Land and Climate Goals

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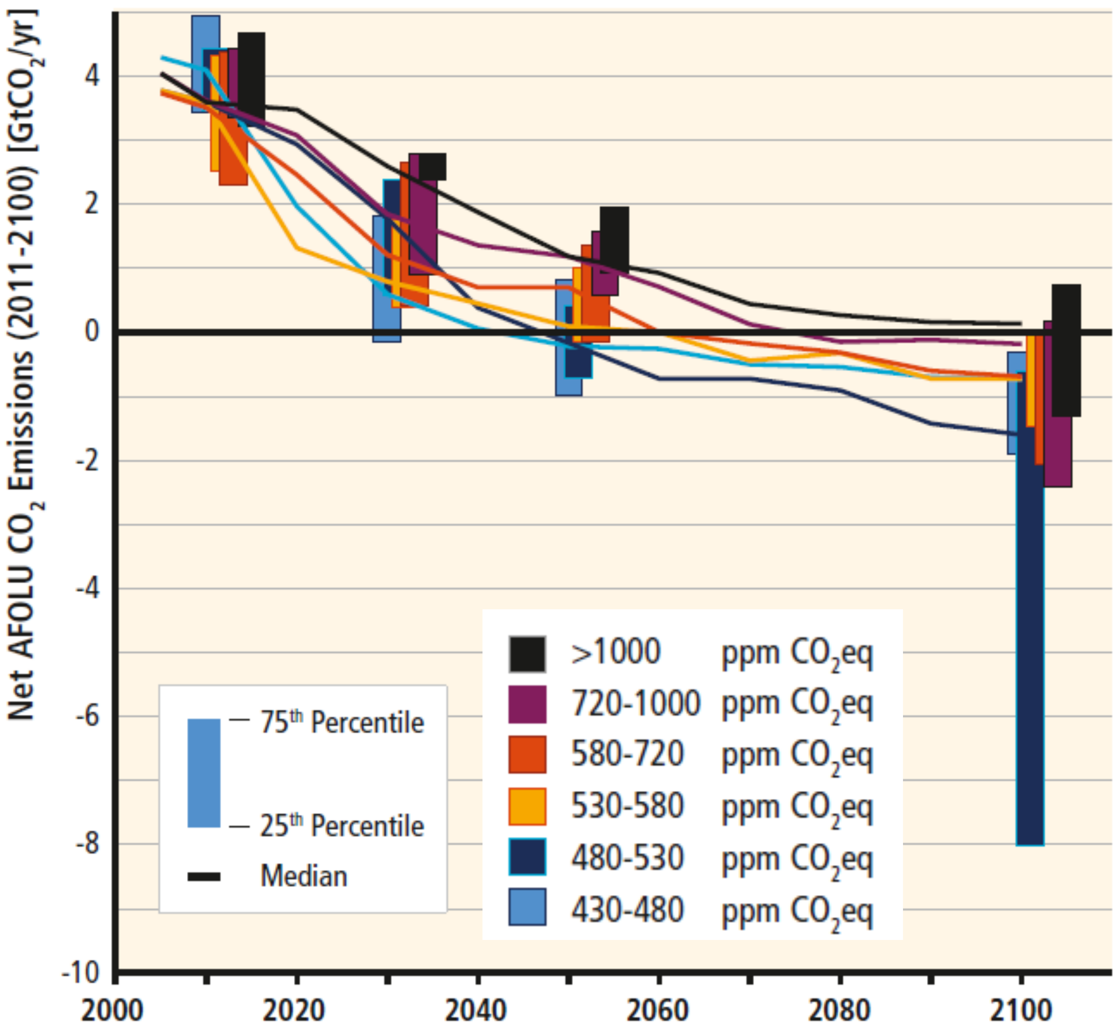
Topics

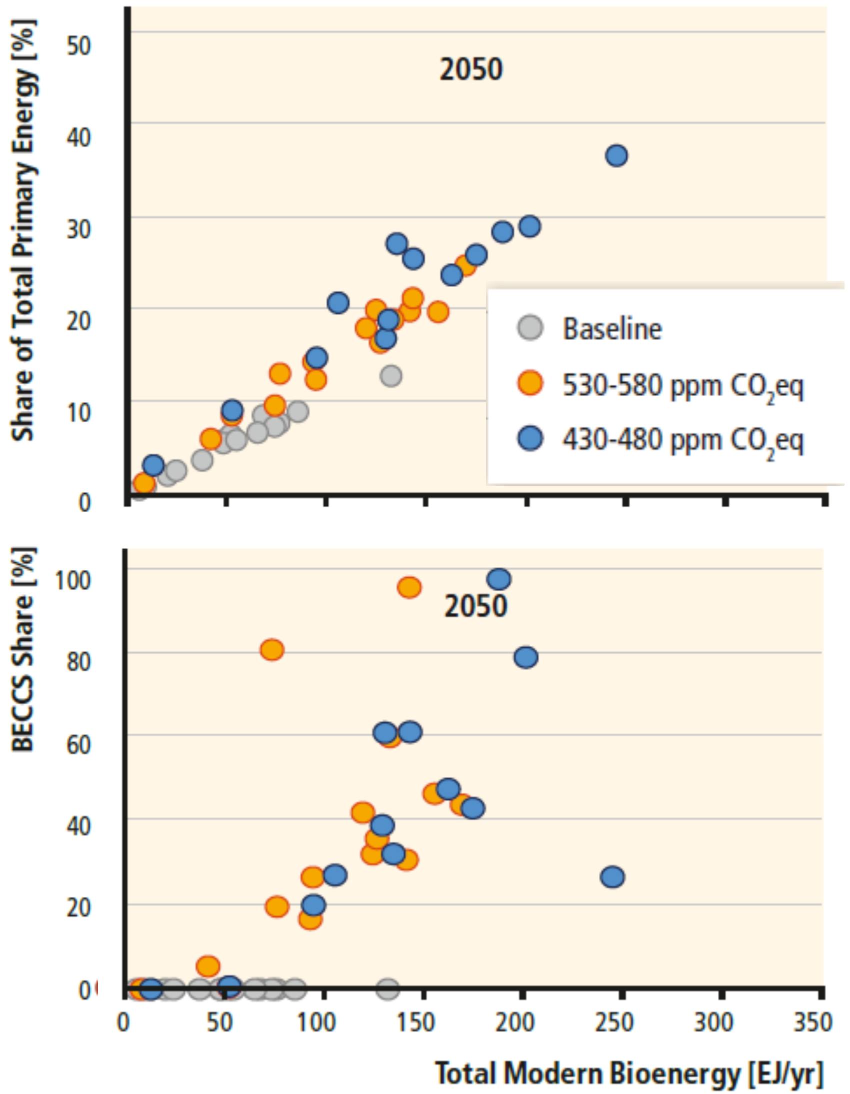
- Emissions source and abatement potential
- Reality and trying to model it better
- Additional modeling issues

