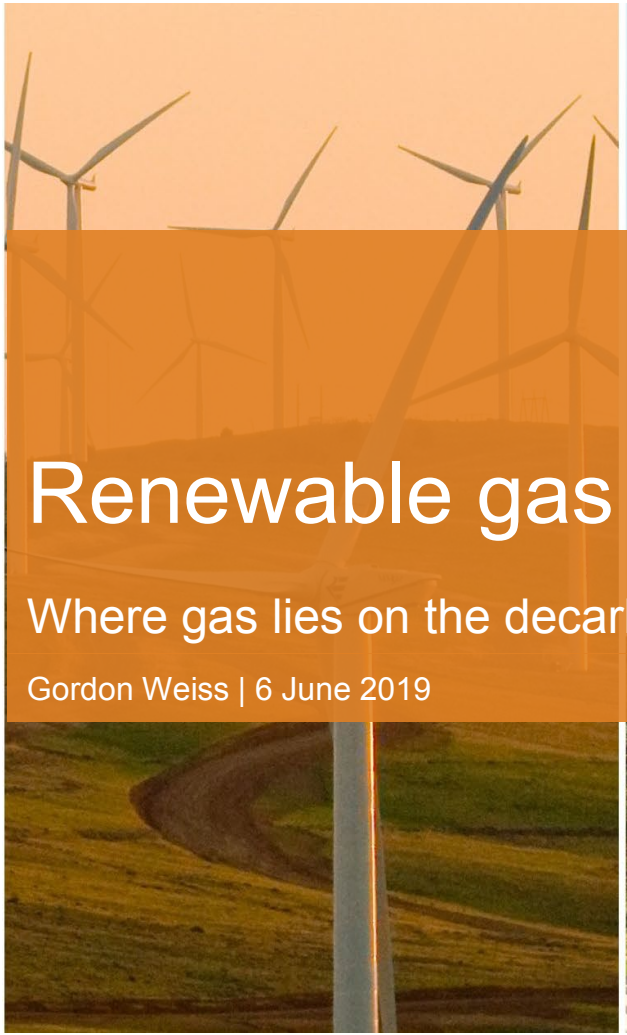


Renewable gas for the future

Where gas lies on the decarbonisation pathway

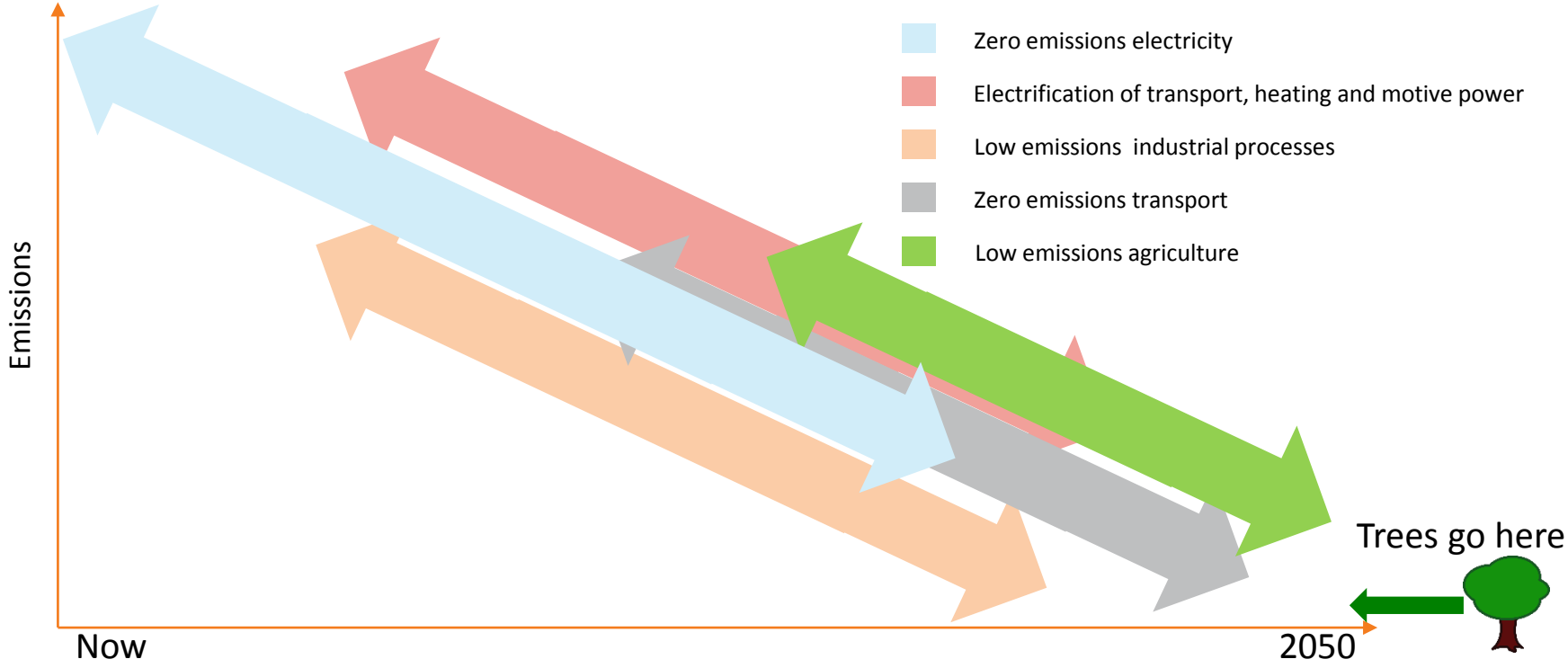
Gordon Weiss | 6 June 2019

Agenda

1. The abatement task
2. Renewable gas and electricity
3. Renewable gas and heating
4. Final thoughts

