DRIVING AUSTRALIAN CLIMATE INNOVATION

Unlocking capital to support a clean industrial revolution

April 2023

Investor Group on Climate Change

Acknowledgements

This report was written by Pollination, a specialist investment and advisory firm accelerating the transition towards a net-zero, nature positive future.

The authors were Associate, Charles Ramsden, Director, Mitch Shannon, and Managing Director, Zoe Whitton.

Within IGCC the project was led by Director of Policy, Erwin Jackson and Director of Media and Communications, Fergus Pitt, who both also helped edit the report. Sarah Findlay project-managed during the early stages.

Various IGCC members and staff were consulted as IGCC was commissioning the report and during the editing stages.

About the Investor Group on Climate Change

The Investor Group on Climate Change (IGCC) is a collaboration of Australian and New Zealand institutional investors focused on the impact of climate change on investments. IGCC represents investors with total funds under management of more than $3 trillion in Australia and New Zealand and $30 trillion around the world. IGCC members' beneficiaries include more than 7.5 million people in Australia and Aotearoa New Zealand.

IGCC is funded by members' fees, philanthropy, partnerships, and sponsorship from supporters who understand the power of capital to support climate action.

Contact
igcc.org.au
+61 2 8974 1160
secretariat@igcc.org.au

Cover Image: Din Din (Barron Falls), Barron Gorge National Park, Queensland.

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1. Executive Summary

1.1 The Opportunity to Build New Businesses, Innovation and Industries

- To reach a resilient net-zero economy, Australia and the world will need to develop and grow a set of new technologies, businesses and industries across the economy.
- Australia is making progress in the energy sector, but decarbonisation will also require new businesses and innovation in transport, agriculture, manufacturing and more.
- This paper calls these new businesses and technologies 'transition industries'.
- Growing those industries domestically will be most beneficial to Australia's economy and population.
- Many new businesses and projects will require capital and will need to offer an attractive investment case at appropriate financial terms and scale for institutional capital.
- Australian and global institutional investors seek opportunities to deploy capital (and gain exposure) into transition industries. Currently, they are not finding a significant pipeline of attractive investment opportunities in Australia.

1.2 How Global Leaders Have Developed Their Climate Transition Industries

This paper includes a novel and valuable review of markets with thriving and investible climate industries. This research:

- identified five jurisdictions (California, Denmark, Netherlands, South Korea and Germany) that have very successful decarbonisation innovation industries,
- reviewed their policy settings, approaches and market conditions,
- compared the global best practice with Australian settings, and
- recommends specific policies and overall policy approaches for Australia.

1.3 The Lessons Australia Can Apply from Global Climate Leaders

Based on its review of global best practices, this paper suggests a set of policy conditions that will realise the opportunity.

- Overall Australia's policies have historically focused on funding the **supply** of climate industries and not enough on **building markets and demand** for low-carbon products and services.
- Policies, to be effective and efficient, must be stable, have broad political support, and be coordinated across portfolios, and national, state and local government responsibilities.
- Policies must include strong carbon constraint systems (normally a carbon price), which can create demand for solutions in new sectors. As a starting point, these will be achieved through the recent legislation of a credible Safeguard Mechanism (SGM). The coverage of the SGM will need to be expanded to include a larger share of national emissions over time.
- Policies must include sector-specific transition plans that are supported by clear industrial development priorities. These will stimulate demand for low-carbon products in these sectors.
- To drive the growth of solutions industries, the above policies should sit alongside national industrial development priorities, which can be embedded in industrial development plans.
- Specifically, the industry plans should be accompanied by transition industry and technology priorities that are evidence-based. These should extend the current Technology Investment Roadmap to provide direction and co-ordination which can
    - guide industry and science policy, including via CSIRO and the CRCs
    - direct additional research and development (R&D) incentives, including at-risk investment and
    - inform targets for public finance, including procurement.
- The mandates of the Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency's (ARENA) should be updated to enable both to make investments with higher risk tolerance in the priority sectors or technologies.
- Important 'enabling' conditions include improvements to the Technology Investment Roadmap's low-emission technology statements, and increased support for the CSIRO and climate Cooperative Research Centres (CRCs).

2. The Context and Status of Transition Industries

2.1 A Global Trajectory with Local Implications

As countries worldwide work to achieve deeper emissions reductions and minimise climate risk, decarbonisation efforts rapidly expand beyond the power system and into a wider set of sectors. To meet even current climate targets, novel low-carbon solutions will be needed across transport, built environment, industry and food production. Solutions that are now only emerging will need to scale significantly. Mobilising funding for these new industries and solutions is a critical part of the overall decarbonisation task, but it also presents a significant and sustained investment opportunity.

Australia faces particular risks and opportunities. Australia will be challenged by very significant physical risks from climate change itself. As a major energy exporter, it faces elevated transition risk from the inevitable shift away from fossil fuels. However, Australia is also extremely well positioned to build and succeed in certain new transition-related industries. To minimise these risks and pursue these opportunities, we will have to quickly allocate significant capital to transition, which Australia has historically struggled to do. This is evidenced by our relatively emissions-intensive industry, exports, investment markets.

Globally, some jurisdictions have excelled at mobilising large volumes of capital into new transition-related economies. These successes have all involved the creation of significant new industries and/or businesses, although from quite various foundations. Some of these jurisdictions have built new transition industries adjacent to existing ones—identifying ways to leverage existing strengths. Other jurisdictions have built these industries almost from scratch, relying on their historic industrial success and clear vision to forge green titans.

3. The Challenge of Funding Transition in Australia

Investors have been working to develop investment pipelines in transition industries for two main reasons.

The first is that the growing global need for climate solutions provides potential growth markets for successful transition companies. The second is that, to protect the broader economy and investors' overall portfolios from climate risks, the transition to a low-carbon, resilient economy needs to accelerate.

The opportunities presented by emerging sectors are becoming increasingly evident.

As the transition speeds up globally, the opportunities presented by new growth sectors have become increasingly evident. Many investors have already seen significant returns developing in what this paper calls 'transition sectors'. Financial institutions have been vying to gain access to investment opportunities that position them with exposure to these growth trends. This interest is partially evidenced by rapid recent growth in transition-branded funds and investment products.

Investing in emerging 'climate solutions' sectors is also a growing focus among transition-aligned investors.

Many investors have been thinking increasingly carefully about how capital can support the energy transition as governments seek to align their economies' emissions trajectories with the Paris Agreement's 1.5 °C temperature objective. Recent UN meetings have seen upward pressure on the scope and level of investors' net-zero targets. Those targets increasingly include allocations to low-carbon sectors or 'climate solutions' (although the definition of 'climate solutions' is generally broad and non-specific). Investing in emerging sectors has become a common theme in industry standards around climate-aligned investment.

Nonetheless, investors in Australia have struggled to find investment opportunities in transition solutions.

Very few ASX-listed firms present pureplay exposures to transition solutions or opportunities. The companies that run major renewable energy projects are also mixed utilities. Renewables-adjacent businesses are often small units embedded within diversified companies. Although Australia has a significant block of unlisted renewable assets, new assets beyond renewables have been more difficult to find than in some other jurisdictions.

Consequently, Australian investment portfolios are still more emissions-intense and have access to fewer transition solutions.

Australia's private infrastructure asset class has presented some strong renewable energy investment opportunities. However, beyond renewables, there have been fewer opportunities to invest in the transition or reduce the emissions intensity of portfolios—especially in larger, more liquid asset classes. The relative emissions intensity of the Australian listed equity market partially evidences this. The emissions intensity per $m of revenue of the ASX 200 is 420 tCO2e/$m. This compares to 324 tCO2e/$m and 112 tCO2e/$m for the S&P 500 and FTSE 250, respectively.[1] Another indicator is that the S&P Global Clean Energy Index tracks the performance of the world's 100 largest clean energy businesses, and none originate from Australia.[2]

In this setting, investors have often sought opportunities in other jurisdictions.

Australian investors have, in many cases, found more offshore investment opportunities in transition, in both listed and unlisted asset classes. On the unlisted side, analysis of European deals since the start of 2017 counts more than 2,000 M&A and commercial debt transactions in large renewable energy infrastructure assets and companies. This is around 20 times the volume of similar activity in Australia in the same period; fewer than 100 transactions.[3]

1 S&P, Pollination Analysis, 2023.
2 S&P, 2023. *S&P Global Clean Energy Index*. https://www.spglobal.com/spdji/en/indices/esg/sp-global-clean-energy-index/#data.
3 S&P, Pollination Analysis, 2023.

For a rough comparison, Europe's Gross Domestic Product (GDP) ($17.2 tn as of 2021) is slightly more than 10 times Australia's $1.6 tn. By this measure European investors have had roughly twice as many opportunities to access transition-related deals.

One of Australia's main roadblocks to greater transition investment opportunities has been the small scale of economic activity in transition sectors beyond renewable power generation.

Investment opportunities for institutional investors rely on underlying economic activity—for example a rapidly-growing renewable manufacturing industry or a thriving scale-up ecosystem for innovations in climate solutions. Fiduciary duties (and, in the case of superannuation funds, legislation) prevent most institutional investors from accepting below-market capital returns, which means that creating new investment opportunities is fundamentally about creating business opportunities. Growth in transition sectors and market demand has been sparse in Australia compared to other jurisdictions. This is evident in Australia's industrial performance—Australia now has the highest intensity of emissions from fossil fuel use and cement production per capita in the Organisation for Economic Co-operation and Development and ranks second for emissions embodied in exports (after Norway).[4]

Australia's policy settings have often been implicated in this dearth of activity and assets.

Until recently, Australia has had policy settings characterised by high conflict and uncertainty and very little directional policy. Investors have repeatedly noted that this policy setting has made deploying capital hard—making it more difficult to assess the investment case against specific assets and less likely that said assets would emerge in the first place. A lack of certainty has made it more difficult to establish new businesses and assets has presented greater risk for investors.

This lack of policy has also produced a gap between transition sectors' capital needs and investors' needs.

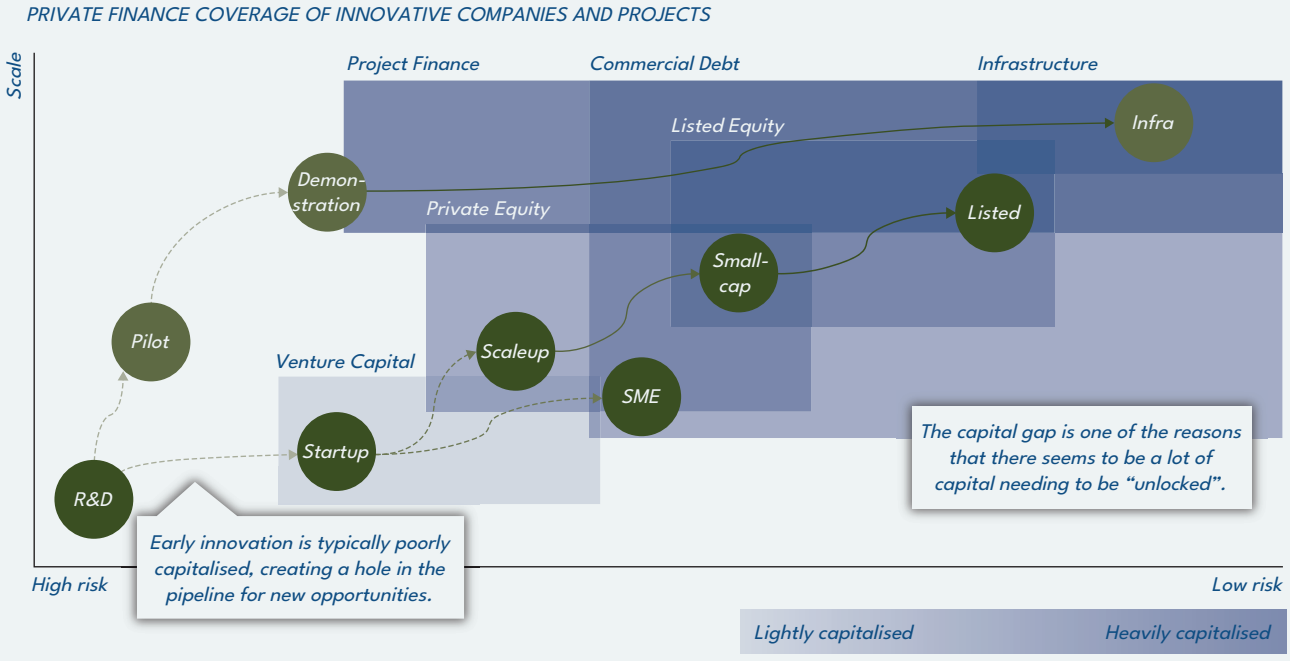
A lack of policy has meant a lack of demand for new entrants and presented challenges for those assessing the case for investment in them. As such, new assets and companies have often found it challenging to find equity and debt financing as they move from R&D through the start-up or pilot phase, making it unlikely that these entities will successfully grow into larger scale commercial enterprises. This gap is not unique to Australia but has been amplified by the broader policy environment.

Policy settings have meant that Australian investors and companies have limited options.

Australia has faced the apparent conundrum of a limited investment pipeline and limited available capital for new entrants.

Figure 1—The Capital 'Gap' for Transition Solutions Companies

Australia has a (typical) capital gap for new companies and assets. This makes proactive innovation hard and reduces the pipeline of new investments.



4 UN Department of Economic and Social Affairs (2022) *The Sustainable Development Goals Report*

4. Looking Abroad for Successful Policy Approaches

In the context of the challenges discussed above, we examine the specific policy levers that can be used to support more and higher quality transition investment opportunities.

We have considered transition investment opportunities at all scales and across asset classes—from rapidly growing scale-ups providing new solutions to large industrial companies focused on transition solutions or relevant infrastructure. We refer to these as transition solutions, green industry and/or green growth sectors.

Although policy has been a frustrating factor for investors interested in these sectors, the policy shortcomings are often discussed in general terms. In this report, we have sought to identify the specific policy settings that, in other jurisdictions, have supported the development of healthy green industry ecosystems and consequently healthy, diverse, and numerous green investment opportunities.

Investment opportunities arise where funding models are in place.

This report focuses on policy interventions that can mobilise large, conventional pools of capital. Some debates around the need to deploy capital in transition often discuss the exercise as if it depends only on investors allocating capital; a need to 'unlock' capital to deploy against transition. Although new financing models are highly relevant and useful to investigate, the most powerful settings must stimulate transition investment opportunities that do not require institutional investors wholly modify their investment requirements and fiduciary requirements.

Most investors need an activity, a project or a company to allocate capital against. Further, institutional investors, in particular, face significant obligations regarding how and under which circumstances they deploy capital—they must be able to make a compelling case regarding the economic return and the scale of the investment. As such, the deployment of large-scale capital depends on the existence of funding models. Put simply, most large investors cannot invest without a viable business model.

This means that investors can support transition and the deployment of new solutions where there are a strong set of business models for transition solutions.

In the case of emerging sectors, strong business models often require demand for solutions and a strong capability for industrial innovation in the country in question. These support the development of new industries and technologies, their commercialisation by large businesses, and the deployment of capital against them.

We often think of transition industries as small or early stage innovations, but these are not the only focus of this report.

As noted above, institutional investors deploy capital across the economy—into large listed companies, significant projects, assets and infrastructure, and emerging companies. As such, we have considered the policy settings which can support the development of transition investment opportunities across scales. We have considered investment opportunities across the board—from California's clean tech giants and Denmark's world-beating listed wind companies to Germany's broad and deep clean industry.

4.1 Learning from Success

The key question we set out to answer is which policy mechanisms appear to create the conditions under which investors can support and gain exposure to transition industries.

We quickly determined that the conditions which make investors more able and likely to invest in emerging sectors act in one of two ways:

1. improving the growth and prospects of transition sectors, hence increasing the number of investible opportunities, or
2. specifically reducing barriers to investment in existing opportunities.

We examined other regions with strong transition investment track records and codified their successful policy approaches.

We used a transition policy framework (outlined below) to categorise policy measures and compare policy across relevant regions, including policy mechanisms relevant to both goals. We reviewed policy mechanisms that relate to the demand for and economic success of new technologies, the commercialisation of these technologies. and the specific financing demand for new sectors and solutions.

