



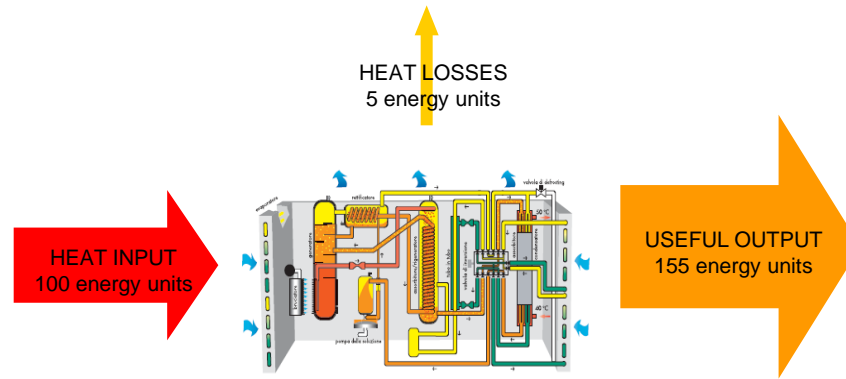
State of Art and Potential of the Gas Absorption Heat Pump Technology

Marco Guerra
Absorption Technology Expert

INTERNATIONAL CONFERENCE
HEAT4U PROJECT January 26th, 2012

Gas Absorption Heat Pump solution
for existing residential buildings

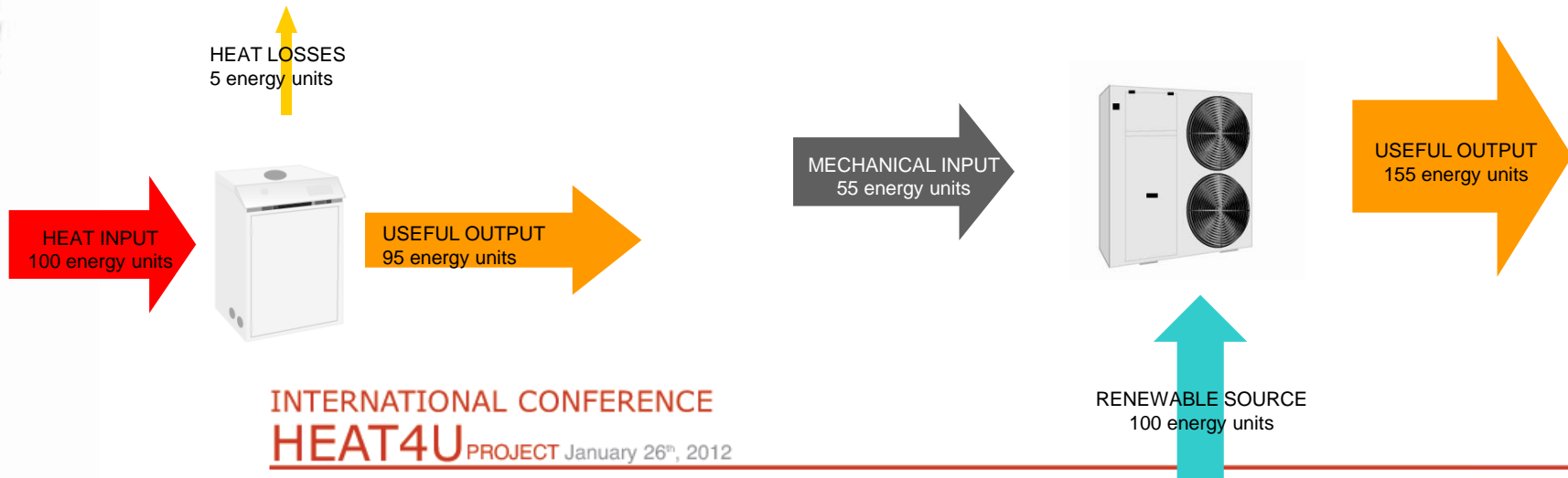
Gas Absorption Heat Pump



Gas Boiler

RENEWABLE SOURCE
60 energy units

Compression Heat Pump



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Heat pump heating systems are already recognized as “the next step” after the condensing boiler to achieve higher efficiencies in buildings

Label classes (efficiency limits and typical examples)

Class	Limit	Examples
A+++	>120%	Vertical el. GSHP, Best Gas Abs. HP
A++	>104%	Gas-fired Abs. HP, Hor. El. GSHP
A+	>88%	Best condens+ solar, Vent. Air HP
A	>80%	Best condens, Outside Air HP
B	>72%	Avg. Condens, Outside Air HP
C	>64%	Best LT, Low Condens
D	>56%	Avg. LT, Best atmo. + solar
E	>48%	Low-end LT, Best atmo.
F	>40%	Avg. atmospheric, Electric res. + solar
G	≤40%	Low-end atmospheric, Electric resistance

LLCC 96%**

LLCC 76%*

Base 54%*

Base 45%**

**= for loads XXL, 3XL, 4XL; *= for other loads



van holsteijn en kemna BV

Ecodesign of Boilers
For European Commission, 2006-'07

31.

Shares of heating sales in Europe

- Approx. 90% residential and light commercial
- 95% + is retrofit / replacement of hydronic systems with radiators



Boiler replacement
is the most significant application
but...

