

Introduction to Carbon Capture Utilisation and Storage (CCUS)

SDI

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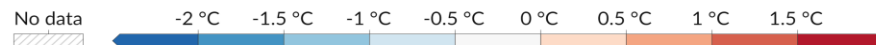
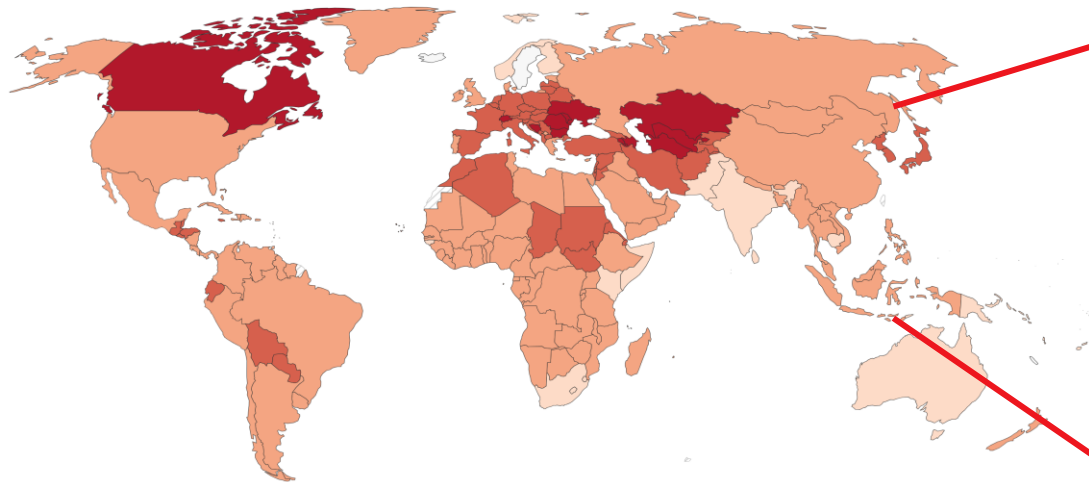
Greenhouse Gases and Climate Change

- Human emissions of greenhouse gases are the primary driver of climate change today. (IPCC,2021).
- Carbon dioxide and other greenhouse gases such as methane and nitrous oxide are emitted during the combustion of fossil fuels, manufacturing processes for materials like steel, cement, and plastics, and agricultural activities involved in food production.
- To limit and stop climate change, global emission of greenhouse gases need to be greatly reduced.
- CO₂ has the highest % in GHG Emissions from fossil fuels and industry annually, thus there is a need to reduce its emission using technologies and renewable energy efforts.

Annual temperature anomalies, 2023

The deviation of a specific year's average surface temperature from the 1991-2020 mean, in degrees Celsius.

Our World
in Data



Data source: Copernicus Climate Change Service (2019)

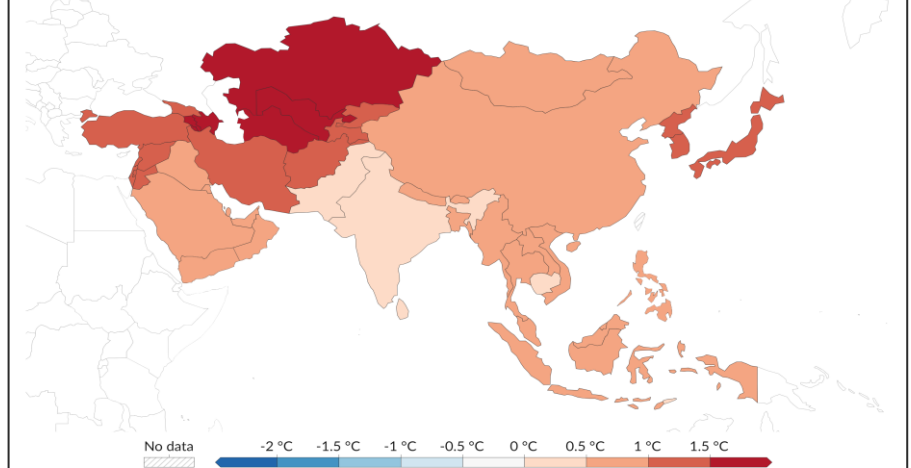
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Malaysia shows annual temperature anomalies of 0.6 °C in 2023

Annual temperature anomalies, 2023

The deviation of a specific year's average surface temperature from the 1991-2020 mean, in degrees Celsius.