energetics

The journey to zero emissions



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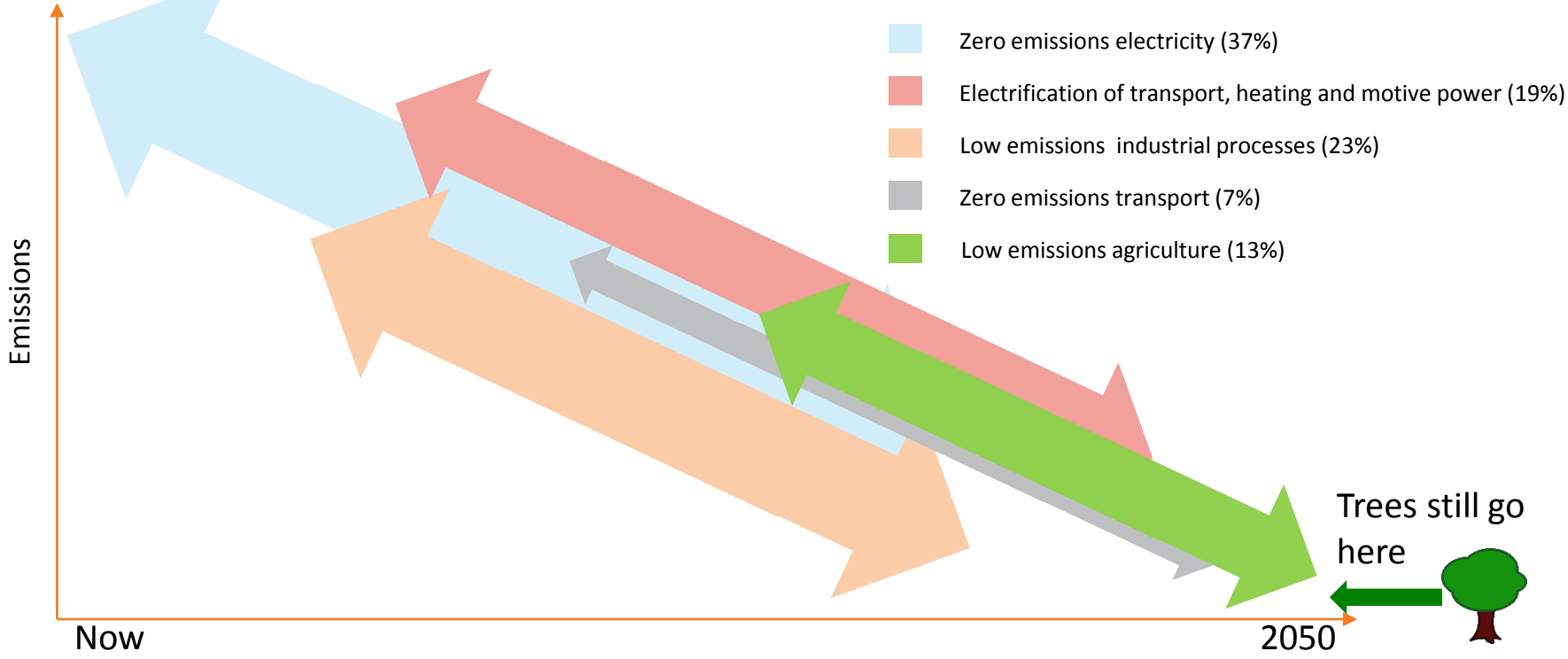
The journey to zero emissions



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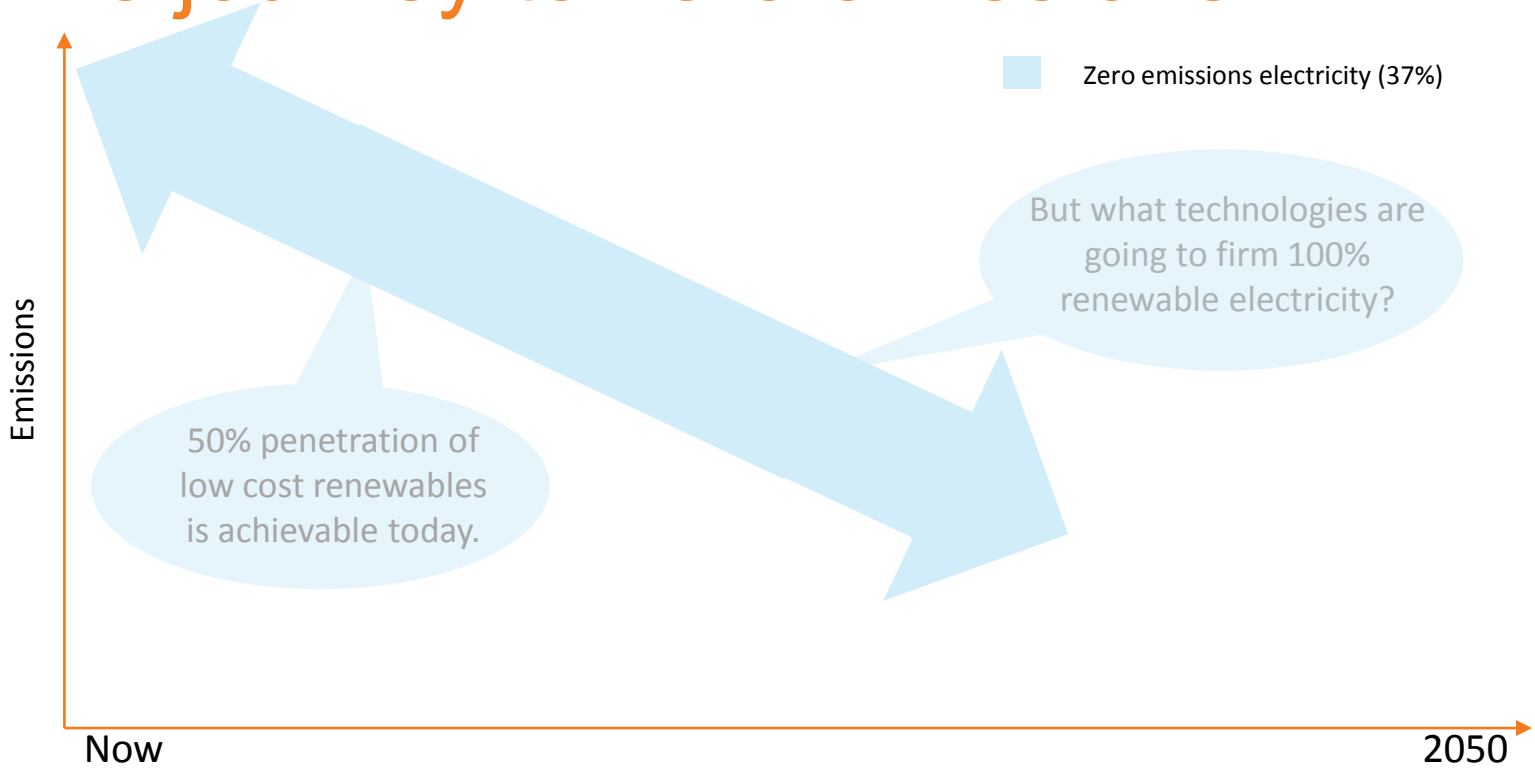
The journey to zero emissions



