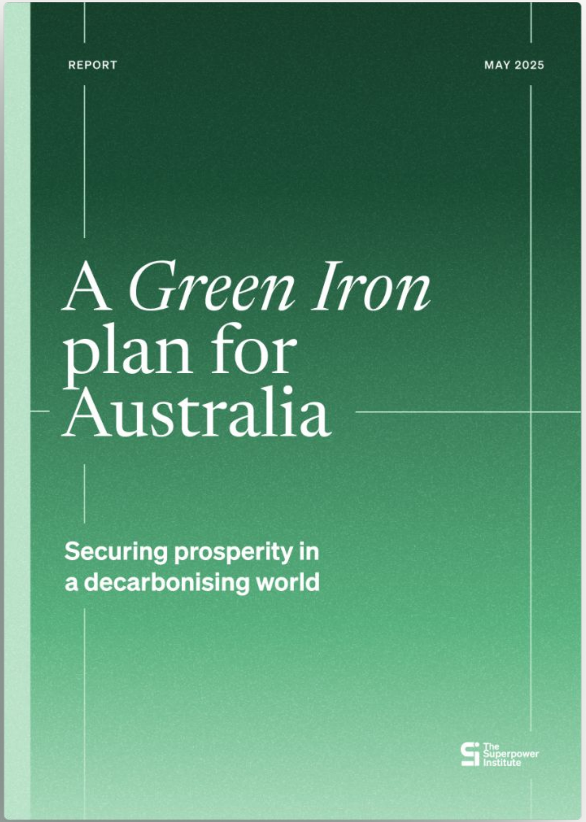

Webinar series: Session 3

Modelling green iron production in five Australian regions

Thursday 19 June, 2025


Max van Someren
Australian Director, Bivios


Ben Scott
Economist, TSI

The Superpower Institute

A Green Iron Plan webinar series

Session 1

Australia's $400 billion green iron opportunity

Dr Ingrid Burfurd
Carbon Pricing and Policy Lead, TSI

Watch recording

Session 2

The technological path to Australian green iron

Chris McMahen
Technical Lead for Green Iron, TSI

Watch recording

Session 3 - Today

Modelling green iron production in five Australian regions

Max van Someren
Australian Director, Bivios

Ben Scott
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Mission

The Superpower Institute is a not-for-profit organisation dedicated to helping Australia seize the extraordinary economic opportunities of the post-carbon world.

The global shift to net zero is Australia's opportunity.

TSI specialises in practical research and policy development to support the policy settings and market incentives necessary for making Australia a green export superpower to support global development in a post–carbon world.

Our role is to embed climate ambition in a broader economic context and to change the public narrative, so that decision-makers are comfortable adopting the required policies and incentive structures that will unlock the Australian superpower.

Ben Scott

Economist, TSI

Ben has contributed to research on energy transition policies with the Grattan Institute, United Nations and Australian Parliament.

He is interested in understanding the role of government in ensuring a smooth and prosperous transitions towards a net-zero economy.

Ben read in Philosophy, Politics and Economics (Honours) before completing post-graduate studies in Applied Econometrics as a Westpac Future Leader Scholar at the University of Queensland.

Max van Someren

Australian Director, Bivios

bivios

Max is the Australia Director of Bivios, a sustainability, strategy and engineering advisory company focused on the energy transition. In a former life a ship designer, today he is an energy systems analyst who has held senior roles at KBR, AEMO, Austal Ships and Frazer-Nash Consultancy.

Max led the development of the techno-economic model featured in TSI's green iron report. He continues to work with the TSI and Bivios teams to quantify, analyse and optimise the industrial systems at the heart of the Australian superpower opportunity.

Max's passion is the energy transition. He is a Co-founder of the Net Zero Network, a not for profit which helps members identify how they can have the greatest impact in reducing global greenhouse gas emissions. Max is also co-chair of the Engineer's Australia WA Working Group for Energy Transition.

Overview

01. A model of green iron investment, production and costs

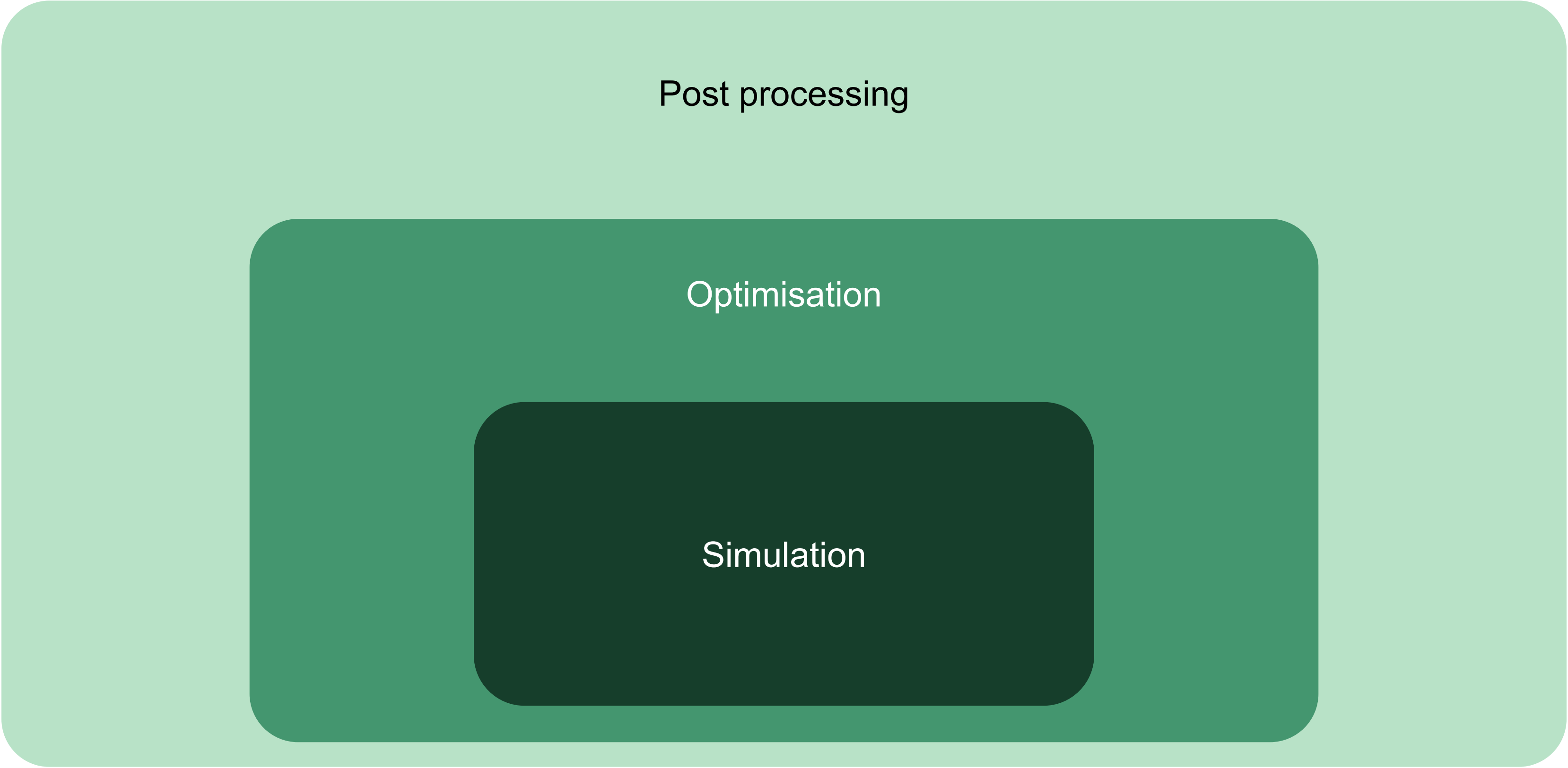
02. Model inputs and data sources

03. Sensitivity analysis

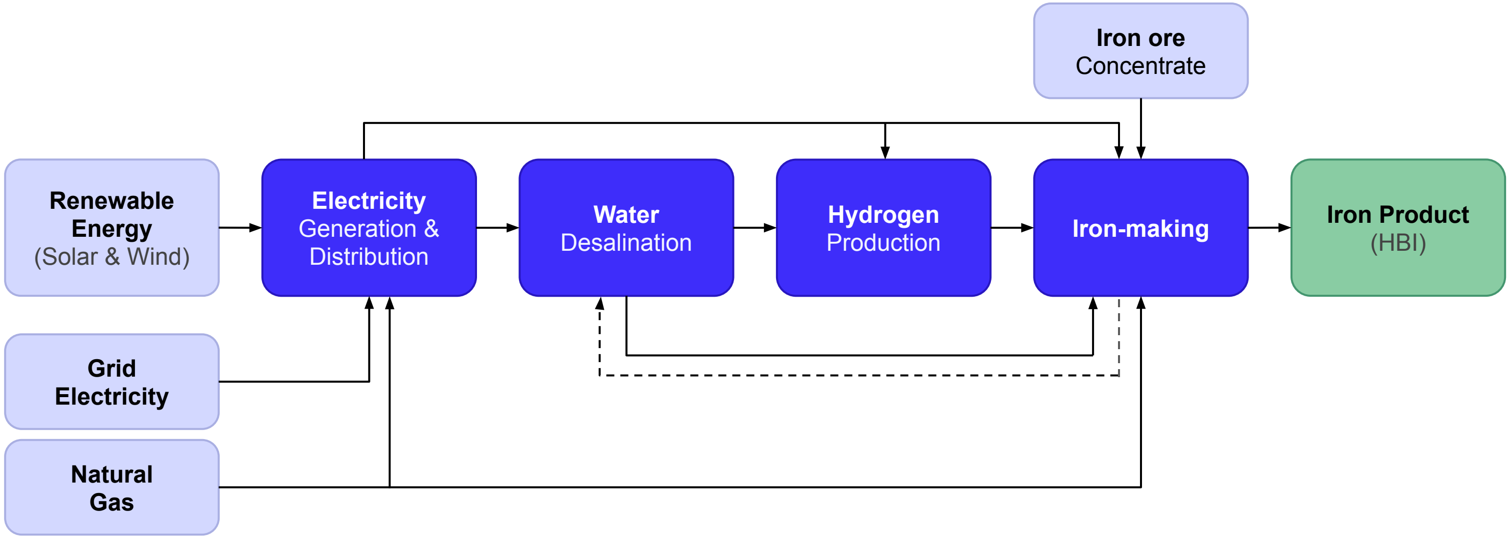
04. Select insights from the model

01.