Emissions source and abatement potential

- Prominent emissions source
- Significant estimated long-run cost-effective abatement potential
  - e.g., 370-1250 GtCO_2 cumulative abatement 2010-2100, 15-40% of total abatement (ag, forest, & bioenergy)
- Land-based mitigation explicitly included in many NDCs (n = 117), e.g., China, India, U.S.
- But,
  - Significant variation in results (abatement and land-use)
  - Declining abatement role with increased ambition
  - Most projected abatement occurring in developing and transitional countries
  - Idealized policy assumptions – immediate, comprehensive global CO_2e pricing on all land activities

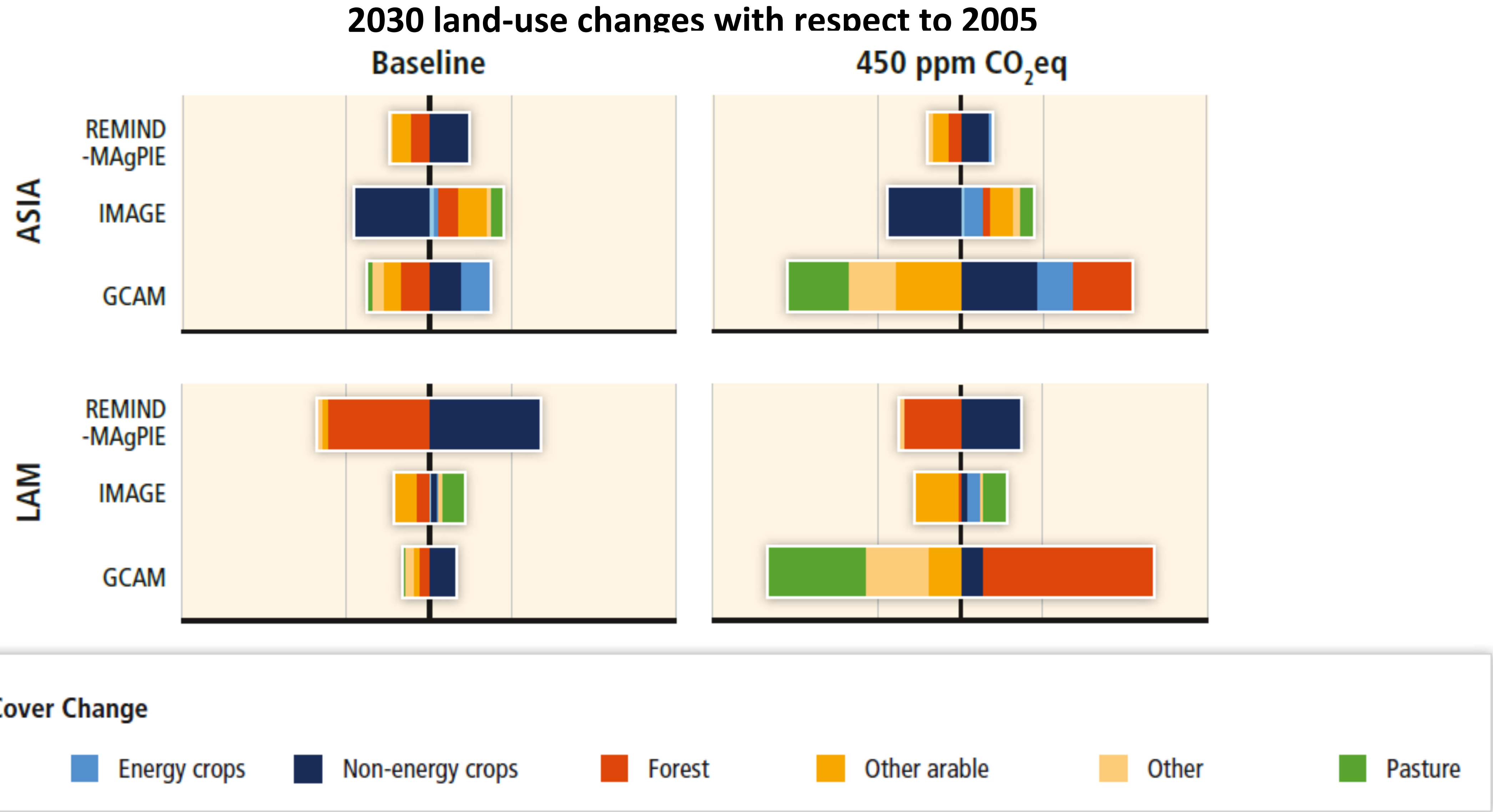
Significant abatement potential





IPCC AR5 WG3 Ch6 (2014)

Land-use change uncertainty

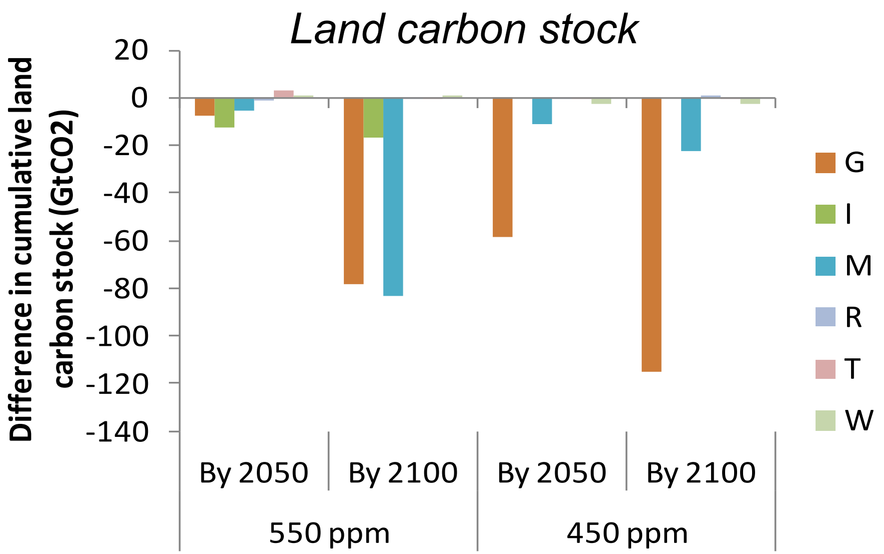


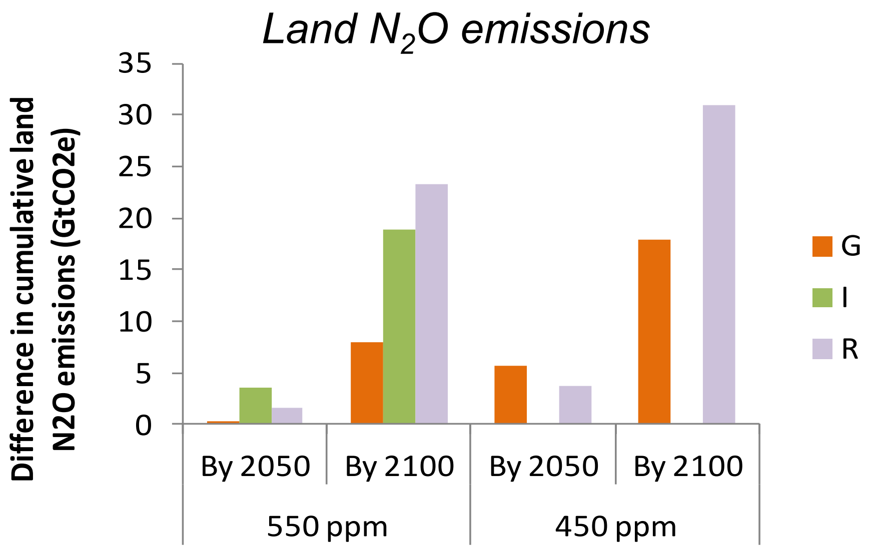
IPCC AR5 WG3 Ch11 (2014)

