



# OFFICIALLY GREEN

*with*

**ADENIKE AKINSEMOLU**

**July 20, 2023**

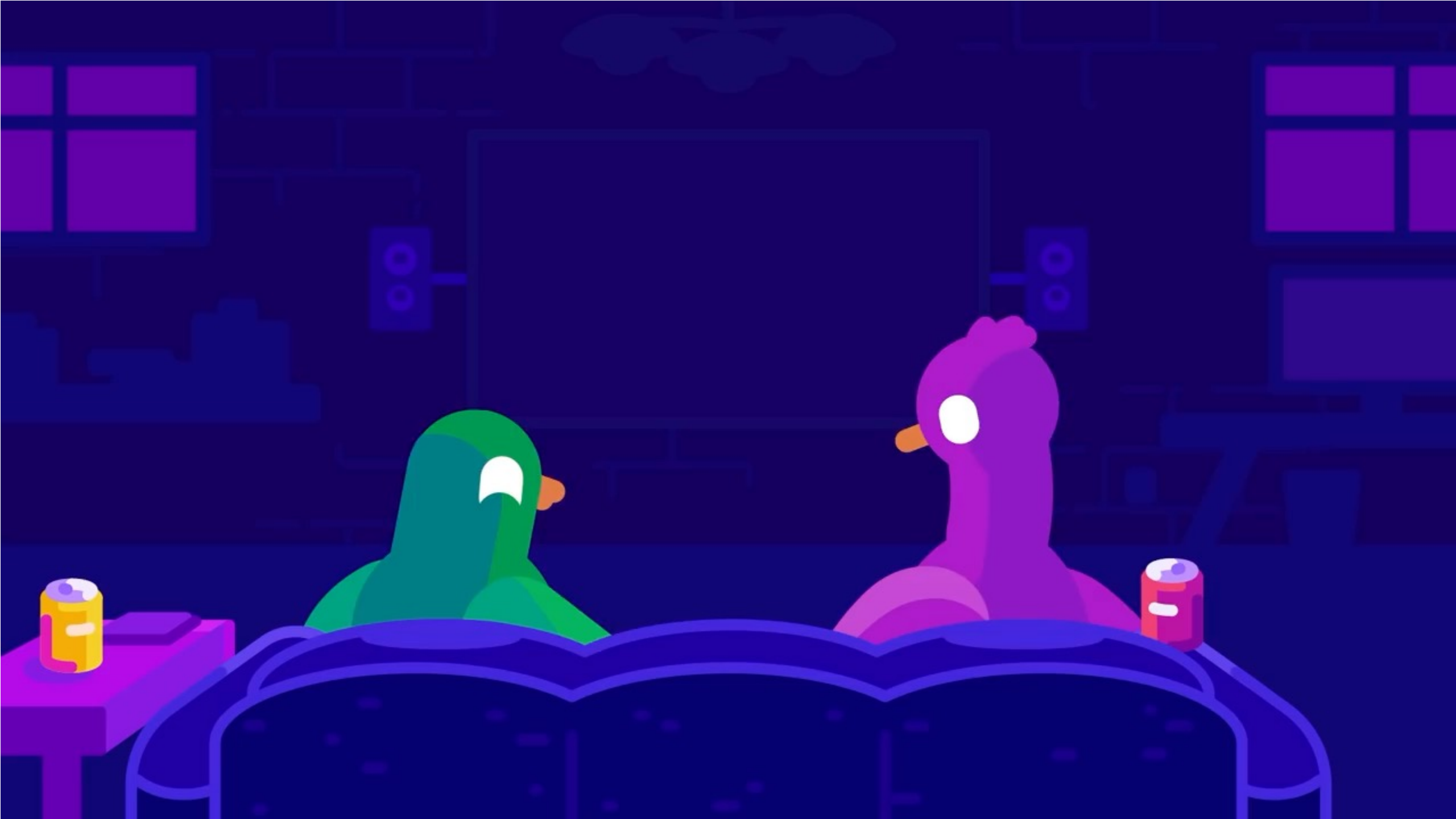
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# Climate Engineering

