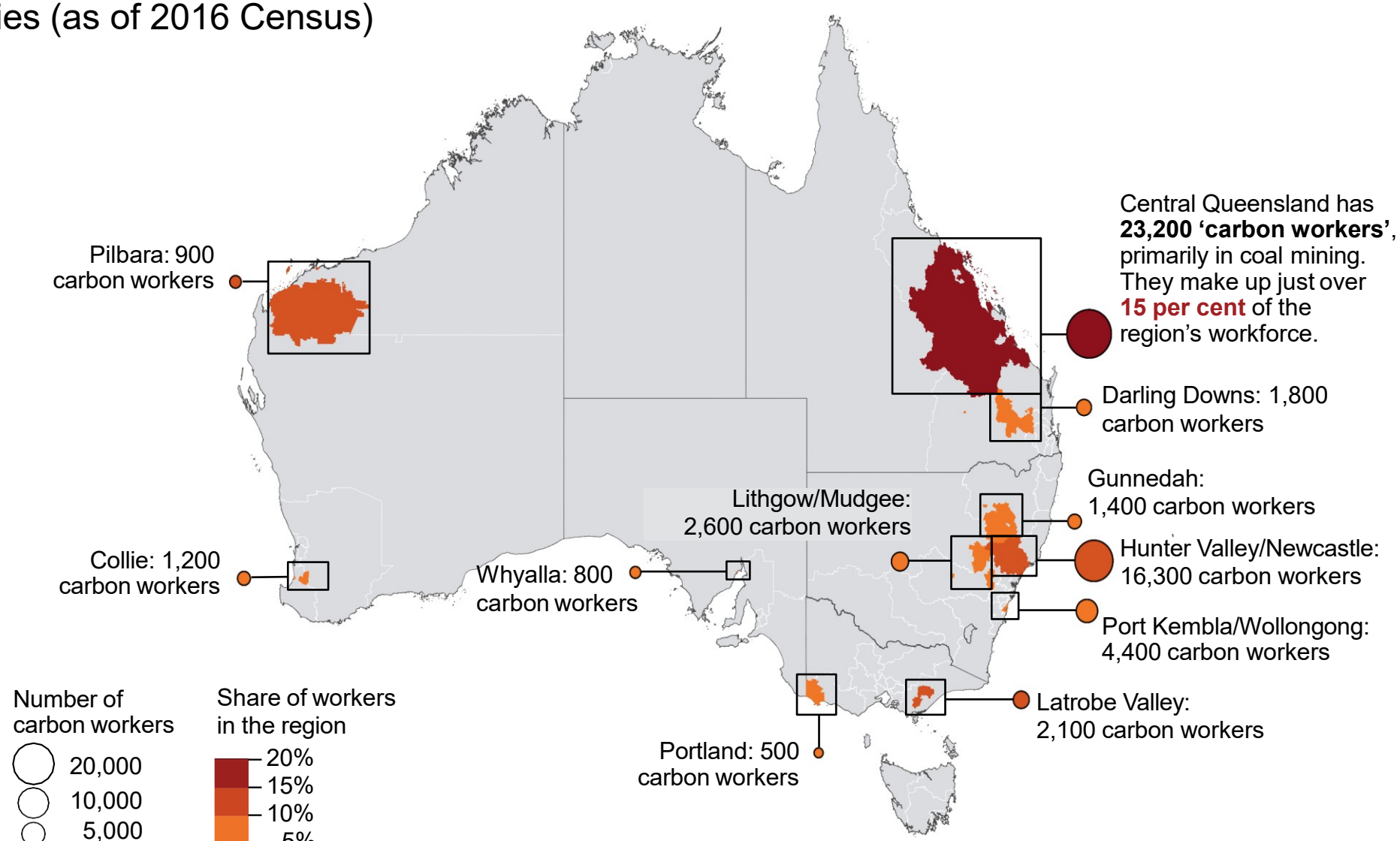
GRATTAN Institute

Green steel in Australia: a case study

Tony Wood
JISEA
12 April 2021

A number of Australian communities have significant concentrations of carbon workers

