and development of market for heat-related products and services. The following factors are at the root of the benefits:

- strategy and legislation transferring global technological trends into national institutional and legal frameworks,
- the legal framework sets boundary conditions for companies and their customers (e.g., through standards), letting new market solutions be invented, provided they meet the state's objective,
- compliance with quality standards guarantees the achievement of reduction targets,
- adaptation to pan-European trends allows the standardisation of goods sold domestically and for export, thus making it easier to achieve production scalability.

Good practice: inclusion of external cost in the heating price in Denmark

The Danish Energy Agency (DEA) regularly publishes fuel price forecasts and energy scenarios. It also develops methods for calculating energy costs and the cost-effectiveness of energy projects and estimates the cost of environmental emissions (NO_x, SO and PM 2.5) based on the current valuation of health costs.

Authorities use these indicators at the national and local levels and by individual users. Including health costs in feasibility studies is mandatory in energy projects – this ensures that project estimates are complete and cost-benefit analysis is comparable for the local authorities that choose them.

In Table 3 we present example values of external costs published by the Danish Energy Agency. The external costs of pollutant emissions are significantly lower for district heating plants than for individual households. The sources of this difference are the type of technology used, the dispersion of pollution, the different quality of environmental equipment and the distance from human settlements.

Table 3. External costs of pollutant emissions by source (EUR/kg)

Issue costs	NO_x	SO_x	PM 2.5
Individual household	3.9	2.4	11.1
Industrial combustion installations	1.8	1.3	3.6
Large combustion installations (district heating plants)	1.3	0.9	3.1

Source: A. Rubczyński, *Good district heating practices from Denmark and Germany. Conclusions for Poland*, Forum Energii, 2019, https://forum-energii.eu/en/analizy/cieplownictwo-dk-de.

Challenge 3

Supporting market participants in making rational decisions

Problem 1: The lack of clear standards

- The lack of energy efficiency standards for existing homes – energy efficiency standards in Poland apply only to new buildings and are not introduced for existing ones, leaving owners to make difficult decisions about the scale of investment,

Problems associated with raising energy standards in residential homes

Raising energy efficiency standards is currently the only way to reduce the cost of heating a home, contributing to climate neutrality across the country.

- **Newly built houses**

With higher energy standards effective from 2021 and the ability to design a home from scratch, the higher cost of erecting an energy-efficient home is quickly offset by other savings, including capital expenditures. For example, using a heat pump instead of a coal-fired boiler avoids building a chimney and flue gas cleaning system and eliminates the cost of building, adapting and operating a boiler room. Despite the obvious economic arguments, insufficient consumer knowledge remains the biggest obstacle.

- **Existing houses**

In the case of existing houses, replacing the heat source is not always economically justifiable for the individual user. An increase in the price of heat shortens the payback period, but the prevailing argument is the health and environmental costs of the pollution generated. So far, however, these have not been added to the cost of heat production in Poland. As a result, it pays to pollute the air and emit CO_2, passing the costs on to others. Replacement of heat sources must be preceded by retrofitting. In the case of multi-family houses, the challenges are the higher total costs of thermal renovation (in the absence of public support) and the need to coordinate between co-owners.

Source: Forum Energii elaboration.

- Inadequately protected consumer interests:
  - No effective verification of the quality of certified buildings and products as well as penalties for dishonest producers,
  - The absence of an energy ombudsman to protect consumers' interests,
  - No confidence in standards – due to poor state control;
- Underestimating the role of the sustainable development taxonomy as a standard-setter – the EU sustainable development taxonomy[19] is not a guideline in Polish legislation, support programmes, and public procurement, this translates into delayed adaptation of production for the domestic market.

19 The taxonomy of sustainable development is a system of classification of pro-environmental activities. It provides a glossary for Europeans with reliable and legible information on whether an economic activity meets environmental objectives. Source of information: European Commission, *EU Taxonomy for Sustainable Activities*, https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en.

Problem 2: No tools to support contribution to strategic objectives

- The lack of an institution to support the implementation of climate policy:
  - No analytical institution to support decision-makers in making decisions on the challenges, the scale of investment, costs, investment processes and technologies,
  - No analytical institution to support heat suppliers to buildings in making decisions on investments and in the financial and management area,
  - The lack of reliable, publicly available forecasts of energy, fuel and other relevant costs,
  - Difficult access to data to support change, optimise costs and facilitate market entry for new players.

Rationale for changes

Increasing the stock of knowledge reduces uncertainty for market participants and thus leads to more informed and beneficial decisions. Changes in this area will therefore bring major economic benefits:

- a clear path towards neutrality will allow for informed public debate on the options and avoid populism,
- taking external costs into account will price health and environmental damage, mobilising emitters to cease harmful activities,
- using the EU taxonomy standard for the internal needs of the Polish market will reduce uncertainty for its participants, unlocking investment potential (and creating stable domestic demand),
- a common European standard will make it possible to adapt production to the needs of the European market and thus scale up production,
- the lack of analysis hinders the ability to make rational choices,
- the lack of publicly available tools means that individuals acquire knowledge individually and with a high risk of error.

Challenge 4

Increasing the freedom of trade relations to stimulate the development of enterprises in the sector

Problem 1: Faulty heat tariff system

- The Polish tariff system is unsustainable in the medium and long term:
  - The minimum price level (favourable for the consumer) makes it impossible to include the full costs related to the maintenance and necessary modernisation of district heating networks in the tariff, which results in heating companies postponing investments and ultimately increasing the cost of services,
  - The lengthening of the tariff adjustment period (about six months out of 12 months of tariffs) leads to a contraction of margins earmarked for, among other things, reinvestment or attractively remunerated employment – the risk of rising prices of emission allowances is passed on to the heat plants;
- The lack of an operational definition of a vulnerable customer:
  - No clear decision – the definition[20] proposed by the Ministry for Climate and Environment is very vague,
  - The criteria for qualifying as a vulnerable customer are set in the regulation, which in Polish political terms means that they will quickly become the subject of political horse trading,
  - The impossibility of assessing whether the goal of the support has been achieved (effectiveness) and whether this objective could not have been achieved more cheaply (cost-effectiveness).

Rationale for changes

The current way of regulating the heating sector is very short-sighted, threatens the industry and its suppliers or may result in full liberalization of prices, increasing the risk of energy poverty among Poles.

- If the overriding aim of the change is to keep household heating costs at an acceptable level, this can be done through two channels: reducing heat demand and lowering unit heat prices. From this perspective, the demand is reduced by increasing the energy efficiency of buildings and adjusting the comfort standards for heating. In contrast, the energy transition will be conductive to lowering or limiting the increase in heat prices.
- If the heat market is sufficiently competitive, the cost of heating a household will become an indicator of the attractiveness of a particular heat source, providing the impetus for further modernisation.
- Preferential tariffs for vulnerable consumers are not the only tool to support households at risk of energy poverty (cf. good practice). It is most promising to make investments that reduce energy and heat demand, as short-term support must be financially reasonable.
- Modernising the heating system and massively improving the energy efficiency of buildings will trigger demand for goods and services, and increasing local content will be a factor in Poland's socio-economic development.

20 "Fuel poverty means a situation in which a household run by one person or by several persons together in a self-contained dwelling or in a single-family dwelling building in which no economic activity is carried out cannot afford sufficient heat, cooling and electricity to run appliances and for lighting, where the household cumulatively meets the following conditions: 1) has a low income; 2) has high energy expenses; 3) resides in a premise or building with low energy efficiency." – Article 5GB(1) of the *Energy Law of 10 April 1997* (i.e. Journal of Laws of 2021, item 716.).

Good practice: freedom of contract in Germany

In Germany, the heating price is determined by long-term contracts between the heat supplier and the consumer. The contract stipulates the criteria for price changes depending on the market situation. The price is adjusted based on changes in fuel prices, production costs or taxes.

It ensures that heat prices reflect the current market situation. The established criteria for price changes during a long-term contract allow for transparent rules for both parties. This reduces the need for the operator to approve the tariff each time.

Good practice: tackling fuel poverty risk in the UK

Weather conditions in the UK vary between regions, resulting in different costs of heating households. To ensure that harsh winters do not lead to poor heating comfort for the energy poor, the UK government has introduced two benefits: Cold Weather Payment and Winter Fuel Payment.

The Cold Weather Payment is an in-cash transfer to poor households to cover heating costs during cold weather. Households in areas with temperatures below freezing for seven consecutive days are eligible for the scheme. For every seven consecutive days between 1 November and 31 March, households can receive £25 to offset higher heating costs. In 2019/2020, the government subsidised over one million people. As a result of more frequent weather anomalies, the scheme will likely become increasingly important.

The scheme is complemented by a Winter Fuel Payment targeted at selected groups of pensioners. This group has been identified as particularly vulnerable to the effects of severe winters. A lump sum of £100-300 per year subsidises home heating in winter. In 2019/2020, 11.4 million people received this benefit.

Challenge 5

Ability to scale up production of goods for heating and construction

Problem 1: Weaknesses in the existing production capacity

- The wide variation in capacity and potential between products that are key to the success of the transition from the perspective of the transformation effort:
  - No clear information on strategic technologies for the transformation,
  - A large variation in the level of product specialisation,
  - Large deficits in areas with high potential for transformation, e.g., heat pumps;
- The business models and scale of domestic producers' operations make the necessary modernisation difficult:
  - Industries facing difficulties are characterised by low financial potential, which implies limited resources for investment and makes it difficult to improve their situation,
  - Strong fragmentation of industries and limited scale of operations of entities,
  - Low innovativeness and (compared to western europe) R&D expenditure;
- Numerous obstacles affecting competitiveness and prospects for further development:
  - Structural: shortages of skilled workers and limited access to raw materials, resulting in an inevitable rise in labour costs,
  - Current: soaring material costs.

