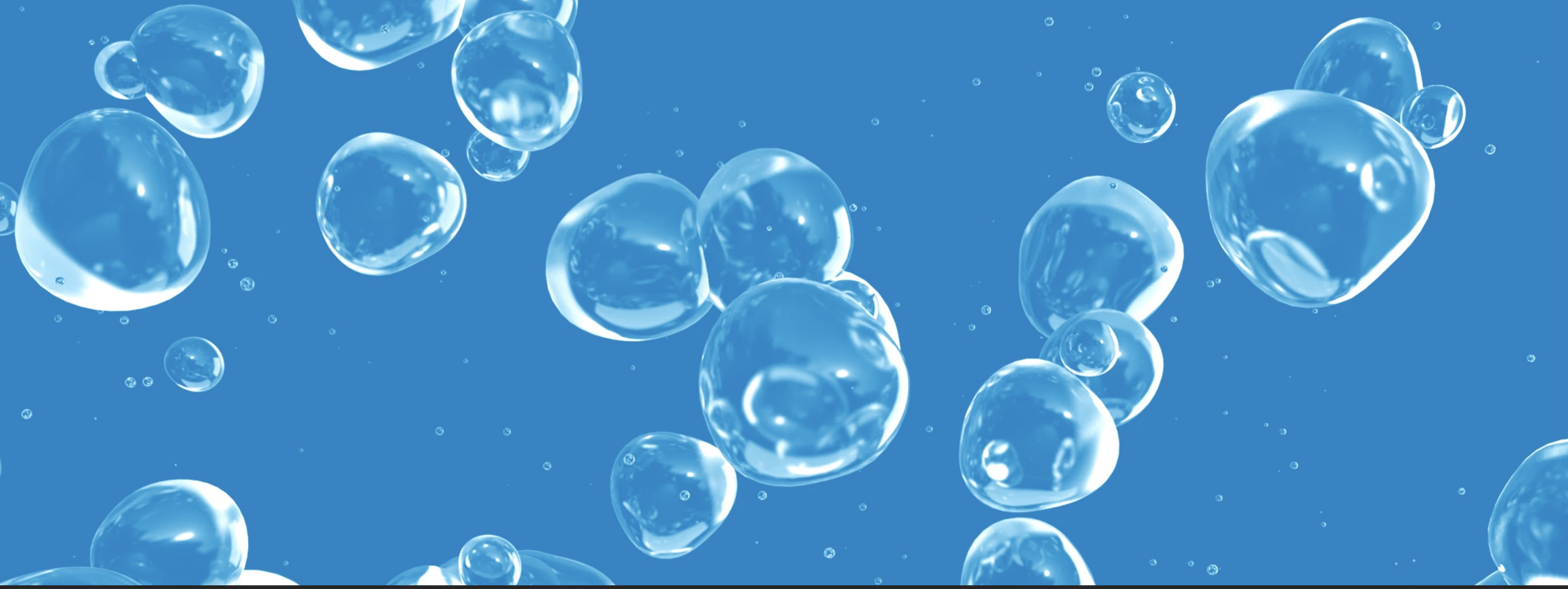


Sky Blue Hydrogen Production

A GAME-CHANGING CONCEPT FOR GAS RESOURCE HOLDERS

“Keep 60% of Natural Gas Reserves in the Ground to keep to 1.5%”

‘Shutting down’ is usually presented as the only safe scenario. No mention made of CCUS or low carbon hydrogen from methane.

The Challenge: How can countries be ‘told’ to ‘shut-down’? i.e. close-in all the gas wells, write–off all the gas processing, transportation and manufacturing assets that produce power, grey hydrogen and valuable industrial products.

