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*Editorial*

# Energy Savings in Production Processes as a Key Component of the Global Energy Problem—The Introduction to the Special Issue of *Energies*

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## 1. The Background of the Special Issue

It is critical to address energy issues as we move through the first half of the twenty-first century, as societies become firmly aware of the consequences of resource scarcity and the disastrous consequences of climate change from human activity (especially heavy industry). Official European bodies have adopted the Fit for 55 package, which plans to noticeably reduce $CO_2$ emissions, paving the way for climate neutrality by 2050. This package makes the issue of energy savings in manufacturing operations an absolute priority.

The data from research show that the industrial sector is undoubtedly the biggest electricity consumer in the world; its energy consumption was 9566 TWh in 2019. The residential sector was the second-largest, yet it consumed one-third less energy [1]. Electricity consumption varies between industry sectors. The largest electricity-intensive branch in Europe is the chemical industry, followed by the paper industry [2]. Globally, some industries are large electricity purchasers, yet the consumption of energy greatly differs between countries, (i.e., the energy unit consumption in the pulp and paper industry noticeably varies among the 27 countries of the EU by a factor of 2–3 [3], with one of the primary reasons being production methods). Industrial reports demonstrate the outcomes and positive effects of energy efficiency improvements on entire economic systems [4].

Incremental changes in industry, across energy-consuming sectors and on all the levels—from industry policies to operational processes in companies—seem to be indispensable. This energy transformation requires both incremental and radical innovations within companies (including in supply chains, technology and products) [5], organised on different levels. The study investigating the literature on energy efficiency from a knowledge-based perspective points out some fundamental fields for energy savings in manufacturing industries: (1) technical and technological issues, including Industry 4.0; (2) analytic and measurement issues; and (3) strategies and leadership for energy efficiency [6].

For substantial progress in efficient use of energy, not only the technological operations of companies should be focused on. Equally as important are the analytic views that will allow us to understand the real state of energy utilisation. Along with possible solutions and economic models, long-term perspectives and incentives of all the kinds are indispensable for real energy transformation. For example, in many countries, SMEs are allowed grant-funded energy audits to help them discover energy-saving investments and calculate their returns on such investments [7]. Some tax reductions are also offered if a company decides to make energy adjustments [8]. Sources describe that merely the spread of best practices in energy-intensive sectors may bring about up to a 20% reduction in energy consumption [9].

Additionally, two shocking events in the second and third decades of the twenty-first century have had an impact on this issue. SARS-CoV-2 has made us much more aware of human influence on the Earth, whereas the war crisis in Ukraine has had an impact on energy prices and provided a strong economic incentive for energy transformation in companies. This Special Issue refers to the majority of issues summarised above, including



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emerging technologies issues, innovations in main manufacturing and energy production/supply processes, and the field of appropriate analysis, strategy and leadership for energy transformation in industries.

## 2. The Contribution of the Special Issue

Five studies have been accepted for publication in this Special Issue. Empirical investigations have been focused on various fields of the industry, they revealed a number of important for energy transformation insights. First of all, a study by Kordel and Wolniak [10] is devoted to technology entrepreneurship in the waste-processing sector. It takes into consideration the circumstances of the SARS-CoV-2 pandemic. The concept of technology entrepreneurship is comprehensively reviewed: both its peculiarity and importance for innovativeness are presented. The authors' main findings relate to waste in the energy industry. According to the study, there are two parallel paths to becoming a high-performing enterprise in the waste-processing sector. The first path is convenient for bigger, well-established companies; the second path is useful for newly established firms trying to find their space in the market. The first model is based on traditional technologies and hierarchical organisational structures, whereas the second model uses innovative technologies and flexible structures.

The circumstances of the SARS-CoV-2 pandemic are also examined. According to the study, the basic economic parameters of the whole economy—namely sales, profitability and employment in the entire industry—noticeably decreased because of the pandemic. However, the same parameters in the waste-processing industry remained at the same level. The authors associate this with high-performance models of technology entrepreneurship by the companies in the studied sector. The study adopts an interesting set of methods; a survey of a little sample has been combined with a fuzzy set qualitative comparative analysis.

