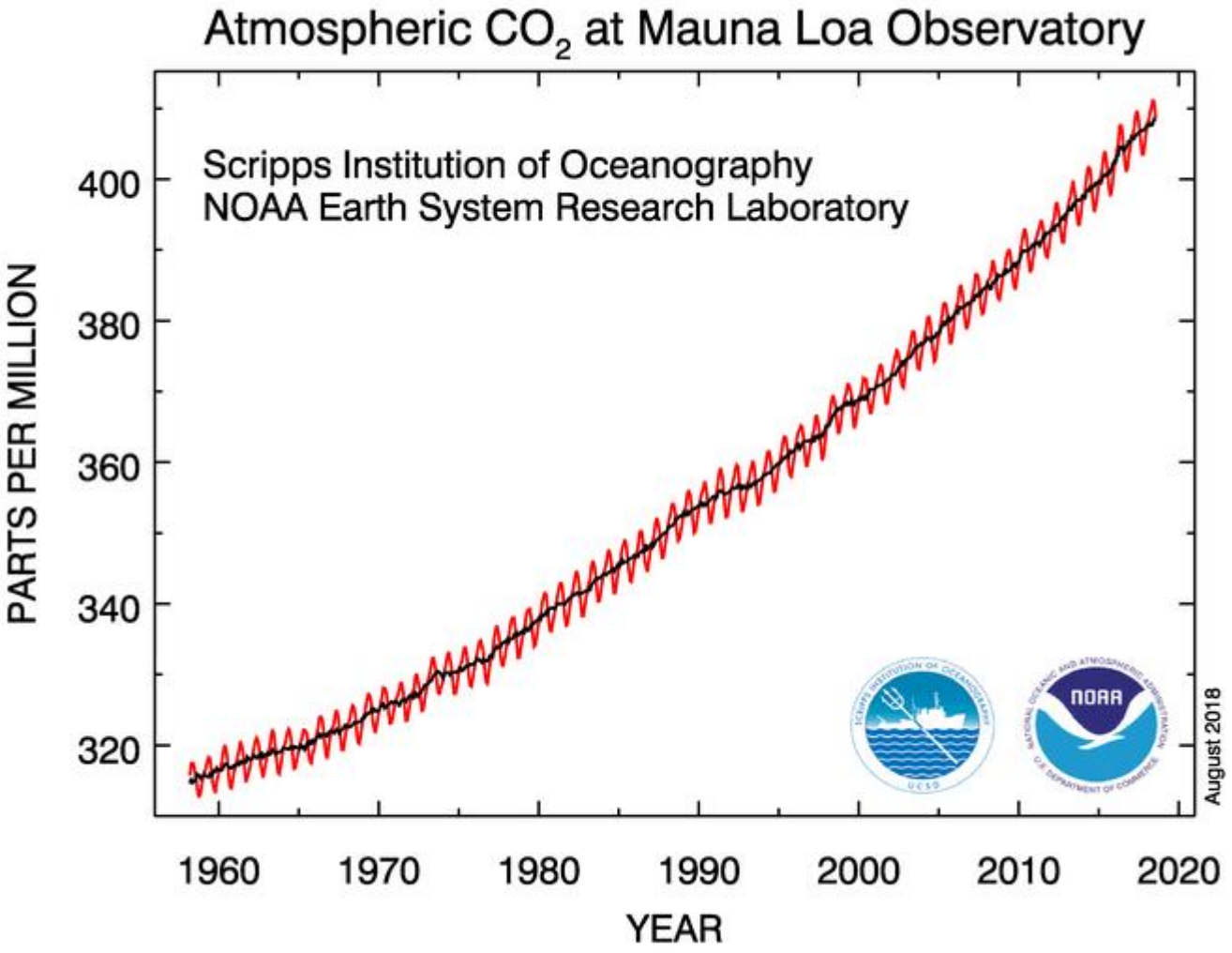
UNIVERSITY of HOUSTON

Climate Engineering, Direct Air Capture, and Climate Change Law

Prof. Tracy Hester
University of Houston Law Center

Climate Change Law 2018
Nov. 12, 2018

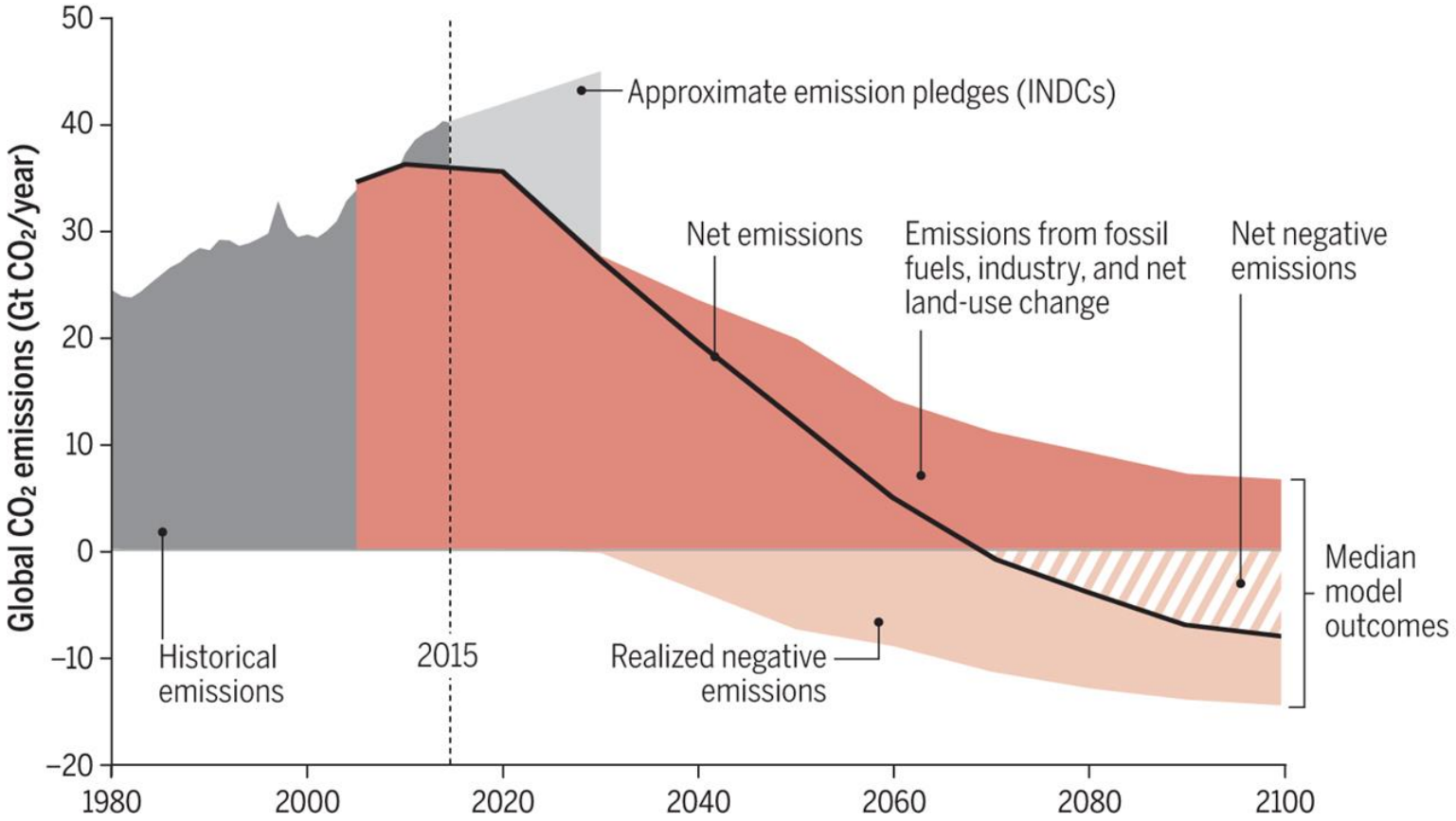
Arguing with physics



The Need for NET

No quick fixes

Modelers generally report net carbon emissions, unintentionally hiding the scale of negative emissions. Separating out the positive CO_2 emissions from fossil fuel combustion, industry, and land-use change reveals the scale of negative CO_2 emissions in the model scenarios (*16*). INDCs, Intended Nationally Determined Contributions.



Climate Change and The Search for Solutions

- Climate Change – a “Super Wicked” Problem
  - Requires collective action
  - Accumulated CO_2 “debt”
  - Immediate sacrifice for remote gains by future generations
  - Justice and equity concerns

- Not surprisingly, difficult to achieve consistent and coordinated action
  - No domestic U.S. legislation; limited mitigation under current laws
  - Paris Agreement and Trump Administration withdrawal
  - Further major international or domestic action unlikely soon

Climate Engineering - “Plan B”?

- Climate Engineering is

  the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change

- Treated as a fringe subject for decades, and still controversial

- Key turning point: proposal by Dr. Paul Crutzen in 2006

- Critical distinction – ***solar radiation management*** vs ***carbon dioxide removal***.

