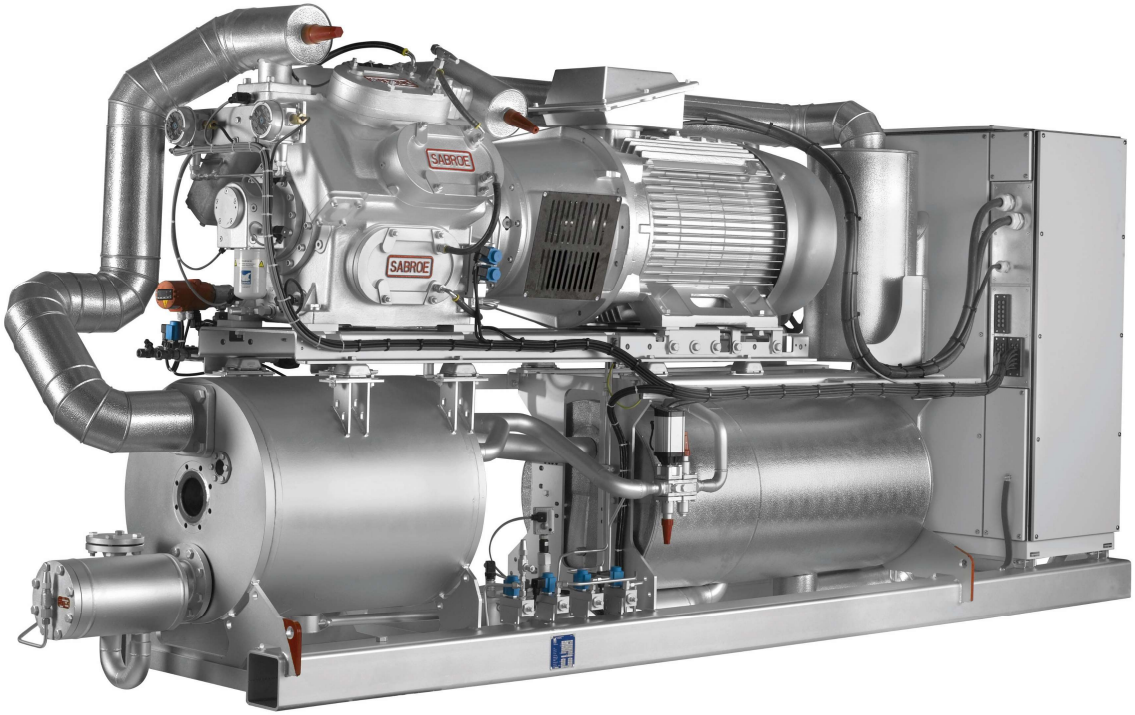

AUSTRALIAN ALLIANCE FOR ENERGY PRODUCTIVITY

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

Jarrod Leak, Chief Executive Officer
Australian Alliance for Energy Productivity

6 April 2022

Our members and partners

FELLOWSHIP LEVEL

SUPPORTER LEVEL

SUPPORTER LEVEL

Energy productivity and decarbonisation

Producing more with less energy

More:

Less:

Instead of focussing on *just* ‘saving energy’, we focus more on **production**, **yield** and **value.**

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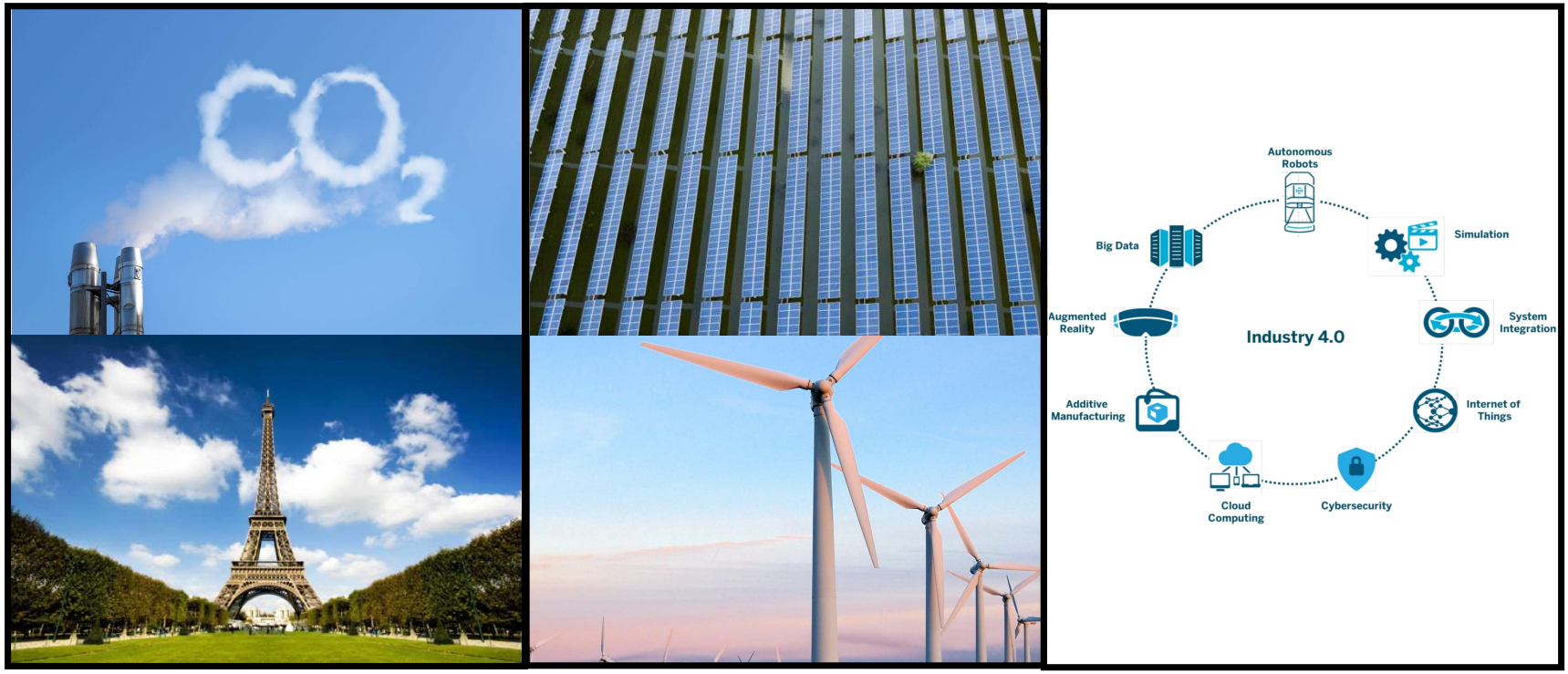
Industrial heat pumps are not new, so why now?

