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POWER COMPANIES STRATEGY ADJUSTMENTS TOWARDS GREEN TRANSITION

DOSTOSOWANIE STRATEGII PRZEDSIĘBIORSTW ELEKTROENERGETYCZNYCH DO WYZWAŃ ZIELONEJ TRANSFORMACJI

Abstract: The green transition creates revolutionary challenges to power companies that have to adjust their activity into new conditions. Green transition should be perceived as a transition from the economic system based mainly on fossil fuels to the system based on renewable and low-emission sources and ultimately emission-free production methods. Observed process shall be defined as green industry revolution. The changes in the

strategy of power companies are required by the development of green economy, public expectations and changes in financial markets towards decarbonization and renewable energy sources. Hence, power companies need to reorient their strategies in a way that ensures profitable operation in fundamentally changed environment and secure economic results against rapidly increasing climate risk and both customers and decision makers' expectations to meet climate goals. There is noticed last years an increasing uncertainty concerning the future shape of the market, on which power companies operate, facing the need to take the fundamental decisions related to their future business model. New market conditions change the sources of profits and importance of current value chains elements, new entities enter the energy market, customers expect new services and existing technology does not provide expected profitability. Strategy should provide answer concerning financial perspective of power company ensuring necessary funds for investments and daily activity. It can be completed only when power company meets the requirements of customers that expect primarily the reduction of carbon footprint while providing cheap power and security of supply. It requires to consider in the strategy not only the development of RES technology and expected technology maturation and commercialization of green hydrogen but also changes in grid management, energy storage, digitalization or prosumers. The future of power companies is determined by regulatory environment creating not only conditions for particular technologies development, but taxes, fees and market-based pollution reduction mechanisms. There become useless the existing models of the power sector operating and approach to the analysis of its future. Author proposes to perceive strategy not only as hypothesis about power company future, but as plan for programming the future of company towards necessary developments, securing profitability and continuity of operations in changed market and new regulatory environment. The structure of the power companies' operations should evolve into business models ensuring success of such defined strategy.
The aim of the article is to define necessary changes in the power companies strategy and its scope for their reorganization and adaptation to new challenges of green transition. Conclusions of the research and considerations concluded in the article are presented in the section dedicated to the recommendations for strategy of power companies.

Keywords: management, strategy, green transition, power company, strategic planning

Streszczenie: Zielona transformacja stawia przed firmami elektroenergetycznymi konieczność dostosowania działalności operacyjnej do zasadniczo zmienionych warunków otoczenia biznesowego. Obserwowane jest przejście od systemu gospodarczego opartego głównie na paliwach kopalnych do systemu bazującego na odnawialnych i niskoemisyjnych źródłach energii oraz docelowo bezemisyjnych metodach produkcji. Obserwowany proces należy określić jako kolejną, zieloną rewolucję przemysłową. Stąd wymagane są zmiany w strategii przedsiębiorstw elektroenergetycznych, które przygotują je na rozwój zielonej gospodarki, wzrost oczekiwań społeczeństw w zakresie redukcji śladu węglowego oraz zmiany na rynkach finansowych. W związku z tym przedsiębiorstwa elektroenergetyczne muszą przeorientować swoje strategie w taki sposób, aby zapewnić rentowną działalność w fundamentalnie zmienionym otoczeniu biznesowym i zabezpieczyć wyniki ekonomiczne przed szybko rosnącym ryzykiem klimatycznym oraz koniecznością realizacji celów klimatycznych. W ostatnich latach obserwuje się rosnącą niepewność dotyczącą

przyszłego kształtu rynku energii elektrycznej, co powoduje konieczność opracowania nowego modelu biznesowego przedsiębiorstw funkcjonujących w elektroenergetyce. Nowe warunki rynkowe zmieniają źródła zysków i znaczenie obecnych elementów łańcucha wartości, na rynek energii elektrycznej wchodzą nowe podmioty, klienci oczekują nowych, zielonych produktów i usług, a obecnie stosowana technologia nie zapewnia oczekiwanej rentowności w przyszłości. Strategia powinna dać odpowiedź dotyczącą perspektywy finansowej przedsiębiorstwa elektroenergetycznego zapewniającego niezbędne środki na inwestycje i codzienną działalność.
Cele strategii można zrealizować tylko wtedy, gdy przedsiębiorstwo elektroenergetyczne spełni wymagania klientów, którzy oczekują przede wszystkim wspierania neutralności klimatycznej przy jednoczesnym zapewnieniu taniej energii i bezpieczeństwa dostaw. Wymaga to uwzględnienia w strategii nie tylko rozwoju technologii OZE i oczekiwanego dojrzewania technologii i komercjalizacji zielonego wodoru, ale także zmian w zarządzaniu siecią dystrybucyjną, magazynowaniu energii, cyfryzacji czy współpracy z prosumentami. Przyszłość firm energetycznych determinuje otoczenie regulacyjne stwarzające nie tylko warunki do rozwoju poszczególnych technologii, ale powodujące także podatki, opłaty i rynkowe mechanizmy redukcji zanieczyszczeń.
Autor proponuje postrzegać strategię nie tylko jako hipotezę o przyszłości przedsiębiorstwa energetycznego, ale jako sposób programowania przyszłości przedsiębiorstwa elektroenergetycznego w kierunku koniecznych zmian, zapewniających rentowność i ciągłość działania na zmienionym rynku i w nowym otoczeniu biznesowym. Struktura działania przedsiębiorstw energetycznych powinna ewoluować w kierunku modeli biznesowych zapewniających powodzenie tak zdefiniowanej strategii. Celem artykułu jest przedstawienie niezbędnych zmian w strategii przedsiębiorstw elektroenergetycznych i ich zakresu, będących kluczowym czynnikiem ich dostosowania do wyzwań zielonej transformacji. Wnioski z badań i rozważania zawarte w artykule przedstawiono w części poświęconej rekomendacjom dla dostosowania strategii przedsiębiorstw elektroenergetycznych do wyzwań kreowanych przez zieloną transformację.

Słowa kluczowe: zarządzanie, strategia, zielona transformacja, przedsiębiorstwo elektroenergetyczne, planowanie strategiczne.

Introduction

There was decided during Paris Climate Change Conference (COP21) to limit global warming up to 1,5°C in order to neutralize climate risk. Global economy shall be climate-neutral till year 2050[1]. Such target requires to reach minimum 95% economy-wide greenhouse gases (GHG) reduction by 2050, what implies at least the full decarbonisation of the energy sector. Hence, power companies must rapidly change the operating activity, reducing carbon emissions and respond to

[1] The specific issues relating to decarbonization and greenhousegas impact on global temperature are discussed in: B. Sadowska, G. Kinelski, M. Wójcik-Jurkiewicz, M. Czarnecka, K. Bilińska-Reformat, *Determinants of decarbonisation in the transition of the energy sector: the case of Poland*, "Energies" 2021.

the expectations of customers. Green transition makes some of their current business models outdated while there is observed the development of new green products and services both on power and financial markets.

