

# Adaptation Strategy of the Energy Companies to the Energy Sector Policy and Regulations in the Sustainable Development Context

Piotr F. Borowski

Warsaw University of Life Sciences (SGGW), Faculty of Production Engineering, Department of Production Management and Engineering, Poland

*Abstract—Development of energy companies is done in a changeable environment. Adaptation of activities to energy regulatory requirements and signals from the business environment is a guiding principle of this article. The tight requirements support among others cutting costs and creating technical innovations and thus the country can e.g. become a forerunner in some areas of an environmental technology. The ability to adapt, in a manner considered appropriate by principal decision makers in the firm, informs about their dynamics capability. The adaptation is the basic goal of strategic management. How the companies are architected to address the combined challenges of innovation, speed and growth in turbulent domains e.g. by selection of appropriate parameters and the right fuel to the engine what was presented in completed studies at SGGW (Warsaw University of Life Sciences).*

**Index Terms—** Management, Adaptation, Energy Sector, Sustainable Development.

## I. INTRODUCTION

The primary purpose of strategic management is to ensure a fit between an organization's external environment and its internal situation. The external environment includes among other things, the regulations, and technologies, demographic and cultural factors. To ensure compatibility and survival, organizations must be able to comprehend those significant environmental shifts taking place around them and to equip strategically their organizations to succeed in the new environment. Legal and regulations are one of the fundamental factors because all companies operate on the basis of legal requirements. The EU has adopted new legislation that introduced new rules and repealed earlier legislation governing the EU energy sector. This requires a review and rethinking of existing law and practice in all of the Member States. It builds on a dramatic increase in regulation in recent years, arising from the introduction and implementation of competition in a highly sensitive and strategic sector of the EU economy. The new legislation will, among other things, modify the competences of the European and national regulatory authorities, creating a new potential for tensions and problems in implementation and observance by the wide range of players now involved, including governments, regulators and industry. The automobile manufacturers, especially in Europe, are fully committed to reducing carbon dioxide (CO<sub>2</sub>) emissions from cars and have a credible track record of practical, innovative and affordable

solutions. To make further progress, concerted and collective effort (the link between research and industrial R+D) is required so the studies at the universities are conducted. According to this requirements Warsaw University of Life Sciences (SGGW) participate in the research which will be useful for automotive industry. To adapt the development of car enterprises to the tight regulations included in Kyoto Protocol, the firms should focus on new engine solution. In the short- and mid-term, internal combustion engines will remain the mainstream for cars, and improving the efficiency of engines is a key to reduce total emission of CO<sub>2</sub>. The cars' factories are working to develop and successively introduce engines that significantly reduce CO<sub>2</sub> output. Another effective solution to support CO<sub>2</sub> reduction is to develop and market a car powered by bio-ethanol fuel. Also, there are developing plans to sell more new models with engines and transmissions that reduce CO<sub>2</sub> emission. Therefore the adaptation is the basic goal of strategic management. The main question in this scope is about companies' flexibility in the changeable environment. Ability, agility, versatility, resilience and robustness are measurers of adaptation process [1]. It is important to possess knowledge whether firms have the capacity to adapt and innovate, as well as how they should adapt over time. There have been several researches in the field of business model adaptation conducted by Papakiriakopoulos [2], Swatman and Schumarova [3] or Andries and Debackere [4]. The term developing, evolution or change are also synonymous of adaptation and describes strategic development path. Adaptation is crucial for the performance, but effect is moderated by the dependence of the new technology-based business and by the industry in which it is active. The results of that research show that adaptation is beneficial in less mature, capital-intensive and high-tech industries. Adaptation reduces failure rates in dependent business units as compared to independent ventures. We can achieve sizeable benefits by working with environmental issues in a systematic, cohesive and organized way. There is no one single solution if it comes to realizing environmental requirements e.g. cutting carbon dioxide emissions in an effective way or raising the level of energy independence. Rather, it's all about a range of measures. It is necessary to optimize every link the chain – every little bit counts and every single detail is important. One of the way to reduce CO<sub>2</sub> is using power plants, engines with higher level of