From The Guardian video, 3rd November 2022

Value of existing fossil fuel assets calculated under two scenarios (Nature Energy) is $14-25 trillion: https://www.theguardian.com/environment/ng-interactive/2021/nov/04/fossil-fuel-assets-worthless-2036-net-zero-transition

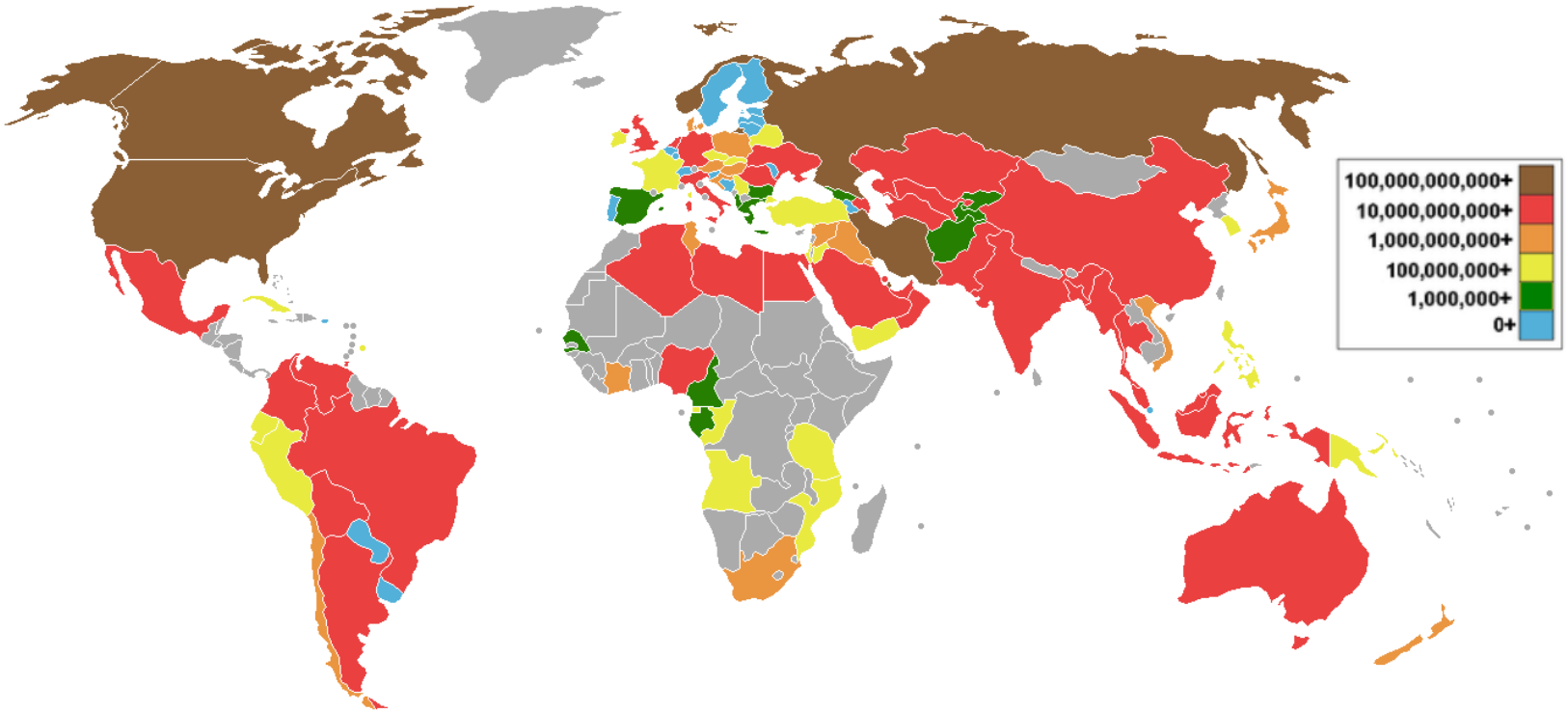
The Climate Justice Challenge

Whilst the largest natural gas producers are North America, Russia and Iran, producers of the next largest volumes, >10 bcm pa, are shown in red on this map.

Many of these countries are in the Global South. Natural gas is used for local energy consumption and for local industrial processes. Sometimes natural gas is exported, often as Liquified Natural Gas to the Global North (much needed in 2022/23).

These activities provide good employment that support very large communities. Do countries shut them down, or clean them up? And if they are cleaned up, how might this be done more cost effectively?

