

Geoengineering 2: Air-Capture of CO₂

EES 3310/5310

Global Climate Change

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Class #37: Friday, Nov. 16 2018



Update on Lab Project Assignment

- Original assignment said to analyze the feasibility of **both** the country's 2030 goal under the Paris agreement **and** the 2050 goal that you come up with.
- Revised assignment:
 - You **only** need to analyze your 2050 goal.
 - You **do not** need to analyze the feasibility of the 2030 goal.

Albedo Control as Technological Fix

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1. Cause-Effect Relationship?

- Mismatched changes: incoming shortwave vs. outgoing longwave
- Feedbacks
- Temperature vs. precipitation
- Geographic distribution
- Ocean acidification

2. Assessable Effects?

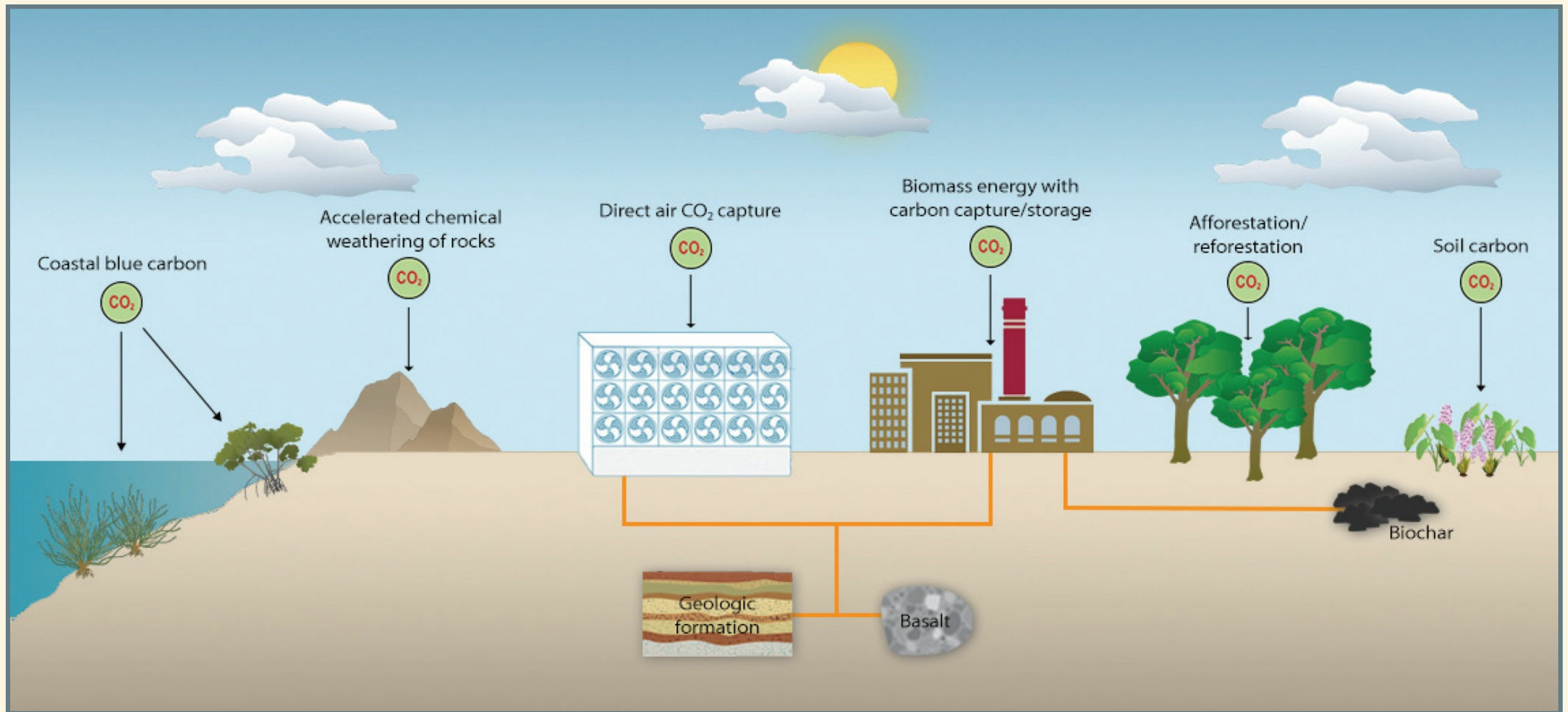
- No way to test it on small scale
- No way to assess unintended consequences

