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Digital Transformation in Management Processes of Energy Companies

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ABSTRACT
This paper is devoted to the digital changes that occur in the energy and fuel complex in the 21st century. Energy companies worldwide are facing the necessity to upgrade and transform their management processes with regard to the changes in economy and society. The rise of the information and communication technologies (ICT) had some profound impact on the energy sector and is required to keep pace with the competitors on the world's energy markets. We show that the creation of horizontal and vertical digital management and logistic systems for better coordination with partners and customers are required to stay afloat in the turbulent times of energy and power market developments marked by the reduction of fossil fuels and the shift towards the renewable energy.
Keywords: *Digital transformation, digitalization, management processes, energy and power market, energy sector.*

1. INTRODUCTION

In the twenty-first century, gas has grown faster than any other fossil fuel, and renewables are growing even faster today [1]. Failure to recognise this megatrend would be a failure of the energy sector as a whole, and not just a policy error. Indeed, a new report by the International Energy Agency (IEA) states: "*The energy sector is undergoing one of its most significant structural changes in the last century*" [2]. These changes, combined with volatile energy prices and occasional shocks, create complex scenarios for the future of the energy sector, according to the report. With the industrialisation of societies, the increase in consumption, the use of technologies for energy production and use, the wealth and control of energy resources, society is becoming more prosperous [3].

This is important because it determines the impact of global warming on the global economy, the environment, and human health and well-being. Today we are exploring how we can achieve a sustainable future by creating opportunities by replacing oil - from raw materials and fossil fuels - with alternative renewable energy sources. While forecasts show that energy-related carbon dioxide (CO2) emissions in developing countries will fall by 3.6 Gt, they are expected to increase in developed countries, particularly in Asia, while they are forecast to decrease in developing countries [4]. This will continue to lead to high energy demand, which is expected to be met to varying degrees by fossil fuels.

This new approach to growth focuses on compact cities that have an economic dynamism that can attract creative talent, businesses, and capital, and high densities that allow for cheaper service delivery and avoid costly sprawl. Agriculture and forests will become the third engine of economic growth, providing more food, water, energy, biodiversity, and resilience to climate change. Promoting new growth will be affordable, clean energy systems and expand access to energy, which is currently lacking for more than half a billion people, replicating and amplifying the impact of mobile communications on equitable growth [5]. The causes of this growth are largely due to developing countries, many of which are on the brink of development and whose economies have been shot down by the rise in global energy demand. This is in site of the fact that oil still has the potential to be the most important fuel in the 21st century, because there is a huge new energy demand that can be met. Oil has long been the primary energy source for many of the world's largest economies, from the United States and Europe to China and India, as well as Russia [6].

On the other hand, coal's importance is expected to only increase in China and India and to decline in the United States and Europe, as well as in other countries [7]. The energy sector is perceived as the key to economic development and income is positively correlated with energy consumption. Economic growth can be identified with the increase in energy consumption over the last decade, and in turn, jobs are being created. Renewable energy statistics reveals that employment in renewable energy technologies is responsible for several million jobs which contributed to the development an economic growth all around the world.

2. SLOWDOWN IN GLOBAL ENERGY SECTOR

Recent COVID-19 pandemic - a global economic meltdown and a "black swan" - could trigger a massive decline in demand for fossil fuels and a slowdown in global energy consumption, changing the way the world forgets about its energy even as the disease is declining. The sharp decline in energy consumption is unprecedented until the Great Depression of the 1930s, and efforts to shift to renewables are accelerating the decline in energy demand, with fossil fuels, especially coal and oil, bearing the brunt of the decline. In the same time, the digital energy market is growing (Figure 1).

Global energy demand is expected to fall by 6% by 2020 compared to the previous year and by a further 5% by 2030.

