

A blue-tinted image of the Earth's horizon as seen from space, with a bright light source (the sun) creating a lens flare effect on the right side.

# Best path to global net zero human CO<sub>2</sub> emissions by 2050

A viable but narrow pathway..



# Executive Summary

- The pathway to global net zero is very narrow but viable.
- A decade of energy technological advancement and installation of enhanced CO<sub>2</sub> and weather monitoring systems is needed to provide the accurate measuring needed to assess exact levels of CO<sub>2</sub> in the atmosphere and its effect on the weather.
- Further, it is vital for turquoise hydrogen/geothermal/nuclear/solar thermal energy to be utilised in addition to traditional solar PV/wind/hydro/wave in order to finalise the transition to and reach the destination of global low fossil fuel usage.
- Turquoise hydrogen is particularly advantageous as it provides clean hydrogen with zero CO<sub>2</sub> emissions and solid carbon products like graphite/carbon black. (See Clean Hydrogen Technologies)
- It is increasingly realized that Carbon Dioxide Removal (CDR), sometimes also called Negative Emissions Technologies (NETs), is a necessary step in achieving net zero human CO<sub>2</sub> emissions by 2050 – as dictated by the Paris Agreement.
- Basalt based green fertilizer and regenerative farming are critical to achieving net zero.
- Paulownia/Juncao and other fast-growing trees/grasses are also invaluable to achieving net zero.
- Current frameworks and regulations need to be reconsidered in order to include macroalgae Carbon in mitigation and adaptation actions.
- Strong support for top companies and compelling industry cases is necessary – Undo Carbon, Noviqtech, Clean Hydrogen technologies, H2I Technology, Hazer Group, CoverCress, Veritree and Brilliant Planet.

# Onshore soil conditioning - Basalt Enhanced rock weathering

Basalt is a mafic volcanic rock, meaning low amounts of silica and high calcium and magnesium content.

Enhanced weathering - involves the crushing of basaltic rocks or the mafic minerals within these rocks (such as olivine) and dispersing the powder either in terrestrial (in agricultural soils) or coastal settings.

As basalt weathers, it increases vital plant nutrients that can boost production and increase crops yields. Mineral nutrients such as calcium, potassium and magnesium create healthier soils.

Calcium ( $\text{Ca}_{2+}$ ) and magnesium ( $\text{Mg}_{2+}$ ) are two key components of the long-term carbon cycle.

Only  $\text{Ca}_{2+}$  and  $\text{Mg}_{2+}$  sourced from the weathering of silicate minerals regulates climate.

Silicate weathering naturally draws down about  $\sim 1$  Gigaton of  $\text{CO}_2$  per year.

- **Macro positives**

- **Climate:** It increases  $\text{CO}_2$  absorption and reduces nitrous oxide emissions.
- **Ocean:** Slows ocean acidification and reduces the associated impacts on coral reefs and fisheries.
- **Soil:** amends degraded soils promoting healthy plant growth, reduces soil nutrient loss and erosion and reduces the need for fertilizers.
- **Global Food Security:** the above co-benefits from enhanced weathering will in turn help with global food security by improving crop production.

# Industry Case :

## Un-do

- Piloted in Scotland and now being used across several estates.
- Undo Carbon generates low cost, green basalt-based fertiliser for farmers.
- It is Permanent, scalable, natural and inclusive.
- Generates carbon credits through a 'Model and Measure' approach.
- It is likely that this will be the first company globally to sequester a billion tons of CO<sub>2</sub>.



# Industry Case : Noviqtech ([NVQ](#))

- Industry leading Carbon reporting and management platform
- Provides transparent and reliable reporting across supply chains, carbon emissions, and guarantees of origin
- In partnership with Google, NVQ offers its industry leading solution through its Carbon Central platform
- Integrated into the Carbon Central platform, NoviqAI offers comprehensive tools that facilitate real-time carbon emissions tracking, guarantee of origin, and overall carbon management.



# Industry Case : CHT



*Turning natural gas into Hydrogen/Carbon products.. Zero CO2*

- CHT has created a thermo-catalytic process that transforms hydrocarbon feedstock (natural gas) into two commercial products: Hydrogen, and solid Carbon composites such as graphite, graphene, carbon nanotubes (CNT) and carbon nano fibers (CNF)
- The process produces no other outputs, and specifically zero CO2. emissions
- Clean Hydrogen Technologies' capabilities are more advanced than any other solution that uses similar processes to produce turquoise hydrogen.