Green transition should be defined as process of creation of climate-friendly and sustainable economic system based on low-carbon technologies. This process means transition into emission-free industry. It requires to secure sustainable economic development enabling reduction of environmental pollution and GHG, amount of waste and improvement of energy efficiency[2]. It causes the power sector to operate globally under conditions that can be defined as green industry revolution focusing particularly on carbon neutrality. There is observed globally shift towards renewable energy sources (RES, renewables) that is stimulated by innovation, technology maturation, green finance and new regulations. New business models are developed rapidly on energy markets. Power companies place green transition at the center of their strategy, what is the respond to the expectation both of investor and customers. The green transition is characterized by following dimensions: technological, strategic, regulatory, environmental and economic. The adjustment to requirements of green transition becomes at present the necessary condition for long-term survival of power companies in changing business environment. The energy intensity and carbon footprint are determinant of the perception in the society and by customers. It requires to consider in the strategy the assumption of full decarbonized power sector by 2050. The influence of regulations, societies' expectation, investors and technological change put into place the dynamics comparable to industrial revolution. This situation will have impact on all elements of power companies' structure. There are cooled down investments in carbon-intensive industries and accelerated into green economy. Demand for green products has been growing strongly in last years. Business started to focus on green hydrogen. Capital is invested into innovation, digitalization, R&D and technology supporting the lowering of renewable energy costs, energy storage, green hydrogen and green innovations. The lower costs of green technologies encourage companies to define ambitious green goals. Necessary adjustments of power companies' strategy should secure the sustainable improvement of profits in long-term perspective.

Operational activity of power companies will be influenced by uncertainty concerning future situation on the power market that will be determined by following drivers:

1) global and regional climate regulations towards climate-neutrality backed by climate commitments;
2) reduction of fossil fuels consumption;

[2] More about sustainable development in: W. Drożdż, A. Maroušková, G. Zych, G. Kinelski, M. Wójcik-Jurkiewicz, M. Czarnecka, Marzena, *Determinants of Decarbonization - How to Realize Sustainable and Low Carbon Cities?*, "Energies" 2021.

3) future prices of CO_2 emissions;
4) development of renewables' capacities and potential reduction of power prices;
5) development of energy efficiency and reduction of power consumption in developed countries;
6) development of power storage capacity.

Operational activity of power company is influenced by progressive skepticism concerning future profitability of business based on fossil fuels utilization. Competitiveness of traditional fossil fuels-based power industry is significantly reduced by increase of CO_2 emissions prices and maturation of green power production and storage technology. Development of green transition is linked to development of CO_2 emission market towards new sectors, what will increase emission price. Financial institution started to focuse on the investments supporting green transition, stopping to fund traditional energy sector. Investments based on fossil fuels record problems with financing. The industry decarbonization shall be backed by green hydrogen and biogas, when natural gas will be only the transition fuel. Nuclear energy, produced in the future also in small modular reactors (SMR), shall be involved into both power and hydrogen production, enabling the security of supply. The green transition shall be supported by development of distributions and transmission grids. Profitability of RES investments is determined by endogenous factors like cost of technology or available technology and exogenous factors that can be determined by regulations (taxation, market fees) or even global energy mixt.

1. Climate risk

Climate change shall be the part of long-term business analyses of power companies that have to be able to manage climate risk. Investors, customers and regulators raised their expectations for power companies concerning reduction of GHG emissions to zero in order to reduce climate risk. Hence, climate risk becomes the important challenge to power companies, being part of systematic risk, influencing the whole economy. President of BlackRock, the biggest investment found in the word, indicated in the letter to the CEOs of the biggest USA corporations that climate risk should be identified as an important element of the investment risk. Efficient climate risk management is crucial for profitability of companies.

Power companies are particularly exposed to climate risk. The severity of this risk has been growing continuously due to increase frequency of extreme temperatures, storms or floods[3]. The most important risk factors are wind and water. Power companies started the climate risk response building reinforced energy infrastructure - strengthening the overhead transmission and distribution grids,

[3] *When climate risk starts to bite*, "Climate risk. Special report 2019", Infopro Digital 2019.

installation of flood-proof equipment at power plants and transformer stations, rivers' temperature forecasting systems, equipping power plants with production control systems. The necessity of financing risk response investments transfers the climate risk of power industry to portfolios of financial institution.

The climate risk of power companies consists from two elements:

1) risk of transition period – risk that results from changes in the business and regulatory environment of energy industry towards green economy. This risk just caused loss in operations of coal power plants. There appears a problem of security of supply under conditions of decommissioning of coal power plants what can take place by end of this decade;

2) physical risk – risk that results from undesirable impact of physical factors' extreme dynamic (mainly weather phenomena) on energy market conditions, fixed assets and operations of power companies. This element of climate risk causes price movements in the commodities and financial markets[4].

Climate risk varies in terms of geographic factors, sectors of the economy, and regulatory and legal conditions. The problem is also the small amount of data in terms of its impact on various companies in the power markets. However, most factors of climate risk are characterized by low probability and high cost of materialization - therefore, the extreme conditions resulting from the advancing climate change have a specific financial dimension for the power industry due to its characteristics, as it concerns the power and financial markets (revenues, business profitability), physical assets (damage as a result of extreme weather events), regulatory and social areas.

2. The essence of strategy definition

Strategy shall be defined as hypothesis about future functioning of the of company that is specified as response to structural changes taking place in its business environment, being a way to implement and achieve future goals. It is therefore about methods of creating future profits and identifying the necessary resources. The strategy relates to a long period, although its operationalization even applies to periods, for which strategic goals are set out even for annual periods[5]. The strategy is therefore defined as a series of long-term activities aimed to programme the greatest possible competitive advantage and the most optimal conditions for the future operations of

[4] The occurrence of extreme heat in Europe is a hundred times more likely than it was a hundred years ago. Germany was the third country in the world in year 2018 in terms of the effects of materializing the risk of extreme temperatures. More: M. Krukowska, *Ryzyko klimatyczne na wysokim szczeblu*, "Obserwator Finansowy" 2019, obserwatorfinansowy.pl [access: 10.12.2019].

[5] Action plans and associated budgets transform the strategy into operational decisions, cascading and operationalizing the strategy to individual levels of management, supporting the control of the management in the enterprise.

the enterprise. The essence of an effective strategy is to create the uniqueness of the company and its distinction on the market. A properly defined strategy allows to create a long-term competitive advantage on the market and to stabilize the profitable development of the enterprise. Growth of the company secures the required scale of operations, reduces costs and increases product quality. There are crucial the long-term nature of the strategy and the way of its implementation. Although functioning of power companies in the world of green transition requires the update of strategy almost every year. Hence, strategy should create the plan for a response to the changing business environment and economy dynamic.

Strategic decisions of power companies are exposed on high risk that originates from climate risk, regulatory and policy changes, maturation of climate-friendly power production technologies and establishment of the green financial markets. Any delay in the adaptation to new operating conditions of power companies results in the loss of profits. The risk component should be taken into account during strategy determining, what requires multifaceted analyzes of the stochastic perceived future in order to work out possible market scenarios and developments of power company's operations. Such defined strategy should lead to the growth of the company's operational flexibility. The defined scenarios must be completed by risk factors arising in the word of global risk that is backed by green transition. It allows to develop strategy by risk response instruments in order to secure the resilience of the enterprise to external shocks. Therefore, the strategy should prepare the company not only to increase the efficiency of management or to improve the creation of added value, but primally to function effectively in the future world of green transition. For example, green technology becomes determinant of competitiveness, but it also shortens business cycles, what should be considered in the strategy[6]. The strategic response should focus on simplicity, flexibility and innovation in terms of both meeting customer needs and managing the enterprise in the context of global change.