Working-age, employed residents in regionally-concentrated, carbon-intensive industries (as of 2016 Census)

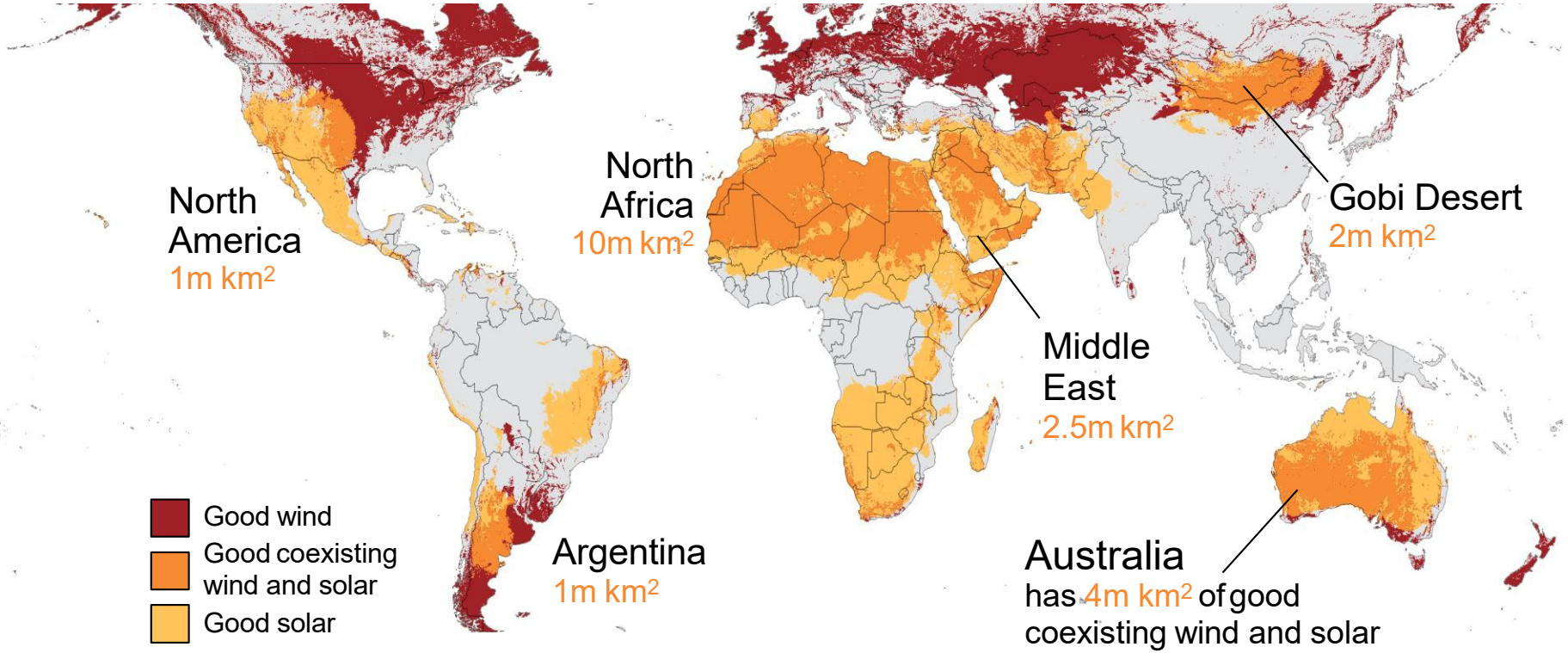


Source: Grattan Institute analysis of 2016 ABS Census

Australia's renewable energy resource endowment is both large and rare, -- a comparative advantage

GRATTAN Institute

Locations with high-quality onshore wind and solar



Notes: Land higher than 3,000 metres is excluded because renewable energy resources are harder to use when they are in mountainous terrain. High-quality resources are defined to be areas with average wind power-density of at least 450 W/m² and average daily solar photovoltaic potential of at least 4.5 kWh/kWp. North Africa includes the Horn of Africa.
Sources: Grattan analysis of Global Wind Atlas (2020), Global Solar Atlas (2020) and U.S. Geological Survey and National Geospatial-Intelligence Agency (2010).

