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Key findings

- **Implementing the "Fit for 55" package is the biggest challenge for the European economy after the pandemic.** The estimated annual costs of investments in the energy sector needed to reduce emissions by 55% are EUR 350 billion higher than in 2011-2020. In total, investments in the years up to 2030 will cost almost EUR 5 trillion. This stimulus will help rebuild the economy after the current crisis caused by COVID-19 and speed up the transition to a climate-neutral economy.
- **Of the Delphi theses, Polish experts deemed the thesis concerning reducing CO_2 emissions by 55% compared to 1990** (the thesis importance indicator was 96 points out of 100) and the thesis concerning increasing the share of energy from renewable sources in gross final energy consumption to over 40% (91 points) the most important for the EU's energy transition. **For the experts, the least important thesis concerning decreasing the share of nuclear energy in energy production to less than 20%** (58 points). The experts' arguments concern the benefits of a stable share of nuclear energy sources in the power system. According to the experts, in richer EU countries, some of the nuclear capacity may be replaced by renewable energy. However, in countries where the share of coal-fired power plants is still high, they will be partially replaced by nuclear power plants.
- **The only thesis that the Polish experts who participated in the study did not agree on was the one concerning reducing the share of nuclear energy in energy production to less than 20%. According to as many as one in three experts, this will not take place.** Experts who were sceptical of the thesis pointed out that the phase-out of nuclear power units is accompanied by the construction of new ones and that, in many cases, the retreat from nuclear power is of a cyclical nature. Nuclear energy will be needed to replace coal-fired power plants.
- **In the experts' opinion, the implementation of the Delphi theses is primarily conducive to high spending, both EU and national.** Among the most important barriers to the implementation of the theses in this study, experts also cited financing. The respondents deemed the high costs of implementing innovative technology another significant barrier.

Key numbers

89% of Polish experts deemed reducing CO_2 emissions by 55% compared to 1990 very important for the EU's energy transition

2032 – the year when the EU will reduce CO_2 emissions by 55% compared to 1990, according to the experts (median response). The EU's official target is 2030

33% of the experts believe that the share of nuclear energy in electricity production in the EU will never fall below 20%

86 points (on a scale of 0 to 100) – importance indicator of the factor deemed the most important by experts for implementing the Delphi theses: *High spending on green investments as part of EU funds*

18% of the experts believe that at least ten EU countries will achieve climate neutrality by 2040

30% of the experts believe that fossil fuels will no longer be burnt in EU cities by 2030

Key years

2045

→ At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions)

2044

→ The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%)

2041

→ Fossil fuels will no longer be burnt in EU cities

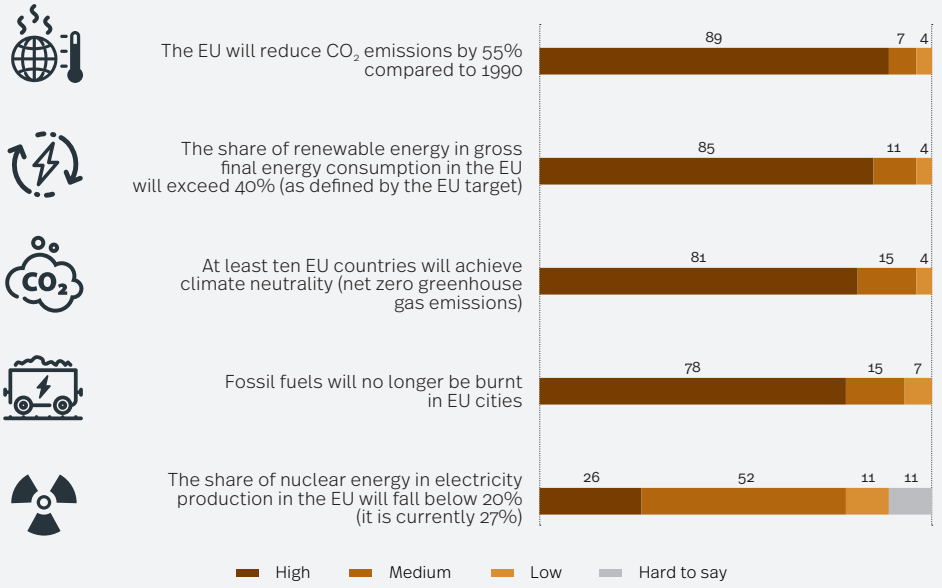
2035

→ The share of renewable energy in gross final energy consumption in the EU will exceed 40% (as defined by the EU target)

2032

→ The EU will reduce CO_2 emissions by 55% compared to 1990

The theses' importance



Introduction

The European Union is the world leader in terms of its commitment to fighting climate change. The EU aims to become the first climate neutral territory by 2050 (www1). To achieve this, the European Commission proposed to increase the target of reducing CO_2 emissions by 55% in 2030 (compared to 1990). It will require huge investment, estimated at around EUR 500 billion per year (EUR 350 billion more than in 2011-2020) (www2, www3). Until then, a strategy with steps for the years in between is needed. In mid-July, the European Commission (EC) presented the "Fit for 55" package, which contains 13 legislative steps to reduce emissions by 55%[1] by 2030 (www4). The proposed solutions also include a Social Climate Fund to support citizens when it comes to financing investments related to the transition. It will be made up of 25% of the funds from the ETS in new sectors and provide member states with EUR 72.2 billion for 2025-2032 (www5). Not all of the member states agree with all the EC's proposals (www6). There are also doubts about whether the target of climate neutrality by 2050 can be achieved with the assumed initiatives (www7). The changes in the package are undoubtedly the greatest challenge for the European economy, which has been weakened by the COVID-19 pandemic and the resulting economic crisis. However, the goal of achieving climate neutrality will remain unchanged. The post-recession recovery is meant to serve as a kind of leverage for the development of a more resilient and competitive European industry based on environmental principles.

In this study, we would like to share our research carried out using the Delphi method, in which we asked external experts for their opinions on what are, in our opinion, five key theses for the EU's energy transformation. The theses were developed in consultation with a selected narrow group of experts, which will be referred to as the Steering Committee. 27 Polish experts on energy and climate took part in the foresight survey. The questions in the electronic survey concerned the five Delphi theses. The experts' task, in addition to assessing the importance of a given thesis for the energy transition, was to determine the time, factors, and barriers to its implementation. The report includes an analysis of the results of the Delphi survey, with the experts' responses presented in tabular and graphical form, along with an analysis of their comments and opinions.

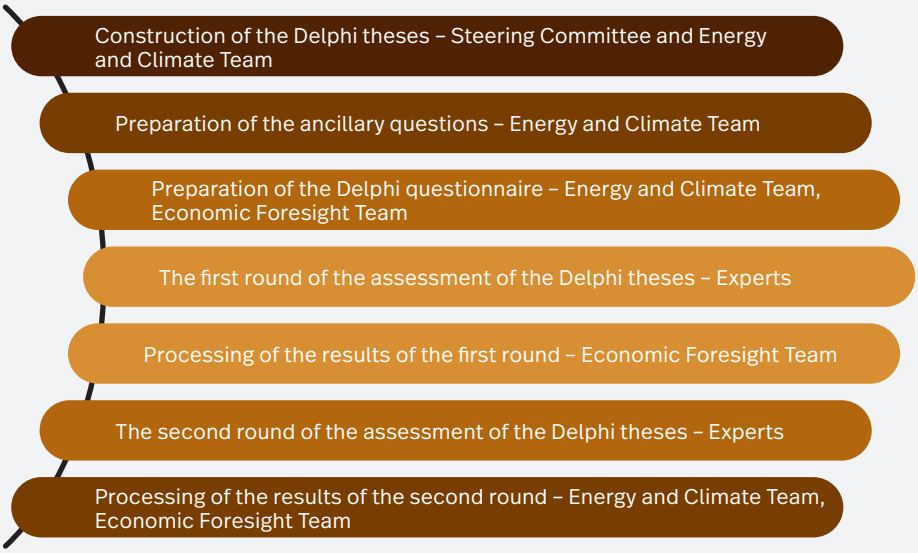
The first area studied contains theses on the EU's fundamental energy and climate goals. In the second area, we asked experts about what we consider the fundamental sources and technologies that need to be taken into account when implementing the goals mentioned in the first area. Similar areas were addressed in the first part of our study "Energy Foresight – Poland". The form of the study and the experts' capabilities mean that, in the part of the study on Europe, we limited ourselves to a smaller number of theses than in the study on Poland.

[1] Compared to emissions in 1990.