Bioenergy–land GHG trade-off acceptable over long-run

Models are trading-off land carbon and increased N_2O emissions for long-run climate benefit of bioenergy

Cumulative differences in global land carbon stock (a) and land N_2O emissions (b) with default versus constrained bioenergy

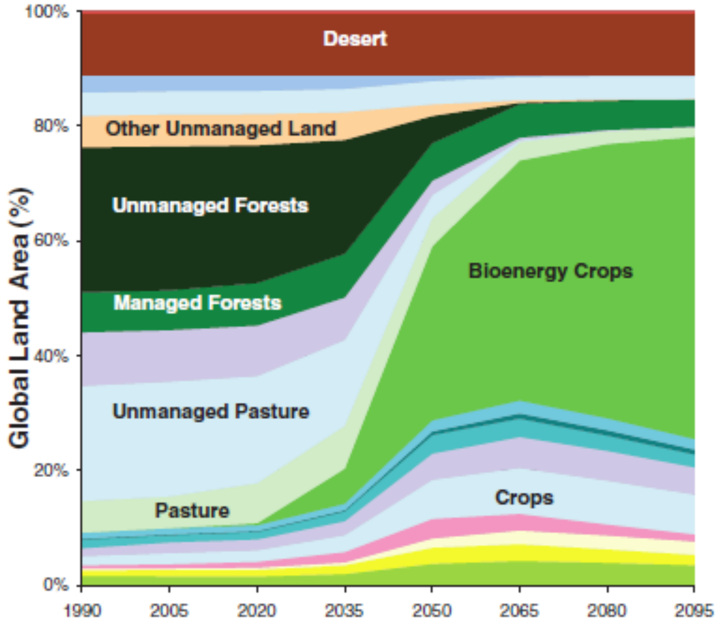




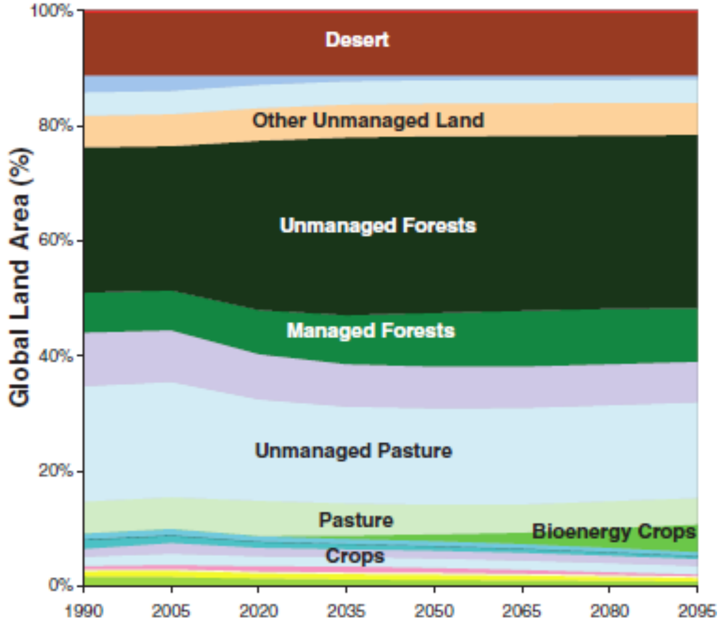
Reality

- Accessing land-based abatement potential will be difficult
- Policy implementation will be challenging
  - Coordination – sectors, regions, options, time, non-climate policies
  - Institutions
  - Instruments
- Issues
  - Leakage
  - Costs
  - Non-climate social concerns

Coordination challenge b/w bioenergy and forest/ag mitigation



From stabilization scenario with energy crop bioenergy incentives WITHOUT global terrestrial carbon price



WITH global terrestrial carbon price

Price or protect all terrestrial carbon? How?

Effect on the cost of bioenergy?

Other bioenergy feedstocks?

Wise et al. (2009)

