Decarbonisation with industrial heat pumps: Policy & program update from Australia

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Producing more with less energy

More: $$$ Less: 🌐💡蝼

Instead of focussing on just ‘saving energy’, we focus more on production, yield and value.
Industrial heat pumps are not new, so why now?

Decarbonisation commitments

Cheap solar & wind (vs gas)

IOT / Industry 4.0

+ Carbon border adjustment mechanisms

$15 per MWh by 2050

>80% reduction in cost for connectivity in last 10 years
Structural changes in energy use

- **Electrification & demand management**
- **Bioenergy**
- **Green hydrogen / ammonia / methanol**
- **Circular economies value chain approach**

- Decarbonisation with fuel switching
- Decentralised manufacturing
How do heat pumps improve efficiency? C.O.P.

A steam boiler may be >80% efficient during normal operation but the steam system is likely less than 70% efficient when allowing for hidden losses:

60-90% × 70-85% × 80-95% × ??% = <30-75%

• Expect a heat pump to operate with a COP of at least 3
• Compared to a steam boiler operating at a COP of 0.7
• That is an improvement of >400%
Types of heat pumps

- **Closed cycle**
  - Absorption heat pumps
  - Mechanical vapor compression
  - Adsorption heat pumps
  - Other kinds
  - Mechanical vapor recompression

- **Open cycle**
  - Thermal vapor recompression

‘Compression heat pumps’
Or reverse cycle refrigerators
Main solution small to medium (<1MW) low-temperature heating

MVRs
Main solution for large (>1MW) industrial, heating 80-250°C

Industrial heat pump applications

Application examples of industrial heat pumps

Temperature levels of industrial processes and HP technology readiness

How much decarbonisation is possible?

Approximately 20% of Australia’s emissions is from stationary combustion (boilers, burners, etc.)

Of this, ~10-15% can be electrified with heat pumps, mainly via MVR technology in the alumina industry

~3% of total emissions can be abated
5 steps to support change

1. Reduce ROI hurdles: Energy savings / carbon savings certificates
2. Create awareness and learning opportunities: Scoping studies + funded feasibility studies
3. Remove (perceived) barriers for changing: Funded feasibility studies
4. Help first movers adopt the technology: Co-funding grants
5. Socialise the learnings: Knowledge-sharing & training
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A2EP Renewable heat feasibility studies

- AU$2m program funded by Australian Renewable Energy Agency
- Completed in two phases from 2018 to 2021
- 20 pre-feasibility & 7 feasibility studies completed across food, beverage and industrial sectors
- Assessed feasibility of renewable heating methods: heat pumps, solar thermal, biogas and geothermal
Study results

• All projects with heat demand below 90°C selected heat pump technology for renewable heating

• Typical payback periods of 5 - 6 years

• Expecting >60% of projects to proceed with heat pump investment

• Positive results for several industries
  • Wine, beer, beverage, chocolate, malting, abattoir, veg processing, pet food

• Capability of advisors was lacking to optimise the integration of a heat pump

• Heat pump suppliers for >90°C are focussed on Europe and Japan, not Australia (or USA!)
Lessons learnt: 1\textsuperscript{st} lesson

It’s all about capacity factor (& heat recovery)
Lessons learnt: 2\textsuperscript{nd} lesson

An integrated design approach overcomes high electricity to gas price ratios
Lessons learnt: 3rd lesson

• Right-size the heat pump, don’t go for a like-for-like replacement.

• Expect the heat pump to be <50% of the nameplate capacity compared to the steam boiler it replaces.
Knowledge-sharing by A2EP

• 10 webinars in last 18 months
• LinkedIn and other social media
• Reports, publications and a new website
• Podcasts to promote findings
• >20 direct contacts with end users to help knowledge sharing from pre-feasibility studies (breweries, malting, aquatic centres)
A new resource for industry

https://www.futureheat.info/

• 11 renewable heat publications and links to important websites
• >10 hours of webinars
• 6 case studies
• + suppliers
Heat pump selection tool

Basic sizing tool developed to give quick CAPEX and OPEX guide
New publication

A how-to guide for optimising industrial heat pump integration.

View this report at futureheat.info
Other useful publications

https://www.a2ep.org.au/publications
Australian Alliance for Energy Productivity (A2EP)
Promoting energy productivity to support business success, jobs growth and the transition to a decarbonised economy.
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Thank you

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