Introduction to Panel 4 Undertaking high impact actions: The role of technology and systems optimisation

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Introduction

While efficient components may bring about gains in the range of 2–5 %, systems optimization measures can attain average efficiency gains of 20–30 % with a payback period of less than two years. System is of course a broad term. The range of a system begins at a single product or technology, which can be regarded as a system and ends at a whole region. So the line between technology and systems optimization is not a clear one, as the following examples demonstrate. But, no matter how you call the item of interest, optimisation to increase energy efficiency remains the top focus and large potentials are still out there.

The Impact of Specific Technologies

The impact of specific technologies is highlighted in the first couple of papers. Besides the importance of a systems approach specific technologies can deliver large savings and are of course the basis for a proper systems optimization.

Morrow *et al.* (4-036-12) start with a look at the iron and steel industry in China. This industry is among the most energy intensive industries in the world. They consider a broad range of technologies to improve energy efficiency and provide a bottom-up analysis of these technological improvements. Their analysis results in detailed cost curves for efficiency options in the Chinese iron and steel industry.

Moving to the paper industry, Suomalainen and Hyytiä (4-142-12) present a case study of steam and condensate optimization in the Finnish paper industry. In their application oriented approach they do not only look at the technologies but also present solutions to foster the implementation of the efficient technologies by an audit model.

Insulation has been a big issue in buildings for a long time. In industry this issue has not been discussed in depth yet. Gürtler *et al.* (4-093-12) highlight the importance of this issue in their paper. Industrial insulation offers rather short payback times and proves to be a cost effective measure in thermal processes.

The telecommunications industry is one of the most dynamic branches due to the continuously increasing demand for communication solutions. Capozza *et al.* (4-025-12) have a look at the efficiency potentials in the Italian telecommunications industry and show the vast amount of saving potentials. Cooling of the electronic components is still a major issue. It can be dealt with mere technical, but also systemic approaches, which can help to lower the energy demand significantly. Within the industry, the wireline networks offer the largest saving potentials in the sector.

As a best-practice example, Voinson (4-032-12) presents the efforts taken to improve the energy efficiency of a specific production site. The measures taken range from are more operational ones like load based speed controls (with almost no investment cost) to costly measures in the building sector. Especially the energy recovery measures have to be taken with regards to the whole energy systems of the production site to achieve optimal results.

Models and Measurements

Measuring energy consumption is one of the very first steps towards a more energy efficient industry. Measuring savings and saving potentials might be considered the second step. However, comparing different efficiency measures and different

policies is not straightforward and many methodological problems arise within this context. The "models and measurements" session adds to this methodological discussion.

The Dutch paper industry forms a non-trivial example studied by Mulder and Reijnders (4-059-12). They analyse the effect of different measures undertaken within small networks of paper mills. Highlighting the role of measuring and understanding a firm's energy consumption they find that energy management and monitoring are among the top five best practices for the Dutch paper industry.

Acknowledging the fact that measuring is a key factor for improving energy efficiency, Le Mouel *et al.* (4-054-12) go one step further: They design and discuss tools to measure energy flows within an industrial site. They also offer a technical solution to a very common problem: Firms are reluctant to install measuring devices because of the expected disruptions in the production process. Le Mouel *et al.* offer a technical solution to measure energy flows without stopping the processes for power flows, compressed air systems and industrial boilers.

The measurement discussion can be directly extended to analysing and measuring the impact of policies. Hirzel *et al.* (4-098-12) suggest an extension of existing methods for modelling energy consumption in industry. Their approach offers a more realistic picture than many current models while still being transparent and feasible. The application to compressed air systems offered by Hirzel *et al.* allows a quantification of the long term gains of continuous energy improvements over single-shot actions.

The approach of the "energy accounting process" presented by Campaniello *et al.* (4-007-12) introduces an instrument to monitor an industrial process including all the process operating conditions. Their set of instruments enables the user not only to analyze their own processes, but also gives the opportunity to make comparisons with the energy performance of competitors of other sites of the same manufacturer, which is a challenge in energy benchmarking.

