iets
Industrial Energy-Related Technologies and Systems
An Implementing Agreement established under the auspices of the International Energy Agency

iea Energy Technology Network
Technology Collaboration Programmes

IEA Expert Workshop in Berlin on April 4 – 5, 2017:

EXECUTIVE SUMMARY:

THE ROLE OF PROCESS INTEGRATION FOR GREENHOUSE GAS MITIGATION IN INDUSTRY

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Prepared by:

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INTRODUCTION

Due to the urgent need for global GHG mitigation, process integration in industry will most probably play an even more important role than traditionally in the areas of industrial GHG mitigation, energy efficiency, industrial clustering and system aspects of innovative technologies. In order to increase the awareness of new developments in this key methodology, a two-day IEA workshop was arranged in Berlin, April 4-5, 2017, with attendance of the majority of the world's leading experts in this area.

This is an executive summary of the the workshop report. The report summarizes the presentations and discussions in and the conclusions from this workshop. It highlights new developments in different types of industry, novel applications and the role of process integration in GHG mitigation and strategic decision-making in industry. It consists of a short description of process integration, a report on main findings and conclusions, and, linked, abstract and slides from all presentations.

The complete report, as well as abstract and slides, can be downloaded from the IETS website.

CONTACT INFORMATION

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PARTICIPANTS

About 30 people participated in the workshop. For a complete list of participants as well as the programme, please refer to the full report.

BACKGROUND AND AIMS

Process integration became a concept in the scientific literature and in industry R&D in the late 70's.

Process integration (PI) deals with system and interaction aspects of industrial technologies as well as process and energy streams for identifying more energy efficient and economically and environmentally more sustainable industrial systems.

Its ability to identify more economic and sustainable system solutions than traditionally has made it an important tool globally in both research communities and in industry.

Around 20 internationally high-level experts were identified and invited to the workshop, of which the majority were able to attend. In addition, country experts, IETS delegates and IEA representatives participated.

The main aims of the workshop were:

- To give an overview of recent developments
- to present success stories

- to show how PI could be used to identify new future technical and system solutions
- to discuss the role of PI for industrial GHG mitigation

MAIN MESSAGES

- Due to the imminent need for radical reduction of GHG emissions in industry, novel technologies, systems, feed-stocks, products, as well as circular economy and cooperation solutions must be introduced in a size- and time-scale hitherto never experienced in industry and in industry-society cooperation
- Process integration methods and tools are crucial in identifying sustainable and economically viable new process and system solutions

PRESENTATIONS

The presentations in the seven sessions are presented below. For complete program and list of participants, plese refer to the full report.

THE ROLE OF PI IN IEA

Main PI activities within the IEA are presented above.

Gudrun Maass, chair of IEA, EUWP, identified the workshop as very timely. In IEA, there is now a strong emphasis on identifying gaps, barriers, opportunities and possible potentials for energy efficiency and GHG mitigation in different sectors. The industry has been identified as a key sector that needs more attention than it has received previously.

Kira West, IEA Secretariat, presented the IEA Secretariat work on large-scale modelling of industry as a whole globally and of different sectors. In order to reach 2C or even well below 2C, a drastic change and many combinations of industrial technologies and systems will be required. More emphasis must be put to include PI opportunities more accurately in future modelling of possible developments in the industry sector.

NEED FOR GHG MITIGATION IN INDUSTRY

Thore Berntsson, chair of IEA, IETS, showed, based on knowledge from e. g. IEA and UN, IPCC, that there is an urgent need for drastic reductions of GHG emissions globally. Within 25 years or probably less, the world must reach zero net emissions. This means an enormous challenge also for the industrial sector. PI will have a key role in identifying changes towards a more sustainable industry sector.

RECENT USE IN PROCESS INDUSTRY

Robin Smith, University of Manchester, gave an overview of the ongoing development in the oil refinery industry. The big potential for energy recovery by combining heat exchanger networks and process models was exemplified by case studies.

Les Bolton, BP plc, discussed PI opportunities in the petrochemical industries. More radical reductions are likely to be achieved only by applying more radical approaches and stronger economic incentives for these.

Philippe Navarri, CanMet, presented the Canadian experience of using PI in the pulp and paper industry. PI for strategic long-term decisions is important as well as developing more knowledge about data mining and evaluation for better energy efficiency.

Lawrence Hooey, Swerea MEFOS, presented opportunities in the iron and steel industry. The lack of awareness of the benefits must be met with more case studies and success stories.

PI AND NOVEL TECHNOLOGIES AND SYSTEMS

Paul Stuart, École Polytechnique Montréal, presented a survey about PI for industrial biorefineries.

Ignacio Grossmann, Carnegie Mellon University, discussed the use of PI in new applications, production of shale gas and future electric power infrastructures.

Truls Gundersen, Norwegian University of Science and Technology (NTNU), discussed a new PI application in sub-ambient processes, combining work and heat integration.

Thokozani Majozi, Wits University, presented opportunities for energy efficiency by using PI in combined water and energy optimization.

