# Emissions paths consistent with remaining below 2 degrees C

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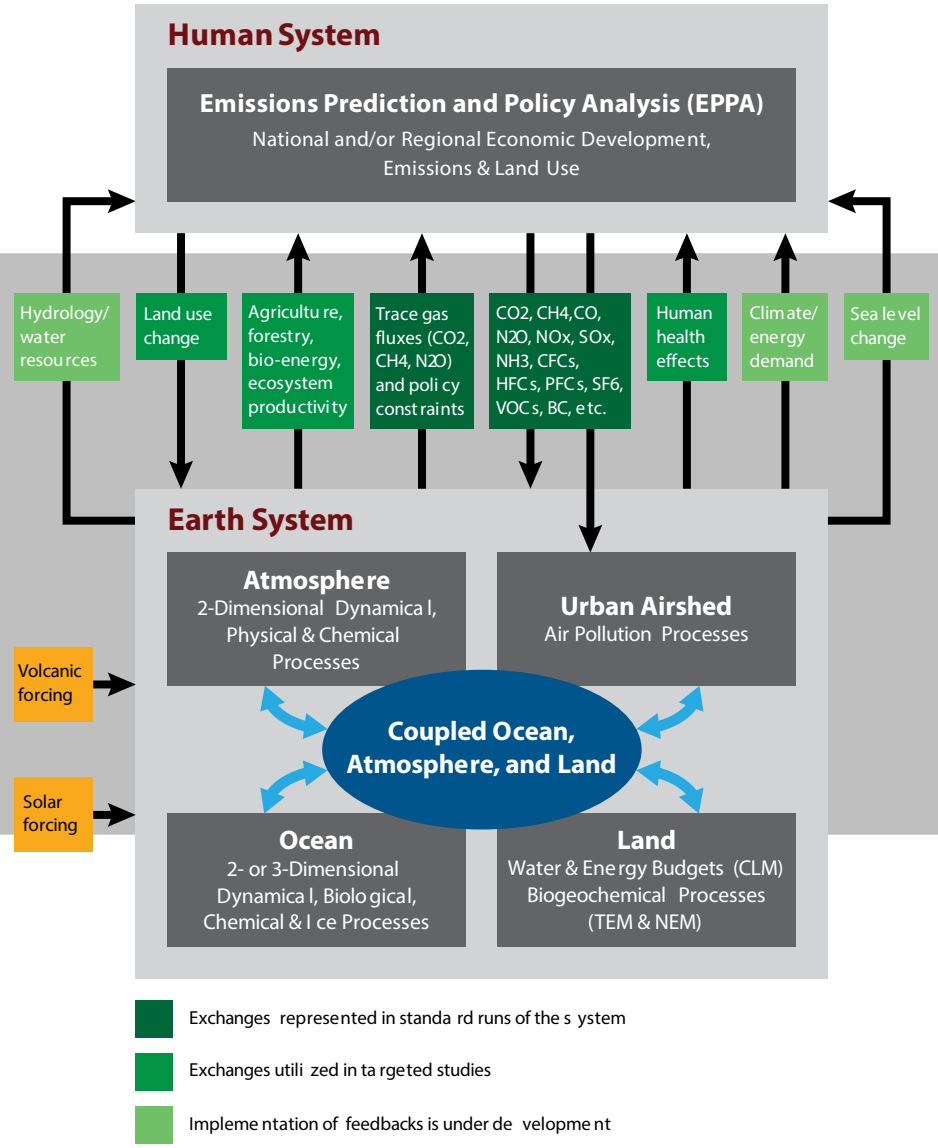
Thanks to Jennifer Morris and Andrei Sokolov

# Emissions paths consistent with remaining below 2 degrees C

- Much of the focus is on emissions through 2050—quite reasonable.
  - But what we assume is possible after 2050 determines how much we need to do now through 2050.
- My story: How do assumptions about
  - when we start
  - forest sinks
  - BECCs
  - ability to get to zero fossil emissions post-2050
  - climate uncertainty

  affect 2020-2050 emissions

# Method: Apply the MIT IGSM and some simple assumptions about abatement post 2050




The MIT Integrated Global System Model (IGSM)

# Scenarios

1. Global carbon price starting in 2020, constant in net present value dollars through time—i.e. rising at a 4% discount rate.

2. Paris through 2025, global carbon price phased in from 2026-2030.

3. Avoided deforestation and land sinks contribute 210 Gt of abatement (Reilly et al, 2012), allowing extra headroom for other emissions equally from 2030-2100.

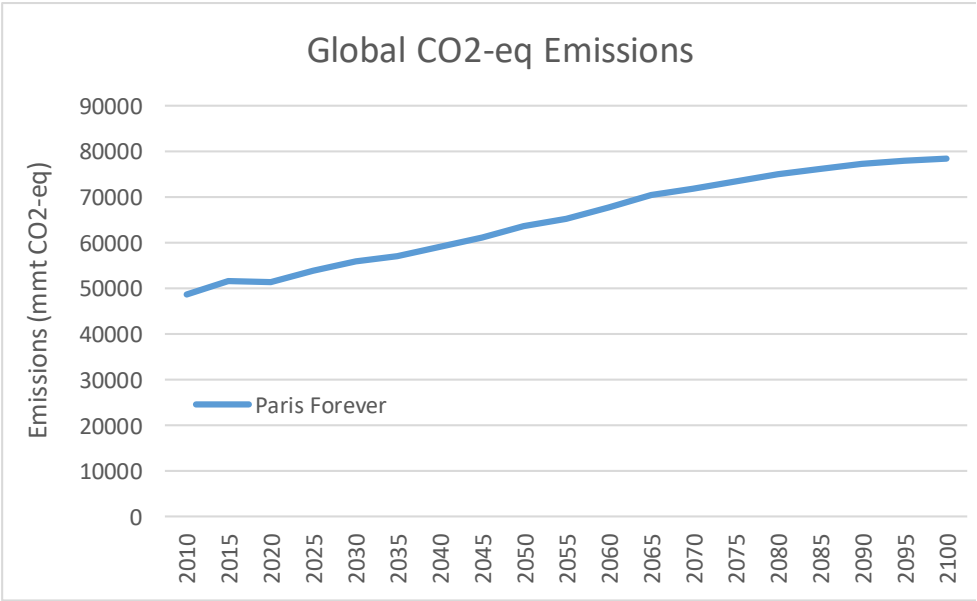
4. Forest and land contribution of 210 Gt with all the headroom used from 2030-2050.