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

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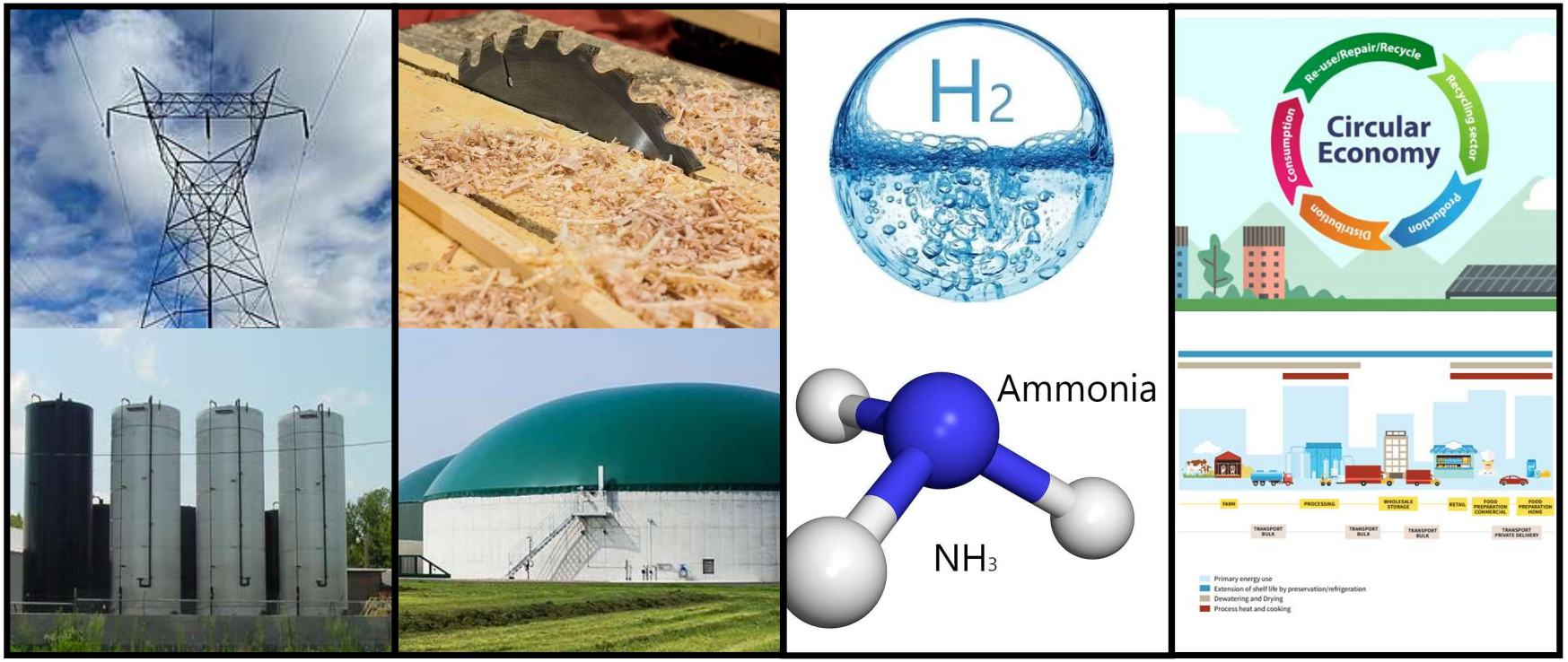
Structural changes in energy use

Electrification & demand management

Bioenergy

Green hydrogen / ammonia / methanol

Circular economies value chain approach



Decarbonisation with fuel switching

Decentralised manufacturing

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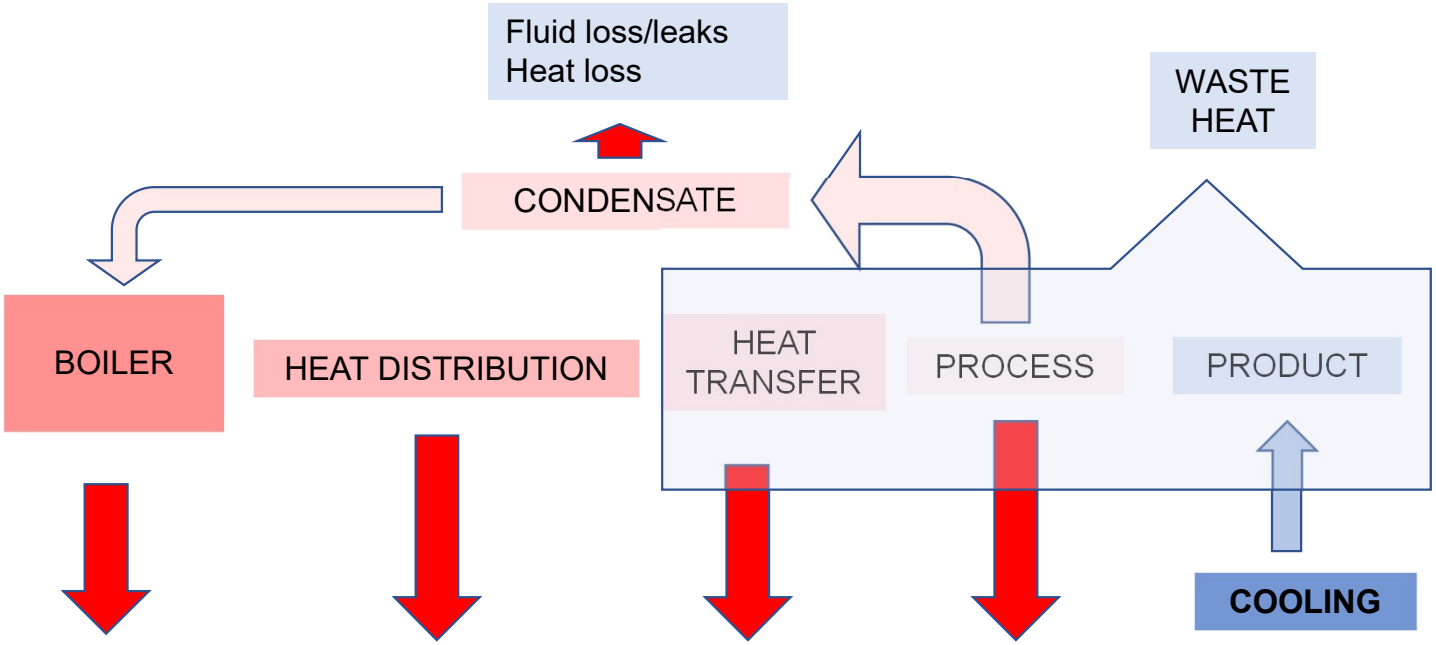
How do heat pumps improve efficiency? C.O.P.