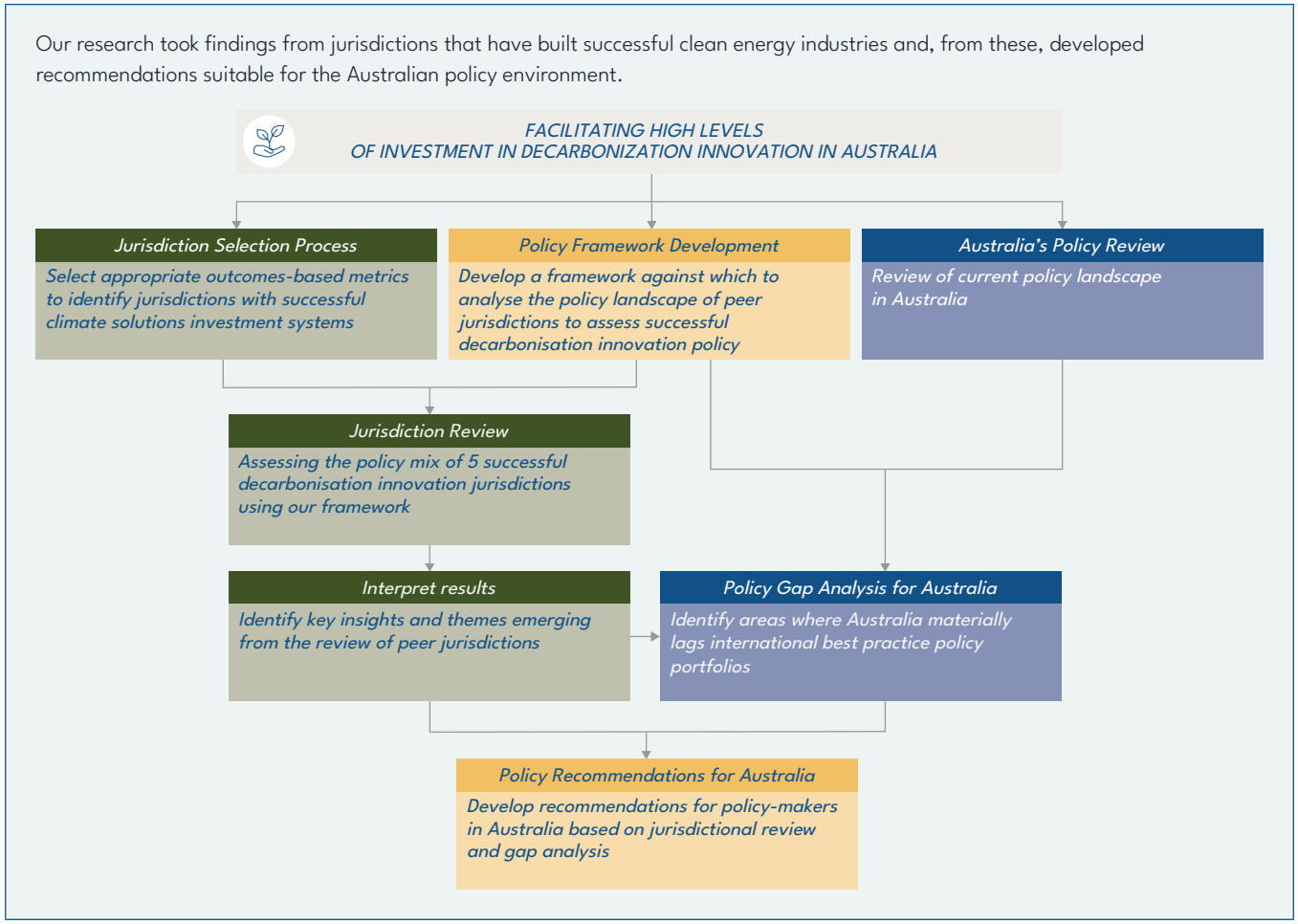
We selected jurisdictions to deeply investigate based on their track record of creating new green sectors and deploying capital into transition sectors.

To understand which countries or regions have the strongest track record, we used several outcomes-based measures to rank countries and identified a subset with particularly strong results. These metrics are not exhaustive, but together give us a broad sense of success at forming new companies and large-scale industrial activity.

We compared the approaches of these jurisdictions to identify the key pillars of successful policy approaches and compared these with the current Australian policy landscape.

We identified several common themes and a number of fairly glaring gaps. The first year of a new government does mean that the policy environment in Australia has been changing rapidly. Nonetheless, a number of the observed gaps are still relevant.

Figure 2—Research Methodology and Outputs



4.2 Identifying Successful Regions

We use four metrics to identify countries and regions that have previously successfully built transition-related economic activity and investment opportunities.

The measures are not exhaustive and do not encompass all aspects of success, but they allow us to narrow in on a subset of nations and states that are successfully investing in transition. The four measures we chose are:

1. the extent of venture capital flows to climate-related start-ups,
2. the extent of existing demonstration projects (particularly in hydrogen),
3. the size of listed climate-related companies headquartered in the region, and
4. the extent of climate-related patenting activity among corporates.

Together these metrics cover success from small-scale innovation through to large-scale enterprise creation. They include the existence of large industrial business models focused on transition in the region and the extent of work within existing companies to develop transition-related offerings. We elaborate on the rationale for these metrics in the sidebar below.

To identify focus regions or states, we selected those which occurred more than once across the top 10 list for each of our metrics.

We also tried to select enough regions to get some geographic variation and economic and industrial composition. We arrived at Germany, California, Denmark and South Korea. We included California as a jurisdiction (rather than the wider United States of America [US]) because much of the US' climate tech success has sprung from California and the state has a specific policy context that differs from the wider US. In addition, we decided to include the Netherlands—a jurisdiction that makes a strong showing below and, like Australia, has historically exported a significant amount of a specific commodity.

Figure 3—Jurisdiction Mapping and Selection

We selected outcomes-based metrics that measure a jurisdiction's ability to innovate and commercialise climate solutions technologies successfully.

1. VC FUNDING	*2. SHAREHOLDER VALUE*	*3. DEMONSTRATION PROJECTS*	*4. PRIVATE PATENTING*
State of Climate Tech 2021 (PwC)	***S&P Global Clean Energy Index (S&P)***	***Hydrogen Demonstration Projects (IEA)***	***Corporate LCE Patent Applications (IEA)***
1 San Francisco, USA	*US*	*Germany*	*Toyota, Japan*
2 London, UK	*China*	*Spain*	*Samsung, South Korea*
3 Berlin, Germany	*Denmark*	*USA*	*Panasonic, South Korea*
4 New York, US	*Canada*	*Netherlands*	*General Electric, US*
5 Boston, US	*Portugal*	*Australia*	*LG, South Korea*
6 Stockholm, Sweden	*Brazil*	*UK*	*Robert Bosch, Germany*
7 Amsterdam, Netherlands	*Spain*	*France*	*Siemens, Germany*
8 Paris, France	*Japan*	*China*	*Hitachi, Japan*
9 Seattle, US	*India*	*Denmark*	*General Motors, US*
10 LA, US	*South Korea*	*Norway*	*Ford Motor, US*

Notes: The table above consolidates the top 10 performers for each metric (S&P, 2023) (PwC, 2021) (IEA, 2022) (IEA, 2021). We identified five jurisdictions that performed strongly across the board (highlighted), with some regional and industrial diversity: Germany, Netherlands, South Korea, Denmark and California. Given that our VC funding results were city-based and our private patenting results were corporate-based, we had to extrapolate to country-level for some measures.

Sidebar: What measures indicate a thriving investment environment?

Attracting climate-related venture capital funding

As many transition solutions begin as new companies, one indicator of the successful creation of new transition sectors is the extent of new venture activity in the space (including scale-up venture activity). PwC's *State of Climate Tech 2021*[5] gives a detailed view of emerging trends in early-stage climate tech investments. Specifically, PwC maintains a database of climate tech start-ups and funding flows. We took the top 10 destinations for climate tech venture capital as our metric for attracting innovation capital.

Deploying demonstration projects at scale

One outcome of successful innovation efforts is the ability to bring research work from the lab to large-scale operation. As such, a country's ability to deploy demonstration projects for emerging technologies is a valuable indicator of innovation accomplishments. We reviewed the IEA's *Hydrogen Projects Database*.[6] Hydrogen technology is at a stage of deployment where it is operationally proven but has not yet reached full-scale deployment. Further, although we consider hydrogen in Australia a resource-based play, green hydrogen is also highly relevant in non-resource-rich jurisdictions. As such, we believe it is a useful (if limited) proxy for the extent of clean energy demonstration projects. We concede that it is imperfect; for instance, the hydrogen project count will be skewed to favourable geographical locations.

Building shareholder value in climate-related industries

In our view, success in public markets is a good indicator of a jurisdiction's ability to create new industries at scale and to deploy capital towards them. The *S&P Global Clean Energy Index*[7] measures the performance of global companies that derive most of their revenue from clean energy-related business lines. Our top 10 jurisdictions were formed by ranking each country's total index weight of the index constituents.

Commercialising climate-related patents

The last outcome measure we wished to observe was not related to the market or funding. Creating new solutions and offerings is often heavily related to creating new intellectual property, as many of these new offerings represent valuable new industrial knowledge. The rate of patent applications is the most directly observable proxy for new IP. To maintain the outcome-based lens, we included corporate low-carbon technology patenting by a company for each domicile. The patents submitted by corporates are necessarily closer to the commercial application than those submitted by the research community. As such, corporate patenting activities were deemed more outcomes-focused than the patenting activity of the country as a whole. These patents also represent efforts by large, existing businesses to provide new products and services relevant to transition. We sourced patenting application data in low-carbon technologies from the IEA.[8]

5 PwC, 2021. *State of Climate Tech*. s.l.: s.n.

6 IEA, 2022. *Hydrogen Projects Database*, s.l.: https://www.iea.org/data-and-statistics/data-product/hydrogen-projects-database.

7 S&P, 2023. *S&P Global Clean Energy Index*. https://www.spglobal.com/spdji/en/indices/esg/sp-global-clean-energy-index/#data: s.n.

8 IEA, 2021. *Patents and the energy transition*, s.l.: https://iea.blob.core.windows.net/assets/b327e6b8-9e5e-451d-b6f4-cbba6b1d90d8/Patents_and_the_energy_transition.pdf.

4.3 The Components of a Successful Transition Policy

We assessed the track record of each jurisdiction using a policy framework that allows us to categorise different policy mechanisms according to their impact.

The framework allowed us to sort through long lists of policy mechanisms and make comparisons. It also allowed us to identify patterns and similarities in policy approaches among jurisdictions with successful low-carbon industrial systems.

The intentional creation of industries involves a wholistic set of policies, including the policy that enables strong collaboration between diverse stakeholders.

In successful jurisdictions, the process appears to require deep, economy-wide coordination across the industry, government and public research institutions. It also requires potentially long pay-off horizons for some types of invested capital. At each stage of development of a new solution or industry, it is exposed to funding, technical and market risks, alongside other social and political challenges. Countries raise the chances of creating successful new industries by building a business, market and knowledge environment that addresses all these challenges.

Successful new industries are built by 'pushing' resources into new technology or solutions and 'pulling' solutions through development by creating demand.

As such, we categorise policies according to whether they primarily act by driving resources into a new sector or creating demand for the sector in question. Push policies include financial incentives for innovation spending, while pull policies include policies like emissions trading systems which prompt companies to seek new low-emissions solutions (creating demand).

Figure 4—Transition Policy by Category

We utilised the following transition policy framework to observe each jurisdiction's major pillars of transition-related policy.

FACILITATING HIGH LEVELS OF INVESTMENT IN DECARBONIZATION INNOVATION

FRAMEWORK PRINCIPLES	Resource Push			Market Pull		
	1. Set Priorities	2. Mobilise Funding	3. Develop Human Capital	4. Enable Markets—Short Term	5. Enable Markets—Long Term	6. Business Innovation Environment
POLICIES & TARGETED ACTION	• Legislated climate-related targets in place • Publicised clean energy priorities in short, medium and long term • Loans and grants for projects and start-ups, public equity or government backed VC • Targeting large-scale demonstration projects • Public Private Partnerships • Funding for higher education, vocational training & researchers • Funding for R&D facilities and laboratories (public or private) • Set corporate R&D tax incentives • Public financing mechanisms to mobilise private capital			• Targets and standards including sustainable investment schemes and taxonomies • Subsidies and direct public funding that leverage private investment • Product standards that rise with ambition over time • Markets for valuing emissions reductions (e.g., carbon pricing mechanism) • Investment in enabling infrastructure for nascent technologies • Regulation supportive of low-carbon businesses • Sustainable public procurement • Stability, duration and consistency of policies		
SUPPORT	**Enabling Conditions** Include knowledge management and brokering, education, and connectivity mechanisms.					

Notes: The framework was developed to classify innovation-related policymaking in the climate solutions space to accelerate investment in decarbonisation. This framework was used to inform our assessment of policy settings in peer jurisdictions and the gap analysis and recommendations for Australia. Adapted from IEA (IEA, 2020).

4.4 Push Mechanisms

The resource push pillar drives innovation by allocating capital to new technologies for their early-stage development, deployment and commercialisation.

In general terms, the resource push view emphasises the development of low-carbon technologies, typically through publicly funded R&D programs, rather than regulatory limitations on emissions. The rationale for the resource push pillar rests on the need to develop technologies that can facilitate cost-effective emissions reductions, often ahead of adopting actual emissions restrictions.

Governments provide resources for new solutions through more policies than pureplay R&D funding.

Governments often support new solutions by consistently resourcing fundamental research, prototyping, pilots, demonstrations and early-stage product development and production. Public funds and financial incentives are often mobilised to ensure steady support for innovation activities. However, the resource push pillar is built on more than just financial incentives. For example, governments often play an important role in setting industrial priorities, which guide the direction of innovation and can de-risk investors' capital allocation decisions. Finally, innovation success also depends on the availability and quality of human capital, with the ability to attract and retain talent contributing to any effort to construct a new industry.

4.5 Pull Mechanisms

Market conditions can also provide demand for solutions and spur industrial development to complement the resource push pillar.

In the climate context, pull mechanisms include regulatory measures such as technology-uptake targets and carbon pricing regimes. In response to these policies, businesses seek solutions that will reduce emissions at the least cost, allowing them to remain competitive. This produces demand and revenue opportunities for solutions providers, be they new entrants or existing companies.

Market forces can 'pull' technologies to scale and help mobilise capital at scale.

The firm expectation of future revenues created by pull mechanisms motivates commercial actors to develop new products and allows investors to forecast value with less uncertainty. Investors in these new entrants still take a risk but do so in the face of legitimate demand growth. By underpinning demand, 'pull' side policies often mobilise capital at scale using conventional capital pathways (rather than creating new ones).

In the climate context, market pull mechanisms go beyond just carbon pricing.

Favourable market conditions for new products can be created using a number of approaches. These include:

1. **Creating short-term markets**, which can be achieved using public procurement, subsidies and tax incentives for customers, and favourable fiscal policy.
2. **Creating long-term markets**, which can be achieved by medium-term industry targets, establishing product standards (like vehicle efficiency standards), carbon constraint mechanisms (such as carbon prices)—which force incumbents to consume new solutions—and investments in enabling infrastructure (such as EV charging networks).
3. **Creating a favourable business environment**, including ensuring finance is accessible for new solutions and lowering administrative barriers from specific public services (e.g., business registration, intellectual property filings, tax regime requirements).

4.6 Enabling Conditions

Alongside financial and market factors, enabling conditions seem to play a role in creating new sectors.

Knowledge-sharing networks seem to be particularly effective for regions building new industries. Protecting and disseminating new knowledge and IP are both important functions, with the first incentivising actors to continue to improve products and the second ensuring the knowledge gets used. A well-functioning patenting and publication system plays an important role in this effect. However, creating an intellectual property protection regime that is not administratively burdensome, costly, or anti-competitive is also important. An effective knowledge management system can also create valuable knowledge 'spill over' effects, where knowledge breakthroughs in one technology improve the research development of other technologies.

Social support for new industries is critical.

Public buy-in is incredibly important for creating new industries and scaling transition solutions. A favourable public perception of new industrial priorities supports their execution on multiple fronts. Public support is also vital to give policymakers the political capital to continue supporting the creation of new industries through push and pull mechanisms (because this often involves forcing change on existing industries). This may seem primarily a political problem, but some regions we reviewed have specific policy mechanisms designed to build and maintain this social licence.

5. Key Insights from Successful Jurisdictions

The following section summarises the policy settings we observed across the jurisdictions we reviewed.

Other than all being developed markets, the jurisdictions we considered are diverse geographically, economically and in the focus or nature of their successful new industry development. Some jurisdictions, including the Netherlands and Denmark, have economies more like Australia due to a shared historical emphasis on resource exports. Other jurisdictions, including South Korea and Germany, have built their transition industries on top of relatively diverse existing industrial footprints.

Although the regions we reviewed were various, a number of key themes emerged.

The regions in question consistently possess durable, non-partisan policy frameworks that provide long-term policy certainty, often supported by industrial development plans (usually in five-year increments). Most jurisdictions reviewed have clear agendas regarding the direction of industrial development—including the specific sectors or solutions being targeted for development. In most jurisdictions reviewed, the policy suite included significant pull mechanisms, creating demand for new solutions and products. Finally, most jurisdictions reviewed also have significant enabling systems, including systems in which the state invests directly in new industries or subsidises private investment.

A combination of policy mechanisms seems to be essential for transition growth.

For those in the industry and those familiar with industrial policy generally, the characteristics of a well-functioning policy system, like those noted above, will be unsurprising. Nonetheless, our research allowed us to empirically confirm that these features are usually present in jurisdictions with strong transition industry growth.

Figure 5—Main Policy Themes

Shared features of successful policy environments range from consistent policy to public capital at risk.

Consistent Policy

*All jurisdictions had **constant long-dated policies**, which were frequently **iterated and improved upon**. The steadfast direction of policy has enabled investors, founders and stakeholders to build successful climate solution businesses.*

Push & Pull Balance

*All regions had significant push and pull policies. This **policy symmetry creates demand for new industries, while simultaneously supplying the resources needed to meet that demand**.*

Industrial Direction

*Another recurring feature was a **clear and pointed set of industrial development priorities**. Identifying and actively supporting sectors which either answered a local decarbonisation need or presented a significant growth pathway is common.*

Public At-Risk Capital

*In our sample, large state-sponsored R&D funding ecosystems support early-stage innovation long before these come into the purview of the private sector. **The provision of at-risk capital is actively encouraged, and the presence of public funding actors is generally seen to crowd-in private capital**.*

Enabling Environment

*Governments took explicit responsibility for creating enabling environments for climate innovation to thrive. This includes **supporting the build out of physical infrastructure, taking an active role in coordinating knowledge and building support across civil society**.*

Sidebar: Regional competition for clean industry development is rising

Ambition for industrial transition is high among the largest economic blocs in the world.