Natural gas production in cubic metres per year (Wikipedia)

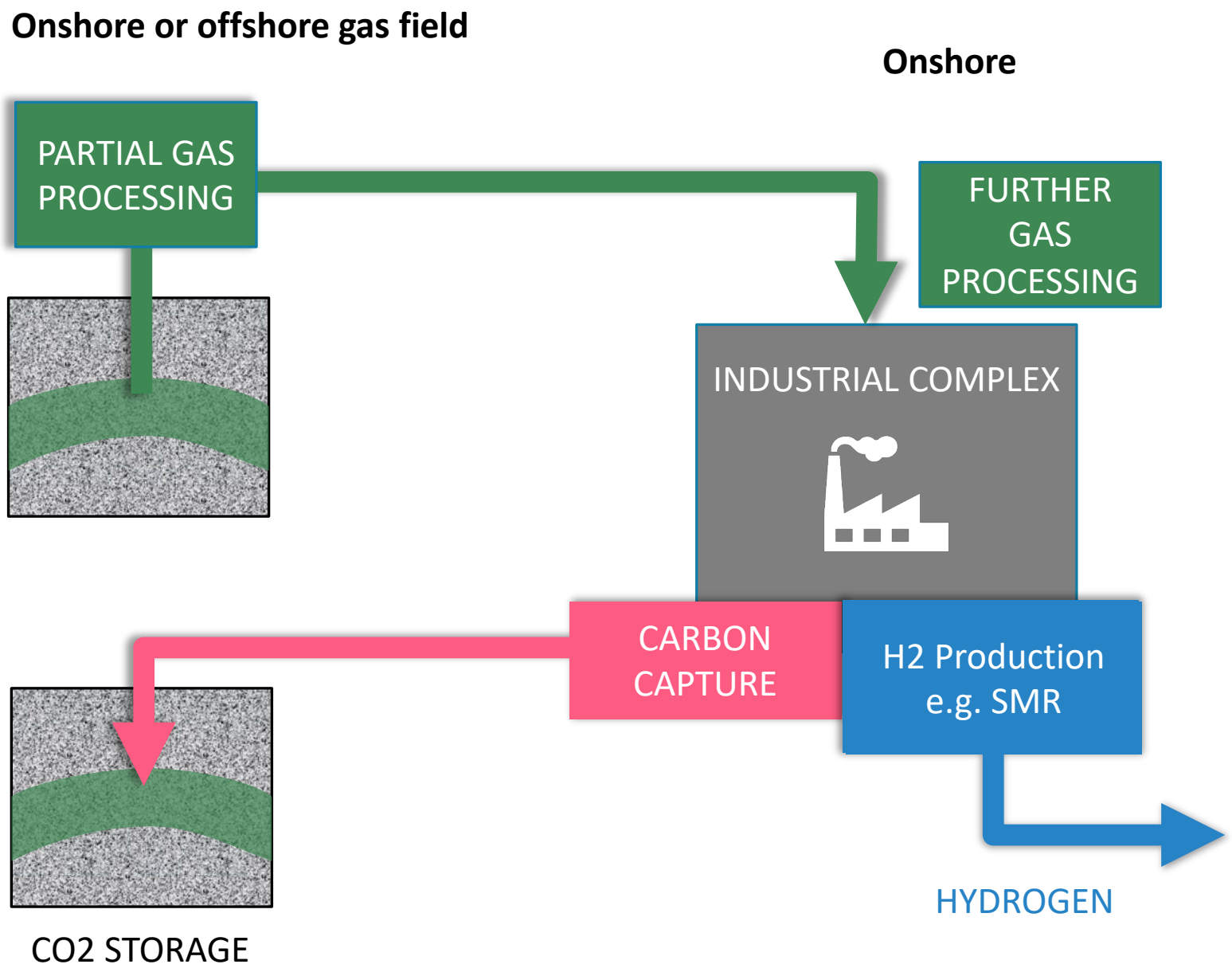


We can decarbonizing the existing global gas assets at the same time as building new, low carbon assets.

Location, location, location

Currently: Gas is often transported great distances, before being used at an industrial complex. This includes the manufacture of Grey Hydrogen, adding to Cluster CO2 emissions.

In coming years, the CO_2 from industrial complexes, including from the manufacture of Hydrogen, will be captured and transported to a depleted (closed-in) gas reservoir, or to a deep saline aquifer, for permanent storage (CCS).

