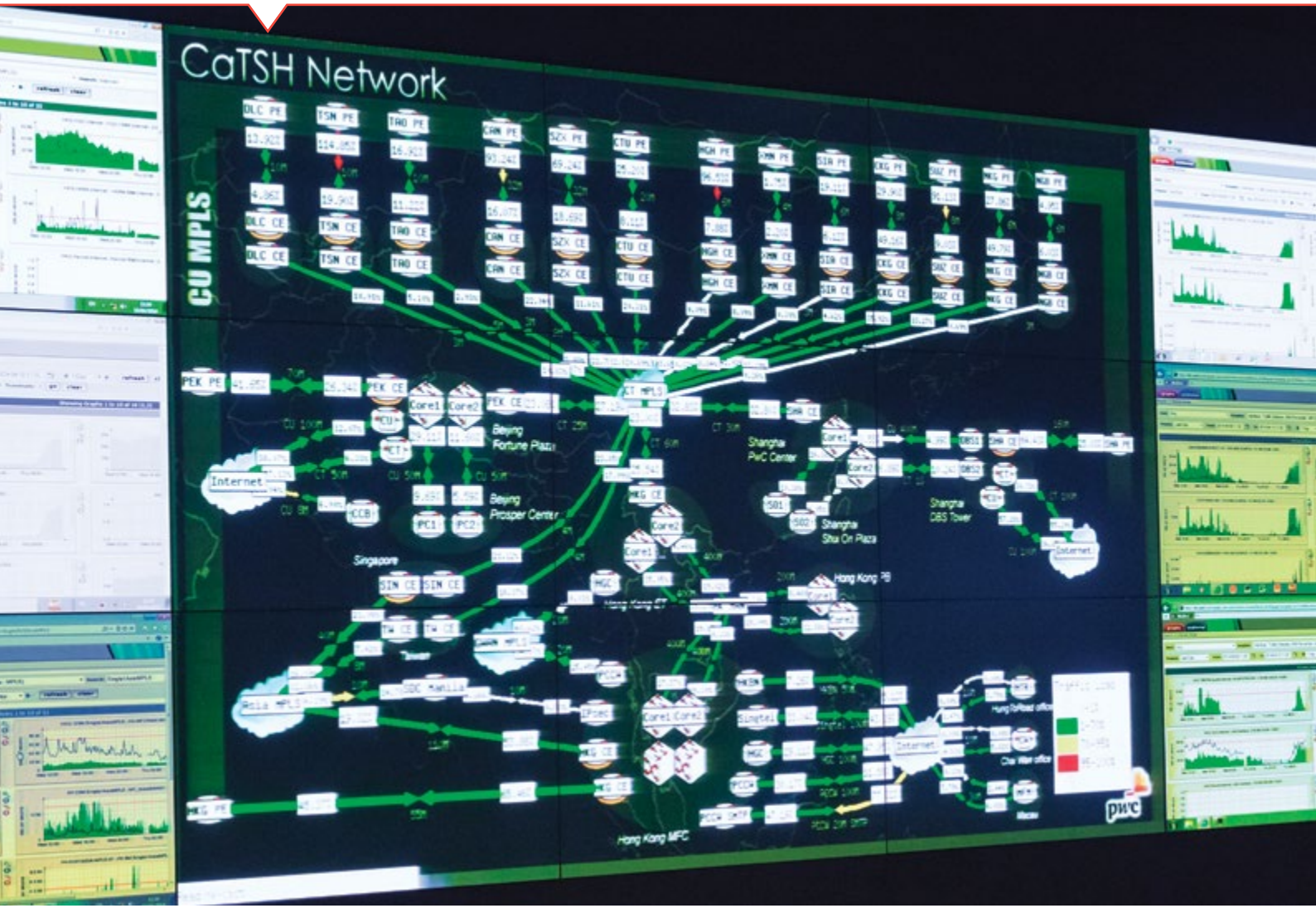
April 2017

Reaching for more:
3.8 billion + for the Polish energy sector



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Dear Readers,

Every year we share with you our thoughts on the energy industry. According to us, this year brings opportunities for the sector that make it possible to “reach for more”, i.e. build based on the resources and infrastructure already held. Our analysis shows that, based on its resources and infrastructure, the Polish energy sector may gain more than PLN 3.8 billion. This amount consists of the value generated from the development of electromobility (PLN 2.0 billion) and crowdfunding (PLN 1.8 billion).”+” means an additional potential enabling the generation of hundreds of millions of PLN per year for the sector, which at the current level of market development cannot be estimated precisely.

This report describes five areas which, in our opinion, are the value generation source in the energy sector. Their proper utilisation is an opportunity to raise the effectiveness of companies, enhance the efficient use of current resources, and identify new sources of revenue.

Electromobility, today heavily underlined and supported, is nothing other than a new sector of the economy, where new products, new services, and new business models appear. The development of electromobility will not be possible, however, without the participation of power utilities – therefore, it is important that the energy sector finds its place in the new stream of revenues.

Because of digital transformation, companies are learning to use the information which has been gathered in order to make better business decisions. The data from the production systems of coal mines, power plants, CHPs, and the grid contain information about how best to use the infrastructure owned: how to prevent failures, how to repair, what really needs to be repaired, and how to produce more for the same investment.

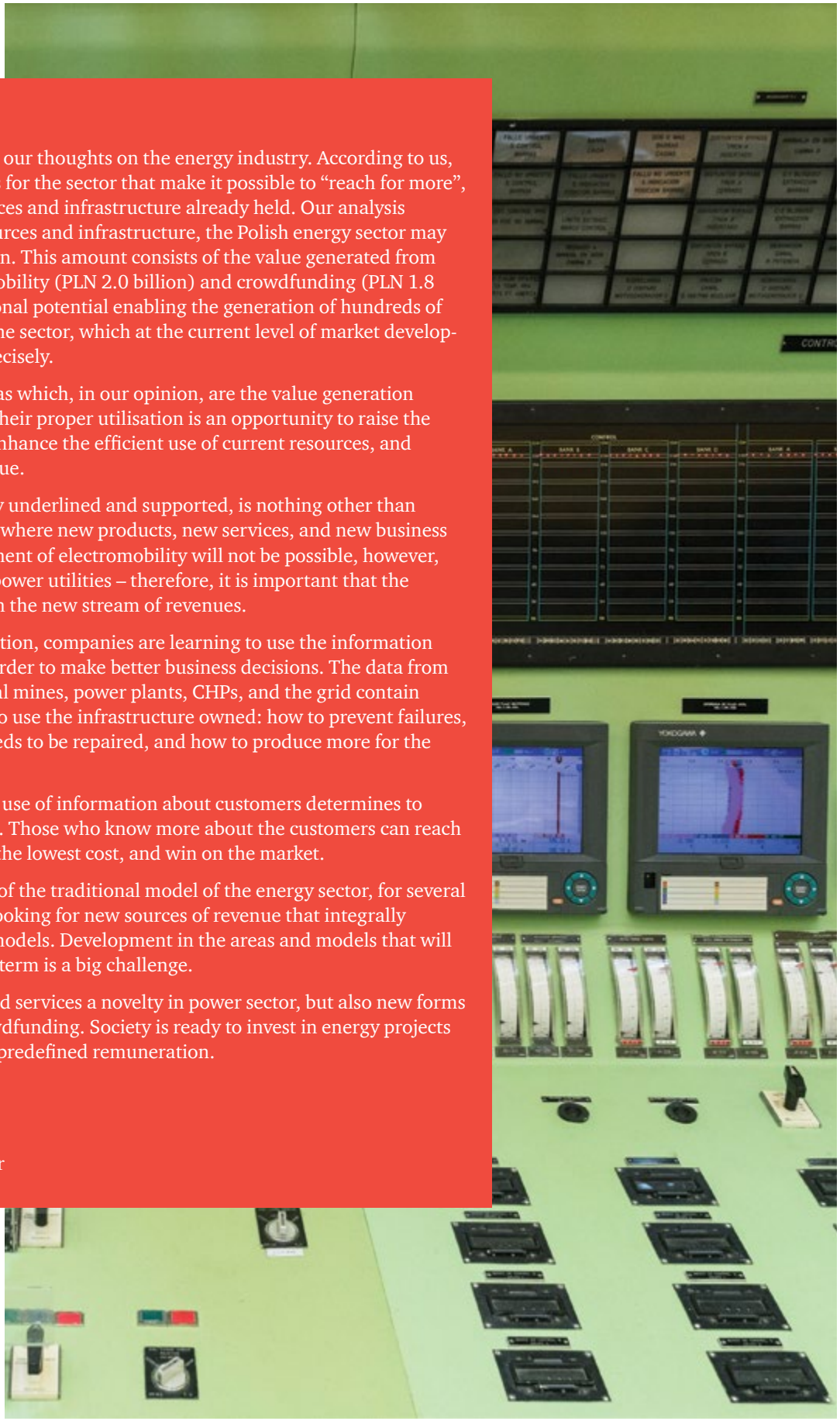
The successful collection and use of information about customers determines to a great extent market success. Those who know more about the customers can reach them with a tailored offer at the lowest cost, and win on the market.

In this age of transformation of the traditional model of the energy sector, for several years the industry has been looking for new sources of revenue that integrally combine with new business models. Development in the areas and models that will remain profitable in the long term is a big challenge.

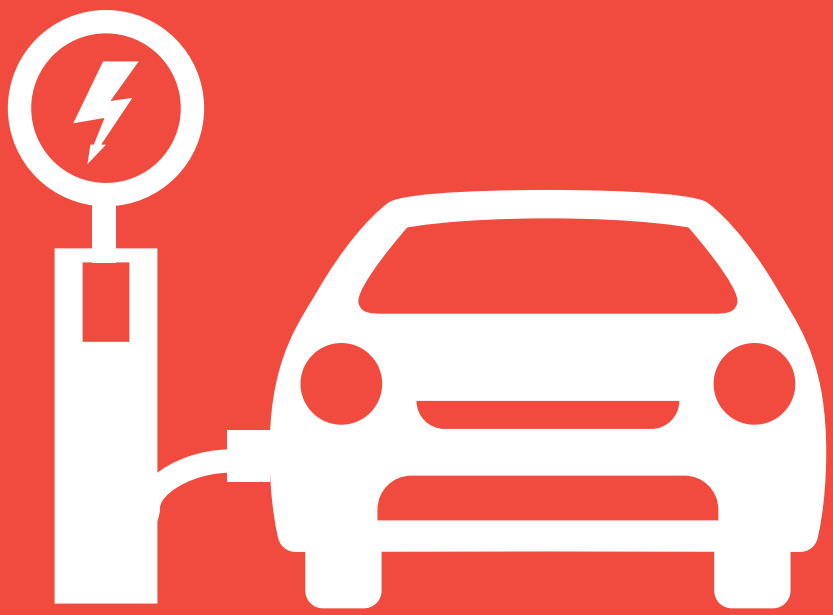
Not only are new products and services a novelty in power sector, but also new forms of funding, for example, crowdfunding. Society is ready to invest in energy projects of a particular type and for a predefined remuneration.

Enjoy reading!

Dorota Dębińska-Pokorska
Partner, Energy Group Leader



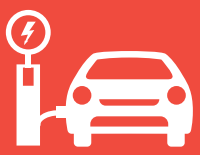
How to earn money through electric cars?
Infrastructure, products, business models



How to earn money through electric cars? Infrastructure, products, business models

In 10 years' time, a million electric vehicles will be travelling on Polish roads. This will require a charging infrastructure supplied from the grid of the power utilities. In order to achieve measurable long-term financial benefits from the implementation of the ministerial plan, the companies interested in the development of the charging infrastructure segment will have to prepare rational business models and plan the optimal location of charging points (for example, using geolocation technology).

PLN 2 billion
by 2025



The investment leap associated with the development of the charging infrastructure segment is estimated at **over PLN 2 billion by 2025**[1]. On the one hand, **this is an opportunity to expand business**, and on the other **a huge organizational challenge** to create a network of approximately 60,000 charging stations.

Charging infrastructure market: it works in other countries

Examples of the business activity of foreign entities indicate that there are three ways to build a company's presence on the charging infrastructure market: by investment in the company's own infrastructure, by establishing a partnership, and by developing technology. For instance, ČEZ focuses on extending the network of charging points using external sources of funding. In contrast, Vattenfall cooperates with scientific centres in building a network of partner charging points, and finances and conducts research on new technological solutions.

1. Value estimated based on the number of chargers needed to service 1 million electric vehicles, defined at the median of the number of chargers per 1 vehicle in Western Europe, and at the median of capital expenditure required to install 1 charger

The business activity of selected energy companies regarding the electric vehicle charging infrastructure

No.	Company	Registered office	Characteristics
1	Energa	Poland	For three years, the group has been implementing a pilot project called eMobility, whose aim is to analyse the potential of the e-mobility sector by providing free charging of vehicles in several points belonging to the company. In 2016, Energa had six charging points (located in the Tri-City area). In the first quarter of 2017, it started cooperation with the Finnish company Fortum on implementing the Charge&Drive system, which is to enable the remote service, monitoring, and update of the charging infrastructure.
2	Innogy	Poland	Since 2009 Innogy has been implementing a pilot project about charging infrastructure. In December 2016 the company had 12 charging stations in Warsaw. Recently, Innogy has been promoting a partner model of cooperation, under which the company conducts training on the operation of its charging stations, ensuring the servicing and technical update of the stations.
3	ČEZ	Czech Republic	ČEZ started to be active in the charging infrastructure sector in 2011 and has since been developing actively in this area. By the end of 2016, the company had about 50 regular charging stations and 25 fast charging stations in the Czech Republic. The group plans to build 42 fast charging points by 2018, using money from the EU fund "Connecting Europe Facility" (CEF). The estimated value of the project is EUR 2.3 million, out of which only 15% will be financed from ČEZ's own funds.
4	Enel	Italy	In Italy, Enel's activity in the area of charging infrastructure consists in the development of the company's own charger network and the sale of cars together with partners (Nissan), and supplying devices for independent partners (e.g. Carrefour). The group plays the role of a commercial and technical operator. Independent partners of Enel, operating in a competitive market, individually set the energy price for drivers. In order to increase price transparency for the end customer, every charging point has a dedicated meter.
5	Vattenfall	Sweden	Together with scientific and research institutions, the group carries out R&D projects under which it develops the electric car charging technology, including the concept of wireless charging. Moreover, the group has initiated a partnership programme, inCharge, which includes planning, installation, management, and commercial and technical operations connected to the infrastructure. The goal of the programme is the full integration of charging networks in Sweden and the greater availability of the infrastructure for electric car drivers, for example, by the company's own mobile application locating Polish charging stations. Currently, the inCharge network has approximately 3,000 charging points.