Our World
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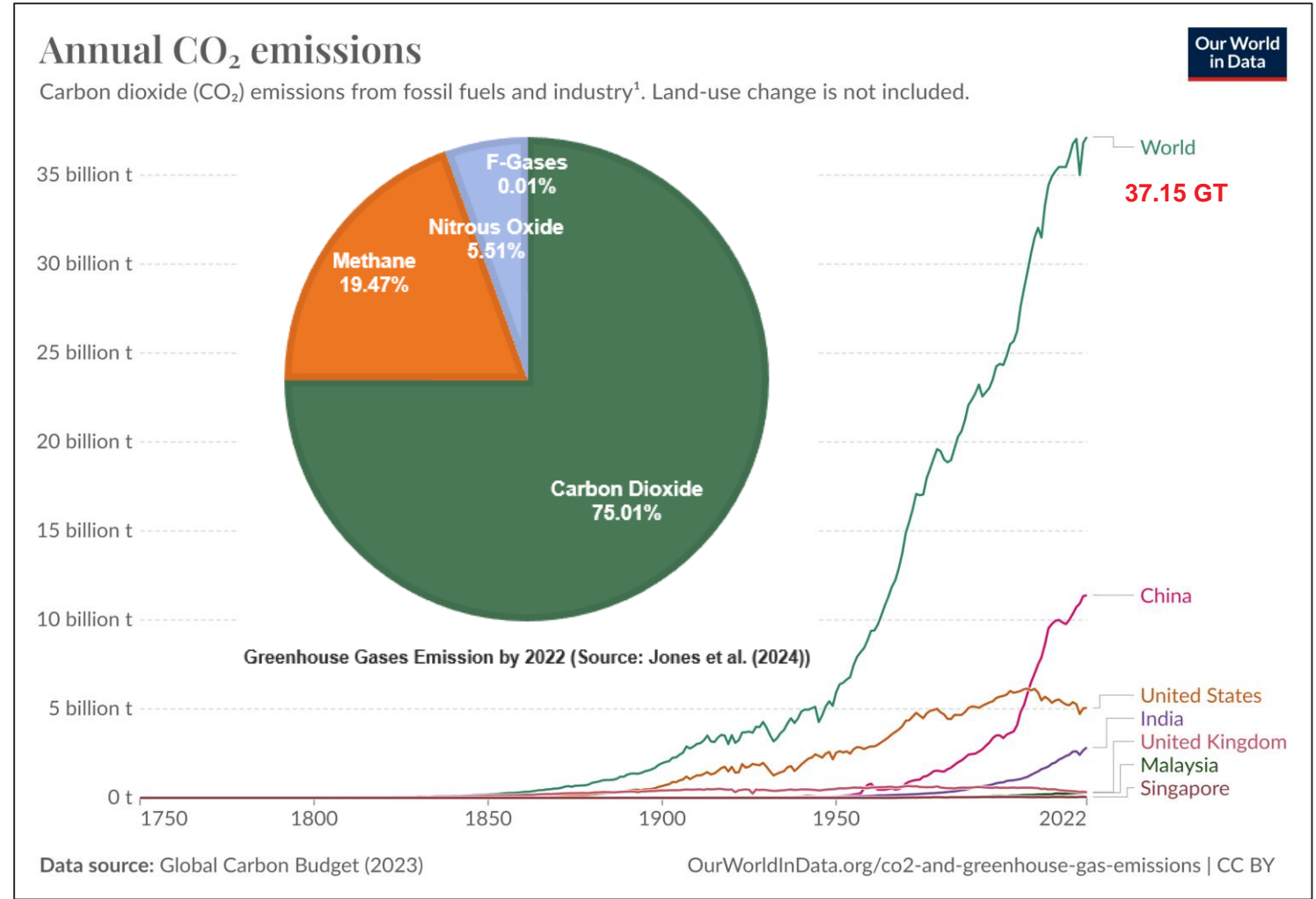


Data source: Copernicus Climate Change Service (2019)

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CO₂ Emission Overview

- Carbon dioxide is a compound made up of carbon and hydrogen atoms and occur naturally in environment.
- Carbon dioxide (CO₂) is an integral part of life. For instance, humans exhale CO₂, and it is utilized by plants during photosynthesis. Additionally, CO₂ is used as an ingredient in carbonated drinks and fertilizers.
- However, excessive levels of CO₂ are detrimental as they contribute to climate change by trapping heat, which leads to an increase in global temperatures.
- CO₂ is one of the Greenhouse Gases, which in 2022 takes **75.01%** of total GHG emission. Annual CO₂ emission from fossil fuels and industry in 2022 is **37.15 GT**. In 2023, CO₂ reached a new record high of **37.4 GT** (IEA,2023).
- Since CO₂ has the highest % in GHG emissions annually, there is an immediate need to reduce its emission using technologies and other means such as fuel switching, electrification, H₂ or renewables.
- However, above method alone cannot reduce CO₂ as required. It will be a great challenge.

