TECHETHOS

FUTURE ○ TECHNOLOGY ○ ETHICS

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FUTURE ○ TECHNOLOGY ○ ETHICS

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VOTE CARD

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VOTE CARD

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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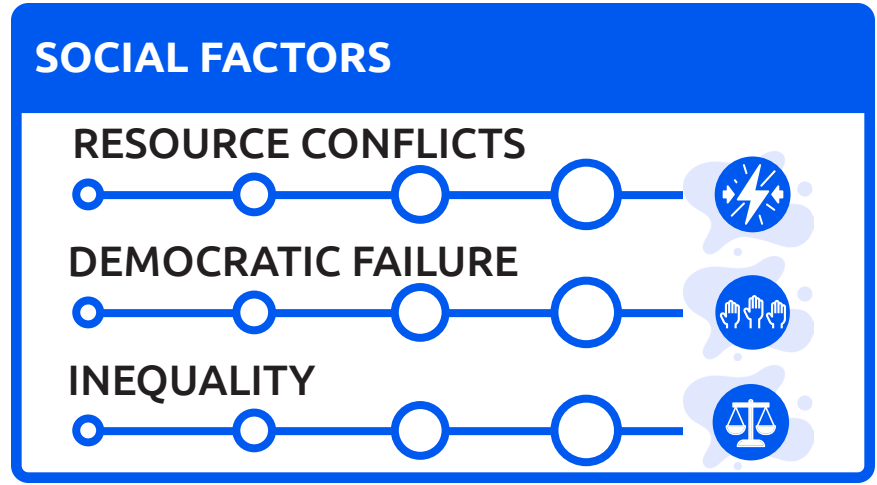
TECH FAMILY


SOCIAL FACTORS
RESOURCE CONFLICTS
DEMOCRATIC FAILURE
INEQUALITY

WORLD CARD

NORMAL

SOCIAL FACTORS

RESOURCE CONFLICTS

DEMOCRATIC FAILURE

INEQUALITY

WORLD CARD

EASY

SOCIAL FACTORS

RESOURCE CONFLICTS

DEMOCRATIC FAILURE

INEQUALITY



WORLD CARD

HARD


COUNCIL RESPONSE CARD

TECH AGE CARD ID:

ISSUE TO SOLVE:

ETHICS PROPOSITION:

COUNCIL RESPONSE CARD

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COUNCIL RESPONSE CARD

TECH AGE CARD ID:

ISSUE TO SOLVE:

ETHICS PROPOSITION:

COUNCIL RESPONSE CARD

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COUNCIL RESPONSE CARD

TECH AGE CARD ID:

ISSUE TO SOLVE:

ETHICS PROPOSITION:

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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.

TECH AGE 1

CE - I - 1

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.

TECH AGE 1

CE - I - 2

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.

TECH AGE 1

CE - I - 3

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STRASTOSPHERIC AEROSOL INJECTION

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

SRM

TECH AGE 2

CE - II - 1

BIOENERGY WITH CARBON CAPTURE AND STORAGE

Biofuels (such as grain alcohol or wood pellets) are burned. CO_2 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

ENGINEERED CDR

TECH AGE 2

CE - II - 2

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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 carbon-efficient trees may reduce biodiversity

NATURE-BASED CDR

TECH AGE 2

CE - II - 3

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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

SRM

TECH AGE 2

CE - II - 4

OCEAN FERTILISATION

Nutrients are deposited in the ocean, causing some plankton to bloom and use up more CO_2 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

ENGINEERED CDR

TECH AGE 2

CE - II - 5

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 CO_2 to be removed and stored.