Problem 2: Low public demand and lack of a good practices

- The public buildings currently being built do not meet the criteria for passive buildings (although the standards for them are higher than for residential buildings),
- No pathway to passive building standards (45 kWh/m^2/year of primary energy) for public buildings,
- No procedures for setting green standards by public administrations – in particular green public procurement and implementation of standards from the sustainability taxonomy (cf. good practice),
- Missing diagnosis of where green public procurement could develop national production (and where it will compete with private demand) and lack of analysis of the impact of green public procurement on the market,
- The lack of dissemination of green purchasing criteria for use by other public or non-public bodies.

Problem 3: The lack of systemic support for export of sector products

- The tool to support the dissemination and export of innovative green technologies (GreenEvo) is attractive but not massively applicable,
- The sporadic activity of the Polish Investment and Trade Agency and the economic departments of Polish embassies in the field of heating – in particular, it is necessary to promote solutions (e.g., through study visits), which is a popular alternative abroad when subsidising exporters within the World Trade Organisation is restricted,
- The lack of a tool to identify markets with the largest potential (taking into account entire supply chains) or a method to break down barriers to entry in these markets.

GreenEvo – green technology accelerator

GreenEvo is a Ministry of Climate and Environment programme aimed at disseminating Polish environmentally-friendly technologies domestically and abroad. Since 2008, the programme has supported 84 solutions in the field of, among others, waste management, RES, energy savings, air protection and passive houses. Promoting highly effective technologies translates into achieving climate and environmental goals, on the one hand, and promoting a positive image of Poland as an innovative country, on the other. Among the winners of the last two editions were modern passive house technologies and building materials, geothermal heat pumps and smart boiler houses.

Winners of the competition are entitled to comprehensive support for the scaling process, including promotion of technologies under the GreenEvo brand, participation in economic missions, a series of specialised training courses (e.g., in sales and presentation techniques, as well as in building export strategies, acquiring funds for R&D, patent protection or continuous development). Support under GreenEvo may amount to EUR 200,000.

Source: Forum Energii elaboration based on information from the Ministry of Climate and Environment (*GreenEvo – Green Technology Accelerator*, 2021, https://www.gov.pl/web/klimat/greenevo).

Rationale for changes

The industry can develop organically if there is stable private demand, and with government support if there is stable public demand or government action stabilises private demand. To maximise the benefits of heating modernisation, it is advisable to pursue the third scenario. Over time, this will enable the organic growth of companies in the sector and their expansion abroad. Among the reasons to ensure the scalability of production, there are also arguments relevant for producers and consumers:

- the development of economic areas that have so far not enjoyed private demand through public procurement,
- scaling up makes it possible to reach the threshold of production profitability – only under these conditions is it reasonable to look for domestic cooperators (which means increasing local content),
- from a consumer perspective, achieving economies of scale reduces the price, and as the product becomes more widespread, the accompanying goods and services become more accessible,
- the unique features of products for the heating sector provides an opportunity to benefit from the experience of industries that have achieved export success (e.g., household appliances),
- the development of the manufacturing for heating and construction materials is an opportunity to create attractive jobs for those employed in declining industries,
- export sales are an additional driver of economic growth.

Good practice: scaling up thermal insulation in the Netherlands

The Dutch Energiesprong programme involves the mass thermal renovation of buildings to zero-energy levels. Thanks to the large scale of investment and cooperation between technology providers, it is possible to develop standardised solutions that are easy to implement. This reduces unit costs, speeds up investments and improves the quality of applied solutions. As a result, the renovation takes only about ten days and has a 40-year quality guarantee. Technologies used include prefabricated materials, insulated roofs on which PV panels are installed, and smart heating/cooling and ventilation systems.

The implementation of the programme is beneficial for many parties. The state's perspective is that climate (energy efficiency) and social (citizen comfort, increased disposable income) goals are achieved. Manufacturers and service providers experience stable demand due to standardisation and mass-scale procurement. For households, the complexity of the investment, the short time needed for its implementation and the costs spread over several years are essential (these are covered by the funds saved by reducing future expenditure on energy, repairs and maintenance of the house over a period of 30 years).

The project's success has led to its dissemination outside the Netherlands, including Belgium, Germany, the UK, Italy and some US states.

Good practice: green public procurement in Canada and Denmark

The public sector is one of the largest purchasers of goods and services. It can therefore use its position to shape the market by systematically selecting desirable (environmentally friendly) solutions. Such a policy is called Green Public Procurement (GPP). From an economic perspective, the public sector heralds a significant and stable demand for a specific category of goods. New producers enter the industry, and the scale of production achieved enables a reduction in the unit price of goods and services and, over time, specialisation and the ability to export. The high expected standard stimulates innovation. At the same time, the state's purchase of green goods and services enables the implementation of environmental and social objectives (attractive jobs).

Such solutions have been recommended in the EU since 2008, but before 2020 they were treated only as good practice. Evaluations from countries that have been using them consistently for a long time (Canada, Denmark) indicate that it is a valuable tool.

Canada[21]

In Canada, GPP is implemented by setting green targets within government departments in line with government priorities and disseminating information about GPP through internal training and workshops for government departments. Transparent information on ongoing procurement and the introduction of measurable evaluation of results also play a role.

The evaluation published in 2019 confirms the programme's positive effects for the environment (primarily reduction of CO_2 emissions) but also for the economy (reduction of emission costs, increase in employment, and increase in government revenues). Even before the coronavirus pandemic, Canadians projected that by 2035 the benefits of active government policies (sustainable production and development of the domestic sector) would amount to approx. CAD 400 billion, and an additional 400 jobs would be created. A fall in cement and steel prices would also impact one channel.

21 Sources of information: *Going green: best practices for green procurement – Canada*, 2014, https://www.oecd.org/governance/procurement/toolbox/search/gpp-procurement-Canada.pdf; A. Bassi, K. McDougal, *Measuring the Benefits of Green Public Procurement in Canada: Evidence from the IISD GPP Model*, 2019, https://www.iisd.org/publications/measuring-benefits-green-public-procurement-canada-evidence-iisd-gpp-model.

Denmark[22]

In 2006, the Danish Ministry of the Environment and Denmark's largest three municipalities (Copenhagen, Aarhus and Odense) initiated a partnership for GPP. Since then, another 14 municipalities have joined the programme. With a budget of DKK 300 billion, 15 per cent of this amount is spent annually on green goods and services (e.g., ICT, transport and food).

While joint procurement activities protect the environment and develop markets, an essential component of the partnership is the exchange of knowledge on environmental solutions – including a website that publishes a set of green procurement criteria that can be used in tender documents. It allows procurers from public and private organisations to keep up to date with best practices in the field, gaining this knowledge without spending any money themselves.

Challenge 6

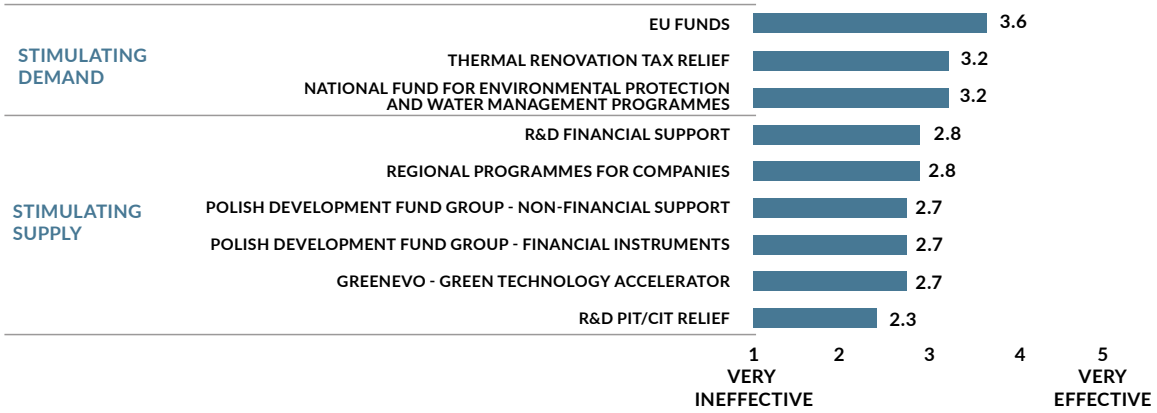
Thoughtful investment support policy

Problem 1: Lack of a concept of a broad support system

- High dispersion of support instruments:
  - The lack of a system of support instruments,
  - Some support programmes duplicate or compete with each other, while other areas remain undeveloped (Table 4),
  - Scattered information on available support instruments;
- Uncertainty of receiving support:
  - The lack of embedding in the strategic objectives makes it difficult to predict the direction, scope and timing of support,
  - Successive editions of support programmes do not appear regularly,
  - Rules of financing can change fundamentally and quite unpredictably, modifying the investment signals sent to the market (e.g., in the case of the clean air programme, the target was reduced by 50 per cent in one year);
- The problematic consequences of the dominant role of public support:
  - The risk that the scale of public intervention will distort incentives (leading to a preference for solutions only because of the accompanying support) or lead to an idle loss (support for investments that would also have been made without support),
  - No incentives incentives to seek equity funding from investors (usually private, e.g., venture capital funds),
  - No information hub on sources of private support;
- Insufficient support for economically strategic areas:
  - Limited support for areas that are responsible for a substantial increase in economic benefits, primarily export activity and R&D,
  - The firms' moderately positive assessment of the effectiveness of existing measures to stimulate supply (Graph 29).