# Industry Case : H2i Technology

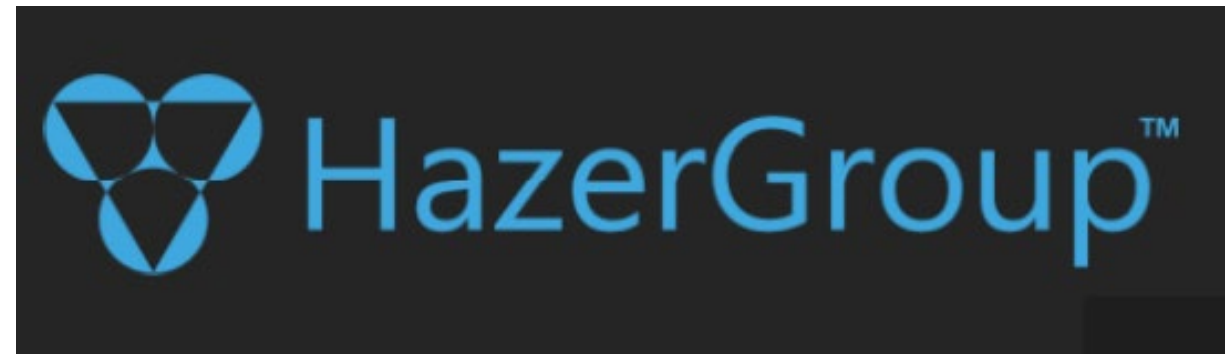
- A hydrogen enhancement system that generates substantial emission reductions & fuel savings for diesel engines
- The core of the system is a custom designed “black Box” control unit which collects multi- variable operational data to optimise and regulate the flow of hydrogen with the fuel mix
- The technology can extend an engine’s operational life, significantly reduce emissions (up to 30%), decrease particulate matter (50%), cut fuel costs (up to 20%), and optimise efficiencies



