MAHON, R. 2024. Faces of carbon capture and storage: successes, challenges, and its impact on public perception. Presented at the UKCCSRC (UK Carbon Capture and Storage Research Centre) Knowledge exchange conference 2024, 5-6 November 2024, Sheffield, UK.

Faces of carbon capture and storage: successes, challenges, and its impact on public perception.

MAHON, R.

2024

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Faces of Carbon Capture and Storage: Successes, Challenges, and its Impact on Public Perception

Dr Ruissein Mahon

How do we achieve the BALANCED approach?

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Carbon capture and storage (CCS)

Climate scientists call on Labour to pause £1bn plans for carbon capture

Letter says technologies to produce blue hydrogen and capture CO2 are unproven and could hinder net zero efforts

Matthew Taylor

Wed 25 Sep 2024 13.00 BST

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Ed Miliband, Rachel Reeves and Keir Starmer visit Teesside, the location of a proposed multibillion-pound carbon capture and storage project. Photograph: Ian Forsyth/Getty Images

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The Growing Conservative Backlash Against Carbon Capture and Storage

A climate technology favored by oil companies is now being attacked from the right.

By **Geoff Dembicki** on Jul 31, 2024 @ 13:24 PDT

4 min read

Conservative leader Pierre Poilievre has spoken in support of CCS. Credit: Pierre Poilievre / YouTube

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JULY 31, 2023

expert reaction to government announcement on CCS

The Prime Minister Rishi Sunak has announced millions of pounds of investment in carbon capture and storage (CCS) facilities in North East Scotland and the Humber.

Prof Geoffrey Maitland FREng, Professor of Energy Engineering at Imperial College London, said:

"The government announcement this morning that significant funding will be made available for two carbon capture and storage (CCS) projects in Scotland (the Acorn project) and on Humberside (the Viking project) is excellent news for keeping the UK on track for achieving net-zero carbon emissions by 2050. The Committee on Climate Change and all credible decarbonisation scenarios state that this target will not be achieved without large-scale CCS implementation and after decades of false starts and indecision, it is good to see the UK government at last giving their support to this essential technology. The immediate target is to capture and store 20-30 Mte of CO_2 pa by 2030 (up to 180 Mte pa by 2050) and these two projects will contribute a significant fraction of that (more than a third). Not only will they be essential for achieving the UK's net-zero target but they will also create tens of thousands of new jobs in these areas as well as safeguarding even more high-value industrial jobs which are at risk if we curtail the use of oil and gas to manufacture the products like cement, steel and refined chemicals that are essential to the quality and affordability of life that the people expect and often take for granted.

"An area which could do with further clarification from the government is the precise funding they are putting into these two CCS projects. The statement simply refers to 'many millions of pounds'. To get these projects in place as soon as possible requires billions of pounds investment, so exactly how much will go to the company consortia involved and is there any new money in addition to the £20bn over 20 years committed to CCS in the 2023 budget?

Home > Press Releases > Cost of carbon capture failures revealed

22ND SEPTEMBER 2024

- New analysis: £500 million of UK public money wasted on failing carbon capture projects

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Carbon capture and storage (CCS)

This article is more than 3 years old

'A shocking failure': Chevron criticised for missing carbon capture target at WA gas project

The Western Australian environment minister is seeking an explanation after the energy company fell short of its five-year target

Adam Morton *Climate and environment editor*

Mon 19 Jul 2021 18.30 BST

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Japanese man who spent 46 years on death row cleared of murders

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Public Perception – Why Consider?

