Considerations

Appendix A – Natural Gas Requirements

Natural gas (many CDR technologies require a higher temperature than can be obtained from electricity)

1. Natural gas energy requirements are often expressed in gigajoules/ton CO2 removed
2. About 947 cubic feet of natural gas are required to provide one gigajoule of energy
3. To capture 10 GT CO2 per year (the scale needed) using natural gas therefore requires 9,470 billion cubic feet per gigajoule of energy required
4. Since the global production of natural gas is about 138,345 BCuFt/year, each gigajoule of energy that is needed to capture one ton CO2 requires about 6.8% of the worlds annual production
5. The “Keith” process is often mentioned when reviewing DAC technologies. It requires 8.81 GJ/ton CO2 if electricity is not used, or 60% of the world’s entire annual production of natural gas for 10 GT CO2/year of CO2 removal

Appendix B - Electricity

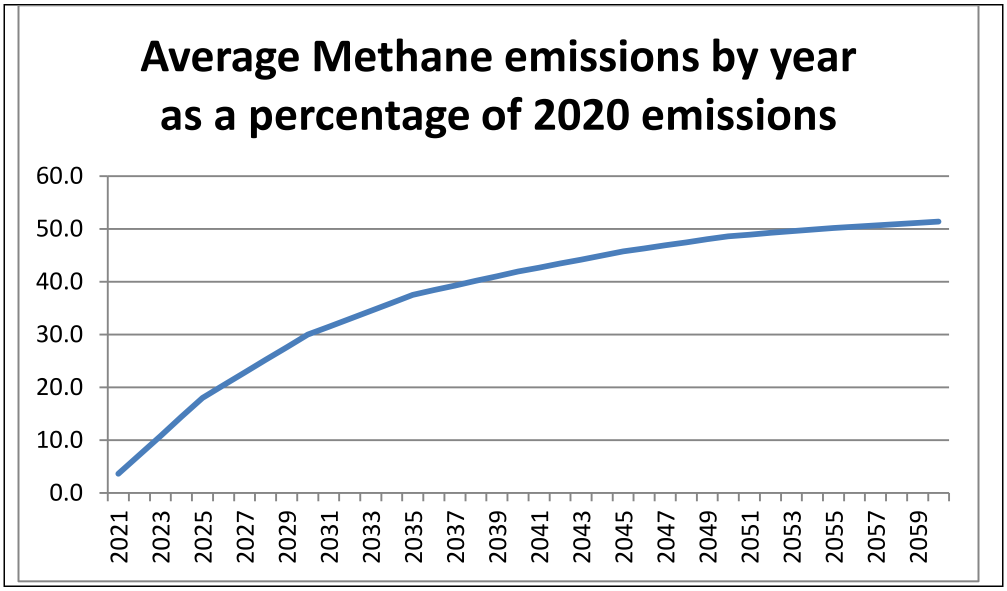
1. Electricity requirements are often expressed in kWh/ton CO2 removed
2. To capture 10 GT CO2 per year (the scale needed) using electricity therefore requires 10 billion kWh per kWh of energy required
3. Since the current global electricity consumption is about 23,845 Billion kWh, each kWh of energy required uses about 0.04 percent of this consumption
4. The “Keith” process mentioned often on this list requires 366 kWh of electricity (assumes 5.5 GJ of natural gas is also used) , or about 15% of the world’s entire annual production of electricity for 10 GT CO2/year of CO2 removal

