Railenergy

Energy Efficiency Days 2009

Panel 4 – Energy Saving On Board

Re-use of waste heat

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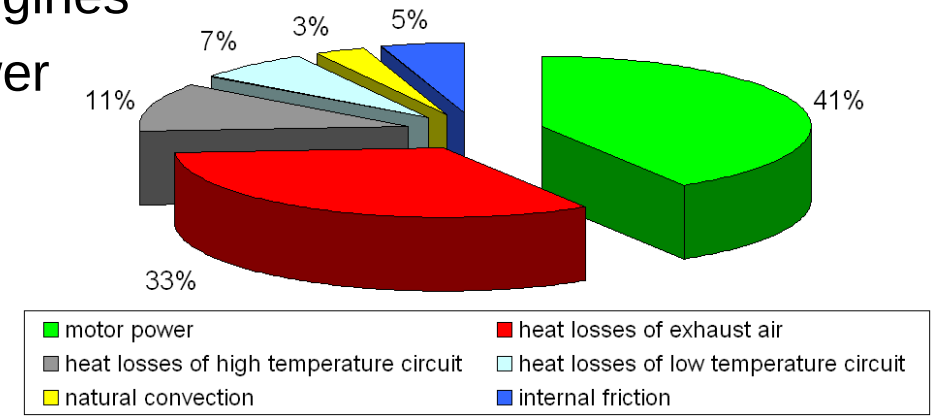
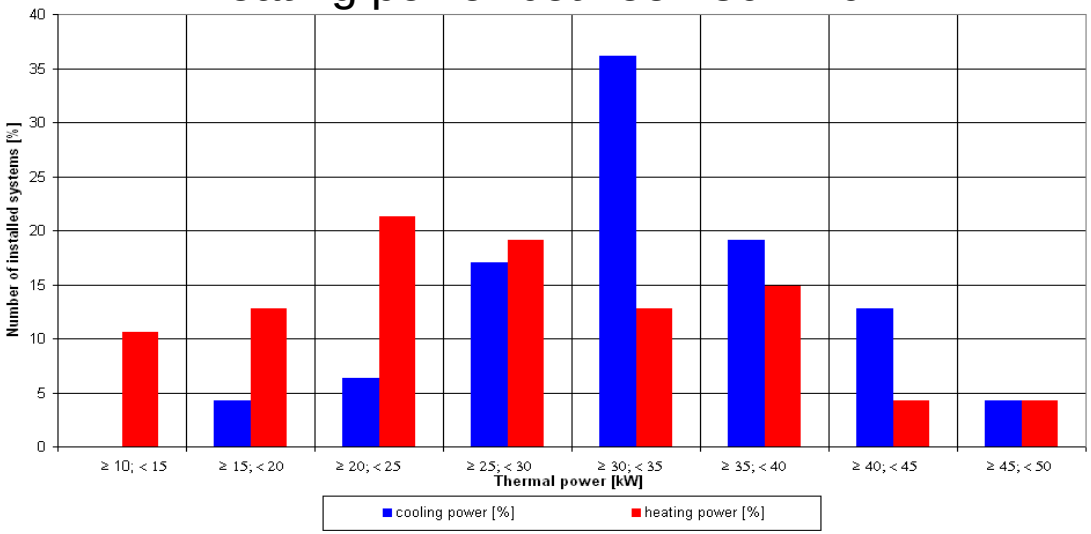
Scope & Objectives