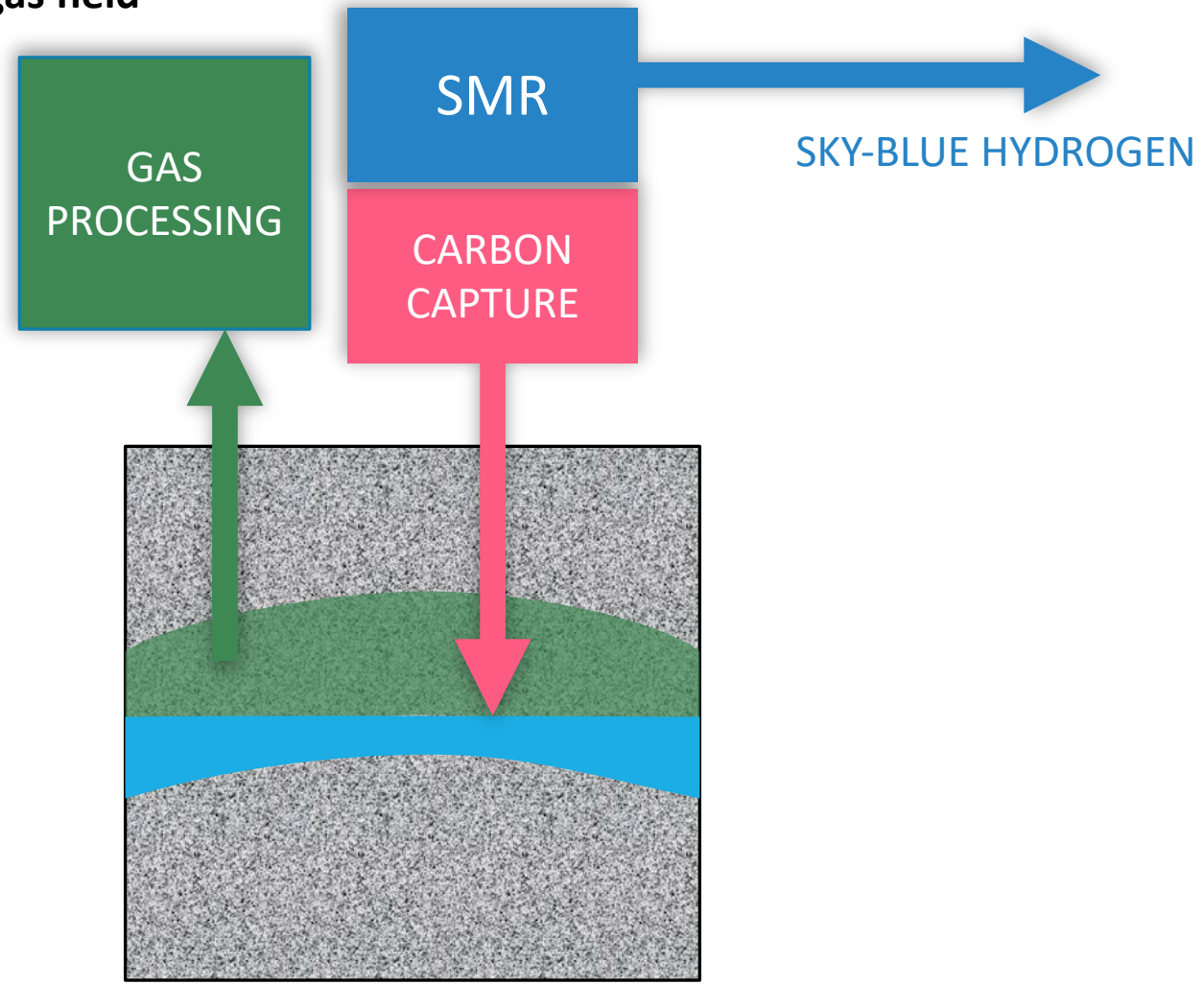


Closing the loop in methane to hydrogen production; introducing ‘sky-blue’ hydrogen from onshore gas fields

We can remove the CO2 from methane ‘at source’, producing low carbon hydrogen, with most of the CO_2 bi-product permanently stored in the reservoir from which the natural gas is being produced.