The past year has seen a number of jurisdictions announce flagship energy and climate policy packages that are likely to significantly impact the timing and location of investment decisions for clean energy technologies over the next decade. In particular, the Inflation Reduction Act (IRA) in the US and the European Union's REPowerEU Plan may make Australia's competitive task in developing low-carbon industries and unlocking investment opportunities more challenging. The generous incentives for renewable energy and clean hydrogen projects embedded in the IRA and REPowerEU demonstrate that the US and European Union (EU) are looking to build a lead over other countries when attracting capital into clean energy investment.

Investors are already favouring these high-ambition jurisdictions.

These announcements appear to already be influencing investment decisions. Investors and corporate leaders in the energy sector have commented on the passing of the IRA as a game changer that has made the US the most attractive destination for green hydrogen investment. According to the US Department of Treasury, since the IRA passed, companies have announced over 90 major new clean energy projects in the US, representing US$90 billion in new investments in areas such as batteries, solar, wind and electric vehicles.[9] In Australia, the Clean Energy Council has also recently highlighted the impact of the IRA on labour availability, referencing reports of local renewable energy companies having recruits poached by US-based organisations before they could arrive in Australia.[10]

Australia needs a strong and timely response to these developments.

They suggest that other countries positioned to be major exporters of clean energy technologies and low-carbon fuels, including Australia, will need to either strengthen incentives for investors or identify strategies that take advantage of the US and EU efforts. The Australian Government should explore opportunities to establish trade blocs with like-minded countries to support an internationally coordinated green transition. This could involve, for example, countries giving foreign-made goods access to their domestic subsidies under certain conditions. Such deals could also be developed sectorally, as illustrated by the Global Arrangement on Sustainable Steel and Aluminium currently being negotiated between the EU and the US.

9 Remarks by Assistant Secretary for Tax Policy Lily Batchelder for the American Bar Association, 2023. s.l.: https://home.treasury.gov/news/press-releases/jy1267.

10 Daniel Mercer (ABC), 2023. *Australia urged to boost clean energy spending over claims 'mammoth' US green subsidies bill a threat—Comments from Clean Energy Council CEO Kane Thornton*, s.l.: https://www.abc.net.au/news/2023-02-13/australia-urged-to-respond-to-mammoth-us-green-subsidies/101942366.

5.1 Consistent Policy

A recurring theme in jurisdictions we reviewed is policy consistency.

In some cases, this consistency was delivered by larger policy blocks—for example, policies within the EU covered the Netherlands, Denmark and Germany. In other cases, consistency was maintained despite the government shifting between political parties with historically opposing philosophies (as in California). Nonetheless, the regions in question maintain relevant policy frameworks over decades. These tend to include medium- and long-run legislated targets supported by a shorter run industrial planning framework.

California's policy system is a clear example.

Since setting its first emissions reduction target in 2006.[11] California has maintained policy stability despite government changes. Republican Governor Schwarzenegger, who was in power from 2003 to 2011, supported the target, and subsequent Democratic governors continued, and in some cases enhanced, transition-supportive policies. This durability is likely partly supported by the use of funding models for transition that directly benefit Californian people and communities. A significant share of revenue generated from California's emissions trading scheme is reinvested in underserved communities,[12] likely building the political capital needed to maintain consistent policies.

Denmark gives another example of this durable policy settings.

The Danish Government has paid particular attention to establishing political consistency around energy policy, an emphasis demonstrated in the Danish Energy Agreements. The Energy Agreements are part of a long tradition of political precedent among parties in the Danish Parliament. They are legally non-binding policy instruments outside the normal legislative process, whereby the parties commit to supporting the necessary policies to achieve specific goals in the energy sector.

Political parties use the agreements to bind each other to decisions that may prove unpopular politically and need to be implemented across more than one term. These include policy goals for which long-term certainty and planning is essential, such as incentives for renewables deployment and transmission infrastructure. The first energy plan—*Energiplan*—was formed in the late 1970s in response to the global oil shock. In its current form, the first Energy Agreement was reached in 2008 and set energy targets for 2009 to 2012. It included a mandate that 20% of gross energy consumption must come from renewable energy sources by 2011.[13] Under the latest Energy Agreement, Denmark planned to phase out coal-fired power generation by 2030.[14]

The policy settings in question are generally material for affected industries and so are not without controversy.

When we speak of consistent policy settings, we are not speaking only of less material policy mechanisms such as disclosure or emissions reporting frameworks. The countries and regions we reviewed achieved consistency in policy settings which were highly material for relevant industries. The Danish Energy Agreements are one example.

All jurisdictions have emissions constraint mechanisms such as carbon prices or emissions caps (although their forms vary).

California has had a cap-and-trade system for carbon pollution permits since 2012. All revenue from the program is reinvested in climate mitigation projects, with a legislated minimum of 25% of proceeds going towards disadvantaged communities.[15] Denmark and the Netherlands have gone beyond the EU Emissions Trading Scheme to provide more extensive effective carbon pricing. Denmark first introduced a carbon levy in 1992.[16] In 2021, it decided to raise its carbon price to the highest level in the EU.[17] The Netherlands charges a carbon levy on top of the energy surcharge tax.[18] The Netherlands is also skewing its taxation regime towards favouring low-carbon technologies (increasing taxation for natural gas, lowering taxation for electricity), thus directly reflecting transition priorities in its fiscal policy.[19] The South Korean ETS was launched in 2015, covering ~73% of national greenhouse gas (GHG) emissions and nearly 700 companies.[20]

11 California Air Resources Board, 2018. *AB 32 Global Warming Solutions Act of 2006*, s.l.: https://ww2.arb.ca.gov/resources/fact-sheets/ab-32-global-warming-solutions-act-2006.

12 OEHHA, 2012. *SB 535 Disadvantaged Communities*, s.l.: https://oehha.ca.gov/calenviroscreen/sb535.

13 IEA, 2008. *Danish Energy Agreement for 2008-2011*, s.l.: https://www.iea.org/policies/54-danish-energy-agreement-for-2008-2011.

14 OECD, 2021. *The Danish Energy Agreements towards a carbon-neutral society*, s.l.: https://www.oecd.org/climate-action/ipac/webbooks-practices/dynamic/ipac-case-studies/74d30bcf/pdf/the-danish-energy-agreements-towards-a-carbon-neutral-society.pdf.

15 OEHHA, 2012. *SB 535 Disadvantaged Communities*, s.l.: https://oehha.ca.gov/calenviroscreen/sb535.

16 World Bank, 2015. *Putting a price on carbon with a tax*, s.l.: s.n.

17 Reuters, 2022. *Denmark agrees corporate carbon tax*, s.l.: s.n.

18 European Commission, 2021. *Ensuring that polluters pay—The Netherlands*, s.l.: https://environment.ec.europa.eu/system/files/2021-10/The%20Netherlands.pdf.

19 IEA, 2020. *Korea 2020: Energy Policy Review*, s.l.: s.n.

20 International Carbon Action Partnership, 2023. *Korea Emissions Trading Scheme*. [Online] Available at: https://icapcarbonaction.com/en/ets/korea-emissions-trading-scheme.

5.2 Push and Pull Mechanisms

A second overarching feature in the regions reviewed is broad policy settings, including a mix of mechanisms across the pillars of our policy framework.

All regions had a significant push, pull and enabling policy mechanisms. Although the jurisdictions reviewed did not tick all policy boxes, they all have active policy mechanisms across each category of our framework. This means that all five have policy mechanisms that create demand for new industries—from South Korea's world-leading public procurement system to the Netherlands' town planning adjustments. Enabling conditions, such as taking an active role in knowledge management and coordination, are present in most jurisdictions reviewed.

Pull policies, in particular, were present in all regions we reviewed.

Pull policies create the demand needed to establish new industries and investment opportunities. As noted above, they include policies like carbon trading systems which create demand by driving industrial decarbonisation. They also include policies like public procurement of green materials. Pull policies were utilised by all regions in our sample and were generally employed across multiple industries. California, for example, has what we consider pull-focused policy mechanisms in place across electricity, transport fuel, technology and infrastructure, and the built environment. Germany has historically been one of the pioneers of clean energy subsidies in the form of feed-in-tariffs, which helped to drive early demand for solar PV and wind energy technologies.

Case Study—Decarbonising California's Transport Sector

California has tackled its most emissions-intense sector (transportation) with complementary policies on both push and pull levers. This combination smoothed the transition to low-carbon alternatives by balancing supply and demand.

Figure 6—California's Policy Suite for the Transportation Sector

RESOURCE PUSH	MARKET PULL
1. Transportation Infrastructure Funding *Legislation that increases the state's gasoline tax, raising over $5 billion per year for transportation projects including improvements in efficiency and emission reductions.*	***1. Low Carbon Fuel Standard*** *A program requiring transportation fuel producers to reduce the greenhouse gas emissions intensity of their products, from extraction to refining and end use.*
2. Low Carbon Fuel Production Program *Supports new and expanded renewable ultra-low-carbon transportation fuel production at commercial scale.*	***2. Sustainable Transportation Planning*** *Transportation planning legislation setting regional greenhouse gas emission reduction targets for passenger vehicles and requiring agencies to assess and mitigate the vehicle miles travelled (VMT) impacts of new developments.*
3. The Clean Transportation Program *Invests up to $100 million annually in a broad portfolio of transportation and fuel transportation projects throughout the state.*	***3. Automobile Emission Standards*** *State law requiring the first set of greenhouse gas emission standards for passenger vehicles.*
4. Zero-Emission Vehicle Related Manufacturing *Provides funding to support in-state manufacturing of zero-emission vehicles (ZEVs) and ZEV-related supply chains.*	***4. Electric Vehicle Charging*** *Law requiring local governments to develop streamlined ordinances for electric vehicle charging infrastructure.*

5.3 Clear Industrial Priorities and Direction

A recurring feature of the policy environments we reviewed is a clear and pointed set of industrial development priorities.

Counter to the regularly repeated mantra of technology neutrality, all jurisdictions we reviewed identified specific sectors or solutions for focused industrial development. This usually included identifying sectors that either answered a local decarbonisation need or presented a significant growth pathway.

These priorities are usually exercised across policy mechanisms.

Development priorities provide direction across push, pull and enabling conditions. Germany's National Research Plan and research projects exemplify this, providing a framework to focus R&D, funding support and direct investment on near-term priorities as needed to support the country's decarbonisation pathway. Similarly, Denmark's use of thematic clusters coordinates action across research institutions, companies and other stakeholders. Finally, the Dutch *Integral Knowledge and Innovation Agenda* (IKIA) includes 13 Multiannual Mission-Driven Innovation Programmes (MMIP) focusing research on driving emissions reductions across priority sectors. These research and industrialisation plans flow through funding programs and have established regional industrial hubs focusing on specific technology stacks.

The process used to identify these priorities varies between jurisdictions.

In California, material emissions and economic dependencies guide policy makers when identifying sectors for focused development. California's population and economy rely heavily on private passenger vehicles for transportation infrastructure, and passenger vehicles make up a large portion of the state's emissions. Conversely, in the Netherlands, the priority sectors were based on synergies with incumbent industries like agriculture and chemicals.

California chose to tackle one of its biggest emissions sources using a set of complementary policies across both push and pull levers.

By employing both sets of levers in the same sector, California avoided the risk of throwing supply and demand out of balance. For instance, if only demand-side policies were employed (e.g., limiting fossil fuel supply and driving demand for alternatives) and supply were kept constant (e.g., not using push policies to drive the supply of zero-emissions vehicles), the probable outcome would have been a sharp rise in transportation costs. California's success is in part evidenced by the creation of a fundamentally new industry in the form of EV manufacturing. This was not by accident, with significant push and pull policies in place to stimulate innovation within the transportation sector.

The Netherlands determined focus areas by building from existing expertise and identifying synergies with incumbent industries.

The Netherlands' largest industry is petrochemical refining and distribution, and the country has focused on developing adjacent low-carbon technologies, including biofuels and hydrogen. The Netherlands designed its push policies to select technologies based on cost efficiency. Technologies were rated on marginal abatement cost curves and subsidised according to the highest-rated technologies. The design of the subsidy program reveals the fundamental trade-off between short-run cost efficiency (it may be favourable to install carbon capture and storage in the short term) and the need to switch in the longer run to radically new technologies (producing new, clean fuels such as hydrogen).

These directions were developed in collaboration with existing industries but not dictated by them.

Interestingly, many jurisdictions in question built their transition industries in indirect adjacencies to existing ones. However, from a distance, they do not seem to have had their industrial development directed only by the needs of existing industries. Further, these new industrial directions were identified and developed even where they might prove a long-run threat to existing industries.

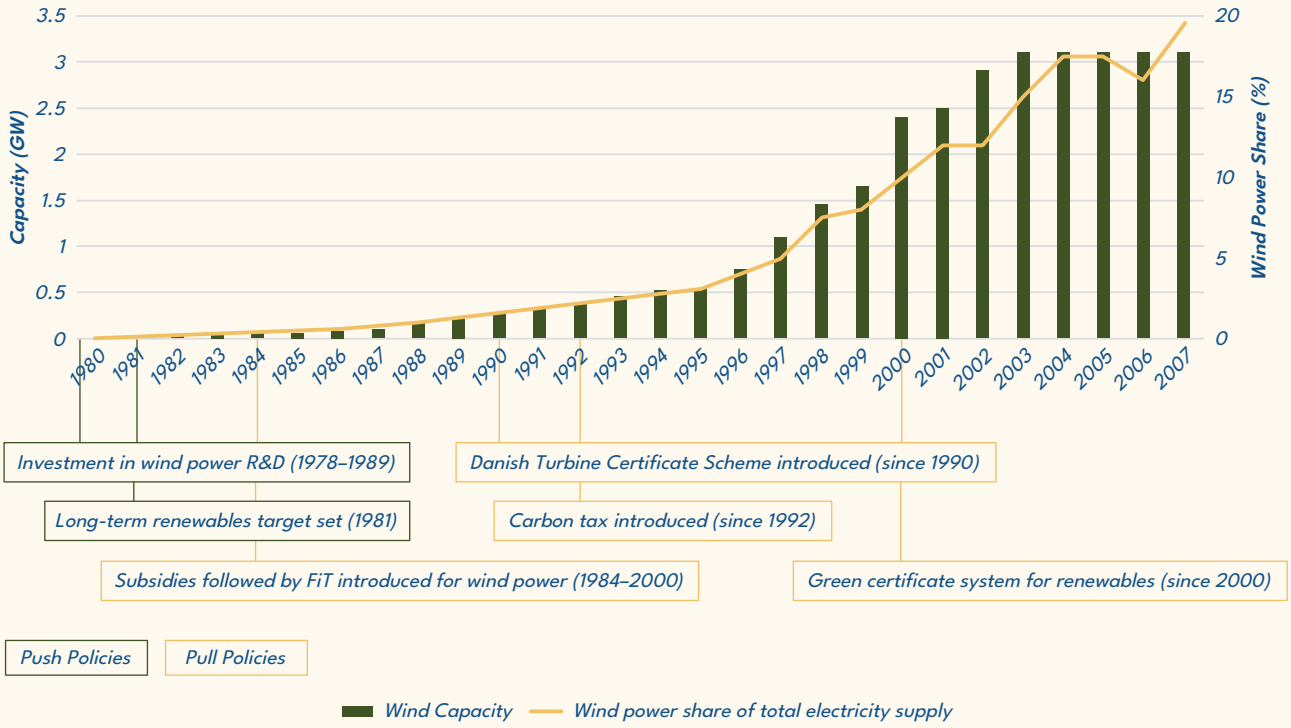
Sharing the success of new industries can smooth the industrial development process.

The Danish Government built a favourable domestic market by creating a policy environment in which incumbents and disruptors could both benefit from the emergence of new industries (in this case, wind power). In the 1980s, Denmark's initial wind power R&D targets were crafted in collaboration between academia, government and industry. The incumbent utilities were the first customers for the turbines being developed by the research institutions, with the revenue from these sales quickly funding the entirety of the R&D effort. As such, strong early ties were crafted between incumbents and the disruptors that emerged from academia. Moreover, the Danish public at large could invest in the new technology through wind power co-operatives. As such, local communities near wind power developments could invest in these projects, receive dividends from their successful operations and share in the wealth of the nation's newly developed technology.

Case Study: Building Denmark into a Global Leader in Wind Energy

The growth of Denmark's successful wind power industry was fostered by sustained support and industrial development priorities—via initial push policies followed by targeted pull policies.