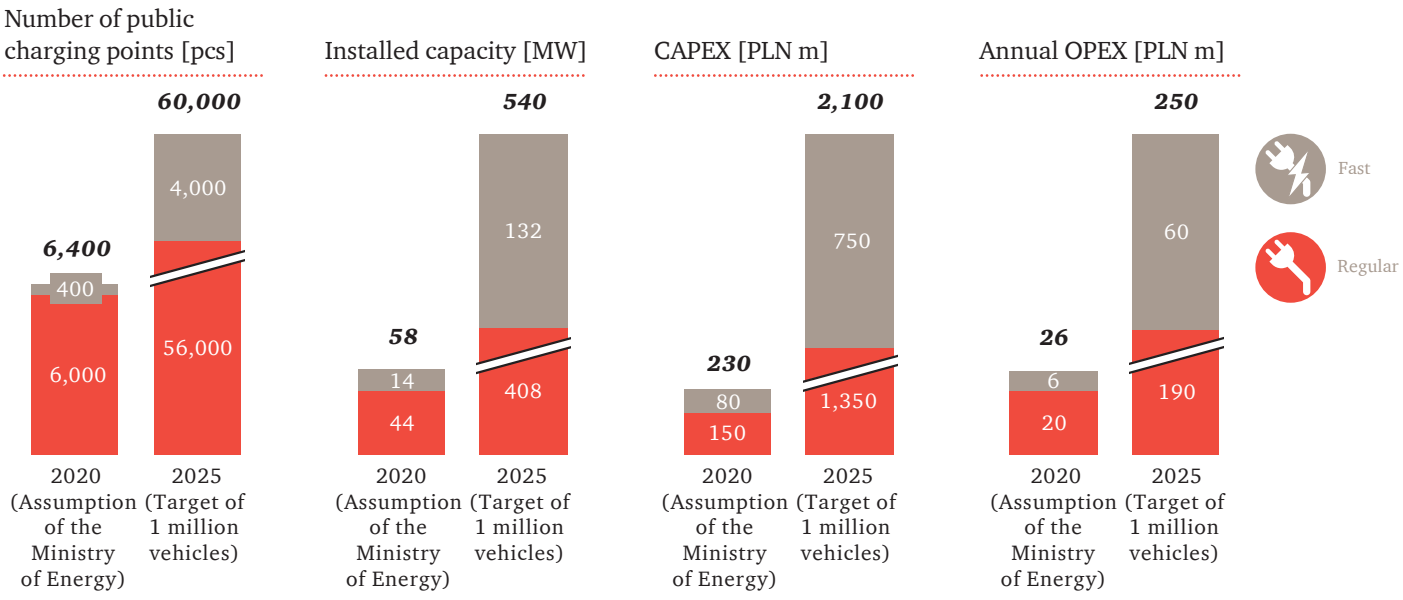
The scale of challenges connected to the charging infrastructure for electric vehicles

According to the assumptions of the Ministry of Energy, by 2020 in 32 urban areas in the whole of Poland, 6,000 regular charging points and 400 large power-charging points are to be built. This, however, is just the beginning of the development, if we take into account the fact that a million electric cars are to be travelling on Polish roads by 2025.

Based on examples from other countries, such a number of cars will need a target number of 60,000 charging stations, assuming that there will be about 15-20 cars per one public charging point. Such a large scale of business entails enormous financial, technical, and organisational challenges, because:

- the plan will require significant capital expenditures and maintenance outlays. Taking into account the average costs of charging infrastructure, the total costs necessary to implement this project have been estimated at about PLN 2.1 billion. This amount includes approximately PLN 250 million necessary for the modernization and enhancement of distribution grids[2], and a further PLN 250 million per year for maintenance of the infrastructure. With such expenditure, it will be necessary to create business models for financing investment and the operation of chargers, which will also have to be included in the current network development and modernization plans of the DSO grids;
- the development scale of charger networks installed by 2025 can be compared to 540 MW installed capacity, which corresponds to the power employed when connecting about 50 thousand apartments. This is similar in size to the city of Opole or to the capacity of the Porąbka-Żar power plant, the second largest pumped-storage power plant in Poland. Fast growth of the grid must be included in the grid development plans of the DSOs, especially in the urban architecture of low and medium voltage grids, and in the grid maintenance concept. The mentioned capacity also means a large potential of storage and feeding electricity back into the grid, provided that a business and technological model that enables this is implemented;
- 60 thousand charging points will require optimal planning of the infrastructure development in terms of time and space, so that the infrastructure can meet the profitability criteria (investment budget savings and a high degree of utilization of charging points), and so that it is adjusted to the technical abilities of the DSO infrastructure (maintenance of supply security). Also the needs of charger users must be met (available parking lots, optimal road access and location). Other issues must be regulated too: for example, the ownership of land and the charging devices.

Development of the Polish charging infrastructure for electric vehicles, 2020-2025



Source: PwC analysis

2. For instance, some fast chargers require a transformer, whose cost may equal as much as 30% of the entire investment

Benefits of the involvement in shaping the charging infrastructure for electric vehicles

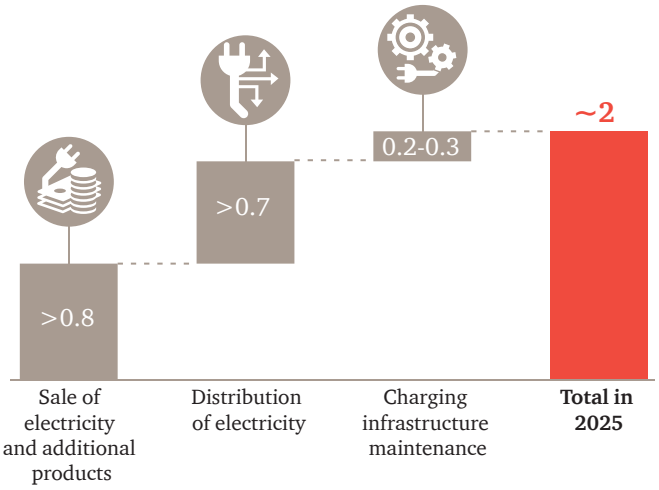
The active involvement of power utilities in shaping the charging infrastructure for electric vehicles brings an opportunity to benefit from a market with high revenue potential. According to estimates, in 2025 the market will be worth almost PLN 2 billion per year, assuming the target number of one million electric vehicles and 60,000 charging points is achieved.

A component of this amount is the revenue from the sale of electricity (for charging electric vehicles) which will reach more than PLN 0.8 billion (according to today's net prices, for about 3 TWh consumption per 1 million vehicles[3]). Attractive products of energy companies could fill the portfolio of retail companies and provide additional margins on bundled products. It is worth stressing, however, that they may be lost to alternative sellers if energy companies do not seize the opportunity to build their own network of charging stations or related products. Other components of the amount mentioned above include revenues from the distribution of electricity reaching more than PLN 0.7 billion[4], which in light of the DSO's role are less likely to be lost to competitors. The margin of this revenue stream will closely depend on the tariff model and the method of settling distribution services with regard to charging electric vehicles. A further element is revenue from the maintenance of the charging infrastructure, with the target infrastructure scale amounting to about PLN 0.2-0.3 million per year.

Moreover, it is worth mentioning the as yet unestimated benefits of using vehicles for energy storage (so-called smart charging), which could reduce the required investment in grid development. Other benefits could be derived from using additional external funding sources for grid development, such as national and EU funds, credits (a positive effect of financial leverage), social financing, and other means that increase returns on capital. Corporate social responsibility (CSR) efforts related to promoting energy companies as entities that care for local communities, particularly air quality, may also bring tangible effects.

Energy companies can use the above categories of benefits in a different degree to build margins (and thus also the companies' value), although the scale and structure of these benefits will depend on the individually adopted business model. Estimates do not include revenue from building private charging stations or the accompanying maintenance services, which create further potential.

Possible benefits for energy companies from active involvement in the shaping of charging infrastructure for electric vehicles, 2025 [PLN bn per year]



Source: PwC analysis

A passive approach by energy companies to building charging infrastructure and using only some of the benefits of this new business opportunity may lead to alternative infrastructure suppliers taking over the market. To avoid this, companies should start working on plans for the development of a charging infrastructure in the area covered by their grids, and on effective business models and attractive products which, given the required capital expenditure, would guarantee maximum target achievement, i.e. an increase in the company's value.

3. The calculation assumes that each vehicle consumes on average about 20 kWh per 100 km, in combined city and motorway driving of 15,000 km per year
4. Out of which, given the current DSO WACC, the return on capital employed may be estimated at about PLN 100 million

Seizing the opportunities provided by the development of charging infrastructure for electric vehicles

Companies from the sector that want to use the development of the charging infrastructure for electric vehicles to reach their own targets must answer a number of strategic, business, and technical questions.

The development of charging infrastructure: key questions and possible answers

	Strategy	Business model and products	Infrastructure development plan	Financing
Key questions	• What are the goals of the activity focused on charging infrastructure?	• Where should we build margin? • What elements of products and services should we create?	• Where should we place charging points to make them most attractive and cost-efficient?	• How to finance the development of infrastructure?
Possible answers	• company's image and promotion • optimisation of the grid's operations conditions • customer retention and protection against competition • increase in income and margin mass.	**Payment model:** • free charging, margin on products • fixed monthly fee • pay-as-you-drive • mixed models. **Additional products:** • purchase/lease of an electric vehicle • home charger and energy for home • car-sharing • mobile applications.	**Locations:** • public roads and buildings • commercial buildings • housing estates. **Types of points:** • regular / fast • for public transport • car-sharing.	• own capital • debt financing • national and EU funds • PPP.

Source: PwC analysis

The development of the charging infrastructure business may translate into the achievement of various strategic goals. Some companies may opt for partial involvement, encompassing only single chargers or company cars, simply to improve their image and promote themselves. More complex strategies may use investment in this area to enhance and modernise the energy grid. This business may also improve customer retention by creating new products. Moreover, it may strengthen protection against competitors offering attractive e-mobility packages combined with basic energy products, which could increase the churn rate. The right strategy may help increase the company's value by raising revenue and the mass of margins from selling products and services.

The key to a successful strategy is the right and attractive business model, and a related product range. Depending on customer expectations and the level of attractiveness for the energy company, the business model may include, for example, a fee for every kWh of charging, even higher than in traditional tariffs, or a fixed fee and a small variable fee. Additional products are also important in building an attractive offer: a dedicated car leasing offer, mobile applications, or a car sharing option. A package from the Italian company Enel is an example of a comprehensive offer. It gives the customers the opportunity to lease a Nissan Leaf for EUR 299 per month; provides access to E-Go, an application that controls the charging process; provides a home charging device, along with its installation, and the opportunity to charge in all Enel's points at a fixed price of EUR 0.4 /kWh, higher than the usual costs of electricity and distribution. In comprehensive solutions, it is important to build a business model that will determine which elements of the offer will bring profit for the company, and which will attract customers.

The optimal planning of infrastructure development will determine how attractive the company's charging offer will be in reality. An insufficiently dense network or unattractive locations of individual charging points may discourage users, leading to low use rates. In contrast, a network that is too dense will involve unnecessary capital and operational expenses. In order to develop plans, conduct a statistical analysis, and build charging points in alternative locations, it will be useful to use spatial data about buildings, public infrastructure, power grid, car traffic, population, and the affluence of the residents.

After the analyses have been conducted, it is important to properly finance the investment, so that it helps improve the profitability of the planned strategy. High costs of employing the company's capital may be reduced thanks to EU funds (for example, from the Connecting Europe Facility programme), and national support schemes. Thanks to market growth, infrastructure form, and ecological character, such investments are also more likely to obtain debt financing than, for example, investment in electricity generation sources.