22 Sources of information: One Planet network, *Partnership for Green Public Procurement in Denmark*, 2015, https://www.oneplanetnetwork.org/initiative/partnership-green-public-procurement-denmark; Danish EPA, *Sustainable procurement*, https://eng.mst.dk/sustainability/sustainable-consumption-and-production/sustainable-procurement/.

Graph 29. Evaluation of effectiveness of existing instruments of support programmes for companies



Source: Forum Energii elaboration based on the survey conducted by WiseEuropa Foundation.

Problem 2: Insufficient number of administrative staff needed to operate support programmes

- Excessive levels of bureaucracy and insufficient numbers of qualified staff:
  - Excessive complexity of applications compared to the support offered by the programmes (from the perspective of potential beneficiaries),
  - The bureaucratic nature of applying for support may lead to negative selection: financially struggling firms will not receive support or will feel forced to employ an intermediary to apply in exchange for the opportunity to invest;
  - The combination of high interest and the complexity of the handling process increases the need for staff to assess and control them; in addition, the lack of staff drastically extends the process of obtaining support (cf. White certificates scheme[23]).
- Insufficient support at the local level:
  - The lack of knowledge among potential applicants about the possibilities of investment support, for example, in heating,
  - The lack of comprehensive technical, organisational and financial support for households at the municipal level.

Rationale for changes

Changes to the heating support policy are necessary to modernise the sector and buildings efficiently and cost-effectively and to achieve additional benefits for the development of selected sectors of the economy:

- The heating sector requires very costly investments, while EU funds have to be partly spent on climate goals (there is no possibility of redirecting it to other purposes),
- Thanks to public programmes, it is possible to create impulses for the development of areas of particular economic (e.g., growing local content in high-tech goods) or social importance (e.g., new jobs in post-coal areas),
- The stability and predictability of public policies contribute to the mobilisation of private resources,
- The regularity of demand enables companies to grow organically in a stable manner – even without state support.

23 Gramwzielone. pl, *Dziurawy system białych certyfikatów* [*Holes in the white certificate scheme*], 2020, https://www.gramwzielone.pl/trendy/102434/dziurawy-system-bialych-certyfikatow.

Table 4. Programmes to support heating transformation and building renovation

Responsible authority	Recipients	Areas of support	Unit support	Budget	Advantages	Disadvantages
Poviat district heating (*Ciepłownictwo Powiatowe*)						
Ministry of Climate and Environment (MKiŚ), National Fund for Environmental Protection and Water Management (NFOŚiGW)	Small heating companies with majority participation of local self-government units (JST)	Modernisation and expansion of district heating networks, new heat sources and conversion of generating units using energy from RES, waste heat and cogeneration	Grant of up to 50 per cent of eligible costs, conditional on a loan from the NFOŚiGW supplementing 100 per cent of eligible costs	PLN 150 million – subsidies, PLN 350 million – loans	• High unit subsidy, • Lack of funding opportunities for carbon sources, • A comprehensive set of measures including the modernisation of the entire district heating system, • Promoting electrification of heat	• Limited number of participants through ownership structure and capacity limits (and no alternative to other actors), • Lack of incentives to increase low-carbon ambitions, • Inadequate budget for needs
Energy Plus (*Energia Plus*)						
MKiŚ, NFOŚiGW	Companies	Improvement of energy efficiency, expansion of heating networks and replacement of heat sources	Loan (on preferential terms) up to 85 per cent of eligible costs, grant up to 50 per cent of eligible costs (only for ORC technologies)	PLN 3.95 billion – loans, PLN 50 million – subsidies	• Lack of funding opportunities for carbon sources, • No restrictions on capacity and ownership structure, • A comprehensive set of measures including modernisation of the entire district heating system	• The predominantly repayable nature of the support, • Small subsidy (up to 50 per cent) for only one technology to incentivise the least carbon-intensive solutions (ORC)
New Energy (*Nowa Energia*)						
MKiŚ, NFOŚiGW	Companies	Innovative projects in the field of: (A) thermal/cooling energy storage facilities with RES (min. 15 per cent; (B) implementation of technologies for biomethane production, energy use of biomass and waste; (C) technologies for energy-plus buildings	Loan (on preferential terms) up to 85 per cent of eligible costs with the possibility of obtaining an innovation bonus of 20 per cent (reducing the loan amount)	A – PLN 300 million, B – PLN 500 million, C - PLN 500 million	• Innovative solutions, • A large programme budget, • Financing the implementation part of the innovation process	No data available
Clean Air (*Czyste Powietrze*)						
MKiŚ, NFOŚiGW	Owners and co-owners of single-family dwellings	Co-financing of heat source replacement and thermal renovation	Subsidy of PLN 25,000-37,000	PLN 103.3 billion	• Preferrence for the most energy-efficient investments (higher level of co-financing for best-in-class appliances), • Promotion of electrification of heat (parallel possibility of subsidies for PV), • A large budget for action, • Possibility of bank settlement	• No intermediate targets (difficult to measure progress), • Creation of stranded assets (purchase of coal-fired boilers possible until 2021), • Lack of incentives to invest in sources with the lowest CO_2 emissions (by the end of July 2021, 2/3 of applications were for gas and coal-fired boilers), • No path for the energy poor, • Inadequate sequencing (possibility of credit after the call for proposals for people with lower incomes)
Stop the Smog (*Stop Smog*)						
MKiŚ, NFOŚiGW	Municipalities	Replacement or decommissioning of heat sources and thermal renovation of single-family dwellings of the energy poor	90-100 per cent subsidy (of which 70 per cent by central administration and 20-30 per cent by local administration)	PLN 883.2 million	• Coordination of Stop Smog and Clean Air programmes under one ministry, • An attempt to improve the energy poverty situation in Poland in a systemic way	• Cannibalisation of Stop the Smog and Clean Air programmes by overlapping income thresholds, • Lack of money in the municipalities blocking participation in the programme (7 municipalities have joined), resulting in high operating costs, • The need for municipalities to develop criteria for those most in need, • Inadequate budget given the needs, • Lack of monitoring of the programme

Thermal renovation bonus (*Premia termomodernizacyjna*)						
Ministry of Development and Technology (MRiT), Bank Gospodarstwa Krajowego (BGK)	Housing cooperatives and commercial companies, local authorities, housing communities, individuals	Thermal renovation projects	16-21 per cent of investment costs	PLN 2.9 billion in 2020-2029 (maximum state budget expenditure limit in this period)	• The only support programme for thermal renovation of multi-family buildings, • Increased premium for the installation of a RES source	• In multi-family buildings, support is only available for thermal renovation of the entire building, • Lack of gradation of benefits motivating to apply the most effective solutions
Thermal renovation tax relief (*Ulga termomodernizacyjna*)						
Ministry of Finance (MF)	Owners and co-owners of single-family dwellings	Thermal renovation of the building, heat source replacement, PV installation, project documentation	Deduction of up to PLN 53,000 from the PIT base	Unspecified	• Wide range of support, • Low maintenance costs, • The relief can be combined with subsidy schemes	• The relief must be known to the taxpayer, • Instrument available only for single-family houses, • Lack of coordination with provisions of anti-smog resolutions (possibility to use coal boilers)
Heat plant of the Future (*Ciepłownia Przyszłości*)						
National Centre for Research and Development (NCBR)	Companies	Innovative technology used to modernise an existing district heating system into a system based on 80 per cent RES	10 x PLN 500,000 for the design of digital models of technology demonstrators, PLN 33 million for the construction and launch of a demonstrator	PLN 38 million	• Funding for development and demonstration, • The solution developed is intended as a benchmark for the market (low temperature district heating), • The opportunity to create new technology	Low budget allowing to build only one conceptual idea
Combined Heat and Power Plant of the Future (*Elektrociepłownia Przyszłości*)						
NCBR	Companies	Innovative technology to create a combined heat and power system supplying heat based on 80 per cent RES	10 x PLN 500,000 for the design of digital models of technology demonstrators, PLN 36 million for the construction and launch of a demonstrator	PLN 41 million	• Funding for development and demonstration, • The solution developed is intended as a benchmark for the market, • The opportunity to create new technology	Low budget allowing to build only one conceptual idea
ELENA (European Local Energy Assistance)						
European Investment Bank (EIB)	Public or private entity	Pre-investment expert support for energy efficiency and RES measures (technical assistance, feasibility studies, business plans, legal and financial advice)	Grant of up to 90 per cent of investment preparation costs		• High funding, • Comprehensive measures needed to start the investment, • The scope of the programme compensates for the technical and financial competence gap of small heating companies, • Support in line with EIB stringent standards	• High minimum investment target, • No linkage with further work stages and other programmes, • The target project must start within 3-4 years of receiving support

* The study omits programmes where calls have closed (e.g., EU Funds 2014-2020, Norwegian Financial Mechanism and EEA 2014-2021: Environment, Energy and Climate Change programme) or those for which the shape of the programme is not fully known (e.g., National Recovery Plan or EU 2021-2027 funds).