Exploring Innovative Solutions for a  
Sustainable Future

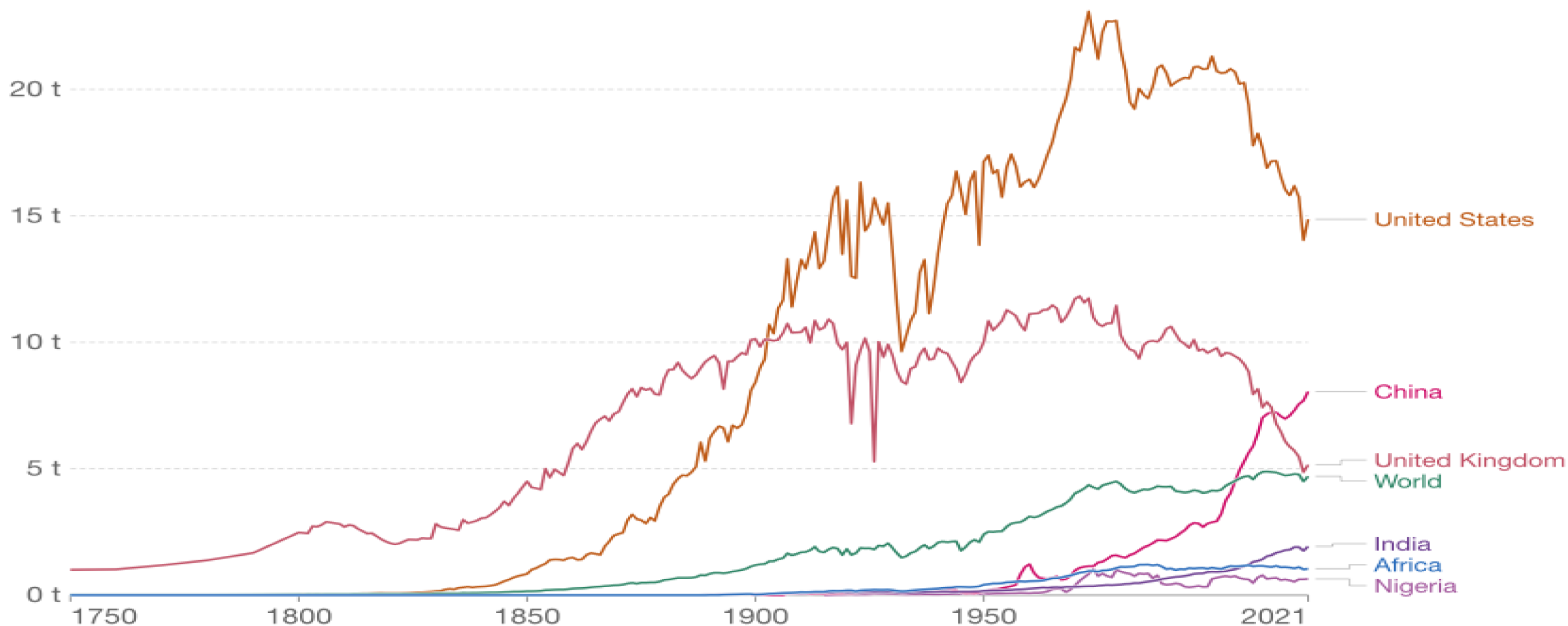
**Dr. Adenike Akinsemolu**





# Per capita CO<sub>2</sub> emissions

Carbon dioxide (CO<sub>2</sub>) emissions from fossil fuels and industry<sup>1</sup>. Land use change is not included.

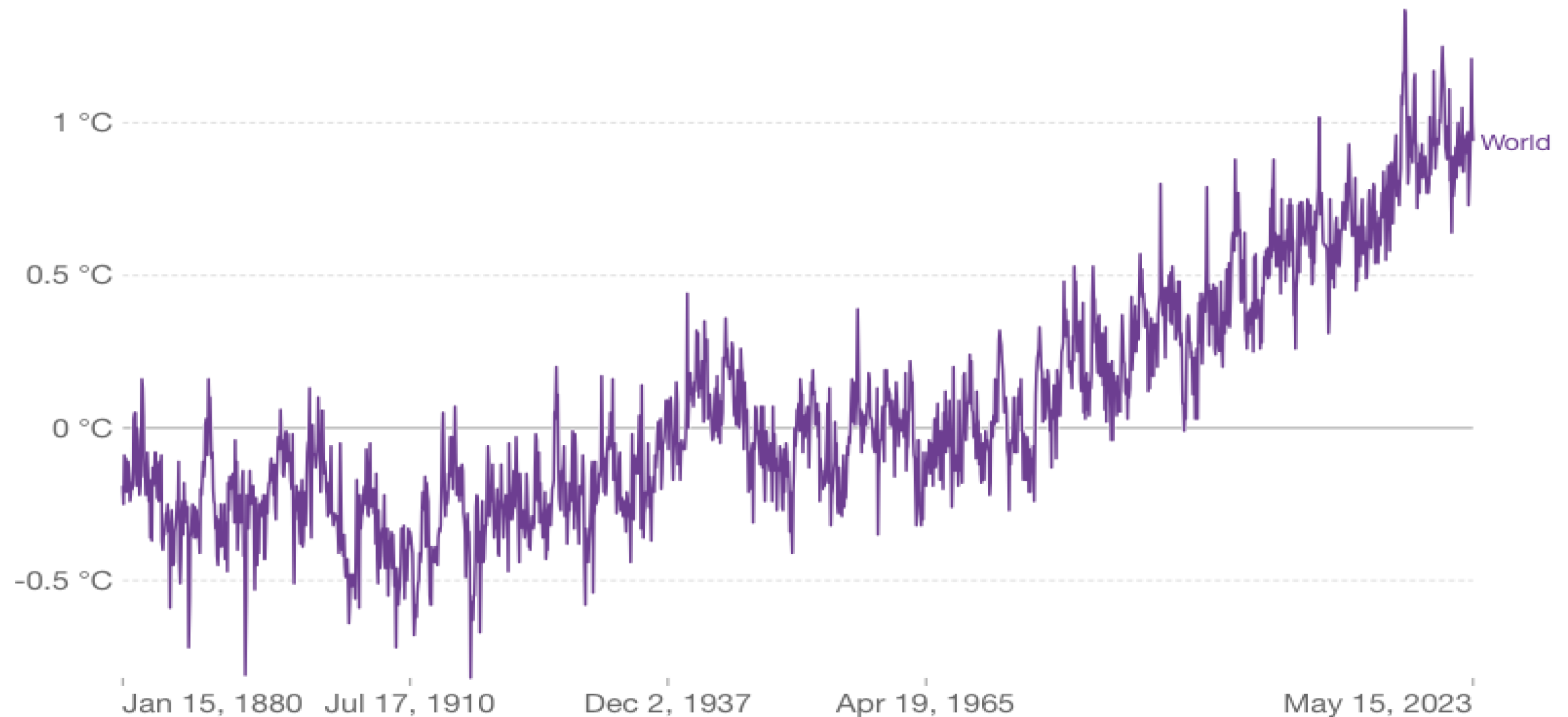


Source: Our World in Data based on the Global Carbon Project (2023)  
OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

