Australia's National
Science Agency

Northern Territory Low Emissions Carbon Capture Storage and Utilisation Hub

Policy and Legislation Settings - Task 10 Report

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Foreword

Transitioning the global energy system while rapidly reducing emissions to net zero by 2050 is a vast and complex global challenge.

Modelling of a range of emissions pathways and decarbonisation scenarios from the Intergovernmental Panel on Climate Change (IPCC, 2023), International Energy Agency (IEA, 2024a) and Net Zero Australia (NZA, 2024) shows that to meet net zero greenhouse gas emissions targets by 2050, a wide range of emissions reduction technologies will be required to decarbonise existing and future industries globally.

These organisations identify that emissions elimination from hard-to-abate and high-emissions industries will require the use of carbon capture and storage (CCS) alongside other abatement strategies, such as electrification, underpinned by power generation from renewable energy sources such as photovoltaics and wind.

Globally, there is considerable effort being undertaken to identify industrial hubs and clusters where common user infrastructure can enable rapid decarbonisation of existing industries and enable future low-emissions industrial development.

Australia has an opportunity to create new low-carbon growth industries and jobs in these areas, but lacks the infrastructure, skills base and business models to realise these opportunities. The transition to net zero will have greater impact on regional communities, particularly those reliant on industries in transition, but it may also create economic opportunities through a wide range of new industries and jobs suited to regional areas.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is working to identify decarbonisation and transition pathways for existing and potential future industries that may be established in the Northern Territory by developing a Low Emissions Hub concept in the Darwin region.

CSIRO has established a portfolio of projects to explore and evaluate a range of emissions reduction and emerging transition technologies and approaches. This includes research into the Northern Territory's renewable energy potential, hydrogen demand generation and storage, and carbon capture utilisation and storage (CCUS). CSIRO is working collaboratively with industry and government to understand their needs, drivers and strategic directions so that our research is informed and relevant. This includes establishing appropriate pathways and partnerships to understand and incorporate the perspectives of First Nations peoples.

A key activity is the research into a business case project (CSIRO, 2025) that aims to enhance understanding of the viability of a CCUS hub centred on the Middle Arm of the Darwin Harbour.

The work has three elements comprising 15 tasks:

1. analysing macroeconomic drivers, Northern Territory and regional emissions, low-emissions product markets (Ross et al., 2023), identifying key learnings from other low-emissions hubs being developed globally, and cross-sector coupling opportunities (Tasks 0–5)

2. completing CCUS hub technical definition and technical risk reduction studies, including detailed studies on the infrastructure requirements for a CCUS hub, renewable power requirements for existing and potential future industries, and road-mapping for CO_2 utilisation industries that could be established to produce low or net zero products (e.g. zero-emission chemical feedstocks)(CSIRO, 2023a) (Tasks 6–9)
3. creating a business case to appreciate the scale of investment required to develop a Low Emissions Hub and the economic returns from doing so. This will lead to suggested business models and routes of execution (Tasks 10–14).

The CCUS business case project will involve research that is based on possible industrial development scenarios, models of future potential emissions, market demand, enabling technologies and costs. The project is intended to provide an understanding of possible future outcomes. Industry development will be determined by individual industry proponent investment decisions, government policies and regulation, and the development trajectories of technologies essential to the energy and emissions transition.

On completion of this research, outcomes of the CCUS business case project will be made publicly available.

This report presents the findings from Tasks 10 and 11 of the Northern Territory CCUS Business Case Project. It reviews CCUS and hydrogen policies in Australia and selected international jurisdictions. While not exhaustive, the focus is on identifying policy gaps that may hinder the development of the Northern Territory CCUS hub.

In addition to highlighting these gaps, the report showcases examples of best practice, drawn from both Commonwealth and state-level policies. The review also includes an assessment of international CCUS and hydrogen policy frameworks, with particular attention to potential barriers to the transnational shipment of liquid CO_2 and low-carbon fuels between Australia and its existing trade partners.

The findings of this report can inform future policy discussions aimed at ensuring the long-term success of the Northern Territory CCUS hub. They highlight the types of policies needed not only to meet Australia's domestic decarbonisation goals, but also to support the climate ambitions of its international trade partners.

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Abbreviations

$, A$	Australian dollar
£	Great British pound
ACCU	Australian Carbon Credit Unit
ACT	Australian Capital Territory
AEA	Australia's Economic Accelerator
AI	Artificial intelligence
ARENA	Australian Renewable Energy Agency
ATO	Australian Taxation Office
BECCS	Bioenergy with carbon capture and storage
BCX	Bursa Carbon Exchange
CCfD	Carbon contract for difference
CfD	Contract for difference
CCA	Climate Change Authority
CCER	China Certified Emission Reduction Scheme
CCS	Carbon capture and storage
CCUS	Carbon capture, utilisation and storage
CCU	Carbon capture utilisation
CEF	Connecting Europe Facility
CEFC	Clean Energy Finance Corporation
CER	Clean Energy Regulator
CERF	Carbon Reduction Facility – China
CO_2	Carbon dioxide
$CO_{2\text{-}e}$	Carbon dioxide equivalent
CO2CRC	CO2CRC Limited
CSF	Carbon Storage Taskforce
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTSCo	Carbon Transport and Storage Corporation
DAC	Direct air capture
DACCS	Direct Air Capture with Carbon Storage
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DLPE	Department of Lands, Planning and Environment – Northern Territory
DME	Department of Mining and Energy
DITT	Department of Industry, Tourism and Trade – Northern Territory
EEA	European Economic Area
EP Act	*Environment Protection Act 2019* (*NT*)

EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (*Cth*)
ETS	Emissions trading scheme
EU	European Union
EUR	Euro
EV	Electric Vehicle
FEEBATE	A feebate program is a self-financing system of fees and rebates that are used to shift the costs of options in the market
FID	Final investment decision
FMA Act	*Future Made in Australia Act 2024* (*Cth*)
GBE	Government business enterprise
GCCSI	Global Carbon Capture and Storage Institute
GO	Guarantee of origin
GW	Gigawatt
H_2	Hydrogen
IAS	Incidental associated substance
IDR	Indonesian Rupiah
IIP	Infrastructure Investment Program
IP	Intellectual Property
ISO	International Organisation for Standardisation
JOGMEC	Japan Organization for Metals and Energy Security
kg	Kilogram
km	Kilometre
LCO2	Liquid CO_2
LEH	Low Emissions Hub
LNG	Liquefied natural gas
m	Million
MASDP	Middle Arm Sustainable Development Precinct
MEROLA Act	*Mineral and Energy Resources and Other Legislation Amendment Act 2024* (*Qld*)
METI	Ministry of Economy, Trade and Industry
Mt	Million tonnes
Mtpa	Million tonnes per annum
NAIF	Northern Australia Infrastructure Facility
NAL	National Action List
NBN	National Broadband Network
NDC	Nationally Determined Contribution
NECPs	National Energy and Climate Plans
NEDO	New Energy and Industrial Technology Development Organisation – Japan
NGER Act	*National Greenhouse and Energy Reporting 2007 Act* (*Cth*)
NOPTA	National Offshore Petroleum Titles Administrator

NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NPI	National Pollutant Inventory
NRFC	National Reconstruction Fund Corporation
NSW	New South Wales
NT	Northern Territory
NT EPA	NT Environment Protection Authority
NTG	Northern Territory Government
NT LEH	Northern Territory Low Emissions Hub
NZEA	Net Zero Economy Authority
NZIA	Net Zero Industry Act – Europe
ONEP	Office of Natural Resources and Environmental Policy and Planning – Thailand
OPPGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006* (*Cth*)
PBoC	Peoples Bank of China
PCIs	Projects of Common Interest
PGPA Act	*Public Service Act 1999* (*Cth*)
PIC	Public infrastructure and construction
PMI	Project of Mutual Interest
PRF	Powering the Regions Fund
Qld	Queensland
RET	Renewable Energy Target
R&D	Research and development
RD&D	Research, Development, and Demonstration
S$	Singapore dollar
SA	South Australia
SMC	Safeguard Mechanism Credits
STEM	Science, technology, engineering, maths
t	tonne
Tas	Tasmania
TEN-E	Trans-European Networks for Energy
TJ	Terajoules of energy – equivalent to 10^{12} joules
UNFCCC	United Nations Framework Convention on Climate Change
UK	United Kingdom
US$	United States dollar
US	United States of America
Vic	Victoria
WA	Western Australia

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Although CSIRO has sought feedback from government and industry on the technical content of the report, CSIRO has sole discretion on the inclusion of this feedback.

Northern Territory Low Emissions Carbon Capture Storage and Utilisation Hub business case project

The Northern Territory Low Emissions Carbon Capture Storage and Utilisation Hub business case project is a result of a collaborative approach between CSIRO, government and industry to develop a business case to assess the viability of a large-scale low-emissions carbon capture utilisation and storage hub outside Darwin.

The project includes inputs from the wider Northern Territory Low Emissions Hub (NT LEH) Collaboration group, whose current members include the Northern Territory Government, Xodus, INPEX, Santos, Woodside Energy, ENI, Total-Energies, Tamboran Resources and SK E&S.

Summary

The realisation of a CCUS hub in the Northern Territory (NT), and CCUS hubs across Australia, is dependent on the development of viable business models that mitigate commercial risks and ensure financial sustainability. Implementation of CCUS hub business models, as with any decarbonisation approach, requires a variety of policy levers to be used by governments at both the national and state/territory level.

This report summarises the CCUS (and adjacent) policy frameworks that have been implemented across Australia and within the NT. These domestic policies are compared with the design of other policies implemented by jurisdictions globally, with the aim of identifying the key policy levers that can, and are, being implemented to drive emissions reduction through the use of CCUS. The report also discusses the role that communication and engagement takes in the successful development and implementation of policies, particularly in contested domains.

For appropriate policy (of any sort) to be developed, there needs to be a level of 'policy salience'. The requirements are:

1. broad agreement that there is a specific problem (climate change)
2. shared understanding of the characteristics of the problem (emissions reduction can reduce the impact of climate change)
3. acceptance of available solutions (as tools to combat emissions reduction, CCS, CCUS and hydrogen fuel substitution can reduce emissions at scale and lessen the impacts of climate change).

In Australia, while climate change and the need to reduce emissions to limit the impact of climate change have been broadly accepted by the community, the approaches to achieve emissions reduction goals are still strongly contested.

A wide range of policy levers can be used by governments to enact policy objectives; these are broad-ranging, from development of high-level strategies, legislation, regulations, financing, incentivisation, support for technology development and innovative practices through to public engagement.

To develop a CCUS hub, there are many benefits and costs associated with sequestering CO_2 that need to be evaluated against other alternatives for achieving decarbonisation, as well as the status quo of doing nothing. Several criteria need to be fulfilled for companies to invest in the necessary infrastructure for a CCUS hub, including:

1. there needs to be a clear economic incentive
2. regulatory and legislative mechanisms need to make CCUS and hydrogen manufacture a feasible alternative
3. there needs to be a clear demonstration of how technical challenges can be overcome
4. social licence from the community needs to be secured and retained.

The Australian Government has implemented a wide range of policies to drive emissions reduction and that support CCUS and hydrogen project development. These fall broadly into the following categories:

1. the development of emissions reduction targets and reporting, and the ongoing development of emissions reduction strategies that will inform policy development
2. carbon pricing through the Australian Carbon Credit Unit (ACCU) and Safeguard Mechanism Credits (SMC) schemes
3. regulation of offshore CCS
4. financing for hydrogen industries and manufacturing
5. grants for hydrogen and CCUS hubs, projects and technology development
6. incentives to produce 'renewable' hydrogen.

A review of these policies has identified the significant progress being made in the development of whole-of-economy emissions reduction targets and sectorial decarbonisation pathways through the Climate Change Authority Sector Pathways Review (Climate Change Authority, 2024), which has acknowledged both the adoption of CCS and the development of low-emissions industrial precincts (noting the link to CCS has not explicitly been made for precincts or hubs).

Critical to the development and implementation of hydrogen policy is the Hydrogen Strategy. Such a strategy is currently absent for CCUS (Figure 1). The development of emissions reporting, large emitter reduction regulations (such as the Safeguard Mechanism) and the incentivisation of emissions reduction through ACCU methodologies will help lower economy-wide emissions. However, additional policy measures are likely to be necessary, particularly for hard-to-abate industrial sectors seeking to reduce their emissions. The current granting and incentive approaches have mostly excluded opportunities for CCS to play a role in the decarbonisation of existing industries and infrastructure (including low-emissions hydrogen project development). In addition, there are gaps within these granting and incentivisation approaches that prevent consideration of sector coupling opportunities with renewable electrification, low-emissions hydrogen and CCS that could be combined to accelerate emissions reduction from industrial precincts and meet net zero emissions goals.

Notwithstanding the lack of direct financing and incentives for CCS, there are Australian Government policies in place that, while not specifically designed to support the development of CCUS projects, could be used to provide financing and corporate structures to enable the delivery of a CCUS hub in the NT.

Australia has some of the most mature offshore CCS legislation and regulations globally, and these are being updated to make sure they reflect best practice. While there is no CCUS legislation in place in the NT, work is underway to amend or develop legislation to enable CCUS to occur, and this will include incorporating learnings from other states where CCUS legislation has already been implemented.

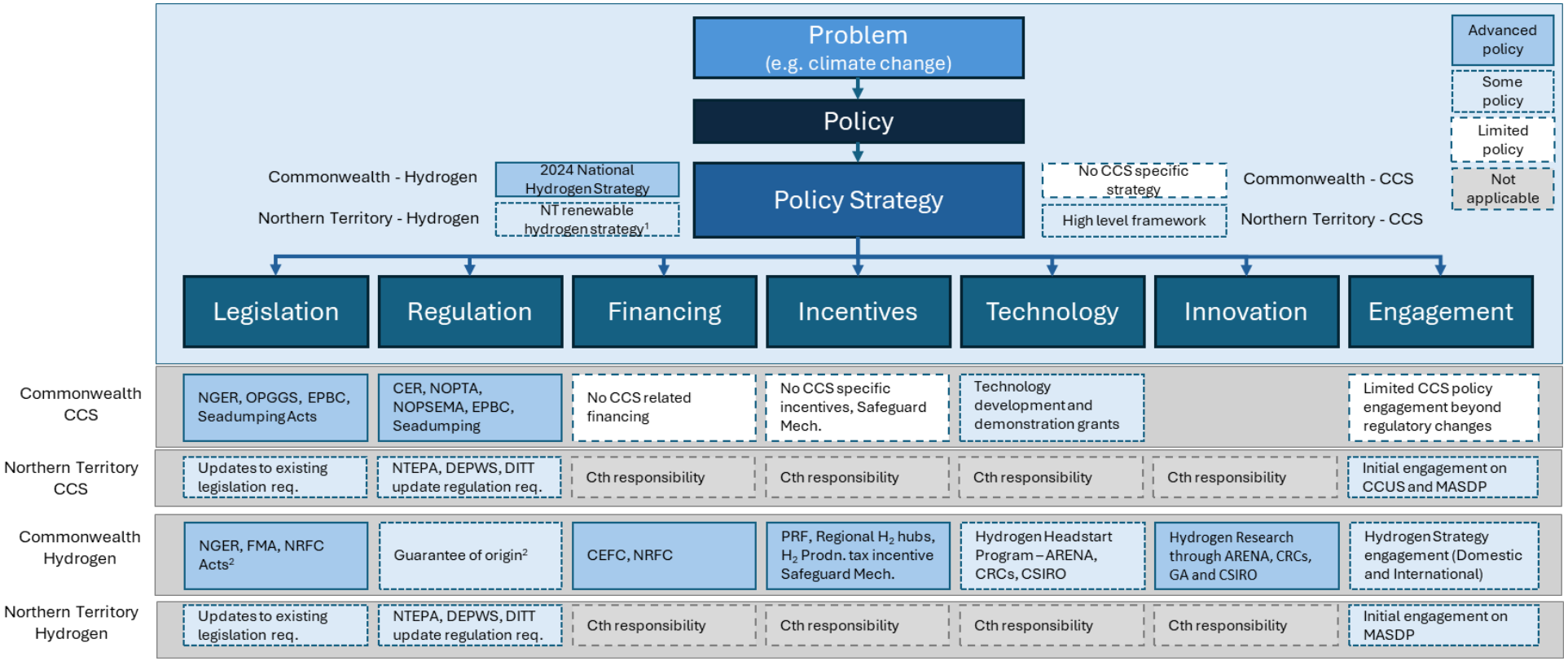
Since 2023, several countries have begun developing their first CCS-specific legislation and regulations, while others have amended existing policies to support CCS. This has led to the emergence of new entrants that are now accelerating demonstration and commercial-scale projects. Across the South-East Asian region, governments are laying the groundwork for CCS

through legislation, policy development, and international collaboration. Collaboration plays a central role in many South-East Asian and European approaches, with memoranda of understanding being signed to facilitate transnational projects and initiate prefeasibility studies. Comparing the regulatory and legislative arrangements for CCS between Australia and South-East Asian countries is important for identifying best practices, harmonising standards, and enabling transnational CCS initiatives. In Europe, the industrial carbon management strategy reflects a similar effort to create a unified market for CCS. In many European countries, these agreements and memoranda of understanding also support compliance with obligations under the London Protocol. This is not necessarily the case for many countries in South-East Asia.

Understanding the interplay between these policies across the globe is important to understand the priority that will be placed by companies on the relative investability of CCUS in Australia versus other jurisdictions. Favourable CCUS and aligned policies globally are leading to deferment of investment in Australia in projects that have the potential to underpin greater harder-to-abate industry decarbonisation.

As well as developing a range of policies, engaging with stakeholders on their purpose and operation is critical. Without this, CCUS hub project proponents will struggle to set their projects within the policy narrative. This increases the risks to projects that will be first-of-a-kind and where outcomes may not be fully quantified due to market uncertainty.

This report discusses the contrasts between CCUS and hydrogen policy; the role of innovation in CCUS; the benefits of an articulated strategy and meaningful engagement for CCUS; the existing financial and incentive mechanisms that could fill CCUS policy gaps; vehicles for policy delivery; and the implications for NT CCUS hub development.



[1] Includes master plan and framework for the future and hydrogen supply chain (https://territoryrenewableenergy.nt.gov.au/strategies-and-plans/hydrogen).

[2] Other Acts and Regulations are applicable for the regulation of activities associated with the production, transport and use of hydrogen (https://www.dcceew.gov.au/energy/hydrogen/regulatory-lists).

Figure 1: Australian CCS and hydrogen policy framework comparison

1 Introduction

The realisation of a CCUS hub in the NT, and hubs across Australia, is dependent on the development of viable business models that mitigate commercial risks and ensure financial sustainability. Implementation of CCUS hub business models, as with any decarbonisation approach, requires the use of a variety of policy levers by governments at both the national and state/territory level.

This report summarises the CCUS (and adjacent) policy frameworks that have been implemented across Australia and within the NT. These policies are compared with the design of policies implemented by other jurisdictions globally, with the aim of identifying the key policy levers that can be implemented to drive emissions reduction through the use of CCUS. The report builds on the findings from the *Task 4 report* (Stalker et al., 2024) and while the review is not exhaustive, it aims to identify those CCUS policy levers from which learnings can be obtained. As well as developing an understanding of CCUS policies both in Australia and globally, the report also discusses the role that communication and engagement take in the successful development and implementation of policies, particularly in contested domains.

Any policy gaps identified through this review can help identify future policy directions, not only to meet local decarbonisation objectives, but also to support the climate ambitions of Australia's international trade partners.

1.1 Policymaking

Butcher and Mercer (2024) describe policymaking as 'an exercise in rational problem solving', but one that is often painful, political, complex and nuanced. Policies often begin as expressions of fundamental values or beliefs. Over time, they evolve into structured rules designed to ensure compliance with legal obligations established by legislation or regulation. Their implementation aims to drive specific behaviours or changes aligned with desired outcomes. This may not always be achieved, however, as second-order effects may emerge that undermine the original objectives set by the policymakers. Mitigating this risk can be achieved in part through the implementation of an overarching strategy that guides policy formulation. Such a strategy would in part enable a comprehensive review of the nature of the problem that could be addressed through policy. This is especially important for complex problems where multiple policy levers may be required.

Climate change mitigation is a case in point, and there is an expectation that emissions reduction technologies (e.g. CCUS) require a suite of policies that go beyond simple financial incentives. A failure to consider a suite of policies – or put another way, a lack of policy support – has been cited as a major barrier to the deployment of large-scale CCUS projects globally (International Energy Agency, 2023). For appropriate policies to be developed, there needs to be a level of 'policy salience' (Kingdon, 1995; Butcher and Mercer, 2024). The requirements are:

1. broad agreement that there is a specific problem (climate change)

2. shared understanding of the characteristics of the problem (emissions reduction can reduce the impact of climate change)
3. acceptance of available solutions (as tools to combat emissions, CCS and CCUS can reduce emissions at scale and lessen the impacts of climate change).

In Australia, climate change and the need to reduce emissions to limit the impact of climate change have been broadly accepted by the community. However, the approaches to achieve emissions reduction goals are still strongly contested. Policy developments have occurred in other jurisdictions, where it has been decided that CCS and CCUS will feature as part of the emissions reduction strategy for their populations. These jurisdictions are likely to have been subject to variable ranges of support and pushback on the implementation of these policies. How these jurisdictions have been successful in the prosecution of their policies, the measure of their success and what can be learned from the implementation of these policies will be addressed herein.

1.2 Policy levers and instruments

A series of levers or tools are available to facilitate the effective deployment of policy (Althaus et al., 2022). Figure 2 illustrates such an approach which starts with the identification of a problem, for example climate change. This strategy can incorporate multiple policy instruments to effectively respond to the identified problem.

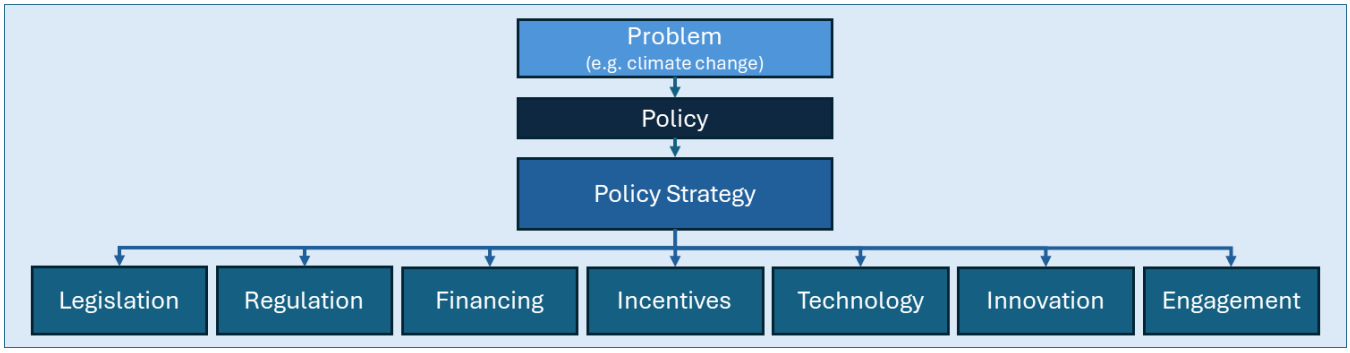


Figure 2: Policy levers and tools
Source: Althaus et al. (2022)

Most people are familiar with the role of legislation, regulation, financing and incentives; however, the additional tools of technology, innovation and engagement also contribute to successful policy implementation. Definitions of the various policy levers for emissions reduction policy are presented below. The various policy levers and their role in the implementation of CCUS will be identified in the following sections.

Policy levers for emissions reduction (with a focus on CCUS, hydrogen and clean energy)

- **Legislation** – creation of laws and signalling the need for regulations (e.g. *National Greenhouse and Energy Reporting Act 2007*).
- **Regulation** – setting of standards and rules to support the legislation (e.g. Safeguard Mechanism) and using legislative powers to enforce changes in behaviour.

- **Financing** – spending and taxing powers, subsidies, grants, carbon pricing, cap-and-trade, R&D funding, FEEBATES (tax/subsidy policies combined).
- **Incentives** – behavioural economics by encouraging via reward (e.g. using integrated psychological and economic incentives or principles regarding public behaviour and behavioural change, or 'nudging'), Renewable Energy Target (RET) or tax credits for clean tech, EV incentives or public transport investment.
- **Technology** – promotion of innovation and development.
- **Innovation** – supporting new ideas and solutions (often via R&D grants and funding to stimulate new innovation and develop new IP).
- **Engagement** – collaborating with stakeholders and the public to execute the change.

Consolidated from Butcher and Mercer (2024) and Althaus et al. (2022).

The development of a CCUS hub is one method for internalising the costs of emissions reduction. The net benefits associated with the hub must be evaluated against alternative approaches to reducing emissions, as well as the status quo of existing policies. Several criteria need to be fulfilled for investments to be made in the necessary infrastructure for a CCUS hub, including:

1. there needs to be a clear economic incentive to invest in CCUS infrastructure
2. regulatory and legislative mechanisms need to enable CCUS as a feasible alternative
3. there needs to be a clear demonstration of how risks, technical or otherwise, can be mitigated
4. social licence from the community needs to be secured and retained.

Policies can be designed to address each of these criteria. Since emissions abatement represents a cost for most firms, the economically rational approach is to adopt the least costly method. This is why legislative and regulatory frameworks alone may not be sufficient to drive change. In the following sections, domestic and international policies will be examined to identify gaps that hinder the establishment of a CCUS hub as an economically viable approach to emissions reduction.

2 Australian Government policies

This section outlines the Australian Government's policy landscape as it pertains directly to CCUS or adjacent sectors such as hydrogen, offering insights based on existing policies. The government has introduced a broad suite of policies aimed at driving emissions reduction while supporting the development of CCUS and hydrogen projects. These fall broadly into the following categories:

1. the development of emissions reduction targets and reporting, and the ongoing development of emissions reduction strategies that will inform policy development
2. carbon pricing through the ACCU and SMC schemes
3. regulation of offshore CCS
4. financing for the hydrogen industries and manufacturing
5. grants for hydrogen hubs, projects and technology development
6. incentives to produce 'renewable' hydrogen.

2.1 Emissions reduction targets and strategies

Since 1992 there has been progressive development on the United Nations Framework Convention on Climate Change (UNFCCC), a framework and strategy for international cooperation with respect to mitigating the impacts of climate change. Prior to the 2015 Paris Agreement, the Kyoto Protocol, which came into force in 2005, introduced the requirement to monitor, review and verify emissions at the country level. The development of such a system is one of the requirements to facilitate a global carbon pricing system. Australia was one of the 192 signatories to the Kyoto Protocol and while binding emissions reduction targets at the country level were a component of the Kyoto Protocol, these targets have been superseded by the Paris Agreement. In 2016 Australia became a signatory to the Paris Agreement, which operates on a five-year cycle of increasingly ambitious climate action targets. As part of the agreement, countries are required to report their actions aimed at reducing greenhouse gas emissions. This aligns with the goal of limiting the global average temperature increase to well below 2°C above pre-industrial levels. In 2016 and 2022 Australia submitted its Nationally Determined Contributions (NDCs), which include two targets, the first being a reduction in greenhouse gas emissions to at least 43% below 2005 levels by 2030, and the second a target of net zero emissions by 2050 (Department of Industry, Science, Energy and Resources (DISER), 2022).