Research method

The research in this report is based on the Delphi method, a type of expert survey where experts' intuitive opinions are treated as a legitimate contribution to formulating a vision of the future for the research subject. The method is used to predict the development of long-term phenomena amid the uncertainty, especially when: (I) the predicted phenomena do not lend themselves to analytical techniques characteristic of forecasting, (II) there is no reliable data on the anticipated processes, or (III) external factors have a decisive impact on the predicted phenomena (Nazarko, 2013, p. 46). The research method involved seven stages (Figure 1).

↘ Figure 1. Research method



Source: prepared by PEI.

In the first stage, PEI analysts and the five-member Steering Committee prepared five Delphi theses relating to the future development of energy in Europe.

In the second stage, the theses were subject to final verification and the PEI Energy and Climate Team's experts prepared auxiliary questions for the theses, concerning factors conducive to their theses realization, as well as the barriers. This enabled the Delphi questionnaire to be developed (stage three). The questionnaire was used to conduct the first round of the assessment of the Delphi theses (stage four) by 27 experts in the form of a CAWI (Computer Assisted Web

Interviewing) survey. The selected technique has many advantages. The most important ones include:

- the logical correctness of the data is automatically verified,
- the test results are automatically saved on the server,
- research is possible to be carried out among groups of respondents scattered across a large geographical area.

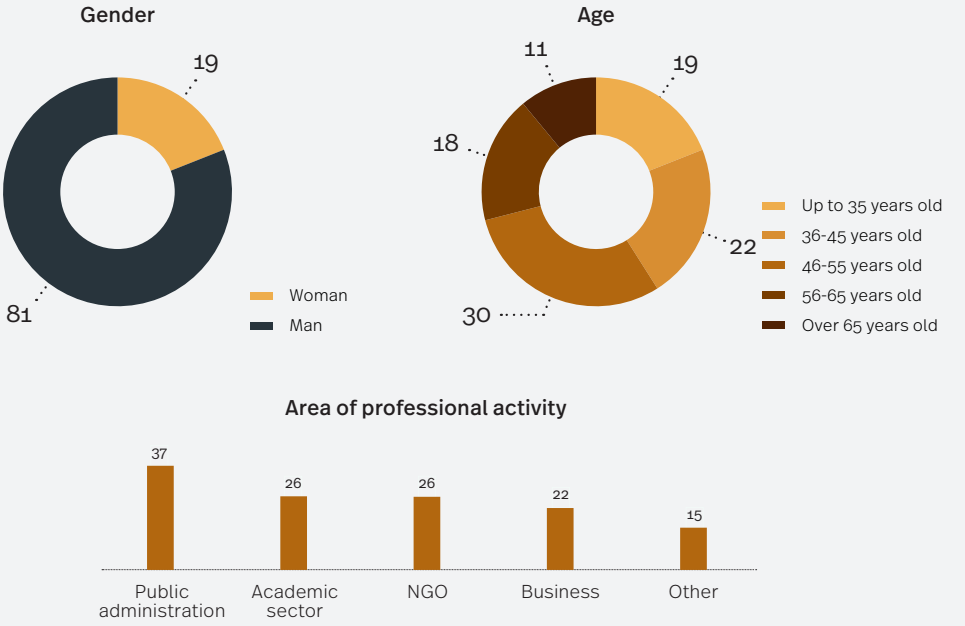
The experts for the Delphi study were chosen by purposive sampling. It was assumed that the group would consist of eminent representatives from science, business, NGOs, and the public administration.

From these groups, 114 experts were selected and invited to participate in the study; 27 of them agreed to take part (see the list of experts in Appendix 1). Taking part in a study conducted using the Delphi method requires a considerable time commitment and work from experts. These factors were often the reason that some declined to participate in the study.

The fifth stage involved processing the results of the first round of the Delphi study and presenting the results to a group of the same experts in the second round (sixth stage). In Delphi studies, successive rounds of questions are used to obtain results that are as unambiguous as possible. The second round enabled the experts to verify their opinions by reading the distribution of responses in the first round. The final results obtained in the second round were analysed in detail during stage seven.

The group of respondents was made up of 5 women and 22 men of different ages (Infographic 1). Almost one-third of them were aged between 46 and 55. The youngest respondents (up to 35 years of age) accounted for 19% of the group and the eldest (over 65) for 11%. The experts represented various areas of professional activity, and some of them several. 7 represented science, 6 business, 7 NGOs, and 10 public administration. In addition, four people listed other areas of activity, including consulting and research institutions.

↘ Infographic 1. Structure of the sample by sex, age and area of professional activity (%)



Source: prepared by PEI.

For the purposes of the report and big data analysis, we presented some of the questionnaire variables port in the form of indicators that synthesise and organise the results of a larger number of detailed observations.

To determine the individual theses' strategic importance for the development of the energy sector in the country or in Europe, importance indicators (WZ) were determined using the formula:

$$W_Z = \frac{100 \cdot n_H + 50 \cdot n_M + \cdot 0 \cdot n_L}{n - n_{HTS}} \quad (1)$$

where:

n_H "high" – number of responses,
n_M "medium" – number of responses,
n_L "low" – number of responses,
n_{HTS} "hard to say" – number of responses,
n total number of responses.

The indicator ranges from 0 to 100; the closer its value is to 100, the greater the strategic importance assigned to a given thesis.

Moreover, indicators relating to the influence of factors (WC) on the implementation of the phenomenon described in the thesis were determined. The indicators were calculated using the formula:

$$W_C = \frac{100 \cdot n_{VH} + 75 \cdot n_H + 50 \cdot n_M + 25 \cdot n_L + 0 \cdot n_{VL}}{n - (n_{NO} + n_U)} \quad (2)$$

where:

n_{VH} "very high" – number of responses,
n_H "high" – number of responses,
n_M "medium" – number of responses,
n_L "low" – number of responses,
n_{VL} "very low" – number of responses,
n_U "factor unrelated to the thesis" – number of responses,
n_{NO} "no opinion" – number of responses,
n total number of responses.

Indicators relating to the impact of barriers on the implementation of the issues raised in the thesis (WB) were also determined. The indicators were calculated using the formula:

$$W_B = \frac{100 \cdot n_{VH} + 75 \cdot n_H + 50 \cdot n_M + 25 \cdot n_L + 0 \cdot n_{VL}}{n - (n_U + n_{NO})} \quad (3)$$

where:

n_{VH} "very high" – number of responses,
n_H "high" – number of responses,
n_M "medium" – number of responses,
n_L "low" – number of responses,
n_{VL} "very low" – number of responses,
n_U "factor unrelated to the thesis" – number of responses,
n_{NO} "no opinion" – number of responses,
n total number of responses.

The indicators range from 0 to 100. A number above 50 means that the factor is favourable in the case of WC or, in the case of WB, that it makes it more difficult to implement the thesis. Indicators below 50 indicate that a factor has a low impact when it comes to supporting or hindering the implementation of a thesis.

Meeting the EU's targets of CO_2 emissions reduction

The European Green Deal is a collection of the European Commission's political initiatives undertaken to combat climate change. It is supposed to result in the creation of a modern and competitive economy with very efficient use of resources. Its objectives are: to achieve zero net greenhouse gas emissions by 2050, to separate economic growth from resource use, and social and regional equality. The European Green Deal is also a way out of the pandemic crisis. Over 30% of the funding for the plan will come from the NextGeneration fund and from the EU budget for 2021-2027 (EC, 2021).

Every ten years, member states are required to present long-term national strategies in line with the commitments in the Paris Agreement and declarations on establishing an energy union. The transition is meant to cover all the areas of the economy that emit greenhouse gases, including the electricity sector, industry, transport, heating and housing, agriculture, waste management, and land use, land-use change, and forestry) (LULUCF) (www8).

Climate neutrality means achieving a balance between greenhouse gas emissions and their absorption from the air. On the one hand, it is crucial to reduce emissions; on the other hand, it is necessary to use carbon dioxide sinks. The EC sees the possibility to develop technologies that can capture and sequestrate carbon dioxide, especially for countries with significant geological deposits of fossil fuels and those increasing energy production (www9). Forests and soil are also natural carbon sinks.

