HOW SAFE IS IT TO BET ON FOREST CARBON SINKS?

Assessing the Economic and Distributional Implications of Forest-related Initiatives in Climate Change Mitigation Strategies

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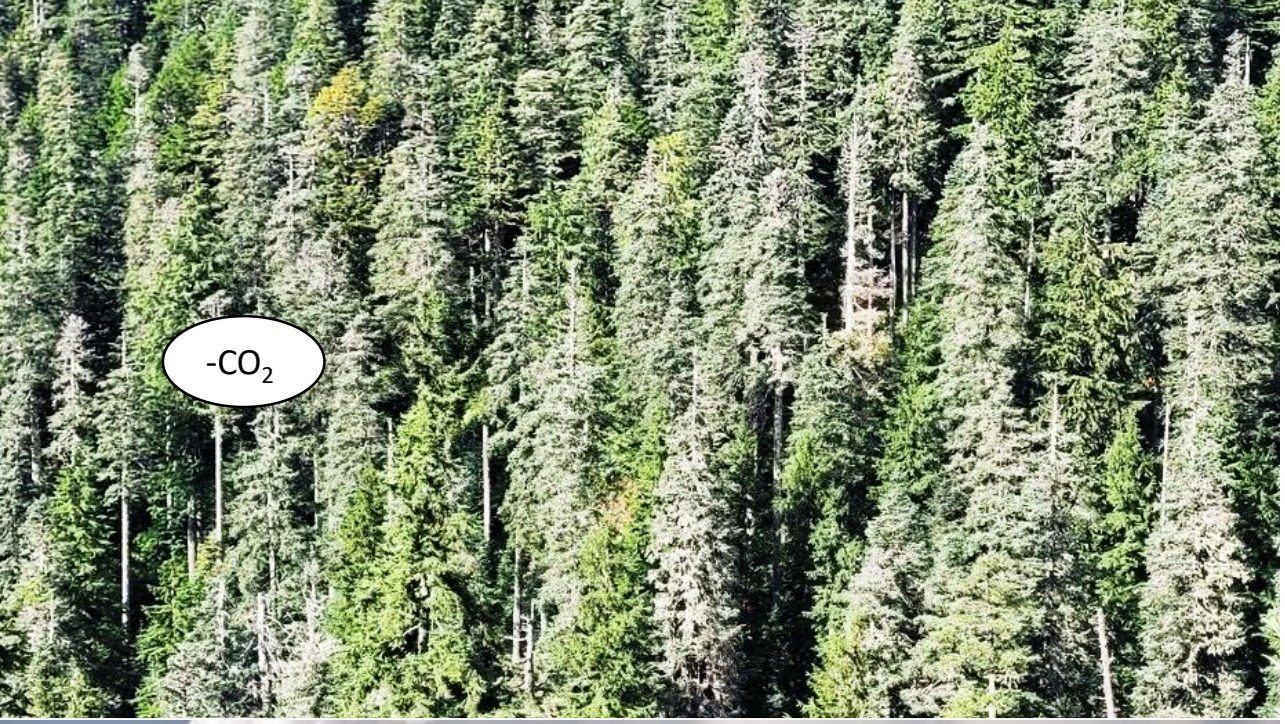
IAEE International Association for ENERGY ECONOMICS



http://www.americanforests.org/blog/forests-carbon-sinks/

INTRODUCTION

- Meeting climate stabilization targets requires vast employment of **carbon dioxide removal technologies (CDR)**
- Forest interventions (**afforestation reforestation/REDD**) provide low-cost and large-scale available technology
- These interventions create forest carbon storage, referred to as **Forest Carbon Offset** (**FCO**), that can be used to achieve climate target
- CDR allows a **reduction** of the effort needed for **decreasing actual emissions** from the energy sector