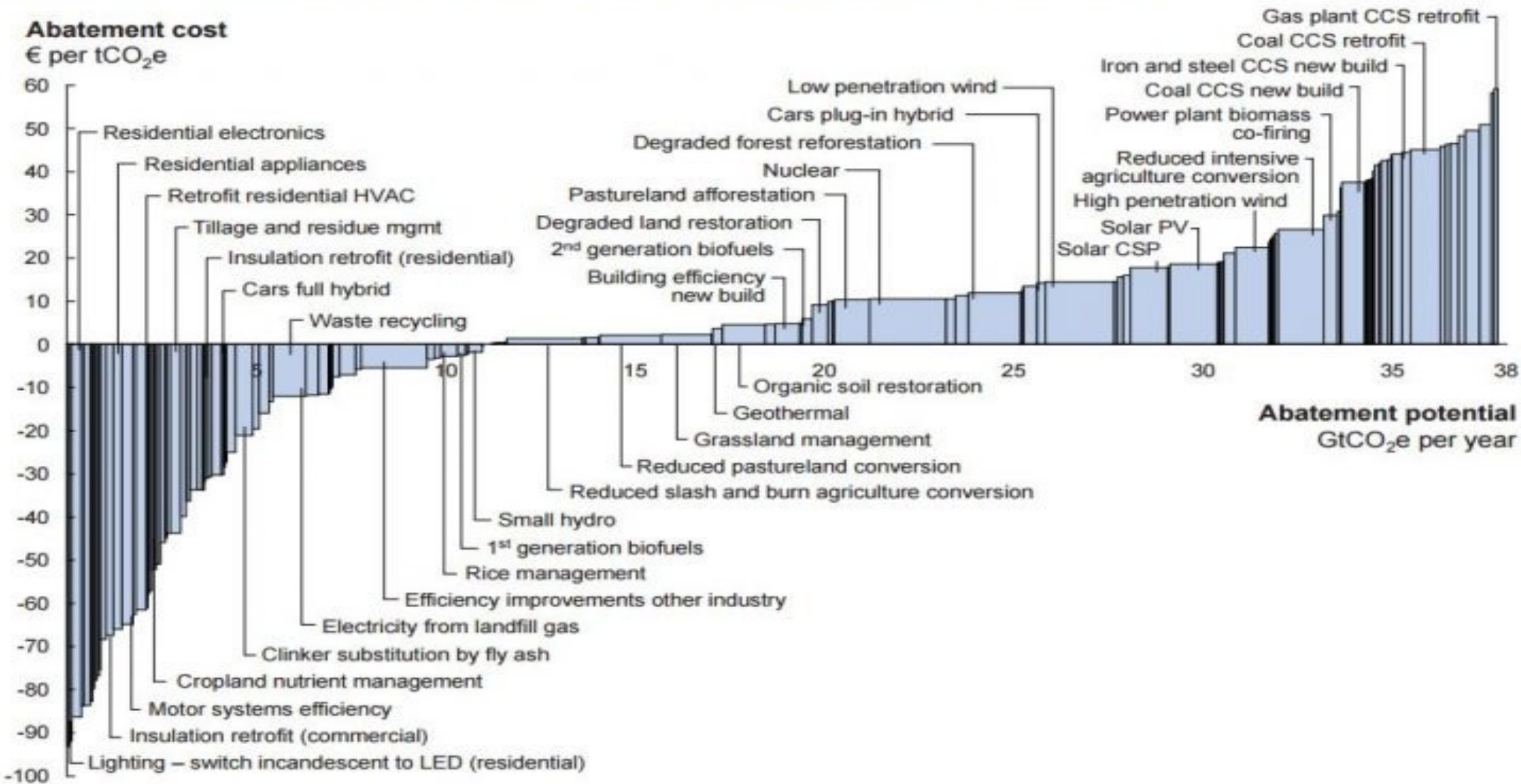
**1. Fossil emissions:** Fossil emissions measure the quantity of carbon dioxide (CO<sub>2</sub>) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO<sub>2</sub> includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

# Global warming: monthly temperature anomaly

The combined land-surface air and sea-surface water temperature anomaly is given as the deviation from the 1951–1980 mean.



# Global GHG abatement cost curve beyond business-as-usual – 2030



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO<sub>2</sub>e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0

# DEFINITION

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Climate engineering, also known as geoengineering, refers to deliberate and large-scale interventions in Earth's climate system to mitigate climate change or counteract its effects.

# **GEO-ENGINEERING VS CLIMATE ENGINEERING**





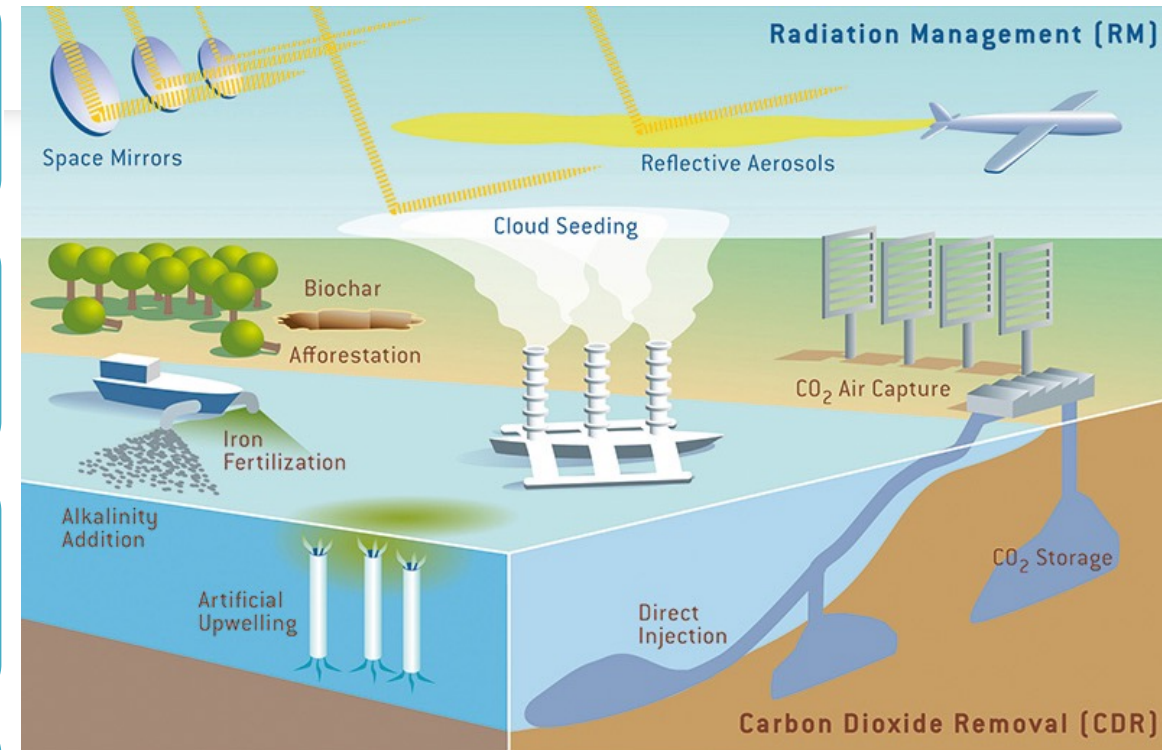
# INTRODUCTION

Climate engineering is currently under consideration as a viable alternative to tackle the negative effects of climate change.

It entails implementing extensive human-made interventions in the Earth's climate system on a large scale.

Concerns center around the potential consequences of geoengineering.

The development and oversight of geoengineering would necessitate a unique form of global governance.