A model of green iron investment, production and costs


Post processing
Optimisation
Simulation

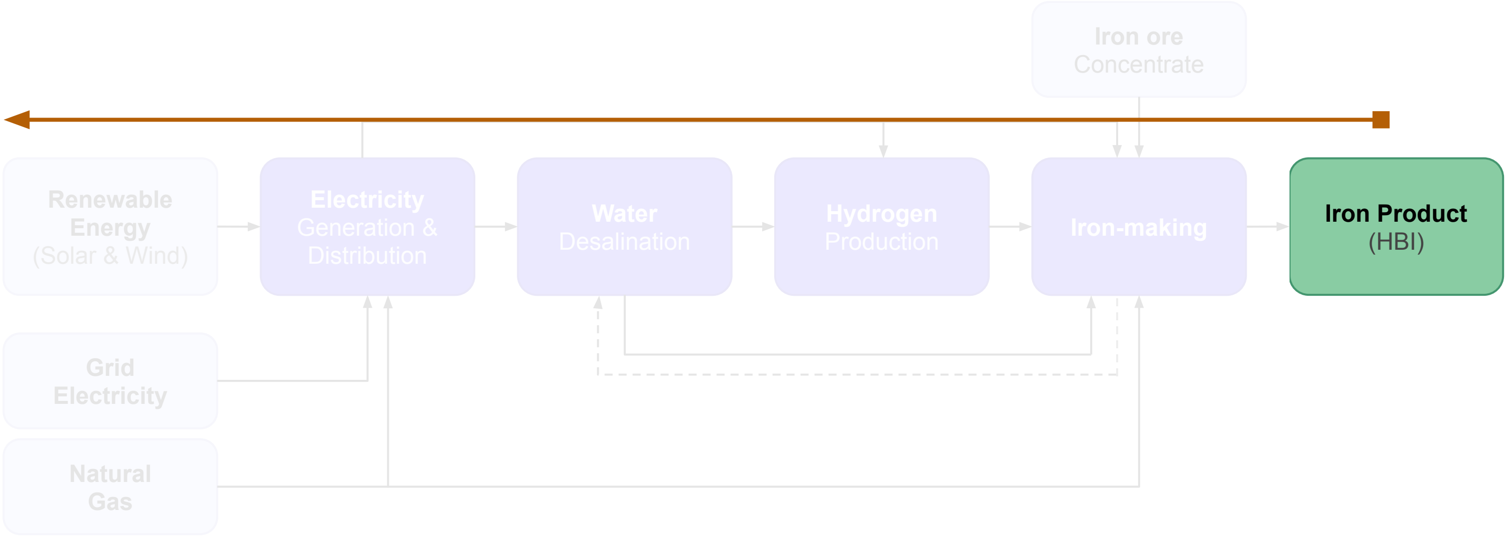
Hourly simulation



Hourly simulation

STEP 1

Calculate demands



Hourly simulation

STEP 2

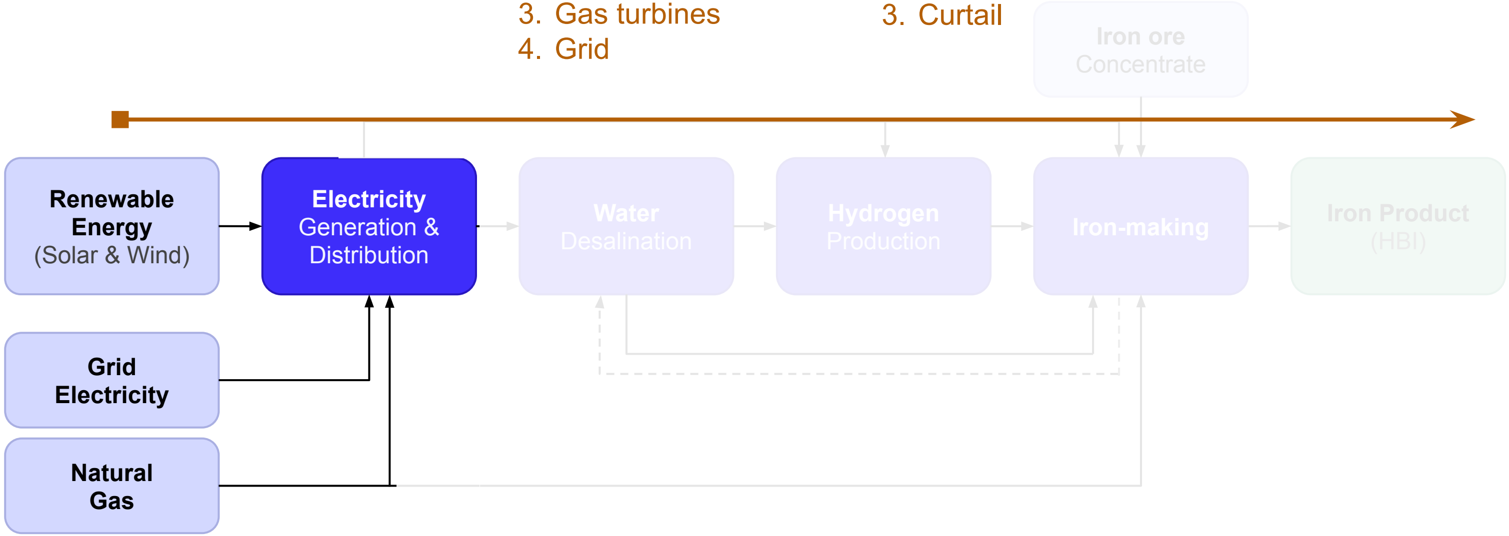
Calculate electricity supply

Priority supply order

1. Renewables
2. Battery
3. Gas turbines
4. Grid

If excess electricity

1. Fill battery
2. Sell to grid
3. Curtail



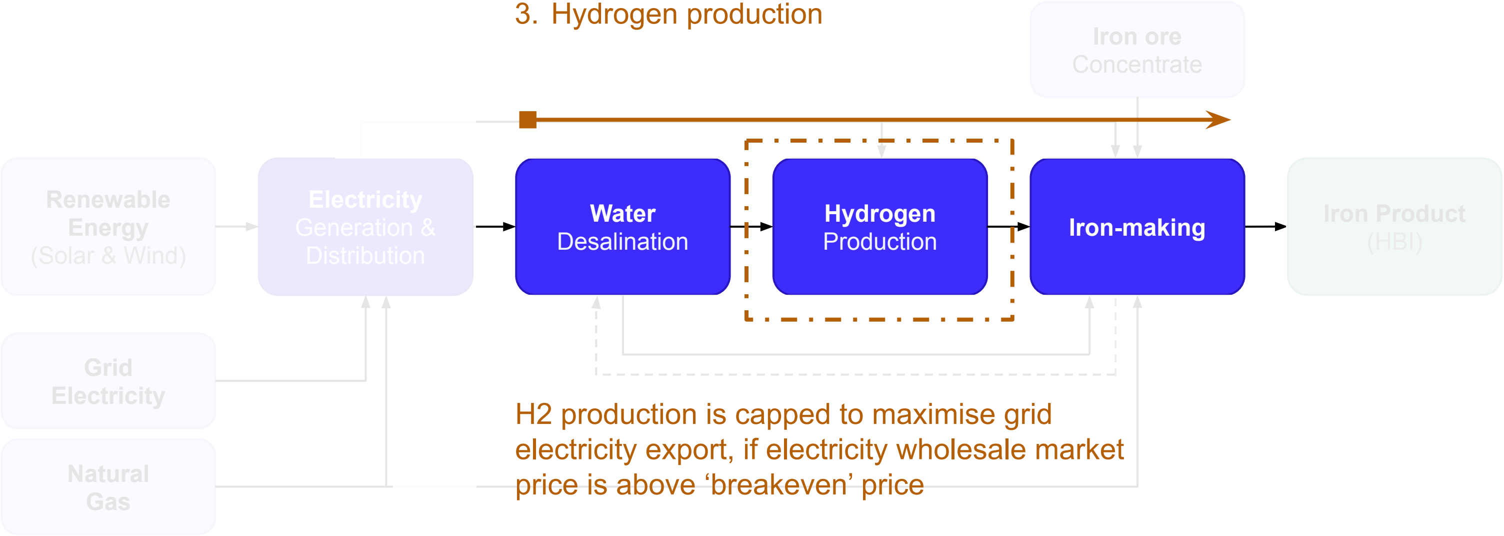
Hourly simulation

STEP 3

Share electricity

Priority demand order

1. Water desalination
2. Iron production
3. Hydrogen production

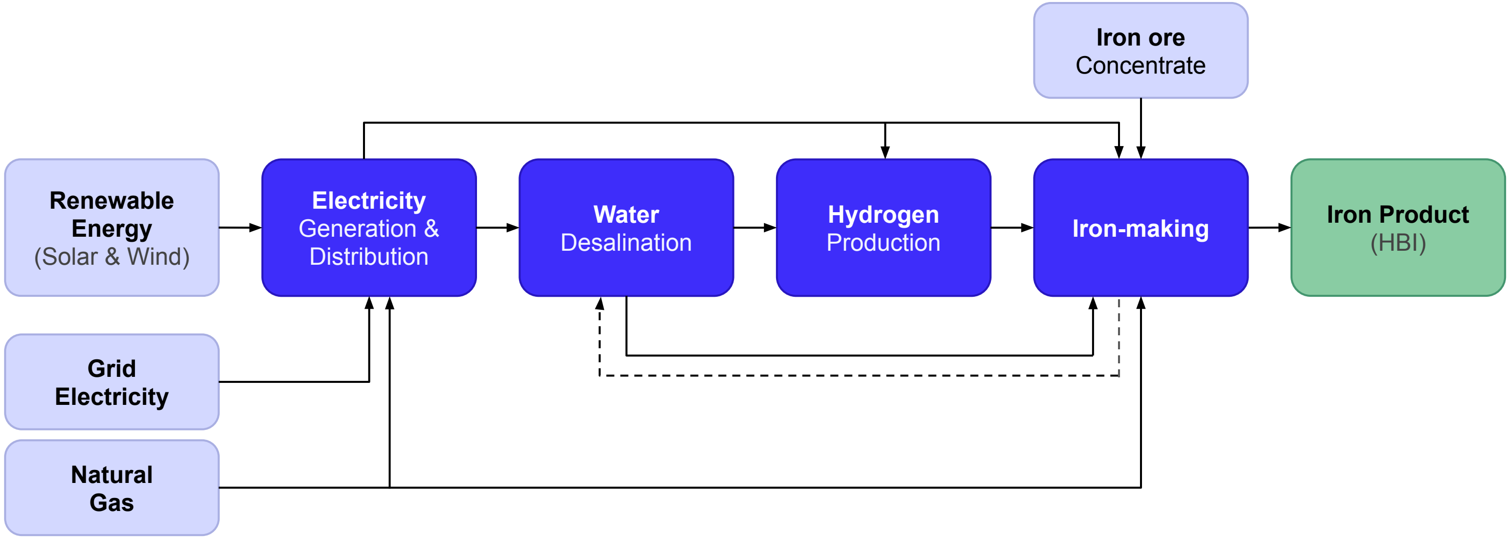


H2 production is capped to maximise grid electricity export, if electricity wholesale market price is above 'breakeven' price