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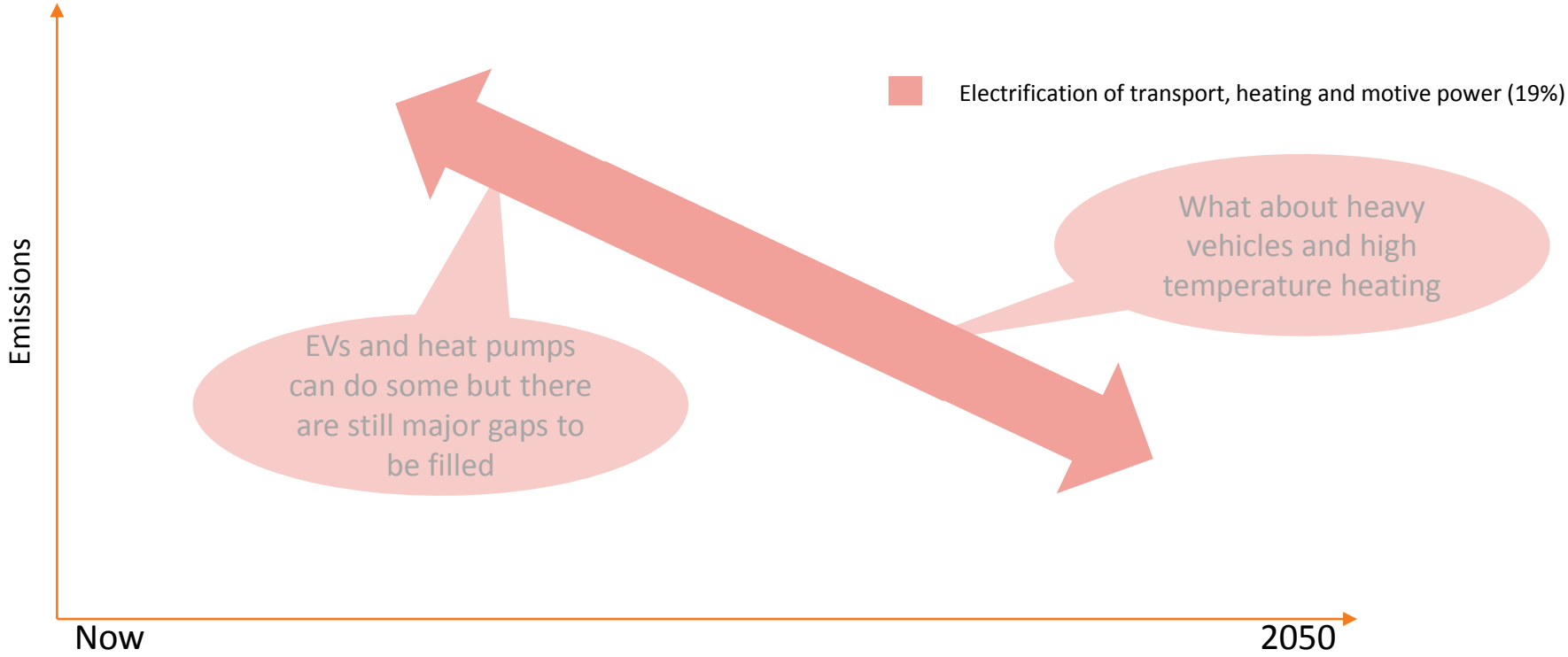
The journey to zero emissions