INTRODUCTION

- Forest carbon offsets (FCO) have **challenges and risks**:
  - **Permanence of carbon sink** (e.g., natural and human disturbances)
  - **Overestimation** (e.g., institutional flaws for monitoring, enforcing, accounting)
  - Perverse **incentive to decrease effort in emissions mitigation** (i.e., moral hazard)
  - **Exacerbation of inequality** (where is the forest carbon sink established and who is benefitting it?)
- FCO are part of an **integrated system** where **expectations matter** → particularly important for **large scale deployment**
- If/when expectations are wrong, **risk of not optimal decisions in mitigation strategies** (myopic behavior)

https://serpmedia.org/scigen/l1.2.html

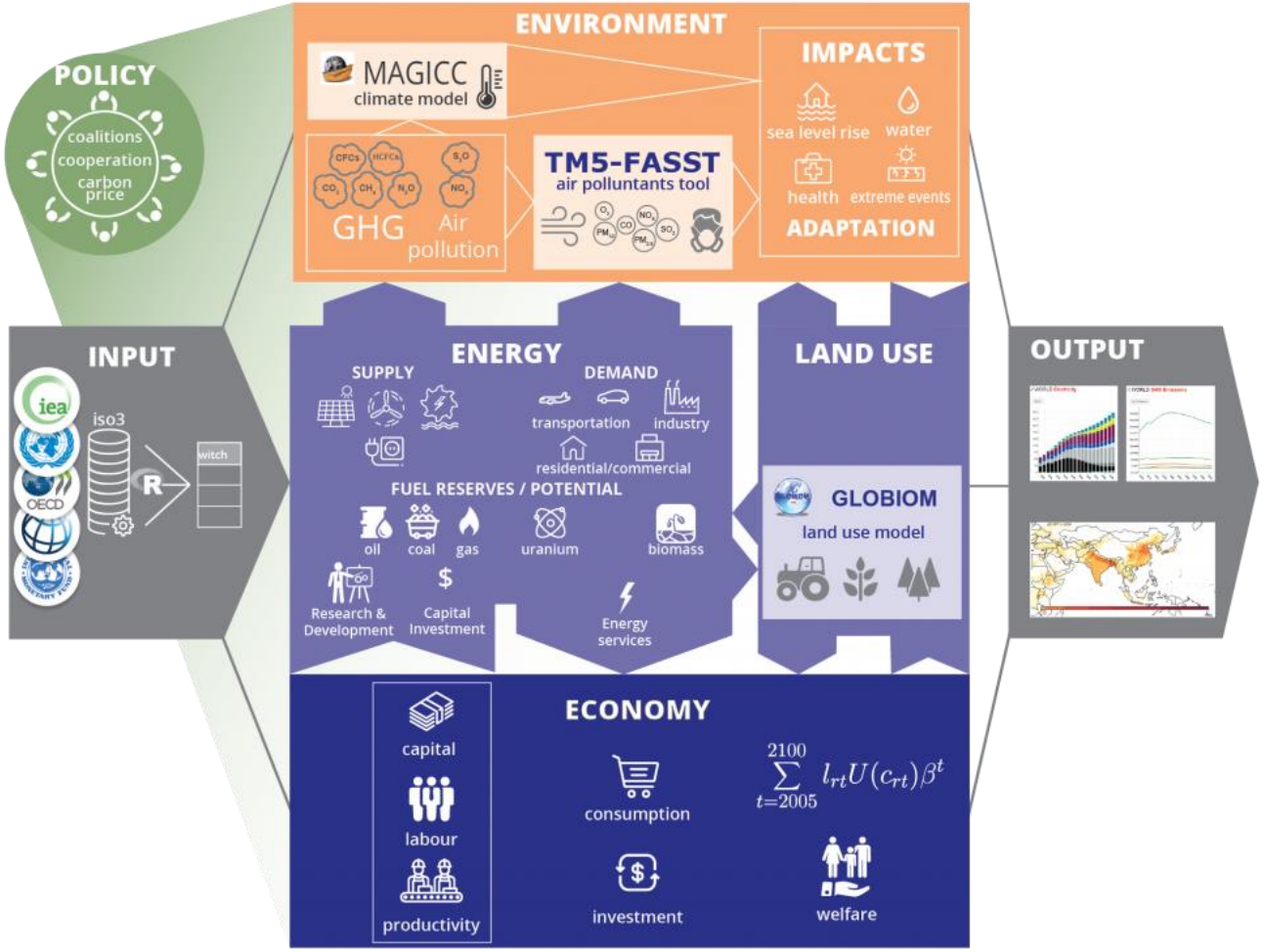
GOAL

Understand **how the use of FCO impacts the energy transition**

OBJECTIVES

- Quantify the **impact of using FCO** on investment in renewables, R&D, carbon capture technologies, and fossil fuels
- Quantify the **cost (GDP loss) associated to failure/overestimation of FCO**
- Understand **how the cost** associated to failure/overestimation of FCO is **distributed across world regions** (OECD vs Non-OECD)

METHODOLOGY – THE WITCH MODEL



https://www.witchmodel.org/model/

- Economy is modelled through an inter-temporal optimal growth model
- Bottom-up + top-down energy sector modelling
- Learning-by-doing and learning-by research
- Investment to maximize societal welfare (endogeneity of R&D diffusion and innovation process)

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- Future cost of green technology function of the current investment decisions
- Expectations about net carbon budget

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- Wrong expectations – suboptimal investment path
- Sharp re-adjustment – costs