Hourly simulation

STEP 4

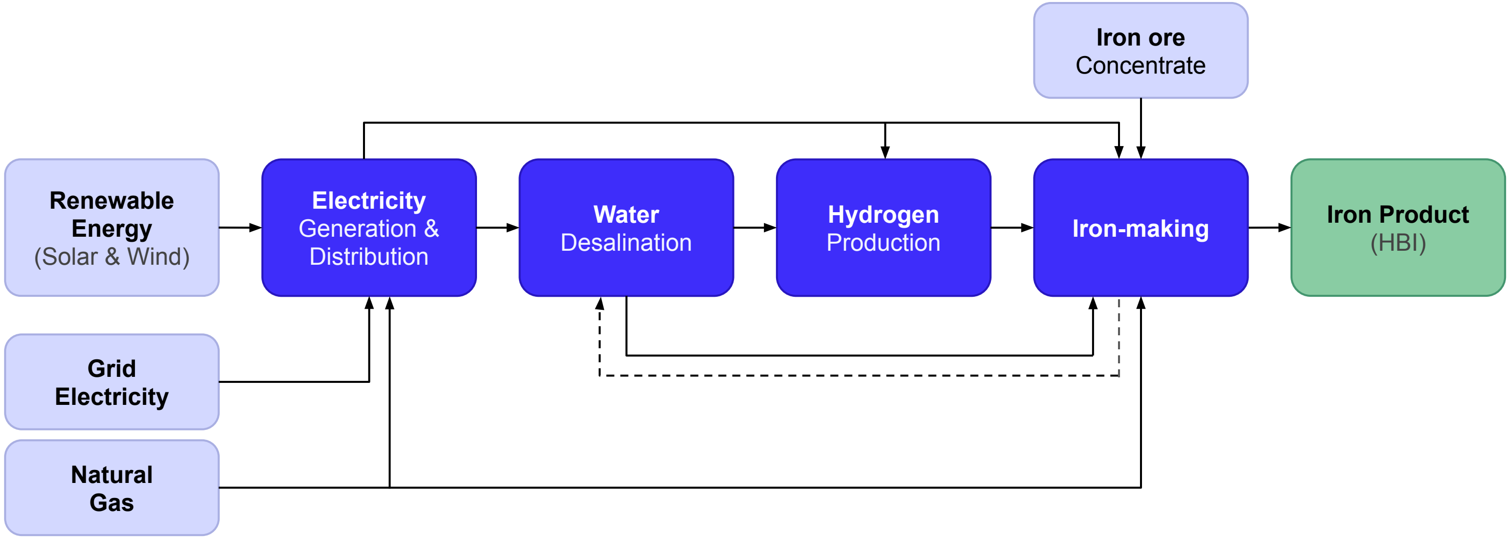
Iterate to balance supply and demand



Hourly simulation

STEP 5

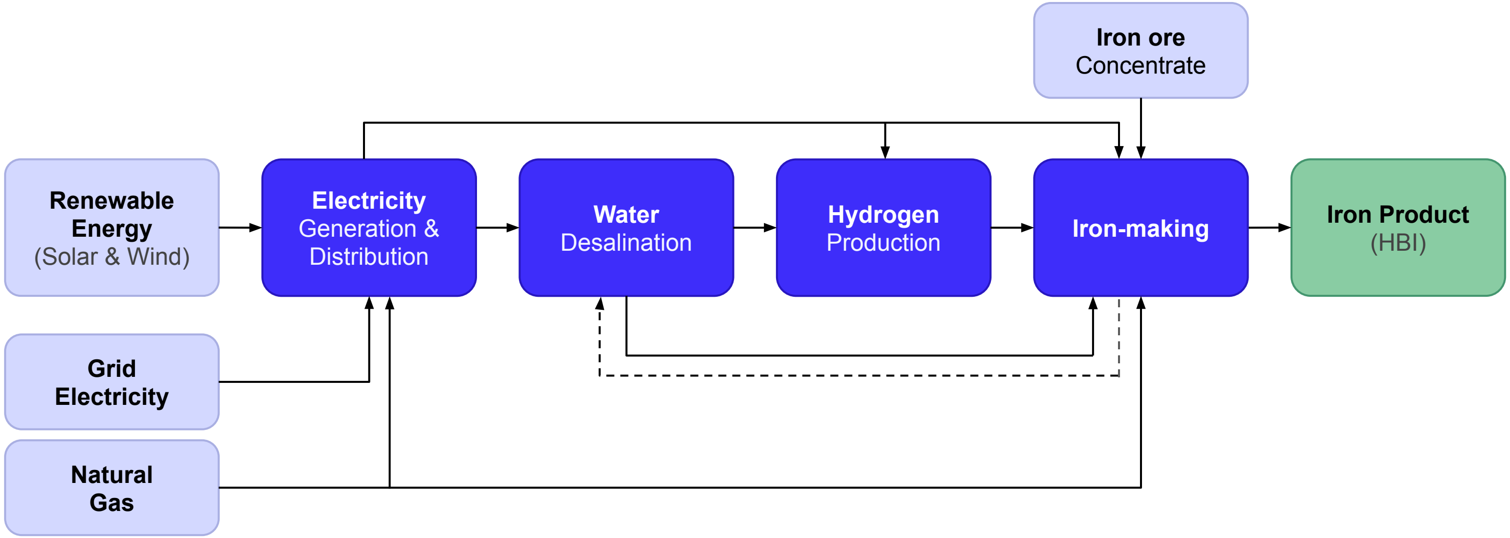
Calculate output volumes and costs



Hourly simulation

STEP 6

Pass state of stores to next hour

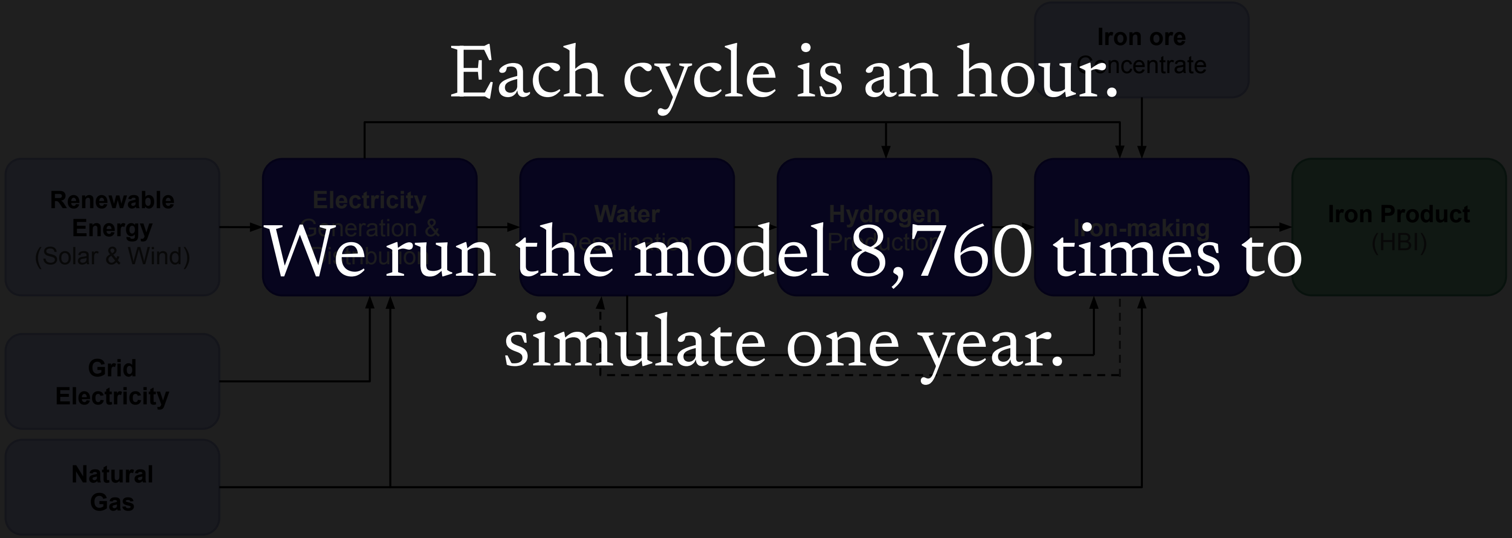


Hourly simulation

Input → Process → Output

STEP 6

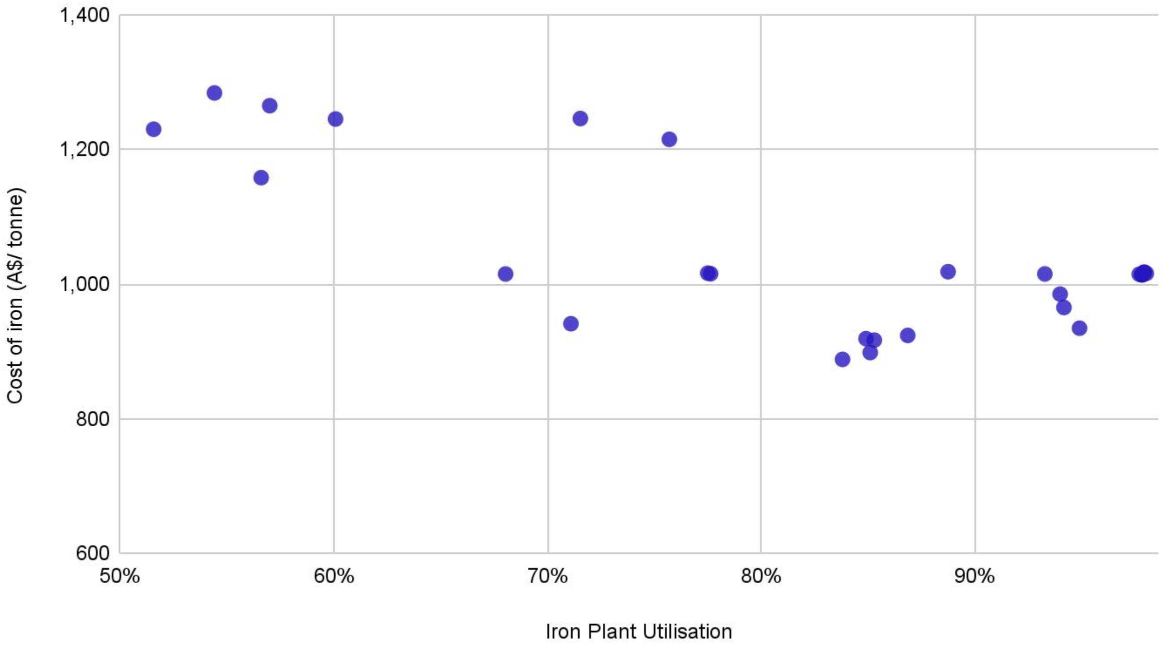
Pass state of stores to next hour



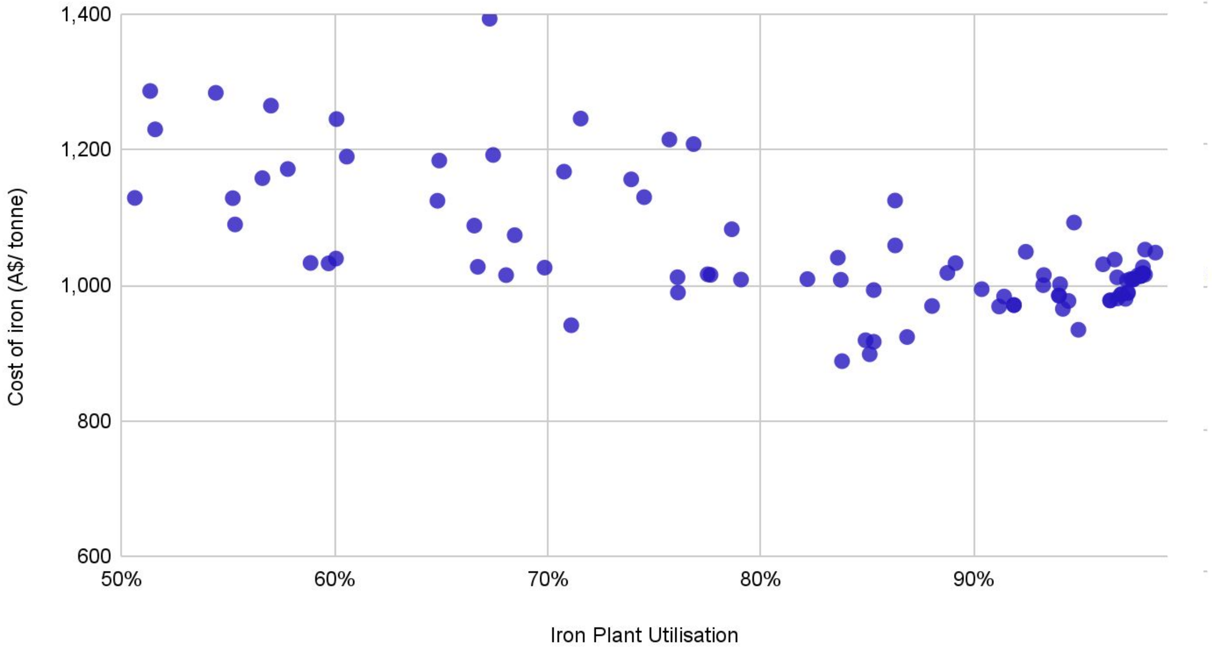
Each cycle is an hour.

We run the model 8,760 times to simulate one year.

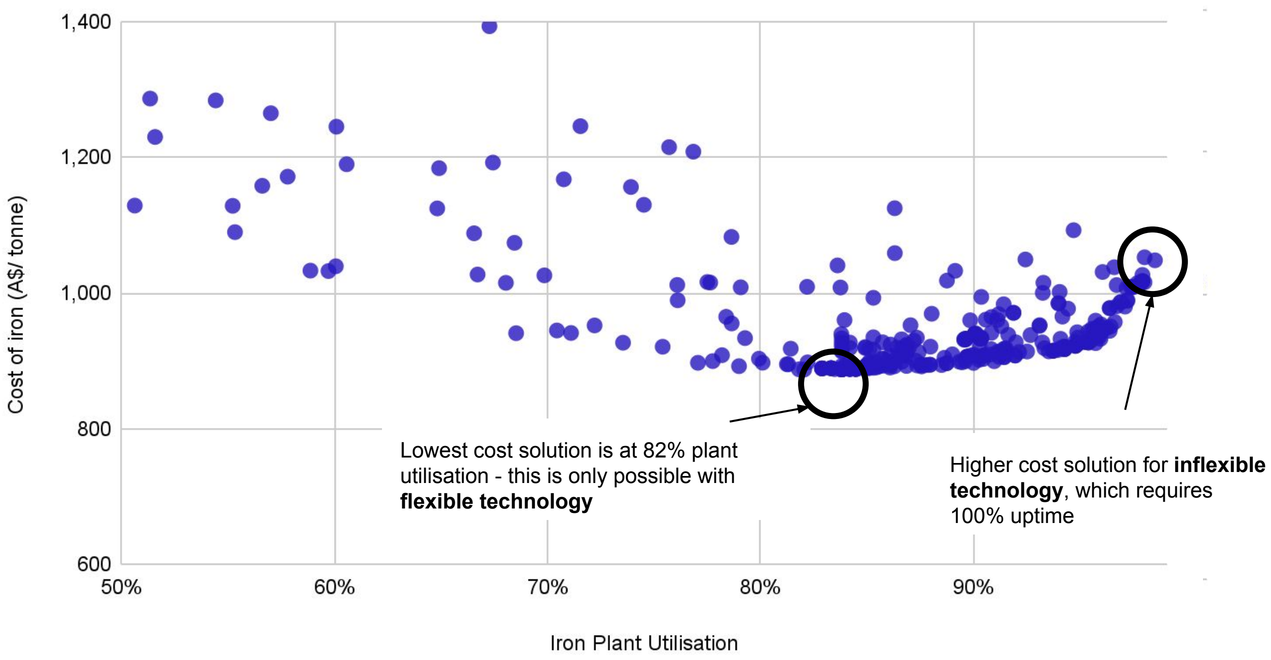
Optimisation



Optimisation



Optimisation



Report results include:

1. *n*th-of-a-kind production, reflecting the cost of capital and technology when production is established

2. ‘First-of-a-kind’ production, reflecting the higher costs of capital and technology for early producers

