


Industrial Energy Management and Sustainability

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Increasing the sustainability of industrial activities is a top priority for national and supranational governmental institutions. Given both their resource intensity and their criticality for competitiveness, industries of all sectors have been at center stage in the fight against pollution and global warming over the last decades as well as the focus of research and of policy and industrial programs in recent years. In this context, energy management and energy efficiency opportunities and technologies play an important role, as energy is a particularly critical resource in terms of cost, availability, and intensity. Despite the increasing attention paid to this topic by academics and policy makers, it is often noted that practitioners and undertakings still present implementation issues and demand support tools and updated data in order to facilitate the identification of practices and technologies, benchmark activities, knowledge transfer, and, ultimately, the transition to more sustainable business models and production systems. Such demands have also become more urgent in the last year, when the COVID-19 pandemic demonstrated that resilience and flexibility are necessary features for a business to thrive and are intimately related to the ability to efficiently and effectively manage resources and energy, in particular.

This Special Issue focuses on Energy Management and Sustainability of both manufacturing processes and systems, including methods, practices, tools, applications, and experiences. It aims on the one hand at highlighting recent advances in the field and, on the other hand, at proposing ready-to-use tools and data that can be valuable for practitioners willing to better understand the topic and contextualize it to their sector and business. It includes a focus on a specific and critical energy efficiency opportunity such as waste heat recovery with the proposal of a database where companies can gather valuable ideas and data (Contribution 1); three in-depth analyses of specific sectors and technologies (CHP in the ceramic sector for Contribution 2, cement industry for Contribution 3, and metal extraction for Contribution 4), all supported by careful and robust data collection and analyses; and the proposal of a broadly applicable methodology to translate energy management theory into practice, providing effective and practical support. Some of the papers (Contribution 2, Contribution 3, and Contribution 4, in particular) are based on data referring to a specific geographical area, but we think that information and outcomes can be considered of general validity and are certainly a fundamental starting point for replication and application to different contexts.

Benedetti et al. (Contribution 1) focus on industrial waste heat recovery, which is nowadays considered one of the hot topics when it comes to energy efficiency and resource preservation. In their paper, a methodology is presented for waste heat recovery opportunities identification as well as two distinct databases containing waste heat recovery case studies and technologies. The databases can be considered as a tool to enhance knowledge transfer in the industrial sector. Through an in-depth analysis of the scientific literature, the two database structures were developed to define the fields and information to collect, and then preliminary population was performed. To highlight the usability of research outcomes by practitioners, a validation phase was carried out and main results are presented.



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Branchini et al. (Contribution 2) present the preliminary results of a research project aimed at defining the benefits of using combined heat and power (CHP) systems in the ceramic sector. Their study is based on data collected from ten CHP installations in Italian ceramic plants, which allowed them to outline the average characteristics of prime movers and to quantify the contribution of CHP thermal energy in supporting the dryer process. Data revealed that when the goal is to maximize the generation of electricity for self-consumption, internal combustion engines are the preferred choice because of their higher conversion efficiency. In contrast, gas turbines allowed minimizing the consumption of natural gas by the spray dryer.

Cantini et al. (Contribution 3) describe the recent application of energy efficiency solutions and technologies in the Italian cement industry and their future perspectives. They analyzed a sample of plants by considering the type of interventions they recently implemented or intend to implement. The outcome is a descriptive analysis, useful for companies willing to improve their sustainability. Results prove that measures to reduce the energy consumption of auxiliary systems such as compressors, engines, and pumps are currently the most attractive opportunities. Moreover, the results prove that consulting with sector experts enables the collection of updated ideas for improving technologies, thus giving valuable inputs to scientific research.

Imasiku and Thomas (Contribution 4) present an evaluation of energy efficiency opportunities in copper operations and the environmental impact of metal extraction by means of a case study on the Central African Copperbelt countries of Zambia and the Democratic Republic of Congo. In addition, four strategies are identified by which the mining and technology industries can enhance sustainable electricity generation capacity: energy efficiency; use of solar and other renewable resources; sharing expertise from the mining and technology industries within the region; and taking advantage of the abundant cobalt and other raw materials to initiate value-added manufacturing.

Solnørdal and Nilsen (Contribution 5) explore the implementation of a corporate environmental program in an incumbent firm and the ensuing emergence of energy management practices. Translation theory and the “travel of management ideas” are used as a theoretical lens in this case study when analyzing the process over a 10-year period. Furthermore, based on a review and synthesis of prior studies, a “best Energy Management practice” is developed and used as a baseline when assessing the energy management practices of the case firm.

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List of Contributions:

1. Benedetti, M.; Dadi, D.; Giordano, L.; Introna, V.; Lapenna, P.E.; Santolamazza, A. Design of a Database of Case Studies and Technologies to Increase the Diffusion of Low-Temperature Waste Heat Recovery in the Industrial Sector.
2. Branchini, L.; Bignozzi, M.C.; Ferrari, B.; Mazzanti, B.; Ottaviano, S.; Salvio, M.; Toro, C.; Martini, F.; Canetti, A. Cogeneration Supporting the Energy Transition in the Italian Ceramic Tile Industry.
3. Cantini, A.; Leoni, L.; De Carlo, F.; Salvio, M.; Martini, C.; Martini, F. Technological Energy Efficiency Improvements in Cement Industries.
4. Imasiku, K.; Thomas, V.M. The Mining and Technology Industries as Catalysts for Sustainable Energy Development.
5. Solnørdal, M.T.; Nilsen, E.A. From Program to Practice: Translating Energy Management in a Manufacturing Firm.