*Cleaning diesel systems and keeping diesel working*

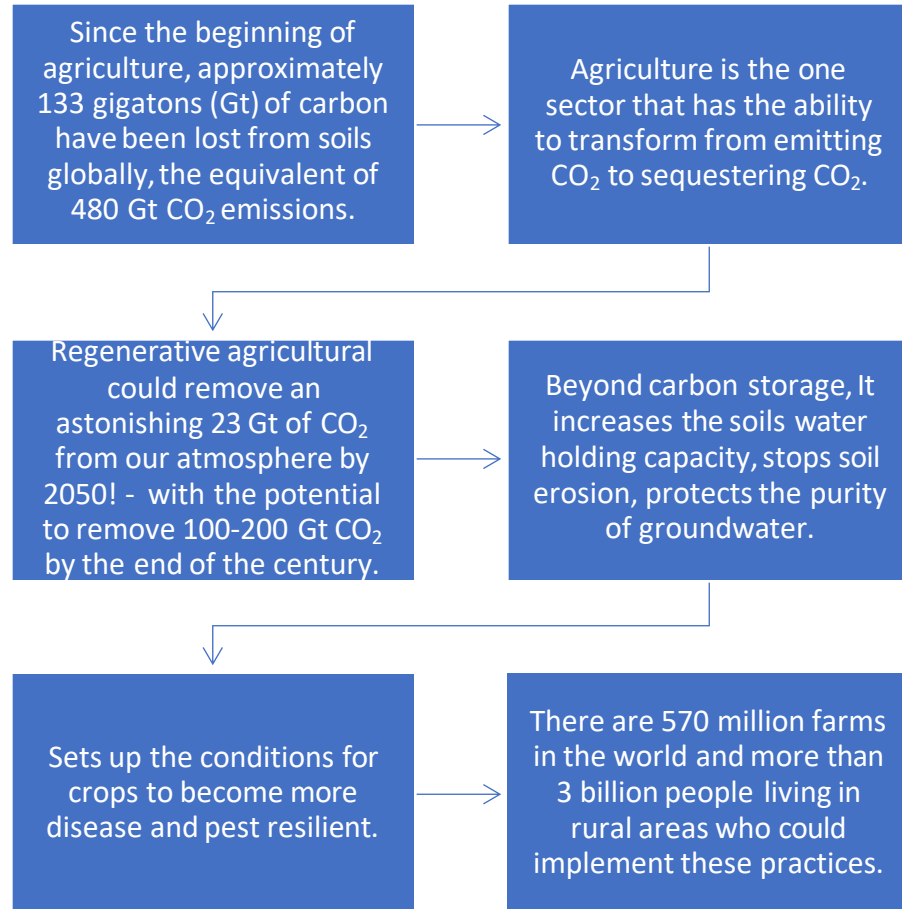
# Industry Case : Hazer Group

- A pioneering ASX-listed technology development company undertaking the commercialization of the HAZER® Process, a low-emission hydrogen and graphite production process.
- Process enables the effective conversion of natural gas and similar feedstocks, into hydrogen and high quality graphite, using iron ore as a process catalyst.
- Hazer's Commercial Demonstration Plant has achieved over 180 hours of hot operation with an agreement signed with South Korean giant POSCO for the integration of Hazer's H2 technology into clean steelmaking processes.
- On track for commercial deployment readiness at the end of CY 2024.





# Regenerative farming – Cover cropping



## • Underlying Principles

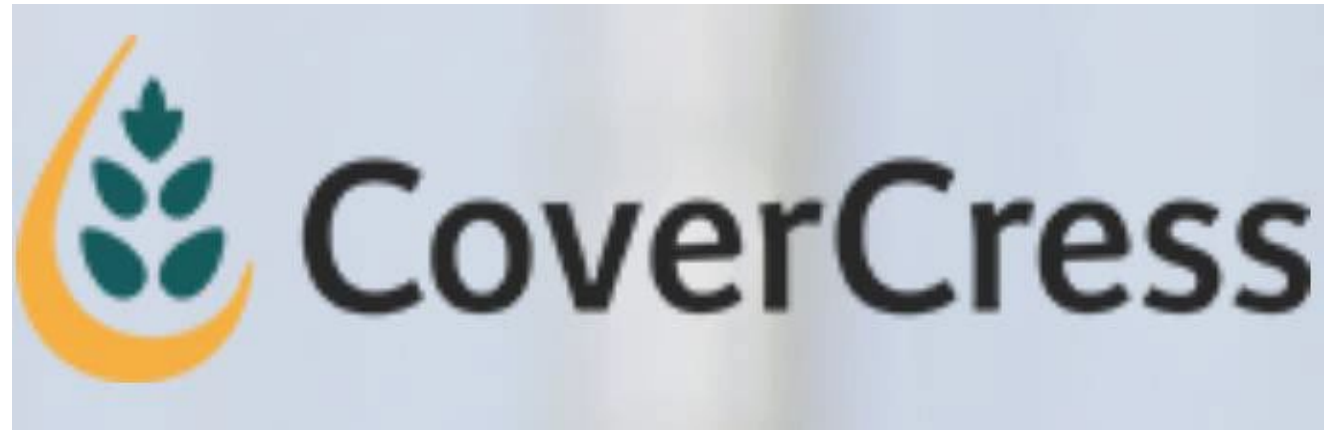
- maintaining continuous vegetation cover on the soil as much as possible.
- reducing soil disturbance to promote stabilization of organic matter on soil mineral complexes.
- increasing the amount and diversity of organic residues returned to the soil.
- maximizing nutrient- and water use efficiency by plants.
- restoring microbial life essential to soil health and biodiversity.

# Reported carbon sequestration from trials around the world..

Place	Crop and practices	reported carbon sequestration	Extrapolation to all global cropland
U.S. <sup>21</sup>	Corn-Vegetable-Wheat   Organic, tillage, composted manure, legume cover crop	2.36 Mg C ha <sup>-1</sup> yr <sup>-1</sup>	12 Gt CO <sub>2</sub> yr <sup>-1</sup>
Egypt <sup>22</sup>	Peanuts   Biodynamic, compost, irrigation	4.10 Mg C ha <sup>-1</sup> yr <sup>-1</sup>	21 Gt CO <sub>2</sub> yr <sup>-1</sup>
Iran <sup>23</sup>	Corn   No-till, manure, hand-weeding	4.10 Mg C ha <sup>-1</sup> yr <sup>-1</sup>	21 Gt CO <sub>2</sub> yr <sup>-1</sup>
Thailand <sup>24</sup>	Unreported Crop   Organic	6.38 Mg C ha <sup>-1</sup> yr <sup>-1</sup>	32 Gt CO <sub>2</sub> yr <sup>-1</sup>
Global <sup>25</sup>	Pasture   Improved grass species	3.04 Mg C ha <sup>-1</sup> yr <sup>-1</sup>	37 Gt CO <sub>2</sub> yr <sup>-1</sup>

# Industry Case : CoverCress

- Developed a variety of pennycress, a weed in other parts of the world.
- Doubles as a cover crop and a feedstock for the trucking and airline industries' growing appetite for low-carbon biofuels.
- Financial backing of two agribusiness giants, Bayer and Bunge.



