The market for environmental technologies in Poland - experiences of technology providers, lessons learned for public institutions

SYNTHESIS REPORT

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MINISTRY OF ENVIRONMENT, POLAND, WARSAW 2013
GreenEvo – a project promoting Polish green technology companies, run by the Ministry of the Environment – is one of the finalists of the prestigious European Public Sector Award 2013 contest.

GreenEvo winners are the most innovative Polish companies offering solutions and technologies in the area of i.a. waste management, energy production or air pollution. The Ministry of the Environment is honoured and delighted to support their growth in foreign markets by organising training courses and specialised trade missions. Our efforts bear fruits. For example, in extremely difficult year 2011, the GreenEvo winners’ revenues increased by more than 30% whilst their export revenues grew by nearly 60%. The awarded technologies may successfully compete in all international markets, being sold even in such developed countries as USA or Japan.

The idea of the project emerged during COP 14 summit in Poznan. Since then, it has been constantly developed. This year, few days after COP 19 summit, EPSA contest results will be announced in Maastricht. This is the best proof possible that linking business and climate changes is reasonable and sensible. The GreenEvo project perfectly combines innovative entrepreneurship development and promotion with environmental care. What once was only an experiment, has become one of our leading programmes, proving that business and administration may efficiently work side by side. Industrial effluents purification, biomass fuel production or solar panels manufacturing not only bring significant environmental improvement but also create new green job opportunities and raise competitiveness of Polish economy.

GreenEvo winners represent the new image of Poland in the international arena. The image of a country having considerable potential for expanding its green technology market. My colleagues, European ministers of the environment, admire GreenEvo as a prominent symbol of Polish entrepreneurship. Our innovative environmental technologies take by storm global market primarily thanks to their quality and Polish companies’ flexibility. I am certain that we will have more and more reasons to be proud of GreenEvo winners, both in the local and global market.
EXECUTIVE SUMMARY

The report summarizes results of a study of Polish suppliers of environmental technologies, characterizing the market and practices of market participants. The market for environmental technologies in Poland has not been sufficiently identified in previous studies, which only offered fragmentary knowledge and concentrated on selected quantitative characteristics, while in-depth knowledge could support the development of national policies.

The research involved in-depth semi-structured interviews with representatives of 40 companies-participants of the GreenEvo - Green Technology Accelerator, a governmental project, run by the Ministry of Environment. The research sample stands out from other industry players in Poland, as the analyzed companies supply own, innovative products, and have demonstrated interests in international markets. Their top international markets in 2012 were Germany, Lithuania, Russia, and the Ukraine, and the most popular non-European destination was Vietnam.

Environmental investments by the public sector in Poland amounted to 0.38% of GDP in 2011 (EU average: 0.13%), and by the private sector: 0.29% GDP (EU average: 0.15% GDP). The impressive results were induced among others by dedicated financial instruments, offered by the National Fund for Environmental Protection and Water Management, and the government considers the environmental expenditures as key element of its investment plans for the EU Structural Funds, 2014-2020. One of Polish success stories is the development of solar collectors market segment, dominated by Structural Funds, 2014-2020. One of Polish success stories is the development of solar collectors market segment, dominated by Structural Funds, 2014-2020.

The interviewed companies described their Research & Development practices. 32.5% of them regarded their in-house engineers as the main source of new technologies, but 65% appreciated the importance of customers, providing ideas for new products or product modifications. 60% of companies admit that they drew inspiration from similar solutions, developed by other companies, but developed original solutions by modifying the underlying product concepts and designs, while 40% claim that they had no competitor to imitate or follow. For most of the interviewees, R&D efforts constitute obvious and indispensable activities, and are regarded as everyday practice in the respective technological industries. Each company was employing on average 4.98 R&D specialists, and 90% of companies were funding R&D projects primarily from own sources. Although directly expressed customer demands were important to companies, as much as 87.5% of them declared that they also conduct R&D efforts without direct motivations, related to existing sales or implementation projects.

R&D results lose their value if they are being copied or imitated by other companies, and technological solutions of 45% of the companies were imitated by their competitors, but many interviewees did not fear this scenario, even though only 42.5% of companies use international patenting. Most companies referred to patents as promotional tools rather than legal instruments, which could protect against copying. 57.5% of the firms use patent databases to analyze competitive technologies and identify market tendencies.

80% of the interviewed companies maintain co-operation with higher education institutions and research institutes, and 65% contract research projects to academics, but the science-industry collaboration involves multiple practical challenges. 77.5% of companies believed that the science sector could be a genuine partner for technological companies, but they were emphasizing that both parties should derive reciprocal benefits from the relation.

Sales of technological solutions usually involved transferring to potential customers specialist knowledge through a sequence of meetings, conversations and collaborations, and this approach supports a better understanding of the needs of a potential client and adjustments of the solutions offered. International sales processes turned out to be more problematic due to the distance, limited contacts and local specificity. Many companies regard their sales processes as exchanges of technical information and advice, and their sales activities can be considered highly professional. Independent reviews, certificates and awards as material evidence of the quality of technologies are more important than traditional promotion techniques. Some of the interviewed companies sell mainly through public procurement and pointed to possible shortcomings of these procedures, when due to insufficient knowedge or lack of time, customers might select products that do not offer satisfactory environmental benefits. European Union countries (including Poland) have launched numerous initiatives, related to the Green Public Procurement, intended to promote the inclusion of environmental criteria in public tenders, but a lot needs to be done to build the awareness of decision-makers.