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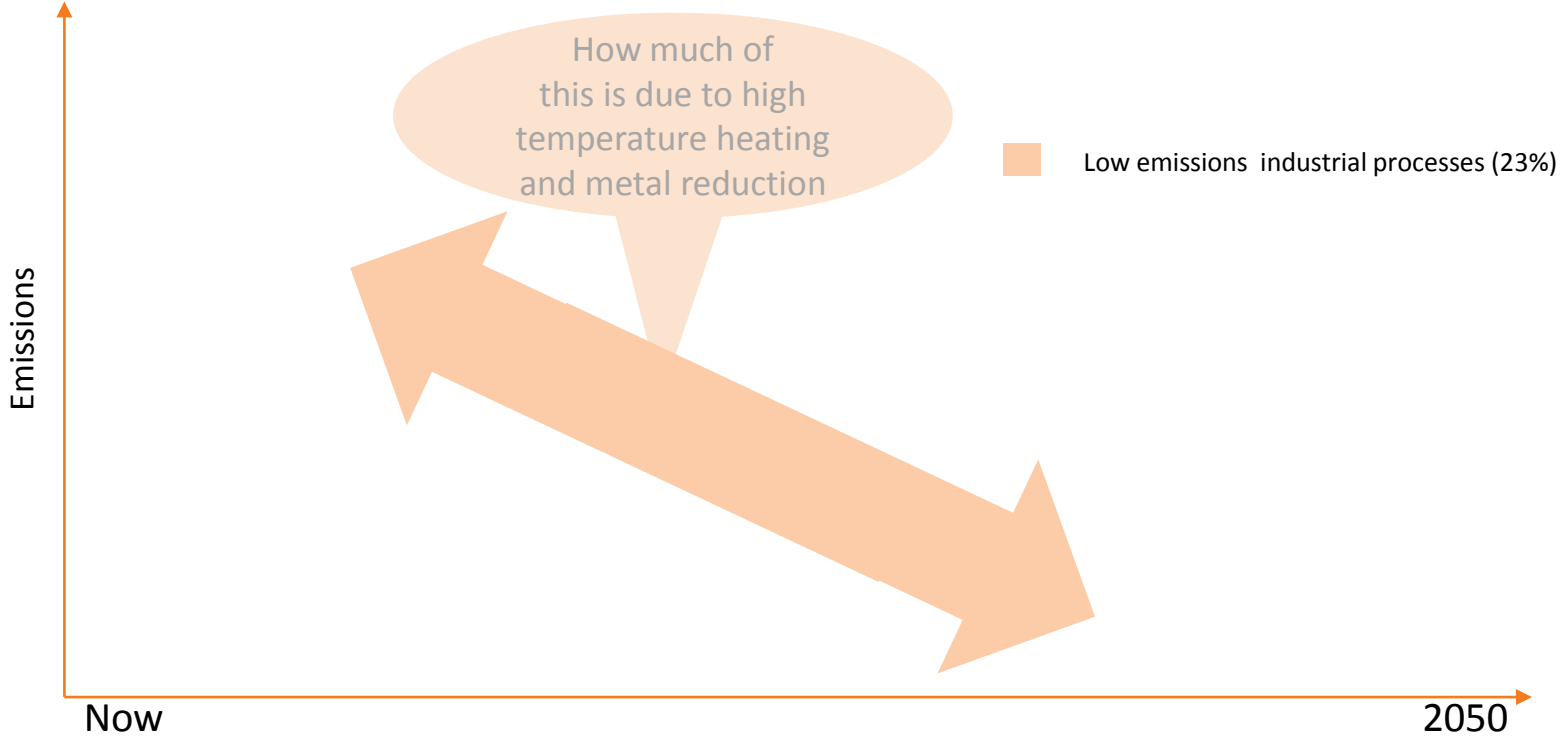
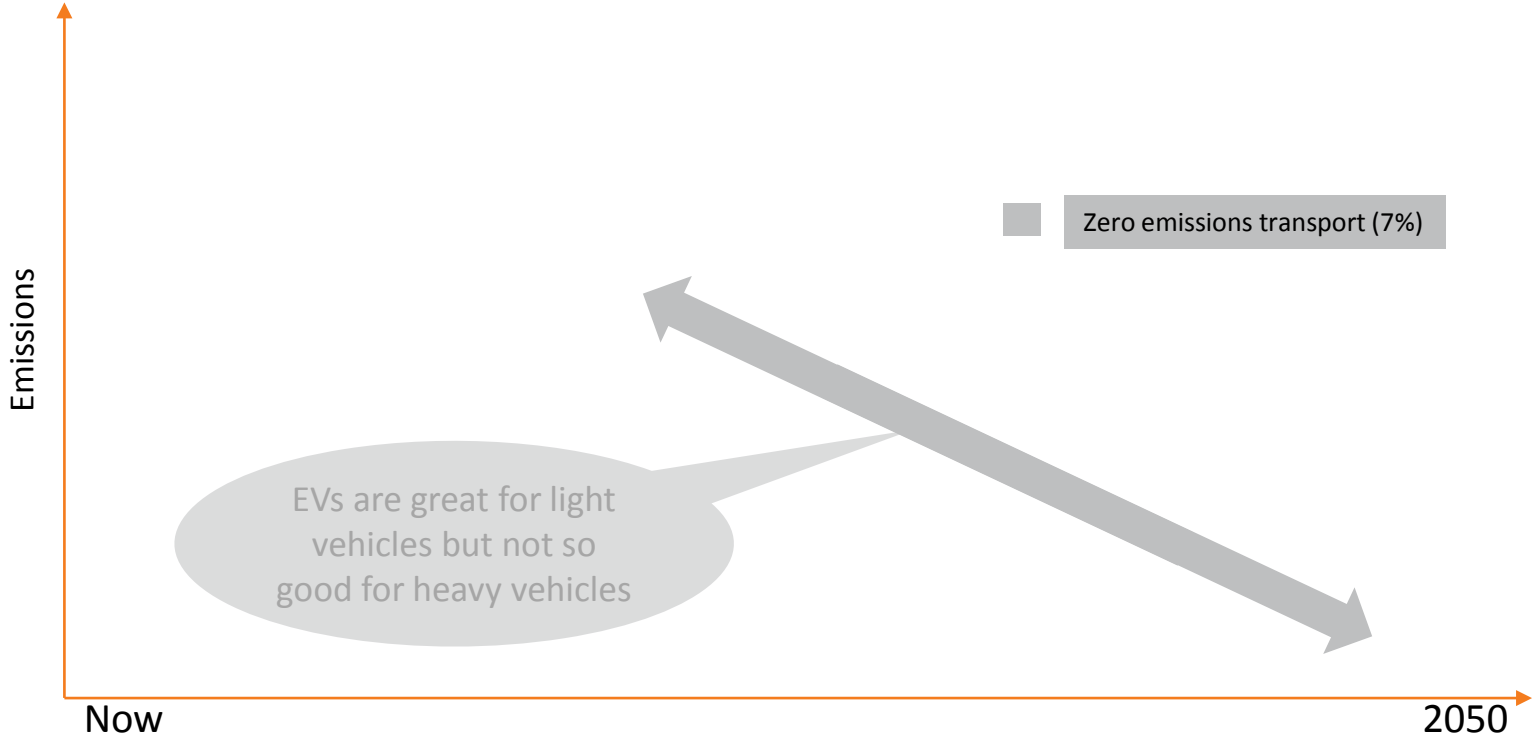
The journey to zero emissions