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

60-90%	X	70-85%	X	80-95%	X	??%	=	<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%

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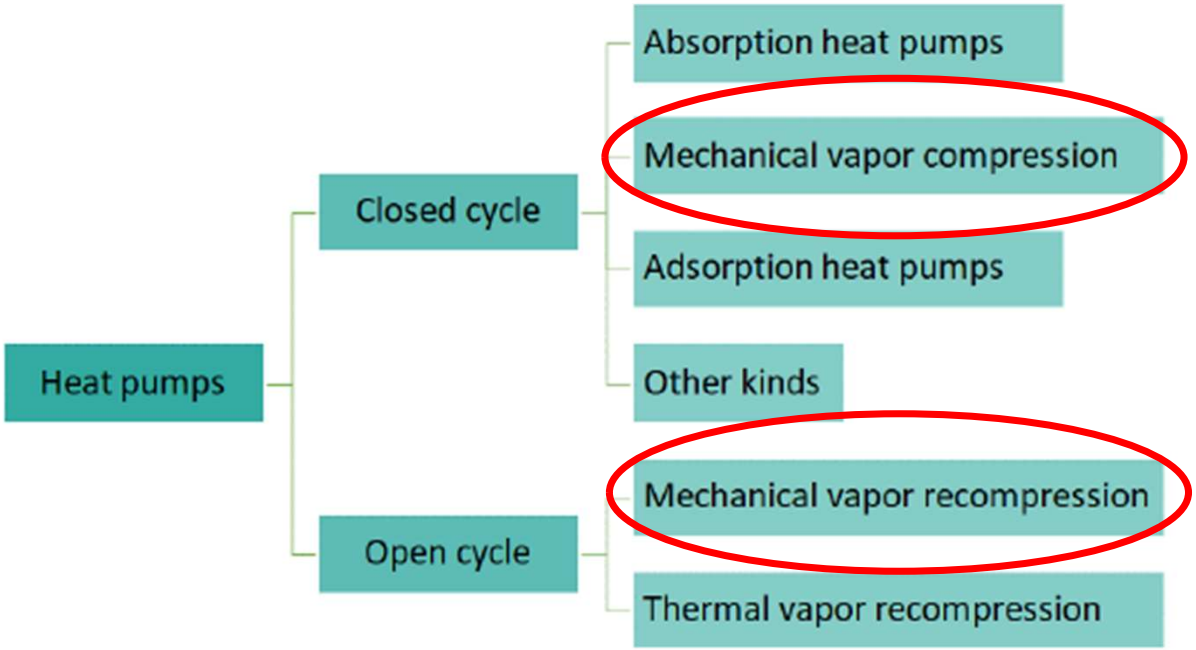
Types of heat pumps



‘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

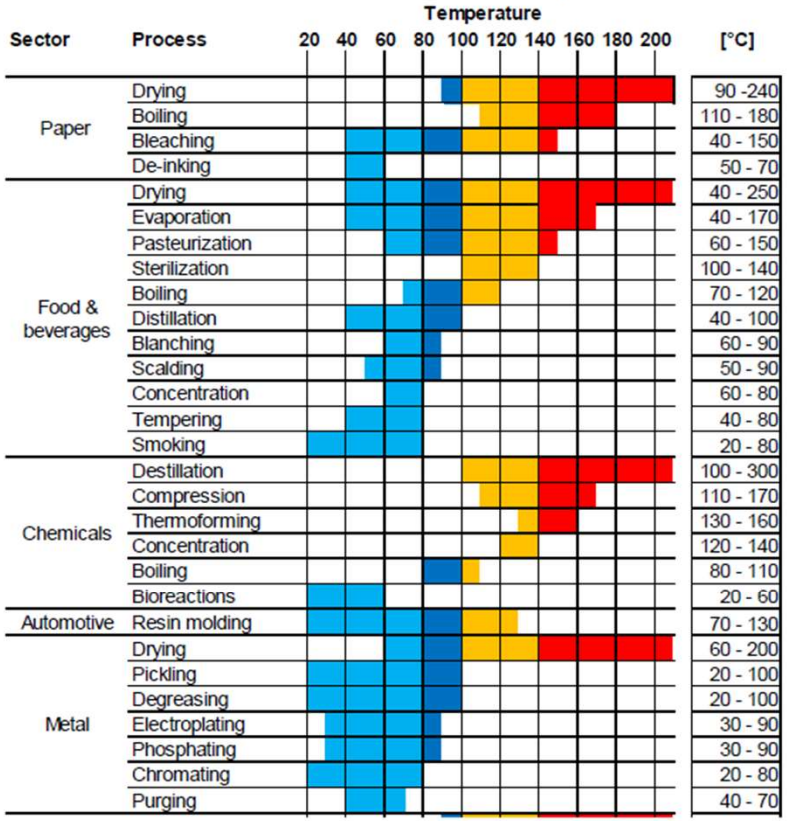
Source: Wu D, Hu B, Wang RZ. Vapor compression heat pumps with pure Low-GWP refrigerants. Renewable and Sustainable Energy Reviews. 2021;138:110571.