Developing the infrastructure plan based on a hot spot analysis and multi-criteria optimisation

Optimal charging points from the perspective of stakeholders (so-called hot spots)

Optimal locations for the DSO (compatible with the grid's capabilities)

Optimal locations for the city (compatible with the spatial development plans)

Optimal locations for users (e.g. availability)

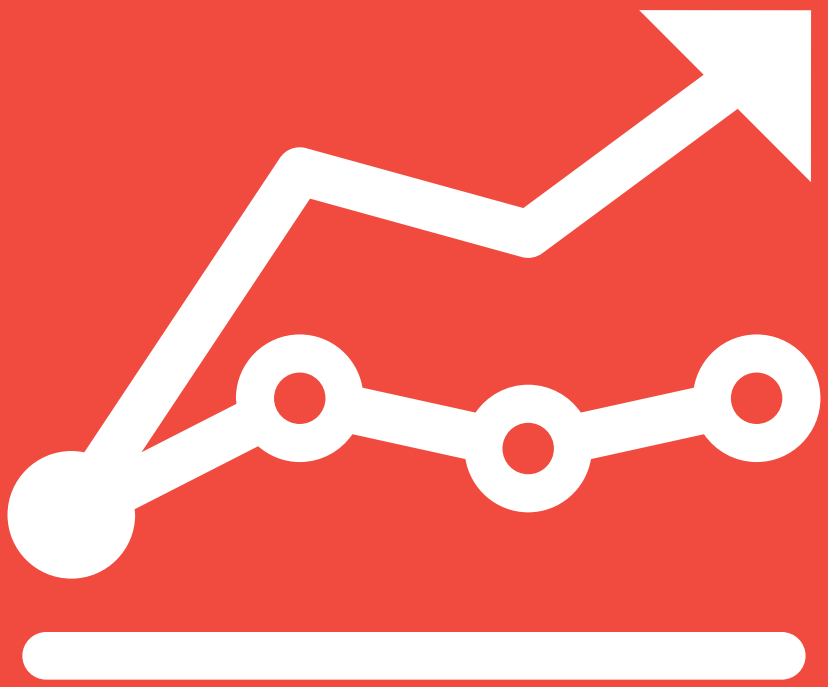
Other

Multi-criteria optimisation

Statistical analysis that identifies the points that meet all or most of the optimum criteria for various stakeholders

Recommended result map of the infrastructure (example)

Why do companies need production data?
Are they useful to engineers only or can they be a source of profit?



Why do companies need production data? Are they useful to engineers only or can they be a source of profit?

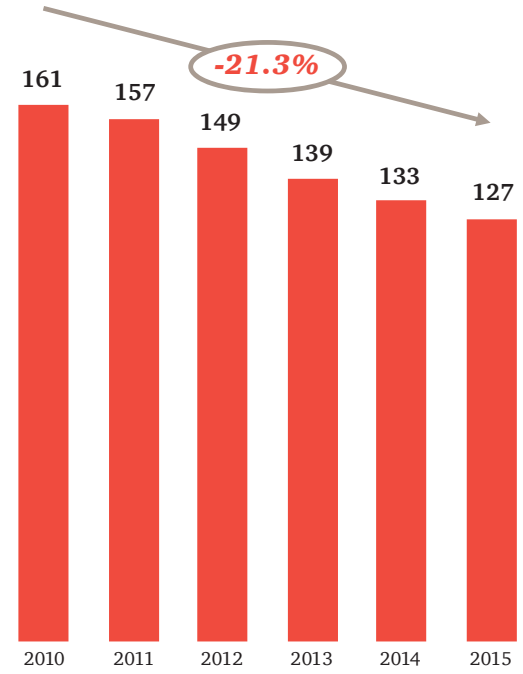
Owing to the current electricity prices, covering the total cost of production is a great challenge for companies in the sector. Even if enterprises achieve a positive margin through the wholesale of electricity, the financial inflows may be insufficient for the implementation of investment and replacement activities. A similar situation may be observed in the distribution segment, which is under pressure from cost control. The coal mining industry also faces the challenge of modernisation and efficiency improvement. Consequently, there is constant pressure in the entire energy sector to optimise operations. A feasible method of raising the operational efficiency is to increase the profitability of the infrastructure used.

several million per year

Professional use of the analytical tools that support business decisions may bring considerable savings for the sector, reaching a minimum of several hundred million per year. [5]

For many years, the energy sector has been implementing optimisation processes. In the first place, companies sought optimisation solutions that could deliver measurable financial results in the short term. Such activities were carried out in several business areas simultaneously. Companies reviewed their employment level and estimated their needs in this area. As a result, employment restructuring programmes, based primarily on voluntary severance schemes, or other similar projects addressed to selected groups of employees, were announced. As a consequence of the changes introduced, the sector was able to significantly reduce its employment level.

Employment in the public services sector (gas, electricity) - in thousands of employees



Source: GUS (Central Statistical Office of Poland)

If further downsizing schemes in the energy sector are launched, they will have decreasing effectiveness. Moreover, at this stage these processes are not easy to carry out because of the risk of losing the key competences of the longest serving staff. Another difficulty about this is the need to negotiate such processes with employee organisations. In consequence, changes in the level of employment will not have a significant financial effect in the optimisation processes.

5. The amount of savings has been estimated based on the assumptions that there have been (i) optimisation of outlays for maintenance, repairs, and modernisation of the devices in the extraction, generation (of heat and electricity), and distribution (of heat and electricity) sectors; (ii) single optimisation effects have been estimated at the first quartile of the savings of those energy companies that have implemented solutions based on IT and OT systems integration, and have made organisational changes in the area of maintenance and repairs

Another element of the optimisation activities was streamlining the business model and building a clear and transparent division into business lines. This was accomplished by merging companies as well as by constructing stand-alone business lines around key links in the value chain of energy companies. At the same time, energy companies tried to limit their peripheral activities, unrelated to their core business, and sell assets (such as real estate) that were redundant. All energy groups operating on the market have implemented the above-described processes. The silo management system, based on the core business segments, remained an open issue in the analysed area of performance improvement.

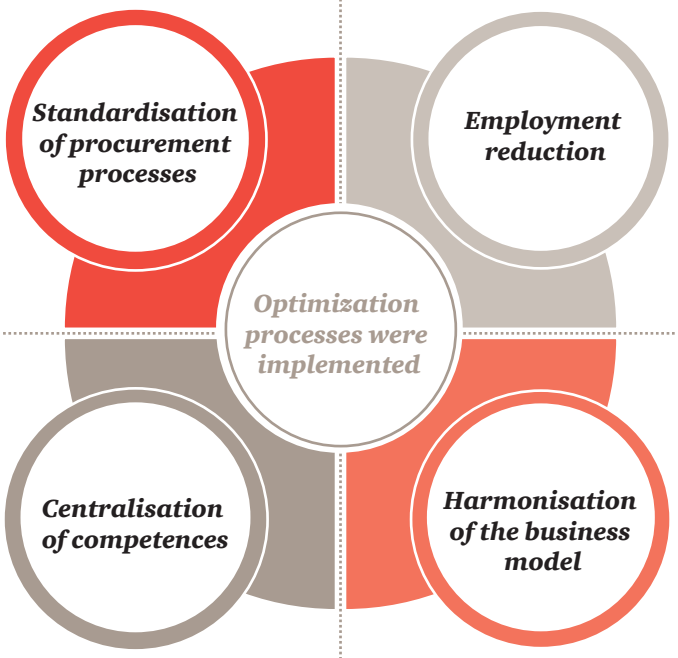
The result of the efforts focused on changing the business model has been the centralisation of competences. Most energy companies have implemented this and created shared service centres, using the synergies related to the centralisation of support functions such as IT, HR, finance, and accounting. However, the scale benefits connected to the construction of such centres have already been exhausted. The improvement potential for this area currently lies in process optimisation and service automation.

Optimisation efforts have also been applied to procurement procedures and policies. To a smaller or greater degree, energy companies have centralised procurement processes and implemented standard procurement procedures and policies. This has made it possible to harmonise the procurement area, increase the transparency of the proceedings, and consequently obtain more favourable prices. Additionally, more and more often energy companies are using electronic tools to support procurement processes, resulting in lower costs of the process, and price reductions in cases of electronic auctions. However, similarly as in other areas, the optimisation potential has in principle been exhausted already, and any possible changes in process and organisation will not directly translate into significant financial effects in the cost base.

Optimisation processes implemented – summary

Energy companies centralised and standardised procurement processes and policies, which resulted in savings in the procurement process.

Energy companies announced and carried out voluntary severance schemes, which significantly reduced employment in recent years.



Companies centralised their competences in the support functions, among others, and they established shared services centres.

Energy companies carried out deep reorganisation and streamlined their structures, benefitting from specialisation.

Source: PwC analysis

Energy companies have to a large extent exhausted the potential of simple optimisation efforts concerning their core business functions. They have brought rapid benefits, but further actions are necessary. The area that still needs attention is fixed costs, whose key component is remuneration, and remuneration has already been reduced. Therefore, it is worth paying attention to a group of costs connected to the maintenance and operation of the property held. In order to improve efficiency in this group of costs, companies in the sector have to use more complex tools. What can help here is the progressive computerisation and automation of production processes, which make it possible to acquire large quantities of technological information that can be used in making business decisions aimed at improving the profitability of the assets held.

Technological change in the energy sector is a fact

More and more aspects of the activity of energy companies, ranging from strategic management to strictly operational activities, are supported by state-of-the-art technologies. Every day companies generate and acquire enormous quantities of information. At the same time, from a business perspective, it is crucial that decisions are better and made faster based on the most accurate data. To achieve this, all functional areas of the organisation (such as operations, repairs, investments, finance, and trading) must communicate clearly with one another, and it must be possible to analyse the transferred data from the perspective of making optimal business decisions.

In the age of information, systems naturally tend to integrate, often connecting many different worlds together. In practice, regardless of the industry and the specific character of a given enterprise, a real way to improve the operational efficiency is to skilfully combine production information and financial/business information. The goal of such efforts is to create in the whole enterprise a common and coherent source of information coming from systems for steering technological processes (DCS/SCADA) and from business systems (data warehouses, ERP, CRM, BI, etc.).

Such an approach enables the coherent and uniform management of the assets held, and of the production and commercial activity. It thus becomes possible to actually monitor the real costs of the operating activity, including the production and maintenance costs, which before had a retrospective, even purely statistical or general, character.

Supporting business processes with technological information may be beneficial

The areas that most often benefit from the technological system data are:

- asset management, i.e. management of the infrastructure held,
- production margin and costs management.

In each of these cases, the ability to capture data from industrial control systems along with a business context gives a new perspective on the operational activity. For example, the processes of assets maintenance may be improved based on the acquired technical and financial information, for instance by implementing an asset management strategy aimed at increasing its effectiveness, so called asset performance management. In practice, the implementation of Predictive Maintenance is frequent. Predictive Maintenance is focused on assets analysis and the likelihood of failures in terms of the failure occurrence risk and influence on business, so called business impact analysis. The Condition Based Maintenance is also frequent. As a derivate of Predictive Maintenance, Condition Based Maintenance focuses on asset management based on its current condition. From the perspective of margin management, actions aimed at the optimisation of technological processes, taking into account cost elements, are possible.

The following are examples of such solutions:

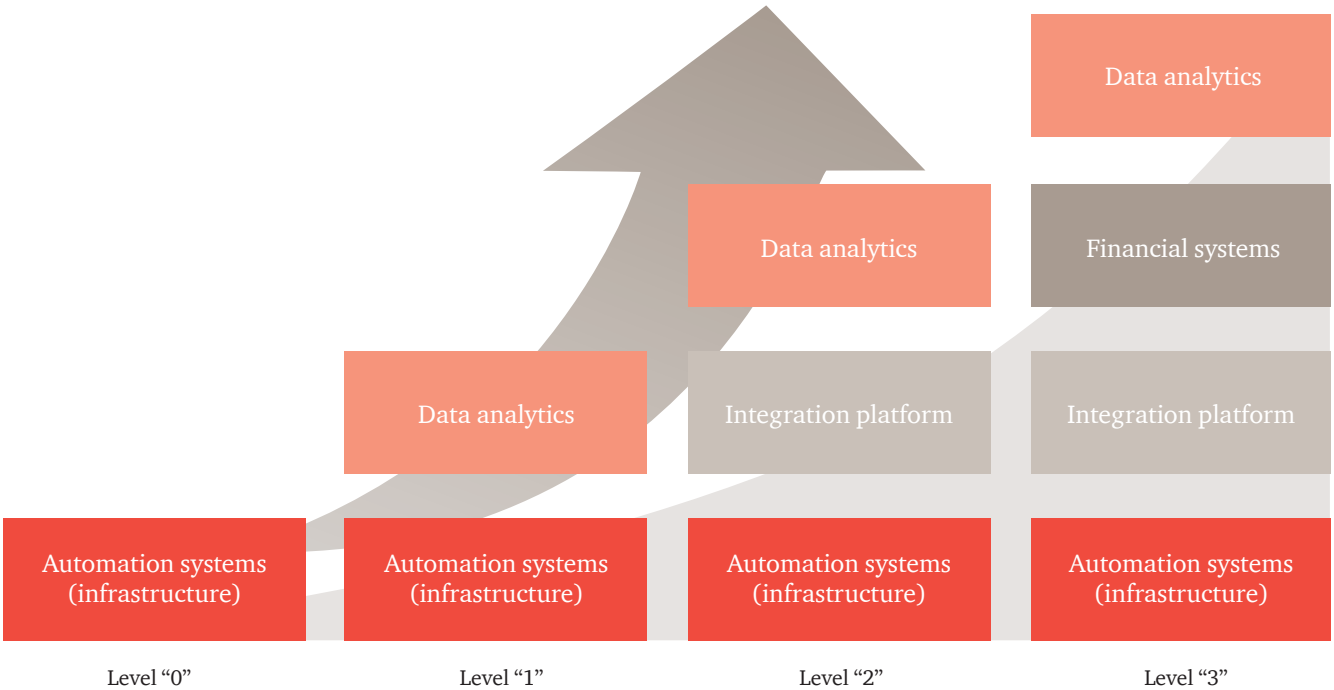
- tools supporting the management of the cost of mining equipment which, for example, identify the most energy-intensive elements of the technological process and enable the estimation of the economic effects of their modernisation,
- boiler optimisers which take into account the technological element and enable reduction of the variable costs of production,
- analytical tools which optimise the load of production systems from the financial perspective, so called ELA - Economic Load Allocation,
- tools monitoring grid work and identifying the areas of interferences and higher losses in energy distribution, which allow the optimisation of maintenance and repair works.