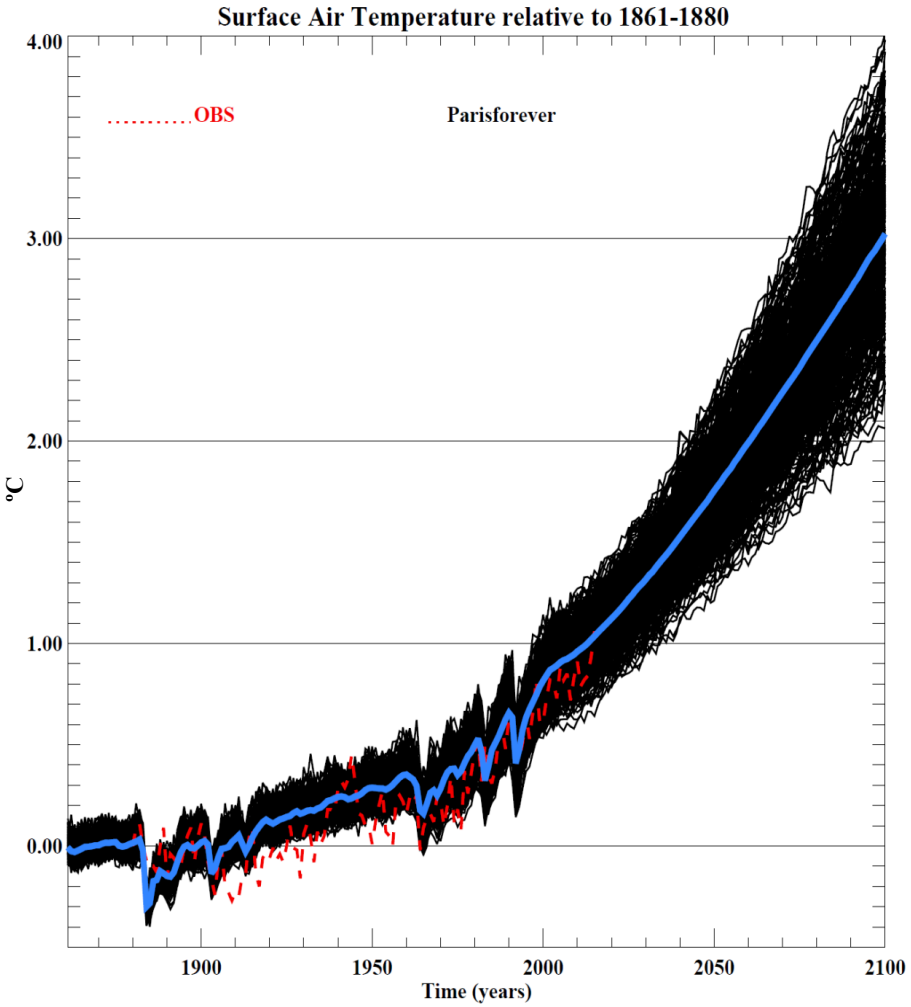
5. BECCS of 250 Gt (mid range of IPCC) cumulative after 2050, headroom used from 2030-2050.

6. Net zero fossil energy emissions after 2070, extra headroom used from 2030-2050 (Difficult-to-reduce methane from livestock/rice, nitrous oxide from fertilizer remain in the post 2070 period.)

2° C with a 50/50 chance, and with a 67% likelihood

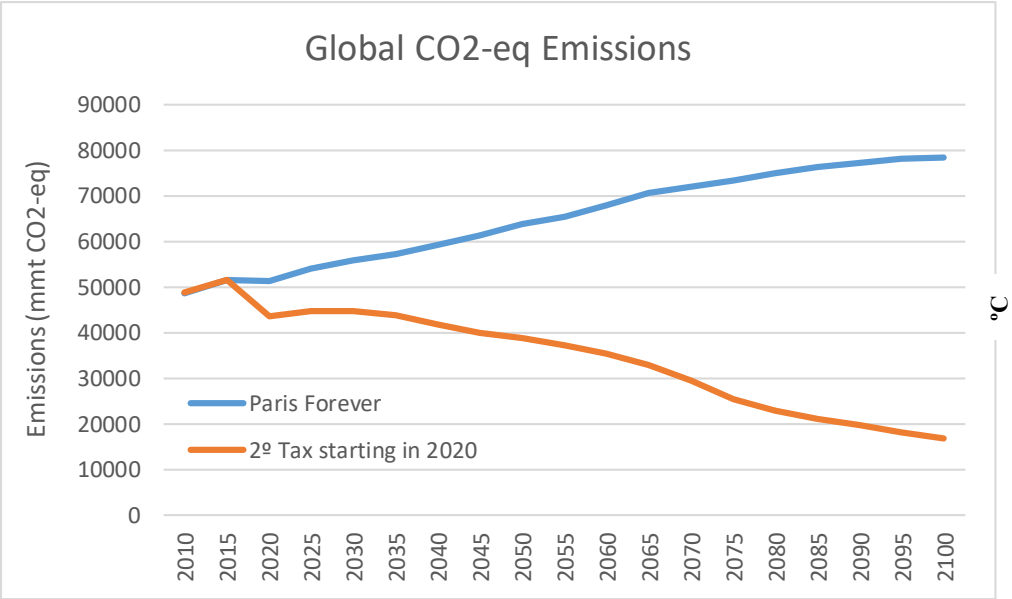
# Global Emissions & Temperature Change, Paris Forever

