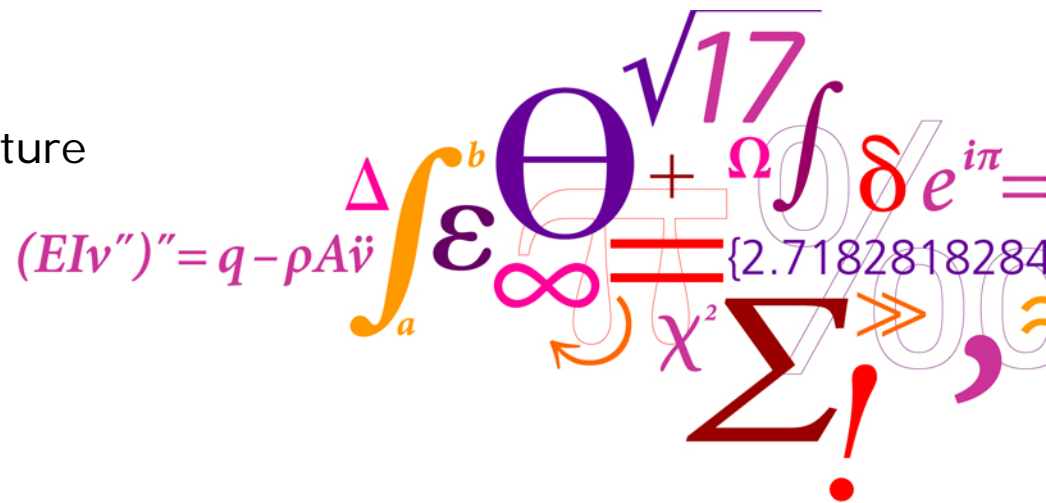


THERMCYC

Advanced thermodynamic cycles
utilising low-temperature heat sources

Innovation Fund Denmark
Energy and Environment for the Future
Conference
November 24-25 2014

Brian Elmegaard



THERMCYC Project

March 2014 – February 2019

Hypothesis

Low-temperature heat sources are available in **many applications**, ranging from waste heat from marine diesel engines, industries and refrigeration plants to biomass, geothermal and solar heat sources.

Great **potential for enhancing the utilization** of these heat sources by **novel cycle and component design** and use of **working fluid mixtures.**"



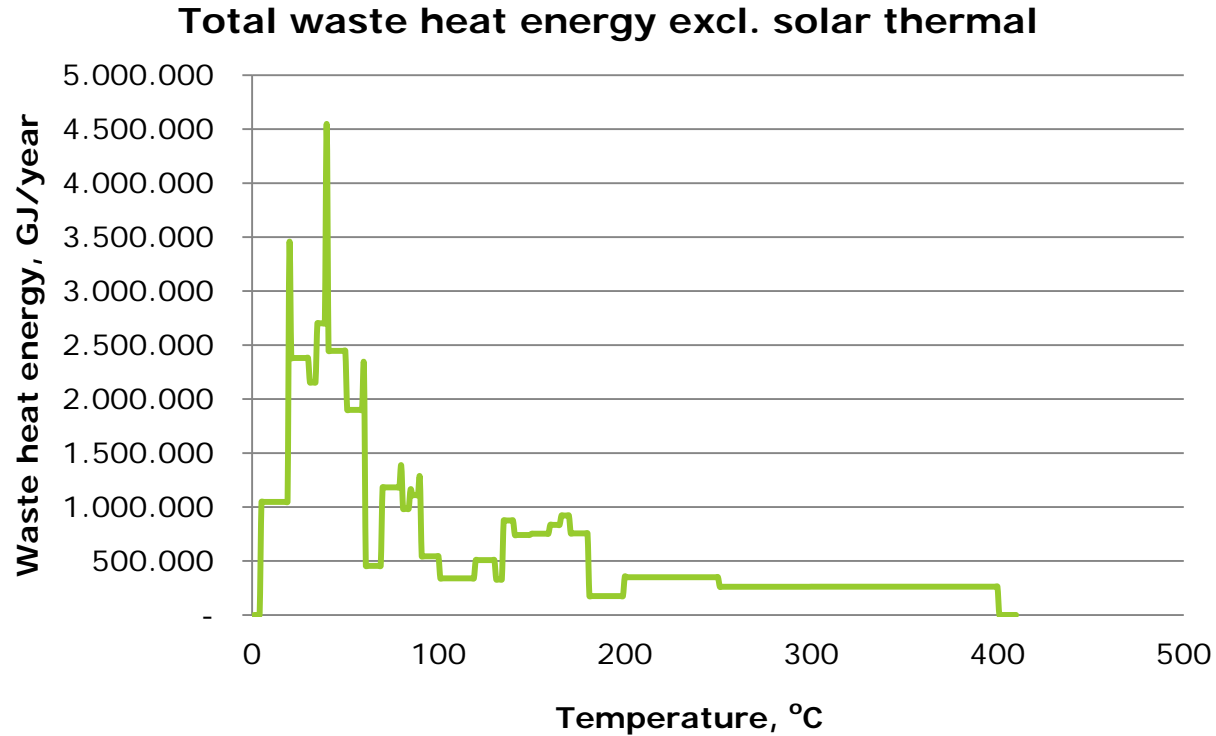
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viegand
maagøe
energy people