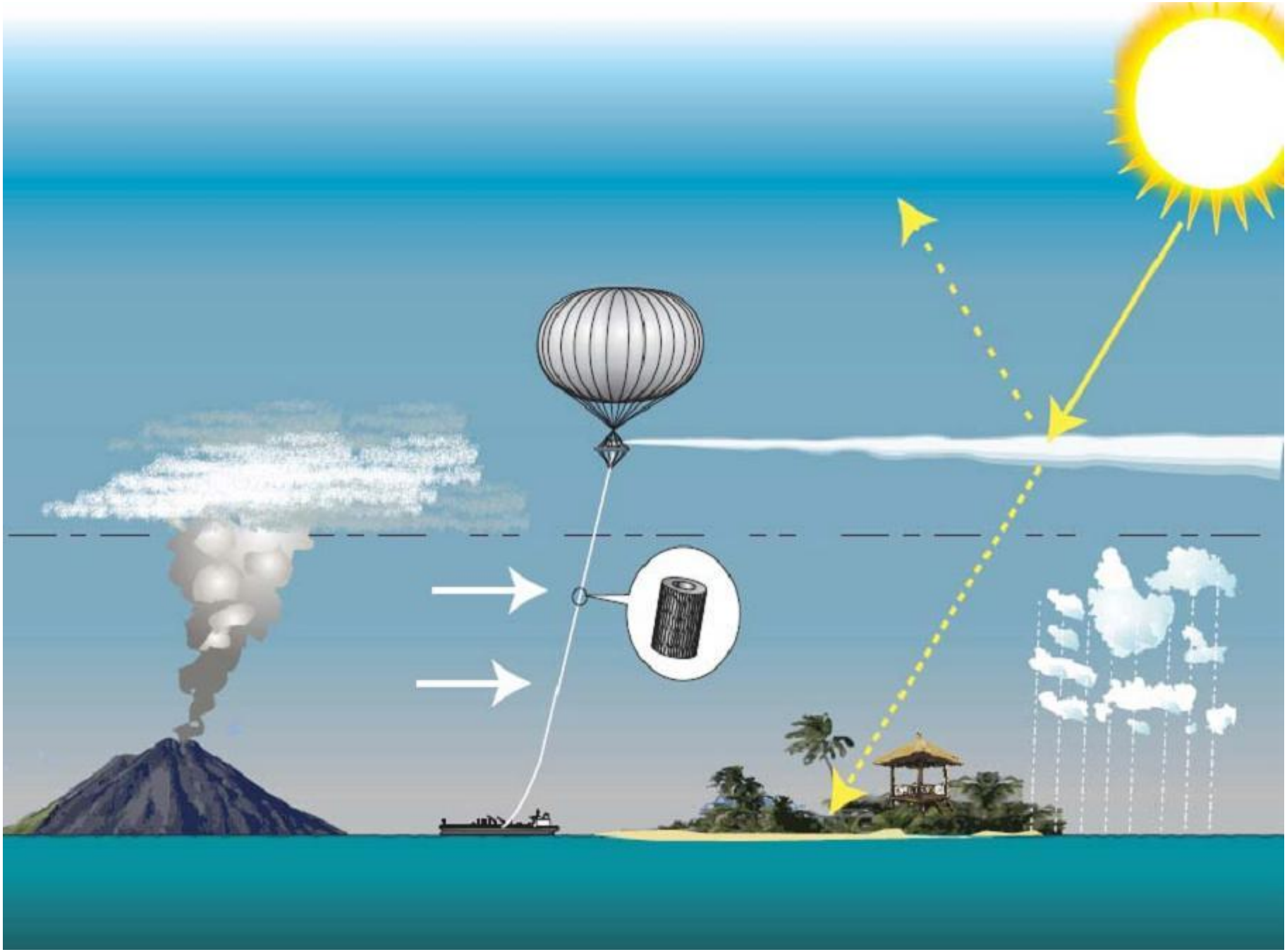
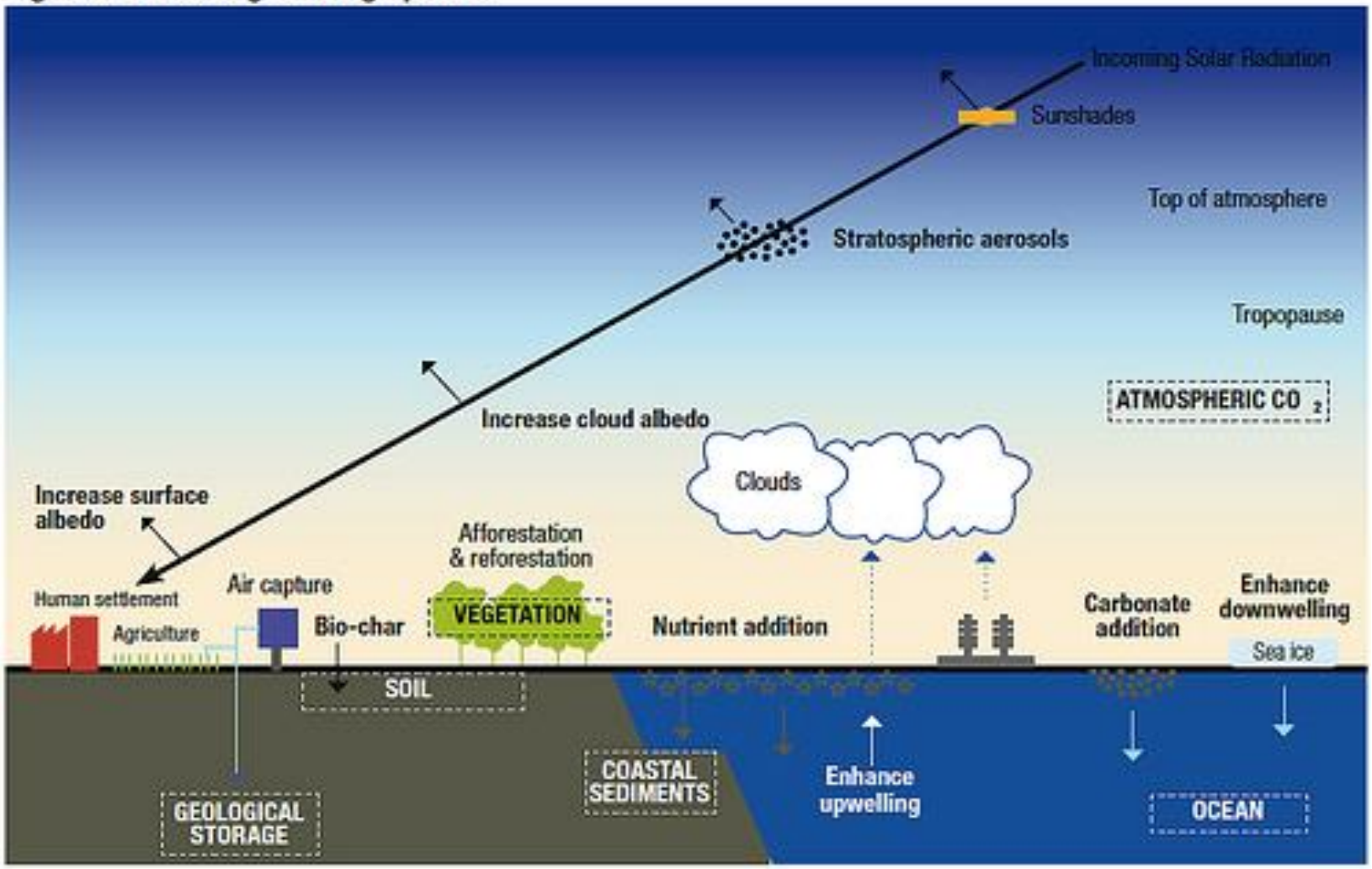


Figure 5.4: Geoengineering options



Types of Climate Engineering

- Solar Radiation Management
- Carbon Dioxide Removal
- Cirrus cloud stripping
- Sink Temperature Management
- Regional Chemical Strategies

NOTE – **including both SRM and CDR under the "climate engineering" rubric risks controversy and confusion**. I'll address them separately here.

