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CLIMATE ENGINEERING

Unless we act now to reduce emissions to net zero, large parts of the world will become uninhabitable. Climate Engineering refers to technologies and techniques that either tackle the cause of climate change by removing greenhouse gas from the atmosphere, or reflect sunlight to reduce its heating effect.













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SOCIAL FACTORS















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COUNCIL RESPONSE CARD

TECH AGE CARD ID:



ISSUE TO SOLVE:

ETHICS PROPOSITION:











SRM



Solar Radiation Modification (SRM) reflects sunlight away from the Earth, by placing a reflective substance either in the air or on the ground. These techniques could be cheap and efficient, but many have only been tested in computer models.









ENGINEERED CDR



Engineered Carbon Dioxide Removal (CDR) technologies remove CO2 from the atmosphere and store it for long periods of time under the ground or sea. Currently they only operate on a small scale.









NATURE-BASED CDR



Nature-based Carbon Dioxide Removal (CDR) uses biological processes like photosynthesis and geophysical processes like sedimentary rock formation to draw CO2 from the atmosphere – there are limits on their effectiveness.













Tiny reflective particles are deposited in the atmosphere via aeroplanes or balloons to cool the planet by reflecting sunlight. SAI seems effective, but its effects vary across the world. BENEFIT

Cheap and effective way to avoid catastrophic warming

ETHICAL CHALLENGE Radical intervention, could create international tension







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04/04/2023 11:47:02

BIOENERGY WITH CARBON CAPTURE AND STORAGE



Biofuels (such as grain alcohol or wood pellets) are burned. CO2 is captured using chemical processes and stored, for example in depleted gas fields.

BENEFIT

In principle, ready to use, provides clean energy ETHICAL CHALLENGE Producing biofuels uses scarce water stocks and land







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04/04/2023 11:47:03

FORESTRY AND LAND MANAGEMENT



Reforestation programmes, especially in tropical latitudes, trap carbon from the atmosphere in trees and forest soils. The restoration of wetlands and mangroves produces a similar effect.

BENEFIT Stores carbon while also restoring nature ETHICAL CHALLENGE Planting more carbonefficient trees may reduce biodiversity







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MARINE CLOUD BRIGHTENING



Sea salt or similar particles are sprayed into the air from ships, making marine clouds brighter and increasing their reflection of sunlight.

BENEFITS Relatively cheap

ETHICAL CHALLENGE Risk of sudden warming if the intervention stops

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04/04/2023 11:47:05

OCEAN FERTILISATION

Nutrients are deposited in the ocean, causing some plankton to bloom and use up more CO2 through photosynthesis. Plankton sink to the bottom of the ocean, storing the carbon deeper. BENEFIT Speeds up the natural cycle of carbon removal ETHICAL CHALLENGE

Unpredictable impact on ocean ecosystems

CE - II - 5

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ENHANCED WEATHERING

Rocks are mined, finely crushed and spread over wide surfaces. The chemical reactions resulting from the contact between rocks, water and air allow for CO2 to be removed and stored. BENEFIT

Rocks act as fertiliser to improve crop production ETHICAL CHALLENGE Requires environmentally destructive mineral mining

CE - II - 6

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GROUND-BASED ALBEDO MODIFICATION

This technique aims to reflect more sunlight back to space. Painting roofs white or placing reflective covers in urban areas would have a significant cumulative cooling effect. BENEFITS Easy to deploy locally, keeps cities cool

ETHICAL CHALLENGE _____ Some communities might object to the intervention

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04/04/2023 11:47:06

DIRECT AIR CARBON CAPTURE AND STORAGE

These systems use chemical processes to capture and separate CO2 from the air through fans and filters. Captured CO2 is then stored underground.

