

# Industrial heat pumps - from idea to realization -

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Simon Spoelstra

Utrecht  
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# Content

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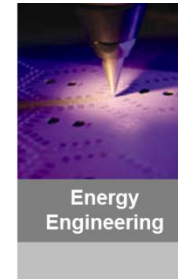
- ECN
- Industrial Heat Technology
- Heat pumps in paper industry
- Summary & Outlook



# ECN - What we do?

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- Problem solving  
*Using our knowledge, technology, and facilities to solve our clients' issues*
- Technology development  
*Developing technology into prototypes and industrial application*
- Studies & Policy support  
*Creating insights in energy technology and policy*



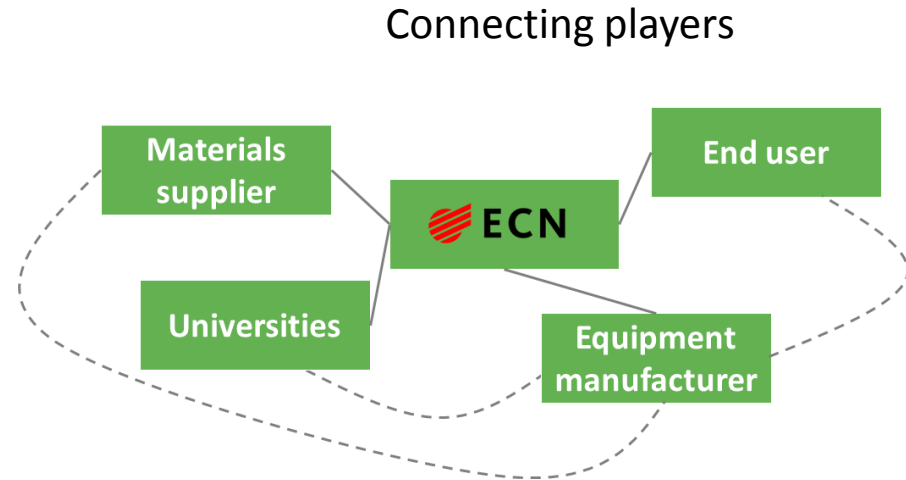
Process & Energy Industry



# How we can work with and for you?

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- Consultancy & Services  
*Serving your short-term needs*
- Contract R&D  
*Supporting your R&D with our knowledge, technology and facilities*
- Technology development & Transfer  
*Implementing our technology in your products & processes*
- Joint Industry Projects  
*Developing tomorrow's technology together*