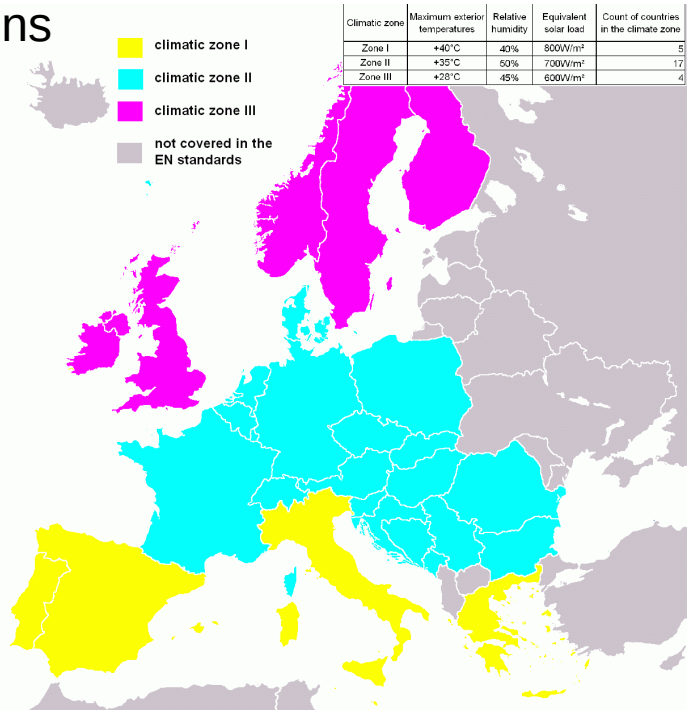
- Waste heat usage for heating in DMUs is state of the art- not for AC
- Up to 10% of traction power is used for air conditioning of DMUs
- Potentials of waste heat usage:
  - Improve the energy efficiency of a DMU
  - Decrease of engine-power requirements (less auxiliary power)
  - Increase of the range of coverage
- Waste heat power of diesel engines exceeds traction power



Activities performed & Status

- Data collection and evaluation of
  - relevant standards and climate data
  - the performance data of air conditioned trains
- Aim: waste heat driven HVAC with a
  - cooling power between 30…35kW
  - heating power between 30…40kW

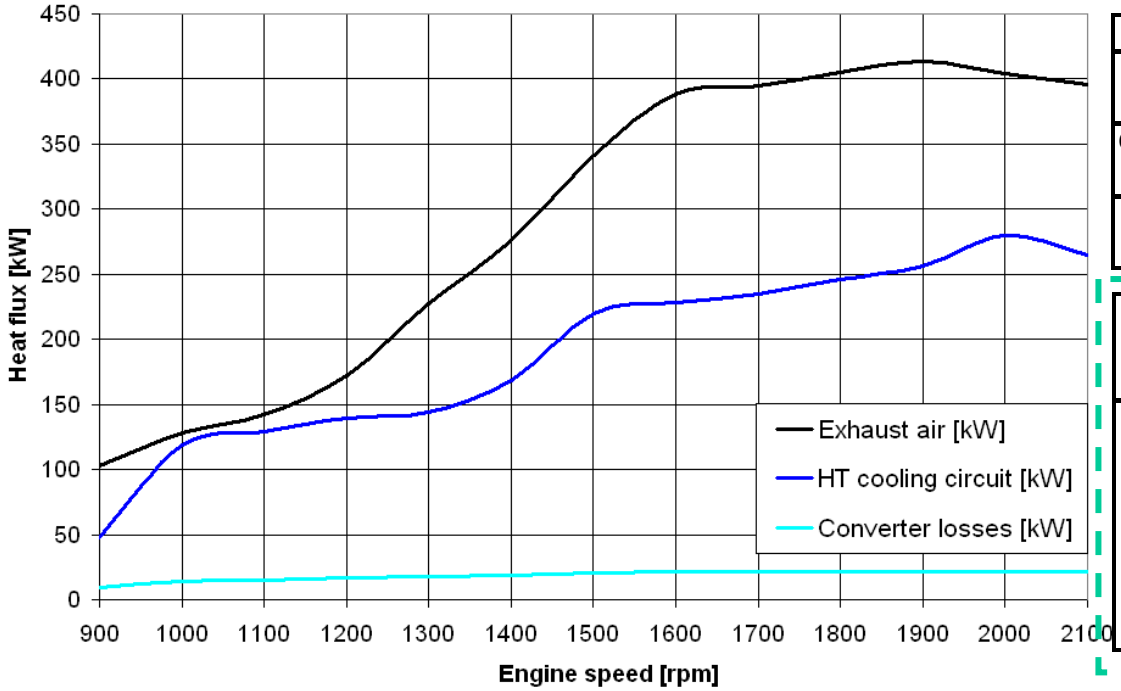




Climatic zone	Maximum exterior temperatures	Relative humidity	Equivalent solar load	Count of countries in the climate zone
Zone I	+40°C	40%	800W/m²	5
Zone II	+35°C	50%	700W/m²	17
Zone III	+28°C	45%	600W/m²	4