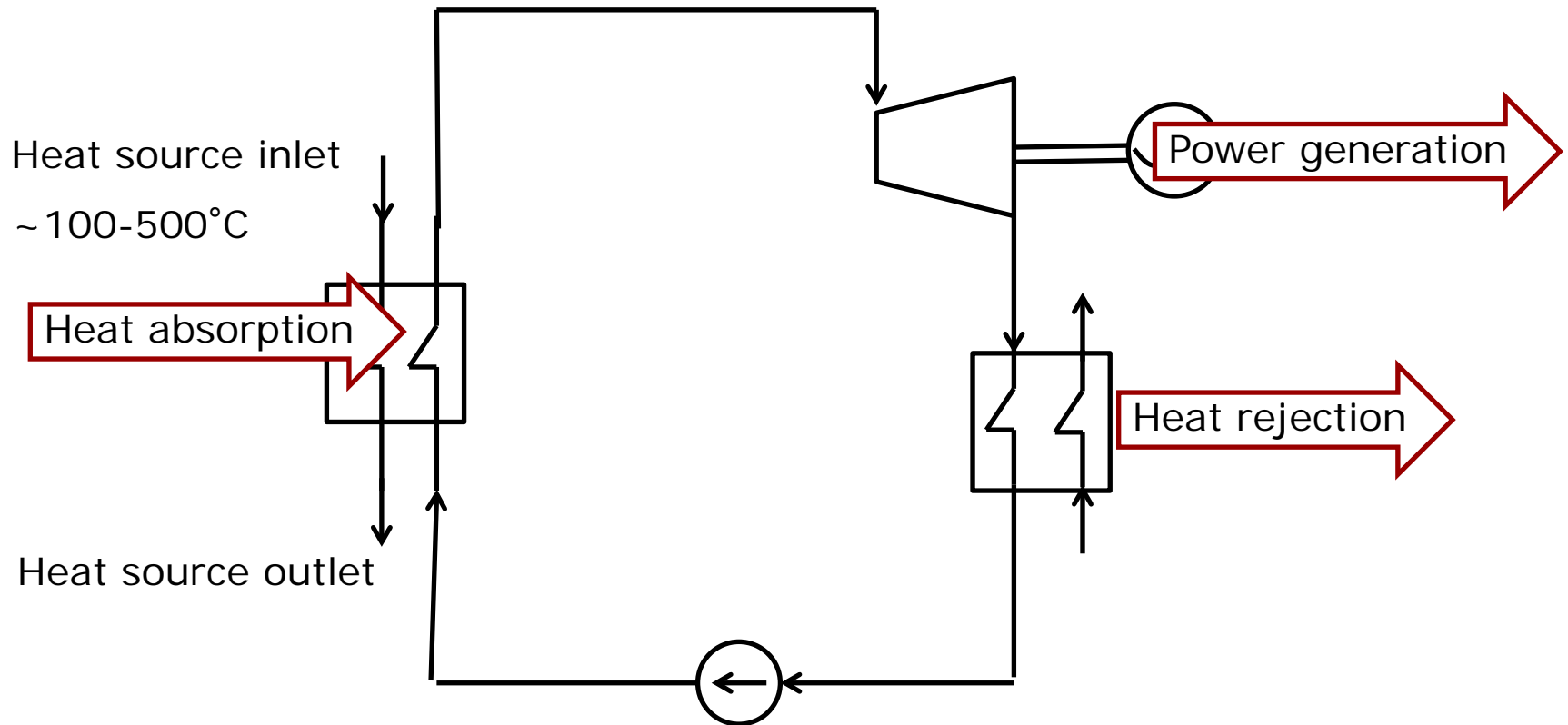


MAN Diesel & Turbo

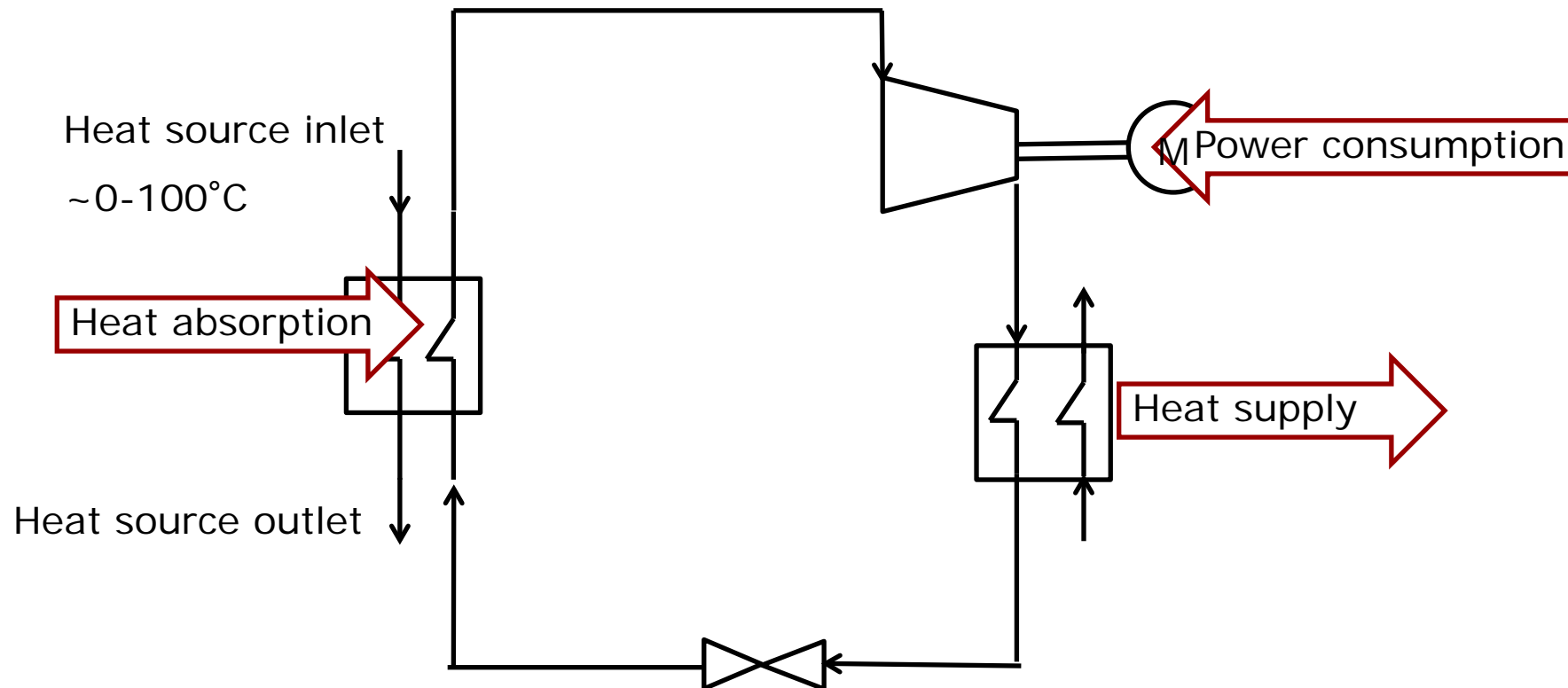
Potential low temperature