75% of the interviewed companies were established based on private savings of founders, and only 10% resorted to the support offered by banks, and the data confirm the importance of private capital in Poland. Half of the companies declared no interests in looking for potential investors. Moreover, government funding is regarded by most of them as non-essential, and only 20% of companies benefited from public support for R&D projects. Nevertheless, they formulated multiple proposals concerning how the government could be supporting R&D: facilitating the promotion and sales of environmental technologies in Poland and abroad. They’ve also noticed that in certain foreign markets, national governments actively support local companies and discriminate against foreign suppliers, usually resorting to implicit preferences, which do not have sound legal foundations.

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The interviewed companies were asked about internal and external barriers to their international expansion, and the most frequently quoted factors included: lack of funding, time, personnel and partners, as well as strong focus on the dynamically growing Polish market and activities of local competitors in foreign markets.

The project GreenEvo is intended to support international transfer of Polish environmentally sound technologies and diffuse technical knowledge, contributing to climate protection, sustainable development and transformations towards the green economy model. 92.5% of companies declared that the participation in GreenEvo induced positive changes in their organizations, 70% referred to new business contacts, 45% spoke about improved visibility in Poland, 30% - about better promotion of their products and services. 30% of companies conclude that being recommended by the Ministry of Environment opens up many opportunities and reassures foreign partners of the reliability and dependency of the Polish companies.

OVERVIEW OF THE RESEARCH

RESEARCH PROBLEM

The report presents summary results of a study analyzing Polish suppliers of environmental technologies. The research project explored the characteristics of the market, experiences of innovative companies and typical practices of market participants in order to offer support for the development of national policies.

The market for environmental technologies in Poland has not been sufficiently identified in previous studies, which only offered fragmentary knowledge and concentrated on selected quantitative characteristics. Lack of relevant analyses has led to mistakes and simplifications in reports and policy documents, exemplified by the following statement from a prominent source, which summarized several basic quantitative indicators for EU member states with a highly biased conclusion that: “eco-innovation does not constitute a driving force for new business opportunities in Poland.” The present report intends to fill the knowledge gap by investigating the processes of development, promotion, sales and implementation of environmental technologies by Polish companies. It contains opinions about the available and desired government support, describes the intellectual property management practices, as well as identified challenges related to public procurement and competitive activities.

GREENEVO – GREEN TECHNOLOGY ACCELERATOR

The research involved in-depth interviews with 40 companies-participants of the GreenEvo project. GreenEvo - Green Technology Accelerator is a governmental project, run by the Ministry of Environment, supporting the international transfer of Polish technologies, which contribute to the protection of the environment. Project participants are selected in a nation-wide competition and verified by independent experts, who evaluate among others their innovativeness, environmental effects and development potential. The winning companies attend a series of trainings, which facilitate their activities in international markets. The Ministry of Environment arranges meetings with potential foreign partners and actively promotes international technological co-operation, with particular focus on the needs of developing countries.

RESEARCH METHODS

The research presented in this report was based on semi-structured interviews with representatives of companies, participating in the GreenEvo project. The interviews were conducted in October and November 2012. The interviewees were owners, board members or directors in the analyzed companies. Each interview was based on the same script, containing a long list of detailed questions, but also allowing for the inclusion of additional topics, which the interviewees considered relevant. The discussions included personal opinions and interpretations of facts, and the respondents were guaranteed anonymity.

The average interview length was 157 minutes, but the longest interview lasted for 266 minutes. Each interview was recorded and transcribed. The collected qualitative material was coded, i.e. divided into text segments, corresponding to specific topics. The codebook consisted of 77 detailed codes, which were subsequently used to analyze and interpret the data. The report presents only selected aspects of the research. Quotations from the interviews are marked by numbers of the anonymous companies. The quantitative summaries were supplemented by data, collected through questionnaire surveys in January 2013 during the annual evaluation of GreenEvo participants.

RESEARCH SAMPLE

40 interviewed companies were winners of the GreenEvo competition in 2010-2012, and the interviews were conducted with all companies that joined the project in these years. The companies represent six broad technological areas: water and wastewater management, waste management, renewable energy sources, energy efficiency, air protection and biodiversity protection.

The companies stand out from other industry players in Poland, as suppliers of own, innovative products, with particular interests in international markets. The environmental technologies industry in Poland includes also many providers of less advanced solutions, as well as distributors of foreign products, so the results of this research cannot be generalized for the entire industry.

The analyzed sample of companies had tangible business successes in recent years. The average growth in sales of companies participating in GreenEvo for one year or longer was 22.01% between 2011 and 2012, and their average sales increase in international markets - 17.92%.
INTERNATIONAL ACTIVITIES OF THE COMPANIES

In January 2013, the companies submitted lists of foreign countries, where they achieved tangible business results (including sales, R&D collaboration, distribution and pilot projects). The most frequently listed EU countries were: Lithuania (11 companies), Germany (9), Czech Republic (6), Spain (8), France (8), Latvia (5) and the United Kingdom (5). In the Central and Eastern European region, the respondents indicated: Ukraine (12 companies), Russia (9), Moldova (6), Belarus (5), Serbia (4), Kazakhstan (3) and Turkey (3), Armenia, Azerbaijan and Macedonia. In other geographical areas, the companies were active in: Canada (5), the United States of America (6), Vietnam (4), China (3), India (3), Malaysia (3), Australia (2), Chile (2), United Arab Emirates (2), as well as Angola, Brazil, Iran, Japan, Morocco, Mongolia, New Zealand, South Korea, Sudan, Taiwan and Thailand. In more distant regions, individual firms focus on selected markets only, with a substantial geographical variation. The overview of key European destinations is presented by 1.

