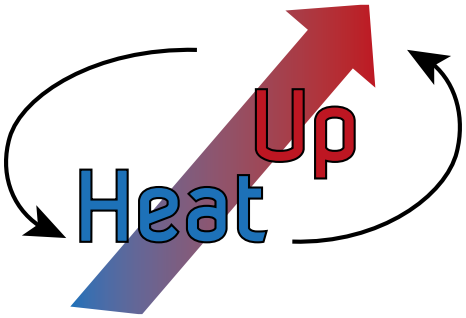
SINTEF FACTS

HeatUp

High temperature heat pumps for efficient utilization of low temperature surplus heat



Heat pumps offer the unique possibility to efficiently produce thermal energy at a usable temperature level when applying a fractional amount of electric input and are coequal to other renewable technologies. Current temperature limits for heat pumps are however around 80°C, which is limiting industrial and large scale applications.

The aim of HeatUp

The aim of HeatUp is to extend the temperature range for heat pumps beyond 200°C by using natural working fluids like butane, ammonia (NH_3) and water (H_20).

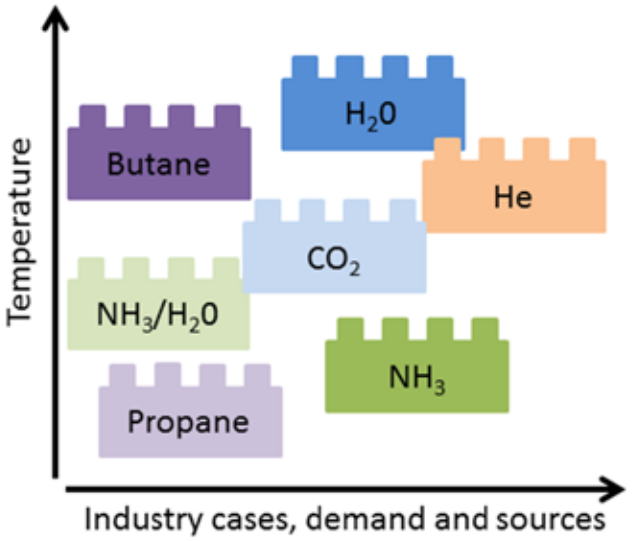
HeatUp is developing novel concepts for high temperature and high capacity heat pumps for the Norwegian and European industry. HeatUp hereby focuses on the utilization and upgrading of industrial surplus heat which is a significant and valuable energy source. This source is nowadays unused because of the lack of suitable high temperature heat pumps and long payback times. At the same time, the dependency on fossil fuels is reduced, which will clear the way towards a carbon-neutral green future. The project is focusing on the application of robust and compact key components and efficient heat pump cascades utilizing environmentally friendly refrigerants.

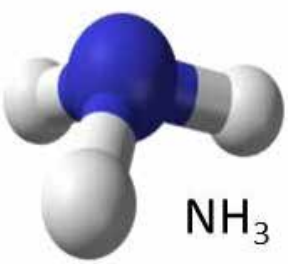
The challenge

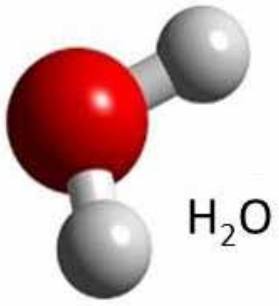
Selected industrial case studies are performed in close cooperation with the project's industrial consortium. The development of high temperature heat pumps applicable for the specific needs of different industries is a complex task where multi-disciplinary skills and close cooperation with industries nationally and internationally is required.

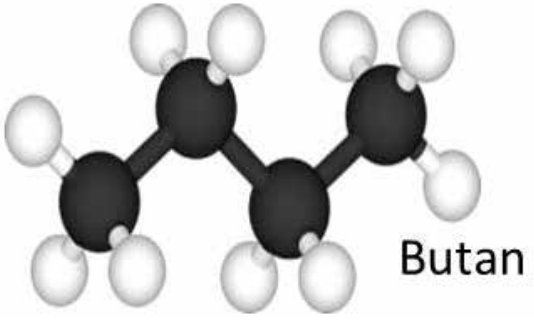
The message

HeatUp will follow the spirit of Prof. Gustav Lorentzen, who re-established CO_2 based heat pumps in the 1980s as an alternative to using halocarbons. The project acknowledges the lessons learned from past and will focus on natural working fluids. Ammonia, butane and water offer excellent thermal properties for refrigeration proposes while at the same time their Global Warming Potentials (GWP) and Ozone Depletion Potentials (ODP) are close to zero.









The project

HeatUp shall document the feasibility of profitable surplus heat utilization using new high temperature heat pumping concepts for production of steam and pressurized hot water. The initial case studies documented a need for thermal upgrade either from a temperature range below 50°C up to around 110°C or from or from 100°C up to 200°C. For the first case heat pumps based on ammonia and/or hydrocarbons will be suitable, while the latter case will use common water as refrigerant.

HeatUp is developing base principals for the identified cases in order allow for a viable industrialization. The key components for the heat pump are designed for the industrial boundary conditions based on the new knowledge achieved. The main contribution is increased efficiency, lower environmental impact and reduced life cycle costs for the industry. Special focus is paid to the concept of steam recycling, commonly known Mechanical Vapor Re-compression (MVR). HeatUp is developing and use in-house tools and methodology for optimal component design and heat pump operations, given thermo-physical properties of the selected natural working fluids and novel component concepts (like ejector technology).

The key deliverables are compact heat exchanger concepts for industrial high temperature heat pumps and high efficient compressor technology for natural working fluids. This contributes to the implementation of novel high temperature heat pumping systems in the industry. Currently the project is planning to assess the feasibility of the developed solutions in two partner industries. Additionally, state of the art knowledge is provided to the participating partners and new competence is built in the research organizations.

HeatUp is financing one PhD student who is addressing the topic of effective compressor designs for high temperature heat pumps based on natural working fluids.

Heat Up is organized in three work packages. The work packages "Component and working fluid selection (WP1)" and "System optimization (WP2)" are addressed based on the "Industrial applications and cost analyses (WP3)". Success criteria are the development of new knowledge and system solutions, energy efficiency and profitability, which will exploit the potential for energy efficiency and integration as well as give a more efficient production, optimized industrial processes and surplus heat recovery.

We have heard a great deal lately of the harmful effects to the environment when halocarbon refrigerants are lost to the atmosphere. This should not really have come as a surprise since similar problems have happened over and over again. Numerous cases are on record where new chemicals, believed to be a benefit to man, have turned out to be environmentally unacceptable, sometimes even in quite small quantities (DDT, PCB, Pb etc.).

In the present situation, when the CFCs and in a little longer perspective the HCFCs are being banned by international agreement, it does not seem very logical to try to replace them by another family of related halocarbons, the HFCs, equally foreign to nature.

Int. J. Refrig., Vol. 18, No. 3, pp. 190-197, 1995
Gustav Lorentzen, NTH

The industrial consortium of HeatUp:

- Statoil ASA (Oil and Gas)
- Statkraft Varme AS (District Heating)
- Hydro Aluminum (Metal)
- Vedde AS, member of TipleNine Group (Aquacultrue/Feed)
- Tine SA (Food)
- Mars GmbH (Petfood)

Supply industry:

- Cadio AS
- Hybrid Energy AS
- EPCON Evaporation Technology AS

Research parther:

Norwegian University of Science and Technology (NTNU)

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