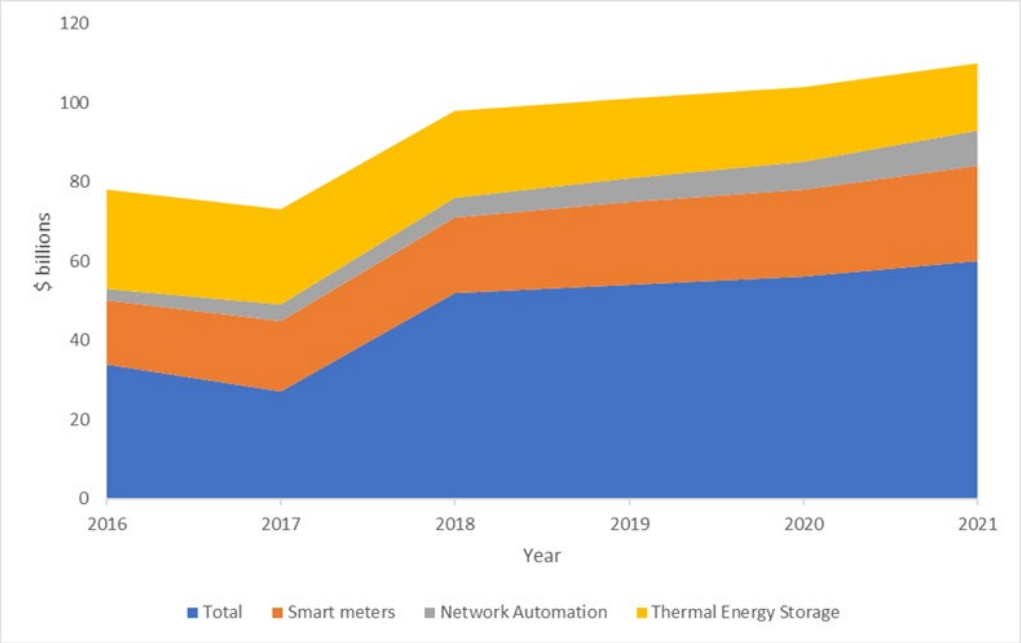

Figure 1 Worldwide spending on the digital energy market (2016-2021)

For example, global oil demand is expected to account for only 1% of global energy consumption in 2020, followed by coal at 1.5% and natural gas at 0.7% [9]. Although oil will remain the dominant fuel, its growth in global aggregate demand will slow over the next decade and a half, without necessarily peaking in aggregate use. It is expected to increase in developing countries, while it is expected to decline in developed countries and decrease in emerging markets. The global demand for fossil fuels is going to peak or has already reached its peak unless the global economy recovers quickly from the crisis and efforts to reduce emissions accelerate moderately. If a rapid recovery in V-form restores demand for fossil fuels while leaving a weakened energy sector, a slow U-form economic recovery will mean that global demand for oil, coal, natural gas, and other energy sources will also peak, and thus become a reality before reaching peak oil demand, which has been accelerated by more than a decade.

Based on an analysis of 100-day data, it is forecasted that global energy consumption will fall by 6% in 2020, which it calls a historic shock to the entire energy world. The reduction in energy consumption will trigger a 2.5 million tonne reduction in global greenhouse gas emissions per year [8]. Coronavirus has caused a sharp drop in energy demand, dwarfing the effects of the 2008 financial crisis and leading to a record decline in carbon dioxide emissions. Fossil fuels have borne the brunt of the decline in demand, and the hardest hit energy source has been coal. The world's largest coal producer, the United States of America, is on the verge of losing more than half of its coal-producing capacity. Industrial coal demand has also fallen, as China's coronavirus restrictions have halted factory production. The constraints on economic activity reduced global coal demand by 8% last year. Travel restrictions contributed to 5% of the decline in demand, with demand in the United States, Europe and the Middle East falling sharply [10]. Low oil and gas prices have made biofuels consumed as blended fuels more attractive to consumers. This has reduced the demand for liquid fuels for transport, as well as the cost of their consumption. Global carbon emissions are expected to fall to levels seen a decade ago by 2020. This has led to an increase in the use of renewable energy sources such as wind and solar power and a decline in fossil fuels. The world is likely to

witness a coronavirus pandemic that will limit spending on health care, education, and other public health services in the coming years. The World Health Organization (WHO) and the International Energy Agency (IEA) have warned that 2020 will be the beginning of a phase of significant changes in global energy demand and consumption. Earlier this year, of course, there was a forecast that global energy spending would rise by 2%, the biggest annual increase in six years. However, an economic slump caused by coronavirus, pandemics and lockouts is expected to cause a decline of nearly $400 billion from 2019, according to the International Energy Agency (IEA). Global economic activity slowed in 2019 and 2020. In a BP scenario that assumes aggressive government climate policies to meet the Paris climate agreement's goals, fossil fuel consumption will fall by half, while the share of renewable energy will rise from 5% in 2018 to 60% by 2050. In the first quarter of this year, renewables accounted for more than half of the world's energy needs, compared to just over a third in 2015 [11].

