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1. **ESG – a revolution awaits business.**
The ESG revolution awaiting EU business in the coming years requires a distinction between small and large companies. The non-financial ESG reporting obligations imposed by the EU CSRD directive in the first stage apply to large companies (with more than 250 employees), but eventually this employment threshold is to be lowered to 10 employees. The plan is for such an obligation to appear no earlier than in 2026.

2. **Onshore wind energy needs to accelerate**
With the likely re-acceleration of onshore wind farm development, a sizeable market space is opening up for the startup community. Although wind technologies have been developed for many years, erected windmills still face a number of issues - from spatial issues, environmental issues, noise emissions, to the instability of energy production depending on current weather conditions or storage. These are the kinds of issues that startups are trying to optimise.

3. **The end of records in photovoltaics?**
According to the Energy Regulatory Agency, at the end of 2021, the number of prosumer photovoltaic installations in Poland was more than 845,000 units, an increase of more than 80 per cent year-to-year. In the last month before the change in the prosumer billing system, a record was set in terms of monthly new prosumer connections, with 44.6 thousand units. However, now that the changes to the billing system regulations have come into force, the number of applications to set up new panels has fallen by up to 90 per cent.

4. **Untapped potential of Polish biogas.**
At the moment, the Polish biogas market is significantly behind European leaders such as Germany. Meanwhile, the authors of the report Biogas in Poland point out that Poland has approximately 1.5 million hectares more land used for agriculture than Germany as well as a highly developed agri-food processing sector producing a huge amount of bio-waste. We are the EU leader in manure production (nearly 100 million t per year). According to KOWR data, at the end of 2021, there were 128 installations belonging to 109 entities in the register of agricultural biogas producers in Poland, which produced over 513 million m3 of agricultural biogas.
5. „Green hydrogen” – the Holy Grail of energy?
Almost all EU countries have also included clean hydrogen in their national energy and climate plans – 26 have joined the Hydrogen Initiative and 14 Member States have included hydrogen in the context of their national policy framework for alternative fuel infrastructure. Some countries have already adopted national strategies or are in the process of adopting them. Also in Poland, the Polish Hydrogen Strategy to 2030 with an outlook to 2040 was adopted in November 2021, with the aim of providing direction for the development of a hydrogen economy in Poland.

6. Diversification as a response to threats.
Geopolitical turbulence and rising energy costs are forcing either individual countries or international organisations, such as the EU, to change their energy policies, both in the present – reacting, for example, to spikes in energy commodity prices – and strategically – modifying the entire energy production philosophy, making themselves as independent as possible from external energy sources and thus protecting their own energy security.

7. Changing the philosophy of energy production – distributed sources instead of central production.
By 2030, already 35 per cent of energy production will come from distributed sources. Distributed generation means reduced energy transmission and distribution losses, higher grid reliability and lower greenhouse gas emissions. Decentralised energy generators are a very important component of future smart grid networks, as they enable the grid to operate in island mode, where they supply electricity, and sometimes heat, to nearby consumers in the event of a failure of the central power plant.

8. Storage crucial for system stabilization.
An important feature of renewable energy sources is their potential instability, so in addition to stabilising alternatives to RES, it is also extremely important to be able to retain surplus energy produced. That energy storage is an important aspect of the ‘green transition’ is confirmed by EU documents.

9. Technological innovation at the service of the energy industry.
The modernisation of energy infrastructure is directly linked to the implementation of innovative digital solutions, such as special sensors, infrastructure using Big Data – facilitating ongoing data exchange and analysis, AI, blockchain or 5G. Technological advances give room for startups offering services to the energy sector and its consumers.

10. Cyber security of the energy industry in the face of threats.
Outdated installations that have been in operation for several decades are vulnerable to cyber attacks. Almost all experts agree that the risk of threats when it comes to energy infrastructure, whether state or individual companies, is now higher than ever.
Introduction

The energy sector has a strategic function in every country in the world and is therefore subject to a whole host of regulations governing its operations, both internationally and domestically. The legislative background for the energy sector is a thicket of EU directives, regulations and recommendations, which, in addition, are constantly being modified and amended. However, this is not only an EU peculiarity - Polish energy market regulations are also complex and subject to constant change.

At present, energy policy is facing three simultaneous crises, each of which is bringing about a real revolution in energy market thinking. Firstly, the world's economies are recovering at a faster or slower pace from the slowdown caused by the coronavirus pandemic. And this has translated into energy commodity prices, triggering a significant jump in global energy prices. The world has not yet had time to breathe after the pandemic, and we have already fallen into another extremely severe crisis. Russia's aggression against Ukraine was met with the strongest economic sanctions in history, including on Russian raw materials, which were the lifeblood of almost all European economies. Unfortunately, demand for these raw materials is outstripping supply, and this is another element pushing up already historically high prices. On top of all this there is a third crisis - the climate catastrophe, of course, the first symptoms of which are already visible to the naked eye. This is the most difficult crisis because it has been going on for years, and it is already rather impossible to avoid it, at least to some extent.

It seems that after years of discussion and declarations rather than action, the problem has finally been recognised and attempts are being made to avoid worst-case scenarios. Documents such as the UN's 2030 Agenda or the EU's Green Deal, of which the Fit for 55 package and the EU Taxonomy are a consequence, show a clear direction in which we are heading. The conclusions reached by EU decision-makers are clear - we need to move away from fossil-based energy as soon as possible and significantly increase the share of renewable energy.
Legislative, business and social background
Legislative, business and social background

European legislation

Energy policy, which defines the rules for the generation and transmission of electricity, is a key strategic element in the functioning of any state, as well as international bodies such as the European Union. However, for the energy market to function smoothly, it is essential to define the legal framework within which the sector can operate. This is done both at the individual country level and at the EU level. European energy policy focuses on creating an integrated energy market and, in doing so, ensuring the security and stability of the sector.