Search topic: 'Carbon Capture and Storage'

- **Google:** ~ 111,000,000 results
- **Google Scholar:** ~2,780,000 results
- **ScienceDirect:** 204,447 results
- **Springer Nature Link:** 60,580 results
- **Wiley:** 116,886 results
- **Sage Journals:** 2,300 results
- **OnePetro:** 17,029 results
- **IEEE Xplore:** 1,711 results
- **ASME Digital Collection:** 6,230 results

Work and contributions made in the field of CCS

- Understanding the skill ecosystems for geological CO_2 storage to support just transition: Lesson from Scotland and Australia
- Environmental Capacity in Industrial Clusters
- The effect of steam on supported molten-carbonate and -hydroxide salt membranes for high temperature CO_2 separation
- CO_2 and Porous Carbons: Adsorption, Separation and Conversion
- Global sensitivity analysis of blue hydrogen production: a comparative study using machine learning
- Pump it up? Quantifying the stress paths of depleted oil & gas reservoirs to prepare for CO_2 injection
- CO_2 Sequestration in the Steel and Cement Industry Using Indirect Mineral Carbonation
- Enhanced Carbon Capture via Carbonation of Biochar-Steel Slag Composites
- An Environmental and Economic Assessment of Project MONET (MOF-based Negative Emissions Technology)
- Circularity and CO_2 utilisation opportunities in SWIC
- Knowledge exchange between academia and industry – Secondment in Uniper Hydrogen UK
- Carbon Negative Energy Production Through Chemical Looping Combustion of Biomass/Biochar
- Synthesis & Application of Waste-derived Sorbents for CO_2 Capture
- Optimising the plant ready for carbon capture – waste wood and gasification
- Northern Ireland/Great Britian clean maritime corridor
- An optimisation model for the design of multi-modal CO_2 transportation in carbon capture and storage supply chain
- A review of problems and methods of optimising sensor placement for CO_2 pipeline and transport systems
- Development of Advanced Silica-alkoxylated Polyethyleneimine (APEI) for Accelerating Basic Solid Adsorbent Looping Technology
- Carbonation heat recovery via dry reforming to improve the techno-economic performance of the Ca-Cu looping post-combustion CO_2 capture
- RECYCLE: REthinking low Carbon hYdrogen production by Chemical Looping rEforming
- Long-term Business Models for CCS
- The cost of carbon capture in Europe, a techno-economic analysis
- A BECCS hub in the UK context – logistical, policy, regulatory and community dimensions

Divergent Perspectives

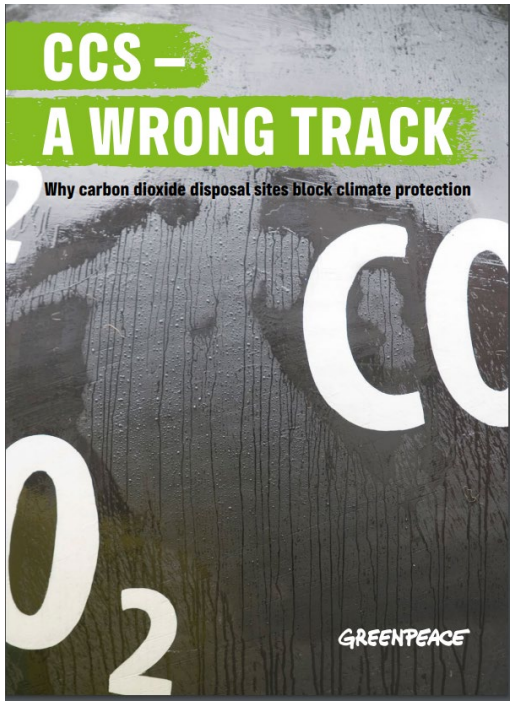
- **Trojan Horse?**
  - "Greenwashing"
  - "Most carbon capture projects have been spectacular failures"
  - "Distraction from cleaner, safer, and better energy options"
  - "CCS will keep households locked into high energy prices"
  - "False promise used to justify continued fossil fuel production"
  - "Governments keep pouring money into it – often from our taxes"

- **Silver Bullet? Social license to operate?**
  - "Deliver cost-effective low carbon power generation"
  - "Can reduce emissions at the source"
  - "Reduce the social cost of carbon"
  - "Robust and innovative tool to reduce carbon emissions and make progress towards net zero goals"
  - "Can address climate change "
  - "Good for the economy"

Extracted from various online sources including blogs, social media, and newsletters

Factors Impacting Public Perception of CCS

- **CCS in the media:** Shapes public opinion.
- **Countering perceptions of risk:** Facility and storage concerns – carbon leakage.
- **Willingness to pay for CCS:** Overall public spend (government subsidies); increase in taxes, increased cost of living.
- **'Not In My Backyard' (NIMBY) effect:** Social rejection – danger to community.
- **Political risk:** Weakened climate policy; delayed decarbonisation; influenced by carbon-emitting industries.
- **Technical scalability:** Track record (variable results); CO_2 chain is prone to technical faults and bottlenecks.