Appendix C - Methane

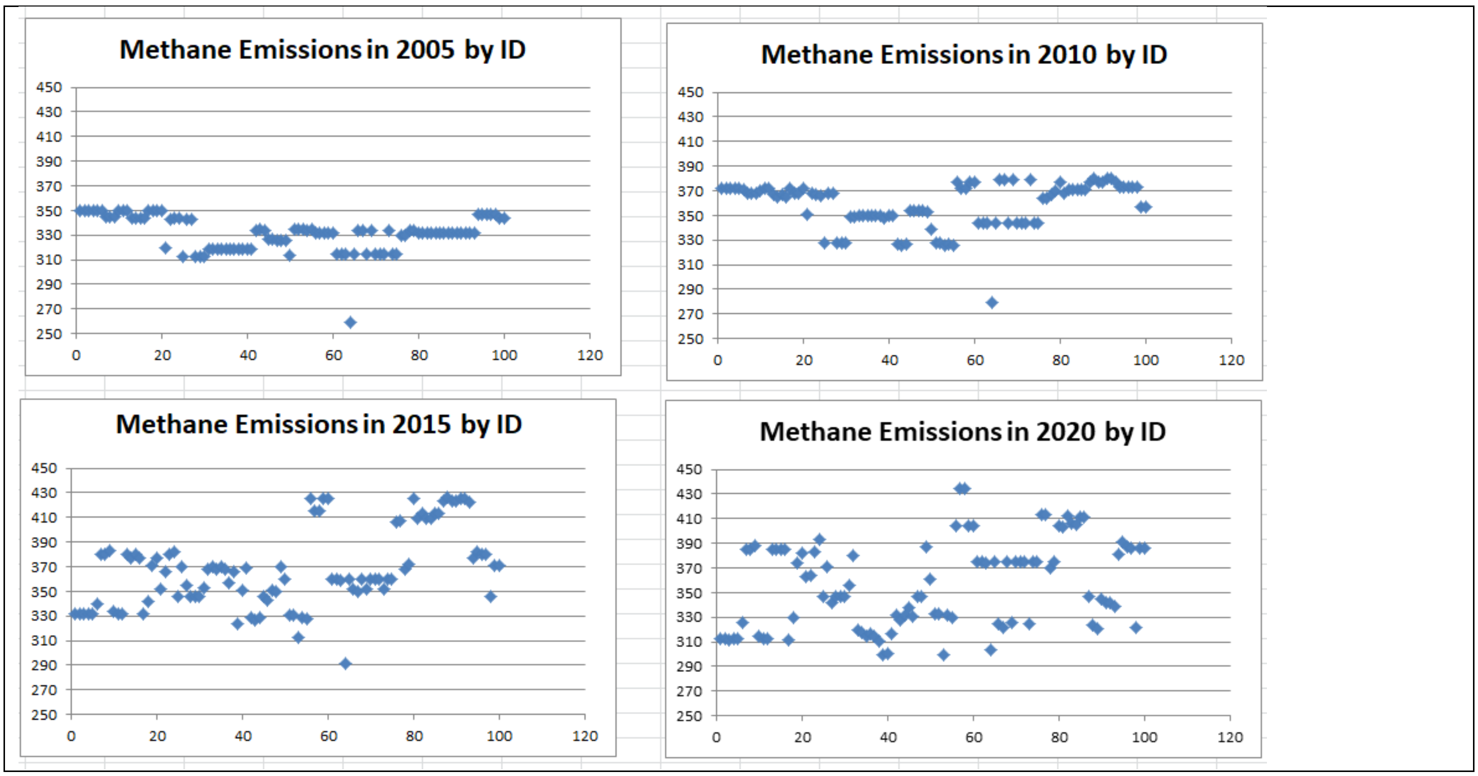
Methane emissions in 2020 differ greatly by scenario (See figure), so it will take some effort to determine both what sources of methane are considered (anthropogenic and natural, which had about 332 and 118 MT of emissions in 2017, for a total of 450 MT) and the effect of methane on the temperature increase in the various MAGICC scenarios. On average, methane emissions in many models are reduced by about 50% in 2060 (see figure) - in line with the Global Methane Pledge of 2021 – so this is what the model assumes. Note that atmospheric levels of methane have been increasing at an accelerating rate (see figure).

Global Methane Pledge (2021)

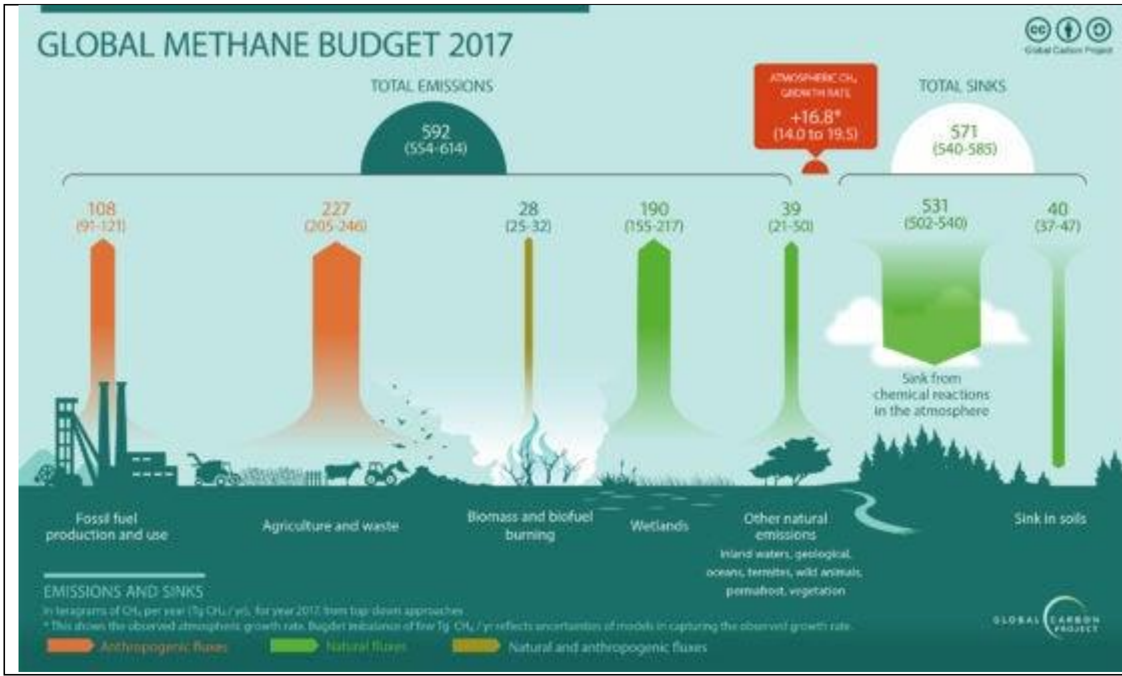
- An initiative to reduce global methane emissions to keep the goal of limiting warming to 1.5 degrees Celsius within reach.
- Collective goal of reducing global methane emissions by at least 30 percent from 2020 levels by 2030 (the
- Delivering on the Global Methane Pledge would reduce warming by at least 0.2 degrees Celsius by 2050
- Note that this almost exactly what the average MAGICC scenario expects