Source: Forum Energii elaboration.

Challenge 7

Comprehensive R&D activities

Problem 1: The lack of Polish R&D facilities capable of supporting

- The lack of a fully-fledged R&D ecosystem:
  - The research is not organised coherently – the activities of NCBR, universities and innovation incubators still do not add up to an effective network supporting research,
  - The scale of existing specialised research centres is incomparably smaller than their European counterparts[24],
  - The networking and internationalisation of Polish research is still limited;
- An undeveloped cooperation path:
  - Low company budgets for R&D,
  - No cooperation between the scientific sector and business,
  - National R&D institutions are not fully adapted to market expectations, the dynamically changing technological environment and the business mindset,
  - The default operating model is *in-house* innovation, i.e., implementing the conceptual and research part using own resources.

Problem 2: A fractured ecosystem of support for low-carbon technology development

- Funding gap:
  - Not all stages of R&D activity receive critical support – the so-called *death valley* is the stage bridging the R&D period and large-scale implementation (between leaving the NCBR support and reaching the stage of using NFOŚiGW resources at early commercialisation and demonstration stage),
  - Low innovativeness of projects causes the lack of access to financing from other sources, e.g., the Innovation Fund.
- Inefficient evaluation of innovativeness – when assessing innovative proposals, an influential voice is still held by representatives of public administration, evaluating projects conservatively.

24 The German Fraunhofer Society employed around 22,000 people in 2019 and managed an annual budget of about EUR 3 billion.

Rationale for changes

Using heat transformation to increase the scope of the high- and medium-high-tech business will mean deriving more added value from the business:

- specialisation guarantees better results (the conceptual and research part for the scientific sector and the business part for companies),
- the commercialisation of solutions offers the potential for market-oriented development of the R&D sector (in particular universities),
- greater commitment to the development of innovative solutions makes it possible to increase local content in the high-value-added segment,
- critical support for all stages before market entry means a greater chance that domestic solutions will not be sold to foreign entities,
- evaluation of projects by the international expert community allows for reliable verification of ideas presented for support.

Good practice: Energy Technology Development and Demonstration Programme (EUDP) in Denmark

After the oil crises, Danish district heating systems underwent a major overhaul – from centralised fossil fuel-based district heating systems to decentralised low-carbon solutions. Today Denmark is in the vanguard of low-temperature systems. Much has been invested in creating innovative solutions.

The Energy Technology Development and Demonstration Programme (EUDP) funds the development of advanced climate-neutral energy technologies. It supports private companies and universities in developing and demonstrate new solutions. The programme has been operating for over a decade and supports environmental objectives while building Denmark's competitive advantage. Calls for proposals are held each year, selecting dozens of innovative projects related to RES, hydrogen, energy efficiency or smart grids.

Since 2007, support has been provided for more than 1,000 projects, of which about one-quarter were related to energy efficiency. Projects supported in 2021 include waste heat from biogas plants, smart control for HVAC systems or the development of machine learning algorithms for the construction sector.

Source: https://www.eudp.dk/en.

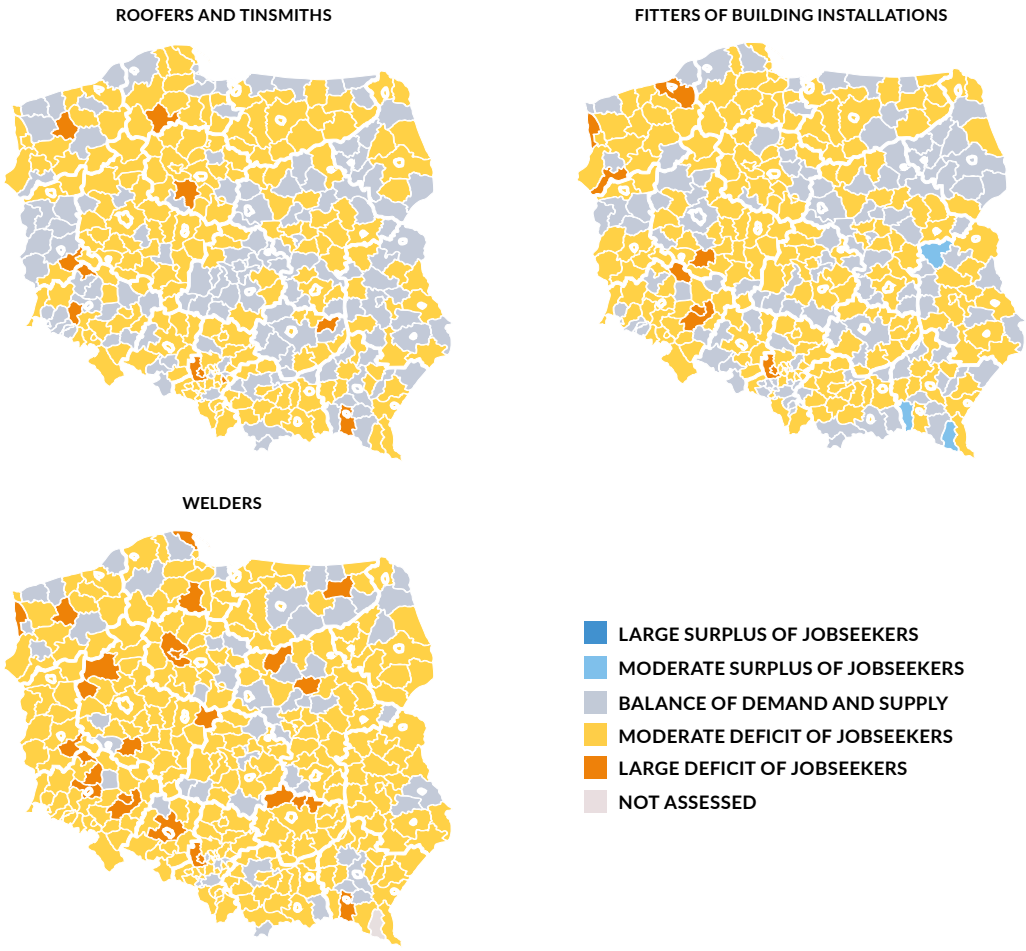
Challenge 8

Targeted vocational training

Problem 1: Labour shortages in the sectors

- Systematic deficits of workers in heating, construction and related areas – in 2021, 29 occupations are considered to be in deficit, of which 16 are crucial for heating and construction[25]; labour shortages concern mostly skilled workers (Graph 30), and there is a lack of an education strategy that takes into account the need to develop human resources to implement key reforms,
- The lack of a binding migration strategy[26] aimed at rapidly filling the skills deficit.

Graph 30. Labour market gap in selected occupations related to heating and construction



Source: *Barometr zawodów - prognoza zapotrzebowania na pracowników [Occupational barometer - Forecast of labour demand]*, 2021, https://barometrzawodow.pl/modul/prognozy-na-mapach-wyniki?map_type=country&map_details=counties&relation=1&year%5B0%5D=2021&profession%5B0%5D=275

25 These include: concrete and reinforcement workers, pavers, carpenters and joiners, roofers and tinsmiths, electricians, electro-mechanics and electrical fitters, fitters of building installations, bricklayers and plasterers, earth-moving equipment operators and mechanics, machine tool operators, construction finishers, construction workers, woodworkers and joiners, welders, locksmiths, teachers of practical vocational training, teachers of vocational subjects.

26 At the end of August 2021, public and inter-ministerial consultations on the document *Migration Policy of Poland – Directions for Action 2021-2022* were completed, but so far, the document has not been adopted.

Problem 2: The lack of an education system allowing to reduce the labour deficit in the medium and long term

- The lack of labour demand forecasts concerning the energy transition:
  - No demand forecasts for specific occupations,
  - No demand forecasts for workers' qualifications;
- Ineffective system of training at vocational and later stages:
  - Insufficient public policy interest in vocational training at the expense of higher education,
  - Insufficient number of employees trained in professions related to heating and modern construction,
  - The long process of updating curricula to keep up with new standards,
  - No laboratories and technical rooms for practical vocational training,
  - A shortage of qualified trainee teachers;
- Insufficient supply of public training:
  - Training and vocational preparation in the areas of product processing for the heating industry, green building, etc., which comply with the highest technological standards, account for a relatively small proportion of offers to the unemployed and economically inactive,
  - Limited scale of public programmes for upgrading and updating competences for people working in related fields and at risk of losing their jobs due to the energy transition (*outplacement*)[27];
- No incentives for further training by employers:
  - The lack of effective system of further training for employees[28],
  - With the low uptake of lifelong learning, subsidising the training of individual employees by the employer creates the risk of being poached by competitors.

Rationale for changes

A strategic approach needs to be taken to human resource development - including preparing the workforce to do the job – for the cost-efficient transformation of the heating and construction. The key arguments for change are as follows:

- given the depletion of domestic labour (also in construction, heating, related manufacturing and services), high labour productivity will play a greater role,
- the implementation of a low- or zero-carbon transition will require the preparation of tens of thousands of employees in the local labour markets – particularly in the field of thermal renovation and in the installation and operation of district heating sources, for which SEP (*Association of Polish Electrical Engineers* – electrical, electricity and gas) and UDT (Office of Technical Inspection – technical equipment operation and maintenance) qualifications are required,

27 *Outplacement* is a programme to assist and support redundant workers in finding new employment (soft dismissal scheme).

28 The National Training Fund (*Krajowy Fundusz Szkoleniowy*) with its competition procedure and small budget is not able to fulfil such a function.