3. ENERGY SECTOR TRANSITION AND THE NEW TECHNOLOGIES

In general terms, rapid transition means that traditional fossil fuels such as coal, natural gas, and oil are rapidly being displaced, with renewable wind and solar power following. Under the rapid transition scenario, the energy sector will face massive changes, but the timing of this energy transition is crucial. If the actors responsible for setting policies, setting policies and making investment decisions by governments adopt a gradual transition when the process is actually fast, they could end up making the wrong decisions. The turning point is likely to be imminent in the coming decades, and humanity has a chance to achieve the goal of limiting climate change to well below 2 degrees. This means examining what the future of transactive energy might look like, as well as the impact of the European Union (EU) and United States Energy Vision (REV) reforms on the energy sector in other countries.

AI-based business cases with strict assumptions, sensitivity and scenario analysis to ensure that investments in new technologies can be optimized and accelerated and that well-integrated energy storage is built for the future.

The 2-degree path outlined in the Paris agreement would require governments to take dramatic steps to achieve the agreement's goals. The energy system could be further disrupted by the resulting development of new technologies, increased demand for energy and innovations that we may not see on the horizon today. The prospects for an accelerated transition are based on a view set out in our annual report, which outlines how energy demand will develop in the future. The new report describes how we distinguish the two narratives - gradual and rapid - with four main features, and how our views on these issues shape our conclusions about where we are headed.

There are many research programmes covering the development and use of low-carbon energy technologies in the EU, including energy efficiency, renewable energy, energy storage and energy management. The EERA has played an important role in monitoring the European Commission's Joint Action Plan, which aims to accelerate the development and deployment of low-carbon technologies to help the bloc achieve its objectives.

Leading experts in emerging low-carbon energy and technologies will share their views on the future of energy in the coming years and beyond. There are technological breakthroughs that could help the EU achieve its climate goals. The Sustainable Energy Transition Programme is an interdisciplinary programme covering a wide range of disciplines and addressing the increasing challenges of reducing energy intensity and demand and enabling access to energy across physical and geographical areas. The program aims to create the next generation of leaders who are able to think and guide the process of sustainable energy transition, while delivering the best possible solutions for energy security, sustainability, and economic growth. It aims to prepare future leaders of the global energy sector and economy to meet emerging needs to ensure sustainable progress for humanity.

Moreover, according to some recent data, global oil and gas investment has fallen by a third over the past decade, with shale gas spending falling by 50%. But there has been a significant increase in investment in clean energy technologies, such as wind and solar, but these levels still fall far short of what is needed to drive the decarbonization of the global energy sector. Spending on clean energy technology, which covers everything from solar and wind to biofuels and renewables, will soar over the next three years, from $1.2 trillion in 2015 to $2.5 trillion in 2020 [12].

As the humanity decarbonizes its generation and develop hyper-personalized and connected services, worldwide digital transformation has the potential to unlock more than a $1 trillion in value. There are four business models have become the digital issues emerging in the electricity industry. Companies must decide which growth platform to invest in, based on a review of existing capacity and infrastructure, together with a thorough assessment of the current and future growth opportunities and risks of the business model. The integration of production and distribution from heterogeneous sources requires new skills to cope with the coming opportunities

and risks (see Figure 2). There is mounting evidence that solar energy is on the way to becoming the world's cheapest source of energy without subsidies. This has the potential to disrupt the industry significantly, and there are growing signs that without subsidies it is likely to become a cheaper source of energy globally. This will lead to a shift from a centralised generation and distribution model to a decentralised generation system that produces electricity closer to the consumer.

All of the above paves the way for the creation of a new type of electricity grid with a smaller technological ecosystem that can complement or replace the central electricity grids, and allows direct contact with customers in their own homes. We can already see the signs of this change as new technologies such as decentralised energy and renewable energy begin to change our understanding of energy. Two other factors are driving change: the fall in the price of oil and weaker demand for the main hydrocarbon products.

Figure 2 Process of digitalization of energy companies

There is work that is currently underway in order to extend this concept and to allow consumers to rent their batteries from utilities while their cars are parked. The oil industry will soon collide with the electric vehicle industry and its fossil fuel business model. By generating electricity, selling it to end users and using the current network of filling stations to provide the energy we need, we can enter the supply market. Convergence will disrupt the industry's architecture, undermine the competitive advantage of incumbents and provide an opportunity for new, well-established players in the renewable energy market. To meet this challenge, offshore drilling rigs will need to drill deeper than at any time in the history of the oil and gas industry. They could actually be responsible for more than just selling gasoline at the pump, but also for producing and distributing energy.

