

# Digital Transformation of Oil and Gas Companies: Energy Transition

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**Abstract** — The authors raise the issues of digitalization in the leading companies of oil and gas industry in terms of the energy transition. In addition, the paper also proposes policy recommendations for the low-carbon transition of oil and gas companies. The core concept of the company's transition is a transition from O&G Company to an energy company. Now hydrocarbons form the basis of the global energy balance; they are the main source of CO<sub>2</sub> emissions into the atmosphere. The issues of reducing CO<sub>2</sub> emissions, for example, by decarbonizing the oil and gas industry, are becoming relevant. The digital transformation companies will create an ecosystem within which any company can appropriately replace business processes with "clean" ones; digital technologies will allow collecting data, monitoring processes and managing them. The object of this study: the largest companies – leaders in the oil and gas industry. The purpose of the study: to develop recommendations on the energy transition of oil and gas companies through the use of business digitalization technologies. The article outlines the main points of energy transition paradigm, as well as digitalization policies used by the companies. The authors explore the motives of the energy transition of O&G companies; analyze the possibilities of digital transformation of the oil and gas business; Using the example of the largest foreign companies in the oil and gas sector, they consider the mechanism of energy transition.

**Keywords** — *oil and gas companies, digital transformation, digitalization, energy transition, decarbonisation*

## I. INTRODUCTION

The Stated Policies Scenario of International Energy Agency (IEA) indicates that "global growth in oil demand slows markedly post-2025 before flattening out in the 2030s" [1]. The IEA made a forecast, that a peak of passenger cars will be reached in the late 2020s, and these cars are a primer consumer of oil-based products. It is expected to happen due to energy transition, namely a major switch to electricity – electric cars soon become cost-competitive with conventional cars. McKinsey forecast has little difference with IEA opinion and states "Oil demand growth slows down substantially, with

a projected peak in the early 2030" [2]. Meanwhile, global energy consumption is projected to increase at almost 50 % by 2050 [3].

However, due to the paradigm shift to sustainable development globally, more and more companies set up strategies on implementation of clean energy to mitigate climate change risks. Companies are also urged to set up sustainability strategies as well as other kinds of strategies – such as, energy transition strategy, low-carbon strategy, decarbonisation strategy etc. Those strategies and policies are usually focused on a particular direction of sustainable development, such as renewable energy promotion, energy efficiency increase, net carbon footprint ambition, reduction of greenhouse gas emissions, ESG concept, decarbonisation path etc. However, if these goals are to be achieved, oil production must be significantly reduced or completely abandoned. The increasing social and economic pressures on oil and gas companies demands to provide answers about the future of these companies as without them a normal functioning of economies is impossible, but with their business as usual practice, safe life of future generations is at risk. Therefore, in the context of environmental urgency and increasing energy demand, the transformation of oil and gas companies to sustainable energy companies is imminent.

This transformation is happening in many parts of the world, as it is to the companies own advantage to be more proactive in these area, because regulatory requirements are constantly tightened and investors' and consumers' pressure is growing. Moreover, it is to the company's advantage to initiate and support transformation, because this energy transformation brings technological benefits and increases competitiveness of a company, as well as its trustworthiness among the public and stronger brand image. The purpose of this paper is to provide a reference for the energy transformation frameworks of global oil and gas companies based on their annual reports and sustainability reports investigation results and analyse the influence of digital technologies in it.

## II. LITERATURE REVIEW AND RESEARCH METHODS

The concept of digitalization is still rather vague and young; scholars, practitioners and companies interpret this phenomenon in different ways. Digitalization seems to be a global trend in management, as it is associated with a wide range of technologies. While consultants and practicing companies have been covering the issue of digitalization in their reports for the past few years (Deloitte [4], BCG [5], McKinsey [6]), scientists' interest in digitalization has only recently appeared and is at the beginning of the journey. Digitalization transformations have been studied from various points of view, such as organizational aspect, technological and social [7].