Methodology – Runs of the model

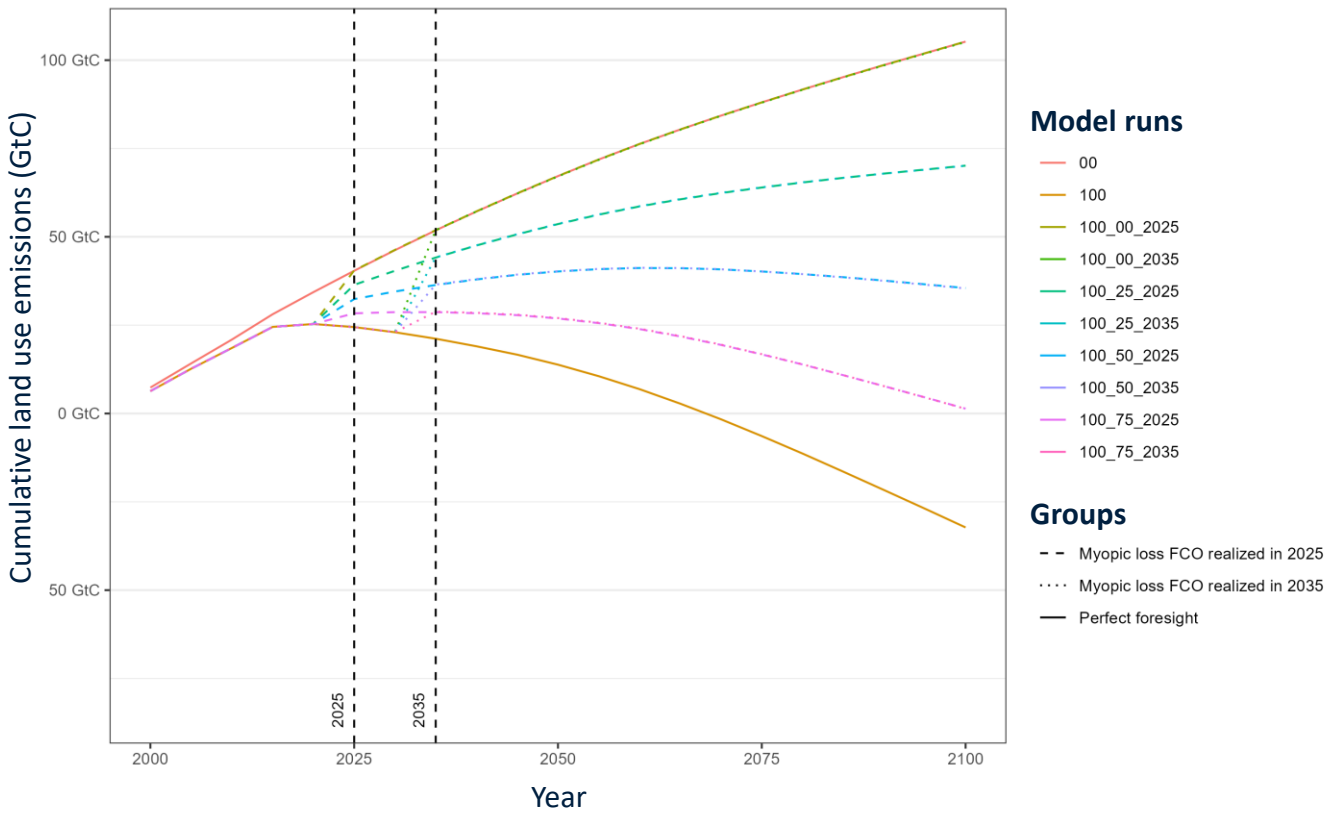

Figure 1: Cumulative carbon emissions trajectories for the perfect foresight (R1 and R2), and for the myopic scenarios (M1-M8).

- **Global emission target** (2 degree Celsius goal)
- 17 regions with perfect cooperation (mitigation strategies optimized for cost minimization)
- **Perfect foresight** (including sensitivity analysis of investment to %FCO) – 6 scenarios
  - **FCO** = 0% (R1), 20%, 40%, 60%, 80%, 100% (R2)
  - R2 (100% FCO) used to calculated maximum quantity of FCO the system would use
- **Myopic losses** (including different loss magnitude and correction timing) - 8 scenarios (M1-M8)
  - **Loss FCO** = 25%, 50%, 75%, 100%
  - **Correction year** = 2025, 2035
- Myopic losses represent **actual loss due to human or natural disturbances** as well as **mis-accounting of FCO for institutional/monitoring failure**

FCO ARE MOSTLY PROVIDED BY NON-OECD COUNTRIES

Perfect foresight 100% FCO

- FCO indicates the carbon stored through afforestation/reforestation or REDD due to the existence of a carbon price (additionality)

- **80% of FCO are provided by non-OECD countries** while only 20% by OECD countries