CCS – A Wrong Track (Greenpeace, 2024)

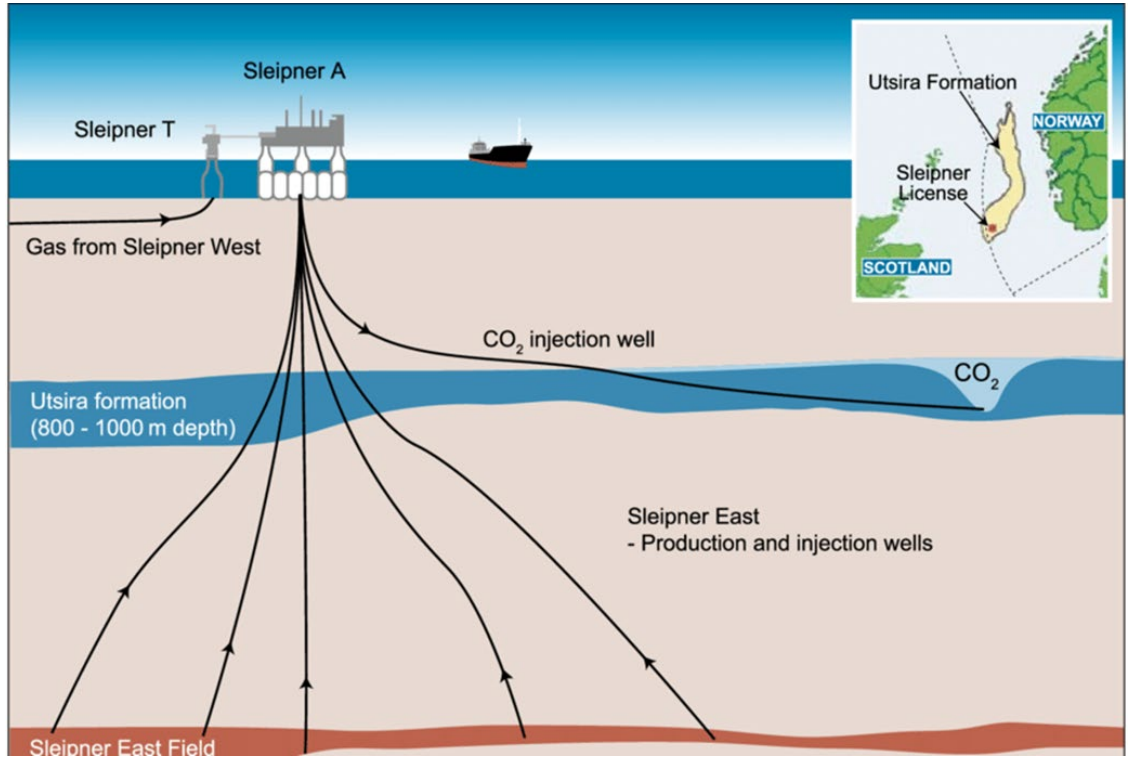
Ban on CCS Operations

- **Austria:** Prohibit permanent geological storage of CO_2 with very few exceptions for research.
- **Estonia:** No geological formation suitable for CO_2 storage.
- **Finland:** Geological formations are not suitable for permanent and safe geological storage of CO_2.
- **Germany:** Draft law prohibits onshore CO_2 geological storage.
- **Ireland:** CO_2 storage in geological formations is illegal.
- **Latvia:** Current Law on Pollution prohibits geological CO_2 storage.
- **Lithuania:** Geological CO_2 storage is currently prohibited by the Law of the Depths of the Earth.
- **Netherlands:** Starting in 2035, no new CCS support will be granted.
- **Queensland, Australia:** To protect its water resources within the Great Artesian Basin.
- **Slovenia:** Environmental Protection Act prohibits the injection and storage of CO_2 in geological formations.