To achieve these targets, a set of strategies and associated policies has been progressively developed and implemented to facilitate decarbonisation throughout the Australian economy.

The Climate Change Authority (CCA) is an independent statutory body established under the *Climate Change Authority Act 2011* and is providing expert advice to the Australian Government on climate change policy. In particular, it is developing advice for the government on the development of the 2035 emissions reduction targets for Australia's next NDC and reviewing sectoral technology and emissions pathways that can support Australia's transition to net zero

emissions by 2050. The CCA is mapping sectoral emissions reduction pathways for: electricity and energy; transport, industry and waste; agriculture and land; resources; and the built environment.

Based on a narrow definition of emissions amenable for CCS, the CCA 2024 Sector Pathways Review (Climate Change Authority, 2024) identifies that industries emitting a comparatively high concentration of CO_2, such as natural gas processing, hydrogen production (from gas) and cement, are most suited for the implementation of CCS. These industries should be prioritised by industry and government for assessment of the potential to adopt CCS at scale. The report also recommends that low-emissions industrial precincts be developed, including pre-evaluation of regions for suitability of priority activities and new net zero industries (including renewable hydrogen production), and of the renewable electricity generation and other infrastructure needed to power them, based on principles including environmental and community impacts.

In addition to the CCA, the Net Zero Economy Authority (NZEA) is facilitating public and private investment in net zero economic transformation where there is a clear role for government, with a focus on impacted industrial regions (Net Zero Economy Authority, 2025). While the NZEA does not advise on the net zero emissions strategy, it is working with government and the private sector to catalyse the investment needed to develop sustainable sources of long-term prosperity and to support Australia's regional communities through the transition to net zero and the changing economy. Specifically, the NZEA has identified six priority regions:

- Collie, WA
- Gladstone, Central Qld
- Hunter, NSW
- Latrobe Valley, Vic
- Pilbara, WA
- Upper Spencer Gulf, SA.

In these areas the NZEA will work with international partners, state and local governments, the private sector and other organisations to identify, broker, facilitate and catalyse transformational projects in regions where required, making use of government Special Investment Vehicles (see below) and policies to drive investment in the net zero transition.

In addition to the activities of the CCA and NZEA, the Australian Government has also implemented emissions reduction strategies based on specific technologies, such as the National Hydrogen Strategy.

National Hydrogen Strategy

The 2019 National Hydrogen Strategy was developed to position Australia as a major player in the global hydrogen market by 2030. The strategy outlines a comprehensive plan to develop a clean, innovative, safe and competitive hydrogen industry. It emphasises the importance of hydrogen in reducing greenhouse gas emissions, enhancing energy security, and creating economic growth. The strategy includes measures to support hydrogen production, infrastructure development, regulatory frameworks and international cooperation. It also

highlights the potential for hydrogen to be used in various sectors, including transportation, industry, and power generation.

The strategy identifies key actions and milestones to achieve its goals, such as establishing hydrogen hubs, undertaking the National Hydrogen Infrastructure Assessment (NHIA), investing in research and development (R&D), and creating certification schemes for hydrogen production. It also focuses on building domestic and international markets for hydrogen, fostering collaboration between governments, industry and research institutions. The strategy aims to leverage Australia's abundant renewable energy resources to produce green hydrogen, positioning the country as a leading exporter of hydrogen to global markets.

In 2024 the strategy was refreshed to consider changes in government policy, including the introduction of the Hydrogen Production Tax Credit and Hydrogen Headstart Program (see below). Greater emphasis has been placed on accelerating the growth of a clean hydrogen industry to support sectors classified as 'hard to abate', due to the lack of alternative emissions reduction options, as ammonia production, iron and steel making and transport fuels for maritime, aviation and long-haul road applications. While many objectives from the 2019 strategy have been retained, they have been reframed as four objectives, supported by 34 actions, as well as targets, collaboration across governments, and associated enablers that will underpin their delivery.

It should be noted that the 2024 strategy has shifted away from mentioning 'clean hydrogen', as the 2019 report did, towards describing hydrogen as 'renewable'. This change reflects that 'the Australian Government has prioritised its policy efforts and financial support towards renewable hydrogen projects, which are clearly aligned with Australia's net zero goals' (DCCEEW, 2024a, p. 42). Several reasons are provided, but relevant to the discussion of CCS is the high cost of achieving a 90% carbon capture rate with steam methane reformers. Additionally, it is expected that the cost of hydrogen production via electrolysis will fall below that of production via steam methane reforming with carbon capture.[1]

2.1.1 Emissions reporting legislation

The *National Greenhouse and Energy Reporting Act 2007 (Cth)* (NGER Act) was established in part to support Australia's international obligations to monitor, review and verify emissions under the Kyoto Protocol. The Act describes a national framework for reporting greenhouse gas emissions, energy production and energy consumption by companies within Australia. Two thresholds exist to determine whether a company must report greenhouse gas emissions under the Act. A company operating a facility that surpasses any of the following thresholds within a financial year must report annually to the Clean Energy Regulator (CER): emitting 25,000 tonnes or more of CO_2-e, producing 100 TJ of energy or consuming 100 TJ of energy. For a corporate group the thresholds are doubled, but if a group only triggers facility-level thresholds, the reporting requirements only apply to those facilities.

[1] This is not to imply that clean hydrogen, defined as hydrogen produced using a combination of renewable energy and hydrocarbon sources with carbon capture and storage, is not allowed under the strategy. Throughout the strategy the term clean hydrogen is mentioned as part of Australia's broader hydrogen strategy.

Several legislative instruments have been developed to provide clarity for businesses as to their reporting requirements under the NGER Act. These instruments include:

- National Greenhouse and Energy Reporting Regulations 2008
- National Greenhouse and Energy Reporting (Measurement) Determination 2008
- National Greenhouse and Energy Reporting (Audit) Determination 2009
- National Greenhouse and Energy Reporting (Auditor Registration) Instrument 2019
- National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015.

Themes related to these instruments include the procedures for reporting, how to measure emissions or energy production/consumption, requirements for third-party validation of reported figures and how the Safeguard Mechanism applies to specific facilities.

Every year a proposed set of legislative amendments are made available for public consultation prior to implementation. Annual amendments have been made to the measurement determination in response to updated emissions factors, improvements to estimation methods identified by the department or stakeholders, and in response to public consultation (Clean Energy Regulator, 2025a). Although the NGER Act established emissions reporting, it did not include any requirements to reduce emissions, with compliance only relating to the reporting of necessary information.

In addition to NGER reporting requirements, many of these industries would be subject to additional policies and regulations, including the Safeguard Mechanism.

The Safeguard Mechanism

The Safeguard Mechanism is one of the Australian Government's key decarbonisation policies and covers facilities with direct Scope 1 emissions of more than 100,000 tonnes of $CO_{2\text{-}e}$ per year. The Safeguard Mechanism covers the largest emitting facilities in the mining, oil and gas, manufacturing, transport, construction and waste sectors. There were 219 Safeguard covered facilities in 2023-24. Collectively, these facilities accounted for 44.89% of Australia's Scope 1 emissions in the 2023–24 reporting period.[2]

For each facility that is covered by the mechanism, a baseline level of emissions is determined. At a minimum the baseline emissions are set to 100,000 tonnes, but this baseline is often adjusted based on the actual emissions of the facility. Several methods are available to determine the baseline; for example, a firm that was reporting emissions for at least 5 years as part of the NGER scheme could use its highest recorded emissions between the years 2009–10 and 2013–14. If insufficient data are available, the CER will determine a calculated baseline based on the emissions intensity for each product a facility produced, multiplied by the quantity produced. Irrespective of the method applied, once a baseline is set, firms are required to reduce their actual emissions each year below the baseline. Firms can purchase ACCUs to reduce their net emissions, and if in

[2] 2022–23 emissions reported by safeguard facilities totalled 136 million tonnes $CO_{2\text{-}e}$ (Clean Energy Regulator, 2025b) and total Scope 1 emissions for Australia were 303 million tonnes $CO_{2\text{-}e}$ (Clean Energy Regulator, 2025c)

any year they exceed their baseline without applying for an exemption or baseline adjustment they may incur financial penalties.

In 2017 the Australian Government conducted a review of the scheme, in part due to criticism that the scheme's reliance on historical emissions may not reflect changes in underlying technologies and economic factors (Commonwealth of Australia, 2017). Following the introduction of the *Climate Change Act 2022* and several rounds of consultation, the Safeguard Mechanism (Crediting) Amendment Bill 2023 was passed (Gibson, 2024). Several safeguard outcomes were implemented, including:

- a total net covered emissions budget for all facilities equal to 1,233 million tonnes $CO_{2\text{-}e}$ for the period 1 July 2020 to 30 June 2030
- an upper limit of 100 million tonnes $CO_{2\text{-}e}$ across all facilities for the financial year beginning 1 July 2029 and net zero by the financial year ending 30 June 2049
- the 5-year rolling average safeguard emissions for each financial year that begins after 30 June 2024 are lower than the past 5-year rolling average safeguard emissions for that financial year
- the introduction of material incentives for facilities to invest in at-source emissions reduction
- support for emissions-intensive, trade-exposed industries. Less onerous requirements are imposed on these industries to prevent the risk of carbon leakage[3].

As part of the reform the baseline number assigned to each facility declines at a fixed rate, equal to 4.9% per annum, until 2030. This is to achieve a reduction in the aggregate emissions of safeguard facilities in line with Australia's legislated emissions reduction targets. In addition, the emissions intensity factor transitions over time from facility-specific factors to industry-average factors. This transition has the aim to incentivise production, whereby the relative emissions intensity is lowest, as opposed to individual facilities that use relatively older, more emissions-intensive technologies driving innovation and investment. New shale gas extraction facilities have had their baseline emissions set to zero, necessitating that net zero emissions must be achieved once gas production commences (Clean Energy Regulator, 2025d).

Facilities can reduce their actual emissions via investments in emissions reduction technologies, purchasing ACCUs, applying for variations in their baseline emissions or purchasing Safeguard Mechanism Credits (SMCs). Facilities cannot purchase international credits to meet their obligations under the Safeguard Mechanism. One SMC represents one tonne of $CO_{2\text{-}e}$ and credits are generated whenever a facility reports actual emissions below its baseline. The credits can be banked for future years (until 2030) or sold to safeguard facilities that have exceeded their baseline emissions in a reporting year. Penalties for noncompliance with the scheme still apply if facilities exceed their baseline emissions in a given year and do not apply for exemptions or enter into alternative arrangements with the CER.

[3] The International Energy Agency (IEA) defines carbon leakage as the potential displacement of industrial production (and associated pollution) to jurisdictions with less stringent environmental controls or emissions reduction requirements.

The mechanism includes a cost-containment measure to provide certainty to safeguard facilities as to the price of carbon. ACCU offsets can be purchased from the government at a fixed price of $79.20 in 2024-25, adjusted for inflation + 2% each year. Finally, as part of the reforms the mechanism is scheduled to be reviewed in the 2026–27 financial year. This is to ensure that the mechanism is working as intended to reduce Australia's emissions in line with its NDCs.

Australian Carbon Credit Unit scheme

The ACCU scheme incentivises individuals and firms to engage in activities that reduce greenhouse gas emissions. By participating in the scheme, individuals and firms can earn financial compensation for their efforts to lower emissions. Several methods exist that, if employed, lead to the creation of carbon credits, each representing one tonne of $CO_{2\text{-}e}$. Currently, there are 20 approved "methods" to generate carbon credits, categorised into the following sectors: agriculture, energy efficiency, landfill and waste, mining, oil and gas, transport, and vegetation (Clean Energy Regulator, 2025e). These credits can be sold to firms that are seeking to offset their own emissions. ACCU Scheme participants with an existing carbon abatement contract can sell ACCUs from their project to the Australian government. Previously the CER would hold ACCU Scheme auctions on behalf of the Commonwealth, however following the 2022 independent review of the scheme and in response to recommendation 3.3 this is no longer the case (Chubb et al., 2022). Following the independent the government has consulted on its objectives and purchasing role in the market (DCCEEW, 2023a).

Carbon capture and storage (CCS) method

The CCS method is designed to incentivise projects capturing greenhouse gases that would otherwise have been released into the atmosphere and transporting them for injection into underground geological formations for permanent storage.

All projects must meet the legislative requirements under the following:

- Carbon Credits (Carbon Farming Initiative – Carbon Capture and Storage) Methodology Determination 2021 (the method)
- *Carbon Credits (Carbon Farming Initiative) Act 2011 (Cth)*
- Carbon Credits (Carbon Farming Initiative) Rule 2015

Eligibility for this method involves capturing CO_2 from either a new capture point of an industrial process (e.g. CO_2 captured from a cement production facility) or gas extraction activities. Project proponents wanting to use this method must submit to the CER a CCS project plan for evaluation. Relevant details of the plan include:

- details of all required physical infrastructure and injection points
- relevant engineering and geological characteristics of the storage site, including how the site is monitored
- how the long-term risk of CO_2 leakage will be managed
- an explanation of how relevant workplace health and safety matters will be managed during operations.

It should be noted that some of these details are also relevant under other pieces of legislation, for example the *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)*

(OPGGS Act). Once injection begins, ACCUs can be generated for up to 25 years, with a 5-year buffer between when the project is registered and the crediting period commencing. The quantity of emissions abated (and therefore the ACCUs generated) is net of any project emissions, any methane captured that would otherwise be oxidised and a 3% buffer that is withheld in the case of any abatement reversal.[4]

Several exclusions exist in relation to using this method to generate ACCUs. Activities that have the effect of supporting enhanced oil or gas recovery cannot use this method. In addition, any CO_2 that is captured by direct air capture (DAC) technologies and then subsequently stored cannot use this method.

Project proponents wanting to use this method for emissions associated with facilities subject to the Safeguard Mechanism have to meet additional eligibility requirements. The main criterion is that the project must relate to abating emissions that are separate from the safeguard facility's covered emissions. For example, a gas production facility that separates CO_2 from existing gas streams and then injects the CO_2 into a reservoir cannot generate ACCUs for the stored CO_2 if it is a safeguard facility. In effect, this rule prevents safeguard facilities from generating ACCUs as a means to subsidise the costs of CCS infrastructure; however, they can generate SMCs. There are exceptions. For example, if a project sequesters Scope 2 emissions associated with electricity supplied to a safeguard facility, and those emissions can be accounted for separately from the facility's covered emissions, then the project would be eligible to generate ACCUs. In addition, engaging in CO_2 sequestration activities does not prevent a safeguard facility from generating SMCs, which can be sold to the owners of other facilities.

Clean Energy Regulator

The CER is established by the *Clean Energy Regulator Act 2011 (Cth)* and is an economic regulator accelerating carbon abatement for Australia. The CER manages the National Greenhouse and Energy Reporting Scheme. The CER indirectly regulates the CCS industry through its administration of the ACCU scheme. The Safeguard Mechanism, including all its reporting and compliance requirements, is also administered by the CER. Applications for ACCU generation using the CCS method are sent to the CER for approval. Once registered, the project must regularly report to receive ACCUs following the delivery of the activities. In addition to monitoring and enforcing reporting requirements, the CER assists relevant parties in finding auditors to independently validate reported information.

2.1.2 Future Made in Australia Act

The *Future Made in Australia Act 2024 (Cth)* (FMA Act) is designed to drive investment in industries that will help Australia to transition to net zero emissions while strengthening economic resilience (Future Made in Australia Act, 2024). A key component of the FMA Act is the National Interest Framework, which identifies priority industries under two streams:

[4] Withheld ACCUs can be returned to the project proponent after injection ceases once the regulator is convinced that CO_2 has been permanently stored and is net of any fugitive or monitoring emissions since the end of the crediting period.

1. **Net zero transformation stream** – this stream focuses on industries that can significantly contribute to emissions reduction while building Australia's competitive advantage, including:
    - renewable hydrogen (section 2.4.5)
    - critical minerals processing
    - green metals (section 2.4.4)
    - low-carbon liquid fuels
    - clean energy manufacturing (such as battery and solar panel supply chains) (Australian Treasury, 2024a)
2. **Economic resilience and security stream** – this stream supports industries that are critical to Australia's economic security but may struggle to attract private investment without government support (Australian Government, 2024).

The FMA Act (s10) requires community benefit principles be applied, ensuring that investments contribute to local communities, supply chains and workforce development (Australian Treasury, 2024).

The FMA Act incorporates $22.7 billion of funding over a decade. The budget measures are broad-ranging and provide support for greater renewable energy generation, transmission and storage. Other key areas of interest include $3.2 billion allocated to the Australian Renewable Energy Agency (ARENA) to support the commercial readiness and uptake of technologies that are critical to the net zero transformation. Also, $1.7 billion allocated to the Future Made in Australia Innovation Fund will go towards the deployment of innovative technologies and facilities linked directly to priority industries, including green metals and low-carbon liquid fuels. The government will work with the CEFC and the National Reconstruction Fund to support investment in critical priorities by derisking projects and reducing upfront capital costs.

In addition to investments in technology and projects, the *Future Made in Australia (Production Tax Credits and Other Measures) Bill 2024 (Cth)* introduced the Hydrogen Production Tax Offset (HTPO) and Production Tax Incentive tax offset (CMPTI tax offset) (Parliament of Australia, n.d). The bill amends the *Income Tax Assessment Act 1997 (Cth)* to create a $2/kg refundable tax offset that is available for eligible hydrogen produced by eligible companies (section 2.4.5). It applies to hydrogen produced in income years between 1 July 2027 and 30 June 2040, for a maximum of 10 years. The act disqualifies hydrogen production pathways involving coal gasification and steam methane reforming of natural gas. The critical minerals tax incentive is a tax offset for 10% of the eligible processing and refining costs for Australia's 31 critical minerals (Australian Government, 2024). Also incorporated within the Act is a further $209.3 million of funding to expand the Net Zero Economy Authority.

The FMA Act (s 10A) specifically states that the support must not be provided by the Commonwealth, a Commonwealth entity or a Commonwealth company for any of the following activities:

- the extraction of coal, crude oil or natural gas

- the construction of infrastructure for the primary purpose of extracting coal, crude oil or natural gas
- directly financing investments for the sole purpose of the use of coal, crude oil or natural gas.

There appear to be no specific exclusions associated with CCUS if the primary purpose is not for the extraction of coal, crude oil or natural gas.

2.2 Regulation of carbon dioxide capture and storage activities

While the NT Government manages many onshore regulations, any parties wishing to inject CO_2 offshore must seek multiple regulatory approvals from several state/territory and Australian Government agencies. There are three major pieces of legislation that define the framework for obtaining approvals for offshore CO_2 storage:

- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
- *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)*
- *Environment Protection (Sea Dumping) Act 1981 (Cth)*.

These Acts are administered across several government departments and are approved by various government ministers. Given the complexity of the process, documentation has been developed to provide guidance to the approvals process, with Figure 3 providing an overview. The Australian Government is currently reviewing this offshore CCS legislation to make sure that it remains fit for purpose and reflects best practice, with the Department of Industry, Science and Resources leading the review (Australian Government, n.d-a). This is in response to the large number of offshore CCS projects under development, particularly with planned offshore storage.

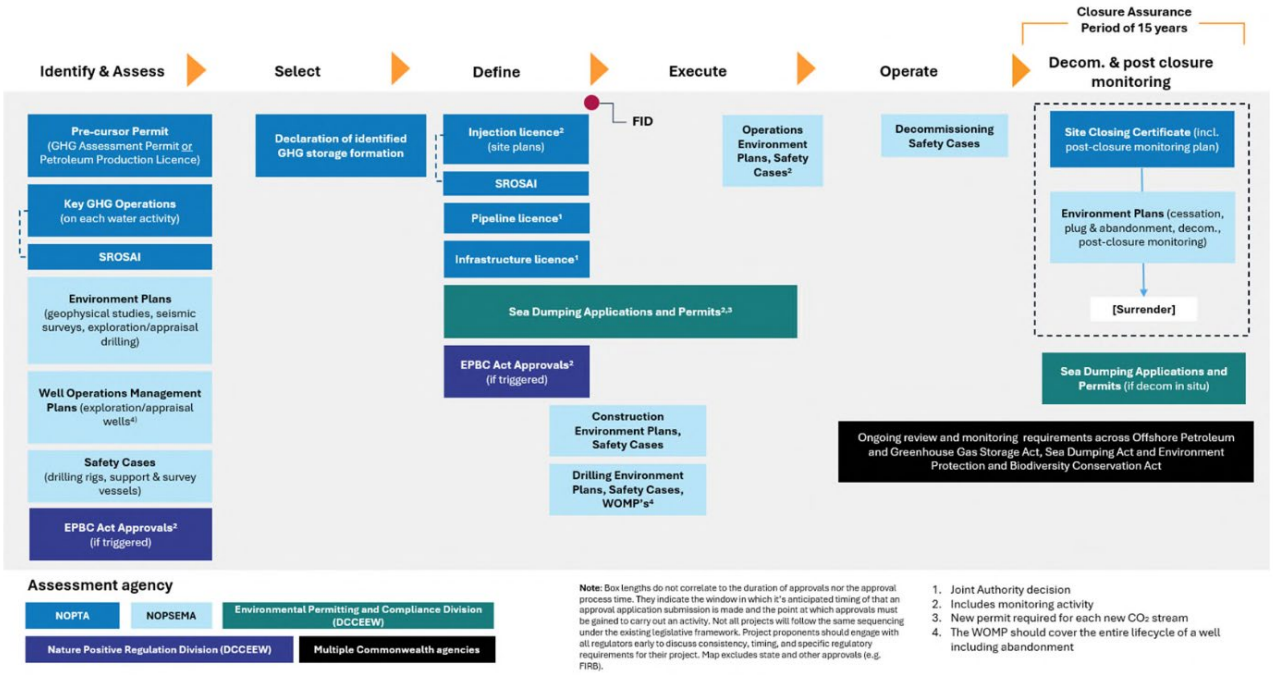


Figure 3: Overview of the approvals process for offshore CO_2 storage
Source: Commonwealth of Australia (2023, p. 6)

Each of the key Acts, government regulators and regulations are summarised below.

2.2.1 Environmental Protection and Biodiversity Conservation Act

The Commonwealth EPBC Act of 1999 provides a framework for the protection of the environment, including its biodiversity and significant natural and cultural places. The Act establishes processes to protect and promote the recovery of threatened species and ecological communities, and to preserve significant places from decline. It is administered by the DCCEEW.

In relation to CCS activities, the EPBC Act plays a crucial role in regulating these operations to ensure that they do not adversely impact the environment. CCS projects must undergo rigorous environmental assessments and obtain approvals under the Act if they are likely to have a significant impact on matters of national environmental significance, such as threatened species, ecological communities or heritage places (Commonwealth of Australia, 2023). In addition, any proposed projects that occur within or are likely to impact an adjacent Commonwealth Marine Area need to be referred to, assessed and approved under the EPBC Act. The EPBC Act is currently undergoing review in the Federal Parliament.

2.2.2 Offshore Petroleum and Greenhouse Gas Storage Act

The OPGGS Act outlines regulations for the exploration, recovery and storage of petroleum and greenhouse gases in offshore areas of Australia. Key sections include an overview of the entire regulatory framework and detailed guidelines for the extraction of petroleum resources, as well as the injection and storage of greenhouse gas substances. The most recent version of this legislation was compiled and enforced as of 14 December 2024.

Any party wishing to inject CO_2 into the subsurface in Australia's offshore waters must seek regulatory approval from the relevant responsible state/territory and Commonwealth minister.

The Act describes two statutory authorities, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and the National Offshore Petroleum Titles Administrator (NOPTA), which assist and advise the ministers on matters relevant to activities covered by the Act. Both authorities are the primary regulators for offshore greenhouse gases and form part of the Department of Industry, Science and Resources (DISR) portfolio.

National Offshore Titles Authority

To be able to inject CO_2 into a storage site, several permits are required prior to any injection, which are evaluated by NOPTA. The permits required pertain to key stages of the regulatory approval process:

1. site exploration – greenhouse gas assessment permit
2. injection site evaluation – declaration of identified greenhouse gas storage formation
3. defined plan for injection – injection pipeline, and infrastructure licences
4. site closing certificate and post-closure monitoring plan.

Each of the above stages is described within its own part and division of the OPGGS Act. Specific details include how applications are assessed, the required details, timelines and other relevant administrative details. Resources based on the requirements set in the Act are available online, for example guidelines and factsheets for obtaining a greenhouse gas assessment permit (NOPTA, 2025).

Other relevant functions performed by NOPTA include managing the titles register, administering greenhouse gas acreage releases, transfer of titles, ongoing compliance and monitoring activities, and providing technical advice as needed to relevant decision makers.

National Offshore Petroleum Safety and Environmental Management Authority

NOPSEMA functions as an independent regulator responsible for regulating offshore petroleum and greenhouse gas storage activities in Commonwealth waters, as well as in coastal waters where regulatory powers have been assigned. Its specific functions include:

1. **health and safety:** NOPSEMA promotes and ensures the occupational health and safety of workers involved in offshore petroleum and greenhouse gas storage operations
2. **environmental management:** it oversees the environmental management of these operations to minimise their impact on the marine environment
3. **structural integrity:** it ensures the structural integrity of wells and other offshore infrastructure
4. **regulatory compliance:** it conducts assessments, inspections and enforcements to ensure compliance with relevant legislation
5. **offshore renewables:** it also regulates offshore renewable energy projects, including work health and safety, infrastructure integrity and environmental management.

Prior to any activities taking place, specifically the initial exploration and identification stage, an environmental plan must be submitted demonstrating how any environmental impacts and risks identified will be mitigated.

A well operations management plan must also be submitted for assessment. The plan must demonstrate that well operations align with performance outcomes, standards and measurement criteria that are suitable. Given that in the case of CCS, the most likely source of leakage is via a well that intersects the storage interval, proponents should ensure that risks to well integrity are minimised to the lowest level reasonably practicable.

Finally, a safety case must also be submitted, providing information with regards to how health and safety issues will be managed, including how major hazards will be controlled. It should be noted that although this documentation is to be prepared and submitted at the initial stages of the regulatory approval process, it may need to be updated at later dates, including at the decommissioning and post-closure monitoring phase.

2.2.3 Environment Protection (Sea Dumping) Act (Cth)

The *Environment Protection (Sea Dumping) Act 1981* (Cth) is legislation administered by DCCEEW, designed to protect Australian waters from the environmental impacts of dumping waste at sea, including in the sub-seabed. The Act focuses on activities related to the loading of waste, incineration, dumping, and the creation of artificial reefs at sea. The legislation covers Australian waters which include all Commonwealth waters, most state or territory waters, but not internal waters of states or territories. Generally, the dumping of waste, including CO_2 for sub-seabed sequestration is a prohibited activity without a permit. Any person wishing to engage in dumping activities, which under the Act includes the sequestration of CO_2 under the seabed, must apply for and hold a permit for the activity.

The Sea Dumping Act implements the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Protocol) in Australia. The London Protocol is an international treaty established in 1996, following on from the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972. Both prevent marine pollution by dumping wastes and other matter and aim to minimise the environmental impacts of human activities. The Convention is in the process of being replaced by the London Protocol, which Australia joined as a contracting party in 2000. The disposal of any waste product is prohibited, except for permitted substances listed in Annex 1 of the London Protocol, which includes CO_2 streams from CO_2 capture processes for sequestration (International Maritime Organisation, 2016).