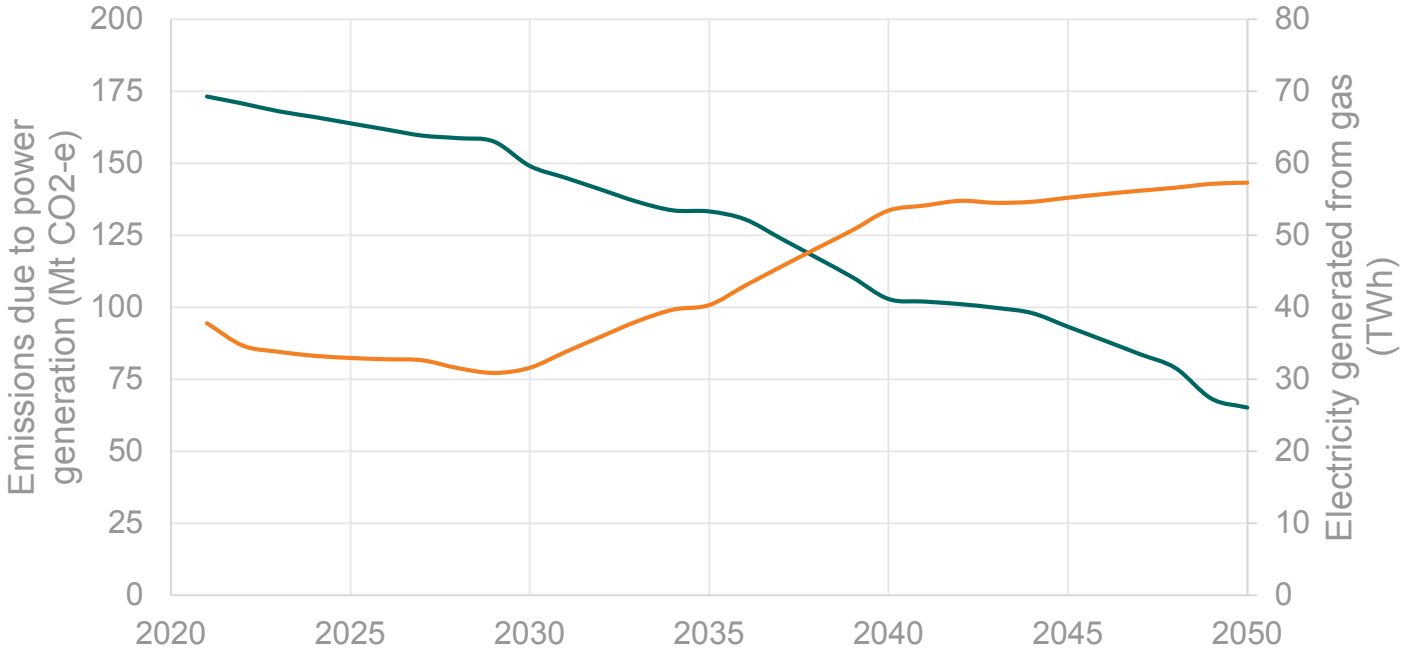


The journey to zero emissions



Driving towards zero emissions electricity

The decarbonisation of Australia's electricity – the base case



Source: Energetics modelling

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The decarbonisation of Australia's electricity – the base case

Assumptions:

- Coal fired power stations close at 50 years
- Rules that define the evolution of the generation fleet

Adjustments up of generation type to meet actual demand	**2020**	**2030**	**2040**	**2050**
Natural Gas	50%	33%	25%	10%
Utility scale wind and solar	50%	67%	75%	90%
Adjustments down of generation type to meet actual demand				
Coal	30%	40%	40%	40%
Natural Gas	50%	60%	60%	60%
Utility scale wind and solar	20%	0%	0%	0%
Minimum dispatchable load	50%	40%	25%	20%

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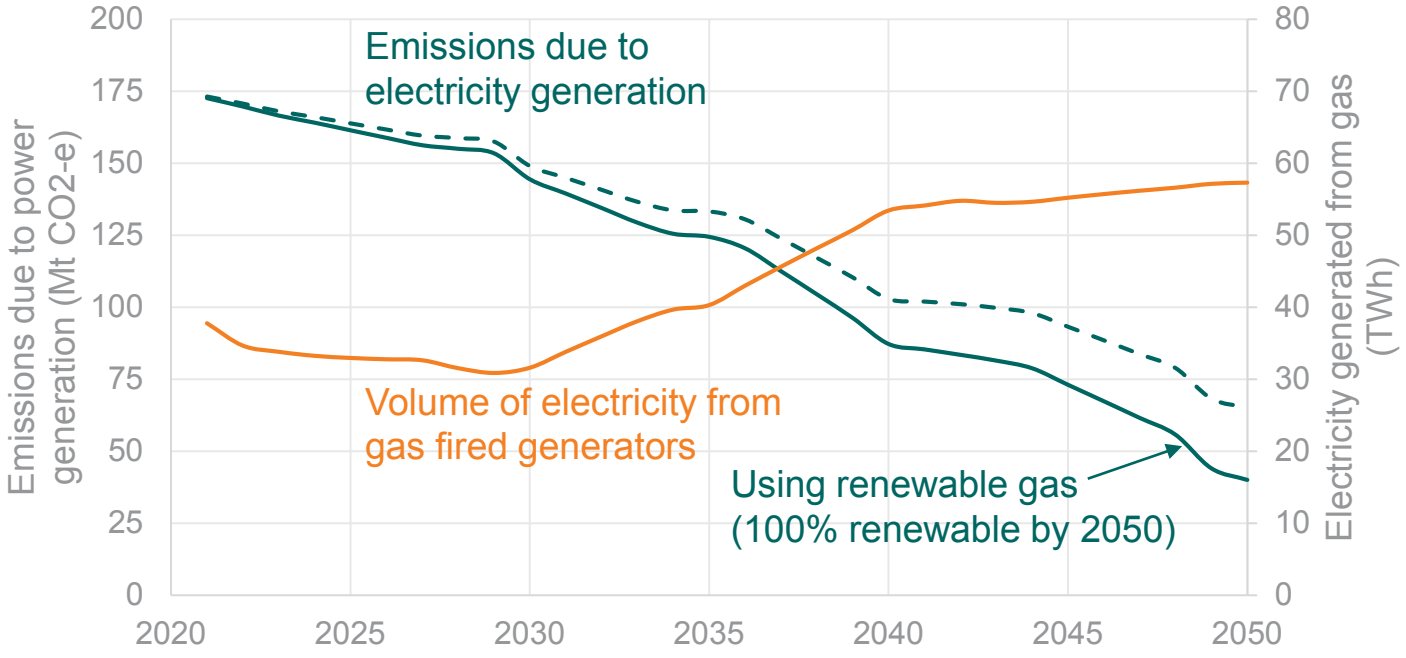
The decarbonisation of Australia's electricity – plus renewable gas