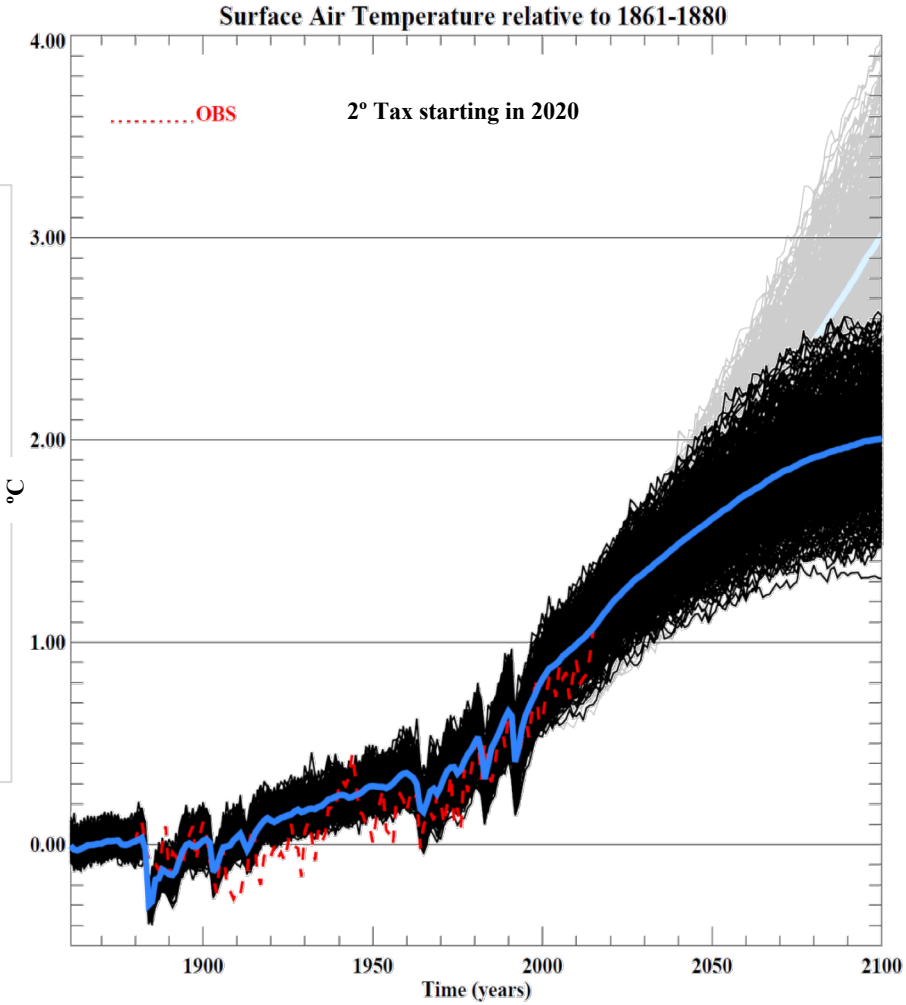


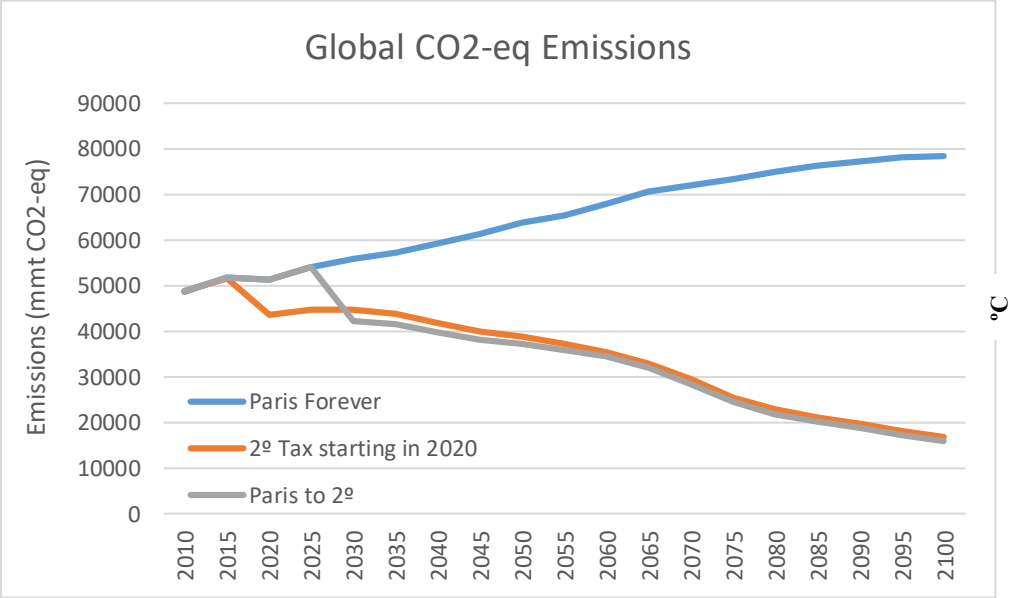

Sokolov, et al., 2017, JP Report No. 320