The turbulent changes in the business environment of power companies require the strategic shift in the targets' determination. The strategic risk and response to green transition should be considered and addressed in the strategy. Power companies must identify drivers of competitive advantage creation in the new market conditions, securing sustainable long-term profitability of operations. It is conditioned by the growth potential of company, ability of management to identify the opportunities and risks and competences inside company allowing to implement correct solutions. Managers, when deciding, base on the analyses of trends, being only the projection of the future. It means that they have no complete

[6] More about factors determining the competitiveness of traditional energy industry in: K. Pająk, G. Kinelski, *Competitive Market and Sources of its Advantages in the Electric Energy Subsector*, "Progress in Economic Sciences" 2017.

knowledge of the future and the decision-making becomes only the anticipation of potential development trajectories. It requires change in the approach to strategy determination. The linear, deterministic approach of future analyses should be replaced by stochastic attitude that requires preparation to the appearance of many various, random scenarios. It enables to avoid the illusion of being in control of the future by planning. However, strategic decisions should always be a deliberate choice from a range of options that are to lead to the most effective achievement of the strategic objectives. The changes in the business environment caused by green transition must be considered by power companies just in the planning process in order to prepare the necessary changes, securing the strategy execution. It has impact on company's development directions. Climate risk should be considered in the strategy as well, what confirms the necessity of building a range of scenarios of the future, determined by developments of various drivers of green transition, being reflected by volatility of different phenomena, processes and their consequences, complexity and ambiguity.

The word of green transition changes the market conditions, defining new ways of meeting the customers' needs. Markets must be redefined. The changes are turbulent and companies must operate in the very volatile environment. It increases the strategic risk, which materialization is particularly severe for power companies. The groundbreaking ideas, affecting the power industry, more and more often occur outside energy sector and together with the emergence and rapid commercialization of breakthrough green technologies destroy the current status quo in the industry. Therefore, power companies must constantly analyze the best green market practices of various industries and absorb the best solutions for their green and sustainable market development at a given moment. At the same time, the current status quo should be questioned by checking whether the current market position of the company is satisfactory for the authors of the strategy. The market dynamics shall be identified as opportunity for profitability increase and reflected in the strategy[7]. Hence, identification of strategic risk factors sufficiently in advance and indication in the strategy the risk reaction instruments become crucial for future success of any company. Ignoring strategic risk can lead to losses resulting from an incorrect strategic business decision. The adjusting of companies operation to fundamental change in the conditions of its operation become increasingly important, while green transition accelerates.

[7] M. Wereda-Kolasińska, *Wpływ ryzyka strategicznego na wartość dla akcjonariuszy*, CeDeWu, Warszawa 2011, s. 6; A. Wawiernia, *Ryzyko a strategia działania przedsiębiorstwa*, http://zif.wzr.pl/pim/2013_1_2_33.pdf [access: 27.10.2019].

3. Strategy developments of power companies under conditions of green transition

Power is essential for the functioning of modern economies, but at the same time, GHG emissions from energy production are by far the largest contributor to global warming. To ensure a sustainable future, the entire system of power production and consumption will have to be transformed in the decades ahead from fossil fuels to renewable energy sources. It develop the necessity to redesign the electrical grid to accommodate for intermittent sources of power from wind, solar, and offshore. Power generation will increasingly become distributed among many suppliers, from large, centralized power plants to individual prosumers. These changes represent both a huge challenge for power companies and society, being an opportunity for new entrants into power sectors, which will play a catalyst role in the transition. The green transition requires high levels of decarbonization and electrification of economy backed by green fuels in areas that are difficult to electrify. There are following areas of impact on power companies operations made by this process:

1) more restrictive environmental protection resulting in improvement of pollution reduction (GHG among others) and changes in operations of industrial customers;
2) roll-out of green power production and reduction of fossil fuel utilization;
3) digitalization of the power sector.

Power is essential for green transition. The use of renewables supports the creation of decarbonized, sustainable energy framework – the contribution of clean energy sources with improvement of energy efficiency.

The green transition influences power market, which is in the shift from fossil-fuel dominated system into based on renewable energy sources and carbon-free solutions. By 2050 renewables will produce more than 90% of energy being dominant power producer in the global power system. Biomass and the waste will surpass fossil fuels as energy sources[8]. Storage of green power and electricity production based on green hydrogen will operate as pick-power producers replacing gas power plants. Power companies have to rethink the role of non-emitting technologies in their portfolio: nuclear, geothermal, hydro. Next important issue is demand flexibility. Power companies used to operate previously in market characterized by predictable and inflexible demand. The application of RES, electric vehicles, power storage systems and e.g. heat pumps starts to change the demand's pattern. On other hand these new elements of power system can offer some flexibility in demand side management. Electric vehicles and heat pumps are manageable concerning time of power consumption. Therefore, electric vehicle can be treated as power storage system element as well (vehicle-to-grid).

[8] P. Nilsen, R. Kombargi, M. Coughlin, *Inventing tomorrow's energy system*, PWC, pwc.com/road-ahead-energy-system [access: 28.04.2022].

It seems that the required direction of strategy development is set - the necessity of adjustment to green transitions demands, right infrastructure investments and business model changes, securing decrease of costs on the other hand. Constantly updated regulations create new dimensions for strategy directions backed by new technological models. Power companies have to find strategic answer to the appearance of new complex business environment of energy system created during green transition. Power companies should develop new business models being climate neutral, adjusting operational activity to challenges of green transition. Strategic response should define what has to be changed and to what extent in order to protect future profitability. Changes of regulatory standards and technological solutions creates new risks that have to be managed.

Renewable energy sources, as mentioned before, shall be basic power producers until year 2050, what requires not only to finance necessary investments, but to provide security and flexibility of power supply – e.g. large scale power storage, decentralized power supply, peer-to-peer power trading, high flexible power plants. The acceleration of windfarms' construction in Europe became in 2022 the determinant of the future security of supply. Hence, power companies face the radical changes of profits drivers. Technology maturation of RES and market innovations require changes both in business strategy and business model of power companies. The main factors influencing power companies' strategy are green transition, customers expectation and regulatory changes. These factors create following strategic challenges, facing the power companies:

1) Renewable energy sources are already competitive to coal and gas power plants, becoming target power sources.
2) Necessity to determine the right definition of pace at which the green transition will progress.
3) The development of green finance and green taxonomy stopped to finance investment related to fossil fuels.
4) The reallocation of capital to green industry will spur booming demand for climate-friendly products and services, produced using green power.
5) New competitors outside the energy sector entered the power market, taking over customers of power companies based on innovative offer, supporting reduction of coal footprint. These competitors are well prepared to new conditions of functioning in green transition and digitalized energy market.
6) Customers aim to decarbonize industrial processes, minimalize carbon footprint and climate change. The energy intensity is the determinant of a positive image of power companies' image that is backed by reduction of GHG emission. Hence, the power companies shall respond the needs of industry.
7) Renewables will create challenges in balancing power system, supporting development of power storage and new sources of power production.

8) Dominant role of renewable energy sources in power system will force to change the characteristics of transmission and distribution grids towards more bidirectional.

9) New value chains shall be considered based on development of renewables, green power storage, green hydrogen, recycling and waste utilization both in products perspective and geographical, e.g. import of green hydrogen from regions with surplus of cheap renewable power.

10) High volatility and significant market risk following the changes in production volumes of renewable power (local) or flows of green hydrogen (global).

11) Necessity to rethink the elements of value chain in power market as a result of erosion of the traditional barriers between energy sectors and development of new products and services. Customers become the value chain partner, helping to work out products better serving their needs.

The transformation of business environment towards green energy sector, new entrants outside power industry, climate risk and technological revolution should be classified as the most significant challenges of power companies. That is why power companies have to work out strategic focus on future business model and to select projects that will support the achievement the climate goals set out in the strategy. There is changed profitability of value chains in power industry, customers define new needs and legacy assets started to lose value and potential to be profitable. Hence, the construction of coal fired power plants was stopped.