Under the Act, proponents wishing to sequester CO_2 offshore must have done the following and other things as indicated in the relevant Sea Dumping application form:

- demonstrated that all alternatives to ocean disposal have been evaluated
- assessed CO_2 streams and incidental associated substances within the streams (see National Action List Box)
- considered their CO_2 transport infrastructure
- provided information on their site selection
- assessed the potential impacts of CO_2 and incidental associated substances (IAS) on human health and the marine environment in the unlikely event that they are released to the atmosphere or marine environment

- developed monitoring and management measures to control or mitigate the impacts of any leakage of CO_2 sequestered in the sub-seabed.

As part of a 2009 amendment, the London Protocol was updated to regulate exporting CO_2 between countries for offshore storage, in effect enabling transnational offshore CO_2 sequestration. In 2023 the *Environment Protection (Sea Dumping) Amendment (Using New Technologies to Fight Climate Change) Act* was passed allowing the export of CO_2 streams to and from Australia for the purpose of offshore sequestration. Approvals are required by the minister and would be subject to conditions as described in any granted permit. These approvals in effect align with the requirements specified in Annexes 1 and 2 of the London Protocol (International Maritime Organisation, 2016).

National Action List

In 2023, DCCEEW began developing a National Action List (NAL) to enable offshore CO_2 sequestration. The NAL is a mechanism that is used to screen a captured gaseous stream overwhelmingly composed of CO_2 but that may also contain other contaminants. Under the London Protocol, these contaminants must be measured and assessed as to their potential effects on human health and the marine environment. The NAL is required to ensure that Australia meets its international legal obligations as required under the London Protocol.

DCCEEW has developed an interim NAL with the CSIRO that was released in February 2024. Any CO_2 stream to be sequestered offshore should contain a minimum concentration of 95% CO_2. Other likely contaminants, termed incidental associated substances (IAS, for example carbon monoxide), are contained in the interim NAL along with their upper-level concentrations and the rationale for the level (DCCEEW, 2024b). The current list of IAS is based on projects most likely to become operational in the near term in Australia, and the capture gas streams that will feed into the sub-seabed sequestration sites. With the development of low-emissions hubs and transnational shipment, it is likely that the gas streams (and IAS) may diversify further.

Sea Dumping applications will be assessed against the interim NAL upper level. Approval of a Sea Dumping application depends on a range of factors, not limited to the project proponent's justification as to how contaminant concentrations remain below the upper-level thresholds throughout the duration of the sea dumping permit, their environmental and human health impacts, and how the IAS will be monitored over the lifetime of the project.

As of early 2025 the full version of the NAL is in development, with consultation including industry and state/territory governments later in 2025. Additional contaminants may be added to the list over time as new sources of CO_2 are proposed for CCS and new methods for capturing CO_2 are developed.

2.3 Financing

The Australian Government has developed several financing mechanisms to promote emissions reduction or that could in principle be used to finance shared infrastructure in the NT.

2.3.1 Clean Energy Finance Corporation

The Clean Energy Finance Corporation (CEFC) is a corporate Commonwealth entity created under the *Clean Energy Finance Corporation Act 2012* (*Cth*). Its main goal is to facilitate increased flows of finance into the clean energy sector and to facilitate the achievement of Australia's greenhouse gas emissions reduction targets", as outlined s 3 of their Act (Clean Energy Finance Corporation Act, 2012). Over time, federal budgets have allocated funds to various sub-funds within the CEFC, each targeting specific objectives, such as the Advancing Hydrogen Fund. Unlike ARENA, which focuses on grant funding, the CEFC has an investment mandate that includes achieving benchmark rates of return. Consequently, projects that are funded tend to have progressed beyond the R&D phase but are not sufficiently derisked to solely rely on private investment.

The CEFC Investment Mandate includes the provision of $200 million for the Clean Energy Innovation fund and $300 million for the Advancing Hydrogen Fund (CEFC, 2024). As an example, two hydrogen-related projects that have been funded include $11.6 million provided to Siltrax and $14.9 million to Hysata, both companies involved in electrolyser manufacturing (CEFC, 2024). With regards to CCS, s 62 of the CEFC Act explicitly excludes funding investments into prohibited technologies, of which CCS is one, however some CCU activities, such as low carbon fuels, may be in scope (Clean Energy Finance Corporation Act, 2012*).*

2.3.2 National Reconstruction Fund Corporation

The National Reconstruction Fund Corporation (NRFC) is a corporate government entity created under the *National Reconstruction Fund Corporation Act 2023* (*Cth*). It is similar to the CEFC in that it provides financing to promote investments in Australia. However, investments are targeted towards priority areas within the Australian economy, including value-add in resources, agriculture, forestry and fisheries, transport, medical science, renewable and low-emissions technologies, defence capability, and enabling capabilities (e.g., information technology or specialized engineering). Investments are focused on manufacturing, meaning that funding cannot be allocated to support the entire construction of a hydrogen production facility (NRFC, 2023). However, it can be used to finance the manufacturing of hydrogen electrolysers. As of February 2025, no investments had been made into hydrogen-related manufacturing and the fund is prevented under the Act from directly financing investments related to gas extraction. However, unlike the CEFC, CCS technologies are not explicitly prohibited.

As noted above, there are significant funds available for financing large infrastructure projects. However, from the perspective of CCUS hub development the opportunities for CCUS financing are either limited or explicitly excluded unless associated with associated value-add or low emission technology industries. If this funding was available for CCUS projects it could help cover the capital infrastructure costs for capture technologies, or the associated transport and storage infrastructure to enable an end-to-end CCUS value chain. Finally, funding for hydrogen is available but is limited to financing only a proportion of the cost of developing a hydrogen-related project.

2.4 Grants and incentives

The Australian Government has used grants extensively, both recently and historically, as a policy instrument for emissions reduction. Examples of relevant recent granting programs are summarised below.

2.4.1 Carbon capture and storage

Carbon Capture, Use and Storage Development Fund

The Carbon Capture, Use and Storage Development Fund provides businesses with grants of between $500,000 and $25 million for pilot projects or pre-commercial projects aimed at reducing emissions. A total of $50 million was set aside for the fund for projects required to be in Australia and completed by 30 June 2025. The fund opened on 1 March 2021 and closed on 29 March 2021.

The objectives of the program were to:

- reduce emissions across energy generation, natural gas or hydrogen production and heavy industries (including manufacturing, chemicals, cement and fertiliser production)
- foster existing, pilot or pre-commercial CCUS facilities that could connect into a regional CCS hub in the future and bring together a network of multiple greenhouse gas emitters, enabling reductions in costs and risks for CCUS projects and large-scale abatement
- support the Australian Government's priority technology stretch goal to compress, transport and store CO_2 for less than $20 per tonne
- leverage expertise and viable geological storage resources for CCUS in Australia
- support new opportunities to use CO_2 in the development of CO_2-derived products and services.

The fund is fully expended having been distributed across a range of recipients (Table 1).

Table 1: Funding awards from the Carbon Capture, Use and Storage Development Fund
Source: Australian Government (n.d-b)

State (project location)	Applicant	Project	Grant amount
SA	Santos Limited	Moomba CCS Project	$15 million
Qld	Energy Developments Pty Limited	Landfill Gas Carbon Capture and Use Project	$9 million
NSW, ACT	Mineral Carbonation International Pty Limited	Australian CCU Flagship: demonstrating decarbonisation for heavy industry	$14.6 million
NSW	Boral Limited	Turning mineral waste to carbon sink – a low-cost carbon storage technology	$2.4 million
SA	Corporate Carbon Group Pty Ltd	Pilot Direct Air Carbon Capture, Use & Storage: off-site abatement & ACCUs	$4 million

Qld	Carbon Transport and Storage Corporation (CTSCo) Pty Limited	CTSCo Surat Basin CCUS Project	$5 million

Carbon Capture, Use and Storage Hubs and Technologies Program – Technologies Stream

This funding opportunity was developed to support innovative advancements in CCUS technologies. Funding was also available to identify and develop viable CO_2 storage sites. The program opened on 11 October 2021 and closed on 8 November 2021. Projects could apply for between $1 million and $30 million, with the projects required to be completed by 30 April 2031.

This grant aimed to:

- reduce the costs of CCUS technology adoption and deployment
- increase deployment of commercial-scale CCUS assets and infrastructure in Australia
- increase domestic and international collaboration on, and industry investment in, CCUS technologies
- increase domestic and export markets for CCUS technologies, products and services
- identify new viable CO_2 storage sites in Australia, or increase the understanding of the commercial viability of known CO_2 storage sites in Australia
- increase knowledge and capabilities in CCUS in Australia
- support the development of clean hydrogen industrial hubs or clean LNG production facilities.

This program complemented the Clean Hydrogen Hubs Industrial Hubs program. As part of the October 2022 federal budget the funding program was discontinued with no projects funded.

Carbon Capture Technologies Program

This $65 million program was developed to support CO_2 capture and utilisation technology development. The two-step grant application process opened on 19 September 2023 and closed on 9 April 2024. Projects could apply for between $1 million and $15 million, with projects expected to be completed by 30 March 2031. The projects funded, as well as the applicant and grant amounts, are shown in Table 2.

The granting program aims to:

- accelerate the development of emerging priority CO_2 capture technologies, including DAC, bioenergy with carbon capture and storage (BECCS) and CO_2 utilisation technologies
- support RD&D to advance the technological and commercial readiness of CCUS in hard-to-abate industries such as cement, chemicals and steel
- demonstrate the verifiable permanence of CO_2 sequestered via a range of utilisation applications
- support global CCUS capability development.

Table 2: Funding awards for the Carbon Capture Technologies Program
Source: DCCEEW (2024c)

Applicant	Project	Grant amount
Calix Ltd	Production of methanol from CO_2 released during cement production	$15 million
MCi Carbon Pty Ltd	Production of building materials from CO_2 released during cement production	$14.5 million
Airthena Technology Development Company Pty Ltd	Demonstrate the feasibility of large-scale DAC of CO_2	$11.7 million
Novalith Technologies Pty Ltd	Demonstrate the production of battery-grade lithium carbonate from CO_2 captured directly from the atmosphere.	$9.9 million
Pilot Energy Limited	Trial the management of multiple CO_2 streams from emerging point sources and DAC technologies-.	$6.5 million
KC8 Capture Technologies Ltd	Demonstrate the use of potassium carbonate to remove CO_2 from hard-to-abate industries	$5.4 million
University of Melbourne	Trial the conversion of CO_2 captured from the atmosphere into travertine, a carbonate rock	$1.6 million

2.4.2 Powering the Regions Fund

The Powering the Regions Fund (PRF) is a $1.9 billion initiative aimed at supporting the decarbonisation of existing industries and the creation of new clean energy industries in regional Australia. It is part of the broader Powering Australia Plan, which seeks to achieve emissions reduction targets of 43% below 2005 levels by 2030 and net zero emissions by 2050.

The PRF prioritises four main areas:

1. **reducing emissions in current industries:** exploring alternative methods to cut emissions in sectors where clean technology is not yet widely used
2. **encouraging new clean energy industries:** promoting the development of new industries that help lower emissions and create jobs and export opportunities
3. **supporting regional workers:** equipping regional workforces with the skills needed for decarbonisation activities and the growth of new clean energy sectors
4. **buying carbon credits:** maintaining the government's practice of purchasing ACCUs to aid in reducing emissions.

The fund aims to work with a wide range of stakeholders, including industry, investors, state and local governments, unions, First Nations Australians and regional communities, to design projects and technologies that will benefit regional Australia.

One of the funding streams related to funding for trade exposed safeguard facilities. Since 2023 $300 million of funding has been made available through grants to cover up to 50% of eligible project expenditure to reduce Scope 1 emissions from safeguard facilities (Department of Industry, Science and Resources, 2023). Although this funding could not be used for a new or expanded gas production facility, it could be used to subsidise the capital expenditure associated with developing CCS infrastructure. As of February 2025, there is still $300 million of funding that could be made available in the future.

2.4.3 Regional hydrogen hubs

As noted in the National Hydrogen Strategy, one of the areas of focus is the development of regional hydrogen hubs. These hubs aim to create a concentrated network of hydrogen production, storage and distribution facilities, leveraging local resources and infrastructure. The primary purpose of these hubs is to accelerate the growth of the hydrogen industry by promoting collaboration between government, industry and research institutions. They seek to reduce costs through economies of scale, support the commercialisation of hydrogen technologies, develop a skilled local workforce and in some cases facilitate the export of low-cost hydrogen to international markets.

Funding totalling $526 million was announced by the Australian Government for the development of five hubs focused in the following locations (noting that many of these hub locations are also NZEA priority regions) (NZEA, n.d):

1. the Pilbara region and Kwinana Industrial Precinct, WA
2. the Hunter Valley, NSW
3. Bell Bay Industrial Precinct, Tas
4. the city of Gladstone, Qld
5. Port Bonython, SA.

After this announcement, the city of Townsville was added as a sixth hub location.

Funding is delivered through two types of grants: large hub implementation grants up to $72 million and smaller (<$5 million) hub development and design grants. To date, almost all the hub implementation grant funds have been allocated to each region (Table 3), with eight successful grant awards, with the relevant states also contributing funds to support hub development (DCCEEW, 2024d). Nine hub development design grants have also been awarded, including for areas outside the six primary hub locations (Table 4).

Many of the related media announcements were made in 2023 prior to the 2024 National Hydrogen Strategy update, but a review of previous grant funding rounds relating to regional hubs makes mention of clean or green hydrogen (Commonwealth of Australia n.d-a; n.d-b).

Several of the hydrogen hub implementation projects have encountered difficulties and have either been withdrawn or are being reassessed by the project proponents.

Table 3: Regional hydrogen hubs implementation grants
Source: DCCEEW (2024d)

State (project location)	Applicant	Project	Grant amount
WA	Western Australian Government	Pilbara Hydrogen Hub	$70 million
WA	bp Australia	H2Kwinana Clean Hydrogen Industrial Hub	$70 million*
Qld	Stanwell Corporation	Central Queensland Hydrogen Hub (CQ-H2 Hub)	$69.2 million*
Qld	Edify	Townsville Region Hydrogen Hub	$71.9 million**

NSW	Port of Newcastle	Port of Newcastle Hydrogen Hub	$41 million*
NSW	Origin Energy	Hunter Valley H2 Hub	$41 million*
SA	South Australian Government	Port Bonython Hydrogen Hub	$70 million
Tas	Tasmanian Government	Tasmanian Green Hydrogen Hub	$70 million

*Under review or not proceeding

** Announced in 2024

Table 4: Regional hydrogen hubs development and design grants
Source: CSIRO (2023b)

State (project location)	Applicant	Project	Grant amount
WA	ENGIE	Pilbara Green Hydrogen Hub	$3 million
WA	Santos	Carnarvon Clean Hydrogen FEED	$3 million
Qld	Ark Energy	Han-Ho H2 Hub Feasibility Study	$2.42 million
Qld	Origin Energy & ENEOS	MCH Gladstone Project	$1.25 million
Qld	Vena Energy	Euroa Energy Project	$3 million
Tas	Origin Energy	Green Ammonia Project for Export (GRAPE) Bell Bay	$3 million
NT	INPEX	Darwin Clean Hydrogen Hub – market development study	$1 million
SA	Santos	Moomba Clean Hydrogen FEED	$3 million
Vic	Zero Degrees	Rosella 1 La Trobe Valley Blue Hydrogen	$2.98 million

2.4.4 Australian Renewable Energy Agency grants

ARENA is a government agency established to support the increased supply of renewable energy in Australia. It supports the global transition to net zero emissions by accelerating the pace of pre-commercial innovation, benefiting Australian consumers, businesses and workers. It funds projects that can help accelerate renewable energy in Australia, spanning from early-stage research to demonstration projects in the field. Initially created in 2012, ARENA has been one of the key organisations in relation to funding hydrogen-related projects, especially those that rely on renewable energy. Since 2017 there have been four funding programs related to hydrogen:

1. Advancing Renewables Program
2. Hydrogen Research and Development Funding Round
3. Iron and Steel Research and Development Funding Round
4. International Engagement Program.

As shown in Table 5, since 2017 ARENA has contributed $354 million, with over half of the funding provided since 2023. These grants have gone towards projects with a total value of $989 million.

ARENA is not permitted to co-invest in CCS projects as they are outside its mandate. As such, the funding for the Hydrogen Research and Development Funding Round was exclusively for renewable hydrogen project development, and while hydrogen was in the scope of the Iron and Steel Research and Development Funding Round, CCS technology pathways were excluded,

however funding may be available for low-carbon liquid fuels and CCU projects where the CO_2 is captured and utilised.

Table 5: ARENA funding, 2017–24
Source: ARENA (2024)

ARENA funding program	ARENA contribution	Total Value of Hydrogen Projects funded by ARENA
Advancing Renewables Program	$317.19 million	$882.87 million
Hydrogen Research and Development Funding Round	$34.29 million	$99.23 million
Iron and Steel Research and Development Funding Round	$2.03 million	$4.24 million
International Engagement Program	$0.99 million	$2.46 million
Total funding	$354.50 million	$988.80 million

2.4.5 Australia's Economic Accelerator grants

Australia's Economic Accelerator (AEA) is a $1.6 billion research funding initiative aimed at changing how academic research impacts Australia's economy. It focuses on bridging the gap between academic research and real-world applications by supporting the translation and commercialisation of world-leading research from the university sector. Between 2023 and 2043 the AEA aims to foster a research ecosystem where research is turned into tangible innovations and productivity improvements. It is administered by the Department of Education and as of March 2025 it has provided $8.53 million in seed funding to renewable and low-emissions technologies, which includes several hydrogen and CCS-related projects (Australian Economic Accelerator, 2025).

2.4.6 Hydrogen production credit incentive

As part of Australian Government's Future Made in Australia package, a temporary hydrogen production tax incentive was announced. The incentive will provide a refundable tax offset of $2/kg of renewable hydrogen produced for up to a period of 10 years between 2027–28 and 2039–40 (Australian Treasury, 2024a; 2024b). Following consultation in 2024, the first year in which offsets will be claimable is the 2027–28 financial year. Several eligibility criteria apply for offsets, including they must:

- be related to hydrogen produced between 1 July 2027 and 1 July 2040
- have a production profile certified by the CER
- be accompanied by a registered product guarantee of origin certificate

The incentive will be jointly managed by the Australian Taxation Office (ATO) and the CER (ATO, 2025).

Guarantee of origin (GO) scheme

The Guarantee of Origin Scheme is an emissions accounting framework to track the embedded emissions associated with products through the supply chain (DCCEEW, 2023b). Central to this will be the emissions intensity of products—for example for Hydrogen, the kg of $CO_{2\text{-}e}$ produced per kilogram of H_2 produced. The scheme also includes a renewable electricity certification mechanism, which, alongside other mechanisms can be used to evidence the renewable electricity used to produce a product such as hydrogen. The scheme will be voluntary and would operate under a cost-recovery scheme levied on scheme participants. However, hydrogen producers seeking to access funds under the Hydrogen Headstart program or Hydrogen Production Tax Incentive would be required to obtain GO certificates to evidence compliance. The scheme was proposed as part of the 2019 National Hydrogen Strategy.

In 2023, public consultation was sought on a draft version of a scheme design, emissions accounting approach and calculator, and the renewable energy certification component of the GO scheme (DCCEEW, n.d) In December 2024, the *Future Made in Australia (Guarantee of Origin) Bill 2024* (*Cth*) and associated bills were passed though both houses. The Department of Climate Change, Energy, the Environment and Water is consulting on subordinate legislation for the scheme ahead of scheme commencement in 2025.

2.4.7 Hydrogen Headstart program

In addition to the programs noted above, the Hydrogen Headstart program is administered by ARENA (DCCEEW, 2024e). Through successive federal budgets up to $4 billion has been allocated to facilitate investments that:

- accelerate the development of Australia's hydrogen industry
- enable the creation of clean energy industries
- establish Australia's connection to emerging global hydrogen supply chains.

In 2023 six expressions of interest renewable hydrogen projects were shortlisted, representing an electrolyser capacity of 3.5 GW (ARENA, 2023). Full applications for funding were received in 2024. Successful projects will be eligible to receive a production credit paid at a rate of $/kg nominated by the producer. This support is aimed at addressing the cost differential between the renewable hydrogen production cost and sales price. As with the Hydrogen Production Tax Incentive, participation in the GO scheme is required to evidence compliance and access funding. The Minister for Climate Change and Energy announced the first successful project on 20 March 2025 - up to $814 million in production support for the Muchison Green Hydrogen Project in the mid-west of WA (DCCEEW, 2025). To date ARENA has not funded any research related to CCS (due to restrictions on mandate), regardless of whether renewable energy was integrated. No hydrogen-related projects have been funded to date in the NT. In addition, hydrogen produced using steam methane reforming or coal gasification with CCS is not eligible for funding.

2.5 Other mechanisms

The Australian Government policies outlined in the previous section are directly relevant to CCUS, or adjacent to CCUS. However, there are also other government policies and mechanisms that may be of interest when considering how CCUS hubs may be enabled. These policies and mechanisms are summarised below. This summary may not capture all possible policies and mechanisms available but represents the key policies that the authors were aware of at the time of writing.

2.5.1 Infrastructure Investment Program

Through the Department of Infrastructure, Transport, Regional Development, Communication and the Arts, the Australian Government makes nationally significant investments in land transport infrastructure across Australia through its $120 billion Infrastructure Investment Program (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, n.d.).

These investments are based on long-term planning, including robust project identification and selection processes. This longer-term commitment provides certainty for stakeholders, allowing industry to efficiently manage skills and resources, and allowing state and territory governments to consider the most effective sequencing of major projects to maintain capacity in the construction sector. The IIP is designed to ensure that Australia's national land transport system is well-placed to meet future challenges (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, 2022a).

The government considers nationally significant transport infrastructure projects to comprise projects that require a clear role for the Commonwealth, and include at least two of the following characteristics:

- an Australian Government contribution of at least $250 million
- alignment with government priorities
- situated on or connected to the National Land Transport Network and/or other key freight routes, such as those identified in the National Freight and Supply Chain Strategy
- supporting other emerging or broader national priorities such as housing, defence, the development of critical mineral resources and Closing the Gap (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, 2023a).

The government priorities that will guide project eligibility include the project's ability to: increase productivity and enhance supply chain and land transport infrastructure resilience; advance equity and connectivity of communities and improve safety; and reduce transport emissions. Within the 2023 Infrastructure Policy Statement (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, 2023a), ensuring reliable links between producers and markets, including through international gateways and intermodal terminals, is noted as being critical to improving the efficiency and competitiveness of national supply chains. IIP funding is split equally between Australian Government and state and territory delivery partners. In addition to this direct funding mechanism, to obtain greater value for money the program also

allows the consideration of a range of other funding mechanisms, such as concessional loans, guarantees, phased grants and availability payments, equity injections, value capture and wider application of user charging (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, 2022b). Within the program, $200 million was assigned in 2023–24 over 2 years from major projects business case development through the Major Projects Business Case Fund (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, 2023b).

Middle Arm Sustainable Development Precinct infrastructure funding

The Australian Government is also supporting other large-scale projects in northern Australia, such as the Middle Arm Sustainable Development Precinct (MASDP) in the NT. The government's $1.5 billion in planned equity to support the development of the Middle Arm will pave the way for the precinct to be a globally competitive, sustainable precinct with a focus on renewable hydrogen and minerals processing, providing significant economic benefit and sustainable jobs and driving Australia's future net zero economy (Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts, n.d; Infrastructure Australia, n.d).

2.5.2 Government business enterprises

A government business enterprise (GBE) is a corporate Commonwealth entity or Commonwealth company, prescribed by the *Public Governance, Performance and Accountability Act 2013* (PGPA Act). It essentially operates like a private business, with a commercial focus, but is owned and controlled by the government. GBEs aim to fulfill a government purpose while also being able to make a profit, and to impact the Australian economy through productivity, job creation and the delivery of policy objectives.

Corporate Commonwealth entities

A corporate Commonwealth entity is a body corporate that has a separate legal personality from the Commonwealth. Corporate Commonwealth entities generally have enabling legislation that establishes the scope of their activities and a multi-member accountable authority (such as a board of directors). Reasons for creating a corporate Commonwealth entity include:

- the entity will operate commercially or entrepreneurially
- a multi-member accountable authority will provide optimal governance for the entity
- there is a clear rationale for the entity's assets not to be owned or controlled by the Australian Government
- the entity requires a degree of independence from the policies and direction of the Australian Government (Department of Finance, 2021).

Examples of current corporate Commonwealth entities include (Department of Finance, 2025a; 2025b):

- National Library of Australia

- Australian Broadcasting Corporation
- Airservices Australia
- CSIRO.

While corporate Commonwealth entities are still part of the Australian Government, they have a level of financial autonomy from the government and can generate, hold, borrow or invest money, enter contracts and own property separately from the Commonwealth. The entities may also engage staff outside those covered by the *Public Service Act 1999* (*Cth*) (Department of Finance, 2025a).

The PGPA Act does not give ministers a general power to direct the activities of a corporate Commonwealth entity, but it does give broad powers to require the entity to provide information about its activities. Corporate Commonwealth entities are generally not required to comply with policies of the Australian Government except where there is a direction from the responsible minister under the enabling legislation or a government policy order.

Although the creation of a corporate Commonwealth entity will generally require new legislation, the Finance Minister can establish a new body corporate through a rule made under the PGPA Act. This option can provide greater flexibility for entities that have a limited span of activity, but Parliament still can disallow a rule made by the Finance Minister and therefore prevent the creation of a Commonwealth corporate entity (Department of Finance, 2025a).

Commonwealth companies

A Commonwealth company is a company established under the *Corporations Act 2001* (*Cth*) that the Commonwealth controls – as such, the creation of a Commonwealth company does not require the development of specific legislation. While the Commonwealth can solely or partly own a Commonwealth company, it is legally separate from the Commonwealth.

Creating a Commonwealth company may be suitable if:

- the company will primarily conduct commercial or entrepreneurial activities and will generate profits for distribution to its members
- the company will operate in a commercial or competitive environment (at arm's length from government)
- the Australian Government is going the sell the company in the short to medium term. (Department of Finance, 2025a)

Examples of current Commonwealth companies include (Department of Finance, 2021):

- Snowy Hydro Limited
- NBN Co Limited
- Australian Rail Track Corporation

The Finance Minister's approval is required for the Australian Government to form or participate in forming a new company. Once created, a company has the power to enter into transactions, borrow money and operate without further permission from its members. The responsible minister is required to table a notice in the parliament when a Commonwealth entity engages in

certain activities involving a company (e.g. acquisition or disposal of shares) (Department of Finance, 2021).

While there are advantages to the creation of Commonwealth companies, there are potential pitfalls that need to be managed appropriately. These include a lack of parliamentary scrutiny over the company's establishment and operation, as well as the company being able to borrow money without government approval. Commonwealth companies can also have problems securing contracts and financing if they rely on annual funding from the government. Commonwealth companies are also neither guaranteed by the government nor exempt from Commonwealth, state and territory taxes and charges, unless in the latter case there is specific legislation for their exemption (Department of Finance, 2021).