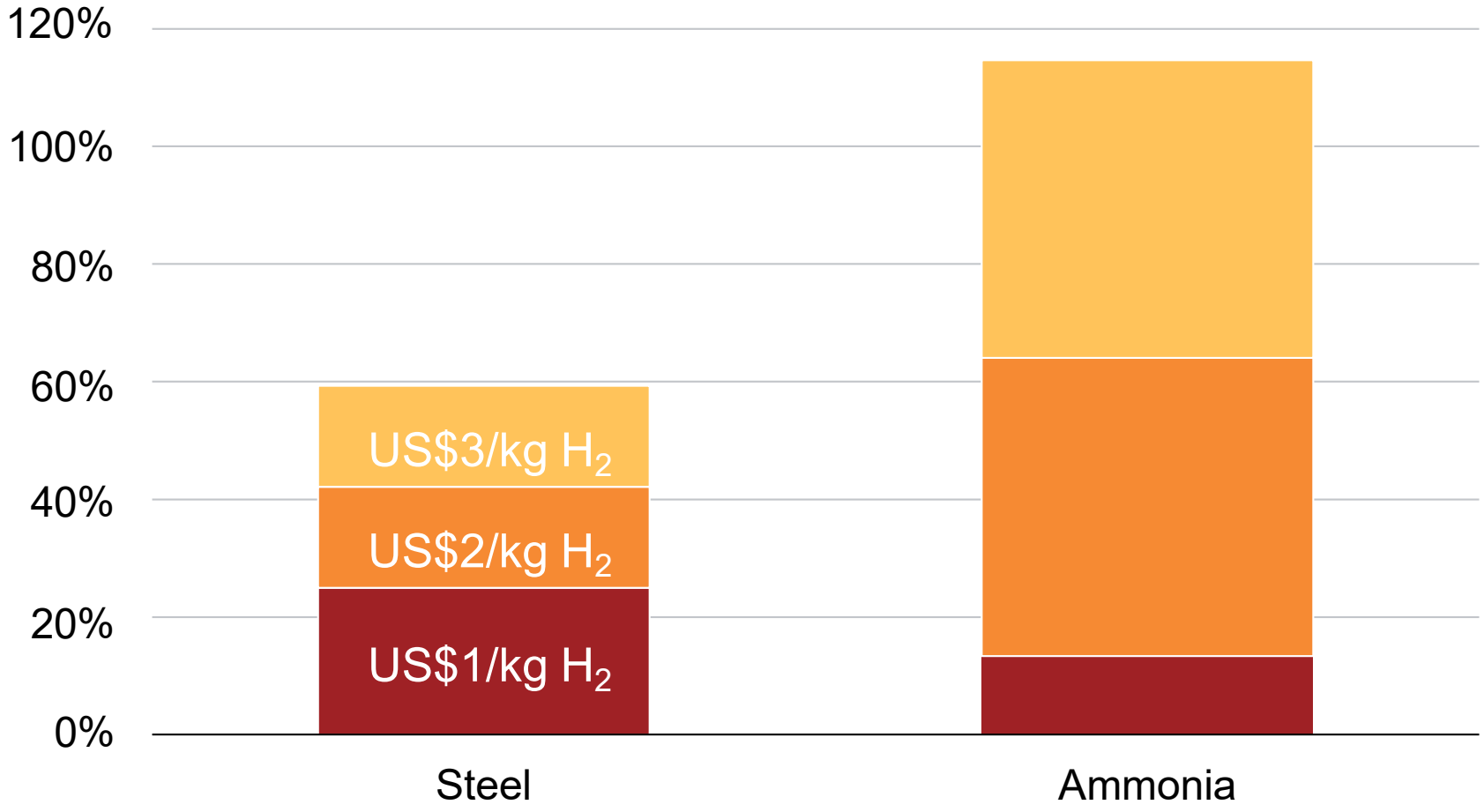
Steel is the largest clean manufacturing opportunity for Australia in a low-carbon world