Forecasting demand for skills – the case of heat pumps

Forecasting skills demand is subject to a high uncertainty. Identifying tasks to be performed is challenging when a technological solution does not exist or is not yet sufficiently mature. Large-scale heat pumps, among others, belong to the latter group. Once the industry uses en masse, the demand for engineers to design heat pumps based on industry expertise from companies in the sector will be triggered. Unlike in homes, it will be necessary to differentiate the product according to their working conditions. Adapting the equipment to the environment will be a job for skilled operators and their installation by competent fitters. The need for service technicians for this type of equipment will also increase over time.

A significant economic benefit will result from linking the manufacturing sector with advanced services – including IT – that will enable the electrification of heat. This will involve programming (IT, automation) of heat pump components to be activated remotely, depending on dynamic energy prices. There is also a great potential for device aggregation services to balance the power network or the broader use of data science and machine learning to create intelligent nodes and networks. This will translate into lower heat consumption and enable better fault prediction.

Source: Forum Energii study.

- given technological progress and changing standards in the construction and heating industry, it is necessary to educate not only new entrants to the profession but also experienced employees,
- the quality of education (including access to qualified apprenticeship teachers) will be a critical factor in the success of the modernisation of heating, heating and construction,
- heating and construction can be an attractive area for retraining by unemployed and economically inactive people whom labour offices support, as these industries provide attractively remunerated and stable jobs,
- foreign workers may temporarily fill the gap until a sufficient number of native workers can be educated – however, specific contexts have to be taken into account: legal restrictions on foreigners' residence, their interest in earning a living (which interferes with education) and high mobility (between professions, employers or regions),
- the risks associated with employer-paid specialised training (employees leaving before the investment in training has been recouped by the employer) are factors that discourage retraining, and the training system should take this fact into account,
- the lack of social dialogue makes it difficult to define a framework for human capital formation strategies to the extent desired by the sectors concerned.

Challenge 9

Public awareness of environmental and climate issues

Problem 1: Low public awareness of the benefits of low-carbon solutions

- Minimal formal environmental education in schools,
- No promotion of pro-environmental behaviour among adults (even though one of the constitutional duties of a citizen is to care for the environment),
- Low awareness of the law to protect citizens from the effects of low emissions (e.g., anti-smog resolutions),
- Low social responsibility for environmental damage – lack of interest in the quality of life of future generations.

Problem 2: Low public awareness of the benefits of the energy transition and how it can be achieved

- Ineffective communication of climate-environmental policies:
  - The lack of a clear message on the need to transform the economy towards climate neutrality (despite the obvious scientific evidence),
  - Failure to promote thinking about transformation as an investment programme,
  - The lack of broad and consistent communication of climate policy and its elements.
- Ineffective communication of individual public programmes – lack of well-profiled information, promotion and educational activities for potential beneficiaries of public programmes (e.g., residents of multi-family houses are more likely to know about the possibility of obtaining subsidies in the Clean Air Programme than residents of single-family houses, although the latter are the addressees[29]).

Rationale for changes

- High consumer awareness translates into higher demand for environmentally friendly products and services, encouraging producers to expand their offerings in this segment,
- To raise awareness of the investment characteristics of green heating and building: higher capital outlays are offset by lower running costs; moreover, the increasing valuation of CO_2 emissions will shorten the payback period,
- Higher quality of life (thermal comfort, better acoustics, faster construction, as well as less smog and reduced health costs),
- The need to use record inflows of EU funds for climate-environmental objectives and the lack of alternatives.

29 Polish Economic Institute, *Polacy i ochrona powietrza. Normy społeczne jako źródło zmiany?*, 2020, https://pie.net.pl/wp-content/uploads/2020/05/PIE-Raport_Ochrona-powietrza.pdf.

Good practice: Education and promotion of environmental activities in Małopolska

The main objective of the LIFE Integrated Project "Implementation of the Air Quality Plan for the Malopolska Region – Malopolska in a healthy atmosphere" is to improve air quality in the region. Among the ways to achieve it was to increase the environmental awareness of the inhabitants (especially in the area of air pollution) and increase local competences. The project assumed support for the 2019 Anti-Smog Resolution limiting the creation of new sources of emissions, imposing obligations on owners of fireplaces and boilers, and introducing fuel quality standards.

To gain public approval for the project:

- many educational and promotional activities were carried out – including workshops, setting up an educational cloud, creating eco-advisor stands, and involving local ambassadors in the distribution of educational materials,
- inspection activities were carried out – more than 5000 thermal imaging inspections of buildings and energy efficiency audits,
- investment support was provided – energy saving devices were installed in 600 homes, and financing was obtained for purchasing RES (solar panels, heat pumps, PV panels).

By building new competencies, additional external funding of more than EUR 1 billion was obtained for low-emission investments. In a survey on environmental awareness, 81 per cent of the Voivodeship residents surveyed positively assessed the anti-smog legislation that had been introduced, and 69 per cent were in favour of rapid intervention by services in the event of the combustion of poor quality fuels. More than 450,000 residents took advantage of advice from eco-advisors, and some decided to eliminate or replace boilers and change their habits.

7. Improving the quality of public policy: a sector deal

7.1. What is the purpose of a sector deal?

Fulfilling the economic potential of heat modernisation will require improvements in Polish public policy. Many of these areas may function better if the information flow between public administration and the sector is improved. It will then be possible to efficiently monitor the situation in this strategic branch of the economy and, if necessary, provide it with precise support. One of the solutions to achieve this is the sector deal. In the following sections, we present this form of cooperation, where it has worked so far, and how it can be applied to heat transition.

A **sector deal** is a partnership between the government and the industry to create favourable conditions for the sector's development and, in particular, to remove the barriers to its organic growth. The agreement involves institutions whose smooth operation will enable the industry's development, so in addition to companies and their associations, this includes the government, selected public agencies, local governments, the R&D sector, and sometimes local communities.

Among the reasons for entering into such deals are:

Relevant to businesses:

- improving the flow of information between the market and decision-makers,
- filling in industry knowledge gaps,
- developing cooperation between sectors (business, academia, public agencies),
- better coordination between public institutions,
- more accurate and faster identification of risk areas,
- the ability to intervene immediately in critical areas,
- a stable institutional and legal framework that increases the willingness of private investors to finance projects.

Relevant to the state:

- easier identification of barriers to development,
- transparency of state-business relations,
- more accurate public policies,
- more effective and cost-efficient support,
- developing cooperation between sectors (businesses, academia, public agencies),
- increasing the role of private investors reducing pressures on public funding,
- achieving key economic objectives (incl. productivity growth, employment, innovation, and competitiveness).

It is worth emphasising that the sector deal will not solve the problems currently faced by the heating and buildings. However, it will make it possible to organise a space for discussion aimed at systematically identifying challenges and co-creating effective support. Notably, a sector deal is not just about signing a declaration of cooperation. Human resources, a robust analytical background on both sides, and the establishment of transparent rules of cooperation, are necessary to succeed.

The handling of the sector deal is time-consuming but can bring about a qualitative change in cooperation. In this way, Poland will maximise the benefits of the investment processes that await it in the coming years.

7.2. Foreign experience

Comparative analysis

Sector deals are a popular form of organizing public policies, especially in industry. In recent years, they have become increasingly important in areas related to the energy transition because of the pace of change, the complexity of the challenges and the scale of the benefits that can be derived from the development of emerging niches. Countries using sector deals in this context include the UK, Denmark, Switzerland and Australia (Table 5).

Table 5. Examples of sector deals in areas related to the energy transition

	United Kingdom*	Denmark**	Switzerland***	Australia****
Name of agreement	Construction Sector Deal	Danish Energy Agreement for 2012-2020	Agreement with operators of waste treatment installations	Climate Smart South Australia
Area of agreement	Construction	Energy	Waste	Clean technologies
Year of conclusion (amendment)	2018 (2019)	2012	2014	2020
Status	pending	completed	pending	pending
Entity representing the government	Department of Business, Energy and Industrial Strategy	Ministry of Climate, Energy and Utilities	Federal Department of the Environment, Transport, Energy and Communications	Ministry of the Environment and Water
Entity representing the business	Construction Leadership Council	Industry associations bringing together over 450 companies from the fuel, electricity, gas and heating sectors	Association of Swiss Managers of Waste Treatment Instalations	Representatives of the Eastern Region of Adelaide
Main objectives	• Achieving global mobility leadership status, • Maximising the benefits of global transformation towards clean growth, • Putting the UK at the forefront of the AI revolution, • Intelligent and safe buildings, • Lower emissions and less polluted air, • Adapting to changes caused by the population ageing	• Decrease in net energy consumption by 12 per cent in the period 2006-2020, • Half of electricity consumption is to come from wind energy (RES will account for 35 per cent of gross energy consumption), • A 34 per cent decrease in CO2 emissions in 2020 compared to 1990, • Replacement of heat sources, • Improved insulation of buildings, • Expansion of district heating networks	• Reduction of emissions from waste incineration, • Encouraging more efficient use of energy in waste treatment installations, • A net reduction of CO_2 emissions by 200,000 tonnes compared to 2010 • Reduction of CO2 emissions by 1 million tonnes between 2010-2020	• Development and delivery of climate change adaptation strategies and plans, • Priority for adaptation to the impacts, risks and opportunities of climate change in the region, • Identifying differences and similarities within the region in order to develop actions that take account of regional geographical differences
Ways of achieving objectives	• Increase investment in technology development centres and R&D projects, • Support for innovation in the sector from the Industrial Strategy Challenge Fund, • Changes in vocational education	• Construction of offshore wind turbines, • Support for financing the development and use of new renewable energy technologies for electricity generation, • An obligation for energy companies to reduce their consumption of energy from non-renewable sources, • Phasing out oil boilers in existing buildings, including banning the installation of oil and natural gas boilers in new buildings, • Support for investment in the efficient use of renewable energy in the production processes of enterprises	• Increased metal recovery at waste treatment facilities, • Heat generated by combustion is to be used for electricity generation and heating purposes and to replace electricity and heat from fossil sources	• Increase forest cover by 20 per cent by 2045 to create cooler and more hospitable living conditions and a positive impact on urban biodiversity, • Engaging the local community in climate change activities to increase the resilience of homes and residents to climate change