2.5.3 Northern Australia Infrastructure Facility

The Northern Australia Infrastructure Facility (NAIF) is an Australian Government financier, providing concessional loans for infrastructure projects within Northern Australia and the Australian Indian Ocean Territories (NAIF, n.d.) Figure 4 shows the geographic region where projects can receive loans from the NAIF; however, projects do not need to be entirely within the region to be eligible for funding. The NAIF was established under the *Northern Australia Infrastructure Facility Act 2016* and its board makes investment decisions in accordance with the *Northern Australia Infrastructure Facility Investment Mandate Direction 2023 (Northern Australia Infrastructure Facility Act 2016, (Cth); Northern Australia Infrastructure Facility Investment Mandate Direction 2023 (Cth)).*

Any project that is seeking funding from the NAIF must submit an investment proposal that meets all the following criteria:

1. the project involves development or enhancement of Northern Australia economic infrastructure
2. the project will be of public benefit
3. the project is located in, or will have a significant benefit for, Northern Australia
4. for financial assistance in the form of a loan, the loan will be able to be repaid or refinanced
5. the project includes an Indigenous engagement strategy
6. if an alternative financing mechanism is provided in the form of equity or equity-like investment, this will generate a return to government.

In addition, the project must align with one or more of the government's policy priorities, which are:

1. sustainable and resilient economic development and the alleviation of economic or social disadvantage in Northern Australia
2. working with jurisdictions to deliver key infrastructure projects in Northern Australia
3. sustainability, climate change and circular economy principles and solutions in Northern Australia

4. realising the critical minerals strategy 2023–30
5. materially improving the lives of Indigenous peoples and communities.

Figure 4: NAIF geographic region
Source: NAIF (n.d.)

Since its inception in 2016 the NAIF has allocated $4.4 billion across 33 projects, with the largest being a $610 million loan to the Kidston Pumped Storage Hydro Project in Northern Qld (NAIF, 2024). As noted in its financial report, up to $7 billion can be allocated to eligible projects. To date, no CCS projects have been funded. However, there is nothing in the Act or investment mandate that explicitly prohibits providing concessional loans to CCS infrastructure projects within Northern Australia.

The finance policy development in this space, while not focused on CCS, can potentially be used to support it in the form of concessional loans. The availability of financing through the NAIF and NRFC (provided that it is required to enable the development of NT manufacturing industries) provides a potential route for financing common user-shared CCUS infrastructure. In particular, the NAIF financing vehicle is required, through its mandate, to provide funding for economic infrastructure, equity mechanisms and sustainable economic development principles. However, these financing mechanisms alone may not be sufficient to enable CCS project development in the near term.

2.6 Summary of Australian Government policies

This section has shown how economy-wide emissions targets have been developed by the Australian Government. The CCA has undertaken a Sector Pathways Review (Climate Change Authority, 2024) for the government and there are technology-focused emissions reduction strategies in place for some technologies, such as the Hydrogen Strategy. These reviews and strategies are critical in the development of a range of policy responses to achieve emissions reduction outcomes.

The CCA Sector Pathways Review (Climate Change Authority, 2024) has acknowledged a need for industry and government to assess the potential for CCU to be adopted at scale. While the report also recommends that low-emissions industrial precincts are developed, including pre-evaluation of regions for suitability for priority activities and new net zero industries, the link to CCS has not explicitly been made.

The updated Hydrogen Strategy and its change in focus from low-emissions hydrogen to renewable electricity-derived hydrogen generation, seeks to drive the development of a new industry, but it does not include incentives for decarbonisation of the existing hydrogen and ammonia industry in Australia. This is despite the strategy highlighting ammonia as a priority use case for enabling industry growth. As a result, emissions reduction technologies that do not depend on renewably produced hydrogen, for example autothermal reforming with CCS, are less well represented in policy. The resultant strategy and policy gaps can lead to a fragmented approach in which economy-wide emissions reduction objectives may not be achieved.

Emissions reduction strategies that encompass sectors, regions and new technologies are required for coherent policy development that will enable NDC and net zero targets to be achieved at least cost. The NZEA is supporting six regional areas for decarbonisation and transition activities but, at present, the Darwin region is not one of these declared areas (NZEA, n.d.).

The development of emissions reporting, large emitter reduction regulations (such as the Safeguard Mechanism) and the incentivisation of emissions reduction through ACCU methodologies will help lower economy-wide emissions. However, additional policy measures are necessary, particularly to drive decarbonization of hard-to-abate industrial sectors while preserving employment in the regions and incentivising new investment.

As outlined, Commonwealth legislation and regulations for offshore CCS (and onshore CCS with respect to the EPBC Act) are well developed and being updated to make sure they reflect best practice. There are also longstanding and experienced bodies that regulate CCS, (e.g., NOPTA, NOPSEMA) that are supported by other parts of government (e.g., Geoscience Australia, CSIRO). As such, Australia's Commonwealth CCS legislation and regulation in this policy area are more advanced and mature than many other jurisdictions in the region and globally (see the sections that follow).

Prior and current grants and incentives for emissions reduction and the generation of new products, such as low-emissions iron and steel, have been heavily focused on renewable energy generation and hydrogen production. There is a critical need to provide grants and incentives for nascent renewable hydrogen technology development and the associated industrial hubs to accelerate cost reductions and to help the technologies reach cost parity with other fuels. A continuing focus on reducing the cost of carbon capture and utilisation technologies will be important to identify alternative capture pathways and future utilisation technologies. As such, recent CCS funding, awarded exclusively through grants, has had a strong focus on CO_2 capture and utilisation technology development and demonstration.

While there are significant funds available for the financing of large infrastructure projects, the opportunities for CCUS financing are either limited or may even be explicitly excluded. Only two CCS projects have been directly funded by government (Moomba and CTSCo) through recent granting rounds. Grants have been provided for hydrogen hub development (with only one focused on the NT), but the focus has been primarily on renewable hydrogen hub development.

The current granting and incentive approaches have excluded opportunities for CCS to play a role in decarbonisation of existing industries and infrastructure (including low-emissions hydrogen project development). In addition, there are gaps within these granting and incentivisation approaches that prevent consideration of sector coupling opportunities with renewable electrification, low-emissions hydrogen and CCS that could be combined to accelerate emissions reduction from industrial precincts and meet economy-wide net zero emissions goals.

Notwithstanding the lack of direct financing and incentives for CCS, there are Australian Government policies in place that, while not specifically designed to support the development of CCUS projects, could still be used to provide financing and corporate structures to enable the delivery of a CCUS hub in the NT.

3 Northern Territory policies

Further to the Australian Government's policies, the NT has also implemented several policies specific to or associated with CCUS, which are detailed below.

3.1 Carbon capture use and storage policies

In October 2023, the NT Government released its CCUS framework as a discussion document describing an integrated system of policy-based themes (Figure 5). The seven policy levers required to implement this CCUS strategy are: regulation, financing, incentives, technology, innovation, stakeholder engagement and legislation. The framework draws upon scientific literature and on experience from existing CCUS projects worldwide. This is summarised into fundamental principles, practical guidance and suggested actions. The framework constitutes part of the NT's larger decarbonisation agenda.

Figure 5: Basic elements of the NT CCUS framework

The NT operates within the policy framework of the Australian Government in matters related to the management of carbon emissions. Consequently, there is an overarching regulatory statement that covers how greenhouse gas emissions are regulated (Northern Territory Government, 2025). This document supersedes the previous large emitters policy that was in effect between 2021 and 2024.

The main guiding policies of the NT's Regulatory Statement are as follows:

- **National Regulation and the Safeguard Mechanism:** the statement notes the Australian Government's 2050 net zero commitment, which is also reaffirmed as a commitment of the NT

Government. It is noted that the Safeguard Mechanism applies to the NT's largest emitters, these being the several LNG facilities and largest mines operating in the territory, and that net zero Scope 1 emissions must also apply to any extraction activities involving the Beetaloo Basin.

- **Changes to the *Environmental Protection Act 2019 (NT)*:** due to changes in national and NT policies on greenhouse gas emissions, the NT Environment Protection Authority (NT EPA) has withdrawn its guidance on 'atmospheric processes' and will issue new guidance. Until then, it has suggested that proponents consult with the environmental assessments team for guidance on greenhouse gas emissions assessments. The NT EPA may consider other statutory processes, such as the Safeguard Mechanism, when determining the need for assessment and may recommend conditions to the Minister for Lands, Planning and Environment to address emissions. This is anticipated to affect whether environmental impact assessments are required, potentially reducing the need if sufficient policies and regulations already exist at the federal level.
- **Petroleum (Environment) Regulations 2016:** the petroleum industry is required to adhere to a code of practice set by petroleum legislation, which outlines minimum standards for the industry. This Code specifies the minimum standards for reporting greenhouse gas emissions from upstream infrastructure. It is currently being updated to include requirements for considering both Scope 1 and Scope 2 emissions, and to acknowledge the Safeguard Mechanism's role in managing emissions from onshore gas activities that emit more than 100,000 tonnes of $CO_{2\text{-}e}$ per year.
- ***Waste Management Pollution Control Act 1998 (NT)*:** noting that the Act's primary focus is waste management, pollution control and preventing environmental harm, rather than the direct regulation of greenhouse gas emissions (Regulatory Statement: Regulation of LNG and other emissions Northern Territory Environment Protection Authority (NTEPA), 2024).
- **Greenhouse Gas Offsets Policy and Technical Guidelines:** these support the consistent, transparent and appropriate use of offsets under NT legislation to compensate for emissions and support achievement of the NT's net zero emissions by 2050 target. The policy is a statutory instrument given effect under s 125(2) of the *Environment Protection Act 2019 (NT)* (EP Act) and is a component of the Northern Territory Offsets Framework.

3.1.1 Specific legislation and regulation associated with CCS

The NT does not yet have specific legislation or regulation that covers CCS and CCUS. The delivery of an assessment of onshore potential for geological storage sites (Talukder et al., 2024) in the NT has illuminated potential favourable locations not previously reported in the National Carbon Mapping and Infrastructure Plan (Carbon Storage Taskforce, 2009). This has provided the impetus to initiate legislation for onshore CCS in the NT. Observations on the development of comparable legislation (passed) and regulation (in draft) in WA are providing a pathway (and lessons learned) to help accelerate the development of similar materials.

However, there is a broad base of other legislation that has the potential to impact on the MASDP CCUS facility. There are also facets of each piece of legislation that have the potential to impact on other legislation, and these interactions must be considered whenever changes are made to any

one piece of legislation. For example, changes to the *Energy Pipelines Act 1981* (*NT*) and its Regulations may (or may not) influence the Environment Protection Act and its Regulations.

The Middle Arm Sustainable Development Precinct

The NT Government is working with industry and the Australian Government to transform the Middle Arm of Darwin Harbour into a sustainable 'development-ready' industrial precinct with common user infrastructure. The MASDP concept envisages a broad range of industries being established (Figure 6). With early conceptual planning largely complete, the project is now transitioning into the key stages of master planning, concept design, and strategic environmental assessment.

Figure 6: A map of the Middle Arm Sustainable Development Precinct
Source: Northern Territory Government (2024)

The following key legislative and regulatory instruments in the NT, group government agency, may be applicable to the CCUS industry.

NT Environment Protection Authority

The NT EPA was established through the *Northern Territory Environment Protection Act 2012* (*NT*). The purpose of the EP Act is to protect the environment and promote ecologically sustainable development that benefits NT residents without harming the environment. It emphasises the importance of environmental impact assessments, environmental approvals and environmental licensing for mining activities in protecting the NT's environment. It also ensures broad community involvement in these processes and acknowledges the role of First Nations peoples as stewards of their land, highlighting their participation in environmental decision making.

Relevant regulations and laws administered by the NT EPA include the following:

- **Environment Protection Regulations 2020:** a framework for environmental protection in the NT. These Regulations outline the processes for environmental impact assessments, the declaration of protected environmental areas, and the management of activities that may cause significant environmental harm. Any development within the NT that is likely to have a significant environmental impact is required to be evaluated by the NT EPA and receive environmental approval by the relevant minister before the development can proceed. Guidance for the environmental approval process has been developed by the NT EPA (Northern Territory Environment Protection Authority (NTEPA), 2024).
- **Environment Protection (National Pollutant Inventory) Objective 2004:** legislation that supports the National Pollutant Inventory (NPI) in the NT. The NT EPA meets its obligations under the Commonwealth NPI National Environment Protection Measure through the collection and dissemination of information regarding emissions and transfers of identified substances to the air, land and water. The reporting thresholds are described in the National Pollutant Inventory Guide (Department of the Environment, 2015); if any relevant thresholds are exceeded, project proponents are required to engage with the NT EPA to ensure that emission data are registered.
- ***Waste Management and Pollution Control Act 1998 (NT)*:** the Act aims to protect the environment by preventing and managing pollution and waste. It establishes a framework for regulating activities that may cause environmental harm, ensuring that individuals and businesses manage and dispose of wastes in line with regulatory requirements. The Waste Management and Pollution Control (Administration) Regulations 1998 detail how the NT EPA regulates specific wastes, including defining what are prescribed wastes as well as maintaining a register of licensed waste handlers and approved disposal sites.

Department of Lands, Planning and Environment

The NT Department of Lands, Planning and Environment (DLPE) administers and regulates various aspects of land use, environmental protection and development. Its main functions relate to land use planning and management, heritage management, environmental management (through the NT EPA), water resources management and Crown lands management. The following Acts relate to these functions:

- ***Planning Act 1999* (*NT*):** this Act provides the framework for land use planning and development in the NT. Any development, whether it be new buildings, works or the creation or consolidation of sub-divisions, requires planning approval from the Development Consent Authority.
- ***Building Act 1993* (*NT*):** this Act regulates building standards and practices to ensure safety and compliance. Building approvals are required before construction can commence and are evaluated by the NT Building Advisory Services Division.
- ***Heritage Act 2011* (*NT*):** this Act protects and manages heritage sites and objects in the NT. The DLPE maintains the NT's Heritage Register and administers changes to what is included in the register.
- ***Environmental Offences and Penalties Act 1996* (*NT*):** this Act establishes penalties for environmental offences to deter activities that cause environmental harm.

- ***Water Act 1992* (*NT*):** this Act regulates the use and management of water resources in the NT.
- ***Crown Lands Act 1992* (*NT*):** this Act governs the management and administration of Crown land in the NT.

The NT Department of Mining and Energy (DME) was established in 2024 to support key the development of major energy and mineral extraction projects within the territory (DME, n.d.). Its primary goals involve supporting the expansion of domestic and regional energy supply, including renewables and energy systems as well as mineral industry development. Relevant to CCS regulation is the Mining and Energy Development Division, which manages policies and regulations relating to pipelines under the following Acts:

- ***Pipelines Act 1981* (*NT*) and Northern Territory Energy Pipelines Act Regulations 2001:** this is the primary legislation that outlines the construction, operation, maintenance and cessation of activities for conveyance of energy producing hydrocarbons (and related purposes). The definitions contained within the legislation do not consider CO_2 and would need amendment if it is to be applied to CCS projects.
- ***Petroleum (Submerged Lands) Act 1981* (*NT*) and Northern Territory Petroleum (Submerged Lands) Act Regulations 1987:** this is the primary legislation that provides for exploration and production of petroleum resources from lands adjacent to the NT coast. Based on activity within the legislation and regulation development by the WA Government, it is likely to have future application if pipelines cross from on- to offshore areas for disposal of CO_2 within and beyond the 3 nautical mile limit.
- ***Trans-Territory Pipeline and Blacktip Gas Projects (Special Provisions) Act 2005* (*NT*):** this legislation applies special provisions for the Trans-Territory Pipeline Project and the Blacktip Gas Project, which operates across the border of WA and the NT. Updates to the legislation are not likely to be considered for the corridor (and/or pipeline) if it is reconfigured for transport of CO_2.

Work on NT CCUS legislation

Except for those associated with the *Dangerous Goods Act 1998* (*NT*), there are currently no regulations that permit (or do not permit) transport and management of bulk CO_2 within the NT. Hazardous goods legislation does not generally apply to materials in the volumes being considered for likely CCS projects.

There are three options that the NT could take to address its regulatory options for the MASDP CCUS facility within the desired timeframe:

1. **Modification of existing Energy Pipeline Act and Regulations:** while this option may seem relatively easy, some complications may exist. As a minimum, definitions within the body of the instruments will need to be modified, reference to appropriate standards should be made and a process of due diligence followed to make sure that conflict with other parts of the broader regulatory framework do not occur.
2. **Project-specific legislation:** in the absence of NT-wide regulations, legislation specific to the MASDP CCUS project could be written, with a view to addressing broader-based regulations at a later date.

3. **Preparation of NT-wide regulations:** this will ultimately be required when the CCS industry grows and is able to expand onshore. NT-wide regulations would be far more comprehensive than project-specific ones and subject to a more thorough and detailed due diligence process.

Irrespective of which form the CCUS regulations take, they should be based on international standards and must be compatible with those nations with whom Australia establishes arrangements under the London Protocol.

3.2 Hydrogen policy

In 2020 and 2021 the NT released its Renewable Hydrogen Strategy and Hydrogen Master Plan, which provide a framework and set of objectives for using hydrogen to achieve its decarbonisation objectives as well as promoting economic growth (Northern Territory Government, 2020). The strategy includes six key themes and related actions:

1. **develop local industry**
2. **optimise available resources:** assist the Australian Government with its national hydrogen infrastructure assessment; develop the necessary infrastructure to enable hydrogen export as well as local utilisation to achieve the NT's net zero target
3. **grow demand for hydrogen:** engage with trade partners to better understand their future hydrogen needs as well as assess current renewable energy availability
4. **support innovation:** encourage local pilot and demonstration projects, with an emphasis on remote power systems and long-distance transport
5. **review and update regulations**
6. **engage with communities**

The Hydrogen Master Plan specifically identifies the MASDP as a location where industrial activities can be undertaken appropriately and a possible location for renewable hydrogen development. The plan is an extension of the strategy following recommendations made by the NT's Economic Reconstruction Commission.

In June 2022, the NT Government announced an investment of $5 million over 4 years to expand the NT's hydrogen industry (Northern Territory Government, 2022). Key focus areas include:

- establishing fit-for-purpose standards and regulations for the production, transportation, storage and use of hydrogen
- enhancing local workforce skills and capabilities
- optimising land use to enable efficient and timely infrastructure development
- coordinating renewable hydrogen industry development with renewable energy resource assessments and strategic water planning
- integrating hydrogen industry planning with the transport and logistics sector
- building community understanding of the emerging hydrogen opportunities
- assessing early commercial applications and economic fuel-switching opportunities.

3.3 Northern Territory policies summary

While there is no specific CCUS legislation in place in the NT at present, work is underway to amend or develop legislation to enable CCUS to occur. Other state-based legislation and regulations that have already been implemented could form the basis of the design of this legislation and regulation.

Apart from these developments, many of the other CCUS framework elements shown in Figure 3.1 currently rely on federal policies.

4 Other Australian states' policies and funding

As discussed in section 2, federal legislation for CCS is principally addressed by the OPGGS Act, but this legislation was specifically developed for offshore Commonwealth waters. As such, each state or territory will need to develop its own legislation and regulation for onshore and state waters for CO_2 transport and storage. The primary legislation to support geological storage is summarised in Table 6.

Table 6: State-level mechanisms to address CCS

State/Territory	Has CCS legislation?	Operationalised CCS
ACT	No	No current demand for CCS in ACT
NSW	No	No current demand for CCS in NSW
NT	No, but under consideration (see section 3)	
Qld	Yes, but the *Mineral and Energy Resources and Other Legislation Amendment Act 2024* (*QLD*) (MEROLA Act) means that CCS is not permitted in Qld's Great Artesian Basin (see right). Related legislation includes: • *Greenhouse Gas Storage Act 2009* (*QLD*) • *Petroleum Act 1923* (*QLD*) • *Petroleum and Gas (Production and Safety) Act 2004* (*QLD*) • *Environmental Protection Act 1994* (*QLD*)	Cessation of Carbon Transport and Storage Corporation (CTSCo) project, and also impact other activities previously considered (e.g., Bridgeport's Moonie CCUS/EOR project).
SA	Yes, *Energy Resources Act 2000* (*SA*) with a Statement of Environmental Objectives and aligned with the *Landscape Act 2019* (*SA*) Petroleum and Geothermal Energy (Energy Resources) Amendment Bill 2023 (*SA*)	Moomba CCS, operated by Santos in the Cooper Basin; 800 000 tonnes of CO_2 have been injected between September 2024 and June 2025.
Tas	No	

Vic	Yes, *Greenhouse Gas Geological Sequestration Act 2008* (*VIC*) *Pipelines Act 2005* (*VIC*)	CO2CRC used a range of instruments prior to Vic's CCS development including the Otway International Testing Centre onshore. CarbonNet project offshore straddles state and federal waters in the Gippsland Basin; permitting is not finalised and no CO_2 injection to date.
WA	Yes, recently passed amendment to *Petroleum and Geothermal Energy Resources Act (1967)* (*WA*) Petroleum Legislation Amendment Bill 2023 to allow CCS through amendments to the • *Petroleum and Geothermal Energy Resources Act 1967* (*WA*) • *Petroleum Pipelines Act 1969* (*WA*) • *Petroleum (Submerged Lands) Act 1982* (*WA*) • *Barrow Island Act 2003* (*WA*) The Southwest Hub and In-Situ Lab were facilitated by the Mining Act for purposes of data collection	Regulations are in development for onshore storage of CCS, and other energy-related activities Barrow Island Act is the instrument by which the Gorgon CCS project is operated. Over 11 Mt of CO_2 have been injected between commencement in 2019 and May 2025. South West CCS Hub data collection CSIRO In-Situ Lab data collection Several projects, both onshore and offshore WA are in development but Barrow Island remains the only location where CO_2 injection has occurred.

Other aspects of policy and regulation at the state or territory level will include transport of CO_2, such as pipelines and offtake if maritime vessels, trains or trucks are used to move substantial amounts of CO_2. While some of these facets will already be included in existing legislation and regulation (e.g. dangerous goods or pipelines legislation), modifications to legislation may be required on a case-by-case basis.

With respect to recent changes to Qld's CCS regulations in 2024, all greenhouse gas storage activities within Qld's Great Artesian Basin have been banned as part of the MEROLA Act (Queensland Government, 2025). A summary of the changes include:

- any permits approved or being considered under the *Greenhouse Gas Storage Act 2009* (*QLD*) should be withdrawn or rescinded; future exploration and lease applications are prohibited
- enhanced petroleum recovery through a greenhouse gas storage stream is an unauthorised activity under the *Petroleum Act 1923* (*QLD*) and *Petroleum and Gas (Production and Safety) Act 2004* (*QLD*); related applications need to be withdrawn

- related approvals and applications under the *Environmental Protection Act 1994* (*QLD*) are terminated.

Given the relative size of the Great Artesian Basin, the scope for CCS within Qld is significantly reduced.

Several states have also provided fiscal support for CCS in addition to support from the commonwealth. The CarbonNet project in Victoria is one example, which since 2009 has received funding from both the commonwealth and Victorian government (CarbonNet, 2023; 2024). In November 2024 the Western Australian government released its Carbon Capture, Utilisation and Storage Action Plan, which sets out the governments vision for CCUS as one method to support decarbonisation and economic diversification within the state (Government of Western Australia, 2024a; 2024b). Several funding streams related to CCUS have been developed in the past with the action plan signalling future plans for co-investment opportunities (Government of Western Australia, 2024c).

Although this review does not exhaustively cover every policy and piece of legislation related to CCS across all states and territories, it remains relevant to the NT Hub. It highlights examples of how the Northern Territory government, in collaboration with the Commonwealth, could further develop policies to support CCS implementation in the region. States that have shown the strongest support for CCS have conducted comprehensive reviews of all available fiscal levers to facilitate its development.

5 International policy and regulatory examples

Within a global context Australia has, for some time, led the development of the necessary policies, legislation and regulations for CCS. By 2023, Australia was regarded as being top of the Global CCS Institute legal and regulatory league table (Table 7; Havercroft and Raji, 2023). Since then, several countries have embarked on developing their first CCS-specific legislation and regulations, while others have made alterations to their existing policies and legislation. This has resulted in the emergence of new entrants who are now accelerating their demonstration and commercial-scale projects (e.g. Greensands project where Belgium and Denmark have accelerated activities in the transnational movement of CO_2 – see the *Task 4* report; Stalker et al., 2024). As well as CCS- and CCUS-specific policies and legislation, several countries have supported CCUS business models through a range of policy levers within the context of low-emissions hub business models.

Table 7: Global CCS Institute legal and regulatory league table, 2023
Source: Havercroft and Raji (2023)

COUNTRY	SCORE	COUNTRY	SCORE
Australia	70	Malaysia	44.5
United Kingdom	68	Spain	43.5
Denmark	66.5	Mexico	41.5
United States of America	66.5	Korea	39.5
Canada	66	Japan	36.5
Norway	61.5	New Zealand	36.5
Croatia	60.5	South Africa	36.5
Iceland	58	Singapore	36
Netherlands	58	Slovenia	36
Germany	57.5	Trinidad and Tobago	34.5
Greece	57.5	Latvia	32.5
Italy	57.5	Egypt	32
Cyprus	57	Estonia	31
Malta	56	Algeria	30
Sweden	56	Austria	30
Luxembourg	53.5	Brazil	30
Czechia	51.5	China	28
Bulgaria	49.5	Philippines	26.5
Hungary	49.5	Vietnam	26
Slovak Republic	48.5	India	25
France	48	Ireland	25
Indonesia	48	Oman	23
Lithuania	47.5	Thailand	22
Belgium	47	Botswana	18
Portugal	47	Brunei	16
Romania	45.5	United Arab Emirates	13
Finland	45	Saudi Arabia	10.5
Poland	45	Switzerland	N/A

This section focuses on selected CCS and CCUS policy examples from South-East Asia and briefly reviews European policy. It augments the examples and information provided in the reports for *Tasks 2, 3 and 4* (Rogers et al., 2024; Joodi et al., 2024; Stalker et al., 2024) and includes hydrogen and other policies where appropriate, but comparison is not the key focus here.

This review of CCS and CCUS policies is not exhaustive as it is often difficult to identify policies, legislation, regulations and engagement methods in other languages. Furthermore, not all jurisdictions are as open with policy and regulatory information as Australia. However, these examples provide indicators of the maturity and styles of approach taken by different jurisdictions to policies with respect to low-emissions hubs and identify learnings where appropriate.

Transnational movement of CO_2

As CCUS hub concepts have developed, there has been increased focus on the potential for South-East Asian transnational transport and geological storage of CO_2. The benefit to proponents with activities in Australia is the ability to manage both Australian and international emissions targets, while increasing storage volumes and developing improved economies of scale for storage projects.

To satisfy London Protocol requirements, international arrangements or agreements will need to be established between Australia and CO_2 exporting and importing countries. Japan, Singapore and the Republic of Korea are looking to other countries with appropriate geology to augment their in-country storage capacities. This will require the development of bilateral instruments to enable the export/import of CO_2. These bilateral instruments will set the conditions under which CO_2 can be transferred between each jurisdiction. Australia may also export CO_2, and the same challenges will apply. For example, CO_2 derived from the Santos-operated Barossa Field (in Australian waters) may be transported by pipeline to the Bayu-Undan Field (located in Timor-Leste's offshore waters).

