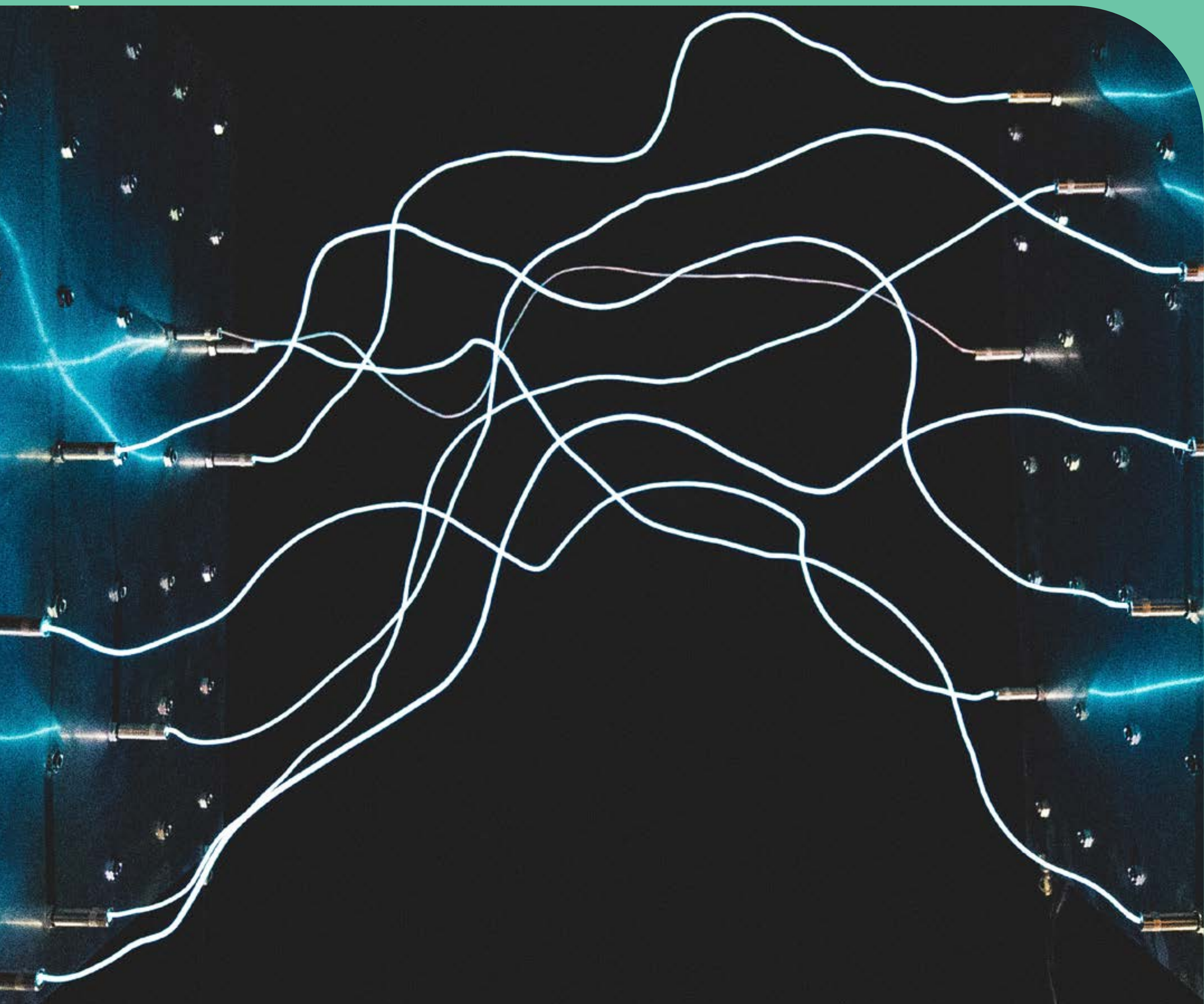
Green gold

A strategy to kickstart Australia's renewable industry future



| Toby Phillips

Centre for Policy Development

About CPD

The Centre for Policy Development is an independent, non-partisan policy institute with staff in Sydney, Melbourne, Canberra and Jakarta, and a network of experts across the Indo-Pacific region.

We confront the toughest long-term challenges facing Australia and the region, and take people on the journey of solving them. Our work is evidence-based and guided by values. We drive broad collaborations to advance long-term wellbeing.

We are not-for-profit and funded by tax-deductible charitable contributions. CPD's funding policy ensures research is independent.

We acknowledge the Traditional Owners of the lands on which we work.

About the author

Toby Philips is Program Director, Sustainable Economy, at the Centre for Policy Development.

Acknowledgements

For their helpful comments, correspondence and critiques, the author would like to thank Alan Finkel, Alison Reeve, Cam Crawford, Erwin Jackson, Frank Jotzo, Guy Debelle, Mara Hammerle, Mark Burford, Nick Flemming, Nicky Ison, Nicole Wyche, Purdie Bowden, Rod Sims, Roy Green, Rowan Moorey, Suzanne Harter, Tennant Reed, Tim Buckley, Tom Quinn, the team at Climateworks Centre, and participants in a July roundtable of the *2035 Climate Initiative* . Dennis Venning gets a special mention in the genesis of this work.

Published by the Centre for Policy Development

Cite this report as: Toby Phillips (2023) *Green gold: A strategy to kickstart Australia's renewable industry future*, Centre for Policy Development.

Table of Contents

Executive summary

The federal government has committed to develop a package by the end of 2023 to "leverage Australia's competitive strengths in renewable energy, critical minerals and highly skilled workforce to accelerate our other clean industrial and manufacturing capabilities". This report focuses on the opportunity to export emission-free iron, alumina/aluminium, and ammonia; energy-intensive commodities with large global markets. This report refers to them collectively as future "green export industries".

Other industrial goals – such as processing critical minerals or onshore component manufacturing – should be seen as secondary outcomes. Pursuing the primary goal (exporting energy-intensive commodities) will contribute to these secondary outcomes, and they can be further supported at the margins.

Australia has impressive natural endowments of (potential) renewable energy and the raw inputs to make green iron, aluminium and ammonia. Over the long-term, these green export industries should thrive in Australia. But in the medium term, the emergence of green export industries is held back by unpredictable technology costs and a global market that gives a significant 'grey discount' to emissions-intensive industries. Overcoming these obstacles will require significant policy support, in the range of at least $60-100 billion, and possibly more.

With this investment, the Commonwealth can have a bigger impact on global emissions than all domestic decarbonisation combined, and secure future industries in the process.

Such a policy package will need to balance many competing interests. With this in mind, the government should balance several principles in designing a package for green export industries:

This report includes example of a package designed around such principles, which would cost $20 billion over the forward estimates (and $85 billion overall, or $100 billion if you count off-budget investment funds)...

Roughly half of this should support first-movers and pioneers:

- ⇒ $30 billion in contracts-for-difference to support the absolute first movers in key industries (iron, alumina, aluminium, and ammonia)
- ⇒ $15 billion to front-load investment in major firmed, dispatchable renewable installations

Around a quarter for the fast followers that build up a critical mass:

- ⇒ $20 billion in production credits to encourage second- and third-movers to reach a critical mass in key export industries

And a quarter for communities, loans, research grants, and regulatory reforms:

- ⇒ $10 billion Regional Transformation Fund to support communities
- ⇒ $5 billion (in concessionality) to allow $22 billion in loans and investments for projects related to the industries above as well as critical minerals processing and value-added manufacturing (eg. lithium, nickel, copper, polysilicon, solar panels and batteries)
- ⇒ $2.5 billion for testing and research
- ⇒ $1.5 billion Net Zero Government Fund to defray costs of procuring low-carbon material (eg. for government infrastructure)
- ⇒ $500 million for permitting and approvals reform, and resourcing local councils.

Materially reduce economic risks	Avoid ongoing reliance on public subsidies
Focus on *additionality* (investments that wouldn't happen otherwise)	Target specific parts of innovation ecosystem and capital stack
Address the marginal cost difference	Simple and clear rules for participants
Front-load investment commitments	Socialise the benefits

Why invest in green export industries?

Industry policy in Australia is, for the most part, agnostic about the direction of structural transformation. The reigning consensus has been that Australian governments do not "pick winners" by deciding which industries to give preferential support; instead relying on competitive and dynamic markets to guide structural change.

There are strong reasons behind the economic policy orthodoxy – it avoids asking taxpayers to prop up uncompetitive businesses, and it ensures the economy is structured as efficiently as possible (where "efficiency" is determined by whatever factors are priced into global markets). But there are three strong reasons to believe that government intervention in green export industries is necessary and valuable. This report focusses specifically on emissions-free iron, ammonia, and alumina/aluminium as "green export industries" (for the reasons detailed in Appendix 1).

Not only will government action help achieve economic goals, but also domestic energy policy goals and climate policy goals.

Global markets are incomplete and distorted

Future Australian prosperity depends on having productive industries in 20 or 30 years' time. Australia is in an enviable position with a strong endowment of natural resources, minerals, and renewable energy potential. Australia has the largest potential for solar energy generation, and indeed, Australia has the largest potential value-add opportunity for hydrogen-DRI iron in the world.[1] This opportunity is important given the inevitable global shift away from fossil fuels (which will affect around $150 billion per year in Australian output).[2] But there is no guarantee Australia will capitalise on those endowments.

Global commodity markets do not adequately incorporate the costs of carbon emissions (an externality), and nor do they incorporate the costs from a global wave of regulation that will limit carbon emissions over the coming decades (incomplete information). The most efficient industrial structure determined by *today's* commodity markets will not be the most efficient structure for tomorrow's markets. This has led to intensifying intervention from governments around the world.

Other countries are making significant investments in green industries, such as the US Inflation Reduction Act, the EU Green Deal Industrial Plan, the Canadian clean investment package, and the Japanese Green Growth Strategy. These subsidies are de-risking projects and attracting significant investment capital to their respective jurisdictions. Whether you view this as distorting the global market or compensating for market incompleteness is merely a matter of perspective. Either way, to become a world-leading exporter of clean energy and related inputs and products, Australia will need to respond quickly and ambitiously.

It is not enough to assume that once the technologies are mature the industries will migrate to Australia where sun is plentiful. The important investments in establishing new green industries are large and lumpy; for example, multi-billion dollar plants for processing ore, of which there might be only tens, not hundred or thousands, built across the world this decade. These will be built where the business model – including government subsidies and support – makes the most sense. And once established these industries will stay where there is the workforce and know-how, there is little chance that these industries will migrate to Australia in 20 or 30 years time.

Australia needs to decarbonise its domestic energy systems

A clear goal of Australian governments is to decarbonise domestic energy systems – evident in the Commonwealth's 43% emissions reduction target by 2030 (and net zero by 2050) as well as more ambitious targets in several states and territories.[3] This decarbonisation of domestic energy systems is a challenge, and current progress is not accelerating fast enough to meet future demand. However it can be achieved more easily alongside the development of new green export industries.