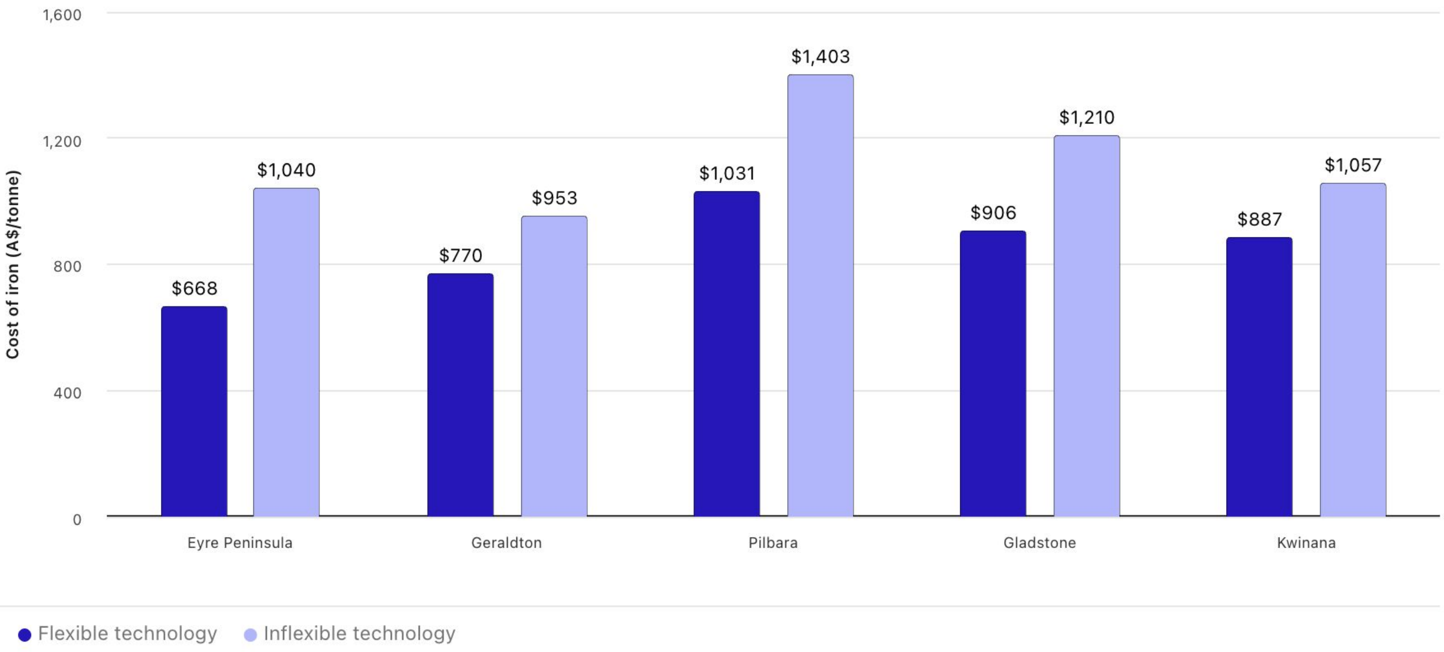
3. Production under different carbon-intensity constraints

This webinar presents results based on nth-of-a-kind production, when carbon intensity is limited to:

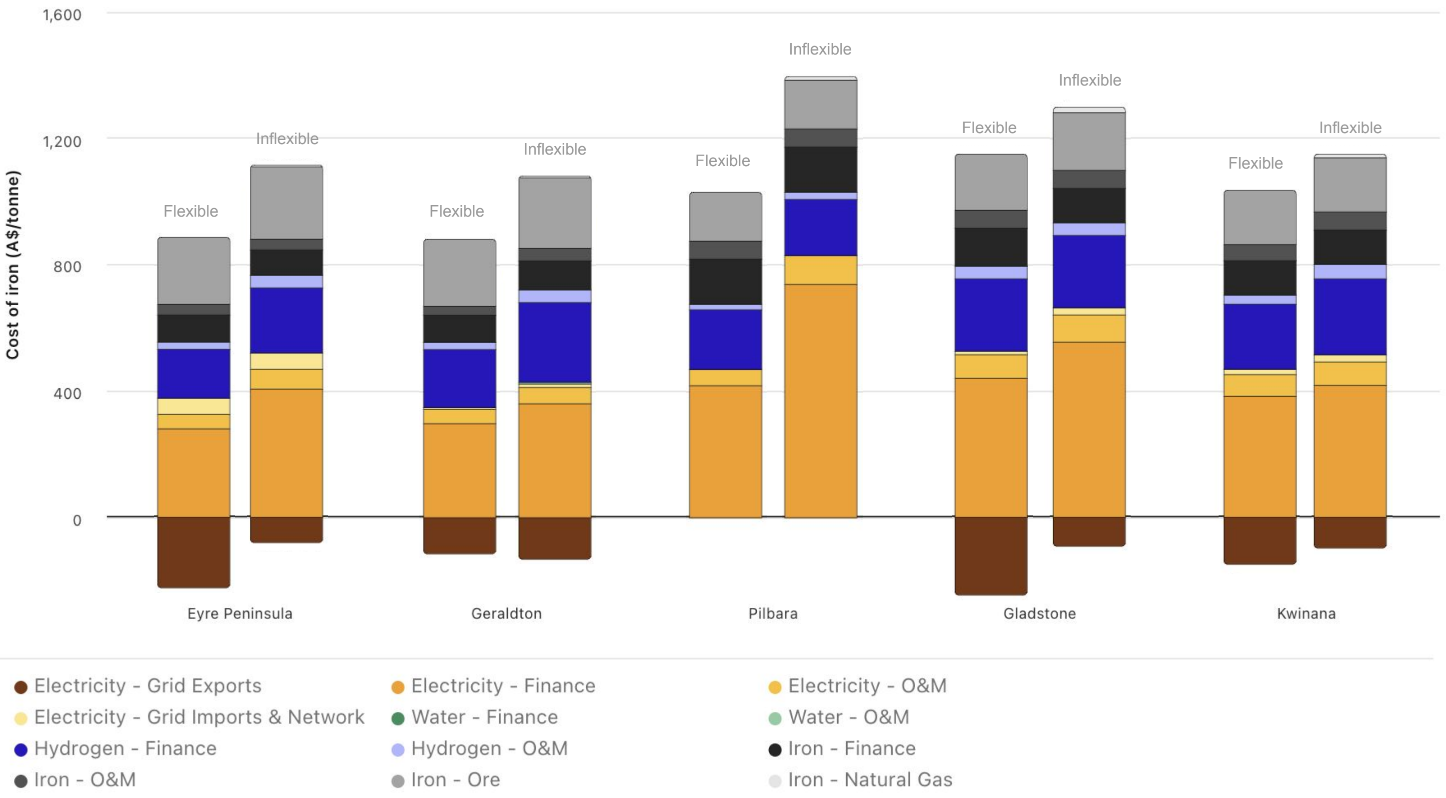
0.6 kilograms of carbon per kilogram of green hydrogen

Consistent with the requirements of the government’s Hydrogen Production Tax Incentive.

The cost of producing iron varies by location and technology type



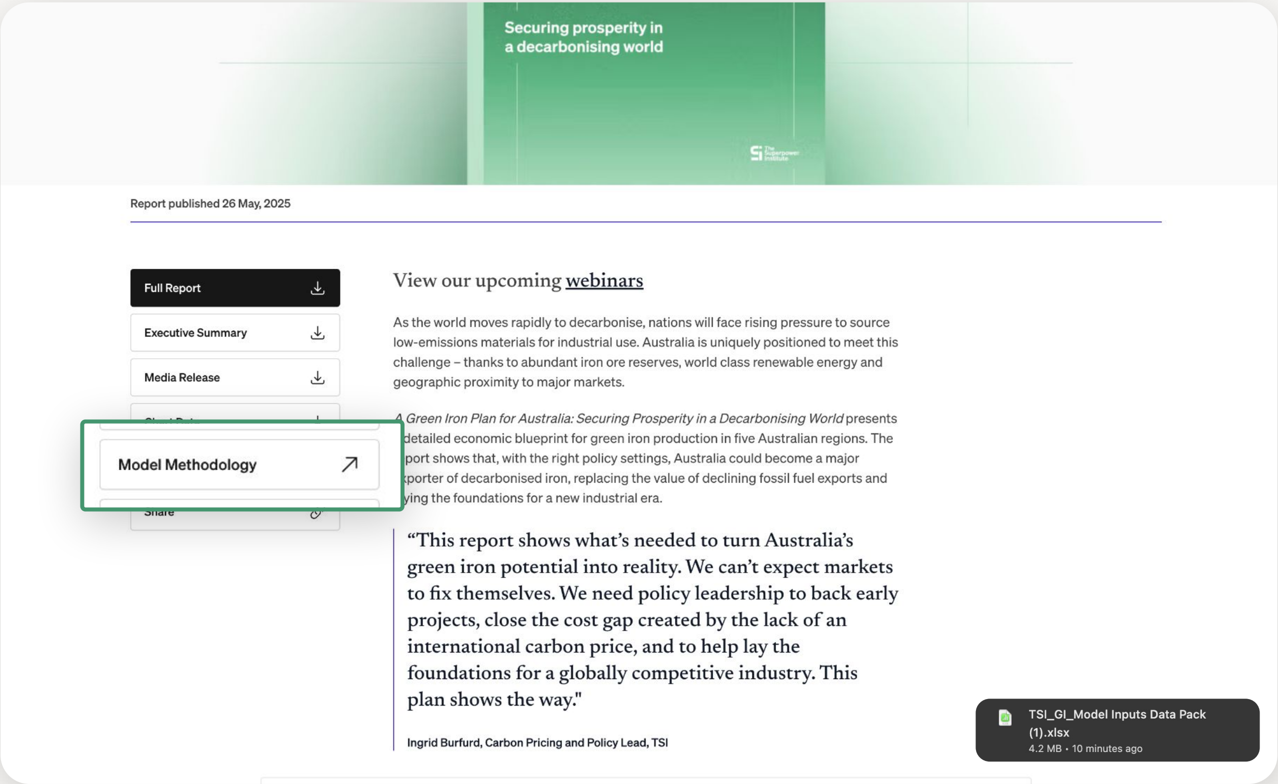
Breakdown of cost components by location and technology type



02.

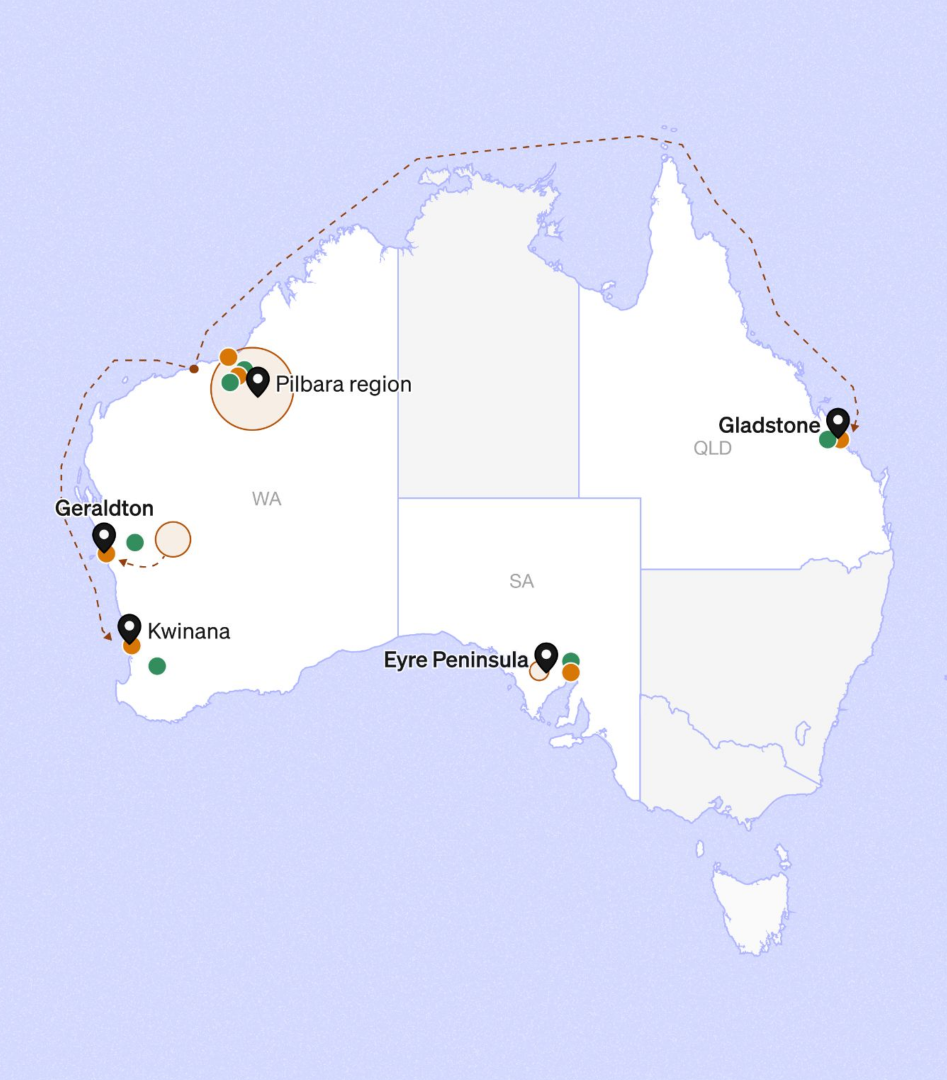
Model inputs and data sources

Where to find our inputs?