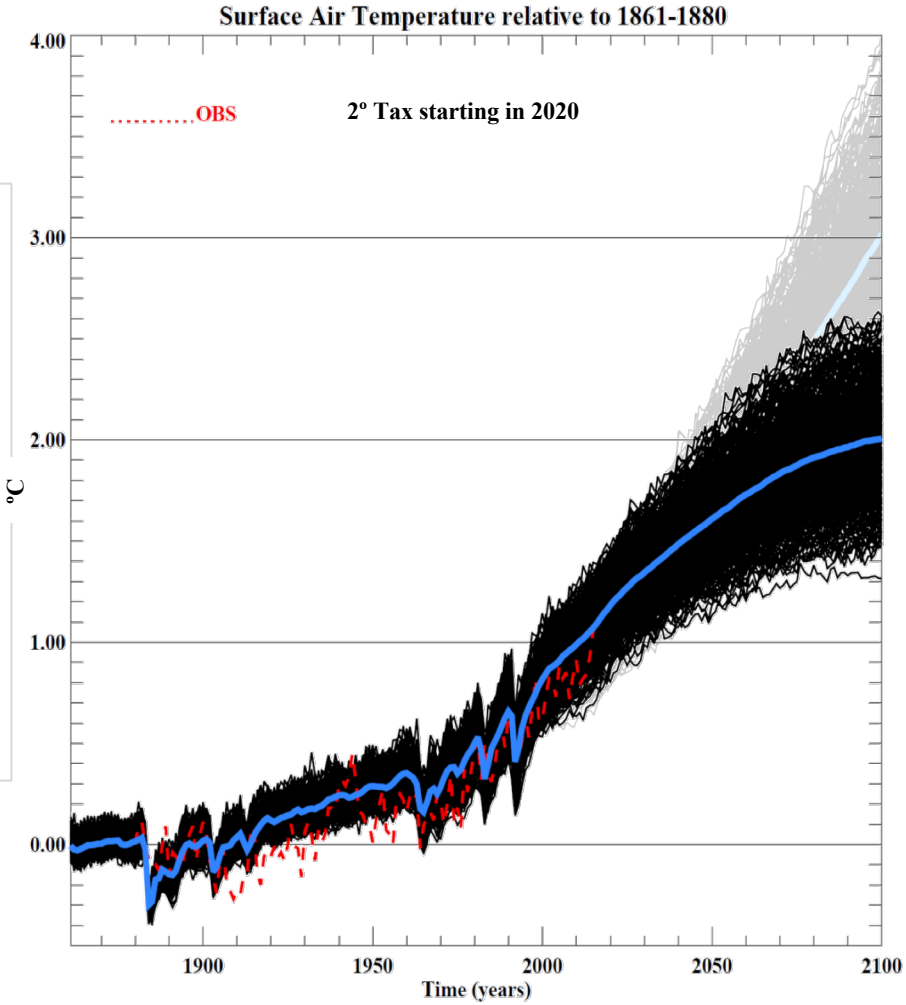
# Global Emissions & Temperature Change, 2°C Starting in 2020