effectiveness [5]. According to Akyuz study, the application of hybrid systems also reduces the CO<sub>2</sub> emission. And to achieve satisfactory level of energy independence is using differentiated sources production or supply [6]. A single technological solution to further reducing CO<sub>2</sub> emissions from cars does not exist. Innovations focus on refining conventional engine technologies, improving aerodynamics of cars, reducing rolling resistance and decreasing the weight of cars. The industry is also developing hybrid vehicles as well as combustion and fuel-cell hydrogen engines in various forms, which will contribute to cutting CO<sub>2</sub>. Biofuels can significantly help reduce CO<sub>2</sub> emissions from cars. Car manufacturers have developed and adjusted engines for different kinds of alternative fuels and combinations of lubricants in the long-term future. The use of alternative fuels is another essential development. In this way the research work at SGGW (Warsaw University of Life Sciences) were carried out. The study undertaken at the Faculty of Production Engineering were dedicated to CO<sub>2</sub> reduction in cars engines, and results showed that level of CO<sub>2</sub> reduction in diesel engine depends on many factors e.g. oil mixture, combustion pressure, torque.

## II. THE ABILITY TO ADAPTATION

### A. *The capacity to adaptation in terms of sustainable development*

The ability to adapt in a manner considered appropriate by principal decision makers in the firm informs about their dynamics capability. Whether this leads to superior performance will then depend on the decision makers' ability to understand correctly the context and import of their decision, as well as the management and deployment of the dynamic capabilities under requirement of sustainable development. Sustainable development is the progress which meets the needs of the present without compromising the ability of future generations to meet their own needs. All definitions of sustainable development require that we see the world as a system—a system that connects space and a system that connects time. When we think of the world as a system over space, we grow to understand that air pollution from power plants of North America affects air quality in Europe and Africa, and that the disaster of nuclear station in Fukushima could harm fish stocks off the coast of Australia. And when we think of the world as a system over time, we start to realize that the decisions of our grandparents made about how to farm the land continue to affect agricultural practice today and the economic policies we endorse today will have an impact on urban poverty when our children will become adults. The specialists predict that the average annual rate of growth of energy consumption will be about 2%. Increasing demand across our economy has, at times, strained our energy system. Demand for energy is predicted to continue to rise, by at least 50% by 2030. At present about 80-85 % of global energy is supplied by fossil fuels: coal, oil and natural gas [7]. Fossil fuel combustion needs to be

substantially reduced for three main reasons: energy security, human health and climate change mitigation. Pressure to replace fossil fuels has focused more attention on renewable sources – e.g. biomass, solar, geothermal, wave or wind. So now, there is the time to work out the strategy for the future. Decision making process nowadays is in many companies, especially in energy sector is conducted under tight regulation. The main topic of this research is to analyze a new solution in tightening limits condition. Sustainable solutions to the climate crisis require the development of new technologies, appropriate policy approaches and innovative business models of power plants. Energy security has become a priority as the World's population increases and their standard of living improves thus increasing energy consumption. The finite nature of fossil fuel reserves and the political instability of many of the countries which supply fossil fuels have caused concern over future energy security and costs. The likely result of fossil fuel deficit is that, as the cost of these commodities increases, they will only be affordable for large industrial processes and therefore cheaper energy sources must be found for domestic purposes and energy companies should be adapted to market requirements.

### B. *The capacity to adaptation in terms of management sciences*

Organizations are both creators and prisoners of their environments. Firms develop within the internal and external environment. Well managed firms require that viability should be established, in both the internal (micro) and external (macro) environments, at each intermediate stage of their development. As the process unfolds, and more information becomes available, top management is able to evaluate the adaptive potential of the new activities for the organization. Adaptation to existing environmental demands may reduce the organization's capacity to adapt to future changes in the environment or to seek out new environments. The new world order of global competition dictates that companies must consistently improve their performance. The energy industry, highly regarded as the 'industry of industries', is facing intense competition in a rapidly changing business environment. As such, industry players must advance not only their products and services, but also, more importantly, their processes and capabilities [8].

