Additional risk, end-of-the-pipe geoengineering technologies

Introduction

Subject: Cultural context of geo-engineering technologies, their acceptability to mitigate climate change and a related risk.

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Disclaimer: And for the lawyers, I present here my views only and not those of my employer.
Two scenes on stage…

It's an intercontinental flight:

The crew informs that the cooling system should be re-engineered, and that first experiments will be undertaken soon, also respecting the Oxford principles [a].

It's Earth:

The G8 informs that geoengineering should provide additional cooling for the planet, and that first experiments will be undertaken soon, also respecting the Oxford principles [a].
Humans are engineers…

Terraced Fields, by Hongkai Gao
Yunnan Province in China
(Imaggeo, EGU)
Humans are engineers…

People live in environments, landscapes that they created.

Well engineered methods have shaped modern societies.

Environmental issues were successfully tackled by:

- *Technological-fixes*;
- *Combined with regulatory measures*;
  - *Both, generally targeting the "start-of-the-pipe";*
Deus mare, Friso litora fecit [1]
Your ship has a leakage; what to do?

**Option:** You install pumps and command pumping duties.

**A Dutch experience:** A substantial part of the Netherlands are below sea-level. To protect their country, the Dutch people use "pumping" since centuries. Evidently, the Dutch people plan to continue, at least for the next meter of sea-level rise. It's part of their culture.

- Does this kind of experience renders geoengineering acceptable in our culture, at least as an emergency-fix?
Experiences – “start of the pipe”

Experience:

Temperature inversion and Airpolution over Madrid, Konstantinos Kourtidis (imaggeo, EGU)
Experiences – “start-of-the-pipe”

Experience:

Acid rain and ozone depletion (e.g.) have been addressed through a combination of a technological-fix and regulatory measures. Threatening emission problems were targeted at their sources; thus at “start-of-the-pipe”.

And to tackle these threats, our habitual consumption and current production patterns were not put into question.

...this was a good experience, well fitting into our culture!
Development trajectories... some “no-options” for nine billion people

Option: Up-scale the global fluxes of resources so that nine billion people (2050) can live like European citizens;

– Comment: Up-scaling by factor 20 is not sustainable for global systems; it is well beyond planetary boundaries [b].

p.m.: The “gross world product” increased ~20-fold in the period 1925-2000.

Option: Proportional down-scaling of European-like production and consumption patterns to reduce resource intensity per capita;

Option: Keep current global imbalances of wealth and poverty;
Mitigating anthropogenic climate change is an essential part of a develop trajectory towards “global sustainability”; a trajectory that possibly comes at a substantial economic cost.

Mitigation anthropogenic climate change likely requires to engineer a disruptive change to our current production and consumption patterns.

*Comment: ...difficult to get accepted, difficult to manage,...*

The economic [*] and social costs [**] are quite high for a „business as usual scenario“ of a non-mitigated anthropogenic climate change (without substantial sea-level rise).

[*] up to: ~ 3 % of the annual world gross product; [**] ?
Mitigating the dilemma, geoengineering a further option?

"Geoengineering" may look appealing: a "technology fix" without disruption of the current economic structures or the habitual consumption patterns…
Geoengineering … a risk of perception

Geoengineering technologies like reforestation, particle injection, carbon-dioxide scrubbing, ... target:

- either the “end-of-the-pipe”
- or feedback loops of the climate system.

Geoengineering does not offer “start-of-the-pipe technologies”. This makes them different from the engineering success stories like mitigating of ozone depletion or acid rain.

Geoengineering appeals to our culture because it offers a regulated technology-fix for a dilemma that is difficult to tackle.

Thus, "geoengineering" is loaded with the risk of being accepted because it fits well into our culture - humans are engineers.
Experiences with particle injection – two events

Vulcanian eruption of Santiaguito, Guatemala
Joel Gill, (IMAGEO, EGU)
Experiences with particle injections – two events

A cancelled project:

- **SPICE**, a project for "stratospheric particle injection for climate change" has been cancelled [2, c].

An executed project:

- Injection of volcanic ash into the atmosphere to test an aircraft sensor for volcanic ash-hazards [3] has been executed.

**p.m.**: Who has the authority to evaluate and regulate the testing of geoengineering technologies?
Regarding acceptability… a comment:

Some cost estimates:

- economic cost of “carbon capture at combustion” 18 to 49 $/tonne CO$_2$ [4]; economic cost of climate change 12 to 64 $/tonne CO$_2$[5]; …

If – then:

- if "social, legal and political issues as well as scientific and technical factors to be considered" [6]...then:
  - experiences advices use of "start-of-the-pipe" technologies;
  - cost are still moderate (0.9% – 2.2% world gross product);
  - no "emergency technology-fix" seems to be needed;
Geoengineering technologies fit into our culture, because they offer a regulated “technology-fix” to mitigate climate change.

Public perception of geoengineering will vary, likely from „No, to in-flight re-engineering“ to „Yes, to an emergency-fix“. However, what is the level of “emergency“ that would render geoengineering an acceptable option and who would regulate it?

Our experience with acceptable political / social choices for technology-fix / regulatory measures show one key-feature: They have been an affordable start-of-the-pipe approach.

Thus to mitigate anthropogenic climate change, an acceptable engineering option would be: “Carbon capture at combustion”.
Thank you for your attention

Does it work?

Robert Supper, Geological Survey of Austria, Austria (imaggeo, EGU)
References

[a] http://www.geoengineering.ox.ac.uk/oxford-principles/principles/ In December 2009, the Oxford principles, initially drafted by scholars were endorsed by the to UK House of Commons Science and Technology Select Committee on "The Regulation of Geoengineering" making them a national-level policy statement on responsibly executed geoengineering research.
[c] The injection height of 1.000m foreseen in SPICE, following habitual definition, would be much below the stratosphere habitually having a lower limit around 10.000 m. However, "SPICE" is not a misname of the project. The cancelled experiment was part of a much wider undertaking that apparently also run into difficulties because of a dispute about patent rights for geoengineering techniques (see: D. Cressy 2012, Geoengineering experiment cancelled amid patent row, Nature, Vol. (485): http://www.nature.com/news/cancelled-project-spurs-debate-over-geoengineering-patents-1.1069).