Main inputs

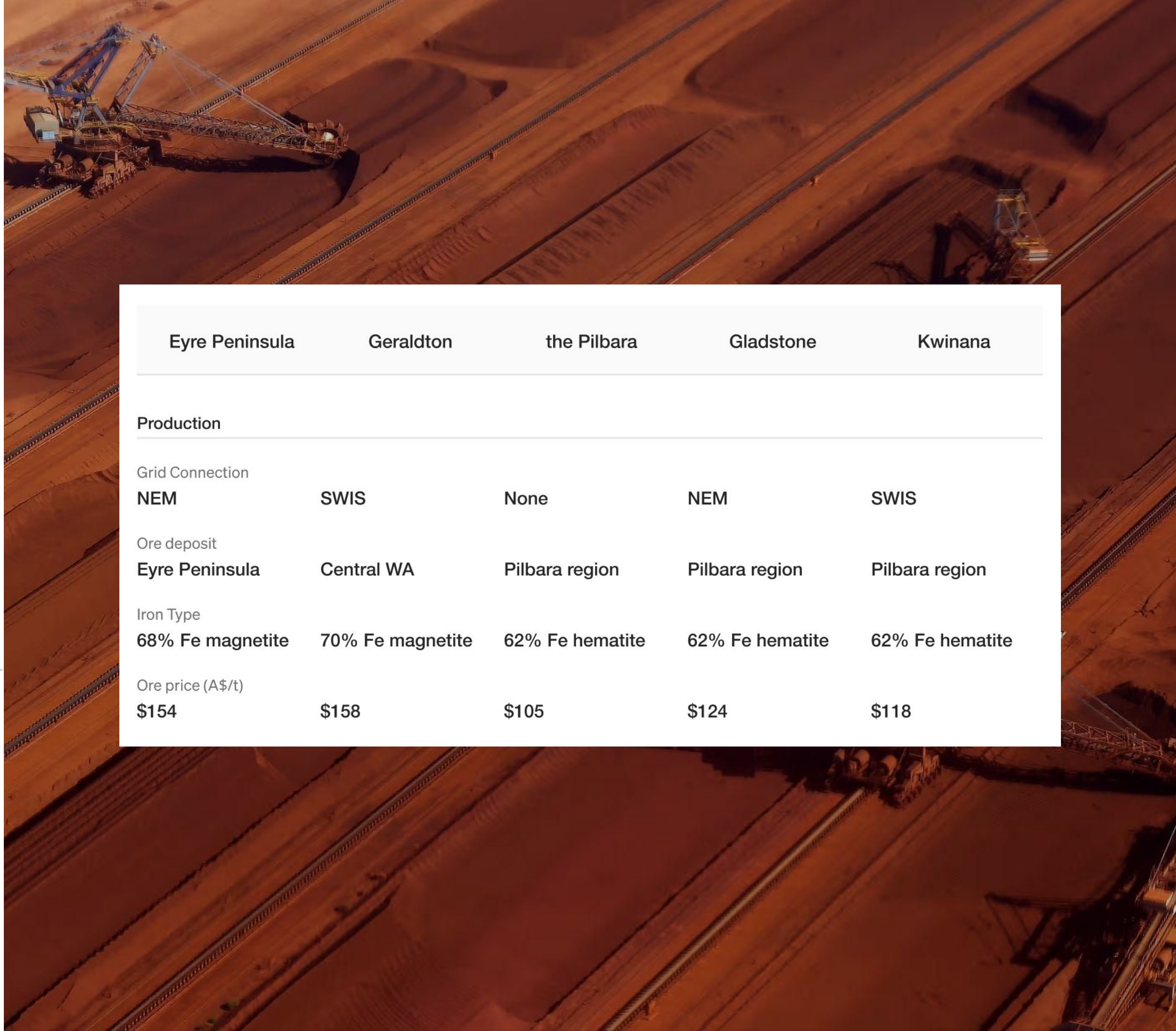
1. Scenario descriptions
2. Locational cost factors
3. Grid assumptions
4. Energy generation and storage CAPEX
5. Capacity factors
6. Ironmaking energy requirements
7. Ironmaking input:output rationale



Input #1

Scenario descriptions

- All but Pilbara modelled as “grid-connected”
- Cost of transporting Pilbara ores to Gladstone and Kwinana reflected in ore price



	Eyre Peninsula	Geraldton	the Pilbara	Gladstone	Kwinana
Production					
Grid Connection	NEM	SWIS	None	NEM	SWIS
Ore deposit	Eyre Peninsula	Central WA	Pilbara region	Pilbara region	Pilbara region
Iron Type	68% Fe magnetite	70% Fe magnetite	62% Fe hematite	62% Fe hematite	62% Fe hematite
Ore price (A$/t)	$154	$158	$105	$124	$118

Sources

Grid
AEMO (2019,2023)

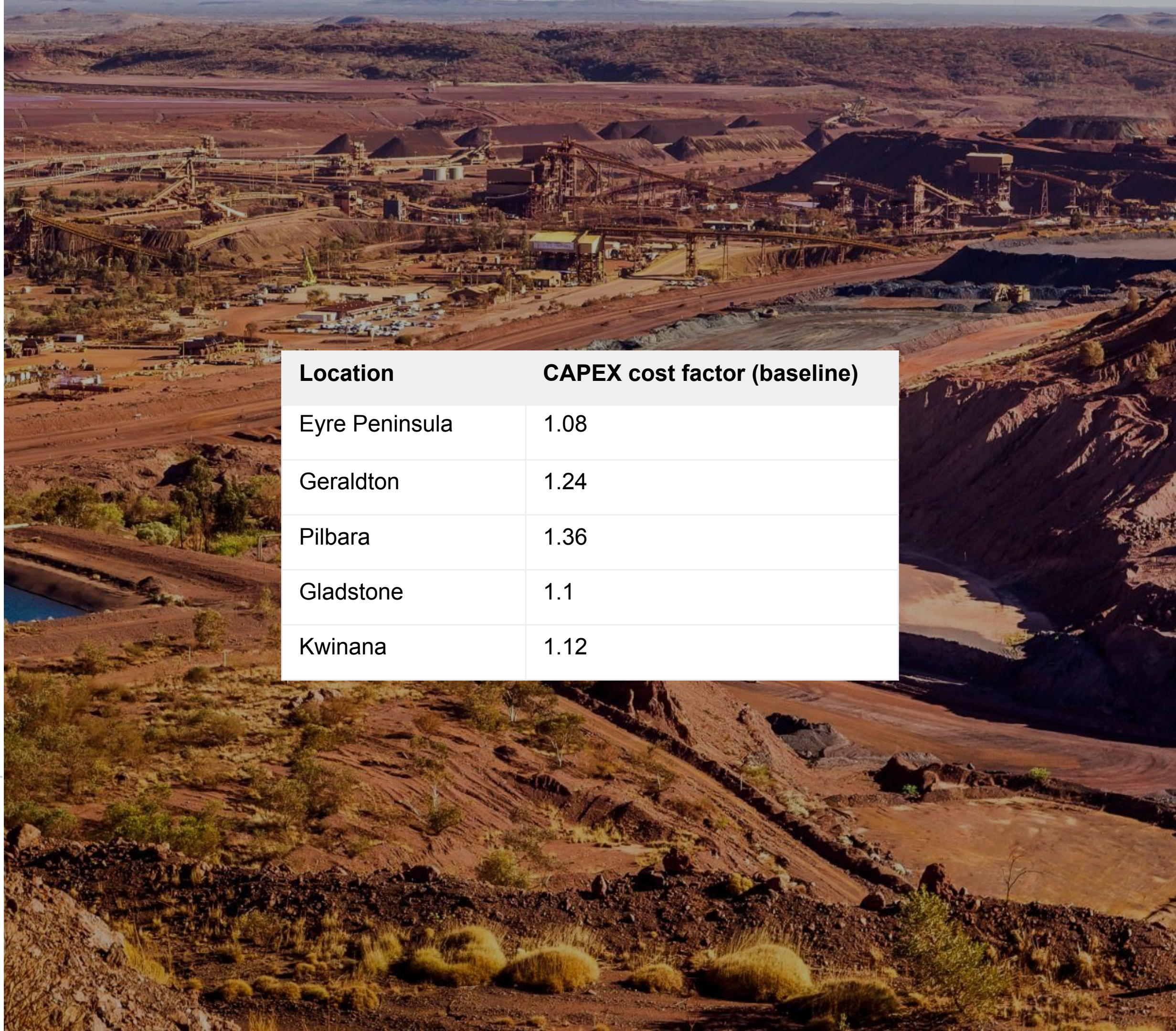
Ore price
Wood Mac (2024), 2030 forecast; S&P (2024); Sea.distances.org

Cost factors
GHD (2018); AEMO IASR (2023); Rawlinsons (2023); Rider Digest (2024)

Input #2a

Locational factors

- Capital costs make up around 90 per cent of first-year total project costs
- Cost breakdown: equipment, land & development, installation costs



Location	CAPEX cost factor (baseline)
Eyre Peninsula	1.08
Geraldton	1.24
Pilbara	1.36
Gladstone	1.1
Kwinana	1.12

Sources

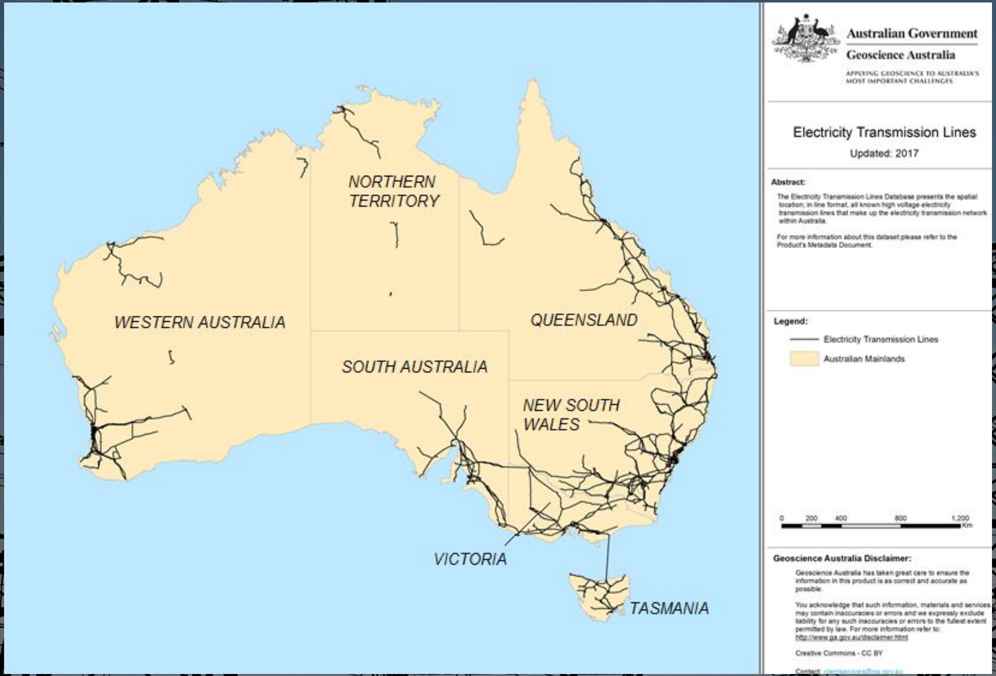
Cost breakdowns
GHD (2018)

Breakdown adjustment
AEMO IASR (2023)

Input #3a

Grid connection

- Grid connections reduce LCOI
- The NWIS does not have enough tradable energy and so is modelled as not grid connected