Organizational digital transformation is connected with a business aspect of transformation and concerns the changes, which are brought by digital transformation into the business model of a company, as well as its organizational processes, value chain etc. The goal of such transformation is to make the business processes and production smarter, thus bringing economic benefits.

Technological aspect of digital transformation is concentrated on making improvement through innovations. Transformation is studied from the point of analysing results of its implementation, how far has it disrupted the existing course of operations and what value did the new technological solutions have brought. Many kinds of those solutions are analysed and new possibilities of their application are researched.

Social aspect is based on studying digitalization with a focus on its implementation and its impact as a global phenomenon not only on organizations, but also on specific functions or groups of the population. Research specifically studies which factors (or capabilities) can contribute to the adoption of digital technology. A widely used model for studying success factors in implementation is the technology adoption model. Many studies rely on this model to investigate the success or failure of digitalization projects. For example, Bai and Gao focus on factors that influence consumers' perceptions of the Internet of things [8]; Constantinides and his colleagues draw attention to the factors that influence the adoption of the Internet of things [9].

The authors aim to build an insightful understanding of the concept of digital transformation. The literature review on the digital transformation's position in scholar vision brought many distinct concepts on considered phenomenon (G. Westerman, Bowersox, M. Fitzgerald). We can offer several definitions of digital transformation for consideration:

G. Westerman, A. McAfee et al: "the use of technology to radically improve the performance or reach of enterprises is becoming a hot topic for companies across the globe. Executives in all industries are using digital advances such as analytics, mobility, social media, and smart embedded devices and improving their use of traditional technologies such as ERP to change customer relationships, internal processes and value propositions" [10].

Bowersox: "process of reinventing a business to digitize operations and formulate extended supply chain relationships. The DBT leadership challenge is aimed at the reenergizing of businesses that may already be successful to capture the full potential of information technology across the total supply chain" [11].

M. Fitzgerald: "use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models" [12].

Thus, digitalization engages transformations of business operating models, supply chain, organisational structure, range of products and services. It also affects other processes in the companies, such as staff's mindset and corporate culture.

In this article, we will study the digital transformation in business organisations, although it is happening also in public, social and other spheres. Digital transformation looks like a comprehensive concept describing technological change and the widespread use of data. As emphasized earlier, digitalization – in the context of organizations – also represents a huge change for companies. Indeed, many organizational concepts are related to digitalization: "Industry 4.0" refers to automation in industry [13]; "New ways of working" emphasize the great flexibility of space and time through work with mobile technologies [14]. From this starting point, digitalization can be defined very broadly as a summary of technological and organizational changes that focus on the creation, exchange and use of significant amounts of data.

Energy transition is a fairly nascent field of research. A. Grubler is one of the main contributors of energy transition study, especially in terms of energy and technology systems and their impact on climate change. Grubler point out three key insights in energy transitions [15]:

1) The power of final energy consumption is usually greater than the power of generation. This implicates that transitions in energy services have an impact on energy supply transitions.

2) Energy transition factors vary from country to country – they are usually slower in large developed countries, but faster in smaller ones.

3) Energy transition schemes are similar to diffusion processes in the general s-curve technology: a long pilot phase with limited implementation, the appearance of optimal structures that slowly are adapted to a more general level, a parallel cost reduction due to standardization, scaling and network economics, and the possible spread from leading innovation host countries to peripheral countries.

As energy transitions were historically happening several times and each next one meant more efficient and profitable type of energy, we can state, that today's energy transition is very different compared to the previous ones, because it was caused by reasons other than energy efficiency. The main driver of current energy transition is the urgency of the global issue of climate change. This energy transition is an instrument to stop or at least mitigate global warming and as the drivers for transition is different and not entirely economic-driven, and

then there is no universal framework, which the companies can use in order to navigate themselves through these global changes. The only framework, which can be called universal and widely approved, is Paris Agreement and energy transition is a part of it. Namely, the concept of decarbonisation prevails as a main type of transformation. Many research institutes and working groups work on the mechanism of decarbonisation and offer their variants: Deep Decarbonization Pathways Project (DDPP) is a project of energy research teams in different countries, which works on country modelling of deep decarbonisation [16]. International Energy Agency (IEA) offers multiple materials on energy transition, such as scenarios, perspectives analysis, indicators etc. [17]. Reports by International Energy Transitions Research Unit in Wuppertal institute develop solution pathways for sustainable energy systems. The phenomenon of “Energiewende” or energy turnaround, which is a main energy policy in Germany since 2011, was born in the Institute of applied ecology in Freiburg by a team of scientists, among which are M. Sailer and R. Grießhammer.