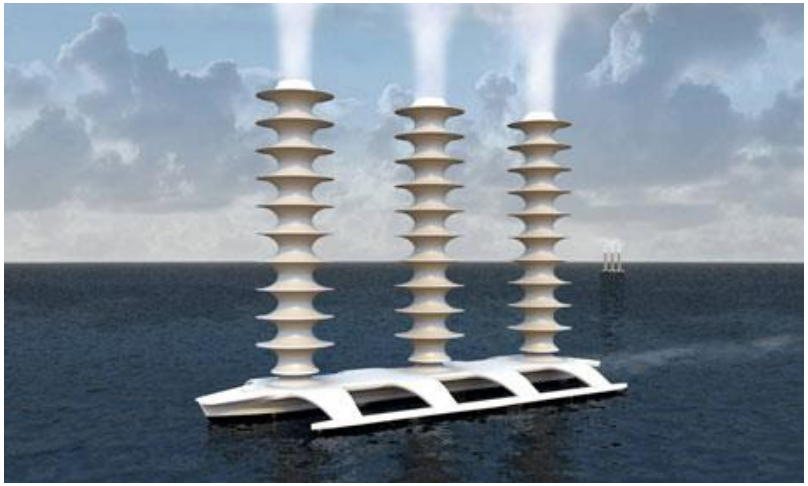
Solar Radiation Management

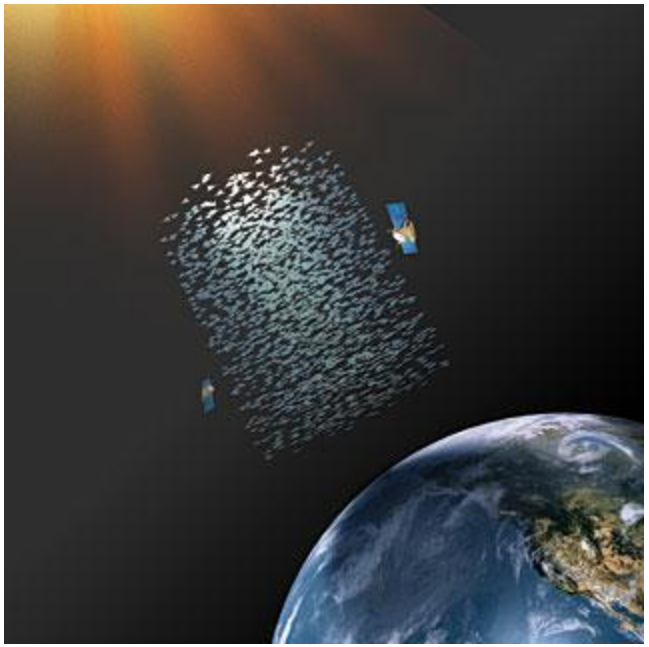
- Focus on reducing the amount of solar energy reaching the Earth's surface
- Key examples
  - Stratospheric aerosol releases
  - Cloud whitening
  - Surface albedo enhancement
  - Satellite reflectors

Solar Radiation Management Through Stratospheric Aerosol Releases

- Mimics global cooling caused by volcanic eruptions
- Effectiveness: half-ounce of SO_2 offsets one ton of CO_2
  global temperatures reduced by 2 degrees C
- Requirements: 5 million tons of SO_2 annually
  $1 billion to $50 billion annually

Other Solar Radiation Management Options





Geoengineering trials get under way

Updated 17:10 14 September 2011 by **Michael Marshall**
Magazine issue 2829.

Volcanic ash inspires sunshade (Image: Arctic Images/Corbis)

– **Update 14 September 2011:** *The field test will be conducted at an abandoned airfield in Sculthorpe, UK. Matthew Watson of the University of Bristol, UK, presented details of the project at the British Science Festival in Bradford, UK.*

Field trials for experiments to engineer the climate have begun. Next month a team of UK researchers will hoist one end of a 1-kilometre-long hose aloft using a balloon, then attempt to pump water up it and spray it into the atmosphere.

Coming up

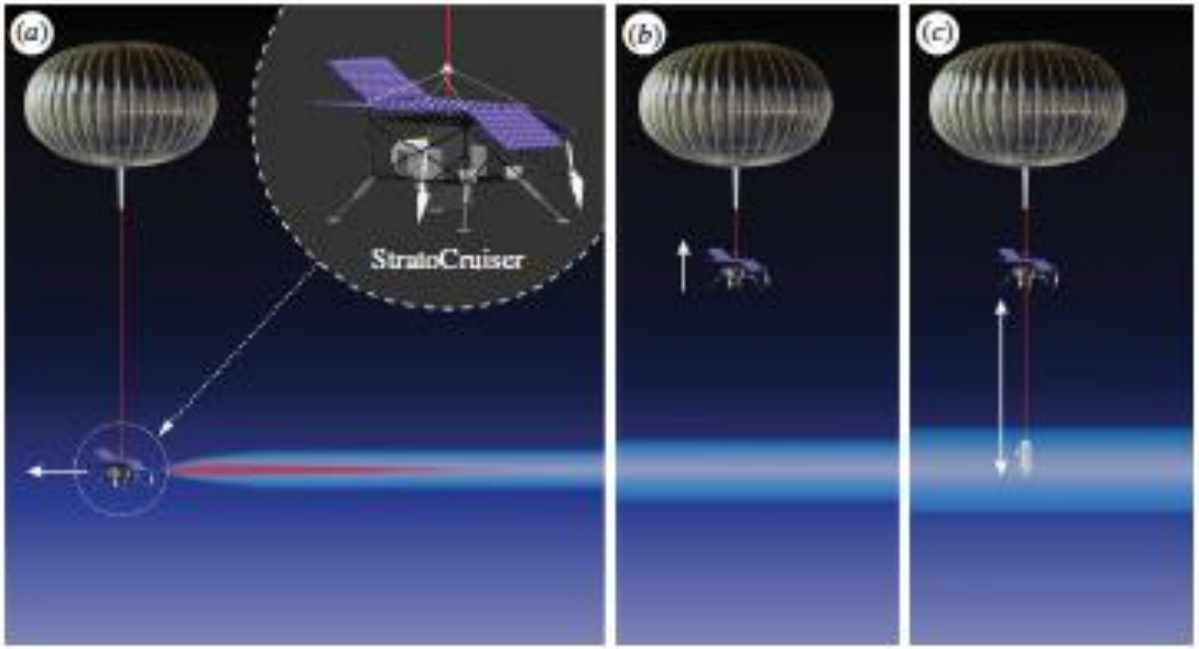
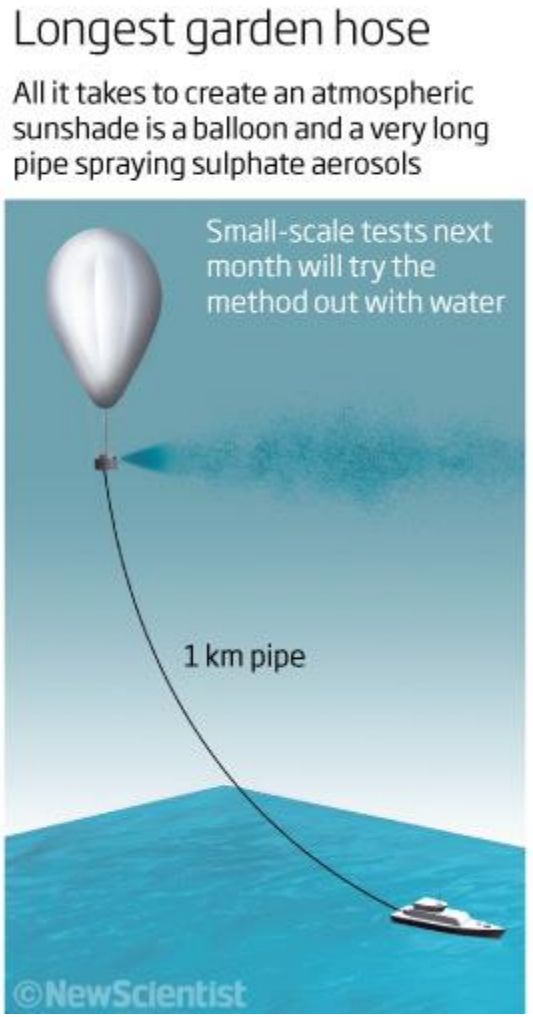