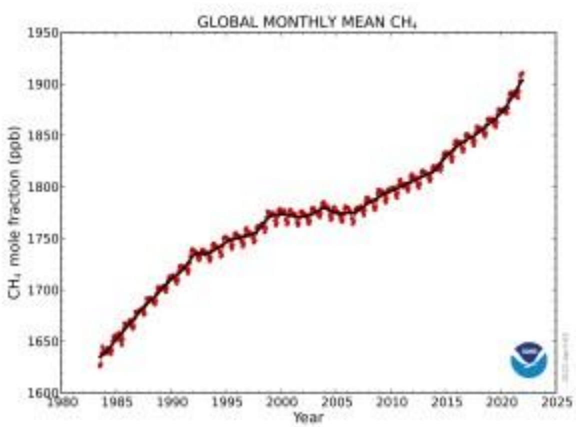


Average Methane emissions by year as a percentage of 2020 emissions
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2021 2023 2025 2027 2029 2031 2033 2035 2037 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059



Methane Emissions in 2005 by ID
Methane Emissions in 2010 by ID
Methane Emissions in 2015 by ID
Methane Emissions in 2020 by ID
450
430
410
390
370
350
330
310
290
270
250
0 20 40 60 80 100 120





Appendix D - BECCS

Operational and planned BECCS capture capacity by stage of development vs Net Zero Scenario, 2022-2030

Last updated 13 Sep 2022

Download chart ↓

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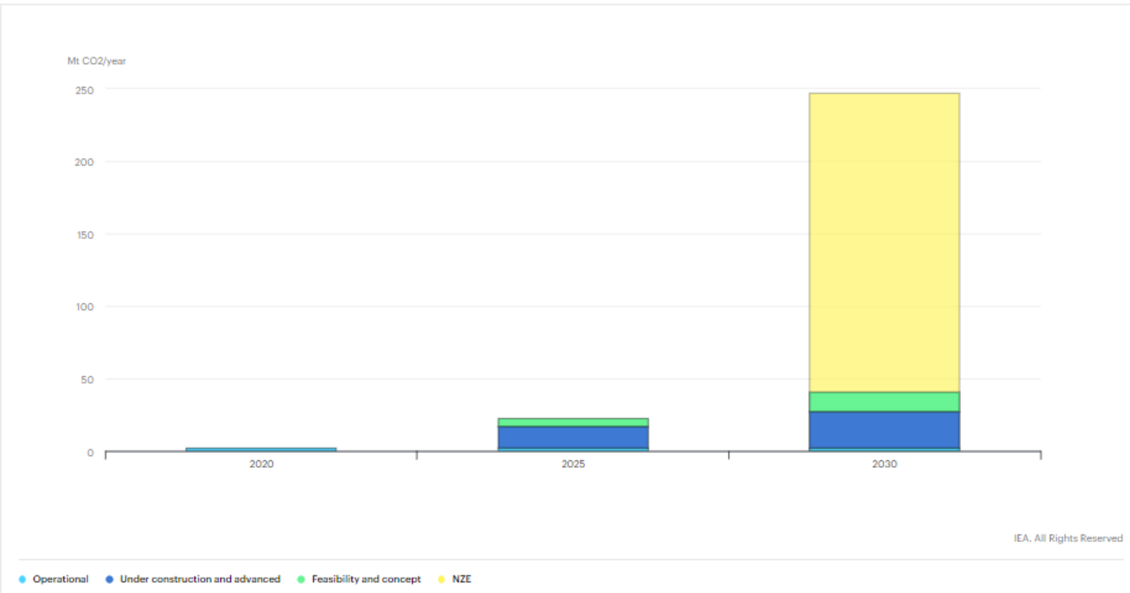