We see decarbonization as the next type of energy transformation, since it involves the transition to renewable energy sources, which are becoming more common and cheaper [18]. Thus, we define decarbonization as a transformational process of transition to renewable energy sources through the replacement of other energy sources in order to significantly reduce CO<sub>2</sub> emissions and, in the future, their potential complete elimination.

Leading companies are paying attention to the topic of energy transition for the last few years, but the majority of the companies are still considering it a trend and not taking any measures to decarbonize, risking by their future success. Companies – leaders of the industries are making energy transition a main goal of their development, which can be seen in their annual and sustainability reports.

In this article we analyze annual and sustainability reports, as well as special reports of the companies, such as energy report, energy transition report etc. Companies show their commitment to energy transition by naming the annual or sustainability reports themselves as, for example, “Energy transition” or “Path to decarbonisation”. We chose these reports for analysis, because such reports represent all the results of company’s activity and its vision for future. It also can be called a “textbook” on the company, because through such reports one can gain an insight into company’s business and its development.

### III. RESULTS AND DISCUSSION

Oil and gas companies recognised the importance of energy transition since 2005 [19]. This energy transition means a change of primary used energy source in economy towards cleaner, environmentally friendly, sustainable sources of energy. Those mainly include renewable resources and gas – natural gas “can be an important complementary transition fuel to support renewable energy in the short – and medium – term transition phases” [20] and low-carbon gas (biogas, biomethane and hydrogen) with carbon capture and storage (CCS).

Despite the fact that energy transition was caused by climate change and resource scarcity reasons, the transformation of the whole oil and gas sector at the world scale required another, more practical reasoning, which effects can be felt immediately by the market. It means that most companies needed other incentives other than long-distance environmental forecasts. Based on annual reports and sustainability reports analysis, we conclude, that the companies rely on different factors stimulating the transformation:

- investors’ expectations and shift in their behaviour towards responsible investing made a push to the companies in starting the transformation, A big role was played by rating agencies, which developed various methodologies of assessing the company’s sustainability performance;
- Environmental regulation tightening;
- Risk management – this includes different kinds of risks, including disaster risks and cybersecurity risks due to increasing digitalization;
- Portfolio resilience – as companies realized a growing diversification of energy sources, they began to invest in other energy sources, additionally, and oil price fluctuations had influenced this decision;
- Corporate responsibility – oil and gas companies are usually large companies, which exploit the resources and have an image of non-transparent, conservative, rich companies. Having in mind, that the activity of such companies often happens on the vast territories, the citizens of these territories are greatly affected by that activity and might be against it. Corporate and Social Responsibility (CSR) practices improve companies’ reputation and allow creating value for both communities and the companies. CSR concept is inextricably linked with sustainability, therefore, when companies are starting to implement CSR into business, it’s evident, that continuing and improving this practice will lead to sustainability shift;
- essentially, any transformation aims to reach a new state, so in the market of such undifferentiated products as oil and gas, it represents an opportunity for companies to differentiate itself and create a new market;
- lastly, this energy transformations entails also a digital transformation, which in turn brings many positive effects as cutting costs, increasing efficiency, higher quality management decisions and transparency.