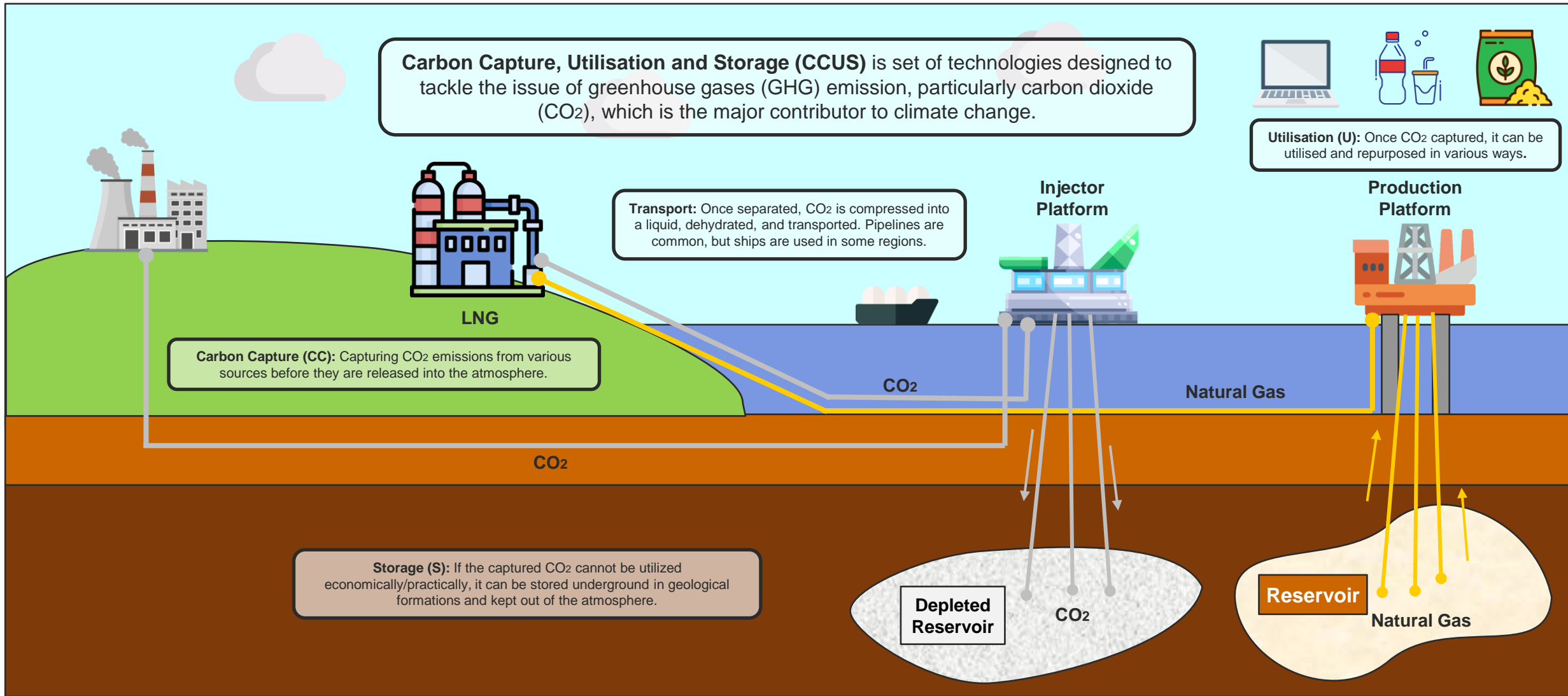


Why is CCUS considered a crucial solution for mitigating climate change?

- **CCUS addresses CO₂ emissions at various stages:**
 - Capturing them at the source (industrial processes and power generation activities).
 - Using them for valuable applications.
 - And ultimately storing them away permanently.
- **CCUS is a promising technology, as well as the only direct and rapid emission reduction option available.**
- **The Intergovernmental Panel on Climate Change (IPCC) has projected that the cost of mitigation will rise by 138% in 2100 if CCS technologies are not adapted.**