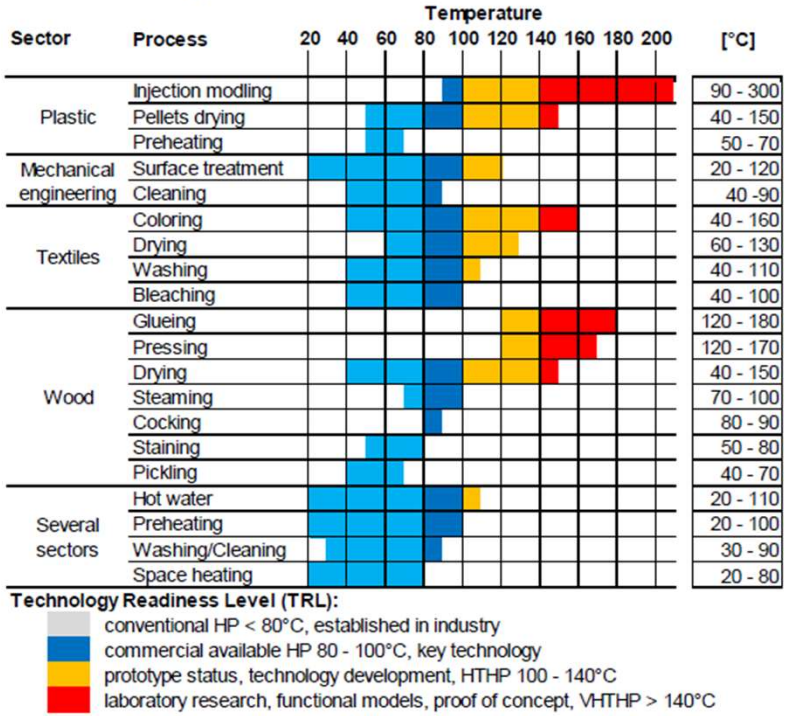
Industrial heat pump applications

Application examples of industrial heat pumps

NTB
Interstate University of Applied Sciences of Technology Buchs
University of Applied Sciences

Temperature levels of industrial processes and HP technology readiness





Data sources: Brunner et al. (2007), Hartl et al. (2015), IEA (2014), Kalogirou (2003), Lambauer et al. (2012), Lauterbach et al. (2012), Noack (2016), Ochsner (2015), Rieberer et al. (2015), Watanabe (2013), Weiss (2007, 2005), Wolf et al. (2014)