In each case, it is important to acquire data from industrial automation systems (OT e.g. DCS/SCADA), collect them in a central data infrastructure, and create a model for integration with the business area, where the production data will gain a new dimension. We can also imagine a situation when trading operations on energy markets are supported continually by efficient decision models that monitor, in real time, the costs of acquiring fuels (their extraction) and electricity production. Therefore, the management of the margin on electricity sales on the Day-Ahead Market and the Intraday Market may gain a totally new dimension. Consequently, using technological data in processes that have so far been seen as purely business processes, is no longer discussed in terms of "is it profitable?", but "when and to what extent will it take place?"

Technological information can support business decisions in every organisation

The maturity of companies in terms of their opportunities and abilities to use technological information for business goals may be assessed based on a three-level model.

Technological maturity of an organisation



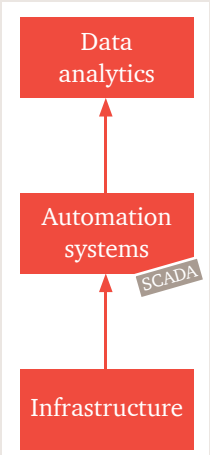
Source: PwC analysis

Level 1 – the organisation has industrial automation systems

Level 1 of the organisation's maturity includes primarily the SCADA class technology systems. Solutions of this kind usually do not have built-in tools for collecting long time series of data. Consequently, the information from the SCADA systems, even if collected, is used statically for device configuration purposes.

Based on the data obtained from sensors and controllers, transferred and collected (in a limited scope) in the control systems, analytical tools are prepared that enable the operators to constantly optimise the operation of the equipment or conduct ex-post analyses, e.g. failure analyses.

Examples of analysed areas - level 1



- modification of the production model in order to increase process efficiency / improve product quality,
- failure analysis / prediction for single devices / production line elements,
- KPI for machine operators,
- monitoring the effectiveness of repairing failures in individual devices,
- quality of maintenance work.

Examples of benefits - level 1

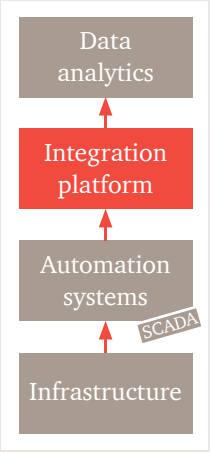
Modification of the production model in order to increase process efficiency / improve product quality	• solutions enabling continuous improvement of the production process, • models – recommendation to change operation parameters, • identification of simple inefficiencies in the work of devices.
Failure analysis / prediction for individual devices / production line elements	• monitoring the performance of individual devices / production line elements, • determining the technical condition of a device based on continuous readings from the sensors, • identifying anomalies and trends, anticipating potential failures, • enabling the taking of preventive measures.
KPIs for machine operators	• ability to continuously monitor the behaviour of operators, • on-going monitoring of device performance, • on-going monitoring of activities undertaken by operators, • determining KPIs and their links to the remuneration system.
Monitoring the effectiveness of repairing failures in individual devices - quality of maintenance work	• improving the quality of maintenance activities for key machines and devices, • analyses of equipment parameters before and after failures and reference devices (e.g. new ones), • evaluating the effectiveness of the work performed and the correction of maintenance tasks.

Level 2 – companies with a data integration platform

Those companies which have reached the second level of maturity, besides solutions based on industrial automation systems, have additionally implemented data integration platforms. Production systems are characterised by a significant level of complexity, and a very large volume of generated information; and integration platforms are the basic tools for gathering and systematising the information.

In consequence, multidimensional analyses may be conducted thanks to the implementation of integration platforms. Unlike level 1 solutions, analytical tools used in organisations that have reached the second level of maturity fully use historical production data from the entire technological process rather than from individual devices or elements.

Examples of analysed areas - level 2



- modification of the production model of the entire process in order to increase productivity / improve product quality,
- margin optimisation,
- failure analysis / prediction for devices and groups of devices jointly,
- optimisation of maintenance.

Examples of benefits - level 2

Modification of the production model of the entire process in order to increase productivity / improve product quality	• monitoring device performance based on the best available device configuration model and work regime, • recommendations for changing the work regime of devices, • improved resource efficiency / quality of manufactured product.
Margin optimisation	• development of tools enabling production managers to freely test alternative configurations of production lines, to margin optimisation devices, • scenario analyses - on-going monitoring of device behaviour based on changed input parameters, • optimisation of device configuration, for example, in terms of production volume.
Failure analysis / prediction for devices and groups of devices jointly	• complex monitoring of data from multiple production systems, • monitoring work and predicting failure of integrated technological systems, • predictive analyses of all key components of the production line - avoiding downtime of devices.
Optimisation of maintenance	• support in the reorganisation of the maintenance function in order to improve the quality and efficiency of service work by monitoring the operation of equipment, • analysis of operation parameters, trends and forecasts concerning systems and devices, • improved maintenance processes based on RCM or CBM, • reduction of maintenance costs while maintaining safety parameters.

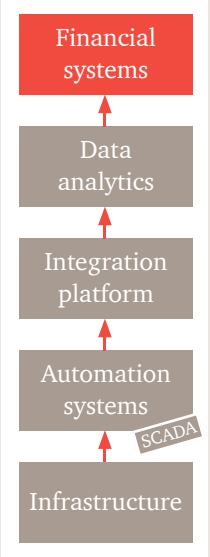
Level 3 – companies that combine technological and financial information

In organisations that have reached the third maturity level, the production systems (OT) are integrated with IT solutions. Technological information from control systems and sensors is collected on an integration platform that is linked to financial data from systems such as the ERP.

The combination of technical and financial data introduces another perspective for the enterprise management system. The range of analyses of varied complexity available at levels 1 and 2 may be dynamically supplemented with financial information, immediately reflecting changes in the cost levels (e.g. commissioning a new device and an increase in the associated depreciation costs). In the analytical solutions of level 1 and 2 such information will be included after some time, along with the update of the periodic cost indices.

The integration of production systems with business systems enables the continuous and automatic monitoring of the company's current production costs (production cost per time unit, marginal cost information per time unit, based on current financial information), defined based on actual technological data. That is why analytical solutions available at level 3 of the organisation's maturity enable even better and faster decision-making in the commercial, management, and operational areas.

Examples of analysed areas - level 3



- integration of financial data and production data: continuous cost control,
- optimisation of repair plans,
- optimisation of the sales policy taking into account the data from the production systems.

Examples of benefits - level 3

Integration of financial and production data: continuous cost control	• supplementing production data with financial information, • management of the production processes from the perspective of production costs, • costs optimisation of the production process, • searching for solutions that reduce the production costs in selected elements of the production process, • continuous controlling of production.
Cost optimisation of repair plans	• changes in the planning processes of maintenance and repair works, • cost optimisation concerning outlays for maintenance and repair works, • optimisation of the schedule of maintenance and repair works taking into account the market situation, the demand forecast, and market prices, • better use of market opportunities.
Optimisation of the sales policy taking into account the data from the production systems	• better integration between the sales and production functions resulting from the implementation of common optimisation tools and data sources, • ability to plan production taking into account the sales policy and vice versa, • more efficient inventory management (materials and finished products), • production portfolio management taking into account the costs of production, storage, supplies, frozen capital, etc.

According to the above model, Polish energy companies have reached the first stage of maturity. The production data are used to a limited degree, mainly for the purpose of the continuous operation of devices. Companies use the analytical tools available at this level only to a minor extent. Companies that belong to large international energy groups are usually classified as being in the second or third level.

Implementing analytical solutions does not have to be a time-consuming and costly process

Implementing solutions based on the analysis of production information is usually perceived as a complex and rarely repetitive process. It involves a broad spectrum of challenges that organisations face, engages resources within the company, and most importantly takes a long time. Consequently, the effects of such implementations are achieved only after a few years. It also happens that the solutions implemented with great difficulty do not meet the current needs of companies that have changed during the implementation period.

However, there is an alternative approach to this issue. It may be more beneficial to implement analytical tools based on technological information incrementally, i.e. step by step, significantly accelerating the moment of reaching benefits, giving the organisation time to analyse the results and make the necessary changes before starting the next stage or extending the scope of implementation. Adopting such an approach, it is possible to develop and implement individual solutions, i.e. applications based on the technical infrastructure available in the organisation, without the necessity to introduce a wide scope of changes in the IT environment. As a consequence, regardless of the level of the system maturity of a company, it is possible to benefit from state-of-the-art solutions based on data analysis.

After the ability to carry out simple optimisations has been exhausted, the use of production data in management processes may become an important source of improved operational efficiency for energy companies. The scope of support offered by this type of solutions is very broad and depends on the level of organisational and technological maturity of a company. Nonetheless, even the simplest industrial automation systems may be used to prepare analytical tools that support business decisions.

Analytical tools may be addressed to multiple recipients: operators, technologists, maintenance services, the functions of asset management, procurement, finance, controlling, wholesale, and management. Access to comprehensive management information may streamline the decision-making processes on the strategic and tactical levels, add a new perspective, or support operational decisions leading directly to savings or revenue growth.

In the energy sector, solutions based on technological data are addressed primarily to the extraction, generation, and distribution of electricity and heat. Nevertheless, also the trade area may use such information.

Is customer satisfaction a must?
Integrated customer knowledge management

Is customer satisfaction a must?
Integrated customer knowledge management

In times when access to and management of a large number of mass customer data sources have become a must, energy companies must tap into the state-of-the-art technologies of data acquisition and processing, as this will help them maintain a high level of competitiveness and profitability.

Establishing efficient sales and marketing processes, supported by data analytics, is of fundamental importance. Proper programming of these processes makes it possible to build an organisation concentrated on meeting real consumer needs. Geolocation, drawing conclusions based on large data collections, and effective information management are the conditions necessary to adjust the electricity and gas sale offers to the needs of individual customers.

hundreds of millions

Implementation of the above-mentioned tools can help the energy sector generate as much as tens or even hundreds of millions of savings on sales costs per year, thanks to an increased effectiveness of sales activities, higher product attractiveness, or the optimisation of customer service processes.[6]

Effective sales processes are fundamental

The effectiveness of sales and marketing processes depends on two dimensions. The first one is strategic and refers to the effectiveness of customer acquisition and retention tools, i.e. segmentation of customers, the offer, sales channels, etc. The second dimension is operational and is connected with reaching the right consumer group. Extensive knowledge about a company's own customer base and the potential group of new customers helps improve effectiveness in these two dimensions.

6. Millions refer to the median effect of increased productivity of sales and customer service employees, observed in companies using integrated customer knowledge management

The strategic dimension

Given the falling margins from electricity sales, adjusting the value proposition and the channel of reaching the customer to real customer needs is becoming more and more important. Therefore, what is of key importance is proper customer segmentation and customised offer on the part of energy companies. Customers vary in terms of demography and their preferences associated with the particular elements of an offer, such as price, channel and level of service, or the range of additional services. Creating segmentation based on these characteristics and selecting the proper offer elements determine the effectiveness of the sales process and the profitability of these activities for the enterprise.

It is worth stressing that the pressure to increase profitability from customers forces energy companies to carry out cross-selling, which makes it possible to reduce the costs of service and acquisition of one customer, and up-selling, i.e. increase in the margin mass.

The operational dimension

Operationalisation of the tools built on the strategic level, i.e. reaching those customers who have the desired features, is of crucial importance for the sales process to be successful. Contacting only selected customers and presenting them with offers tailored to their needs helps reduce the costs and improve the effectiveness of operations both in the acquisition and the retention processes.

The effective sales of products such as electricity and natural gas is still based on outbound channels. Energy companies actively seek customers via the D2D (door to door) sales force and remote channels, usually phone contact centres. Therefore, it is very important to complete the databases of potential customers with information that will increase the likelihood of conversion and finalising sales. From the perspective of the effectiveness of the sales force in the field, it is very important to define the location of customers with particular characteristics (consumption volume, access to individual utilities, e.g. gas). In addition, faced with pressure on optimisation of sales costs, when acquiring customers with low consumption it is important to improve the effectiveness of inbound marketing (marketing that enables customers to learn about a company's message on their own).

Elements of managing relations with customer in the CRM system

Collecting and storing data

Collecting information about customers from many sources, for example, via websites, self-service channels, customer service

Segmentation

Using multi-factor analysis to create personalised 1:1 communication (instead of sending the same message to everyone)

Turning touch points into a real "Customer Journey"

Using every interaction with the customer to deliver the right message to the right customer, at the right time and through the right channel (e-mail, text message, etc.)

Measurement of results

Automated reporting of the achieved sales and marketing goals supports the measurement of the achieved business goals

Source: PwC analysis

Using data from the CRM to finalise product sale

CRM

1 **Marcin** starts his day at work by logging onto the system and checking his tasks.

Multi-Channel

2 **Paulina** has just received an invoice from her energy supplier. She does not know where the amount on the document comes from.

Phone

3 **Paulina** calls her energy company. **Marcin** picks up the phone.

CRM 360

4 **Marcin** helps **Paulina** and registers her complaint.

Integration with the failure management system

5 **Marcin** involves **Paulina** using the information from the system: he informs her about the planned power switch-off.

E-Mail

6 **Marcin** sees that **Paulina** is the addressee of the last sales campaign and that she opened the e-mail containing a proposal, but she has not bought the service yet. **Marcin** talks to **Paulina** and sends a detailed offer via e-mail.