There can be significant economic advantages in partial or complete reservoir pressure maintenance of the gas field. Plus, can be economic advantages from co-locating processing and H2 production facilities.

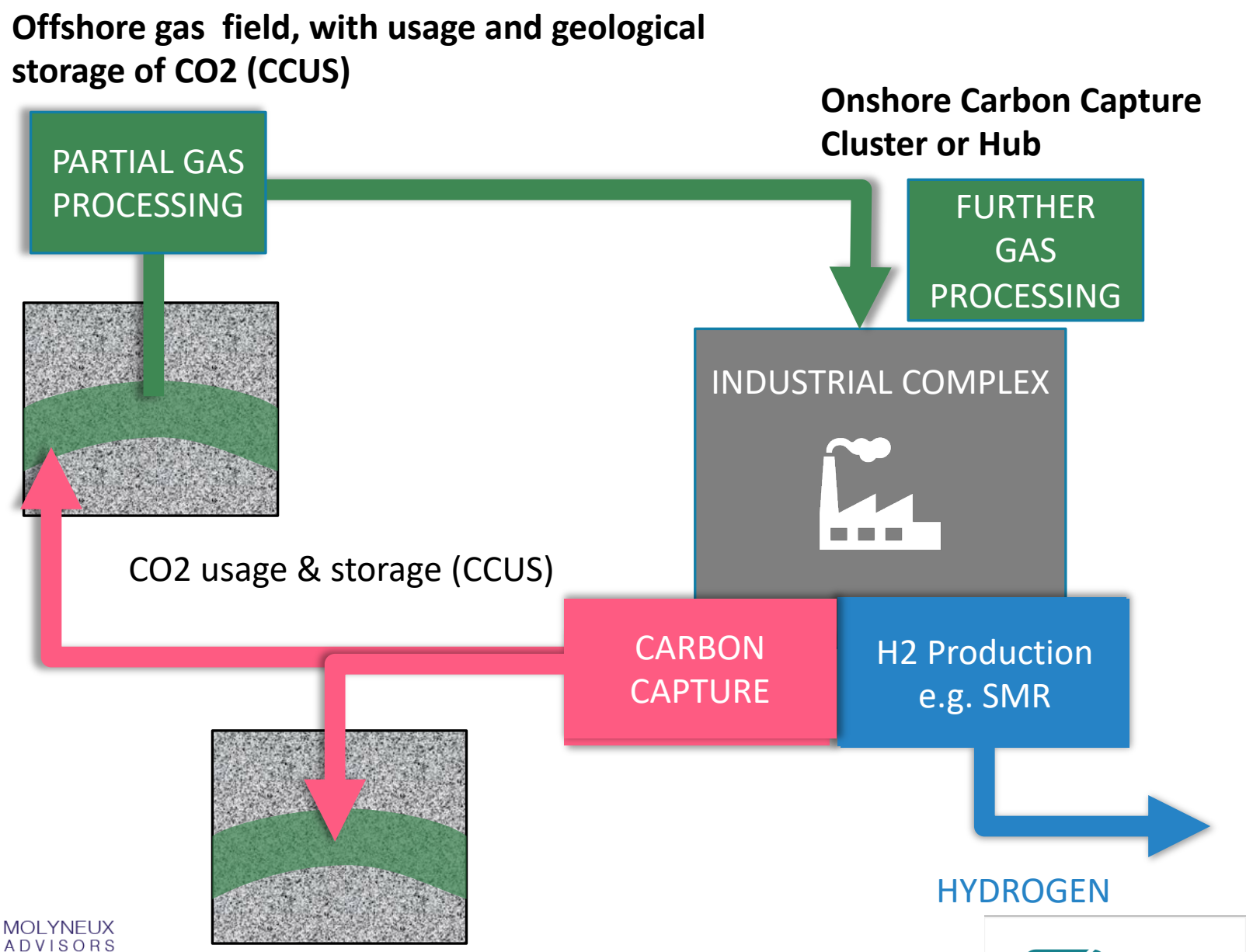
Onshore gas field



Green house gases are removed (CO2 capture) and the CO2 is injected immediately back into the same onshore reservoir to increase reservoir pressure and hence gas production, and this increases the production of clean hydrogen. What leaves the site is no longer natural gas; it is low carbon hydrogen.

