Application of an industrial heat pump for steam generation using district heating as heat source

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Business Model

Installation

Technology

Environmental Impact

Incentives
Basic system principle

District Heating

85 C
267 kW
1041 MWh/a

COP$_h = 2.1$
212 kW
825 MWh/a

Electric Power

10 bar$_g$
183 C
449 kW
1753 MWh/a

Steam

105 C
Basic commercial principle / business model
Helium (R-704) as a refrigerant

• Environmentally friendly:
  • GWP = 0
  • ODP = 0

• Safe
  • non flammable
  • non reactive and stable
  • no known toxicological effects

• Very well suited for both high and low temperatures
Stirling Cycle

cylinder with pressurised working medium (He)

dynamic piston rod seal

cold source inlet

cold side

hot side

hot sink inlet

heat exchanger package (cold, regenerator, hot)
piston rods (kinematically driven)
Our implementation
Model vs. reality?

Temperature fraction, $\frac{T_c}{T_h}$ (K/K) vs. Hot Coefficient of Performance share of Carnot COP.
Environmental Impact?
COP vs. thermal efficiency

\[ COP_{(h_{,brk})} = \frac{1}{\eta} \]
European electricity mix

early energy data 2014
Life cycle assessment global warming potential emissions for electricity generation

CO$_2$-emissions
TINE Ålesund
Layout of the installation
Similar installation (AstraZeneca, Gothenburg (SE))
Status of the similar installation May 2017