New green export industries require massive amounts of electricity (as quantified below). Securing these industries in Australia will require building renewable generation capacity that is several times greater than the current National Electricity Market (NEM). This "pull through demand" for a large amount of firmed, dispatchable renewables for industry would make it uneconomic to continue generating electricity from coal or gas for domestic consumption, and would result in domestic energy systems that have sufficient capacity to provide energy to households and domestic-oriented businesses.[4]

Australia can have an outsize impact on global emissions

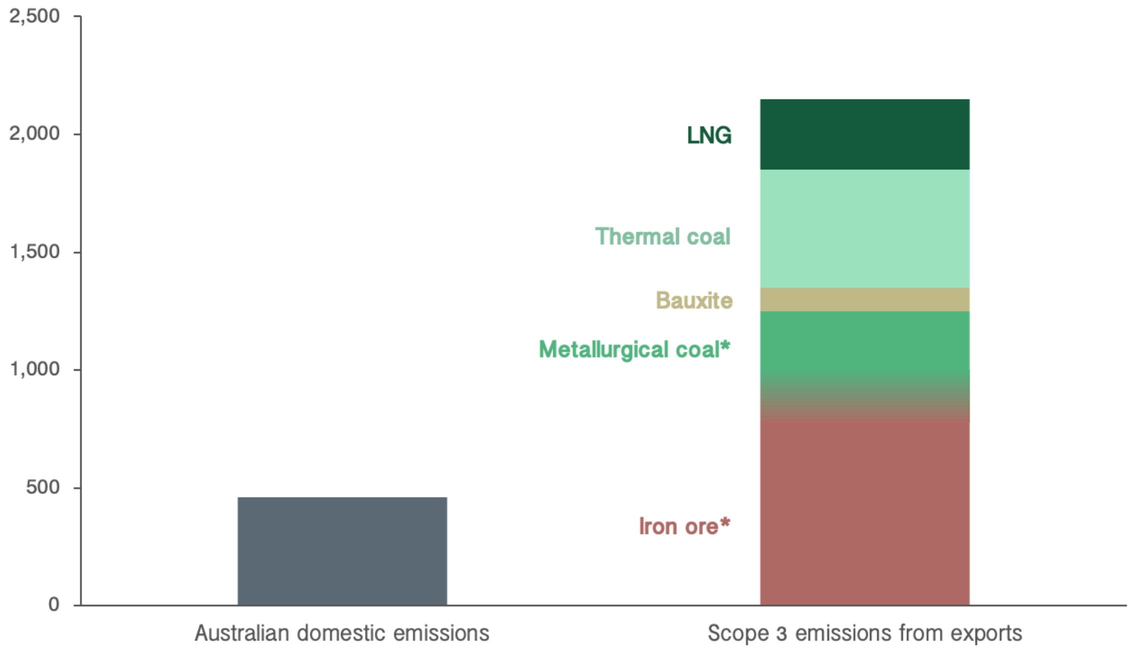
Emissions associated with Australian exports significantly outstrip domestic emissions (see Figure 1). The carbon released in the downstream processing of many Australian commodities is significant, for instance the emissions associated with the transport and processing of Australia iron ore is estimated at around 900 million tonnes annually, nearly double all the domestic emissions in Australia.

Australia has committed to a clear policy goal of limiting global warming, ideally keeping it within 1.5°C. The single most significant way Australia can reduce global emissions is to prevent the emissions associated with processing its exports (by processing them onshore first using renewable energy).[5] Green onshore processing of 25% of Australia's iron ore and alumina exports would avoid over 250 Mt CO2-e per year of global emissions, dwarfing Australia's commitment to a domestic reduction of 110 Mt CO2-e per year from 2021 levels by 2030.[6] This opportunity is present across a range of possible Australian export supply chains, including ammonia/fertiliser, alumina/aluminium, and processed energy transition minerals (including copper, nickel, lithium, etc).

One of the most significant blockers to the development of new clean supply chains for these products is the large upfront capital requirements and risk associated with their scale-up, and the uncertain demand for products if they are meaningfully more expensive than emissions-intensive incumbents.

Figure 1. Reducing emissions from Australia's exports is our biggest lever to impact global emissions

Approximate 2022 emissions (Mt CO_2-e)



Source: DISR (2023), '*Resources and energy quarterly (March 2023)*'; DCCEEW (2023), '*Australian National Greenhouse Accounts Factors*'; Rio Tinto (2021), '*Scope 1, 2 and 3 Emissions Methodology*'; DCCEEW (2022), '*Quarterly Inventory (December 2022)*'; BHP (2022), '*Annual report 2022*'; and FMG Fortescue (2022), '*FY22 Climate Change Report*'.

Note: there is overlap in scope 3 emissions for downstream use between metallurgical coal and iron ore, so reported figures have been moderately reduced to avoid double counting.

The fundamentals: missing technology and missing demand

The potential future of Australia as a green export "superpower" is far from guaranteed. Developing world-leading green export industries is not a trivial exercise. The physical capital (in terms of renewable generation, energy storage, transmission, industrial facilities, and so on) is not trivial. While the domestic energy transition might require 2-3 times current electricity generation as we electrify everything (including transport), building new export industries could require 20 times (see Figure 2 below).

There are two fundamental, existential hurdles that will need to be overcome for these industries to take off: a lack of technology and a lack of demand for the products. Costs need to come down for low-carbon industrial goods to compete on their own merits, and the investors need to be shown there is enough demand to justify large capital commitments.

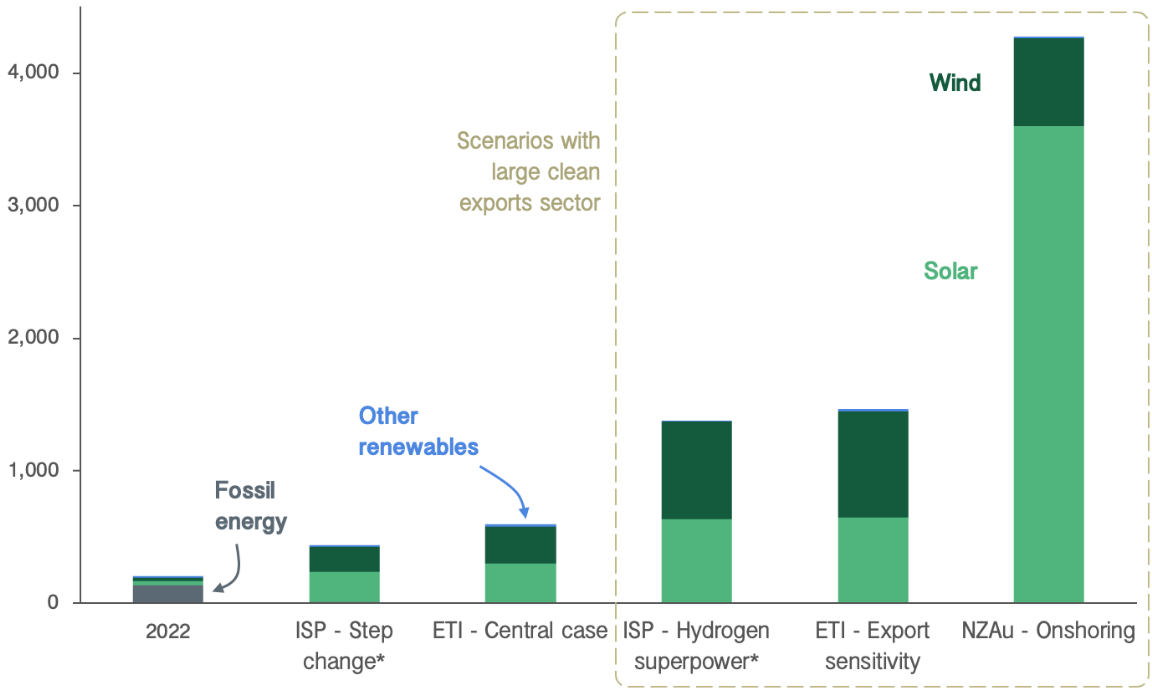
A third missing piece is a level playing field: fossil fuel intensive goods benefit from a 'grey discount', which is addressed in its own section towards the end of this report.

Cost decline is a function of deployment, not time

The success of low-carbon export industries depends upon the costs becoming low enough that they out-compete 'grey' fossil fuel-based commodities on their own merits. We can be relatively confident of this eventual end state with mature technologies and close-to-zero marginal cost energy. The 'learning rates' that lead to cost declines are a consistent phenomenon, particularly with standardised and mass-produced industrial processes. For instance, each doubling of solar PV deployment has led to around 20% cost declines.[7]

Figure 2. Becoming a green export "superpower" will require many times more energy generation than the current NEM

Annual generation (GWh)



Sources: ETI: Australian Industry Energy Transitions Initiative (Climateworks Centre and Climate-KIC Australia, 2023); ISP: Integrated System Plan (Australian Energy Market Operator, 2022); NZAu: Net Zero Australia (UniMelb, Uni Queensland, Princeton, Nous Group, 2023)

But there is a difficult period between where we are today and that eventual end state. In particular, many of the technologies required to decarbonise industrial processes are not yet fully mature – such as hydrogen electrolysers or substitutes for blast furnaces. As these technologies are developed, built and deployed, we can expect costs to fall dramatically.

Importantly, the decline in cost is a function of deployment, not time. For instance, the current global installed capacity of hydrogen electrolysers is approximately 0.5GW, increasing that to 32GW could result in cost reductions of 50-70%.[8] And this cost reduction could take 5 years or 15 years, depending on how long it takes to go from 0.5GW to 32GW of installed capacity. For this reason, recent economic analysis suggests a large *benefit* from rapid transition – particularly when counting the costs of continued emissions and a disorderly transition. The quicker these technologies move down the cost curve, the more years society has to benefit from lower costs and lower emissions.[9]

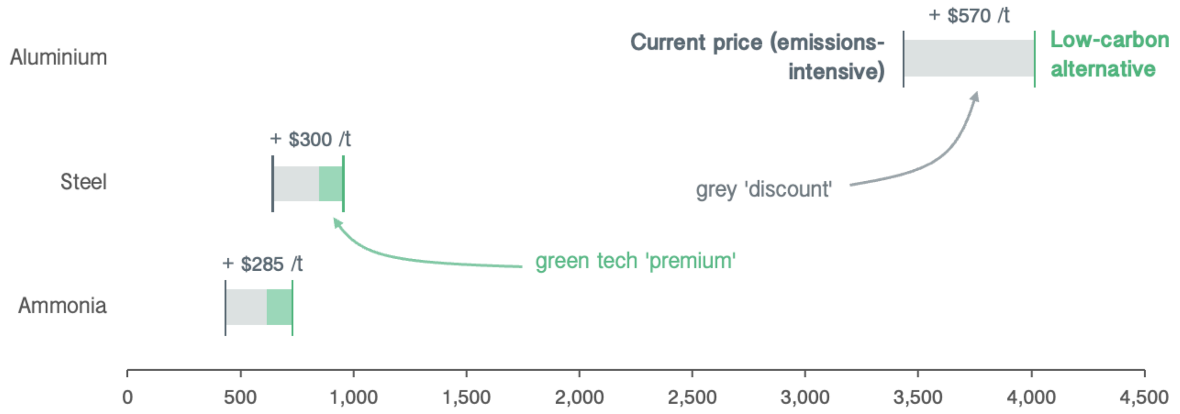
This also means that there is no way to avoid the fact that the first few deployments of any technology – hydrogen electrolysers, direct reduction of iron, or alternatives to carbon anodes in aluminium electrolysis – will be expensive. The only way to make them cheaper is to build the expensive ones first.

Missing demand for green goods

At the moment, there are no robust drivers of demand for low-carbon industrial outputs in the Australian market, nor widespread policy mechanisms to solve this. Current low-carbon goods are expensive compared to carbon-intensive counterparts which dampens demand for these products. This price difference is often described as a 'green tech premium' but this is misleading; the 'grey discount' that benefits fossil fuel-based incumbents is a more significant factor than the 'green tech premium' of new technologies (see Figure 3).[10]

In the absence of regulation or government support to create markets, large-scale production is unlikely to emerge on its own, despite growing interest from investors. This creates a first-mover problem. When facilities are built they will lock in the tech mix (and associated capital costs) available at the time of development. Investors cannot make these investments when they do not have guaranteed demand at these higher prices, and everyone's best interest is to wait for others to invest in high-cost early deployment. Particularly because they can then undercut the first-mover high-cost producers. This is compounded by the fact that the demand-side of the market is slow to mature in the absence of supply; it is not clear how deep the market is for green products (although these markets will grow over time).

Figure 3. Low-carbon goods will cost more than their fossil fuel-based counterparts through to 2030, but the 'grey discount' is a bigger factor than the 'green tech premium'



Source: CPD estimate of 2030 prices using data from the Mission Possible Partnership and the Australian Industry Energy Transitions Initiative. Notes: all figures are only indicative, based on average global production and vary highly between regions. Figures for aluminium are projected costs in 2035. The 'grey discount' is based on a 2030 carbon cost of US$50 or AU$75 (consistent with Mission Possible Partnership scenarios and the Australian government's Safeguard Mechanism price cap).