5.1 South-East Asia and adjacent regions

Governments across the region are laying the groundwork for CCS through legislation, policies and collaboration. For early-mover countries such as Australia, the focus has been on operationalisation and streamlining existing regulations (see section 2).

Several other jurisdictions have developed their CCS policies or passed their first CCS legislation since the last *Global Carbon Capture and Storage Institute Annual Status Report* (Global CCS Institute, 2024a):

- Indonesia (22nd in the Global CCS Institute legal and regulatory league table in 2023) released a presidential regulation in January 2024 providing a framework for CCS regulation, specifically allocating 30% of the country's storage capacity for imported CO_2 (President of the Republic of Indonesia, 2024).
- Japan (33rd) (Matsuoka, 2024) introduced its CCS Business Act in 2024, and is exploring nine candidate CCS networks, with five intended for CO_2 storage within Japanese territory and four considering geological storage in other countries, such as Malaysia (Ministry of Economy, Trade and Industry (METI), 2023a).
- Malaysia (29th) has just introduced to parliament the Carbon Capture and Storage Bill 2025, aiming to establish itself as a storage hub for Asia, viewing it as a long-term economic opportunity (Kiat, 2025).
- The Republic of Korea (32nd) announced its CCS Act, which was fully enacted in March 2025 (Lee and Ko, 2024). The Act outlines processes for permitting and financial support mechanisms, and provides a framework for operations, safety standards and monitoring. Notably, this legislation includes provisions for the transnational transport of CO_2.

- China (45th) is making considerable progress with roadmaps and other activities to fund developments (Asian Development Bank, 2015; Asian Development Bank, 2022; Global CCS Institute, 2024a).
- India (48th) has recently recognised the need to evaluate domestic potential for decarbonisation (Mukerjee and Chatterjee, 2022).

Collaboration is key for these South-East Asian (and European) approaches, with many memoranda of understanding being signed between countries to facilitate transnational projects and proceed with prefeasibility studies. Comparing the regulatory and legislative arrangements for CCS between Australia and other South-East Asian countries is crucial for identifying best practice, harmonising standards and facilitating transnational CCS projects. Such a comparison helps us to understand the diverse regulatory landscapes, address potential legal and technical barriers, and promote regional cooperation. In addition, it helps inform relevant government agencies and project proponents as to the gaps in Australia's CCS regulatory and policy framework to enable the development of CCS projects as part of Australia's existing trade relationships.

Table 8 and the following sections briefly summarise CCS- and CCUS-related policies in key jurisdictions across South-East Asia and the surrounding region.

Table 8: Current status of CCUS policy within key jurisdictions globally[5]

	Strategy	Legislation	Regulation	Financing	Incentives	Technology	Innovation	Engagement
Timor-Leste	✓	⚙	⚙					
Japan	✓	✓	⚙	✓	✓	✓	✓	✓
Republic of Korea	✓	✓	⚙	✓	✓	✓	✓	
Indonesia	✓	✓	⚙		✓			
Malysia	✓	✓	⚙		✓			
Singapore	✓	✓	⚙		✓	✓	✓	
Thailand		⚙	⚙					
China	✓	✓	✓	✓	✓	✓	✓	
India		⚙	⚙	⚙	⚙	⚙	⚙	
European Union	✓	✓	✓	✓	✓	✓	✓	✓
Norway	✓	✓	✓	✓	✓	✓	✓	
United Kingdom		✓	✓	✓	✓	✓	✓	

5.1.1 Timor-Leste

Timor-Leste has a national cumulative annual emissions rate of less than 0.003% of global emissions but is highly impacted by the effects of climate change. It has provided initial and updated NDCs and prepared a National Climate Change Policy in 2021. The government cites an 'acute need for immediate, sustainable, predictable, and appropriate support from the international community to access the required financing, capacity building, technology transfer and technical assistance needed' to minimise these impacts (Government of the Democratic Republic of Timor-Leste, 2022)

Timor-Leste has committed to developing new climate change laws, a National Climate Change Strategy and Action Plan to guide implementation of the National Climate Change Policy, and new land tenure reform, and to introduce a new initiative to formulate a low-carbon development strategy. A nature-positive integrated approach to Timor-Leste's adaptation, mitigation and socioeconomic development objective will address improving integrity, carbon sequestration potential, landscape management and resilience. Within these objectives will be the development

[5] In this table, a 'tick' symbol indicates that there is evidence of the relevant policy being implemented in a given country. The 'two cogs' symbol signifies that the policy is currently under development. Please note that the table does not assess the effectiveness of these policies, only their presence or development status.

of a vision for diversification of growth in Timor-Leste's non-oil economy, while engaging in carbon market mechanisms for nature-based solutions and other approaches.

For Timor-Leste to import CO_2 via the Bayu-Undan pipeline from Darwin, Australia must be satisfied that Timor-Leste has in place sufficient CCS management and regulatory safeguards to ensure that the Santos-proposed Bayu-Undan project complies with the terms of the London Protocol. In November 2023, Timor-Leste established a draft CCS framework to cover matters related to economics, regulations and policy of its developing CCUS industry. This framework was developed by the International Finance Corporation and is currently undergoing review and consideration by the Petroleum Minister in Dili prior to the commencement of bilateral treaty negotiations.

5.1.2 Japan

Early research for CCS in Japan commenced in the 1980s, with public funding to explore geological storage including the Nagaoka Project (Akai, 2016; Research Institute of Innovative Technology for the Earth, 2007). The Tomakomai CCS Demonstration Project was a large-scale project that injected 300,000 tonnes of CO_2 between 2016 and 2019 (Japan CCS, 2020). In 2023, the Japan Organization for Metals and Energy Security (JOGMEC) announced seven projects that, if successful, will secure 13 million tonnes per annum storage capacity by 2030 (Ministry of Economy, Trade and Industry (METI), 2023a). In 2024 the list of projects was updated with nine projects identified as "Advanced CCS Projects", representing a mix of projects capturing and transporting CO2 by pipeline and or ship (JOGMEC, 2024).

In 2022, the CCS Long-term Roadmap was developed to implement CCS systematically, promoting the development of CCS with minimal social costs, in an effort to develop an energy-secure economy (Ministry of Economy, Trade & Industry (METI), 2023b). The roadmap includes several actions, including:

1. implementing laws for governing CCS business
2. reducing CCS costs
3. securing additional government support
4. promoting public support for CCS
5. promoting overseas CCS business.

Prior to 2024 there were no specific laws or regulations governing CCS activities. The Tomakomai Project relied on existing laws for capture activities, specifically the *High-Pressure Gas Safety Act* and *Industrial Safety and Health Act*, to carry out research on CCS. (Japan CCS, 2020). Onshore injection was regulated under the *Act on Prevention of Marine Pollution and Maritime Disaster (2007)*. In March 2023, METI published its final report on the implementation of CCS and released a draft interim summary of the CCS regulatory framework the following December. Currently, the regulatory framework allows for offshore disposal under conditions consistent with the London Protocol only. Onshore disposal of CO_2 is not currently permitted. The *CCS Business Act* was passed in May 2024, introducing a regulatory framework for CCS activities (Matsuoka, 2024). The framework introduced a licensing regime for CCS operators and new regulations for CO_2 pipelines. Further development of specific regulations and guidance are in development.

Japan has several other related emissions reduction policies in place that will support the development of CCS; they are discussed in the reports for *Tasks 2 and 3* (Rogers et al. (2024) and Joodi et al. (2024). Briefly, these include establishment of the Asia CCUS Network, CCUS projects having access to US$130 billion (approximately A$209 billion) of climate bonds, a proposed low-emissions hydrogen contract for difference (CfD) mechanism, as well as funding for pilot and demonstration projects (e.g. the Excool demonstration test vessel for the transport of LCO_2 funded through the New Energy and Industrial Technology Development Organisation (Mitsubishi Heavy Industries (MHI), 2023).

5.1.3 Republic of Korea

The Republic of Korea is focusing on CCS as a means of reaching its carbon goals and has a target of 11 Mt of CO_2 reduction through CCS by 2030 by actively seeking to develop transnational CCS value chains and to export CO_2 for storage in Indonesia, Malaysia and Australia (Global CCS Institute, 2024b).

The Republic of Korea is building a platform for CCS management through its *Climate Crisis Response Act 2021* and the allocation of US$10.3 billion (approximately A$16 billion) in its budget for greenhouse gas emissions reductions (Korea Energy Economics Institute, 2021). In early 2024, the *Act on Capture, Transportation, Storage and Utilization of Carbon Dioxide* (CCUS Act) was passed. Previously, details of CCUS-related regulations were described across 40 different laws, with this Act attempting to reduce the regulatory risk associated with CCUS (Lee and Ko, 2024). A summary of the key elements of the Act include:

1. CO_2 no longer being considered a waste product under the *Waste Management Act*
2. permitting is required to be obtained from the Minister of Trade, Industry, and Energy for the following activities, with the potential for administrative and financial support:
    a. installation and operation of capture facilities
    b. supply of CO_2 for the purposes of research, experimentation and empirical study
    c. transportation of CO_2
    d. exploration activities for storage sites
    e. the establishment and implementation of monitoring plans after cessation of injection.
3. supporting activities from the government for:
    a. the creation of clusters for CCUS development, including support for the costs of infrastructure and operations
    b. research, development and commercialisation of CCUS technologies
    c. other support for matters pertaining to certification, standardisation of technologies, funding support, and workforce training.

Implementation of the Act, including the development of subordinate legislation and regulations, is still a work in progress as of March 2025.

In addition to the policies and legislation, the Republic of Korea has a clean hydrogen/ammonia CfD mechanism through which methane-derived hydrogen production with CCS will be eligible for funding (for more details see the *Task 3* report; Joodi et al., 2024).

5.1.4 Indonesia

Indonesia has a rapidly developing and comprehensive regulatory framework. It is one of the first countries in the Asia-Pacific region to introduce regulations on CCS. Specific regulations include Presidential Regulation #2 of 2023 (Minister of Energy and Mineral Resources, Republic of Indonesia, 2023) and Presidential Regulation #14 of 2024 (President of the Republic of Indonesia, 2024). Regulation #2 permits CCS activities and covers the following topics:

1. **planning and execution:** contractors must propose CCS or CCUS plans during exploration and exploitation periods, including feasibility studies and technical, economic and safety aspects
2. **monitoring and verification:** continuous monitoring from the approval of the CCS/CCUS plan until 10 years after closure; CCS/CCUS activities must be independently verified to ensure compliance with standards and regulations
3. **economics and finance:** funding and tax incentive can be made available for CCS/CCUS activities
4. **emergency response:** emergency response systems must be in place to mitigate risks
5. **administrative sanctions:** these can include temporary suspension of activities.

It should be noted that while this regulatory framework is in place, the detailed regulations and policies have yet to be established. The current regulation focuses on the oil and gas sector, while Regulation #14 is broader in scope. It builds on the previous regulation and requires separate permits for CO_2 exploration and storage operations. CCS operators that have already invested in Indonesia are allowed to allocate up to 30% of their total storage space for imported CO_2 and to use depleted reservoirs or aquifers within their assets for CCS operations. Foreign suppliers of CO_2 and CO_2 storage site operators are able to ease their decarbonisation pathways, contribute to Indonesia's climate efforts and provide the country with benefits by paying royalties on the storage fees imposed. Domestically, Indonesia also has a carbon price, which was introduced in 2021. It was set to 30 IDR per kg $CO_{2\text{-}e}$, (approximately A$2 per tonne $CO_{2\text{-}e}$) and forms part of a broader domestic cap-and-trade system that is in development (Ministry of Energy and Mineral Resources, Republic of Indonesia, the IEA and the OECD (2022)).

5.1.5 Malaysia

Since the Malaysian Government's 2009 emissions reduction pledge, there has been growing interest in developing a domestic CCS industry. Until recently, Malaysia lacked a regulatory framework for CCS activities. A 2013 regulatory review identified some existing legislation that could be used, but many issues remained unresolved, including the lack of a definition for CO_2 within Malaysia's regulatory framework (Global CCS Institute, 2013).

In 2022, the state-owned oil and gas company PETRONAS announced the development of its Kasawari CCS project, which is expected to inject 3.3 million tonnes of $CO_{2\text{-}e}$ per annum (Petronas,

2022). Following this announcement, the Malaysian state of Sarawak passed several ordinances related to CCS, including the Land (Carbon Storage) Rules 2022 and the Environment (Reduction of Greenhouse Gases Emission) Ordinance 2023 (State Government of Sarawak, 2023). Under these ordinances, the State Planning Authority regulates CCS activities within the state. Additionally, CCS is now part of various emissions reduction policies within the state.

Under its National Energy Policy 2022–2040, the Malaysian Government proposed several tax incentives related to CCS in its 2023 budget, including a 100% investment tax allowance related to capital expenditure, exemptions to import duties and sales tax related to CCS technology, and a tax deduction for pre-commencement expenses (Ministry of Finance Malaysia, 2023a; 2023b). In 2024 the government began developing a CCUS bill to regulate key aspects of the CCUS value chain. This bill, developed in conjunction with the *National Climate Change Act*, would regulate domestic CO_2 emissions. In March 2025 the bill resulted in a high-level regulatory framework for implementing CCUS projects within the country, with the exception of the states of Sarawak and Sabah. The bill covers several topics related to CCS including licensing, permits, compliance, safety and monitoring protocols, penalties, injection levels, and post-closure monitoring requirements (Kiat, 2025). It should be noted that although a regulatory framework now exists, transnational trading mechanisms and mandatory carbon pricing policies are not currently in effect. The Bursa Carbon Exchange (BCX) is Malaysia's voluntary carbon market, enabling companies to trade carbon credits and renewable energy certificates (Bursa Carbon Exchange (BCX), 2025). In October 2024, a consultation paper on a proposed National Climate Change Bill was released, which includes plans to establish a mandatory emissions trading scheme (International Carbon Action Partnership, 2025a).

5.1.6 Singapore

Singapore is actively positioning itself as a leader in sustainable energy solutions, with CCUS playing a pivotal role. In 2022 the Singaporean Government submitted its updated NDCs to the UNFCCC Secretariat, which reaffirmed a desire to explore CCUS development pathways (Government of the Republic of Singapore, 2022). In 2021, the government allocated S$55 million (A$65.7 million) as part of its R&D agenda for 12 hydrogen and CCUS projects that accelerate decarbonisation of the power and industry sectors (Energy Market Authority, 2021).

CCUS projects in Singapore are primarily covered by legislation that governs general industrial activities (Seah, 2024), with specific legislation including:

- *Environmental Protection and Management Act 1999*
- *Carbon Pricing Act 2018*
- *Workplace Safety and Health Act 2006.*

As of March 2025, there is no specific regulatory framework for CCUS in Singapore, although in June 2024 the Singapore and Indonesian governments signed a letter of intent to collaborate on transnational CCS activities (Ministry of Trade and Industry Singapore, and Coordinating Ministry for Maritime and Investment Affairs, 2024). In addition, since 2024 there has been in place a national carbon tax that starts at S$25/$tCO_{2\text{-}e}$ (A$29.8). It will increase to S$45/$tCO_{2\text{-}e}$ (A$53.8) in 2026 and 2027, reaching a price range between S$50 and S$80/$tCO_{2\text{-}e}$ (A$ 59.8 and A$95.6) by 2030 (National Climate Change Secretariat, Singapore (NCCS), n.d.).

5.1.7 Thailand

The regulatory framework for CCUS is still in development in Thailand. The governmental organisation directly responsible for the development of CCS is the Office of Natural Resources and Environmental Policy and Planning (ONEP), operating within the Ministry of Natural Resources and Environment. ONEP is responsible for drafting environmental policies and master plans through a number of committees and subcommittees, with members drawn from various private and public organisations.

On 22 August 2023, the Department of Mineral Fuels launched a public hearing on the draft amendment to the *Petroleum Act B.E. 2514 (A.D. 1971)* (as amended) (Petroleum Law Amendment). The objective of this amendment is to regulate the operation of CCS directly by defining the carbon business, including exploration for carbon storage areas and CO_2 injection. Implementation of the Petroleum Law Amendment will establish a clear regulatory framework for conducting CCS business in Thailand. As of March 2025, no updates have been found regarding the continued development of this regulatory framework. Analysis of other relevant laws in Thailand by Sutabutr (2024) highlights additional gaps in existing regulation; for example, the *Land Transport Act (B.E. 2522)* does not allow for CO_2 pipeline transportation.

5.1.8 China

Historically, China has supported pilot and large-scale demonstration CCS programs, and through its state-owned enterprises it has invested in commercial-scale CCS projects (Global CCS Institute, 2024b).

In 2015, the Asian Development Bank developed a CCUS Roadmap for the Peoples Republic of China in collaboration with the Department of Climate Change of the National Development and Reform Commission (Asian Development Bank, 2015). The roadmap described three phases of CCUS development within China: the 13th plan period (2016–2020), the expansion phase (2020–2030), and the commercialisation phase (2030–2050). The first phase included numerous recommendations relating to funding, demonstration of technologies, formulation of policies and frameworks, and assessing storage capacities in various locations. An updated roadmap was developed in 2022, identifying that as of 2020 there have been 10 full value chain CO_2 sequestration projects conducted in China, representing 2 million tonnes of CO_2 that could be stored (Asian Development Bank, 2022).

Since its NDC pledge in 2020 to reach net zero emissions by 2060, China has been incorporating CCS into its decarbonisation policy (Global CCS Institute, 2024b), testing policy instruments and addressing the barriers for its broader deployment (Global CCS Institute, 2024a).

Policies include the release of a 2024 action plan for the decarbonisation of coal-fired power plants through co-firing with ammonia and biomass or implementation of CCUS. This plan aims to reduce the emissions of this sector to levels comparable with that of gas-fired power plants by 2027 (Global CCS Institute, 2024a).

Another policy with direct relevance to CCS is the Implementation Plan for Green and Low-Carbon Technology Demonstration led by the National Development and Reform Commission and 10 other ministries, which is providing financial support to recognised decarbonisation projects, including

CCS (Global CCS Institute, 2024b). Six out of 47 projects selected under this program for funding were CCUS-related (National Development and Reform Commission of China, 2024a). CCUS projects are associated with coal-fired power plants and steelmaking. In addition to funding, the government will assist these projects in identifying avenues for low-cost financing (see below). This program will allow the Chinese Government to determine the most effective policies for driving commercial CCUS projects in the country (Global CCS Institute, 2024a).

In addition to these new policies, China hosts the largest emissions trading scheme (ETS) in the world, covering more than 40% of the country's greenhouse gas emissions, primarily in the power sector (International Carbon Action Partnership, 2025b). The scheme currently sets pre-determined emissions intensity benchmarks for coal and gas units, but there is no explicit reference to the role or eligibility of CCS-related emissions reductions from these units within the ETS (IEA, 2020; 2024b).

In January 2024, China officially relaunched its voluntary carbon market, the China Certified Emission Reduction Scheme (CCER), designed to supplement China's ETS and assist in achieving national carbon targets. The CCER was initially established in 2012 but was suspended in 2017. Although CCUS is not included in the first announced methodologies of the relaunched CCER (which include forestation, mangrove cultivation, solar thermal power and offshore wind power), CCUS stakeholders in China are making efforts to link the technology to the voluntary market (Global CCS Institute, 2024a). As of June 2024, the average CCER price was around US$15/t (A$23/t), and as such these measures alone will not currently incentivise widespread CCS deployment (Global CCS Institute, 2024a).

In addition, to the ETS and CCER, through the People's Bank of China (PBoC) the government established the Carbon Reduction Facility (CERF), a monetary policy tool that enabled financial institutions to finance decarbonisation projects between 2021 to 2024 including renewables, energy conservation and CCS, subject to carbon reduction disclosures (People's Bank of China, 2021). At the beginning of 2023, the PBoC had lent approximately US$44 billion to banks to support emissions reduction projects (People's Bank of China, 2023).

To build its knowledge base, China is actively involved in the international standards development for CCS through ISO/TC265, also drawing on lessons from the IPCC and global voluntary carbon markets (Global CCS Institute, 2024a). Although a growing number of CCS projects are under development or have commenced operations across China, critical gaps remain in the regulatory frameworks relating to core aspects of the CCS project lifecycle, including post-closure transfer of liabilities and pore space ownership, monitoring reporting and verification, and site characterisation and selection. To address these aspects and provide regulatory certainty, new legislation or amendments to existing legislation will be required (Global CCS Institute, 2024b).

As well as single-source-to-sink CCS projects, several CCUS hubs are under development, including the Dayawan Hub in Guangdong province located in the Dayawan Petrochemical Industrial Park (CNOOC, ExxonMobil and Shell) and the East China Region Hub (SINOPEC, BAOWU, Shell and BASF). Both hubs aim to develop the capacity to capture up to 10 Mtpa of CO_2 in the long run and to support decarbonisation across their regions (Global CCS Institute, 2024a).

5.1.9 India

India has highlighted a significant potential and need for CCS technologies while managing its use of coal for energy. Its NDCs propose reaching net zero by 2070, with a 2030 target to have 50% of its power capacity to be non-fossil fuel based. It has been reported that there are seven CCUS pilots running in India in 2024 (Mukerjee and Chatterjee, 2022; Patidar et al., 2023; Ram, 2024). With a 170,000 km long natural gas pipeline network, there is the potential to repurpose infrastructure for CCUS. As India is the world's second largest steelmaker, CCS is seen as an important opportunity to decarbonise this sector going forward.

Policy measures that are under consideration include: direct capital grants to enable funding for current CCUS projects and reducing exposure to capital expenditure; carbon pricing mechanisms to develop schemes for CO_2 emissions and structural incentives for its reduction; regulatory requirements and frameworks for encouraging CCUS projects; and the aforementioned pilot projects to provide R&D opportunities and long-term capability development (Mishra et al., 2022).

Four interministerial CCUS taskforces are actively working on various aspects of CCUS, including safety and the development of technical standards. Despite ongoing challenges in regulatory and financial areas, the activity has been accelerating.

In some regard, CCS is still nascent in India and Rao et al. (2023) have identified the cost of CCS, geological storage capacity, source-sink matching, supply chain building rate, policy regulation, and marketing and public acceptance as key barriers to deployment. Rao et al. (2023) recommend dynamic policy regulations including a carbon trading mechanism prior to initiating CCS to promote investment support for the initial capital costs, such as feed-in schemes and a carbon floor price.

A comparative review by Patidar et al. (2023) between the US, the UK, China and India has facilitated the Indian Government's implementation of monetary incentive policies. Furthermore, the government has placed significant emphasis on public–private partnerships to evaluate the techno-economic feasibility and scalability of new projects, so that it can meet updated NDC targets.

5.2 Europe

The European Commission has made it clear that it now sees CCS as a key technology to reaching the bloc's climate targets. Its February 2024 Industrial Carbon Management Strategy provides guidelines for capture, transport, trade, permanent storage and use of CO_2, with a view to creating a single European market for industrial carbon management. There is a significant emphasis on recycling CO_2 for the production of 'synthetic' fuels, chemicals and plastics through implementation of sustainable carbon cycles (Clean Energy Wire, 2024). This is similar to the objectives of the NT's low-emissions hub.

A summary of the state-of-play on CO_2 geological storage through to mid-2021 has been brought together by CO2geonet (CO_2GeoNet, 2021). It reviews the following:

1. national policies and climate-protection strategies
2. national legislation and regulations

3. national storage options, potential and capacity
4. large-scale and demonstration CCS projects, pilot and test sites for CO_2 capture, transport and storage
5. research activities with respect to CO_2 storage
6. national actors driving CCS forward, public awareness and engagement.

The CO_2GeoNet (2021) study reported that over the last 10 or so years, all 27 member states have completed their National Energy and Climate Plans (NECPs), which address actions from 2021 to 2030. They provide a foundation for each country's long-term strategies to meet Paris Agreement and EU commitments. Most NECP documents referred to considerations of how to deploy CCS, either to decarbonise industry and/or generate or implement negative emissions technologies such as BECCS or DACCS. Member states have initiated and supported CCS in a range of different ways, from R&D activities to national mapping of capacity for storage and feasibility studies for large-scale CCS projects.

Such support mechanisms are in keeping with those deployed in Australia over the last 25 years. Comparing the current CO2GeoNet (2021) findings with the previous study by Rütters and CGS Europe partners (2013), like Australia they too have seen a shift away from a focus on CO_2 capture from oil-, gas- and coal-fired power stations to capture from hard-to-abate industries such as cement, steel, chemical manufacture, waste incineration, geothermal and hydrogen production. The role of CCU over CCS by some countries may address some of the community concerns, but is unlikely to address the volumes of emissions required to be managed currently.

The backbone of EU Directive 2009/31/EC has been used by both member states and affiliates (i.e. Norway and the UK) as the basis for their national legislation. This has resulted in 19 of the 32 countries having the ability to permit geological storage generally, though there may be restrictions on regions or limitations on volumes to be stored. The remaining 13 countries (Slovenia, Lithuania, Latvia, Ireland, Finland, Estonia, Austria, Denmark and Germany) have essentially prohibited CO_2 storage (but not capture), and in four countries (Ukraine, Turkey, Switzerland, and Bosnia and Herzegovina) it is prohibited because the specific laws required are not present. Some countries that Rütters and co-authors had reported as having bans in 2013 have now lifted them, while others that were previously supportive have now banned geological storage.

As with Australia, there is very limited experience in using the legislation and regulations available. In 2021, only Norway had applied experience of seeking relevant licensing for Sleipner and Snøhvit under the *Offshore Energy Act*. The more recent Project Greensand in Denmark was able to work through the process far more rapidly than in the past to conduct a pilot-scale injection in 2023. This will lead to an initial CO_2 injection of 400,000 tpa beginning at the end of 2025, scaling up to a potential 8 Mtpa by 2030 (EUDP, 2023).

As new projects in the EU and Australia progress, the process will become more familiar for both proponents and regulators. Project announcements in Norway (Northern Lights/Longship), the Netherlands (Porthos, Aramis, CO_2NEXT) and the UK (HyNet, Humber, TEESSIDE) will all start to work through this new licensing process in the next few years, providing further insight into successfully navigating these new regulations. This could aid rationalisation and streamlining without watering down the key components and metrics required to demonstrate safe operation

of a CCS project and ability to report emissions reduced in the not-too-distant future. While the projects listed above tend to be large scale with multimillion tonne storage targets, there are small- and pilot-scale studies that can and have been permitted using other available legislation and regulation (e.g. mining and geothermal).

Global efforts to identify geological storage sites have commenced at different times and with different levels of detail. The CO_2GeoNet (2021) study notes that there are comprehensive national storage atlases and databases with significant levels of detail produced in Norway, the UK, Spain, and collective Nordic countries. Some countries have done partial studies (either less detailed or focused on specific regions) and there are basic assessments only in Eastern and South-Eastern European countries. In 2021, CO_2GeoNet regarded the CO_2StoP database to be the most up-to-date European overview. However, the database uses older datasets than are publicly available. The conclusion is that there is sufficient geological storage at a consolidated European level, both on- and offshore for conventional depleted field or saline aquifer storage, while some countries (in particular, Iceland) have noted potential for in-situ mineralisation, mafic and ultramafic rock use.