3. Established Technological Base?

- No “practice earth” for testing
- Can’t build it incrementally

Air-capture of CO₂

Technologies



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Forests and Soil

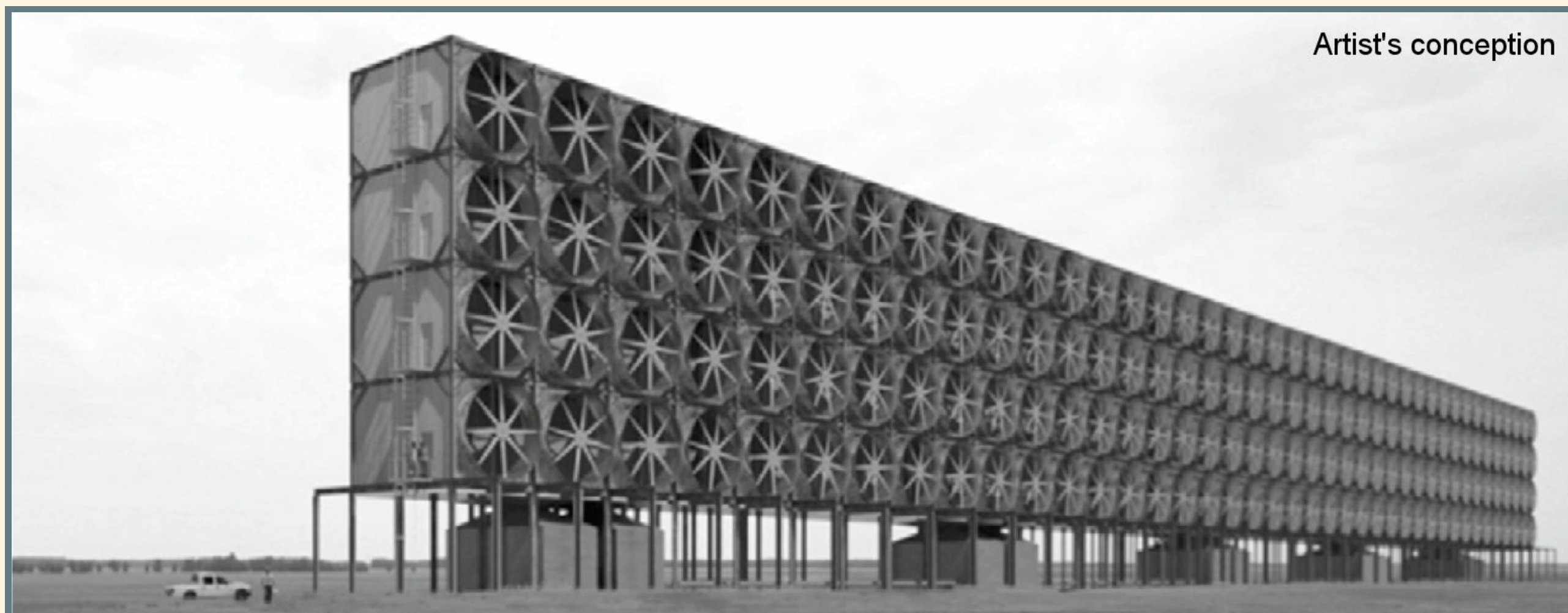
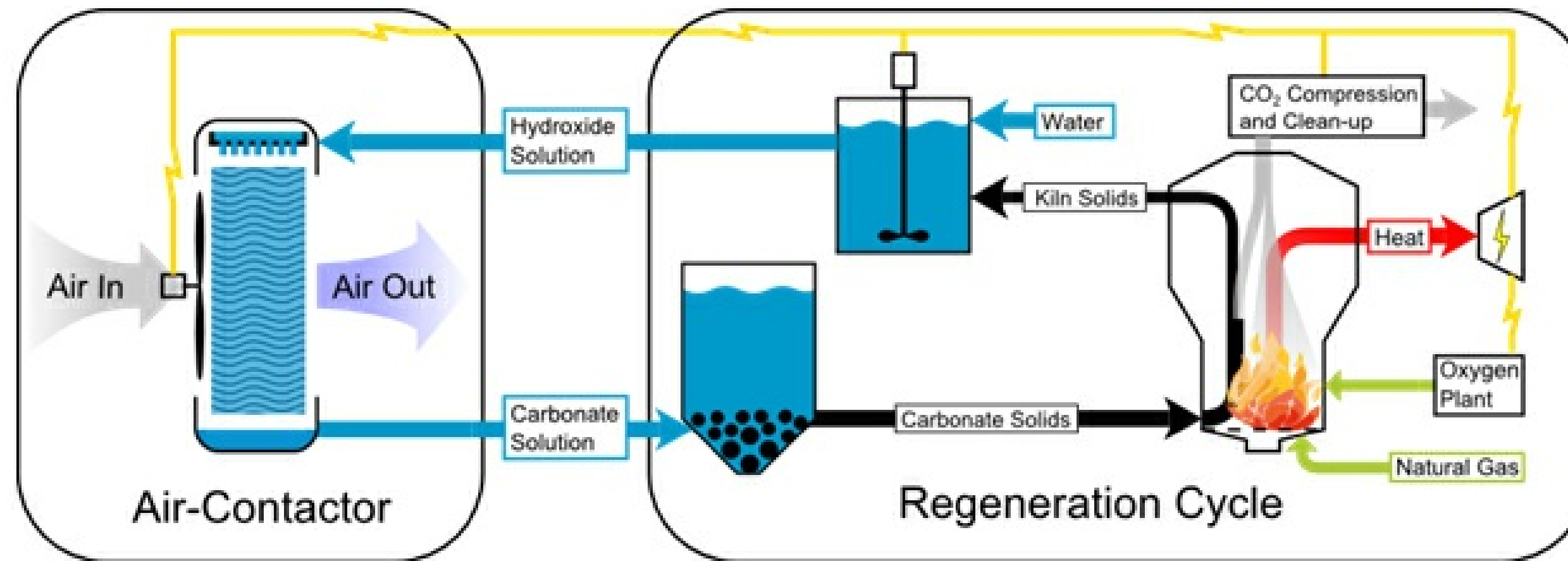
Potential capture/storage rates (GT CO₂ per year)