The next study, presented by Slowik and Urban [11], is devoted to methods of energy consumption forecasting. The study supports the vision of energy transformation by the widespread use of sustainable small-scale grids with an industry consumer. It implies that the accurate forecasting of energy consumption by large customers, such as factories, is one crucial element to the success of a micro-grid. Generally, the appropriate planning and forecasting of energy consumption/production within small-area energy systems are pathways to achieve smooth and effective operations, and ultimately, much broader applications.

In the study, which is based on the energy consumption data of a printing company, 8640 samples of measurement are considered. The authors developed a universal forecasting tool for energy consumption by end-use consumers. A single, long short-term memory (LSTM) layer-based artificial neural network model for short-term energy demand prediction was developed. The tool estimates energy use based on real energy consumption data obtained from a factory or a production machine. This model allows the end-users to be equipped with an energy demand prediction, enabling them to participate more effectively in the smart grid energy market. The model provides high-quality predictions. It was tested on real industry data, and a mean absolute error value of 0.0464 was recorded. The proposed model was compared with two other forecasting methodologies.

Energy saving in the oil production industry is investigated by Midor et al. [12]. The study identifies the main constraints on the implementation of the energy efficiency policy in the oil production industry. The study explores the strategic-level classification of energy-saving measures, which is based on the assessment and comparison of implementation costs and a payback period. The classification takes into consideration investments in artificial lift technology; thus, it supports the identification of investment priorities in the field of energy management.

The study is deeply embedded in the experience of Eastern European oil companies, which is particularly important when it comes to the global view on energy efficiency and the inevitability of depleting natural resources. The study identifies advanced directions for investments in oil production technologies and proposes an algorithm for the development

and implementation of key indicators of energy consumption efficiency. The study underlines the positive role on the enterprise level of the energy management system according to international standard ISO 50001.

The next two studies focus on municipality-owned companies supplying citizens with heat energy. The study by Wolniak et al. [13] presents a case study of environmental corporate social responsibility (ECSR) implemented by an energy producer operating in Central Europe. The study carefully investigates pro-environmental activities introduced to the study object in the last four years. The study demonstrates the fundamental synergy of ECSR and energy saving.

The authors develop several recommendations for the further development of ECSR in the investigated object, namely the further implementation of standard-based management systems, deployment of ECSR to whole supply chains, adoption of annual ECSR reporting, and implementation of CSR-dedicated standards. Generally, the study strongly supports formal standards—such as ISO 26000, ISO 50001 and ISO 14001—as very prospective and valuable strategies for energy companies' development and energy savings.

Another in-depth case investigation focuses on a company purchasing heat energy for citizens [14]. The study aims to examine new pro-ecological investments to be made by the studied company. The impact on the environment by pro-economical investments is demonstrated, and a model for the analysis of pro-ecological investments (cause–effect model) is also developed by the authors. It appears to be a useful tool for pro-ecological investment assessments in organisations and even countries. The best practices presented here can be followed by other managers dealing with district heating organisation.

## 3. Conclusions

Energy efficiency is undoubtedly a challenge to civilisation, and this challenge cannot be overcome without disruptive changes to energy use in production processes. We need new systems at the power supply and energy conversion levels, new approaches and solutions for transforming energy usage across manufacturing plants and new energy-efficient, greener technologies in companies across industries (particularly from those intensively consuming energy). New technologies of Industry 4.0 also appear to be important in saving energy. The Special Issue contributes to all the fields and includes comprehensive literature reviews [6]. In particular, it examines technological issues with the study of technology entrepreneurship [10] and pro-ecological innovations [14]. The study of algorithms for energy consumption forecasting [11] meets the scope of Industry 4.0 for energy transformation. Analytic and measurement issues for energy transformation are raised in the study on oil producers [12], and both studies focus on district heating companies [13,14]. The last two studies also contribute to strategies and leadership issues. It is indicative of modern times that so many studies are considering the energy supply as a sphere with huge potential to bring about substantial savings in energy. Additionally, standard-based management systems are of special importance in the field of energy transformation.

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