This paper collects the energy transition information of some oil and gas companies, which is helpful to the establishment of a knowledge system and provides a reference for other oil and gas companies that have not yet started energy transition. Through companies’ and research organisations’ reports, will analyse the energy transformation of seven large oil and gas companies from two aspects: energy transformation actions and strategy and digitalization. The seven major oil and gas companies include BP (UK), Sinopec

(China), Royal Dutch Shell (Netherlands), Equinor (Norway), Eni (Italy), Chevron (USA), ExxonMobil (USA).

A. Energy transformation actions and strategy

According to global carbon project research, carbon dioxide emissions associated with oil and gas will continue to rise and these sources are already responsible for 54 % of global fossil CO<sub>2</sub> emissions cumulatively [21] (Figure 1).

Moreover, Climate Accountability Institute evaluated that 20 top global fossil fuel companies have contributed to 35 % of all energy-related carbon dioxide and methane worldwide since 1965 [22]. Those companies include Chevron, Exxon, BP, Shell and state-owned companies such as Saudi Aramco and Gazprom (Figure 2).

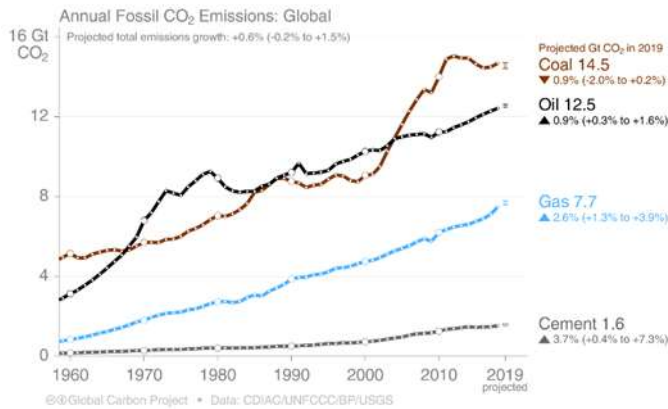


Fig. 1. Fossil CO<sub>2</sub> emissions by source.

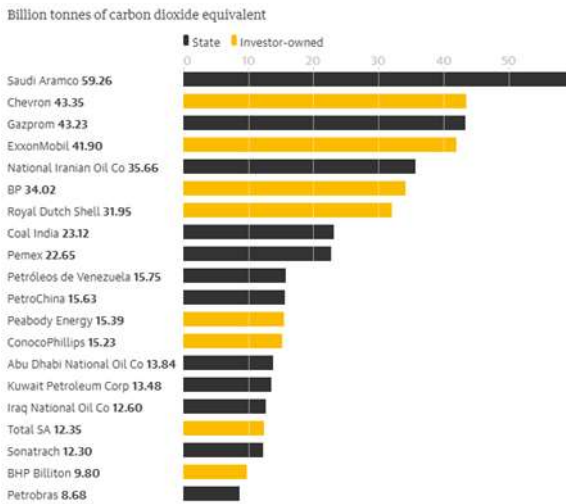


Fig. 2. Top 20 fossil fuel companies' emissions in 1965 – 2017.

Further, The Directorate-General for Climate Action (DG CLIMA) of European Commission states “CO<sub>2</sub> is the greenhouse gas most commonly produced by human activities and it is responsible for 64 % of man-made global warming” [23]. Consequently, many countries agreed on the urgent need to stop or at least mitigate global warming, which is crucial for humankind’s sustainable development. This was expressed in the adoption of the Paris Agreement in 2015, which aims to keep “a global temperature rise this century well below 2

degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius” [24].

Therefore, oil and gas companies, as one of the main emissions contributors, were encouraged to act in this direction and transform their business-model to be more sustainable. As the goal of transformation is very ambitious and expensive to execute, this process had to begin from the top level, namely, from adoption of sustainability strategies.

The analysis of sustainability and other reports of aforementioned companies has shown, that the companies have established sustainability strategies or other kinds of programs, which will lead to progress in energy transformation (Table 1).