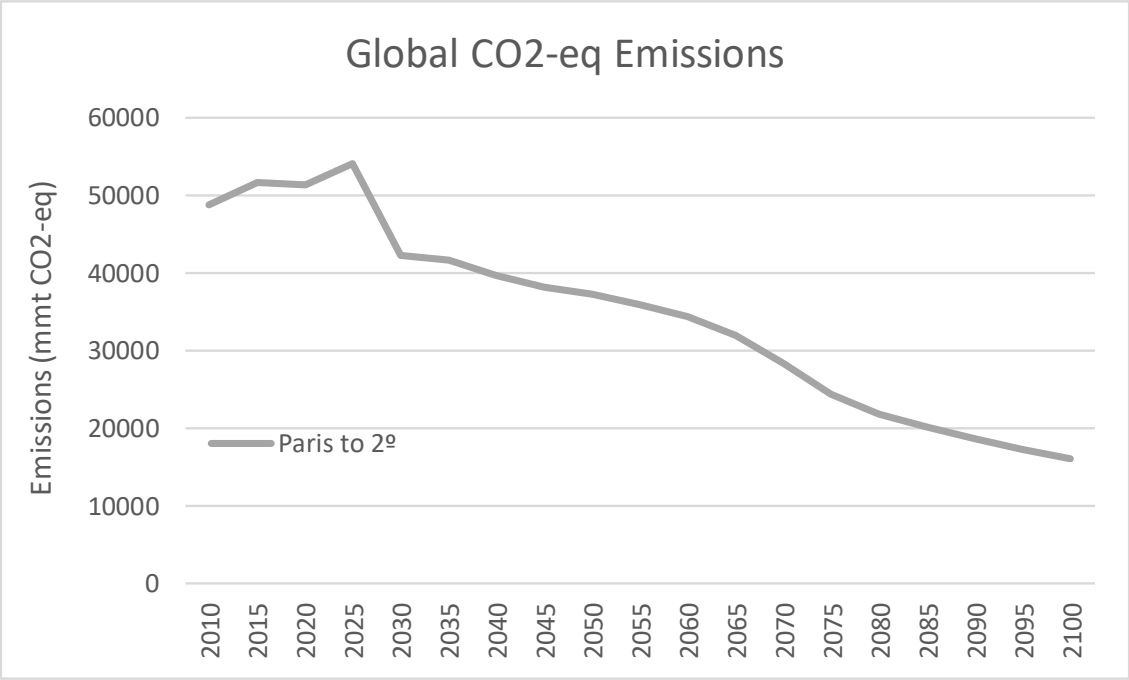



# Global Emissions & Temperature Change, Paris to 2C

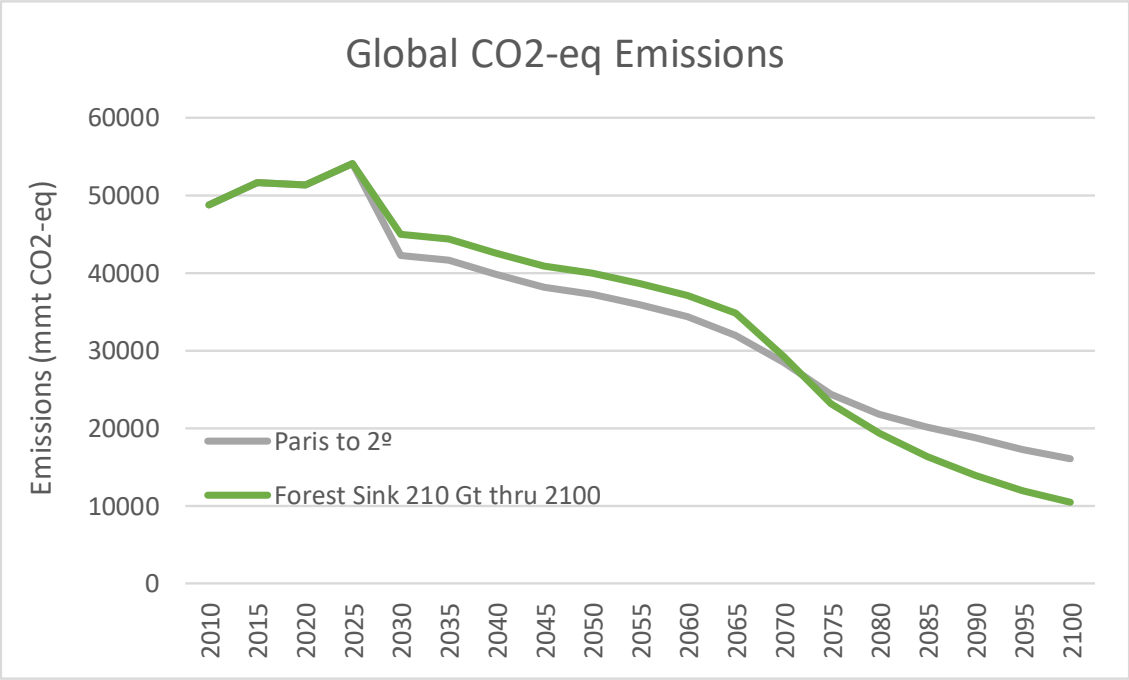


# Emissions Pathways to 2C: Paris to 2C



# Emissions Pathways to 2C: New Forest Uptake



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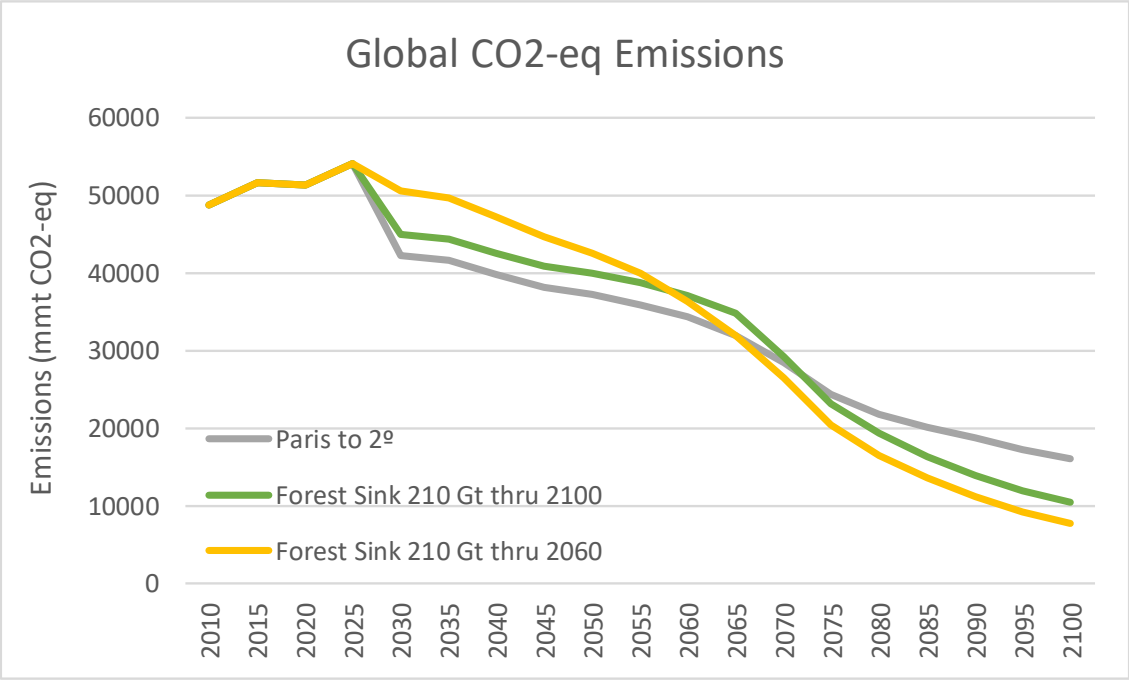