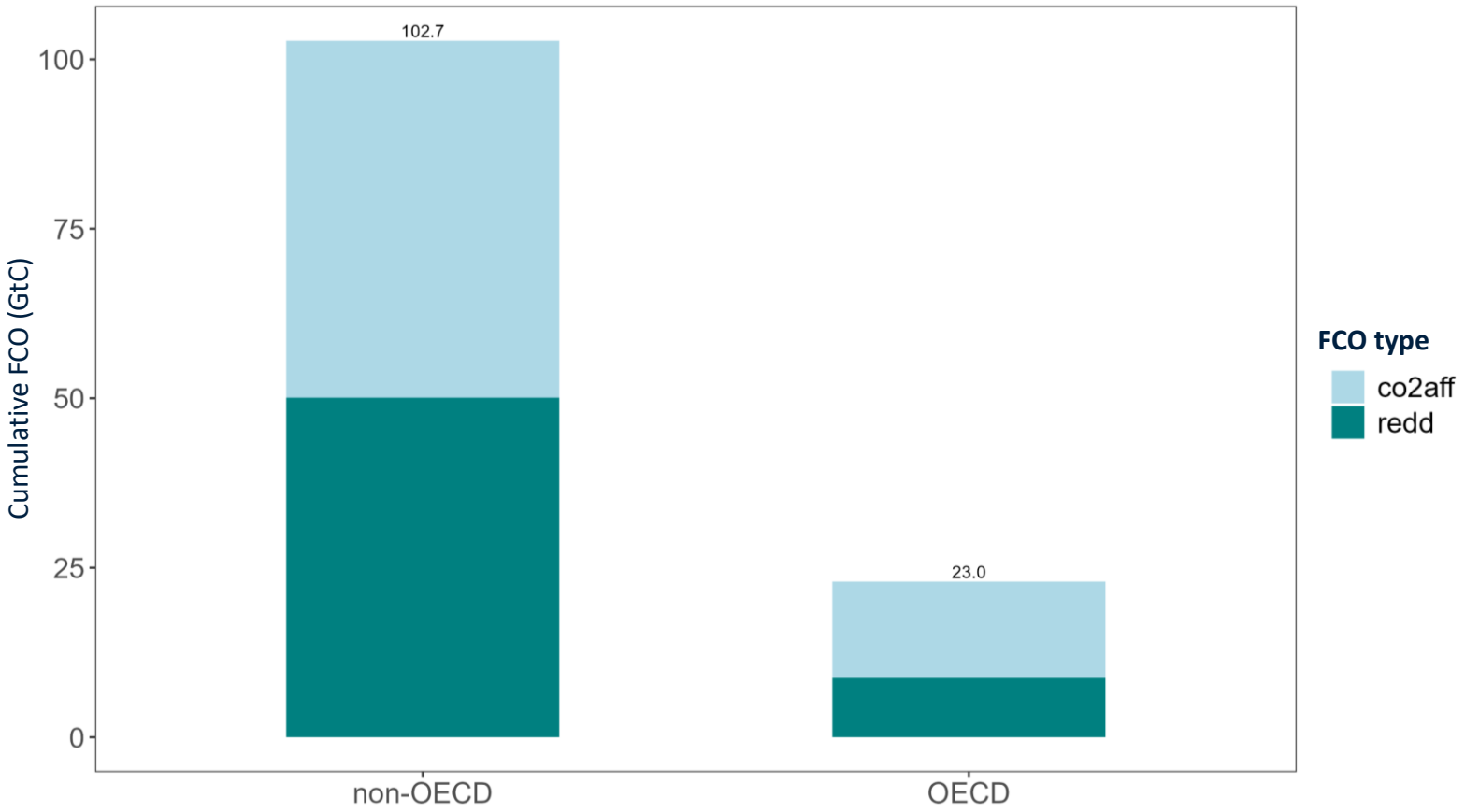

Figure 2: Cumulative CO_2 stored from reforestation/afforestation (co2aff) and REDD (redd) from 2020 to 2100

