Workshop: Decarbonising the industry – a wishful thought

The aim of this ISEC workshop was to bring together experts from different industrial fields like process technology, renewable energy and financing. This was a starting point and platform to develop common pathways for decarbonising the industry. The workshop was attended by almost 70 experts covering the whole envisaged value chain, reflected in the keynotes and the following discussion, led by Sonja Starnberger (Energieinstitut der Wirtschaft GmbH) and Christoph Brunner (AEE INTEC).

Keynote speaker, a presentation summary and their statements

- **Ute Collier & Cédric Philibert**, Renewable Energy Division, International Energy Agency
- **Andrzej Stankiewicz**, Process Intensification and Process Technology Institute at Delft University of Technology, Netherlands
- **Simon Harvey**, Division of Energy Technology at Chalmers University of Technology, Göteborg, Sweden
- **Gerald Koglbauer**, Business Development, KELAG Energie & Wärme GmbH
- **Winfried Braumann**, REENAG Holding GmbH

Ute Collier & Cédric Philibert, Renewable Energy Division, International Energy Agency

The share of renewables in electricity supply is increasing faster than for supplying heat and in the transport sector. At the same time energy demand in industry is expected to be almost constant in the upcoming decades, presenting a challenge for CO2 reduction. While solar heat offers opportunities for some industrial applications, direct electrification can prove cost-competitive and helping to integrate more renewables. One pathway are new fuels as green hydrogen, methane or synthetic fuels.

"The emergence of low-cost renewable power is a game-changer!"

Andrzej Stankiewicz, Process Intensification and Process Technology Institute at Delft University of Technology, Netherlands

The future is green electricity. Process intensification (using much less to produce much more) is part of this approach as new technologies offer drastic decrease in (fossil) energy consumption and use renewable electricity as primary energy source. Examples can be found in all industrial sectors as multifunctional reactor, heat-integrated distillation column, regenerative processes or electric-based processes (e.g. inductive heating, plasmas, photocatalysis). But to achieve the set climate goals, electricity based processing methods have to be combined with (i) green electricity generation, (ii) new energy supply-related process instrumentation and control, (iii) integrated long- and short-term energy storage and recovery on-site and (iv) new region-dependent process plant design.

"So-called "green processes" utilizing fossil energy are not really "green". Future processing plants will be modular and will use renewable electricity as the main energy source."

Simon Harvey, Division of Energy Technology, Chalmers University of Technology, Göteborg, Sweden

Industry is an integral part of society, therefore decarbonisation must be addressed at the local and/or regional level. In Sweden the energy mix supplied to district heating is mainly covered by renewables (38.9%) and recovered energy (54.5%) including industrial excess heat. The Swedish pulp and paper plants, which consume more than 50% of industrial energy demand, have significant potential for capturing excess heat recovery. To identify the best solutions, the application of suitable methods as the Pinch analysis has to be strengthened. This may also help to assess the availability of excess heat as top-down methods (used in the Heat Roadmap Europe) may in fact over-state the potential.

"Energy efficiency is very important, but deep decarbonization will bring about radical changes in the industrial sector. How can rapidly changing industrial processes be handled in bottom-up / top-down energy system studies?"

Gerald Koglbauer, Business Development, KELAG Energie & Wärme GmbH, Austria

KELAG Energie & Wärme is focussing on district heating projects. Presently 66% of the operated district heating networks are "CO_2-neutral" due to the high share of heat from biomass combustion and the integration of industrial excess heat. The challenge for further use of excess heat is the low temperature level (low exergy) and the needed technologies to overcome this barrier (heat pumps). As most industries don't recognise the "value of this waste", the awareness has to be raised by frontrunner projects as the Brauquartier Puntigam.

„Decarbonisation is …mainly a question of exergy!"

Winfried Braumann, REENAG Holding GmbH, Austria

Cost reduction is a weak driver for decarbonisation in industry. The broad range of different projects lead to specific financial assessments in terms of cost competitiveness (process innovation), long amortisation times (renewable energy sources) and small projects with technical risks (energy efficiency). To address industrial process heating (huge potential for energy efficiency and integration of renewables) a mix of instruments must be applied: Rules – Energy prices – Shared values. Possible pathways, also addressed by the H2020 project TrustEE, are: (i) Third-party financing of energy efficiency for projects that need short amortization time and high degree of standardisation, (ii) Renewable heat energy projects with long amortization times should be supported by long-term credit guarantees similar to export credit guarantees provided by Export Credit Agencies (ECAs) and (iii) Guarantees by European institutions should be available also for small project sizes.

