Issue
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SPOT

Sustainable Process Heating

The overall objective of this SPOT project is to start an innovation program on Industrial Heat Technology in order to achieve a coherent and consistent program that leads to significant reduction of the use of fossil energy carriers in industry. The goal is to reduce fossil energy use for industrial heat with at least 100 PJ/year in 2030. The associated CO_2-emission reduction is estimated at 6 Mton/year. Innovations within this program lead to new products with export potential for technology suppliers.

Dear Consortium partners

This is the second issue of a newsletter with which we try to inform you about the progress made within the SPOT project. Should you wish to know more or provide feedback, please get in touch with specific WP leader.

Work Package 1: Carbon free fuel for industrial high temperature applications

The objective of this work package is to determine which chain of conversion and storage technologies will provide industry with the most effective way of producing high-temperature heat that eventually originates from fluctuating renewable electricity.

Progress

As indicated in the last newsletter, (heat) demand and (renewable) electricity supply scenarios were developed for 2050. TU/e has defined technology chains between these end points, including storage and conversion.

Storage technologies that are considered, depending on the technology chain, are mechanical, electro-chemical, thermal and chemical storages(H_2, NH_3, …). Conversion technologies include electrical heat pumps & boilers, single and dual-fuel furnaces, electric furnaces, and electrolyzers.

These chains are characterized on efficiency, investment costs, energy density and Life Cycle Cost Of Energy (LCOE).

With respect to efficiency, it's no surprise that chains containing a heat pump outperform other chains.
The storage costs seem to dominate the total required investment when the overall investment costs are evaluated, despite the fact that the storage size in absolute terms is rather limited.
Chemical storage (H_2, NH_3, metal fuel) has the highest storage density.

Preliminary results show that heat pumps combined with a heat storage provide the lowest cost solutions for heat demand < 200°C. The picture is less clear for the heat demand > 200°C.

One uncertainty that still needs to be addressed are the infrastructure costs. Depending on the technology chain, infrastructure needs to be modified (natural gas => H_2 pipelines) or added (electricity grid). Investment numbers in literature show a large variation. However, these costs seem to be lower than the dominating storage costs.

More information

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Recoy

KWA

Tata

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BlueTerra

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DOW

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IBK

TUE

Papierfabriek Doetinchem

BHT

Standard Fasel

Corbion

DBS

SAPPI

DSM

Nuon

EMMTEC

Vattenfall

VDL

Work Package 2: Fuel cell based cogeneration of heat (steam) and power

The objective of this work package is to proof the viability of fuel cell cogeneration for steam and electricity production in industry as dual fuel CHP alternative in the energy transition.

Progress

After contacting multiple SOFC manufactures, contact with one supplier of micro-CHP units as well as fuel cell stacks was intensified. Plans were made for adapting one of their mCHP units to fit an additional heat exchanger for steam production. Contact was established and detailed design was shared with Alfa Laval and Oversluizen Thermal Engineering for supplying a prefabricated heat exchanger. Unfortunately, after ample consideration the supplier of the mCHP unit withdraw from the project due to lack of personnel capacity and inconsistency of the targeted application with their portfolio. Currently contact with another supplier of SOFC mCHP units is established and the technical feasibility of steam production with their mCHP unit is investigated. Separately a manufacturer of SOFC fuel cell stacks is approached for supplying one of their fuel cell stacks. It is expected that both parties will give a quotation on a short notice.

More information

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Work Package 3: High temperature heat recovery and storage

The objective of this work package is to proof the technical feasibility of molten salt technology for heat transfer, storage and re use in the high temperature processes in the steel and chemistry sector.

Progress

The test facility for molten salt as heat transfer and thermal storage fluid is finished and the system is commissioned in the Carnot Lab in Petten. We will use this test-rig, combined with a hot air supply system, to study the properties and applicability of molten salts in recovery, storage and re-use for high temperature industrial heating processes.

Figure 1 overview f the hot air (left) and molten salt (right) test facilities in the Carnot Lab.

Thermal design calculations for a heat exchanger were made to study the heat transfer between air and molten salt. A tube-in tube heat exchanger design is prepared that allows to simulate high temperature heat recovery process conditions such as in TATA and DOW. Design calculations are under review by Bronswerk and the construction will take place in the coming months.

More information

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Work Package 4: Steam Compression

The goal of this work package is to assess the applicability, availability and feasibility of steam compression technology into existing processes and

Expected Results

- Future industrial heat demand;
- Required future energy storage and type thereof;
- Assessment of carbon-free fuel technology chains;
- Assessment of fuel cell cogeneration technology for industrial applications;
- Experimental results of a small scale cogeneration fuel cell;
- Techno-economic analysis of a full-scale cogeneration fuel cell;
- Requirements for high temperature heat recovery and storage;
- Market and energy saving potential for HT-recovery-storage;
- Heat transfer and thermal storage properties of molten salt
- Identification of future R&D needs on molten salt technology
- Assessment of the integration aspects of steam compression.
- Performance of different type of steam compressors
- Definition of pilot projects and future R&D needs
- Fact sheets for innovative industrial heating technologies
- Selection relevant innovations in heating systems for industrial processes in NL
- Impact assessment of industrial heating transitions on the national energy system

identify innovation and development needs.

Progress

Integration of steam compression in the drying section of a papermill is assessed together with SmurfitKappa. A system integration model is made to analyse the various options to use flash steam from a condensate flow as a source for the steam compressor. Extracting heat from this condensate, allowing it to cool down further, will lead to an increase of the boiler energy efficiency. This integration can be expanded by incorporating additional waste heat sources, to enlarge the waste heat recovery potential.
The operational conditions for steam compression in the papermill match quite well with the available steam compression technologies.

To test these steam compression technologies, modifications and expansion of the existing heat pump test-rig are elaborated and the basic engineering of these modifications is being finalized.

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Work Package 5: Future industrial heating technologies and energy systems

The objective of this work package is generating an overview of international innovations in industrial heating systems, selecting most relevant innovations for the Dutch industry and determining the impact on the national energy systems.

Progress

Factsheet templates are made and filled with information describing the key characteristics of state-of-the-art and future heating technologies for industrial processes with a strong focus on heat supply, recovery and reuse, and future robustness regarding the energy transition. Currently, the information in the factsheets is checked and validated before it will be released and used for matching the identified innovations with the process heating requirements of the different industry sectors and determining their influence on the primary process.

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