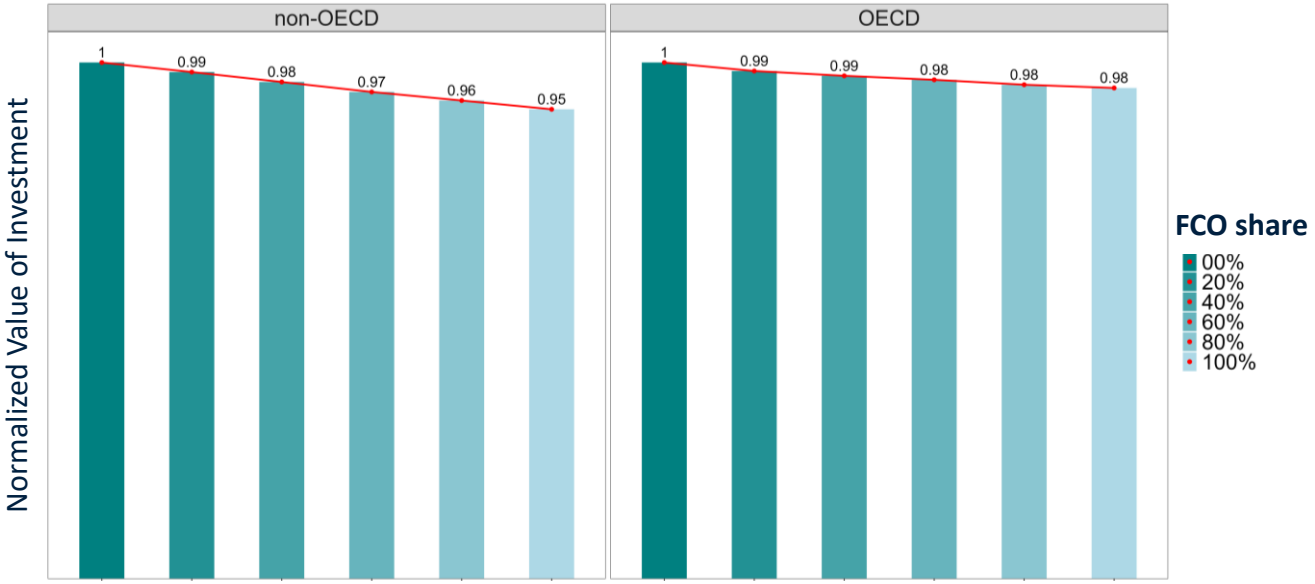

Figure 3: Change in investments in **renewables** for different FCO share

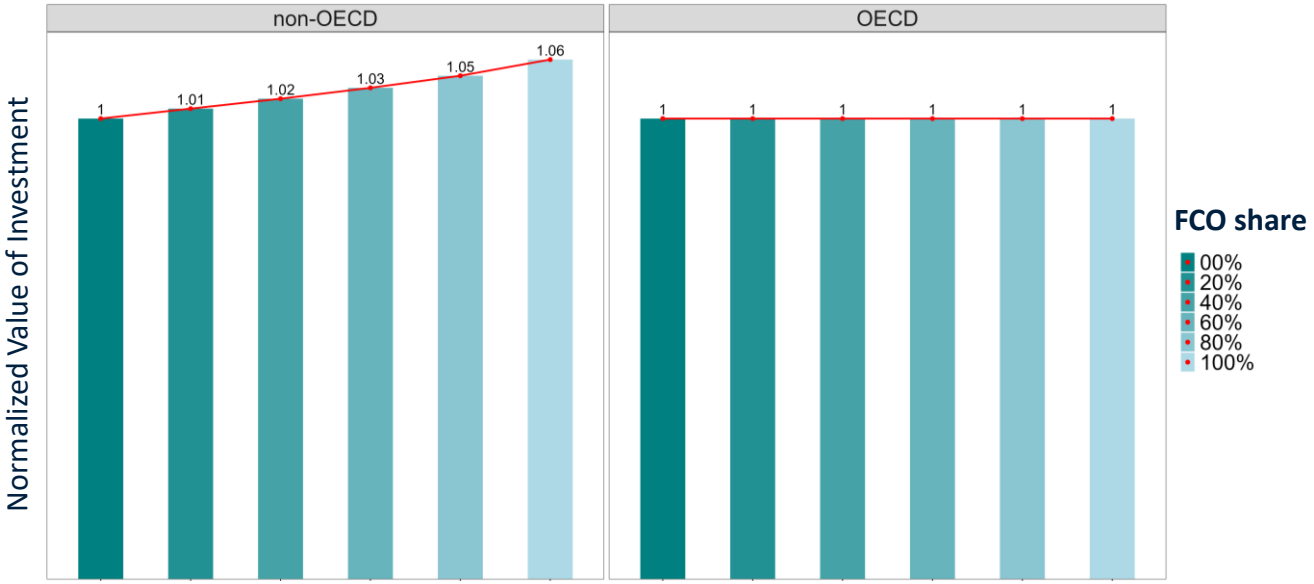

Figure 4: Change in investments in **fossil fuel** for different FCO share

FCO IMPACTS THE ENERGY TRANSITION STRATEGY MORE IN NON-OECD COUNTRIES

Perfect foresight scenarios

- FCO changes the investment in **deployment of renewables** (non-OECD 5% vs OECD 2%):
  - Affect learning-by-doing curve
  - Impact **future costs** (decrease in **learning-by-doing**)
- FCO seems to be used as **fossil fuel** offsets just in **non-OECD countries.** OECD deployment of fossil fuel remains unchanged