Policies that address these price differences and make it economically viable to invest in production are discussed further below, but could include a mix of explicit or implicit carbon pricing (removing the 'grey discount'), clean purchasing requirements on public and private producers (a regulatory mandate to purchase the 'green' goods), or subsidisation and underwriting (public subsidy of the price gap).

A green export policy package

Showing long-term vision and commitment to key industries: iron, aluminium and ammonia

Specifying the Commonwealth government's ambitions for green export industries would assist industry and communities in planning for the future. An overarching goal could galvanise action, and such industries could eventually become worth hundreds of billions of dollars a year.[11]

This vision (and the sorts of policies discussed below) should involve a long-term commitment over a timeframe of one to two decades, and be clear about the specific industries the government wants to support (but not specific technologies or projects).

The bulk of government support should target industries and activities that achieve climate and economic goals. The climate goals are simple: supporting activities that contribute the most to global emissions reduction. Economic goals can be achieved by targeting support to industries where (a) there is likely to be significant global demand for exports, (b) Australian industries cannot compete globally today (because of the 'grey discount' or not-yet-mature technology), and (c) there is reason to believe that Australia would be competitive over the long-term. These factors are analysed further in Appendix 1, and this analysis leads to a primary focus on production of iron, aluminium and ammonia.

Given the range of possible scenarios, it is hard for industry, investors and communities to know what "superpower" means. Figure 2 above shows the different energy requirements for different scenarios of Australia developing energy intensive export industries; does the government envision 3x or 20x current levels of energy generation when it talks about being a green export "superpower"? A well-articulated vision from government – backed by policy – would give this clarity to industry and investors. This could be something like a target of annual exports by 2035 of 30 Mt/yr green iron, 10 Mt/yr green alumina, 8 Mt/yr green aluminium and 6 Mt/yr green ammonia.[12]

Supporting other industries can be thought of as secondary goals surrounding the core outcome: kickstarting green export industries in energy-intensive products. The Commonwealth's 2023-24 Budget item also refers to "other clean industrial and manufacturing capabilities". Domestic industries like polysilicon, turbine components and batteries will be indirectly supported by massive build-out of export-scale renewables, and they can be additionally supported at the margins through things like concessional loans and incentives for local content requirements. But they are unlikely to meet the criteria for large subsidies articulated above and in Appendix 1. (Polysilicon is an edge case discussed further in the appendix.)

The vision and commitment to new green export industries should also be integrated into other planning exercises like the 2035 Nationally Determined Contribution, Net Zero 2050 Plan, sectoral roadmaps, Integrated System Plans, and the Net Zero Economy Authority's transition plans.

Spending at least $60-100bn (over 20 years) to kickstart new industries

Kickstarting green export industries and realising Australia's net zero ambitions and will require significant capital – including a step change in the level and nature of government assistance. At least $60-100 billion or more of policy support over 20 years, targeted to support emission-free production. This is the order of magnitude of support required to bridge the cost difference between clean products and emissions-intensive incumbents, and it also reflects historical levels of government co-investment. See Appendix 2 for more details on how this estimate was calculated.

In this context 'policy support' refers to spending or regulatory measures that bridge cost differences. This does not include near-commercial investments (such as the bulk of investments from the CEFC, NAIF and other similar financing vehicles). These loans can still be valuable, but only the concessional component should be counted as 'policy support'.[13]

$100 billion is a significant sum of money comparable to some of the Commonwealth's largest fiscal commitments (such as the AUKUS submarines or the stage 3 tax cuts). Assuming the government has a clear vision about the industries they wish to support, the actual design of policies should balance several principles to ensure that this spending achieves industrial, economic and climate outcomes.

1. Any policy support should **materially reduce economic risks** associated with major capital investments in green export industries – such as by guaranteeing demand.
2. Subsidy-like support should achieve **additionality** through either incentive design or project selection. The public should not give large subsidies to projects that would already be economically viable through commercial capital markets.
3. Where possible, policies should be designed to dynamically **address the marginal cost difference** between green goods and prevailing market prices. The public should not provide broad subsidies to industry when green goods are expected to become cheaper in the future.
4. Interventions should **target specific parts of the innovation ecosystem and capital stack** that are not yet producing the technology, projects, or investments that are needed.[14]
5. Policies should be **front-loaded** in order to secure as many committed investment dollars in the next 5 years as possible, although this may still mean most of the spending is beyond the forward estimates (eg. in production tax credits or contracts for difference).
6. Policies should be designed to phase out or sunset over time and **avoid ongoing reliance** on public subsidies (eg. unlike the LNG industry's reliance on export support and fuel tax credits).
7. Funding arrangements should be **simple** and clear for participants: there should be no ongoing uncertainty about whether a venture will be eligible for support.
8. If the costs of developing new export industries are shared through public funding, the Commonwealth should **socialise the benefits** as well, sharing the upside across all Australians (discussed in its own section below).

There is a wide range of policy interventions available to kickstart green export industries. A comprehensive package should use a mixture of tools, aiming to optimise the principles above. Appendix 3 catalogues and discusses fiscal mechanisms including subsidies, tax credits (for investment, production or consumption), underwriting through contracts-for-difference, concessional loans, grant funding, or equity investments. Other sections in this report discuss non-financial interventions such as workforce development and the approvals pipeline.

There is no "correct" way to put together a policy package that will kickstart green export industries and hold them steady through the next two decades. Ultimately, it will be a political decision. Box 1 shows an example of a package based on the principles above. In short, it proposes that half of government support is directed towards supporting the first-movers and pioneers who locking in unfavourable capital structures (after all: we won't get to cheap green iron unless we produce expensive green iron first). A quarter of the package is then used for production credits to encourage fast followers to build a critical mass (the second- and third-movers). And the remaining quarter is for communities, loans, research grants, and regulator reforms.

Box 1. An example policy package to kickstart new green export industries

Roughly half of the support for first-movers and pioneers...

- ⇒ $15 billion to front-load investment in major firmed, dispatchable renewables that can serve industrial users, through **investment tax credits** or putting more funds behind the Capacity Investment Scheme
- ⇒ $30 billion in **contracts-for-difference** to support the absolute first movers in key low-emissions industries: 12 Mt/yr iron, 6 Mt/yr alumina, 3 Mt/yr aluminium, and 2 Mt/yr ammonia.[15]

A quarter for the fast followers that build up a critical mass...

- ⇒ $20 billion in **production credits** to encourage second- and third-movers in key export industries (green iron, ammonia, alumina, aluminium) and related industries (hydrogen, steel, polysilicon)[16]

And a quarter for communities, loans, research grants, and regulatory reforms...

- ⇒ $10 billion in **grants to support communities** with transition planning, worker retraining, common-use infrastructure, remote energy infrastructure, and necessary social investments (eg. local training facilities, housing, early childhood education, and more). This could be administered through the Net Zero Economy Agency or a new Regional Transformation Fund.
- ⇒ $5 billion in concessionality/discounts to support $22 billion of **loans and investments** for projects related to the industries above (iron, steel, alumina, aluminium, ammonia, hydrogen, firmed renewables, common-use infrastructure, polysilicon) as well as the critical minerals value chain (eg. lithium, nickel, copper, solar panels and batteries), through both:
  - ➢ a facility for venture-style equity investments ($2 billion)
  - ➢ a fund ($20 billion) for loans and investments with no dollar cap on concessionality and a return mandate that only covers operating costs (inclusive of the cost of capital)[17]
- ⇒ $2.5 billion for testing and research
  - ➢ including grants for research and CRCs ($500 million) and grants for demonstration and deployment projects ($2 billion)
- ⇒ $1.5 billion **Net Zero Government Fund** to defray costs of procuring low-carbon material over the next 5 years (eg. for government infrastructure)
- ⇒ $500 million for **permitting and approvals** reform, and resourcing local councils

Appendix 3 contains more detail on each type of mechanism (eg. production credits vs. contract for difference). These are rough cost estimates but they give a sense of the order of magnitude each component could take. The cost to the budget would be approximately $20 billion over the forward estimates (or approx. $85 billion in total plus a further $20 billion in loans and investments with minimal budget impact).

Sharing the upside

If Australia shares the costs of developing new export industries through government spending, the benefits should be shared too. This applies both to the long-term profits from successful enterprises, as well as the secondary benefits from industrial activity.

A public return on investment

Australia has been blessed with natural resources, and we can learn from past mistakes where privately owned (and often foreign owned) firms have enjoyed the lion's share of profits from these national endowments. For instance, despite significant government support in the development of the petroleum industry, the Australian public have not received a significant share of the revenues – in contrast to how other nations have handled similar industries (eg. Norway).

There are multiple ways the government could consider locking in a return for the public. The simplest option is through royalties or super-profit taxes that apply to resource extraction (eg. ores and critical minerals). Special royalties on renewable energy (eg. solar/wind royalties) or mineral *processing* (rather than extraction) make less sense, because these do not exhaust finite resources. The Commonwealth could strike deals with state governments to reform their mining royalties, as Queensland has recently done, in return for co-financing under a green export industry development scheme.

An alternative approach, rather than taxing profits, is to lock-in a public share of ownership (and thus profits) from firms on a project-by-project basis. The most direct version of this would be for the Commonwealth to *require* participants in contract-for-difference or production credit schemes to pay back a certain amount of profits over the long term. This could be structured as an investment, where the firm must offer the public the opportunity to invest for an equity stake on "most-favoured nation" status (this opportunity could be directed at the CEFC, the Future Fund, or even the local community). This would need detailed consultation with industry: on the one hand, this requirement could spook investors, on the other hand, they may appreciate the clear alignment of interests.

A more subtle version would be to give funds like the CEFC, NAIF, and NRF a mandate for aggressive capital recycling, and enough capital to take an equity stake in most major projects over the next 20 years. Either way, the intended end-state is the same. In return for an overall package that supports cashflow in the short-term, the Australian public would receive a share of profits over the long-term.

Building rather than depleting the social licence

The investment catalysed by a green exports package will have many secondary spillover benefits for the people, places, communities and firms involved. Other governments have required recipients of funding to contribute to broader goals such as domestic supply chain development or community revitalisation. In turn, these broader goals have built the social licence for the industrial transition.

For instance, most US Inflation Reduction Act credits and grants are reduced by a factor of 5 unless firms meet requirements including paying good wages, employing apprentices, employing people in transition affected communities, using local inputs, or serving low-income or indigenous communities.[18]

In Australia, similar measures can ensure a green export package builds rather than depletes the social licence for transition. For instance, the credits and subsidies discussed in Box 1 could include a marginal incentive (say, an additional 10% or 20%) if firms source a certain amount of components from Australian suppliers, or if they site themselves in transition-affected communities, or if they employ a certain level of apprentices and trainees. Other parts of a government funding package – unrelated to project requirements – can also contribute to the social license. For instance, rigorous community-led transition planning, investments in social infrastructure, and strengthening the ability of indigenous people to exercise free, prior and informed consent.

The government's role as a buyer and regulator

Apart from being a source of public investment and finance, the government plays an important role as a buyer and a regulator. Reforming procurement policy and project approvals pipelines can have a significant impact on the private sector investment and deployment. One regulatory lever – the treatment of fossil-fuels – is so important it is dealt with separately in the next section.

Using procurement commitments to demonstrate demand

The public sector is one of the largest buyers of carbon-intensive goods through infrastructure and construction projects (eg. cement and steel). The US Inflation Reduction Act included USD $2 billion for the use of low-carbon materials in highway construction and USD $3 billion for the use of low carbon materials and technologies in government buildings.

Like in the US, Australian governments can use fiscal and procurement policy in a similar way, such as by using internal "shadow" carbon pricing to incentivise departments and projects to use low-carbon options, creating a central pool to defray the costs on line-agencies of low-carbon procurement, and working with states to write financial incentives for low-carbon materials into infrastructure contracts.[19]

The public sector's position as one of the largest actors in the economy can further be leveraged – without directly spending money – through things like minimum environmental standards in supplier eligibility criteria, changes to building codes, agreements with states and territories for standards to promote greater reuse and recycling in infrastructure, and forming green purchaser coalitions to work with suppliers.