The basis for EU energy policy is the Treaty on the Functioning of the European Union (TFEU) itself, more specifically Article 194 of this document. It covers all issues relating to security of supply, the operation of energy networks, decarbonisation policy, nuclear energy, as well as all other provisions determining the shape of European energy policy - both in terms of the internal market and the Union’s external policy. It is worth noting, however, that under Article 194(2) TFEU each Member State retains the right ‘to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply’. However, the objectives set out in the Treaty are common to all Community countries.

The European Commission published the Strategy for an Energy Union in February 2015. Its aim is to provide European consumers with a secure competitive and affordable energy supply. In turn, in 2016, EC published the Clean Energy for All Europeans package. This is a set of EC proposals in the field of energy adopted by the European Parliament and the EU Council to ensure a clean and fair energy transition at all levels of the economy.
It addresses the entire process – from energy production to consumption at the level of individual households. The document strikes a balance between the importance of decisions taken at EU, national and local level. It points to synergies and increasing the efficiency of Community energy policy. On this basis, EU member states have to present and implement 10-year national energy and climate plans and report on progress every 2 years and develop coherent national long-term strategies.

The EU has set climate neutrality by 2050 as the key objective. In response to this plan, a package of policy initiatives called the European Green Deal was prepared. This document emphasised the need for a holistic and cross-sectoral approach to the topic. The EGA also produced the European Climate Law, a document that translates the Union's ambitious climate targets planned for 2050 into legislation.

An element of the European Green Deal is the Fit for 55 package, adopted in July 2021, which aims to align EU law with the planned transformational changes in the economy and society. According to this plan, the EU is to achieve climate neutrality by 2050 and reduce net greenhouse gas emissions by at least 55% compared to 1990. Energy plays a key role in this plan. Provisions include changes to CO₂ emissions trading to further incentivise emission reductions through a gradual increase in its price and an accelerated transition to renewable energy sources. Up to 40 per cent of energy was supposed to come from RES by 2030, but in the face of sanctions imposed on Russia, the EU’s energy efficiency target for 2030 will be increased from 9 per cent to 13 per cent and the 2030 target for renewable energy in the EU from 40 per cent to 45 per cent. In addition, public sector entities will be required to thermally upgrade their buildings to reduce energy consumption.

The European Union is certainly a global leader at the moment in terms of solutions to achieve climate neutrality. It wants to be an example for the others, reinforcing pro-environmental aspirations in other regions of the globe. However, it should be remembered that the member states are very diverse in this respect, and their readiness to make changes in these areas will entail different levels of costs. Poland is in a difficult position here, in view of the fact that a significant part of the Polish energy sector is based on coal, and the use of renewable energy in Poland is still small compared to many EU countries.
And how has our national legislation in the field of energy evolved? In April 1997, the Energy Law was enacted - this is a law that sets out the principles for shaping the state’s energy policy, the principles and conditions for the supply and use of fuels and energy, including heat, and the activities of energy companies. The Energy Law has been amended several times. It was on the strength of this act that the Energy Regulatory Office was established, i.e. the body of central government administration carrying out tasks in the field of promoting competition and regulating the economy in, inter alia, the electricity, fuel and gas markets. Appointed for a 5-year term, the President of the ERO regulates the activities of entities in the sector, balancing the interests of energy companies and energy consumers.

In 2015, in response to the EU directive on promoting the use of energy from renewable sources, the Renewable Energy Sources Act was enacted. This law describes in detail the rules for the share of RES energy in overall consumption and divided energy generation into micro, small and large installations, which made it easier to invest in RES power plants producing energy for the investor’s own needs, which can be an individual, entrepreneur, farmer or local government. Thanks to the legislation introduced, an auction system for the sale of RES electricity fed into the grid was regulated.

Other important national legislation was the Energy Efficiency Act of May 2016 and the Electromobility and Alternative Fuels Act of January 2018. When analysing legal acts related to the production and distribution of electricity, it is impossible not to mention the Power Market Act, enacted in 2017. It defines the organisation of the power market and the rules for the provision of a standby service for the supply of electric power to the electricity system and the supply of this power to the system during emergency periods.

This is, of course, only part of the existing energy market legislation. Such a large number of legal acts and regulations, as well as their frequent amendments, both at EU and national level, is no coincidence. At the same time, it is clear that the legislation being enacted is intended to support changes and ambitious plans to reduce greenhouse gas emissions, increase the efficiency of the sector and promote energy-efficient solutions.
Energy demand

According to Eurostat analysis, in 2020 the EU produced roughly 42 per cent of its own energy (up 2 per cent compared to 2019), while 58 per cent of its energy was imported (down 2 per cent over the same period). The decrease in imports is partly related to the economic crisis caused by the pandemic. These figures do not yet take into account the current situation caused by the war and sanctions on Russia.

EU countries differ significantly when it comes to their energy mix. Petroleum products (including oil) account for a significant share of total available energy in Cyprus (87 per cent), Malta (86 per cent) and Luxembourg (60 per cent), while natural gas accounts for 40 per cent in Italy and 38 per cent in the Netherlands. Renewables have the largest share in Sweden (49 per cent) and Latvia (40 per cent), while nuclear energy accounts for 41 per cent of available energy in France and 25 per cent in Sweden and Slovakia respectively. More than half of the energy available in Estonia (53 per cent) and 41 per cent in Poland comes from solid fossil fuels, mainly coal.