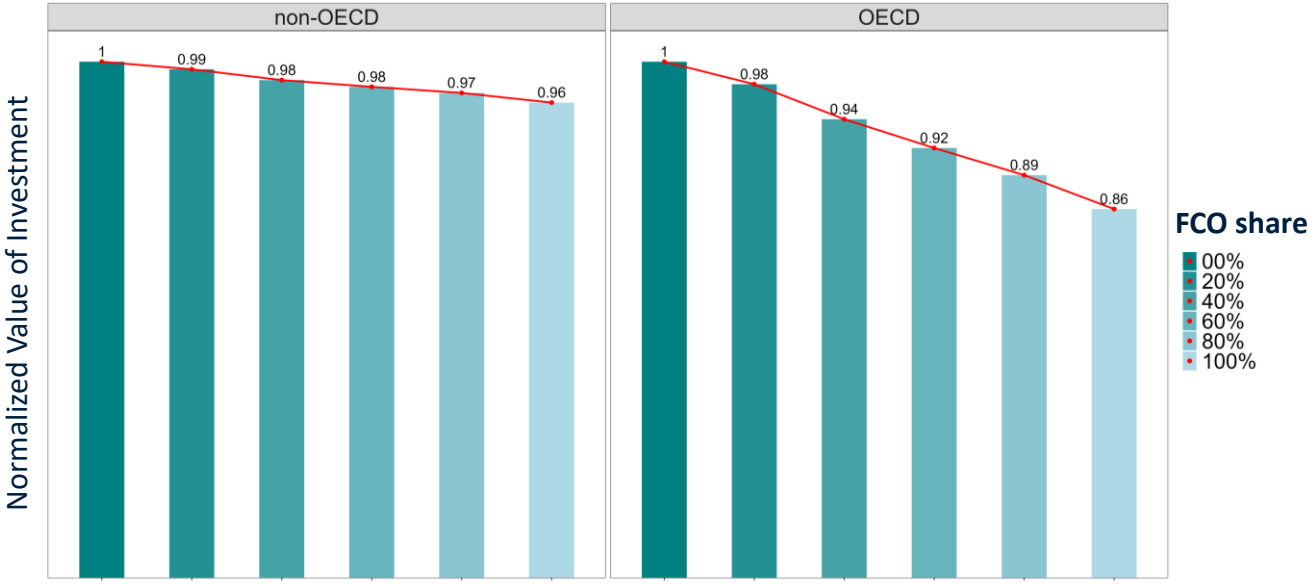

Figure 5: Change in investments in **CCS** for different FCO share

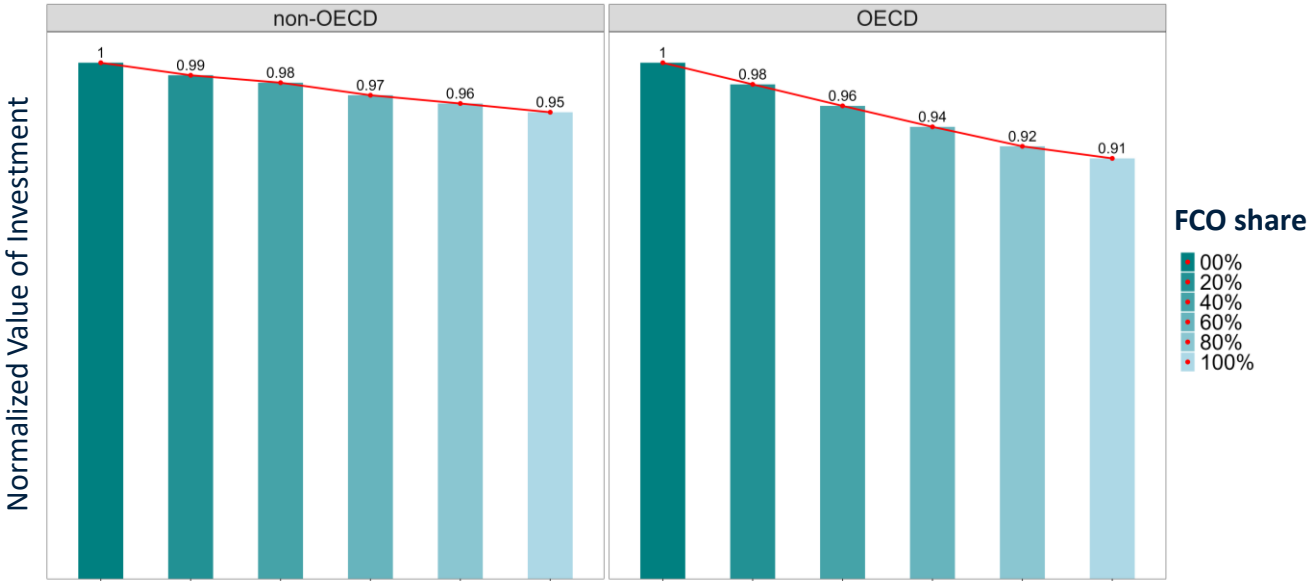

Figure 6: Change in investments in **R&D** for different FCO share

FCO IMPACTS THE INVESTMENT IN NEW TECHNOLOGIES MORE IN OECD COUNTRIES

Perfect foresight scenarios

- **Innovation** is more impacted in OECD countries
- **CCS** (carbon capture storage) shows the highest correlation with FCO share – CDR substitution
- **R&D** in backstop technologies decreases (non-OECD 5% vs OECD 9%)
  - Affect **learning-by-research** (decreases knowledge stock)
  - Impact **future costs**

NON-OECD COUNTRIES HAVE THE MOST TO LOSE FROM FCO FAILURE

Table 1: GDP loss compared to BAU for **selected perfect foresight scenarios** (R1 and R2 only), and **myopic scenarios** (M1-M8).

Run	FCO	Loss FCO	Correction year	GDP loss global	GDP loss OECD	GDP loss non-OECD
R1	0%	0%	-	3.7%	3.2%	4.3%
R2	100%	0%	-	2.4%	2.1%	2.6%
M1	100%	25%	2025	2.7%	2.4%	3.0%
M2	100%	50%	2025	3.0%	2.7%	3.4%
M3	100%	75%	2025	3.4%	3.0%	3.9%
M4	100%	100%	2025	3.9%	3.3%	4.5%
M5	100%	25%	2035	2.7%	2.4%	3.0%
M6	100%	50%	2035	3.1%	2.7%	3.5%
M7	100%	75%	2035	3.6%	3.1%	4.1%
M8	100%	100%	2035	4.2%	3.5%	4.9%

Discussion and Implications

- The **majority of FCO** (80%) comes from **non-OECD countries**
- FCO has implication **on how the energy transition will look like**, decreasing investment in new green technology (R&D and CCS), mostly in OECD countries.
- Deployment of renewables seems to be less sensitive to FCO (more for non-OECD countries)

- The reduction in investment will increase the **cost of the new technologies in the future**
