INDUSTRIAL EXCESS HEAT RECOVERY – TECHNOLOGIES AND APPLICATIONS (2)

Reference

Based on the Final Report from Annex XV Task 2, 2019, prepared by Thore Berntsson and Anders Åsblad, CIT Industriell Energi AB, Sweden.
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The full report as well as information about current projects can be found at the IETS website.

Introduction

There is an increasing awareness about industrial excess heat as a potential resource for contributing to an improved economy and sustainability in larger systems. Based on the Phase 1 (see Topic sheet no 7) results further work were carried out. Some important areas are:

- Methodology on how to perform an inventory in practice
- Evaluation and inventory of excess heat levels
- Possible policy instruments and the influence on future use of excess heat

Methodology on how to perform an inventory in practice

The different approaches for performing an inventory has been divided into three different categories:

- Questionnaires to companies
- Industrial energy system identification and process integration methodologies
- Use of existing knowledge of real plants or ”model” plants for different industry types and identification of excess heat levels.

Questionnaires to companies

Regarding quality of received data in questionnaire approaches, it seems to differ between industry types and individual plants. The larger and more energy intensive the industry is, the better knowledge seems to be available in-house (through e.g. energy managers). On the other hand, complex energy-intensive industries often have complex heat exchanger networks, which may make it more difficult to identify the real excess heat levels, both amounts and temperature levels, without a deeper study. The directly observable level may sometimes lead to an underestimation.

In the questionnaire approach, directly “visible” excess heat sources are not seldom reported, i.e. measurable excess heat from different unit operations. This would normally give a good estimation about available levels for industries having simple or moderately complicated energy systems. For complex industries, especially industries having a complex heat exchanger network for both process heat and utilities, the identification of excess heat amounts and temperatures can become more difficult.

Industrial energy system identification and process integration methodologies

With process integration methods, a more detailed picture of excess heat opportunities can be achieved. However, they need considerably more information about the energy system and more time and efforts from both energy managers and process integration experts. These more advanced methods are probably of interest in energy intensive industries having complex heat exchanger networks.

Some new and interesting process integration, pinch analysis-based, methods and tools have been presented and demonstrated. These projects have shown that identified excess heat levels, both amounts and temperatures, differ considerably depending on the depth of the study, how much possible changes in the heat exchanger networks are taken into account and if theoretically, technically or economically possible amounts are considered. As a general remark, the identifiable amount and temperature level of technically available excess heat seems to increase with increasing depth of the study, whereas the economically available level depends highly on the economic and policy instrument assumptions.

Use of existing knowledge of real plants or ”model” plants for different industry types and identification of excess heat levels

In terms of complexity, this method seems to be somewhere in between the two extremes discussed above. Available data bases on industrial energy systems and process schemes are used, in several cases followed up by questionnaires, visits or interviews. This methodology probably means much shorter times and smaller efforts than a process integration study, as it capitalises on previous in-depth studies. Again, the level of accuracy of excess heat amounts and temperatures depends most probably on the level of complexity and energy intensity of the plant in question.

Evaluation and inventory of excess heat levels

Results from surveys

Results from survey projects, dealing with possible amounts and temperature levels of industrial excess heat, have been compiled. This shows the huge amount of data available in participating countries and provides an excellent overview of the latest knowledge on possible available excess heat. Food and beverage, pulp and paper, textile, oil and gas, biorefineries, data centres, iron and steel, metal, non-metal, chemical and pharmaceuticals are important examples of industry types.

Examples of industrial energy systems

In the discussions on methods and how to identify opportunities for increasing possible excess heat amounts and/or temperature levels it was concluded that knowledge about the whole energy system can give very important information about such opportunities. By having more detailed knowledge of some industrial energy systems, different groups can use their approaches or methods for identifying excess heat and compare results and methods between each other. More detailed information about a small number of real industrial plants, based on results from different projects with industry, was shared and compiled, and should be used as a valuable data base in future projects.

The role of policy instruments

Different types of nationally used policy instruments have been reported from the participating countries. These types include general policy instruments for GHG mitigation, influencing excess heat usage, tailor-made ones for excess heat and support/funding for R&D, demo plants and full-scale plants.

The variety of types of policy instruments and their design is huge. In addition, the definition of policy instruments in this context is unclear. None of the national reports discuss more quantitatively how different policy instruments specifically influence the economy for excess heat usage. However, this is more or less impossible to do in a more general way due to the large number of parameters and variations. It is clear. however, that policy instruments connected to GHG emission costs in many cases should be beneficial for excess heat usage in situations when the alternatives emit more GHG.

Due to the need for radical decarbonisation in society, policy instruments will most probably successively change in the near future. As excess heat has very low GHG emissions in most cases, this sector will very likely benefit from such a development.

Conclusions

Some general conclusions from the task:

- All participating countries seem to have excess heat usage as one of their prioritized energy efficiency areas, based on the many large projects reported from all groups.
- Although excess heat usage is common in all participating countries, there is still a big potential for energy saving in this area. The technical potential seems to be huge and there is also a big economic potential. This is obvious from the many surveys performed, in which promising opportunities have been identified.
- There are also many hurdles for implementation of excess heat usage. Many opportunities have not been realized due to one or more of these hurdles. They are, e.g.:
  - Lack of proper inventory, i.e. the real amounts and temperature levels of excess heat have not been identified;
  - Uncertainty about integration, control and interplay with other parts of the energy system;
  - Different needs for return of investment between provider and user;
  - Uneconomical project with today’s policy instruments (but in many cases promising with possible future policy instruments);
  - Excessively high risk due to uncertainty about future conditions.

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About IETS

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.

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