Technology	Cost	US	Global
Forest Growth	L	0.15	1.0
Forest Management	L	0.10	1.5
Agriculture/Soils	L to M	0.25	3.0
Total		0.50	5.5

National Research Council, *Negative Emissions Technologies and Reliable Sequestration*, (2018)

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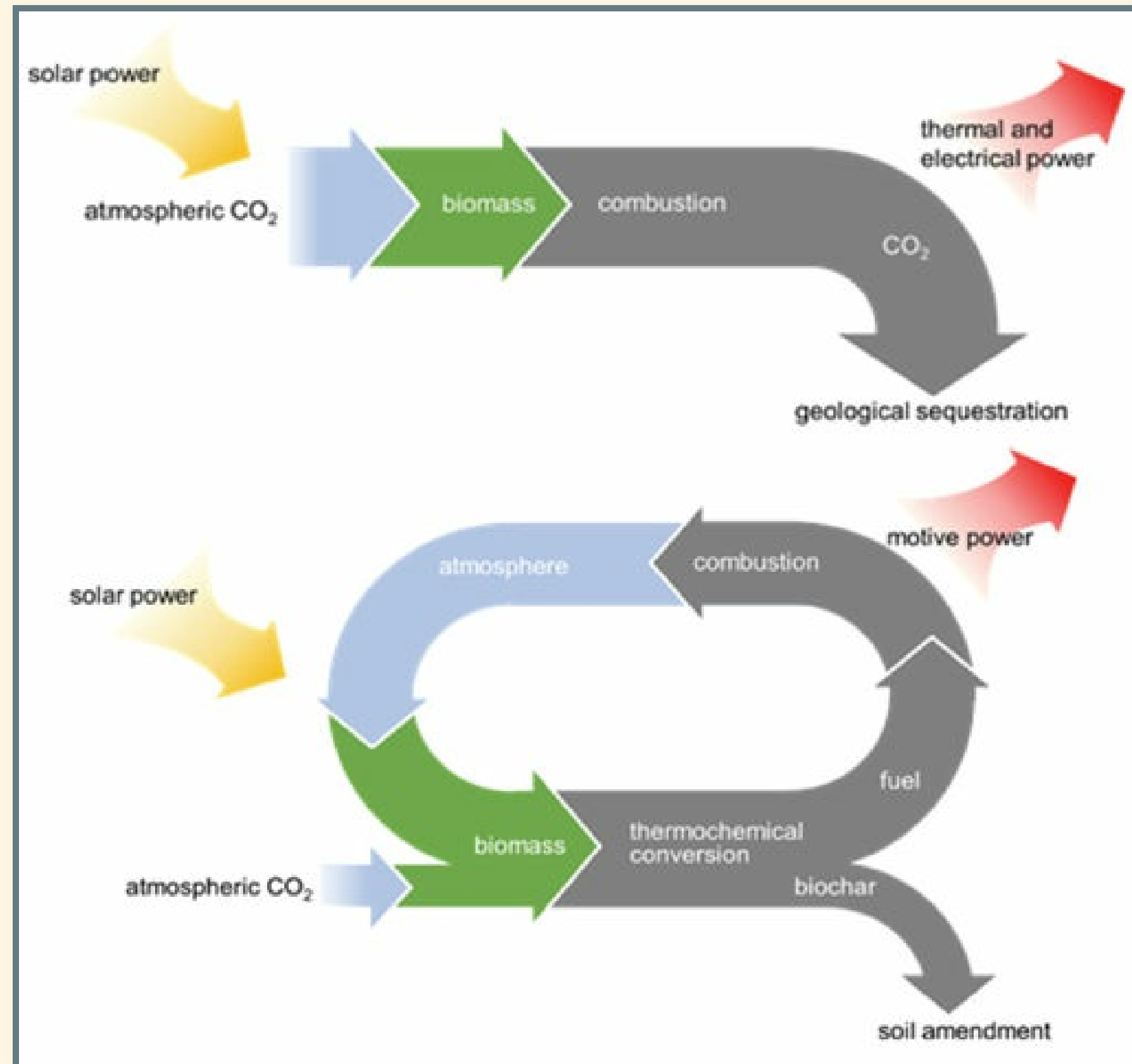
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 - Takes 1.5–3.4 times as much

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- Concerns about impact of converting so much land to energy production.

Feasibility of Air Capture

Cost & Capacity of Air Capture

Technology	US	Global	Cost
Coastal	0.02	0.13	\$0
Forest Growth	0.15	1.00	\$70–90
Forest Management	0.10	1.50	\$250–500
Agriculture/Soils	0.25	3.00	\$0–50
BECCS	0.50	4.35	\$30–130
Direct Air Capture	NA	NA	\$90–600
Total	1.00	9.98	

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 - Stern: “If mitigation costs 1% of world GDP by 2100 ... this is equivalent to growth rate dropping from 2.50% to 2.49%”
 - GDP in 2100 would still be 950% greater than today.

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4. What's missing?
 - Where to store CO₂ after we capture it?

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... if you built a hundred million trailer-size units you could actually keep up with current emissions.

— Elizabeth Kolbert, The New Yorker, 20 Nov. 2017

Should Geoen지니어ing
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- Playing God argument
- Moral hazard argument
- Illusion of safety argument

Recent Scholarship

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The promise of ... negative-emission technologies is more politically appealing than ... rapid and deep mitigation now.

If we rely on [negative-emission technologies] and they are ... unsuccessful at removing CO₂ from the atmosphere at the levels assumed, society will be locked into a high-temperature pathway.

Context

The IPCC considered more than 1000 possible [emissions] scenarios.

Of these, only 116 limit warming to below [2°C], and of these 108 involve negative emissions.

In many below-two-degree scenarios, the quantity of negative emissions ... reaches the same order of magnitude as the “positive” emissions being produced today.

