

- Overview:

The scientific consensus is overwhelming. The earth and especially the oceans are getting much hotter. Unless the top 4 emitters (China; America; India ; EU) quickly transition to minimal GHG emissions; catastrophic impacts will happen (beyond what we are seeing now) and many hundreds of millions humans & countless other lifeforms will die. ...America will not be spared.

Natural feedback systems are kicking in: Warming Permafrost release of GreenhouseGases; Loss of sea ice in Arctic and Antarctica allowing dark ocean absorb more sun heat; Rain forests changing to net carbon emitters; Marine heat waves killing coral & ocean life; very large numerous Wildfires, etc). These feedbacks will make the climate impacts much worse. ..

Several facts are painfully obvious:

FIRST:

in America the construction of solar/ wind is progressing much too slowly; held back by an old electric grid and complex rules/ calculations on transmission lines. New technology Grid transmission lines are urgently needed. But who will pay the many billions required? This will take decades. The \$\$ for new solar and wind installations from IRAAct is in limbo.

Capture of CO2 offers many techniques to eliminate CO2 emissions from Utilities and major emitters. And allows for the start of new business for global oil/ gas industry. Many billions are being spent to scale up various techniques and evaluate them; and to buy safety time while a new electric grid is built.

There are many varied CO2 capture techniques that range from air to ocean to 'natural' biomass. Some result in CO2 being buried or sequestered permanently; others in temporary fragile sequestration (soils; trees).

Hundreds of start-up companies offering various CO2 capture techniques are looking for and obtaining monies from DOE and Shopify; Frontier and other venture firms. These will be trialed and assessed. In time those with better efficiency and cost will survive.

What is critical and needed ASAP are technologies that will remove CO2 from the atmosphere to bring CO2 back to safer level (400 ppm ?) from 460 ppm (by 2045)

The magnitude of CO2 removal from either atms & the ocean is huge. Literally billions of tons of CO2/ yr will need to be removed & safely sequestered permanently each year ; while the fossil fuel industry transitions away from selling products that yield GHG when burned.

SECOND: The fossil fuel industry is not transitioning away from oil/ nat gas. And will not for decades..

Many Billions \$\$ being awarded to a hundreds of firms; including large oil/ gas companies to scale up various carbon capture techniques . DOE will award \$3.2 Billion split between 4 "hubs". This phase is necessary to evaluate number of techniques for scale up most efficient in the next 5 -10 yrs.

Recently DOE awarded: \$1.5 Billion split between two hubs in Texas & La. for- **Air capture & deep burial in secure geological formations.**

The risk assessments were done by either EPA geological experts or geological experts in the states that have gained primacy on Class 6 deep-wells over EPA eg: Wyoming & N. Dakota. NOTE: Texas & Louisiana working on primacy.

Texas; Louisiana; Wyoming; North Dakota are already funding large

carbon capture sites and geological repositories.

This immense amount of CO₂ needs to be safely stored in deep caverns on land or under the oceans. Numerous geological surveys have shown there are more than enough geological caverns both on land and under the ocean to safely sequester all global human CO₂ emissions forever (it does react with rocks).

Geological experts have performed risk assessments and all believe this process to be safe with virtually no leakage. However, continuous pressure monitoring is required to detect potential leaks.

NOTE: leaks from the pipelines carrying CO₂ ; actually have higher risk of leaks; tho still acceptable; but continuous monitoring triggers quick valve shutoffs; and an odorant must be added to the CO₂ like nat gas. And first responders must be trained and retrained annually (wear SCBA etc).

Some Capture/ sequestration techniques that look very promising:

1. the large amounts if CO₂ needed to be captured require suitable large deep caverns on land or under oceans. With impermeable cap rock.

Currently the technologies to do this involve pulling in large amounts of air or seawater into basic solutions and reheating or some other techniques to release the CO₂ and condense it for burial.. Capture on other substrates like zeolites or other solid structures that allow more efficient capture and lower energy removal are being scaled up.

Electrochemical techniques for capture from seawater or brine from wastewater operations look very promising. -Esp since the captured CO₂ could be buried under the ocean . Many of these also produce green H₂. Work underway.

Other promising low risk technologies:

Grow Algae then sun dried & buried (huge potential !)

Biochar from biomass; -low cost; used on farms; large potential

Bio-oil from biomass injected into wells; low cost; safe; large potential

Deep burial in Middle east periodate rock; -huge potential

Bury biomass/ trees with salt/ antimicrobial in landfills.. cheap- easy- large potential

Capture in concrete - various techniques; large potential

Enhanced "rock" or mine tailings spread on farm land- - hard to measure amount CO₂ captured. climate / rain sensitive.

Deep ocean burial (lack of O₂) of seaweed/ kelp / biomass-?? problematic- methane release ? & unknown impacts in ocean

Passive chemical adsorption - Unknown efficiency

Trees -limited time of sequestration; Risky: die from heat; insects; fires; logging; etc. not enough land to impact climate..

Grow GMO trees - faster take up of CO₂.- Hmm

Burn wood pellets (from USA farmers). Capture CO₂ -burial (UK)- hmm ?

Soil - increase organic content.: Again limited sequestration time. Needs many samples to verify Soil Carbon over time and depth and across fields- variable; tilling / digging destroys; currently defaulting to conservation practices (cover crops etc).

Grasses- yes great- plant more- very difficult to measure how effective

See list of start up companies & Brief descriptions in slides; these have won some \$\$ after submitting data on their techniques..

My Recommendations on a Better Strategy than just saying "No".

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