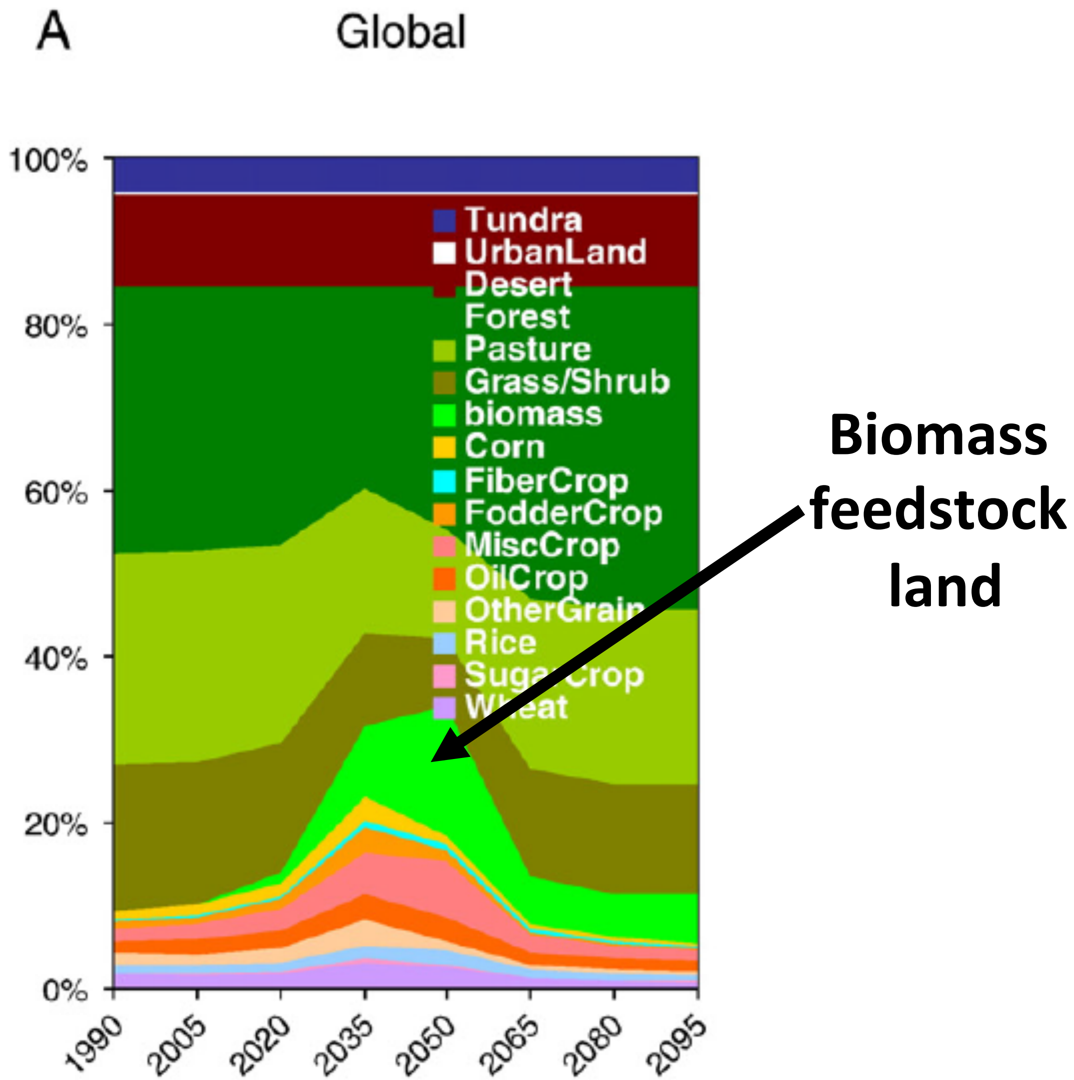
Coordination challenge across regions

Global land use in 2.6 W/m2 Delayed Accession with Overshoot scenario (and terrestrial carbon pricing)

Staggered regional climate policies (w/ global terrestrial carbon pricing) could produce land conversion and emissions

Table 3
Delayed accession (S2).

Group	MiniCAM regions	Period of policy phase in
Group 1	USA, Canada, W. Europe, E. Europe, Japan, Australia and NZ	2010 to 2020
Group 2	The Former Soviet Union, India, China, and Latin America	2036 to 2050
Group 3	Korea, South and East Asia, Middle East, and Africa	2051 to 2080



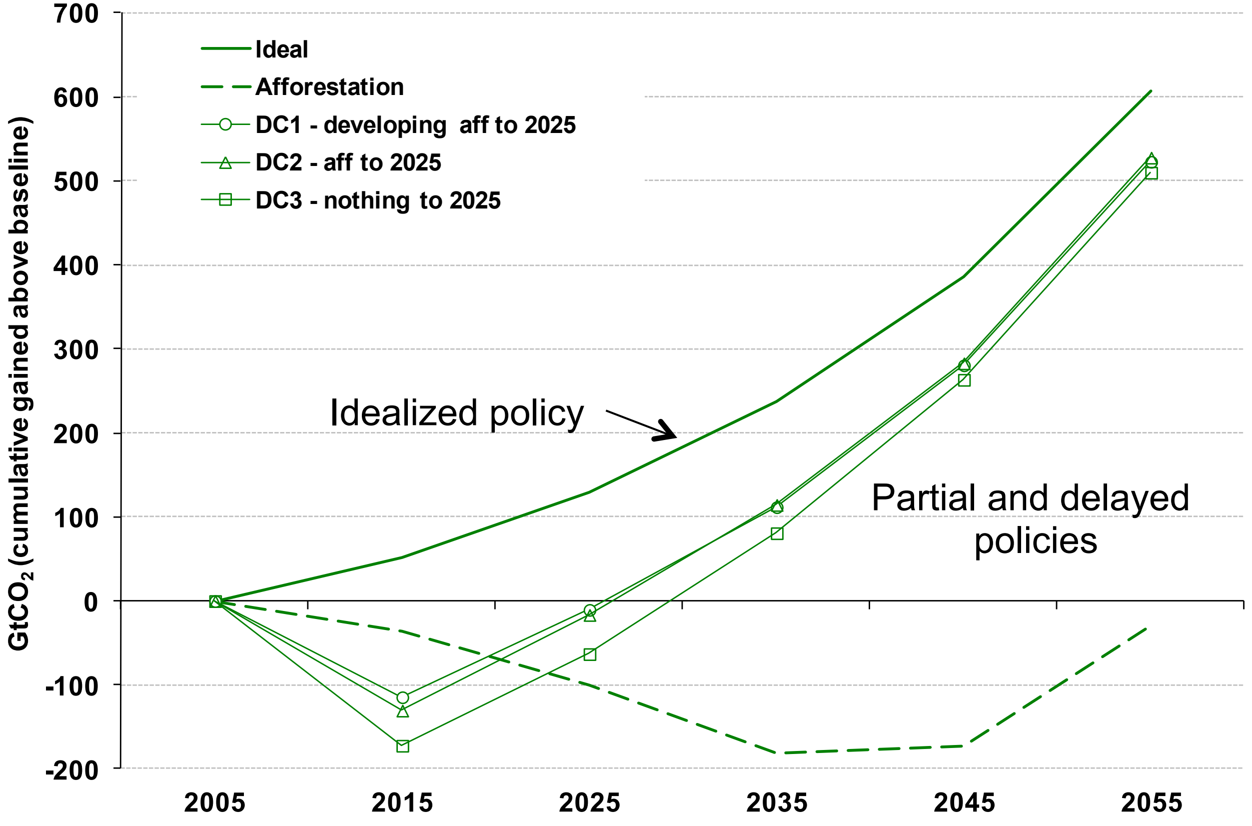
Calvin et al. (2009)

Coordination challenge across regions and activities

Partial and/or delayed global forest carbon policies could accelerate deforestation

Competition b/w avoided deforestation and afforestation, but complementarities b/w afforestation and forest management

Cumulative global forest carbon gains over time with different global forest carbon policy designs ($15/tCO$_2$ + 5%/yr)



Developed from Rose and Sohngen (2011)