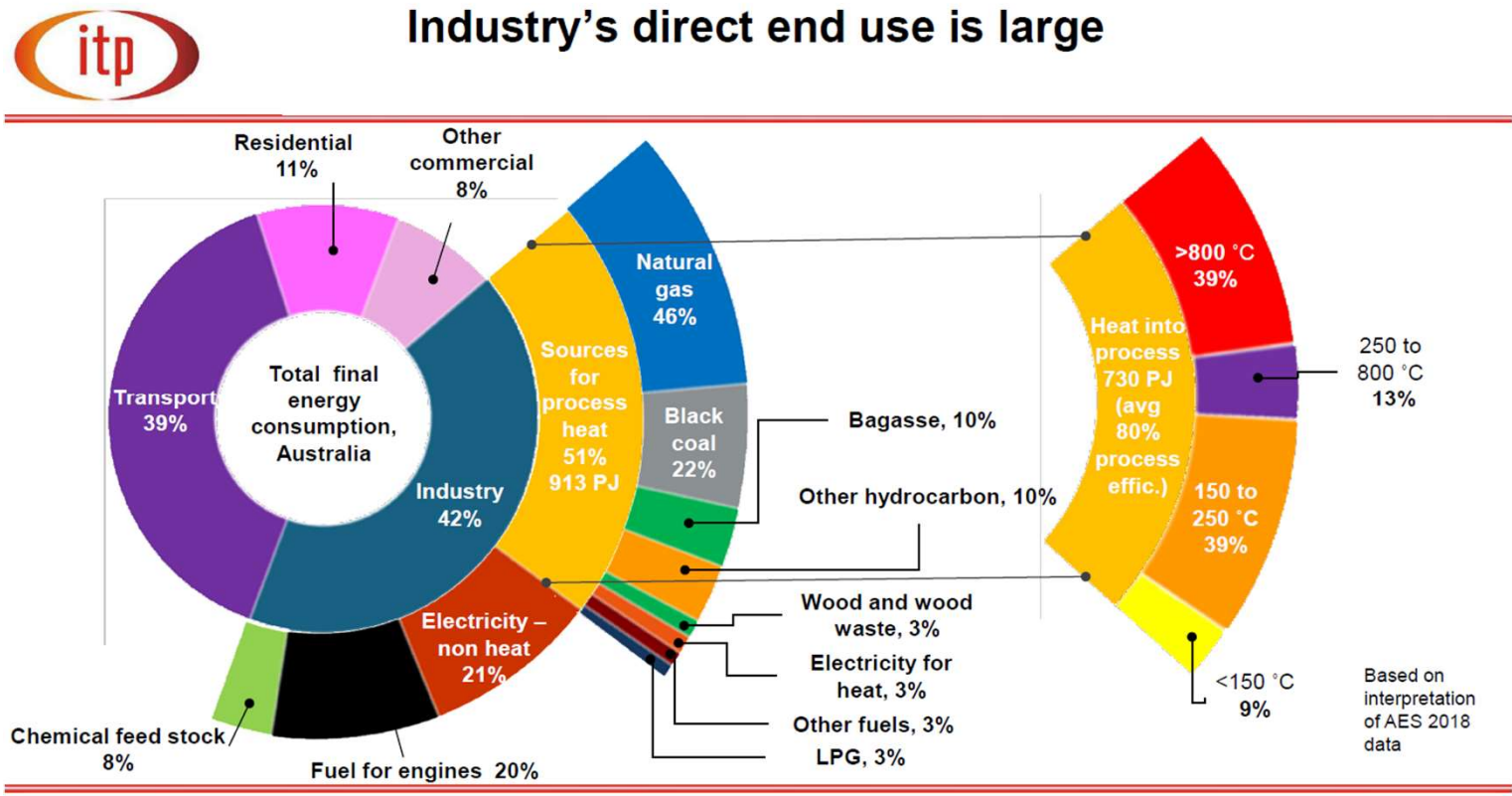
cordin.arpagaus@ost.ch

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



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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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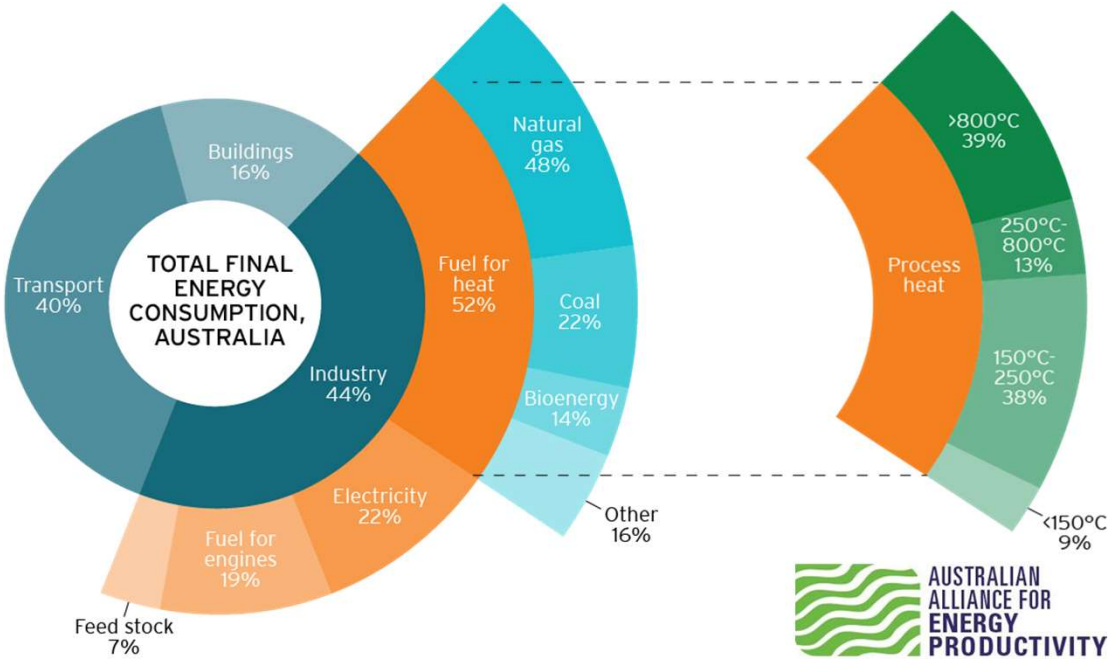
A2EP Renewable heat feasibility studies

- 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

Australian Government
Australian Renewable Energy Agency

ARENA



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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!)

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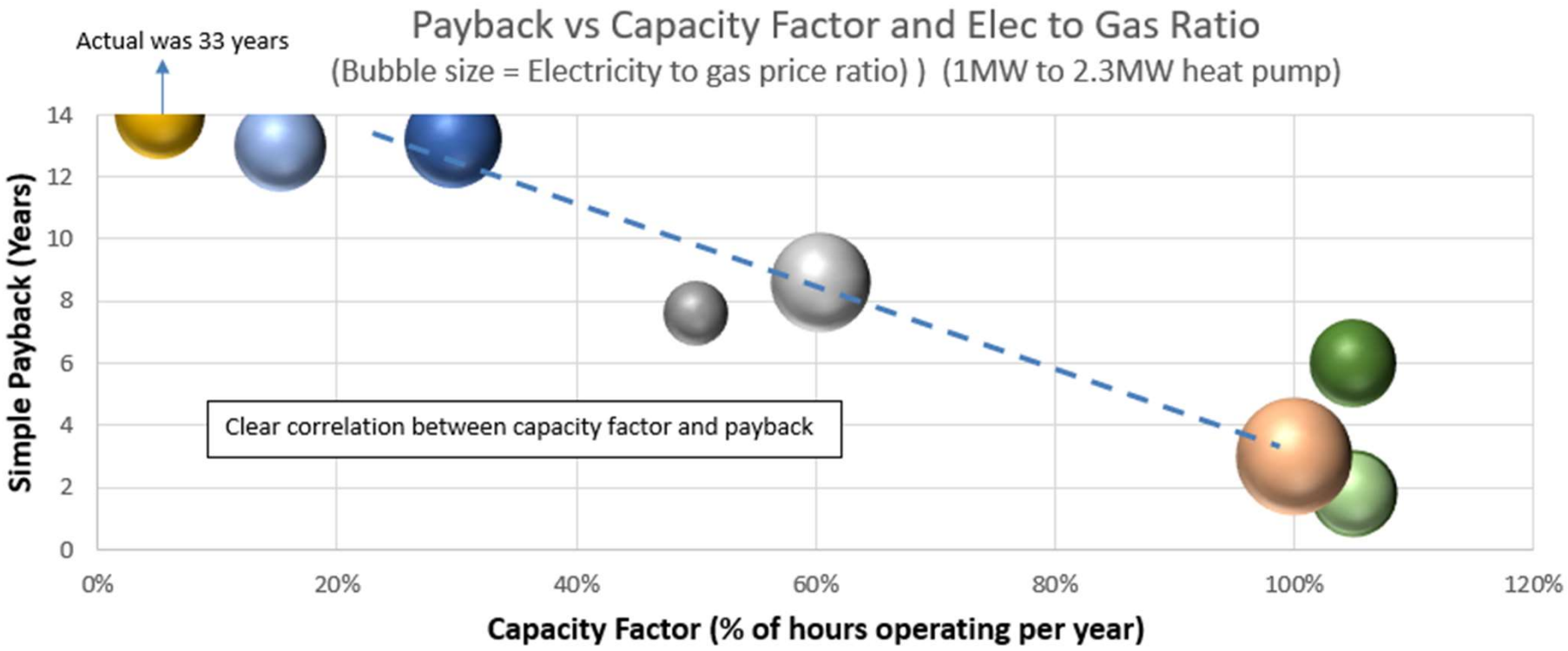
Lessons learnt: 1st lesson

It's all about capacity factor (& heat recovery)