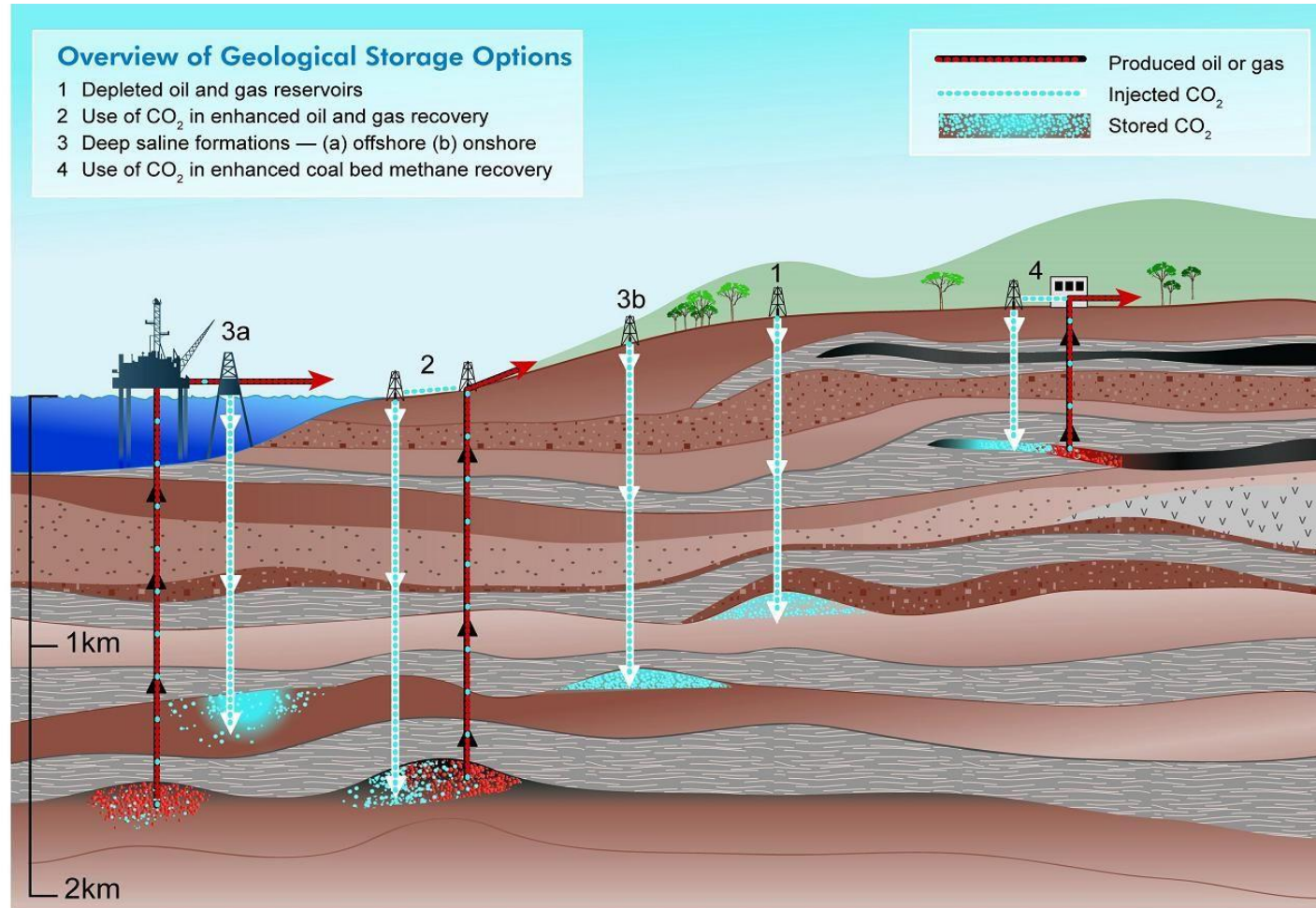
Malaysia CO ₂ Emission by Sector in 2020 (in tonnes)	
Electricity and Heat	130.97 million
Land-use change and forestry	65.15 million
Transport	59.53 million
Manufacturing and Construction	32.80 million
Industry	11.29 million
Fugitive Emission	4.74 million
Buildings	3.28 million
Other Fuel Combustion	2.54 million

What is CCUS?



This approach offers industries and countries a way to **reduce their carbon footprint** and **mitigate the impacts of climate change** while also potentially creating **new economic opportunities** through the development of carbon-based products and technologies.