### C. *Tight environmental requirements*

The tight environmental requirements may bring competitive edge. The tight requirements support cutting costs and creating technical innovations and thus the country can e.g. become a forerunner in some areas of an environmental technology. Tight environmental requirements favored the new clean fossil energy technologies because of their superior performance in this area. Environmental and other regulations needed to be developed, provided and enforced so that a level playing field would be provided. From the viewpoint of environmental protection global requirements should be met with globally fixed measures. The global, regional and local requirements should be laid down on the basis of available, reliable, scientific facts with the aim

of taking adequate precautions. The research and technology development objectives must be met in order to successfully make the transition to a low carbon economy. Global emissions of energy-related CO<sub>2</sub> would be about 57% higher in 2030 than in 2005 under the International Energy Agency's (IEA) reference scenario [9]. To limit environmental pollution and to slow the rate of increase of CO<sub>2</sub> concentration, responsive long term energy mix strategies exploiting the maximum potential of non-greenhouse gas emitting energy sources need to be developed and implemented as rapidly as possible. In many power plants the power generating and emission control equipment was engineered, procured and constructed in order to meet emissions requirements [10]. As was mentioned above there is no one way to fulfill environmental requirements. There are many different kinds of enterprises responsible for CO<sub>2</sub> emission such as power plants, car factories or green houses and agriculture sector. The choice of global emissions trajectory will need to take into account technological requirements and costs in the energy sector. One of the major pathways of reducing the CO<sub>2</sub> emissions from fossil-fired power generation is to maximize the efficiency of new plants built to meet future demand growth and for replacing older or inefficient plants. To enable the other major pathway, carbon dioxide capture and storage, it is imperative that new plants are designed and operated at highest efficiency. The challenge to the policy makers now is to formulate measures that would enable wider deployment of these technologies globally but particularly in countries which need these most, while also encouraging operational best practice and continued technological improvement towards higher efficiency. The electrical efficiency of a power plant is the proportion of the fuel input energy that emerges as electric power, conventionally expressed as a percentage value. Another widely used measure is the heat rate, which is the fuel input energy divided by the electrical output energy. The efficiency may be stated on either a net (sent out) value or a gross (generated) value [11]. As governments seek ways of reducing their dependence on fossil fuels, researchers are investigating new sources of renewable energy. One of these is "bio-fuel", a term used to describe any kind of fuel derived from cultivated crops. Not only are bio-fuels infinitely renewable, but they can be burned without increasing the amount of carbon dioxide in the atmosphere - the CO<sub>2</sub> released in burning is balanced by an equal amount removed from the air via the photosynthesis process when the crop is growing. This energy resource thus reduces the problem of global warming. Mainly fuel consumption of biodiesel is higher than diesel fuel but CO<sub>2</sub> emission can be lower if we prepare correct biodiesel. McCarthy study indicated that biodiesel containing 80% tallow and 20% canola oil methyl ester produce lower emissions across the board compared with diesel and biodiesel: 70% chicken tallow and 30% waste cooking oil methyl ester [12]. Biofuels with their carbon neutrality seemed to be the perfect "silver bullet" to the environmental problems the world is now facing. But now doubts are emerging, especially in relation to the increasing world shortage of food and increased biofuel production.

Notwithstanding the effects of biofuels on food production there are of course other factors involved in the high cost and scarcity of basic foodstuffs. In this point, technical, regional and economic factors should be considered altogether. Especially regional advantages should be benefited in terms of renewable energy resources. For example, in the regions having important geothermal energy potential, total costs can decrease in comparison to fossil fuelled systems. In regions having high solar radiation, solar systems could be used as the main or auxiliary heating systems with economic advantages. The current financial crisis is not expected to affect long-term investment, but could lead to delays in bringing current projects to completion, particularly in the power sector. Just over half of projected global energy investment in 2007-2030 goes simply to maintain the current level of supply capacity: much of the world's current infrastructure for supplying oil, gas, coal and electricity will need to be replaced by 2030 so it should have positive connection with level of employment in the energy sector. Highly skilled workers will be needed to meet new challenges but this subject should be studied in another researches.

### III. RECOMMENDATIONS

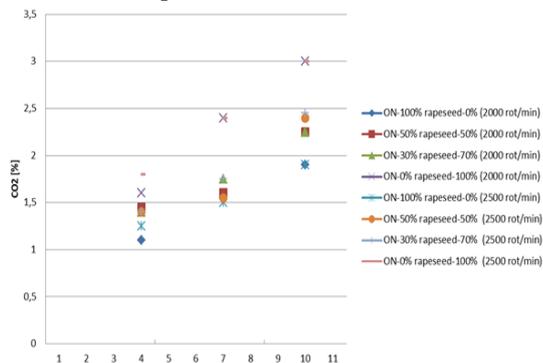
Companies should adjust their activities and their development to market requirements. Enterprises should read all the signals coming from the environment and adapt themselves to changing conditions. The legal environment, directives and regulations are forcing companies to build a new strategy in continuous way. For example in transport sector researchers and companies should looking for new solution in engine construction. In the development of advanced petrol and diesel engines, the group of researchers at SGGW (Warsaw University of Life Sciences – Faculty of Production Engineering) has introduced key technological innovations (e.g. common rail station, see Fig. 1.), along with the associated systems to control pollutant emissions.