Source: Energetics modelling

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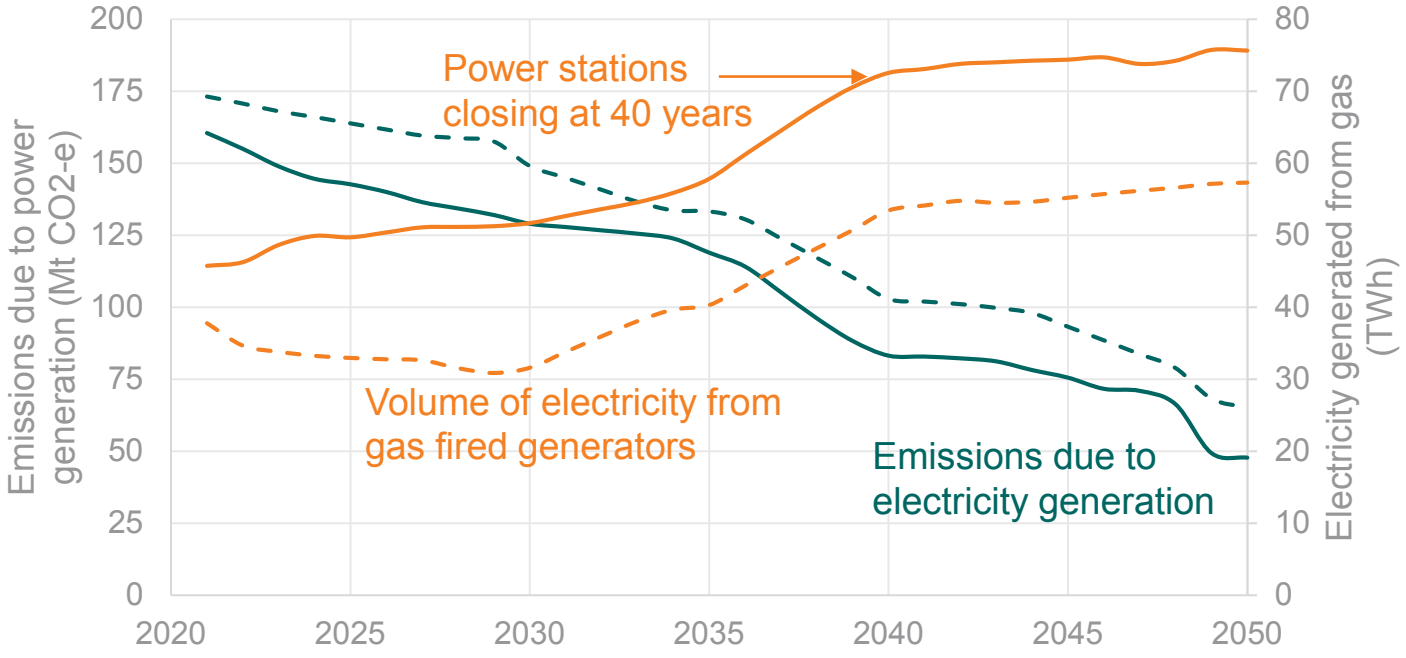
The decarbonisation of Australia's electricity – 40 year closures



Source: Energetics modelling

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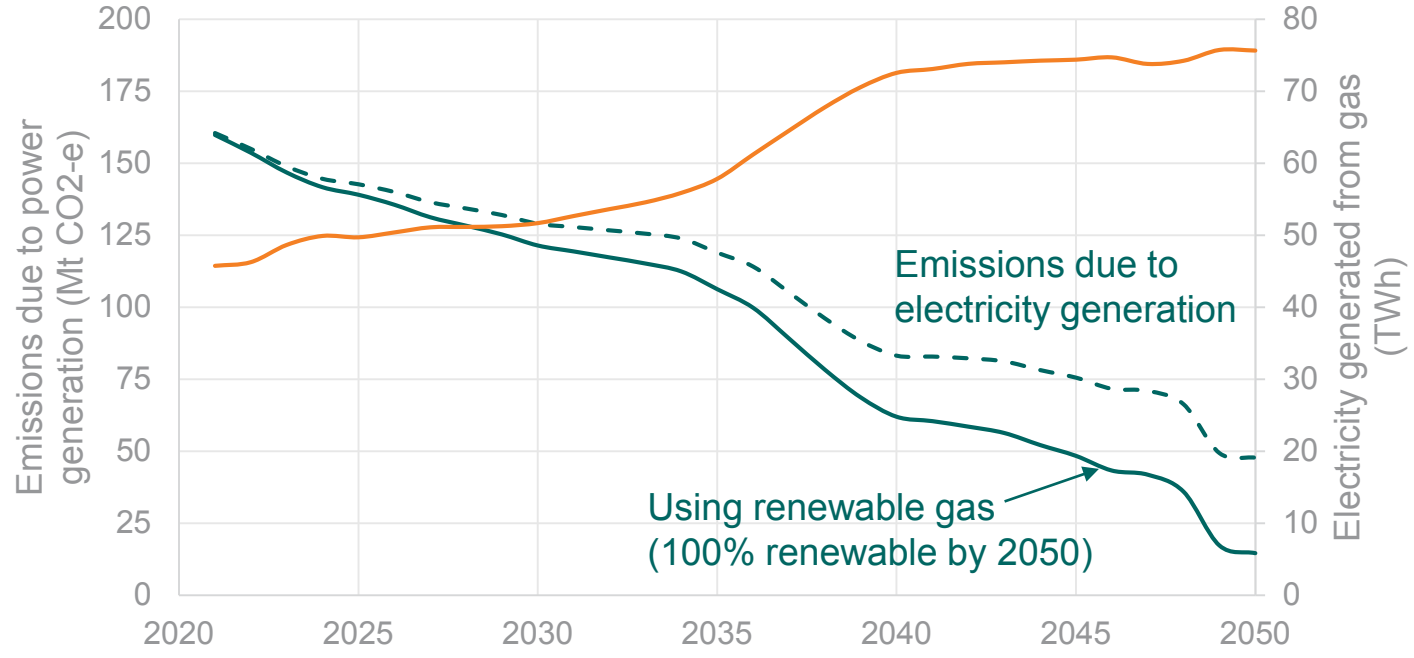
The decarbonisation of Australia's electricity – plus renewable gas