Industrial Heat Technology

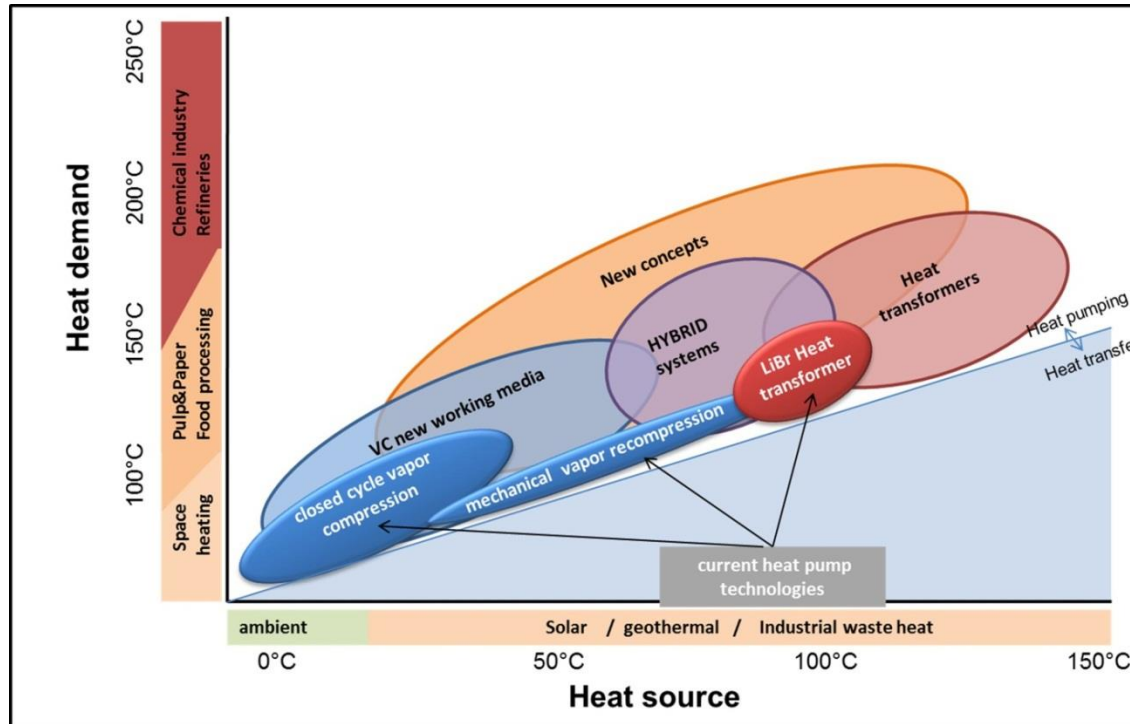
# Industrial energy use & waste heat

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- Use of heat in industry accounts for 80 % of the final energy use
- Temperature level very diverse (< 100°C to > 1000°C)
- Total industrial energy use is available as waste heat
- Amount of waste heat decreases with increasing temperature
- Large heat demand @ high temperature  
Large waste heat sources @ low temperature  
=> Industrial heat pumps



# Heat pump concepts in industry



Energy saving potential estimated in NL: 80 PJ



# Heat pumps in Paper Industry

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- Joint process analysis identified 7 heat pump options
- Benefits SmurfitKappa (SK)
  - Energy costs reduction
  - Closing cycles
  - Reducing foot print
- Benefits ECN
  - SK partner in development and potential customer (22 mills, approx. 50 machines).
- Selected for further development:
  - Short term: Compression heat pump
  - Medium term: Thermoacoustic (2x) & Hybrid Thermochemical,

# Involve Technology partners

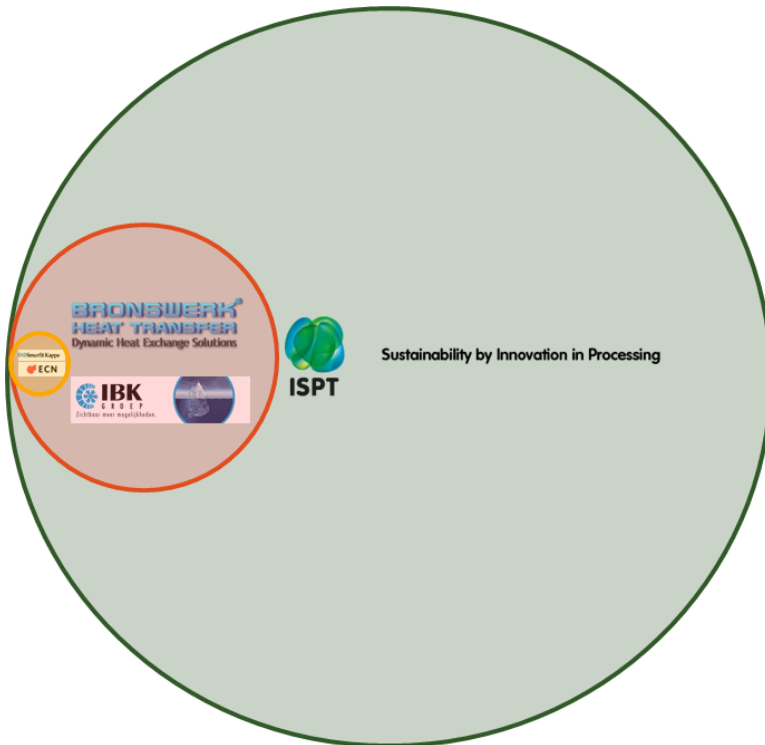
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- **Benefits for SK**
  - Development partners
  - Supply chain in place
- **Benefits for tech suppliers:**
  - IBK to go into new market with their technology
  - BHT from equipment manufacturer to system supplier
  - Enhance innovative & sustainability profile
  - Launching customer
- **Benefits for ECN**
  - Partners to build, market and sell the technology