However, the recently released *Net Zero Industry Act* (NZIA) intimates the urgent need for 50 Mtpa geological storage capacity by 2030 to meet decarbonisation targets set at national and EU levels. To prioritise the clear definition of sites that would be 'ready to go', the Act is putting the onus on current oil and gas licensees to invest in the identification of those sites and have them suitably characterised. This may also include the need to manage existing assets and infrastructure with a view to be able to use and repurpose pipelines, wells, platforms and so on in the future for more rapid roll-out of CCS.

Most EU countries have significantly invested in R&D for CCS and all but one country has at least one dedicated research institution conducting storage-related research. Some countries have up to 15 institutions actively engaged. This compares well with Australian CCS research, which has been well maintained over two decades, see for example the CO_2CRC. This Australian research includes laboratory, pilot and field research along with applied research for industry proponents in geological storage, monitoring capabilities, modelling, data integration and site screening activities, as well as research focused on capture, conditioning and transport.

Many of the research activities have been consolidated across the EU to facilitate knowledge sharing and management of research infrastructure (specialised labs, field sites etc.). This has been mirrored by other countries, including Australia. The role of the Horizon2020 and other EU funding has facilitated R&D for many years. Because there is such extensive R&D it was difficult for the CO_2GeoNet (2021) study to synthesise activities, but in broad terms much of the geological storage research focused on storage capacity assessment and modelling of subsurface storage processes. Well technologies, social acceptance and complex management were less well supported, while other countries have favoured utilisation over geological storage research and deployment.

The national drivers for countries within and associated with the EU have been mixed, as CCS and its deployment is still relatively unfamiliar. CCS has often been perceived by the public as a 'risky technology'. Norway is an exception, where roll-out of their approach has been seen as neutral to positive (Merk et al., 2022). The role of pilot-scale and demonstration projects that have been engaged to promote public awareness has had a positive influence on opinion (e.g. Hontomin,

Ketzin and Cork) (Szizybalski et al., 2014; Gastine et al., 2017; Koukouzas et al., 2022). Political and media interest has grown, as CCS has been discussed in the light of new 2030 targets at national levels. The favourability of CCS is sometimes associated with the way in which it is deployed; that is, it is favourable where industrial facilities or waste incinerators are the emitters, or where negative emissions might occur (e.g. BECCS or DACCS) (Dziejarski et al., 2023). By omission, one could guess that where it is seen as less favourable is in the LNG or oil and gas industries.

The evolution in Europe over the last 10 or so years towards increasing uptake and deployment has, as in the rest of the world, followed a wavering path that has seen a major upswing that commenced in the very early 2020s (IEA, 2025). Stronger targets to reduce emissions may have played a part in putting CCS as a scalable and low-risk process back in the toolkit for several EU countries (Meyer-Ohlendorf et al., 2025). The emergence of hubs and clusters has further enabled deployment, with the ability to share risks and costs, while consolidating some activities through not only shared infrastructure, but also regulation and permitting, may have further aided deployment.

An outstanding need for well-defined pore space for storage has encouraged several countries to develop storage capacity estimates and atlases (Global CCS Institute, 2024a). The most recent changes to EU legislation with the implementation of the NZIA have further emphasised the need for storage locations to accelerate deployment (Clean Air Task Force, 2025).

Under the NZIA, the Net-Zero Europe Platform has been established. This governance body's role is to monitor progress, discuss coordination and share best-practice developments, ensure implementation of the NZIA across all EU countries, and engage with civil society stakeholders and other industries (European Commission, n.d.). This includes the provision of financing advice for net zero strategic projects, and the engagement of international net zero industrial partnerships to facilitate global clean energy transition.

CCS in the European Union

The European Commission recently released *Towards an Ambitious Industrial Carbon Management for the EU*, communication COM (2024) 62, which sets out the conditions and intent of the EU on carbon management. This document is an important reflection on current policies and sets the EU's strategic direction on industrial carbon management. As such, some abridged passages are included below (European Commission, 2024).

CO_2 storage targets

- The EU's strategic objective for 2030 is the deployment of CO_2 storage capacity of at least 50 Mtpa together with related transport modes consisting of pipelines, ships, trains and trucks, depending on each business case.
- Modelling results for the EU's 2040 climate target communication indicate that approximately 280 Mt would have to be captured by 2040 and around 450 Mt by 2050.

- Industry stakeholders expressed that, by 2030, they could capture up to 80 Mt of CO_2 per year in Europe if the necessary investment conditions are in place.
- In their draft plans, member states project that annually a volume of up to 34.1 Mt of CO_2 will be captured in 2030. This compares with an overall injection capacity of 39.3 Mtpa in 2030 estimated by the member states.

EU CCS policies

Since 2009, geological storage of CO_2 has been regulated by the EU CCS Directive, which sets permitting rules to ensure the safety and environmental integrity of CO_2 storage and prescribes transparent and non-discriminatory access to the infrastructure. Furthermore, CO_2 transport projects are supported under the revised Trans-European Networks for Energy (TEN-E) Regulation and the current list of 14 Projects of Common Interest (PCIs) or Projects of Mutual Interest (PMIs) that add up to an overall planned capacity of up to 103 Mtpa of CO_2 through four onshore storage sites and eight or more offshore locations. The development of CCS networks will require minimum CO_2 quality standards to ensure that CO_2 can flow freely across the European Economic Area (EEA).

Twenty member states have already included industrial carbon management solutions in their draft NECPs, and seven have also included these technologies in their recovery and resilience plans. Denmark and the Netherlands already have functioning national subsidy schemes for carbon capture and have accelerated action to make CO_2 storage available. France, Germany and Austria are currently developing carbon management strategies.

CCS costs

In the period up to 2030, additional support at EU and national level will be critical to developing and scaling up industrial carbon management solutions, including investments to develop the necessary skills.

- The target of 50 Mt of annual CO_2 storage capacity by 2030 requires approximately EUR 3 billion (A$5.3 billion) of investments in carbon storage facilities, and in capacity of the geological storage sites.
- The European Commission estimates investment needs for transport infrastructure of between about EUR 6.2 billion (A$11 billion) and EUR 9.2 billion (A$16.3 billion) by 2030. However, a Commission study estimated that the CO_2 transport network, including pipelines and shipping routes, could span up to 7,300 km and deployment could cost up to EUR 12.2 billion (A$21.7 billion) in total by 2030, rising to around 19,000 km and EUR 16 billion (A$28.4 billion) in total by 2040.
- Capture costs from point sources are estimated to range from EUR 13/t (A$23/t) and EUR 103/t (A$182) of CO_2 depending on the industry, capture technology and CO_2 concentration.
- Industry CCUS forum stakeholders estimate a funding shortfall of cumulatively EUR 10 billion (A$17.75 billion) by 2030 for currently announced CCS projects.
- Beyond 2030, the Commission estimates that the required investment needs in CO_2 transport infrastructure would rise to between EUR 9.3 billion (A$16.5 billion) and EUR 23.1 billion (A$41 billion) in 2050 to meet 2040 and 2050 objectives.

Funding mechanisms

- Bridging grant funding through the EU ETS Innovation Fund for innovative large-scale CO_2 projects (26 large- and small-scale CCS and CCU projects with more than EUR 3.3 billion [A$5.85 billion] in grants) has been provided to date. The Innovation Fund could be envisioned as a joint 'auctions-as-a-service' support mechanism that would enable EEA countries to use their national budget to award support to projects located on their territory based on an EU-wide auction mechanism.
- Connecting Europe Facility (CEF) energy mechanism for transnational energy and transport infrastructure projects – EUR 680 million (A$1.2 billion) investment in CO_2 projects of common interest to date.
- CCS is also included in the EU sustainable finance taxonomy – the European Investment Bank has included CCS in its EUR 45 billion (A$80 billion) financing package to support the Green Deal Industrial Plan.
- State aid for CCS and CCU investments would be permissible under EU funding rules.
- Market-based finance for economically viable CCS and CCU projects can, in principle, also be supported under the InvestEU Fund.
- Member states can look at proposing carbon contract for difference (CCfD) schemes with subsidies covering the difference between a carbon reference price and an agreed 'strike price' representing the project's true costs to derisk investment.
- The carbon price signal in the EU ETS will be key to make CCS projects commercially viable. A commercially viable market will begin to take shape after 2030, where investors will earn a competitive return on invested capital based on the EU carbon price.

Additionally, the introduction of tariffs, new financing instruments, guarantees and risk instruments will be required to facilitate investments. Ultimately, these investment needs are set against an estimated extrapolated theoretical market potential of captured CO_2 in the EU of between 360 and 790 Mt of CO_2, which could generate between EUR 45 billion (A$80 billion) and EUR 100 billion (A$177 billion) in total economic value of the future CO_2 value chain in the EU from 2030 onwards and help create between 75,000 and 170,000 jobs.

Enabling CCS in the EU

The first CO_2 infrastructure hubs and industrial clusters are expected to emerge in Europe, serving CO_2 capture projects, many of which will rely on transnational CO_2 transport. In this early phase of CO_2 transport development, the majority of CO_2 transport will be to the coast, followed by shipping to offshore storage locations. Alongside these CO_2 infrastructure hubs, the first commercial off-take agreements for CO_2 capture and storage are being signed, especially for the industrial facilities where carbon capture costs are relatively low.

While pipelines are in many cases the most common transport option for CO_2, the initial capital costs of building them are high and they have long lead times. Before 2030, shipping of CO_2 will be an important option, but this requires the availability of a fleet of specialised CO_2 transport ships. All CO_2 transport modes are covered by the EU ETS, but accounting and liability rules need to be developed for emissions from all modes within this framework.

Uncertainty regarding future CO_2 volumes, complicated coordination across the value chains, and long permitting procedures constitute significant barriers for investors to move ahead with the projects. Also, to optimise the benefits of capital spent on infrastructure, the

interactions with the electricity, gas and hydrogen sectors, the need for future spare capacity, and the potential repurposing and reuse of existing infrastructure for CO_2 streams need to be coordinated. The aim should be to ensure system integration and to promote flexibility and resilience in the EU energy system.

The business case for developing critical CO_2 storage infrastructure extends beyond the immediate goal to reduce emissions over the next decades as it has the potential to contribute to economy-wide negative emissions even after 2050.

5.3 The influence of international policies on Australian CCUS development

Anecdotal evidence frequently underscores the impact of international policy levers on the development of CCUS in Australia, particularly regarding the fiscal mechanisms used abroad to support commercial-scale projects and the financial leverage they offer. This review of international policies is relevant to the NT Hub, as it presents examples of best-practice legislative and policy models that could inform future developments in the Northern Territory. It also identifies gaps in the policy and legislative landscape that may hinder the transnational movement of CO_2 and low-carbon liquid fuels between Australia and its Southeast Asian trading partners. If cross-border shipment is essential for the NT Hub's success, understanding these gaps is critical to shaping effective future policy.

Most of the early CCUS developments in Australia will be led by large oil and gas companies seeking to decarbonise their operations through the sequestration of existing CO_2 captured from reservoir gas streams at LNG plants and domestic gas processing plants. These companies have the motivation and also the skills and expertise to deploy CCUS at scale. Due to the nature of these businesses there has to be some degree of acknowledgment that these activities operate in a global market. Thus, the ability of these multinational companies to identify the most favourable jurisdictions that offer the best financial leverage leads to investments being focused on those countries. This is to the detriment of jurisdictions that do not have such favourable policies in place, even though they may have enabling legislation, regulations, captured emissions and suitable geology for CCS. Deferred investment has knock-on impacts for wider hard-to-abate industries and CCUS hubs, as the captured emissions from large scale oil and gas operations often represent foundational, lower cost CO_2 volumes that can underpin hub investments.

Other international influences come from the perception of policy stability. Prior to investing in major infrastructure projects, proponents will evaluate institutional stability, consistency in policy, the rule of law, and economic stability (i.e., sovereign risk) to support their investment decisions. However, when favourable conditions are challenged by political polarisation, economic shocks, social unrest and low levels of social acceptance for CCUS implementation, preferences to invest in those countries or regions will be downgraded.

Thus, stable policy with enduring clarity of messaging and appropriate policy levers to support long-term investment decisions ("pull-towards" factors) will draw investment into a country to establish CCUS hubs. The converse "push-away factors", which include actual or perceived policy instability, will drain investment and redirect it elsewhere.

6 Policy communication and engagement

While previous sections have primarily focused on legislative, regulatory, and financial policies to support the development of CCS, CCUS, and low-emissions hydrogen, policy settings also play a crucial role in signalling intent and direction to stakeholders and to the broader community. Butcher and Mercer (2024) note that policy development shapes social, economic and physical environments. When community opinion about a policy is divided, there can be significant ramifications at a societal level.

While the purpose of policymaking is to implement a rational solution to a societal problem (in this case, reducing CO_2 emissions to mitigate climate change), there is a balancing act to demonstrate consideration of public opinion, competing interests, social relations, and the fair and equitable distribution of benefits within society. Thus, using all policy levers is essential to facilitate implementation and uptake of new practices, and reduce barriers to adoption.

As discussed in Section 1, policies often commence as statements of values and intents (Butcher and Mercer, 2024) and thus provide signals to communities. The term 'policy salience' (Kingdon, 1995) has been used to outline why a policy may be developed. There needs to be general consensus that a particular problem exists, and that steps are required to resolve said problem. There is a requirement for an extensive and shared understanding about the nature of the problem. There also needs to be broad acceptance of the available solutions that will be implemented. In the case of CCS being one of the technologies that could be used to combat emissions, this has not yet been achieved at a domestic level, and so the evolution of policies, without framing and social acceptance of this emissions reduction solution to be implemented, may consequently remain contentious.

If the policy levers are well crafted (and communicated), they provide appropriate and structured guardrails that indicate the overall strategic direction of the policy goals. How does a government know it has been successful? Using suitable metrics to benchmark the efficacy of the policy can help shape the fiscal methods to be implemented to achieve the change desired (i.e. targets are met; see the Net-Zero Europe Platform, (European Commission, n.d.)) and encourage behaviours to achieve the policy outcome. Socialising the policy, by using a range of education and communication methods to clarify the policy's purpose with robust evidence, can make or break the specific outcomes being encouraged by the policy.

The use of evidence in the development of policy responses – through empirical research, statistical analysis, comparative policy studies, public consultation, evaluation studies and so on – is important to independently assess need (Butcher and Mercer, 2024). The series of reports developed through this NT CCUS business case project attempt to provide a range of evidence and materials that can be used to consider policy changes or reviews or identify gaps, specifically those related to legislation, fiscal instruments and other relevant policies.

6.1 Who ‘owns’ engagement and communication?

One of the challenges for both government and industry proponents relates to who is responsible for engagement and communication, and when it should occur. From a national perspective, engagement related to policy development and implementation would sit with government, while project-specific engagement would reside with the proponent.

In 2024 the Middle Arm Industrial Precinct was reviewed as part of a Commonwealth senate inquiry, with the terms of reference examining government roles and funding, intended future uses, and associated industries (Parliament of Australia, 2024). It also considers potential climate, environmental, health, and cultural heritage impacts, the strategic environmental assessment process, and industry engagement—particularly with First Nations communities and adherence to free, prior, and informed consent. No unanimous set of recommendations were provided for the future development of the precinct, though the individual committee members recommendations highlight significant differences in the perceived merits of the precinct (Parliament of Australia, 2024).

For industry, it is frequently the case that engagement, outreach, communication and determining public interest ramp up at the final investment decision (FID) for a project. Figure 7 illustrates the historical industry approach. It shows that delays in engagement are due to a resource disconnect resulting from incongruent timing of the release of appropriate funds to establish a communication strategy (alongside many other outreach and engagement activities) once a project is financed. However, this frequently occurs after most of the major decisions that are of interest to the community have already been made. For example, limited engagement leading up to the concept selection milestone (i.e., a decision to choose one potential storage site over others) can lead to public pushback due to local or place-based concerns that are not immediately obvious to an external party. A lack of early consultation has resulted in the termination of, or extensive delays to, many types of major projects, especially those with new and unfamiliar technological approaches. This includes examples associated with CCS (e.g. Barendrecht, the Netherlands; Feenstra et al., 2010).

Larger-scale projects such as major public infrastructure and construction (PIC) projects may have shared engagement responsibilities; for example, because of a public–private partnership between government and industry. They can become highly focused on the stakeholders who are in control of project resources and may bypass, often unintentionally, the impacted stakeholders in the local community (Di Maddaloni and Davis, 2017). If essential policy levers such as stakeholder engagement, public education, and clear communication are absent or limited, the risks associated with large-scale projects may increase.

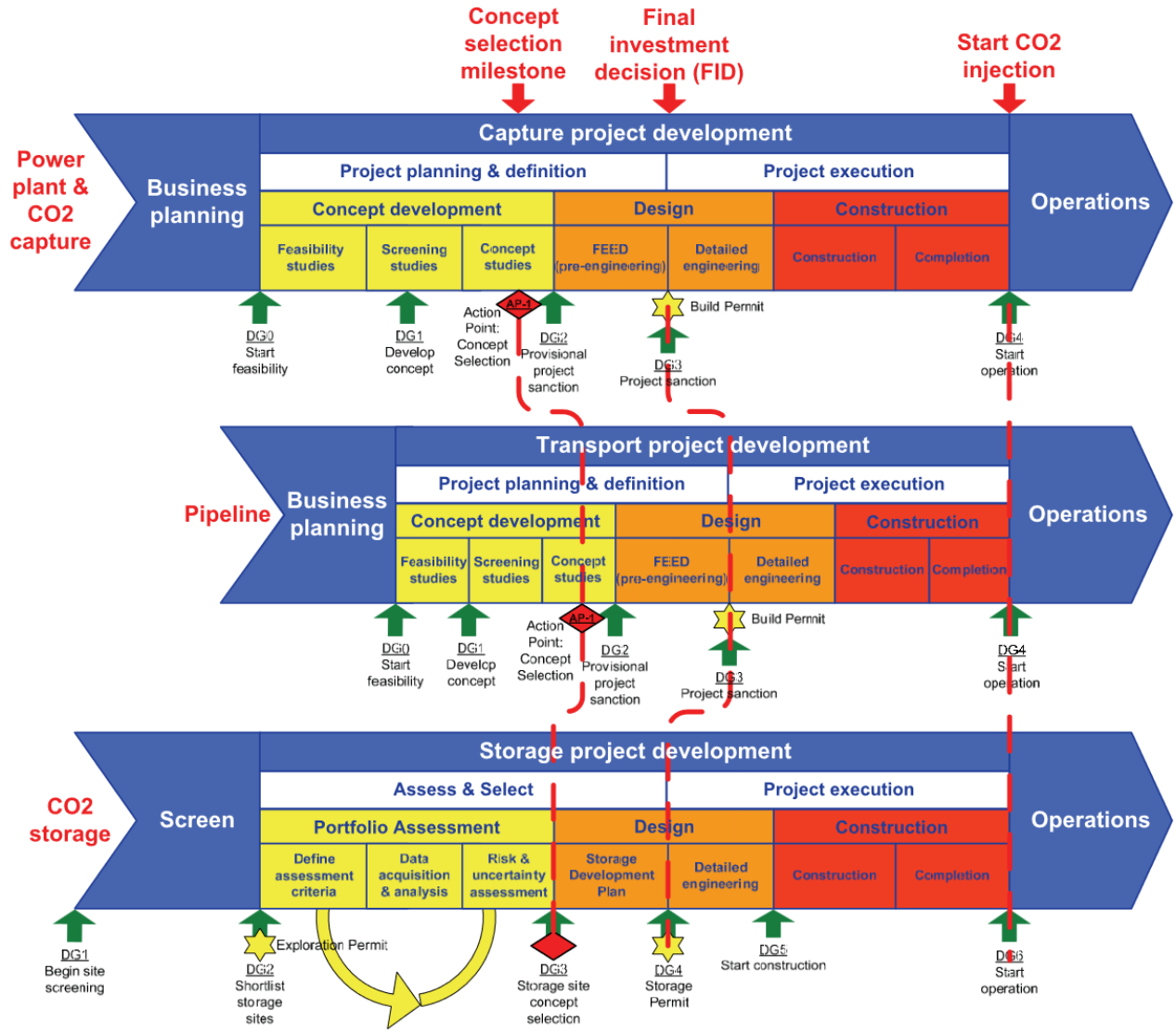


Figure 7: Where investment is unlocked for CCS projects. FID is mapped across the value chain, illustrating how far it is placed along the decision timeline.
Source: Kvien et al. (2011)

Construction-heavy projects have often favoured delivery models that manage large-scale infrastructure investment and can be extended to private–public partnerships to manage finances and timelines. The development of a CCUS hub and the wider MASDP in Darwin could fall into this category, and so lessons can be learned from other major projects elsewhere. Frequently these projects are noted to be good for producing local impact (for example disruptions to traffic and short-term increased demand on local services), but not local benefits such as significant employment opportunities or improvements to local infrastructure (Di Maddaloni and Davis, 2017 and references therein). In the absence of a fully developed national strategy (including policy narrative and engagement plan), risks are further compounded as local stakeholders may not be aware of the required strategy (i.e. at least 43% emissions reduction by 2030 through tools such as CCUS) and so will not understand how these major projects fit within it.

When seeking local community opinions at the initiation phase of any major project there is also a requirement to monitor the project's impacts at the local level, as this can help improve project performance and acceptance – and limit delays that may result from coordinated efforts by

community groups and outside influences. The absence of simultaneous engagement and outreach at a policy level may also undermine projects due to the disconnect between policy objectives and project development.

Di Maddaloni and Davis (2017) note in their paper on megaprojects that stakeholder engagement using traditional approaches has been generally inefficient and lacks inclusion, which has led to the historically low levels of support being seen. Their systematic literature review further supports their view that poor performance of a delivered megaproject and inefficient stakeholder management are frequently seen together.

What is a megaproject?

Sykes (1998) proposed that megaprojects differ significantly from conventional infrastructure projects, increasing their risks. This is because of:

- their scale
- the time required to bring them to fruition
- their location
- the unique risks associated with them being one-of-a-kind or first-of-a-kind
- difficulty in financing due to market immaturity and elevated risk
- public opposition for large-scale development
- the impact they can make on existing markets
- insufficient personnel experience.

Some of these characteristics could map onto the development of a large-scale CCUS hub in Darwin, especially those of unique risks, financing difficulties, market impact, insufficient personnel experience (or perceptions thereof) and potential for public opposition and unpopularity due to the relationship between the intended project activities and the backgrounds of some of the proponents (oil and gas producers).

These large-scale projects can be complex and marked by investments in infrastructure, be initiated by government, have a long duration and may have large social impacts that are not always negative (e.g. job creation, economic activity and returns).

Government has a strong stake in developing the communication and engagement strategy and delivery for large-scale, often co-invested megaprojects – but this has to be supported by policy engagement and messaging (Sykes, 1998).

Therefore, behind all of the challenges with stakeholder communication and engagement, an inability to articulate the purpose of a new or amended policy and its goals can leave a vacuum that can be filled by 'the protectionist attitude of and oppositional tactics adopted by community groups facing an unwelcome development in their neighbourhood' (Dear, 1992, p. 1).

The study by Di Maddaloni and Davis (2017) suggests that the unique nature of megaprojects, such as a large-scale CCUS hub and associated MASDP development, means that they may need to be managed differently. However, the absence of a national narrative and engagement can further add to the burden of a proponent. As a potential public–private partnership, the NT CCUS hub and MASDP will have to develop messaging that not only relates to place and immediate impacts, but also explains how low-emissions hubs and CCUS fit in the national narrative. Additionally, the key

messages will need to be balanced and not over-emphasise the cost as a metric of 'success' due to the size and scale of the project(s). Focus should be on stakeholder engagement, and relevant communications may need to focus more closely on outcomes at a given time and cost (see Box below.

An example of a large-scale project and its impacts: the Thames Barrier project in London, UK

Delivery of this complex, long and expensive megaproject impacted many local communities and stakeholders in the area of the development. With an initial cost estimate of £13–18 million, the Thames Barrier was priced at £110.7 million in October 1973, before being delivered at a cost of £440 million. In parallel with the huge increase in costs, the timeline was almost twice as long as estimated (i.e. nearer to 8 years than 4). On a purely cost and time basis, the project could be regarded as a failure. However, with respect to acceptance it is regarded as a major engineering achievement and its impact on preventing flooding and associated loss of homes and lives gives it a high social value (Di Maddaloni and Davis, 2017 and references therein).

Forty years on, the barrier protects 125 km^2 of central London from flooding caused by tidal surges and has become increasingly important to mitigating risks of flooding due to rising sea levels and more frequent climate extremes. The barrier protects 420,000 at-risk properties, 25 mainline and 54 underground and DLR stations, 226 schools, 13 hospitals, 15 fire stations, 15 police stations and 1.4 million people who live and work below the average high tide. The Institution of Civil Engineers reports that this equated to roughly £321 billion in asset capital value in 2024 (Institution of Civil Engineers, 2024).

Communicating the impacts of a large-scale public–private project through both messaging related to the project and the underpinning frameworks provided in the policy, legislation, regulation and financing of any NT CCUS hub, will be critical to its support, development, implementation and impact. However, to do that all policy tools should be used, especially community education, engagement and influence, and information campaigns. Improved mapping of primary (i.e. contractual relationships) and secondary (influential relationships) stakeholders to facilitate engagement, understanding and participation in aspects of the project is also critical to the success of any large-scale project.

6.2 Addressing the challenges ahead for NT CCUS hub development

So, how might an NT CCUS hub project reflect on such an approach? This project, if it were to proceed beyond its current stage, could be regarded as a complex megaproject (or part of one). Key to engagement and communication will be articulating its benefits and impacts today and 20–40 years from now.

Social benefits may be realised through job creation and diversification as some core employment sectors pivot away from traditional oil and gas production to alternative fuels, CCS, hydrogen generation, and energy transport and storage. This provides more options and reduces risks to many workers in economies with low diversification such as the NT, which has a high reliance on

the resources sector (see the *Task 1* report; Rogers et al., 2024). The NT will have improved capacity to meet interim and 2050 net zero targets through the development of a CCUS hub.

Framing key messages as impact benefits and outlining how they can be shared equitably can help reduce barriers to project development. However, the effectiveness of this approach depends on how well the overarching engagement strategy is supported and implemented over time by project proponents. Success will also rely on consistent messaging and collaboration with government, industry partners, and community groups. This includes meaningful engagement with First Nations groups and securing free, prior, and informed consent from all relevant stakeholders. The specific methods used would be determined by project proponents, drawing on best practices from previously successful initiatives.

6.3 Developing communication and engagement in the context of policy

A theme of this report is the need to use all policy levers (Figure 2) to achieve the desired outcome from the policy being developed. However, the area of engagement is often an afterthought and a poorly resourced activity in the haste to implement policy and regulation. The timing of each of these facets of policy implementation may also be overlooked, resulting in unintended consequences or progress stalling.

For policy development, there are several activities (Althaus et al., 2022, Butcher and Mercer, 2024; Krupnick and Parry, 2011) under the umbrella of engagement. These could include, but are not limited to:

- advocacy (e.g. education, persuasion, arguing the case, spreading information, mass media campaigns)
- narratives (e.g. storytelling and communication, including public advertising in order to frame issues and solutions, identifying community benefits, equity, a just and fair transition, and issues such as safety, and monitoring and verification to provide evidence)
- networking (e.g. cultivating and using relationships to influence behaviour, working together to solve problems for or in the community and its interests)
- influence (e.g. via information campaigns).