— E. Kolbert, The New Yorker, 20 Nov. 2017

*You might say it's against my self-interest to say it,
but I think that, in the near-term, talking about carbon removal is silly,
because it almost certainly is cheaper to cut emissions now
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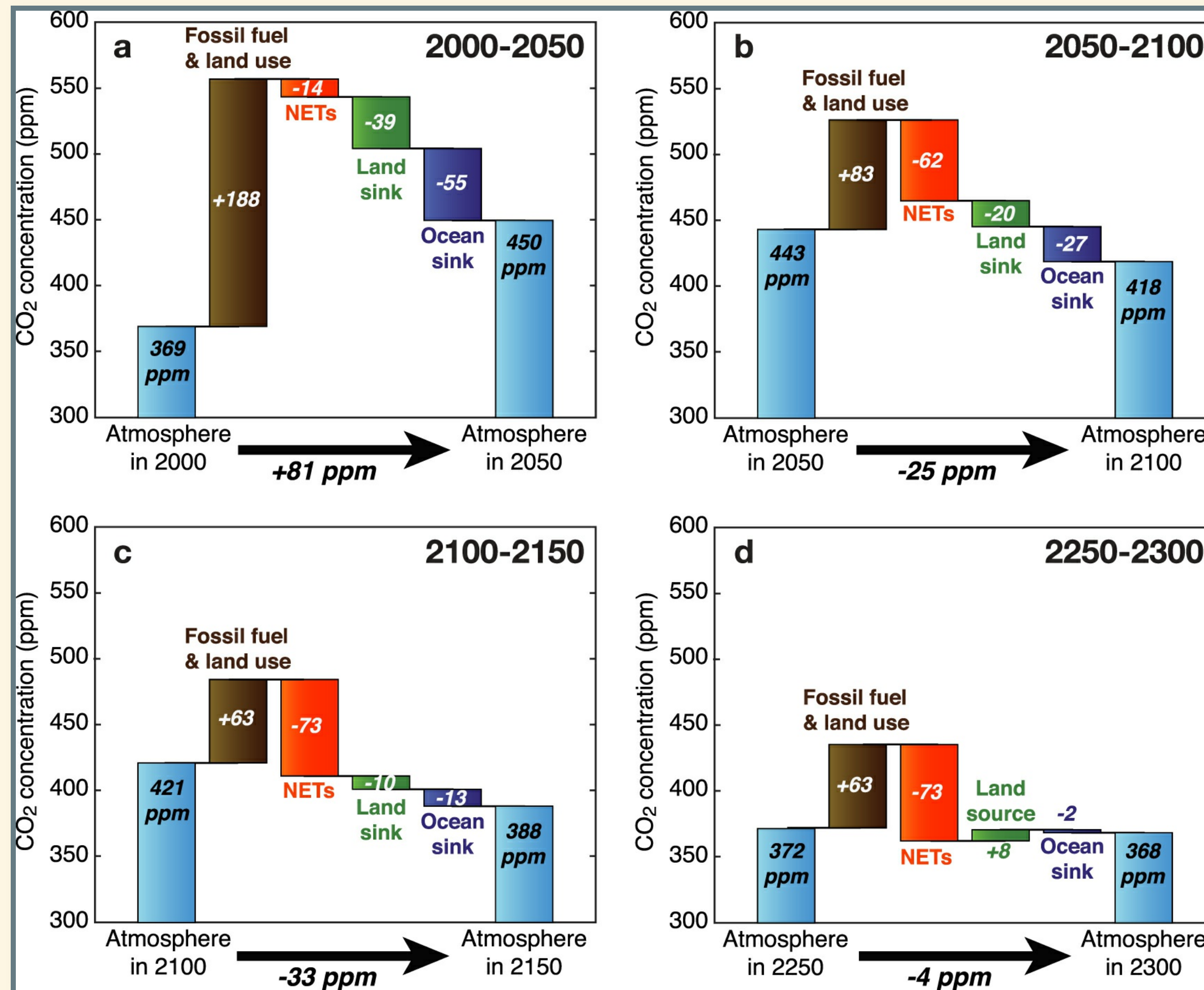
*The punch line is, it doesn't matter. We actually need to do direct air capture,
so we need to create technologies to do that. Whether it's smart or not,
whether it's optimized or not, whether it's the lowest-cost pathway or not,
we know we need to do it.*

*— Julio Friedmann
former Principal Deputy Assistant Secretary,
Office of Fossil Energy,
U.S. Department of Energy*

National Research Council Report (2018)

Negative emissions technologies are best viewed as a component of the mitigation portfolio, rather than a way to decrease atmospheric concentrations of carbon dioxide only after anthropogenic emissions have been eliminated.

National Research Council Report (2018)



Comparing Imperfect Solutions

- Mitigation
 - Cut emissions
 - Geoengineering
- Adaptation
- Do nothing

*“We have three options:
mitigation, adaptation, and suffering”
— Prof. Lonnie Thompson*