Activities performed & Status

- Evaluation and assessment of the potential heat sources of a DMU

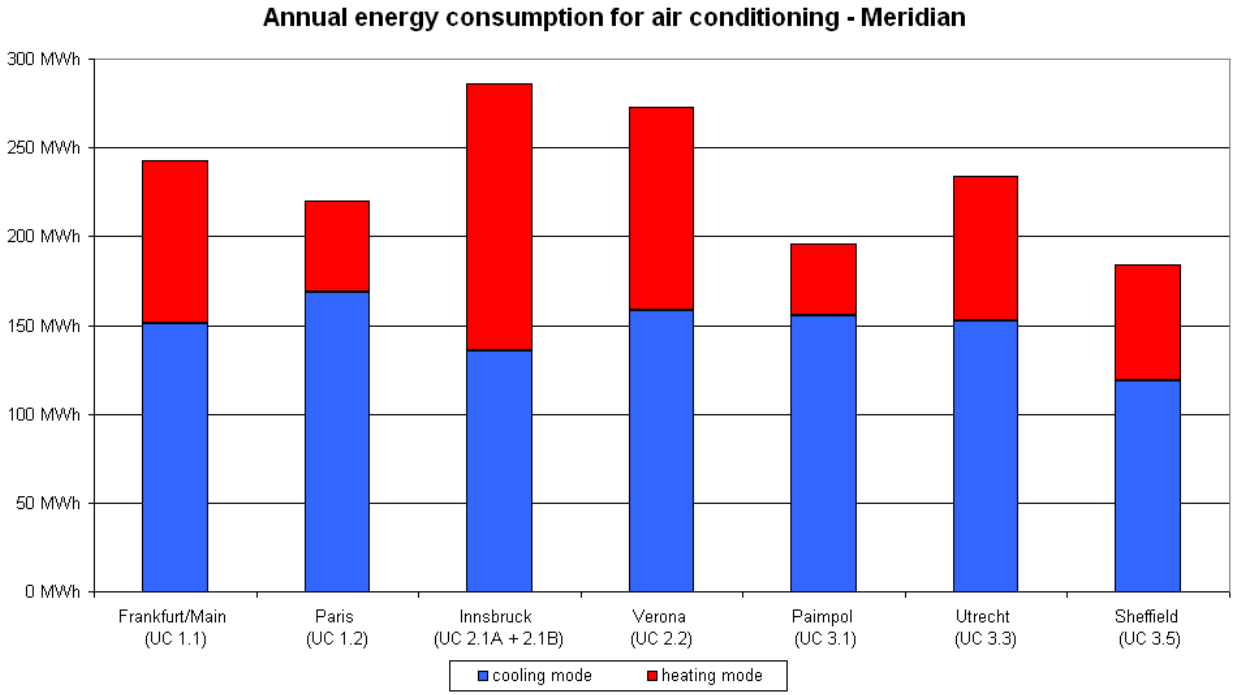


	Temperature range	Available waste heat
Exhaust air of the diesel engine	420°C…560°C	102kW…413kW
Cooling circuit (HT)	76°C…90°C	48kW…280kW
Converter cooling circuit	90°C…110°C	5kW…22kW

Waste heat from the exhaust air	Waste heat from the cooling circuit (HT)	Waste heat from the converter cooling circuit
Good potential due to the high temperature range. Back pressure of the exhaust system to be considered.	Good potential for heating mode, limited potential for AC due to the operating conditions of the diesel engine (min. temp.)	No potential for heating, AC, combination with other heat sources too complex.

Activities performed & Status

- Evaluation of energy saving potentials for representative operations
  - Analysis of the annual energy consumption
  - 2 train types, 7 locations