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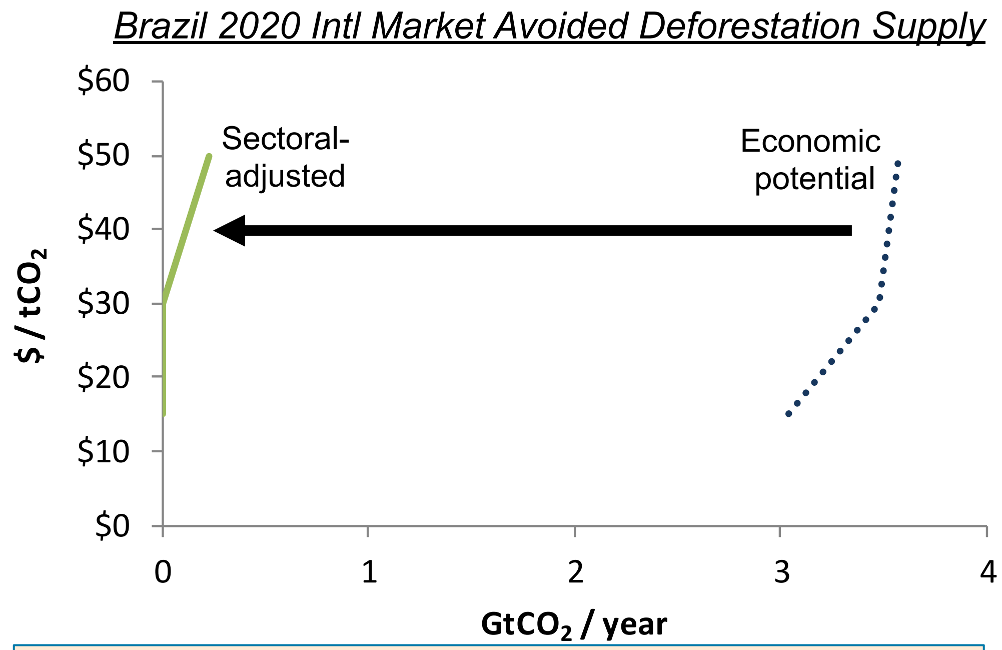
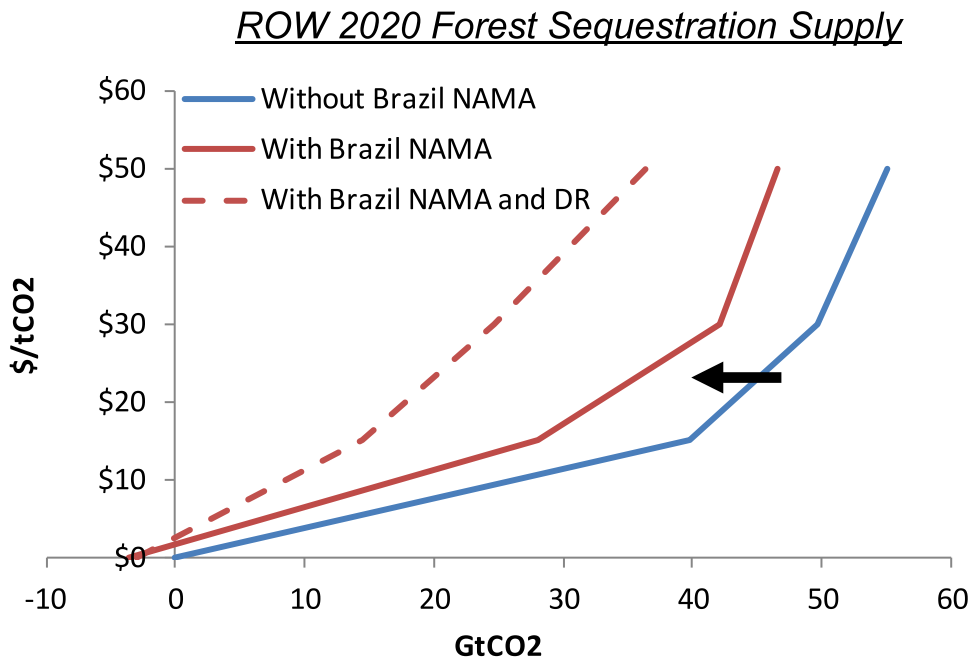
Coordination challenge across regions and activities

Brazil avoided deforestation (RED) policy…

- Reduces international abatement supply
- Drives up forest carbon abatement costs for others