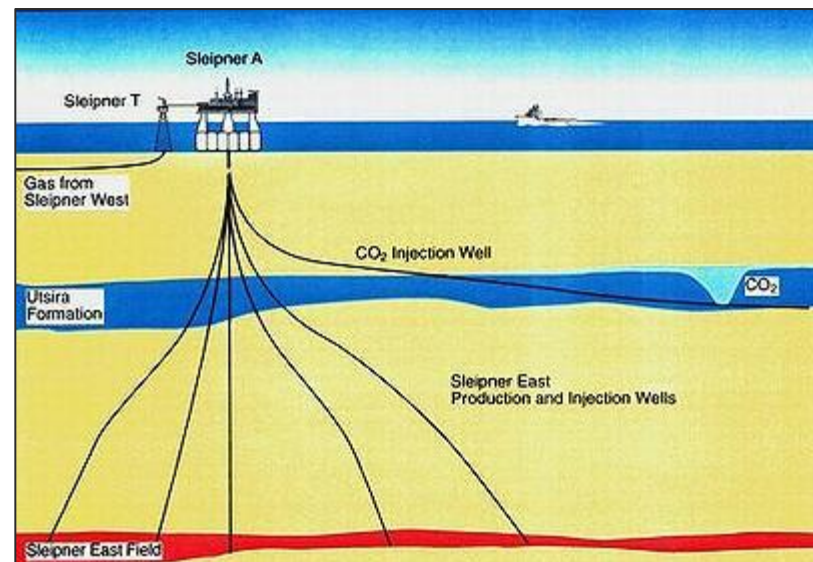
Geological Storage Summary



Overview of geological storage options for CO₂ (© CO₂CRC, image courtesy of CO₂CRC)

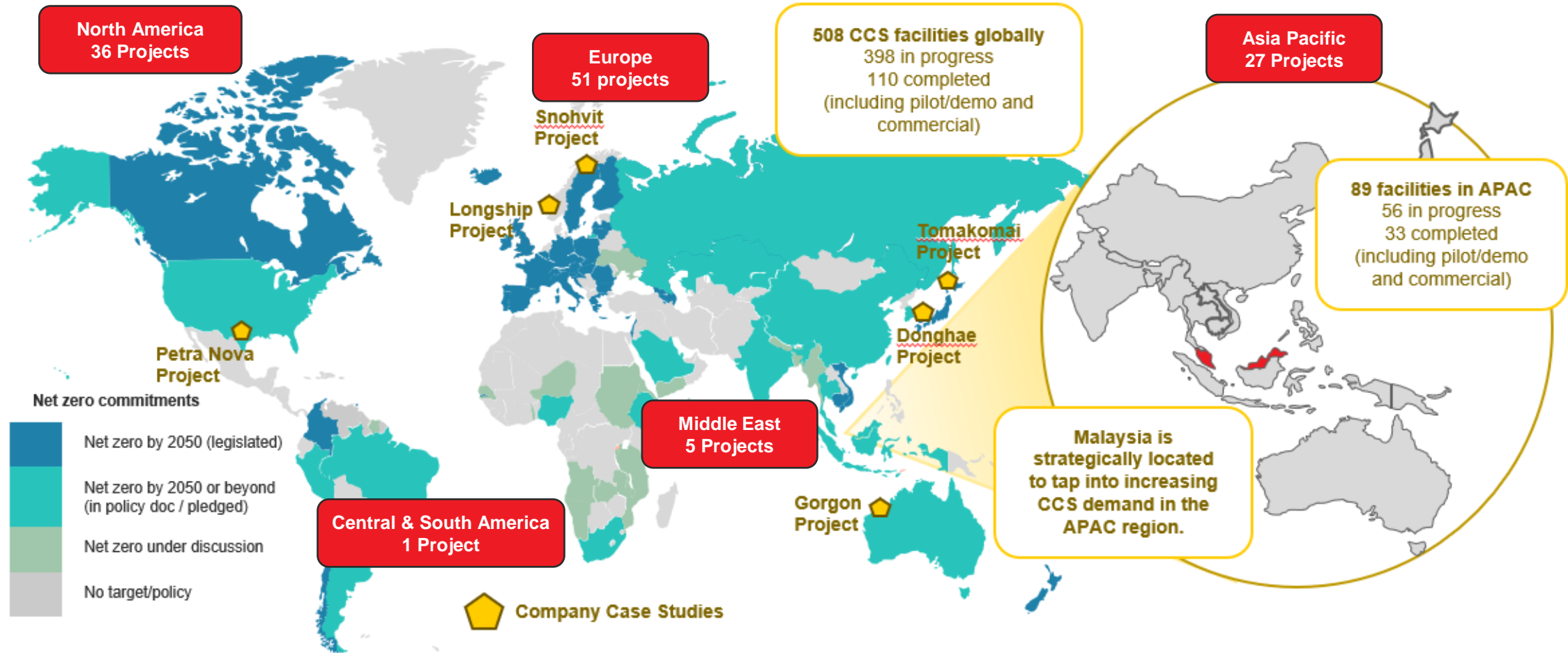
When did CCUS start? Is it new?