The experts were presented with the following Delphi theses regarding the reduction of CO_2 emissions by EU countries:

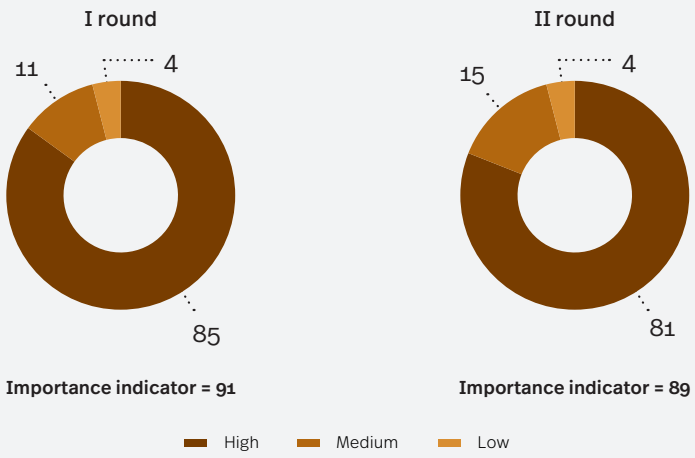
- → At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions)
- → The EU will reduce CO_2 emissions by 55% compared to 1990

Thesis: At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions)

As part of achieving the European Green Deal's objectives, the EC wants the EU to become climate neutral by 2050. In 2018, it presented a long-term strategy outlining the road to climate neutrality. The strategy involves investing in new technologies, empowering citizens, and aligning policy responses in key areas such as industrial policy, finance, and research. The EC's vision is in line with the goal of the Paris Agreement, keeping the increase in temperature significantly below 2°C and attempting to reduce this increase below 1.5°C (EC, 2018). Some European countries have set their climate neutrality targets. Sweden (2045), Austria (2040), and Finland (2035) intend to achieve it before 2050.

The vast majority of experts in both rounds of the study deemed the achievement of climate neutrality by at least ten EU countries very important for the energy transition (Figure 1). 81% of respondents thought so and the importance indicator was 89.

↘ Chart 1. **Importance of the thesis: At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions) – comparison of two rounds of the Delphi study (%)**



Source: prepared by PEI.

Experts who deemed this thesis very important pointed out that the achievement of climate neutrality by ten countries would set a good example for other member states. They also noted that almost all of the EU's 27 member states have already set a target date for achieving climate neutrality. Going deeper into the energy transition process, they stated

that the greatest barrier to achieving this goal will be transforming agriculture and transport and that the transition to a zero-emission energy system is a prerequisite for climate neutrality. Examples of the arguments used by the experts include:

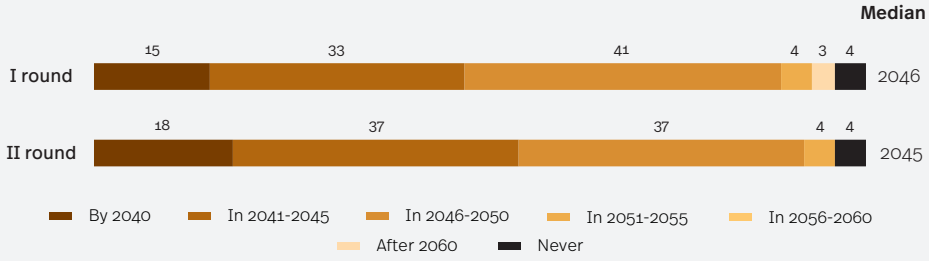
> *This is a strong signal that climate neutrality is not only on paper; it is actually happening.*
>
> *Showing social awareness and responsibility for the environment.*
>
> *If 10 countries (37% of all the EU countries) achieve climate neutrality, the pressure on other countries to accelerate the energy transformation will increase and shorten the time before the EU achieves climate neutrality, compared to the current 2050.*

Selected comments by the experts

Experts who deemed the achievement of climate neutrality by ten EU countries not very important stated that how much emissions are reduced is more important than how many countries will achieve climate neutrality.

According to half of the experts, the achievement of climate neutrality by at least ten EU countries will not take place before 2045 (Figure 2). The largest number of experts believe that it will take place in 2041-2045 (37%) or 2046-2050 (37%). Only a small percentage (4%) believe that it will never happen.

↘ Chart 2. **Time for the following thesis to be implemented: At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions) – comparison of two rounds of the Delphi study (%) and median value of the needed realisation time (years)**



Source: prepared by PEI.

Experts who stated that climate neutrality will be achieved earlier believe that countries that develop renewable energy intensively stand a chance. At the same time, a significant

share of nuclear energy in the country's energy mix is helpful. Experts who thought that climate neutrality will be achieved later pointed out that the EU target is 2050 and that it entails huge costs. Examples of the arguments used by the experts include:

> *Some countries stand a chance of achieving climate neutrality before 2040. Nevertheless, the overwhelming majority will start to achieve this goal in 2041.*

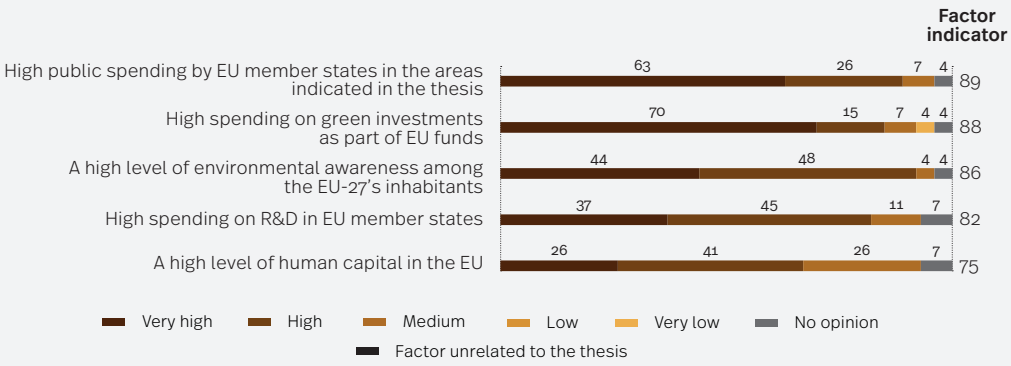
> *Many countries can reduce emissions by > 90% by 2040, but removing the final few percent of fossil fuels from the energy mix is the hardest. The same applies to process emissions from agriculture and industry.*

> *It will depend on the understanding of this process – it seems that the ability to buy something like emission removal units will be key here.*

Selected comments by the experts

Experts believe that the achievement of climate neutrality by at least ten EU countries will primarily be supported by high public spending by EU member states on this purpose (Chart 3). As many as 89% deemed this factor very significant; the indicator was 89 points. High spending on green investments as part of EU funds (88 points) and a high level of environmental awareness among the EU-27's inhabitants (86 points) will be very important, too. The high level of human capital in the EU (75 points) will have the lowest impact. The experts also highlighted the impact of fossil fuel prices, geopolitical stability, public awareness and assistance measures, and pressure from the international community.

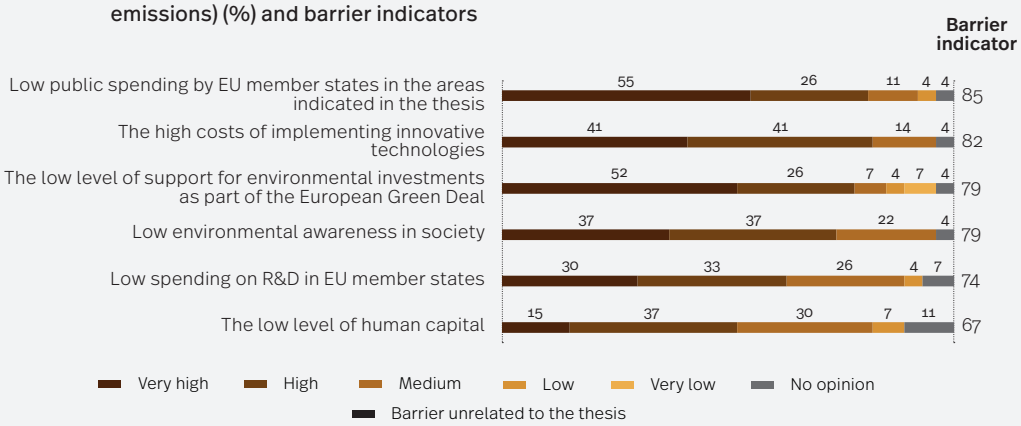
↘ Chart 3. **Influence of factors supporting the implementation of the thesis: At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions) according to experts (%) and the factor indicators**



Source: prepared by PEI.

According to experts, the biggest barriers hindering the achievement of climate neutrality by at least ten EU countries are low public spending in EU member states in the area indicated in the thesis (barrier indicator 85 points) and the high costs of implementing innovative technologies (82 points) – Chart 4. The smallest problem is the low level of human capital (67 points). Experts also deemed attachment to fossil fuels, especially natural gas, and political influence, both in individual countries and at the EU level, potential barriers.