In Australia, the forward pipeline of public infrastructure projects will require $26 billion of steel.[20] Through clear procurement reform, Australian government's can send strong demand signals to industry that there will be buyers for green goods. In the short term, much of this demand will need to be met from imports. But this reason (the relative lack of current Australian suppliers) is the exact reason why procurement reform can be a powerful tool to spur the development of domestic industry.

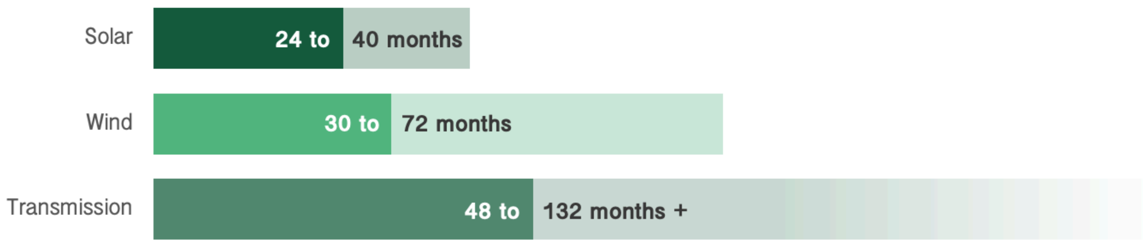
Shortening project lead times

Building the renewable generation required for new green export industries necessitates a dramatic shortening of lead times for project development. Slow project development increases costs and uncertainty, and ties up capital reducing the amount of financing available for deployment (see Figure 4). Energy market bodies are progressing a range of reforms that will address some of these issues, but there is significant opportunity for policy action. Other governments are tackling this with direct funding and legislation: for instance the US Inflation Reduction Act includes over USD $1 billion in funding to make environmental and community approval processes more "efficient and effective" through a Permitting Action Plan, and the EU Net Zero Industry Act legislates upper bounds on permitting of 9-18 months depending on facility size.[21]

Place-based planning frameworks could accelerate lead teams by focussing activity in key areas, such as renewable energy industrial precincts (REIPs) or renewable energy zones (REZs).[22] Such an approach would allow for pre-planning around things like environmental assessments, community co-design, and offtake market development. These processes could be government-led even in the absence of specific development proposals, but would depend on significant changes to staffing levels and practices within relevant Commonwealth departments and regulatory agencies, and would require much stronger coordination with state governments and local councils. Councils in particular are under-resourced relative to the role they play in local development.

Other reforms, while not as transformational, could reduce regulatory requirements and planning processes at the margins. For instance, approval processes could be streamlined where proponents are building on existing sites (eg. repowering a decommissioned site or adding small amounts of capacity), and investments in better data tools and mapping (such as those suggested through the EPBC reform process) can improve decision-making.

Figure 4. The planning and approvals pipeline means it will take many years for new generation to come online



Source: CPD analysis drawing from: Clapin & Longden (2022); and AEMO Integrated System Plan (2022)

Neutralise the 'grey discount'

The need for government intervention – and the size required – is significantly smaller if carbon-intensive products stop receiving a 'grey discount' (relative to the socialised cost of production). There are also legitimate concerns around competitiveness and carbon leakage if Australian green industries are selling into global markets that give a significant discount to emissions-intensive production. The Commonwealth government can tackle this through regulated carbon pricing mechanisms and through diplomatic channels.

Domestically, the Safeguard Mechanism is designed to take the edge off of the 'grey discount'. However, the current cost of emissions faced by industrial producers is too low, and the sector-wide treatment of the electricity industry masks any price signals that would encourage electricity-intensive processes to shift to renewables (like aluminium smelting). The intent of the 2023 safeguard reforms is that the cost of emissions will rise as baselines tighten, but the government's $75 ceiling on ACCU prices could hinder progress, particularly if the global market starts effectively pricing carbon.[23]

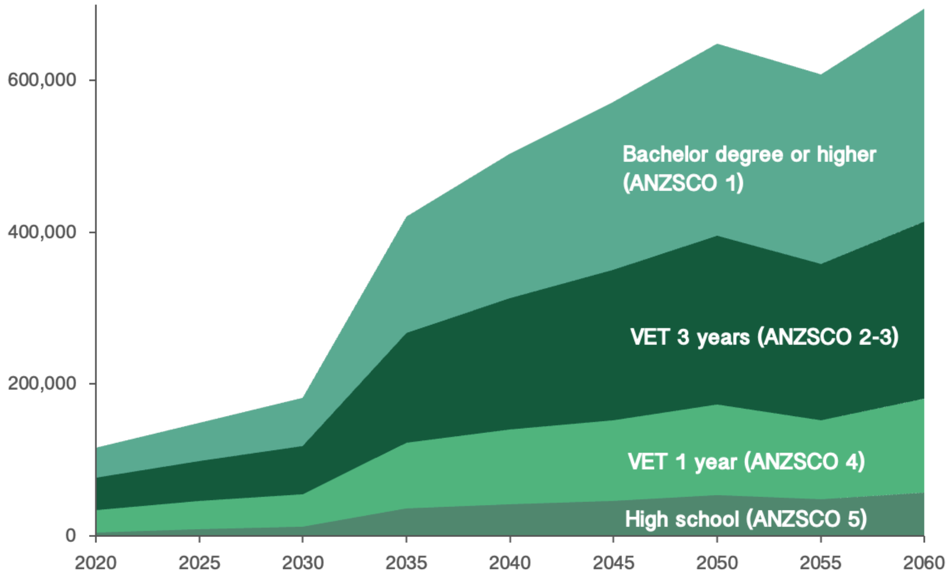
Apart from strengthening domestic regulations, the Commonwealth can also use diplomatic and trade channels to support better pricing of carbon in global markets. The more the global market is willing to pay for low-carbon goods and stop subsidising carbon-intensive production,[24] the less the Commonwealth would need to bridge prices through mechanisms like a contract-for-difference. Two avenues are worth pursuing.

The first is unilaterally implementing a carbon border adjustment as the EU has done – levying an equivalent carbon tariff on imports and providing a partial rebate to exports.[25] This would ensure that, at least for domestic consumption, no imported products can undercut the carbon constraints placed on Australian industry.

The second avenue would entail working with major trade partners and other producers of iron, aluminium and ammonia to build a level playing field globally, not just in Australia. This could be a part of the agenda of an Australian COP presidency. A coalition that brings together countries like Brazil (seeking to host COP in 2025), Canada, Japan, South Korea, EU countries, and China would include most of the world's production of iron, aluminium and ammonia. Australia's diplomatic and trade efforts should advance a common pricing goal. These countries could also form a coalition for global reform of fossil fuel subsidies, a practice that directly undercuts the formation of low-carbon heavy industry.

Figure 5. Building green export industries could require more than 700,000 workers

FTE job requirement



Source: E+ Scenario (from Net Zero Australia, 2023)

A new industrial workforce

The workforce required to deliver this once-in-several-generations industrial transition will be significant; but this presents an opportunity. The jobs required to build this future will be almost an order of magnitude larger than the jobs currently related to fossil fuel industries. Figure 5 shows job estimates from a ‘Net Zero Australia’ scenario, which are in the same order of magnitude of the jobs for 869,000 workers across 2025-2050 estimated by the Australian Industry Energy Transitions Initiative.[26]

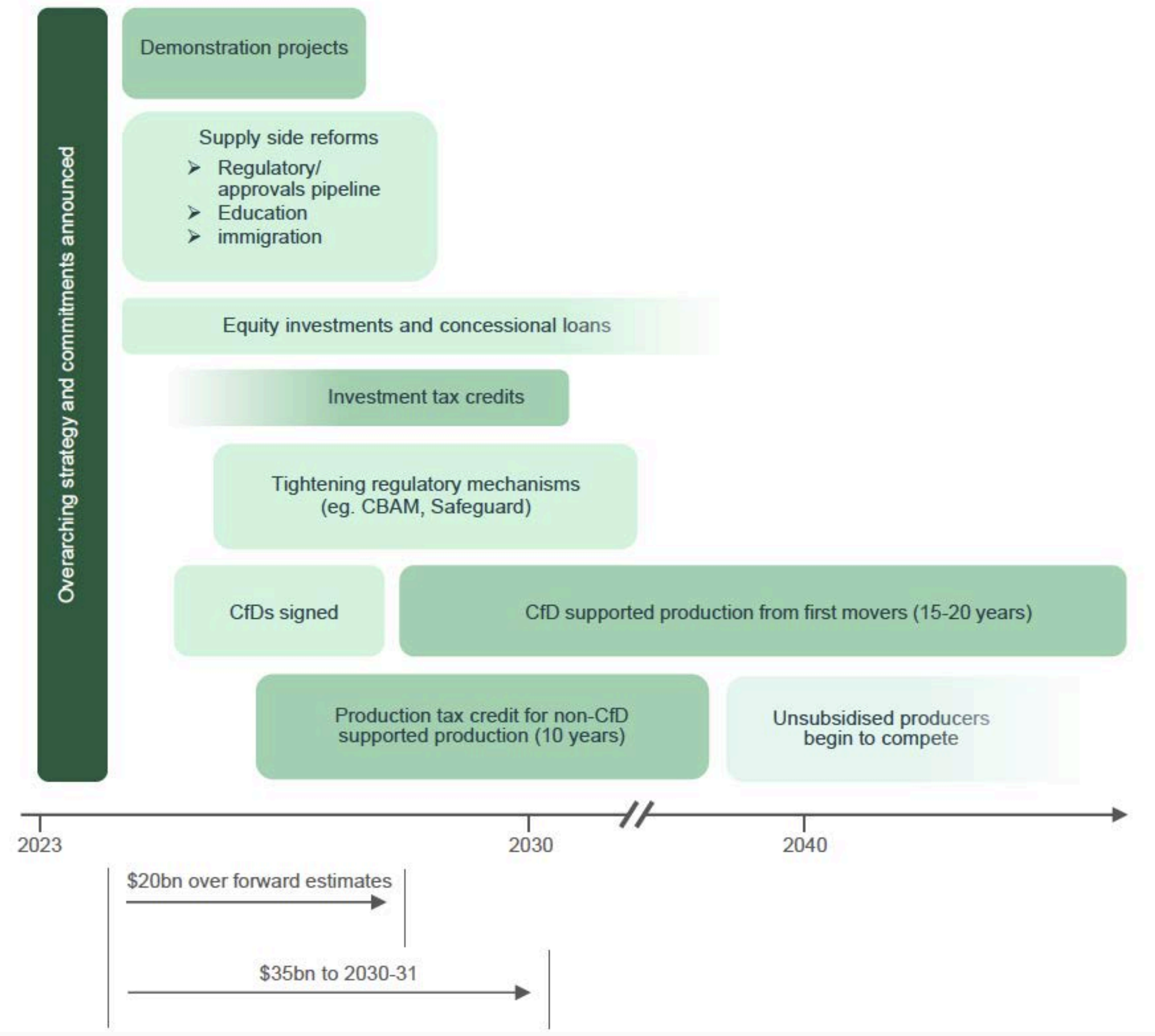
Dedicated training pathways and incentives can help start this pipeline of workers, and this will need to be accompanied by VET curriculum overhaul to include skills like fuel cell design and electrolyser maintenance. In addition, Australia will almost certainly need to open dedicated immigration pathways, particularly where workers are needed away from existing population centres. Much as there is a global race to establish green industries, there will also be a race to attract global transition talent. Australia should get out on the front foot.

Sequencing spending and managing inflationary risks

In a major package to develop new green export industries, spending should be sequenced to manage economic constraints, keep one eye on inflationary pressures, and spread out the cost to the government budget (see Figure 6). For the example package discussed in this report, around $20 billion (of a total $80 billion on budget) would be spent over the forward estimates, with a further $15 billion to be spent by 2030-31, and the remainder to be spent over the next 15 years. Near term policies should focus on building the enabling environment for action: such as investment incentives in firmed renewables, workforce development, demonstration projects, immigration reform, and making approvals more efficient.

Longer-term policies can be set today to immediately spur investment, but would not start making significant fiscal outlays until industrial-scale production of green exports commences. These could include credible commitments to bridge the demand gap for key products (for example, through the policy tools like contracts for difference or production credits).