MARKET DATA

Based on Eurostat data, the environmental investment by the public sector in Poland in 2011 amounted to 0.38% of GDP, being almost 3 times higher than the EU average (0.13% GDP), and supplemented by the private expenditure on environmental investment of 0.29% GDP (compared with the EU average of 0.1% GDP). Depending on data aggregation techniques, Poland is regarded as the 6th or 5th largest emitter of greenhouse gases among the 28 EU countries, but the country has made a significant progress in reducing its emissions based on the Kyoto Protocol obligations. Environmental investments are strongly supported through dedicated financial instruments, offered by the National Fund for Environmental Protection and Water Management, which targets key technological areas, including renewable energy sources, energy efficiency and management of water resources. The government considers the environmental expenditure as key element of its investment plans, based on the EU Structural Funds in 2014-2020, and in recent years, appropriate legal frameworks have been improved to facilitate the green transformation. The project GreenEvo, linked to this report, is one of numerous government initiatives, focused on environmental innovations, and offers an opportunity to support the transfer of green technologies to other countries. According to a previous study from 2010, altogether 510 companies were supplying environmental technologies in Poland, including 194 local producers. Importers were offering products mostly from: Austria, China, Denmark, Germany, Italy, Sweden, and the United Kingdom. The total employment in the sector was between 24,000 and 27,000.

ENVIRONMENTAL TECHNOLOGIES IN POLAND

Local producers accounted for 49.2% of environmental products sold in Poland in 2009. Total sales volumes of the analyzed companies in 2009 were PLN 1,143m (approximately €4,696m), and an average producer had annual sales of PLN 4.56m (approximately €18.81m). The sales data seems under-estimated as many companies refused to disclose their quantitative results.

CASE STUDY: DIFFUSION OF RENEWABLE ENERGY TECHNOLOGIES

The dynamic diffusion of renewable energy technologies in Poland helped the country exceed its international obligations related to the GHG emission reduction. In 2012, Polish entities operated 1,715 installations generating energy from renewable sources, and the total installed capacity was 4,384,306 MW (56.9% of this power was generated from wind, followed by hydropower and biomass. By the end of 2012, 288 new installations were awarded licenses and expected to generate additional 5,033.367 MW/4.

Wind energy is an example of a market segment developed in Poland within only several years, but in 2011, the country ranked as high as 11th in the European Union based on the total installed capacity5, and the on-going investments will likely raise this rank.

It might be worth mentioning that the share of renewable energy in total consumption of energy in Poland (10.4%) reached in 2011 a level similar to Germany (12.3%), France (11.5%) and Italy (11.5%),...
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The emergence of new technologies results from substantial R&D (Research and Development) efforts, and 13 interviewed companies (32.5%) believe that their in-house engineers were the main source of these innovations. Figure 2 lists the circumstances, which were identified by interviewers as contributing to the creation of their technologies.

"It started as a quest for innovations in order to stand out in the already existing market, to find its own place. But in order to find this place, we had to get to know the market and answer the question: what is the market like? We started going abroad to attend some kinds of trade fairs and established contacts with other firms, which presented various types of solutions. We were looking at these solutions from the perspective of the lack of similar products in the market in Poland. There was nothing, so each of these solutions seemed new and specific to us. 

... So we were thrown among the existing solutions. And in this way, other solutions, better and cheaper were born in mind. Than we had to find companies in Poland, which would invest in these innovations that we came up with."  

[Company 20]

Ideas for new products or product modifications may be contributed by customers, as experienced by 26 firms (65%). 27 companies (67.5%) state that their technologies result from scientific research. 24 companies (60%) admit that they drew inspiration from similar solutions, developed by other companies.

"You cannot come up with a technology from start to finish by yourself without taking into account things that had been developed by others before. So if somebody made a car of one type, then somebody else made another car before. If somebody made the first car, then it was preceded by a rack wagon - and so on... So we always draw inspiration from similar items. Nevertheless, we do not copy them, because it would make no sense. We try identifying weaknesses of these solutions and improving them, while developing our ones."

[Company 24]

According to 30 companies (75%), inspiration to develop technologies may also come from the extended environment, including mass media, trade fairs, or books.

"Ideas emerge somehow. At different stages of the daily life. Sometimes one goes to the river, sometimes one sees a power station, has a look at a solution and notices that it might look totally different. Everything inspires. The contacts with industry raise issues and suggest solutions."

[Company 38]

Many GreenEvo companies offer solutions, which initially had no direct counterparts, and 16 companies (40%) claim that they had no competitor to imitate or follow.

"In fact, we had nothing to refer to. We did not know what would be the feature of this [new] material. Solutions are ours, original."  

[Company 22]

17 companies (42.5%) claim that at the time of creation, their technologies were innovative on a global level, and Figure 3 lists the answers to the question of technological uniqueness.

"It was negative inspiration, that means: we were observing, what was available and saw that it sucked, so that we were inspired to do something different."

[Company 29]
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When it comes to sources of funding for the companies at their start-up stages, 75% of them were established based on private savings of founders, and only 10% resorted to the support offered by banks, as Figure 5 reveals. This confirms the importance of private capital for environmental investments in Poland and demonstrates the commercial feasibility of eco-innovations in the country.

Figure 4. Disciplines contributing to the technology creation (font size represents the number of responses).

The diversity of specialist knowledge, used to develop technologies, is impressive and Figure 4 presents an overview of the disciplines of science and technology, which were listed by companies as their development bases (the font size corresponds to the popularity of a given discipline).
RESEARCH & DEVELOPMENT ACTIVITIES

while significantly surpassing the United Kingdom (3.8%), the Netherlands (4.9%), Belgium (4.1%) and Ireland (6.7%).