↘ Chart 4. **Influence of barriers making it more difficult for the following thesis to be implemented: At least ten EU countries will achieve climate neutrality (net zero greenhouse gas emissions) (%) and barrier indicators**



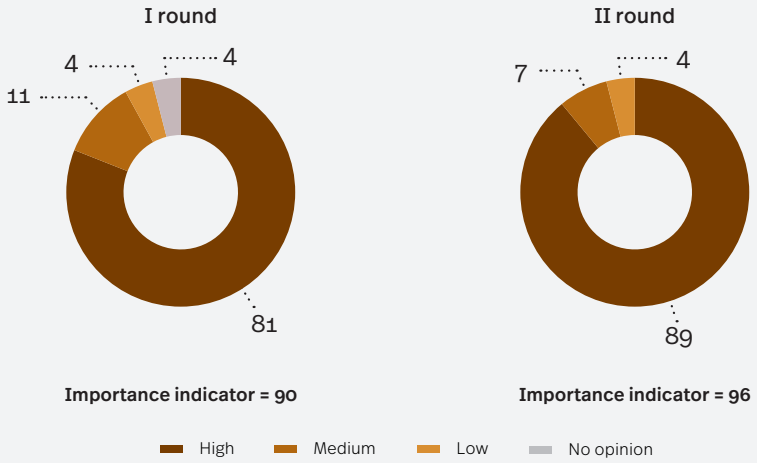
Source: prepared by PEI.

Thesis: The EU will reduce CO_2 emissions by 55% compared to 1990

One of the objectives of the European Green Deal is climate neutrality, which requires reducing CO_2 emissions. On 14 July, the EC adopted a package of legislative proposals to adopt EU climate, energy, transport, and tax policy to the goal of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 (EC, 2021). The year 1990 adopted as the base is in line with the one adopted in the Kyoto Protocol. In the ETS system, changing the reduction target will result in a reduction in the supply of emission allowances, which will increase their prices and, as a result, decrease greenhouse gas emissions (Luboińska, 2020).

The vast majority of experts (89%) deemed reducing CO_2 emissions by 55% compared to 1990 very important for the energy transition (Chart 5). The thesis importance indicator was very high, too (96 points). Experts who considered this thesis important argued that reducing greenhouse gas emissions, along with a significant improvement in energy efficiency and the development of renewable energy sources, constitutes the essence of the energy transition

↘ Chart 5. Importance of the thesis: The EU will reduce CO_2 emissions by 55% compared to 1990 – comparison of two rounds of the Delphi study (%)



Source: prepared by PEI.

in the climate dimension. Such a large reduction in emissions will lead to a change in the technology used to generate electricity, first from coal to gas and renewable sources, followed by a complete departure from all fossil fuels. Examples of the arguments used by the experts include:

> *Meeting this target requires significant emission reductions where it is easiest to achieve. The energy sector is among the ones with the greatest potential when it comes to reducing emissions and implementing a zero-emission economy.*

> *The reduction of CO_2 is clearly linked to the energy transition.*

Selected comments by the experts

Experts for whom reducing CO_2 emissions was of medium or low importance for the energy transition pointed out that reducing CO_2 emissions is a climate goal, whereas – in the process of the energy transition – it is also extremely relevant to guarantee uninterrupted energy supplies at an acceptable price.

> *It's just a matter of numbers; it's important to find an effective way to achieve climate neutrality.*

Selected comment by the expert

According to half the experts, the reduction in CO_2 emissions will take place no later than 2030. 45% of them said 2026-2030 and 37% 2031-2035 (Chart 6). Only a few percent believed that it would place later or never.

Experts who chose the earliest implementation period (2026-2030) argued that the tools implemented at the moment, including the EU ETS, allow for an appropriate reduction in emissions within the set deadline if appropriate actions are taken by member states. However, this may lead to social costs, such as increasing energy poverty, or the collapse of regions with a dominant mining and quarrying industry. Examples of the arguments used by the experts include:

> *The rapid fossil fuels elimination (especially coal) in industry and heating will be offset by a slower reduction in emissions from transport and agriculture.*

> *In the case of Poland, the key is to reduce the use of coal, which will already contribute to the reduction of CO_2 significantly.*

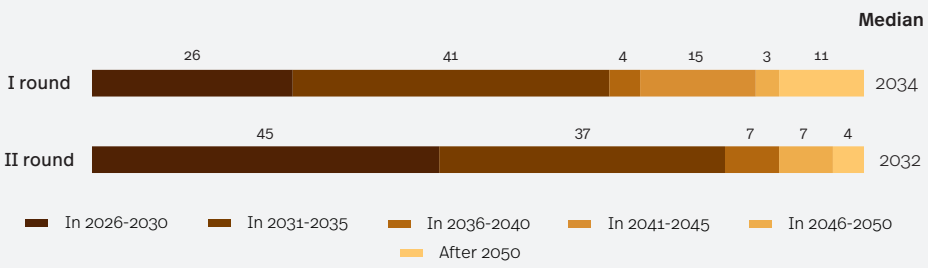
Selected comments by the experts

Experts who deemed 2031-2035 the most likely timeframe for implementing the thesis pointed out that there is a serious risk that this goal will be achieved "with slight slippage"; that is, in the early 2030s. The goal is very ambitious and the intensification of activities needed will lead to results that will be considerably delayed. Examples of the arguments used by the experts include:

> *There is a chance that this target will be met by 2030, but there may be a slight delay. The financial resources already planned for – as well as legal and institutional solutions that, in my opinion, will speed up this process – are important. If that happens, we will have a snowball effect.*

Selected comment by the expert

↘ Chart 6. **Time for the following thesis to be implemented: The EU will reduce CO_2 emissions by 55% compared to 1990 – comparison of two rounds of the Delphi study (%) and median time needed (years)**

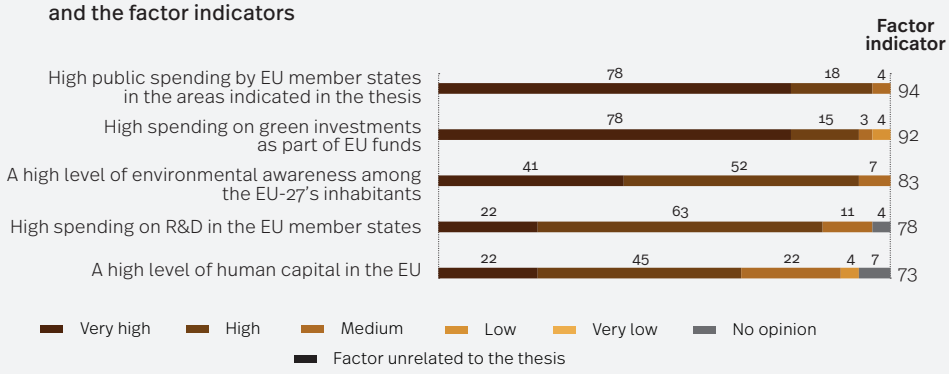


Source: prepared by PEI.

The small percentage of experts who thought that emissions would be reduced later stated that there are at least 10 countries in the EU that may struggle to meet this target, so the EU might reduce CO_2 emissions by 55% compared to 1990 after 2050 at the earliest.

The experts believe that the reduction of CO_2 emissions will mainly be supported by: high public spending by EU member states in this area (96% indications of very high and high importance, factor indicator 94 points) and high spending on green investments within the framework of EU funds (92 points) – Chart 7. A high level of environmental awareness among the EU's inhabitants (83 points) will be slightly less important, followed by high R&D funding in EU member states (78 points) and a high level of human capital in the EU (73 points). Experts also pointed out that the reduction of emissions is influenced by the prices of fossil fuels and the prices of greenhouse gas emission allowances.

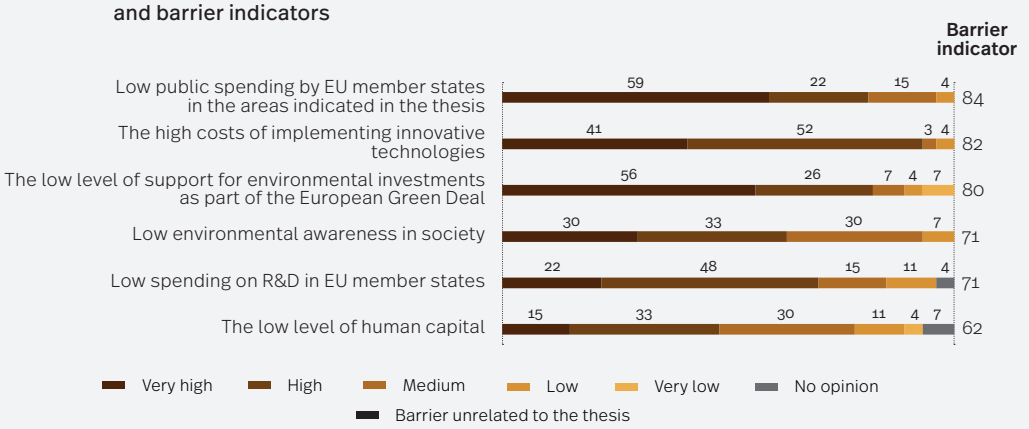
↘ Chart 7. **Influence of factors supporting the implementation of the thesis: The EU will reduce CO_2 emissions by 55% compared to 1990 according to experts (%) and the factor indicators**



Source: prepared by PEI.