Which segments of the economy in EU countries are the most energy-intensive? In 2020, industry consumed the most energy (32 per cent of final energy consumption), followed by transport (26 per cent), households (25 per cent), services (12 per cent) and agriculture and forestry (3 per cent). Overall energy consumption in the European Union has been decreasing in recent years. Last year, primary energy consumption fell by 1.9 per cent and final energy consumption by 0.6 per cent. Meanwhile, an upward trend is being observed in Poland.

Koszyk energetyczny dla Unii Europejskiej

Ujemne wartości w kategorii „Inne” dla niektórych państw członkowskich wynikają z eksportu netto energii elektrycznej

źródło: Eurostat – dostęp do zbioru danych
Figures published by Polskie Sieci Elektroenergetyczne (PSE) in May 2021 show that domestic electricity consumption rose by 9.39 per cent year-to-year, and between January and May last year alone it increased by 6.7 per cent year-to-year. Total electricity production increased by 17.3 per cent. In terms of the breakdown of energy sources used in Poland compared to the EU as a whole in 2020, our system was far more coal-based, while many other countries relied heavily on gas. The current geopolitical situation is bound to have a significant impact on this split, notwithstanding ambitious plans for radical reductions in greenhouse gas emissions by EU countries⁴.

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Poland</th>
<th>European Union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total petroleum products</td>
<td>34.7%</td>
<td>35.0%</td>
</tr>
<tr>
<td>Electricity</td>
<td>16.8%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Gas</td>
<td>13.7%</td>
<td>22.3%</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>12.9%</td>
<td>11.8%</td>
</tr>
<tr>
<td>Derived heat</td>
<td>8.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>13.9%</td>
<td>2.7%</td>
</tr>
</tbody>
</table>

**Potential risks and threats**

Energy security means that uninterrupted supply of energy demand is ensured, both at a given point in time and in the future. Interruptions in supply would mean huge economic losses and a total blackout would cause chaos that would be difficult to predict. However, failures related to the operation and degradation of energy equipment and facilities or caused by external destructive factors such as fires or weather phenomena are possible all the time.

It must be remembered, however, that in addition to such spectacular risks as a potential blackout and its consequences, energy costs are also an element of a country’s energy security. Demand for energy is rising steadily worldwide, and this is translating into the biggest price increase since the oil crisis of 1974. It is therefore crucial that its sources are as diversified as possible - energy supplied from multiple sources allows flexibility in the face of a threat.

Investment in the development and maintenance of refining and transmission infrastructure as well as storage technologies, is therefore essential. The latter is essential, particularly for renewable energy, whose sources are sometimes
unstable and unpredictable. The use of storage technology facilitates a flexible response to this type of situation. In this area, not only in Poland, we have a lot to do. In May 2020, the European Commission published a report entitled ‘Study on Energy Storage - Contribution to the Security of Electricity Supply in Europe’. In it, the Commission points to the need for public support for the development of innovative energy storage technologies within the EU. At the same time, the Commission warns that only some Member States have implemented proper support systems for these investments in their countries, and those already implemented are mostly too small.

The geopolitical threat has perhaps never been as great as it is today. In the face of the war in Ukraine and in the wake of the sanctions imposed on Russia, there is a sudden and ultimately complete change in energy policy, both of Poland and of almost all countries in the wider West. This calls for further development and strengthening of international cooperation between these countries.

**No longer a trend but an obligation**

Scientists clearly indicate how rapidly the number of unpredictable, extreme weather phenomena is increasing - torrential downpours and floods, hurricanes, droughts, tornados, devastating heat waves - in fact, we see more of them every year. And we can already see the disastrous consequences they bring. Apart from the real threat to human health and life, such phenomena also have a direct, negative impact on almost all areas of the economy. However, attempts are being made to minimise these risks.

The 2030 Agenda, adopted unanimously in 2015 by all 193 UN member states, contains 17 Sustainable Development Goals to be achieved by the end of this decade. As the Agenda 2030 materials read, as much as 13 per cent of the world’s population still lacks access to modern electricity and 3 billion people depend on coal, wood and charcoal and animal waste for cooking and heating. Energy is a major cause of climate change, accounting for roughly 60 per cent of global greenhouse gas emissions. 

The share of RES in the energy mix is therefore becoming important, also for geopolitical reasons. No less important than access to cheap energy from renewable sources is increasing the energy efficiency of the economy itself. The energy intensity of an economy is a conversion factor of how much GDP per unit of energy the economy is able to produce. With rising prices and demand, reducing energy consumption is becoming increasingly rational. Difficulties arising from a shortage of sufficient generating capacity and still
outdated technologies are forcing a rationalisation of energy consumption and maximisation of efficiency. Unfortunately, in this respect, we in Poland still do not compare very well with other European countries.

An important issue in the context of energy efficiency is thermo-modernisation. This is part of the whole process of increasing energy efficiency and is actively supported by the government’s Clean Air Scheme. In addition, from 1 January 2019, the thermal modernisation allowance, i.e. the possibility of deducing from the tax base the expenses for construction materials, equipment and services related to the realisation of a thermal modernisation project in a single-family residential building, is in force. Such support is offered by the government to owners of private residential houses. However, it is equally important to ensure energy efficiency in companies and their offices or production facilities. Solutions such as modern systems to reduce energy consumption, motion sensors and LED lighting, energy recovery systems, energy-efficient ventilation systems, photovoltaic installations and thermal insulation of walls are already available. There are many opportunities to reduce energy consumption in businesses.