# OBJECTIVE

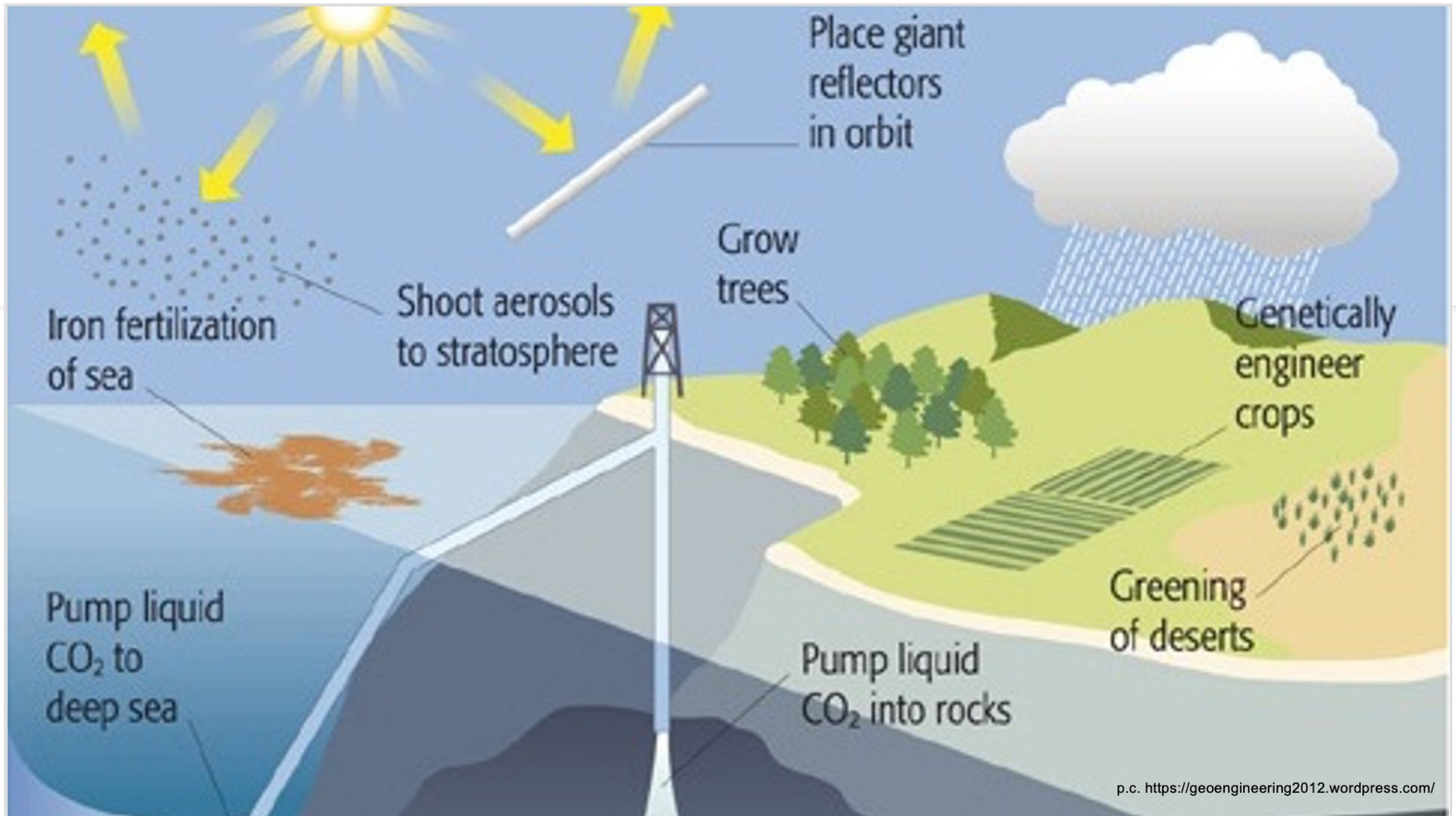
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The primary objective of climate engineering is to develop innovative techniques that can address the challenges posed by climate change and its impacts on our planet.

# KEY QUESTIONS

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- What are the different approaches and techniques employed in climate engineering?
- How effective are these techniques in addressing climate change challenges?
- What are the potential benefits and risks associated with climate engineering?
- What are the ethical considerations and potential unintended consequences?
- What scientific research and ongoing initiatives are exploring climate engineering?



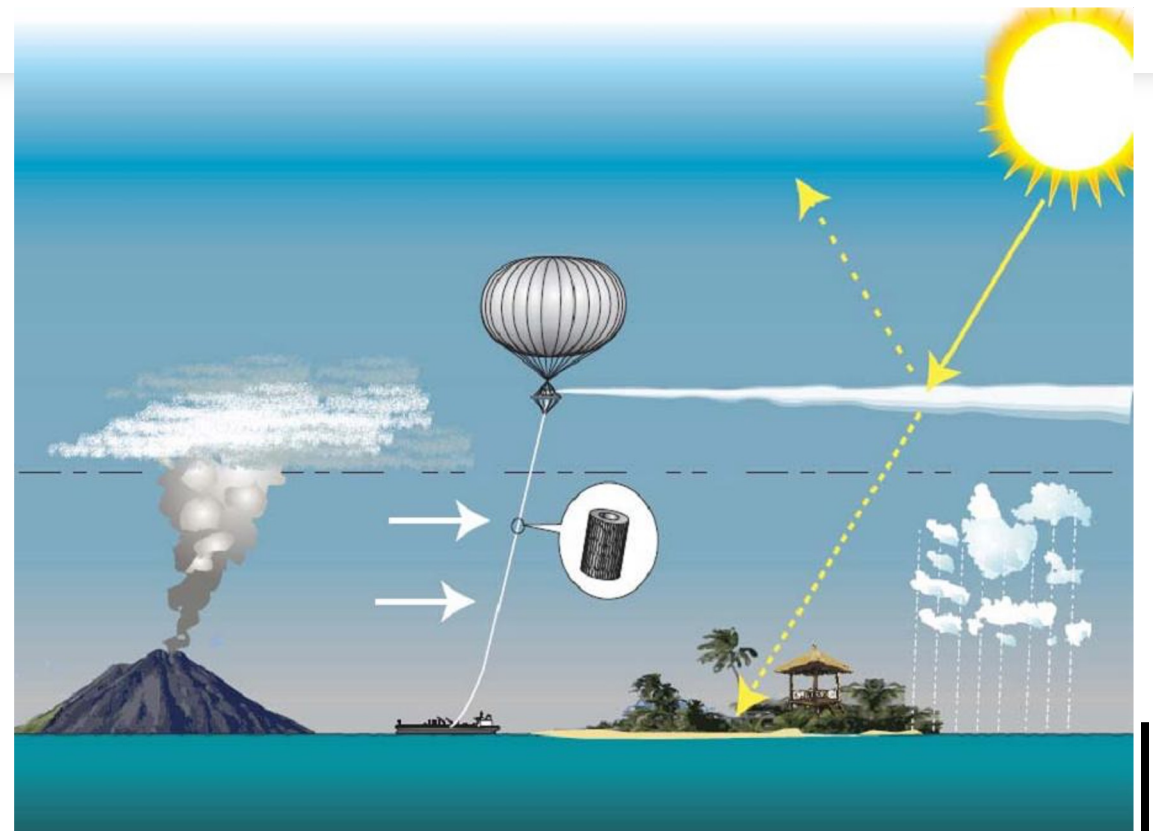
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Solar Radiation Management (SRM)