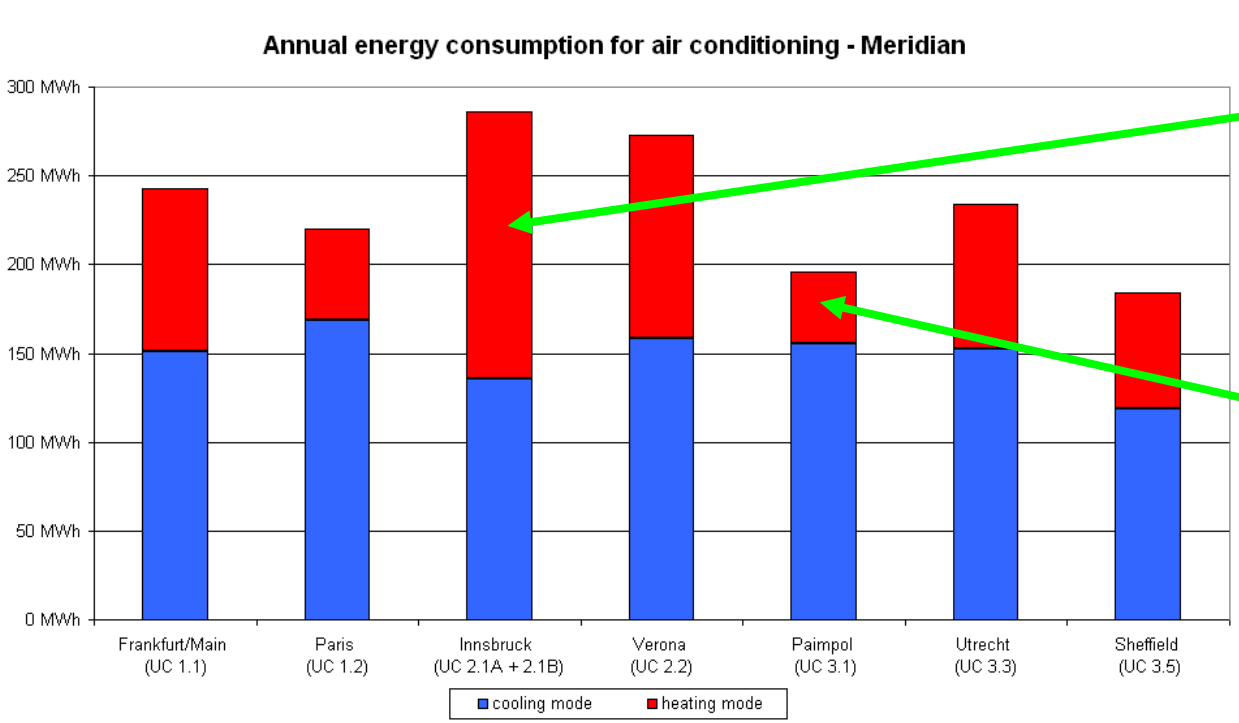


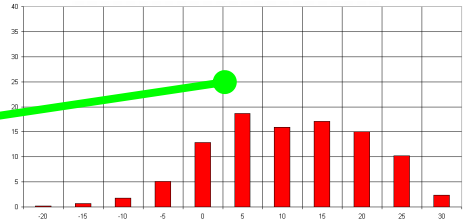
Talent classic DEMU

Meridian

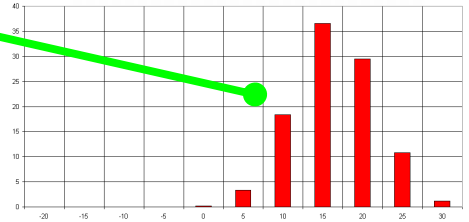
Activities performed & Status

- Evaluation of energy saving potentials for representative operations
  - Energy consumption heavily dependent on climatic conditions!