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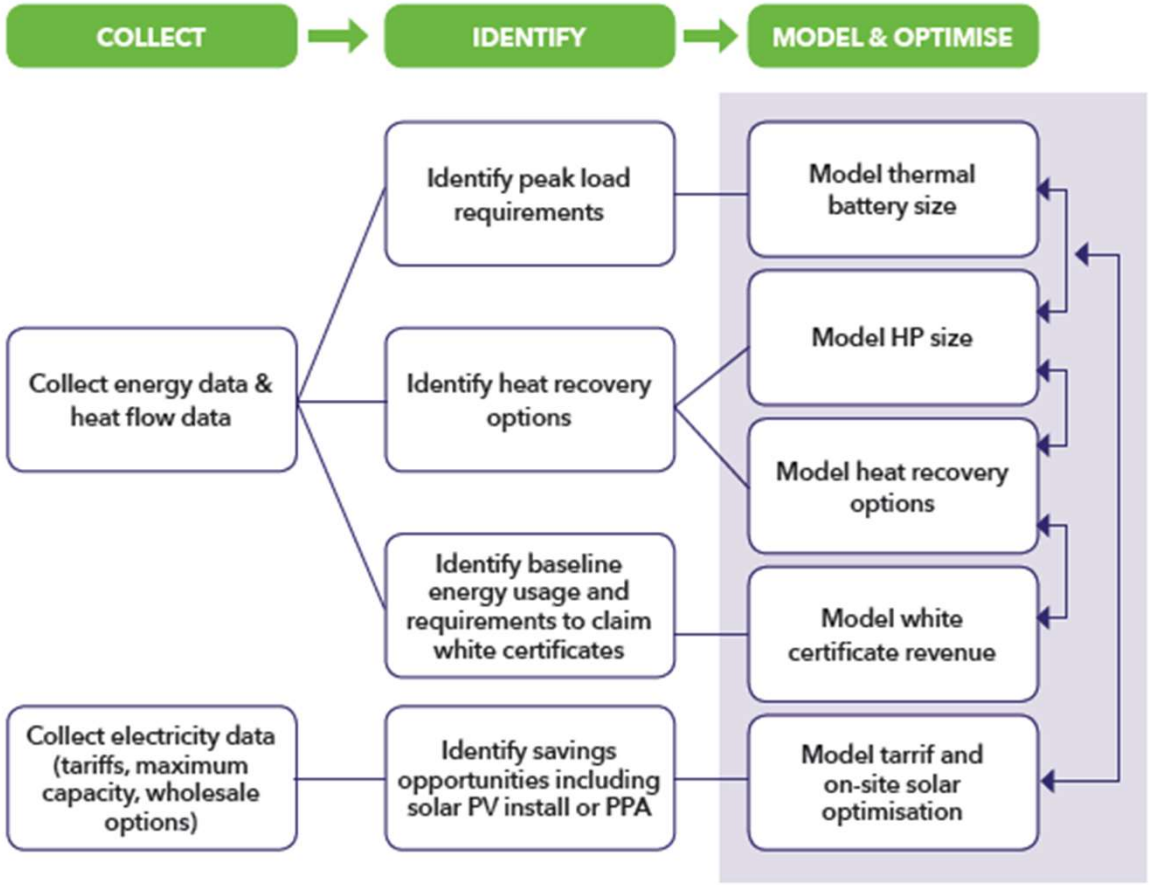
Lessons learnt: 2nd lesson

An integrated design approach overcomes high electricity to gas price ratios



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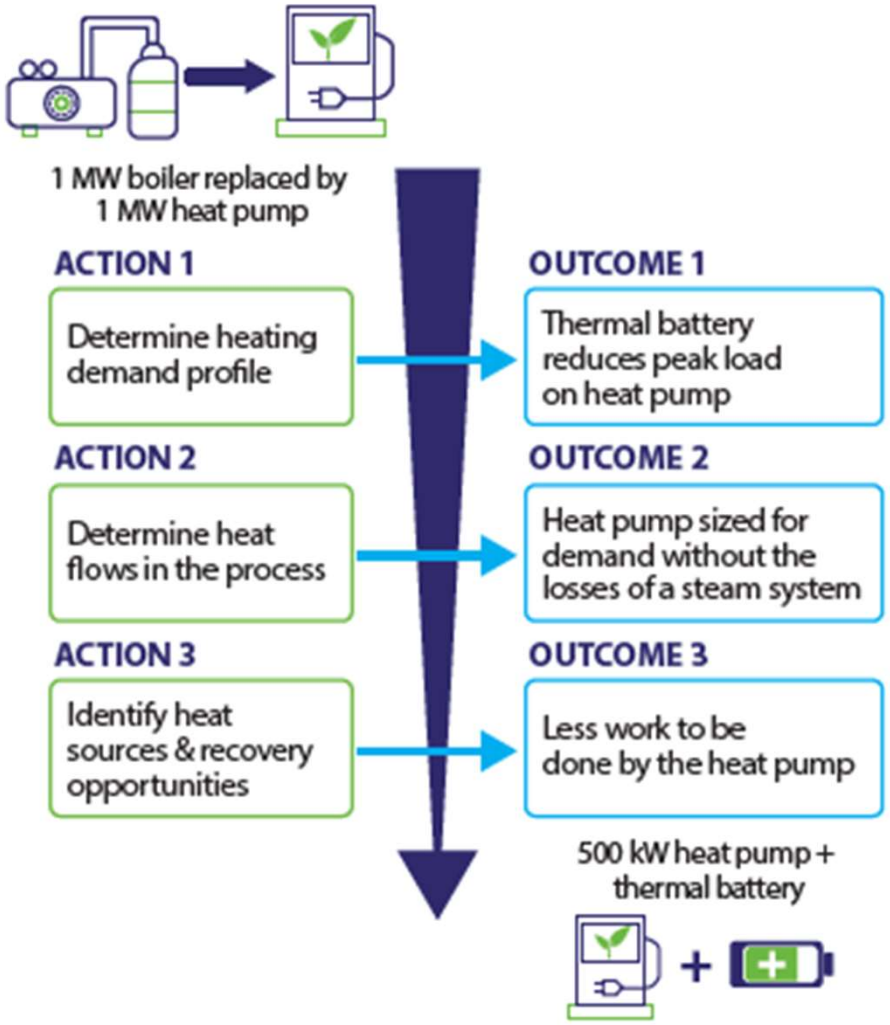
Lessons learnt: 3rd lesson

- 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.