Carbon Dioxide Removal (CDR)

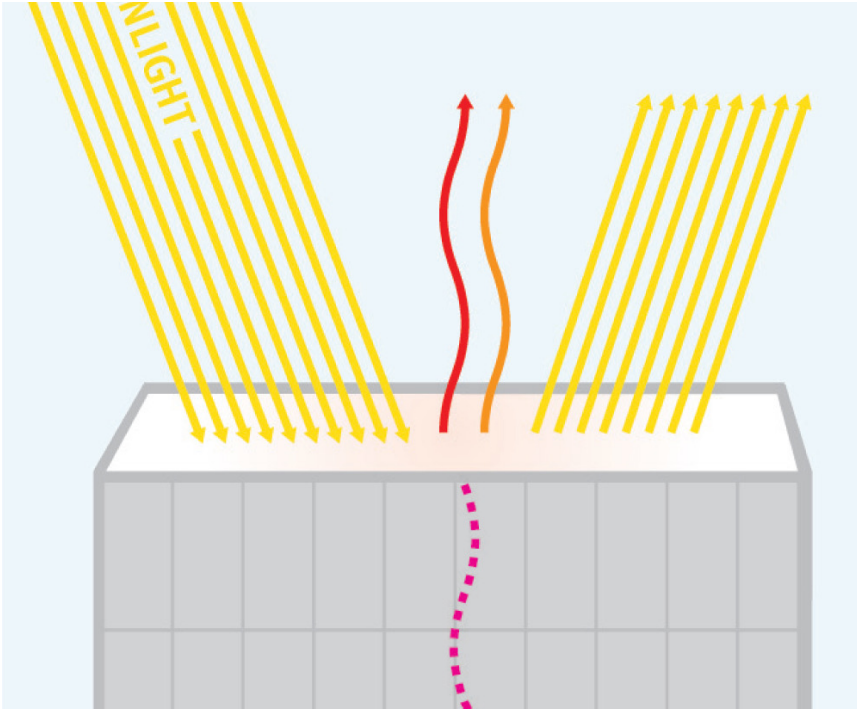
# WHAT IS SRM?

One potential geoengineering approach involves creating artificial barriers to reflect solar radiation back into space, thereby controlling the amount of solar energy that reaches the Earth's surface.