Figure 6. Reforms can be sequenced and laid out to prepare markets and manage inflationary risks



The potential inflationary impacts of a green industrial revolution could be significant – ambitious action means significant turnover of capital stock in the order of ~5% of global GDP over a sustained period of time.[27] Governments will need to balance demand against real constraints in the economy during a phase of massive capital investment. However, this is not unique to low-carbon industries; demand management is necessary during any period of growing investment. The size of this challenge for green export industries in Australia is unclear. Many of Australia's large electricity generators and industrial plants are nearing end-of-life and will need to be replaced no matter what else happens. The inflationary risk is mostly relevant only to the extent that investment in new green export industries outstrips the natural turnover of capital stock.

The sequence of policy reforms above is intended to manage this risk. Furthermore, accelerated investment in renewable energy (and parallel investment in climate adaptation) can ameliorate the inflationary impacts of physical climate risks and volatile fossil fuel prices.[28]

Conclusion: putting it all together

Australia has a golden opportunity in front of it. Investing in green export industries can have an outsize impact on global emissions – quite beyond domestic emissions reductions – and by acting now Australia can secure future industries in green iron, ammonia, alumina and aluminium.

Doing so will require significant support from the government; it could take something in the order of $60-100 billion to kickstart these green export industries. This would need to cover investments in firmed, dispatchable renewables, policy support to bridge cost differences, grant funding for test projects and community development, as well as concessional finance.

This level of spending needs to be targeted: providing support where it will have the most impact. This report provides a set of principles to achieve just this, as well as an example of a $100 billion policy package designed around these principles.

This proposal is only a starting point for discussion, particularly because this package is focussed solely on kick-starting green export industries, which is only one part of the economic challenge facing Australia and the world.

The proposals in this report need to be read alongside complementary priorities – such as subsidies for domestic consumers, household electrification and efficiency, community development, climate adaptation, and environmental protection. Where other countries have rolled everything all into a single "one and done" climate package, Australia should consider securing strong green export industries to be a strong step, but not the *only* step, towards a prosperous and sustainable future.

Appendix 1: a framework for identifying which industries to target

The government must be selective about the industries it supports, and this report focuses specifically on making big bets on iron, aluminium and ammonia. The recommendations suggest more modest support for industries like steelmaking (the next step after iron smelting/reduction) or critical mineral extraction and value-adding (eg. lithium and nickel refining or battery manufacturing). This appendix details the rationale behind this choice.

It makes sense to target big government support to industries that meet the following criteria:

1. There will be large global export demand for this product.
2. Australian industries could not compete globally today (because of the 'grey discount' or not-yet-mature technology).
3. There is reason to believe that Australia would have a comparative advantage over the long-term (assuming global markets reflect the social cost of carbon, ie. no 'grey discount').

The first question is a threshold question: is there an export market? It is unlikely that hydrogen itself will be exported on ships or in pipes – ammonia will be the export product. That said, green hydrogen is a key input for several industrial processes, and a large part of the cost of green ammonia is just the cost of first producing green hydrogen. Support for hydrogen will still be critical, but any attempt to produce (and support) green ammonia and green iron will implicitly require producing green hydrogen.

The second question is simply to screen out industries where Australia is already competitive regardless of government support, such as critical mineral extraction. In some cases global demand is patchy and slow to emerge, but as global markets mature Australian industries will be able to compete because this is where the minerals are. It may be useful to use policy to attract early investors (such as using the CEFC to provide concessional loans as an anchor funder for mineral extraction and processing) and provide seed capital to help value-add industries get to scale (such making batteries or polysilicon). But these industries will not require the same massive support to bridge cost differences and the 'grey discount' from fossil-powered iron and aluminium processing.

Table 1. Iron, aluminium and ammonia are the stand-out opportunities for Australian green export industries

	Global demand	Short-term cannot compete	Long-term comparative advantage	Suitable for large subsidy?
Iron	y	y	y	y
Steel	y	y	unclear	modest support
Alumina	y	y	y	y
Aluminium	y	y	unclear	y
Hydrogen	n	y	y	(implicitly)
Ammonia	y	y	y	y
Critical minerals extraction	y	n	y	modest support
Value-add manufacturing	y	y (because of IRA)	unclear	modest support

The last question is about ensuring Australia makes strategic bets that we can be confident will be competitive over the long-term (towards 2050 and beyond). In this case, it is useful to refer to fundamental natural endowments that only Australia has: raw natural resources and potential renewable energy to power energy-intensive processes. This also ensures the focus is squarely on emissions. By investing in using renewable energy to power energy-intensive processes, Australia can make the biggest contribution to global emissions reduction.

In Table 1 there are three edge cases for the comparative advantage question. Steelmaking is not included because it is 15x less energy intensive than ironmaking. There is every reason to believe Australia will have a long term advantage in the energy intensive smelting/reduction of ore into crude iron – but turning crude iron into steel could potentially be done closer to final markets. Aluminium is difficult because smelters require non-stop reliable electricity supply, which is not possible with today's renewable energy technologies. Currently this means that countries with large hydropower installations (not Australia) are best suited for low-carbon aluminium processing. Assuming the problem of providing firmed, dispatchable renewable energy in Australia is solved over the long-term, Australia should be a good site for aluminium smelting. However, this technological challenge will require significant investment in itself (which could be encouraged through an investment credit). For the value-added processing of critical transition minerals into refined metals and final products (eg. solar cells and batteries), Australia's long-term competitiveness would rely mostly on factors outside of natural endowments: human capital, intellectual property, cost of capital, cost of labour, know-how, and agglomeration. These factors should be optimised through broad, secular industry policy; value-add industries do not represent as much of a sure bet for government intervention as other energy-intensive processes.

Polysilicon is a particularly interesting edge case where it is currently energy intensive to produce, and therefore a good prospect for Australia. However new fluidised bed reactor processes are coming to market with significant reductions in energy intensity – so it is unclear what factors will determine global competitiveness in 10-20 years' time.

Ideally, each of these questions/criteria should be analysed with much more detailed analysis and modelling than presented here. For instance, are there short-term technological factors that mean critical mineral extraction is *not* currently competitive in Australia? (This report assumes 'no', but maybe there are.) Or are there reasons to think that profits in energy-intensive ironmaking will be competed away over the long term as the whole world shifts to renewables? (Again, this report assumes 'no' because these sectors are very lumpy.)

Appendix 2: estimating how much support is needed

This report talks about providing $60-100 billion of support. This number is a rough estimate, but the magnitude required is robust to several methods of calculation – each is imperfect but together they can be used to triangulate on estimates in the order of $50-150 billion. This report then proposes at least $60 billion to include a $10 billion regional transition fund.

Based on bridging forecast cost differences

A key concept in this report is the idea that policy can be used to bridge cost differences (the marginal premium) between the first movers in green export products and the market price which is set by emissions-intensive incumbents. Bridging this cost gap is the purpose of a contract-for-difference, and estimating the cost of a contract-for-difference (CfD) can indicate the magnitude of policy intervention required.

For this report, two methodologies are used to estimate the hypothetical cost of a CfD over the first 20 years of operation for "first-and-second movers" in green export industries. The first methodology uses credible forecasts of costs and demand (including implicit global carbon prices over the next two decades). This methodology finds that over the first 20 years of operation, first movers in green steel, ammonia, and aluminium (not alumina) will have cumulative costs that exceed market prices by $46 billion.[29]

The second methodology uses estimates of *current* premiums and assumes these stay relatively constant: a 30% cost premium for green steel, 50% for green ammonia, 50% for alumina and 15% for aluminium.[30] The size of these cost differences will likely fall dramatically as projects are deployed and technology improves, but the learning will only benefit new facilities; the first facilities to deploy these technologies will likely have higher costs for their operating lifetime. This methodology finds it would cost $94 billion to bridge the difference between the cost of production and the market price.

Both of these methodologies assume the "first-and-second movers" are producing 15 Mt/year of steel, 6 Mt/year alumina, 4 Mt/year aluminium and 3 Mt/year ammonia (taking seven years to scale up linearly from zero production).[31] Even though this report recommends focusing on *iron* instead of *steel* as an export commodity, these calculations have been done for the overall steel industry because of better data availability. In both methodologies, a discount rate of 4% is applied to spending beyond the first year.

One of the reasons the first methodology produces a lower estimate is that it internalises a cost of emissions of approximately AU$75 /t CO2-e in 2030, increasing by $15 per year, which quickly eliminates the 'grey discount' and makes emissions-intensive production uneconomical in the 2030s.[32]

Based on historical levels of government co-investment

Credible estimates for the capital requirements over the first decades of a green export "superpower" scenario vary significantly but are all quite large, for instance:

- ⇒ Australia Industry Energy Transition Initiative 'coordinated action with export sensitivity': $1.4 trillion[33]
- ⇒ BloombergNEF New Energy Outlook 'net zero' plus 'hydrogen export' scenarios: $3.2 trillion34
- ⇒ Net Zero Australia 'rapid electrification and onshoring': $9 trillion[35]

Over the 10 years from 2012-2022, ARENA's historical grant or subsidy-like funding comprised over 2% of spending on energy transition.[36] Over the same period, CEFC loans comprise around 30% of capital invested in their projects.[37] Meanwhile McKinsey's 'Transition Finance Model' estimates that going forward, around 25% of the capital for the global energy transition will need to come from governments (including multilateral climate funds and development banks).[38]

Assuming a conservative range of $1-3 trillion capital investment over the next 20 years, and a modest-but-arbitrary level of 5% public investment, this will require $50-150 billion to build green export industries in Australia, with most of this front-loaded in the first 10-15 years.

Appendix 3: a catalogue of government spending mechanisms

Subsidies or tax credits (investment, production, consumption)

Many countries are providing credits to subsidise the investment, production and consumption of green energy and green technologies. For instance, around two-thirds of projected expenditure under the US Inflation Reduction Act comes through tax credits (with over 20 individual credits, see Appendix 4), and a similar ratio is true for Canada's package.

Investment credits subsidise the construction of new plant and capital, lowering the up-front costs required to establish a facility, and creating an incentive for up-front financial commitments. In the context of establishing new green industries, investment credits would be used to encourage early capital investment and could phase out beyond 2030 (or even before) as production credits take over.

Production credits provide a per-unit subsidy to firms that produce renewable energy or key commodities (eg. green iron, hydrogen or critical minerals), helping bridge the gap between market price and the cost of production. While this would be an important part of an overall package, one drawback is that production credits lock in a set subsidy rather than addressing the *marginal* premium. This could leave the government paying over the odds if costs fall faster than expected. And for supporting the very first facilities to produce green exports (which will be particularly expensive), contracts for difference can better address the marginal unit economics of production (see below).

Consumption credits operate similarly to production credits, but are given to the purchaser not the producer (raising demand for green goods). This can shore up domestic demand, but given that the main consumers of export-oriented goods are foreigners, a consumption subsidy may not be the optimal tool.

Underwriting through contracts for difference

Contracts for difference (CfD) give producers a guaranteed total return for their product, underwriting risk in a targeted way. They are specifically designed to provide the producer with the marginal difference between the market price and a pre-agreed price (the "strike price").[39] CfD-like instruments have been used extensively overseas (such as in the UK's renewable energy sector) and domestically (both the proposed Hydrogen Headstart program and the Capacity Investment Scheme have some characteristics of CfDs). In certain circumstances, CfDs can be cashflow positive for government.[40]

Box 2. Benefits and disadvantages of providing subsidies through the tax system

The use of *tax* credits are common overseas, but such subsidies do not have to operate through the tax system; they can also operate as direct payments to recipients. The specific features of a tax credit – the fact that it operates automatically through the tax system – is the source of its benefits and also its weaknesses.

Automatic offsetting through the tax system means the government does not have to make appropriations to fund the subsidy on an ongoing basis, and recipients can just claim it like any other tax offset without needing to enrol in a separate scheme. It is entirely demand driven.

But for governments, this creates an open-ended unlimited liability. And for households and businesses, a tax credit is regressive; only available to the extent that recipients have taxes to offset (excluding low-income households and early-stage ventures that are not yet profitable). This can be ameliorated by making company credits transferable as the United States have done, but this brings its own overheads to small and early-stage companies who must now engage in complex financial markets.