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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)

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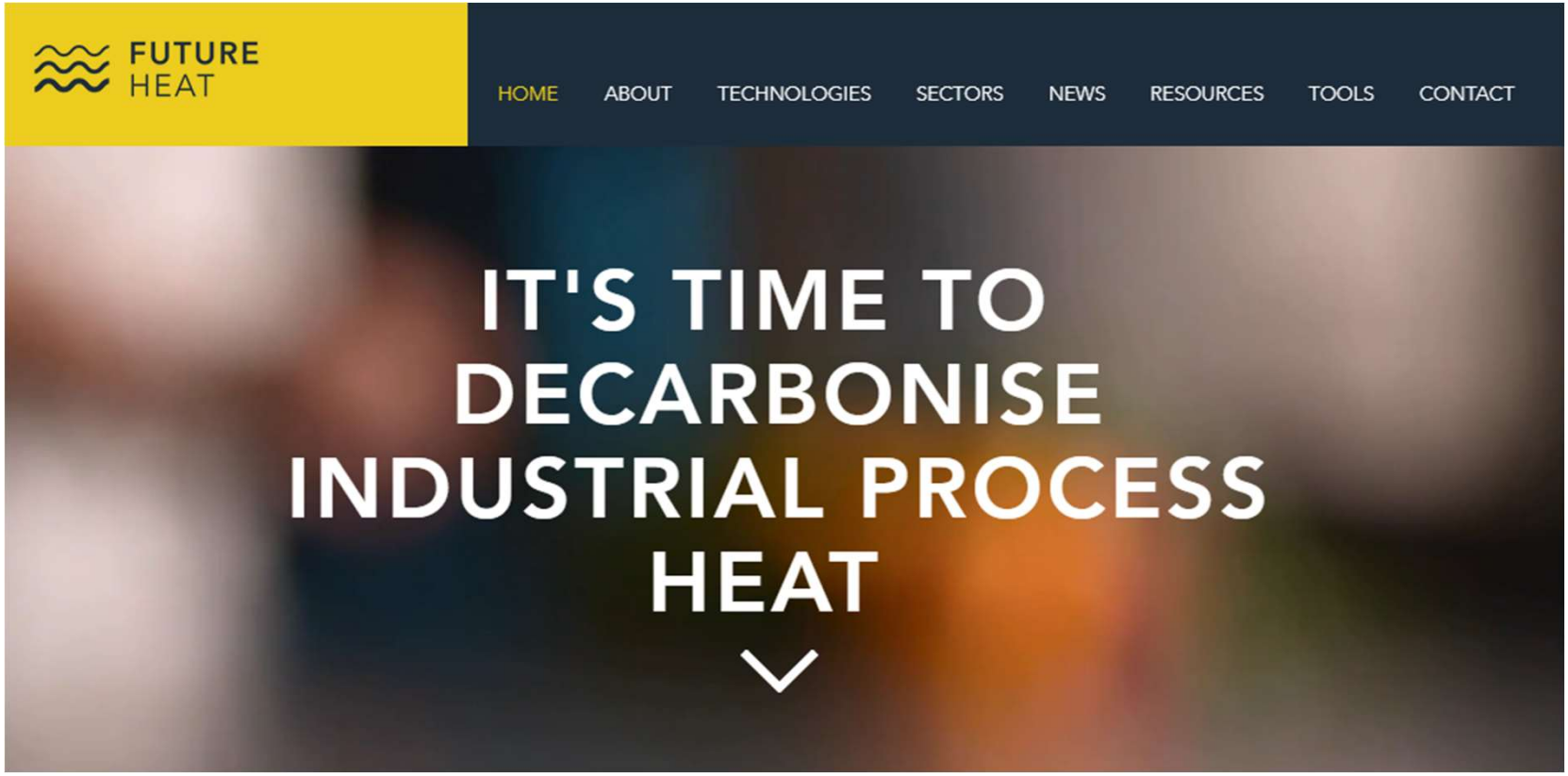
A new resource for industry

https://www.futureheat.info/

- 11 renewable heat publications and links to important websites
- >10 hours of webinars
- 6 case studies
- + suppliers



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Heat pump selection tool

Manual Inputs (Basic)

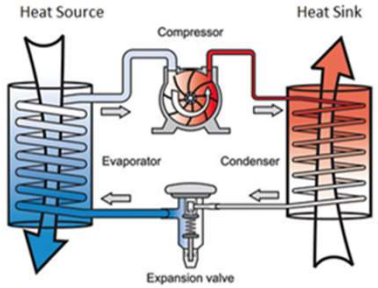
Current heating fuel cost ($/GJ)	11
Annual Process Heating Cost ($ p.a.)	
Process Hours of Use p.a.	8700
Current electricity cost ($/kWh)	0.11
Heat source	Air
Location	

Image source: http://www.veoliawater2energy.com/en/references/heat-pumps/

Average heat required (kW)	1500
Peak heating requirement (kW) - if known	2000
Maximum hours of continuous peak heating use (hrs)	9

Heat source in temperature (C)

65 Heat sink out temperature (C)



Average heat sink return

Manual Inputs (Advanced)

Heat source air temperature (C)	8
Current heating system efficiency (%)	50
Other operating costs of current system ($ p.a.)	
Capital cost of current heating system ($)	
Current system rated life (yr)	
discount rate for NPV calculation (%)	
Portion of energy use of heat pumps from solar (%)	

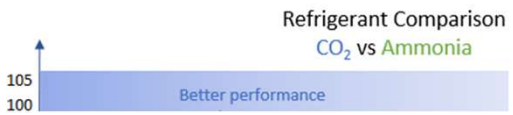
Heat source out temperature (C)

Is cooling usable?

30 Average heat sink return/in temperature (C,

Outputs

	Ammonia (R717)	CO2 (R744)
Annual heating energy use (MJ)	46,980,000	46,980,000
Heat pump size required (kW thermal)	1500	1500
COP (heating)	3.3	3.5
COP (cooling)	0.0	0.0