# ALBEDO ENHANCEMENT

*Increase land reflectivity*



<https://historicalbanyfoundation.wordpress.com>

*Brighten marine cloud*

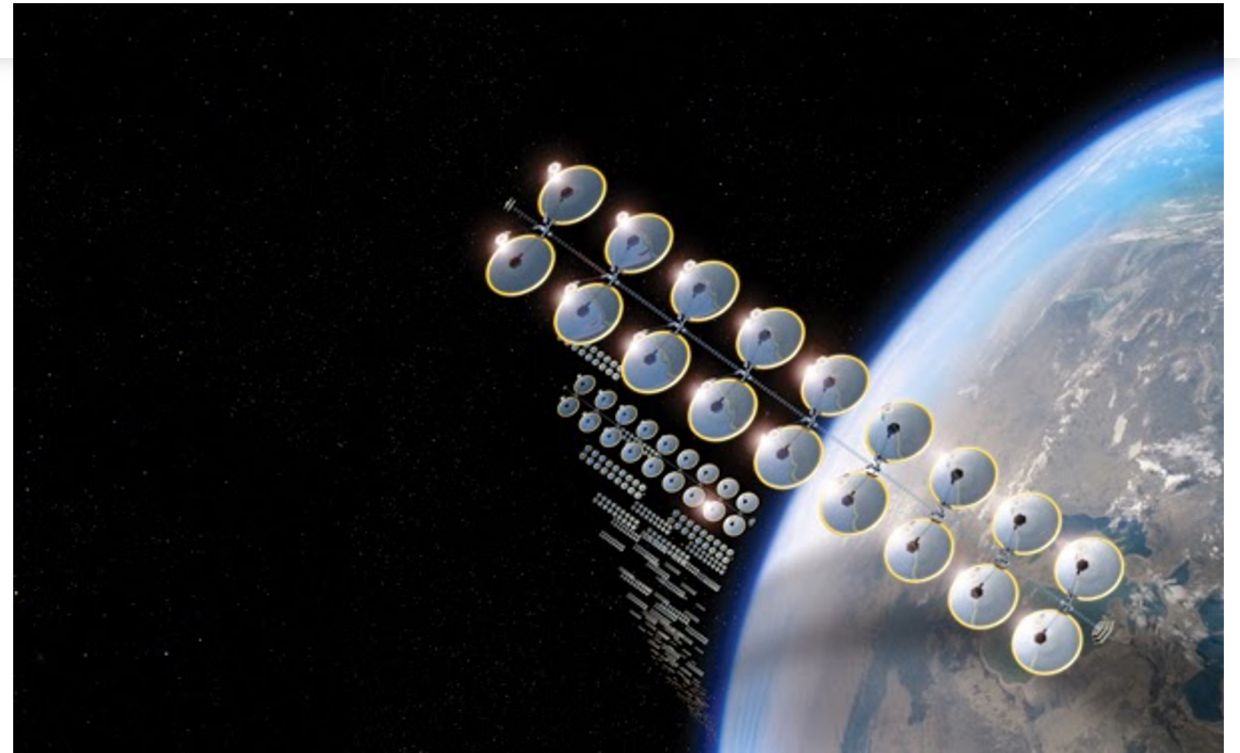


<http://www.climatecentral.org>

# SPACE REFLECTORS

Float small mirrors in the space

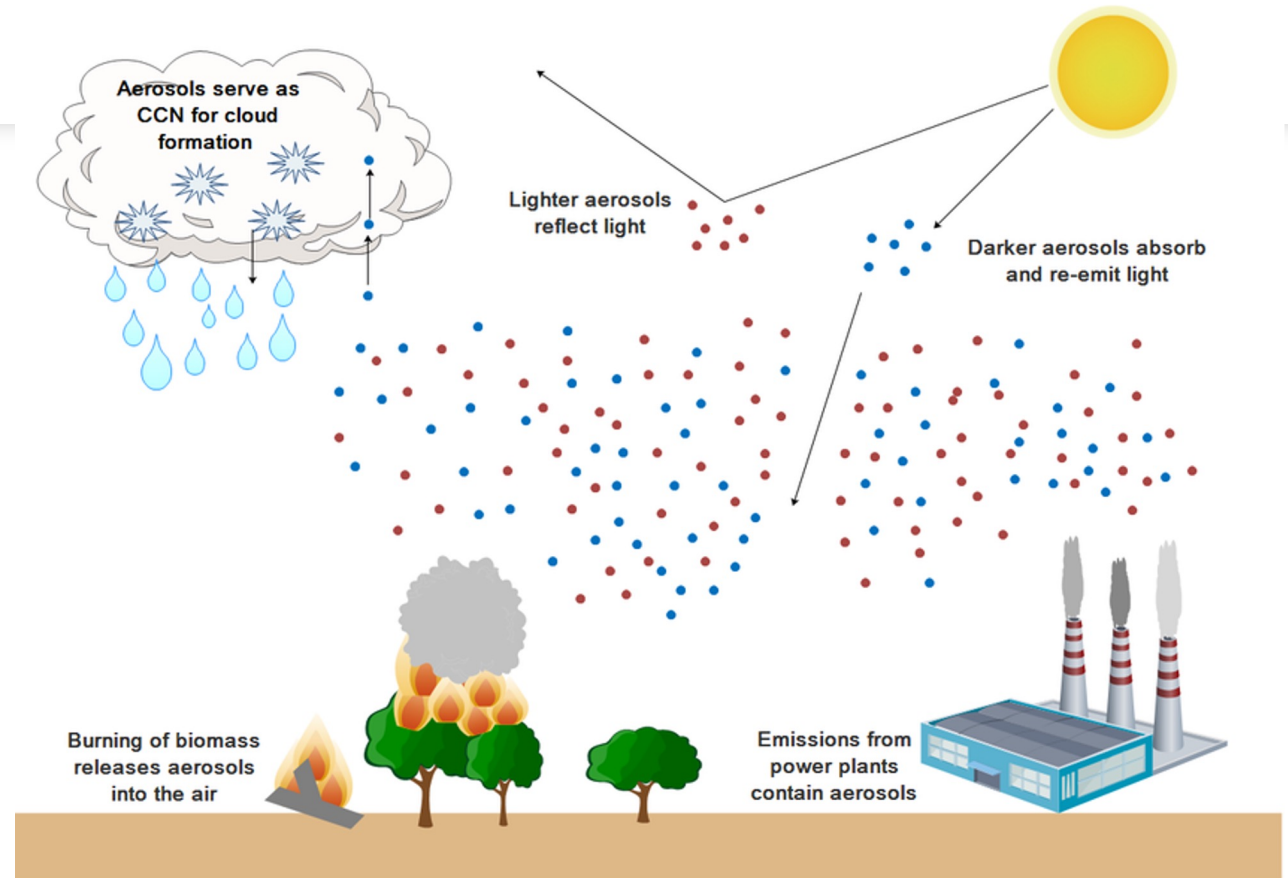
Block a small proportion of sunlight before it reaches the Earth





# STRATOSPHERIC AEROSOLS

Another geoengineering proposal is to introduce small, reflective particles into the upper atmosphere. This strategy aims to reflect a portion of sunlight back into space before it reaches the Earth's surface, effectively reducing the amount of solar energy absorbed by the planet.



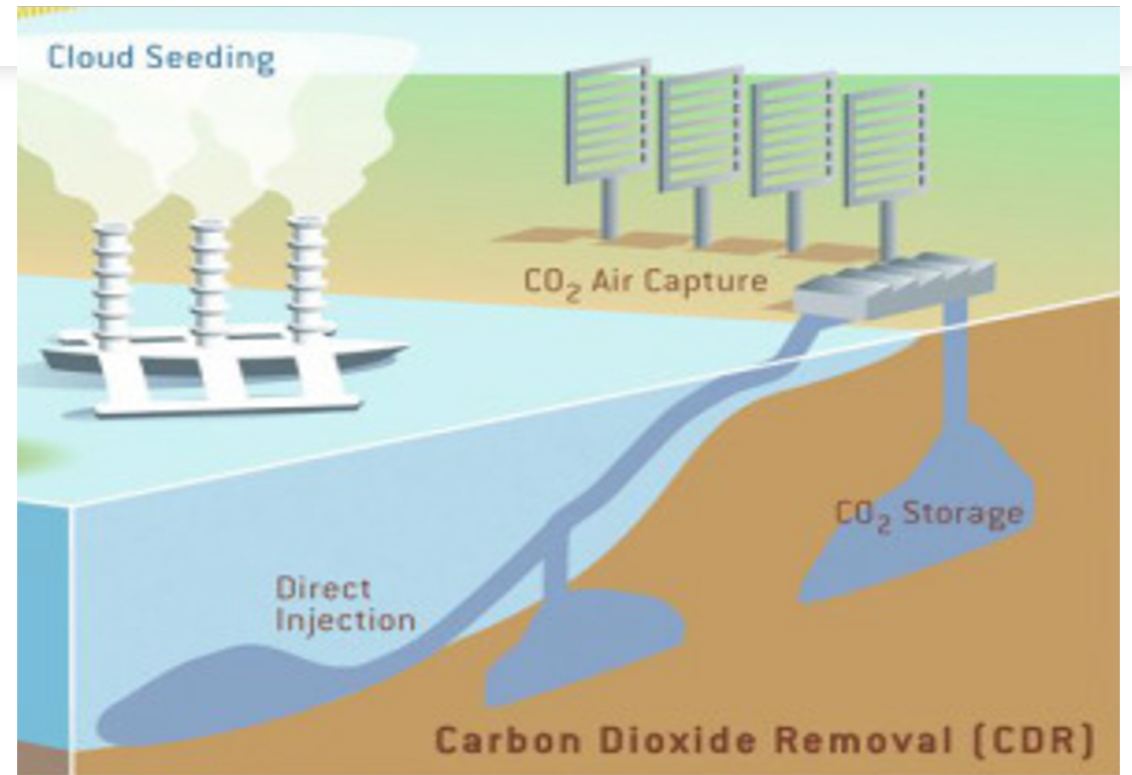


# CASE STUDY: ERUPTION FROM MOUNT PINATUBO VOLCANO

- Erupted in 1991 in Philippines
- Ejected more than 20 million tons of sulfur dioxide spreading particles in the stratosphere
- These particles scattered and obstructed light to reach Earth Surface.
- Following two years, global temperatures declined by 0.5° Celsius.