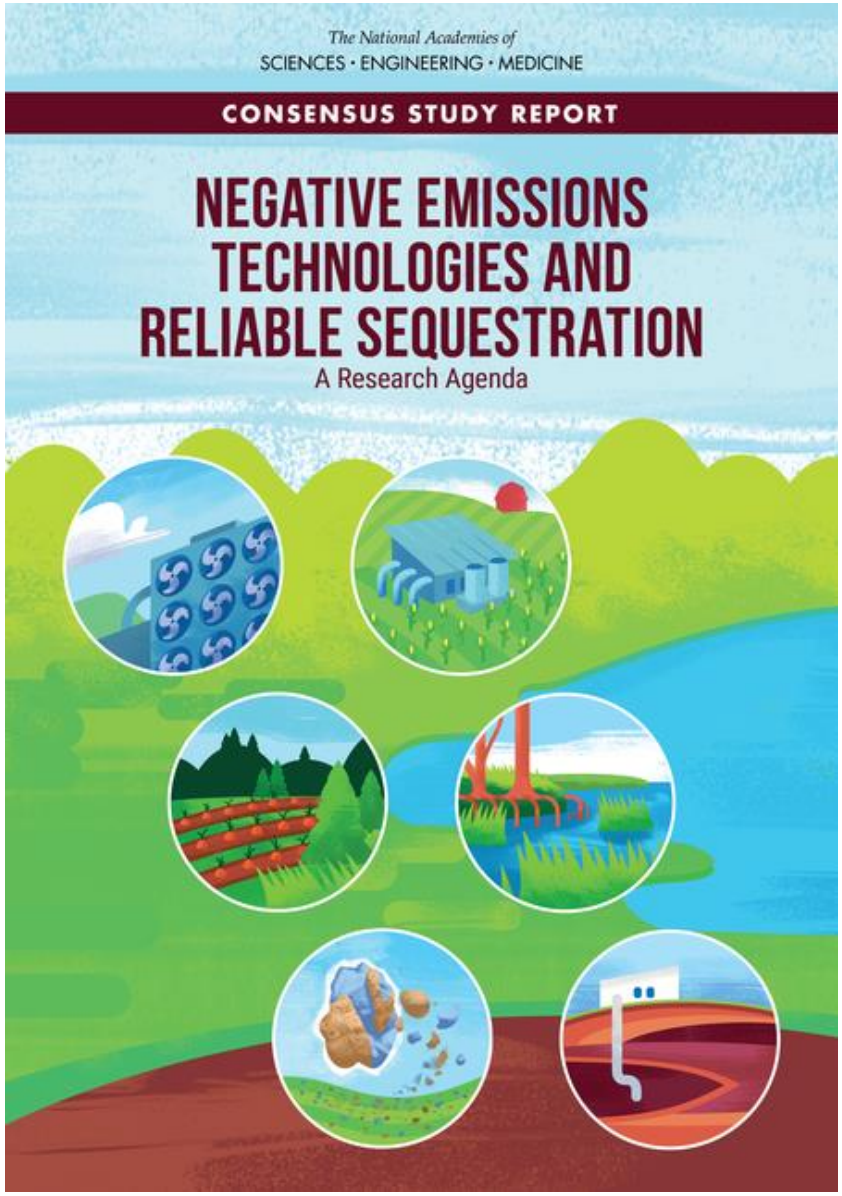
Figure 4. The concept of operations for the proposed experiment is initiated by seeding a 1 km length of stratospheric air with a combination of water vapour and sulfate aerosol using the propulsive capability of the StratoCruiser (*a*). Using a combination of its altitude and propulsive capabilities, the StratoCruiser manoeuvres past and above the seeded volume, which continues to expand owing to the turbulent wake generated by the propellers. The suspended instrument payload is reeled through the seeded volume to measure aerosols, water vapour and chemical species including HCl and ClO (*b*). The propulsion capability together with the LIDAR surveillance is used to track the seeded volume as it drifts with ambient wind and to make repeated measurements with the suspended payload, resolving the chemical evolution within the seeded volume as a function of time (*c*).

Solar Radiation Management and Climate Engineering Field Experiments

- SPICE (2007-2009)
- Russian aerosol injection experiments (2009)
- E-PEACE (2011)
- SCOPEX (projected 2019)



In the news…


The National Academies of
SCIENCES · ENGINEERING · MEDICINE
CONSENSUS STUDY REPORT
NEGATIVE EMISSIONS TECHNOLOGIES AND RELIABLE SEQUESTRATION
A Research Agenda


Greenhouse gas removal
THE ROYAL SOCIETY
ROYAL ACADEMY OF ENGINEERING

In the news…

COMMITTEE ON
SCIENCE, SPACE, & TECHNOLOGY
Lamar Smith, Chairman

For Immediate Release
November 8, 2017

Media Contacts: Thea McDonald, Brandon VerVelde
(202) 225-6371

Statement from Chairman Lamar Smith (R-Texas)

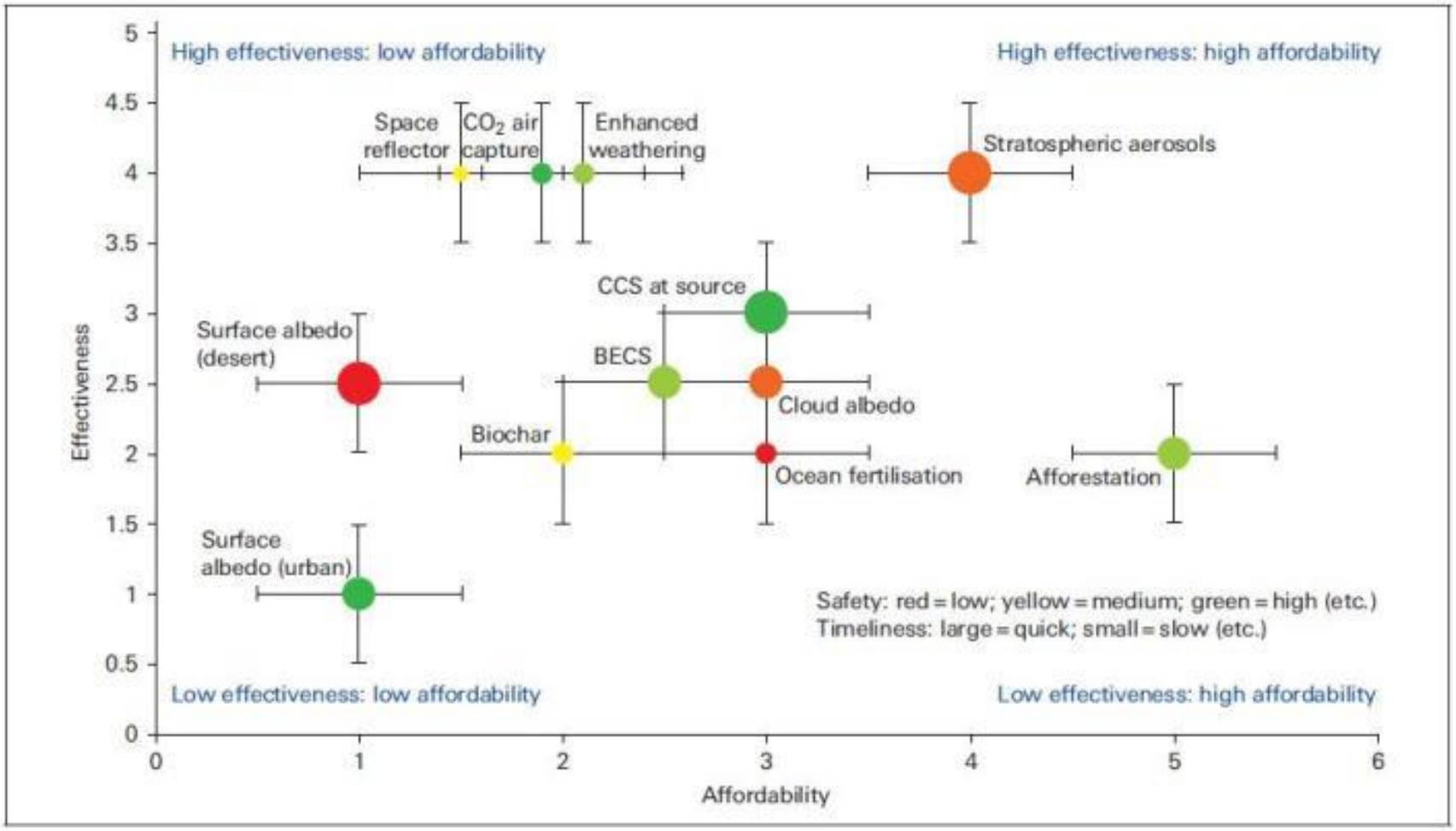
Geoengineering: Innovation, Research, and Technology

Chairman Smith: First, I want to thank you, the Chairman of the Environment Subcommittee, and the Chairman of the Energy Subcommittee, Rep. Weber of Texas, for holding this important hearing, and Rep. McNerney of California for his persistent interest in this subject.

Geoengineering's potential is worth exploring. Generally, we know that the technologies associated with geoengineering could have positive effects on the Earth's atmosphere.

These innovations could help reduce global temperatures or pull excess greenhouse gases out of the atmosphere.

Comparison of Climate Engineering Options and Risks



What International Laws Might Apply to Solar Radiation Management and other Climate Engineering Projects?

- UNFCCC and the Paris Agreement
- Convention on Biological Diversity
- London Convention and London Protocol
- UNCLOS, ENMOD, Space Treaty, treaties related to polar regions
- Customary International Law

Problems: Treaties may not be ratified by important parties, are focused on sovereigns, and are difficult to enforce

Another possible tool for climate engineering governance: domestic law

http://www.youtube.com/watch?feature=player_embedded&v=s2unEYk9XnY&t=82

- Logical that stakeholders would turn to national laws if international law cannot offer immediate relief.
- Acknowledges that climate engineering is already regulated – albeit indirectly, unintentionally and in highly fragmented way

Levels of Domestic Law that Could Apply to Solar Radiation Management and other Climate Engineering Methods

Level one – sue in national court system to enforce an international legal obligation that might apply to climate engineering project.