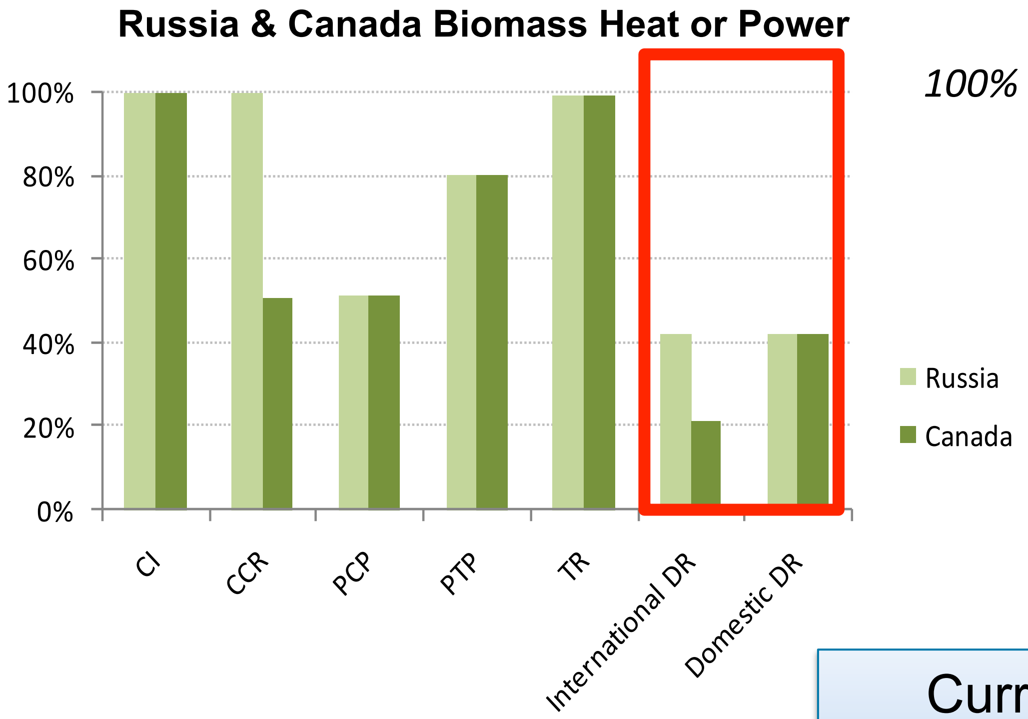




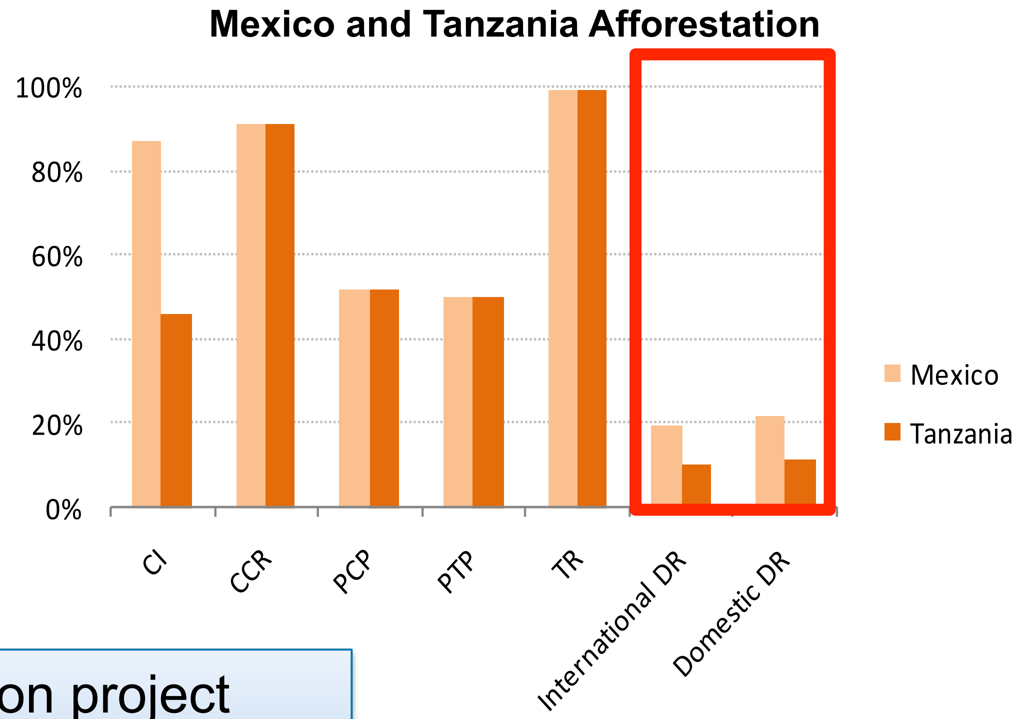
Copenhagen commitment: Reduce deforestation rate 80% by 2020 compared with the average rate over the decade 1996–2005 (19,508 km^2/year)

Institutions affect costs – abatement project risks

Projects have costs beyond those captured in global economic modeling – e.g., country and technology risks, transactions costs



100% = no risk



Current carbon project investment risks are significant

Rose et al. (in prep)

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Institutions affect costs – abatement project risks

Risks change abatement supply costs and importance of regions and technologies

Cumulative Carbon Gains* Above Baseline by 2020 ($15/tCO$_2$)

	Economic potential (GtCO2)	Market potential (GtCO2)	% of economic potential	Prescribed delivery rate
India	11.6	10.6	91%	50%
SE Asia	8.7	0.5	6%	37%
Sub-Saharan Africa	7.3	1.4	19%	22%
Rest of S America	6.3	3.4	55%	38%
Brazil	5.7	4.2	73%	46%
China	4.5	4.2	94%	50%
Russia	3.1	2.0	63%	51%
Oceania	2.6	0.8	31%	29%
C America	2.6	2.5	97%	38%
E Asia	2.2	0.2	10%	35%
S Asia	0.6	0.1	16%	28%
N Africa/Middle E	0.6	0.5	82%	25%
Group 2 Total	55.7	30.4	55%	n/a

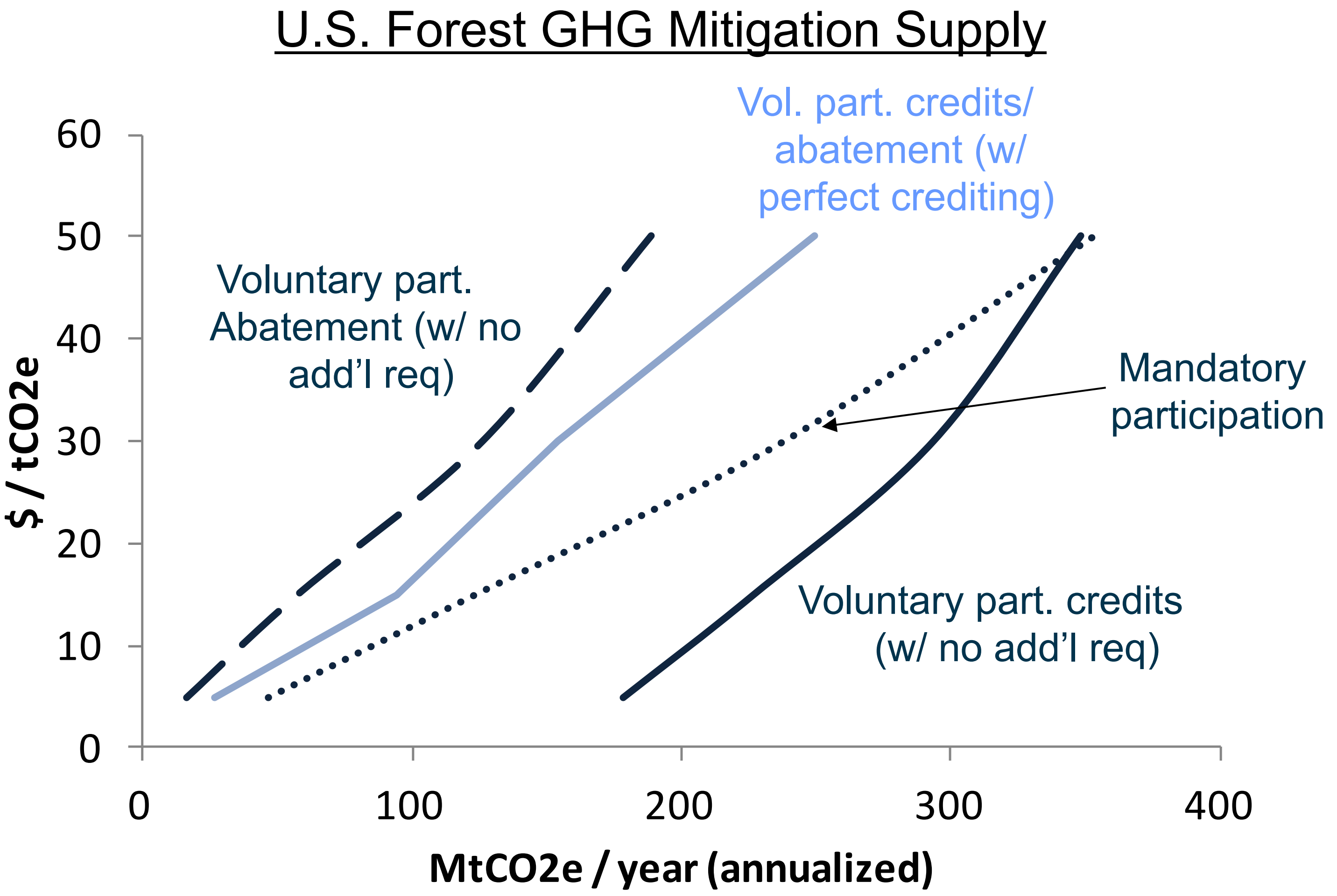
* Note: Includes additional aboveground and below ground carbon sequestration

Rose et al. (in prep)

Policy instrument matters – mandatory vs. voluntary abatement incentives

Credit supply and net mitigation will depend on the type of incentive!

