inventions

MDPI

Editorial

Editorial for Special Issue "the Development and Optimization of Innovative Systems, Processes and Materials for the Production, Conversion, and Storage of Energy"

Alessandro Dell'Era

Department of Basic and Applied Sciences for Engineering, University of Rome "La Sapienza", Via del Castro Laurenziano 7, 00161 Rome, Italy; alessandro.dellera@uniroma1.it

check for updates

Citation: Dell'Era, A. Editorial for Special Issue "the Development and Optimization of Innovative Systems, Processes and Materials for the Production, Conversion, and Storage of Energy". *Inventions* **2022**, *7*, 100. https://doi.org/10.3390/inventions7040100

Received: 13 October 2022
Accepted: 27 October 2022
Published: 4 November 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Editorial is dedicated to a Special Issue focused on the development and optimization of innovative systems, processes and materials for the production, conversion and storage of energy. These topics are currently gaining remarkable significance due to increasing environmental and energy security issues today. Consequently, a significant amount of the currentresearch focuses on developing beneficial and efficient systems, processes and materials for electrochemical and thermochemical devices and integrated systems. These must be able to produce, convert and store energy, favoring the use of renewable sources for distributed generation and transport and at the same timereducing fuel consumption and emissions. Therefore, muchresearch hasbeen carried out on the development and optimization of particular systems, such as high- and low-temperature batteries, supercapacitors and fuel cells able to accumulate and deliver electrical energy, as well as electrolyzers and storage materials for the production and re-use of hydrogen. The main desirable characteristicsof these devices are their small size, high specific energy, low environmental impact and low costs. Additionally, with regard to hydrogen, there has been greatefforts in the development of processes for its production usingrenewable sources such as thermochemical cycles powered by solar energy, biomass gasification, etc. In this process of the rapid evolution of power systems, the use of integrated storage systems is particularly necessary in orderto improve the operational greed capacity, reduce costs (both investment and management), and increase the reliability and safety of modified systems using new technologies. In total, six papers have been submitted tothis Special Issue coveringtopicsincluding the production and use of hydrogen, fuel cells, gasification technology, and energy system efficiency optimization throughexperimentation and numerical simulation. V.Seroshtanov and A.Gusakov [1] presented an experimental investigation based on the combined application of gradient heatmetry and particle image velocimetry and applied it to convective heat transfer around cylinders installed one after another. Theirchosen method made it possible to simultaneously measure heat flux and velocity fields. The authors highlighted the lack of experimental data on heat transfer when there is a flow around cylinders of various configurations and cross-sections. Theirexperimental resultswere compared with the results found in the literature and used as a data source for conductingverification experiments. The utilized innovative method, based on gradient heatmetry, showed high information content and a high measurement accuracy. On the basis of new-found data, the authors believe that it will be possible to refine the methods of designing heat exchangers, modernize the existing equipment and create new, more efficient equipment. Nowadays, software for the numerical simulation of fluid dynamics processes is largely utilized by the power engineering industry in designing new devices and systems. Osipov et al. [2] analyzed the influence of the boundary conditions and the main grid settings in the Ansys software package on the error in the computer simulation of flows in standard elements of power systems. They alsogaverecommendations for their optimization. They performed a computer simulation of flows in turbomachine nozzle