# Reforestation – The Empress Tree (Paulownia)

---

Absorbs 10 times more CO<sub>2</sub> than any other tree species, releasing large quantities of O<sub>2</sub>.

---

An acre of empress trees can absorb 103 tons of CO<sub>2</sub> per year.

---

10-20 feet growth in its first year and reaches maturity within 10 years.

---

Highest strength/weight ratio of any commercial wood.

---

Employs a unique and powerful type of photosynthesis.

---

This system is found in only about 3% of all land plants, including some grasses like corn and sugarcane, but very few trees.

---

Regenerates without replanting, providing ongoing revenue through multiple harvests

---

Suitable for inter-cropping.

---

Will grow on marginal land and can be used for soil restoration.

---

Nitrogen fixing leaves naturally fertilize and replenish the soil.

---

Flowers provide pollination benefits and attract honey bees.

---

Ability to offset global individual CO<sub>2</sub> footprint created through daily activities.

---

Adding about 10% more global forest using Empress trees would offset all of the CO<sub>2</sub> generated by human civilization each year.

- Key traits

- Capable of adapting, growing and developing in poor soils.
- It is an ideal tree for improving and reclaiming poor, polluted and endangered soils.
- Grows on soils polluted with heavy metals and harmful substances, where other trees would not survive.
- Absorbing these substances, it relieves the earth from them - remedying fragile soils, which would otherwise perish and be lost completely.

## Industry Case : [Veritree](#)



- Veritree verifies and monitors the impacts of tree planting to ensure visibility and accountability for your climate actions.
- Connects businesses with verified tree planting projects to restore our planet - creating local jobs, sequestering carbon, and restoring ecosystems.
- Proudly supporting over 20,000 restorative businesses including industry leaders like Samsung, Hyundai, Docusign, BMO among others.

# Offshore Ocean Conditioning – Macroalgae (Seaweed)



Environmentally friendly, economically feasible, and a sustainable technology.



A noteworthy feature is the capacity to convert flue gases into inorganic carbon sources from power plants and other industrial exhausts.



The ability to fix carbon dioxide 10-50 times more than other terrestrial plants.