The transition of power companies' operational activity towards green energy industry is a necessary condition for their survival. Decarbonization of power companies' legacy operations will support the profitability allowing to gain market share in new geographical and product areas. The experience of leaders in changing business suggests that success is among companies being first to take advantage of net-zero opportunities. The power companies participating as first in green transition are characterized by the value-creation advantages of green leadership. New entrants to power market are getting ahead traditional utilities by locking in customers to tap green finance and set up operations, building new business models. Power companies leading in green transition look for transition-driven growth opportunities, backed by capital gained from divested assets that are less likely to be profitable in new business environment conditions. The strategy of power companies needs to consider following issues:

- technological context;
- regulatory context;
- financial context;
- market context;
- customer context.

- **Technological context**

The new power market conditions influence the technological areas of power companies' operations. The legacy business based on fossil fuels starts to be minimized and operations must be adjusted towards requirement of being carbon-neutral. The expectation of required return on capital is related to design of efficient business model based on climate-friendly production assets backed by flexible power grids. Hence, environmental policy aspect is mainly reflected in technological context. There arises strategic problem for long term decisions concerning year 2050, because any decision concerning assets structure of power companies has long-term implications. Power company musts analyze the competitiveness's dynamic of production technologies in constantly changing market environment, what creates issue of definition of optimal technological mix (production, power grids) just now.

Market developments delete existing competitive advantage, what requires to implement new, innovative technical solutions. Technology can give the advantage, but there appears a new solution and technological novelties become standard soon, what demands the power companies to develop new solutions. Technology determines the decisions concerning the energy mixt of power companies at three following perspectives:

1) security of power supply;
2) availability of power for customers;
3) environmental-friendliness.

The market dynamics and technical progress act as moderator determining use of available technology, changing the paradigm of power supply to customers that become more and more locally power producers. Hence the one of the most important challenges created by green transition is the stabile work of power grid in condition of significant penetration of RES. It requires to increase the technical and digital advancement of power grid, in order to support development of RES production locally on site and regionally. Power companies must develop new operational routines increasing the flexibility of power flow management - both production and network management. The digitalization allows to manage also the demand side linking power produced and stored locally (mainly photovoltaic and batteries) the power supplied to power grid. Customers, used digital solutions, can increase efficiency of power usage, reducing energy costs. There is observed just the maturity of power storage technology and power storage capacity (USA, Australia) that is relevant for operations of power system (peak power supply, ancillary services). Power companies shall support the development towards maturity of biomass market, what should support the green production based on biomass. Power companies shall use the technology and know-how that they possess – existing technical expertise, deep knowledge of power networks, capital engineering capa-

bilities – to prepare organization to operate in condition of new requirements of green transition and develop new, innovative services. Technology level is important, because only basic transformation of operations and breakthrough of technology will secure success in green transition. Power companies shall consider the development of renewables-based co-generation and green hydrogen production. Above presented developments changes globally the power production structure that becomes greener, renewables-based. The new shape of power sector differs fundamentally from previous based on fossil fuels.

The development of power storage supports the increase of RES competitiveness in relation to traditional fossil-based power production[9]. The utilization of power storage increased significantly and the costs of this technology is reduced faster than investments costs of wind farms and photovoltaics. The global capacity of power storage shall achieve 15 GW by 2035. Power storage takes over the current role of gas power plants as the peak power suppliers. Companies operating gas power plants identified this risk and started the response activity developing polar-plus-systems, mainly in USA – for example project Vistra in California (including 1,5 GW and 6 GWh power storage capacity), Capital Dynamic in California (including 1,5 GW power storage capacity). Both investments aim to replace gas power plants as peak power suppliers. There are developed investments in large power storage: Neoen builds 1,5 GW power storage capacity, project Goyder South 0,9 GW and 1,8 GWh storage capacity backed by 1,2 GW of wind farm and 0,6 GW solar capacity. The demand for power storage is generated not only by RES and electric transportation, but also by distribution and transmission systems operators in order to stabilize operation of power system (mainly for frequency and power control services).

The process of green transition of power companies is determined by economics. The choice of the applied technology in power sector has always long-term consequences. Hence, the companies; management has to choose a technology securing long-term sustainability of economic profits in the business environment transforming towards green solutions. The climate regulation strive to execute global green transition instead of previous the gas supply assurance and to ensure global withdrawing from use of fossil fuels.

- **Regulatory context**

The regulations moderate the shape of used technology – regulations encourage the development or decommissioning of the available technology[10] and can affect RES investments by following determinants:

[9] It has impact on risk assessment of elements of the power industry done by financial institution.
[10] The example of this situation is the stop of onshore windfarms development in Poland as a consequence of so called Distance Act defining rules on location and construction of wind farms.

1) emissions' norms for power plants constructions;
2) profitability, steered by taxation or market fees;
3) taxation steering the investments financing.

Power industry is influenced by costs of global limitation of GHG emissions. The example is increase of CO_2 emissions' prices in European Union Emission Trading Scheme (EU ETS). The green transition in global economy supports deep and urgent decarbonization of power production because RES are cheaper option as fossil-based power plants. The problem of investments' funding concerns gas-fired power plants as well.

The result of green transition is the rise of stranded assets that refer to the assets characterized by high risk of being out of operations in the future - e.g. the problematic issue is specified by the period of profitable production of fossil-fired assets. The global climate policy negatively influences the financing of fossil-based investments, what has the impact on the strategic decisions concerning assets development, making it green orientated. It is reflected in the real operations. Thirteen states of USA defined in year 2020 goals concerning climate neutrality. Power companies responded this initiative – e.g. Xcel Energy Inc. decided to reach 80% of emissions' reduction until 2030 (increase of natural gas utilization, investments in power storage, pumped-storage plants, new types of nuclear power plants, green hydrogen). Similar initiatives took European power companies: Endesa, E.ON, RWE, CEZ, EdF or Orsted, which decided to be climate-neutral by 2025 (Orsted plans to install 30 GW of renewable energy and from 2021 bases on electric vehicles). Orsted influences twenty thousand of its suppliers to be climate neutral as well, demanding to present the carbon footprint minimalization schedule. European Union plans to become by 2050 first territory climate neutral, aiming to create a fair, competitive and carbon neutral society. Important step was done by European Parliament in January 2020 that adapted the European Green Deal and legally confirmed the ambitions of net zero emission goal in the European Climate Law. It highlighted the need to decarbonize the power sector. At the same time European Commission prepared budget of EUR 1 trillion for investments in green projects by 2030 that considered the instruments attracting the private investments as well. The climate aspiration of EU were confirmed in the *Fit for 55%* legislation package that aim is to adjust EU climate and energy policy towards minimum 55% reduction of GHG emissions by 2030 (comparing to year 1990). The following actions shall be executed for this purpose:

- application of emissions trading in new sectors of the economy, particularly in construction and transport;
- reduction of emission limits and requirements of emissions reduction's acceleration;
- reinvestment of the obtained funds from the sale of European Emission Allowances (EUA) to projects related to the implementation of climate goals;

- improvement of energy efficiency;
- acceleration of the low-emission transport development through a prohibition of the sale of cars burning fossil fuels from 2035 and creation of separate emission trading system for road transport fuels;
- adjustment of the fiscal policy in the EU to the implementation of the Green Deal objectives by modification of products and technology taxation in the direction supporting green transition;
- prevention of emissions leakage by introduction of boarder climate carbon tariff - *Carbon Border Adjustment Mechanism* that shall improve the EU producers competitiveness and market position from year 2026 by charging the imported products with emission costs based on EUA price;
- protection and development of natural GHG sinks in order to made climate neutral the EU land, forestry and agriculture sectors that shall remove 310 million t. CO_2 by 2030.

The scope of the package shows the cross-cutting nature of the fight against climate change, which applies to all sectors of the European economy.