Big Challenge for Heat Pumps...

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The Retrofit Challenge

- Low temperature source access and viability
- Water temp. in excess of 70 C (with -20 C outside ambient temp)
- Modulation of heating capacity
- Domestic Hot Water

The Retrofit Challenge

- Ease of installation for the average installer
- Low noise
- High efficiency but very simple controls
- Low emissions
- Cost versus condensing boiler

Addressing the retrofit challenge with HP

- Renewable source: outdoor air (+ eventual solar support)
- Hydronic system and water temp. >70 C: $\text{NH}_3\text{-H}_2\text{O}$ absorption; double stage compression; CO_2
- >70 C & -20 C outside: absorption or back up boiler
- Latest technology for noise reduction and auxiliary energy (inverter circulators, fans,...)
- Large volumes potential cost reduction

Water Ammonia Gas Fired Modulating Absorption Heat Pumps Benefit

- Highest efficiencies available among heating systems
- Natural refrigerant H₂O+NH₃ ODP=0, GWP=0 Lower CO₂, NOX and particulate emissions
- GAHPs are gas fired, can be air source and deliver temperatures in excess of 70 C

Water Ammonia Gas Fired Modulating Absorption Heat Pumps Benefit

- Hermetic and almost static thermodynamic cycle (long life and maintenance free on the cycle)
- Steel made GAHPs versus copper compression HPs: 1/5 or less material cost

Water Ammonia Gas Fired Modulating Absorption Heat Pumps Benefit

- GAHPs are gas fired:
no extra load to electrical grid
- Absorption technology known since late 1800, but huge potential for GAHPs development

Water Ammonia Gas Fired Modulating Absorption Heat Pumps Benefit

- GAHPs have already reached GUE=160 %
Potential increase up to 190%+ are already possible with advanced cycle design
- High education, strong expertise, technology core competence team required
Adding value to the entire organization

Other Water Ammonia New Technology Application



Self Adaptive Three Pressure Absorption Thermodynamic Cycle

- ❑ Double effect low temperature heat driven absorption cycle
- ❑ Uses pure water-ammonia as the working fluid
- ❑ Suitable for air-cooled and water cooled operations
- ❑ Driven by low grade heat (down to 70 C with air cooled operation)

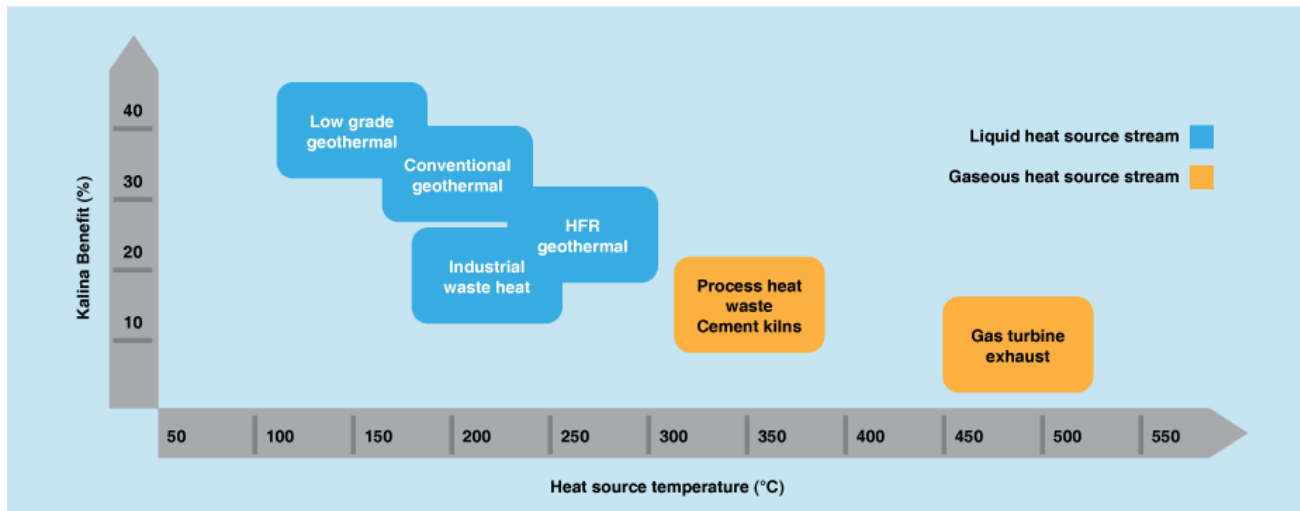
Other Water Ammonia New Technology Application

Applications

- ❑ Suitable for cooling/refrigeration applications (output temperature below 0°C)
- ❑ Automotive AC or truck refrigeration
- ❑ Solar cooling application
- ❑ Trigeneration for combined Heat&Power application

Other Water Ammonia New Technology Application

Kalina Cycle® versus Rankine Cycle





GAHP offer unique opportunity for providing

- Significant energy saving
in EU heating market
- High efficiency product range fitting
in to the real and most demanding
marketplace (the retrofit/replacement)

GAHP offer unique opportunity for

- Shifting the excess manufacturing capacity of the heating industry toward high tech industrial environment
- Creating highly qualified jobs and new proprietary core competence teams
- Exploring other significant possibilities offered by the same core technology