According to experts, the largest barriers to reducing CO_2 emissions are low public spending in EU member states on the areas indicated in the thesis (81% indications of very high and high importance, barrier indicator 84), the high costs of implementing innovative technologies (82 points) and low support for green investments as part of the European Green Deal (80 points) – Chart 8. The low level of human capital is considered the least important (62 points). As an example of an additional barrier, experts indicated attachment to fossil fuels, especially natural gas.

↘ Chart 8. **Barriers making it more difficult for the following thesis to be implemented: The EU will reduce CO_2 emissions by 55% compared to 1990 according to experts (%) and barrier indicators**



Source: prepared by PEI.

Change in the structure of energy production and consumption

Overall energy consumption in the EU has been declining in recent years. Of all the energy available in the EU, oil and natural gas remain the dominant fuel. The share of renewable energy sources (RES) has been increasing steadily and has exceeded the share of solid fossil fuels since 2018. Nuclear energy consumption is slightly below that of solid fossil fuels. In the case of electricity, the share of RES in the EU has more than doubled since 2000 and has the largest share in the structure of energy production. Nuclear energy and solid fossil fuels are second (Eurostat, 2020). Three types of energy sources – renewable energy, nuclear energy, and fossil fuels – were included in the theses that the experts were asked about.

The Delphi theses on fossil fuel replacement, production, and consumption structures presented to the experts:

- → The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%)
- → The share of renewable energy in gross final energy consumption in the EU will exceed 40% (as defined by the EU target)
- → Fossil fuels will no longer be burnt in EU cities

Thesis: The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%)

Despite the controversy caused by nuclear energy, especially in the EU forum, some of the experts cannot imagine that climate change can be halted without increasing the share of nuclear energy. The new president of the United States, Joe Biden, assigns nuclear energy a significant role in his programme for a sustainable and clean energy future worth an estimated USD 2 trillion. Small modular reactors (SMRs) occupy a special place in this plan by (www10). The European Commission has also shown interest in this type of technology (www11). Progress in this area may result in the spread of nuclear energy for climate purposes and the development of distributed energy.

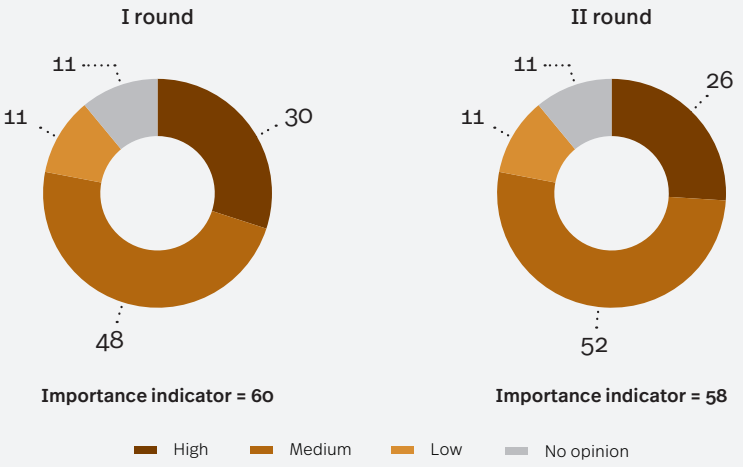
Most of the experts (52%) concluded that the fall in the share of nuclear energy in electricity production in the EU below 20% is of medium importance for the energy transition (Chart 9). The importance indicator for this thesis (58 points) was also lower than for the other theses concerning the substitution of fossil fuels. Experts who pointed to its medium importance justified this by pointing out that nuclear energy will be

a stable part of the energy mix. In countries where the share of nuclear energy declines, it will be replaced by other low-carbon sources, and in countries where nuclear energy will replace coal, emissions will be reduced. Examples of the arguments used by the experts include:

> *Cheap RES will push out nuclear energy, especially in countries with a high share of it.*

Selected comment by the expert

↘ Chart 9. **Importance of the thesis: The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%) according to the experts – comparison of two rounds of the Delphi study (%)**



Source: prepared by PEI.

Just 26% of the experts claimed the decline in the share of nuclear energy in the energy mix was very significant. They noted that climate neutrality is unlikely to be achieved without nuclear energy, but that it is not an alternative to the energy transition. Nuclear energy is expensive and inflexible, and it takes a long time to build. There are also problems with radioactive waste. Examples of the arguments used by the experts include:

> *A 'green' alternative to the decommissioned nuclear power units must be found.*

> *This will force (but also enable) RES to develop more rapidly.*

Selected comments by the experts

Few experts (11%) considered the decrease in the share of nuclear energy of low importance. They primarily argued that, based on the current level of development of electricity generation technologies, nuclear technologies constitute a real alternative to coal and gas technologies in stabilizing the system operation. Examples of the arguments used by the experts include:

> *An extreme scenario for the development of the energy sector (without nuclear technologies) is the development of microsystems (distributed energy) operating independently of each other.*

> *There is no alternative to primary sources of electricity other than nuclear energy. This means that the share of nuclear energy in electricity production in the EU should not fall below 20%.*

Selected comments by the experts

In their opinions on the importance of nuclear power, the larger percentage of experts who were unable to define its importance – compared to that of the other theses – is also striking. The 11% of experts who chose this option argued that the share of nuclear energy in EU energy production is the result of many factors, including an increase in the share of RES in the energy mix, the decommissioning of some nuclear units, and political will in individual countries. There is therefore no direct correlation between nuclear energy in the EU and the energy transition.

According to half of the experts, the share of nuclear energy in electricity production in the EU will not fall below 20% before 2044 (Chart 10). 39% of the experts say that the share will fall no sooner than 2040. They believe that many EU countries will strive to continue to produce energy from nuclear sources for as long as possible. In addition, until efficient and cheap energy storage is developed, nuclear power is the only source stabilising energy systems after the fossil fuels used to produce electricity are abandoned. Examples of the arguments used by the experts include:

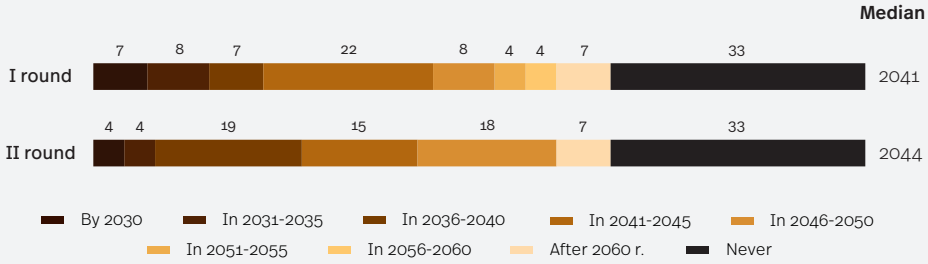
> *Nuclear energy is more expensive and inflexible and takes a long time to build. There are still problems with radioactive waste, too. It is therefore not an alternative in the context of the rapid development of the distributed generation market, community energy, and the significant potential for improving energy efficiency.*

> *Since there is no alternative to primary sources of electricity other than nuclear energy, I do not see the share of nuclear energy in electricity production in the EU soon falling below 20%.*

Selected comments by the experts

Just 27% of the experts thought that the decrease in the share of nuclear power is likely to take place before 2040. They pointed to how it will be replaced by renewable sources, but also to how many EU countries will strive to maintain a larger share of nuclear energy for as long as possible.

↘ Chart 10. **Time for the following thesis to be implemented: The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%) according to the experts – comparison of two rounds of the Delphi study (%) and median time needed (years)**



Source: prepared by PEI.