The rationale for CfDs is less strong for mature technologies like undifferentiated/unfirmed energy generation (eg. if solar and wind projects are economically viable in their own right), but they can be used to address the first mover problem for deployments of new technologies. Technologies for production of green iron, aluminium and ammonia, or for the storage and dispatch of firmed renewable energy, will only get cheaper if someone takes the first step, but the first mover is at risk of being undercut.

CfDs can address the cost difference between the first mover's high cost structure and the market price set by carbon-intensive incumbents, or second- and third-generation green technologies. They would solve the uncertainty for project proponents, guaranteeing an economic return for the duration of the CfD. They would also flexibly adapt to cover marginal premiums (see Figure 7 for a stylised example).

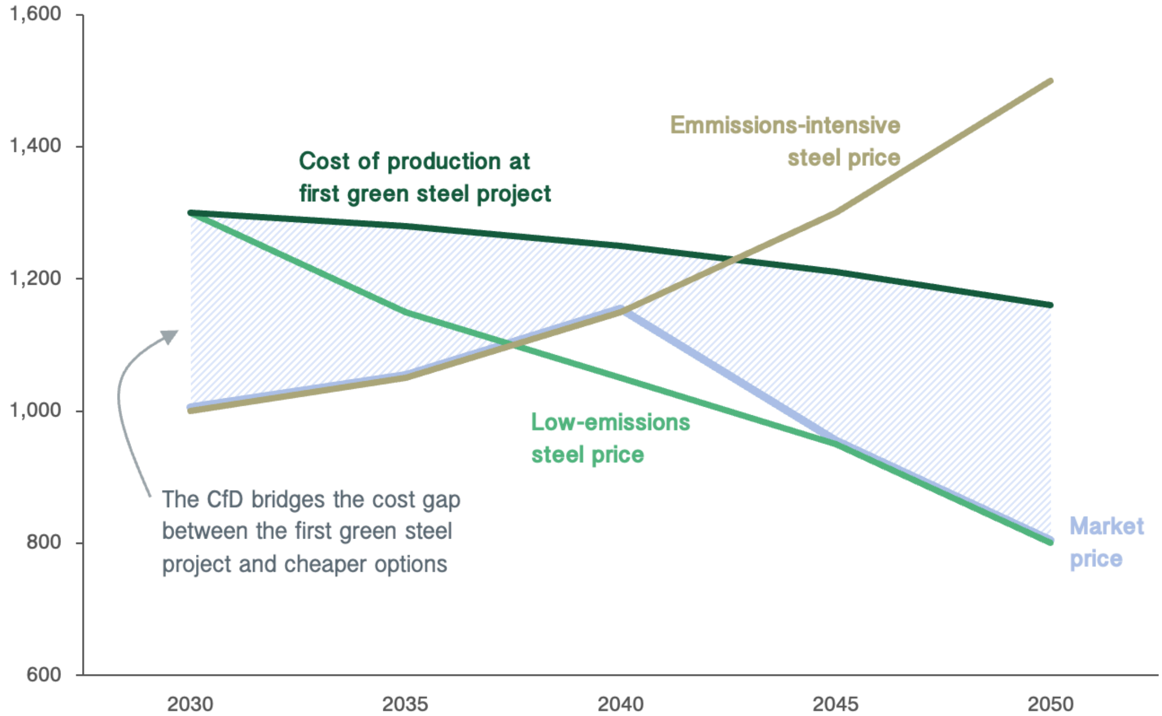
CfD outlays may increase in later years if technological advances mean market prices fall below current levels. The government can limit its exposure with a cap-and-collar approach, but the ultimate policy goal should still be to support those first-movers who commit to an unfavourable early cost structure. In terms of project and technology selection, the government should be as hands-off as possible, using a straightforward reverse auction to award CfDs to the most efficient proponents.

Concessional loans

Many countries are creating loan facilities to support new investment in green industries – indeed apart from tax credits the Canadian package consists entirely of a CAD $20 billion loan facility. The US Inflation Reduction Act appropriates tens of billions of dollars in credit subsidies to allow government loan programs to make hundreds of billions of dollars in new loans.

For Australia, the CEFC is a well-established organisation that could be used to dramatically scale up financing available to build out new green export industries. The National Reconstruction Fund (NRF), the Northern Australia Infrastructure Facility (NAIF), and Export Finance Australia (EFA) could also play a role. However all of these funds have benchmark portfolio rates of return that are close to commercial lending rates.

Figure 7. Contracts for difference could address first mover problems in key markets, like green iron



Note: these are stylised costs for illustrative purposes. Low-emissions iron may remain more expensive than emissions-intensive iron through to 2050, particularly in the absence of implicit or explicit global carbon pricing.

In pursuing green export industries in Australia, these financing facilities could be recapitalised (where required) and allowed to provide truly concessional finance through a flexible range of instruments. This would require increasing risk appetites, lowering mandated rates of return (to be simply the cost of capital plus operating costs), and increasing or removing the annual dollar-value caps on concessionality. It could also include novel financing deals that materially de-risk investment and front-load capital spending, such as loans with initial 0% interest rates that only start being paid back once certain production and revenue milestones are reached.

Grant funding for research, industry and regions

Grant funding schemes are used to complement debt financing facilities in most countries, and are broadly a tool to finance activities that will not generate a commercial return. The single biggest line item in the US Inflation Reduction Act is a USD $27 billion fund for grants and technical assistance for community-level investment in renewable energy generation (see Appendix 4 for summary of all US IRA measures).[41]

Research and development is also a key part of the puzzle, given the lack of market-ready technologies for some key processes (eg. hematite ore processing, or anode decarbonisation in aluminium smelters). Existing programs under the CSIRO, the University Research Commercialisation Package, and CRCs could be used to provide further grant funding for Australian-led innovation in core sciences.

In Australia the Australian Renewable Energy Agency (ARENA) fulfils a grant-making function for a broad range of renewable technologies, and its role could be expanded (with a significant capital boost) to support industry-led demonstration, testing and deployment projects. Such a capital boost could also be accompanied by a relaxation of co-funding requirements and an increase in risk appetite, making it easier for ARENA to use its discretion to support a larger share of riskier projects.[42]

The new Net Zero Economy Agency could also be used as a grantmaker, putting money behind its function to support regions and communities.[43] Along with supporting workers, a regional transformation fund could fund regional common-use energy infrastructure or renewable energy infrastructure in isolated communities. Grants could also support the necessary social infrastructure required in specific places (eg. local training facilities and training programs, housing, early childhood education and care providers, and more).

Equity investments

Governments can also use their balance sheets to make equity investments. This could be a vital source of financing for early-stage ventures designed around testing and proving new technologies. It may be less *necessary* for industrial-scale production facilities (who may have no need of an additional equity holder), but in this case the government may still wish to invest to secure an ongoing share of profits.

Apart from investing in deployment of existing technology, governments can also bridge the capital gap in hard tech ventures that seek to push the frontier of existing technologies.[44]

The Commonwealth has made some venture-style investments through the CEFC's Clean Energy Innovation Fund, ARENA, and Main Sequence Ventures. These investment funds could be given more capital to work with, but an even more transformative investment would be for the government to invest as a limited partner/minority supportive investor in deep tech venture funds set up by experienced managers.

Any single venture fund is inherently shaped by the background of the general/managing partners. Governments should seek diversity in management, not just diversity in investee companies. Otherwise the risk is that a single fund might concentrate on one area (say, component manufacturing) while ignoring another (say, chemical catalysts). This 'fund of funds' model may not even require a change to the CEFC mandate – but rather a change in overall risk appetite and management comfort.

Appendix 4: summary of US Inflation Reduction Act measures

The US Inflation Reduction Act contains a large number of subsidies, credits and grants to support energy transition in America, costed at US$400 billion by the Congressional Budget Office (and subsequently estimated at much higher values, based on greater-than-expected uptake of demand driven tax credits).

Around US$150 billion of the package is for electricity supply-side subsidies (such as production and investment credits for renewable electricity), around US$140 billion is for demand-side subsidies (such as EV rebates and incentives to electrify buildings), around US$40 billion subsidises local manufacturing, and the remainder for other matters like hydrogen, biofuels, carbon capture and storage, land-use changes, etc.[45]

The table below itemises each measure based on its categorisation by the White House and costing from the Congressional Budget Office.[46]

	Agency	IRA Section	Tax Code Section	Program Name	Amount ($m USD)
Advancing and Deploying American Made Clean Energy Technologies					**$299,807**
	Financing and Expediting Deployment of Clean Energy Technologies				**$188,386**
1	Department of the Treasury	13101	45	Production Tax Credit for Electricity from Renewables	$51,062
2	Department Of the Treasury	13102	48	Investment Tax Credit for Energy Property	$13,962
3	Department of the Treasury	13103	48(e), 48E(h)	Increase in Energy Credit for Solar and Wind Facilities Placed in Service in Connection with Low-Income Communities	
4	Department of the Treasury	13105	4501	Zero-Emission Nuclear Power Production Credit	$30,001
5	Department of the Treasury	13701	45Y	Clean Electricity Production Tax Credit	$11,204
6	Department Of the Treasury	13702(h)	48E	Clean Electricity Investment Tax Credit	$50,858
7	Department Of the Treasury	13703	168(e)(3)(B)	Cost Recovery for Qualified Facilities, Qualified Property, and Energy Storage Technology	$624
8	Environmental Protection Agency	60103		Greenhouse Gas Reduction Fund	$27,000
9	Department Of Energy	50141		Funding for Department of Energy Loan Programs Office	$3,600
10	Department of Energy	50145		Tribal Energy Loan Guarantee Program	$75
	Revitalizing American Manufacturing to Build the Clean Energy Economy				**$46,572**
11	Department of the Treasury, Department of Energy	13501	48C	Advanced Energy Project Credit	$10,000
12	Department of the Treasury	13502	45X	Advanced Manufacturing Production Credit	$30,622
13	Department Of Energy	50144		Energy Infrastructure Reinvestment Financing	$5,000
14	Department of Energy	30001		Enhanced Use of Defense Production Act	$250
15	Department Of Energy	50173		Availability of High-Assay Low-Enriched Uranium (HALEU)	$700
	Investing in America's Electricity Grid				**$2,860**
16	Department of Energy	50151		Transmission Facility Financing	$2,000
17	Department of Energy	50152		Grants to Facilitate the Siting of Interstate Electricity Transmission Lines	$760
18	Department of Energy	50153		Interregional and Offshore Wind Electricity Transmission Planning, Modeling and Analysis	$100
	Investing in Affordable and Reliable Clean Energy in Rural America and on Tribal Lands				**$12,875**