- Some national laws directly incorporate international legal obligations (e.g., U.S. considers customary international law as federal common law)
- Problems:
  - Limited ability for private parties to bring claims
  - Act of State doctrine
  - Ability of legislature to override domestic obligations under international law
  - Justiciability (political question doctrine)

Levels of Domestic Law that Could Apply to Solar Radiation Management and other Climate Engineering Methods

Level two – sue to claim that national environmental, natural resource or safety laws apply to the climate engineering project

- In U.S., could include Clean Air Act, Clean Water Act, Endangered Species Act, CERCLA (“Superfund”), NEPA
- Special ability for private parties to sue over enforcement (citizen suits)
- Problems: standing, proving causation, procedural requirements for suits.
- State or local laws can impose stricter obligations and requirements.

Levels of Domestic Law that Could Apply to Solar Radiation Management and other Climate Engineering Methods

Level three - common law, typically tort or personal injury.

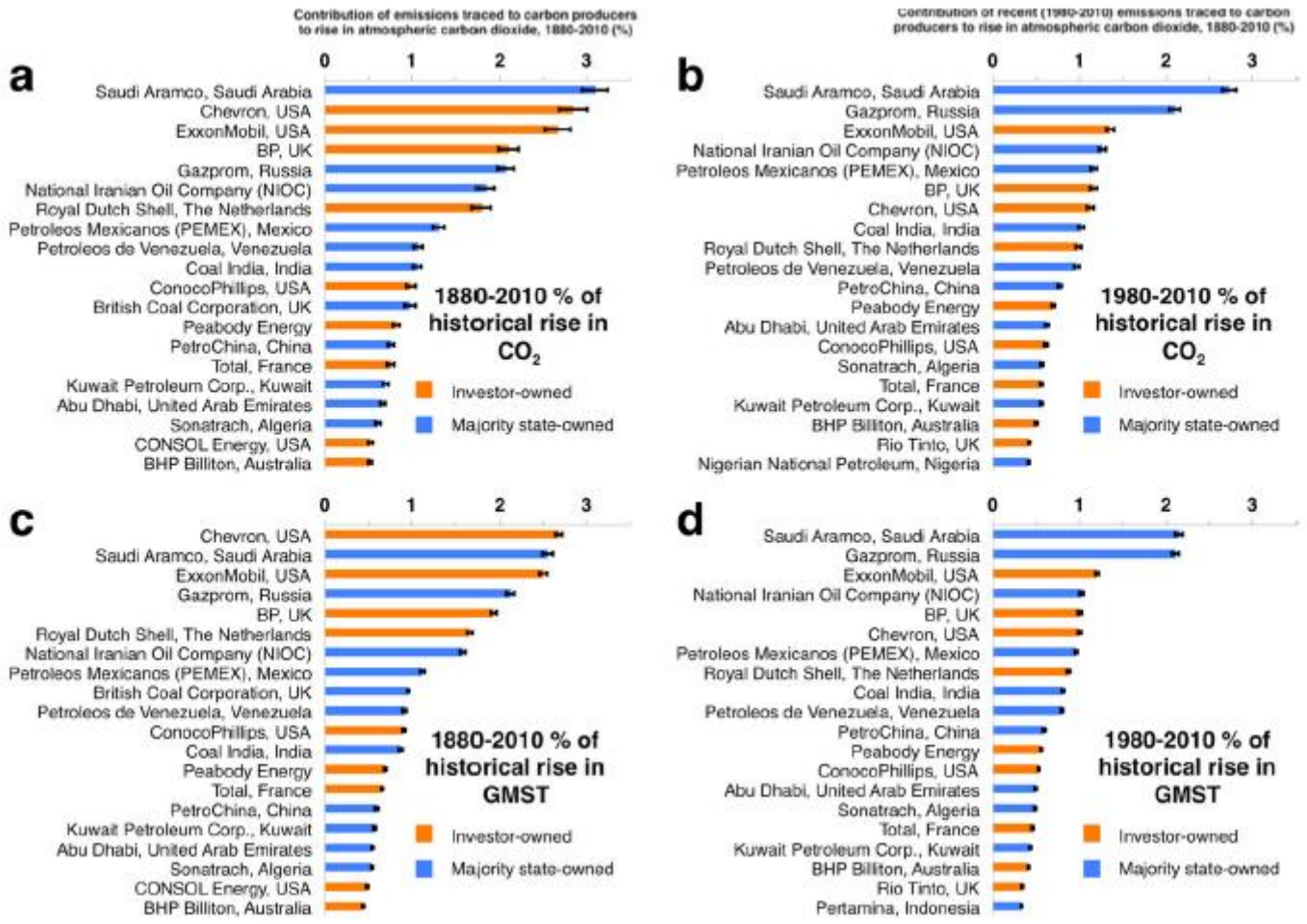
-- Climate change torts have had little success in U.S. federal courts (standing, political question, displacement/preemption)

-- Seeing new theories of liability in response (state law, public trust)

NOTE: All of these frameworks can shift dramatically if you make simple changes to the core facts of the climate engineering project.

- Who is doing the project? (governmental or private?)
- Where is the project being done?
- Exactly how is the project going to work?

Tort Liability and Climate Change Attribution



Future scenarios – regional climate SRM

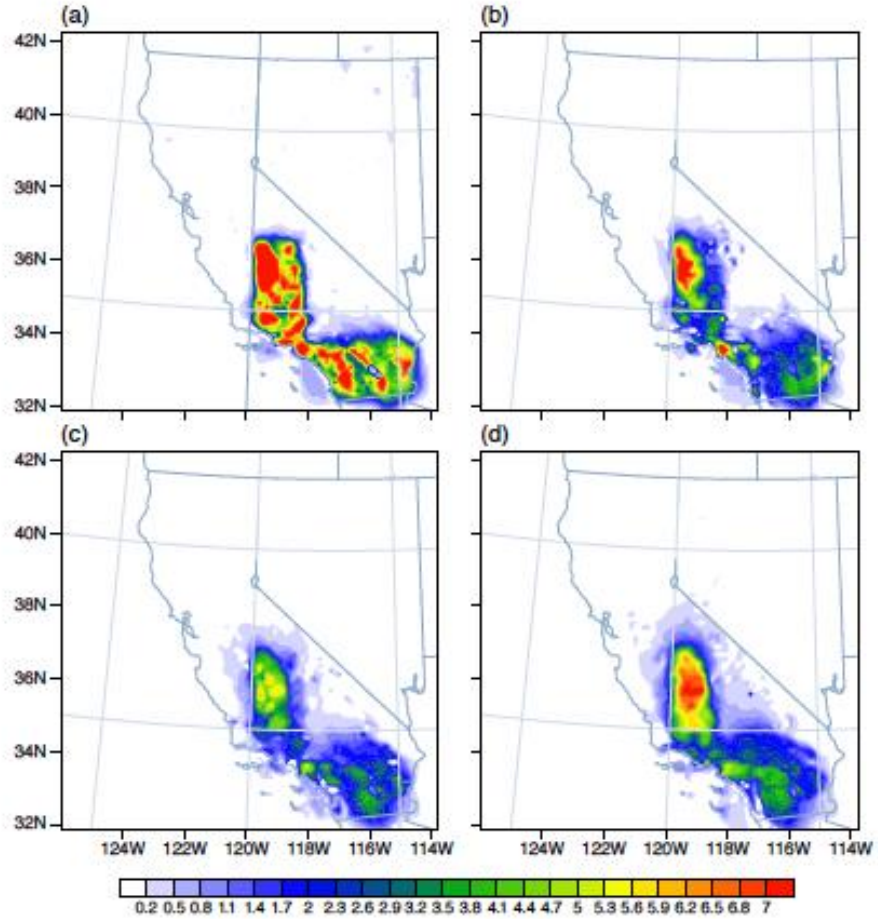
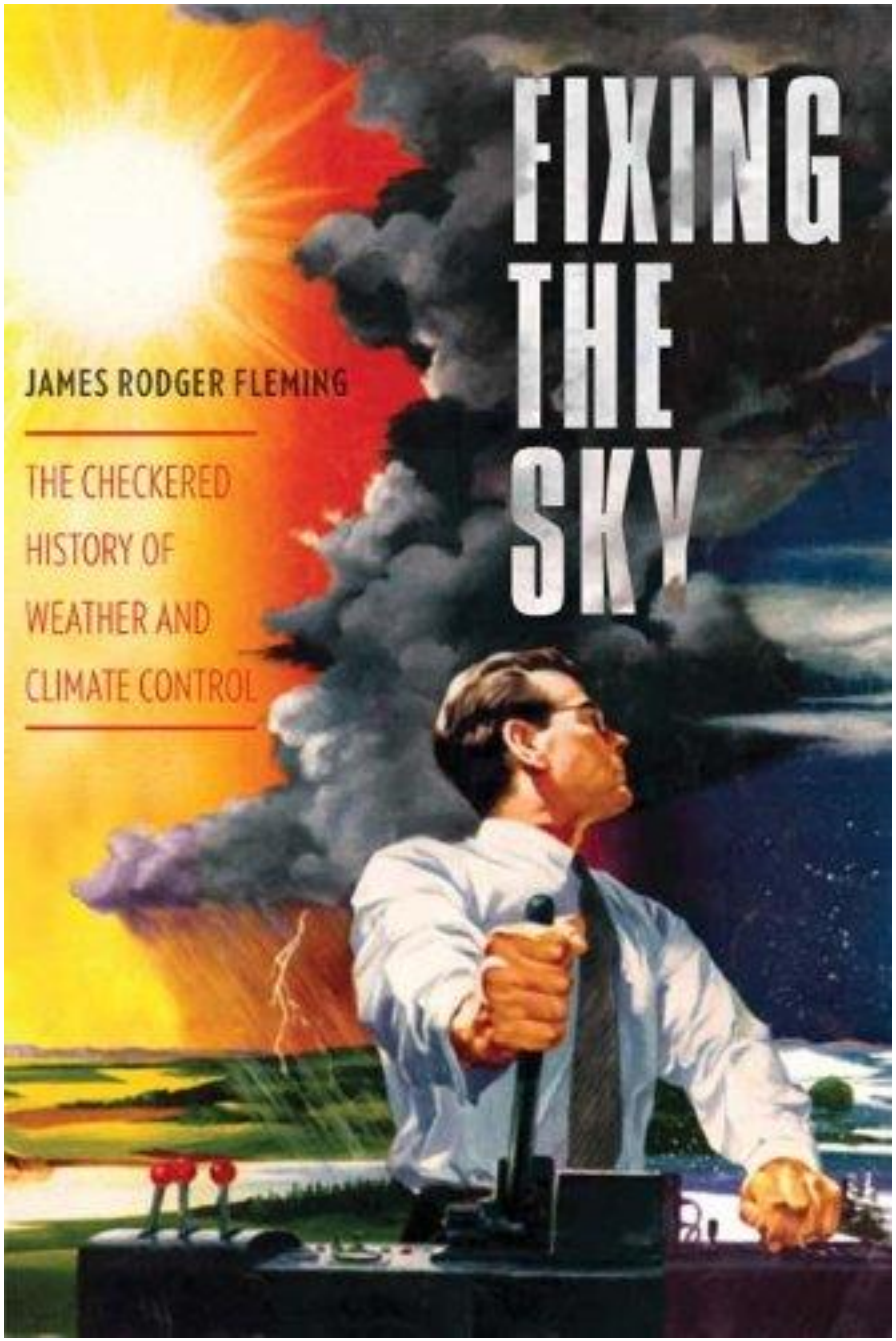


