

Review Article

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Reversing Global Heat with Paleoclimatology offers Hope for Climate Recovery

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ABSTRACT

The past few years have created heat waves and rain events to shatter records, with a surge in health hazards and air conditioning demand. Observationally informed projections of climate science more realistically find that a five to six-degree (5°C - 6°C) increase is "most accurate" outcome due to present trends and climate models for 2100. The likely causative triad for the present warming trend *from 1950 to the present* is identified by this author as: 1) the tripling (3x) of world population; 2) the quadrupling (4x) of carbon emissions; and 3) the quintupling (5x) of the world energy consumption. Perhaps the linear, inextricably tight correlation between global CO_2 values and global temperature, will provoke an international gigaton direct air carbon capture effort, along with carbon-free fuels, zero carbon emissions, and renewable energy development. By emphasizing immediate CO_2 removal, a conversion to 100% renewable energy can begin to drastically reduce carbon emissions, which add about 40 gigatons of CO_2 annually to the universal air blanket. The industrial processes for capturing billions of tons of atmospheric carbon dioxide intended for permanent removal are shown in this paper. The review focuses on the problem and solution for global warming.

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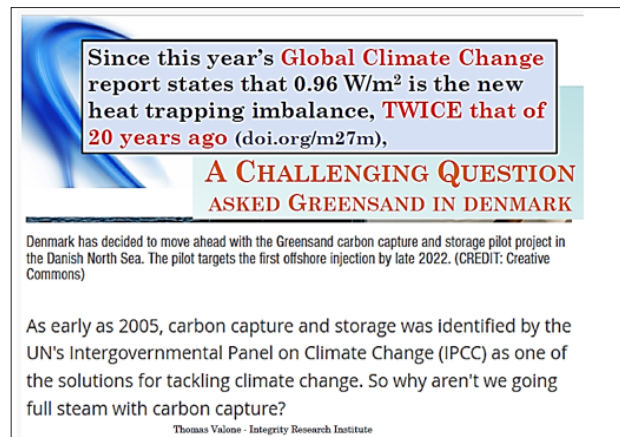
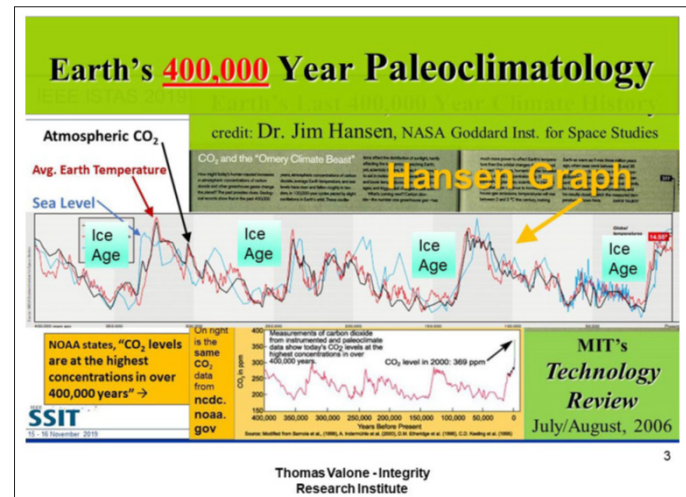
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Summary

Back in 1950, with only 2 billion people on earth and 1 billion of them starving, it seemed like a Godsend that Dr. Norman Borlaug came to the rescue with hybrid wheat and other feedstock. He created the Green Revolution causing the world's population to go up from then on. As related with slides that follow, the world population RATE peaked around 1975 which allowed us to estimate the time (about a century later) when the total number of people in the world will level off and start to decline. This same behavior seen from a system science perspective also applies to the global emissions system RATE but unfortunately it is still not reaching a linear growth limit but instead, *exponentially increasing*. Therefore, we cannot predict when the total world CO_2 emissions quantity will level off! More specifically, the Hansen climate graph of the last 400,000 year history surprisingly reveals a linear, tight correlation between global temperature, sea level, and CO_2 level that has not been disclosed on such a scale before now. With the help of the Table of values for each of the three parameters, Dr. Hansen explicitly found them to be transparently linear, which led this author to write the simple relationship between them: **(+/-) 20 ppm of CO_2 = 1°C = 20m change in sea level.** Hansen chose 290 ppm as the baseline which corresponds to a 15°C worldwide baseline. Therefore, we find at least 6 units of 20 ppm to reach the present 420 ppm, which translates to more than a $+6^{\circ}\text{C}$ past the baseline. Since we have experienced about $+2^{\circ}\text{C}$ already worldwide, we are indebted for

an additional $+4^{\circ}\text{C}$ by the end of the century, according to the Stanford University experts Brown and Caldeira and others. My adapted graph of Dr. Hansen's is applicable to the temperature, CO_2 , and sea levels of the world. NatGeo has also predicted the same $+6^{\circ}\text{C}$ that Hansen and Stanford University has found as well. The "Six Degrees" documentary of our future world is very graphic and shocking. All the more important when we are still refusing to limit the rate of increase of CO_2 emissions worldwide.