Source: Energetics modelling

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The decarbonisation of Australia's electricity – what matters

How rapidly the coal fired power stations close?

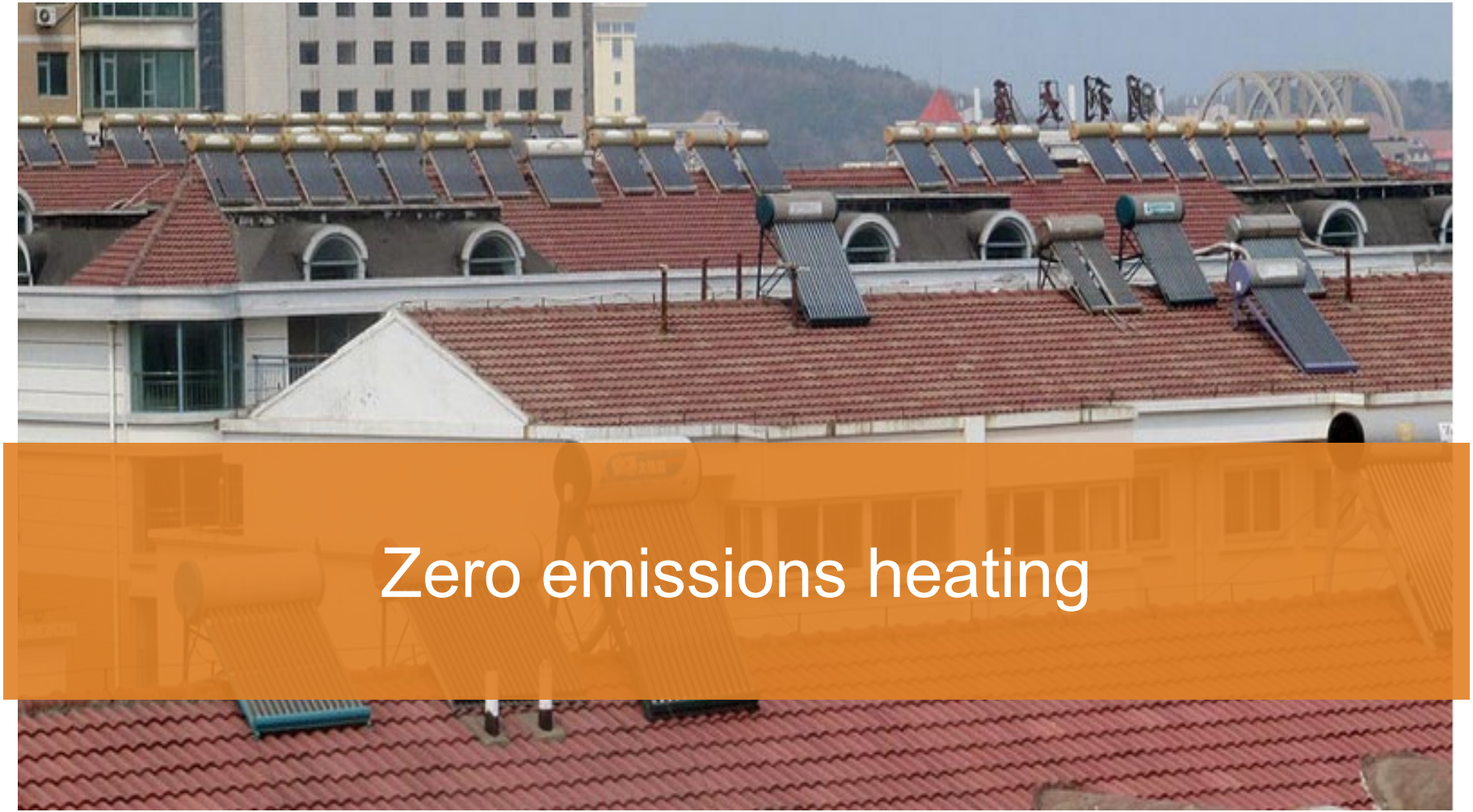
Are the variable renewable generators correlated or uncorrelated?

Is the grid robust?

How much dispatchable generation is needed to firm the variable renewable generators?

How effective are batteries and pumped hydro at meeting requirements for dispatchable load over mid to long time horizons, or is it necessary to introduce additional gas fired generation?

How does the cost of electricity from renewable gas compare to the cost of mid and long term storage?



Zero emissions heating

Renewable energy's next frontier: heat

6 December 2016

Developing countries represent more than 90% of the global growth in water heating demand until 2040 (Photograph: Wikimedia Commons)

While energy use is commonly associated with lighting or transportation, more than half of the world's energy consumption serves a simple function: heating things. This ranges from heating homes and buildings, to firing up industrial production, or even cooking. And because heat is mostly produced by burning fossil fuels, heat production accounts for 39% of the world's energy-related carbon dioxide emissions.