„Decarbonizing means long – term investments. For financing such big investments in renewable heat energy in industry, we will need long-term guarantee instruments, not for technical risks, but for counterparty credit risks."

Discussion findings

The keynotes were followed by an open and lively discussion (fishbowl-concept) including questions to the speakers and comments among others from Pedro Dias, Juergen Fluch, Hans Schnitzer Mikel Duke, Wim van Helden (presentation related or personal point of view). The input is summarised in the following main topics:

Electrification: The potential for renewable electricity is huge and the electrification of industrial processes is part of the holistic solution. Nevertheless, national studies (e.g. Austria) have shown that renewable electricity cannot cover the demand in all sectors (industry, mobility, buildings), not even the industrial demand by itself. Therefore, it is essential to follow a broader approach including renewable electricity *as well as* renewable heat for (industrial) heating and cooling. Due to the fact that renewable technologies as solar thermal, heat pumps and also excess heat are limited regarding maximum supply temperatures, tailor-made integration concepts have to be developed for monovalent and combined systems.

Exergy: The key is a comprehensive concept considering the technical possibilities of supply technologies as well as the demand of industrial processes, the exergetic combination of supply and demand. Processes operating at low and medium temperature level are suitable to be supplied by renewable heat. Therefore, there is no need to electrify these. The innovative approach is to reduce the process temperatures (innovative/emerging technologies, process intensification, hot water systems instead of steam system, etc.) and by doing so, widen the potential for technologies as solar thermal, heat pumps and the integration of excess heat. In that way, renewable electricity can be used most efficiently for processes operating at high exergetic levels. Another pathway is to identify the low-temperature excess heat (anergy) and to re-integrate it in the production process or district heating networks.

Diversity: The future industrial supply system is a hybrid combination of different technologies, combining demand and availability (addressing exergetic optimised matching). The diversity of the system will maximise the advantages and minimise the disadvantages and challenges of different technologies. The key is the optimised design and control of this system. This technology combination must not be seen as a competition between different renewables but as a chance for a significant increase of the technical and market potential. Industry is requesting key-turn-solutions, so the relevant stakeholders have to work together on these solutions.

Easy solutions (addressing all stakeholders): Climate change and goals are overwhelming and especially challenging for industry, which doesn't see itself as energy supplier. Coming up with easy solutions and messages is even more important for policy makers and politicians. So, engineers have to develop ideas and pathways to explain, on the first sight, difficult solutions in an easy way. Key messages, clear impact and ideas how to combine different measures on energy efficiency, renewable energy sources and roadmaps for realisation. There are different concepts to achieve the climate goals in the sectors industry, mobility and buildings. Specific solutions are needed and it is important to include this in the communication towards decision makers, promote these solutions and provide the necessary framework.

Reasons to follow efficient and renewable energy supply: Finally, it is all about the money. Energy is in many industry sectors only a small part of the production costs and therefore these investments are low ranked in the priority list of companies. Both policy makers and industry need a driving force from outside. The energy efficiency directive and its implementation at the national level is one possibility. Economic incentives, funding, CO2-taxes or the ETS are some others. It is especially important to

initiate frontrunners and at the same time ensure that also others follow. Beside research on innovative technologies and the market penetration of identified solutions the financing of projects is the key to spread the concepts and make a business case out of it.

Taking the risk: But who takes the risk in case an implementation or development fails? The role of suppliers is clear, but the impact on the industrial production is crucial and long-lasting. In district heating networks in some cases the energy supplier takes the investment and operation risk, but this is an exception. Policy makers have to build up the legal and financial framework, to ensure that projects on process and efficiency level are supported in the same scale as renewable heat projects with long amortisation times or renewable electricity projects. By standardised project assessments and proven certificates, investors will overcome their resentments and see these projects as business cases. For suppliers and industry tailor-made guarantees are needed to cover technical risks and therefore push bankable projects.

Stakeholder involvement needed: The conclusion is that all relevant stakeholders have to learn from each other and find a common understanding and language on the challenges and solutions. (i) Researchers have to work on the holistic approach and the real market-oriented impact of innovative concepts, solutions and technologies. (ii) Suppliers have to be involved in this process from the very beginning as they have to see the market potential and are the missing link between an idea and (iii) the industrial customers implementing these solutions. This becomes more important in the first phase of market penetration, namely frontrunners. (iv) Investors have to trust the solutions so that they are willing to give their money to these projects. Therefore, standardised project assessment is necessary covering both the technical and financial evaluation. (v) And finally, it is up to the policy makers to create and build up the framework for legal and financing issues on national and European level to allow the realisation of these projects. Beside investment support this touches legal and contractual issues for innovative financing vehicles and guarantees for invested money.