Marcin
energy company hotline operator

Paulina
customer of an energy company

Source: PwC analysis

Dimensions of customer knowledge

The key dimensions of knowledge needed to design sales activities are demographic features, preferences, and the physical location of customers. Demographic features determine the structural characteristics of customers, such as using particular media, consumption volume, income, and life style. On the one hand, they characterise the financial potential of customers for an energy company, on the other, they indicate customers' preferences. This is why they can be used when determining proper customer segments and planning the strategy for sales channels.

Customer preferences determine their approach to various elements of an offer, such as price, commercial conditions, or additional services. They decide about customer's inclination to using the services of an energy company and are used to shape the value proposition. The said data are used in an aggregated form to draw strategic conclusions about customers, create segmentation, and prepare offers. The last data dimension is connected with the acquisition of information about the location and contact channel, i.e. finding customers with desired features.

Dimensions of customer knowledge

Data dimension	***Quantitative data***	***Customer preferences***	***Location of customers***
Examples of data	• socio-economic data - marital status - income - consumption level - social status - life style • consumption of utilities - electricity - gas - district heating	• price form preferences (variable price, fixed price, commodity exchange indexed price) • preferences regarding additional services (products in packages) • preferences regarding commercial conditions (commercial fee, payment date) • preferences regarding service quality (channel, level of personalisation of contact) • attitude to the energy company • knowledge about the energy market	• physical location of customers with defined demographic features and preferences.
Type of data	Aggregate data for the entire group of customers		Data for individual customers
Data usage	Building the segmentation of customers, offers, strategy of sales channels		Operationalisation of sales activities

Source: PwC analysis

Using innovative sources of data and knowledge

There are several data sources and methods of customer knowledge building which can be successfully used by energy companies.

Geolocation

The ability to physically locate customers becomes crucial when creating a basis of leads (potential customers) both for remote channels (providing the hotline employee with a set of information about the customer before starting a conversation), and D2D. Combining information about the desired socioeconomic features of customers with data about infrastructure makes it possible to create geolocation maps presenting the desired segments of customers.

For example, customers with high energy consumption and a defined life style (correlated with their place of residence) impacting the willingness to buy a given product of an energy company – for instance, residents of detached houses. This is especially important in the case of gas sales, where identification of customers using this fuel is a great challenge and cost for energy companies.

Categories of spatial data that can be used when localising selected customer segments

Spatial data that can be used when locating selected segments of energy company customers

Spatial data

Demography and behaviour of population

- number and location of residents
- purchasing power
- consumption expenses
- education
- unemployment rate
- marital status

Environment influencing the life style

- environmental pollution
- real estate costs
- schools
- parks
- theatres, cinemas
- shopping centres
- public transport

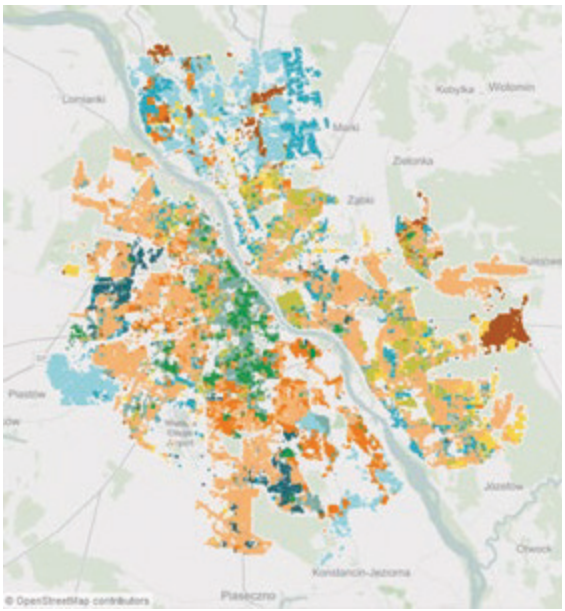
Potential customer segments

- housing estates
- banks
- food stores
- service companies
- industrial companies

Energy infrastructure

- power grid
- gas network
- heating network

Identification of the location of customer segments – example analysis result



Source: PwC analysis

Internet

Energy companies may use customer profiling based on analyses of information about visited websites, social media, or e-stores. These data can be used to obtain information about the method of positioning the remote contact channels in order to generate a lead, and to tailor an offer in line with the customer's demographic features.

Smart meters

Although in Poland the implementation of AMI (smart meters) is still at an early stage, it will be deployed on a mass scale in the future. Energy companies must be ready to analyse and use this data source. The development of AMI creates an opportunity to acquire detailed information about customers' energy consumption by hours. Such knowledge can be used to create products tailored to individual needs of customers, and the character and life-time of the electrical devices used by the customers.

Qualitative and quantitative customer research

Customer research used in the mass industries is becoming increasingly popular among energy companies. Qualitative research with a good structure, such as individual talks with customers or groups of customers is a source of inspiration for the creation of new products and the testing of concepts. Quantitative research, in turn, enables the identification of client segments on a representative sample (for example, based on demographic features or declared preferences). The Internet comes in handy as a platform to carry out research, which shortens the time needed to conduct studies and thus reduces the "time-to-market" of new products. Of course, it should be stressed that the key aspect is using the data collected during research in an integrated way. This is primarily linked to feeding integrated customer data into such sales tools as the CRM systems (customer relationship management systems).

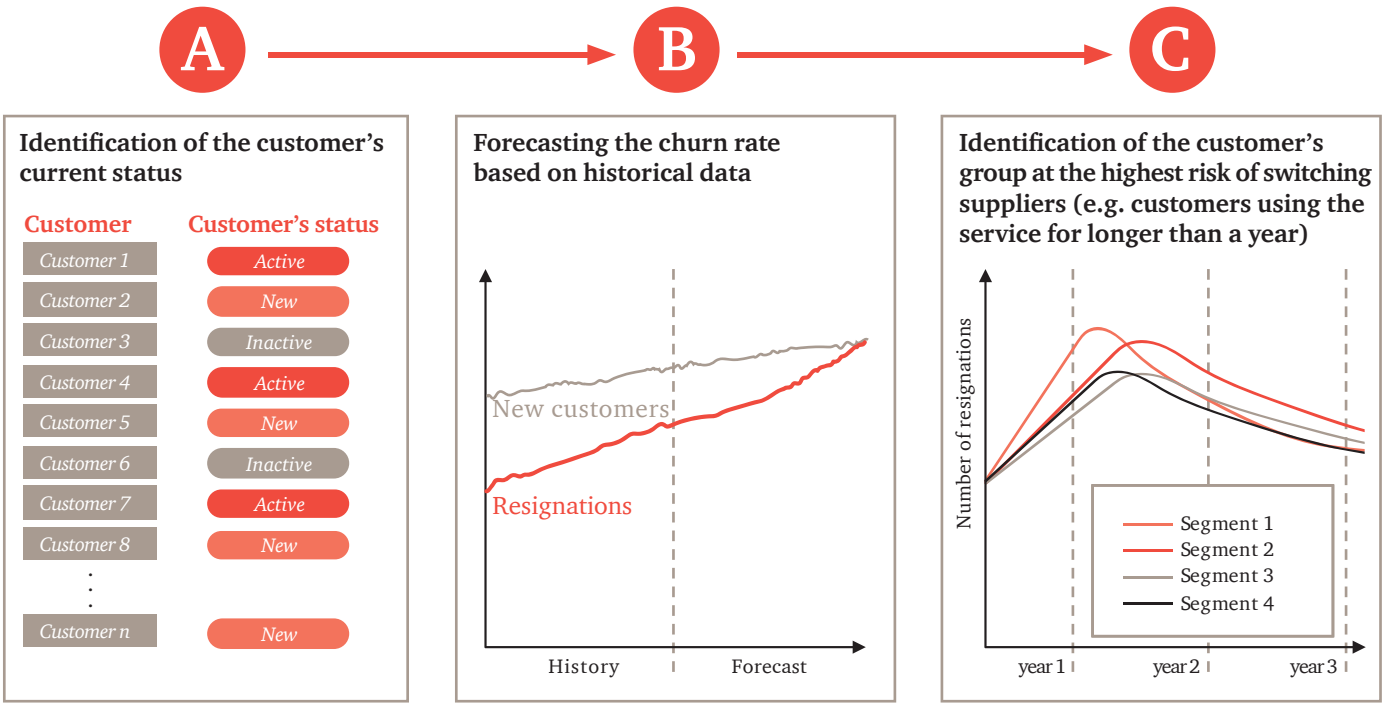
Electronic customer service centre and hotline

Energy companies have ambitious plans to migrate customers to a remote service channel, but they do not always take the opportunity to acquire data. The electronic customer service centre (self-service) and hotline may be an important source of information about customer behaviour, preferences, and satisfaction with the quality of service. To acquire data, however, proper data collecting processes must be built (especially for the hotline) and integrated with the CRM, so that the data can serve as an important source of information for planning retention activities.

Analyses and conclusions based on large data sets

These tools are widely used in telecommunications, insurance, and banking. They help identify the key relationships between observable characteristics and customer behaviour (for example, between the tendency to switch providers and purchase additional services). By using appropriate statistical tools, such as data grouping, conjoint analysis, decision tree algorithms, or neural networks, it is possible to prepare and plan adequate marketing and sales activities.

An example of Big Data Analysis – determining the number and main causes for resignation from a service

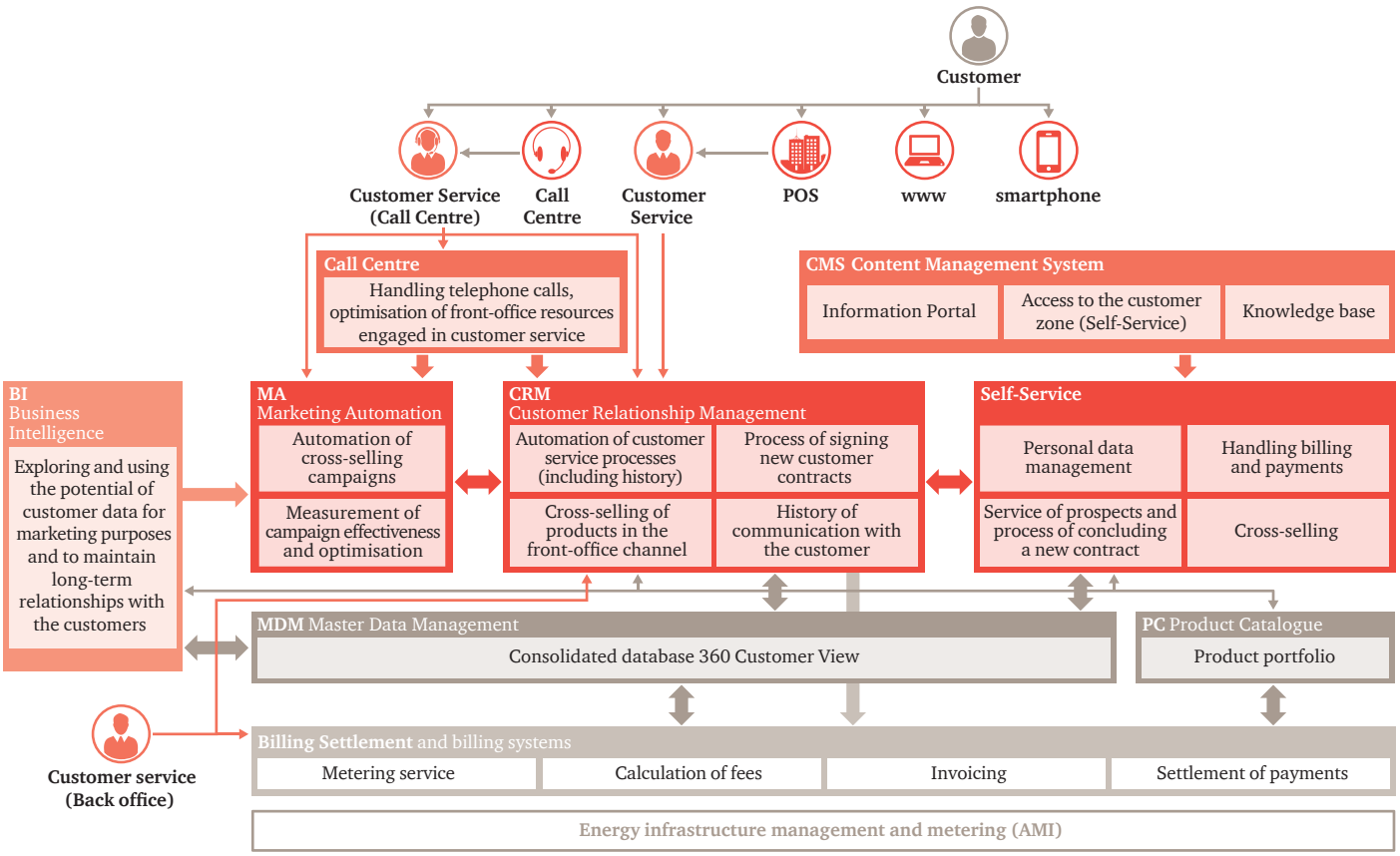


Source: PwC analysis

In order to achieve actual effects in marketing, sales and customer service, the knowledge acquired analytically must be implemented in the company's operations: in the electronic client service centre, hotline, and direct sales structures. Successful provision of this knowledge to mass processes is a condition for effective communication of personalised information, which can be ensured only by proper client-oriented IT system architecture.