Based upon the Carbon Gap Policy Tracker, 2024 and European Commission CCS Report, 2023

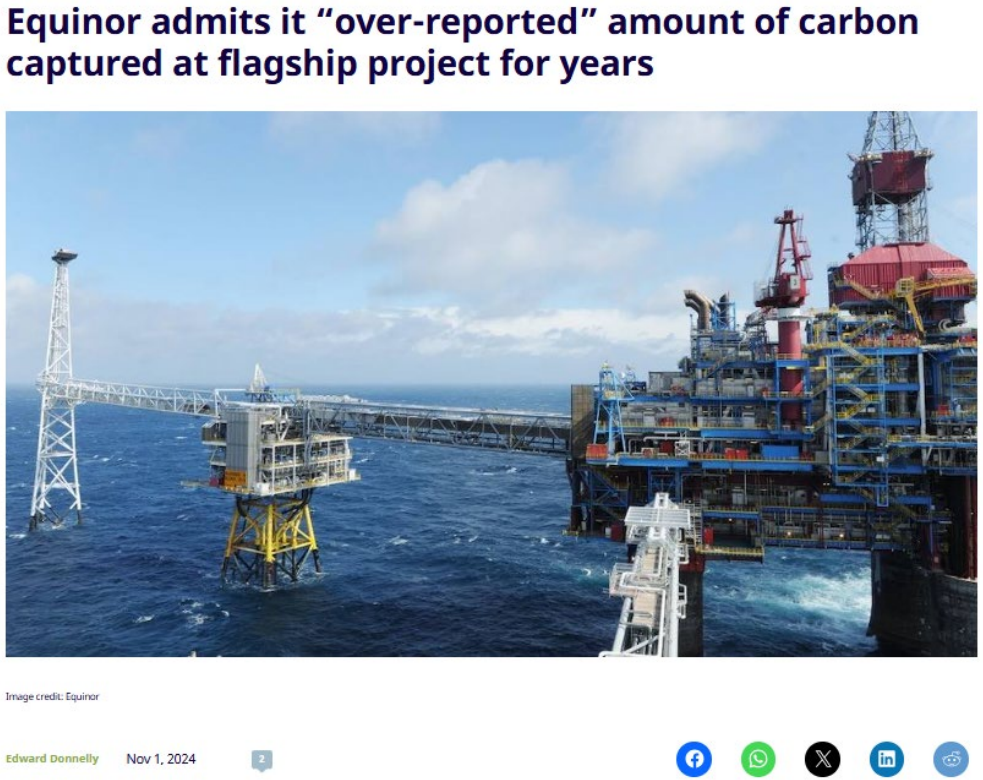
Case Study: Sleipner, Norway

- **First large-scale** CCS project to become operational in Europe and **longest-running** CCS project in the world.
- **Regulatory frameworks:** EU Directive, London Protocol (amended), and OSPAR Convention.
- **Stringent emission regulations:** Combination of the CO_2 tax and levied climate quota.
- **Operational issues:** Faster CO_2 migration, into a previously unidentified shallow layer in unexpectedly large quantities.



CO_2 injection in the Utsira Formation at Sleipner (Solomon, 2007)

Case Study: Sleipner, Norway



Case Study: Sleipner, Norway

Carbon Dioxide Captured and Storage (Equinor, 2024)