Although this is a helpful checklist, Young et al. (2014) present a more comprehensive set of tools for developing a communication and engagement plan that can elevate the purpose of a policy. As well as clarifying the policy influence objectives, there is a need to develop a pragmatic set of stakeholder-focused outcomes so that the desired policy goals are achieved. To do that, the stakeholders need to be identified, and their perspectives need to be considered.

Table 9: Measuring stakeholder-focused outcomes
Source: Young et al. (2014)

Outcome		Points to consider
1	Interest of key stakeholders; getting issues onto the policy agenda	How interested and open are policy actors to the issues? What type of evidence will convince them?
2	Public opinion	How does the public engage in these issues?

3	Capacity and engagement of other actors	Who else is engaging in this policy area? How influential are they? What can be done to involve others?
4	Change in discourse among policy actors and commentators	What are the influential policy actors saying on this issue? What language are they using?
5	Improvements in policymaking procedure/process	Who is consulted during policymaking? How is evidence taken into account?
6	Change (or no change) in policy content	What new legislation, budgets, programs or strategies are being developed?
7	Behaviour change for effective implementation	Who is involved in implementing targeted policies? Do they have the skills, relationships and incentives to deliver?
8	Networks and systems for supporting delivery	Are different actors working coherently together to implement policy? Are the necessary structures and incentives in place to facilitate this?
9	Relationship between actors	Do bonds of trust exist between different actors?

It is often the case that many (but not all) stakeholders may have been identified during the research phase of the policy development or amendment, allowing policymakers the opportunity to address the key points in Table 9. Unpacking the key points to consider will be highly beneficial in the development of a communications and engagement strategy, who to target and what they care about.

In supporting a new policy or amending an existing policy, refining the communications strategy and consulting with stakeholders can be addressed by developing a defined communications and engagement strategy (Table 10).

Table 10: Communications and engagement strategy template
Source: Young et al. (2014)

Stage	Action
Policy objective and intended outcome	Set out policy-influencing objective, as in the main strategy, and the outcomes being sought.
Stakeholders	Identify and prioritise key audiences based on existing stakeholder mapping. Produce a stakeholder map specifically for the communications strategy.
Key actions	Undertake linear research communications (e.g. packaging materials and presenting to media houses). Facilitate debate through events and roundtables. Develop capacity among audiences to use knowledge more effectively.
Messaging (not always clear in complex settings)	Develop overall messages and sub-messages for each audience group. This may be difficult to do initially and can be refined over time.
Channels, tools and activities	Once the above have been prepared, decide on the main channels for each audience group and the relevant tools and activities. Be general initially, but aim to be more specific and realistic over time.

Resources	Effective communication does not necessarily mean a large budget, but it is essential not to underestimate the time and effort required. This needs to be addressed early. Use free online tools to share the communications rather than developing a website from scratch. A dedicated person is required to manage the resources.
Timescales	Always deliver what has been promised and never over-promise.
Evaluation and amendment	Set aside time to assess the impact of the strategy; this does not need to be complicated. Use online tools, coordinate short review meetings or create an impact log. This monitoring should align with the key elements of the policy engagement strategy.

The communications and engagement strategy should clearly articulate the policy objective and its intended influence. It must acknowledge both supporting and opposing forces, and outline any change management strategies needed to support implementation. Desired outcomes and success metrics should be defined before execution, along with a clear assessment plan. Available and required resources should be identified (Young et al., 2014). Monitoring progress is essential to understand what works and what doesn't across different stakeholder groups. As with geological site characterisation in CCS, effectiveness can be highly context-specific.

Finally, as noted in Young et al. (2014), to evaluate the effectiveness of a specific policy implementation and determine whether the intended behaviours and outcomes have been achieved, requires focusing on the following key areas:

- Ensuring financial accountability and responsible use of resources.
- Assessing whether operations are running effectively and efficiently, with flexibility to adjust strategies if needed.
- Building and maintaining trust among stakeholders.
- Addressing information gaps by transparently sharing results and progress.

6.4 The role of research as a communications tool

Another important but indirect policy lever is research and innovation. Effective communication around policy can involve a wide range of actors, including research funders, universities, learned societies, research organisations, intermediaries, policy bodies, professional associations, think tanks, independent research institutes, non-profits, and consultancies (Oliver et al., 2022).

In their evaluation, Oliver et al. (2022) identified nine key practices that support engagement between research and policy.

- disseminating and communicating research
- formal institutional requests for evidence
- facilitating access to research
- building decision-maker skills

- building researcher skills
- building professional partnerships
- strategic leadership
- rewarding impact
- creating infrastructure and posts.

Research-policy related activities are used more frequently in areas such as: (1) public policy, business and commerce; (2) health (public, environmental, clinical and medical), and (3) STEM (science, technology, engineering, maths). Environment comes 5th, research and innovation comes 6th, and global, foreign policy (or EU with respect to the paper) comes 10th (Oliver et al., 2022).

Barriers to implementation of evidentiary materials to bridge the gap, and the means to overcome them, highlight an evidence-policy gap. By enhancing engagement between researchers and policymakers, organisations have sought to improve outcomes, perhaps via networking events, secondment schemes, training courses and so on. However, it is noted that with respect to impact, policy activities related to research tend to be poorly reported and it is difficult to evaluate these impacts. Most activity (and money spent) tends to be in the sphere of disseminating and communicating research related to the policy topic, and historically this approach has been unsuccessful in supporting policy implementation and societal change (Oliver et al., 2022).

Ultimately, there remain several policy instruments and approaches that are still to be fully implemented in the CCUS policy area that could be highly complementary to the robust legislation and regulation already developed in Australia. The limited use of several of the 'softer' levers (i.e. engagement, innovation and technology) would be highly influential in the future deployment of the NT CCUS hub and other major industrial decarbonisation projects, whether they be public–private partnerships or private enterprises.

7 Discussion

The realisation of a CCUS hub in the NT and CCUS hubs across Australia is dependent on the development of viable business models that mitigate commercial risks and ensure financial sustainability. The implementation of CCUS hub business models, as with any decarbonisation approach, requires a variety of policy levers to be used by governments at both the national and state/territory level. This report has summarised the CCUS (and adjacent) policy frameworks that have been implemented across Australia, within the NT and globally.

Analysis of these policies reveals gaps in existing CCUS policy, and shows how these gaps have been addressed through adjacent policies in Australia and internationally (as reviewed here and in *Task 4*). For the NT CCUS Hub, these reflections can guide future policy directions to address fiscal, legislative, and regulatory gaps. They also offer a foundation for transnational policy discussions on decarbonisation, such as the cross-border transport and sequestration of CO_2 and export of low-carbon liquid fuels.

7.1 Contrasts between CCUS and hydrogen policy

When CCUS and hydrogen policy settings are compared (Figure 8) it becomes apparent that significant differences in approaches are taken at the state/territory and national level. For both emissions reduction technologies there are several legislative instruments in place, although the purpose of each is somewhat different. While there are opportunities for optimisation, Australia's CCS regulations are some of the most well-developed globally, with the majority of CCS regulations in place already. This contrasts with hydrogen-specific regulations such as the GO scheme, which only recently commenced development.

Financing and incentive regimes have been developed for renewable electricity-derived hydrogen to provide the 'market pull' through low-cost financing, grants and production incentives and through the Safeguard Mechanism emissions disincentive. Apart from the Safeguard Mechanism disincentive, these systems are absent for CCUS. The absence of 'market pull' through financing mechanisms and incentives does not allow the pricing gap between the cost of ACCUs (the mechanism by which safeguard facilities can offset their emissions) and CCUS technology implementation to be bridged. For both hydrogen and CCUS, there are granting mechanisms designed to assist technology developers to develop or demonstrate technologies at the pilot scale. When comparing engagement on renewable electricity derived hydrogen and roll-out of CCUS, the communication of policy through the Hydrogen Strategy has provided policy clarity for stakeholders. CCUS remains contested, with only limited engagement and communications activity linked to developing and implementing policy in the area.

7.2 The role of innovation in CCUS

While not explicitly discussed in detail here, Australia's investment in CCS, and decarbonisation technologies more broadly, over the last decades has allowed the country to maintain its global competitive edge and retain the skills required for the transition to a low-emissions economy.

This position is not guaranteed. Several jurisdictions globally have sought to attract skills, expertise and technology developers through generous incentives. For technology developers needing to scale up their investment and commercialise technologies, the lack of access to deep pools of capital (including venture capital) is a disincentive to them remaining in Australia. This has had the effect of not only having Australian technology developers move their operations to other jurisdictions but also the further development of skills and expertise occurs in these countries. Furthermore, multinational companies with operations in Australia are making investments in the deployment of CCUS technologies in other jurisdictions –as such, invaluable practical experience will be gained elsewhere and investments in Australia are being deferred.

It is for these reasons that CCS policies need to consider the role that innovation serves in ensuring the development and retention of CCUS skills and expertise within Australia. Innovation does not just occur at low technology readiness levels; it is required across all technology levels and all steps along the value chain. This includes pilot and demonstration projects, through integration of new technologies into existing systems or at scale, or by developing new ways of doing business. A vibrant CCS R&D ecosystem is required to identify efficiencies and address problems as they arise. Current investment in capture and utilisation technologies is prudent as these technologies represent high-cost elements of the CCUS value chain. However, as CCUS becomes operationalised, new R&D opportunities will emerge throughout the CCUS value chain.

7.3 The benefit of an articulated strategy and meaningful engagement

One of the key differences between CCUS and hydrogen policy is the national Hydrogen Strategy (Figure 8). This 2024 document and its original 2019 incarnation articulate the vision and policy levers required to enable the development of low-emissions and subsequently renewable electricity-derived hydrogen. They provide clarity to stakeholders on government priorities and as such serve as an important engagement tool.

A similar national strategy could be developed for CCUS, especially as, like hydrogen, the application of CCUS cuts across industrial sectors and regions. The inclusion of CCUS in decarbonisation strategies in other jurisdictions (see the examples in section 5 of this report and those in the *Task 4* report (Stalker et al., 2024) has provided certainty and direction for industry and the community. Feedback from proponents, government representatives and other stakeholders to CSIRO during elicitation discussions in the UK and Europe was that while strategies should evolve, they should also provide long-term certainty. This reduces investment risks in projects with high upfront capital expenditure and long return periods.

7.4 How other jurisdictions have addressed CCUS policy gaps

Within the examples discussed herein and in the *Task 4* report (Stalker et al., 2024), various mechanisms have been used for financing and incentivising CCS and CCUS. For financing, this

typically includes either direct granting for early projects (e.g. Norway Northern Lights, PCI projects in Europe) or concessional loans (e.g. the People's Bank of China, Carbon Reduction Facility). These financing mechanisms lower the upfront capital or long-term costs of CCS projects, reducing the cost differential between unabated technology choices and the implementation of more costly emissions reduction technologies. These measures are typically combined with other incentives such as a price on carbon (e.g. EU ETS), CfD mechanisms (effectively a variable unit subsidy) or tax incentives similar to those implemented for hydrogen production. These mechanisms help provide certainty to proponents on the costs and returns for CCUS projects, enabling that initial investment.

While a range of financing and incentivisation policies have been used in many jurisdictions, the impact of these policies on the likelihood of success for the deployment of CCS and CCUS needs to be understood prior to their implementation. The mechanisms also need to be sufficiently flexible so that risks can be managed, even under changing market conditions. This is the driver behind the implementation of CfD mechanisms in many jurisdictions. Although most jurisdictions are focused on domestic policies, there is growing acknowledgment of the need for policy harmonisation (e.g. common carbon pricing) or the management of carbon leakage through carbon border adjustment mechanisms (e.g. EU-CBAM).

As discussed above, engagement with stakeholders on CCUS has been enhanced through articulation of a clear strategy, combined with discussion of CCUS' role in economic development and employment (e.g. EU strategy documents), as well as in the decarbonisation of hard-to-abate industries to achieve negative emissions. In addition, engagement has been enhanced through the reporting of progress towards targets (e.g. the Net-Zero Europe Platform (European Commission, n.d.)) and the publication of information from projects (e.g. Gassnova – Norway, (Gassnova, 2025)) to enhance knowledge sharing and understanding.

7.5 Existing financial and incentive mechanisms that could fill CCUS policy gaps

While there are gaps in specific CCUS policy in Australia, there are potential mechanisms through existing policies and legislation that could be used to support its development. This could include the provision of funding through the Future Made in Australia Fund, provided the purpose is not for coal, crude oil or natural gas production. The Infrastructure Investment Program objective to enhance links between producers and markets, including through international gateways and intermodal terminals, could also enable the development of CCUS infrastructure. An example of this type of infrastructure funding is the proposed $1.5 billion equity investment in the MASDP. In addition, concessional loans through the Northern Australia Infrastructure Fund could be considered as a mechanism for financing. Although these mechanisms appear to be available to support CCUS, further detailed investigation and clarification are warranted on the eligibility of CCUS for these funds and financing. If these mechanisms were to be used to address policy gaps, there would be a need for close cooperation across governments to ensure alignment.

7.6 Vehicles for policy delivery

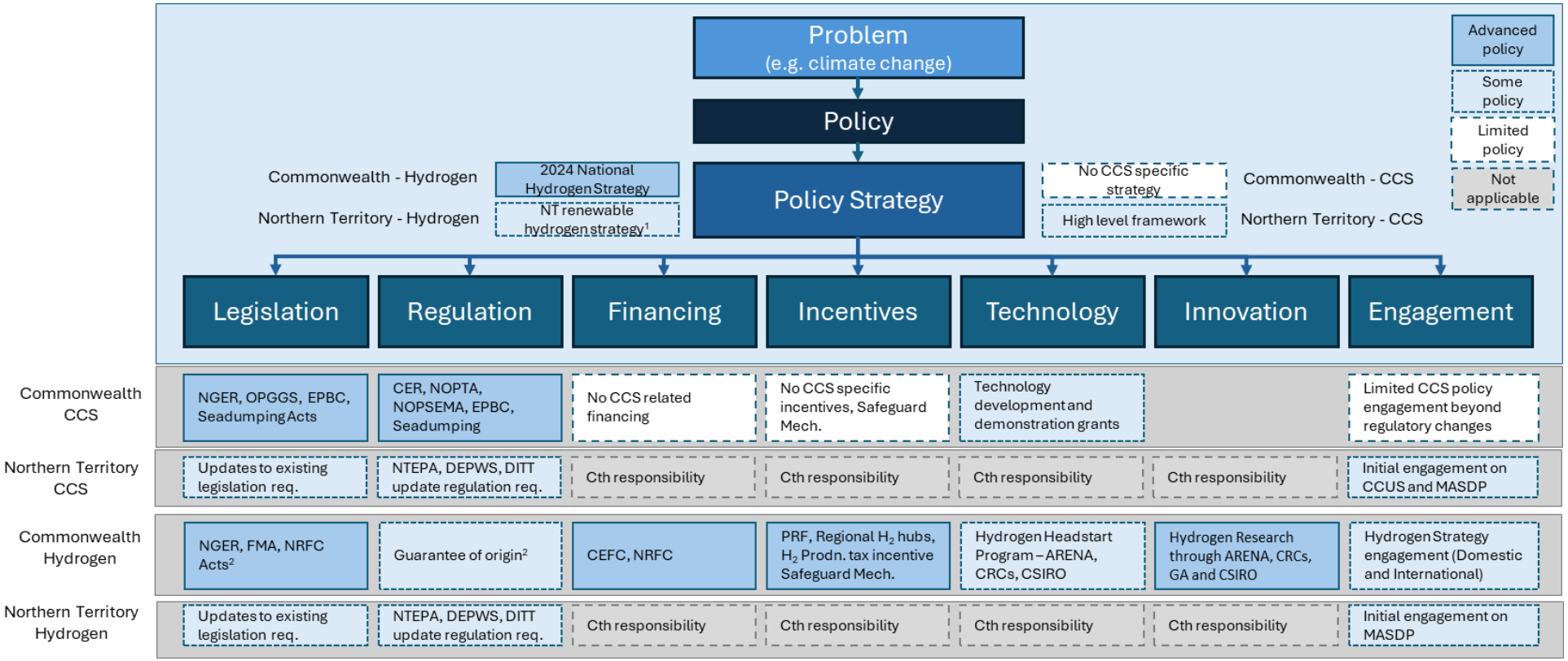
As discussed, globally there is a range of policies and enablers for CCUS. A key question is how these policies are operationalised and delivered. As outlined in the *Task 4* report (Stalker et al., 2024), this may comprise the development of policy and direct contracting between proponents and central government (e.g. UK CCUS funding models), the development of policy and allowing the market to operate without government intervention or the development of policy and the delivery of that policy through a government business enterprise (e.g. Norway – Gassnova). Each model has different advantages and risks. For example, the US 45Q regime allows the market to find the optimum economic outcomes for proponents, but this may lead to uneven distribution of market power.

Policy development and direct contracting with government can be useful in retaining government control of decarbonisation strategy implementation, but it can lead to exposure to risk associated with a change of government and policy approaches. Depending on the structure, a government business enterprise can be responsible for the delivery of government policies (and the provision of advice to policymakers) and due to its separation from the day-to-day operation of government it allows that enterprise to be focused on its core objective (e.g. ARENA, NZEA). Australia has a long history of using these vehicles for delivery, particularly for infrastructure projects.

7.7 Implications for NT CCUS hub development

Development of a NT CCUS hub requires the creation or amendment of NT legislation to permit the transport of CO_2 in pipelines. Work is underway to amend or develop legislation to enable CCUS to occur. Other state-based legislation and regulations have already been implemented that could form the basis of the design of the NT's legislation and regulations.

There is also a need to clearly articulate the opportunities that could be provided by developing a CCUS hub. This could be achieved by developing NT Government CCUS strategy and/or through mechanisms such as direct community engagement on the role of CCUS in decarbonisation of existing and future industries in the NT. While there are gaps in explicit policies for CCUS both at the territory and national level, there are other policy mechanisms that could potentially provide incentives and financing for the development of shared CCUS infrastructure. Consideration needs to be given to the nature of the delivery vehicle and the model that will be used for both implementation of the CCUS policy and the delivery of the NT CCUS hub infrastructure.



[1] Includes master plan and framework for the future and hydrogen supply chain (https://territoryrenewableenergy.nt.gov.au/strategies-and-plans/hydrogen).

[2] Other Acts and Regulations are applicable for the regulation of activities associated with the production, transport and use of hydrogen (https://www.dcceew.gov.au/energy/hydrogen/regulatory-lists).

Figure 8: CCS and hydrogen policy framework comparison

References

Legislation

Clean Energy Finance Corporation Act 2012 (Cth)

Climate Change Authority Act 2011 (Cth)

Environment Protection and Biodiversity Conservation Act 1999 (Cth)

Environment Protection (Sea Dumping) Act 1981 (Cth)

Environment Protection (Sea Dumping) Amendment (Using New Technologies to Fight Climate Change) Act 2023 (Cth)

Future Made in Australia Act 2024 (Cth)

Future Made in Australia (Production Tax Credits and Other Measures) Act 2025 (Cth)

Greenhouse Gas Storage Act 2009 (Cth)

Income Tax Assessment Act 1997 (Cth)

National Greenhouse and Energy Reporting Act 2007 (Cth)

Northern Australia Infrastructure Facility Act 2016 (Cth)

Northern Australia Infrastructure Facility Investment Mandate Direction 2023 (Cth)

Northern Territory Environment Protection Act 2012 (NT)

Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)

Petroleum Act 1923 (QLD)

Petroleum and Gas (Production and Safety) Act 2004 (QLD)

Sources

AEA (Australia's Economic Accelerator) (2025) Funded Projects. Viewed 15 March 2025, https://www.aea.gov.au/funded-projects.

Akai M (2016) CCS Activities and Support by Japan. Carbon Capture and Storage: Way Forward in Asia. Deep Dive Workshop - Asia Clean Energy Forum 2016. Asian Development Bank Headquarters, Manila.

Althaus C, Ball S, Bridgman P, Davis G and Threlfall D (2022) Policy instruments. In: Althaus C, Ball S, Bridgman P, Davis G and Threlfall D (eds) The Australian Policy Handbook. 7th Edition, Taylor & Francis Group, Australia.

Asian Development Bank (2015) Roadmap for Carbon Capture and Storage Demonstration and Deployment in the People's Republic of China. Viewed 11/7/2025, https://www.adb.org/sites/default/files/publication/175347/roadmap-ccs-prc.pdf

Asian Development Bank (2022) Road Map Update for Carbon Capture, Utilization and Storage Demonstration and Deployment in the People's Republic of China. https://www.adb.org/sites/default/files/publication/814386/road-map-update-carbon-capture-utilization-storage-prc.pdf

Australian Government (n.d-a) Carbon Capture Use and Storage Development Fund grant recipients. Viewed 28 July 2025, https://business.gov.au/grants-and-programs/carbon-capture-use-and-storage-development-fund/grant-recipients

Australian Government (n.d-b) Carbon Capture Use and Storage Development Fund grant recipients. Viewed 28 July 2025, https://business.gov.au/grants-and-programs/carbon-capture-use-and-storage-development-fund/grant-recipients

Australian Government (2024) Budget 2024-25 Factsheet: A Future Made in Australia. https://budget.gov.au/content/factsheets/download/factsheet-fmia.pdf

Australian Renewable Energy Agency (ARENA) (2023) Six shortlisted for $2 billion Hydrogen Headstart funding. https://arena.gov.au/news/six-shortlisted-for-2-billion-hydrogen-headstart-funding/

Australian Renewable Energy Agency (ARENA) (2024) ARENA Projects (Category: Hydrogen Energy). Viewed 25 June 2025, https://arena.gov.au/projects/?project-value-start=0&project-value-end=200000000&technology=hydrogen

Australian Taxation Office (ATO) (2025) Hydrogen Production Tax Incentive - How to claim the Hydrogen Production Tax Incentive (HPTI) tax offset for producing renewable hydrogen in Australia. Viewed 25 June 2025, https://www.ato.gov.au/businesses-and-organisations/income-deductions-and-concessions/incentives-and-concessions/production-tax-incentives/hydrogen-production-tax-incentive

Australian Treasury (2024a) Future Made in Australia: National Interest Framework: Supporting paper. https://treasury.gov.au/sites/default/files/2024-05/p2024-526942-fmia-nif.pdf

Australian Treasury (2024b) Hydrogen Production Tax Incentive - Consultation Paper.

Bursa Carbon Exchange (BCX) (2025) Bursa Carbon Exchange (BCX) - Resources and Guides. Viewed 30 June 2025, https://bcx.bursamalaysia.com/web/resources

Butcher JR and Mercer T (2024) Making public policy. In: Barry N, Fenna A, Ghazarian Z, Haigh Y and Perche D (eds) Australian politics and policy. Sydney University Press, Sydney.

CarbonNet (2023) CarbonNet Stage 3 - Federation Funding Agreement - Environment. Viewed 28 July 2025, https://federalfinancialrelations.gov.au/sites/federalfinancialrelations.gov.au/files/2023-07/CarbonNet%20Stage%203%20-%20Signed.pdf

CarbonNet (2024) Carbon Capture and Storage FAQs. Viewed 28 July 2025, https://djsir.vic.gov.au/carbonnet/resources/frequently-asked-questions

Carbon Storage Taskforce (CSF) (2009) National Carbon Mapping and Infrastructure Plan - Australia: Full Report, Department of Resources, Energy and Tourism, Canberra. https://www.parliament.wa.gov.au/parliament/commit.nsf/($lookupRelatedDocsByID)/518FAC2BBA6C246648257C29002DB8E6/$file/NCM_Full_Report.pdf

Chubb I, Bennett A, Gorring A and Hatfield-Dodds S (2022) Independent Review of ACCUs. Department of Climate Change, Energy, the Environment and Water, Canberra, December. CC BY 4.0 https://www.dcceew.gov.au/sites/default/files/documents/independent-review-accu-final-report.pdf

Clean Air Task Force (2025) European Commission issues landmark decision assigning CO_2 storage obligations to oil and gas producers under NZIA. Viewed 28 July 2025, https://www.catf.us/2025/05/european-commission-issues-landmark-decision-assigning-co%E2%82%82-storage-obligations-to-oil-and-gas-producers-under-nzia/

Clean Energy Finance Corporation (CEFC) (2024) Clean Energy Finance Corporation Annual Report 2023-24. https://www.cefc.com.au/document?file=/media/d3dodzn3/cefc_annualreport2023-24.pdf&page=24

Clean Energy Regulator (CER) (2025a) Amendments to national greenhouse and energy reporting legislation. Australian Government. https://cer.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme/report-emissions-and-energy/amendments-to-national-greenhouse-and-energy-reporting-legislation

Clean Energy Regulator (CER) (2025b) 2023-24 safeguard data insights. https://cer.gov.au/document_page/2023-24-safeguard-data-insights

Clean Energy Regulator (CER) (2025c) 2023-24 published data highlights. https://cer.gov.au/markets/reports-and-data/nger-reporting-data-and-registers/2023-24-published-data-highlights

Clean Energy Regulator (CER) (2025d) Safeguard baselines. https://cer.gov.au/schemes/safeguard-mechanism/safeguard-baselines

Clean Energy Regulator (CER) (2025e) ACCU Scheme methods. https://cer.gov.au/schemes/australian-carbon-credit-unit-scheme/accu-scheme-methods

Clean Energy Wire (2024) Q&A: The EU industrial carbon management strategy. Viewed 23 July 2025, https://www.cleanenergywire.org/factsheets/eu-industrial-carbon-management-strategy

Climate Change Authority (2024) Sector Pathways Review 2024. https://www.climatechangeauthority.gov.au/sites/default/files/documents/2024-09/2024SectorPathwaysReview.pdf

CO_2GeoNet (2021) State-of-play on CO_2 geological storage in 32 European countries - an update. https://co2geonet.com/media/73750/co2geonet_state-of-play-in-europe_2021.pdf

Commonwealth of Australia (n.d-a) Funding for development of a Hydrogen Hub in Townsville. https://business.gov.au/grants-and-programs/regional-hydrogen-hubs-townsville-region

Commonwealth of Australia (n.d-b) Funding to develop and advance hydrogen hub concepts to investment ready projects. https://business.gov.au/grants-and-programs/hydrogen-hubs-development-grants

Commonwealth of Australia (2017) 2017 Review of Climate Change Policies https://www.dcceew.gov.au/sites/default/files/documents/2017-review-of-climate-change-policies_0.pdf

Commonwealth of Australia (2023) Offshore Carbon Capture and Storage Regulatory Approvals - In relation to the *Offshore Petroleum and Greenhouse Gas Storage Act 2006, the Environment Protection (Sea Dumping) Act 1981, the Environment Protection and Biodiversity Conservation Act 1999*. https://www.nopta.gov.au/_documents/fact-sheets/Offshore-Carbon-Capture-and-Storage-Regulatory-Approvals-2023.pdf

CSIRO (2023a) Opportunities for CO_2 Utilisation in the Northern Territory. CSIRO, Canberra.