Research & Development activities are important sources of innovations in the environmental technology sector and can be considered a driver of corporate competitiveness. R&D rests upon:

- “the optimization of manufacturing processes, optimization of parameters of existing products, and coming up with new, innovative technologies that help either produce things in better ways, or produce faster, or deliver better products.”
  - [Company 23]

For most of the analyzed companies, R&D efforts constitute obvious and indispensable activities, and 38 companies declared that they carry out R&D (the remaining two companies associated R&D with scientific research and suggested that they work on developing technological products instead, so their activities could still be classified as R&D). The companies had on average 4.88 R&D specialists, and one of the companies employed as many as 72 researchers.

“We are like the Mercedes. Having developed a car, and despite the existing sales, […] it still thinks, where it wants to be in several years. It’s not that one could not drive this Mercedes at present and changes are indispensable. But we know, what we can improve.”
  - [Company 11]

“We observe, what could be changed, improved, because we ourselves use our equipment. In the production plant, […] our technology is used and we see and test every piece of equipment manufactured, but also see, what could be improved.”
  - [Company 13]

36 companies declared that they fund R&D projects primarily from own sources. For most of the interviewees, R&D efforts were nothing special or ennobling, but rather presented everyday practice in the respective technological industries.

“This is not a quest for the Holy Grail, which might appear somewhere, but if there is a specific topic, we tackle it. We either apply existing solutions, or reflect on how to make things better. And this is the essence of all these inventions. And this is the essence of progress.”
  - [Company 25]

Many companies initiate R&D projects in response to specific requirements, expressed by their clients.

“R&D consists in a continuous dialogue with customers. A continuous dialogue with our present customers, potential customers and a dialogue between separate departments [of the company], which have slightly different scopes of activities. It consists in continuously defining new, required functionalities of the solution. When an issue arises, solutions are being searched for. Listen, guys, please find a solution. The customer has this specific problem, please find a solution.”
  - [Company 9]

“Customers are very wise and in many cases they explicitly say, what else they would expect. So we react and include the improvements in the product, in one of its versions. For us, such a customer - from Poland on abroad - only enriches the product.”
  - [Company 20]

Companies are not only driven by the needs that their customers directly express - 35 of companies (87.5%) conduct R&D efforts without direct requirements, which would be defined by current sales or implementation projects.

“Marketing department comes and says that for example a competitor has recently implemented a specific solution. […] And at that moment, deadly silence falls. Constructors look at each other, start acting, so they develop something that is similar. Not the same solution’ . ”
  - [Company 25]

Some companies started deliberately involving customers and suppliers in the process of developing new solutions. This approach is usually called crowdsourcing, when a company encourages external entities to suggest new ideas, and selects the best of them to implement.

“We involved our clients and suppliers in the group, developing and improving technologies. In consequence, our clients call us or send drafts saying: Listen, I would like to do this or that… or: Listen, I have problems with this or that… These things are not always entirely related to the building blocks of our solutions, […] but inspire us. Besides, we have millions of ideas on our own, starting from a machine operator to the managing director, or in a reverse order: from the managing director to a machine operator. Moreover, there are also our suppliers: […] They invite us to attend some conferences, tell about research directions, which they take: […] Our clients or our distributors […] have a lot of ideas, or at least emphasis, what problems they have and say: You are smart, do something about it.”
  - [Company 5]

“Sometimes there are things that seem to have already been solved, but there is just one parameter, with which everybody in the world has still problems. It is worth looking into this problem, because if everyone has got it, it is a major issue and deserves reflecting upon. […] Then we have some brain storming and consider, with whom from the industry we could potentially establish a joint project. We cannot specialize in everything, […] so we look for people who are specialists or have some [relevant] ideas.”
  - [Company 3]

Research & Development activities are important sources of innovations, identified by the interviewees, are presented in Figure 6.

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R&D results lose their value if they are being copied or imitated by other companies. Many interviewees indicated that they do not fear this scenario.

“There is only the question, whether it makes sense and whether there is a need for this. [...] Because, when we attend trade fairs, or on Internet websites, we publish construction diagrams and so on, so one does not need to have business intelligence to copy something. [...] We innovate all the time. One more factor is the automatics, because the body of a device can be copied, since they come to trade fairs and snap photos. [...] They would photograph it from all sides. There is no point concealing it, as somebody can always [...] order the product - it was developed with the sales in mind.”

[Company 27]

“There have been cases when foreign buyers were trying to copy our technology. We inferred several times that a piece of our equipment was purchased not with the intention to use it, but in order to check what is inside. In our technology things that can be copied, do not even need to be looked at. One can do them on his own. But the critical elements cannot [simply] be copied.”

[Company 1]

“This knowledge is not inaccessible. However, one needs to know how to do it - how to set the timing, flows, at what value… [...] And this is our knowledge, not everyone does it in the same way.”

[Company 36]

“If somebody wants to imitate, sometimes there is no motivation. They would know that investments are needed and one needs to establish a network of suppliers, hire engineers... Copying does not pose a problem, but later it turns out that we invent something [new], so before they copy it, the products manufactured would hurt them, because nobody buys obsolete designs.”

[Company 12]

Technological solutions of 18 companies (45%) were imitated by their competition. Interestingly, when asked how the companies protect their technologies against imitation, they were usually answering by making references to technical and business aspects, not mentioning patents as a potential protection mechanism.