As demand for hydrocarbon-based products wanes, oil and gas companies will be grappling with how to adapt their business to a low-carbon world. These markets will be transformed into a market where they will compete with utilities that have long provided energy services to people. In addition to converging on these services, they will also diversify into electric vehicle charging solutions, energy storage and other energy-efficient technologies.

One can see that as companies move from a supply chain to a new approach to partnerships, they will also examine a range of new business models for market relocation, including supply chains, supply chain management and business partnerships. Toyota Motor is seeking a wide range of partnerships to meet its goal of moving from zero environmental impact to eliminating CO2 emissions by 2050. Ford is developing the My Energy Lifestyle Program to explore the possibility of integrating a number of new business models to reduce the overall carbon footprint. In addition to increasing the number of electric vehicles available to its customers, Ford sees how customers would live a more electrified lifestyle overall. In our first deep dive, one can see the massive changes in the energy industry and how the falling costs of natural gas, renewable energy and energy efficiency will significantly change the business models of energy companies. One can grasp the risks to producers and utilities and the opportunities, but it is also becoming very clear that many companies like Tesla, Google, Tesla Motors, Toyota Motor and others are willing to change their energy companies "existing cost structures.

4. CONCLUSIONS

Overall, currently we can witness the ongoing digital transformation in the existing management processes of energy companies. Partly it is due to the recent global issues such as the COVID-19 pandemic and the decline of international travel and business. However, more importantly it is due to the recent trends in digitalization of economy and society that the pandemic only fostered.

In addition, there is the artificial intelligence (AI) that is starting to play an important role with regard to the digitalization processes. For example, AI applications in the energy industry are increasingly helping companies to manage, optimize and maintain the performance of their networks, infrastructure, operating systems and management systems. This is one of the areas where AI is influencing the energy industry to give companies greater

value. Operators identify key processes to automate the support of digital and human workers for optimal efficiency.

In the short term, network automation and intelligence will enable more efficient and cost-effective grid management in the energy sector and other sectors. The Internet of Things (IoT) and Internet of Energy (IoE) will underpin the ability to create new customer experiences and efficiently respond to emerging business needs. Methods that use smart energy management and internet technology are a key element in promoting the deployment of smart buildings, smart energy and smart grid technologies. In particular, the link between Internet technology and energy is already creating a new emerging market for energy services. New advanced measurement methods facilitate the process of gathering information on energy consumption, energy consumption and waste, as well as the use of intelligent energy management systems. The aim is to simplify the complex problems faced by industrial energy users and identify energy waste in a number of categories. This technology responds to the need for a more efficient and efficient energy management system, thereby promoting the growth of a new market for energy services in the industrial energy sector.

Businesses no longer need to buy electricity from a locally regulated utility, but must negotiate directly with energy suppliers and even play them off against each other to do business. They need to connect customers, communities, investors and employees to their energy strategy by tailoring communication to their interests. Businesses must work with governments to influence energy and environmental legislation affecting their businesses. Increasing efficiency and investing in renewable energy can directly help companies to cope with costs. The current production of semiconductor devices has reached a fundamental efficiency limit, the so-called energy wall, which prevents a reduction in energy consumption when transistor sizes are scaled to upcoming technology nodes. Businesses can also use a combination of energy efficiency measures, such as electricity consumption, to optimise the amount of electricity they draw from the grid and the use of renewable energy sources. Based on current projections, a ten-fold improvement in the energy efficiency of chips is needed to maintain the scalability of information technology over the next decade. The ultimate frontier of architectural design is almost impossible to derive, but based on current technology, there is a strong possibility that new architectures will be able to significantly reduce power consumption and improve switching devices. In the context of the so-called "economic meltdown trend" embedded systems such as mobile devices will cause a significant increase in cooling energy costs. Software applications and even ICT hardware are becoming an energy infrastructure that some estimates can last 50 years or more. While policy makers design a range of energy policies, they should ensure that they are adequately flexible in dealing with new developments in digital communications technologies, as they continue to evolve rapidly and often in ways that are difficult to predict. As this article examines, there is no certainty how a particular digital technology will interact with a particular energy system or application in complex real-world situations with a variety of variables such as temperature, pressure, humidity, wind speed, and other factors. Accordingly, governments should consider setting up and researching real experiments that can provide insights into what we can learn from what works and what does not in terms of energy systems and applications.

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