- **Financial context**

Customers started committed to reduce the carbon footprint to zero and financial institution declare to fund only green investments[11]. It can create the significant capital reallocation from assets characterized by carbon emissions to projects emitting minimal or even zero GHG volumes. It is the confirmation of global trend of integration of finance and environmental protection, what is the after-effect of Paris Agreement and definition of climate targets. This issue was confirmed during COP-26 in Glasgow.

Sustainable financial system creates and valuates financial instruments during concluding transactions in order to meet long-term needs of society, shaping real and sustainable welfare. Climate-friendly investments are prioritized over the unsuitable capital spending. Power companies must begin to operate in green financial markets in order to raise capital for necessary investments adjusting their operating activity to green transition worldwide. The green finance promote the long-term investments supporting the climate targets and responding on climate risk. Green finance ensures financing in all financial sectors and asset classes that take into account environmental, social and investment decision management criteria, considering their climate risk, and are executed to promote sustainable development. Green finance funds the development based on renewables energy sources using both direct capital investments in RES investments and power pur-

[11] *Playing offense to create value in the net-zero transition*, "McKinsey Quarterly" 2022, no from 11.04.2022.

chase agreements (PPA) – physical PPA; virtual PPA, being the financial instrument. Other financial instruments connected with sustainable development that attract investors worldwide are green bonds, green loans and ESG-linked credits, green credits, sustainability-linked derivatives, Credit Default Swaps (CDS) connected with ESG, contracts related to ESG stock indices, derivatives concerning European Union Emission Allowances (EUA) trade, derivatives whose underlying asset are renewable fuels and weather derivatives.

- **Market context**

Power market is in the process of changes of fundamental factors affecting both supply and demand side:

- supply – change of power production techniques – increase of renewables and power storage capacity, while reducing importance of fossil fuels and nuclear power. There is observed increase of RES efficiency resulting from maturation of renewables technology, costs reduction and improvement of production reliability, what allowed RES to start to compete with fossil fuels power plants. The traditional power plants, ensuring the security of supply, started to lose competitiveness in situation of emission prices jump [12]. On other hand, the reduction of power prices in peak hours (result of dynamic growth in solar capacity) decreased margins of gas-fired power plants;
- demand – distributed generation located at the point of demand backed by power storage. The shape of demand curve is changed because of reduction of demand in the pick hours (risk for gas power plants' profitability) as result of photovoltaic investments executed by households, hotels, office buildings and industry or shopping centers. Industry plants strive to cover part of demand by RES installed on the site.

The significant growth of RES capacity creates the necessity to adjust the business models by power companies in order to defend future profitability. Above presented dynamic changes the model of power industry operations being valid in last decades. The intraday market become more important, taking over part of trade from spot market. It results from higher predictability of RES production during the delivery day. Increased market prices volatility encourages new no-assets entrants outside power industry to generate profits based on pure trading activity. The volatility results from production of inflexible nuclear and coal power plants, market dependent RES and renewables that hedged the market risk by PPA and produce in order to deliver the contracted volumes – the volume of production is not conditioned by market situation, but by the weather (mainly wind and sun).

[12] The issue of security of supply creates the opportunity for nuclear power plants to remain important for power system.

Hence, there appears power that production is not steered by market mechanism. Development of RES and power storage opened the power market for new companies, suppling photovoltaic installation and power storage batteries that created virtual power plants, taking advantages from power sales from thousands distributed installation during periods of prices increase in intraday and balancing markets. Each GW of installed RES capacity corresponds to the capacity of a system power plant, therefore it is important to predict the impact of RES production on the wholesale power market, what supports the analyses of weather data and forecasting its impact on power system balancing. Above-presented trends requires development of new financial instruments allowing to hedge new risk exposures. Next important issue is the change caused by net-metering, net-billing and power storage – part of the RES production can be utilized in night hours and winter season, what requires new approach to the security of supply.

Power companies adjust strategy decisions to increased renewables production, which influences the market prices and competitiveness of power production technologies. Therefore power companies started to decommission coal power plants (only in USA process started Alliant, Platte River Power Authority, WE Energies, Southwestern Electric Power Co., Gulf Power, Talen, Xcel, GenOn Holdings LLC, Tennessee Valley Authority, Tampa Bay). Ownership of coal power plant requires large capital expenditure, which is unjustified in the conditions of worsening competitiveness of coal-fired power plants. The transformation of production assets towards becoming energy sources ensures higher rates of return on investment. Alliant phasing out Lansing power plant shall safe 150 million USD of environmental protection's investments. The funds can be invested in solar capacity (400 MW) and formation of carbon free production portfolio by 2040. The next reason is the reduction of power costs for Alliant's customers.

- **Customer context**

Power companies are required by the business environment to change the operational activity towards climate neutrality that will be important determinant of future competitiveness. Customers of the power sector defined goals regarding the negative impact of business on the environment. Declarations of eliminating greenhouse gas emissions by 2050 are submitted by industrial companies – e.g.: steel manufactures (ThyssenKrupp, SSAB), cement producers (HeidelbergCement, Cemex), aluminium (NorskHydro), mining companies (BHP Billiton, Vale), BigTechs companies (Aple, Google, Facebook). An example is the oil and gas industry – Spain Respol, Italian Eni, Canadian Cenovus Energy, British BP declared to be emission zero by year 2050. Apple, Google, Microsoft and next 160 companies participate in the RE100 initiative that strive to cover demand of 190 TWh a year only by RES (global and local investments).

Industry customers and society expects from power industry concrete support in transition towards modern and low-emission economy that is a key element in staying competitive when customers leave oil and fossil fuels in general and investors and financial institutions depart from financing investments in fossil fuels. Industrial customers of power companies have to execute following actions:

- decarbonization of operation activities by switching to renewables, biofuels and the use of green hydrogen;
- implementation of green hydrogen-based fuels;
- reduction of energy consumption and increased energy efficiency;
- cessation of construction of new coal-fired power plants and start to decommission the existing ones;
- power storage development;
- development of flexible demand side management;
- transition into climate friendly manufacturing technologies.

Industry and society perceive the acceleration of green transition and carbon footprint minimalization as an additional impulse to development and value creation[13]. There is required the fundamental change of core activity in order to build new perspective of the functioning in transforming environment and to survive in new market conditions. It is applied to power companies as well that have to meet expectations of customers and policy makers. Reconstruction of business models towards sustainable development also results from the attitude of financial institutions and investors, who identified long-term benefits of investing in accordance with the ESG (Environmental, Social and Governance) principles and require that entities, entrusted with capital, will act with respect to the environment and climate.

4. The strategy adjustment of chosen power companies to the reality of green transition

The green transition implies not only the change in power market, but also way of power industry functioning. Current power companies recorded losses in the market being under transition, where leaders of change are new, flexibles entities. The young managers, computer scientists, entrepreneurs strive to transit power industry in direction of climate-friendly power supplies. This approach becomes standard for all power market participants. The rigid and immobile, old-fashioned concern-based power companies should be shifted towards start-up culture. Hence, energy transition has the qualitative impact on power market functioning. The exit of companies from the coal-based energy power production makes them more resistant to the

[13] More in: Ł. Dobrowolski, A. Liszka-Dobrowolska, Ł. Broniewski, P. Wróbel, *Lepiej późno niż później*, Climate Strategies Poland, Gdańsk 2022.

risks arising from the green transition. The one of the example of business model change in power industry is power company GDF Suez that acts under the name Engie at present. The global change of business environment, expected economy decarbonization and RES development convinced Engie to write off EUR 15 billons of fossil production assets in Europe just in 2013. Engie sold next year coal power plants in Poland, Germany and Netherlands. It confirmed the begin of change of fossil fuels into renewables in production portfolio of GDF Suez and it was reflected in purchase of RES investors Sameole and Langa. Engie plans to decommission owned coal power plants with capacity in 2021 of 4 GW in Europe, Africa and Latin America by 2027[14]. New climate-friendly objective of Engie is to replace coal in cogeneration production by biomass. Swedish power company Vattenfall divested the lignite power plants as well, paying additional EUR 200 million to Czech company EPH for future reclamation of degraded areas. Finish company Fortum just in year 2018 identified the coal-fired power production as unprofitable in the future. Swiss Repower took over in Italy in cooperation with investment fund (joint venture) the wind and solar power producers with the capacity of 90 MW. Repower defined target for 2025 to be 100% based on RES production.