Industry	Share of global emissions	Current market size (2019 real US$b)	2050 market size (2019 real US$b)	Limits on low-emissions commodity production in Australia
Steel	7.0%	660	590	None
Cement	4.5%	490	540	Carbon dioxide storage reservoir capacity
Aviation fuel	1.9%	160	230	Biomass availability
Shipping fuel	2.2%	110	180	Depends on technology pathway
Aluminium	1.4%	70	130	Economics of firming wind and solar
Alumina	0.2%	60	110	Market size
Ammonia	0.8%	60	100	Market size

Notes: Aluminium market size excludes value of alumina to avoid double-counting Sources: Grattan analysis

Green steel is more cost-competitive than green ammonia in the near-term

Green premium (additional cost of hydrogen-based product over cost of fossil fuel-based product) for Australian-made green steel and green ammonia



Notes: The green premium is calculated based on historic market prices, in real 2019 US dollars.
Sources: Grattan analysis, Steel Benchmarker export steel prices (hot rolled coil), and USGS 2020 Commodity survey ammonia prices.

Green steel could deliver tens of thousands of jobs

	Central Queensland	Hunter Valley	Combined
Ongoing jobs in region	15,000	10,000	25,000
Direct reduced iron (DRI) output (Mt per year)	60	35	95
DRI exported (Mt per year)	30	17.5	47.5
Steel exported (Mt per year)	25	15	40
Output: share of global steel market (including steel produced from exported DRI)	4%	2.5%	6.5%
Output as share of today's integrated steel production by prospective trading partners	30%	20%	50%
Annual value ($b)	40	25	65
Capital investment ($b)	115	80	195
Renewable generation capacity required (GW)	75	60	135

Notes: Dollar estimates are real 2019 Australian dollars. Job estimates exclude construction. Plant jobs include operation and maintenance of both steel plant and electrolysers for hydrogen supply. Prospective trading partners are Japan, Korea, Indonesia, Malaysia, Taiwan, and Vietnam.
Source: Grattan analysis

These opportunities will emerge in two broad phases

Phase 1 (indicatively 2020 to 2035)

- Positioning for an uncertain market opportunity
- Government policy is crucial
- Focus should be to develop technological, engineering and financing capability in Australia.
- The scale of early commercial deployment, e.g. to serve the 'green premium' market and/or with government support, is quite uncertain and likely to be modest in scale.

Phase 2 (indicatively 2035 to 2050)

- Market and policy drivers, especially internationally, will drive speed and scale of opportunity
- The potentially large opportunity requires private capital underpinned by fundamental economics, not ongoing subsidies
- The role of government is to facilitate investment through land-use planning and worker retraining.