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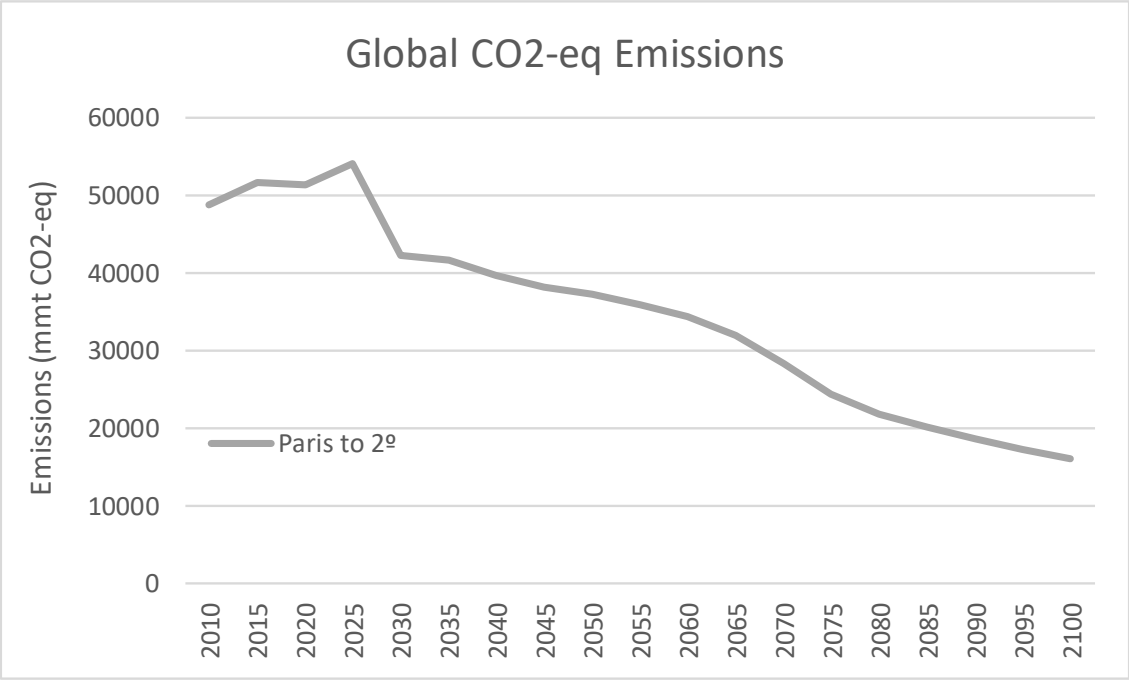
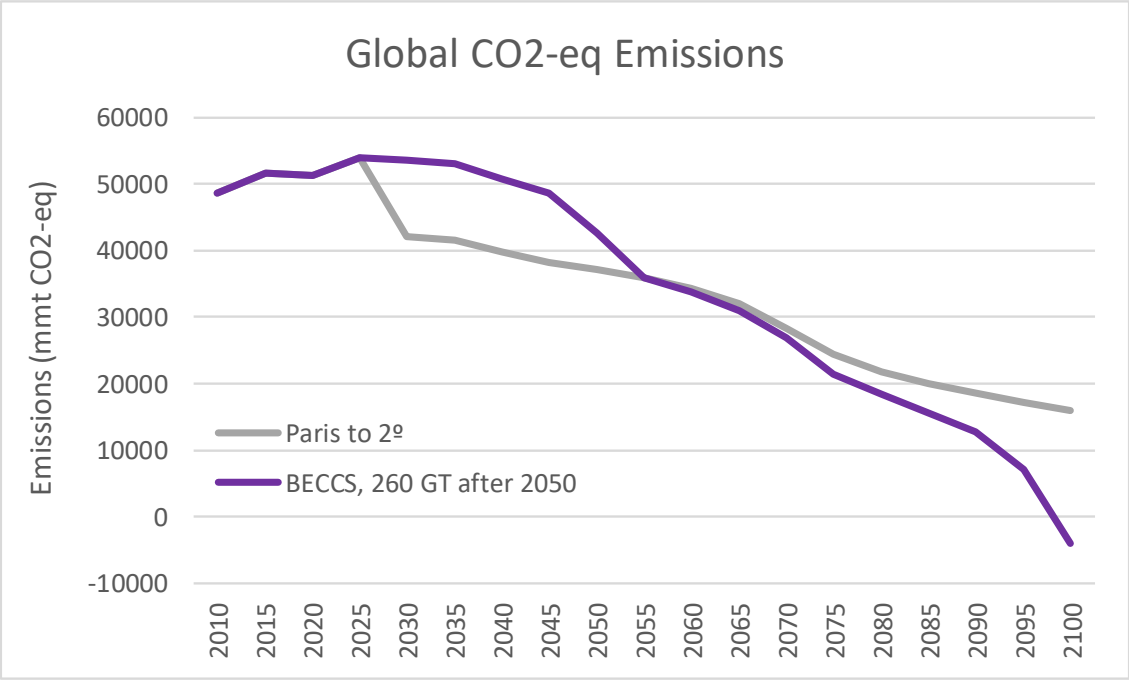
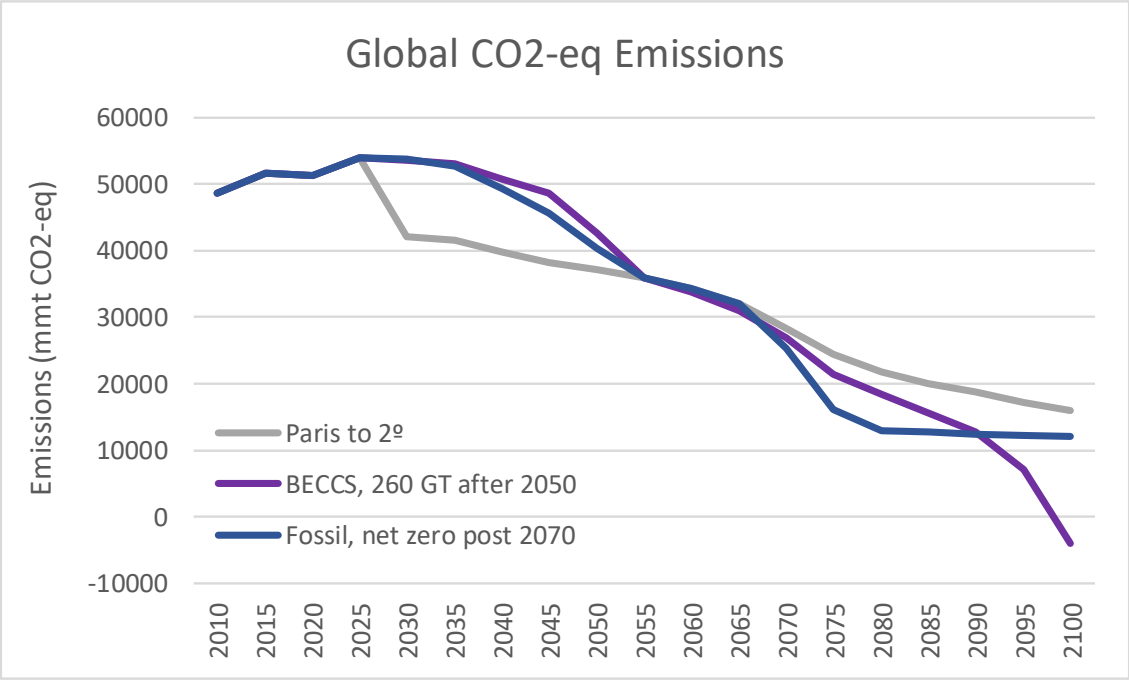