BENEFIT

Rocks act as fertiliser to improve crop production

ETHICAL CHALLENGE

Requires environmentally destructive mineral mining

NATURE-BASED CDR

TECH AGE 2

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

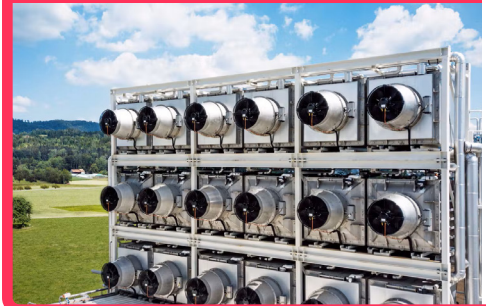
Some communities might object to the intervention

SRM

TECH AGE 2

CE - II - 7

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

ENGINEERED CDR

TECH AGE 2

CE - II - 8

SOIL CARBON SEQUESTRATION

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

CE - II - 9

TechEthos Game_Card Deck_Climate Engineering.indd 39 04/04/2023 11:47:07

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 long-lasting effects. The geopolitical consequences of one actor holding the "global thermostat" may lead to political and economic power imbalance and generate conflicts.

GEOPOLITICAL TENSION

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STRATOSPHERIC AEROSOL INJECTION

TECH AGE 3

CE - III - 1

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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

BIOENERGY WITH CARBON CAPTURE AND STORAGE

TECH AGE 3

CE - III - 2

How can we implement large-scale 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

TECH AGE 3

CE - III - 3

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

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MARINE CLOUD BRIGHTENING

TECH AGE 3

CE - III - 4

TechEthos Game_Card Deck_Climate Engineering.indd 47 04/04/2023 11:47:07

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

TECH AGE 3

CE - III - 5

TechEthos Game_Card Deck_Climate Engineering.indd 49 04/04/2023 11:47:07

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

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

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ENHANCED WEATHERING

TECH AGE 3

CE - III - 6

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.

PROCEDURAL JUSTICE

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GROUND-BASED ALBEDO MODIFICATION

TECH AGE 3

CE - III - 7

TechEthos Game_Card Deck_Climate Engineering.indd 53 04/04/2023 11:47:07

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

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

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DIRECT AIR CARBON CAPTURE AND STORAGE

TECH AGE 3

CE - III - 8

TechEthos Game_Card Deck_Climate Engineering.indd 55 04/04/2023 11:47:07

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

TECH AGE 3

CE - III - 9

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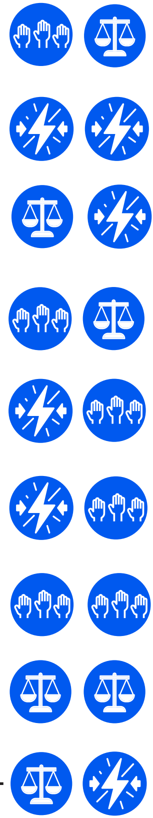

SAI

BECCS

FORESTRY AND LAND MANAGEMENT

MARINE CLOUD BRIGHTENING

OCEAN FERTILISATION

ENHANCED WEATHERING

GROUND-BASED ALBEDO MODIFICATION

DACCS

SOIL CARBON SEQUESTRATION

IMPACT CARD AGE 2

GEOPOLITICAL TENSION

FOOD SECURITY

RIGHT TO LAND

OVERCONFIDENCE

BIODIVERSITY

ENVIRONMENTAL DEGRADATION

PROCEDURAL JUSTICE

DISTRIBUTIVE JUSTICE

FUTURE RESPONSIBILITY

IMPACT CARD AGE 3

SRM

ENGINEERED CDR

NATURE-BASED CDR

IMPACT CARD AGE 1

TURN SUMMARY

I. PLAYER ROUND

(1. TECHNOLOGY FAMILY)

2. TECH AGE EVOLUTION

3. OPEN DEBATE

4. CITIZEN WORLD COUNCIL DECISION

II. WORLD ROUND

1. IMPACTS

2. ETHICAL ISSUES

3. CITIZEN WOLRD COUNCIL RESPONSE

4. TECHNOLOGY TREE

5. END OF GAME?

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TURN CARD


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CREDITS

THIS GAME WAS DEVELOPED BY THE EU-FUNDED PROJECT TECHETHOS, BASED ON NEW RESEARCH CARRIED OUT BY ITS PARTNERS.

FOR MORE INFORMATION, VISIT:
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CREDITS