Policy action is needed to help Australia capture potential opportunities

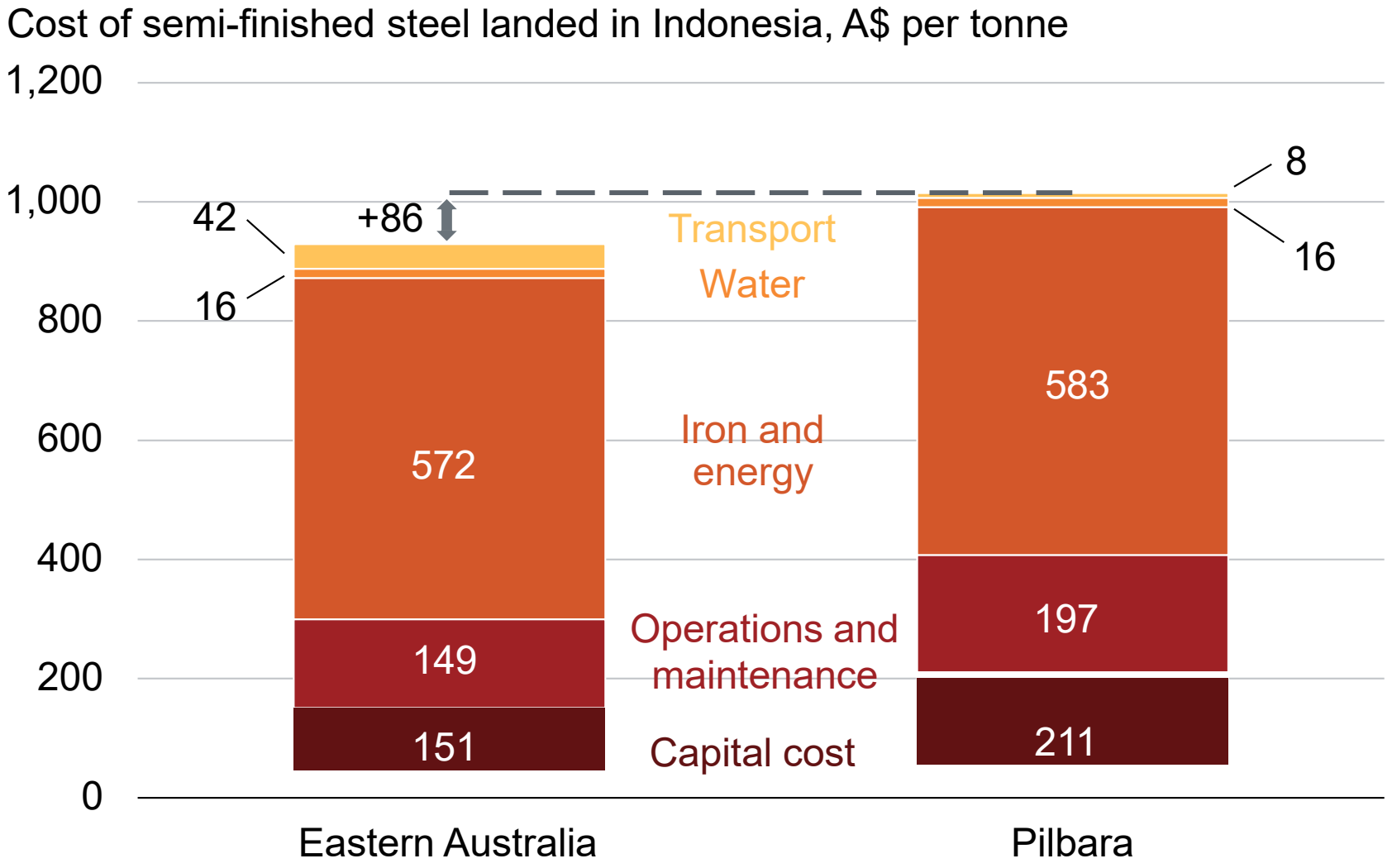
Green steel:

- Develop Australia's low-emissions steel capability through a steel flagship project – indicatively requiring government co-funding of $500 million
- Develop Australia's hydrogen storage potential – through early geotechnical work on potential salt storage basins
- Continue policy efforts to support broader hydrogen industry (e.g. electrolysers)

Other industries

- Low-emissions aviation fuel mandate
- Green ammonia doesn't require specific support, other than broad hydrogen industry support.