Figure 7—Danish Policy Interventions and Wind Power Growth, 1980–2007

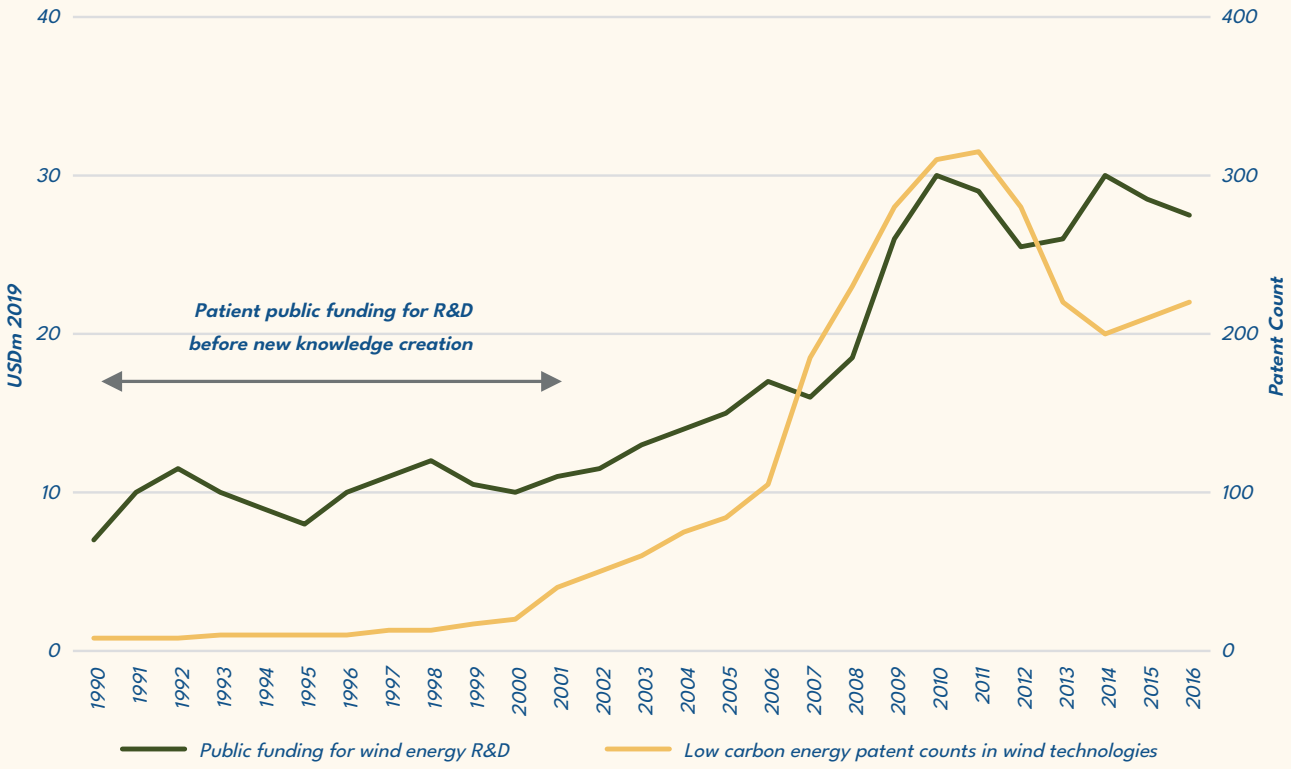


Source: UN ESCAP, Denmark's Renewable Energy Policies, *2012.*

Denmark's policy suite was carefully tailored to suit wind power's development needs through its development curve.

Sustained and predictable policy was important in developing Denmark's wind industry. Consistent financial support in the early years of technology development prompted the creation of new IP and expertise in Denmark's wind power innovation system. Denmark's successful wind power research and deployment was also supported by close industry collaboration, sensible financial support and strong standard setting.

Figure 8—Public Support for Wind Energy Development and Patent Creation, 1990–2016



Source: IEA, Tracking clean energy innovation, *2020.*

5.4 R&D Funding Support

Another common feature of the jurisdictions is their significantly developed R&D and commercialisation funding systems.

All of the regions reviewed have large and active state-sponsored R&D funding efforts. These systems generally support R&D and commercialisation long before these come into the purview of the private sector and use several funding mechanisms to do so. As noted above, they tend to also be directed by national industrial development priorities.

California and the Netherlands provide two particularly striking examples.

The Netherlands utilises an extensive and diverse array of financial support across technology maturity levels, funding instruments and capital requirements. Funding solutions are made available across the capital stack, funded largely with public money. Similarly, California's system supports new industries through multiple stages, including funding, which aids development, testing, scaling manufacturing and establishing demonstration projects.

Interestingly, although Australia famously has two well-developed funding mechanisms, systems like them were not widely visible in the jurisdictions reviewed.

In particular, ARENA and the CEFC are notable for focusing on later-stage, commercially viable activity. In contrast, the state funding systems we observe in other regions allow the state to take greater risks, sometimes including non-commercial positions earlier in the technology development timeline. This ability to take greater risks is one advantage of using public money to support R&D and commercialisation. These early-stage positions are not small. The California Energy Commission's R&D efforts mobilise US$200mn per annum[21] and are supported by various follow-on funding systems.

These funding systems can be large enough to be dominant in their ecosystems.

Invest-NL is a public venture capital fund deployed by the Dutch Government. The IEA notes that half of all venture capital deployed in the Netherlands is related to a government entity.[22]

Earlier-stage investment and support for commercialisation from the public sector helps to 'crowd in' the private sector.

In certain jurisdictions, these systems would be criticised for crowding out the private sector. However, their consistent presence across jurisdictions with strong industrial development and associated private capital deployment suggests public finance may help to crowd in the private sector by assuming a role private capital cannot or does not play. These extensive early-stage and higher risk funding systems seem to be associated with significantly increased investment opportunities for private sector investors.

R&D systems also often allow incumbent industries to diversify their interests by investing early in up-and-coming solutions and sectors.

Denmark provides a clear example of this outcome. The first turbine offtakes came from the Danish Wind Technology company, a joint venture between the Danish Ministry of Energy and the SEAS utility.[23] Policy certainty around wind power also meant that utilities could plan around the emergence of new, disruptive technology and adapt and invest accordingly. These structures may create conditions in which existing industrial players and investors do not get locked out of emerging sectors and are therefore less likely to present political roadblocks.

21 California Energy Commission, n.d. *CalSeed*, s.l.: https://calseed.fund/the-program/.

22 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

23 Kamp, L. M., Smits, R. & Andriesse, C. D., 2004. *Notions on learning applied to wind turbine development in the Netherlands and Denmark*, s.l.: s.n.

Case Study: Funding for Emerging Technologies in the Netherlands

The Netherlands has a particularly strong technology funding environment, which supports innovation at all development and technology maturity levels.

The Dutch technology funding environment deploys an extensive and diverse array of public financial support across technology maturity levels, funding instruments and capital requirements.[24]

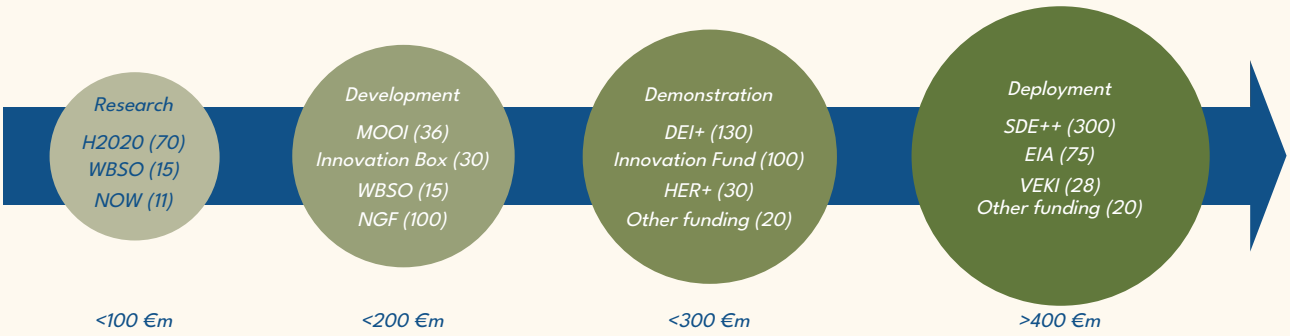
Funding schemes are also designed to complement and follow one another. For instance, the Stimulation Energy Transition Incentive Scheme (SDE++) only funds eligible technologies under the Demonstration Energy and Climate Innovation scheme (DEI+). As such, each funding scheme provides a project pipeline to the next.

INVESTNL

457 €m

in committed capital was deployed by Invest-NL in 2020 and 2021, a public venture capital fund with several focus areas, one of which is the energy transition, according to Invest-NL.

Figure 9—Transition Technology Funding Environment in the Netherlands



Note: The individual program names are shown with their annual budget (EURm). Source: IEA.

24 Invest-NL, 2021. *Annual Report 2021*, s.l.: s.n.

5.5 Strong Enabling Environments

Finally, all of the regions reviewed had what we might call strong enabling conditions.

This goes beyond simple operating conditions—ease of doing business, labour and the like. The government played a constant and active role in knowledge management and connectivity in each region we reviewed.

These environments took direction from national decarbonisation and industrial development priorities.

As noted above, national development priorities were often embedded across policy mechanisms. In this case, several regions particularly emphasised enabling connectivity in specific sectors or themes identified as priority industrial development areas.

For example, California has a coordinated system of support that allows the state to support upcoming companies through their development.

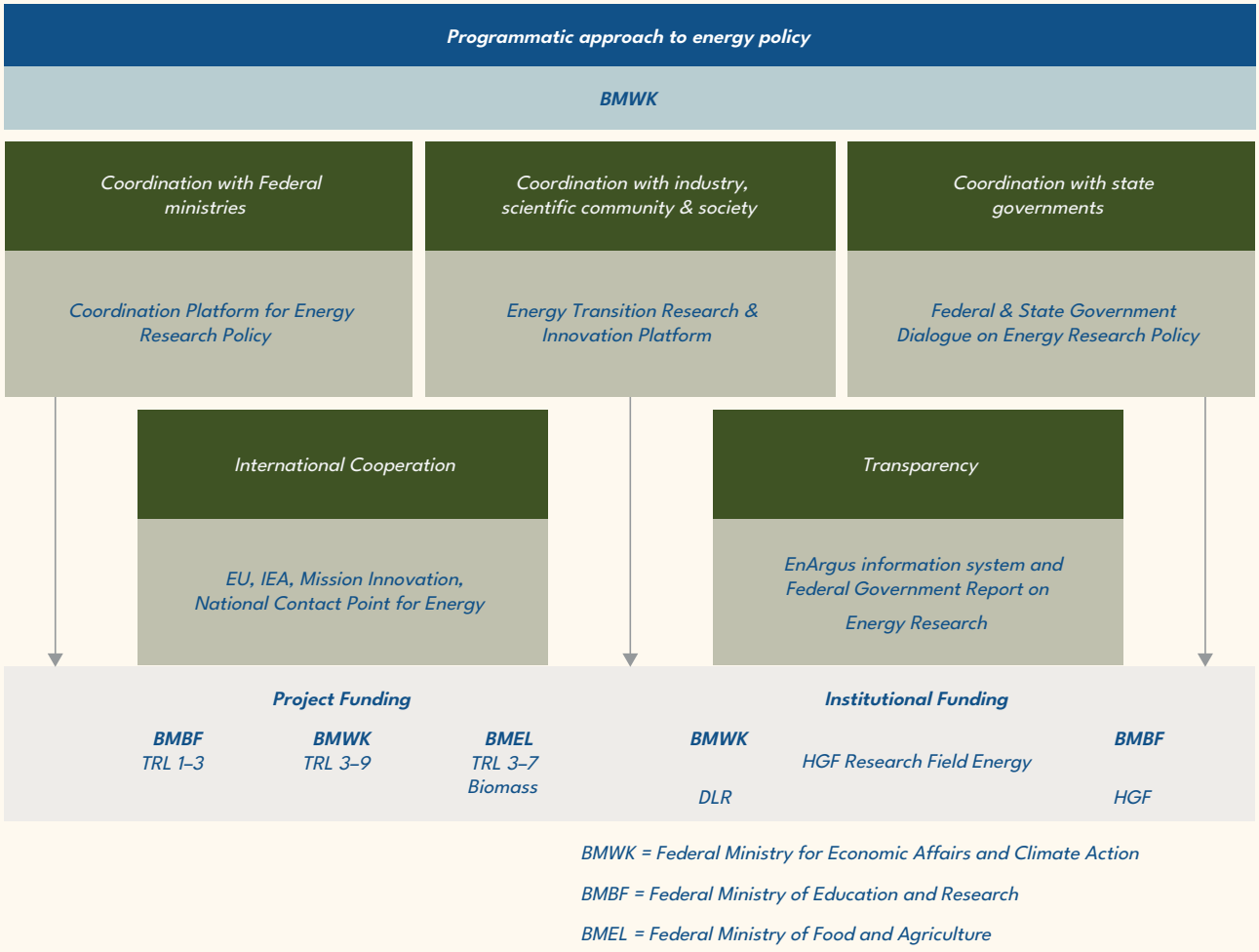
CalSEED leverages four Regional Energy Innovation Clusters to support companies located throughout 21 counties in California to accelerate the success of energy innovation.[25] The *California Energy Innovation Ecosystem* is a state-wide initiative of the California Energy Commission that connects clean energy entrepreneurs with the funding, training, resources and expertise they require.[26] The California Vehicle-Grid Integration Roadmap brings together the California Independent System Operator (ISO), California Public Utilities Commission (CPUC), California Air Resources Board (CARB) and other stakeholders to integrate electric vehicle charging requirements with the needs of the power system.[27]

25 California Energy Commission, n.d. *CalSeed*, s.l.: https://calseed.fund/the-program/.
26 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.
27 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.

Case Study: Germany's 7th Energy Research Programme (ERP)

Germany's ERPs are a strategic element of the government's energy policy that aims to support continuous research and innovation. The governance model outlined below shows the public sector's strong coordinating role in scoping research objectives and deploying research funding.

Figure 10—Institutional Setup for Energy Research



BMWK = Federal Ministry for Economic Affairs and Climate Action

BMBF = Federal Ministry of Education and Research

BMEL = Federal Ministry of Food and Agriculture

€6.4 billion

FUNDING IS AVAILABLE UNDER THE 7TH ERP.

This is dedicated to researching, developing, demonstrating and testing viable future technologies and concepts. This amounts to an increase of about 45% on the previous period of 2013 to 2017.

Funding is available for cross-sector issues such as energy efficiency, sector coupling and digitisation to ensure a holistic funding approach. More funding is also made available to start-ups compared to previous ERPs. Improving international competitiveness and capacity to export is a key consideration.

6. Shortcomings in Australia's Policy Landscape

Australia's policy landscape currently has several notable gaps relative to the jurisdictions we reviewed—likely due to a tradition of highly partisan climate policy.

We reviewed Australia's federal policy settings for comparison to the jurisdictions above. We have not included state policy settings, as these are developing rapidly and not always in consistent directions. Although Australia has several focused and well-developed policy mechanisms, the Australian federal climate policy landscape is sparse and relatively unstable compared to the jurisdictions reviewed in this report. Australia also has many policy mechanisms that are in place but not presently used to their full effect. A particular point of contrast between the Australian policy landscape and those reviewed is the lack of clear overarching decarbonisation priority areas or an industrial development framework.

Figure 11—Policy Mechanisms by Jurisdiction

Successful jurisdictions had relatively deep policy environments, with mechanisms spread across each policy pillar.

Framework fundamentals	High-level actions	Approaches & policy levers	Jurisdictions	Australia's policy performance*
RESOURCE PUSH	Set priorities	Legislated climate-related targets in place	DE KR DK US NL AU	Very strong
		Publicised clean energy priorities in short, medium and long term	DE KR DK US NL AU	Satisfactory
		Embed R&D components in broader energy policy	DE KR DK US NL	Satisfactory
	Mobilise funding	Loans & grants for projects & start-ups, public equity or government backed VC	DE DK US NL AU	Satisfactory
		Public financing mechanisms to mobilise private capital	DE KR	Weak
		Set corporate R&D tax incentives	US NL AU	Satisfactory
		Targeting large-scale demonstration projects	DE KR DK US NL AU	Satisfactory
	Develop human capital	Funding for higher education, vocational training & researchers	KR DK US AU	Satisfactory
		Funding for R&D facilities and laboratories (public or private)	DE DK US NL	Weak
		Scholarships, awards, grants, training, tax incentives for R&D staff	US	Weak
MARKET PULL	Enable markets—short-term	Public procurement of pre-commercial technologies & green products	KR DK US	Weak
		Subsidies and tax incentives for emerging technologies	DE KR DK US NL AU	Weak
		Embed climate considerations in tax code	NL	Weak
	Enable markets—long-term	Investment in enabling infrastructure for nascent technologies	DE KR NL AU	Weak
		Product standards (e.g. environmental), with rising ambition over time	US	Weak
		Carbon Pricing Mechanisms (tax, levy, subsidy or cap & trade)	DE KR DK US NL AU	Weak
	Business innovation environment	Stability, duration and consistency of policies	DE KR DK US	Weak
		Address permitting, regulatory and administrative bottlenecks	KR NL	Satisfactory
		Mitigate risks associated with access to finance	DE KR DK NL	Satisfactory
		Facilitate norms, standards and safety regulations	DK US AU	Strong

*Based on current policy settings

Weak · Satisfactory · Strong · Very strong

A notable feature of the Australian policy landscape is a lack of material, durable policy.

Although Australia has had some policy instruments consistent for the past decade (the Emissions Reduction Fund, financing bodies, the Renewable Energy Target), these policy mechanisms have only been relevant for very specific sectors. Further, a number of Australian policy instruments have been in place for some time but have not yet been leveraged effectively. The Safeguard Mechanism is a prime example—having been lightly, if at all, utilised.

The partisan nature of climate change debates has heightened policy uncertainty.

Even the Australian policy mechanisms noted above have been the subject of ongoing conflict. Although the amount of policy change has sometimes been limited, removing the original Carbon Pollution Reduction Scheme and the adversarial climate policy environment in the following years set a clear tone for private sector actors. Policy interventions in recent years have likely reinforced the impression of uncertainty in Australian climate policy. Interestingly, climate policy appears to be considered largely non-partisan in the jurisdictions we reviewed.