heat 245 TJ/y



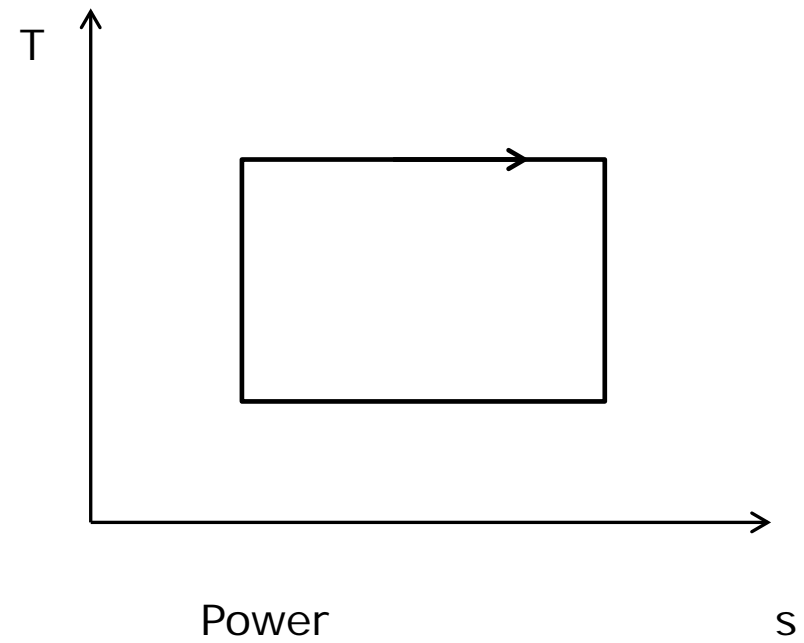
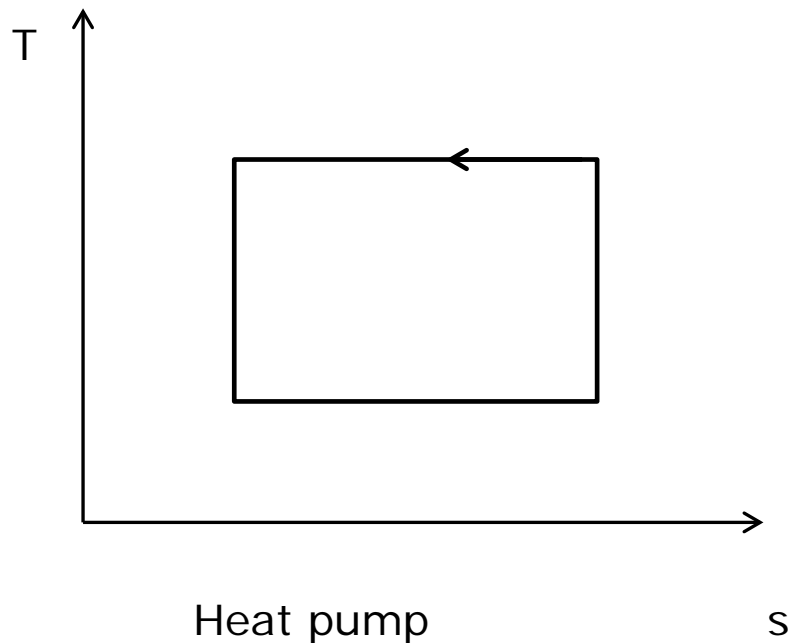
Power cycle – Power generation from low temperature heat source



Heat Pump – High temperature heat supply by low temperature heat source and power