With voluntary participation incentives, abatement likely (a) **<u>less</u>** than with mandatory participation incentives, and (b) **<u>less</u>** than the credits supplied.



Rose et al. (in prep)

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Non-market policy instruments?

- E.g., land management best practices or conservation (maybe with multiple objectives)
- Pragmatic? Economically efficient?
- Implementation still a challenge. Same issues lurking:
  - Coordination
  - Institutions
  - Instruments

Coordination challenge with non-climate policies

Some non-climate policies

- Sustainable development
- Farm
- Conservation
- Trade
- R & D

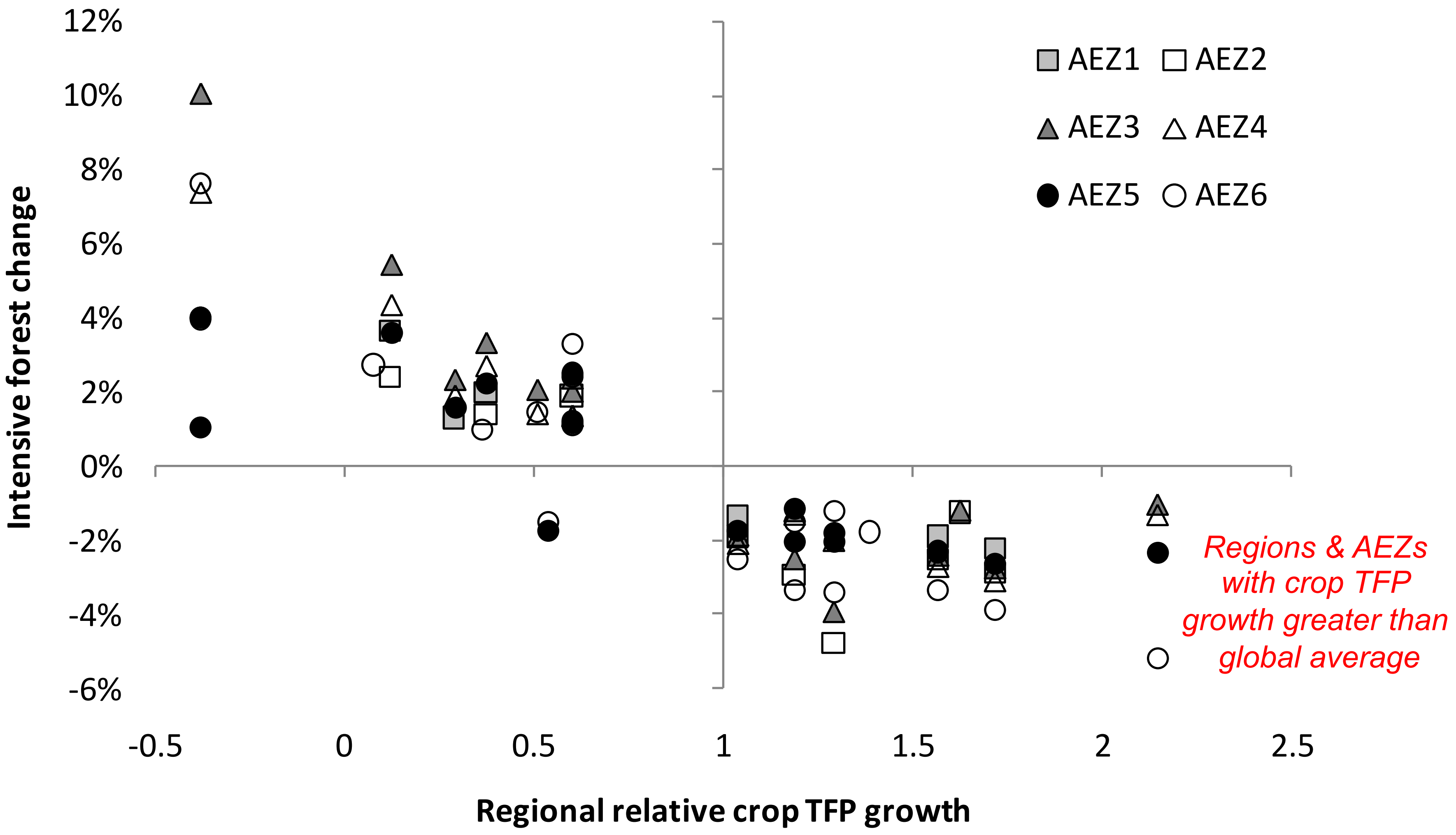
Other land-related social concerns

- Food
- Fiber
- Water
- Soil
- Biodiversity
- Income
- Culture

E.g., bioenergy could drive up prices and motivate land conversion, so could forest protection or enhancement, together even more so

Coordination challenge with non-climate policies

Future agricultural productivity improvements could result in **increased** deforestation



Rose, Golub, Sohngen (2013)

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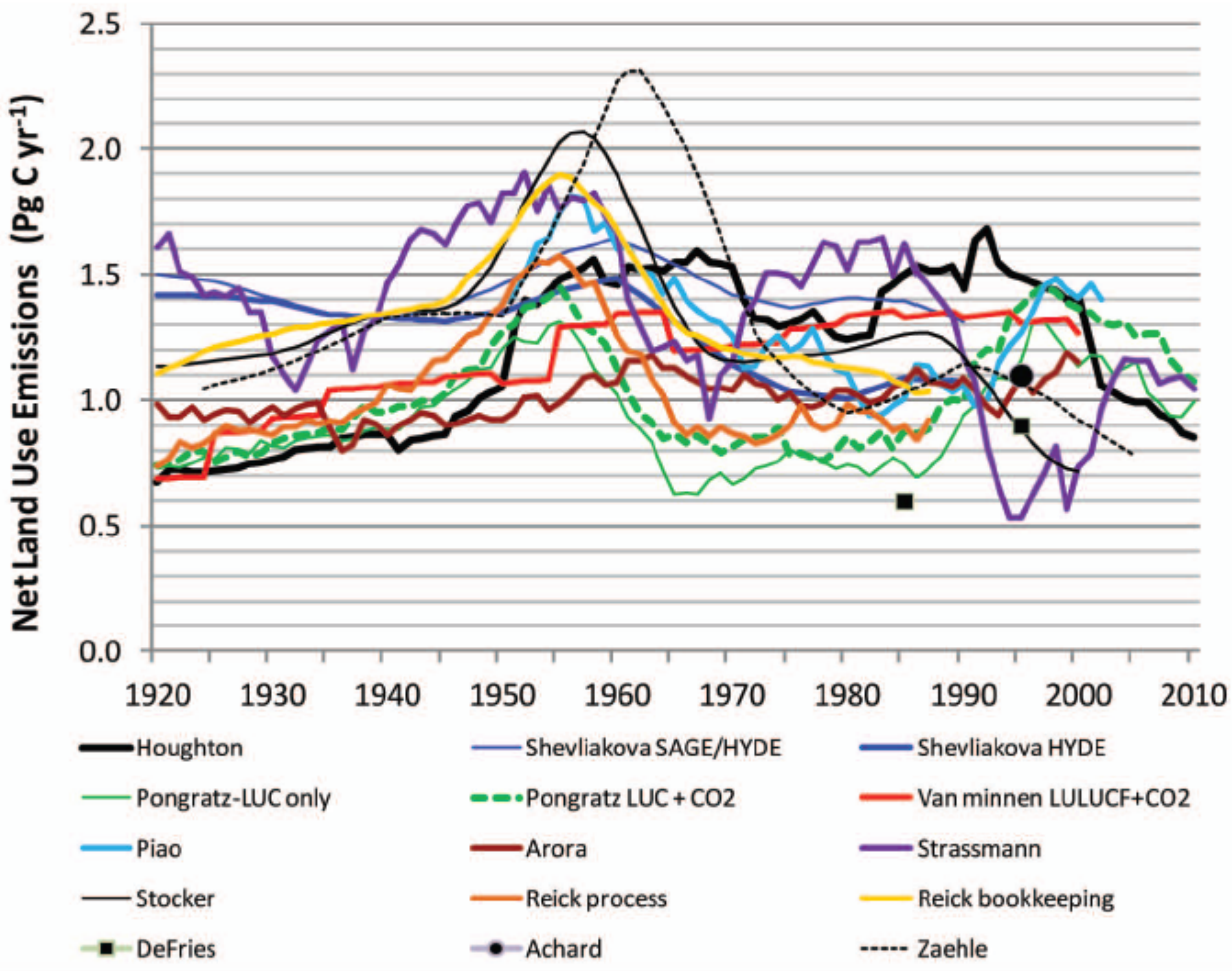
Additional modeling issues