This is where innovative young companies can step in, whose solutions will significantly reduce the costs associated with the use of electricity in industry. Technology appears to be key to achieving the targeted zero-carbon plans. It is not without reason that the start-up market for RES solutions, for example, is growing, including in our country. In PRF Ventures alone, there are already more or less 60 startups dealing with energy transformation in the broadest sense. The Polish market is opening up more and more to this type of solution. Also from the point of view of investors, the clean energy industry is becoming less risky and much more attractive. It is worth taking advantage of this opportunity.
Diagnosis of barriers to the implementation of „Environmental“ (ESG) activities among SMEs
Diagnosis of barriers to the implementation of „Environmental” (ESG) activities among SMEs

Regulatory barriers

There is increasing pressure on companies to make the way they do business as environmentally positive as possible, while combating greenwashing. However, remaining compliant with rapidly changing ESG regulations requires keeping abreast of changes and legal analysis in order to get the company’s change process right. For many companies, particularly smaller ones, this can be a task beyond their means.

The European Commission has published a draft CSRD (Corporate Sustainable Reporting Directive), which, once accepted by member states, is expected to take effect in 2024. The document imposes a number of new reporting obligations on companies’ ESG activities. The proposal covers all relevant environmental, social and corporate governance factors. Properly preparing for the implementation of this directive in an orderly and timely manner will require the involvement and competence of very different departments within companies - from finance, compliance and the legal department to risk managers. The second major EU regulatory project, complementary to the CSRD, is the EU Taxonomy. The main purpose of this regulation is to help determine whether a business activity qualifies as environmentally sustainable.

So you can see that navigating the maze of changing regulations and new obligations will be a major challenge for companies. Of course, this does not mean that the regulations being introduced are not necessary. However, it is worthwhile for businesses to have certainty about the changes that apply to them and the chance to prepare for them early.
Financial barriers

As shown in the survey Smart Industry Poland 2021 carried out among companies from the SME sector by Siemens, as many as 71 per cent of them – as the biggest barriers to the implementation of ESG measures – point to the lack of free financial resources followed by insufficient financial incentives.

It is worth taking a cue from the leaders in this process, who argue that ESG changes are an investment, not a cost. Reducing the impact companies have on the environment will make current operations more sustainable and efficient, which in turn will translate into tangible savings for companies. The ability to transform current business models can translate into productivity gains in the medium to long term.

Also key is the fact that investors or financial institutions, such as banks, will have to take ESG factors into account in companies, deriving their knowledge from comparable, reliable reports produced by companies, in order to motivate the market to make changes. This is also where space is being created for innovative startups offering cutting-edge technologies that will facilitate compliance with low-carbon requirements, while helping to reduce the ongoing costs of doing business.

Awareness barriers

In a 2021 Pew Research Center survey of residents of 17 highly developed countries in North America, Europe and the Asia-Pacific region, a majority express widespread concern about the personal impact of global climate change, saying they want to change the way they live and work to combat the effects of global warming. However, they are unsure whether their attitude will make a difference in stopping negative changes. Respondents offer mixed views on how their society has responded to climate change, with many questioning the effectiveness of international efforts to address the global climate crisis. However, the sense of personal threat from this is growing. Younger people are most likely to be significantly more concerned about climate change and are more likely to believe that it will be an immediate threat to them.
People across world greatly concerned about climate change and willing to make sacrifices to address it, but there is less confidence in efforts to solve the problem.

Personal Impact of global climate change

- Concern that global climate change will harm you personally at some point in your lifetime:
  - Very/somewhat concerned: 72%
  - Not too/not at all concerned: 27%

- Willing to make changes about how you live and work to help reduce the effects of global climate change:
  - A lot of/some: 80%
  - Only a few/none at all: 19%

Action to address global climate change

- Our society is doing a job dealing with global climate change:
  - Very/somewhat good: 56%
  - Very/somewhat bad: 44%

- Confidence that actions taken by the international community will significantly reduce the effects of global climate change:
  - Very/somewhat confident: 46%
  - Not too/not at all confident: 52%

And what is the situation in Poland? In November 2020, the Ministry for Climate and the Environment conducted a survey showing that more than three quarters of Poles believe that current climate change is having mostly negative effects, only 6 per cent believe positive effects, and 67 per cent believe that climate change will harm them moderately or more.

As Startup Poland Foundation, we have conducted many interviews with dozens of companies in the SME sector on the state of their knowledge regarding the new ESG obligations imposed by EU decision-makers. The conclusions so far do not inspire optimism. Although more than 70 per cent of the companies interviewed say they are operating in a sustainable manner, when asked for details, they admit that they either still have a long way to go or are not aware at all of the changes that await them. Only one in 10 companies surveyed said they use tools to measure their carbon footprint, and one in four would like to measure their carbon footprint, but do not know how. On the other hand, almost half declared that they have already introduced some kind of action to reduce CO₂ emissions.
When asked what hinders the introduction of energy-saving solutions in a company, most - as many as 40 per cent - declare a lack of knowledge of the relevant solutions, tools and possibilities or problems with financing and the excessive costs of such solutions. Furthermore, the vast majority of those questioned are not aware of any state support and incentive programmes for such a ‘green transformation’. What may worry most is that the vast majority of companies do not know or have no intention of finding out about the changes that await them soon in terms of their obligations to publish an Environmental Impact Report.

Even this brief survey of dozens of companies shows the scale of the challenges we will be facing in a short while. Awareness barriers or simple ignorance will not protect companies from the consequences of change. What is needed here, therefore, are some kind of large-scale educational programmes, and perhaps also financial support or incentives for such a transformation. Without this, Polish business may face very significant turbulences.