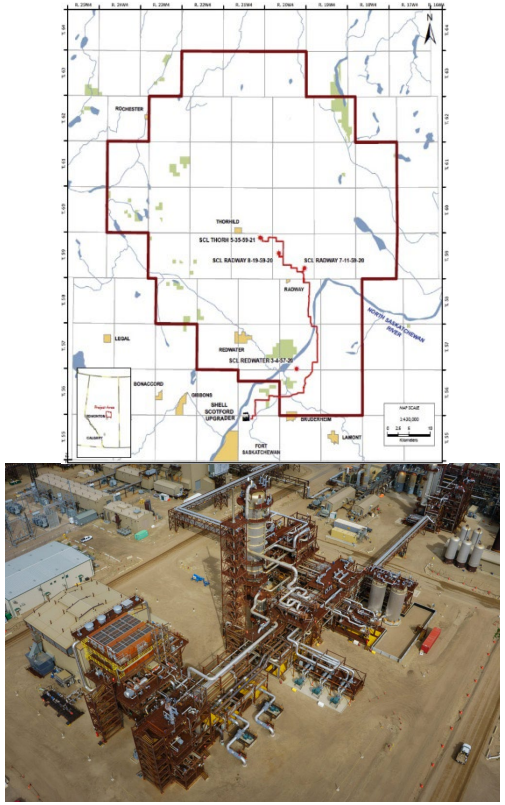
Indicators	Boundary	Unit	2023	2022	2021	2020	2019	2018	2017	2016
CO2 emissions captured and stored per year	Operational control	million tonnes	0.8	0.5	0.3(b)	0.9(b)	1.2(b)	1.3(b)	1.2(b)	1.4
Accumulated CO2 emissions captured and stored	Operational control	million tonnes	27.1	26.3	25.8	25.6	24.6	23.4	22.2	20.9

(b) Due to a flawed flow transmitter at Equinor's CO2 injection facilities at Sleipner, the figures for CO2 injected were over-reported in the period 2017-2021. The transmitter was replaced in March 2021, and the figures have been updated accordingly.

What is the implication to public perception?

- **Should independent performance monitoring be mandatory?**
- **Can negative public perception have a 'knock-on' effect to other sectorial project development, e.g., blue hydrogen?**
- **Does this boost the ideology of CCS is not a proven at scale system?**