channels formed by C-90-22 A profiles and compared the data with their experimental study results. Blade turbine channels formed by C-90-22 A profiles were considered as standard elements. Liao et al. [3] used drones to capture thermal images and find different kinds of failure in solar modules and used MATLAB® image analysis and3D image construction to perform an evaluation of the health of solar modules installed on buildings. Moreover, by using a combination of mean and median filtering techniques, an innovative box filtering method was successfully produced. The results showed that the use of drones for monitoring solar modules could greatlyimprove the inspection efficiency. In addition, the maintenance process can be simplified by using this new method, achieving an enhancement of power generation efficiency. They demonstrated that 3D image recognition technology can enhance the clarity of thermal images, thereby providing better defect diagnosis capability and optimizing the management process of solar module systems. Pavlenko et al. [4] developed a dynamic equivalent scheme of the fuel cell throughnumerical simulation by considering a phenomenon that is not normally taken into account, namely, the presence of eddy currents in the conductive parts of the system. Indeed, the effect of these currents on the characteristics of fuel-cell-based power plants has not yet been studied, and no data are availablein the literature.Pavlenko et al.'s intent wasto propose a practical way to figure out the parameters of this equivalent circuit and also to highlight the adequacy of the scheme and parameters throughexperimental comparison. The main result of their work is that, in general, it is necessary to consider the influence of eddy currents in analyzing the functioning of a fuel cell; otherwise, the results of numerical simulation may differ from the actual processes in the device. Conversely, also taking this parameter into account, the results of the numerical simulation of the power plant based on the PEMFC show an excellent correlation with the experimental data. Komarov et al. [5] produced a review of the gasification technology, identifying the best types of blowing agents and gasification methods in terms of efficiency and environmental safety. The authors also performed a mathematical model of a steam–oxygen gasifier using the MS Excel software package. The authors analyzed the effect of changing the input parameters of the syngas, such as the temperature orrelative mass flow rate of steam and oxygen, on the combustion heat of the produced syngas and the improvement inthe energy system efficiency. Komarov et al., in another study, also investigated [6] the technological solutions in the field of production and the use of hydrogen as fuel. They showed that its combustion in a steam–oxygen environment can significantly increase the initial parameters of the steam turbine cycle and thus increase the thermal efficiency of traditional steam turbine thermal power plants. Their paper also pays particularattention tothe additional energy costs associated with preparing hydrogen for combustion, which ultimately has a large impact on the overall efficiency of electricity generation in a power system. Moreover, the authors performed a study ontechnologies used for the industrial production of hydrogen and carried out a related analysis of their technical and economic features. They found out that, ofthe several available technologies, electrolysis is the most promising method to use in the electric power industry because it makes it possible to obtain inexpensive hydrogen during hours of low electricity demand or heat and electricity cogeneration when electricity is a by-product. Further, it has been shown that the process of hydrogen production by electrolysis and its further use for intermediate overheating in steam turbines is effective in increasing their efficiency, creating conditions for the transition to hydrogen energy that are necessary for creatingenvironmentally friendly and resource-saving energy systems. In summary, this Special Issue highlights, in particular, the importance of mathematical modeling and simulation analysis as useful tools in the experimental validation of a wide range of applications. Moreover, it has been demonstrated thatthe modeling procedure could be essential in the sizing, designing and managing of energy systems in order to reach high efficiency, leading tobreakthroughs in many fields of science. We would like to thank all the authors who contributed their high-qualityresearchto this Special Issue, and we also wish to thank the Editorial Office of *Inventions* for the fast and professional handling of the manuscripts throughoutthe submission process.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Seroshtanov, V.; Gusakov, A. Gradient Heatmetry and PIV Investigation of Heat Transfer and Flow near Circular Cylinders. *Inventions* **2022**, *7*, 80. [CrossRef]
2. Osipov, S.; Shcherbatov, I.; Vegera, A.; Bryzgunov, P.; Makhmutov, B. Computer Flow Simulation and Verification for Turbine Blade Channel Formed by the C-90-22 A Profile. *Inventions* **2022**, *7*, 68. [CrossRef]
3. Liao, K.-C.; Wu, H.-Y.; Wen, H.-T. Using Drones for Thermal Imaging Photography and Building 3D Images to Analyze the Defects of Solar Modules. *Inventions* **2022**, *7*, 67. [CrossRef]
4. Pavlenko, A.; Burtsev, Y.; Vasyukov, I.; Puzin, V.; Gummel, A. Equivalent Scheme of the Fuel Cell Taking into Account the Influence of Eddy Currents and A Practical Way to Determine Its Parameters. *Inventions* **2022**, *7*, 72. [CrossRef]
5. Komarov, I.; Rogalev, N.; Osipov, S.; Zlyvko, O.; Kharlamova, D. Development of a Mathematical Model for Solid Fuel Gasification and Its Sensitivity Analysis. *Inventions* **2022**, *7*, 65. [CrossRef]
6. Komarov, I.; Rogalev, N.; Rogalev, A.; Kindra, V.; Lisin, E.; Osipov, S. Technological Solutions in the Field of Production and Use of Hydrogen Fuel to Increase the Thermal Efficiency of Steam Turbine TPPs. *Inventions* **2022**, *7*, 63. [CrossRef]