Fig. 12. Surface air temperature differences [°C] on 22 July at hours **(a)** 10:00 LT, **(b)** 12:00 LT, **(c)** 14:00 LT, and **(d)** 16:00 LT for the smaller-scale injection experiments.

Future scenarios – regional climate engineering to preserve coral reefs

- Marine cloud brightening options for Great Barrier Reef
- Local pH modification as well
- MCB for coastal forests



Future developments and domestic laws

- Unilateral regulation, or coordination of laws among nations
- Intellectual Property
- Rights of minorities and human rights implications

The Other Path: Carbon Dioxide Management

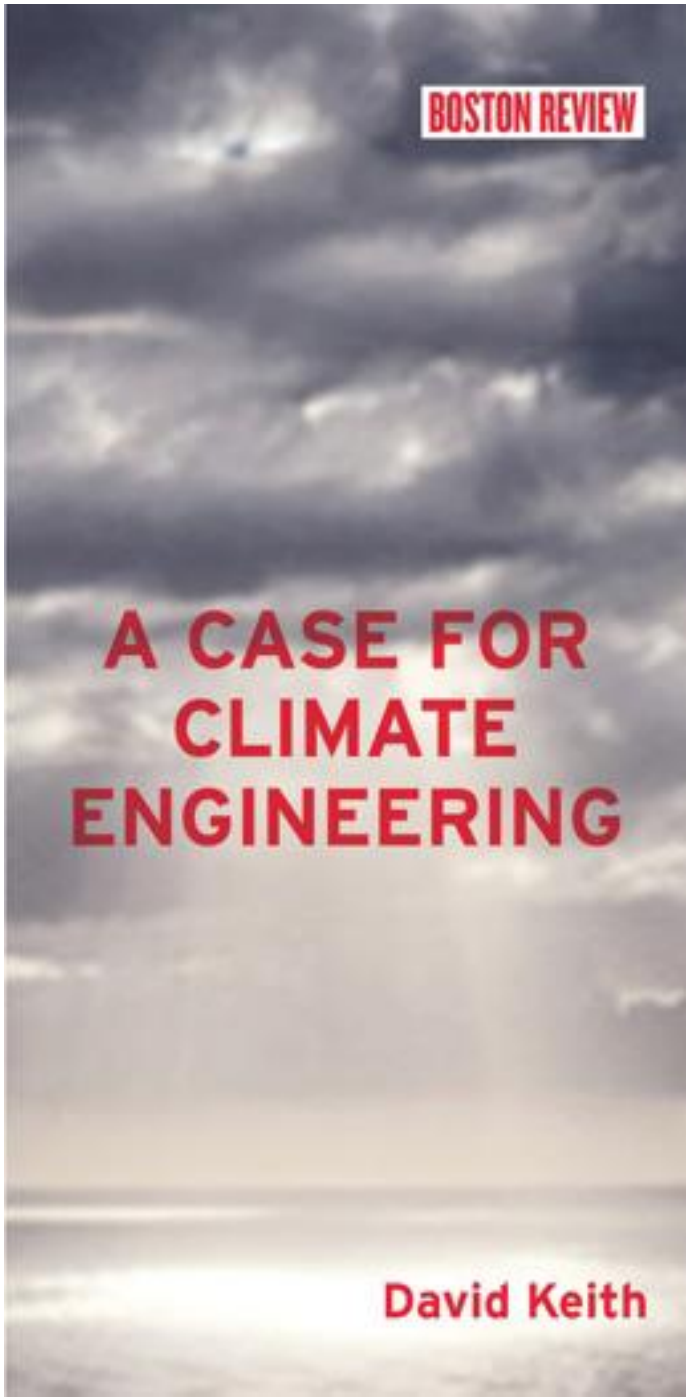
- Dispute over whether to include CDM as climate engineering at all
- Mechanism: enhance or directly engineer absorption of carbon dioxide and other greenhouse gases from ambient atmosphere
- Techniques:
  - Afforestation
  - Ocean fertilization
  - Mechanical removal of CO_2
  - Biochar

Carbon Removal and the Governance Divide

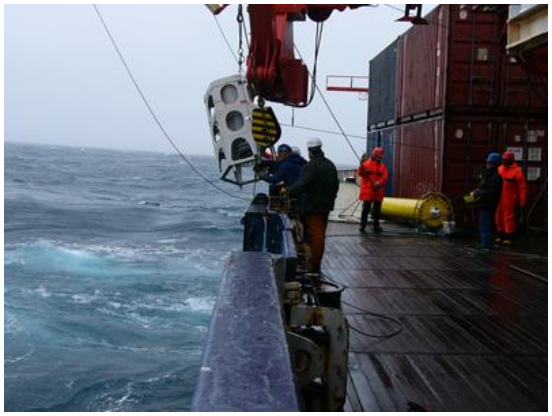
"This divergence of costs and risks means that the challenges of solar geoengineering and carbon removal raise for policy and governance are almost wholly different. Carbon removal is like mitigation….

Because solar geoengineering and carbon removal have little in common, we will have a better chance to craft sensible policy if we treat them separately."