Heating applications in industry and the built environment

Process heating operation	Description/example applications	Typical temp range (C)
Fluid heating, boiling, and distillation	Distillation, reforming, cracking, hydrotreating; chemicals production, food preparation	70-500
Drying	Water and organic compound removal	90-400
Metal smelting and melting	Ore smelting, steelmaking, and other metals production	400-1600
Calcining	Lime calcining	800-1100
Metal heat treating and reheating	Hardening, annealing, tempering	90-1400
Non-metal melting	Glass, ceramics, and inorganics manufacturing	800-1600
Curing and forming	Polymer production, moulding, extrusion	150-1400
Coking	Coke making for iron and steel production	400-1100
Other industrial applications	Preheating; catalysis, thermal oxidation, incineration, softening, and warming	90-1600
Heating in the built environment	Space heating, hot water heating	30-100

Source: An Assessment of Energy Technologies and Research Opportunities, US DoE, 2015

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Where gas is used for heating

Sector	PJ
Food, beverages and tobacco	33.4
Textile, clothing, footwear and leather	5.1
Wood and wood products	2.6
Pulp, paper and printing	14.4
Petroleum refining, Other petroleum and coal product manufacturing	19.2
Basic Chemical and Chemical, Polymer and Rubber Product Manufacturing	122.9
Glass and glass products	9.2
Ceramics	17.5
Cement, lime, plaster and concrete	18.9
Other non-metallic mineral products	4.9
Iron and steel	12.9
Basic non-ferrous metals	126.7
Fabricated metal products	1.7
Machinery and equipment	2.4
Furniture and other manufacturing	0.1
Commercial and services	58.5
Residential	165.7

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Options for low emissions heating

HIGH TEMPERATURE HEAT PUMPS
for the Australian food industry:
Opportunities assessment
August 2017

Renewable gas

The decarbonisation of heating – what matters

How efficient is the electrification of heating?

How will electrification of heating affect the networks? Will new investments in power systems be needed?

Are high temperature solar thermal technologies sufficiently flexible for them to be deployed for process heating applications?

Are the pathways to renewable gas feasible on a large scale?

How does the cost of renewable gas, delivered to end users compare with the cost of other zero emissions technologies (or the cost of doing nothing)?

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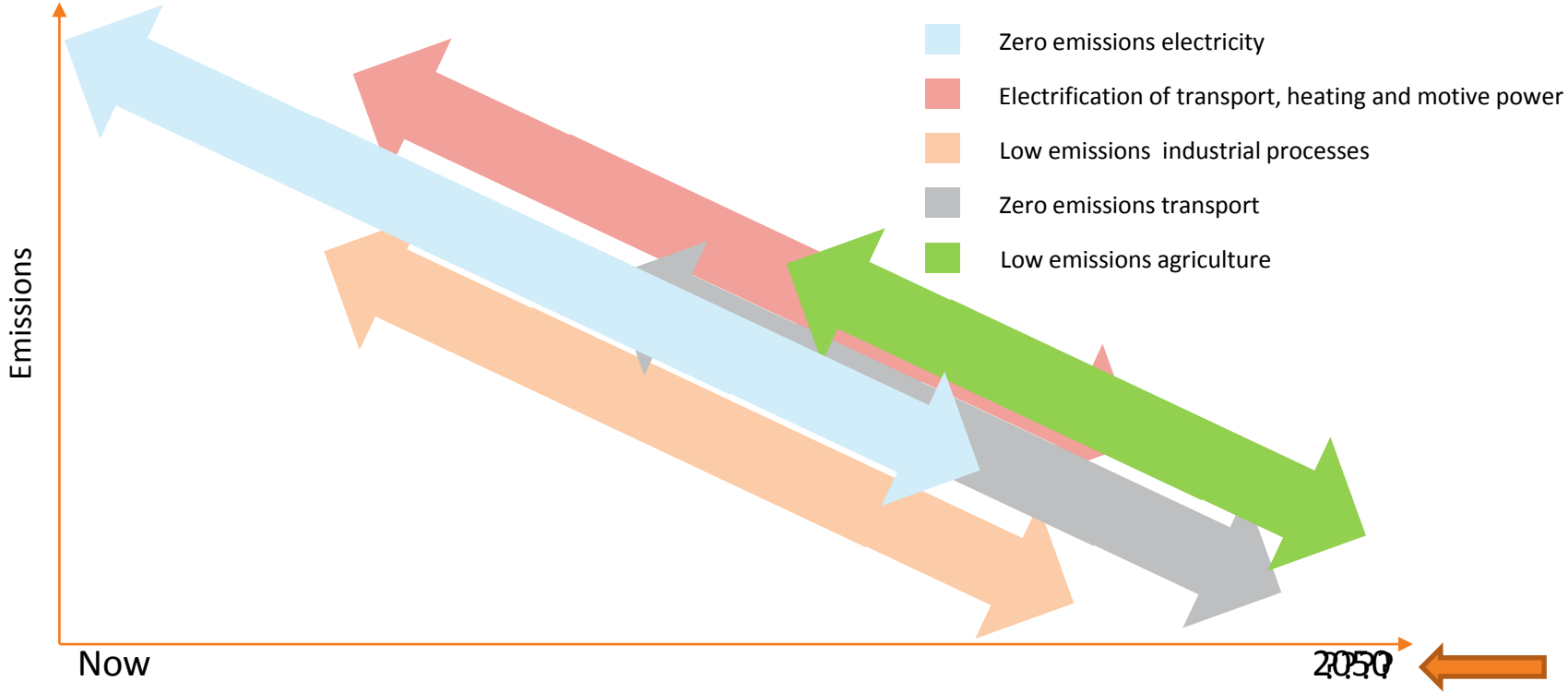
Renewable gas for the future

Renewable gas for the future

- What we know
  - Renewable gas already excels in niche applications such as waste to energy
  - Renewable gas has the potential to address key components of the national and global decarbonisation journey
- What must be discovered
  - How to generate and transport renewable gas so that it can make a meaningful contribution to the journey to zero emissions
  - How to conquer the technical and economic barriers that are currently seen

One last point



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