Interestingly, as many as one in three experts believe that the share of nuclear energy in electricity production will never fall below 20%. They pointed out that the phase-out of nuclear power units is accompanied by the construction of new ones, and that the retreat from nuclear power has been of a cyclical nature in many cases. Nuclear energy will be needed to replace coal-fired power plants. Examples of expert statements were as follows:

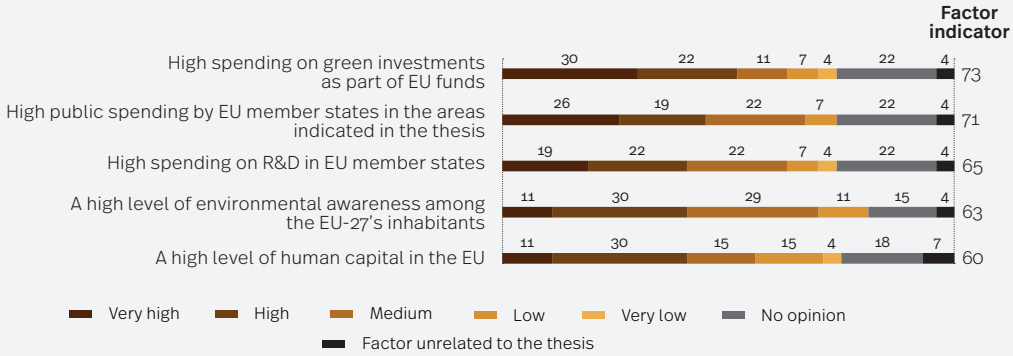
> *Certain countries will never abandon nuclear energy as a stabiliser of their energy systems when they move away from an energy based on fossil fuels.*

> *I expect nuclear energy to develop with SMR technologies.*

Selected comments by the experts

The experts believed that the decline in the share of nuclear energy in electricity production in the EU below 20% will primarily be supported by high spending on green investments within the framework of EU funds (52% indications of very high and high importance, factor indicator 73 points) and high public spending by EU member states in this area (71 points) – Chart 11. They considered high spending on R&D in the EU member states (65 points) and a high level of environmental awareness among the EU27's inhabitants (63 points) less significant. The high level of human capital in the EU (60 points) was deemed the least important. The experts also pointed to the impact of energy and climate policy at the EU and national levels and on the price of EU ETS allowances and fossil fuels.

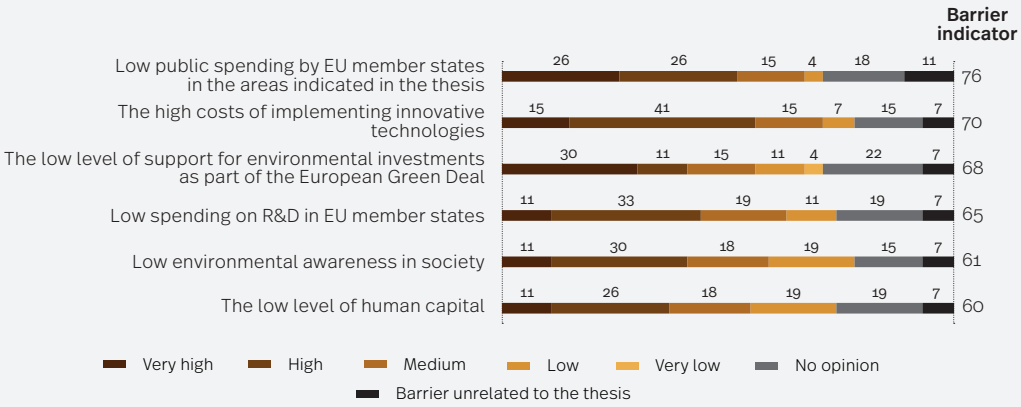
↘ Chart 11. **Influence of factors supporting the implementation of the thesis: The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%) according to the experts according to experts (%) and the factor indicators**



Source: prepared by PEI.

According to experts, the key barriers to a decrease in the share of nuclear energy are low public spending on nuclear energy in EU member states (52% indications of very high and high importance, barrier indicator 76 points), the high costs of implementing innovative technologies (70 points) and the low level of support for environmental investments as part of the European Green Deal (68 points) – Chart 12. The other factors will have a slightly smaller impact. In addition, the experts pointed to the importance of individual EU countries' policies and the level of investments needed to continue producing energy from nuclear sources.

↘ Chart 12. **Influence of barriers making it more difficult for the following thesis to be implemeted: The share of nuclear energy in electricity production in the EU will fall below 20% (it is currently 27%) according to experts (%) and barrier indicators**



Source: prepared by PEI.

Thesis: The share of renewable energy in the EU's gross final energy consumption will exceed 40% (as defined by the EU target)

In the "Fit for 55" package, the European Commission proposed to increase the target for the share of renewable energy in the EU from 32% to 40% by 2030 (www12). In addition to the energy sector, the guidelines apply to transport, heating and cooling, and buildings and industry. All the member states will help meet the target to a given extent. Such ambitious plans require financial and regulatory support.

Most of the experts consider increasing the share of renewable energy sources in final energy consumption very important for the energy transition (85%). The importance indicator for this thesis was also very high: 91 points. (Chart 13). The experts justified their position by stating that increasing the share of renewable energy sources is crucial for the energy transition and for achieving climate neutrality. This will allow countries to stop using solid fuels to a large extent (apart from nuclear energy, which will be the second zero-emission pillar of the EU mix). Energy from renewable sources, along with energy storage, constitutes the basis for the energy transition. Examples of the arguments used by the experts include:

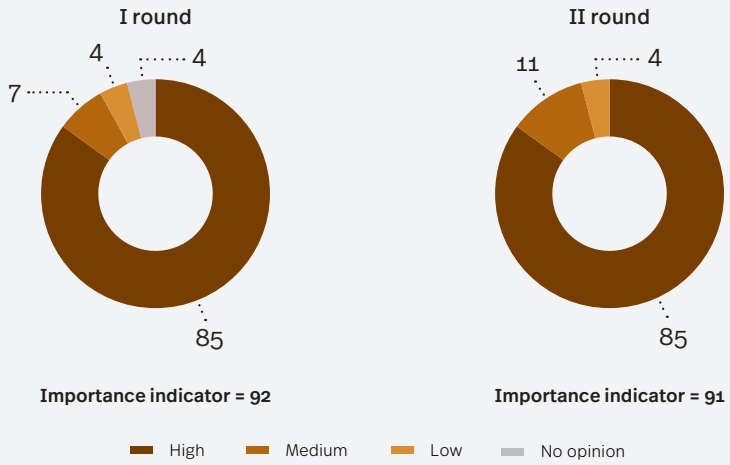
> *RES is crucial for the transition and for achieving climate neutrality.*

> *Such a significant share of renewable energy sources in energy consumption will be strongly correlated with the volume of energy from renewable sources produced, which is related to the reduction of the share of coal in the energy sector.*

Selected comments by the experts

Only 15% of the experts considered increasing the share of energy from renewable sources of medium or low importance, arguing that the increase in electricity consumption, coupled with the limited possibility of producing energy from biomass, raises doubts about whether this target will be achieved.

↘ Chart 13. Importance of the thesis: The share of renewable energy in the EU's gross final energy consumption will exceed 40% (as defined by the EU target) according to the experts – comparison of two rounds of the Delphi study (%)



Source: prepared by PEI.

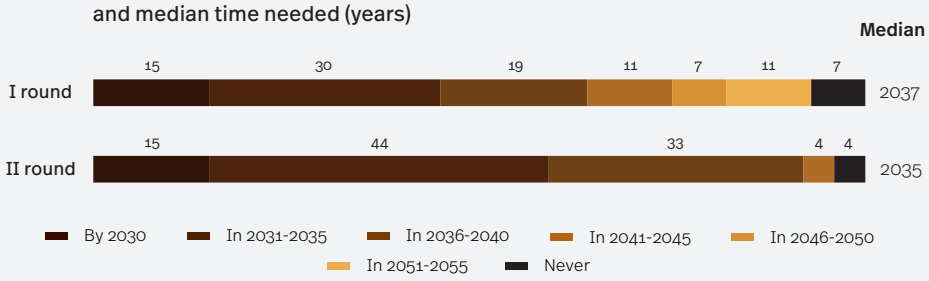
Half of the experts think that the share of RES in final energy consumption in the EU will exceed 40% by 2035 (Chart 14). 44% believe that this will happen in 2031-2035, arguing that the growing prices of emission allowances will stimulate the development of RES. Technological progress, the development of cheap energy storage, and the digitisation of energy management are important prerequisites for the rapid development of RES. Examples of the arguments used by the experts include:

> *Technological progress is significant, costs are falling rapidly, cheaper energy storage is developing, as is the digitisation of energy management – these are important prerequisites for the fast development of renewable energy.*

> *By then, energy storage technologies will have been developed that will allow the energy sector based on fossil fuels to be closed down gradually.*

Selected comments by the experts

↘ Chart 14. **Time for the following thesis to be implemented: The share of renewable energy in the EU's gross final energy consumption will exceed 40% (as defined by the EU target) according to the experts – comparison of two rounds of the Delphi study (%) and median time needed (years)**

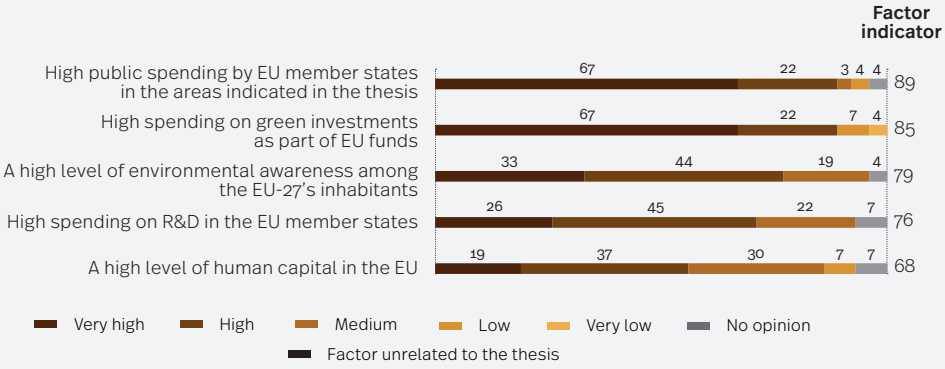


Source: prepared by PEI.