D. Keith, A Case for Climate Engineering at p. xxi (2013)



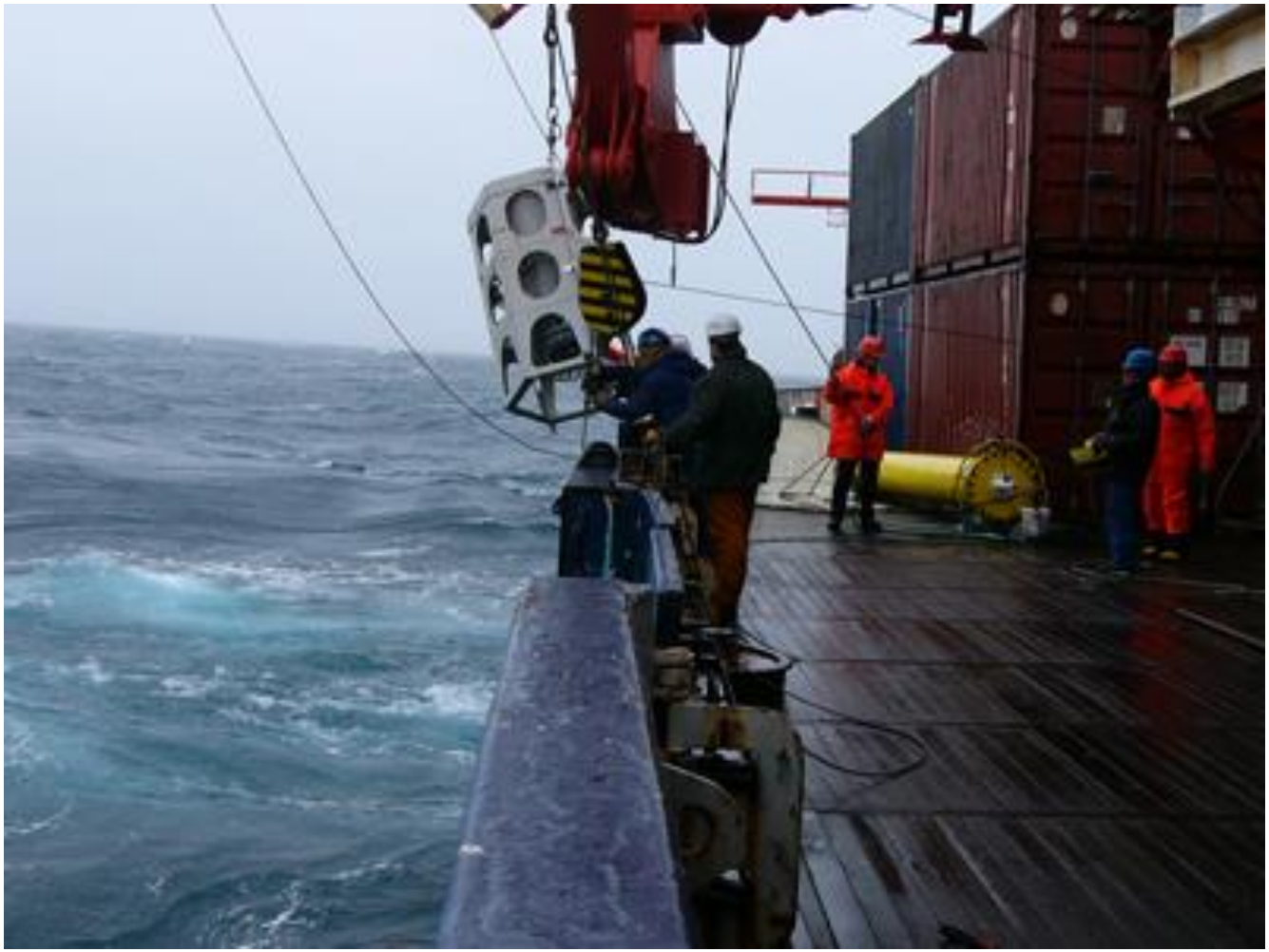
The Varieties of Direct Air Capture



- Mechanical Direct Air Capture
- Carbon Capture & Storage (CCS)
- Biological Energy + CCS (BECCS)
- Ocean Iron Fertilization
- Biochar
- Soil enhancement
- Ocean CO2 entrainment
- Afforestation
- Air Fuel Capture


Elevator
Filter loaded with CO_2
Clean filter
Regeneration chamber
Loaded filter
Compressor
Water tank
CO_2 tank
Drain

A Controversial Example of Carbon Dioxide Removal: Ocean Iron Fertilization



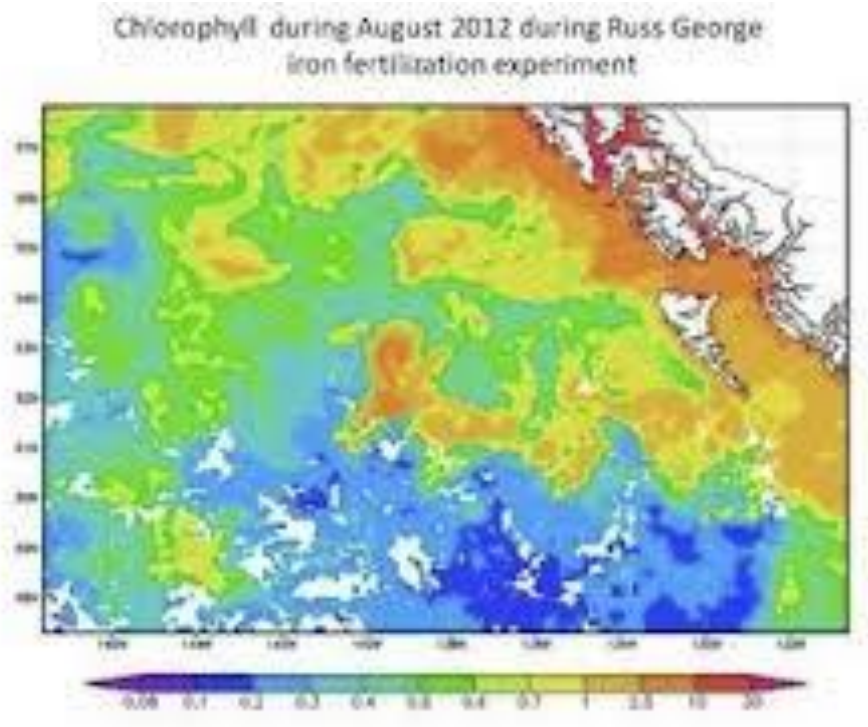
Haida Ocean Fertilization

100 tons of iron sulfate

Dispersed into coastal waters off British Columbia in July 2012

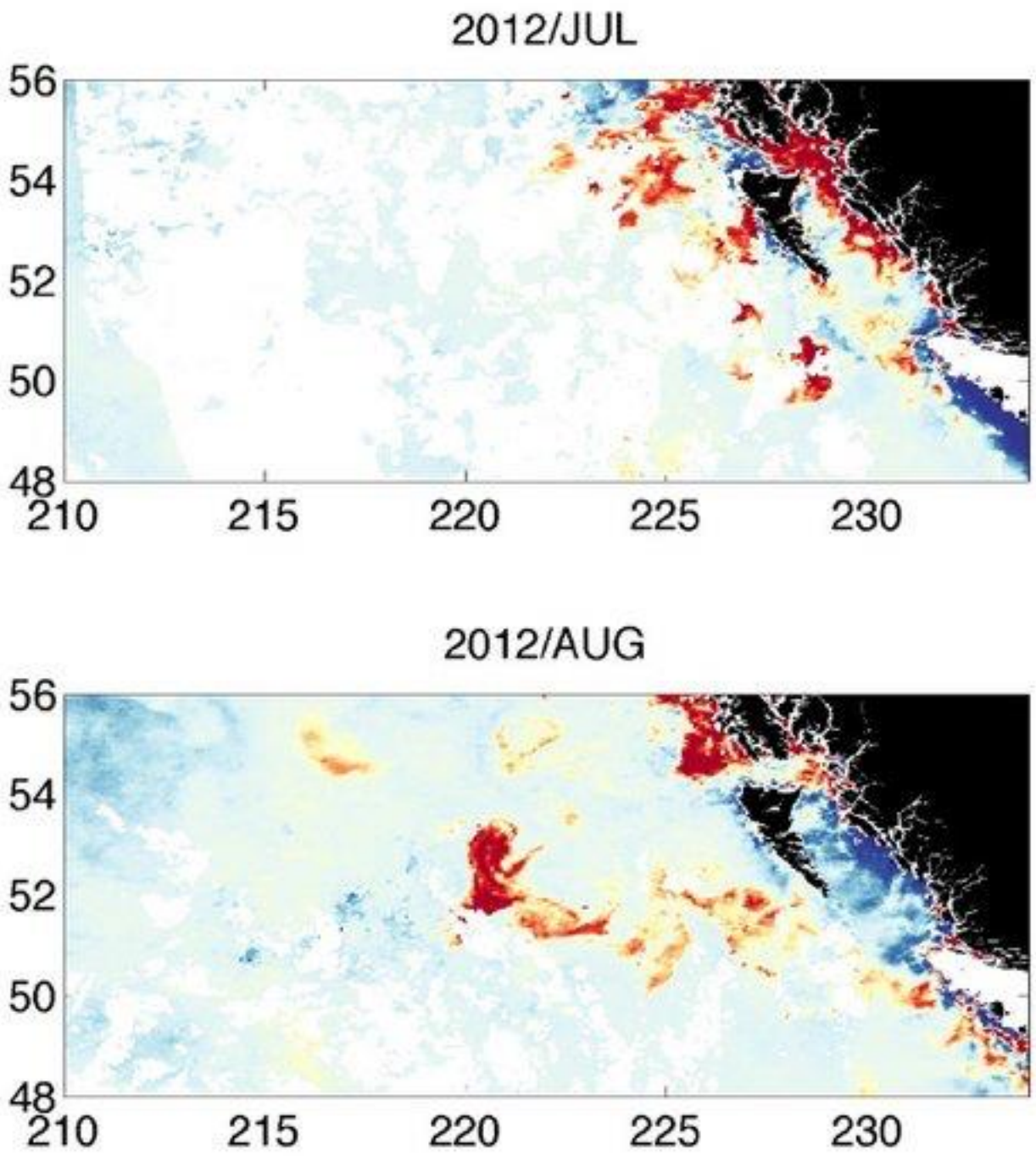
Plankton bloom and salmon runs

By Haida Salmon Restoration Corp.