Modelling of technologies is a very useful tool to assess their impacts ex-ante. Thermal storage is an emerging field, especially in the context of demand side management due to the increased use of renewable energy sources. Jumel *et al.* (4-027-12) present a modelling approach for thermal storage in refrigeration units. By their ex-ante modelling approach, they ensure an appropriate design of the refrigeration units to fit into an energy system properly.

In contrast to the technological modelling, a stochastic approach is used by Cano *et al.* (4-125-12) to determine the cost optimal energy saving potentials. With a broad variety of stochastic and deterministic parameters covering the economic parameters of an enterprise as well as different technological variables in their modelling they can therefore integrate technological and economic aspects in their calculations.

The Role of Systems

The role of systems in the context of energy efficiency improvements is subject to the following papers. The energy losses of several processes or process stapes – which may not be significant themselves – may cumulate to significant losses if you look at the whole system. Fuchsberger and Hinterndorfer (4-077-12) present the approach of the "chain of efficiency" to identify weak points in the whole system. With case studies and best practice examples they are able to show the effectiveness of their approach.

The systems approach is also used by Vuillermoz *et al.* (4-085-12) using the example of a papermaking site. They show the systematic analysis of heat sources and energy needs. By means of this analysis they are able to close energy cycles and can show that significant savings are possible.

Tolvanen *et al.* (4-137-12) show that the systems approach not only applies to whole industrial sites as shown in the papers before, but can also be applied to a single technology, if you look at it as a system itself. They are able to show the potentials of pumps, if you don't optimize them on a component but a systems level. An important issue highlighted by them is the need for cooperation of the different engineers involved in the development of these technological improvements.

Waste Heat

Closing energy cycles by the use of waste heat is an important part of an energy efficient system. Nevertheless there is often no balance between the supply of waste heat and the heat demand at an industrial site. The generation of electricity may then be an option for the remaining waste heat. Forni *et al.* (4-078-12) present the potentials for the organic Rankine cycle (ORC) in different industrial branches. Payback times less than ten years can be reached with reasonable internal rates of return. They also show how a political instrument like the Italian white certificate system can improve these economic conditions for the enterprises.

Jumel *et al.* (4-086-12) give a more in-depth look at the ORC process itself. They analyse the impact of different working fluids on the efficiency of the ORC-process as well as the impact of the thermodynamic operation. By their analysis they are able to show potentials for technological improvement by using other fluids or a supercritical process, but also show the barriers to implementation.

Waste heat utilization must not end at an industrial sites fence. The system's boundaries can be expanded to a larger scale to optimise the waste heat recovery. Schnitzer *et al.* (4-079-12) show the potentials for waste heat utilization on a local and regional level in Austria and how these potentials can be used with the appropriate instruments.

One overview of the waste heat potentials in France is given by Berthou and Bory (4-012-12). With a statistical approach they analyze the waste heat potentials in the different industrial sectors differentiated by type of energy and temperature level. Within the five most energy intensive industrial sectors a broad range of large waste heat potentials exist. Their potential use is of course highly dependent of the local conditions of the single enterprises, which makes an individual analysis necessary.

Heating Technologies

Process heat is one of the largest end-uses of energy in industry. Accordingly, also small gains offer large absolute savings and more insights into how to improve energy efficiency and its consequences are helpful. Vairamohan *et al.* (4-114-12) discuss real-world examples of new electro-technologies in process

heating. They find that the application of these technologies offers not only energy savings but also productivity gains and reduced maintenance costs. Hopefully, their results will reach out to industrial users and find new applications.

Heat pumps on the other hand are a well-established technology for industrial applications. But improvements are still possible. Wolf *et al.* (4-082-12) discuss latest technological developments of improved heat pumps and derive potential market shares in the German industry for heat pumps with different refrigerant temperatures. They find that insufficient knowledge on the industrial consumer side is the main reason for the lack of widespread use of this energy efficient technology.

How to increase the use of energy efficient technologies with the help of specific programs is discussed by Tiedemann (4-159-12) for industrial boilers in Canada. The author discusses the industrial energy efficiency program and can show that participation in the program significantly increases the use of more-efficient industrial boilers. The paper helps to bridge the gap between knowledge in the scientific community and the use of energy-efficient technologies in industry.