- CCUS is not new since it already started in **1996 in Norway called the Sleipner CCS project** and in **2000 in Canada called the Weyburn**. Both were the first international demonstrations of the large-scale capture, utilization, and storage of anthropogenic CO₂ emissions.
- Sleipner CCS Project has stored more than **25 million tonnes (MT)** of CO₂ in total, Weyburn Project stored safely over **35 MT** of CO₂ since October 2000.
- The success of the Weyburn Project has established the irreplaceable role of CCS technology in reducing GHG.
- CCS features prominently in:
 - Paris Agreement (COP 21) / Glasgow Accord (COP 26)
 - IEA / IPCC “2-degree scenario” (2DS)
 - Oil and Gas Industry Climate Initiative (OGCI)
- CCS is listed as one of three mandatory emission reduction technologies in the four key emission reduction technology pathways in the 1.5 °C special report released by the IPCC in 2018
- Most of **CCUS value chain** is similar to **O&G Production**. CO₂ has been injected into the reservoir to enhance oil production for decades.



Overview of the Sleipner area with CO₂ injection (SACS2, 2002)

Where have CCUS been successfully implemented?



Note:

- # of facilities includes both pilot/demo and commercial projects. "in progress" facilities includes planned, in development and in construction facilities; "completed" facilities includes both completed construction and operational facilities
- As of end of July 2023

Source: Global CCS Institute, IEA, BloombergNEF, Grand View Research

Sarawak is considered a good hub for CCUS because



Geological suitability

- Sarawak has extensive geological formations suitable for CO₂ storage (depleted fields and deep saline aquifer)



Existing infrastructure

- The region has a well-developed O&G industry with existing pipelines, wells and processing facilities which can be repurposed for CCUS



Proximity to Emission Sources

- Close to industrial and energy production sites



Government support and policies

- Both the Malaysian government and Sarawak state government has shown support for CCUS initiatives through policies and incentives to encourage investment and development. Regulatory frameworks that facilitate CCUS implementation has been established since 2022.



Economic benefits

- Offers economic opportunities in Sarawak, such as job creation and potential sour gas development



Research and Development

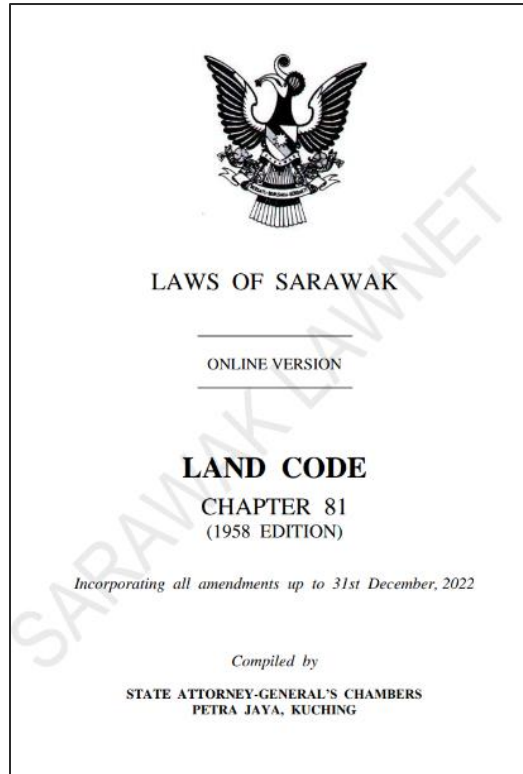
- Sarawak is involved in various research and development activities related to CCUS in recent years



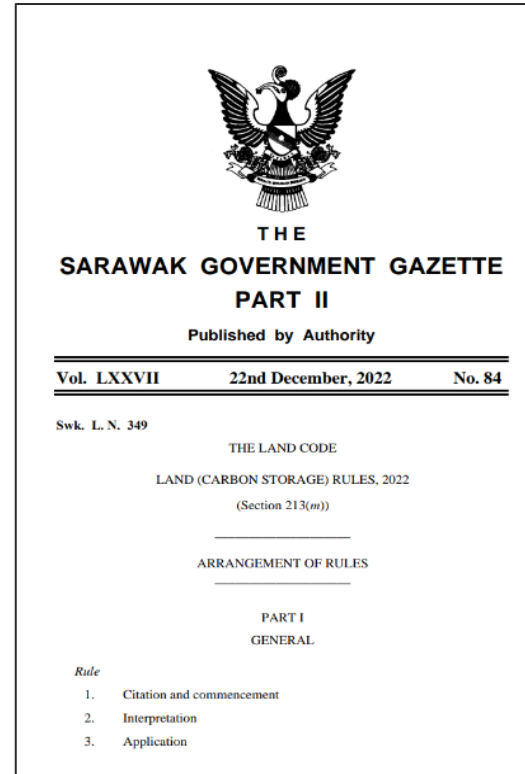
Environmental commitment

- Sarawak is committed to contribute to Malaysia's climate change mitigation goals, reducing GHG emissions and promoting sustainable development (PCDS)