Sky-blue hydrogen production from offshore gas fields

Can be significant economic advantages in what is more likely to be complete reservoir pressure maintenance of the gas field.



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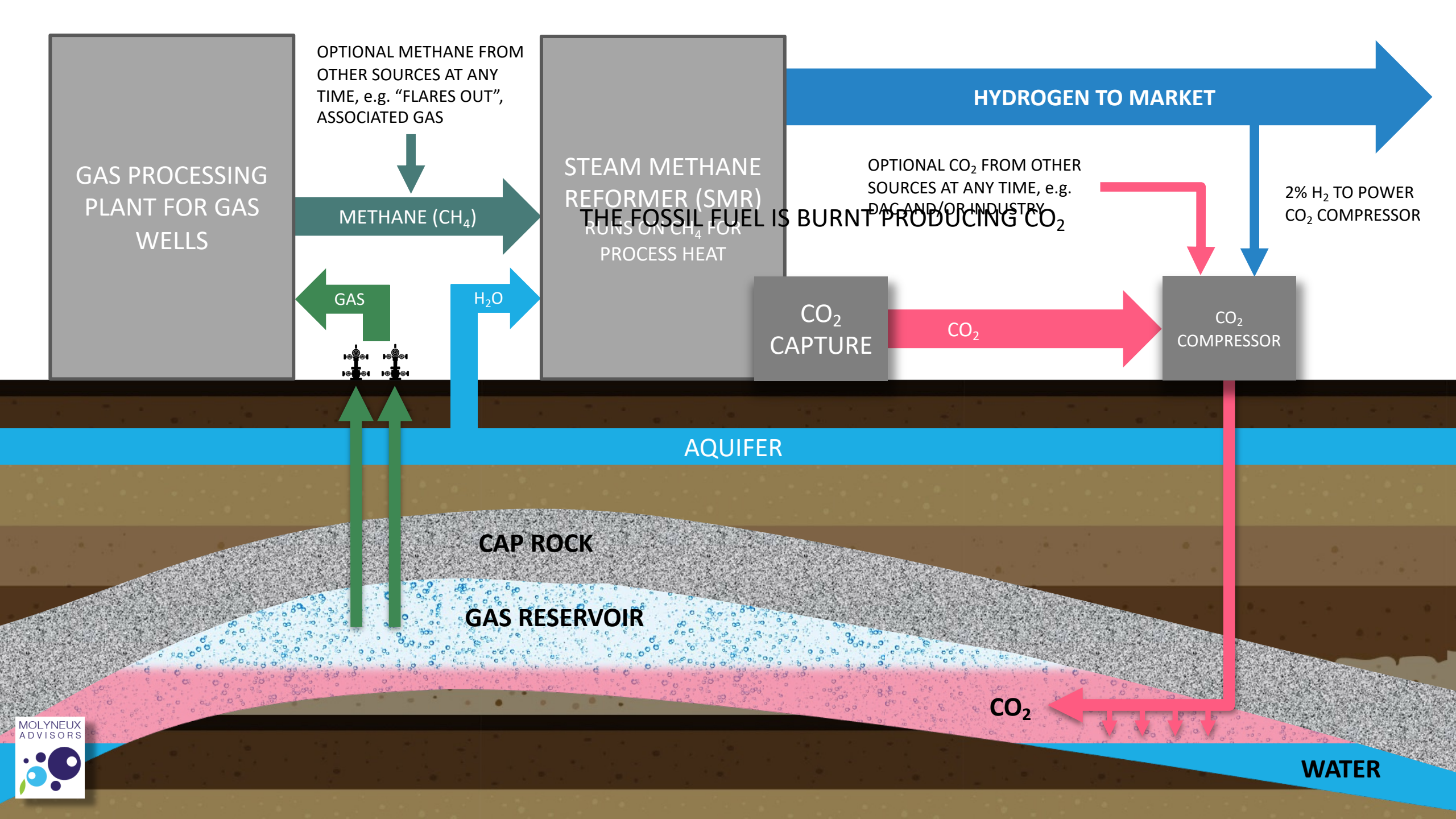
Energy to Transport