**Network limitations**

The move away from a centralised network management model and the resulting regionalisation is expected to decisively accelerate the decarbonisation implemented by EU policy. Unfortunately, in Poland this process faces numerous obstacles and requires decisive changes. Poland’s power grid is outdated. As Policy Insight experts reported in 2019, as many as 76 per cent of the country’s high and medium voltage lines are over 25 years old, and 37-42 per cent are even over 40 years old, and these form the backbone of this infrastructure in Poland. In addition, only 26 per cent of medium voltage lines are cabled (are underground). According to Policy Insight analysts, with the current level of spending by operators, it will take us as long as 50 years to reach the optimal level of cabling.

Interruptions in electricity supply translate directly into costs for the economy. According to the company PSE, responsible for the stability and security of the power system in our country, the value of the index of energy not supplied by the system (ENS), which was calculated for all outages (emergency and planned), amounted to 124.35 MWh in 2020. Although this level has been improving in recent years, it is still one of the highest in Europe. As calculated by Policy Insight analysts, a total of 273,000 MWh of electricity was not supplied in Poland between 2014 and 2018, costing consumers more than PLN 7 billion.
In recent years, a significant barrier in Poland has been the so-called Distance Act of July 2016, where the 10H rule was enshrined, according to which wind turbines cannot be erected at a distance of less than 10 times the total height of the turbine from a residential building (or a building with a mixed function that includes a residential function). This law has hindered the development of onshore wind energy in our country for years, and without liberalising it, dramatic problems await us - already accelerating energy costs will rise even faster. The amendment to this controversial law, although at an advanced stage of work, has not yet been passed and it is unclear if and when it will be. At the moment, there is no agreement within the government coalition to carry it out.

At the moment, for legislative reasons, a customer using a direct line cannot simultaneously draw energy from the transmission network. This greatly limits the development of this system in our country. As of June 2021, work is already underway in the Sejm to make this legislation more flexible and to adapt it to real market needs.

The energy industry is also waiting for legislation to allow for so-called cable pooling, i.e. the possibility of sharing energy infrastructure between wind and photovoltaic farms. This would create synergies between wind and solar power; at the same time, it would relieve the burden on the entire power grid. It is precisely the insufficient grid capacity that stands in the way of accelerating the development of RES in Poland, and its sharing would be a significant step forward for photovoltaics and wind energy. The Ministry of Climate and Environment has already started work on this solution.

Another key issue is the need for the development of smart grids (so-called smart grid). A smart grid is one in which real-time communication between all energy market participants is possible, which in turn allows for cost reduction and increased efficiency, as well as the integration of distributed energy sources, including, of course, RES sources.
Technologies for energy
Technologies for energy

Wind
Figures from the Global Wind Report published last year show that 2020 was the best year on record for the global wind industry, with 2021 not far behind. It saw the arrival of installations generating 93.6 GW of capacity, meaning that globally, wind power capacity increased to 837 GW, up 12 per cent year-on-year. In terms of offshore wind power, 2021, with 21.1 GW of new installations, was also a record year. The total capacity generated globally by offshore wind farms rose to 57 GW, with as much as 80 per cent of new capacity coming from China.

New wind power capacity in 2021 by region

New wind power capacity in 2021 and share of top five markets
Until some time ago, wind farms accounted for the largest share of RES-generated capacity in Poland, but due to regulations introduced a few years ago, their capacity is growing at a very slow pace. Data from the Energy Regulatory Agency shows that the installed capacity of wind farms in Poland is more than 7.2 GW (March 2022). Wind farms now account for 38 per cent of all power generated from RES in Poland, and photovoltaics already account for 50 per cent.8

The government has prepared a draft amendment to the so-called Distance Law. Apart from the obvious, extremely difficult situation in terms of recent energy prices, this change was also influenced by the pressure of public opinion, which is increasingly in favour of wind energy. Opinion polls conducted for the Ministry of Climate and Environment in November 2020 showed, among other things, that as many as 85 per cent of Polish women and men support the development of onshore wind farms, and more than half of respondents living in the vicinity of a wind farm positively assess the actions of the local authorities and the investor.9

This moment of regulatory change, and the likely acceleration of wind farm development as a consequence, seems to be a very good omen for wind technology companies, as well as startups operating in this area. There is certainly a sizeable market space to be developed, where innovation, out-of-the-box thinking and flexibility are essential, and these are, after all, immanent characteristics of the startup environment. Although wind technologies have been developed for many years, erected windmills still face many problems – from spatial issues, environmental issues, noise emissions, to the instability of energy production depending on current weather conditions or storage. These are precisely the issues that start-ups are trying to optimise

**Sun**

Photovoltaic systems have become the most cost-competitive way of generating electricity over the past decade. Technological advances, whether in the efficiency of the photovoltaic cells themselves or in ways to store energy, have allowed the field to progress by leaps and bounds. Photovoltaics are poised to account for 60 per cent of global renewable energy growth in 2022, IEA analysts predict. The same experts predict that by 2026, global renewable electricity capacity will increase by more than 60 per cent compared to 2020 levels. - to more than 4,800 GW - equivalent to the current total global fossil fuel and nuclear power capacity combined. According to the IEA, renewables are expected to account for almost 95 per cent of the global capacity increase by 2026, with solar PV alone providing more than half of this growth, in their view.
According to the authors of the Global Market Outlook for Solar Power report, installations generating 3.8 GW were built in Poland in 2021, an increase of 56 per cent compared to 2020. According to the analysts, the change came as a big surprise, but they point out that the government’s successful and hugely popular programme to build photovoltaic panels on the roofs of private homes has been modified, and unfavourable regulatory changes may make Poland’s position on this list a one-off exception. As of 1 April this year, the rules regarding discounts for prosumers have changed, and prosumers can only use them until the end of June, and from the beginning of July they will automatically switch to net billing, which means selling energy and billing according to its value rather than the quantity produced. This has had a significant impact on the Polish photovoltaic market – the number of applications to set up new panels has dropped significantly.