ProjectGreensand.com
partnered with INEOS company for
CDR and DAC
Capable of reaching 8 million
tonnes of CO₂ per year by 2030
Already the first carbon storage
injects CO₂ in 1800 meters below
the North Sea seabed.

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Why Do We Need Carbon Removal?
Climate change - Climate change refer...
Why we need carbon removal to address the climate crisis

Gigaton CO₂ Removal
Anu Khan | Chairman, 3rd Science & Innovation at Carbon180 United States - Contact info 500+ connections
Message Follow
John Kerry's Climate Warning: 'Even If We Get To Net Zero, We Need Carbon Removal' nuffrnc
About Reformed electrochemist working at the intersection of technology, policy, equity, and justice to bring the carbon removal sector to gigaton scale
Integrity Res. Inst. wants to help save the world by advocating Gigaton Carbon Dioxide Removal (CDR) or Direct Air Capture (DAC). Will billionaires and Congress help?

Analysis by the National Academy of Sciences (NAS) and Intergovernmental Panel on Climate Change (IPCC) shows that deployment of carbon removal is critical to achieve U.S. and global emissions reduction targets by 2050. Even with rapid investment in emission reductions, the United States could need to remove about **2 gigatons** of CO₂ per year by midcentury to reach net-zero – that's about **30%** of U.S. 2019 greenhouse gas emissions. Globally, scientists predict that up to 10 GtCO₂ will need to be **removed annually** from the atmosphere by 2050, with increased removal capacity up to 20 GtCO₂ per year by 2100.
Dan Lashof, Dir. World Res. Inst.

IEEE ISTAS 2019 Carbon Capture & Utilization (CCU) or Carbon Capture & Storage (CCS) in Gigatons?
"Pulling CO₂ out of the air and using it could be a trillion-dollar business"
Put CO₂ to work making valuable products. www.VOX.com/energy-and-environment
1 ppm CO₂ = 2 Gt Carbon = 7.77 Gt CO₂
THE HANSEN CHALLENGE
Can we REDUCE the CO₂ level to **lower temperature**? YES, it is reversible!
• Choose 350 ppm (+3 °C) as the target CO₂ level just to lower temperature
• Calculate gigatons (Gt) to remove in total **if done today**
• Take present 410 ppm – 350 ppm = 60 ppm which is equal to **466 Gt CO₂**
• However, every year an average of 5 ppm CO₂ or **+40 Gt/yr** will be added (in A2)
• Therefore, any **Global Carbon Reduction Program** will require CCS-CCU to invest enough to remove say, **100 Gt/yr for 10 years and 50 Gt/yr after**, until the hoped-for carbon emission rate peaks and a **century later**, the emissions slow down, level off, as population has done globally
Carbon Engineering out of Calgary, Canada → Tested Direct Air Capture (DAC) for CCU, CCS
SSIT 13 - 10 November 2019

GIGATONNE CARBON DIOXIDE DISPOSITION
Scaling to Billions of Tons of Carbon Capture & Management Infrastructure
Effective decarbonization requires that carbon capture, management and disposition infrastructure and systems be planned and implemented at "GT scale" (Giga Tonne scale), and not through a piecemeal project-based approach.
Enabling GT scale carbon capture and management requires common, scalable and seamless carbon disposition infrastructure; commoditized cost of carbon capture, storage and disposition; mechanisms for risk transfer & arbitrage for CO₂; mechanisms for net-back and utilization of carbon credits; and enabling policy design.
DasturEnergy.com – aims at 5 Gtpa CDR soon and over 10 Gtpa later on
CEE

Integrity Research Institute
"Dedicated to researching scientific integrity in the areas of energy, propulsion, and bioenergetics"
GOALS
40 gigatons CDR/year by 2030
100 gigatons CDR/year by 2050
www.integrity-research.org
www.futureenergy.org
www.BioenergyDevice.org

Using the Oceans to Help Capture Carbon > How can the deep blue seas fight climate change best?
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Atlantic Council <https://www.atlanticcouncil.org/s/3lgsz-energysource>
Gigaton carbon removal and the Paris Climate Agreement
May 14, 2021 - Gigaton scale removal, capture, and storage technologies will be
This large-scale Captura facility, shown in an artist's rendering, could capture gigatons of carbon dioxide dissolved in ocean water. CAPTURA COBP

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