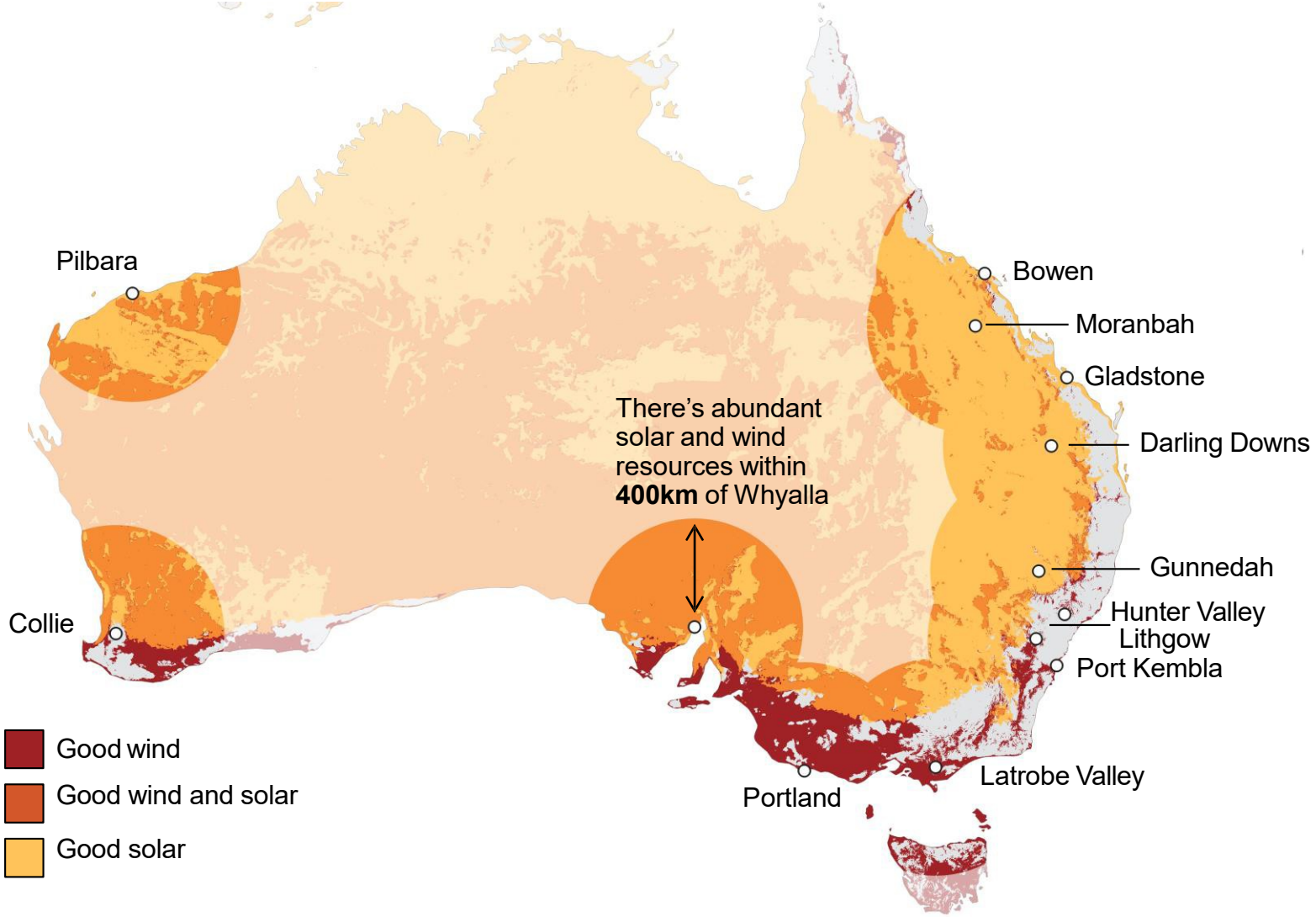
It is cheaper to move iron ore to existing workers than move workers to the iron ore



Notes: Cost estimates assume a hydrogen cost of US$2 per kilogram in both locations. Cost differences primarily come from higher labour and construction costs in the Pilbara.
Source: Grattan analysis.

