Introduction to Panel 2 Sustainable production towards a circular economy

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Introduction

Industrial sustainability and circular economy have become hot topics in the policy-making agenda. Energy, being a strategic production resource, represents one effective means towards increased industrial sustainability. When dealing with industrial enterprises, energy efficiency is not just about retrofitting existing equipment with new and more efficient technologies, but rather a new and more efficient way of using and managing all production resources that use energy, from local and distributed generation to final use, in the perspective of circular economy, offering energy and additional benefits, thus leading to a more sustainable production and sustainable business model.

For this reason, this panel aims to look at several opportunities to bring a boost towards industrial energy efficiency at multiple levels: by considering actions specifically devoted for final users, but also with a deeper coordination of the stakeholders involved in the supply chain of energy efficiency solutions, and through a creation of specific networks in which the exchange of experiences and knowledge should be fostered.

This panel aims at offering a contribution in the debate over the aforementioned issues through a blend of peer-reviewed papers and extended abstracts, with relevant contributions from industry, academia and policy-making institutions, organized into four main sub-streams as follows: *i) network and supply chain for energy efficiency; ii) benefits of energy efficiency; iii) digitalisation for energy efficiency; and iv) energy efficiency and heat.*

Network and supply chain for energy efficiency

This sub-stream presents broad evidence from industry, academia and policy-making institutions regarding the emerging networking approaches for improved experience and knowledge aimed at increasing energy efficiency. In particular, Jutsen (extended abstract 2-011-18) discusses the highlights of an innovative value chain methodology to define the major opportunities for transforming energy use, with applications in the food supply chain. Moreover, Marchi et al. (peer-reviewed paper 2-045-18) present a model to evaluate the opportunity to integrate thermal recovery as well as electricity generation taking benefits from industrial waste heat, while Chinese et al. (peer-reviewed paper 2-083-18) interestingly consider opportunities for industrial waste heat from the water-energy nexus perspective. Finally, Rootzén & Johnsson (peer-reviewed paper 2-082-18) present and discuss two case studies in which authors analyse the transformative roadmaps for the supply chains related to buildings and transportation infrastructure, aiming to identify and analyse measures/tools to incentivize such transformation.

Benefits of energy efficiency

Nsangwe Businge et al. (peer-reviewed paper 2-024-18) analyse energy efficiency measures to look at opportunities for increased performance and competitiveness in industrial enterprises, offering new insights from two sectors – paper and glass – in Italy. The contribution by Trianni et al. (peer-reviewed paper 2-040-18) complement this study by looking at the factors driving the adoption of energy efficiency measures, with specific focus on compressed air systems. Among other things, multiple benefits could increase the adoption rate of those technologies, but measuring them requires innovative approaches, as shown by Eichhammer et al. (peer-reviewed paper 2-112-18). The presentation from Vogl et al. (extended

abstract 2-064-18) further highlight several opportunities for the whole steel-making industry to improve energy efficiency by new technological advances.

Digitalisation for energy efficiency

This sub-stream shows a broad set of opportunities of digitalisation for improved energy efficiency. In particular, Arens et al. (peer-reviewed paper 2-118-18) discuss recent developments in the digitalisation of the European steel industry, by means of literature review and expert interviews, while Rezende et al. (peer-reviewed paper 2-097-18) present a cast study in the plastic industry where a thorough an analysis of times series data, together with additional information about the processes, is conducted to highlight productive and non-productive electricity embodied in manufacturing operations and get a better understanding of the production processes. Benzi et al. (peer-reviewed paper 2-059-18) continue on the same theme by presenting an innovative value stream mapping companion, aimed at collecting, organizing and processing the main production processes data, so to perform diagnostics and energy efficiency improvement. The discussion on those topics also benefits from the presentation by Lang (extended abstract 2-073-18) on energy efficiency evaluation for machines in discrete manufacturing. Finally, Boermans & Underhill (extended abstract 2-131-18) present the interesting perspective of industry 4.0 issues, in terms of current view and beliefs, as well as work with industry and scientific partners, by one major energy player in Europe.

Energy efficiency and heat

The relevance of heat in industrial processes is widely known, as well as its relevance for a more sustainable production. Nevertheless, too little discussion is so far brought regarding the opportunities to save, re-use or exchange excess heat within a company. Zuberi & Patel (extended abstract 2-006-18) present excess heat recovery potentials in Swiss industrial systems, through exergy and energy analyses, highlighting different areas in the country with high levels of excess heat that could serve as basis for potential district heating networks. Fourmigue et al. (peer-reviewed paper 2-026-18) propose a method to evaluate the potential of heat recovery with heat pumps in France, by looking at each industrial sector and taking into consideration several technological and economic constraints. Aydemir & Rohde (peer-reviewed paper 2-066-18) bring interesting elements to the discussion over heat integration by presenting excess heat potentials for differentiated for German industrial sectors, using a top-down approach. In conclusion, Manz et al. (peer-reviewed paper 2-098-18) continue this discussion by presenting an approach that, through the integration of multiple sources of data, determines the georeferenced production capacity of selected energy intensive processes, so to come up to an estimation of excess heat potentials.