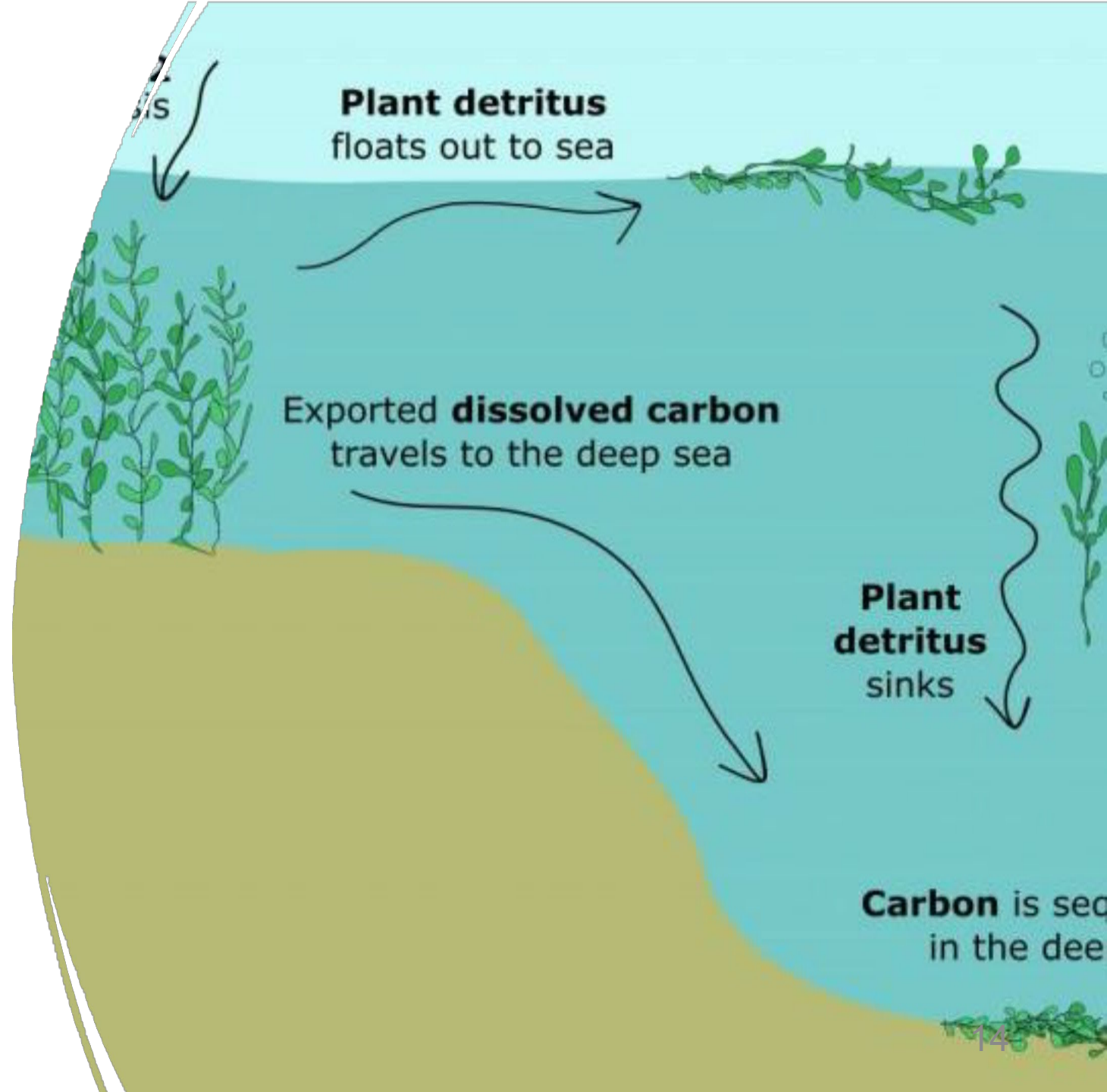
Algae farming in the sea represents a tremendous potential to provide biomass for generation of renewable energy.



Form the most extensive and productive vegetated coastal habitats in the global coastal ocean, es3.4 million km<sup>2</sup>



Analysis shows potential to fix approximately 100 Gt of CO<sub>2</sub> into biomass annually.



# Industry Case :

## Brilliant Planet

- 30,000 m<sup>2</sup> production facility with the world's largest algae growth pond in the coastal desert of Morocco.
- Backed by some of the world's leading climate technology investors.
- Innovative process enabling vast quantities of microalgae to grow in open-air pond-based systems on coastal desert land.



# Conclusion

The work of John Doerr from Kleiner Perkins investment bank in America and the website [speedandscale.com](http://speedandscale.com). This is another example of a private attempt to solve the net zero target in a timely and orderly fashion.

---

The Best path to net zero human emissions by 2050 starts with a great deal of abatement through advanced weathering technologies that double as fertilisers (e.g. Un-do).

---

Fast growing trees like Paulownia and the Juncao grass also present viable commercial carbon sequestration opportunities to utilise stored carbon as building product (construction materials).

---

Macroalgae/Seaweed forms a critical component of Ocean conditioning and de-acidifying as well as producing sustainable food and fertiliser while sequestering carbon.

---

Carbon Abatement/Sequestration has substantial GDP/economic benefits as well as the environmental dividend.