- However, the regional results are limited as these model runs apply a **global carbon budget** and a **unique global carbon price**

- **Perfect foresight (R1-R2)**: FCO could reduce the cost of climate mitigation (**1.3 pp globally**) more significantly for non-OECD countries (1.6 pp)
- Myopic loss of FCO (**M1-M8**) are more costly for **non-OECD countries**
- In the worst myopic case scenario (**M8**) **GDP loss is 0.5 pp (+13%)** bigger than the GDP loss for perfect foresight allowing 0% FCO

- Analysis of **timing of correction** is limited and modelled early (up to 2035) allowing the system to adjust and still be able to meet the climate target (2 degree Celsius)
- **Direct mitigation action** is the best way to prepare for the high uncertainty of nature based solutions (forest mitigation actions)

Conclusions and steps forward

- FCO influences investments and GDP
- FCO impact on investments is very different between OECD countries and non-OECD ones → **different use of FCO**
- **GDP is more sensitive to use and failure of FCO in non-OECD countries** → this poses **equity concerns** and requires a deeper analysis on the cost-benefits-risks of FCO
- Reforestation/afforestation and REDD+ could still contribute to mitigation efforts, but need to account for buffer of loss that could decrease the appeal of forest interventions
- Uncertainty about future forest disturbance and forest policy evolution might have significant impacts on the actual losses
- Forest based mitigation initiatives could create **more benefits** than only carbon sequestration

Thank you!

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