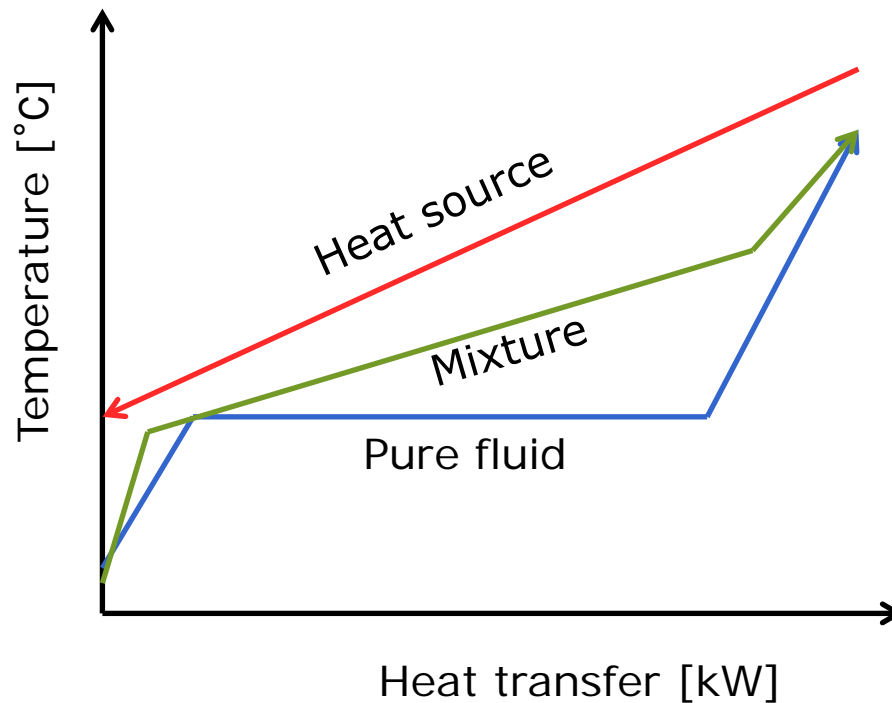


Carnot Cycle

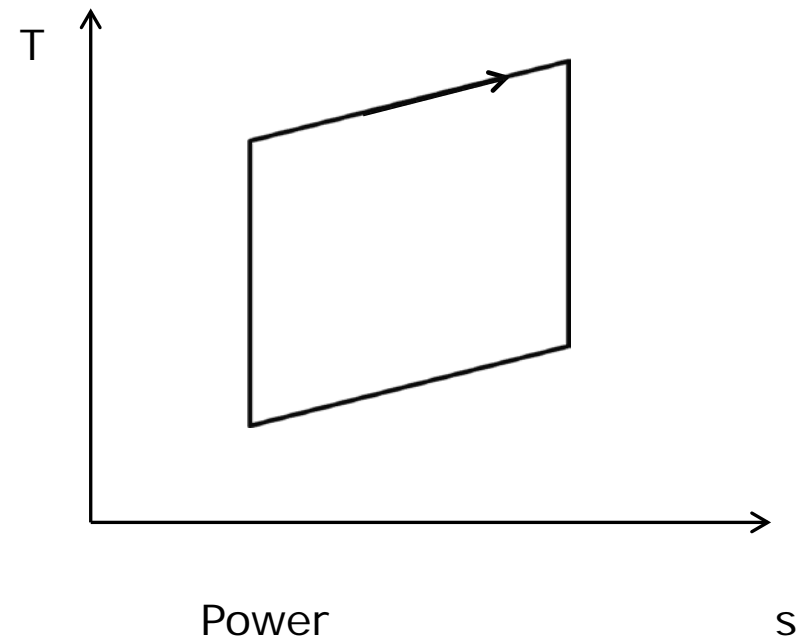
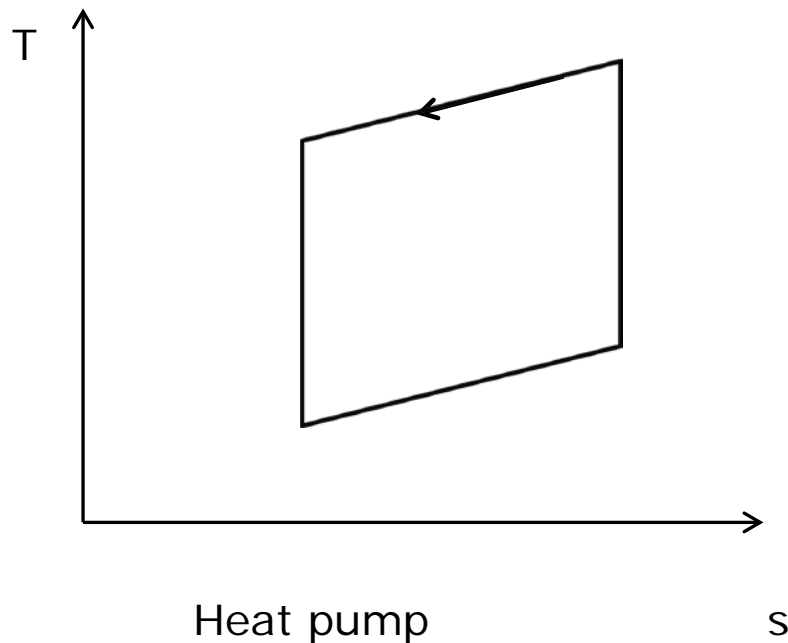