# Joint Development project

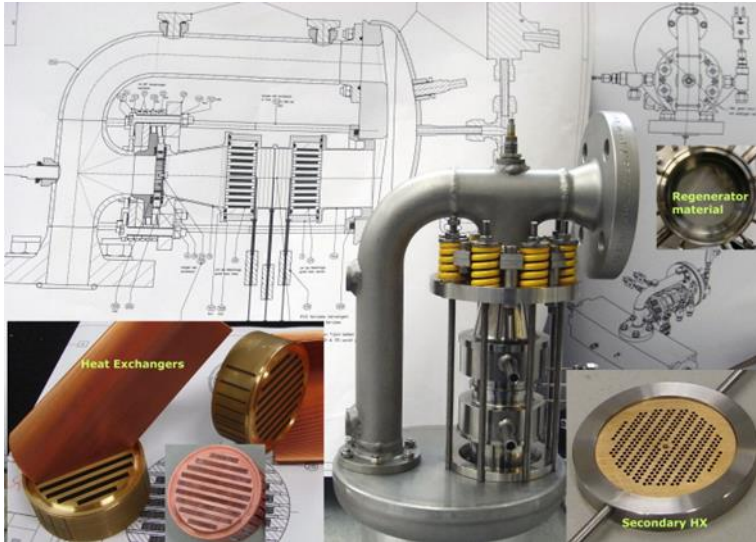
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- **Benefits for ISPT**
  - Strong involvement of industrial partners
  - A balanced mix of short term and medium term developments.
  
- **Benefits for SK, IBK, BHT, and ECN**
  - Partners share the development costs and risks
  - Additional financing via ISPT
  - SK short term perspective on HP benefits
  - IBK, BHT short term perspective on a new market
  - ECN collaborative heat pump development with industrial partners

# Thermoacoustic heat pump

Lab scale (100 W)



Tested for

- 10 -> 80°C
- 50 -> 100°C
- 80 -> 140°C
- Efficiencies approaching 40% of Carnot

Bench scale (10 kW)

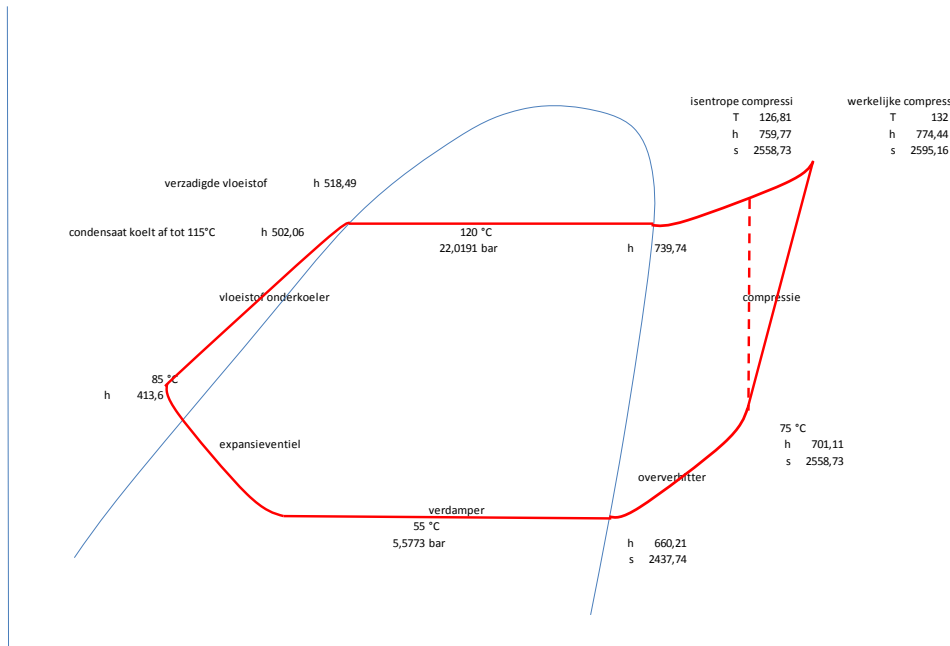


Testing currently underway

# Compression heat pump

From idea

To realization





# Summary & Outlook

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- Large energy saving potential for heat pumps in industry, conservative estimate of 15% of the industrial use for heat.
- New concepts/working media needed for higher operating temperatures and higher temperature lifts
- Technically feasible concepts under development & implementation
- Organise value chain, committing all relevant partners to the development

# Thanks for your attention

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