Demand creation is another notable gap in the Australian policy landscape.

Australia has a relative shortage of pull-type policy mechanisms to create demand for new sectors and solutions. The Renewable Energy Target (RET) has been a successful mechanism in this respect, stimulating demand for renewable energy and supporting the development of an industry that has driven renewables as a share of Australia's generation base. The Emissions Reduction Fund (ERF) is another example—creating demand for a now-thriving land-based offset production sector. However, Australia has a notable shortage of demand creation policy mechanisms beyond these very focused systems.

Australia's approach to industrial development also presents a notable contrast to the approaches observed in the jurisdictions we reviewed.

Australian industrial policy has often developed in response to existing industry needs (e.g., for carbon capture and storage) or under the assumption that the private sector should be responsible for identifying compelling development angles. Australia has historically been rarely inclined to pick winners in industrial development. This is potentially changing slightly with the introduction of the Technology Roadmap and in recent aspects of ARENA and CEFC's development. However, the Australian policy setting is still significantly less directed than the jurisdictions considered above, which have strong innovation and industrial development outcomes and greater opportunities for investors to support transition sectors.

The R&D and commercialisation funding approach Australian federal agencies use is also notably different from the jurisdictions reviewed.

Compared to the jurisdictions in question, Australia has very little federal funding at risk for small enterprises without significant co-investment and administrative requirements. Existing funding focuses primarily on technologies already viable or close to commercialisation and often has what might be considered generic commercial conditions. Unlike the jurisdictions reviewed, Australia has no large-scale funding mechanism for early-stage innovation and technology development beyond activity supported by the private sector. This is a distinct contrast to the approach deployed in our reviewed jurisdictions.

Australia's broader innovation infrastructure is dispersed and uncoordinated.

Australia does have some government-driven innovation and knowledge management infrastructure. The CRCs and CSIRO are examples of government-supported research exercises designed to generate industrial outcomes with significant funding allocated against them and with a significant focus on aspects of industrial transition. However, this infrastructure is not connected to broader industrial development efforts like other jurisdictions with successful and thriving transition industries. In the jurisdictions reviewed, governments typically play a key role in providing the connective tissue between research institutions, investors and the private sector to catalyse innovation and ensure integration between R&D efforts and industrial and climate policy. This includes establishing federal government departments that are specifically mandated to foster disruptive innovation and support the growth of start-ups and SMEs.

Finally, where federal innovation support is available in Australia, the overheads to accessing this support often include significant administrative burdens.

Administrative processes to access funding and green public procurement, as well as comply with import and export requirements, are significant in Australia and are highlighted in jurisdiction comparisons. Although it is hard to find comparative evidence regarding the relative intensity of different schemes providing access to innovation support, anecdotal evidence suggests that applications for innovation funding in Australia impose relatively high administrative burdens. Major grant schemes certainly require very substantial dedications of time and resources to complete. This administrative intensity could deter smaller or less established businesses from pursuing this process, resulting in missed opportunities to support innovation.

Sidebar: Major Aspects of the Australian Climate Policy Landscape

Push Mechanisms

National Targets and Pathways

Unlike other jurisdictions mentioned, Australia has not had ambitious and legislated mid-and long-term emissions reduction targets. The Albanese Government has legislated a 43% emissions reduction target by 2030 (on a 2005 baseline), but this is yet to be accompanied by a systematic policy system of the type we observed in the jurisdictions reviewed.

Clean Energy Finance Corporation (CEFC) and Australian Renewable Energy Agency (ARENA)

ARENA supports the innovation and commercialisation of renewable energy and low-emission technologies. It bridges the gap between innovation and investment to help emerging early-stage technologies become commercially viable. ARENA has provided AU$1.96bn of funding to date across 632 projects (ARENA, 2023), spanning a range of clean energy technologies. ARENA's strategic priorities are optimising the transition to renewable energy technologies, commercialising clean hydrogen, supporting the transition to low-emissions metals and decarbonising land transport.

CEFC co-funds near-commercial low-emissions technologies, projects and enterprises alongside the private sector. The fund has committed AU$18.3bn of investment. CEFC's Clean Energy Innovation Fund focuses on early-stage clean tech companies (targeting the deployment of $200mn across its investment period) and invests in businesses pursuing opportunities across mobility, smart cities, agriculture, circular economy and energy demand management. CEFC is frequently cited as being the world's largest government green bank.

Taxation R&D Incentives

The R&D Tax Incentive (RDTI) is currently one of the key pillars of innovation policy in Australia. The RDTI provides targeted R&D tax offsets designed to encourage more companies to engage in R&D. The RDTI is not thematic or sector focused. Hence, it applies to all innovation activity in Australia.

Entities engaged in R&D may be eligible for refundable tax offsets against innovation-related spending, which are larger for smaller companies.[28] Australia's heavy reliance on 'indirect' funding measures, like the RDTI, to support business R&D is a characteristic Australia shares with only a few other industrialised nations.

Start-up Tax Incentive

Australia provides tax incentives for investors in early-stage companies in innovative sectors across the board. Investors in a qualifying early-stage innovation company can be eligible for tax offsets against a portion of their investment and modified capital gains treatment.[29]

Pull Mechanisms

Safeguard Mechanism (SGM)

The SGM provides a legislated framework originally intended to limit the emissions of large industrial facilities that produce more than 100,000 tonnes of carbon dioxide equivalent each year (currently implicating around 215 facilities in Australia). The SGM has been operating for six years and requires regulated facilities to keep their net emissions below an emissions limit (a baseline).

The SGM's effectiveness to date at reducing emissions has been limited, largely due to relaxed baseline settings. However, the significant tightening of baselines under the legislated reform to the SGM will enable the mechanism to operate at its full capacity as an emissions constraint and trading mechanism.

28 Australian Government, 2023. *Overview of the R&D Tax Incentive*. [Online] Available at: https://business.gov.au/grants-and-programs/research-and-development-tax-incentive/overview-of-rd-tax-incentive.

29 Australian Department of Treasury, 2023. *Tax incentives for early stage investors*. [Online] Available at: https://treasury.gov.au/national-innovation-and-science-agenda/tax-incentives-for-early-stage-investors.

Emissions reduction fund (ERF)

The Clean Energy Regulator (CER) is responsible for administering Australia's ERF, under which the government purchases lowest-cost emissions abatement (in the form of Australian carbon credit units [ACCUs]) from a wide range of sources to incentivise participants to proactively reduce their emissions.

The CER's functions include developing methodologies enabling ACCUs to be generated from technology and nature-based emissions reduction projects. The generation of ACCUs for emissions reductions provides a revenue stream to help de-risk investment in emerging decarbonisation technologies.

Renewable Energy Target (RET)

RET is a federal government policy designed to ensure that at least 33,000 gigawatt hours (GWh) of Australia's electricity comes from renewable sources by 2020. In September 2019, the CER announced that Australia had met the Large-scale Renewable Energy Target (LRET) more than a year ahead of schedule.

Despite the LRET being achieved in 2019, the scheme will continue to require high-energy users to meet their obligations under the policy until 2030. However, the price of large-scale generation certificates under the LRET will likely decline significantly over the next decade due to an oversupply in the market as more renewable energy is generated beyond the 33,000 GWh LRET.

Enabling Conditions

The Climate Change Authority

The Climate Change Authority is an agency established to advise the federal government on climate change, including conducting regular reviews of Australia's progress against national climate priorities (in the Annual Climate Change Statement) and undertaking specific research.

Technology Roadmap

The Technology Investment Roadmap (TIR) is an Australian Government strategy to develop and deploy low-emissions technologies. The TIR was introduced by the former Coalition Government and supported by the publication of annual Low Emissions Technology Statements (LETS), which:

- review and refine the government's technology priorities and goals
- report on progress towards these goals
- fine-tune the government's investment approach for the biggest economic and emissions reduction outcomes.

The first LETS was published in 2020, with an updated LETS in 2021 that refined the government's objectives and introduced additional technology priorities under the TIR. While the LETS identify specific technology supporting decarbonisation, they provide limited details about how these technologies were selected, the role the government will play in creating market demand and supporting these technologies through widespread adoption, and the obligations of the private sector regarding these priorities. Further, the TIR is not referenced significantly in surrounding industrial policy.

CSIRO

CSIRO, Australia's national science agency, works with universities, research institutes and industries to develop technologies and support commercial uptake across many areas of the economy, including low-emission technologies. CSIRO's research areas relevant to climate change include clean hydrogen production, energy storage, industrial decarbonisation and agricultural emission reduction. CSIRO has also established a mission-driven multidisciplinary science and research program to drive demonstration and investment activities in areas of high importance to Australia.

Cooperative Research Centres (CRCs)

Australia makes use of a range of mission-driven, directly funded programs to foster business innovation through the CRC Program. Relevant CRCs in the decarbonisation space include the Heavy Industry Low-carbon Transition CRC ($39M in grant funding across 10 years), the Future Fuels CRC ($26M in grant funding across seven years) and the Reliable Affordable Clean Energy CRC ($69M in grant funding across 10 years).[30]

30 Australian Government, 2023. *Current Cooperative Research Centres (CRCs)*. [Online] Available at: https://business.gov.au/grants-and-programs/cooperative-research-centres-crc-grants/current-cooperative-research-centres-crcs.

7. Which Approaches Should Australia Consider?

Australia has a number of potential policy directions to better support the development of transition industries and investment opportunities.

Australia's policy infrastructure has historically been insufficiently directed and connected, which has been a headwind for new transition sectors and associated investment opportunities. A number of policy changes can support the development of more extensive transition industries and associated investment opportunities.

Durable policy infrastructure combined with near-term planning should be a primary consideration.

This paper shows that durable and long-run policy settings a core plank of policy systems in regions with thriving transition sectors and consequent investment opportunities. To the extent that climate policy in Australia can become permanent and non-partisan, capital deployment opportunities for Australian investors and investors in Australia will be strengthened substantially. Legislating Australia's interim and long-run targets are a useful part of this. However, these could be usefully accompanied by a national planning capability responsible for supporting industrial development towards a low-carbon state in shorter term increments. Australia has a number of policy mechanisms already in place, but these are not clearly interlinked or coordinated. Such a capability could be developed within an existing departmental mandate (such as the Department of Industry, Science and Resources) and supported by expert opinion and research support from entities like the Climate Change Authority or CSIRO.

Sharpening and extending existing policy mechanisms will likely have a significant impact within this policy system.

A distinct feature of the Australian landscape has been the existence of policy mechanisms that are not presently directing active decarbonisation or industry development. Even without any other policy development, the legislated tightening of the Safeguard Mechanism will provide a more robust emissions reduction framework that has ever previously existed in Australia. It will produce demand for new sectors and solutions, in kind creating investment opportunities. The reformed Safeguard Mechanism presents a powerful opportunity to drive industrial decarbonisation and establish demand for transition solutions and sectors. However, it should be reviewed with a goal of supporting the development of transition industries as well as achieving national emissions goals. Now in its improved form, the Safeguard Mechanism must provide sufficient challenge to industry to prompt demand for new sectors and solutions if it is to support the development of new industries and investment opportunities.

Establishing national technology priorities and coordination can increase the efficacy of our existing policy mechanisms.

Within the above policy system, this report recommends establishing a national industrial strategy (which includes development priorities for new sectors and associated support). This should include clearly identified themes or sectors and coordination across research, industry and R&D funding. For example, a green hydrogen development theme could be supported by government procurement, industry adoption targets, specific early-stage funding, support for development zones and increased connectivity between research institutions, industry and finance.

Industry pathways that outline the transition trajectories for relevant industries and associated technology development needs are one mechanism that might sit at the heart of such a strategy. Within these, specific industry sub-targets (e.g., targets on installing charging infrastructure alongside vehicle efficiency and EV uptake targets) should be adopted to provide clear demand pathways for relevant solutions.

Five-year industrial development and research plans, a repeated feature of policy environments in regions with successful transition sectors, can direct industry innovation and allocate research funding against these industry pathways. Five-year plans can link existing mechanisms and initiatives (such as the TIR, CSIRO, CRCs, and the CEFC and ARENA), achieving greater leverage from the existing policy system. Government procurement can be deployed to support these five-year plans by providing early demand for relevant solutions. Together, industry pathways and five-year plans could help ensure that Australian decarbonisation and industry growth priorities are clear, coordinated across agencies, and unambiguous to companies and investors alike.

Existing financing mechanisms should be repositioned to support industrial development more effectively.

The CEFC and ARENA have been effective and innovative financing mechanisms. However, these, too, could be directed more effectively, at least in the name of developing new transition industries. In particular, both should provide more focused industrial development finance against the system of priorities suggested above. Similarly, both should also provide finance for commercialisation efforts in priority areas accessible to a wider group of proponents and with fewer administrative overheads.

This flies in the face of many of the points of discipline which define the CEFC and ARENA today. Both have focused on co-funding with the private sector and, in CEFC's case, near-commercial terms. However, this contrast reflects the contrast we observe in the Australian Government's relationship with financing innovation more broadly. Australia tends to approach innovation financing activity primarily through the lens of high discipline rather than with any significant appetite to take a risk. If the risk appetite of these institutions were higher, they would be less likely to crowd out private sector financing and more capable of supporting the development of new industries.

Beyond this, deepening early-stage at-risk funding will likely support Australia's broader capital system to mobilise on transition.

In addition to repositioning existing financing mechanisms, Australian policymakers should consider pathways to deepen R&D, commercialisation and early-stage funding, particularly funding able to take a sufficient risk. There is an obvious question of whether Australian investors might have a role in this funding space, and mechanisms such as technology validation and government procurement could play a role in de-risking private sector financing. However, there is also a role for state-sponsored investments in parts of the capital allocation landscape that are too high-risk for private institutions. If the experience of other jurisdictions is to be believed, these investments are not likely to crowd out the private sector. Instead, they may support the development of new businesses and assets that can provide large-scale investment options in transition sectors.

Finally, the federal government has a role in coordinating and supporting specific regional development.

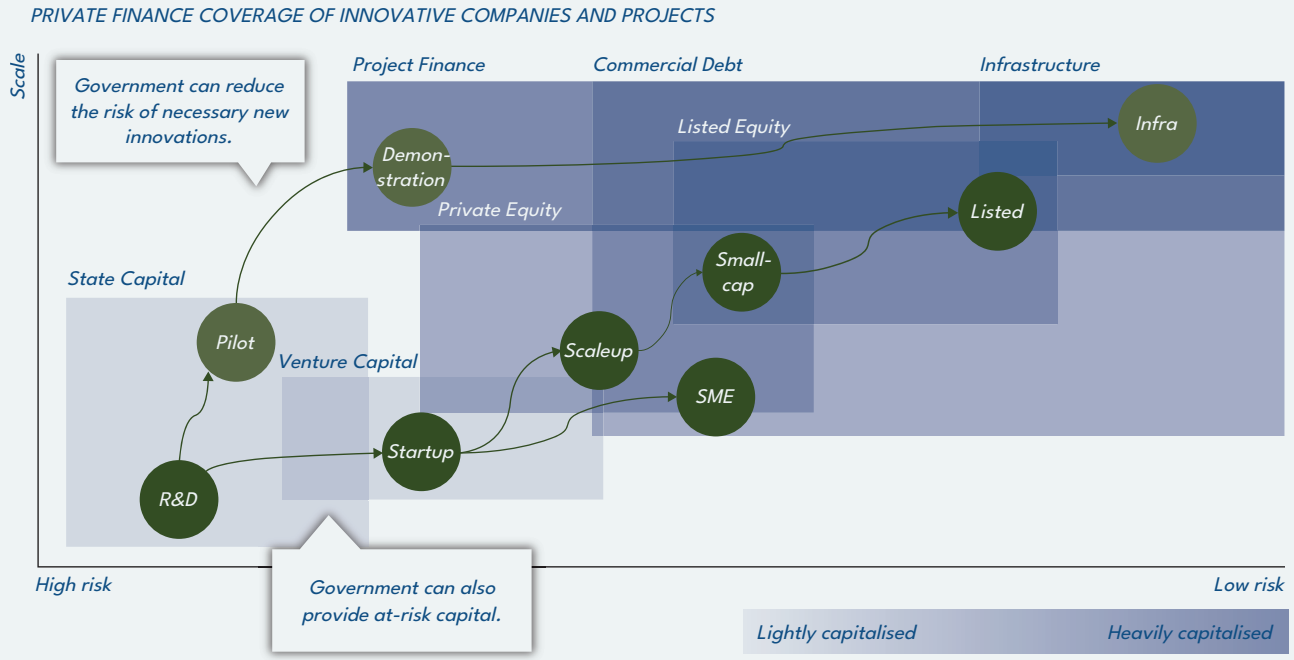
Central support and coordination for regional development have been deployed effectively in a number of the jurisdictions we reviewed. The state-level policy is presently significant and will contribute extensively to Australia's decarbonisation and industrial development efforts. Ensuring that this policy development, including creating special economic zones, is coordinated and does not compete in value-destructive ways is likely to be a useful and productive activity for the federal government.

Building a coordinated industrial decarbonisation policy suite can create new investment opportunities at scale and, in doing so, mobilise capital to support the transition.

In our view, the above policy infrastructure can achieve two major outcomes. The first is supporting the successful development of specific transition industries in Australia from innovation to scale, including by utilising Australia's existing policy infrastructure more effectively. The second is creating an unambiguous policy environment in which capital providers at all stages in the capital deployment pipeline have visibility over national development directions and the confidence to invest in transition. In doing so, the above interventions should reduce the size of the capital gap outlined at the outset, supplement the early stages of this gap and support the overall investment pipeline. As such, in our view, creating a coherent national policy system is one of the most effective pathways to 'unlocking' capital at scale for transition in Australia.

