

Remediation and Geoengineering

The Gods will not save you — Ervin Burrell.

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Be Prepared

Be prepared

Be very prepared

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1. Get CO₂ Out Of The Air

- ▶ *Not* undoing combustion: $\text{CO}_2 \rightarrow \text{C} + \text{O}_2$.
- ▶ Instead:
 - ▶ Sequester CO₂ into underground reservoirs.
 - ▶ Speed up natural sequestration:
 - ▶ Rock weathering.
 - ▶ Ocean CO₂ absorption.

Social Cost Of Carbon

- ▶ Logically, sequestration cost is the upper limit to IAMS' Social Cost of Carbon (SCC).
- ▶ Of course, there is no world government.
 - ▶ SCC and sequestration cost are both intellectually interesting,
 - ▶ but practically irrelevant for the real world.
- ▶ What would \$20/tCO₂ say about the world's free-rider problem?
 - ▶ When do you think it will change?

Lumber

Cheapest Sequestration Process:

- ▶ Foresting *with* lumber harvesting.
- ▶ Local benefits of trees on water, air, etc.
- ▶ As cheap as ***\$10/tCO₂!***
 - ▶ on the margin, even cheaper, and
 - ▶ probably for the first 1 GtCO₂/year.
- ▶ Nevertheless, not pursued at large scale.
 - ▶ Instead, poor farmers burn Brazilian forest.

Environmentalists won't like tree-felling.

Lumber Farming

- ▶ Needs more research:
 - ▶ What trees where for most efficiency?
 - ▶ How much sequestration at what cost?
 - ▶ Is 20 GtCO₂ feasible at \$40/tCO₂?
 - ▶ Local benefits can justify local subsidies.
- ▶ Easy US suggestion:
 - ▶ Grant free Federal shrub lands to purpose.
 - ▶ Tie Brazilian and Indonesian trade to satellite-measured forestation.

Other Processes

- ▶ Algae are potentially even more efficient.
 - ▶ Yet perhaps not as economical.
 - ▶ Needs more research first.
- ▶ Ocean liming
 - ▶ Crush and shovel chalk into ocean.
 - ▶ Needs more research first.
- ▶ Sequester on top of coal smokestack?
 - ▶ Maybe yes. Maybe never. Cost?

Crazy Ideas — Why?

- ▶ Industrial processes (e.g., Climeworks)
 - ▶ Wrestling towards \$200/tCO₂.
 - ▶ Business Model: Sell carbon credits to environmentalists.
 - ▶ What?
- ▶ Enhanced rock weathering
 - ▶ Wrestling towards \$150/tCO₂.
- ▶ Research *only if* cost can go to <\$50/tCO₂.
 - ▶ (I don't mean alternative cement research.)

Usually, I am for research, but this seems still-born.

2. Change Solar Radiation

(Reduces warming only, not ocean acidification.)

1. Star Trek Space Shield?

- ▶ Nonsense, too expensive.

2. Sulfur particles into stratosphere.

- ▶ Feasible, cheap, think 1% of CO₂ removal;
- ▶ circulates for 2-5 years.

3. Cloud Seeding.

- ▶ Potentially cheaper yet, shorter-term,
- ▶ but not much known.

Radiation Management Problems

- ▶ Dangerous unknown unknowns,
 - ▶ but modest interventions can and should be researched.
- ▶ We don't even know for sure if it works
 - ▶ though volcanoes have suggested it would.
- ▶ Many possible unintended consequences,
 - ▶ but so does the current alternative:
global warming.

Global Cooling

- ▶ We may also need solar radiation capture on demand:
 - ▶ i.e., heating up earth, e.g., reducing albedo.
 - ▶ Think Asteroid *Apophis* 99942.
- ▶ We don't know enough about this either!
- ▶ Much less urgent for now.

Be Prepared

- ▶ Solar radiation management is dangerous!
 - ▶ It is also potentially the only way to stop a run-away loop (e.g., Permafrost Methane melting) in its tracks,
 - ▶ to buy humanity some time.

- ▶ Do not deploy!
 - ▶ But research and understand,
 - ▶ and think about acceptable use scenarios.

Conclusion

- ▶ Subsidize lumber farming.
- ▶ Research intelligent sequestration.
- ▶ Research solar radiation management.