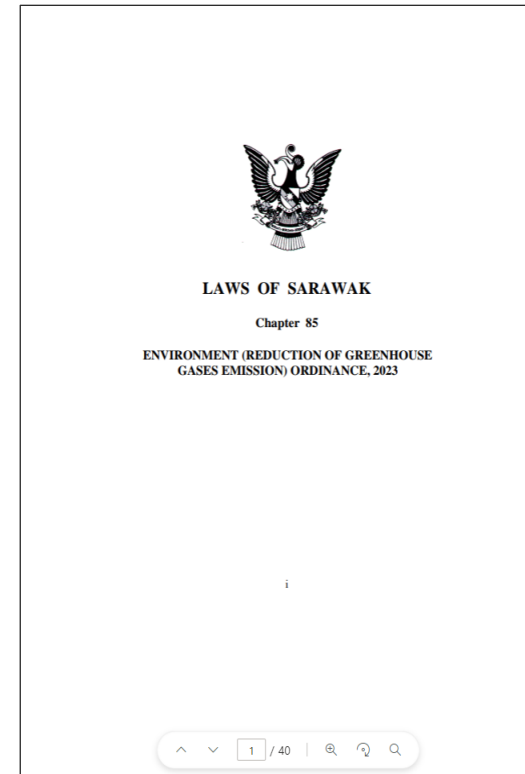
Laws and Regulation Set in Place regarding CCUS in Sarawak