Patenting is nevertheless used by 31 companies, and 17 of them engage also in international patenting, either directly at selected patent offices or through the international PCT procedures. Most of companies had no experiences with patent enforcement.

“Patenting something in [name of technological category] is like patenting a paperclip. There are components, which one could patent, but we prefer not to disclose them. We have a better protection when nobody knows about it, rather than having some sort of a patent. We do not think that a patent is the best protection for a product. We have elements that were elaborated on our own and even people, who prepare them, do not know that this is some untypical solution. This masking of the system is better.”

[Company 8]

“It will say something perverse. Patents are very easy to circumvent. And even if they are not circumvented, they are difficult to enforce. [...] We are too small to play this game. Large legal firms are involved, money and a powerful machine that feeds on it. The best way of protecting a patent is simply by continuously evolving. By running ahead. A patent by itself does not offer significant protection. It might only give an illusion sense of security.”

[Company 29]

PATENTING

Protection against copying (legal instrument)
Credibility (facilitating client’s decision-making process)
Differentiator (promotion tool)
Facilitates applying for public support
Makes sales more difficult (perceived by some customers as restricting free competition)

“In reality, a patent is a marketing tool. If somebody wants to demonstrate that something is innovative, he applies for a patent, because it gives him visibility. If somebody wants to circumvent the patent, he will do it anyway - it cannot be helped.”

[Company 3]

PRESENTATION OF TECHNOLOGIES

Present different motivations for using patents, revealing that protection against copying is not the most common reason for patenting. 23 companies use patent databases to analyze competitive technologies and identify market tendencies, so this confirms their beliefs that patents may reveal more than the patent owners would like to.

Also, filing a patent application draws the attention of competitors - as one of interviewees stated, a patent “creates some concerns and opposing actions by others, who could invent something new, better.”

[Company 25]

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[Company 29]
Companies acquire new knowledge about their markets by systematically surveying the needs of potential customers. However, such analyses are conducted only by 26 companies (65%), usually without involving external service providers.

Many companies (15 companies, 37.5%) complain that their customers do not have sufficient, specialist knowledge, which would facilitate in-depth comparisons of solutions, available in the market. At the same time, educating potential buyers might be the source of competitive advantage for the solution providers.

"[Clients] do not have [specialist knowledge, so] a lot of our energy is invested into education. [...] I believe that a good sales representative listens twice more than talks. First of all, listening. Customers are very diverse, each is different. Customers have very different levels of technical knowledge."
[Company 29]

"Customers that take an interest in this, select our company due to their interests in this knowledge, which is difficult to obtain. This is our advantage. When discussing with a customer, we open up to his needs, explain many specialists issues and [present] solutions in ways understandable for the customer."
[Company 38]

When considering international sales, partners turn out to be irreplaceable, as they can offer knowledge about local markets, their specific characteristics and availability of competitive products.

"They are our windows to the world, especially when other countries are considered. They inform us and suggest, whether a given solution makes sense in their market or not, whether it should be developed in one way or another."
[Company 23]

Most of the interviewed companies do not systematically follow Polish and international scientific research, but employees of 34 companies (86%) regularly read specialist industry magazines, and the Internet turns out to be a particularly useful source of technology-related information. 35 companies (87.5%) follow the changes in relevant legislations and draft proposals for legal acts in Poland and in the EU on a regular basis.

CO-OPERATION WITH SCIENTIFIC INSTITUTIONS

32 interviewed companies (86%) maintain co-operation with higher education institutions and research institutes, and 26 of them (65%) contract research projects to academics. "We did not contract the entire [R&D project], because it would be difficult for them to have all the necessary knowledge. Nevertheless, with specific issues, for which we did not have equipment or appropriate scientific and modern approach, or choice of materials, or choice of technological elements - we were turning ourselves to universities."
[Company 12]

In some cases, companies wanted also "consult when developing [technologies] or creating new product concepts."
[Company 19]

"There is a joke that a theoretician knows, how something works, but does not know, how to do it, and a practitioner knows, how to do it, but does not know why. Therefore, co-operation could be beneficial."
[Company 10]

Another area of the science-industry co-operation is the teaching (11 firms, 27.5%). "We teach [students] our technology, we show them equipment that we are selling and we teach them how to operate and use it. [...] We hope that they have open minds and will invent something new, based on what they are getting from us. [...] We also sell equipment to the institutes so that they can carry out research projects. They might have new ideas - OK, let them do it and communicate this to us."
[Company 24]
Science-industry collaboration involves multiple practical challenges, which are listed in Figure 8. Although 31 of the interviewed companies (77.5%) believed that the science sector could be a genuine partner for technological companies, they also emphasized that both parties should derive reciprocal benefits from the relation.

“It is a very difficult partner. Very. With a different mindset, having different priorities. Our priority is about making money. Theirs - about doing research. They can be a partner, but mindsets of both sides need to evolve.”

[Company 20]

Only 10% of companies (4 firms) employ researchers, who are at the same time working for scientific institutions. Universities can however be attractive channels of recruitment:

“We hire new employees] through co-operation with universities, with academics, who recommend a given person that seems interesting. The person gets an offer from us and can give it a try.”

[Company 8]

75% of companies declared that finding competent and experienced employees in Poland constitutes a major problem. The interviewees identified gaps in contents of the university education, as presented in Figure 9, with unsatisfactory practical orientation of studies.

SALES PROCESSES

Selling technological solutions usually involves transferring to potential customers knowledge that results from a long-drawn communication process between suppliers and customers.