Sources

SWIS

AEMO: WEM Weekly market report, 2019

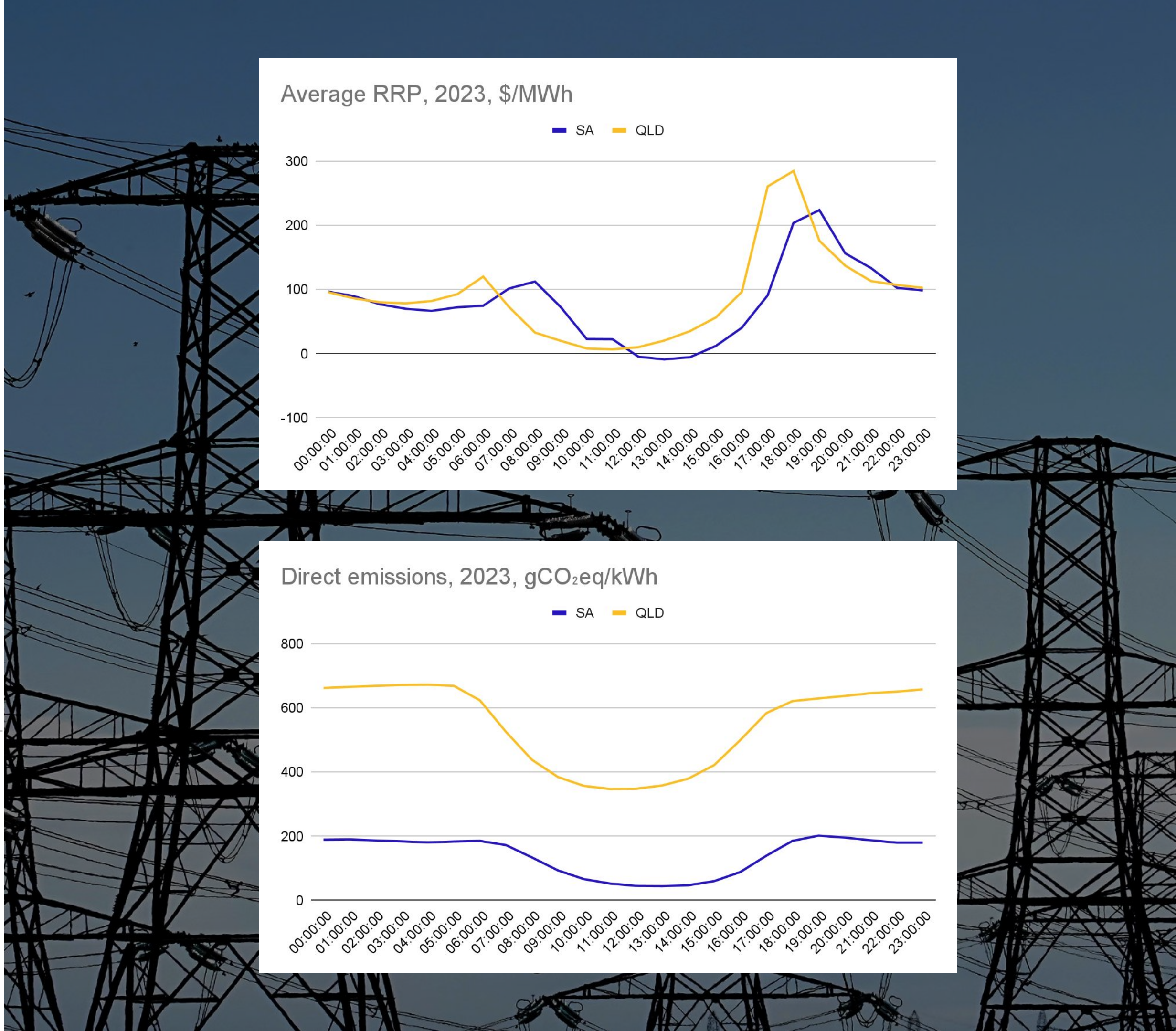
NEM

AEMO: Aggregated price and demand data, 2023

Input #3b

Grid connection - Wholesale prices and grid intensities

- The South Australian grid is very clean
- Grid import restrained by HTPI 600kgCO2e/tH2 limit



Sources

SWIS
AEMO: WEM Weekly market report, 2019

NEM
AEMO: Aggregated price and demand data, 2023

Grid intensities
Open Electricity API

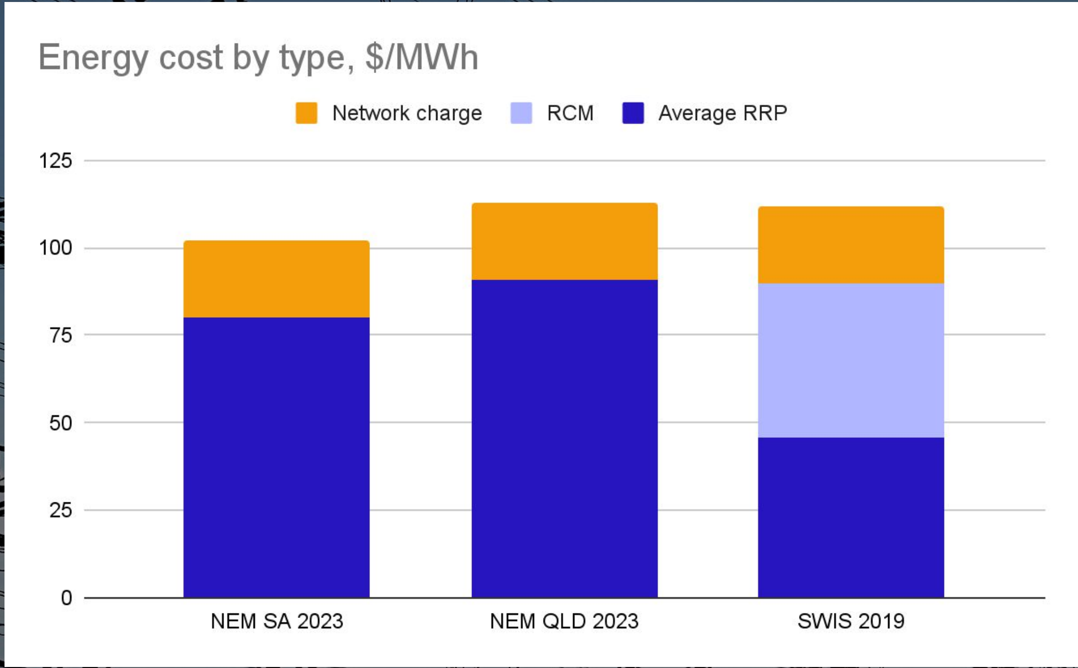
Input #3c

Grid connection - Network charges

Input	Units	Low	Medium	High
Variable network charge	A$/MWh	10	22	35

Area for collaboration

- Pricing of large industrial connections are confidential
- Informed figures here will uncover important state-based variation & more clearly define grid costs
- Reserve Capacity Mechanism (RCM) priced in addition to wholesale and network charges in the SWIS



Sources

Variable network charge

Powerlink (2024) and Electranet (2024) Pricing Schedules

Input #4

Energy generation and storage CAPEX

- Rely heavily on GenCost
- **Area for collaboration:** Overseas generation and storage asset prices in the Australian context

Input	Units	Low	Medium	High	
Solar PV	mA$/MW	1.14	1.18	1.22	2024-25 GenCost
Wind turbines	mA$/MW	2.49	2.53	2.6	
Battery	mA$/MWh	0.23	0.26	0.3	
PEM electrolysers	mA$/tph	103.65	114.02	124.38	
H2 storage (tanks)	mA$/t	1.86	2.19	3.52	DNV; CSIRO

Sources

Solar, wind etc
GenCost 2024-25, Current policies scenario, 2030

H2 storage
DNV; CSIRO Hydrogen Roadmap

Input #5

Capacity Factors

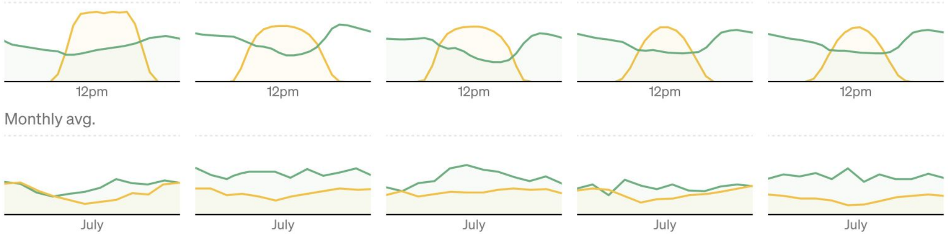
- Geraldton sun and wind a standout
- Western Australian data from 2019, others from 2023

Eyre Peninsula	Geraldton	the Pilbara	Gladstone	Kwinana

Capacity Factor

Hourly avg.

Monthly avg.



Yearly avg.

	Eyre Peninsula	Geraldton	the Pilbara	Gladstone	Kwinana
Solar	28.2 % Great	27.8 % Great	26.9 % Great	27.2 % Great	20.4 % Okay
Wind	35.9 % Good	52.3 % Excellent	44.5 % Great	34.8 % Good	48.3 % Excellent

Sources

Kwinana, Geraldton, Pilbara
Renewables.ninja (2019)

Eyre Peninsula, Gladstone
ISP trace (2023)

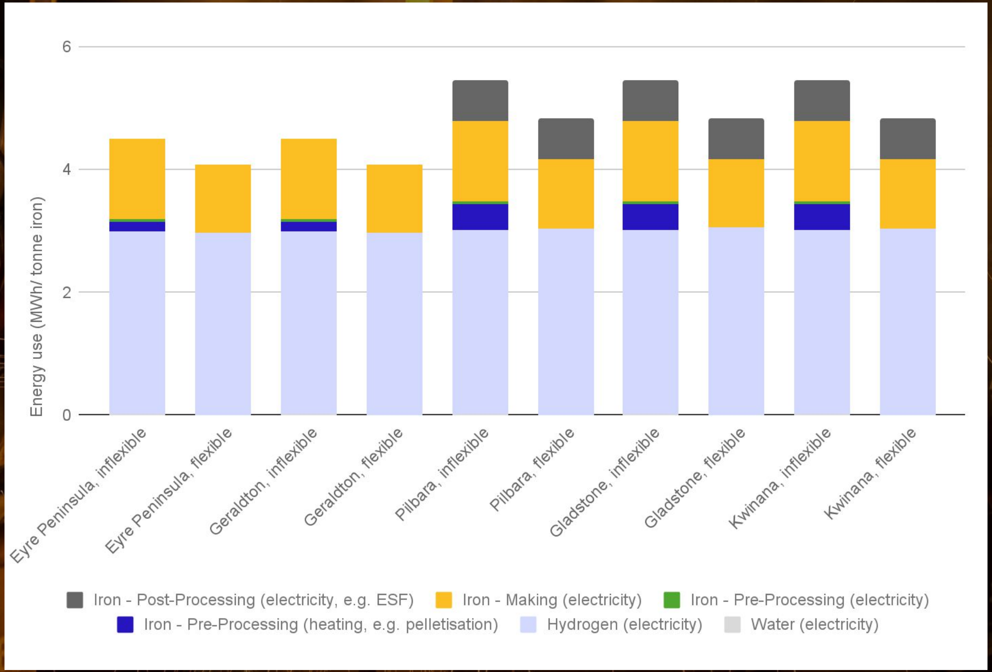
Taking stock of inputs

1. Scenario descriptions
2. Locational cost factors
3. Grid assumptions
4. Energy generation and storage CAPEX
5. Capacity factors
6. Ironmaking energy requirements
7. Ironmaking input:output rationale

Input #6

Ironmaking energy requirements

- Hydrogen assumptions: stoichiometric 54kgH2/tHBI and 55MWh/tH2 efficiency
- Zesty does not require pellets as input
- Assumed 1.1MWh/tHBI reduction for Zesty; 1.3MWh/tHBI for Midrex
- Low-quality ores require energy intensive ESF



Sources

Water
Midrex; Castro (2024)

Hydrogen
Aurecon (2024); IEA (2024)

Reduction
Midrex; Zesty

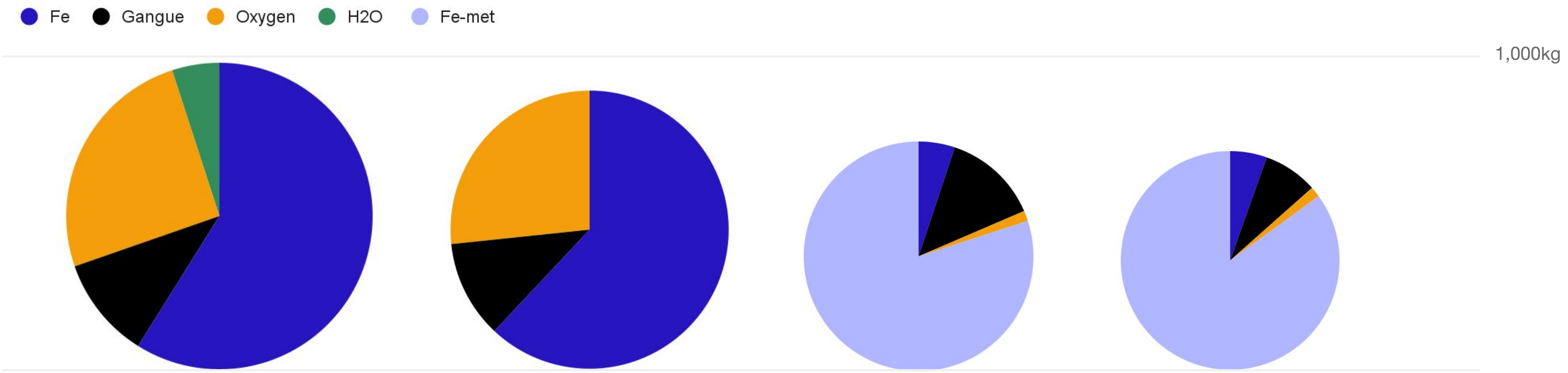
ESF / briquetting
Paymooni et. al. (2023); RMI (2024)

Pelletisation
European Commission Joint Research Centre (2013); RMI (2024)

Input #7

Ironmaking input:output rationale

62% Fe hematite, Midrex-ESF route (Pilbara, Kwinana, Gladstone)