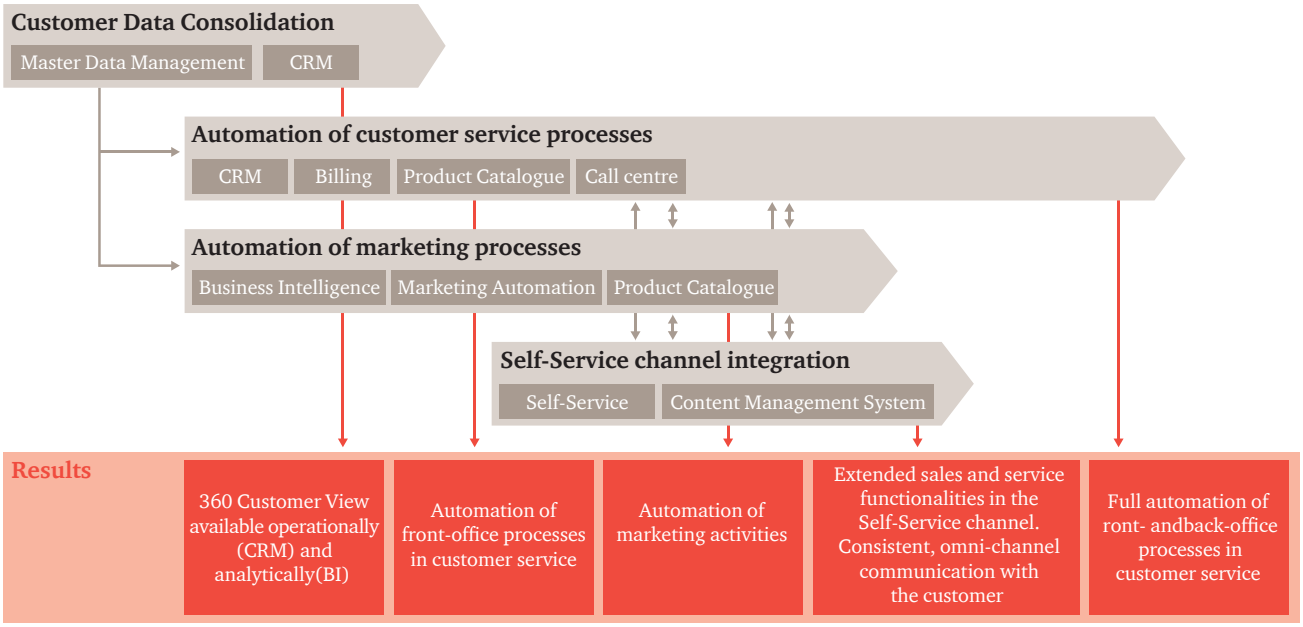
Such architecture includes not only systems supporting the call centre, billing, and CRM, but first of all the primary systems that facilitate data management and knowledge personalisation: Master Data Management, Marketing Automation, Product Catalogue, self-service, and Content Management System.

Client-oriented IT system architecture



Source: PwC analysis

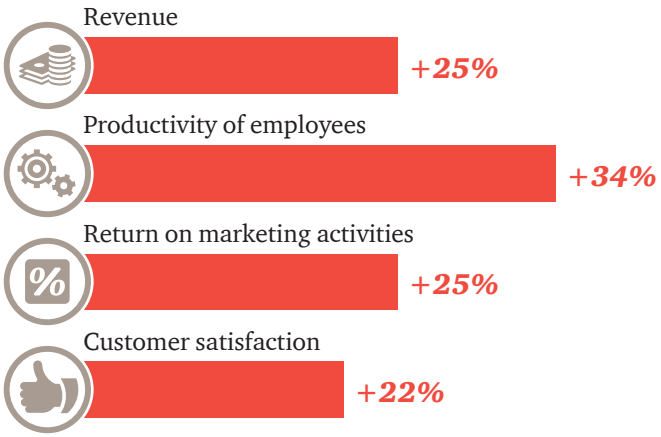
Strategy of achieving a client-oriented IT system architecture in an energy company



Source: PwC analysis

Analysis of the results of implementing integrated customer relationship management systems shows that they bring a number of benefits to companies in terms of improved financial performance (higher revenue resulting from more efficient up-selling and customer acquisition), increased productivity (faster customer acquisition and customer service), and above all higher customer satisfaction.

Average increase in selected indices among companies using the CRM-class solutions



Source: Study conducted from 2014 to 2016 among Salesforce customers

How can we look for profitability?

New streams of revenue

How can we look for profitability?
New streams of revenue

Energy companies are constantly looking for areas to be developed and optimised, resulting in better financial performance. The natural direction is the core business, but benefits may come also from new business solutions. Nowadays energy companies are broadening their scope of activity by offering services that are connected to the power sector, but have so far been reserved for players from other industries.

percentage income increase

The dynamic development of technology, customer needs and expectations, and the political and regulatory environment may provide opportunities for the development and implementation of new business models and products by energy companies. If energy companies take advantage of the emerging market opportunities, they can create a source that represents only a 1-digit percentage of their revenues, but which is a quantitatively significant contribution.[7]

A photovoltaic joint-venture

Introducing the TPA (Third Party Access) principle in 2004 marked the beginning of the liberalisation of the electricity market in Poland. This change had a very significant impact on the energy sale market for industrial customers. In the first years after this change, the sale of electricity to large customers became extremely attractive. However, along with the progressive maturity of the market, the margins of energy sellers in groups A and B decreased significantly, often reaching negative values for the sold MWh. This situation became the source of competitive pressure on electricity sellers, forcing them to expand their offerings to industrial customers in order to attract not only by low prices, but also by complementary services, which include energy audits and services aimed at optimising electricity consumption.

What helps energy companies in the competition for industrial customers is the new auction system, whose aim is to support the development of investment in distributed energy in the country and to meet the climate targets for renewable energy in 2020. The system also provides an opportunity for energy companies to be more effective in reaching industrial customers through an innovative way of selling electricity.

According to the draft Regulation on the maximum quantity and value of electricity from renewable sources that may be sold at auctions in 2017 of 14 November 2016, the Ministry of Energy will designate about PLN 2.2 billion on purchasing electricity produced by small renewable energy installations (below 1 MW), which will be selected on auctions in 2017. In practice, this will mean that more than 300 MW photovoltaic plants will be built in the country, with a guaranteed average energy price of over 460 PLN/MWh (guaranteed for 15 years, indexed by inflation from the previous year). Guaranteed prices combined with decreasing financial outlays necessary for the construction of small solar farms make it possible for energy companies to present offers for the construction of photovoltaic farms tailored to the needs of industrial customers, following the model of foreign suppliers of the photovoltaic (PV) technologies.

American SolarCity offers enterprises comprehensive design and construction of PV installations on the premises of the enterprise. In return, the customer signs with SolarCity a 20-year PPA (Power Purchase Agreement) with a fixed energy price that, depending on the location, may be several percent lower than the price offered by large energy companies.

However, Polish conditions do not allow for a direct import of this business model to the local market, because of:

- relatively less beneficial weather conditions in comparison to the key regions for SolarCity (i.e California or Nevada),
- the position of SolarCity as a supplier of services connected to solar energy, which is able to give up a part of its energy seller's margin for the margin on the sale of its PV panels.

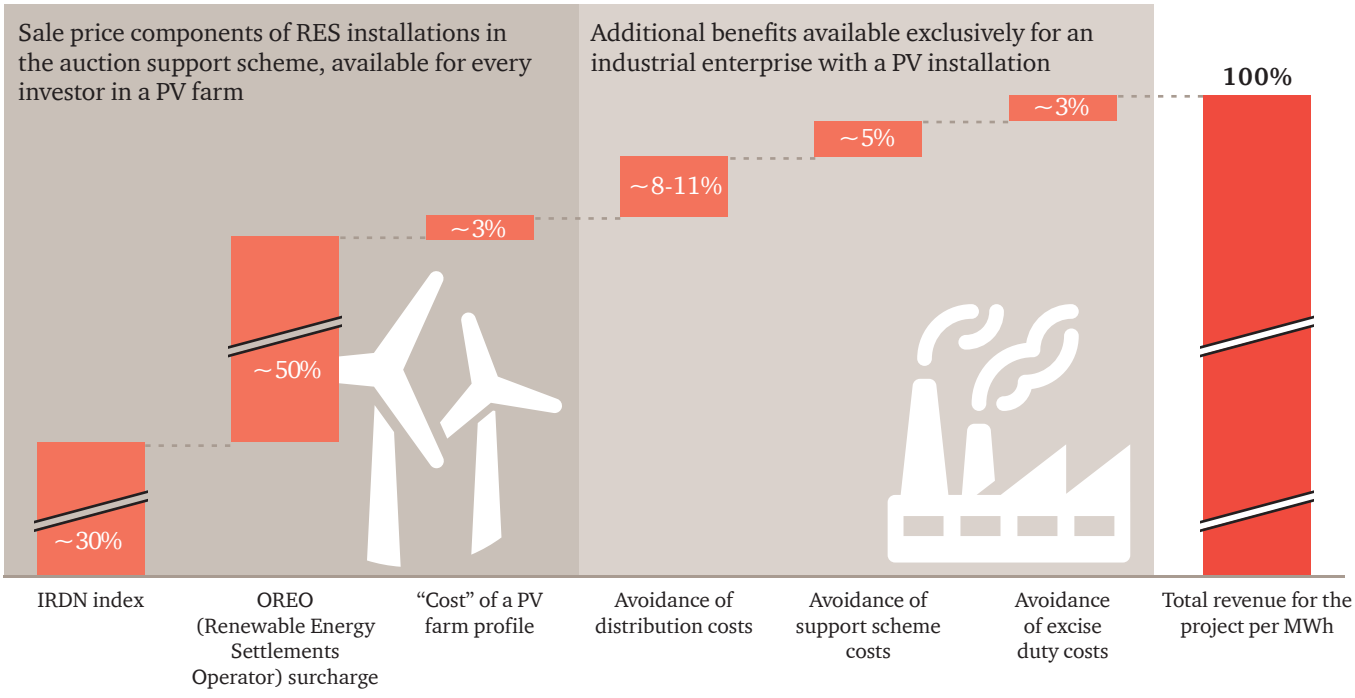
7. Estimation concerning the potential of the smart street lighting market only, assuming installation of smart solutions in 5-10% of existing lighting poles and additional revenue/savings connected to smart solutions at the level of the first quartile of the benefits achieved from the implementations carried out

However, this does not mean that energy companies may not benefit from this strategy. They should remember 0nly to adapt it to their local conditions. At present, Polish energy companies have the opportunity to collaborate with industrial customers. The purpose of the collaboration will be to prepare a photovoltaic farm project on the premises of an industrial enterprise, and to participate jointly in an auction. The energy sector's contribution in the joint venture will include the know-how, the choice of contractor, and energy supervision for the investment, while the industrial partner will contribute land or another space where the farm will be installed.

The key aspect of the success of such a joint venture will be the fair sharing of the benefits resulting from the collaboration. The industrial partner may purchase all the energy produced by a farm at the wholesale price of electricity (e.g. according to the IRDN index, or the RTT indices, i.e. indices of the Commodity Futures Market), eliminating the seller's margin. In return, the energy company would receive a subsidy (in the amount of the auction price minus the IRDN in a given period), which would be spent on covering capital expenditure and would be a return on the investment. Additionally, the energy company would sell the remaining electricity needed for the production activity of the industrial customer.

An additional benefit for industrial enterprises with their own DSOs would be a reduction of the transmission or distribution fees, which constitute as much as 20-30% of the total electricity cost.

Financial benefits for an industrial enterprise with an installation of more than 0.5 MW – an example of an enterprise with distribution tariff B23



Source: PwC analysis

Car sharing

Another element that may provide a lasting, additional source of revenue for energy companies is the use of electric cars in the form of car sharing, i.e. short-term rental of mainly urban vehicles. Car sharing is a modern and ecological approach to the idea of urban car communication, and its formula is similar to that of city bicycles available in several cities in Poland. Bikes are attached to racks, but in the case of car sharing , cars would be attached to charging stations. From the perspective of energy companies, car sharing can be seen as a natural extension of the offer for charging electric vehicles. By building a fleet of electric vehicles for rent, energy companies:

- ensure for themselves adequate loading of the charging installation (constant use of the installation), which may have a positive effect on grid management and stability. In addition, electric vehicles may easily be used as energy storage facilities,
- will be able to raise their margins on the sale of electricity by integrating it properly in the rental price of electric vehicles,
- will be able to use the building of a network of electric vehicles for rent for the purposes of the CSR, as it will be an ecological and highly innovative solution supporting the local community.

A good example of the successful adoption of the idea is the Autilieb' company, which offers car sharing services with Bollore Bluecar electric cars. The company started its operations in Paris at the end of 2011 and was designed to resemble the Velieb' public bicycle rental system. At the beginning, it had 250 cars. However, because of the positive reception of the service, the number increased seven times over half a year. Currently, there are 4,000 vehicles in use. The company has started operations also in Lyon and Bordeaux, and launched pilot programmes in London and Indianapolis.

The principle is simple: cars are parked in the streets and connected to a charging station. The user comes up to the station, a car is assigned to him, and he can start driving. The whole procedure is very simple and takes only a few minutes. The user can end driving at any time by leaving the car in one of over a thousand stations in the urban area. There are two tariff plans: with a fixed subscription and without it. The customers paying the subscription fee of 10 euros a month pay 0.23 euros per minute of use, the others pay 0.32 euros/minute. The minimum rental time is 20 minutes.

Smart street lighting

Lighting is one of the business areas of energy companies. It is part of a service offer addressed to infrastructure and building owners, local government units, etc. These services are based on:

- the company's own lighting infrastructure,
- qualified staff and technical resources.