GAS PROCESSING PLANT FOR GAS WELLS
OPTIONAL METHANE FROM OTHER SOURCES AT ANY TIME, e.g. "FLARES OUT", ASSOCIATED GAS
METHANE (CH_4)
STEAM METHANE REFORMER (SMR)
RUNS ON CH_4 FOR PROCESS HEAT
HYDROGEN TO MARKET
OPTIONAL CO_2 FROM OTHER SOURCES AT ANY TIME, e.g. DAC AND/OR INDUSTRY
2% H_2 TO POWER CO_2 COMPRESSOR
THE FOSSIL FUEL IS BURNT PRODUCING CO_2
GAS
H_2O
CO_2 CAPTURE
CO_2
CO_2 COMPRESSOR
AQUIFER
CAP ROCK
GAS RESERVOIR
CO_2
WATER
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Sky-blue Hydrogen*: a new contribution to the energy transition

* Registered Business Name 1-51717918810 (Australia)

Sky Blue Hydrogen	is an innovative process to provide additional and material volumes of low carbon hydrogen. This can help enable critical infrastructure for a hydrogen economy to develop in a country.
Sky Blue Hydrogen	uses existing technology that is proven, and its individual components have a performance track record. It is the closed loop aspect that is truly novel.
Sky Blue Hydrogen	It is scalable & replicable, with competitive price/tonne compared to other forms of low carbon hydrogen.
Sky Blue Hydrogen	can provide lower $/tonne storage costs for CO2 captured from other sources. Why? Since the CO2 serves a useful purpose, helping to maintain reservoir pressure.

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Fuelling the journey: a verified screening tool provides smart analysis (mass streams and economics) of Sky-blue Hydrogen* opportunities

We bring a team with expert technical and commercial knowledge to assist at both the screening stage, and towards Sky Blue Hydrogen project maturation.

We are well connected to wide networks with engineering capacity, and we are developing more formal engineering partnerships.

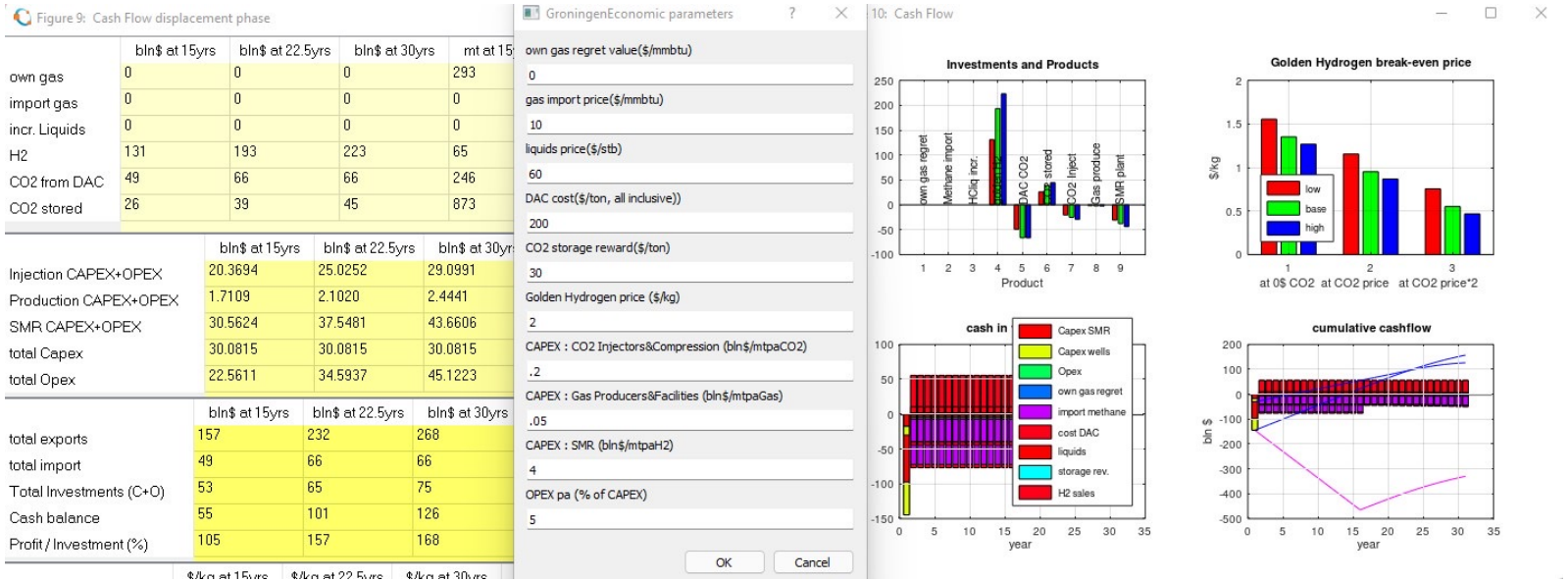
* Registered Business Name 1-51717918810 (Australia)