1. Concentrate
1,00kg

2. Pellets
950kg

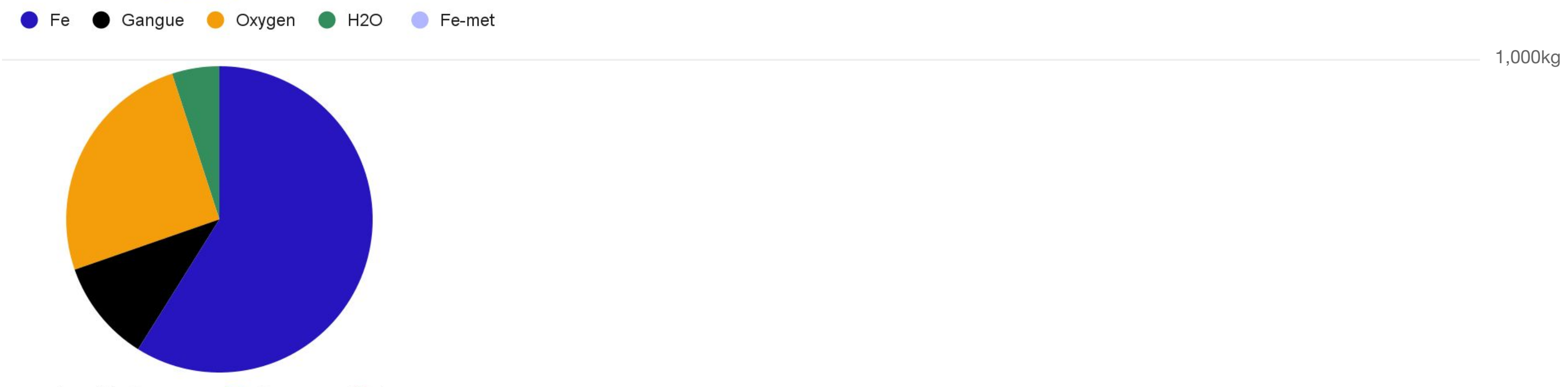
3. DRI
692kg

4. Pig Iron
651kg

Input #7

Ironmaking input:output rationale

62% Fe hematite, Midrex-ESF route (Pilbara, Kwinana, Gladstone)



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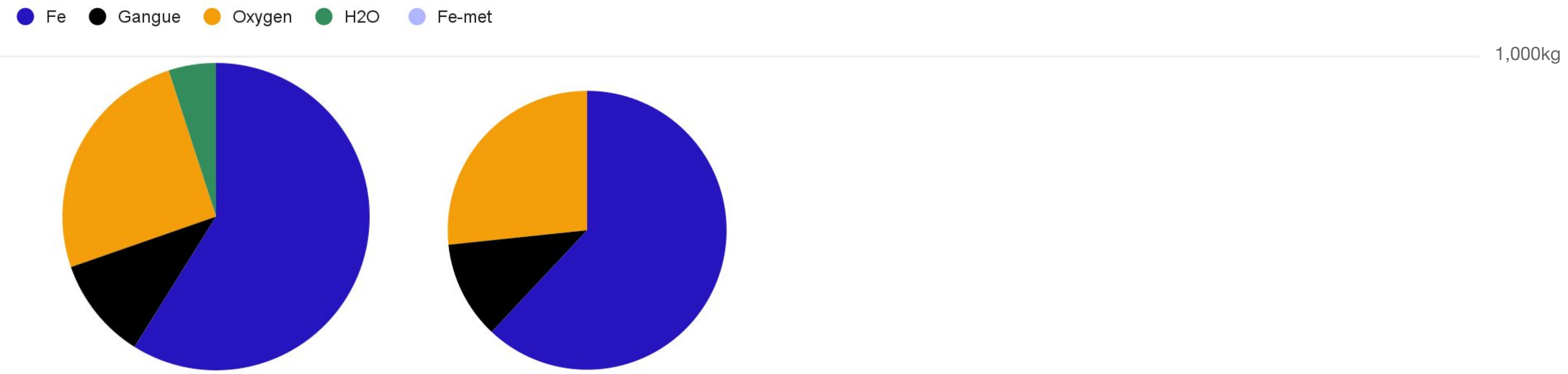

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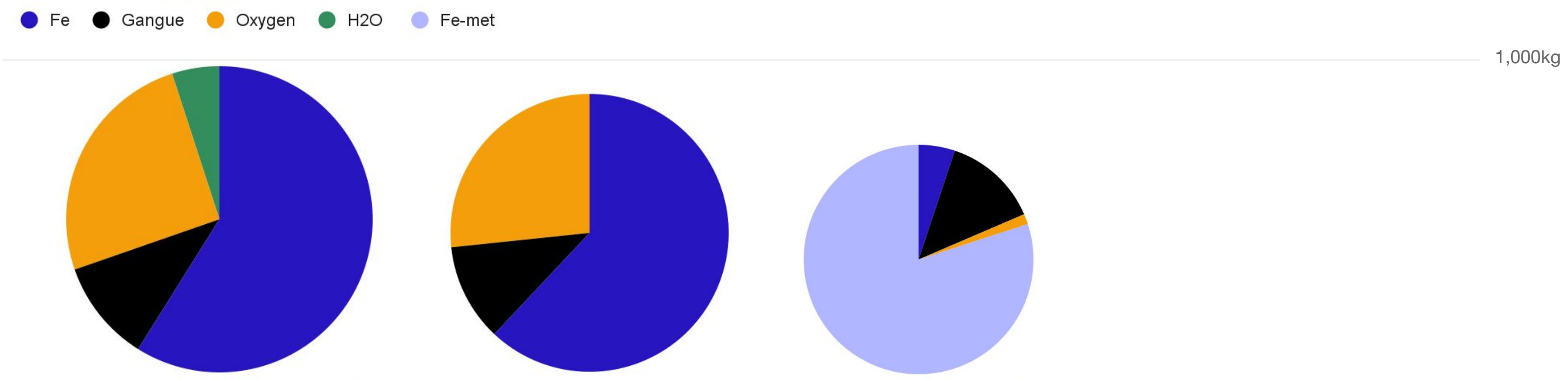

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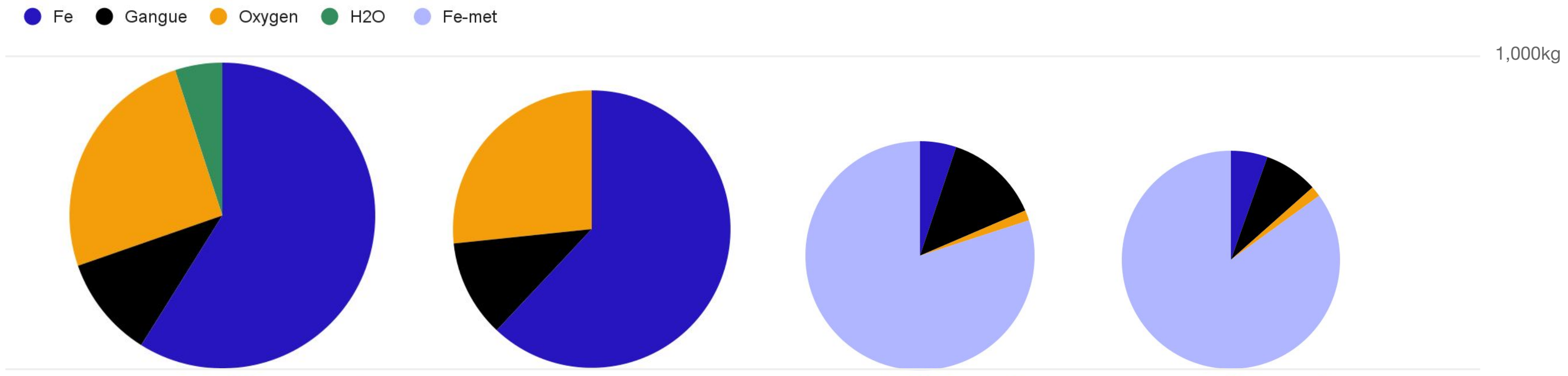

1. Concentrate
1,00kg

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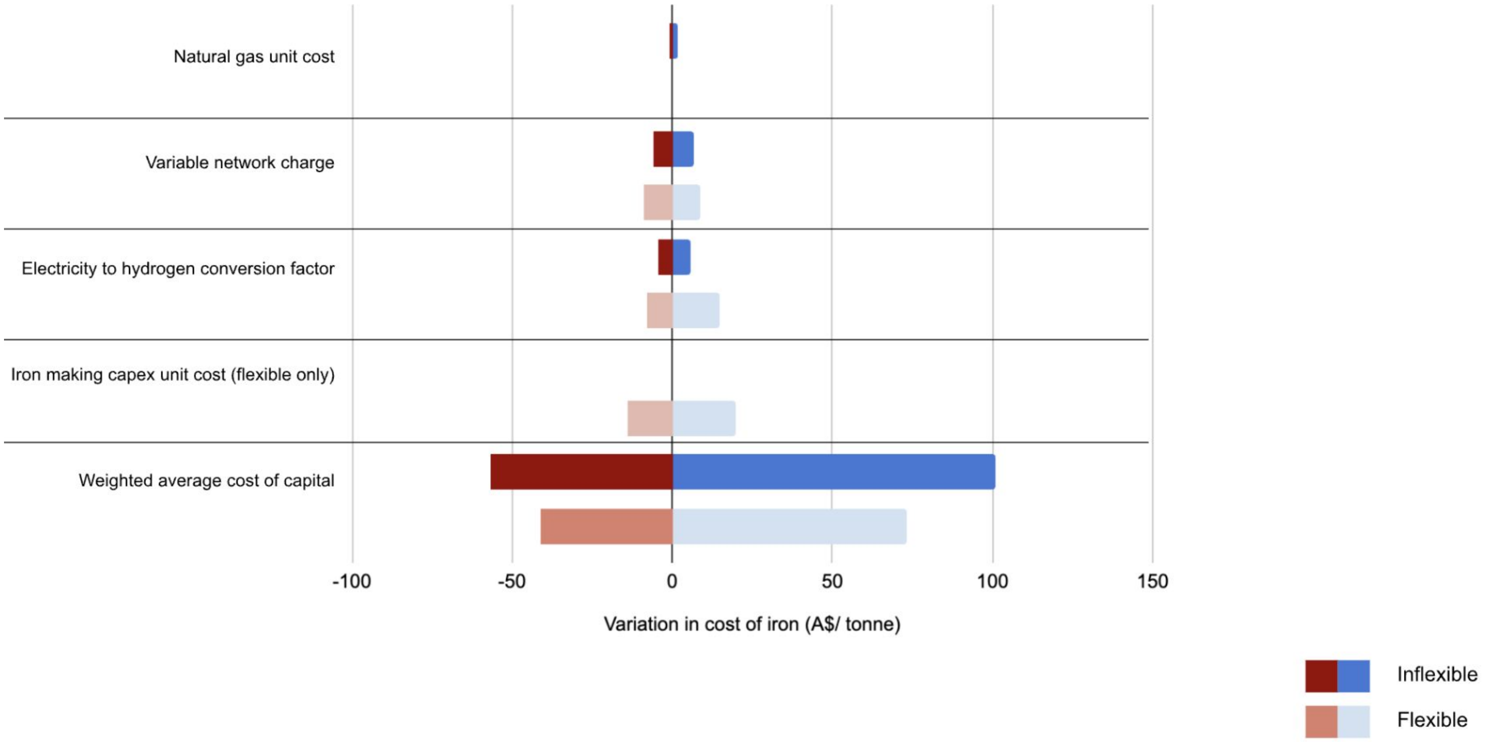
4. Pig Iron
651kg

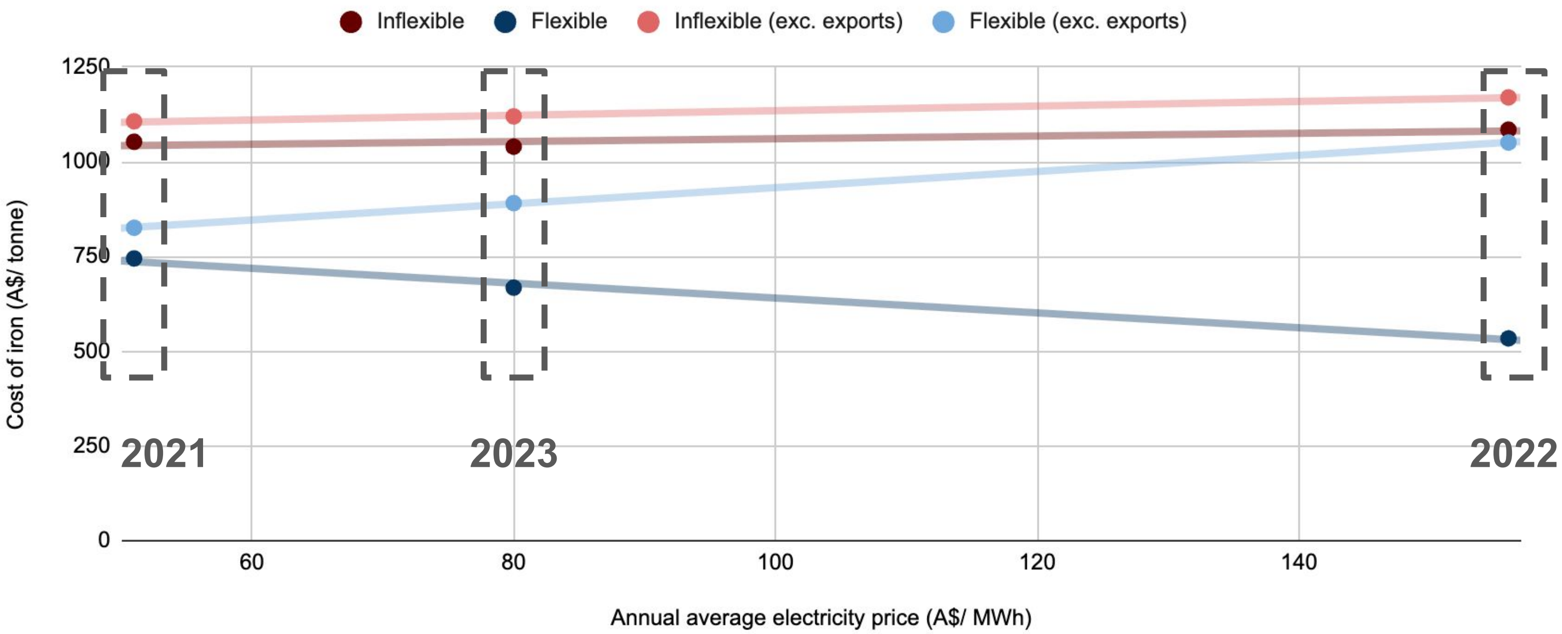
03.