Figure 12—Vanishing the Capital Gap

Government intervention can close the capital gap and can also improve the risk profile of innovation investments.



7.1 The Safeguard Mechanism as a Cornerstone of Industrial Decarbonisation

Carbon constraints or pricing schemes are a constant feature of successful jurisdictions.

All the jurisdictions we reviewed have had effective carbon constraints or pricing regimes in place for significant periods (three decades in the case of Denmark). These policies often form the cornerstone of these jurisdictions' 'pull' policies by creating demand for low-carbon products and solutions. On this front, Australia has a lot of ground to make up. Industries in jurisdictions with long-run carbon pricing regimes have had much longer to respond to these signals and benefit from consequent demand. In this context, if Australia wishes to develop a transition-ready industry, it must legislate a carbon constraint regime with high integrity and longevity.

A strengthened Safeguard Mechanism is a useful addition to the Australian federal policy suite in this context.

The reforms to the Safeguard Mechanism are broadly positive. However, we believe they are not yet sufficiently ambitious to drive transformational industrial decarbonisation. Ideally, the scheme should have a wider coverage of the economy's emissions.

The emerging technologies exemption could be delivered more effectively.

Under the current draft, a five-year multi-year monitoring period, during which abatement activity can be delayed, is available to facilities that lack the available technology to decarbonise. We do not believe this measure is required due to other proposed flexibility provisions (banking and borrowing). Moreover, the definition of 'unavailable' technology should be clarified, as many technology solutions already exist, albeit at a higher cost. This measure introduces political risk by allowing facilities to delay action and increase lobbying efforts to weaken the system and absolve their obligations.

We believe this is an area where targeted deployment support would be more suitable. This could take the form of a contract for difference scheme that fixes the margin that the facility receives for its product. Funds would be made available to negate producers' initial cost increase from their abatement activities.

Lifting the government ACCU price cap and limiting ACCU use would increase the scheme's ability to drive industrial innovation.

The price at which facilities can purchase government-held ACCUs is $75, increasing at 2% plus CPI per annum. We believe the price cap growth is too conservative, only reaching $86 real in 2030. This will potentially incentivise facilities to achieve most of their targets through offsetting rather than decarbonising their operations.

First, we suggest employing a more ambitious ACCU price growth curve. The ACCU price curve must be compatible with Australia's commitment to limiting climate damages above 1.5 °C. However, we also emphasise the need to restrict facilities' ability to meet emissions reduction obligations in the ACCU market. As such, we suggest that the next review of the mechanism examine adding a cap on the share of emissions reduction obligations that can be met with ACCUs.

The Role of Regional Development Zones

Regional development strategies are already popular with state governments in Australia.

Australian governments are already employing targeted industrial development strategies that focus on leveraging the competitive advantages of specific geographic regions in a decarbonisation context.

For example, the Special Activation Precincts established by the New South Wales (NSW) Government encompass regional areas that align with the NSW Government's long-term economic vision and provide growth opportunities for new and existing industries, among other factors. The government is reforming planning frameworks and investment support services to better enable the delivery of industrial and commercial infrastructure in these regions, in turn driving job growth and other economic outcomes.

There are also various state government frameworks aimed at supporting the development of renewable energy zones and hydrogen hubs around Australia. Various states have committed considerable funding and policy support to attract investment in clean energy projects located in designated areas.

National coordination can help optimise regional development.

These policy developments are positive insofar as they will help to provide certainty to investors and drive capital into regions with characteristics that favour the development of clean industries. However, a coordinated national industrial development strategy should effectively address the risk that investment in clean industries in Australia is cannibalised as a result of state governments seeking to 'outbid' each other to de-risk investment by companies in the same industries or infrastructure.

The federal government could play an important role in the establishment of regional industrial development zones by developing a framework to encourage collaboration and coordination between states in this context. This would include a focus on driving mutually beneficial outcomes for states and ensuring that such development occurs in an equitable manner.

Models to enable some degree of benefit sharing among states with respect to the development of clean industries could also be considered. It would be logical for responsibility for such coordination at the federal level to sit with the entity that is responsible for the broader exercise of developing a national industrial development strategy.

7.2 How Can Australia Leverage Synergies Between Industrial and Trade Policy?

Australia's position in the global economy places it in a unique position at the nexus of trade and the energy transition.

On the one hand, Australia's commodity export-oriented economy is highly exposed to demand destruction in fossil fuel commodities. Currently, 24% of Australia's export value consists of fossil fuel sales,[31] putting it at risk of losing a large proportion of its export revenue. Conversely, Australia is well positioned to supply the green commodities of the clean energy economy.

Australia's success in global green commodity markets will be defined by its ability to supply value-added products instead of simply exporting raw materials. This, in turn, presents a unique opportunity for Australia to reindustrialise by, for instance, onshoring value-added mineral processing.

Although building new industries from the ground up is undeniably a significant and capital-intensive undertaking, Australia has recently built new industries at this scale.

Australia has recent experience in building new export-oriented industries from scratch. The boom in iron ore and LNG exports over the past two decades prove Australia's ability to build new industries given the appropriate industrial direction and policy support.

To this end, Australian industrial development plans in transition sectors can and should be closely linked with Australia's national trade strategy. In Australia's case, industrial development plans should include export targets for value-added products such as green steel, aluminium, critical minerals and agriculture.

31 World Energy Data (2018) *Australia's fossil fuel exports*. https://www.worldenergydata.org/australias-fossil-fuel-exports/

Case Study: Critical Minerals Value Chain

Picking trade-enabled and adjacent opportunities will be critical in Australia.

Australia will not be able to match the scale of subsidies and investments for transition industries currently emerging in the US, EU and China. However, these subsidies and investments will create demand for materials and capital goods for which production capacity will be limited. In this context, Australia would be better focused on specific components of the battery value chain in which we have production advantages.

Existing trade relationships can support these industrial development priorities.

Australia's existing strong links in global commodities provide strong foundations to leverage the capital endowment of partners' funding packages. The IRA includes several provisions that require battery and EV manufacturers to source raw materials and components from suppliers in allied nations or those the US has a free trade agreement with. Australia's natural resource wealth in critical minerals and strong political alliance with the US puts it in a prime position to service the demand that will inevitably stem from the IRA.

Value capture should be a focus of industrial development in global supply chains.

The federal government is currently in the process of developing a National Battery Strategy. We would expect such a strategy to include a robust plan for Australia's position in the global battery value chain. Evidence from 2018 shows that in the lithium-ion battery value chain, Australia only captured 0.53% of the total value chain market value.[32] The extraction of raw materials only captures a small portion of the total market value, with a significant value add achieved in electro-chemical production (cathodes, anodes and electrolytes).[33]

A National Battery Strategy should include detailed direction on which elements of the value chain Australia will play in.

Australia is well endowed with lithium reserves, the primary input in electrolyte production. Large and high-grade reserves of nickel and manganese could also position cathode production as a viable value-added industry. We expect that the National Battery Strategy should include a detailed assessment of Australia's role in the battery value chain and give strong direction as to where the private sector should allocate capital.

Australia has an obvious value proposition in the global battery supply chain.

Many governments are pursuing the development of battery industries. Australia's competitive offering can include industrial hubs that co-locate mining and processing operations, electrify these processes with renewable electricity and operate them with best-in-class environmental and community standards. This is a unique value proposition compared to market competitors in this space, such as China and the Congo.

A clear industrial strategy will be needed to build a competitive position in a rapidly changing global industrial system.

The energy transition provides a rare opportunity for industrial resets, but these are likely to be more successful with a clear strategy. Fatih Birol, executive director of the International Energy Agency, recently stated that in a new industrial age of clean energy technology manufacturing, 'industrial strategies are essential to enable countries [to] leverage their strengths and address areas where they are less competitive'.[34] Australia should use the opportunity to equip the nation to trade in the major export markets of the future.

32 CSIRO, 2020. *State of Play—AUSTRALIA'S BATTERY INDUSTRIES*, s.l.: https://fbicrc.com.au/wp-content/uploads/2020/10/20-00191_MR_REPORT_FBICRC-StateOfPlayBattery_WEB_201002.pdf.

33 CSIRO, 2020. *State of Play—AUSTRALIA'S BATTERY INDUSTRIES*, s.l.: https://fbicrc.com.au/wp-content/uploads/2020/10/20-00191_MR_REPORT_FBICRC-StateOfPlayBattery_WEB_201002.pdf.

34 Birol, F., 2023. *We are entering a new industrial age of clean energy technology manufacturing.* [Online] Available at: https://www.linkedin.com/pulse/we-entering-new-industrial-age-clean-energy-technology-fatih-birol/

8. Appendix: Jurisdiction Review

8.1 California

California has a broad policy system to support decarbonisation and the development of new industries, including push, pull and enabling mechanisms.

As noted above, we chose to review California's policy settings instead of reviewing settings for the broader US economy. This is because California has been the site of particularly significant transition industry growth and funding and has a policy environment distinct from federal policy settings. California's policy mix is holistic, running across a range of key policy areas. It also mobilises climate action funding in a way that directly benefits communities. By providing tangible social benefits through its funding priorities, the government strengthens public buy-in for climate action and increases its political capital to increase ambition over time.

Push Factors

- **Durable Policy Settings**
  California has a long tradition of government leadership in setting environmental objectives.
  It was the first US state to pass climate legislation when the *Global Warming Solutions Act* was ratified in 2006, setting a target of an 80% reduction in GHG emissions from 1990 levels by 2050.[35] In 2018, the target was updated to achieving carbon neutrality 'as soon as possible, and no later than 2045'. The *California 100 Percent Clean Energy Act* also mandated that the state's electricity production be carbon free by 2045.[36]

- **Science-based Policymaking**
  There is a noticeable intention from policymakers across the board to ground policy in the best available science.
  A structured process of setting policy priorities for California falls out of the above legislation. California's Climate Change Assessments and the state's Indicators of Climate Change reports provide the scientific foundation for its policymaking. The Global Warming Solutions Act is intentionally short and succinct. As such, expert agencies are given broad authority to develop regulations and market mechanisms to meet the act's targets.

  The science-based approach to policymaking is also reflected in the capability of public institutions.
  The California Council on Science and Technology (CCST) was established to provide scientific advice on public policy issues to the governor, the legislature and other civic entities. Each year CCST embeds 15 PhD-level scientists and engineers as fellows in legislative and executive branch offices.[37] This provides integrated resources within the government for science-based policymaking.

- **Actively Targeting the Funding Environment for Early-stage R&D**
  Significant at-risk capital for early-stage research.
  The California Energy Commission's research, development and demonstration programs mobilise over US$200 million annually. CalSEED is one of several initiatives funded by the California Energy Commission EPIC program to advance energy innovation. CalSEED grants of up to US$600,000 are awarded to early-stage clean energy entrepreneurs.

35 California Air Resources Board, 2018. *AB 32 Global Warming Solutions Act of 2006*, s.l.: https://ww2.arb.ca.gov/resources/fact-sheets/ab-32-global-warming-solutions-act-2006.

36 California Energy Commission, n.d. *SB 100 Joint Agency Report*, s.l.: s.n.

37 Issues in Science and Technology, 2022. *States as Laboratories for Science Policy Innovation*, s.l.: https://issues.org/states-laboratories-science-policy-innovation-mace-bando/.

Providing resources for product testing and quality control.
The *California Testbed Initiative* allows start-ups to test their products at state-of-the-art experimental facilities, aiming to de-risk prototypes and accelerate them along the learning curve. The public–private partnership includes more than 60 testing facilities at nine University of California campuses and the Lawrence Berkeley National Laboratory.[38]

Maintaining funding touchpoints for promising technologies and projects.
The *Bridging Rapid Innovation Development to Green Energy (BRIDGE)* initiative employs a competitive process to allocate follow-on funding for the most promising technologies that previously received funding for early-stage development.[39] BRIDGE is a key support mechanism for start-ups to address the funding gap between stages of product development.

Supplying financial assistance for early-stage manufacturing.
The *Realizing Accelerated Manufacturing and Production Initiative* funds companies to transition prototype products to the initial, low-throughput production stage.[40] This low-rate production phase is the first step in moving from highly customised prototypes to high-volume manufactured products that can benefit from the associated economies of scale and movement down the learning curve.

Funding for demonstration and commercial scale projects.
Funding priorities actively target large-scale demonstration projects. The *Geothermal Grant and Loan Program*[41] has been essential in supporting the state's large up-front capital needs for geothermal projects. California's *Waste Heat and Carbon Emissions Reduction Act*[42] supports the development of new, efficient combined heat and power systems. The *Clean Transportation Program* allocates up to $100 million annually in a broad suite of transportation and fuel projects throughout the state.[43] Specifically, it provides financial support for in-state manufacturing of zero-emission vehicles and developing their related supply chains. The *Low-Carbon Fuel Production Program*[44] supports new and renewable ultra-low-carbon fuel production at a commercial scale.

- Within the state's *Cap and Trade Program*, the regulator sets emissions limitations and creates a market where high-emitting facilities and companies trade emissions allowances.
- The *Low-Carbon Fuel Standard* mandates fuel producers to sell lower emissions intensity products over time. This captures full value chain emissions for fuel production, from extraction to refining and end use.
- The *Automobile Emission Standards* introduced the first set of emissions efficiency standards for passenger vehicles sold in California.
- The *Green Building Standard* requires reduced energy consumption in buildings, including energy efficiency standards for new construction and retrofits for existing buildings.
- The 2010 *Energy Storage Law* requires electric utilities to install predetermined amounts of grid-scale energy storage.
- The *Electric Vehicle Charging Law* obligates local governments to develop streamlined ordinances and permitting processes for electric vehicle charging infrastructure.
- The *Sustainable Transportation Planning* legislation of 2008 set regional emission reduction targets for passenger vehicles and compelled agencies to assess and mitigate the impacts of personal vehicle travel arising from new developments.
- In 2017, the state's gasoline tax was raised by $0.12 per gallon, collecting over $5 billion annually to be redeployed to transportation infrastructure projects to reduce emissions.

Enabling Conditions

- **California Mobilises Climate Action Funding in a Way that Directly Benefits Communities and People**
  The state government has provided tangible social benefits through its climate policies.
  The *Transformative Climate Communities Program*[45] contributes grant funding to underserved communities to finance their own priorities, strategies and projects to reduce emissions at the local level. This decentralisation of policymaking provides a level of autonomy to localities to decide their own climate action priorities. It allows the state government to share the administrative burden with local governments. Moreover, the *Partners Advancing Climate Equity* (PACE)[46] program provides technical assistance and expert resources to support communities and their elected officials in pursuing climate action.

38 California Energy Commission, n.d. *CalSeed*, s.l.: https://calseed.fund/the-program/.
39 California Energy Commission, n.d. *CalSeed*, s.l.: https://calseed.fund/the-program/.
40 California Energy Commission, n.d. *CalSeed*, s.l.: https://calseed.fund/the-program/.
41 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.
42 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.
43 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.
44 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.
45 Berkeley Law, n.d. *California Climate Policy Dashboard*, s.l.: https://www.law.berkeley.edu/research/clee/research/climate/climate-policy-dashboard/.
46 American Progress, 2021. *Learning From California's Ambitious Climate Policy*, s.l.: americanprogress.org/article/learning-californias-ambitious-climate-policy/.

California also specifically directs revenues from policy mechanisms to community use.
The 2012 *Disadvantaged Community Benefits Act* requires a minimum of 25% of the proceeds from California's cap-and-trade program to be reinvested to benefit the most disadvantaged communities. Under the California Climate Investments program, the proceeds are allocated to projects that reduce emissions while also delivering economic, environmental and public health benefits, particularly for these target demographics. In 2020, US$6.3 billion in implemented projects were funded, and 55% of this funding—amounting to US$3.5 billion—benefited priority communities.[47]

- **Actively Connecting Innovators and Enabling Knowledge-Sharing**
  California utilises a number of entities and policy mechanisms to support knowledge management.
  CalSEED leverages four Regional Energy Innovation Clusters to support companies located throughout 21 counties in California to accelerate energy innovation. The *California Energy Innovation Ecosystem*[48] is a state-wide initiative of the California Energy Commission that connects clean energy entrepreneurs with the funding, training, resources and expertise they require. The *California Vehicle-Grid Integration Roadmap*[49] brings together the California ISO, CPUC, CARB and other stakeholders to integrate electric vehicle charging requirements with the power system's needs.

47 American Progress, 2021. *Learning From California's Ambitious Climate Policy*, s.l.: americanprogress.org/article/learning-californias-ambitious-climate-policy/.

48 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.

49 California Energy Commission, n.d. s.l.: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.

8.2 Denmark

Denmark's clean energy innovation is exemplified by the successful development of its globally leading wind power industry.

Denmark provides a compelling case for jurisdictions to go 'all-in' on a specific technology in which it has natural advantages. Our review considered the historical factors that have supported the successful development of wind technologies in Denmark.

Push Factors

- **Highly Ambitious National Targets with Broad and Sustained Political Support for a Low-Carbon Transition**
  Denmark has long-term legislated emissions targets combined with a system of rolling interim targets.
  The 2020 *Climate Act* sets a target to reduce Denmark's emissions by 70% by 2030 compared to 1990 levels and to achieve net zero by 2050.[50] The act also prescribes a rolling five-year emissions target, set 10 years in advance and a series of reporting obligations, including an annual parliamentary examination of the government's progress towards meeting the targets.