BENEFITS

Can help balance industries hard to decarbonise

ETHICAL CHALLENGE High price, access limited to the wealthy

CE - II - 8

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New land management practices allow soils to absorb and hold more carbon. These practices include farming that disturbs the soil less and changing planting schedules. BENEFITS

Improves soil health making farming more sustainable ETHICAL CHALLENGE The carbon captured can be released if disturbed

NATURE-BASED CDR

TECH AGE 2

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How can we minimise risks to global security?

SAI technology allows a single actor (a country, consortium or a powerful individual) to modify global weather patterns with longlasting effects. The geopolitical consequences of one actor holding the "global thermostat" may lead to political and economic power imbalance and generate conflicts.

GEOPOLITICAL TENSION

How can we ensure that climate engineering implementation doesn't threaten food security?

Large-scale BECCS will require using fertile land to grow biofuels, replacing food crops and requiring large amounts of water. Rising food prices will hit the world's poorest people hardest. How can large-scale BECCS be implemented with minimal impact on the world's poor?

FOOD SECURITY

CE - III - 2

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How can we implement largescale solutions without promoting injustices?

Land is a crucial aspect of people's livelihoods. CDR techniques that rely on planting or protecting forests on a large scale create dangerous incentives to seize lands. This could lead entire communities to be displaced or dispossessed.

RIGHT TO LAND

FORESTRY AND LAND MANAGEMENT

CE - III - 3

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Can climate engineering be justified given limited human knowledge about the future?

CE allows humans to intentionally modify global climate. This "playing God" attitude places them in a position of control and dominance over nature. This overconfidence is often not supported by sufficient knowledge and leads to the promotion of risky techniques that might not work.

OVERCONFIDENCE

MARINE CLOUD BRIGHTENING

CE - III - 4

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How can we tackle planetary climate change while maintaining biodiversity?

Climate engineering technologies often impact the local environment where they are used . Ocean fertilisation restructures marine ecosystems, causing the deep ocean to become more acidic.

BIODIVERSITY

OCEAN FERTILISATION

CE - III - 5

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How can we ensure climate engineering doesn't cause more harm to nature?

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Enhanced weathering requires massive amounts of minerals, which must be mined, crushed into dust, transported, and spread over a wide area. How can we ensure these processes do not emit more carbon than is stored? How can we prevent environmental degradation from mining activities?

ENVIRONMENTAL DEGRADATION

CE - III - 6

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Who gets to decide which technology is implemented and where?

Choices about where to implement a particular technique, under what conditions and at which time should be addressed by all those affected by the implementation of CE technologies. For SRM, this is a daunting problem as all citizens will be impacted by it.

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PROCEDURAL JUSTICE

CE - III - 7

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How can we ensure that big emitters are held accountable for their actions?

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Because DACCS is very expensive per unit removed, it is mostly available to large corporations. Fossil fuel companies are often the ones who control the projects. How can we ensure DACCS is used where it is most needed, rather than allowing big emitters to evade responsibility?

DISTRIBUTIVE JUSTICE

DIRECT AIR CARBON CAPTURE AND STORAGE

CE - III - 8

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How to act responsibly toward future generations?

Although capturing carbon in soils has long term benefits for soil productivity, in the short term, some farmers find it interferes with their business. How can we ensure practices are continued indefinitely, to make sure carbon isn't re-emitted?

FUTURE RESPONSIBILITY

SOIL CARBON SEQUESTRATION

CE - III - 9

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TURN SUMMARY

I. PLAYER ROUND

- (1. TECHNOLOGY FAMILY)
 - 2. TECH AGE EVOLUTION
- **3. OPEN DEBATE**
- 4. CITIZEN WORLD
- COUNCIL DECISION

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II. WORLD ROUND

- **1. IMPACTS**
- 2. ETHICAL ISSUES
- COUNCIL RESPONSE 3. CITIZEN WOLRD
 - 4. TECHNOLOGY TREE
- 5. END OF GAME?

CREDITS

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FOR MORE INFORMATION, VISIT: **OR MEET US ON SOCIAL MEDIA:** WWW.TECHETHOS.EU

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