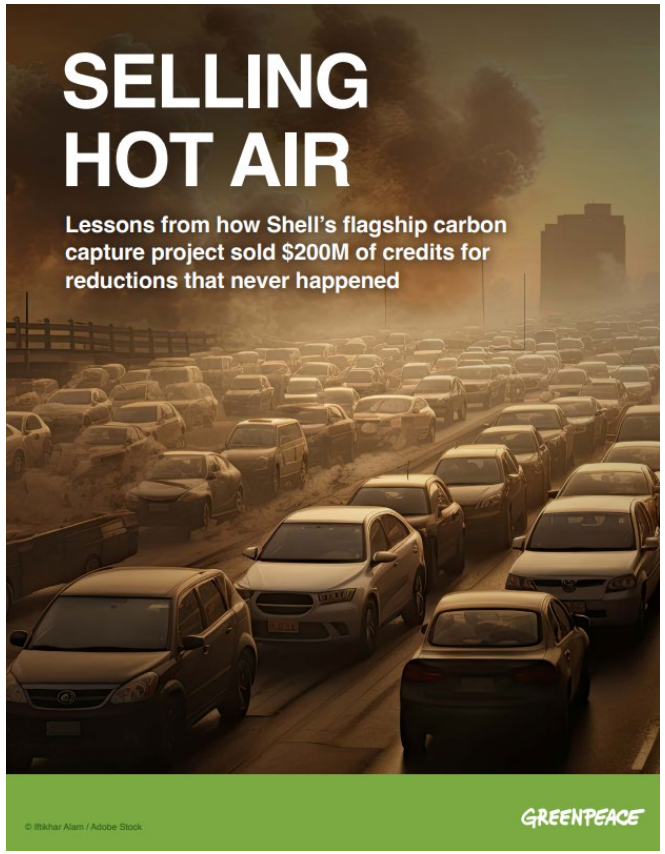
Case Study: Quest, Canada



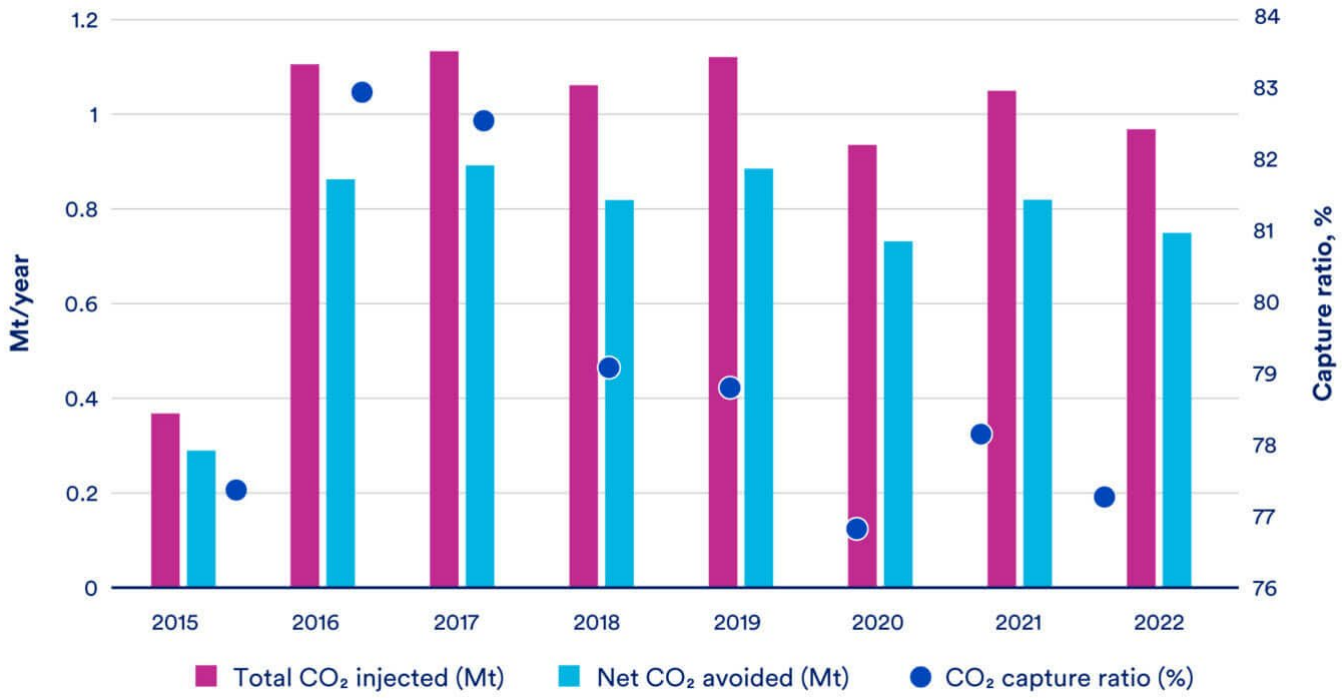
Quest CCS project location and capture facility (Rock et al., 2017)

- **World's first oil sands CCS project.**
- Produced CO_2 is injected into a saline formation for permanent storage.
- **Grant funding:** ~ CA$865 million from the provincial and federal governments.
- **Offset credits:** Benefits from the Alberta 'Technology Innovation and Emissions Reduction Regulation'.
- **Capture rate reduction:** scheduled maintenance and various rapidly resolved equipment faults such as power trips or faulty valves.