German power companies E.ON and RWE decided to split clean operations from fossil fuel production. E.ON just in 2016 executed fundamental change defining new strategic approach based on dominant role of RES for future success of company. There was founded company Uniper, which took over fossil based power plants. Hence, E.ON operating remaining assets focuses on renewables and sales to retail customers. RWE decided on opposite solution and isolated renewables, transmission network and retail sales to company Innogy. The dirty part of assets (nuclear and fossil-based power plants) remained in RWE. This approach can be criticized because it is similar to bad banks, where are collected bad credits. There is risk that fossil-based part of assets can become the stranded costs soon and it will be decommissioned in the near future. On other hand, the clean part of the company can develop on the market in new environment without burden of funding the assets being at climate risk. The economic results of the clean part of these companies are determined by distribution tariffs, RES operation and efficiency on green financial market or profitability of sales to final customers.

There are presented below in the article examples of power utilities implementing strategic shift towards green transition.

[14] Last coal power plants in Europe should be closed untill 2025. Other installed coal capacity owned by Engie are mainly in 8 power plants in Brazil, Chile and Peru.

- **Enel**

Italian power company Enel plans to mobilize EUR 190 billion of investments until year 2030 in order to create sustainable profitability for shareholder by decarbonization of operation activity and electrification of meeting energy demand. The execution of investment program shall let reduce the Group GHG emission by 80% versus 2017. It is the confirmation of Enel's strategic directions:

1) the acceleration of the energy transition;
2) new business and operating models enabled by digital platforms;
3) sustainable and profitable growth.

Execution of above presented strategic directions shall create significant value added and profitability growth. The coal phase-out will be executed to 2027 and 85% of energy production shall be coal free in 2030, when Enel shall reach reduction of GHG emission's level to 82 kg/MWh. The target of net zero emissions is set to be done by 2040. Digitalization will develop new operating models and create new roles and competences along the value chain, what shall be used to increase the Enel's efficiency and profitability. There is planned the simplification and rebalancing of the Enel's portfolio by divestment of assets no longer instrumental for strategy execution and M&A to acquire expertise and generate synergies.

Enel operates globally, what is supported by distributed generation assets, multi-layer digital platform and increasingly active role of customers. Enel created overall approach to be positioned as global player in green transition process, allowing to benefit fully from opportunities becoming available during acceleration of the energy transition. Concern aims to seize new opportunities to generate profitability through 2 complementary business models – ownership and stewardships that are used in the investments' execution:

1) ownership – digital solutions support investment profitability in renewables, networks and customers' relations backed by platform-based operating models – Enel shall invest EUR 150 billion in following programs:

a. Global Power Generation with renewables totaling around EUR 70 billion, what shall secure the 120 GW of installed RES capacity by 2030 (from current 45 GW), within EUR 5 billion will develop the battery storage linked to renewables to reach the capacity of 20 TWh in 2030. Next step is to integrate the electrolyzers with renewable energy sources to produce green hydrogen and to create profitability based on ancillary services and sales of green hydrogen to industrial customers and transportation;

b. Infrastructure and Networks in order to improve quality and resiliency of power supply supported by new connections and infrastructure digitalization totaling of EUR 70 billion of investments. Enel plans to expand the customer base to 90 million customers thanks execution of this program, having 100% digitalized customers through smart meters.

c. Customers – remaining amount shall build value for customers by sustainable electrification and new portfolio of services. Current product portfolio (e.g. energy efficiency, PPA) will be developed by new services including demand flexibility and e-mobility, including electrification of public transport and smart city lighting.

2) stewardship – Enel cooperates with third parties in capital allocation and digital solutions acting as business generator - Enel will invest directly EUR 10 billion and plans to catalyze EUR 30 billion from third parties in order to develop renewable energy sources, fiberglass network, electrification of transport and demand side flexibility. Stewardship model bases on following solutions:

a. operating platforms – services to third parties based on exchange of know-how and best practices;

b. business platforms – creation of business opportunities for customers by offering new products and services;

c. joint ventures and partnerships – creation of co-investments opportunities based on platforms enabling third-party investments.

The investment program will be financed by sustainable finance sources including green bonds, sustainable linked bonds and green credits. The share of these sources on total Enel's debt will increase to 70% in 2030.

Enel develops renewable capacity in various parts of the word, mostly outside Europe – in South America using government support and PPAs; in North America based on PPAs. Enel replaces decommissioned fossil power plants by RES capacity. The share of RES located in Europe constitutes 40% of company capacity (24% in Italy, Iberian peninsula 14%, rest Europe and Nort Africa 2%) – e.g. Enel Green Power operates totally 47 GW of RES capacity, of which 22,6 GW in Europe and 6 GW in USA and Canada (by end of 2022 should be added 1 GW). The confirmation of Enel's global ambitions is the conclusion of the contract with the Qatar Investment Authority (QIA) for the development of renewable energy projects in Sub-Saharan Africa. QIA purchased 50% of Enel's shares in RES company owning 800 MW of capacity in South Africa and Zambia. Enel confirmed in November 2021 global ambition to become green company and to invest EUR 160 billons in next 10 years, while QIA stopped the investments in companies utilizing fossil fuels. Enel Green Power concluded in 2021 together with Monsson Alma (part of Monson Group) contract for wind farms development in Romania – production capacity up to 1 GW, power storage capacity up to 300 MW. Investments should be completed until year 2024.

- **Iberdrola**

Another power utility that is striving to become a leader in green transition is Spanish Iberdrola that plans to invest EUR 150 billion by 2030. Company will spend EUR 75 billion until 2025 in order to rebuild business model towards development of re-

newables production, power storage, smart solution for customers and power network upgrade. The 90% of its long-term investment plan is aligned with the green taxonomy defined by European Union. This responds to minimum target of 32% of renewable energy by 2030 set by European Parliament and the Council in the Renewables Directive[15]. Iberdrola defined its own decarbonization commitment to reduce its global CO_2 emission to 50kg/MWh by 2030 and to become carbon neutral in 2050. The company stopped to generate power from coal and oil. The construction of reshaped business model focuses on execution of this target, but the first steps toward greening company's operation were undertaken just in early 2000. Iberdrola started then to invest in cleaner and reliable power system (renewable energy, smart grids, efficient power storage), optimizing assets portfolio (decommissioning of coal and oil plants, divestments of non-core assets), what was supported by maximizing efficiency (improved operations and supply chain management) and innovation. The new undertakings base on innovation and technological advances, better customer connectivity, securing increase of production capacity in main renewable technology to 95 GW and doubling its network assets to EUR 60 billion. The RES capacity growth is secured by long-term PPAs concluded with large companies (e.g. Amazon, Apple, Facebook, Nike, MAPFRE, Total, Shell). Iberdrola cooperates in the electrification and electric mobility development with Volkswagen, Renault, Irizar and Walbox. Company's investment plan until 2025 focuses primarily on RES in order to reach capacity of 60 GW at the end of planning period. Iberdrola plans to grow in offshore wind power productions – offshore windfarms in Europe 37 GW by 2025; USA and Asia-Pacific 13,8 GW until 2025; Japan, Poland, Sweden, Ireland 12 GW by 2030. Company after this investments shall own one of the world's largest RES portfolio.