The Carnot limit applies for infinite heat capacity of source

Heat exchange between source and evaporating fluid

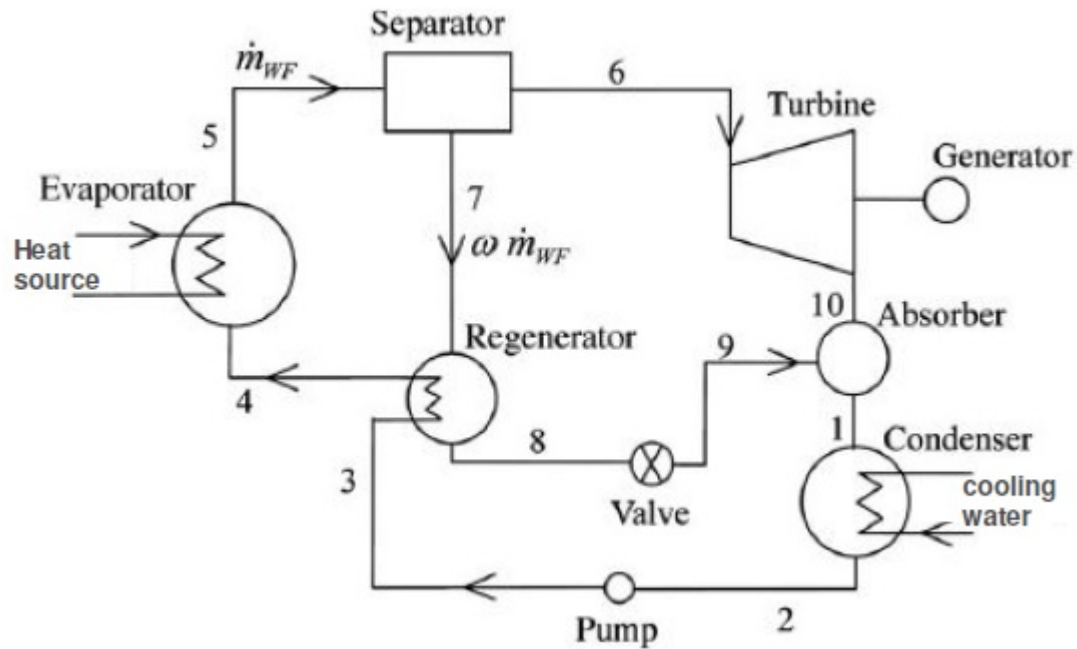


Lorenz Cycle

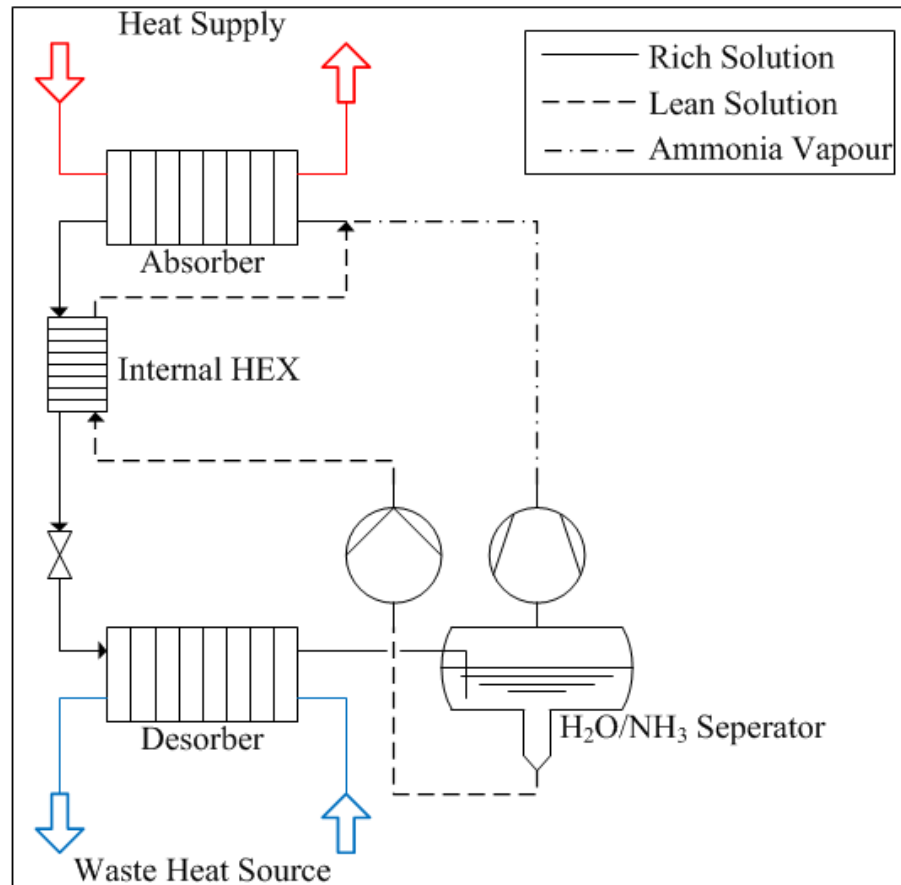


The Lorenz limit applies for finite heat capacity of source

Power cycle with mixture Kalina



Heat Pump Cycle with mixture – Osenbrück

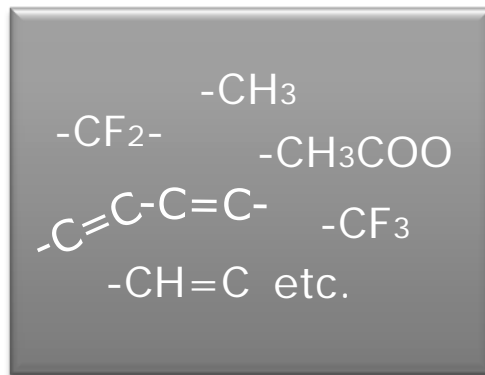


Component Test facility



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CAMD – Computer-aided Molecular Design



Building blocks:

- 1) Molecular groups
- 2) Molecules



Optimization
algorithm

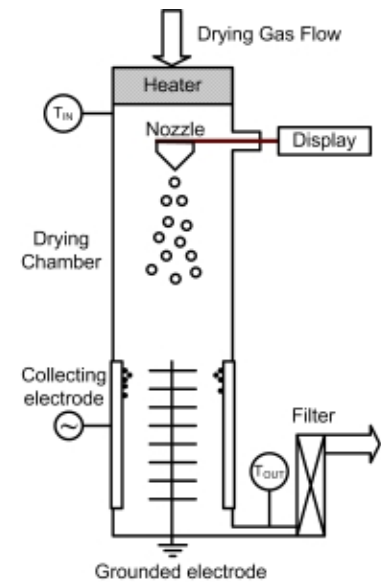
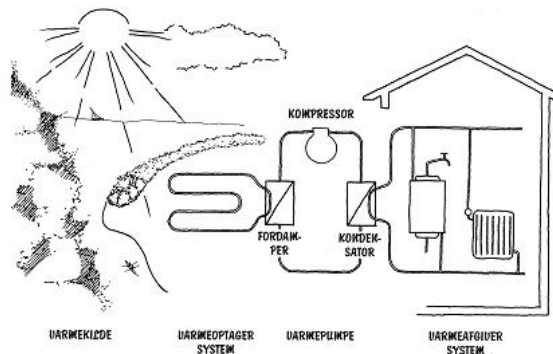


Chemical product:

- 1) Pure components
- 2) Mixtures

Applications

- Marine waste heat utilization
- Industrial heat pumps
- Biomass in industry
- Geothermal cycles
- Domestic heat pumps



Posters

- Jesper Graa Andreasen, Technical University of Denmark, Mechanical Engineering
Utilization of low temperature heat for environmentally friendly electricity production
- Deenesh K. Babi, DTU Chemical Engineering
A framework for the selection, design and verification of working fluids
- Fridolin Müller Holm, DTU/Viegand Maagøe
Identification of low temperature heat sources in Denmark – Work package 6 in Thermcyc project

Website

- <http://www.thermcyc.mek.dtu.dk/>