“We attend trade fairs, have an interesting conversation with a person from the industry, who - as it turns out - is currently looking for a solution, which we can offer. We are meeting him, talking to him for a year or two. We are writing proposals, having discussions, negotiating and finally, it is concluded by signing an agreement and by an implementation. This is one of possible variations (of the sales process). Primarily, it is about having many talks with the client. Particularly since these are pretty advanced technologies and such a contact is needed to avoid any undertakings, to make everything crystal clear.”

[Company 10]

International sales processes are more problematic due to the distance, limited contacts and local specificity.

“Lack of good customer relations prevented us from reacting timely, when circumstances were changing. It prevented us from reacting, when a competitor submitted another bid. We were far from the client’s decision-making and advising centers, so if the client hesitated, we had lower chances since we were too far away. And this is very often due to the fact that we did not invest enough in a particular market, so customer relations in these markets are relatively loose, even though often the product sells itself.”

[Company 1]

Sales process can be viewed as a sequence of meetings, conversations and collaborations, as presented in Figure 10. This approach supports a better understanding of the needs of a potential client and adjustments of the solutions offered. This step-wise approach requires substantial involvement by the supplier, dedication of his employees and willingness to nurture clients’ needs.
Many companies regard their sales processes as exchanges of technical information and advice, contrasting their approach to the activities of typical distributors, who merely sell off-the-shelf, ready-to-use products. These consultancy-based sales processes involve a larger number of employees and specialist knowledge. On average, each of the interviewed companies had 5.07 employees directly involved in sales processes, and the sales activities could be considered highly professional.

“If one is selling a technology, [...] it might happen, that he needs to spend two years going after it. For example in foreign countries. It will slowly progress and then, it comes to a meeting and signing a contract. We do not need a sales representative understood as a seller, who would stand at a place or run around the entire Poland by car and broke all possible traffic regulations, because he had to deliver a product and sell it.”

[Company 25]

Commercial bids are important capacity building tools, supporting knowledge transfer to potential clients and supplementing the face-to-face communication.

“Our proposals - this is our differentiator compared with competitors - are pretty large documents. They are not merely three pages, but they are extensive documents, having for example 120 pages. [...] They check them in laboratories and thanks to that we eliminate any concerns about dishonesty. Because if the client can verify by himself that the technology works, afterwards we move towards a given client's interests - it all depends on him.”

[Company 11]

Companies tend to avoid traditional, costly promotion techniques, including advertising, as these activities are considered irrelevant for their target segments.

“Anyway, nobody would believe it. We could buy a world-wide advertising campaign for 200 million dollars in wonderful business media, but in any case everybody reading this would say: ‘How can I believe this?’ Everybody. Therefore, the first contact with us concludes with a visit at our plant and ‘touching the system.’”

[Company 11]

“A stage [in the sales process], which could never be skipped, is the preparation of tests for an individual client. Everybody wants to see by himself whether the technology works. Initially, while working with foreign customers, we did it in such a way that they were sending us samples, and we were analyzing them in Poland. But a situation has emerged that clients did not trust the results, which they were getting from Poland, even though they were prepared by an external, accredited laboratory, that was independent from us. [...] But the clients could not believe that so good parameters could be achieved. Therefore, we changed our approach and currently, for subsequent tests we try conducting them on a client’s site and leave the samples behind. They check them in laboratories and thanks to that we eliminate any concerns about dishonesty. Because if the client can verify by himself that the technology works, afterwards we move towards a given client's interests - it all depends on him.”

[Company 9]

Many companies rely on independent reviews, certificates and awards as material evidence of the quality of their technologies. Such documents are used by 27 companies (apart from the GreenEvo distinction, which had been awarded to all of the 40 interviewed companies).

“We sell some products under the brand names of other producers. [...] We are still providers of this technology, but the label says for example: made in [country name]! [...] Sometimes this is the only way for the product to be found in every corner of Europe, isn’t it? Not necessarily branded by the manufacturer.”

[Company 40]

The interviews revealed also after-sales problems, involving among others unfortunate provisions in contracts.

“Agreements are prepared for times of war not peace. No agreement could ever protect you [entirely]. [...] Each agreement can be misconstrued, each piece of paper or each provision is to be broken or misinterpreted. [...] Through years of experience, we’ve worked out a model agreement, which is very comprehensive and sets many standards. It standardizes not only the stage of signing the order, but also the subsequent co-operation, which occurs in the warranty period and after that.”

[Company 11]

“Life itself... A change of date, some paragraphs, something... Some stupid setbacks, which had not been foreseen. The life takes us by surprise. Very often.”

[Company 29]
The interviewed companies presented their interpretations of purchasing motives of their customers, as listed in Figure 11. The views were based on market analyses conducted by the companies and past sales experiences. 33 companies (92.5%) claim that customers do not really consider environmental benefits when making their technological purchases.

“...”

Only 7 companies (17.5%) believed that purchases of their technologies were directly linked to the ecological effects, expected by buyers.

“...”

Over years, it really is an exception if a customer says that he decides to purchase a solution due to e.g. reduction in carbon dioxide emissions. Unfortunately, the environmental awareness related to the emission of pollutants is still very limited. People do not attach importance to it. [...] However, they realize that they would pay smaller bills for heating and smaller bills for other energy media, and it is by all means the best argument to convince a customer that it pays back.”

Figure 11. Opinions of companies about factors that motivate customers to purchase environmental technologies.
Interestingly, despite their critical views concerning the customers’ purchasing motives, 92.5% of companies (37 firms) resort to arguments related to environmental benefits in their promotion and sales activities. In many cases, they can also combine these messages with references to individual benefits, perceived by the clients.