MARKET READY SCREENING SOFTWARE

TABULAR OUTPUT

SIMPLE INPUT

GRAPHICAL OUTPUT



	bln$ at 15yrs	bln$ at 22.5yrs	bln$ at 30yrs	mt at 15
own gas	0	0	0	293
import gas	0	0	0	0
incr. Liquids	0	0	0	0
H2	131	193	223	65
CO2 from DAC	49	66	66	246
CO2 stored	26	39	45	873

	bln$ at 15yrs	bln$ at 22.5yrs	bln$ at 30yr
Injection CAPEX+OPEX	20.3694	25.0252	29.0991
Production CAPEX+OPEX	1.7109	2.1020	2.4441
SMR CAPEX+OPEX	30.5624	37.5481	43.6606
total Capex	30.0815	30.0815	30.0815
total Opex	22.5611	34.5937	45.1223

	bln$ at 15yrs	bln$ at 22.5yrs	bln$ at 30yrs
total exports	157	232	268
total import	49	66	66
Total Investments (C+O)	53	65	75
Cash balance	55	101	126
Profit / Investment (%)	105	157	168

The built-in economics module indicates profitability, H_2 break-even prices and sensitivities to 100% product switching from natural gas to a clean burning product.

Scenario Ranking based on cumulative Cashflow and H_2 break even price

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https://www.molyneuxadvisors.com/sky-blue-hydrogen/

We welcome questions and discussions, especially on how we might embark on this blue-sky thinking journey together.

* Registered Business Name 1-51717918810 (Australia)

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Overview of the ‘circular’ Sky Blue Hydrogen* concept

- Sky Blue Hydrogen is generated from a single site process that starts with a new, or a producing gas reservoir.
- A Steam Methane Reformer (SMR)- or other hydrogen production unit (HPU)- is installed alongside the gas processing facilities. Processed natural gas is used as as both feedstock for the SMR to produce hydrogen, and for process heat & other utilities to run the SMR. Together with steam, Hydrogen (H_2) is manufactured, with Carbon Dioxide (CO2) produced as bi-product.
- Hydrogen is transported for sale, either through re-purposing the existing gas pipeline network, or providing additional volumes to a Green Hydrogen project, thus supporting a new hydrogen pipeline.
- CO_2 is captured from the SMR (using amine or other technology) and injected back into the base of the same gas reservoir (just above the Gas Water Contact), helping to maintain reservoir pressure and gas well rates, thus increasing the life of the field.
- Additional volumes of CO_2 should be investigated. ‘Mopping up’ and capturing CO2 from any CCGT and/or nearby energy intensive industry. Any additional volumes would better maintain reservoir pressure.
- Additional methane could be added to the SMR by collecting, instead of gas flaring at any oil wells or facilities in the area.
- Sky Blue Hydrogen can be lower CO_2 than Blue Hydrogen due to the co-location and synergy between gas processing, SMR & CO_2 Capture processes. It involves the same building blocks as Blue Hydrogen but is economically more attractive due to the use made of the CO_2 to generate additional feedstock for the process.
- Even with modest hydrogen price assumptions, the process could be self-funding or highly economically attractive.

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