  Denmark's Energy Agreements allow policymakers to commit to difficult goals.
  Danish energy policy is underpinned by the Energy Agreements reached by political consensus between parties and revised approximately every five years. These agreements bind political parties to decisions that may prove challenging or unpopular, such as necessary structural reform or long-term certainty and planning (e.g., incentives for renewable energy deployment and transmission infrastructure). For example, the Energy Agreement sets out plans to phase out electricity production from coal by 2030.[51]

- **Public Investment Funds Target Early-stage Innovation and Demonstration**
  Like many of the other jurisdictions reviewed, Denmark has a series of public investment funds that specifically target early-stage innovation.
  The *Energy Technology, Development and Demonstration Programme* supports private companies, universities and research institutions to develop and demonstrate a broad range of low-carbon technologies.[52] The government has also adjusted the mission statement of the state-run Innovation Fund to ensure its investments have a clear environmental mandate. This positions the fund as the key actor in achieving the innovation and research goals of the Energy Agreement. Denmark's *Green Future Fund* is a public venture capital vehicle that boosts the development of green technology solutions in Denmark and deploys these internationally.[53]

  The government's financial support for the wind industry has been marked by its flexibility and long-term stability.
  The government ensured that its financial support for wind power R&D and turbine deployment was consistent and steady over time. It also adopted a flexible financial support package for deploying wind power that catered to the relative maturity of the technology. That support began with an investment subsidy, subsequently evolving into a production subsidy as the industry developed. This was complemented by a feed-in tariff, a network connection guarantee and a cost subsidy.[54]

Pull Factors

- **Denmark uses a carbon price in addition to the EU ETS to drive decarbonisation.**
  In 2022, Danish lawmakers introduced a new corporate carbon tax, which would be the highest in Europe. It will cover companies both within and outside of the EU ETS. The carbon levy will gradually increase to US$159 per tonne by 2030 for companies captured by the EU ETS. The levy will consist of the base price of emissions permits in the EU ETS supplemented by an additional fee to reach the US$159 price level.[55]

- **The government set long-term targets for the growth of its wind industry that the private sector was required to meet.**
  The Danish Government installed long-term targets for its wind industry and progressively ratcheted them over time. In 1981, Energiplan 81 was released by the Ministry of Energy. The plan aimed to deploy 60,000 small wind turbines by the turn of the millennium, equating to 8.5% of electricity production in the country.[56] In 1985, the government set a stretch goal for power companies to install 100 MW of wind power by the end of 1990.[57] In 1990, the updated Energiplan 2000 set an ambition of 1,500 MW of wind power by 2005. Six years later, Energiplan 21 restated the 1,500 MW goal, called for 4,000 MW offshore wind power by 2030, and mandated that 50% of Danish electricity be supplied by wind power in 2030.[58]

50 Grantham Research Institute on Climate Change and the Environment, 2020. *Climate Change Laws of the World*, s.l.: https://climate-laws.org/geographies/denmark/laws/the-climate-act.

51 OECD, 2019. *The Danish Energy Agreements towards a carbon-neutral society*, s.l.: https://www.oecd.org/climate-action/ipac/practices/the-danish-energy-agreements-towards-a-carbon-neutral-society-74d30bcf/.

52 IEA, 2017. *Energy Policies of IEA Countries—Denmark*, s.l.: https://iea.blob.core.windows.net/assets/1192d4c7-aa20-458a-b4cd-37a3d10efd0e/EnergyPoliciesofIEACountriesDenmark2017Review.pdf.

53 Danish Ministry of Higher Education and Science, 2020. *Green solutions of the future*, s.l.: https://ufm.dk/en/publications/2020/filer/green-solutions-of-the-future.

54 Kamp, L. M., Smits, R. & Andriesse, C. D., 2004. *Notions on learning applied to wind turbine development in the Netherlands and Denmark*, s.l.: s.n., and Buen, J., 2005. *Danish and Norwegian wind industry: The relationship between policy instruments, innovation and diffusion*, s.l.: s.n.

55 Reuters, 2022. *Denmark agrees corporate carbon tax*, s.l.: s.n.

56 Buen, J., 2005. *Danish and Norwegian wind industry: The relationship between policy instruments, innovation and diffusion*, s.l.: s.n.

57 Buen, J., 2005. *Danish and Norwegian wind industry: The relationship between policy instruments, innovation and diffusion*, s.l.: s.n.

58 Buen, J., 2005. *Danish and Norwegian wind industry: The relationship between policy instruments, innovation and diffusion*, s.l.: s.n.

- **Capturing international market share through quality control and reputation while securing public support through guarantees.**
  Denmark's support for the wind power export industry was designed with product quality at its core. Strong standard setting and quality control were administered through the publicly funded Riso Research Institute, and compliance was mandatory for companies to access export markets.[59]

  The Wind Turbine Guarantee Company was established to develop the Danish wind power export industry. Manufacturers' turbines were certified by a rigorous approval scheme administered by the Riso Research Institute to be eligible for the guarantees. This reputation for quality enabled Danish companies to sell 2,000 wind turbines to California in 1985 as the state introduced its investment subsidy. This export base enabled the Danish wind industry to scale and thereby descend down the cost curve.[60]

Enabling Conditions

- **Innovation Clusters**
  Denmark uses thematic clusters to coordinate and drive innovation in specific themes.
  Since 2021, the Ministry of Higher Education and Science and the Danish Board of Business Development have funded the development of 12 new national cluster organisations. The mandate of the innovation clusters is to navigate and coordinate the interactions between researchers and knowledge institutions, private actors and other relevant stakeholders.[61]

- **Learning by Interacting**
  The government coordinated between academia and industry to craft research and commercialisation goals in the wind industry.
  The Wind Power Programme—a development program for wind energy—was set up in the late 1970s.[62] The Riso Research Institute and the Technical University of Denmark were the main institutions tasked under the program with developing the knowledge needed to build large wind turbines.

  A key feature of the Danish Wind Power Programme was that turbine owners and off-takers were heavily involved in crafting the research aims of the program from the beginning. Shortly after the program was launched, turbine manufacturers' orders became the research centre's primary funding source. The deployment and commercialisation aspects of the R&D process became the research centre's primary focus. Consequently, a strong network developed between wind turbine producers, owners and the research centre, creating a dynamic and interactive innovation system. Coordination between knowledge supply and demand enabled the first wind turbines to be brought to market. The first turbine offtakes came from the Danish Wind Technology company, a joint venture between the Danish Ministry of Energy and the SEAS utility.[63]

59 Kamp, L. M., Smits, R. & Andriesse, C. D., 2004. *Notions on learning applied to wind turbine development in the Netherlands and Denmark*, s.l.: s.n.
60 Kamp, L. M., Smits, R. & Andriesse, C. D., 2004. *Notions on learning applied to wind turbine development in the Netherlands and Denmark*, s.l.: s.n.
61 Danish Ministry of Higher Education and Science, 2020. *Green solutions of the future*, s.l.: https://ufm.dk/en/publications/2020/filer/green-solutions-of-the-future.
62 Kamp, L. M., Smits, R. & Andriesse, C. D., 2004. *Notions on learning applied to wind turbine development in the Netherlands and Denmark*, s.l.: s.n.
63 Kamp, L. M., Smits, R. & Andriesse, C. D., 2004. *Notions on learning applied to wind turbine development in the Netherlands and Denmark*, s.l.: s.n.

8.3 Netherlands

The Netherlands policy system includes targeted policy encompassing push, pull and enabling mechanisms.

The Netherlands has a particularly strong technology funding environment. The Dutch system deploys an extensive and diverse array of financial support spanning various technology maturity levels, funding instruments and capital requirements. Policy instruments such as Invest-NL, a public venture capital fund, bring the discipline typically observed in capital markets to government research funding. Moreover, the funding schemes are designed to be complementary, each providing a project pipeline to the next.

Push Factors

- **Legislated Climate-related Targets in Place to Guide Policymaking**
  The Netherlands has long-term legislated targets in place.
  The 2019 *Climate Act* sets targets to reduce GHG emissions by 49% by 2030 and 95% by 2050 (versus 1990 levels).[64] Under the Climate Act, the government is compelled to release a Climate Plan every five years that guides climate policy over a 10-year period.

  The 2019 Climate Agreement is at the core of the Dutch policy framework.
  The Climate Agreement includes extensive innovation provisions. For example, a core building block of the Climate Agreement was the founding of an Innovation Task Force, which constituted public servants, research institutes and private entities and was created to develop a new RD&D policy framework. The IKIA (Topsector Energy, n.d.) has constructed 13 MMIPs that focus research on driving emissions reductions across all sectors.

- **Funding Solutions Across the Capital Stack**
  Public funding solutions address a range of different capital requirements.
  The Dutch Government has an array of instruments in place to support early-stage innovation in the form of debt, equity and grant funding, as well as tax relief. These funding instruments aim to leverage large private sector investments to support climate tech companies and innovation.

Venture Capital
The public investment fund *Invest-NL* supports innovative, low-carbon technologies with higher risk profiles, intending to crowd-in private capital in subsequent funding rounds. Significantly, the government's strong involvement and track record in at-risk capital markets has resulted in half of all venture capital invested in the Netherlands being related to a government entity.[65] Invest-NL employs bottom-up capital market practices to build an investible innovation pipeline and complements top-down, sector-focused decarbonisation strategies.

SME Funding
The *SEED Capital Scheme*, a joint venture between private lenders and the government, administers several funds that grant low-interest loans to energy start-ups.[66] Alongside this, the *Small Business Innovation Research Programme* provides competitively allocated funding for feasibility studies by small businesses. Conditional on the study results, subsequent funding is provided for applicants to develop their products or services.[67] In addition to the above, the *Incentive Scheme for SMEs* encourages innovation by SMEs in various sectors, including energy RD&D. A range of activities are eligible for funding, such as feasibility studies and RD&D collaborations.[68]

Tax Measures
The *Research and Development Promotion Act* provides tax breaks to companies for RD&D-related expenses, including capital and labour expenses. The total budget for tax breaks under the act is €1.4 billion for 2023; however, there are measures in place for this budget to be increased.[69]

Demonstration Projects
The DEI+ allocates funding to demonstration-stage projects. The grants can make up 45% of project costs, with an upper limit of €15 million per project.[70]

The different funding schemes are interlinked, not separate and siloed.
The Stimulation of Sustainable Energy Production (SDE+) and the SDE++ schemes support projects in the demonstration or commercialisation phases. The Renewable Energy Scheme (HER) provides earlier-stage grant funding covering technologies eligible for SDE+ and SDE++, providing a pipeline of projects for those incentive schemes.[71]

64 Government of the Netherlands, 2019. s.l.: https://www.government.nl/topics/climate-change/climate-policy#:~:text=To%20combat%20climate%20change%2C%20the,Act%20on%20May%2028%2C%202019.

65 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

66 Government of the Netherlands, n.d. s.l.: https://business.gov.nl/subsidy/seed-capital-scheme/#:~:text=This%20scheme%20consists%20of%20financial,to%20the%20funds%20for%20startups.

67 Government of the Netherlands, n.d. s.l.: https://business.gov.nl/subsidy/small-business-innovation-research/.

68 Government of the Netherlands, n.d. s.l.: https://business.gov.nl/subsidy/incentive-scheme-learning-and-development-within-smes-slim-subsidy/.

69 Netherlands Enterprise Agency, n.d. s.l.: https://english.rvo.nl/subsidies-programmes/wbso.

70 Government of the Netherlands, n.d. s.l.: https://business.gov.nl/subsidy/demonstration-energy-innovation-dei-subsidy/.

71 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

- **Stimulating Collaboration Across Commercial Entities through Financial Incentives**
  The Netherlands provides targeted funding for R&D collaborations between public and private actors.
  The *Public Private Partnership (PPP) Allowance* funds PPPs focused on research and innovation. To qualify, at least one private entity within the partnership must fund the R&D activities of at least one research institution. Contingent on several factors, €0.25 to €0.4 of public money is contributed for every €1 of private funding.[72] Alongside this, the *Mission-driven Research, Development, and Innovation Scheme* sponsors consortia of companies in the offshore wind, renewable electricity, the built environment and industry sectors. The funding is contingent on the project being led by a partnership of at least three companies.

  The Dutch Government also provides coordination and collaboration support for public–private partnerships.
  The *Knowledge and Innovation Covenant* is a collaboration instrument that assists entities in forming partnerships and administers the funding of R&D projects.[73] It aims to stimulate public–private coordination on specific innovation priorities identified by government policy, with themes including energy transition and sustainability, as well as agriculture, water and food.

  Finally, the Netherlands uses public funds to support specific industrial research via the nation's applied research institution.
  TNO, the Dutch organisation for applied scientific research, is an independent research, development and consultancy organisation with over 3,000 employees and annual revenue of more than €500 million. TNO's mission is to aid the Dutch industry, SMEs and government in technology innovation by providing services and transferring knowledge and expertise.[74]

Pull Factors

- **Clean Energy Subsidies**
  The Netherlands utilises generous subsidy schemes to improve the bankability of late-stage energy projects.
  The *Stimulation of the SDE+* scheme applies a competitive bidding process to fund the subsidised operation of renewable energy projects. From 2011 to 2020, SDE+ allocated €60 billion of these subsidies, which can last up to 15 years depending on the amount of renewable energy generated. In 2020, SDE+ was expanded into the SDE++, which uses a similar auction to award subsidies to a larger subset of low-carbon technologies.[75]

- **Reinforcing Transition Priorities through Taxation and Fiscal Policy**
  The Netherlands employs emissions reduction levies in a number of forms.
  A carbon levy was introduced in 2021. The levy is applied to emissions above a specified threshold. To protect the international competitiveness of domestic industries, the government balances the cost of the levy with financial support from SDE++.[76] Moreover, the Netherlands has a wide-ranging gas, electricity and district heating energy tax. Consumers also pay a surcharge for the *Sustainable Energy Act levy* (ODE) and the energy tax, the proceeds of which are redirected to emissions reduction projects.[77]

  The Netherlands also uses fiscal policy to reinforce transition priorities.
  The country's strong intent to transition from reliance on natural gas is reflected in its fiscal policy. The taxation of natural gas use will increase by up to 43% by 2026 from 2019 levels, which will be complemented by the lowering of taxes on electricity.[78] Moreover, the government is looking to shift some of the financial burden arising from the energy tax burden of households to businesses. These measures are part of a larger review by the government of fiscal policy and its ability to support the energy transition.

72 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

73 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

74 TNO, n.d. s.l.: https://www.tno.nl/en/.

75 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

76 European Commission, 2021. *Ensuring that polluters pay—The Netherlands*, s.l.: https://environment.ec.europa.eu/system/files/2021-10/The%20Netherlands.pdf.

77 Government of the Netherlands, n.d. s.l.: https://business.gov.nl/regulation/energy-tax/#:~:text=Agency%20(RVO).-,Sustainable%20energy%20surcharge,kWh%20electricity%20or%20m3%20gas.

78 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

- **Driving Demand for Alternatives Via Planning Policy**
  The Netherlands has mandated that developers cease to utilise the gas distribution network.
  The government is assisting the transition of 1.5 million homes to low-carbon heating by 2030 through the *Natural Gas-Free Districts Programme*.[79] This included amending existing legislation that forced all new developments to be connected to the gas network to prohibit new gas connections instead. This change was complemented by other programs to reduce gas demand through energy efficiency measures and the installation of renewables.

Enabling Conditions

- **Funding Local Government Responses to Climate Change**
  The Netherlands' central government supports and funds local government-level responses via the *Regional Energy Strategies* initiative.
  Local governments are collaborating with electricity networks, private entities and social organisations to deploy renewables at scale by resolving costs, planning, permitting and public buy-in barriers. The central government provides technical and financial support for the development and execution of these strategies.[80]

- **Driving Demand-side Response (DSR)**
  The Netherlands has also focused extensively on establishing DSR in the power system.
  The new *Energy Law* of 2022 focuses on DSR, energy services and aggregators and other initiatives to improve the flexibility and efficiency of energy systems and markets. This includes the development of a market for energy management services. In 2018, 1 million households had installed systems to manage their electricity consumption. The Netherlands set a goal of 80% of households installing a smart metre by the end of 2020. The government also has measures to support infrastructure development for EV charging and hydrogen fuelling stations.[81]

79 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

80 Regionale Energie Strategie, n.d. s.l.: https://www.regionale-energiestrategie.nl/english/default.aspx.

81 IEA, 2020. *The Netherlands 2020—Energy Policy Review*, s.l.: https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf.

8.4 South Korea

South Korea has a long history of targeted industrial policy focused on major companies.

This policy was designed to accelerate the growth of specific industries that had the potential to underpin the country's economic development. As a result, innovation in South Korea has largely been driven by its large industrial conglomerates (referred to in the country as 'chaebols'), which historically received significant support from the government. This included tax breaks and low-interest finance to support the country's transition from an agricultural economy to an industrialised, export-oriented economy.

A green growth policy drive has utilised a mix of push and pull mechanisms.

Enabling 'green growth' has increasingly become a focus area for the government over the past decade. Government policy to accelerate innovation in the climate space is focused on a number of key areas,[82] including:

- setting clear long-term targets and priorities for decarbonisation-related RD&D in a transparent and coordinated manner
- subsidies and investment in enabling infrastructure to support the widespread deployment of clean energy technologies, particularly hydrogen
- playing a strong coordinating role in fostering connectivity and collaboration between government, corporates and researchers to support the commercialisation of R&D
- supporting the development of human capital and capabilities in key industries through training programs and incentives for firms to attract and retain talented employees.