* Department for Business, Energy & Industrial Strategy, *Construction Sector Deal*, 2018, https://www.gov.uk/government/publications/construction-sector-deal.
** The Ministry of Climate, Energy and Utilities, *Danish Energy Agreement for 2012-2020*, 2012, https://www.iea.org/policies/606-danish-energy-agreement-for-2012-2020.
*** Federal Office for the Environment, Transport, Energy and Communications, *Agreement with operators of waste treatment installations*, 2015, https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/sector-agreements/agreement-waste-treatment.html.
**** Government of South Australia, *Climate Smart South Australia*, 2020, https://www.environment.sa.gov.au/topics/climate-change/climate-change-legislation/sector-agreements.

Source: Forum Energii elaboration.

United Kingdom – Dissemination of agreements

Comparatively, the most extensive use of sectoral agreements is observed in the UK. So far, such partnerships have been established with ten sectors, including the automotive, offshore wind sector and construction.

The agreements form part of a national strategy for the industry. It assumes that industry will be the sector raising productivity and wages across the country; in other words – improving economic indicators translates into higher well-being for citizens and a reduction in inter-regional inequalities. The strategy is based on five pillars (objectives):

1. Ideas (the world's most innovative economy).
2. People (good jobs and greater earning power for all).
3. Infrastructure (a major upgrade to the UK's infrastructure).
4. Business environment (the best place to start and grow a business).
5. Places (prosperous communities across the UK).

The Construction Sectoral Agreement is a tool for achieving this vision. A set of commitments from the sector and the state is formulated for each of the pillars described above. The selected commitments are presented in Table 6. The document also indicates the timetable until 2021 and how the process will be managed via steering groups.

Denmark – Agreement successfully concluded

The Nordic countries are known for their widespread use of social dialogue tools – from this perspective, sectoral agreements are a natural extension of this. The energy partnership ended in 2020. Its evaluation shows that in 9 years all the assumed goals have been achieved, among others:

- 30 per cent of the energy consumed in Denmark in 2020 came from renewable sources,
- 80 per cent of electricity comes from RES (10 pp above target),
- 57 per cent of electricity comes from wind power (7 pp above target),
- Total CO_2 emissions fell by 43 per cent between 1990 and 2019.

In addition, according to a report by the Danish Energy Agency published in 2015, the green transition has also enabled the following economic objectives[30]:

- Economic development and investments in green energy have benefited the competitiveness of Danish companies through less exposure to highly volatile fossil fuel prices.
- The transition is also encouraging the emergence of new green products, services and industries.
- In 2015 Denmark produced green services and products worth EUR 25.8 billion.
- In 2015 renewable energy, green services and products sector accounted for 67,000 jobs of which 31,000 were employed in wind energy.
- Total energy technology exports accounted for more than 10 per cent of Denmark's total goods exports in 2015, with green energy technologies accounting for almost 60 per cent of them.

30 Danish Energy Agency, *Danish Energy Model. Innovative, efficient and sustainable*, 2015, https://ens.dk/sites/ens.dk/files/Globalcooperation/the_danish_energy_model.pdf.

Table 6. Mutual obligations of the sector and the state in the UK sectoral agreement in construction

Area	Sector commitment	State commitment
Ideas	• A £250 million contribution to the Industrial Strategy Fund, • Support for commercialisation of new technologies and construction techniques	• A £170 milion contribution from the Industrial Strategy Fund to the Construction Transformation Programme, • Working with homeowners, developers and participating in construction supply chains to deliver the 2015 commitment – 1.5 million homes by 2022, • Increase total investment in R&D to 2.4 per cent of GDP by 2027
People	• Attracting and training new workers in line with industry demand, including by increasing the number of apprenticeships and traineeships in the construction and building sector to 25,000 places per year, • Working with government to develop structured career paths, including quality industry internships for pupils and students	• Investment of an additional £406m in maths, digital and technical education to address skills deficits in science, technology, engineering and maths (STEM), • The creation of a new national upskilling and skills programme (around £64 million earmarked for digital and construction training), • Intergenerational exchange programmes in the construction industry
Infrastructure	• Over £50bn invested in the energy sector, £47bn in utilities and over £10bn in digital infrastructure in 2020-2021, • Working with Kings College London to create model forms of procurement to increase innovation in the housing sector	• Promotion of long-term, collaborative relationships with industry to reduce transaction costs in procurement and increase innovation, • Over £70 billion invested in transport infrastructure and over £43 billion in social infrastructure, housing and healthcare by 2020-2021, • Strengthening digital infrastructure with over £1bn of public investment, • Supporting the uptake of electric vehicles through £400m of investment in charging infrastructure and £100m to extend subsidies to plug-in cars
Business environment	• Improving the lifespan of buildings, • Developing an industry-wide definition of value more appropriate than the cost of capital, • Developing a universal procurement methodology and promotion of a consistent industry standard	• Establishing the UK as a global leader in the global infrastructure market, • Working with the construction sector to develop consistent benchmarks for the design, construction and operation of built assets, • Introducing a sustainable business model
Places	• Working with government to strengthen the supply chain for mineral and construction products in the UK	• Working with the wider construction sector to strengthen the supply chain for mineral and construction products across the UK, • Providing high quality training in the UK

Source: Forum Energii elaboration.

7.3. Polish experience

Sector deals have a short history in Poland, and therefore, it is not yet possible to assess their effectiveness. Selected national agreements concluded in renewable technologies and construction in recent quarters are presented below.

- ***Polish Offshore Wind Sector Deal***

  In September 2021, representatives of nine ministries, local administration, education and science circles, investors, and industry associations (PSEW, PTMEW)[31] signed the *Polish Offshore Wind Sector Deal*[32]. The agreement's purpose is to support the sector and increase the share of domestic entrepreneurs in the supply chain (local content). The declaration assumes striving to create offshore wind farms with the capacity of up to 11 GW by 2040, thanks to the launching investments worth about PLN 130 billion. The agreement was inspired by its British counterpart (*Offshore Wind Sector Deal*[33]) and is to be used to coordinate actions for offshore development. To this end, six working groups were established (on industry development, logistics, social education, human resources development, R&D, and stakeholder cooperation).

- ***Sectoral Agreement for the Development of the Hydrogen Economy in Poland***

  In October 2021, *the Sectoral Agreement for the Development of the Hydrogen Economy in Poland*[34] was signed. Already in the letter of intent, the rationale for developing the hydrogen economy was diagnosed: making better use of the national scientific and research and economic potential, creating new competencies, managing market niches and strengthening the global competitiveness of Polish companies. The agreement contains five strategic objectives (local content, R&D, investment, people, and cooperation) and the corresponding tasks. It is to be an executive instrument of the *Polish Hydrogen Strategy until 2030 with a perspective until 2040*[35], which includes 44 activities, such as creating "hydrogen valleys" or developing hydrogen vehicle production facilities.

- ***Memorandum of cooperation for the development of the biogas and biomethane sector***

  In November 2021, representatives of four ministries, the scientific and financial sectors, business environment institutions and stakeholders of the business sector signed a *Cooperation Agreement for the development of the biogas and biomethane sector*[36]. It assumes that increasing the share of biogas and biomethane in the Polish energy mix will benefit the national economy and local communities. For this to happen, a strategy for action needs to be created, national legal frameworks need to be harmonised with European ones, and other barriers to development need to be lifted. A platform for dialogue between stakeholders is to be used to identify them efficiently. To this end, working groups have been set up on, among others, ETS, supply chain, local content or support and promotion mechanisms.

31 PSEW – Polish Wind Energy Association; PTMEW – Polish Offshore Wind Energy Society.

32 Ministry of Climate and Environment, *Sectoral Agreement for Offshore Wind Energy Development in Poland*, 2021, https://www.gov.pl/web/klimat/podpisano-porozumienie-sektorowe-na-rzecz-rozwoju-morskiej-energetyki-wiatrowej-w-polsce.

33 Department for Business, Energy & Industrial St rategy, *Offshore Wind Sector Deal*, https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal.

34 Ministry of Climate and Environment, *Sectoral agreement for the development of the hydrogen economy in Poland*, 2021, https://www.gov.pl/web/klimat/porozumienie-sektorowe-gospodarka-wodorowa.

35 Ministry of Climate and Environment, *Polish Hydrogen Strategy to 2030 with an Outlook to 2040. – Draft*, 2021, https://www.gov.pl/attachment/47841420-867b-4cec-a7d1-beeca70879d8.