- Historical uncertainty – ignored, yet large
  - Biophysical – land conversion, carbon densities, marginal land productivity
  - Economic – land extensification & intensification behavior, agricultural productivity changes
- Technological change – how it is modeled matters
  - PFP v TFP: land saving v land using. History suggests TFP changing.
- Expectations about future markets
- Land-use conversion constraints – hidden, but can be significant

Historical understanding poor

e.g., 1990s net land-use/cover change emissions



1990s

1.3 +/- 0.23 PgC/yr

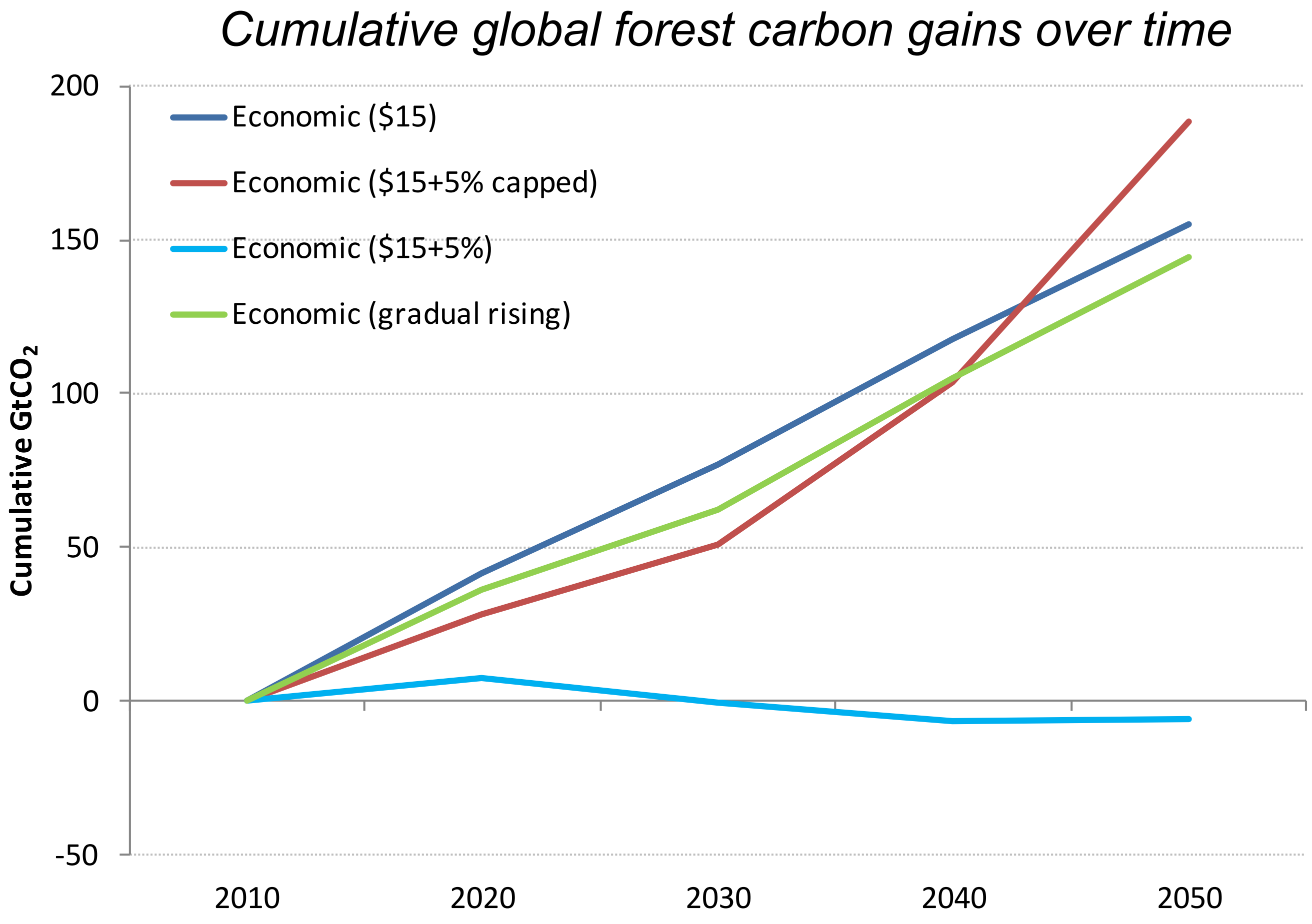
(across studies)

Differences in LULCC rates and area, C densities, included processes, environmental change

Houghton et al. (2012)

Future markets – expectations

Expectations of higher future carbon prices can delay forest carbon gains.



Rose et al. (in prep)

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Concluding thoughts

- It will be challenging to abate with land on a large global scale – with market or non-market policies
  - Significant policy implementation and design challenges that affect mitigation costs and net GHG benefits
  - Substantial near-term abatement seems unlikely
- Some near-term pain may be necessary for long-term climate gain
  - Significant potential that over long-run could be net beneficial
- More realistic modeling needed to properly evaluate land's role
  - Our understanding is fairly limited
- Important modeling issues to consider
  - Including uncertainties in our basic scientific understanding

Thank You

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