# WHAT IS CDR?

Carbon Dioxide Removal (CDR), focuses on removing carbon dioxide, a major greenhouse gas, from the atmosphere.



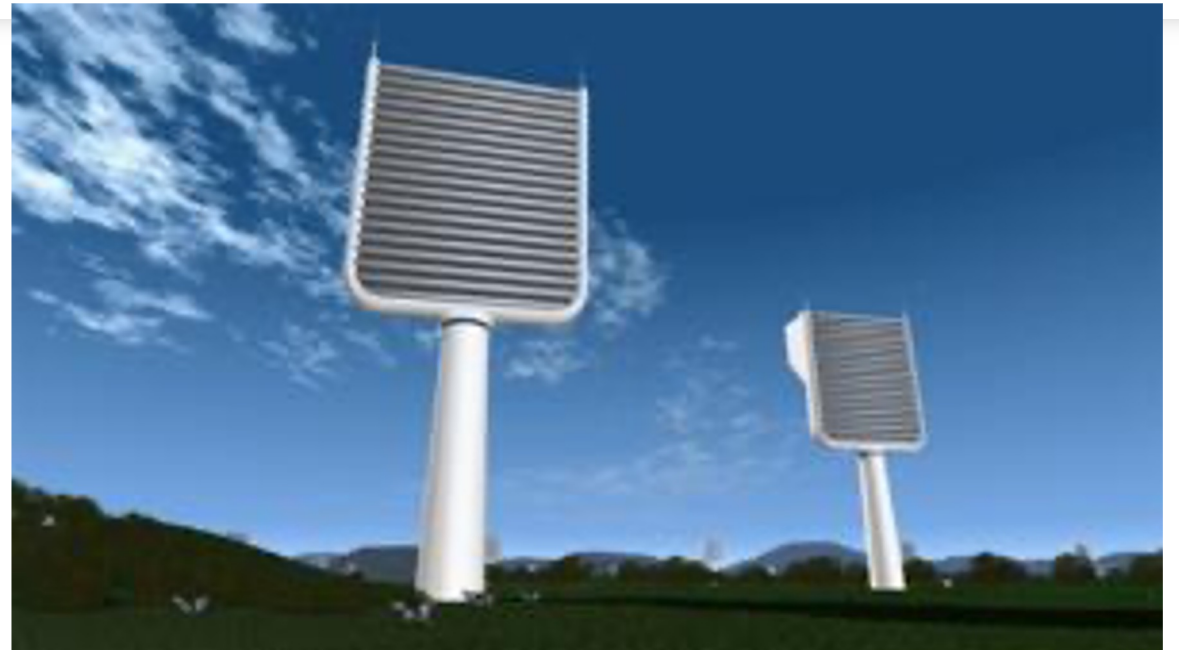


# AFFORESTATION

- ✓ **Global-scale tree plantation effort**
- ✓ **Slow but more effective to counter the adverse impacts of climate change**
- ✓ **No side effect**

# AMBIENT AIR CAPTURE

Set-up sophisticate machines that can eliminate carbon dioxide directly from our surrounding air and store it elsewhere



Synthetic trees

<http://www.earth.columbia.edu>



# BIOCHAR

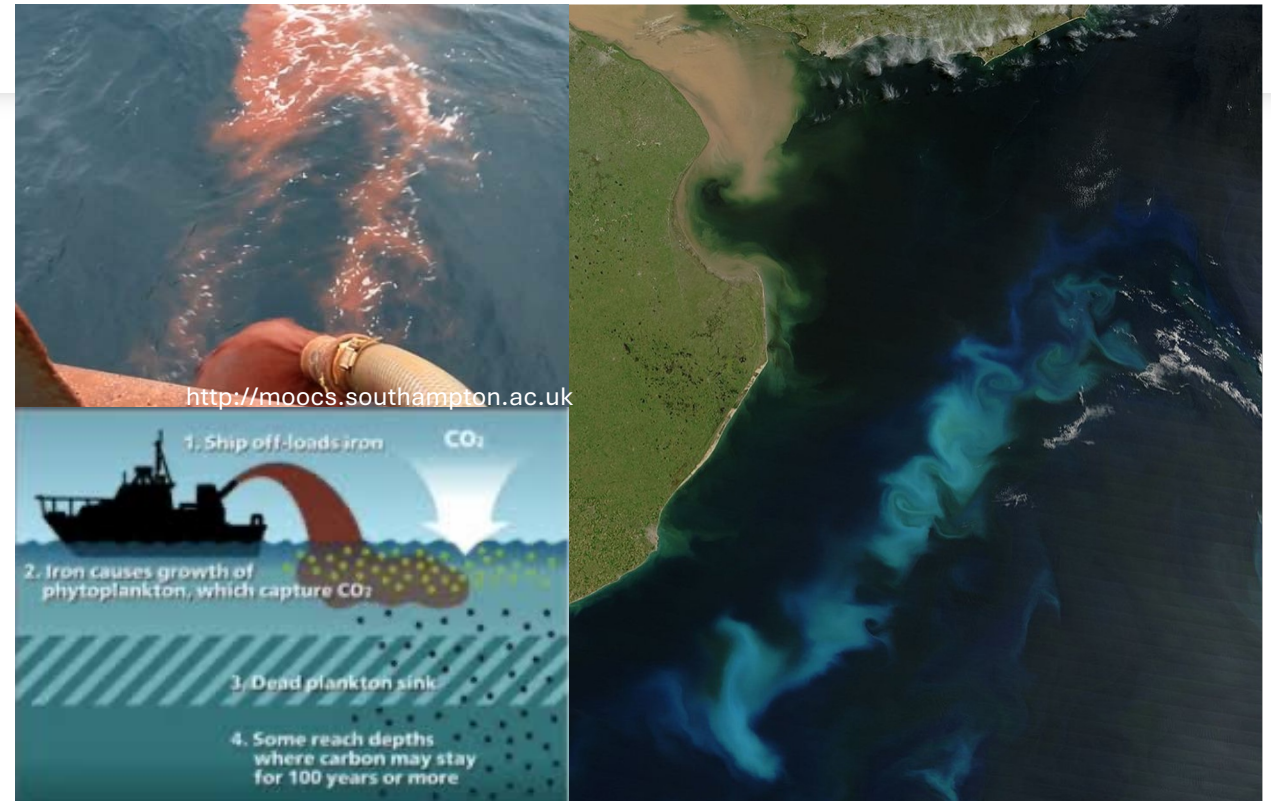
Bury large amounts of charcoal into soil so that its carbon is locked up and cannot enter the carbon cycle