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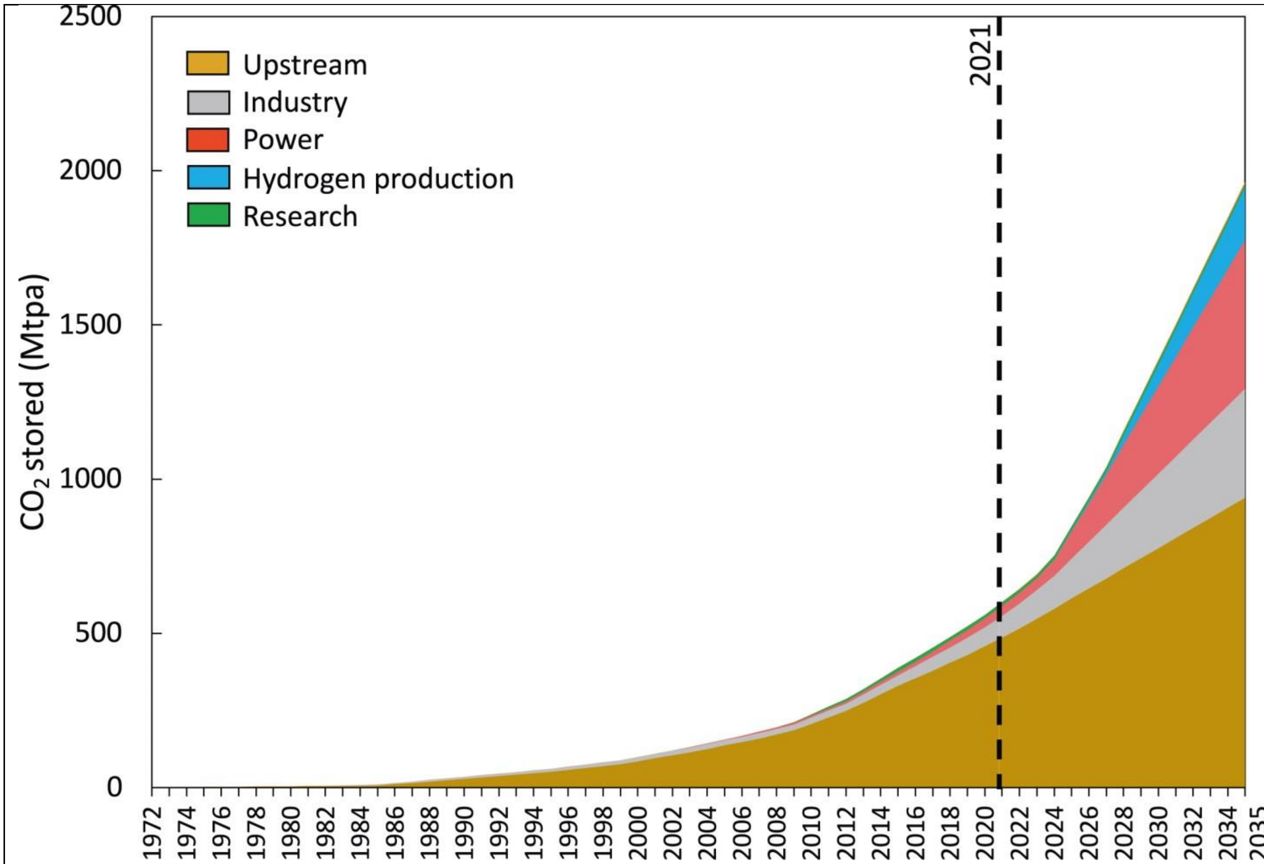
Cross-Cutting Technologies & Infrastructure

https://www.iea.org/data-and-statistics/charts/operational-and-planned-beccs-capture-capacity-by-stage-of-development-vs-net-zero-scenario-2022-2030

The Feasibility and Future of Carbon Capture and Storage Technology

Today, there are only 24 commercial CCS plants worldwide of which 12 are in the US. We will have to wait and see in the decades to come if carbon capture becomes an economically feasible tool in the fight against climate change and if it will become enmeshed into the fabric of human civilisation.
https://earth.org/the-feasibility-and-future-of-carbon-capture-and-storage-technology/



https://www.sciencedirect.com/science/article/pii/S2590332221005418