Sensitivity

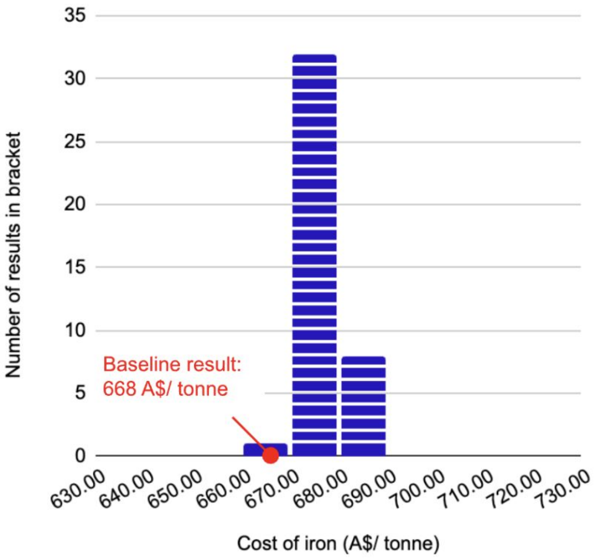
Static inputs



Hourly inputs

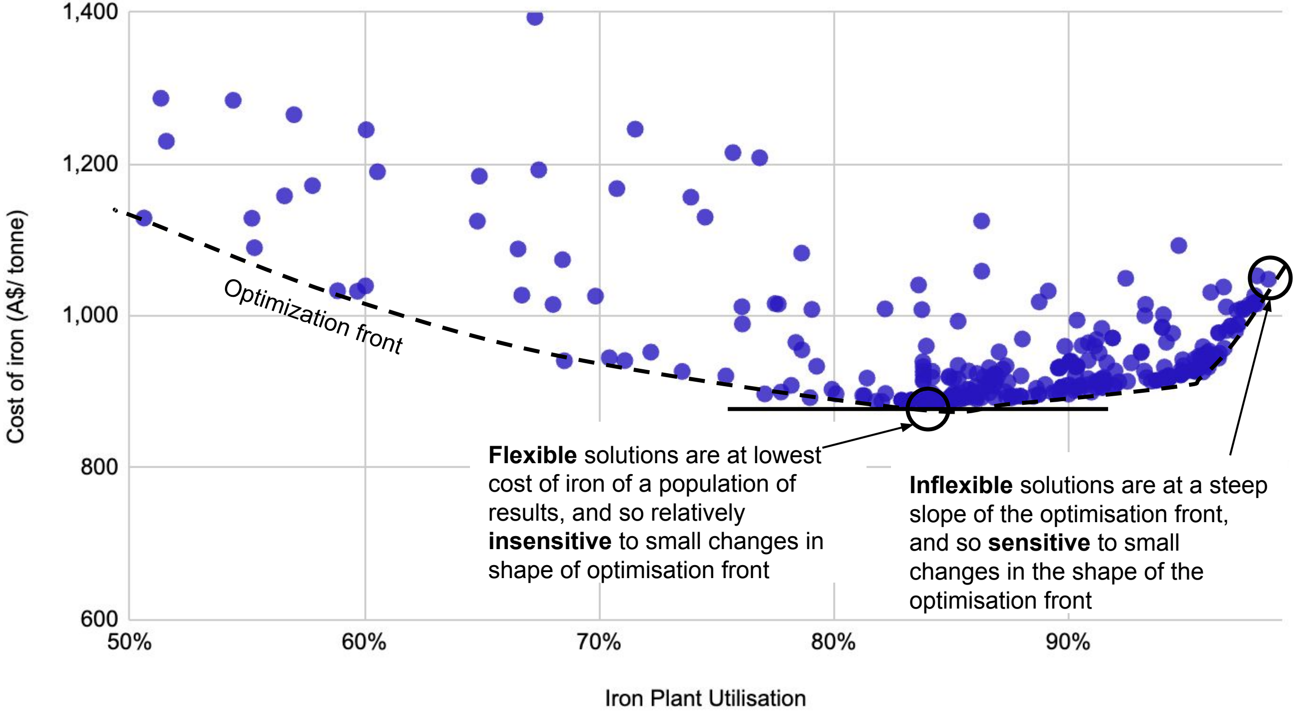


What is the variation in the optimisation process?



Eyre Peninsula, flexible

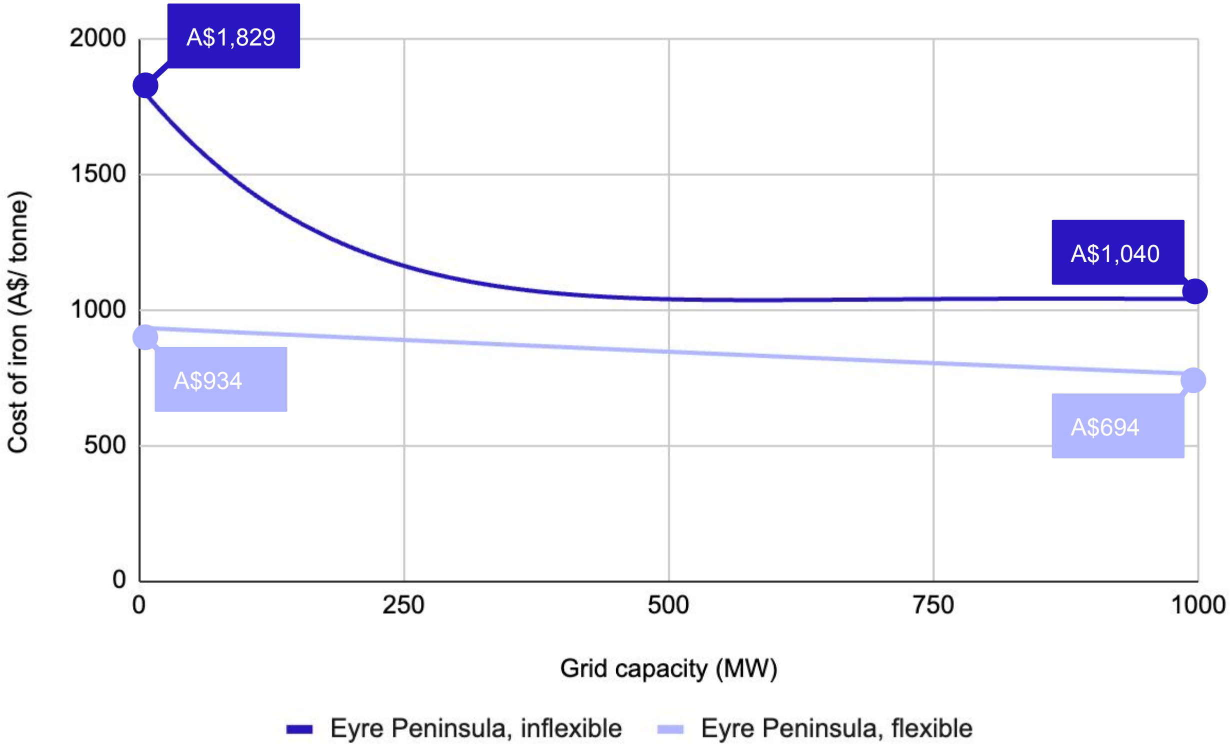
What is the variation in the optimisation process?



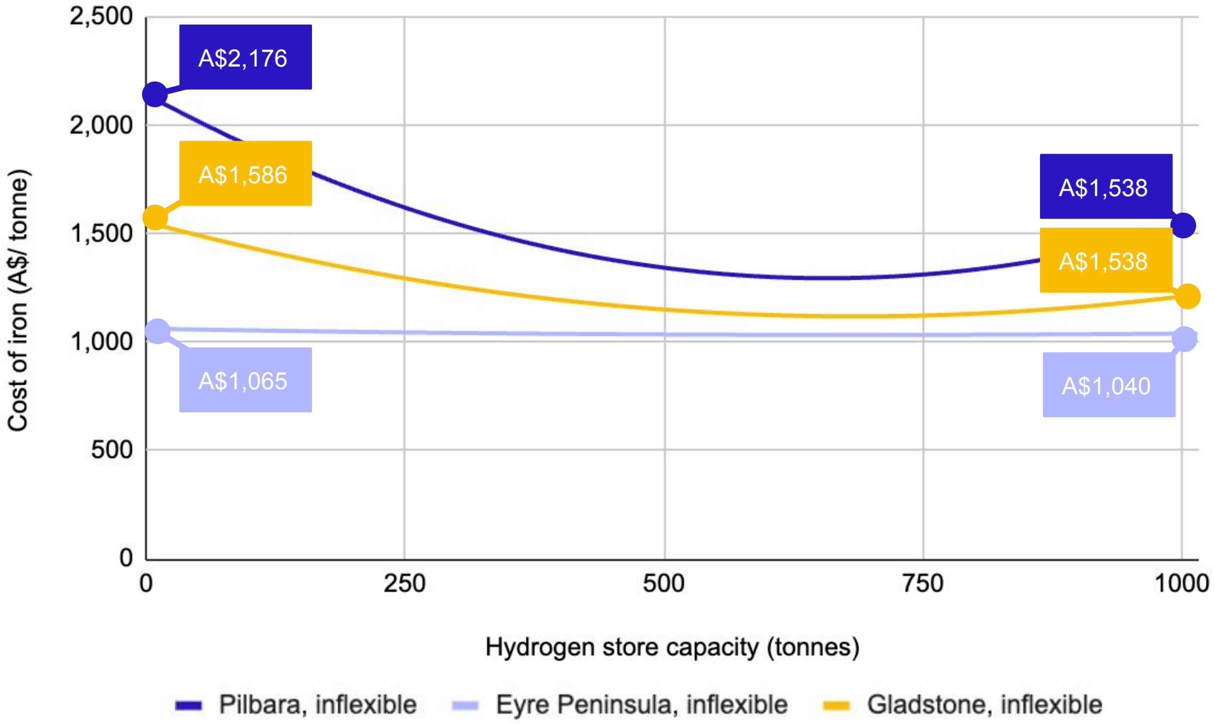
04.

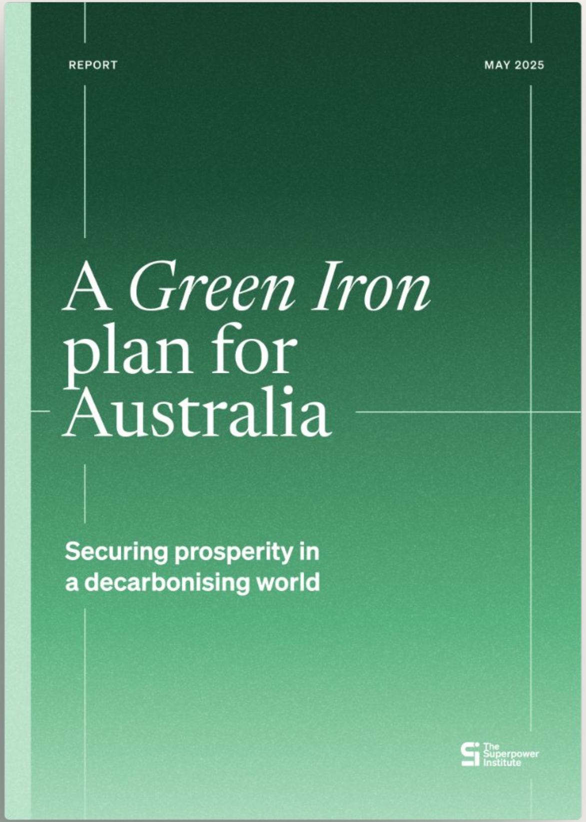
Select insights from the model

Reducing the grid capacity increases the cost of iron



Hydrogen storage capacity matters for inflexible plants





Q&A

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Thank you