Thus, essentially, all of the companies recognized the changing paradigm in energy system and being a part of energy market they realize, that for them, as one of the main polluters, a change is a question of survival. Renewables are becoming cheaper; consumer behaviour is changing towards being more active and responsible; technology progress contributes to the appearance of new cleaner energy solutions and all of that represents threat for O&G companies. However, it is actually a good chance for such companies to change their development vector and become something more, than fossil fuel companies. The urgency to make an energy transition is supported by governments (Paris agreement) and scientists, despite that some companies are promoting the idea, that this transition is very far and oil will be still having a significant part in the future. Nevertheless, the company’s realize, that making a shift will be more beneficial for them, as energy demand will grow, as well as the planet’s population and not everyone will have an access to energy. Therefore, there is no future for them without a transition, otherwise they will become niche companies, as there will be still industries, which are incredibly hard to decarbonize. Most importantly, it will enable them to contribute to an important sustainable development goal – Goal 7: Affordable and clean energy.

Having that said, becoming an energy provider is what leader companies in sustainability aspire. This gives them more opportunities to evolve in technological sense as energy is becoming more and more digitalized. Digitalization brings new kinds of services, which a company can offer, as well as efficiency and safety improvements.

B. Digitalisation

While pursuing energy transition and building resilience, oil and gas leader companies apply a variety of technologies, which now consist more and more of newly developed digital technologies. Analysis of companies’ reports and press releases shows, that they have invested funds heavily into digitalisation and made significant changes in their whole business models (Table 2).

Thus, the companies use different approaches to digitalization, depending on their priorities in development. Mainly we would highlight the intellectual approach – when a company wants to establish its own intellectual digital hub and works on attracting top talents, collaborating with universities and investing in education programs for staff; secondly, the

acquisition approach or business portfolio approach, when a company aims to acquire a successful digital enterprises or to set up different start-ups in an incubator, which enables the company to experiment with digital solutions with less risk; and thirdly, a partnership approach, when a company makes an agreement with a leader in IT sphere, which is beneficial for them both – company bears less risks and enjoys a steady support during transformation.

#### IV. CONCLUSION

This paper discusses the companies' energy transition through the use of digitalization approach. Sustainable development phenomenon, which rushed energy transition and was supported by progress in digital technologies has made a huge impact on the companies all over the world, disrupting their business agenda and making them pursue new goals, which align with environmental needs of the whole world.

TABLE I. COMPANIES' PROGRAMS CONCERNING ENERGY TRANSITION

Company	Program	Description
BP	The energy transition	BP's business strategy embraces 'reduce, improve, create' framework, which means reduction of GHG emissions, improvement of products in order to lower customers' emissions, and creation of low carbon businesses [25].
Chevron	Climate change resilience framework	Chevron supports energy transition, however frequently pointing out, that transitions "can take decades" and highlighting this particular low-carbon transition's long-term nature. Primary focuses in sustainable activities are energy efficiency, CCS, renewables, flaring and methane reduction [26].
Eni	Path to decarbonization	Eni has established a decarbonisation strategy and has its goal to become a leader in energy transition with the priority target as reaching net zero carbon footprint upstream in 2030. The strategy is based on energy efficiency and GHG reduction, low-carbon portfolio, renewables and circularity [27].
Equinor	"From oil company to a broad energy company"	Equinor aims to be at the forefront of energy transition and has set a low-carbon approach as one of three sustainability priorities. Moreover, it was rated as the most prepared for energy transition among O&G companies by CDP [28]. Three components of company's strategy are making the transition happen: GHG emissions reduction in O&G operations with "natural gas as a part of climate solution", renewables and portfolio resilience [29].
Exxon-Mobil	Environmental, social, governance (ESG) concept	Exxon is employing mainly ESG framework, thus contributing to many sides of sustainable development. Company's position in terms of energy transition is that "Oil will continue to play a leading role in the world's energy mix" [30] as there will be growing energy demand from heavy-duty transportation. Therefore, Exxon works on making its current products more competitive and also enhances its activity in biofuels, CCS and energy efficiency [31].
Shell	Shell Energy Transition Report	Shell's business strategy is aligned with energy transition challenge. The company works on preparation to become resilient through future shift to lower-carbon energy system. Main ambition is "to halve the Net Carbon Footprint of the energy products by 2050". Key actions in terms of building resilience and enabling transition include reducing GHG, expanding in lower-emissions businesses – natural gas business and electricity and developing new solutions – biofuels and CCS [32].
Sinopec	Energy transition	Sinopec is actively involved in China's green and low-carbon transition and has a vision that "hydrogen is key to foster the energy transition". Company's actions also include improving energy efficiency, growth of natural gas share, development of alternative energy and GHG emissions management [33].