According to calculations by the Institute of Renewable Energy, the installed capacity of photovoltaics at the end of 2021 was 7.6 GW and the growth of new capacity was over 3.7 GW (an increase of 105 per cent). A key feature of the Polish sector is its largely prosumer nature (around 80 per cent). According to the Energy Regulatory Agency, at the end of 2021, the number of prosumer photovoltaic installations amounted to more than 845 000 units, an increase of more than 80 per cent year-on-year. It is also worth mentioning an already noticeable new trend - the market is beginning to open up to collective prosumers, i.e. those installing panels on multi-family houses, for example. Last but not least, photovoltaics are entering the business world more and more willingly. It therefore looks like there will still be plenty of room on the market for young, innovative companies operating in this segment.
Biogas

Biogas can be used for a variety of purposes, including vehicle fuel, cooking and power generation. The main sources of biogas are municipal, industrial and agricultural waste, etc. Currently, sources of biogas generation can be divided into: landfills, sewage treatment plants, agricultural biogas plants and energy biogas plants.

Europe was the largest player in the biogas market in 2021. - its main producer in this part of the globe is Germany, with the UK being the second largest. According to the European Biogas Association (EBA), biogas and biomethane production in Europe could double by 2030 and quadruple by 2050. In 2021, there were already roughly 19,000 biogas plants and 725 biomethane plants in operation in Europe, which produced around 167 TWh of biogas and 26 TWh of biomethane¹¹.
The unquestionable advantage of increasing the share of biogas in the energy mix is that it is not dependent on weather or climate conditions, as is the case with wind and solar power. Therefore, according to specialists, it is biogas plants that should operate as peak plants, operating during the morning and evening high demand for power, while photovoltaic installations decrease or cease production. An additional important advantage of this technology is the potential for energy storage in the form of biogas.

Unfortunately, at the moment, the Polish biogas market significantly lags behind European leaders such as Germany in terms of scale. According to KOWR data, at the end of 2021, there were 128 installations in the register of agricultural biogas producers in Poland, belonging to 109 entities, which produced more than 513 million m³ of agricultural biogas. National biomethane initiatives are also emerging. Biomethane plants are a specific type of biogas plant. They produce a gas purified from CO₂ and other unnecessary substances, which can be directly injected into the gas grid, liquefied or compressed. The potential for the use of biomethane is enormous. This has already been recognised by state-owned energy companies.

The Orlen Group has declared explicit plans to enter the biogas segment. The Płock-based fuel company intends to create its own network of biomethane plants. The first steps in this direction have already been taken - Orlen has purchased three already operating Polish biogas plants, in Konopnica, Wojny-Wawrzyniecy and Jeżewo, and wants to convert them to biomethane production after modernisation. Similar plans are declared by PGNiG, which, together with Orlen Południe, will create a company to invest in the development of a network of modern biomethane plants. Orlen Południe will hold 51 per cent and PGNiG 49 per cent of the shares.

**Hydrogen**

Hydrogen is emerging as one of the most promising energy fuels with high hopes as a very good alternative for replacing fossil fuels and, at the same time, an ideal because stable complement to other RES solutions that are not so stable. Hydrogen has another extremely important feature - it is great for energy storage and transport. It can be easily stored in large quantities, making it an ideal medium for energy accumulation.

As we read on the CIRE website, the stationary capacity of fuel cells globally has been growing significantly in recent years. In 2018, the number of fuel cells installed worldwide was around 363,000. The leader in this area is Japan, where the ENE-FARM domestic fuel cell installation programme has been introduced. In Europe, in turn, domestic fuel cell technology is being developed.
in Germany thanks to a special support programme. As for larger systems - with a capacity of more than 100 kW - they are almost exclusively used at the moment in South Korea (300 MW) and the United States (150 MW).

The EU’s strategic vision for a climate-neutral EU, published in November 2018, predicts that the share of hydrogen in Europe’s energy mix will increase from less than 2-4 per cent today to 13-14 per cent by 2050. Total investment in renewable hydrogen in Europe could reach €180-470 billion by 2050 and investment in low-carbon hydrogen from fossil fuels could reach €3-18 billion by 2050, analysts estimate. According to estimates, pure hydrogen could meet 24 per cent of global energy demand by 2050, with annual sales of €630 billion.13

In November 2021, the Polish Hydrogen Strategy to 2030 with an Outlook to 2040 was adopted, which aims to indicate the direction of development of the hydrogen economy in Poland. The strategy sets out specific objectives for building a hydrogen economy, laying the foundations for activities related to its development and maintaining the competitiveness of the Polish economy. As we read in the document, the realisation of these goals will enable the development of individual regions of Poland by, among other things, creating hydrogen valleys in these regions, which will ensure the development of industrial hydrogen applications, the integration of sectors, finding business partners, and optimising processes and costs.14

In view of the optimistic prospects facing hydrogen technologies, it seems that more and more players involved in this market segment - whether producing or storing hydrogen - will emerge. This is also an interesting option for potential investors, as the chances of scaling this business should increase over time.
Changing the philosophy of energy production
Changing the philosophy of energy production

Moving away from centralised to local production

By 2030, experts from the consultancy Frost & Sullivan estimate that 35 per cent of energy production will already come from distributed sources. The Frost & Sullivan analysts further point out that distributed generation means reduced energy transmission and distribution losses, higher grid reliability and lower greenhouse gas emissions. In their view, a shift towards decentralisation could eliminate or at least reduce the instances of blackouts that are associated with the operation of the electricity grid at large power plants.