The proposed range of services focuses primarily on providing adequate lighting in an area indicated by the customer and/or service and modernisation of the lighting infrastructure (lamps, poles, electrical installations, etc.). According to the data published by the Central Statistical Office, the annual costs of maintenance and operation of street lighting systems in Poland reach PLN 2 billion. They use up around 2% of the budgets of local government units.

Expenses on pubic lighting in 2015 (in millions PLN) and as % of local government units budget spendings

Source: GUS (Central Statistical Office of Poland)

According to the applicable regulations, local government units are obliged to provide adequate lighting in public spaces in their territory. To fulfil this obligation, they collaborate with energy companies. Nevertheless, this collaboration is difficult owing to:

- the need to modernise the lighting infrastructure and improve its energy efficiency, which entails additional spending,
- budgetary constraints faced by local government units.

As a result, local authorities are looking for new ways to fulfil the obligations imposed by regulations. They are seeking business partners with whom they can cooperate in various forms to modernise the lighting systems or provide illumination in public spaces. As a consequence, competition in the market has intensified, and new engineering companies, contractors, and lighting technology providers (e.g. Philips, Osram, Siemens) have joined the four major energy groups. The activity of energy companies with regard to street lighting focuses primarily on two areas:

- construction and operation of street lighting systems (in various business models),
- provision of illumination in public spaces as a service for local governments.

Obviously, these actions include initiatives connected to the construction of state-of-the-art, smart lighting systems that are based on LED technology and smart light management systems . Nevertheless, new market opportunities are emerging: street lighting infrastructure that can provide additional revenue to the owners of the infrastructure.

New technologies in the lighting segment may help energy companies meet the expectations of customers (local government units) and offer more complex services with greater added value than the standard solutions of efficient public lighting. An appropriately prepared offer, the right model of cooperation with a local government unit, and new business partners from outside the energy sector may make the solutions proposed to local governments attractive also in terms of their price.

New services addressed to public entities may be based on the smart pole technology. Smart poles are complex devices that, in addition to the standard lighting function based on energy-saving LED lamps, are platforms for additional services:

- **environmental protection** – smart lighting poles can be equipped in pollution sensors, which enables continuous air quality monitoring in a given locality. The information collected may be used by the environmental services to plan air quality improvement measures, and monitor their effects. Additionally, information on pollution levels can be communicated on a regular basis to the residents of the particular locality;

- **public parking** – smart lighting poles can be used to build an integrated system for the management of public parking spaces. Sensors installed on the lighting poles collect information about the use of parking spaces (location, parking time, type of vehicle, etc.) and help optimise the parking fee system, parking organisation, etc. In addition, based on such information, it is possible to build a system informing drivers of free parking places in particular locations, which may have a positive impact on limiting traffic congestion, particularly in city centers;

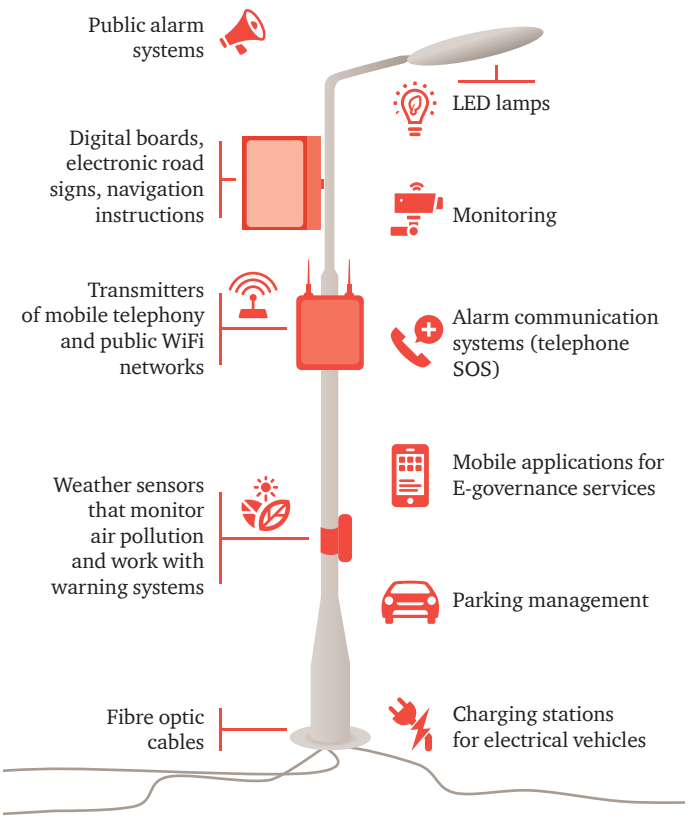
- **telecommunication** – light poles can also be adapted for mounting the telecommunications infrastructure. As a result, the poles can be used by mobile phone operators for extending their networks, while their space can be leased and serve as an additional source of revenue for the infrastructure owners. At the same time, the poles can be used to build public wireless networks, for example in squares, parks, etc., in accordance with the expectations of the residents;

- **monitoring** – light poles can be equipped with surveillance cameras, which can raise the safety of residents and speed up interventions of emergency services in case of an emergency (fire brigade, police, ambulance, municipal police). At the same time, monitoring cameras may improve the quality of traffic management, provide information about traffic jams, road accidents, etc.;

- **information boards** – the street lighting system can be equipped with electronic information boards. On the one hand, these boards can be used as carriers of city information (e.g. about available parking places, traffic restrictions), and on the other, they may be leased by advertising companies, for example . In the latter case, rental fees for advertising space may be an additional source of revenue for owners of the infrastructure;

- **chargers** – street lighting systems and smart poles may also be equipped with charging stations for electric cars. This can help in building an efficient electric vehicle charging system in cities, and constitute an additional source of revenue for owners of the infrastructure.

Options of using lighting poles



The infrastructure of smart street lighting is only a platform for new types of services. Thus, classic business models focused on the maintenance and service of the infrastructure or provision of public space illumination will not allow the use of the full potential of these solutions.

Therefore, energy companies must develop new models of collaboration with both local authorities and other business partners. At the same time, they will have to develop a new portfolio of services/solutions for cities in order to use the full potential of smart street lighting.

Local authorities will not be inclined to make additional investment in the development of the city lighting system. From their perspective, it is crucial to provide residents with light in public spaces at the lowest possible cost. That is why the potential burden of investing in modern lighting poles falls on energy companies. Nonetheless, forms of collaboration based on the PPP formula are possible. Under such collaboration:

- the energy company is the investor in and operator of the lighting infrastructure,
- the energy company receives additional revenue from the lease of advertising space, space in the poles (telecommunication), charging stations for electric vehicles, etc.,
- local authorities benefit from lower costs of maintaining energy efficient lighting, monitoring, and parking systems by participating in the joint venture.

Energy companies are not present in some areas of smart street lighting services. In consequence, the development of their offers will require collaboration with companies outside the energy sector (e.g. advertising agencies, telecommunication companies) or supplementing their scope of activity with new elements.

An example of an effective solution is a project carried out by Philips in Los Angeles, which together with Ericsson has created a new street lighting model integrating the LED lamp and mobile telephony devices. Mobile network operators using the technical solutions of Ericsson will be able to lease the space within the lighting poles, and on this basis expand the network infrastructure. At the same time, the cities which install the solutions proposed by Philips and Ericsson will be able to get additional benefits from leasing the space inside the poles, which will improve the economic efficiency of the investment. According to the adopted cooperation model, Philips has installed new lighting poles at its own expense and gives the city a part of the revenue from leasing the space in these poles. The city income is estimated at 1200 USD/pole/year.

How to use crowdfunding?
Additional stream of funds

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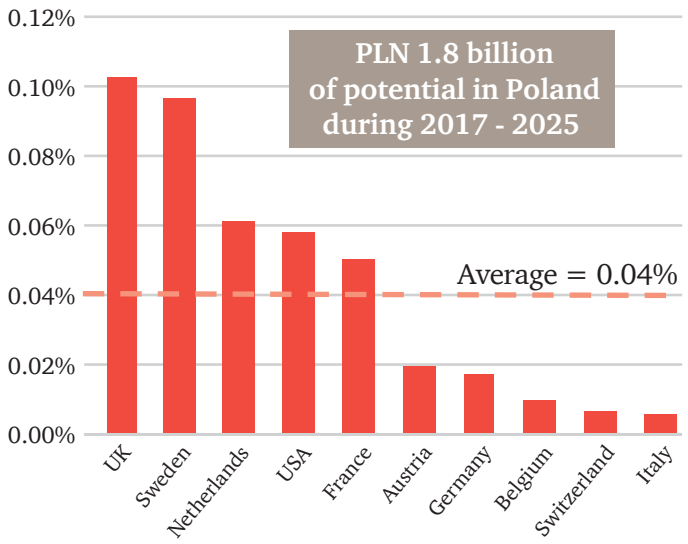
The capital needs related to energy investments amount to billions of PLN. Only in the last year, the capital expenditure of the four main vertically integrated energy groups in Poland amounted to more than PLN 17 billion[8]. The development of new forms of capital raising gives the Polish energy industry an opportunity to obtain funds for its investments in a completely new way, for example, through crowdfunding.

Crowdfunding is a way to finance investments, projects, and ideas through a large number of individual investors. It's current popularity is mainly due to to the recent spread of social technology, which provides a non-expensive way for people (called entrepreneurs) with ideas for projects, investments, or products to connect with investors, i.e. people who are interested in a given project and have some savings. In return for funding, investors are rewarded in a form proposed by entrepreneurs.

Percentage of households' savings invested in crowdfunding worldwide



Source: PwC analysis based on data from IMF (household savings) and CrowdfundingHub

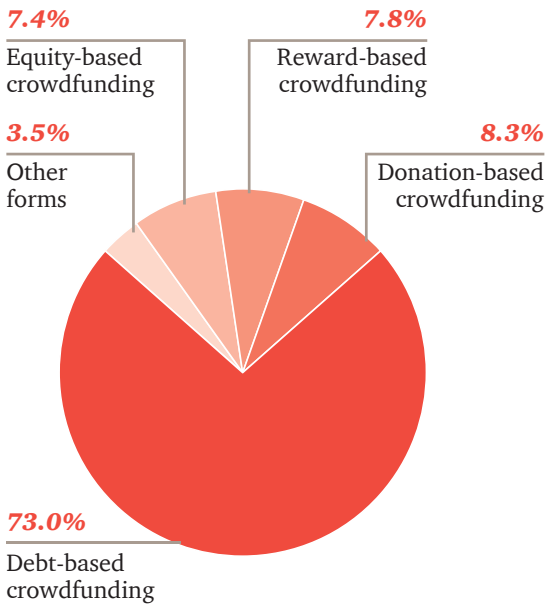
PLN 1.8 billion

As society becomes more affluent, more and more people in Poland will be willing to take greater risks and seek higher return from the capital accumulated in their bank accounts and deposits. Crowdfunding might be one of such options. Polish households have PLN 961 billion in savings and PLN 470 billion invested in risk assets.[9]

Based on examples from Western countries, which have a more more mature culture of investing in crowdfunding, on average 0.04% of the total savings of their residents[10] was allocated in 2015 to crowdfunding. Given the readiness of Poles to participate in crowdfunding and the increase in their savings, as forecast by the IMF, in the next 10 years the potential of crowdfunding in Poland will amount to approximately PLN 1.8 billion.

8. Analysis of financial statements of: PGE, Tauron, Enea, Energa. As data for the entire 2016 were unavailable, as at the date of the report, data from Q4 2015, Q1-Q3 2016 were used
9. Data according to NBP (National Bank of Poland) as at 3Q 2016
10. USA, UK, Sweden, Germany, Austria, Switzerland, France, Belgium, and Italy

Share of crowdfunding types in all the funds collected in 2015



Source: crowdexpert.com

Boom on the crowdfunding market

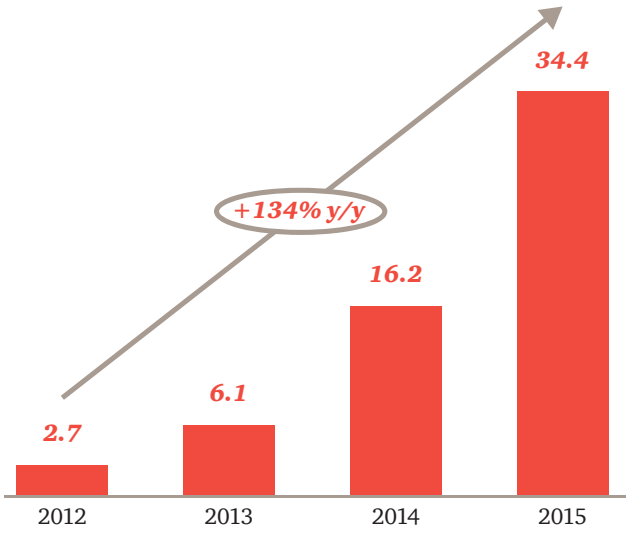
The origins of contemporary crowdfunding date back to 2003 when the ArtistShare portal was launched. The site made it possible for fans to support their favourite artists through donations or in exchange for the products of their work. In the first project, more than USD 100 000 was collected for recording and producing the album of The Maria Schneider Orchestra, which later won a Grammy Award. This and further successes have led in the subsequent years to a donation-based crowdfunding and reward-based crowdfunding boom in the United States. The next stage of development was the introduction of the debt financing mechanism and equity crowdfunding. The popularity and significance of both solutions has increased significantly in recent years.