“Customers value [energy security. […] People want to feel good, want to be able to save, if necessary. In general, people are uncertain about the future, so they think positively about anything that allows them to save - either now or at any given moment.”

[Company 3]

Many companies expressed the opinion that the real market success can only be proven when a company manages to sell its products abroad. 10 companies (25%) believe that their international success is linked to personal contacts of employees and partners. Features and benefits of technologies were ranked second and indicated by 7 companies (17.5%). The third place is taken by competitive prices (5 companies, 12.5%), and it is worth noting that the best technological solutions would not necessarily be significantly cheaper than their foreign counterparts.

As revealed by Figure 12, most companies believe that the source of their success is the functionality and characteristics of technical solutions (30 companies, 75%). Their quality and its constant monitoring takes the second place (21 companies, 52.5%), followed by customer satisfaction and maintaining close relations with users, who recommend products to other potential buyers (16 companies, 40%). 15 companies (37.5%) excel in offering custom-built solutions instead of out-of-the-box products, and this personalization of technical products helps better address specific requirements of clients.

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Figure 12. Sources of success for suppliers of environmental technologies in international markets.

Figure 13. Sources of first contacts with foreign customers.
The market for environmental technologies in Poland - experiences of technology providers, lessons learned for public institutions.

24 out of 40 interviewed companies expressed the view that they witness intensive competitive rivalry in their market sectors. 31 of them have also observed instances of inappropriate conduct by competitors, but most were unwilling to discuss them.

“Sales representatives of competitors might say things that are untrue. That is the practice [...] In such cases, we try to talk to the client and explain him how it really is. We do not allow situations, when the client has a shadow of a doubt.”

A very specific problem, related to environmental technologies, is their suitability for a specific customer, as technical parameters of certain solutions might dramatically change depending on where they are being installed and used.

“We have a problem with dishonest providers and distributors [...] from southern markets, where the technologies [...] are produced and adjusted strictly to their latitudes. These products turn out not to be weatherproof in Poland, not suitable for winter conditions, heavy rain, hail, frost or snow... These companies do not emphasize it when talking to customers, and the products are as it somebody was trying to sell convertible cars in England, with the high accumulation of rain.”

And we’ve been trying to fight it for years. End customers may not be aware of this. They see products, which look the same to them, but they differ in specific aspects and one will sell well in Greece, Spain or Sicily, but in Poland or Scandinavia will not work. The first winter comes and it breaks down.”

(Company 23)

“We have two cost estimates – a higher one and a lower one - for similar equipment, and in order to lower the price, a company might use cheaper substitute parts. [Somebody] points to the customer: ‘Sir, this is the price. Specially for you, I lowered it by 10k, and here it is 20k lower. Which one would you select?’ Afterwards, the customer goes on saying: ‘This element is missing, that element is missing. I still have to run about a great deal, and wasted time making purchased. True life...’

(Company 29)

37.5% of the interviewed companies carry out implementation projects by themselves. Half of the companies implement their technologies with the involvement of partners as well as own employees, while the remaining 12.5% deliver finished solutions to other firms that take care of the implementation.

Implementation projects tend to be repetitive, and 32 firms (82.5%) managed to establish frameworks (best practices, methodologies), replicated in new projects. This standardization helps optimize the length of implementation projects, eliminate errors, re-use parts of existing documentation and prepare adequate cost estimates.

Potential problems concern the post-implementation support and maintenance, with interviewees referring to additional costs, logistical challenges and lack of specialists, who could perform maintenance tasks abroad.

“This is not an easy topic, particularly with regards to implementations somewhere at the far end of the world, because it cannot be done remotely. Visits are needed, it involves costs, and the right people need to be employed.”

(Company 30)

Figure 15 presents the cycle of activities, which are performed during a typical sales and implementation project, and which could be delivered either by the company itself or with the involvement of its partners.

“Figure 15. Activities performed by the company and/or its partners during sales and implementation project.”
CO-OPERATION WITH PARTNERS

Providers of environmental technologies have two broad groups of partners: suppliers (of materials, components, services or knowledge) and distributors (including specialist providers of implementation services). Particularly in international markets, alliances with local companies help better understand specific requirements of customers and adapt solutions to these conditions.

“When talking to contractors, active in a given foreign market, we cannot know the local circumstances, so when it comes to organizational matters, we mostly try relying on experiences that our foreign partners have.”

[Company 10]

“It is all about specialization. Specialization and organization make costs lower and help focus on other, strategic matters. This is important for economic and safety reasons. And we know that a failure of a foreign component may bring down everything, but the risk of such an occurrence is relatively lower, or does not concern key matters. If we do something, we try doing the most important things by ourselves.”

[Company 29]

“Lack of capacity for all these meetings is a major problem. Our colleagues in Poland can visit 50-100 customers per week if they are well-organized. If I want to travel across Europe, I am able to visit 5 customers per week. So it is about time, distance and headcount.”

[Company 23]

“Outside of Poland, we build a network of partners, selling our technologies or carrying out [implementation] projects. In Poland, sales conclude of course with the contract signature and the technologies or carrying out [implementation] projects. In Poland, sales conclude of course with the contract signature and the implementation. Abroad, we insist on shortening this and reducing risk of such an occurrence is relatively lower, or does not concern key matters. If we do something, we try doing the most important things by ourselves.”

[Company 29]

“Only time will tell if somebody fooled me then I know that he is not a good partner.”

[Company 29]

“... taking care of support and maintenance and direct engagement with clients, monitoring the work, and so on”

[Company 12]

“For years, we’ve been trying to teach them the very same thing. To put it simply: a credible and honest approach to a client. So that the client is treated as a partner. So that he trusts them as much as they trust us. If we help them with any activity, they are confident that it will be well-done.”