Quite a large number of experts (33%) believe that such a significant increase in the share of RES will not be possible until 2036-2040, according to the EU policy. The 4% of experts who do not believe that this phenomenon will be implemented think that the increase in electricity consumption, with limited possibilities of producing energy from biomass, raises doubts about whether this goal will be achieved.

According to experts, the factors that foster an increase in the share of RES in the energy mix to the greatest extent are high public spending by EU member states in the area indicated in the thesis (89% indications of very high or high importance, factor indicator 89 points) and high spending on green investments as part of EU funds (85 points) – Chart 15. The high level of environmental awareness among the EU-27's inhabitants (79 points) and high spending on R&D in member states (76 points) will be important, too. The high level of human capital in the EU (68 points) will be slightly less important. Experts also highlighted the importance of EU ETS prices, climate policy outside the EU ETS sectors, fossil fuel prices, and the transport operation model.

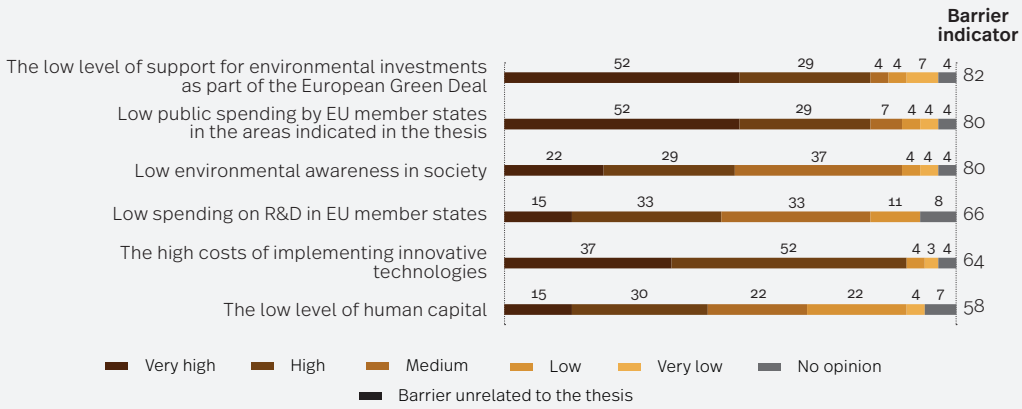
↘ Chart 15. **Influence of factors supporting the implementation of the thesis: The share of renewable energy in the EU's gross final energy consumption will exceed 40% (as defined by the EU target) according to experts (%) and the factor indicators**



Source: prepared by PEI.

According to the experts, the barriers that most hinder the increase in the share of RES in final energy consumption are: the low level of support for environmental investments as part of the European Green Deal (81% indications of very high and high importance, indicator 82 points), low public spending in EU member states in the area indicated in the thesis (81%; 80 points) and low environmental awareness of the society (51%; 80 points) – Chart 16. The low level of human capital was considered the least important (45%; 58 points). In addition, experts pointed to EU ETS prices, climate policy outside the EU ETS sectors, fossil fuel prices, and the transport operation model.

↘ Chart 16. **Influence of barriers making it more difficult for the following thesis to be implemented: The share of renewable energy in the EU's gross final energy consumption will exceed 40% (as defined by the EU target) according to experts (%) and barrier indicators**



Source: prepared by PEI.

Thesis: Fossil fuels will no longer be burnt in EU cities

No major modern cities can be considered sustainable, not only due to the use of fossil fuels, but also due to the consumption habits of its citizens. The EU Covenant of Mayors for Climate and Energy brings together thousands of local governments that have voluntarily committed to the EU's climate and energy goals (www13). Seven EU cities, including Bratislava, Rotterdam, and Vienna, have already taken the initiative to stop using fossil fuels, including natural gas, for heating purposes. Heating and cooling systems in these cities are supposed to become zero-emission by 2050 (www14). The activities at the local level, coupled with initiatives at the EU and national levels, have given rise to hope that the use of fossil fuels in cities in the EU can be reduced and later eliminated.

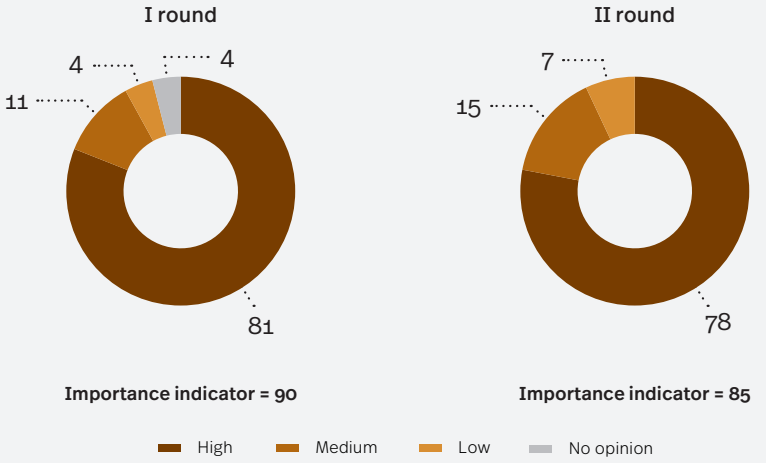
Most of the experts (78%) deemed ceasing to burn fossil fuels in EU cities of great importance for the energy transition; the importance indicator was 85 points. (Chart 17). Experts pointed out that this is one of the goals of the current energy transition; it is primarily important in terms of clean air and the health of the inhabitants of

EU cities, but also reducing greenhouse gas emissions. In their opinion, the importance of ceasing to burn fossil fuels in EU cities mainly concerns countries where fossil fuels are still used on a significant scale. Examples of the arguments used by the experts include:

> *Changing trends will differ depending on the size of the city.*
>
> *Moving away from burning natural gas – a fuel often used in cities – will be key to the energy transition and achieving climate neutrality within the required timeframe.*

Selected comments by the experts

↘ Chart 17. **Importance of the thesis: Fossil fuels will no longer be burnt in EU cities according to the experts – comparison of two rounds of the Delphi study (%)**



Source: prepared by PEI.

22% of the experts deemed ceasing to burn fossil fuels in cities of medium or low importance. They argued that fossil fuels also include crude oil and natural gas, which are used on a large scale in cities; hence it does not seem possible to them that fossil fuels will no longer be burnt in EU cities at all.

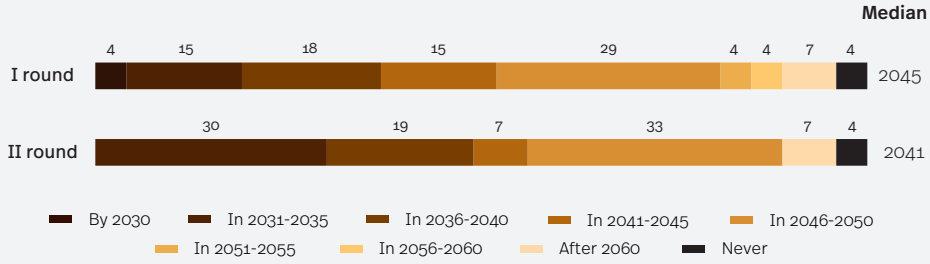
Half of the experts concluded that EU cities will continue to burn fossil fuels until at least 2041 (Chart 18). They argued that ceasing to burn fossil fuels in EU cities involves large investments that poorer EU countries cannot afford. Examples of the arguments used by the experts include:

> *Furnaces using solid fuels should be eliminated first, but ultimately this awaits gas, too.*

> *The year 2035 is realistic in Poland, so probably in the entire EU, too.*

Selected comments by the experts

↘ Chart 18. **Time for the following thesis to be implemented: Fossil fuels will no longer be burnt in EU cities according to the experts – comparison of two rounds of the Delphi study (%) and median time needed (years)**



Source: prepared by PEI.