TABLE II. COMPANIES' ACTIONS CONCERNING DIGITALISATION

Company	Description
BP	BP works on digital transformation as a part of energy transition process and its focus includes blockchain, robotics and cognitive computing. BP introduced a subsidiary – Launchpad, which is a business incubator, its goal is create five \$1bn companies by 2025 in digital low-carbon sphere. BP has invested into companies like Beyond Limits – artificial intelligence company, PowerShare – provides transport solutions through online platforms and Drover, which is a virtual marketplace for car sharing, also the recent investment was in Grid Edge – provider of AI technology, that enables customers to optimise their building's energy [25].
Chevron	Chevron accelerates digital transformation by collaborating with Microsoft in terms of implementing AI technologies ("DELFI") into Chevron operations. Overall company's aim in digital transformation is to "streamline information technology (IT) operations around a digital core connecting the company's engineers and operations through nimble analytics and increased automation" [26].
Eni	At Eni technological innovation and digitalisation are incorporated into business model in a broad way – it covers all three levels of value creation (operational excellence, carbon neutrality and local development). Eni leads digital transformation through the whole company aspects, including changes in company culture. Eni firmly links digitalization and sustainable development. This transformation is supported by HPC5 supercomputer of Green Data Center, which is a digital technology center of a company and also by Digital Business Unit and Digital Competence Center [27].
Equinor	Equinor puts digitalisation at the forefront in achieving its three main strategic goals – being safe, having high value and low carbon. Saying, that digitalisation is part of our DNA", the company considered to be one of the best examples, of successful digital transformation, which led to sustainability and financial success. Company believes, that they will "produce oil and gas more effectively with lower greenhouse gas emissions", also investing in CCS and renewables. Company approached digital transformation as a business transformation and used a wide digital roadmap [29].
Exxon Mobil	ExxonMobil made a partnership with Microsoft on its operations in Permian Basin and anticipates to receive improvement in capital efficiency and also establish largest O&G acreage with cloud technology. ExxonMobil also collaborated with FuelCell Energy, Inc. to "enhance carbonate fuel cell technology for the purpose of capturing carbon dioxide from industrial facilities", thus contributing to reducing GHG emissions [30].
Shell	Shell is concentrated on implementing digital solutions to its existing business, such as standardizing the operations on their territories across the globe or simplifying the processes in a supply chain. Also, company is focusing on creating new business models by investing into digital ventures and combining them with their industry leader's experience. Shell also has a partnership with Microsoft, which will leverage AI application in Shell's operations [32].
Sinopec	Sinopec in a petrochemical corporation, and in terms of digitalisation its development is directed at intelligent manufacturing. Company has a long history in establishing smart manufacturing models, starting from 2003 and having constructed different kinds of factories: smart factories, fully automated warehouse, 3D digital factory and others. The biggest achievement is the application of ProMACE smart factory solution, which brought many digital changes in Sinopec operations [34].

In general, sustainable development as a phenomenon is beneficial for oil and gas companies, as it is their chance to become more trustworthy and somehow contribute to the well-being of the population and the economy. Before, it was only charity, which gave an opportunity to companies to contribute to the society and even charity activities were not always perceived positively and were transparent. Now, the goal of achieving sustainable development has allowed the companies to create many programs, strategies, frameworks and projects that “legally” and most importantly, consciously and reasonably make two improvements – they help the company to become better and legalize in trust and help the world receive it from companies in the form which will be most beneficial.

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