[Company 8]

Partners need to acquire knowledge, which helps them adequately represent the company, promote technological solutions and implement them according to the producer’s recommendations.

“We had to teach them practically all this knowledge that we have. Starting from commercial issues, like the contents of proposals, the scope of our capabilities, performance, implementation time, all the technical and sales matters. But they also need to be capable of [... taking care of support and maintenance and direct engagement with clients, monitoring the work, and so on]”

[Company 12]

GOVERNMENT SUPPORT

About 80% of the interviewed companies operate based merely on their own capital - initial, financial contributions of the owners and reinvested corporate profits. Half of the group declared no interests in potential investors, and some of the companies rejected investment proposals in the past. At the same time, II of the companies might consider foreign investors, who could provide not only capital but also contacts and know-how.

Government funding is regarded by most of the companies as non-essential, and only it companies benefited from public support for R&D projects. Interviewees pointed to the perceived difficulties in securing financial public support and its possible negative impact on some corporate initiatives, which could be deprived of the necessary flexibility.

Companies tend to recommend further liberalization of the national economy by lowering tax rates, elimination of some legal requirements and less stringent government regulations. At the same time, 33 companies proposed further instruments, which were actually increasing the involvement of the government in supporting R&D, or facilitating the promotion and sales of environmental technologies in Poland and abroad.

Interviewed managers were complaining about problems observed in some foreign markets, where governments actively support local companies and discriminate against foreign suppliers by excluding them from public tenders, restricting their contacts with potential customers in the government sector or intervening in technology selection procedures. In many cases, this market protection can be described as "soft", with implicit preferences not having legal foundations.
The market for environmental technologies in Poland—experiences of technology providers, lessons learned for public institutions.

“But we put it this way: ‘If you buy a technology from us, we will not bring Polish specialists[,] but will hire local firms[,] So we make business by selling the technology, while at the same time ensuring that it is a local product. For example, made by Iraqi workers. In this way, the governments conclude that it is better than buying directly from [another country][,] because the other company brings both equipment and labor. We know about these limitations and try smoothly adjusting to them.”

[Company 5]

The project Green Technology Accelerator - GreenEvo is run by the Ministry of Environment. GreenEvo is intended to support international transfer of Polish environmentally sound technologies and diffuse technical knowledge, contributing to climate protection, sustainable development and transformations towards the green economy model. Within the framework, the Ministry selects in a nationwide competition the best, proven environmental technologies and supports their delivery to foreign recipients.

The interviewed companies were asked about internal and external barriers to their international expansion, and the most frequently quoted factors are listed in Figures 16 and 17, including: lack of funding, time, personnel and partners, as well as strong focus on the dynamically growing Polish market and activities of local competitors in foreign markets.

As Figure 18 reveals, 30% of companies conclude that being recommended by the Ministry of Environment opens up many opportunities and reassures foreign partners of the reliability and dependency of the Polish companies.

“It changed our approach. Proved to us that there are several interesting markets outside of Poland, in which we can enjoy some opportunities. It had an impact on our image and reassured us in our competitive struggles. It also allowed us to explore several markets which are potentially interesting to us.”

[Company 15]

As Figure 18 reveals, 30% of companies conclude that being recommended by the Ministry of Environment opens up many opportunities and reassures foreign partners of the reliability and dependency of the Polish companies.

“The brand of the Ministry of Environment establishes trust in discussions. It does not directly translate into transactions with clients, but this hint of confidence helps listen to us. And afterwards, we can fight our way.”

[Company 24]

37 companies (92.5%) declared that the participation in GreenEvo induced changes in their organization.

It changed our approach. Proved to us that there are several interesting markets outside of Poland, in which we can enjoy some opportunities. It had an impact on our image and reassured us in our competitive struggles. It also allowed us to explore several markets which are potentially interesting to us.”

[Company 15]
Even though the GreenEvo project is focused on the developing countries, some participating companies suggested extending the project to Western European markets as well. 25% of the interviewed companies demonstrate particularly interests in Central and Eastern European countries, located close to Poland and having high potential for environmental technology transfer.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>New business contacts</td>
<td>70%</td>
</tr>
<tr>
<td>Improved visibility in the Polish market</td>
<td>45%</td>
</tr>
<tr>
<td>Opening up new markets</td>
<td>40%</td>
</tr>
<tr>
<td>Better promotion of the company</td>
<td>32.5%</td>
</tr>
<tr>
<td>Support from the Polish government</td>
<td>30.0%</td>
</tr>
<tr>
<td>Improved visibility in international markets</td>
<td>27.5%</td>
</tr>
<tr>
<td>New knowledge acquired through training</td>
<td>17.5%</td>
</tr>
<tr>
<td>Increased sales of the technology</td>
<td>15.0%</td>
</tr>
<tr>
<td>Increased competitiveness of the company</td>
<td>10.0%</td>
</tr>
<tr>
<td>Cooperation with other companies - GreenEvo winners</td>
<td>10.0%</td>
</tr>
<tr>
<td>Improved communication with clients</td>
<td>7.5%</td>
</tr>
<tr>
<td>Increased motivation for international sales</td>
<td>5.0%</td>
</tr>
<tr>
<td>Employing new sales personnel</td>
<td>5.0%</td>
</tr>
<tr>
<td>Increased number of R&amp;D projects</td>
<td>5.0%</td>
</tr>
</tbody>
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![Figure 18. Impact of the participation in GreenEvo on the interviewed companies.](image)