PI AND PROCESS INTENSIFICATION

Jeff Siirola, Purdue and Carnegie Mellon Universities, (presented by Rafiqul Gani) and Rafiqul Gani, DTU, discussed the importance of PI in process intensification studies. Different methods for achieving PI were presented with successful application examples.

PI IN INDUSTRIAL CLUSTERS AND ENERGY CONVERSION

Diane Hildebrandt, University of South Africa, presented a PI methodology called the GH–space for considering thermodynamic interactions between processes

François Marechal, École Polytechnique Fédérale de Lausanne, discussed the importance of PI in industrial symbiosis/industrial clusters.

PI AS A TOOL FOR FUTURE RADICAL GHG MITIGATION IN INDUSTRIAL SYSTEMS

David Miller, National Energy Technology Laboratory, U.S. Department of Energy, discussed different opportunities for GHG mitigation industry, mainly different carbon capture technologies (CCS).

Dominic Foo, University of Nottingham Malaysia Campus, presented the use of PI for carbon management networks, focusing on carbon-constrained energy planning

Simon Harvey, Chalmers University of Technology, discussed the importance of an approach for identifying opportunities to achieve substantially increased energy efficiency and reduced GHG emissions in future industrial processes.

NATIONAL PRESENTATIONS FROM GERMANY AND PORTUGAL

Carsten Ernst, ÖKOTEC Energiemanagement GmbH, presented improved forecasting methods in energy efficiency.

Henrique Matos presented four GHG mitigation projects from the Portuguese National Group for Process Integration (GNIP), in the following areas: Biodiesel plant, Refinery hydrogen network and pinch analysis as well as biomass-based power plant.

MAJOR CONCLUSIONS

- Process integration is a major strategic design and planning technology, with which considerable improvements in energy efficiency and investment costs can be achieved and new processes and systems can be optimally designed in terms of efficiency, economy and environmental aspects.
- There is an imminent need for radical reduction of GHG emissions in industry. The global emissions must be reduced to zero net emissions in a very short time period, say 6-25 years.
- This means that novel technologies, systems, feedstocks, products, and cooperation solutions must be introduced in a size- and time-scale hitherto never experienced.
- Due to the need for a radical transition of industrial systems, process integration will play a more important role than it traditionally has towards GHG mitigation measures.
- Potentials for energy efficiency and GHG mitigation in industry through process integration are partly included in large-scale modelling of future industry developments within e. g. IEA. However, methods for transferring R&D and case-study results from researchers and industry to modellers should be developed.
- There is a great need for improved education and training in academia as well as in industry about opportunities for designing significantly more sustainable industrial processes and energy systems. Case studies highlighting the use of the concepts and PI methods-tools need to be collected and distributed for educational purposes.
- The international RD&D cooperation in process integration should be strengthened in order to develop and disseminate knowledge about opportunities for e. g. GHG mitigation in industry.

POSSIBLE AREAS FOR INTERNATIONAL COOPERATION WITHIN IEA, IETS

- Sharing of data for industrial energy systems
- PI training and implementation in industry
- PI methods for retrofitting and for novel industrial concepts
- Sharing experiences from demo projects and success stories in different types of industry
- GHG mitigation opportunities in different types of industry
- Collaboration with the IEA Secretariat

ABOUT IEA, TCP IETS AND ANNEXES

The International Energy Agency (IEA) is an autonomous organisation which works to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA has four main areas of focus: energy security, economic development, environmental awareness and engagement worldwide.

There are no quick fixes to long-term energy challenges. To find solutions, governments and industry benefit from sharing resources and accelerating results. For this reason the IEA enables independent groups of experts - the IEA Technology Collaboration Programmes, or IEA TCPs (formerly known as Implementing Agreements).

Through the Technology Collaboration Programme, the IEA provides a framework for more than 40 international collaborative energy research, development and demonstration projects. It enables experts from different countries to work collectively and share results, which are usually published. The programme deals with technologies for fossil fuels, renewable energy, efficient energy end-use and fusion power, as well as electric power technologies and technology assessment methodologies.

The IEA TCP on Industrial Energy-Related Technologies and Systems (IETS), founded in 2005, is dealing with new industrial energy technologies and systems.

The mission of IETS is to foster international cooperation among OECD and non-OECD countries for accelerated research and technology development of industrial energy-related technologies and systems. In doing so, IETS seeks to enhance knowledge and facilitate deployment of cost-effective new industrial technologies and system layouts that enable increased productivity and better product quality while improving energy efficiency and sustainability.

Through its activities, IETS will increase awareness of technology and energy efficiency opportunities in industry, contribute to synergy between different systems and technologies, and enhance international cooperation related to sustainable development.

The principal work of IETS is about identifying, observing, following and sharing work among countries and their organisations and industry clusters. This is done through defined projects, so called Annexes, in which experts from countries who choose to take part form a working group with an Annex Manager in charge of coordinating. For more information, please refer to the IETS website.

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