RES development needs the upgrade of power grid. Therefore Iberdrola invests in modernization, digitalization and automation of networks backed by creation of potential for innovations and knowledge acquisition. Results of this activity are observed in Spain, USA, Brazin and Great Britain, where company developed and implemented smart grids. There is planned to install 21 million smart meters by 2025. RES are backed by power storage systems based on pump technology (capacity of 4,5 GW) and projects of battery systems: three in Spain, one in USA and Brazil[16].

Iberdrola strive to reduce the GHG emission focusing on electrification of transport that is responsible for a 25% of CO_2 emission in cities, being the first Spanish company committing to electrify its entire car fleet in Spain and United Kingdom by 2030. Next area od concentration is the development of self-consumption and use of

[15] *Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.)*, OJ EU L328 from 21.12.2018.

[16] The electrolyzer in Puertollano will have the battery storage system with capacity of 5 MW and 20 MWh of storage capacity.

heat-pumps in building. Company develops capacity of green hydrogen production and will pose 830 MW in 2027. Currently group of Iberdrola companies has 60 projects in Spain, United Kingdom, Italy, Brazil, USA, Mexico and Australia. These undertakings will require investments of EUR 3 billion until 2030 in order to produce 134 thousand tonnes per year. Company concluded cooperation with Norwegian company Nel (the largest producer of electrolyzes in the word) for this purpose in order to secure technological support and the creation of supply chain in Spain. Important area of future operation's is the development of digital technologies in every area, where it is value adding. The investments in this area shall amount to EUR 400 million. Target is to improve processes, increase assets productivity and efficiency of operators services and develop the customer base, offering smart, innovative solutions to customers (heat pumps, prosumers, demand flexibility, electric mobility, smart solutions, electrification processes, green hydrogen). The development of new Iberdrola's operation is related to sustain around 0,5 million jobs in the word and to recruit new 20 thousand people to the company until 2025.

- **Vattenfall**

Vattenfall has formulated a strategy to be carbon-neutral until year 2050. This strategy underlines the sustainability of business as one of the competitive advantage and key driver of business success in power market. It is crucial, because green transition encourages new companies and financial institutions to enter the power market and develop new green products and services. The development of new business model is the reaction on this situation and acceleration of demand for fossil-free power. The development of electrical transportation and heating and electrification of industrial processes will challenge the business of power companies in area of power production, transmission and services for customers. Vattenfall defined five strategic focus areas responding identified challenges[17]:

1) fossil-free energy supply backed by development of renewables and focus on value maximization of RES owned by Vattenfall;
2) cooperation with customers and partners in decarbonization of the economy, developing customers centricity and smart energy solutions;
3) development of management and flexibility of power demand backed by optimization of power system;
4) focus on high efficiency of operations and costs supported by digitalization and social and environmental responsibility;
5) securing development of necessary competences for being successful in green transition.

[17] *Our strategy*, https://group.vattenfall.com/who-we-are/about-us/our-goals-and-strategy [access: 10.05.2022].

Strategy execution is financed by investors and instruments of green finance, mostly green bonds issued within the Vattenfall's Green Bond Framework for creation of Vattenfall Eligible Green Project Portfolio.

The development of renewables portfolio is backed by PPAs, e. g. projects Kriegers Falk (605 MW) – PPA concluded with pharmaceutical companies Novozymes and Novo Nordisk for 20% of capacity. Other investments in offshore wind farms are Vesterhav Syd and Nord (together 350 MW). Vattenfal just in 2015 won the auction for construction of offshore wind farm Horns Rev 3 (406 MW). Company uses PPAs for hedging the market risk of wind farms Hollandse Kust Zuid I and II (700 MW) that will operate without any subsidy – it is first such investment in the word. Company develops solar plants in areas of gas power plants – Dutch projects Eemshaven, Velsen and Hemweg (together 15 MW), Welsh Parc Cynog (5 MW). The same type of investment is planned to be realized in area of Dutch wind farm Haringvliet (up to 40 MW). Planned investments in solar power production shall amount up to EUR 100 million. The usage of existing power networks allows to reduce investments costs. Vattenfall started to operate first power storage facility connected to wind farm Pen y Cymoedd in Wales that offers ancillary services for Welsh system operator. Vattenfall divested lignite assets in Germany, selling it to Czech EPH and paying extra EUR 200 million for environmental remediation of lignite mine's area. Vattenfall, LKAB and SSAB participate in project HYBRIT aiming to development of Swedish carbon-free steel industry – green hydrogen will be used instead of carbon as a "reducing agent" to remove oxygen from iron ore. Execution of this project should reduce Swedish carbon emission by 10% and stop coal importation from Australia. Next example of Vattenfall's involvement in the green projects is factory producing green hydrogen used in transportation. Company plans to reshape the area of divested coal power plant Mooburg in Hamburg towards green hydrogen hub – construction of 100 MW electrolyzer based on green power. The existing power infrastructure of previous power plant allows to produce hydrogen on large scale and access to harbor installations. Vattenfall plans to finance this investment using support form European Union Important Projects of Common European Interest (IPCEI) funds. The investment will be in operations by 2025.

- **Orsted**

Orsted started changing strategy twelve years ago, when former Dong Energy, company based on sales of heat and power produced in 85% from coal, announced strategic shift towards green business generating 85% of heat and power from renewable energy sources by 2040. This target was reached just in 2021, when Orsted being the world's largest offshore wind produces, recorded 86% of renewable generation. Dong became the first company developing the offshore wind farms, based on new, dedicated business model of green transition into Orsted, being the leader in the

producing power from wind. The important impulse for starting the strategic change was failure of 1.600 MW coal power plant Lubmin project in Germany in 2008. The strong opposition of local society stopped the investment. It was the clear signal for Dong management that the expectations of power and heat customers started to move into different directions than the company's operational activity. It was confirmed in 2009 during COP 15 in Copenhagen. The decided strategy shift in Dong's activity meant the turnround of generation mix into 85% of RES from 15% in 2009, leaving in generation portfolio only 15% of conventional production in 2040. The decision was that offshore wind power would be the basis for the strategic change based on experience gained during operation of the existing projects in Denmark and United Kingdom. The potential for development of wind capacity was identified in building large scale offshore projects with the yearly frequency.

There were identified following challenges potentially impacting the strategic shift:

1) security of supply chain;
2) Dong's competences;
3) financing model.

Dong identified risk of lack of necessary potential of installation companies that could answer the demand for offshore wind farm construction. There was a significant credit risk in this market, negative influencing the investments. Therefore, Dong acquired A2SEA installation supplier to minimize this risk. Next step was to enter a partnership with suppliers of turbines, foundations and cables. Siemens became the important supplier of turbines, identifying the offshore wind as promising area of large business. Important issue became the internal competence change in company based by three decades on traditional fossil fuels. Dong's top management established a wind power business unit responsible for turning the operational activity into new direction. There was introduced operating model for offshore business, established global functions, geographical business units responsible for particular markets, project governance structure and operations, which enabled to reduce the costs of offshore power by optimization of investments' portfolio. Next issue was the funding of new projects. Dong developed so called "farm down" model, allowing to finance half of the project on Orsted balance sheet and rest to fund by external financial partners. This structure made Dong responsible for hedging the investment risk, including development and construction of the project. At the end of 2017 Dong changed name to Orsted. Orsted keeps divesting fossil fuel business in order to be the major global renewable player. Domestic coal and gas assets are converted into biomass. As result, Dong shall exit coal in 2023 and be carbon neutral from 2025. Last couple of years Orsted reentered the onshore wind business and moved into photovoltaic and power storage in order to diversify production mix and secure better meeting needs of customers. The expansion of Orsted's business follows the potential of advantages

of scale, which requires investments in markets, where is large market for onshore and storage (e.g. North America). At the same time offshore wind farms became the global business operating in all continents.