Push Factors

- **South Korea has well-defined frameworks for defining R&D priorities and signalling how these fit within the government's broader energy and climate strategy.**
  Policymaking in this context is underpinned by the government's target of achieving carbon neutrality by 2050, enshrined in law through the *Framework Act on Carbon Neutrality and Green Growth*. The government has also committed to reducing emissions by 40% by 2030 (from 2017 levels).

- **A number of coordinated policy frameworks and mechanisms support these commitments.**
  The government's Energy Master Plan is an overarching strategy that covers all energy technologies and seeks to coordinate energy-related development at a macro level. The plan aims to provide a mid- to long-term energy policy vision and sets a range of targets to be met. In 2019, the government presented the 3rd Energy Master Plan, which indicates a shift of focus towards larger scale R&D and demonstration projects.[83]

- **Technology development plans are a key pillar of clean technology development support.**
  The Ministry of Trade, Industry and Energy prepares an Energy Technology Development Plan (ETDP) every five years as a statutory requirement. The ETDPs serve as the primary policy framework for energy technology development and set out the government's R&D investment strategy for the next 10-year period. The 4th ETDP was finalised in 2019.[84]

Pull Factors

- **Stable Industrial Policy—a Long-running Feature**
  More broadly, long-term planning and policy stability have been consistent features of South Korean politics, both with respect to decarbonisation and industrial policy.
  For over three decades (1962–1996), the South Korean Government instituted targeted five-year plans designed to support growth in key industries. These plans provided a stable political environment and facilitated methodical long-term economic planning, with each five-year plan building on the success and outcomes of the previous one. This enabled the country to pursue a coordinated transition from a reliance on labour-intensive industries like agriculture and textiles to capital-intensive industries like petrochemicals and shipbuilding and finally to technology-intensive industries like electronics and precision machinery.

  The South Korean Government has consistently provided signals to the market over the past decade that it embraces green growth.
  After the 2008 financial crisis, the government issued a stimulus package earmarking 80% of the investment for green growth projects.[85] In 2009, the government set mid- and long-term emissions reduction targets, introduced a carbon tax, and introduced a new five-year plan committing 2% of GDP to decarbonise the economy. In 2020, the government introduced the New Deal as a package of policies to stimulate economic recovery in response to the COVID-19 pandemic[86]
  The 'green' component of the New Deal sets out eight targets under three strategic areas: green urban development, low-carbon decentralised energy and innovative green industry. The government will spend US$61.9 billion on expanding renewable energy, smart grids, electric vehicles and hydrogen projects.

  The Korean ETS was launched in 2015.
  It covers ~73% of national GHG emissions and nearly 700 companies from 23 sub-sectors of the steel, cement, petrochemical, refinery, power, construction, waste and aviation sectors.[87]

82 IEA, 2020. *Korea 2020: Energy Policy Review*, s.l.: s.n.

83 Government of the Republic of Korea. Ministry of Trade, I. a. E., 2020. *Third Energy Master Plan: A New Energy Paradigm for the Future*, s.l.:

84 Ministry of Trade, I. a. E., 2019. *4th Energy Technology Development Plan*, s.l.: Government of the Republic of Korea.

85 World Bank, W., 2012. *Korea's Global Commitment to Green Growth*. [Online] Available at: https://www.worldbank.org/en/news/feature/2012/05/09/Korea-s-Global-Commitment-to-Green-Growth.

86 Government of the Republic of Korea, 2020. *Korean New Deal: National Strategy for a Great Transformation*, s.l.: s.n.

87 International Carbon Action Partnership, 2023. *Korea Emissions Trading Scheme*. [Online] Available at: https://icapcarbonaction.com/en/ets/korea-emissions-trading-scheme.

- **Market Development—A Key Focus of South Korean Policy**
  The South Korean Government utilises various policy levers to support market development for clean energy products and services.
  The RPS is one example, which requires major electric utilities to increase the renewable energy share in their electricity mix to 10% by 2023.[88] The revised Renewable Energy Act, passed in March 2021, raised the threshold to 25% by 2034.[89]

  South Korea is presently focused on hydrogen development, with a specific technology development framework in place for hydrogen.
  The government is planning for hydrogen to be a key pillar of the country's transition to net zero. Supporting technology RD&D is an important element of the government's hydrogen strategy. The Hydrogen Law, which went into effect in 2021, sets out several important industrial strategy policies, including developing a clean hydrogen certification system, establishing a hydrogen power generation bidding market and supporting hydrogen-focused companies through R&D subsidies.[90]

  Push policies also include the development of the market for hydrogen fuel cell cars and the hydrogen-based industry.
  To support its ambitious targets for hydrogen fuel cell electric vehicles, the government provides a subsidy of about 50% of the purchase price of a hydrogen passenger vehicle and up to 50% of the installation cost of refuelling stations. According to the Ministry of Environment, 16,920 hydrogen-powered vehicles (16,000 passenger cars, 700 buses and 220 cargo and garbage trucks) will receive government subsidies in 2023.[91] The government is also investing US$25 million to transform three cities into 'hydrogen cities', which will be test beds for technologies that enable hydrogen to be used as a major fuel for urban functions such as cooling, heating, electricity and transportation.

  Infrastructure investment is a key component of the government's hydrogen strategy.
  The Hydrogen Energy Network (HyNet) was established in 2019 with an initial investment of US$119 million to expand the hydrogen refuelling station fleet from about two dozen in 2019 to 310 by 2022 and 1,200 by 2040. The government also supports the construction of a 200 km hydrogen pipeline and associated hydrogen-receiving infrastructure as part of a national supply network, including providing funding and establishing a legal framework for constructing and operating hydrogen distribution infrastructure.

- **Public Procurement as a Mechanism for Demand Creation**
  Korea's green public procurement (GPP) policy is globally recognised as a best practice example.
  The policy requires all government agencies, from central to local governments, public corporations and public education institutions, to submit an annual GPP implementation plan. In doing so, each organisation sets its own voluntary target and prepares a performance report on the number of green products purchased. All public institutions' total expenditure on green products increased from US$759 million in 2006 to US$2.9 billion in 2017. The percentage of green product procurement over the total expenditure was 47.5%.[92]

Enabling Conditions

- **The South Korean Government plays a strong coordinating role in the domestic innovation ecosystem.**
  South Korea's 'top-down' planning for industrial, energy and R&D policy has facilitated strong ties between government, academia and industry that helps facilitate the conversion of RD&D outcomes into innovation and new business models. The government also established a dedicated department in 2017 to consolidate its practices in this area. The Ministry of SMEs and Start-ups systematically oversees various start-up support schemes to drive South Korea's momentum as an innovation hub.

- **The government also actively pursues measures to reduce administrative burdens for industry.**
  Avoidance of unnecessary red tape is a priority. The 'SME Regulation Impact Assessment' detects regulations that affect new industries and systematically identifies and resolves unreasonable regulations and other difficulties that interfere with SMEs and micro-enterprises. Finally, the South Korean Government has a history of transparent consultation with industry on policy and strategy development, as evidenced by its close engagement with the private sector in implementing its national hydrogen strategy.

88 IEA, 2020. *Korea 2020: Energy Policy Review*, s.l.: s.n.

89 Government of the Republic of Korea, 2021. *Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy*. s.l.: s.n.

90 Government of the Republic of Korea. 2020. *Hydrogen Economy Promotion and Hydrogen Safety Management Act*.

91 Government of the Republic of Korea. Ministry of Environment 2023. *Environment Ministry to increase the supply of hydrogen-powered vehicles, together with local governments*. [Online] Available at: https://m.me.go.kr/eng/web/board/read.do?menuId=461&boardMasterId=522&boardId=157819.

92 UNEP, 2019. *Green Public Procurement in the Republic of Korea: A Decade of Progress and Lessons Learned*, s.l.: s.n.

8.5 Germany

Germany's policy environment is characterised by a durable bipartisan policy.

For several decades, stability and consensus-building have been key features of German environmental policy. Subsidies for adopting emerging technologies have historically been a key driver of innovation in Germany and continue to be a pillar of the government's climate strategy (with a strong focus on hydrogen and other industrial decarbonisation solutions).

Germany has strong mechanisms to support innovation and emerging companies.

The German Government has adopted various programs to help overcome barriers to accessing finance for SMEs and innovation activities. The focus on supporting start-up activities in this space appears to be paying dividends. An estimated 30% of German start-ups can be classified as 'green'.[93] Green start-ups also account for most start-ups in five sectors: agriculture, energy, textiles, consumer goods and food and nutrition.[94] Germany also strongly focuses on demonstration projects and initiatives to enable the application of emerging technologies at an industrial scale. This is illustrated by the fact that Germany has the most hydrogen demonstration projects of any country, according to IEA data.[95]

Push Factors

- **Binding Targets Supported by Long-term Plans**
  The stability of environmental policy in Germany has historically provided strong investment signals.
  German climate change policies started to be developed around 1987 and have included consistent goal setting for emissions reductions, deployment of renewable energy, energy efficiency standards, market-based approaches to climate action and voluntary agreements with industry.

  Germany has strong mechanisms for codifying innovation-related objectives within broader climate strategy frameworks.
  Germany's *Climate Action Law* sets out legally binding medium and long-term emissions reduction targets. The government is targeting emissions reductions of at least 65% by 2030 and 88% by 2040 (both from 1990 levels) and net zero by 2045. The government's Climate Action Plan 2050 sets out its strategy for achieving these commitments.[96] The plan is underpinned by several sectoral programs and will be updated every five years.

  Germany also has a national research plan which specifies decarbonisation innovation priorities.
  The Energy Research Programme (ERP) is the primary instrument guiding the federal government's strategy for adopting new initiatives and defining priorities for research funding and innovation policy in the energy sector.[97] The first ERP was published in 1977, while the 7th and most recent was published in 2018. The government shifted strategic direction under the 7th ERP to focus more on technology and innovation transfer. The ERP follows a dual strategy for funding instruments. One-third of the budget is directed towards institutional funding of the HGF, Germany's largest scientific organisation, focusing on long-term research objectives. The other two-thirds are being directed to competitively funded projects with shorter term objectives.

- **Supporting Demonstration Projects**
  Germany provides funding support for demonstration projects through a range of programs.
  For example, the first call for the 'living labs' introduced under the 7th ERP is focused on hydrogen technologies and will be supported by €100M/yr in government funding.[98] The living labs allow testing innovative technologies in practical applications under real conditions and on an industrial scale.

  Germany uses national research projects to support the development of energy transition technology.
  The Kopernikus projects make up one of the largest research initiatives in Germany in the field of energy transition. The four projects are designed to enable economists, scientists and civil society to work in close cooperation to develop climate solutions to the point of market maturity in three phases spread over 10 years. They focus on:
  - developing the power grid of the future
  - conversion of CO_2, water, and electricity from renewable sources into gases, fuels, chemicals and plastics
  - how energy-intensive industrial processes can be made more flexible to adapt them to the availability of renewable energy sources
  - analysis of scientific and social policy measures from individual sectors to the whole of society.

  The government allocated up to €120M for initial three-year funding of the projects starting in 2016, followed by another €280M in 2025.[99]

93 Borderstep Institute, 2021. *Green Startup Monitor*.

94 Borderstep Institute, 2021. *Green Startup Monitor*.

95 IEA, 2022. *Hydrogen Projects Database*, s.l.: https://www.iea.org/data-and-statistics/data-product/hydrogen-projects-database.

96 Federal Republic of Germany Government, Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), 2016. *Climate Action Plan 2050: Principles and goals of the Germany government's climate policy*, s.l.: s.n.

97 Federal Republic of Germany Government, (2018). Ministry for Economic Affairs and Climate Action *7th Energy Research Programme of the Federal Government*, s.l.: s.n.

98 Federal Republic of Germany Government, (2018). Ministry for Economic Affairs and Climate Action *7th Energy Research Programme of the Federal Government*, s.l.: s.n.

99 Federal Republic of Germany Government, Federal Ministry of Education and Research *Kopernikus Projects*. [Online] Available at: https://www.kopernikus-projekte.de/en/projects

- **Unlocking Capital**
  Mobilising private sector capital and enabling access to finance are key focus areas for government policy.
  Policy initiatives developed by the government to support these objectives include:
  - INVEST is a grant program supporting business angels to invest more VC in innovative start-ups and young firms. INVEST offers investors a tax-free grant of 20% of the capital invested in the company.[100]
  - The government's Coparian fund provides funding for innovative companies at the same commercial terms as the private sector lead investor, doubling the available capital and making it an important player in the German VC market. Coparian has €275M in AUM.[101]
  - The ERP Digitisation and Innovation Programme enables companies, sole traders and freelancers to access finance for projects in Germany at attractive interest rates.[102] Loans under the ERP Digitisation and Innovation Programme can cover up to 100% of eligible costs, up to a maximum of €5 million per project. However, projects linked to the German energy reforms for the development of technologies that render energy generation, storage, and transmission more efficient are offered special support and can access loans of up to €25 million. A grant is offered in addition to the loan. There are two parts of the program that companies can apply for separately.
  - Part I is about funding close-to-market research and developing new products, processes and services in Germany.
  - Part II is about supporting the launch of new products, processes and services in Germany.

  The German Government seeks to make R&D services accessible to companies whose own resources or location may limit R&D activity.
  The Innovation Competence program has established non-profit-making external industrial research facilities to provide R&D services for industry. These services focus on companies in regions identified as structurally weak, which tend not to house large companies with research departments that can serve as crystallisation points for the innovative activities of SMEs.

Pull Factors

- **Emissions constraints beyond the EU ETS**
  Germany launched its National ETS for heating and transport fuels in 2021.
  This measure complements the EU ETS. Due to GHG emissions from the country's energy, industry and domestic aviation sectors being already covered by the EU ETS, the introduction of the national ETS leads to most major sectors in Germany facing a CO_2 price from 2021 onwards.

- **Subsidies Driving Demand**
  The German Government has a history of offering generous subsidies for clean energy technologies.
  Such subsidies have been a key lever enabling technological innovation and cost reductions and have impacted RD&D outcomes globally. For example, Germany was one of the first countries in the world to introduce feed-in tariffs for renewable energy, which were highly effective at fostering the deployment and development of solar PV and wind energy technologies over the past three decades. Research suggests that the domestic feed-in tariff offered since 1991 has been a significant driver of wind power development in Germany, with a €1-cent/kWh increase in the feed-in tariff increasing additions to installed wind capacity at the national level by an average of around 796 MW per year from 1996 to 2010 and 905 MW per year from 2000 to 2010.[103]

- **Direct Financing and Financial Incentives**
  Germany continues its tradition of subsidisation, financial incentives and investment in enabling infrastructure.
  This includes the adoption of innovative policy instruments like Carbon Contracts for Difference, which will help subsidise and de-risk investment in CO_2 reduction technologies by industrial companies in Germany.

  Direct investment is also used extensively by the German Government.
  In May 2021, the German Government announced investing US$10 billion across 62 hydrogen projects.[104] The German Government has also announced several tranches of investment in developing decarbonisation-related infrastructure, including 1,700km of hydrogen pipelines and constructing electric vehicle charging stations.[105]

100 Federal Republic of Germany Government, Federal Ministry for Economic Affairs and Climate (2023). *Financing for start-ups, company growth, and innovations.* Available at: https://www.bmwk.de/Redaktion/EN/Dossier/financing-for-start-ups-company-growth-and-innovations.html.

101 Federal Republic of Germany Government, Federal Ministry for Economic Affairs and Climate (2023). *Financing for start-ups, company growth, and innovations.* Available at: https://www.bmwk.de/Redaktion/EN/Dossier/financing-for-start-ups-company-growth-and-innovations.html.

102 Federal Republic of Germany Government, Federal Ministry for Economic Affairs and Climate (2023). *Financing for start-ups, company growth, and innovations.* Available at: https://www.bmwk.de/Redaktion/EN/Dossier/financing-for-start-ups-company-growth-and-innovations.html.

103 Claudia Hitaj, A. L., (2019). The impact of a feed-in tariff on wind power development in Germany. *Resource and Energy Economics*, Volume 57, pp. 18–35.

104 Federal Republic of Germany Government, (2021). Federal Ministry for Economic Affairs and Energy, *Report of the Federal Government on the implementation of the National Hydrogen Strategy*, s.l.: s.n.

105 Federal Republic of Germany Government, (2021). Federal Ministry for Economic Affairs and Energy, *Report of the Federal Government on the implementation of the National Hydrogen Strategy*, s.l.: s.n.

Enabling Conditions

- **There are various mechanisms to support the private sector in commercialising innovative technologies.** Similarly to South Korea, Germany established a dedicated government agency in 2020 to translate ground-breaking innovations into German products and jobs—the Federal Agency for Disruptive Innovation. The government has also established regulatory sandboxes that allow for the testing of innovative technologies in both action and interaction with one another, doing this on an industrial scale in real-life conditions.
- **Finally, Germany has a long tradition of strong integration between corporate decision-making and community needs.** There is a strong trend towards consensus-seeking and consultation in environmental policymaking in Germany, particularly with major employers and unions. This has encouraged a decision-making process that promotes public and private sector collaboration and has proved effective in informing policy design.

Contact

+61 2 8974 1160
secretariat@igcc.org.au

igcc.org.au
twitter.com/igcc_update
linkedin.com/company/investor-group-on-climate-change-igcc

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