**Fig. 1. Common Rail Research Station -Laboratory at Warsaw University Of Life Sciences, Faculty of Production Engineering (Own Material)**

The project concerned the study of combustion of rapeseed oil and its mixtures with additives in a test chamber with variable parameters of air and fuel supply. In order to achieve the best possible energy efficiency, engine durability and reliability, and lowering environmental impact the modification of rapeseed oil is recommended. Use of additives to rapeseed oil affects its properties. When rapeseed oil is used as a fuel, add the appropriate dose of fuel is advised, which has a significant effect on combustion

efficiency (see Fig. 2). Studies have shown that CO<sub>2</sub> emissions depend on the used mixture, combustion pressure and torque. For some combination of mentioned parameters the lowest emissions of CO<sub>2</sub> is achieved with 100% canola oil while for another combination of parameters, turns out to be a better blend of rapeseed oil and fuel.



**Fig. 2. CO<sub>2</sub> content [%] depending on torque [Nxm], rotary speed [rot/min] and CR [MPa] (own material)**

For some combination of mentioned parameters the lowest emissions of CO<sub>2</sub> is achieved with 100% canola oil (e.g. 1.75% CO<sub>2</sub> for 2500rot/min, 4Nxm and CR-50MPa) while for another combination of parameters, turns out to be a better blend of rapeseed oil and fuel (e.g. 1.9% CO<sub>2</sub> for 2000rot/min, 10Nxm and CR-50MPa). The research was conducted also with single cylinder engine with self-acting ignition Farymann 18W. The results of the research shows that combustion of rapeseed oil generates exhaust more smoke and the fuel consumption is higher about 6% to 13%. Similar study were realized by Alpgiray in 2006 [13], whose studied the effects of canola oil on the performance and emission characteristics of a one-cylinder diesel engine and in research of Aybek (2011) whose analyzed the effect of diesel fuel (BO) and 3 different biodiesel blends made of canola oil. The torque of the engine, emission, and fuel consumption values were also measured as a function of engine speed. Results demonstrated that the power and torque of the engine while running on canola oil were lower than with petrodiesel. Moreover, using methyl esters of oil acids, higher and similar power and torque performance could be obtained when compared to raw canola oil and petrodiesel, respectively [13]. The objective of the research: to cut fuel consumption and protect the environment by reducing CO<sub>2</sub> emission were achieved. Important is also to have support from legislation and government field which focus on renewable sources of energy. The EU Commission similar to local parliaments will encourage industry, governments and NGOs (non-government organizations) to set up certification schemes for all types of biofuels, including those imported into the EU [14]. Biomass and biofuel are currently part of a range of solutions to tackle climate change. There should also be recognition that biofuels are just one of a range of options available to tackle climate change [15]. There are many other effective, inexpensive and less impactful solutions which

could be used alone or together to tackle the problem which was shown in this article (for example, enhancement of power plants, improving car engines-including also adaptation and rebuilding engines for rape oil). Alternative fuels are currently an important issue all over the world due to the efforts of reducing emission CO<sub>2</sub> which is contributed by combustion of petroleum or other fuels [16].

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#### AUTHOR'S PROFILE

**Piotr F. Borowski (PhD, Visiting Professor, Director)** works at Warsaw University of Life Sciences. He is a member of Faculty Council and member of Science Committee and Quality of Education Committee. He belongs to International Soil and Tillage Research Organization. He is a multi-holder of scholarships of Erasmus Programme. Under Erasmus Scholarships he conducted many lectures at Akdeniz University in Antalya (Turkey), at EGE University in Izmir (Turkey), at Esitpa University in Rouen (France), at Algarve University (Portugal). In his activity there are also lectures which he said at Agriculture University in Lvov (Ukraine) and Pharos University in Alexandria (Egypt). Under IMAT-bilateral Turkish-German Programme he was invited as Visiting Professor at Akdeniz University in Antalya (Turkey) to deliver series of lectures on management for engineers. Dr. Piotr F. Borowski participated also in international conferences in Turkey, Greece, Ukraine, Egypt and Jordan, where he had oral presentations about management in energy sector scope.