The main factors raising the popularity of all types of crowdfunding are primarily:

- convenience – crowdfunding makes it possible to make transactions without leaving your home, and also to monitor the thousands of offers that appear every day worldwide;
- low barriers to entry – almost everyone can find a crowdfunding project that they are able to support. For example, in the United States, debt-based projects start from investments in the amount of USD 25;
- project profitability – the median of long-term investors of the Lending Club website (a debt-crowdfunding portal) achieves a return on investment of almost 6% a year, and the returns on investment made by Abundance Investment can exceed 8%;
- access to financing – this factor has become very important, especially at the onset of equity and debt-based crowdfunding, after the global economic crisis, when banks significantly reduced loans for the most risky projects.

Owing to all the above mentioned reasons, the amount of funds allocated each year to crowdfunding in 2012-2015 more than doubled.

The value of funds allocated to crowdfunding globally 2012-2015 [in billions USD]



Source: crowdexpert.com

The most popular types of rewards in crowdfunding

- debt-based crowdfunding - return of capital and interest within a time period specified in the agreement;
- a product or reward (reward-based crowdfunding) – the most popular in financing new technology and product development projects. In return for support, the investors receive a future product or its limited version at a favourable price much earlier than other customers;
- shares in a project (equity-based crowdfunding) – the funders receive shares in the special purpose vehicle that implements the project equal to the amount of paid-in capital. This is most often used in cases of start-ups and individual investment projects.

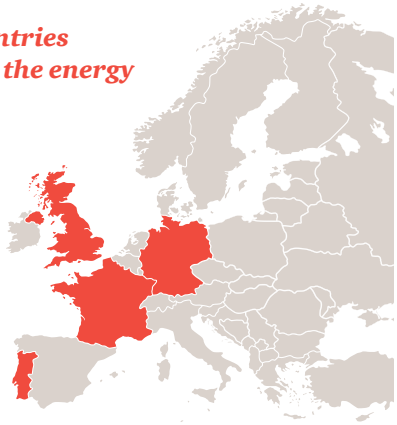
Crowdfunding is also used in charity. Payments for a given project are treated as donations for the founders and for projects. This is called donation-based crowdfunding.

As the experience of a leading crowdfunding platform, Fundable, shows, investments with relatively low capital requirements achieve the greatest success through crowdfunding. Despite this, users are also able to finance projects worth several dozen or even more than a hundred million dollars. An example of such a project can be the ultra-modern online investment vehicle The DAO (over USD 100 million). Pebble, a smartwatch producer, has also been very successful, collecting over USD 30 million during two crowdfunding campaigns.

The energy sector is also reaching for crowdfunding

In recent years, the successes mentioned above have made crowdfunding an alternative way of financing used also by the energy sector. This type of funding of energy projects has already become popular in five European countries - Portugal, the UK, the Netherlands, France, and Germany, as well as in other parts of the world, such as the United States and Asia.

Leading European countries using crowdfunding in the energy sector[11]



Source: PwC analysis

Currently, three types of crowdfunding are used in the following energy market areas:

- constructing energy installations (mainly RES installations),
- sale of energy products (mainly as innovative methods for energy sales),
- sale of energy services (mainly from the area of electromobility),
- research and development (mainly regarding solutions for consumers).

Popularity of crowdfunding types in the energy sector

Examples of investments in the energy sector	Types of crowdfunding		
	Equity -based	Debt -based	Reward -based
Construction of energy installations	✓	✓	✗
Sale of energy products	✗	✗	✓
Sale of energy services	✓	✗	✗
Research and development	✗	✗	✓

Source: PwC analysis

11. Even though there is a dedicated crowdfunding platform for the energy sector, Italy is not on the map, because of lack of information about the actually financed projects

Examples of crowdfunding in the energy sector

Construction of energy installations: equity-based crowdfunding

The construction of energy installations is primarily carried out through the equity- based formula, for example, through Abundance Investment, a UK private equity crowdfunding fund. This institution focuses on investments in RES installations in the UK, raising capital from individual investors. So far, it has raised almost GBP 38 million, and the number of funded projects has reached 24. The entry threshold is very low - only GBP 5. The success of the fund can be traced to very high return rates for investors. According to the company's information, with the donated GBP 38 million, Abundance Investment generated approximately GBP 6.4 million of total return for investors by the end of January 2017. The profits of the fund are significantly higher than the standard values guaranteed by classic forms of savings (deposits or treasury bonds).

List of project and conditions of return finalised by Abundance Investment

Technology type	Average return on investment offered
Wind	8.30%
Photovoltaics	7.12%
Biomass	8.00%
Energy efficiency	7.00%
Other	8.00%

Source: PwC analysis

The business model of the fund consists in the buying by the investors of a selected amount of the equity of the investment, in accordance with the offer made by the fund. The profile of profit payment, the proposed way of dividing the investment risk, and the investment horizon are determined each time by the investor. Such an approach to raising finance makes it possible to open an alternative method of obtaining funding for social projects in which local residents can participate and from which they can derive profits.

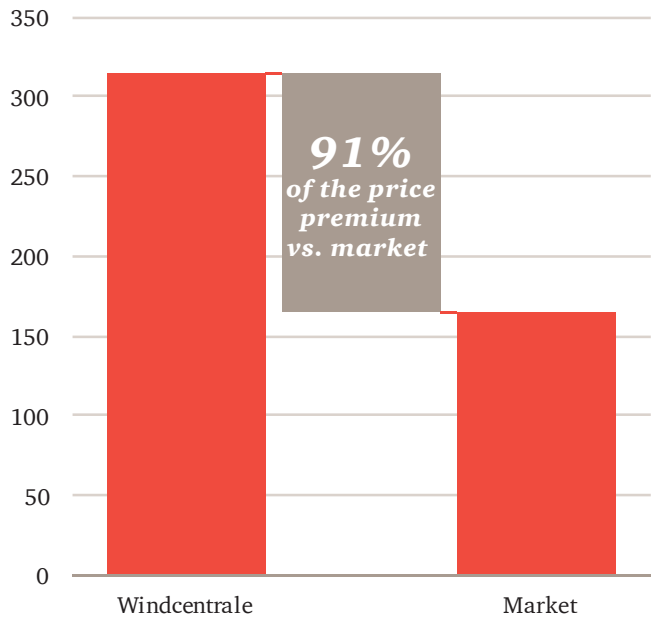
Construction of energy installations: debt-based crowdfunding

Open Energy is an American start-up considered as one of the pioneers of obtaining direct debt financing for energy projects through crowdfunding. Open Energy is first of all a platform connecting people who want to build a photovoltaic project with potential investors. Thanks to the full automation of the evaluation of investment applications, Open Energy declares that it is able to significantly reduce the cost of raising capital (up to 70% in the case of a USD 2 million loan) and minimise the related transaction costs. That is why Open Energy is able to offer interest rates of approximately 6.5% per annum and a margin below 2%.

Sale of energy products: product-based crowdfunding

Windcentrale is a Dutch crowdfunding platform, where households can buy shares in existing RES installations (mainly wind farms). By purchasing a wind share in a selected installation, the investor acquires a volume of electricity (product in the form of electricity) produced by a given wind turbine, adequate to the number of wind shares purchased. So far Windcentrale has collected more than EUR 15 million. The wind share value may vary depending on the project. For example, a share in a Vestas V80 2MW turbine from 2005 costed EUR 200 in 2013. According to Windcentral, the turbine should operate until 2025, generating for investors approximately 500 kWh of electricity per year. In addition, every year the company adds a wind turbine maintenance fee of EUR 23 per wind share. As a result, the electricity received by each investor was priced higher as compared to electricity sold by a traditional seller. Assuming constant energy prices on the market, consumers will pay an average of around 91% more over a 5-year horizon, which shows a significant bonus for Windcentrale for selling electricity in this innovative formula.

Comparison of prices for 0.5 MWh of energy purchased through Windcentrale and from the market within 5 years [EUR]



Source: PwC analysis based on information from Windcentrale and average energy prices in the Netherlands, according to data from the European Commission

Sale of energy services: equity-based crowdfunding

ECAR is a British company that rents electric cars using the pay-as-you-go formula. This means that users are not obliged to subscribe, but only pay for the time actually spent in the rented car. The implementation of the service, especially for an independent supplier, was very capital intensive. Therefore, in 2013, the authors of the idea decided to raise the capital needed by offering shares in the undertaking. Soon after the launch and market success of the formula, the company was acquired by Europcar. Although companies did not reveal value of the transaction, according to press releases, the people who supported ECAR through crowdfunding could count on double-figure return on investment in a very short period of time.

Research and development: reward-based crowdfunding

Sono Motors is a German company founded by electric vehicles enthusiasts. Because the company wants to make the technology more popular, it has decided to finance the commercialisation of its products through a crowdfunding platform. The company owners have decided not to sell shares in their venture, but to focus on pre-order. This option makes it possible to order a product before its global premiere, guaranteeing the buyer priority delivery. Investors supported the project by pre-ordering a car with a 12% discount as compared to the expected retail price, risking non-delivery of the order. Moreover, investors have the opportunity to make donations to help develop the product.

Poland is at the initial stage of crowdfunding development

Polish crowdfunding is at the beginning of its development. Nevertheless, it has had significant success cases in its history. One of them is the collection in the form of equity-based crowdfunding of approximately PLN 1.6 million needed for the development of Willo, producer of organic and natural aspirin. Crowdfunding in Poland also has a series of successful real estate investments on its account. However, similarly as in the Western countries, the best years for this form of financing are still to come.

Promotion of crowdfunding requires action from investors

Attracting individual investors to invest in crowdfunding will require several actions from crowdfunding entrepreneurs, as well as platform developers, and state authorities. The key success factors for crowdfunding in Poland include primarily:

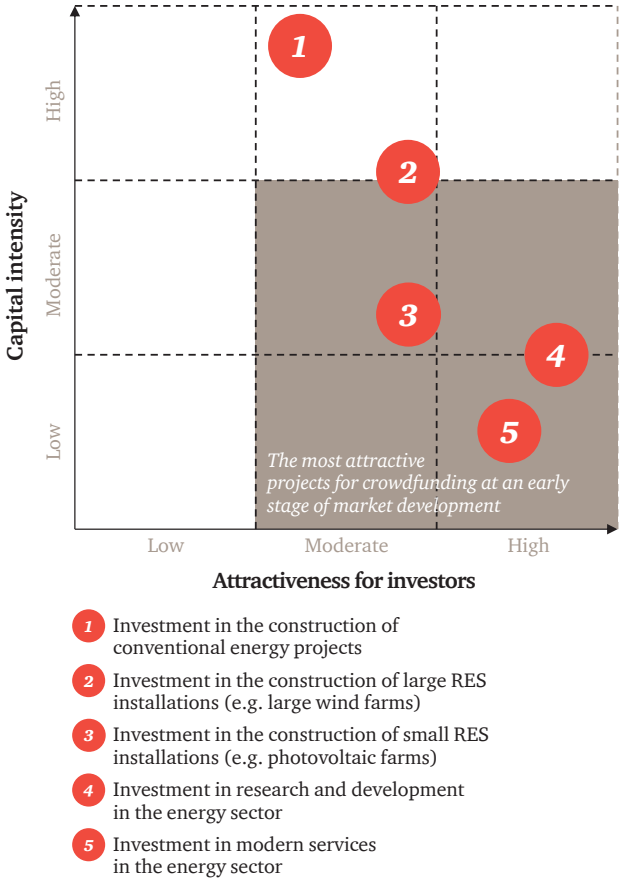
- ensuring the security and legality of the investment (both legal and regulatory),
- guaranteed respect for the interests of minority shareholders,
- ensuring the transparency and authenticity of financial results,
- providing tools for investment monitoring,
- business structuring of the project, including the design of detailed entry and exit conditions, profit payment profile, and risk sharing.

In the coming years, the demand of the Polish energy sector for capital will be very high and driven primarily by:

- necessary investments in conventional energy – the coal-fired units which are now being constructed in Kozienice, Opole, Turów, and Jaworzno require an investment of over PLN 22 billion[12] in total, and each next new large scale unit will require outlays reaching billions of Polish zlotys;
- investment in RES aimed at meeting 2020 RES objectives set by the European Union. For this purpose, the Ministry of Energy has already allocated about PLN 20 billion in the form of electricity auctions in 2016 and 2017;
- investment in the modernisation of the distribution grid;
- investment in research and development, and in modern technologies, such as electromobility projects;
- other investments focused on the development of innovative energy and non-commodity services.

Not all of these investments will qualify for crowdfunding in its current state of development in Poland. The main barrier is the level of capital needed for an investment. Only investments requiring a contribution of several million Polish zlotys from crowdfunding have relatively good chances of success. It is impossible to finance through crowdfunding the largest energy investments, requiring billions of Polish zlotys, as confirmed by experience from abroad.

Assessment of the attractiveness of energy investment in the crowdfunding formula



Source: PwC analysis

The feasibility of project financing combined with organisational and legislative barriers as well as with the trust barrier of investors will be key to the successful development of crowdfunding in the energy sector in Poland. National energy projects may bring the investors returns on investment at levels significantly above those guaranteed by traditional financial institutions, such as banks. This will enable crowdfunding to become a new source of funding for the energy sector in Poland.

12. Sum of net contract amounts, according to press releases

Contacts

Dorota Dębińska-Pokorska
Energy Group Leader
T: +48 502 184 883
E: dorota.debinska-pokorska@pl.pwc.com

Jan Dziekoński
Energy Group Expert
T: +48 519 504 286
E: jan.dziekonski@pl.pwc.com

Michał Gawrysiak
Energy Group Expert
T: +48 502 184 796
E: michal.gawrysiak@pl.pwc.com

Jan Biernacki
Energy Group Expert
T: +48 519 506 582
E: jan.biernacki@pl.pwc.com

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