36 Ministry of Climate and Environment, *Cooperation Agreement for the Development of the Biogas and Biomethane Sector*, 2021, https://www.gov.pl/web/klimat/podpisano-porozumienie-o-wspolpracy-na-rzecz-rozwoju-sektora-biogazu-i-biometanu.

- ***Memorandum on cooperation for the development of photovoltaic sector***

  In December 2021, a *Memorandum of Cooperation for the development of the photovoltaic sector*[37] was signed, the parties to which are eight ministries, representatives of investors, suppliers, business environment institutions, the financial and scientific sector. Photovoltaics drives the development of RES in Poland, so it is essential to maximise the share of domestic production in the supply chain. The agreement identifies four areas: development of the domestic PV equipment industry, development of new PV segments and grid integration, barriers to PV development, as well as educational and promotional activities. The initiative can be seen as an attempt to translate to Poland *Solar Europe Now*[38], the European platform for the development of PV manufacturing capacity, bringing together nearly 100 European companies.

- **Bottom-up agreements**

  There are also agreements organised from the bottom-up. These do not meet the definition of sector deals (because one of their parties is not the government), but they have the potential to form the nucleus of such agreements. Among such bottom-up agreements can be found:

  - associations co-founded by companies, local authorities, educational and research institutions and individuals (e.g., Polish Green Building Council - PLGBC),
  - associations co-established by representatives of enterprises and municipalities (e.g., Association of Municipalities Polish Network Energie-Cités - PNEC),
  - organisations representing the business sector (Industry Alliance for Energy Efficiency - POBE, Association of Heating Appliances Manufacturers and Importers in Poland - SPIUG, Association of Mineral Wool Manufacturers - MIWO).

7.4. Sector deal on clean heat

International experience shows that sector deals can be a valuable tool for creating a favourable ecosystem for developing industries and services. Poland has been blazing a trail in this form of cooperation since 2020. Therefore, we recommend that this momentum be used for clean heat measures. Addressing the challenges using a sectoral agreement has a good chance of unlocking the potential of the industries and increasing the benefits of modernisation of district heating, inidvidual heating and green buildings in Poland. We propose crucial elements of such an agreement.

- **The agreement's primary objective** should be to achieve climate neutrality in the field of district heating, inidvidual heating and buildings (with an intermediate target) while supporting and developing Poland's industrial potential (increasing local content in critical technologies and stages of the supply chain). Such an objective is formulated long-term and links climate benefits with socio-economic ones.
- Before an agreement can be concluded, it will be necessary for the government to firmly define the milestones for the transformation of the heating and construction sectors, together with the definition of the key technologies needed to achieve this. The solutions in the sector deal are intended to achieve further milestones.
- **The tasks to be fulfilled** by the committee will include a diagnosis of development barriers in the process of modernisation in the heating sector and key technologies and, above all, working out ways of overcoming them based on a transparent social dialogue. In particular, this means

37 Ministry of Climate and Environment, *Cooperation Agreement for the Development of the Photovoltaic Sector*, 2021, https://www.gov.pl/web/klimat/podpisanie-porozumienia-o-wspolpracy-na-rzecz-rozwoju-sektora-fotowoltaiki.

38 Gramwzielone.pl, *Polskie firmy angażując się w inicjatywę europejskiego sektora PV* [*Polish companies get involved in European PV sector initiative*], 2020, https://www.gramwzielone.pl/energia-sloneczna/102965/polskie-firmy-angazuja-sie-w-inicjatywe-europejskiego-sektora-pv.

harmonising existing legal frameworks and guidelines, disseminating best industry practices and sharing experiences. Given the complexity of the challenges, the work should be organised in several working groups that will propose fleshed-out solutions to address the abovementioned needs.

- It should be emphasised that dialogue with the sector on the part of the administration requires commitment and is time-consuming, although if well-organised, it brings significant benefits. It improves communication, increases the knowledge of both parties, supports the search for pragmatic solutions and creates the conditions for transparent cooperation.
- **Desirable participants in the agreement** include the following groups:
  - Representatives of the public sector: government (ministries dealing with heating and industry), local authorities, and representatives of public procurement units.
  - Representatives of the private sector: energy, construction, manufacturing of goods used in heating and construction, architects and other service companies (including high-tech ones) – the starting point could be already existing bottom-up agreements.
  - Representatives of sectors involved in effectively implementing the objectives, including the scientific and financial sector and labour markets. The organiser of the agreement should be a minister bringing together the competencies of the sectors concerned.
- **The potential benefits** of effective implementation of the agreement will include energy security, increased innovativeness of the economy, improved material situation of Poles (also in post-coal areas) and higher role of social dialogue in shaping national development policy.

8. Summary and recommendations

Modernisation of the heating and construction sectors in Poland is inevitable and will require significant investment outlays. Therefore, it is worth organising this process in such a way to maximise the benefits for the domestic economy. The starting position of producers of goods is very diverse. There are product categories in which we are among the European leaders, but also those in which we have missed opportunities, and regaining them will require increased efforts. We import many products. R&D is not our strength, which – if unchanged – in the future will condemn Poland to develop less favourable niches and stages of supply chains.

Public policy in Poland has considerable room for improvement. Implementation of the proposed changes will first and foremost enable the achievement of climate and environmental objectives in the heating sector and increase local content in areas important for industrial processing, construction and services. However, the removal of barriers to development requires a broader view. It is worth systematising the existing policy of supporting investments, ensuring comprehensive R&D activities, increasing efforts to adjust labour resources to the needs of the energy transition, as well as educating more effectively on climate change and ways of counteracting it. Changes in the abovementioned areas will benefit all of us. We recommend:

1. Creating a clear vision for district and individual heating to achieve climate targets in 2030 and 2050, with a set of documents (national strategies and programmes) available for all to operationalise this vision. Political determination to implement it is also required.
2. Aligning national legislation with ambitious strategic objectives taking into account the economic benefits of the modernisation process.
3. Increasing incentives for low-carbon investments by including external costs and providing tools to enable rational decisions by different market actors.
4. Changing the pricing model for heating services to a system based on the cost of providing thermal comfort.
5. Supporting the development of key technology manufacturing, including green public procurement in line with the EU taxonomy for sustainable activities.
6. The efficient use of EU and EU-ETS funds for district heating modernisation, energy efficiency, and ensuring complementarity between public and private funds.
7. Improvement of the R&D system for increasing the share of highly innovative activities in sectors related to the district and individual heating.
8. Increasing the availability of skilled labour in key sectors through modifications to education systems, facilitating up-skilling and re-skilling, as well as migration policies.
9. Rational support of the energy poor through monitoring and long-term solutions (thermal renovation, replacing heat sources with low-emission ones).
10. Establishing a Clean Heat Sector Deal to improve the information flow among key market actors and remove barriers to sector's organic growth.

9. Appendix

9.1. Survey methodology

We use five research methods in this report. A description of the key assumptions is presented below.

Macroeconomic modelling and ***input-output*** **analysis**

The contribution to GDP and the number of jobs created depend on the level of climate and environmental ambitions. These, in turn, determine the extent of modernisation that must take place in Poland by 2050. Modernisation is about replacing infrastructure and improving the energy efficiency of buildings. It means creating (direct) demand for equipment and services, which further triggers indirect demand for raw materials, materials or semi-finished products. Part of the demand (both direct and indirect) will be met by domestic suppliers (so-called local content), and the rest will be imported.

Indirect demand is estimated using *input-output* analysis. It illustrates how individual industries contribute to the added value and to what extent they use the output of their industry and the other branches of the economy to do so. For this analysis, we focus on flows in six sections:

- *Electrical equipment* – Manufacture of electrical equipment (NACE v.2.0[39] division C27),
- *Machinery and other equipment* – Manufacture of machinery and equipment n.e.c. (C28),
- *Repair and installation* – Repair and installation of machinery and equipment (C33),
- *Construction* – Construction (F),
- *Financial services* – Financial service activities, except insurance and pension funding (K64),
- *Architecture and engineering* – Architectural and engineering activities; technical testing and analysis (M71).

These industries are analysed for their use in three areas: system heat, individual heat, networks and thermal renovation. As a rule, investments in system sources are based primarily on fuel combustion installations (classified as C28), while individual sources are mainly based on electrical appliances (in particular, heat pumps classified as C27).

Table 7. Assumed structure of demand

Division	District heat	Individual heat	Networks and thermal renovation
Electrical equipment	6.25%	73.33%	
Machinery and other equipment	56.25%	6.67%	
Repair and installation	6.25%	4.00%	
Construction	18.75%	2.67%	100.00%
Financial services	3.75%	4.00%	
Architecture and engineering	8.75%	9.33%	
Total	100.00%	100.00%	100.00%

Source: WiseEurope Foundation estimations for Forum Energii.

39 NACE is the statistical classification of economic activities in the EU – NACE v.2.0 is its version valid since 2008.

Depending on the modernisation ambitions and absorptive capacity of the economy, we assume different levels of domestic production shares (Table 8). They were estimated based on the analogous distributions for other large European countries.

Spending PLN 1 million on investments in system heat in 2020 leads to an increase in demand for construction services by over PLN 187,000, of which 90 per cent (PLN 169,000) will go to domestic companies. Depending on the adopted scenario, 15 years later, this impact may remain at the same level (reference scenario), increase to PLN 173,000 (low-emission scenario) or PLN 178,000 (zero-emission scenario). An analogous procedure is carried out for all types of investments.