	Agency	IRA Section	Tax Code Section	Program Name	Amount ($m USD)
19	Department of Agriculture	22001		Electric Loans for Renewable Energy	$1,000
20	Department Of Agriculture	22002(a)		Rural Energy for America Program (REAP)	$1,722
21	Department of Agriculture	22002(b)		Rural Energy for America Program (REAP) Underutilized Renewable Energy Technologies	$304
22	Department of Agriculture	22004		USDA Assistance for Rural Electric Cooperatives	$9,700
23	Department of the Interior	80003		Tribal Electrification Program	$150
	Incentivizing and Supporting Deployment of Clean Vehicles				**$19,209**
24	Department of the Treasury	13401	30D	Clean Vehicle Credit	$7,541
25	Department of the Treasury	13402	25E	Credit for Previously-Owned Clean Vehicles	$1,347
26	Department of the Treasury	13403	45W	Credit for Qualified Commercial Clean Vehicles	$3,583
27	Department of the Treasury	13404	30C	Alternative Fuel Vehicle Refueling Property Credit	$1,738
28	Department of Energy	50142		Advanced Technology Vehicle Manufacturing Loan Program	$3,000
29	Department of Energy	50143		Domestic Manufacturing Conversion Grants	$2,000
	Incentivizing and Supporting Development and Use of Cleaner Transportation Fuels				**$9,426**
30	Department Of the Treasury	13201	40A, 6426(c), 6427(e)	Extension of Tax Credits for Biodiesel and Renewable Diesel	$5,571
31	Department of the Treasury	13201	6426(d), 6426(e), 6427(e)	Extension of Tax Credit for Alternative Fuels	
32	Department of the Treasury	13202	40	Extension of Second-Generation Biofuel Incentives	$54
33	Department of the Treasury	13704	45Z	Clean Fuel Production Credit	$2,946
34	Department of Agriculture	22003		Biofuel Infrastructure and Agriculture Product Market Expansion (Higher Blend Infrastructure Incentive Program)	$500
35	Environmental Protection Agency	60108		Funding for Section 211 of the Clean Air Act	$15
36	Department of the Treasury	13203	40B	Sustainable Aviation Fuel Credit	$49
37	Department Of Transportation	40007(a)(1)		Fueling Aviation's Sustainable Transition through Sustainable Aviation Fuels	$245
38	Department of Transportation	40007(a)(2)		Fueling Aviation 's Sustainable Transition Technology	$47
	Expanding America's Leadership in Industrial Decarbonization and Carbon Management				**$10,630**
39	Department of the Treasury	13104	45Q	Credit for Carbon Oxide Sequestration	$3,229
40	Department of Energy	50161		Advanced Industrial Facilities Deployment Program	$5,812
41	Environmental Protection Agency	60113		Methane Emissions Reduction Program	$1,550
42	Environmental Protection Agency	60109		Implementation of the AIM Act	$39
	Investing in Clean Hydrogen				**$7,849**
43	Department of the Treasury	13204	45V	Clean Hydrogen Production Tax Credit	$7,849
	Investing in Science and the Department of Energy's Core Research Mission				**$2,000**
44	Department of Energy	50172(a)		National Laboratory Infrastructure - Office of Science	$1,550
45	Department of Energy	50172(b)		National Laboratory Infrastructure - Office of Fossil Energy and Carbon Management	$150
46	Department of Energy	50172(c)		Idaho National Laboratory Infrastructure Investments	$150
47	Department of Energy	50172(d)		National Laboratory Infrastructure - Office of Energy Efficiency and Renewable Energy	$150
Protecting Communities from Harmful Air Pollution					**$15,700**
	Cutting Air Pollution that Harms Public Health and the Climate				**$15,447**
48	Environmental Protection Agency	60201		Environmental and Climate Justice Block Grants	$3,000

	Agency	IRA Section	Tax Code Section	Program Name	Amount ($m USD)
49	Environmental Protection Agency	60114		Climate Pollution Reduction Grants	$5,000
50	Department of Transportation	60501		Neighborhood Access and Equity Grant Program	$3,205
51	Environmental Protection Agency	60101		Clean Heavy-Duty Vehicles	$1,000
52	Environmental Protection Agency	60102		Grants to Reduce Air Pollution at Ports	$3,000
53	Environmental Protection Agency	60104		Diesel Emissions Reductions	$60
54	Environmental Protection Agency	60106		Funding to Address Air Pollution at Schools	$50
55	Environmental Protection Agency	60105(d)		Funding to Address Air Pollution: Emissions from Wood Heaters	$15
56	Environmental Protection Agency	60105(f)		Funding to Address Air Pollution: Clean Air Act Grants	$25
57	Environmental Protection Agency	60105(g)		Funding to Address Air Pollution: Mobile Source Grants	$5
58	Environmental Protection Agency	60107		Low Emissions Electricity Program	$87
	Improving Pollution Monitoring and Tracking				**$253**
59	Environmental Protection Agency	60105(a)		Funding to Address Air Pollution: Fenceline Air Monitoring	$118
60	Environmental Protection Agency	60105(b)		Funding to Address Air Pollution: Multipollutant Monitoring	$50
61	Environmental Protection Agency	60105(c)		Funding to Address Air Pollution: Air Quality Sensors in Low-Income and Disadvantaged Communities	$3
62	Environmental Protection Agency	60105(e)		Funding to Address Air Pollution: Methane Monitoring	$20
63	Council on Environmental Quality	60401		Environmental and Climate Data Improvement	$33
64	Environmental Protection Agency	60110		Funding for Enforcement Technology and Public Information	$25
65	Environmental Protection Agency	60111		Greenhouse Gas Corporate Reporting	$5
Making Homes and Buildings Cleaner and More Efficient to Save Consumers Money and Cut Pollution					**$47,818**
	Lowering Energy Costs for Households				**$45,516**
66	Department of the Treasury	13301	25C	Energy Efficient Home Improvement Credit	$12,451
67	Department of the Treasury	13302	25D	Residential Clean Energy Credit	$22,022
68	Department of the Treasury	13304	45L	New Energy Efficient Homes Credit	$2,043
69	Department of Energy	50121		Home Energy Performance-Based, Whole-House Rebates	$4,300
70	Department of Energy	50122		High-Efficiency Electric Home Rebate Program	$4,500
71	Department of Energy	50123		State-Based Home Efficiency Contractor Training Grants	$200
	Supporting Investment in Energy-Efficient and Low-Carbon Buildings				**$2,302**
72	Department of the Treasury	13303	179D	Energy Efficient Commercial Buildings Deduction	$362
73	Dept of Housing and Urban Development	30002(a)(1)		Green and Resilient Retrofit Program Grants and Loans	$838
74	Dept of Housing and Urban Development	30002(a)(3)		Green and Resilient Retrofit Program Contracts and Cooperative Agreements	$60
75	Dept of Housing and Urban Development	30002(a)(4)		Green and Resilient Retrofit Program Benchmarking	$43
76	Department of Energy	50131		Assistance for Latest and Zero Building Energy Code Adoption	$1,000
Investing in a Sustainable, Lower-Carbon Federal Government					**$9,225**
77	U.S. Postal Service	70002		U.S. Postal Service Clean Fleets	$3,000
78	Environmental Protection Agency	60112		Environmental Product Declaration Assistance	$250

	Agency	IRA Section	Tax Code Section	Program Name	Amount ($m USD)
79	Environmental Protection Agency	60116		Low Embodied Carbon Labelling for Construction Materials	$100
80	General Services Administration	60502		Assistance for Federal Buildings	$250
81	General Services Administration	60503		Use of Low-Carbon Materials	$2,150
82	General Services Administration	60504		General Services Administration Emerging Technologies	$975
83	Department of Transportation, Federal Highway Administration	60506		Low-Carbon Transportation Materials Program	$2,000
84	Department of Homeland Security	70001		DHS Office of Chief Readiness Support Officer	$500
Harnessing Nature-Based Solutions and Climate-Smart Agriculture to Deliver Economic, Climate, and Resilience Benefits					**$34,335**
	Supporting Climate-Smart Agriculture and Rural Economic Development				**$25,285**
85	Department of Agriculture	21001(a)(1)		Environmental Quality Incentives Program	$8,450
86	Department of Agriculture	21001(a)(2)		Conservation Stewardship Program	$3,250
87	Department of Agriculture	21001(a)(3)		Agricultural Conservation Easement Program	$1,400
88	Department of Agriculture	21001(a)(4)		Regional Conservation Partnership Program	$4,950
89	Department of Agriculture	21002(a)(1)		Conservation Technical Assistance	$1,000
90	Department of Agriculture	21002(a)(2)		Conservation Technical Assistance - Greenhouse Gas Emission Quantification Program	$300
91	Department of Agriculture	22006		Assistance for Distressed Borrowers	$3,100
92	Department of Agriculture	22007		USDA Assistance and Support for Underserved Farmers, Ranchers, Foresters: Technical and Other Assistance	$125
93	Department of Agriculture	22007		Increasing Land, Capital, and Market Access (Increasing Land Access) Program	$250
94	Department of Agriculture	22007		Equity Commission	$10
95	Department of Agriculture	22007		From Learning to Leading: Cultivating the Next Generation of Diverse Food and Agriculture Professionals	$250
96	Department of Agriculture	22007		Assistance and Support for Underserved Farmers, Ranchers, and Foresters	$2,200
	Preserving and Protecting the Nation's Lands and Waters for Climate Mitigation and Resilience				**$9,050**
97	Department of Agriculture	23001(a)(1)		Hazardous Fuels Reduction Projects in Wildland Urban Interface	$1,800
98	Department of Agriculture	23001(a)(2)		Vegetation and Watershed Management Projects	$200
99	Department of Agriculture	23001(a)(4)		Develop and Implement Activities and Tactics for Old Growth	$50
100	Department of Agriculture	23002(a)(1)		Assistance to Underserved Forest Landowners Climate Mitigation and Forest Resilience Practices	$150
101	Department of Agriculture	23002(a)(2)		Assistance to Underserved Forest Landowners Emerging Private Markets for Climate Mitigation and Forest Resilience	$150
102	Department of Agriculture	23002(a)(3)		Assistance to Forest Landowners with <2,500 Acres of Forestland - Emerging Private Markets for Climate Mitigation and Forest Resilience	$100
103	Department of Agriculture	23002(a)(4)		Payments to Private Forestland Landowners for Implementation of Forestry Practices	$50
104	Department of Agriculture	23002(a)(5)		Wood Innovations Grant Program	$100
105	Department of Agriculture	23003(a)(1)		Forest Legacy Program	$700
106	Department of Agriculture	23003(a)(2)		Urban and Community Forestry Assistance Program	$1,500
107	Department of the Interior	50221		Conservation and Resilience	$250
108	Department of the Interior	50222		Conservation and Ecosystem Restoration	$250

	Agency	IRA Section	Tax Code Section	Program Name	Amount ($m USD)
109	Department of the Interior	50223		National Park Service Employees	$500
110	Department of the Interior	50224		National Park Service Deferred Maintenance	$200
111	Department of the Interior	60301		Endangered Species Act Recovery Plans	$125
112	Department of the Interior	60302		Refuge System Resiliency	$125
113	Department of Commerce	40001		Investing in Coastal Communities and Climate Resilience	$2,600
114	Department of Commerce	40002		Facilities of the National Oceanic and Atmospheric Administration and National Marine Sanctuaries	$200
Increasing the Resilience of Our Communities in a Changing Climate					**$5,377**
	Strengthening Communities' Resilience to Drought, Flooding, and Other Climate Impacts				**$4,863**
115	Department of the Interior	50231		Domestic Water Supply Projects	$550
116	Department of the Interior	50232		Canal Improvement Projects	$25
117	Department of the Interior	50233		Drought Mitigation	$4,000
118	Department of the Interior	80004		Emergency Drought Relief for Tribes	$13
119	Department of the Interior	50241		Climate Change Technical Assistance for Territories	$16
120	Department of the Interior	80001(a) & (c)		Tribal Climate Resilience	$225
121	Department of the Interior	80001(b)		Tribal Climate Resilience: Fish Hatchery Operations and Maintenance	$10
122	Department of the Interior	80002		Native Hawaiian Climate Resilience	$25
	Improving Climate Science and Weather Forecasting				**$514**
123	Department of Commerce	40004		Research and Forecasting for Weather and Climate	$200
124	Department of Commerce	40005		Computing Capacity and Research for Weather, Oceans, and Climate	$190
125	Department of Commerce	40006		Acquisition of Hurricane Forecasting Aircraft	$100
126	Department of the Interior	50271		USGS 3D Elevation Program (3DEP)	$24
Making Permitting of Energy Infrastructure More Efficient and Effective					**$1,005**
127	U.S. Department of Agriculture, U.S. Forest Service	23001		Effective and Efficient Environmental Reviews	$100
128	National Oceanic and Atmospheric Administration	40003		Effective and Efficient Environmental Reviews	$20
129	Department of Energy	50301		Effective and Efficient Environmental Reviews	$115
130	Federal Energy Regulatory Commission	50302		Effective and Efficient Environmental Reviews	$100
131	Department of the Interior	50303		Effective and Efficient Environmental Reviews	$150
132	Environmental Protection Agency	60115		Effective and Efficient Environmental Reviews	$40
133	Council on Environmental Quality	60402		Effective and Efficient Environmental Reviews	$30
134	Department of Transportation, Federal Highway Administration	60505		Effective and Efficient Environmental Reviews	$100
135	Federal Permitting Improvement Steering Council	70007		Effective and Efficient Environmental Reviews	$350

Endnotes

[1] For information about solar potential see ESMAP (2020) '*Global Photovoltaic Power Potential by Country*'. DRI (directly reduced iron) refers to iron ore that directly undergoes the first stage of production – "reduction", the removal of oxygen – without being melted in a coal-based blast furnace. Devlin et al. (2023) '*Global green hydrogen-based steel opportunities surrounding high quality renewable energy and iron ore deposits*', *Nature Communications*.