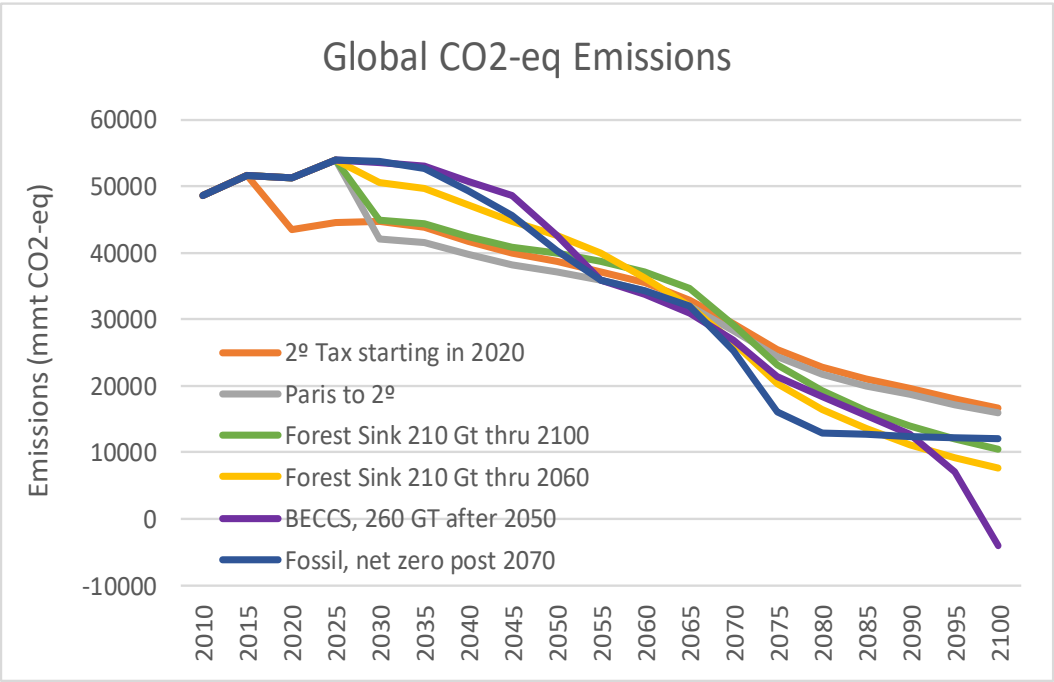
# Emissions Pathways to 2C: BECCS



# Emissions Pathways to 2C: Net Zero Fossil

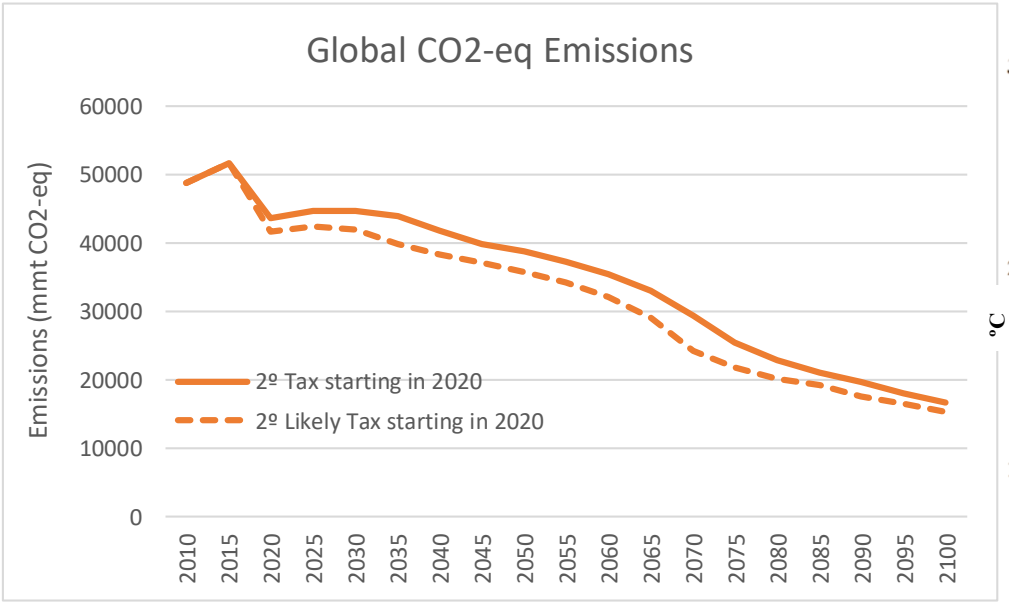


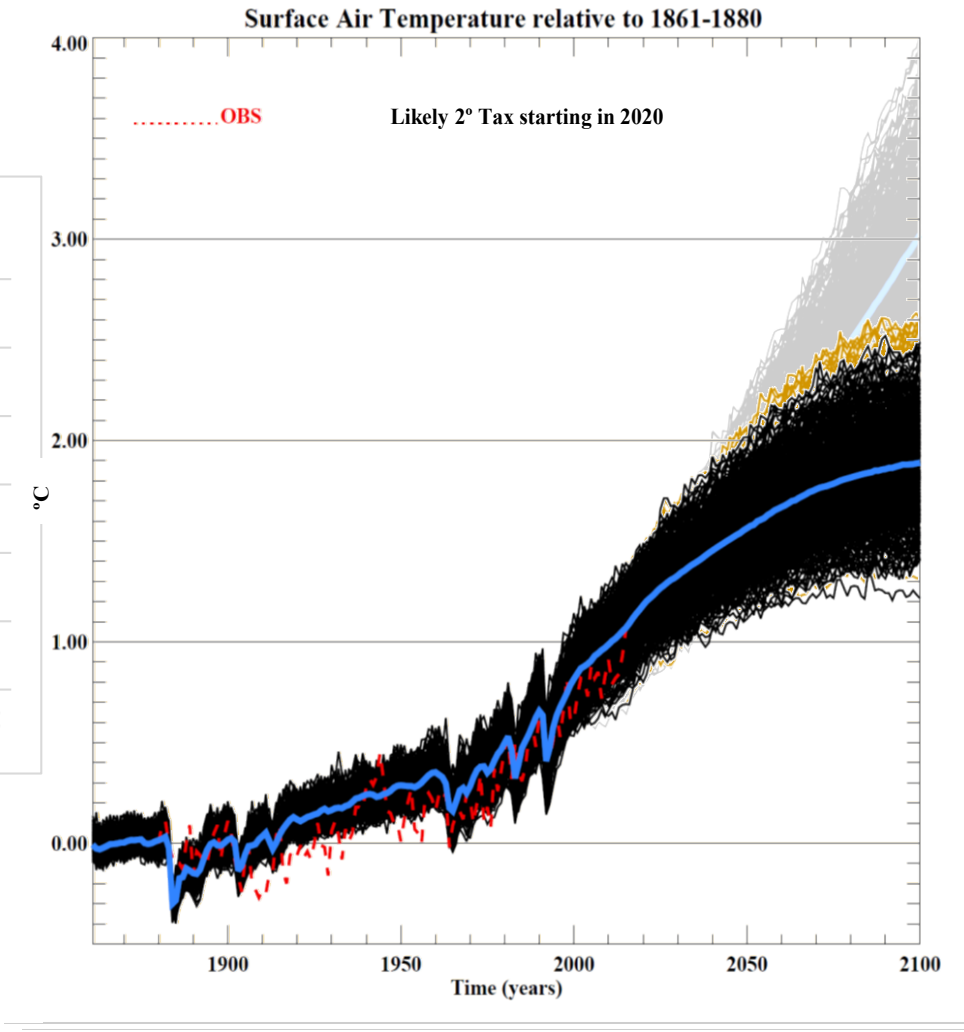
# Emissions Pathways to 2C: Carbon Prices