Table 8. Assumed levels of *local content*

		Initial			Target (linear convergence by 2035)		
Scenario	**Division**	**District heat**	**Individual heat**	**Networks**	**District heat**	**Individual heat**	**Networks**
Reference	Electrical equipment	30%	20%	100%	30%	20%	100%
	Machinery and other equipment	40%	40%		40%	40%	
	Repair and installation	90%	100%		90%	100%	
	Construction	90%	100%		90%	100%	
	Financial services	100%	100%		100%	100%	
	Architecture and engineering	90%	100%		90%	100%	
Low-emission	Electrical equipment	30%	20%	100%	40%	40%	100%
	Machinery and other equipment	40%	40%		45%	40%	
	Repair and installation	90%	100%		93%	100%	
	Construction	90%	100%		93%	100%	
	Financial services	100%	100%		100%	100%	
	Architecture and engineering	90%	100%		93%	100%	
Zero-emission	Electrical equipment	30%	20%	100%	50%	55%	100%
	Machinery and other equipment	40%	40%		50%	70%	
	Repair and installation	90%	100%		95%	100%	
	Construction	90%	100%		95%	100%	
	Financial services	100%	100%		100%	100%	
	Architecture and engineering	90%	100%		95%	100%	

Source: WiseEuropa Foundation estimations for Forum Energii.

When the volume of direct and indirect demand is given, it is possible to estimate the added value (additional contribution to GDP) to the economy from the modernisation of heating and construction. We show it as an absolute amount and relatively to the forecast GDP. The value added linked to labour productivity allows us to estimate the labour demand.

Analysis of economic statistics

In this report, we analyse the situation of producers of selected goods for heating and construction and the situation of companies in selected construction industry segments. We describe them using several indicators:

- **production volume** as a share of Polish production in EU production by PRODCOM categories based on Eurostat data,
- **foreign trade** as the volume and structure of exports, imports and their balance by PRODCOM categories and foreign trade directions based on Eurostat data.

Table 9. Categorisation of products for heating and construction according to PRODCOM

Category	Product	PRODCOM code
District heating networks	Steel tubes and pipes	24.20.11.10, 24.20.11.50, 24.20.12.10, 24.20.12.50, 24.20.13.10, 24.20.13.30, 24.20.13.50, 24.20.13.70, 24.20.14.00, 24.20.21.10, 24.20.21.50, 24.20.22.00, 24.20.23.00, 24.20.24.00, 24.20.32.10, 24.20.32.50, 24.20.33.10, 24.20.33.40, 24.20.33.70, 24.20.34.10, 24.20.34.30, 24.20.34.50, 24.20.34.70, 24.20.35.00
	Plastic tubes and pipes (incl. PE, PP, PEX)	22.21.21.53, 22.21.21.55, 22.21.21.57, 22.21.21.70, 22.21.29.20, 22.21.29.35, 22.21.29.37, 22.21.29.50
	Copper tubes and pipes	24.44.26.30, 24.44.26.50
Individual heat sources	Heat pumps	28.25.12.50, 28.25.13.80
	Stoves and boilers	25.21.12.00, 25.21.13.00, 27.52.12.34, 27.52.12.35, 27.52.12.50, 27.52.12.70, 27.52.20.00
	Heat storage	25.29.11.20, 25.29.11.30, 25.91.11.00
	Water heaters	27.51.25.30, 27.51.25.50, 27.51.25.60, 27.52.14.00
Heating installations	Non-electric radiators	25.21.11.00, 27.52.13.00
	Electric radiators	27.51.26.30, 27.51.26.50, 27.51.26.90
	Hydraulic and pneumatic valves	28.12.14.20, 28.12.14.80
	Pressure reducing, control, check and safety valves	28.14.11.20, 28.14.11.40, 28.14.11.60, 28.14.11.80
	Valves dedicated for radiators	28.14.12.53, 28.14.12.55
	Process control valves (incl. gate, globe, ball, butterfly, diaphragm valves)	28.14.13.13, 28.14.13.15, 28.14.13.33, 28.14.13.35, 28.14.13.37, 28.14.13.53, 28.14.13.55, 28.14.13.57, 28.14.13.73, 28.14.13.75, 28.14.13.77, 28.14.13.80
	Parts for taps, cocks, valves	28.14.20.00
	Heat meters	26.51.52.83, 26.51.52.89
	Others (flow meters, manometers, etc.)	26.51.52.35, 26.51.52.39, 26.51.52.55, 26.51.52.59, 26.51.52.71, 26.51.52.74, 26.51.52.79
	Automation (thermostats, manostats, smart devices, etc.)	26.51.65.00, 26.51.70.15, 26.51.70.19, 26.51.70.30, 26.51.70.90, 26.51.85.50, 27.12.31.30, 27.12.31.50, 27.12.31.70, 27.12.32.03, 27.12.32.05
	Pumps	28.13.14.13, 28.13.14.15, 28.13.14.17, 28.13.14.20, 28.13.14.30, 28.13.14.51, 28.13.14.53, 28.13.14.55, 28.13.14.60, 28.13.14.71, 28.13.14.75, 28.13.14.80
	Heat exchange units	28.25.11.30
District heat sources	Steam and water boilers	25.30.11.10, 25.30.11.50, 25.30.11.70, 25.30.12.30, 25.30.12.50, 25.30.13.30, 25.30.13.50
	Steam turbines	28.11.21.60, 28.11.31.00
	Gas turbines	28.11.23.00, 28.11.33.00
Thermal renovation	Styrofoam	20.16.20.35, 20.16.20.39, 22.21.41.20
	Mineral wools	23.99.19.10
	Other	23.99.19.20, 23.99.19.30
	Windows, doors	25.12.10.30, 25.12.10.50, 16.23.11.10, 16.23.11.50, 22.23.14.50, 23.12.13.30

Source: Forum Energii elaboration.

- **financial standing of producers,** including revenue, profitability, liquidity and debt ratios, investment activity and scale of foreign operations by NACE[40] codes based on Pont Info data,
- **the competitive situation of entities** by NACE (PKD) codes as a result of the fragmentation of the industry and revenue per company, and the origin of capital by NACE codes based on Pont Info data,

Table 10. Categories of producers of goods for heating and construction by NACE

NACE code	Activity	of which products for heating
NACE classes within manufacturing		
2813	Manufacture of other pumps and compressors	Pumps (Heating installations)
2814	Manufacture of other taps and valves	Valves (Heating installations), Parts (Heating installations)
2521	Manufacture of central heating radiators and boilers	Non-electric radiators (Heating installations), Boilers and furnaces (Individual heat sources)
2530	Manufacture of steam generators	Steam and water boilers (District heat sources)
2221	Manufacture of plastic plates, sheets, tubes and profiles	Plastic pipes (Heat distribution networks)
2420	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	Steel pipes (Heat distribution networks)
2444	Copper production	Copper tubes (District heating networks)
1623	Manufacture of other builders' carpentry and joinery	Windows and doors (Thermal renovation)
2223	Manufacture of builders' ware of plastic	
2512	Manufacture of doors and windows of metal	
NACE classes within construction		
4221	Construction of utility projects for fluids	Construction of district heating networks
4322	Plumbing, heat and air conditioning installation	Installation of district heating systems
4329	Other construction installation	Installation of thermal insulation
4332	Joinery installation	Installation of doors and windows

Source: Forum Energii elaboration.

- **selected business barriers** described in the business climate survey (*Business tendency in manufacturing, construction, trade and services*) by Statistics Poland,
- **R&D expenditures** of sectors in relation to EU countries – benchmarks,

40 Provided that the Polish data (PKD) excludes micro-enterprises and firms not completing the F-01 report as well as industries that are subject to statistical confidentiality.

Table 11. Categorisation of producers of goods for the heating and construction by NACE

NACE code	Products	NACE code	Products
C16	wood	C25	metal products
C22	plastic and rubber products	C26	electronics
C23	mineral	C27	electrical equipment
C24	basic metals	C28	other machinery and equipment

Note: In addition, outside manufacturing, F – construction

Source: Forum Energii elaboration.

Within the publicly available statistics framework, it is impossible to separate the information on the production of industrial products, which are delivered only to the heating sector. These products, even taking into account the most detailed possible division of data, are often included in broader groups of products, the recipients of which are various sectors of the economy. One can mention automation or pipes (steel, plastics, copper), for which the heating sector is often a secondary source of demand. Apart from the issue of data availability, such an approach allows us to have a broader look at the production potential of the Polish industry in terms of possibilities of satisfying the rapidly growing needs of the heating sector in the future.

Case studies

In the report, we rely on foreign examples of good practice to use what has been proven and avoid repeating costly mistakes in Polish modernisation. We cite 20 solutions – mainly from Denmark and Germany (which in the last 40 years have carried out a comprehensive reconstruction of district heating systems), the Netherlands (experience in rapid, scalable retrofitting), and the United Kingdom (effective sector deals resulting in the modernised heating sector in an economy- and environmentally-friendly manner).

Survey and interviews with business representatives

An online survey was conducted among its representatives to find out the motivations of companies in the sector. The total sample amounted to 12, and the topics focused on the development barriers and needs indicated by the companies operating in the analysed sectors today, as well as the evaluation of the public support provided so far.

The survey was supplemented by online interviews with eight experts – representatives of industry associations. During the interviews, we asked about development trends shaping the industry's future, high-potential technologies, challenges in developing low-carbon technologies, public support for companies and their effectiveness, and desired directions for public intervention.

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Notes

Notes

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