5. Recommendations regarding strategy modifications of power companies

Power companies must adjust strategy towards response to requirements of green transition. The important issue is to implement business model and organizational structure prepared to new business environment. The option are changes in the organizational structure of business units and the creation of the separate business unit for green operations, being responsible for development of green business model within company. The final shape of business model shall aim to create cross-sector energy utility instead of power company. It requires building the network of partnerships with suppliers of green and digital competences, technologies and services, creating the new value for customers. Example can be development of green hydrogen business and partnership with customers by production of hydrogen in electrolyzers supplied with green power. Next issue is to introduce the digitalization of operational activity and processes supporting the costs optimization, value added creation, operations efficiency and productivity. Digitalization shall support the implementation of smart services for customers as well. Strategy must aim to upgrade the production and grid assets, preparing it for change of the daily and yearly demand seasonality and bidirectional power transmission. It is important to analyze the utilization of owned infrastructure to RES development, e. g. use of power plants and wind farms areas and localizations of grid infrastructure to developm the solar production. The global expansion of green assets creates potential to develop market risk hedging products dedicated to RES. Green transition changes the energy market. The target structure of this market shall base on following dimensions: local RES production and global green hydrogen market. Smart and green innovations develops local peer-to-peer power trading outside power system and virtual power plants basing on thousands of prosumers installation backed by power batteries. Power companies need to build competences enabling to be part of such reshaped energy market, expanding operations in areas of green products, changed trading techniques and new geographics markets using organic growth or mergers and acquisition.

Power company should be prepared to execute investments in new conditions of green finance requirements and to develop efficient project management, allowing to adapt quickly the fixed assets portfolio not only to reality of green economy, but to hedge company against climate risk. Investments must secure the resilience

of fixed assets (production, power grid) on physical materialization of climate risk. Other aspect of climate risk is the necessity to comply to climate-neutral and zero-carbon regulation, responding successfully on new society and industry green needs and expectations, being profitable in changed conditions. It requires the efficient risk management and development of the effective research and development unit, building base for profitable operations of transforming company. The reality of green transition requires also to adjust the risk and pricing models at least to dynamics of the market conditions caused by change of daily and yearly demand seasonality and evolution of intraday and spot markets.

Green transition means change not only for the real economy, but also for widely perceived corporate finance, exposing them both to risks and opportunities. New approach to financing power companies requires a long-term analysis of investments that have an environmental impact and compliance with all criteria of climate-neutral development. There is developed a broad variety of green financial products and services, which can be divided into investment, banking and insurance products that can be used by power companies. The important issue is meeting the conditions set by green transition, what means mostly the execution of initiatives and projects connected with sustainable development, carbon-free products and climate-neutral policies. New approach to financing power companies set by financial markets focuses mostly on green sustainable investments, green technologies and carbon-free operations. It requires the creation of solution for funding necessary investments in green portfolio, modernization of power grids, digitalization of operations and development of smart technologies for customers. The necessity to adapt to new market situation requires to consider the development of partnership with investors (joint ventures, partnerships, green bonds) that can support development of new model of investment implementation. Such cooperation networks can be created also with industrial customers (e.g. on site solutions), with suppliers of heat-pumps, photovoltaics, with municipalities concerning the solutions for buildings. Industrial customers can be part of contracts, hedging the market risk of RES investments, using PPA. There can be granted the European Union funds, dedicated to support green transition that can be used to develop the green portfolio of production assets and products supported sustainable development. Capital can be raised from also divestments of unprofitable assets (fossil based mainly).

Green transition creates the new needs and expectations of society and customers. Power companies must to respond in the strategy to the societies' demand for green products and to the necessity of industry to become carbon-neutral or minimize carbon footprint at least. The green innovation for customers shall respond to customers needs aiming to become green and to reduce the carbon footprint. The customers goal is to be climate-neutral. Offered products must support the development of energy efficiency, energy production on site and development

of green hydrogen. Power companies must consider in the strategy the development of smart solutions for households and municipalities that support the better customer connectivity. Strategy in this perspective shall contain the initiatives developing prosumers, green electric mobility, electrification of energy demand meeting, green electrification of heating with use of RES and electrification of industrial processes. Next important area is the development of products of demand side management and demand flexibility offering both to households and industry. The important driver for future profitability of power companies can be also the cooperation with municipalities and industry on sustainable transport electrification – both electric vehicles and public transport.

Strategy shift shall direct the power company to chose the proper production technology of green power. There is observed the continuous change of technologies' competitiveness while RES improve the profitability and return on invested capital by permanent worsening of market position of fossil fuels based assets. Coal and gas power plants can be in few years out of business. Hence, strategy must consider not only the development of renewable production, but the creation of distributed power production – the production perspective of strategy shall be developed by innovation in power trading on customers behalf backed by usage of power storage, connection the RES production with power storage systems, formation of virtual power plants (trading, ancillary services) and optimization of power supply supported by digitalization of operations. The interesting perspective for security of supplyis the power production in small nuclear power reactors, being supplementary to RES. The development of RES must be linked to development and upgrade of power grid, what should secure the optimization of power grid operations and creation of smart, bidirectional power transmission.

Final remarks

The green transition impacts the operations of power companies not only with speed of change, but also with high degree of complexity of business environment, what requires strategic response, adjusting power companies' operational activities to new challenges. The technological change, climate focusing revolution, climate risk, new market participants and society expectations create new energy landscape that requires new dedicated approach to generate any profit. The decarbonization of value chain and creation of green core activity of power companies shall secure strategic and competitive advantage. Power companies must adjust business structures to new conditions of operating in environment shaped by green transition. The biggest European power companies responded with delay to RES development – for example in year 2015 these companies owned only 1% of renewables in Germany being European leader in this area.

Previous schemes of power capacity developments are useless. RES become more competitive than existing power capacity using fossil fuels. Moreover, use of fossil fuels is related to the high pollution's emission. That is why power companies operating fossil power plants started the radical reconstruction of business model towards RES and customers' green needs. Development of RES is the global trend in power industry with main drivers wind and solar power plants. The important issue becomes the necessity of maintaining the reserve capacity in power system in case of low power supply from RES being dependent of the weather conditions. The gas power plants will be replaced by power storage systems and demand side management. The surplus of renewable production shall be also consumed by heating systems and green hydrogen production. The decarbonization of the power sector will be achieved in this way.

The green transition of power industry bases on connection of financial instruments, changes of the market conditions and investments in the fixed assets. The result of the green transition is the decoupling of global economic growth from greenhouse gas emissions. This situation creates strategic risk for power companies that requires reaction in all perspectives of power utilities business that shall be developed by new green products and services meeting new needs and expectations of industrial customers and societies. Author presented in the article changes in the power market functioning in the reality of green transition, challenges for power companies, necessary developments in the strategy and business models of the leading power companies in the green strategic shift and recommendation for the strategy developments of power utilities to become successful in the coming green transition business future. Necessary adjustments must take place in the area of funding the operational activity and investments, cooperation with customers, production technologies and power grid upgrade.

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