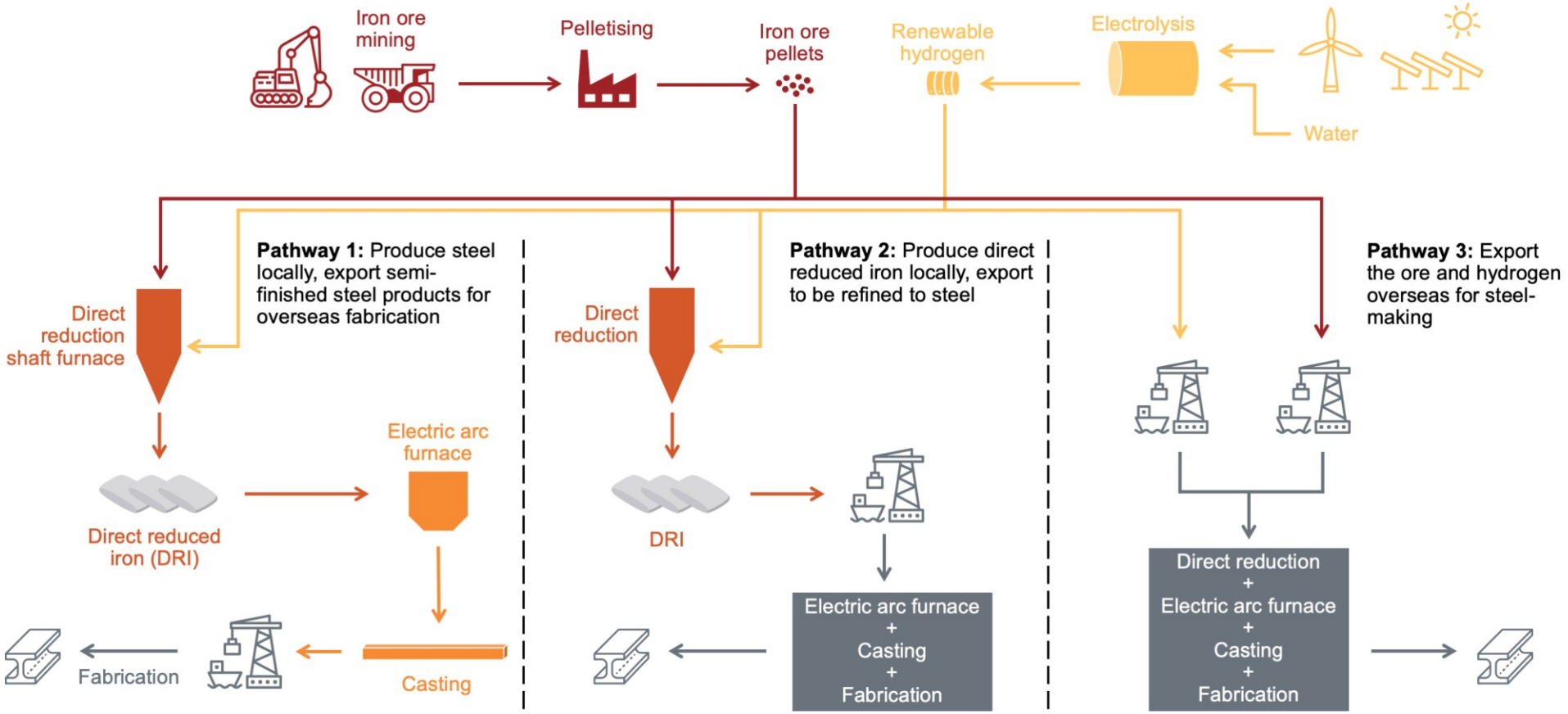
Carbon regions are close to high-quality renewable resources

Wind and solar resources within 400km of carbon-intensive regions



Sources: Grattan analysis of Global Wind Atlas (2020) and Global Solar Atlas (2020).

Australia has three main green steel export pathways: steel, 'direct reduced iron' (DRI), or the hydrogen input



Notes: All three pathways require low-emissions electricity in each step. Iron ore mining and pelletising need not occur in Australia.
Source: Grattan analysis. Some icons sourced from flaticon.com (2020).

Australia could export steel directly, or export direct reduced iron for further processing overseas

Steel-consuming country	Japan			Indonesia
Hydrogen price scenario	US$2/kg in Australia, plus transport	BNEF 2030 estimates	BNEF 2050 estimates	US$2/kg in Australia, plus transport
Production pathway				
Pathway 1: Australia exports steel	937	874	797	929
Pathway 2: Australia exports DRI	968	905	828	930
Pathway 3: Australia exports hydrogen	1,099	-	-	1,026
Pathway 4: importing country produces own hydrogen	-	1,010	876	-

Notes: BNEF is Bloomberg New Energy Finance. BNEF estimates 2030 hydrogen costs of US$1.48/kg and US$2.85/kg for renewable hydrogen produced in Australia and Japan respectively, and 2050 costs of US$0.84/kg and US$1.74/kg respectively. Hydrogen transport costs from Australia to Japan are US$1.59/kg, and US$1.50/kg to Indonesia (based on the 2018 CSIRO Hydrogen Roadmap).
Sources: Grattan analysis