As many as 47% of the experts believe that fossil fuels will only cease to be burnt in EU cities after 2040. In their opinion, they will be eliminated from heating first, and only later from transport. The late departure from natural gas will probably be related to (ongoing and future) investments in the transmission of natural gas, which will result in it being burnt in cities for longer. They also emphasised the importance of social awareness among city dwellers for the process to succeed. Examples of expert opinions were as follows:

> *To achieve the target of climate neutrality by 2050, fossil fuels should no longer be burnt in EU cities, but also in rural areas.*

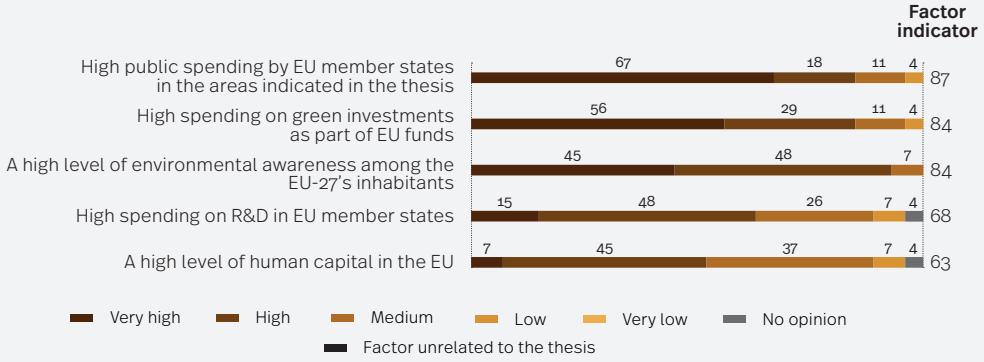
> *The elimination will occur when natural gas is completely replaced by hydrogen.*

Selected comments by the experts

Only a few experts (4%) did not believe that fossil fuels would ever be phased out in EU cities.

According to the experts, the factors most conducive to ceasing to burn fossil fuels in EU cities are high public spending by EU member states in this area (85% indications of very high and high importance, factor indicator 87 points), high spending on green investments as part of EU funds (85%; 84 points) and the high level of environmental awareness among the EU-27's citizens (93%; 84 points) – Chart 19. In their view, other factors will have less of an impact. In addition, experts pointed to the impact of the EU climate policy and EU countries' efforts to stop being dependent on imported energy commodities; largely gas and oil.

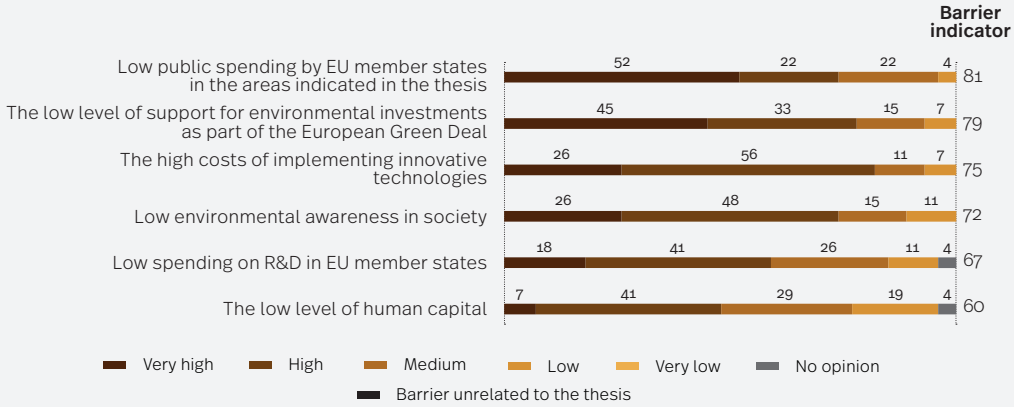
↘ Chart 19. **Influence of factors supporting the implementation of the thesis: Fossil fuels will no longer be burnt in EU cities according to experts (%) and the factor indicators**



Source: prepared by PEI.

According to experts, the barriers to ceasing to burn fossil fuels in cities are primarily low public spending in EU member states in this area (74% indications of very large and large, indicator 81 points) and the low support for environmental investments as part of the European Green Deal (78%; 79 points) – Chart 20. The low level of human capital was considered the least important (60 points). Experts also mentioned the overly slow development of the hydrogen economy and attachment to fossil fuels, especially natural gas and motor fuel.

↘ Chart 20. **Influence of barriers making it more difficult for the following thesis to be implemented: Fossil fuels will no longer be burnt in EU cities according to experts (%) and barrier indicators**



Source: prepared by PEI.

Summary

The energy transition in the EU remains one of the key points on the European Commission's agenda for the coming decades, as shown by the recently-presented "Fit for 55" package. The experts we surveyed agreed that meeting the package's main target – to reduce CO_2 emissions by 55% in 2030, compared to 1990 – is extremely important; the thesis importance indicator was 96 points, which is the highest result among the theses relating to EU. According to the median response, this target will be met slightly later than planned by the European Commission – in 2032. In this context, the energy sector was deemed the most important due to the very high potential to reduce emissions and the availability of low-emission technologies. However, the experts warn of the potential negative social impact: increasing energy poverty and the collapse of mining regions, which must be prevented by programmes at the EU and national levels.

The actions described above are supposed to result in EU countries achieving climate neutrality. According to the experts, the first ten countries could get there as early as 2045. These are countries that are already developing RES intensively and have a significant share of nuclear energy in their energy mix. In addition to reducing greenhouse gas emissions, the achievement of climate neutrality by the first set of EU countries would also have significant political effects. In this way, the EU would indicate that the energy transition is a real priority, increasing pressure not only within the EU but also on countries outside it. However, the experts pointed out that while many countries can achieve reductions above 90%, removing the final few percentage points of fossil fuels from the energy mix will be a considerable challenge.

One of the key measures needed to meet the emission reduction target is renewable energy. As many as 85% of the experts deemed exceeding a 40% share of RES in gross energy consumption of major importance for the energy transition in the EU. This will significantly reduce the burning of fossil fuels and, with the development of energy storage, will be the basis for changing the structure of the energy mix. According to the experts' median response, this goal will already be achieved in 2035 due to the rising prices of CO_2 emission allowances, as well as technological progress, including cheaper energy storage technology and the digitisation of energy management.

There were big discrepancies among the experts regarding the thesis on limiting nuclear energy. Only 26% deemed decreasing its share in the energy mix highly important. According to experts, there is little chance of climate neutrality being achieved without nuclear power plants. Nevertheless, nuclear energy should not be an alternative to other steps towards the energy transition. The share of nuclear energy will decline in richer countries, where it will be replaced by cheap RES while increasing in countries that still obtain a large part of their electricity from fossil fuels and need technology that can stabilise their energy system. Even though, according to the experts' median response, the share of nuclear energy could fall below 20% in 2044, as many as 33% of them did not believe that this will happen. The experts also cited individual member states' uncertain political will. The conflict between Germany, an opponent of nuclear energy, and France, where nuclear still accounts for close to 70% of the energy mix, is particularly important here. The European Commission needs to work

out a stable position. The prolonged uncertainty about the possible inclusion of nuclear energy in the green energy category is not conducive to meeting the energy transition targets.

To carry out the energy transition, it is also important to put an end to emissions outside the energy sector. 78% of the experts deemed ending the combustion of fossil fuels in EU cities very important – not only in terms of reducing greenhouse gas emissions but also to reduce the damage to residents' health. The key to achieving this target is to end the widespread use of stoves that burn solid fuel, and in the long term, to end the use of natural gas and fossil fuels in transport. According to the experts' median response, this target can only be achieved around 2041. Among our recommendations, programmes supporting the thermal modernisation of residential buildings and the development of fast and reliable public transport are particularly relevant here. It is also necessary to support the replacement of the high-emission cars that run on gasoline and diesel with hybrid and electric ones, as well as hydrogen vehicles in the future.

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Polski Instytut Ekonomiczny

Polski Instytut Ekonomiczny to publiczny *think tank* gospodarczy, którego historia sięga 1928 roku. Obszary badawcze Polskiego Instytutu Ekonomicznego to przede wszystkim handel zagraniczny, makroekonomia, energetyka i gospodarka cyfrowa oraz analizy strategiczne dotyczące kluczowych obszarów życia społecznego i publicznego Polski. Instytut zajmuje się dostarczaniem analiz i ekspertyz do realizacji Strategii na Rzecz Odpowiedzialnego Rozwoju, a także popularyzacją polskich badań naukowych z zakresu nauk ekonomicznych i społecznych w kraju oraz za granicą.

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