CSIRO (2023b) Regional Hydrogen Hubs Program. Viewed 29 July 2025, https://research.csiro.au/hyresource/regional-hydrogen-hubs-program/

CSIRO (2025) Northern Territory Low Emission Hub (NT LEH) Carbon Capture Storage and Utilisation (CCUS) business case project. Viewed 25 June 2025, https://www.csiro.au/en/research/technology-space/energy/Carbon-management/NT-low-emissions-hub/LEH

DCCEEW (n.d) Australia's Guarantee of Origin Scheme: consultation on scheme design, emissions accounting and renewable electricity certification. Commonwealth of Australia. Viewed 25 June 2025, https://consult.dcceew.gov.au/aus-guarantee-of-origin-scheme-consultations-on-design

DCCEEW (2023a) Independent Review of Australian Carbon Credit Units: Implementation Plan June 2023. Department of Climate Change, Energy, the Environment and Water, Canberra, June. CC BY 4.0 https://www.dcceew.gov.au/sites/default/files/documents/accu-review-implementation-plan.pdf

DCCEEW (2023b) Australia's Guarantee of Origin Scheme Design - Policy Paper. https://storage.googleapis.com/files-au-climate/climate-au/p/prj291cc9979281a4ffc59d8/public_assets/Guarantee%20of%20Origin%20Scheme%20design%20paper.pdf

DCCEEW (2024a) National Hydrogen Strategy 2024. Department of Climate Change, the Environment and Water, Canberra.

DCCEEW (2024b) Interim National Action List for offshore carbon dioxide sequestration, Department of Climate Change, Energy, the Environment and Water, Canberra. CC BY 4.0.

DCCEEW (2024c) Carbon Capture Technologies program grant recipients announced. Viewed 25 June 2025, https://www.dcceew.gov.au/about/news/carbon-capture-technologies-program-grant-recipients-announced

DCCEEW (2024d) Building regional hydrogen hubs. Viewed 25 June 2025, https://www.dcceew.gov.au/energy/hydrogen/building-regional-hydrogen-hubs

DCCEEW (2024e) Hydrogen Headstart program: The Australian Government has announced a further $2 billion for an additional round of Hydrogen Headstart. Viewed 25 June 2025, https://www.dcceew.gov.au/energy/hydrogen/hydrogen-headstart-program

DCCEEW (2025) Albanese Government to power Australian industry with reliable renewables, as WA hydrogen project receives green light. Viewed 28 July 2025, https://minister.dcceew.gov.au/bowen/media-releases/albanese-government-power-australian-industry-reliable-renewables-wa-hydrogen-project-receives-green-light

Dear M (1992) Understanding and Overcoming the NIMBY Syndrome. Journal of the American Planning Association 58(3), 288-300. DOI: 10.1080/01944369208975808.

Department of the Environment (2015) National Pollutant Inventory Guide - Version 6.1. Department of the Environment, Canberra.

Department of Finance (2021) Structure of the Australian Government Public Sector - Types of Australian Government Bodies. Viewed 25 June 2025, https://www.finance.gov.au/government/managing-commonwealth-resources/structure-australian-government-public-sector/types-australian-government-bodies

Department of Finance (2025a) List of Commonwealth entities and companies under the *Public Governance, Performance and Accountability Act 2013* (PGPA Act) | 1 April 2025. Viewed 25 June 2025, https://www.finance.gov.au/sites/default/files/2025-03/Bodies%20list%201%20April%202025%20-%20FINAL.pdf

Department of Finance (2025b) Structure of The Australian Government Public Sector - PGPA Act Flipchart and list. Viewed 25 June 2025, https://www.finance.gov.au/government/managing-commonwealth-resources/structure-australian-government-public-sector/pgpa-act-flipchart-and-list

Department of Finance (2025c) Government Business Enterprises - Governance arrangements. Viewed 25 June 2025, https://www.finance.gov.au/government/government-business-enterprises

Department of Industry, Science, Energy, and Resources (DISER) (2022) Australia's Nationally Determined Contribution: Communication 2022. https://unfccc.int/sites/default/files/NDC/2022-06/Australias%20NDC%20June%202022%20Update%20%283%29.pdf

Department of Industry, Science and Resources (DISR) (2023) Grant Opportunity Guidelines: Powering the Regions Fund - Safeguard Transformation Stream Round 1.

Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts (n.d) Infrastructure Investment Program. Viewed 4 August 2025, https://investment.infrastructure.gov.au/

Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts (2022a) National Initiatives. Viewed 25 June 2025, https://investment.infrastructure.gov.au/about/national-initiatives

Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts (2022b) Innovative funding and financing. Viewed 25 June 2025, https://investment.infrastructure.gov.au/resources-funding-recipients/innovative-funding-and-financing

Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts (2023a) Infrastructure Policy Statement. https://www.infrastructure.gov.au/department/media/publications/infrastructure-policy-statement

Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts (2023b) Major Projects Business Case Fund. Viewed 25 June 2025, https://investment.infrastructure.gov.au/about/national-initiatives/major-projects-business-case-fund

Department of Mining and Energy (DME) (n.d.) Department of Mining and Energy - About us. Viewed 26 June 2025, https://dme.nt.gov.au/about-us

Di Maddaloni F and Davis K (2017) The influence of local community stakeholders in megaprojects: Rethinking their inclusiveness to improve project performance. International Journal of Project Management 35(8), 1537-1556. DOI: 10.1016/j.ijproman.2017.08.011.

Dziejarski B, Krzyżyńska R and Andersson K (2023) Current status of carbon capture, utilization, and storage technologies in the global economy: A survey of technical assessment. Fuel 342, 127776. DOI: https://doi.org/10.1016/j.fuel.2023.127776.

Energy Market Authority of Singapore (2021) 12 Projects Awarded $55 Million to Accelerate Decarbonisation in Singapore. Viewed 30 June 2025, https://www.ema.gov.sg/news-events/news/media-releases/2021/12-projects-awarded-55-million-to-accelerate-decarbonisation-in-singapore

EUDP (Energy Technology Development and Demonstration Programme) (2023) Greensand Phase 2 Final report - EUDP. https://eudp.dk/files/media/document/Final%20report%20Greensand%20Phase%202.pdf

European Commission (n.d.) Net-Zero Europe Platform. Viewed 11 July 2025, https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act/net-zero-europe-platform_en

Feenstra CFJ, Mikunda T and Brunsting S (2010) What happened in Barendrecht? Case study on the planned onshore carbon dioxide storage in Barendrecht, the Netherlands. Global CCS Institute, Energy Research Centre of the Netherlands (ECN). Viewed 11 July 2025, https://www.globalccsinstitute.com/archive/hub/publications/8172/barendrecht-ccs-project-case-study.pdf

Gassnova (2025) Gassnova's reports about Longship - In this section you will find Gassnova's reports to the Ministry of Energy from the FEED phase and Gassnova's lessons learned reports. Viewed 28 July 2025, https://ccsnorway.com/project-outcomes/

Gastine M, Berenblyum R, Czernichowski-lauriol I, de Dios JC, Audigane P, Hladik V, Poulsen N, Vercelli S, Vincent C and Wildenborg T (2017) Enabling Onshore CO2 Storage in Europe: Fostering International Cooperation Around Pilot and Test Sites. Energy Procedia 114, 5905-5915. DOI: https://doi.org/10.1016/j.egypro.2017.03.1728.

Gibson E (2024) Nature Positive (Environment Protection Australia) Bill 2024 [and related Bills]. https://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/bd/bd2324a/24bd075

Global CCS Institute (2013) Malaysian CCS Legal and Regulatory Workshop - Workshop Report, Lumut, Malaysia, 27 February - 1 March 2013. https://www.globalccsinstitute.com/archive/hub/publications/109316/malaysian-ccs-legal-and-regulatory-workshop-report.pdf

Global CCS Institute (2024a) Global Status of CCS 2024: Collaborating For A Net-Zero Future. Australia. https://www.globalccsinstitute.com/wp-content/uploads/2024/10/Global-Status-Report-2024-Interactive.pdf

Global CCS Institute (2024b) 2024 Thought Leadership - CCS Policy, Legal and Regulatory Review. https://www.globalccsinstitute.com/wp-content/uploads/2024/11/PLR-Review-Report_15-November.pdf

Government of the Democratic Republic of Timor-Leste (2022) Nationally Determined Contribution Timor-Leste 2022-2030. Timor-Leste. https://unfccc.int/sites/default/files/NDC/2022-11/Timor_Leste%20Updated%20NDC%202022_2030.pdf

Government of the Republic of Singapore (2022) Addendum to Singapore's Long-Term Low-Emissions Development Strategy. https://www.nccs.gov.sg/files/docs/default-source/publications/nccsleds_addendum_2022.pdf

Government of Western Australia (2024a) Western Australia's Carbon Capture, Utilisation and Storage Action Plan, November 2024. Viewed 28 July 2025, https://www.wa.gov.au/system/files/2025-04/ccus_action_plan_nov_2024.pdf

Government of Western Australia (2024b) Driving Western Australia's CCUS future. News story: Inaugural action plan release and $26 million to support 2 Western Australian projects. Viewed 6 August 2025, https://www.wa.gov.au/government/announcements/driving-western-australias-ccus-future

Government of Western Australia (2024c) Lower Carbon Grants Program - Gorgon Fund recipients. Meet the recipients with conditional grant funding from the $33.6 million Lower Carbon Grants Program - Gorgon Fund which will deliver green energy and greentech projects in Western Australia to support a sustainable low carbon future. Viewed 6 August 2025, https://www.wa.gov.au/organisation/department-of-energy-and-economic-diversification/lower-carbon-grants-program-gorgon-fund-recipients

Havercroft I and Raji N (2023) 2023 Thought Leadership: CCS Legal and Regulatory Indicator 2023. https://www.globalccsinstitute.com/wp-content/uploads/2023/10/CCS-Legal-and-Regulatory-Indicator-Report-Global-CCS-Institute-.pdf

IEA (2020) China's Emissions Trading: Designing efficient allowance allocation. Viewed 11/7/2025, https://www.iea.org/reports/chinas-emissions-trading-scheme

IEA (2023) CCUS Policies and Business Models: Building a Commercial Market. OECD Publishing, Paris. https://doi.org/10.1787/6ef05538-en

IEA (2024) World Energy Outlook 2024. International Energy Agency. https://iea.blob.core.windows.net/assets/02b65de2-1939-47ee-8e8a-4f62c38c44b0/WorldEnergyOutlook2024.pdf

IEA (2024b) Enhancing China's ETS for Carbon Neutrality: Introducing Auctioning - Lessons from international experience. Viewed 11/7/2025, https://www.iea.org/reports/enhancing-chinas-ets-for-carbon-neutrality-introducing-auctioning

IEA (2025) CCUS projects around the world are reaching new milestones. Viewed 28 July 2025, https://www.iea.org/commentaries/ccus-projects-around-the-world-are-reaching-new-milestones Licence: CC BY 4.0

Infrastructure Australia (n.d) Infrastructure Priority List: Common user infrastructure at the Middle Arm Precinct. Viewed 25 June 2025, https://www.infrastructureaustralia.gov.au/ipl/common-user-infrastructure-middle-arm-precinct

Institution of Civil Engineers (2024) Guardians of the Thames: the past, present and future of the Thames Barrier. https://www.ice.org.uk/news-views-insights/inside-infrastructure/the-past-present-and-future-of-the-thames-barrier

International Carbon Action Partnership (2025a) Welcome to the ICAP ETS Map - Malaysia. ICAP. Viewed 30 June 2025, https://icapcarbonaction.com/en/ets/malaysia

International Carbon Action Partnership (2025b) Welcome to the ICAP ETS Map - China National ETS. Viewed 11/7/2025, https://icapcarbonaction.com/en/ets/china-national-ets

International Maritime Organization (IMO) (2016) London Convention and London Protocol. International Maritime Organization. https://doi.org/10.62454/KB532E

IPCC (2023) AR6 Synthesis Report: Climate Change 2023. Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/syr/

Japan CCS (2020) Report of Tomakomai CCS Demonstration Project at 200 thousand tonnes cumulative injection ("Summary Report") - Overview - May 2020 - Ministry of Economy, Trade and Industry (METI), New Energy and Industrial Technology Development Organization (NEDO), Japan CCS Co., Ltd. (JCCS). Viewed 26 June 2025, https://www.japanccs.com/wp/wp-content/uploads/2020/05/report202005_overview_en.pdf

JOGMEC (2024) Advanced Efforts for Commercialization of CCS - JOGMEC selects Nine projects as Japanese Advanced CCS Projects. Viewed 28 July 2025, https://www.jogmec.go.jp/english/news/release/news_10_00072.html

Joodi B, Ironside M, Tocock M, Rogers J, Gee R, Ross A, Clennell MB and Squiers I (2024) Northern Territory Low-emissions Carbon Capture Storage and Utilisation Hub. Potential Market Analysis - Task 3 Report. CSIRO report number EP2024 -6138, pp 82. CSIRO, Australia.

Kiat LS (2025) CCUS Bill 2025 - Ready to Capture. Kenanga Investment Bank. Viewed 30 June 2025, https://www.kenanga.com.my/wp-content/uploads/2025/03/ESG-250307-CCUS-Bill-2025-Kenanga.pdf

Kingdon JW (1995) Agendas, alternatives, and public policies. Longman, New York.

Korea Energy Economics Institute (KEEI) (2021) Energy News - 12 tln won earmarked for carbon neutrality in 2022. Viewed 27 June 2025,

https://www.keei.re.kr/board.es?mid=a20302000000&bid=0031&tag=&act=view&list_no=121072

Koukouzas N, Christopoulou M, Giannakopoulou PP, Rogkala A, Gianni E, Karkalis C, Pyrgaki K, Krassakis P, Koutsovitis P, Panagiotaras D and Petrounias P (2022) Current CO2 Capture and Storage Trends in Europe in a View of Social Knowledge and Acceptance. A Short Review. Energies 15(15), 5716. DOI: https://doi.org/10.3390/en15155716

Krupnick A and Parry I (2011) Decarbonizing the Power Sector: Are Feebates Better Than a Clean Energy Standard? Viewed 28 July 2025, https://www.resources.org/archives/decarbonizing-the-power-sector-are-feebates-better-than-a-clean-energy-standard/

Kvien K, Garnett A, Carpenter ME and Aarnes J (2011) Application of the CO2QUALSTORE guideline for developing a risk-based investment schedule for an integrated CCS project. Energy Procedia 4, 5911-5916. DOI: 10.1016/j.egypro.2011.02.592.

Lee and Ko (2024) Newsletter - Environment and Energy Team - Enactment of the Carbon Dioxide Capture, Utilization and Storage Act (CCUS Act). Viewed 27 June 2025, https://www.leeko.com/upload/news/newsLetter/1026/20240123120422141.pdf

Matsuoka T (2024) The Establishment of the CCS Business Act Will Mark a Major Milestone for Social Implementation of CCS in Japan. RITE. Viewed 27 June 2025, https://www.rite.or.jp/en/results/today/pdf/rt2024_foreword_e.pdf

Merk C, Nordø ÅD, Andersen G, Lægreid OM and Tvinnereim E (2022) Don't send us your waste gases: Public attitudes toward international carbon dioxide transportation and storage in Europe. Energy Research & Social Science 87, 102450. DOI: https://doi.org/10.1016/j.erss.2021.102450.

Meyer-Ohlendorf N (2025) Implementing the EU 2040 Climate Target: Building blocks and measures. Institute for Applied Ecology, Berlin. https://www.ecologic.eu/sites/default/files/publication/2025/60028-Implementing-EU-2040-Climate-Target-measures.pdf

Minister of Energy and Mineral Resources, Republic of Indonesia (2023) PERATURAN MENTERI ENERGI DAN SUMBER DAYA MINERAL TENTANG PENYELENGGRAAN PENANGKAPAN DAN PENYIMPANAN KARBON, SERTA PENANGKAPAN, PEMANFAATAN, DAN PENYIMPANAN KARBON PADA KEGIATAN USAHA HULU MINYAK DAN GAS BUMI. (Regulation of the Minister of Energy and Mineral Resources about the implementation of carbon capture and storage, as well as capture, utilisation and carbon storage in oil and gas business activities). Number 2 of 2023. Viewed 27 June 2025, https://jdih.esdm.go.id/dokumen/download?id=ABSTRAK+PERMEN+ESDM+NO+2+THN+2023.pdf

Ministry of Energy and Mineral Resources, Republic of Indonesia; the IEA and the OECD (2022) Indonesia emissions trading system, Summary of insights: Focus Group Discussions Nov 2021 - May 2022. https://www.oecd.org/content/dam/oecd/en/about/programmes/cefim/indonesia/news-and-events/Indonesia-ETS-FGD-series-summary-report.pdf/_jcr_content/renditions/original./Indonesia-ETS-FGD-series-summary-report.pdf

Ministry of Economy, Trade and Industry (METI) (2023a) Full-scale Commencement of Japanese CCS Projects. Viewed 26 June 2025, https://www.meti.go.jp/english/press/2023/0613_001.html

Ministry of Economy, Trade and Industry (METI) (2023b) CCS長期ロードマップ検討会 中間とりまとめ (CCS Long-term Roadmap Study Group Mid-term Summary). Viewed 26 June 2025, https://www.meti.go.jp/shingikai/energy_environment/ccs_choki_roadmap/20220527_report.html

Ministry of Finance Malaysia (2023a) Belanjawan 2023 Malaysia (Budget 2023) - Website. Ministry of Finance, Malaysia. Viewed 30 June 2026, https://belanjawan.mof.gov.my/en/2023

Ministry of Finance Malaysia (2023b) Appendix II Tax Measures - Budget 2023. Viewed 6 August 2025, https://belanjawan.mof.gov.my/pdf/belanjawan2023/ucapan/tax-measure.pdfMinistry of Trade and Industry Singapore, and Coordinating Ministry for Maritime and Investment Affairs, Republic of Indonesia (2024) Press Release - Singapore and Indonesia sign letter of intent to collaborate on carbon capture and storage (CCS). Viewed 30 June 2025, https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2024/02/Press-Release-on-Singapore-Indonesia-LOI-on-CCS_MTI---Final.pdf

Mishra PR, Verma AK, Jain A, Mathuria P and Bhakar R (2022) Carbon Capture Utilization and Storage: Pathways for India. 2022 22nd National Power Systems Conference (NPSC).

Mitsubishi Heavy Industries (MHI) (2023) Mitsubishi Shipbuilding Holds Christening and Handover Ceremony in Shimonoseki for Demonstration Test Ship for Liquefied CO_2 Transport -- New Vessel "EXCOOL" to Contribute to Protecting the Global Environment --. Viewed 27 June 2025, https://www.mhi.com/news/23112802.html

Mukherjee A and Chatterjee S (2022) Carbon Capture, Utilization and Storage (CCUS) - Policy Framework and its Deployment Mechanism in India. Viewed 11 July 2025, https://www.niti.gov.in/sites/default/files/2022-12/CCUS-Report.pdf

National Climate Change Secretariat Singapore (NCCS) (n.d.) Website - Carbon Tax. Viewed 30 June 2025, https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/carbontax/

National Offshore Petroleum Titles Administrator (NOPTA) (2025) Obtaining a GHG assessment permit. https://www.nopta.gov.au/application-processes/greenhouse-gas/ghg-assessment-permit.html

National Reconstruction Fund Corporation (NRFC) (2023) Renewables and low emission technologies. https://www.nrf.gov.au/what-we-do/our-priority-areas/renewables-and-low-emission-technologies

National Development and Reform Commission of China (2024) Notice of the General Office of the National Development and Reform Commission on Issuing the List of Green and Low-Carbon Advanced Technology Demonstration Projects (First Batch). Viewed 1 October 2024, https://www.gov.cn/zhengce/zhengceku/202404/content_6945545.htm

Net Zero Australia. Viewed 25 June 2025, https://www.netzeroaustralia.net.au/

Net Zero Economy Authority (NZEA) (n.d.) Regions - our regions of focus. Viewed 29 July 2025, https://www.netzero.gov.au/regions

Northern Australia Infrastructure Facility (NAIF) (n.d.) How and Where We Invest. Viewed 5 August 2025, https://www.naif.gov.au/our-investments/how-and-where-we-invest/

Northern Australia Infrastructure Facility (NAIF) (2024) Annual Report 2023-2024. https://www.naif.gov.au/media/2iqd3brg/naif-annualreport-2023-24-digital.pdf

Northern Territory Environment Protection Authority (NTEPA) (2024) Regulatory Statement: Regulation of LNG and other emissions, viewed 5 August 2025, https://ntepa.nt.gov.au/_media/waste-and-pollution/air-quality/pdf/_other/regulatory-statement-regulation-lng-other-emissions.pdf

Northern Territory Government (2020) Northern Territory Renewable Hydrogen Strategy. https://dme.nt.gov.au/__data/assets/pdf_file/0014/905000/nt-renewable-hydrogen-strategy.pdf

Northern Territory Government (2022) Northern Territory Media Release - $5 Million to Accelerate the Territory's Hydrogen Industry. Viewed 26 June 2025, https://newsroom.nt.gov.au/article/_nocache?id=61d5611364bd3ce194d941d7c4e03a3b

Northern Territory Government (2024) The Middle Arm Sustainable Development Precinct: The Precinct. Northern Territory Government. Viewed 26 June 2025, https://middlearmprecinct.nt.gov.au/about-the-precinct

Northern Territory Government (2025) Regulatory Statement: Regulation of Greenhouse Gas Emissions in the NT. Department of Lands, Planning and Environment.

Northern Territory Environment Protection Authority (NTEPA) (2024) Regulatory Statement: Regulation of LNG and other emissions.

Oliver K, Hopkins A, Boaz A, Guillot-Wright S and Cairney P (2022) What works to promote research-policy engagement? Evidence & policy 18(4), 691-713. DOI: 10.1332/174426421X16420918447616.

Parliament of Australia (n.d.) Viewed 29 July 2025, https://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/bd/bd2425/25bd046

Parliament of Australia (2024) Environment and Communications References Committee - Middle Arm Industrial Precinct. Senate Printing Unit, Parliament House, Canberra. https://parlinfo.aph.gov.au/parlInfo/download/committees/reportsen/RB000239/toc_pdf/MiddleArmIndustrialPrecinct.pdf

Patidar AK, Singh RK and Choudhury T (2023) The prominence of carbon capture, utilization and storage technique, a special consideration on India. Gas Science and Engineering 115, 204999. DOI: 10.1016/j.jgsce.2023.204999.

People's Bank of China (2021) The People's Bank of China Launches the Carbon Emission Reduction Facility. Viewed 1 September 2024, http://www.pbc.gov.cn/en/3688110/3688172/4157443/4385345/index.html

People's Bank of China (2023) China Monetary Policy Report Q1, 2023. https://www.pbc.gov.cn/en/3688229/3688353/3688356/4756453/4985743/20230711100004462553.pdf

Petronas (2022) Media Release - Kuala Lumpur, 29 November 2022 - Petronas Carigali Reaches Final Investment Decision for Kasawari CCS Project Offshore Sarawak. Viewed 30 June 2025, https://www.petronas.com/media/media-releases/petronas-carigali-reaches-final-investment-decision-kasawari-ccs-project

President of the Republic of Indonesia (2024) PERATURAN PRESIDEN REPUBLIK INDONESIA NOMOR 14 TAHUN 2024, PENYELENGGARAAN KEGIATAN PENANGKAPAN DAN PENYIMPANAN KARBON (Presidential Regulation of the Republic of Indonesia number 14 of 2024, Implementation of activities for carbon capture and storage), viewed 27 June 2025, https://peraturan.bpk.go.id/Details/276843/perpres

Queensland Government (2025) Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development - Greenhouse gas storage in Queensland. Viewed 26 June 2025, https://www.nrmmrrd.qld.gov.au/mining-exploration/initiatives/greenhouse-gas-storage-in-queensland

Ram R (2024) Interview: India sees CCUS policy launch by end 2024, says planning body advisor. S&P Global Commodity Insights. S&P Global. Viewed 11 July 2025, https://www.spglobal.com/commodity-insights/en/news-research/latest-news/energy-transition/020524-interview-india-sees-ccus-policy-launch-by-end-2024-says-planning-body-advisor

Research Institute of Innovative Technology for the Earth (RITE) (2007) Nagaoka Project CO_2 Geological Storage - Basic Research. Viewed 26 June 2025, https://www.rite.or.jp/English/lab/geological/basic.html

Rao TJ, Pandey KK and Wang X (2023) Carbon Capture and Storage (CCS) for India: Bottlenecks and Their Role in Adoption. Springer International Publishing, Cham, 247-254.

Rogers J, Gee R, Ironside M, Joodhi B and Ross A (2024) Northern Territory Low Emission Carbon Capture Storage and Utilisation Hub, Regional Understanding & Context - Task 2 Report. CSIRO Report number EP2024-6192. pp 78. CSIRO, Australia.

Ross A, Stewart M, Richardson C and Clifford A (2022) Collaborative development of the Northern Territory low-emissions carbon capture, utilisation and storage hub – a blueprint for the rapid decarbonisation of Northern Australia. The APPEA Journal 62. DOI: https://doi.org/10.1071/AJ21185.

Ross A, Ironside M and Gee R (2023) The Northern Territory low-emissions carbon capture, utilisation and storage hub development – the collaborative business case development. The APPEA Journal 63. DOI: https://doi.org/10.1071/AJ22210.

Seah S (2024) Carbon Capture, Utilisation and Storage (CCUS): A Singapore Perspective. Viewed 30 June 2025, https://www.twobirds.com/en/insights/2024/singapore/carbon-capture-utilisation-and-storage-ccus-a-singapore-perspective

Stalker L, Ross A, Gee R, Jenkins C and Squiers I (2024) Northern Territory Low Emissions Carbon Capture Storage and Utilisation Hub. International Hub Examples – Task 4 Report. CSIRO, Australia.

State Government of Sarawak (2023) Environment (Reduction of Greenhouse Gases Emission) Ordinance, 2023. Viewed 30 June 2025,

https://lawnet.sarawak.gov.my/lawnet_file/Ordinance/ORD_Cap.%2085%20ENVIRONMENT%20%28REDUCTION%20OF%20GREENHOUSE%20GASES%20EMISSION%29%20ORD%202023%20LawNet%202024%20.pdf

Sutabutr T (2024) Carbon Capture Storage and Utilisation (CCUS) Development in Thailand, ERIA Discussion paper Series no. 515. Economic Research Institute for ASEAN and East Asia - Discussion Papers. Viewed 30 June 2025, https://www.eria.org/uploads/Carbon-Capture-Storage-and-Utilisation-CCUS-Development-in-Thailand.pdf

Szizybalski A, Kollersberger T, Möller F, Martens S, Liebscher A and Kühn M (2014) Communication Supporting the Research on CO2 Storage at the Ketzin Pilot Site, Germany – A Status Report after Ten Years of Public Outreach. Energy Procedia 51, 274-280. DOI: 10.1016/j.egypro.2014.07.032.

Talukder A, Dance T, Michael K, Clennell B, Gee R, Northover S, Stalker L and Ross A (2024) CO_2, H_2 and compressed air energy storage site screening study - selected onshore basins in the Northern Territory. NTGS Record 2024-005. Northern Territory Geological Survey, CSIRO.

Young J, Shaxson L, Jones H, Hearn S, Datta A and Cassidy C (2014) ROMA: a guide to policy engagement and influence. Viewed 28 July 2025, https://odi.org/en/publications/roma-a-guide-to-policy-engagement-and-influence/

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