Basic sizing tool developed to give quick CAPEX and OPEX guide

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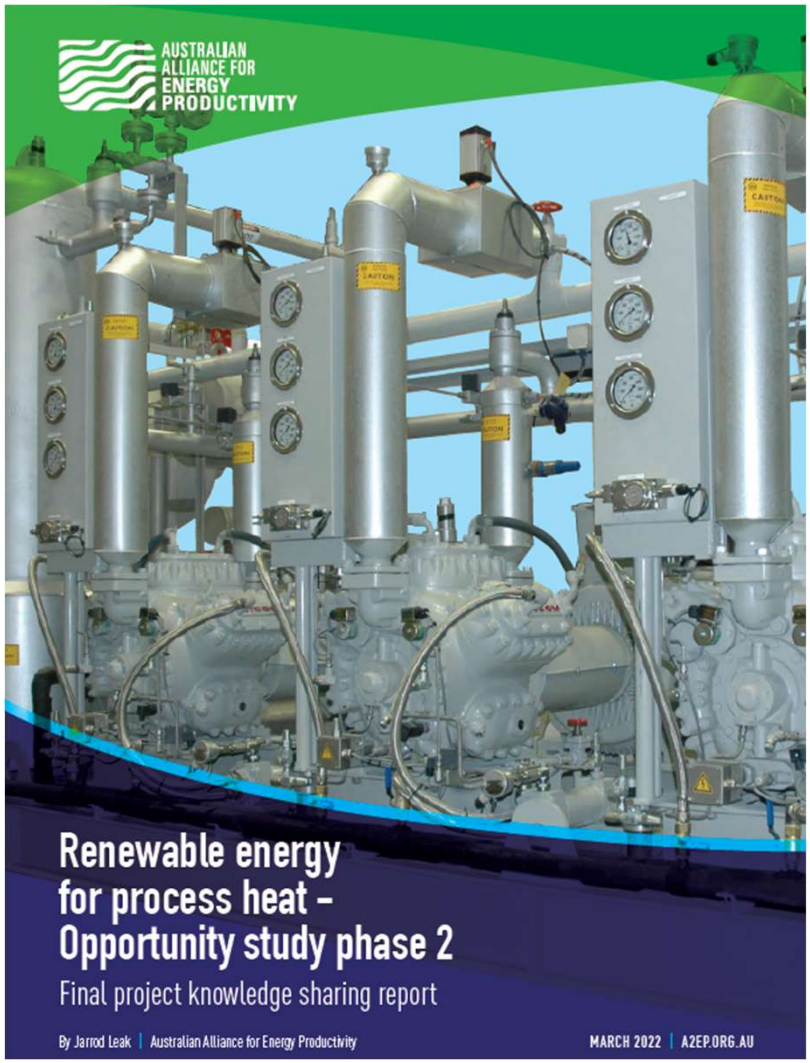
New publication

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

View this report at futureheat.info



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Other useful publications

https://www.a2ep.org.au/publications

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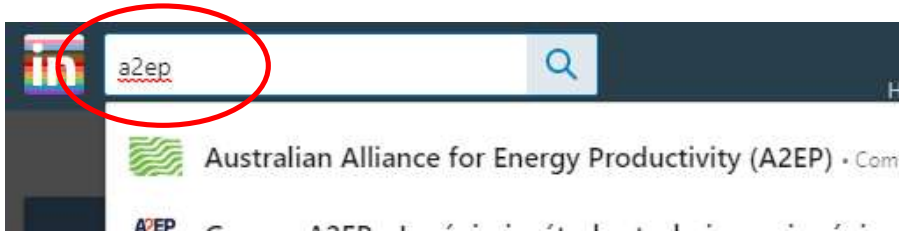
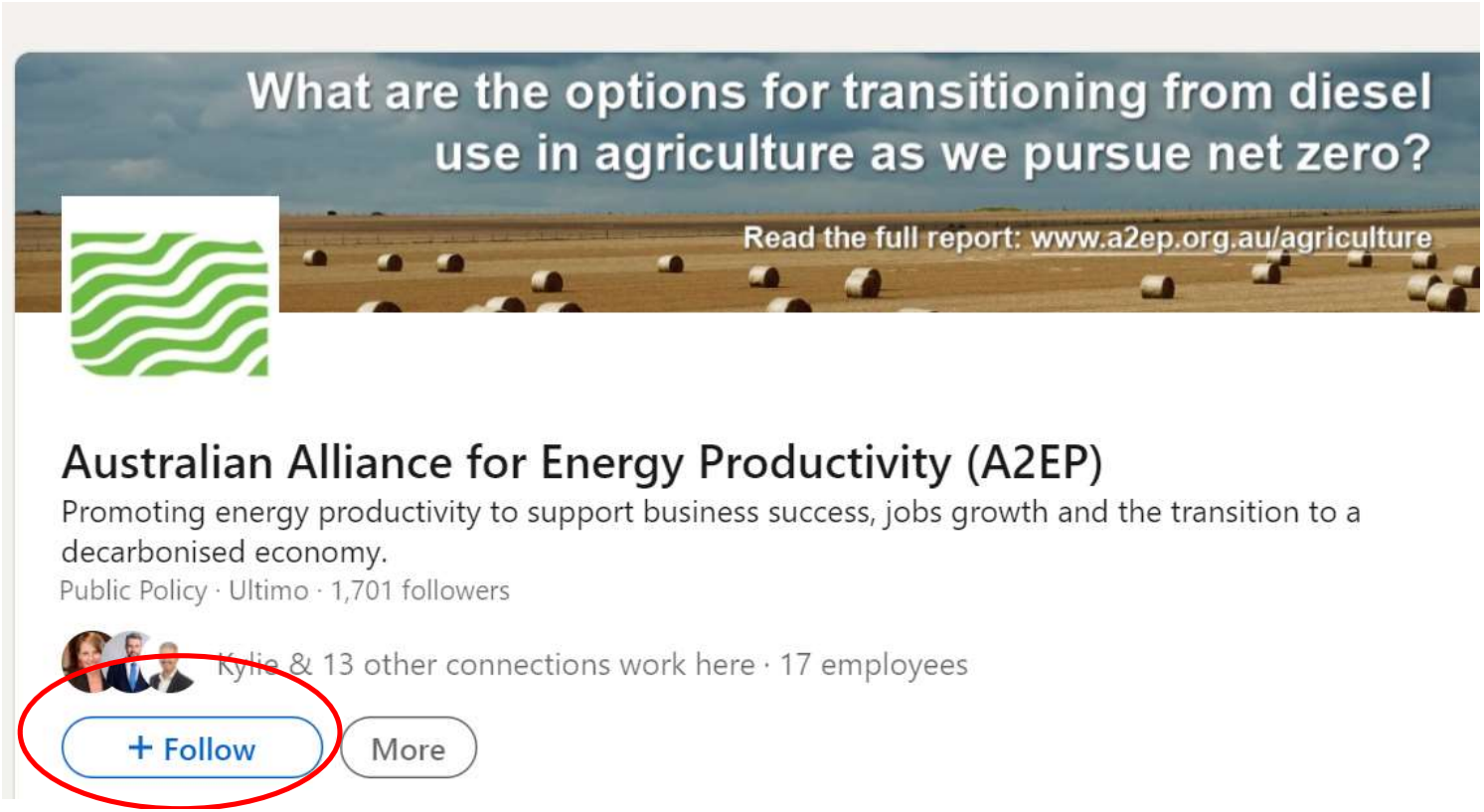
Want more?

https://www.a2ep.org.au





Thank you

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