Histogram of the climate in Innsbruck

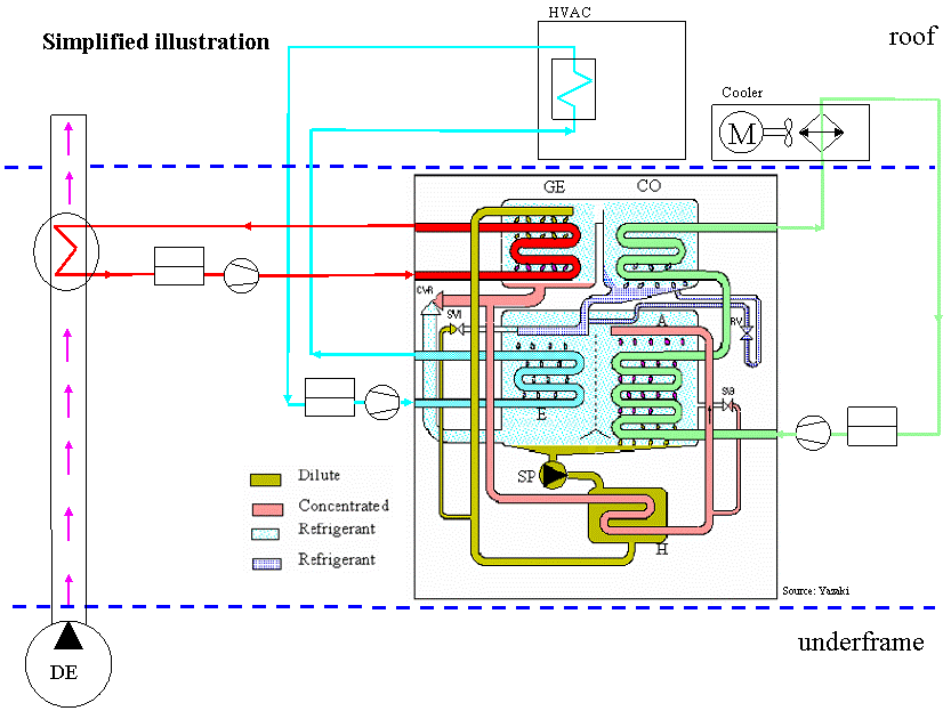


Histogram of the climate in Paimpol

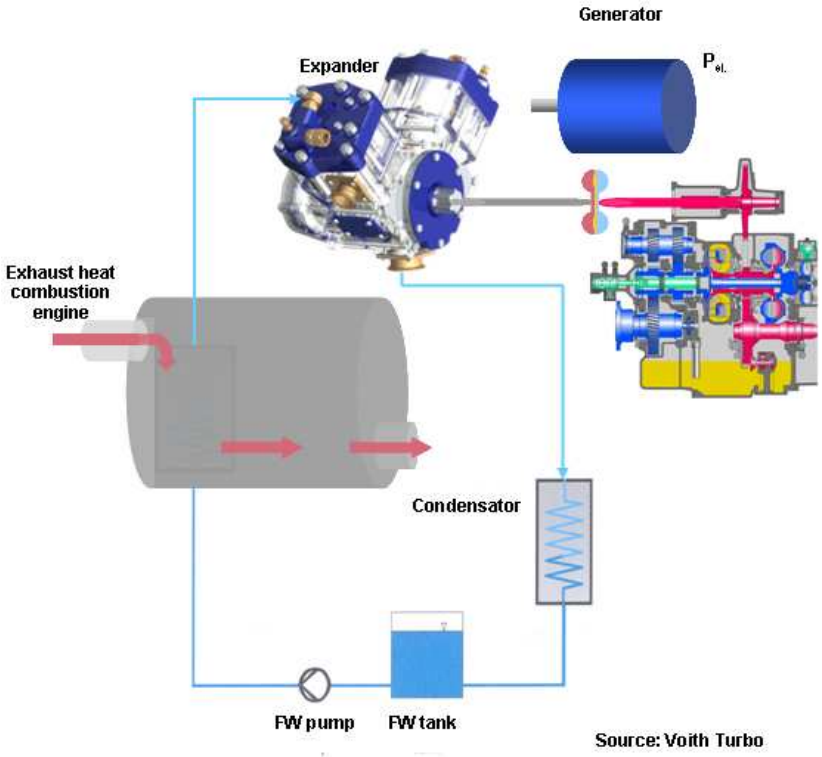
Activities performed & Status

- Two technologies has been taken in to account:

Absorption refrigeration process



Clausius-Rankine Process



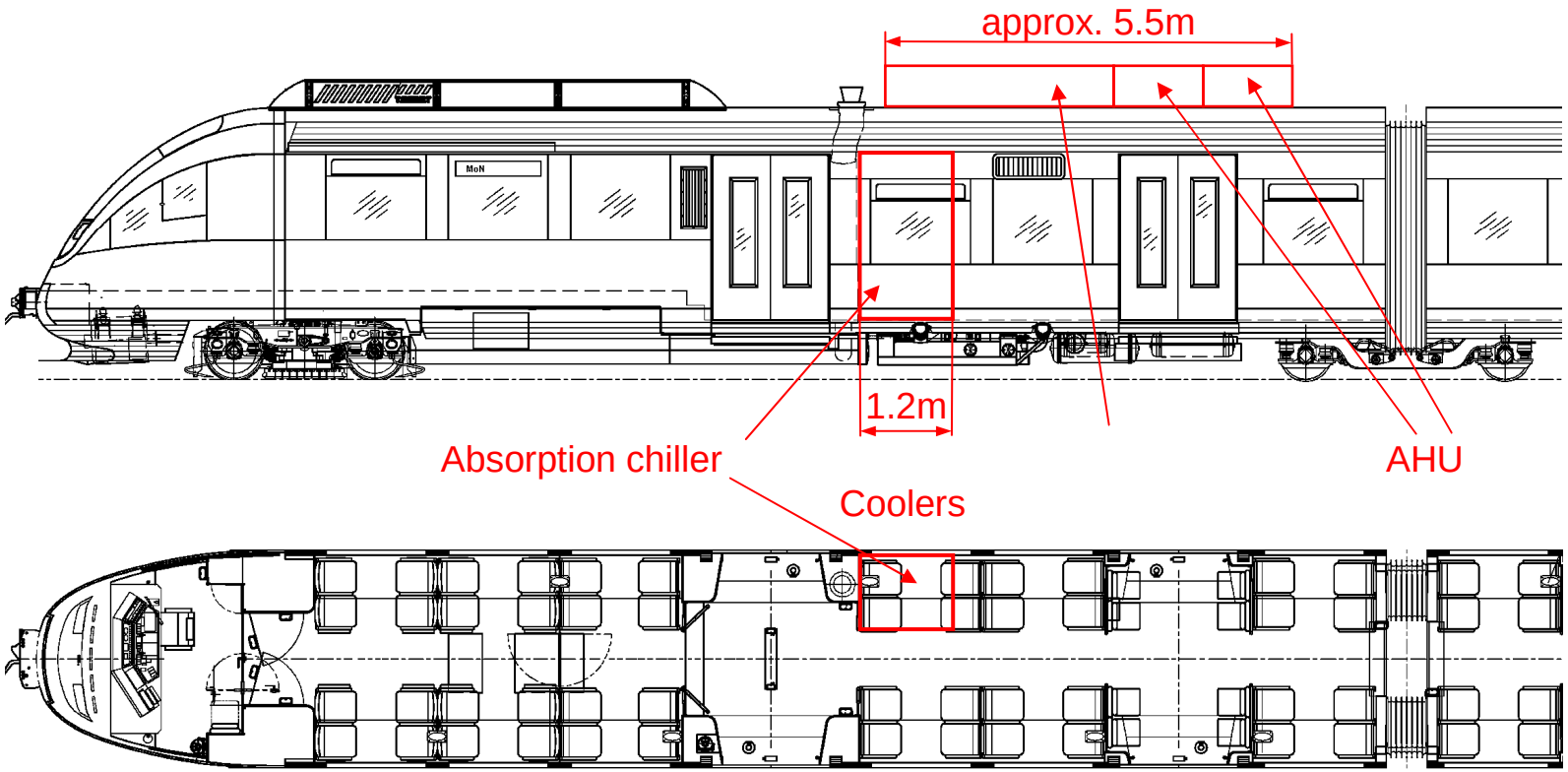
Activities performed & Status

Most promising combination of heat source and waste heat technology

Potential for waste heat usage for	Waste heat from the exhaust air	Waste heat from the cooling circuit (HT)	Waste heat from the converter
Temperature level	420°C…560°C	76°C…90°C	90°C…110°C
heating	+++	+++	
cooling 1.Absorption refrigeration machine	+++	++	
cooling 2.Clausius-Rankine process	+++		