Case Study: Quest, Canada

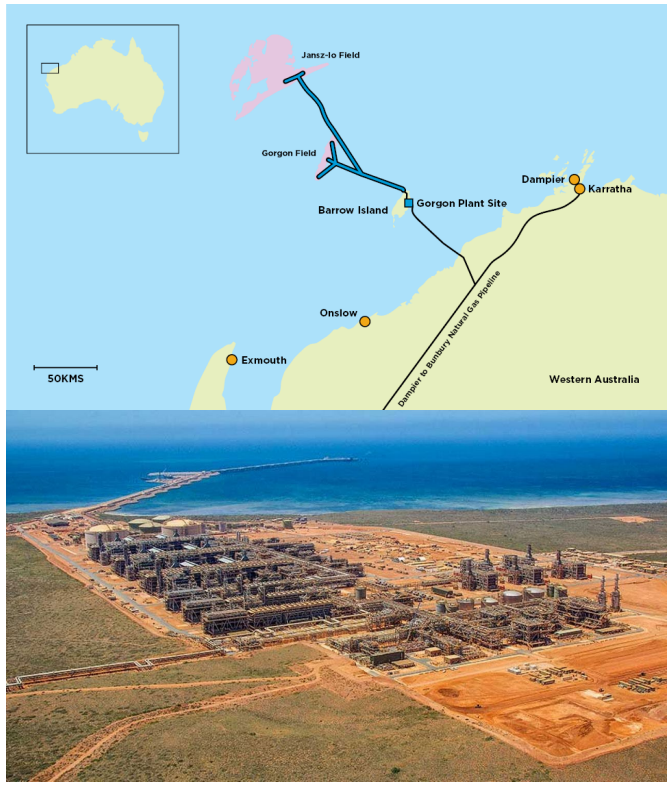


Selling Hot Air Report (Greenpeace, 2024)



Quest CCS project performance over time (Clean Air Task Force, 2024)

Case Study: Gorgon, Australia

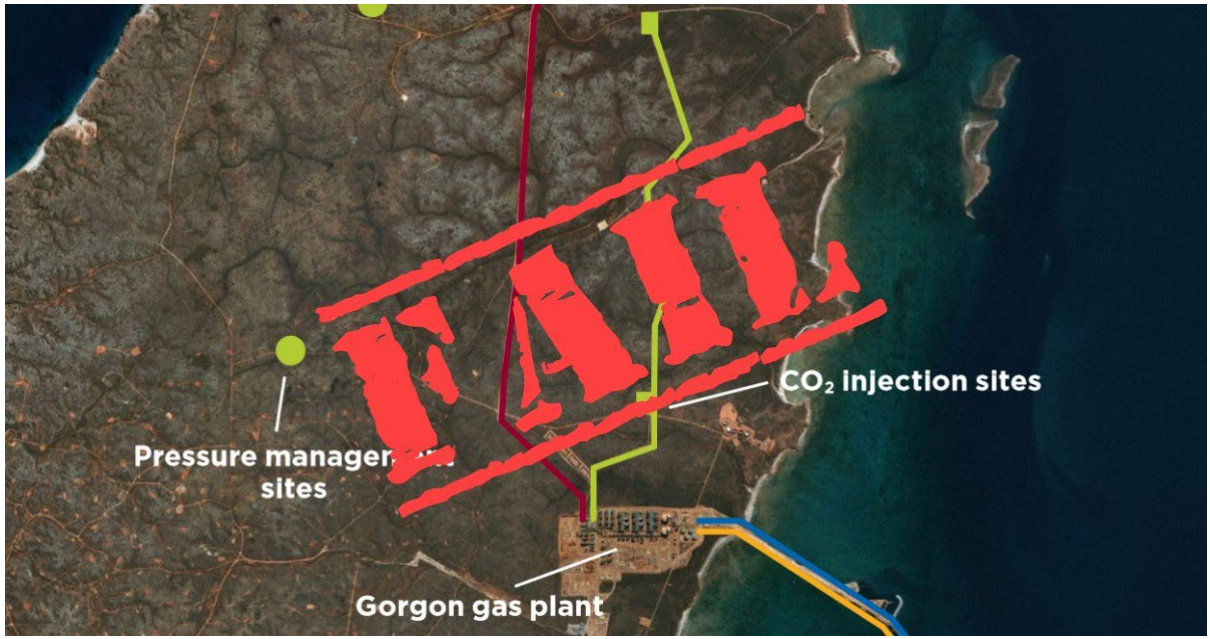


Location of Gorgon CCS project and facility (Chevron Australia, 2024)

- World's largest CCS project.
- Gorgon CO_2 injection is part of the wider Gorgon LNG development project offshore Western Australia.
- Nominal maximum capacity of 4 Mtpa accounting for 40% of the capacity of all CCS projects.
- Received $60 million from the Australian government as part of the Low Emissions Technology Demonstration Fund.
- Project's revised target for the first five-year period was about 10.1 MT and it **failed to meet its target by about 50%.**