In the face of so many contemporary challenges, the model of the energy nexus chain has therefore had to undergo a fundamental transformation - from a unidirectional one, in which energy is produced in large, centralised power plants and then distributed to end users, i.e. consumers, to a prosumer one, in which everyone can produce clean, ‘green’ energy through RES solutions. This means the decentralisation of the energy system and the emergence of so-called microgrids. This is a physically separate area for the supply of electricity, comprising local energy sources (mainly from RES) and the consumers of this energy concentrated around them. The microgrid additionally contains energy storage and stabilising sources (which can make up for production shortfalls in the event of a shortage).

The decentralisation process points to two important issues - the ability to react rapidly and flexibly to unforeseen situations that limit energy supply, and the wise use of surplus energy and the possibility to store it. In order for networks to cope, they need to be more flexible, that is, operators need to have
solutions that can react very quickly to decreases or dynamic increases in both demand and supply.

It is therefore not just a matter of decentralising energy networks, but of doing it wisely, in a way that is profitable for all participants in this market. For this, education is essential – building awareness of how best to install and use distributed energy sources. This can also be the role of startups involved in the RES sector. It is their innovative ideas, needs analyses and concrete solutions that can help, first and foremost, end users to apply the best, optimal solutions.

**Energy storage**

Energy storage is one of the most important aspects of the energy transition. The fact that energy storage is an important aspect of the “green transition” is confirmed by EU documents. According to a report published by the European Commission, innovative energy storage solutions will play an important role in supporting the process of achieving the objectives enshrined in the European Green Deal, while ensuring the security and stability of energy supply in EU countries.

*Top 10 European grid-scale energy storage markets; new capacity 2022 – 2031 (GWh)*

- **UK**: 25,68 GWh
- **Italy**: 12,23 GWh
- **Germany**: 8,81 GWh
- **Spain**: 8,09 GWh
- **France**: 5,14 GWh
- **Ireland**: 4,28 GWh
- **Netherlands**: 4,25 GWh
- **Greece**: 3,45 GWh
- **Belgium**: 2,74 GWh
- **Portugal**: 2,1 GWh

Top 10 demand total versus rest of the region
Unfortunately, Poland lags far behind the European average - energy storage facilities in Poland are rare, but this is slowly beginning to change. The change in energy law has opened up new possibilities in this area, but the profitability and sources of funding for such investments are still a challenge. However, the new law has created a legal framework for the development of modern energy storage technologies in our country.

The NCRD, among others, is active in this area - last year, the Electricity Storage project was announced to give a boost to the development of innovative storage solutions. The budget for this project, financed by European funds under the Intelligent Development Programme, is PLN 12.9 million.

In April 2021, a 6 MW energy storage facility with a capacity of 27 MWh was launched - a project jointly implemented by PSE, Energa and Hitachi. This is not Energa’s first venture in this area. Its battery storage facility in Puck has been in operation for several years; the corporation is also planning to open a storage facility at the solar farm in Czerników. PGE, in turn, plans to have storage facilities with a capacity of approximately 800 MW by 2030. The company has already selected over a dozen locations - the largest project with a capacity of 205 MW and 820 MWh is to be built in Żarnowiec.

**Digitisation for the environment**

The accelerating digitalisation of industry has its effects in the form of a continuously increasing demand for electricity. Digitisation in the energy industry already appears to be an irreversible process, without which a ‘green transformation’ is in practice impossible.

Last year, the European Commission developed an Action Plan for the digitisation of the energy sector, which will pursue two priority areas of the European Commission’s work: striving to make the objectives of the European Green Deal a reality and achieving a Europe capable of meeting the challenges of the digital age. In the EC’s view, digitalisation must become an integral part of the energy transition in the European Union at every stage of the energy supply chain.15

So what digital solutions are already working in the energy sector? Various types of systems used to manage the network infrastructure and its individual components appear to be playing an increasingly key role. Another important element in the digitalisation of the sector is smart grids, i.e. intelligent energy supply systems for reducing costs and increasing efficiency, and the integration of distributed energy sources, including renewable energy. Tools
are also emerging for the digital modelling and design of new energy networks, as well as the improvement of existing ones. Systems to facilitate energy management directly by prosumers and end users are also now available.

These smart, digital solutions make use of the most cutting-edge IT technologies - artificial intelligence (AI) makes it possible to, among other things: forecast demand and consumption levels, optimise resources, coordinate activities and operations on the grid or automate processes in metering, billing and distribution. AI is also at the heart of such key technologies for the energy transition as IoT (Internet of Things) and the Internet of Buildings. Building automation - the operation of lighting, ventilation and air conditioning, heating, security - translates directly into a reduction in energy consumption and thus in the cost of their daily operation. From the point of view of the energy sector, blockchain technology for securing and automating transactions within the power grid is increasingly important.

**Security and cyber-security in the energy sector**

Digitisation processes in the energy sector will accelerate and this brings with it many cyber security risks. The energy sector is a strategic sector for any country, hence the potential risk of dangerous hacking attacks, data leaks or other types of threats that could affect the proper functioning of systems. On top of the already vulnerable energy sector (leaks of personal data, confidential information or the activities of criminal groups specialising in cybercrime), further problems resulting from Russia’s aggressive policy have been added, further compounding the potential dangers and possibilities of attacks. KMPG data shows that there has been a marked increase in the perception of the threat of cyber activities by foreign-backed groups. At the beginning of 2022, 27 per cent of companies surveyed showed this, reversing the declining trend seen in previous years.16

The European Union has proposed new legislation on cyber security in the energy sector, which all member states will have to comply with. The so-called NI S2 Directive (replacing the previous version of the NIS Directive) imposes obligations on all energy sector entities to report security incidents and threats.17

Meanwhile, Poland still has outdated installations in use that have been in operation for several decades and are therefore vulnerable to attacks. It is also for this reason that we need to modernise these systems, taking into account the aspect of cyber security. Almost all experts agree that the risk of threats when it comes to energy infrastructure, whether state or individual companies,
is now higher than ever. Above all, it must be remembered that technological advances are taking place on both sides of power - both the good side and the bad side.