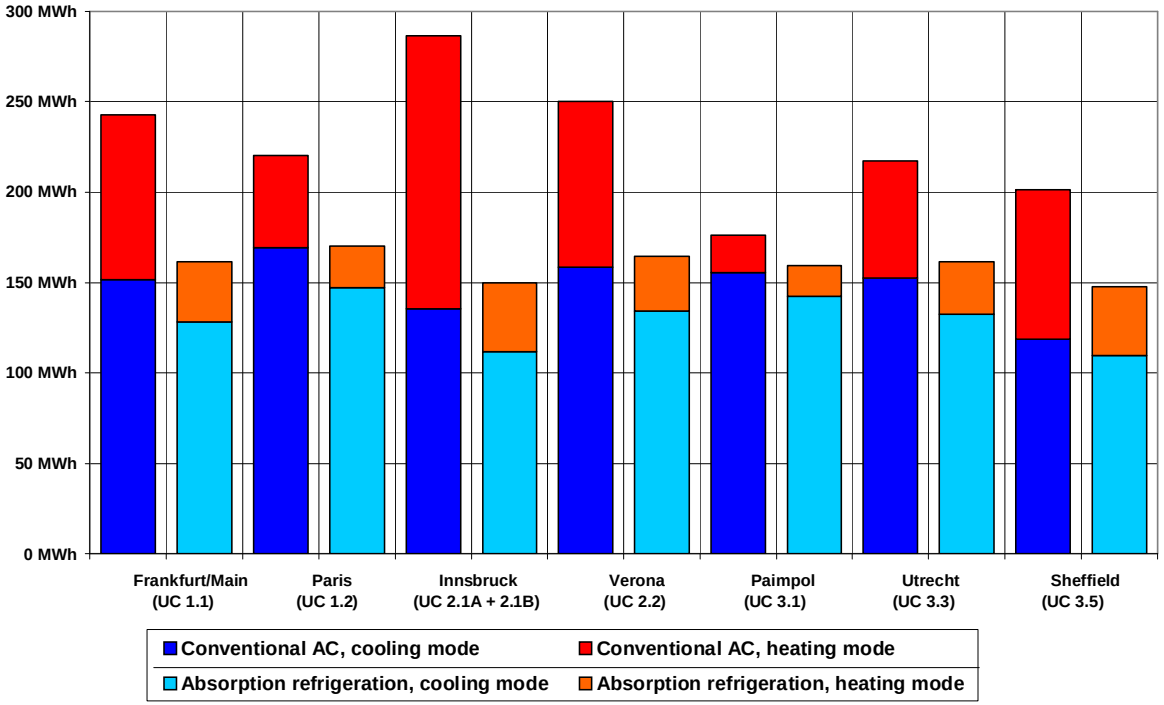
Results achieved and possible implementation

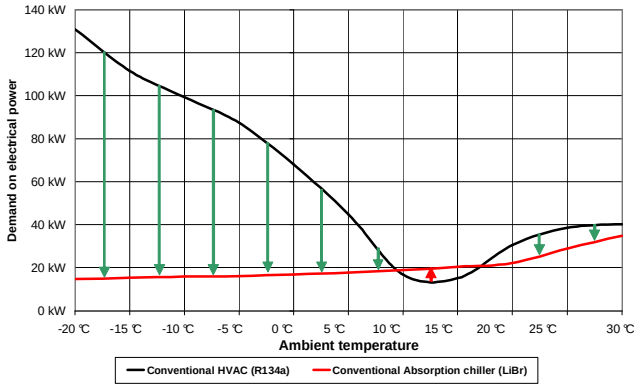
- Feasibility study of a waste heat driven air conditioning system
  - based on a conventional absorption chiller

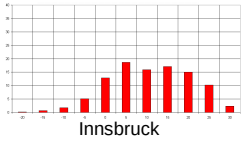


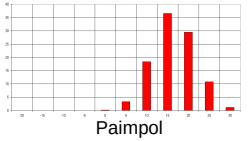
Results achieved and possible implementation

- Saving potential between 17 MWh (10%) and 137MWh (48%)
  - dependent on climatic conditions






Innsbruck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Next Steps & Outlook

- Conventional absorber chillers
  - designed for steady operation
  - size and weight not acceptable for usage in rolling stock

- Possible solution:
  - new generation of membrane absorbers under development
  - polymer pore membranes instead of conventional absorbers
  - weight and volume of the unit can be reduced by up to 80%
  - this leads to a reduction of the needed space for heat exchangers for the cooling circuit

- Optimisation of the cooling circuit
  - Increase of the cooling circuit temperature to reduce the needed installation space of the coolers
  - alternative refrigerants

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Thank you for your attention!

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