Case Study: Gorgon, Australia

“Meaningful contribution…lower carbon future”



“Gorgon a poster-child for CCS shortcomings”

Lessons Learnt

- Stringent emission regulations are key drivers behind successful CCS projects at scale.
- Technical issues have been one of the most prominent barriers to the roll-out of CCS at scale project.
- 90% emission reduction target generally claimed by industry has been difficult or unreachable in practice.
- Pilot projects have the potential to demonstrate its value and increase public awareness and acceptability.
- Cost efficiency in monitoring plans required.
- Risk sharing mechanism for long-term liability required.

A CCS project is **NOT** a hydrocarbon project, but valuable lessons can be derived. Business cases must be built, not harvested.

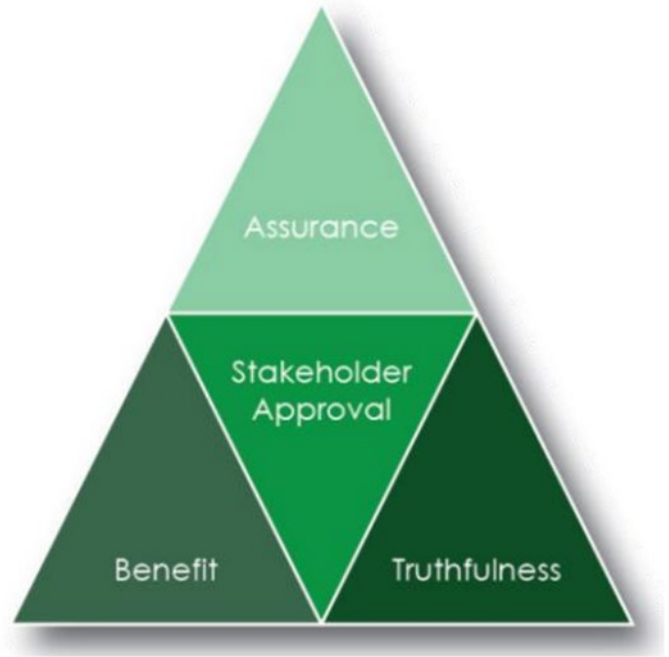
Hurdles and Enablers Influencing Perception

- **Hurdles**
  - **Lack of Awareness:** Limited understanding and knowledge of CCS technologies.
  - **Negative Public Perception**: Often rooted in past industrial experiences, NIMBYism, and misinformation.
  - **Socio-Demographic Factors:** Varied responses based on age, gender, and locality.
  - **Distrust in Project Developers:** Scepticism towards the motives behind corporations and governments involved in CCS projects.
  - **Negative Coverage:** Media's coverage can lead to heightened fears and opposition.
- **Enablers**
  - **Trust and Credibility:** Crucial to gaining public and stakeholder support.
  - **Public Awareness Public:** Educational campaigns that explain the science behind CCS.
  - **Community Engagement Engaging:** From inception to ensure concerns are heard and addressed, and the benefits of the projects are clearly communicated.
  - **Research and Knowledge:** Sharing ongoing research into public perceptions and publishing findings from research efforts including lessons learned.

Based upon the Zero Emissions Platform Public Perception Report, 2024

Strategies for Improving Public Perception

- **Communicating needs and benefits:** Emphasise benefits with transparency and assurance.
- **Values based communication:** 'Social license'; shared ethics, values and expectations.
- **Tackling stakeholders' fears and concerns:** Separation of the concepts of technical 'risk' from perceptions of 'riskiness'.
- **CCS language:** Simple and easy to understand – education and awareness.
- **Stakeholder management:** Views, opinions and concerns must be listened to and acted upon wherever possible.



Balancing needs to obtain stakeholder approval

Call to Communicate

The research community's voice is a powerful one which matters in shaping a sustainable future– let us use it for positive impact in our environment and communities.

Public communication platforms (Copilot, 2024)

Thank you for listening!