# OCEAN FERTILISATION

## Process

- Add nutrients such as iron, urea, etc. to the top layers of the ocean
- Lead to increased phytoplankton growth
- Draw down carbon dioxide from the atmosphere
- Phytoplankton sink from the surface to the deep ocean as dead cells.



<https://geoengineering2012.wordpress.com>

By NASA - <http://earthobservatory.nasa.gov/>



# OCEAN FERTILISATION

## Impact

- Plankton blooms can affect the physical properties of surface waters by absorbing light and heat from the sun
- Changes in phytoplankton species
- Harmful algal blooms and the production of nitrous oxide and methane
- Adverse impact on Marine life
- Unknown consequences on the ecosystem





# GEOENGINEERING EXPERIMENT By RUSS GEORGE

- An American businessman named Russ George made a private geoengineering experiment.
- He dumped around 100 tons of iron sulphate into the Pacific Ocean as part of a geoengineering scheme off the west coast of Canada.
- The iron has spawned an artificial plankton bloom as large as 10,000 square kilometers.
- The experiment adversely affected the surrounding ecosystems, producing toxic tides, severing ocean acidification
- Huge outcry by different bodies including Lawyers, environmentalists and civil society groups



# GEOENGINEERING EFFORTS SO FAR

- Large scale interventions on climate change are still in research level.
- However, some field level experiments have taken place.

## **Harvard project**

- The world's biggest solar geoengineering programme to date
- Launch a high-altitude balloon from a location in Tucson, Arizona
- Spray aerosol 20km up into the earth's stratosphere

# ETHICAL CONSIDERATION



Unintended Consequences



Equity and Justice



Informed Consent and Public Participation



Technological Lock-In



Intergenerational Equity



Global Cooperation and Governance



Moral Hazard

# SECURITY IMPLICATIONS



Geoengineering will have unknown and uncertain consequences



Impacts may go beyond our control leading to fatal consequences on global climate



Geoengineering technology may be weaponised in the guise of addressing the climate change



It may be exploited for military and political ambition over other countries



It might trigger a race for military expansion and geoengineering might be exploited for military purpose

# SECURITY IMPLICATIONS

Large military establishments in the duty of implementing geoengineering may be target of militant or military attack.

The suspicion and blame-game can give rise to 'weather war'.

Once started, geoengineering mechanism must be continued for an extended period of time.

If the process is stopped abruptly, we may experience termination shock that will negate the success of geoengineering that has been achieved so far and the temperature will shoot up again in a dramatic rate.

# GOVERNANCE STRUCTURE NEEDED



Right now, a huge opaque condition exists regarding the research and experimentations of geoengineering.



There is no accepted oversight body to monitor the issue.



It is high time we fixed the governance structure to avoid unmanageable circumstances in the future.



<https://www.project-management.pm>

# GOVERNANCE STRUCTURE NEEDED CONTINUED

Wider information debate on each dimension of geo-engineering technology at international level is needed.

The rules and regulations of the application of geo-engineering are needed to be set up.

An international body to oversee and regulate the mechanism has to be set up perhaps under the UN umbrella.

There should be a verification regime to accurately monitor the impacts after deployment.

## “OXFORD PRINCIPLES”

1 *Geo-engineering to be regulated as a public good*

2 *Public participation in geo-engineering decision making*

3 *Disclosure of geo-engineering research and open publication results*

4 *Independent assessment of impacts*

5 *Governance before deployment*



# CAREER PROSPECT

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1. Academic Research
2. Engineering and Technology
3. Policy and Governance
4. Interdisciplinary Approaches
5. Entrepreneurship and Innovation
6. Collaborative Research Projects
7. Public Engagement and Communication



# WAY FORWARD

- There should be global moratorium to undertake large-scale geoengineering intervention on climate until everything is in place.
- Recent findings regarding geo-engineering must be transparent and open access must be given to all.
- A global research pool has to be formed.
- Contingency planning should be made ready beforehand at global level.



# #OfficiallyGreen

By Adenike Akinsemolu

Welcome to #OfficiallyGreen, the podcast that ignites your passion for a sustainable future! Join Adenike Akinsemolu on an awe-inspiring journey as we explore the wonders of our planet and unlock the secrets to living in harmony with nature. From captivating stories of environmental champions to insightful discussions on innovative solutions, this podcast is yo...

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### SUBMIT AN ABSTRACT

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## Hi there!

We're Drs. Adenike Akinsemolu and Helen Onyeaka, and we're honoured to be the driving force behind the Green Microbiology Lab. But we're not the only ones working towards a sustainable future! Our dynamic team of doctoral students, postdocs, and associate researchers shares a passion for harnessing the power of microorganisms to create a sustainable future. Together, we're making a positive impact on the environment through innovative research, collaborations, and education. Join us on this exciting journey towards a greener world!



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[www.greeninstitute.ng/pledge](http://www.greeninstitute.ng/pledge)



Culture



Nature is Green



Green Adventure



Remaking Sustainable Footwears



Sustainability in the Textile Industry



Green Kids



Education

# THE GREEN PLEDGE

My name is \_\_\_\_\_

I will never that drop waste on the floor

I will eat and drink moderately because I know some people do not have access to food and water

I will always switch off my appliances when not in use

I will travel sustainably

I will tell others about the Green Movement

Above all, I pledge to be GREEN