Search warrants executed by Canada Environment

Originally planned to renew iron fertilization in 2013; now halted


2012/JUL
56
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48
210
215
220
225
230
2012/AUG
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230

Environmental Laws and Direct Air Capture

- Legal Advantages of DAC
  - Slow Pace
  - Reversibility
  - Familiarity

- Likely focus of initial legal hurdles
  - Permits and approvals for environmental side effects of the capture process
  - Management of captured CO2
  - Legal status of products or materials generated from captured CO2

International Law and Direct Air Capture: Whither the Paris Agreement?

1. Implementation of Paris Agreement – update on Bonn
2. 1.5 degree target, NET and NDCs
3. ITMOs, NETs and unfinished business
4. Other treaties
5. Sustainable Development Goals

Thought Experiment

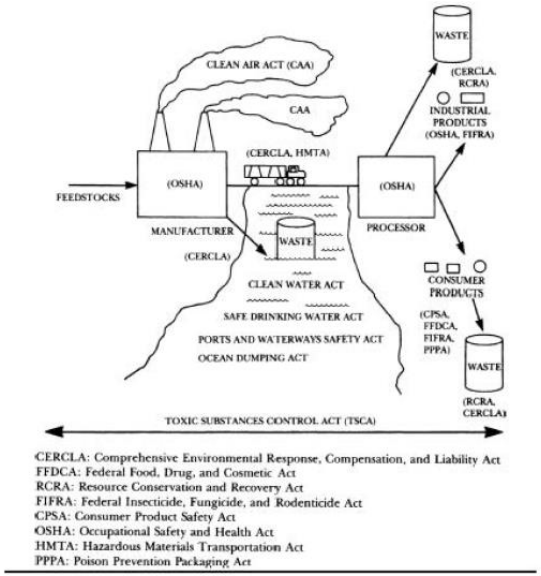
Default governance pathway: regulation by surrogate

- Note that all of these regulatory options focus on regulating DAC through its environmental side effects.

- So focus on the hard case – how (or should) we regulate a DAC process that does not pose any obvious environmental side-effects

- Consequence of the black box model to U.S. environmental regulation, which consciously seeks not to regulate the production process itself

  - Clean Air Act (BACT, MACT, LAER)
  - Pollution Prevention Act of 1990
  - Toxic Substances Control Act



Governance by Environmental Surrogate

Kamala D. Harris
Attorney General of the State of California
Office of the Attorney General
1300 "I" Street
Sacramento, CA 95814-2919

To the Proposed Defendants:

The undersigned attorneys represent Proposed Plaintiffs (listed below) and complain under the statutory "citizens' suit" provisions of the federal Clean Water Act, §505(a), 33 U.S.C. §1365(a) *et seq.* (CWA), and Safe Drinking Water Act, §1449(a)(1), 42 U.S.C. 300f *et seq.* (SDWA) (collectively, as amended, the "Statutes") of past and continuing violations of the Statutes by Proposed Defendants (listed below) in the State of California, including, without limitation, Shasta, Placer, Siskiyou and Santa Cruz Counties. Upon the expiration of the 60-day statutory waiting period required under both Statutes, and in the absence of adequate remedial effort by Proposed Defendants, Proposed Plaintiffs will file one or more citizens' suits in the United States District Court for the State of California under the applicable provisions of the Statutes, as follows:

A. PRELIMINARY STATEMENT

The Default Governance Pathway: Permitting the Direct Air Capture Process

- All permit issues will be heavily dependent on facts of individual operations and process

- But in general, U.S. environmental laws would regulate in same way as any industrial process (air emissions, spent media). Not insurmountable.

- But some quirks:

  – Clean Air Act content and certification requirements for fuels
  – Integration of captured CO2 into existing or future GHG permit programs
  – Environmental Impact Statements and analyses

Environmental Legal Requirements for Captured CO_2

- Driven by CCS debate
- Example: RCRA conditional exclusion for captured CO_2
  - Heavily keyed to ultimate fate of CO_2
  - Class VI vs Class I wells
  - Limited to CO_2 captured from source
  - Feedstock and commercial use exemptions
  - Solid waste management requirements
  - Tort liability
- TSCA notification and premanufacture approvals

Legal status of projects manufactured from captured CO_2

- Rule of capture for ownership
- Derived-from rule (if hazardous waste)
  - Fuels
  - Placed onto ground
- Ownership upon injection for disposal?

Possible alternative models for governance

- Pollutant discharge as surrogate for environmental impairment
  - Normative question: *should* we regulate DAC capture step?
  - Any possible risk of any conceivable damages from inept or faulty implementation of DAC?

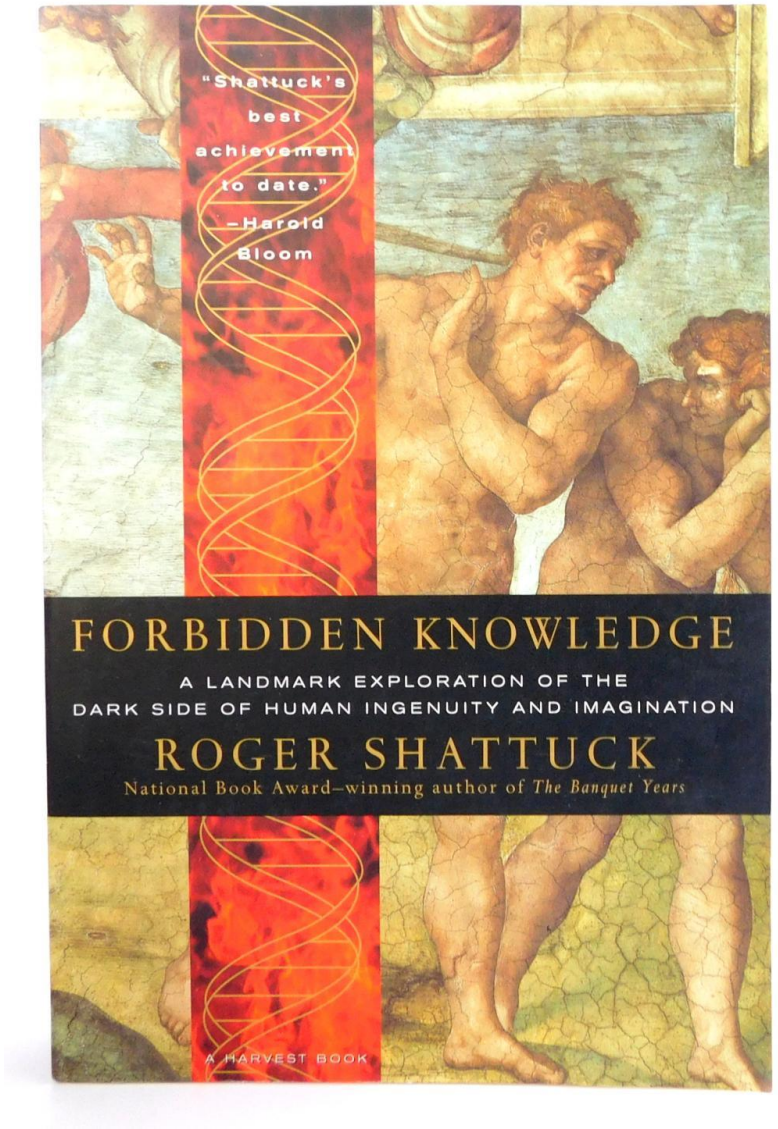
- Frameworks – Economic model (emergent management via market mechanisms); Rights-based model (social acceptance); Information and recursive regulatory model (complex systems behavior)

  - Embrace the gap – confirm absence of permitting requirement for CO2 removal step via regulatory finding or guidance

- Ecosystem services disruption tort; akin to Good Samaritan model

Risks of the Inquiry

- Unnecessary distraction from vitally needed technology
- Role of precautionary principle and risk-risk comparisons
- If governance required, risk of anti-commons lockout
- Global forced pooling concepts



Short Term Regulatory Options to Promote DAC (from Deep Decarbonization Pathways Project)

- Start-up Research Gap – Increase Financial Support

- Emissions and other environmental impacts from DAC operation
  - Likely regular permit processes for conventional emissions. If needed, explore standard permits, legislative waivers
  - NEPA and EIS (if triggered) – CatEx or programmatic EIS
  - Land acquisition and use (BECCS, eminent domain, regional HCPs)

- Management of captured CO2
  - Revisit Class VI UIC well rules and conditional RCRA exclusions
  - Regulatory pre-approval of products (fuels, mineralization)
  - Include within advanced renewable fuel mandates
  - Life cycle assessments of product CO2 footprint

Short Term Regulatory Options to Promote DAC (from Deep Decarbonization Pathways Project)

- Incentives
  - Carbon pricing (especially if included in fuel pricing)
  - Tradable emission reduction credits
  - Integrating DAC into GHG permitting and trading

- Liability limitations and management
  - Liability caps (OPA, Price-Anderson)
  - Tort liability limits (LULU concerns, applicability of permit shields to DAC)

Professor Tracy Hester
University of Houston Law Center

tdheste2@central.uh.edu
713-743-1152 (office)