[2] Smith, W & Phillips, T, (2022) '*Who's Buying? The impact of global decarbonisation on Australia's regions*', Centre for Policy Development

[3] For instance, Victoria aims to be 75-80% below 2005 levels by 2035 ('*Setting An Ambitious Emissions Reduction Target*', Victorian Government) and Tasmania aims to be net zero by 2030 ('*Reducing our Greenhouse Gas Emissions*', Tasmanian Government).

[4] This is demonstrated in AEMO's 2022 *Integrated System Plan* (2022). In the central 'Step Change' scenario, approximately 6GW of renewables are installed annually to 2030, and coal generation exits in 2042. In the 'Hydrogen Superpower' scenario, more than 12GW of renewables are installed annually to 2030, and coal exits in that year. Some gas is still needed to balance the grid in the 'Hydrogen Superpower' scenario, though it runs relatively infrequently.

[5] Burke et al. (2022) '*Contributing to regional decarbonization: Australia's potential to supply zero-carbon commodities to the Asia-Pacific*', Energy

[6] The package discussed in Box 1 of this report is designed around kickstarting the "first movers" that process approx. 3% of iron ore and approx. 30% of aluminium ore, and grows from there. Australia's current commitment is to reduce emissions by 43% from the 2005 baseline of 621.1 Mt CO2-e (which equals 354 Mt CO2-e by 2030); this represents a 110 Mt CO2-e reduction from 2022 levels of 463.9 Mt CO2-e. For more, see: '*Australia's Nationally Determined Contribution*' (2022) and '*Australia's greenhouse gas emissions: December 2022 quarterly update*' (2023)

[7] Malhotra & Schmidt, '*Accelerating Low Carbon Innovation*', *Joule,* 2020.

[8] The 70% cost reduction is based on a learning rate of 18%-per-capacity-doubling from R Detz and M Weeda, *Projections of electrolyser investment cost reduction through learning curve analysis* (2022), and assuming six doublings from 0.5GW to 32GW installed capacity, using capacity estimates from IEA, *Global Hydrogen Review* (2022), and DCCEEW, *State of Hydrogen*, 2022. A more conservative 10% learning rate would lead to 50% cost reduction.

[9] Way et al., '*Empirically grounded technology forecasts and the energy transition*', *Joule*, 2022.

[10] In this analysis, the 'grey discount' is simply the discount that comes from inadequate pricing of the social cost of emissions, but in reality carbon-intensive production is also directly subsidised through trillions of dollars of fossil fuel subsidies around the world.

[11] Assuming 1.6 tonnes of iron ore required to make one tonne of crude iron, and a global iron price of $500 AUD per tonne. Iron ore exports in Australia were around 900 million tonnes in 2022. The idea of a $100bn green export industry has also been promoted by Beyond Zero Emissions (see '*Export Powerhouse*', 2021).

[12] If Australia on-shored all the processing of its ore exports, it could make over 500 Mt/yr of iron, 40 Mt/yr alumina or 20 Mt/yr aluminium.

[13] For instance, despite managing over $10 billion, the CEFC has a cap of only being able to provide $300 million per year of concessionality in loan discounts, and in practice seems to fall far below this cap. (The CEFC is the Clean Energy Finance Corporation, and NAIF is the Northern Australia Infrastructure Facility).

[14] For more on this see IGCC (2023), '*Driving Australian climate innovation: Unlocking capital to support a clean industrial revolution*'

[15] Using existing emissions-intensive technologies Australia currently produces 5.8 Mt/yr steel, 20.7 Mt/yr alumina, 1.66 Mt/yr aluminium, and over 1.5 Mt/yr ammonia (Australian Industry ETI, 2023, '*Phase 3 technical report: pathways to industrial decarbonisation*').

[16] These production credits would be set to taper off towards an end date (eg. 2040) and would not be intended to fully bridge the marginal cost difference faced by producers. Furthermore, it should be designed to avoid double counting with any CfD (eg. facilities with a CfD are not eligible for the production credit; or the CfD strike price is discounted to account for the production credit).

[17] These investments could be managed by the CEFC, and the concessional components would have a ~$4-5 billion impact on the budget.

[18] The US IRA credits are actually set up with a low base rate that assumes non-compliance with social good requirements, and then a 5x multiplier incentive is available for firms that do meet the criteria.

[19] Hammerle, M & Phillips, T (2023), '*Briefing note: Government leadership on net zero*', Centre for Policy Development

[20] Infrastructure Australia (2023), '*Infrastructure market capacity 2022 report*'.

[21] White House (2023), '*Inflation Reduction Act Guidebook*'; and European Commission (2023), '*Questions and Answers: The Net-Zero Industry Act and the European Hydrogen Bank*'.

[22] For more, see: Climateworks Centre (2023) '*Renewable energy industrial precincts: Scaling up industrial decarbonisation through a coordinated approach*'; Australian Industry ETI (2022) '*Setting up industrial regions for net zero: phase 2 report*'; Beyond Zero Emissions (2021) '*Economic Analysis: Renewable Energy Industrial Precincts*'; and Hammerle, M & Phillips T, (2023) '*Making our way: Adaptive capacity and climate transition in Australia's regional economies*', Centre for Policy Development.

[23] The global green steel scenario produced by the Mission Possible Partnership finds that green steel can be competitive under a global carbon price of approximately USD $50 per tonne CO2-e in 2030, rising to USD $200 by 2050. The Commonwealth's ACCU price cap will remain flat in real terms at $75 per tonne (or approx. USD $50).

[24] The IMF (in a 2023 blog post) estimates that global fossil fuel subsidies in 2022 exceeded US $7 trillion, providing a generous additional 'grey discount' to any facilities producing iron, aluminium or ammonia with fossil fuels.

[25] Such a rebate for exports could be independent of an exporter's performance – eg. based on a ratcheting down industry average – to create a further incentive for producers to decarbonise their operations. '*Swings and Roundabouts: The unexpected effects of Carbon Border Adjustments on Australia*', Ai Group, 2021.

[26] See: Accenture and Australian Industry ETI, (2023) '*Skilling Australian industry for the energy transition*'; and McCoy, J, Davis, D, Mayfield, E, and Brear, M (2023), '*Downscaling – Employment impacts*', Net Zero Australia

[27] Recent global estimates are that $3-6 trillion USD per year of investment is required to meet climate goals, this equates to approximately 5% of global GDP. See: UNEP (2022), '*Investment and trade to meet the Paris climate goals*', speech delivered by Inger Andersen.

[28] For more, see: Tom Arup and Fraser Simpson (2022), '*Recent commentary on the interaction between inflation, fossil fuel markets, energy prices and climate change*', Centre for Policy Development. For instance, the European Central Bank (2023) projects climate change will increase headline inflation by 0.3-1.2 percentage points by 2035.

[29] Forecasts of future costs of low-emissions vs. high-emissions steel and aluminium come from the Mission Possible Partnership data sets. Forecasts for ammonia are modelled based on assumed hydrogen cost declines (becoming US$1 /kg cheaper per decade) and 2% annual efficiency gains for other underlying technology.

[30] These are based on the authors judgement of reasonable mid-points from a range of sources including BloombergNEF (2023), '*Transition Metals Outlook 2023*'; IEA (2021) '*Ammonia Technology Roadmap*'; Mission Possible Partnership (2022), '*Making Net-Zero Steel Possible*' and '*Making Net-Zero Aluminium Possible*'; Climateworks Centre and Climate-KIC Australia (2023), '*Pathways to industrial decarbonisation: Positioning Australian industry to prosper in a net zero global economy*', Australian Industry Energy Transitions Initiative, Phase 3, Climateworks Centre; and BloombergNEF (2021) '*Decarbonizing Steel, Technologies and Costs*'.

[31] This is slightly more than the volume of first-movers recommended for CfD support in the example policy package presented in this report. This is because second movers can be supported through general production credits, not project-specific CfDs.

[32] This is consistent with the Mission Possible Partnership which assumes US$50 in 2030 rising by US$10 per year. Mission Possible Partnership (2022), '*Making Net-Zero Steel Possible*'

[33] Climateworks Centre and Climate-KIC Australia (2023), '*Pathways to industrial decarbonisation: Positioning Australian industry to prosper in a net zero global economy*', Australian Industry Energy Transitions Initiative, Phase 3, Climateworks Centre

[34] This is based on the US$1.9 trillion Net Zero Scenario, but with US$592 billion for Hydrogen Export (replacing approximately US$235 billion of hydrogen investment already in the NZS). See: BloombergNEF (2023), '*New Energy Outlook Australia*'

[35] This comprises $4.9 trillion for domestic energy supply cost and $4.1 trillion for export system investment. See: Davis, D, Pascale, A, Vecchi, A, Bharadwaj, B, Jones, R, Strawhorn, T, Tabatabaei, M, Lopez Peralta, M, Zhang, Y, Beiraghi, J, Kiri, U, Vosshage, Finch, B, Batterham, R, Bolt, R, Brear, M, Cullen, B, Domansky, K, Eckard, R, Greig, C, Keenan, R, Smart, S (2023), '*Modelling Summary Report*', Net Zero Australia

[36] Over 2012-2022 ARENA provided $2,040 mil in grants and subsidy-like programs (as stated on their website's *about* page in February 2023) out of a approx. AU$93,000 mil invested in energy transition (based on US$65,273 mil from BloombergNEF (2023), '*Energy Transition Investment Trends*').

[37] The CEFC's historical leverage ratio of 2.42:1 implies that there is approximately 0.3 CEFC dollars for every 0.7 non-CEFC dollars financing their projects. See: Clean Energy Finance Corporation (2022), '*CEFC Annual Report 2021-22*'

[38] McKinsey (2023), '*Financing the net-zero transition: From planning to practice*'

[39] For example, for a product like green iron, the government may agree to a strike price based on the producers cost of production plus a modest profit (say, strike price of $800 per tonne). To the extent that the green iron is sold at a market price of less than $800 per tonne, the government will make up the difference.

[40] If prices are volatile, it is entirely possible that the market price will exceed the strike price – in which case the contract recipient only retains returns up to the strike price and passes on any excess returns to the government. This happened in the UK when energy prices rose dramatically in 2022 and their offshore wind CfDs started returning money to the government.

[41] The USD $27 billion Greenhouse Gas Reduction Fund is the single biggest program that required appropriation, the tax credits (which do not have an appropriated amount) will almost certainly be larger.

[42] See IGCC's *Driving Australian Climate Innovation* (2023) whitepaper for more on the gaps in the innovation and at-risk capital landscape.

[43] The NZEA has three functions, broadly speaking, to help (1) investors, (2) communities and (3) workers. CPD has put significant effort into understanding how the NZEA and similar agencies can support communities, most recently in the *Making Our Way* report (2023).

[44] IGCC (2023), '*Driving Australian climate innovation: Unlocking capital to support a clean industrial revolution*'

[45] This breakdown is based on: Saul Griffith (2022), '*Electrification is anti-inflationary*', Rewiring Australia

[46] See: White House (2023), '*Inflation Reduction Act Guidebook*'; and Congressional Budget Office (2022), '*Estimated Budgetary Effects of H.R. 5376, the Inflation Reduction Act of 2022*'

CENTRE FOR POLICY DEVELOPMENT

CREATE. CONNECT. CONVINCE.

Published by the Centre for Policy Development

CONNECT WITH US

@centrepolicydev

centrepolicydev

Centre for Policy Development

Cpd.org.au

CONTACT

Melbourne
Level 16, 1 Nicholson Street,
East Melbourne VIC 3002
+61 3 9929 9915

Sydney
Level 5, 320 Pitt Street,
Sydney NSW 2000
+61 2 8199 9407