This, in turn, gives room for startups offering cyber security and grid monitoring services. Demand for such services is bound to grow. The ability to predict failures, identify threats in advance and prevent them will increasingly be a responsibility that will help avoid destabilisation of energy sector entities. Such destabilisation would be a threat to the entire economy.
Support path for startups
Support path for startups

Polish startups in the energy sector can play an extremely important role in the country’s energy transition - whether at the level of the energy industry itself or in the process of implementing ESG measures in business. We are now at the threshold of the ‘green revolution’ - it is worth taking advantage of this opportunity and supporting innovative entities offering their own solutions, whether in the field of construction, optimisation or security of RES solutions, operation of energy networks, their analysis and monitoring.

PGNiG Ventures

Corporate investment funds, so-called ‘CVCs’, which include PGNiG Ventures, are today one of the primary tools for large corporations to acquire innovation. The primary benefit of a corporation can be to attract innovation and talent that would be unlikely to emerge from the traditional structure of a large company and thus provide a supply of new technologies that have the potential to achieve its strategic goals. Startups, in turn, can receive not only financial support, which is increasingly one of the expectations of startups, but also support in the form of expertise and extensive experience in the market segment in which the corporation conducts its core business. Cooperation between startups and corporations seems to be particularly important in the energy sector, which is dominated by large players that have been operating in the market for many years. The energy sector in Poland has its own specifics and a startup planning its development path in this area should take such specifics into account in order to maximise its chances of effective and rapid growth.
As a CVC fund, PGNiG Ventures invests up to PLN 15 million in startups that have reached a minimum threshold of EUR 100,000 in revenue in the last 12 months and have been on the market for no longer than seven years. If a startup is at too early a stage from PGNiG Ventures’ point of view, it is worth mentioning that the PGNiG Group has a wide range of possibilities for supporting innovative startups and an appropriate solution may be to use, for example, an acceleration programme.

**EU funds**

As we read in the European Commission’s Communication, its Investment Plan for a European Green Deal makes EU funding available and creates a framework to facilitate and stimulate the public and private investment needed to make the transition to a climate-neutral, green, competitive and inclusive economy.

Complementing this EU plan is the so-called "Just Transition Mechanism", designed to support the Community’s more lagging regions. The mechanism provides targeted support, mobilising at least €100 billion by 2027 to be redirected to the regions most affected by the negative socio-economic consequences of the transition.

The mechanism is based on three main sources of funding:

- **The Equitable Transformation Fund** – this is €7.5 billion earmarked for equitable transformation in the EU. In addition to the funding from the Equitable Transformation Fund, Member States must add an equal amount from the European Regional Development Fund and the European Social Fund Plus and make additional national resources available. Together, this provides funding of EUR 30-50 billion.

- **InvestEU** – a scheme to mobilise investments of up to €45 billion. The aim of InvestEU is to attract private investment, including in sustainable energy and transport infrastructure, benefiting the affected regions and helping these economies find new sources of growth.

- **The European Investment Bank’s public sector loan facility**, guaranteed by the EU budget, to mobilise €25-30 billion of investment. It will be used for loans to the public sector, for example for investments in district heating networks and building renovation.
The EU’s National Recovery Plan also has a role to play in this area - which is why, among other things, the mobilisation of money for the NRP is so important. It is within the framework of this plan that as much as EUR 6.4 billion is to flow into programmes related to ‘green energy’ and the reduction of energy intensity, and a further EUR 6.1 billion into ‘green intelligent mobility’.

The Polish NRP envisages the allocation of EUR 97 million for investment and advisory support for RES installations realised by energy communities (energy clusters, energy cooperatives, collective agreements of prosumers and others) – it is planned to establish 20 such communities by 2026. In turn, up to 300 local energy areas are to be established in Poland by 2030, which will be characterised by their ability to self-mobilise. The NERP also emphasises increasing public participation in the energy production model (prosumers) and the use of new renewable energy sources. EU funds are therefore the engine of the whole green transformation.
Regulatory recommendations from Startup Poland
Polish law should respond to the needs of the renewable energy industry and implement European solutions for energy efficiency. Despite the many positive changes introduced in Polish regulations in recent years, there is still much to be done in terms of legislation serving renewable energy sources, technologies, prosumers or energy storage.

In the current situation resulting from the ongoing war in Ukraine, removing barriers to the development of RES in Poland as soon as possible is not only a necessary action to achieve the energy goals resulting from the EU agenda and to limit the upcoming energy crisis, but also a moral obligation.

Therefore, we appeal to policy makers and members of parliament:

- To ensure regulatory stability.
- To make effective use of NRP funds for the green transition.
- To abolish the ‘10h rule’ under the Wind Power Investment Act.
- To abolish location limits for the construction of photovoltaic installations.
- For formal facilitation for the RES industry.
- For removal of regulatory brakes on the repowering of tools used to produce energy from renewable sources.
- To support energy storage facilities.
- For implementation of the RED II Directive into the Polish legal order as soon as possible.