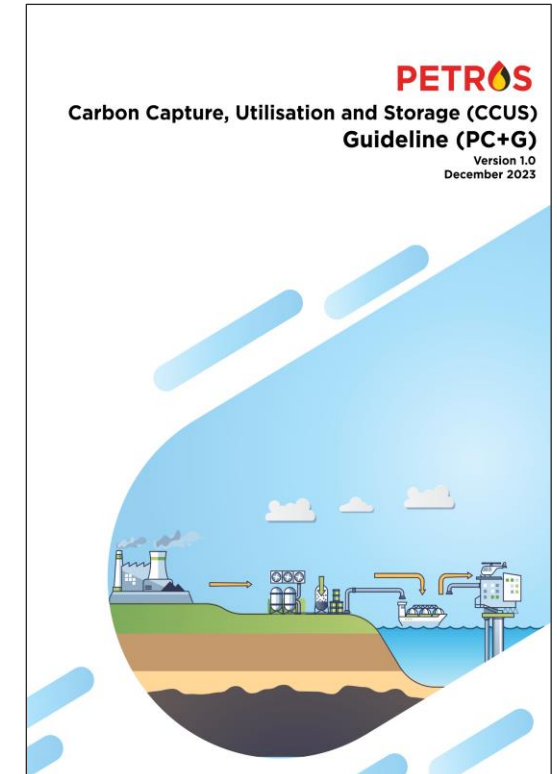
Land Code 1958



Land (Carbon Storage) Rules, 2022



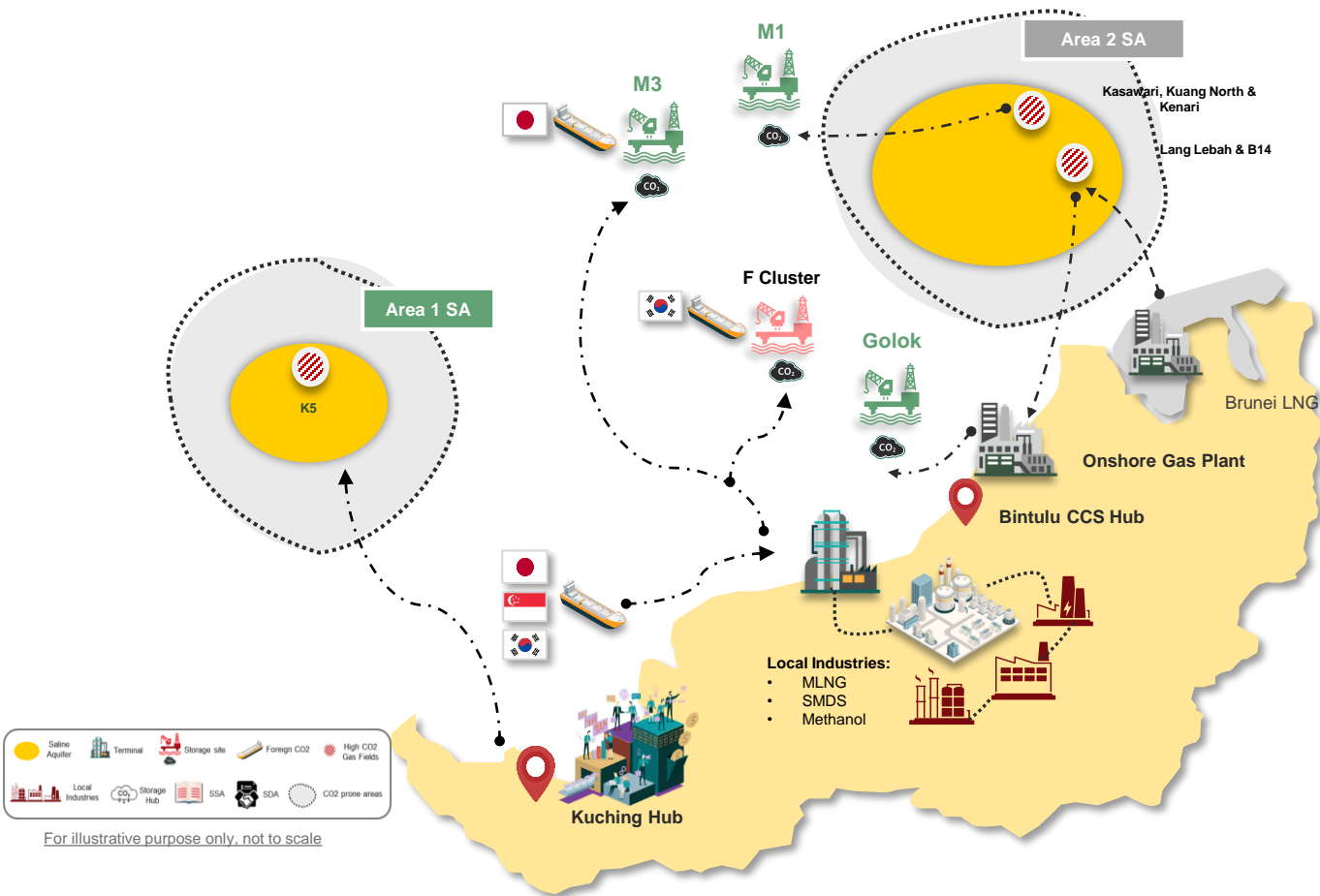
Environment (Reduction of Greenhouse Gases Emission Ordinance, 2023)



PETROS CCUS Guideline (PC+G)

PETROS is striving towards establishing 4 carbon storage sites in Sarawak by 2030

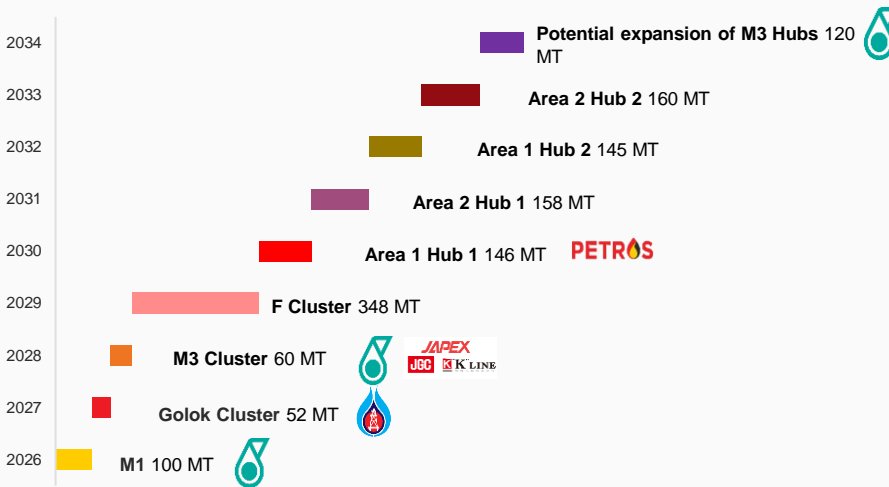
Key Industrial Area and Potential Storage Sites in Sarawak



Timeline



Planning of Storage Sites over the Years



End