---

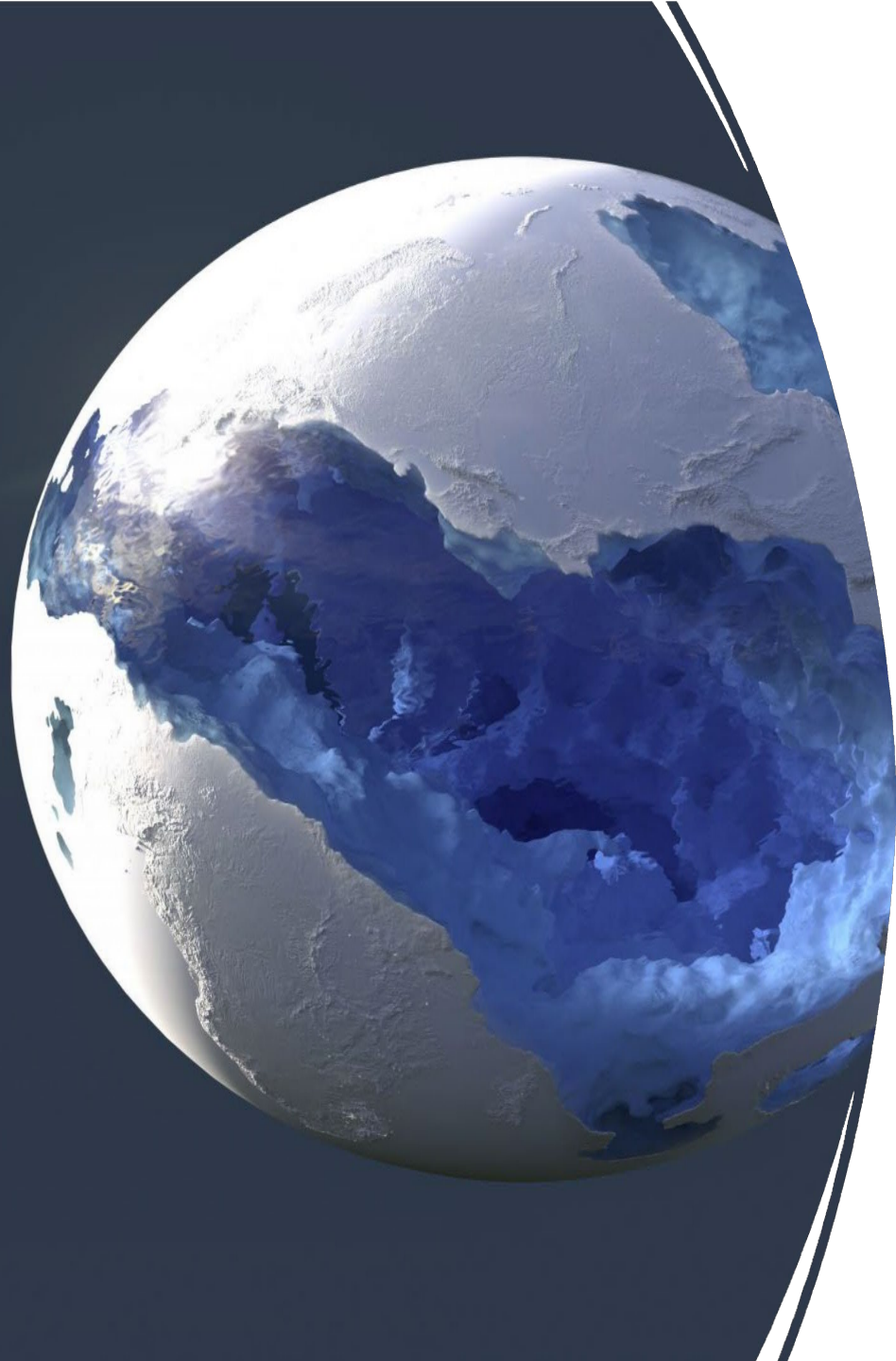
Absolute cuts to human emissions from fossil fuel usage must begin with engine efficiencies and hydrogen driven clean burning technologies that increase energy output while decreasing emissions and particulate matter. (e.g H2I Technology).

---

Turquoise hydrogen for energy and solid carbon products is critical as well as a broad mix of energy and storage solutions such as [Green Gravity](#) and [1414 degrees](#).

---





# Earth Facts

---

- Weight of earth's atmosphere - 5.5 quadrillion tons, or roughly one millionth of Earth's mass.
- Weight of the planet - 6,000,000,000, 000,000,000,000,000 kilograms.
- Co2 level in atmosphere - 414.72 parts per million
- Volume of the hydrosphere earths ocean - 1.37 billion cubic kilometres
- Annual human CO<sub>2</sub> emissions – 34 billion Tonnes each year
- Natural CO<sub>2</sub> emissions - 100 billion tons of carbon dioxide yearly
- % of annual O<sub>2</sub> emissions from algae. - Photosynthesizing algae responsible for 70% of Earth's oxygen production.