| Pathway to 2C | 2030 Emissions Price ($/mmt CO2-eq) |
|---|---|
| 2º Tax ($50) starting in 2020 | 74 |
| Paris to 2º | 106 |

# 2C vs. 2C Likely: Global Emissions & Temperature Change



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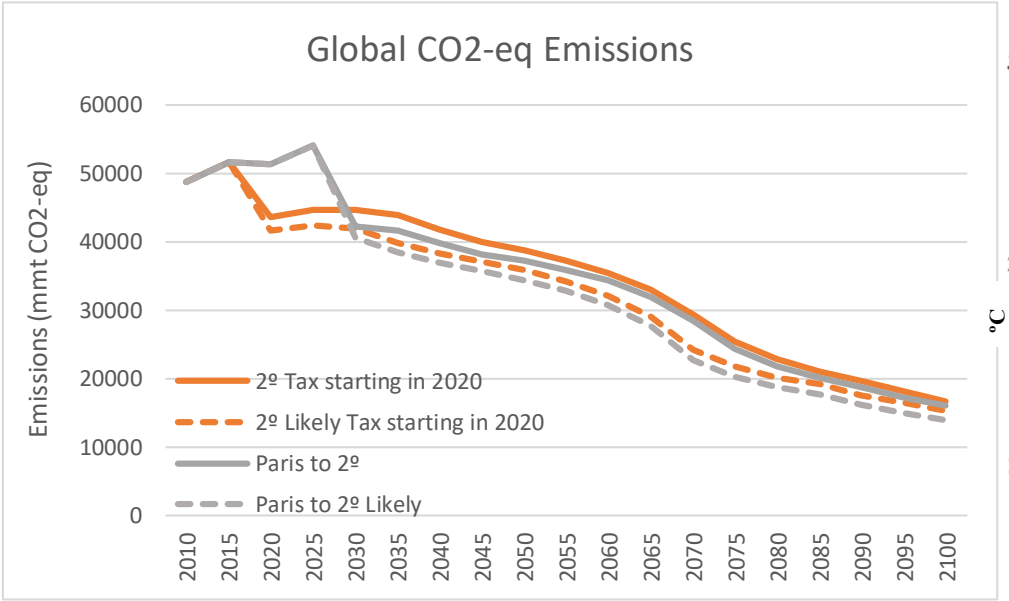
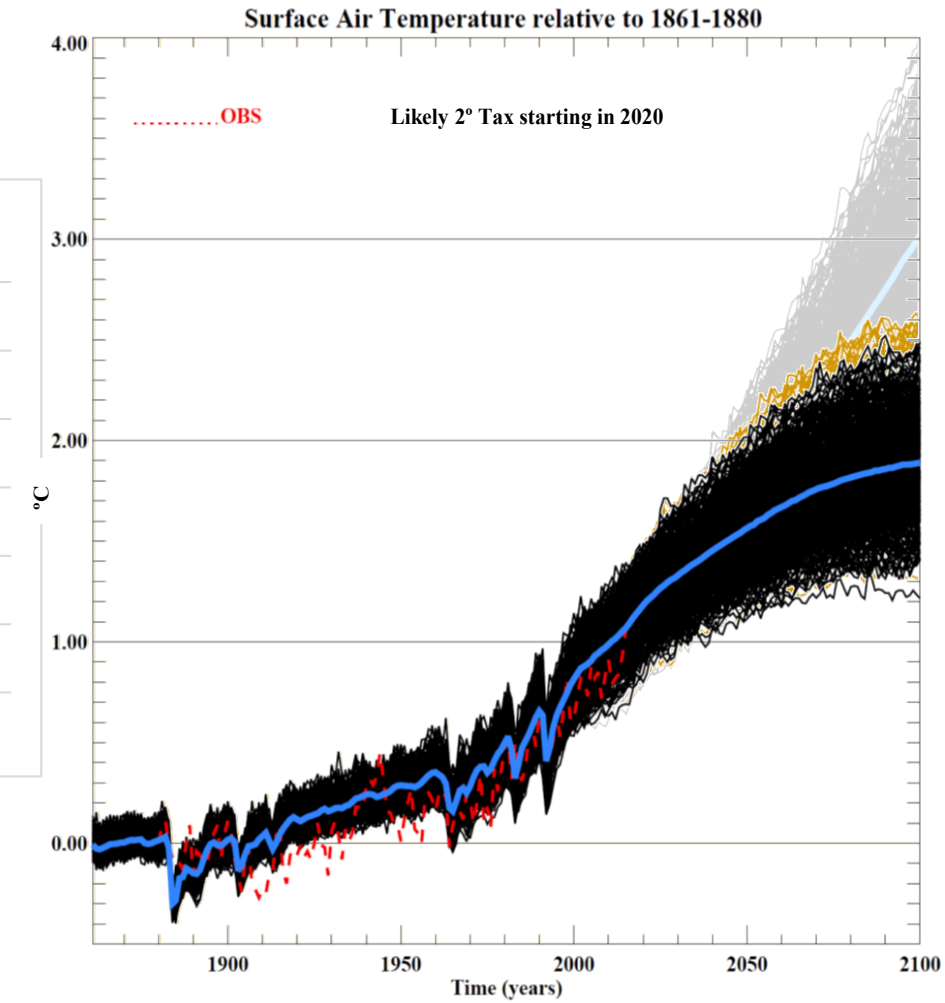
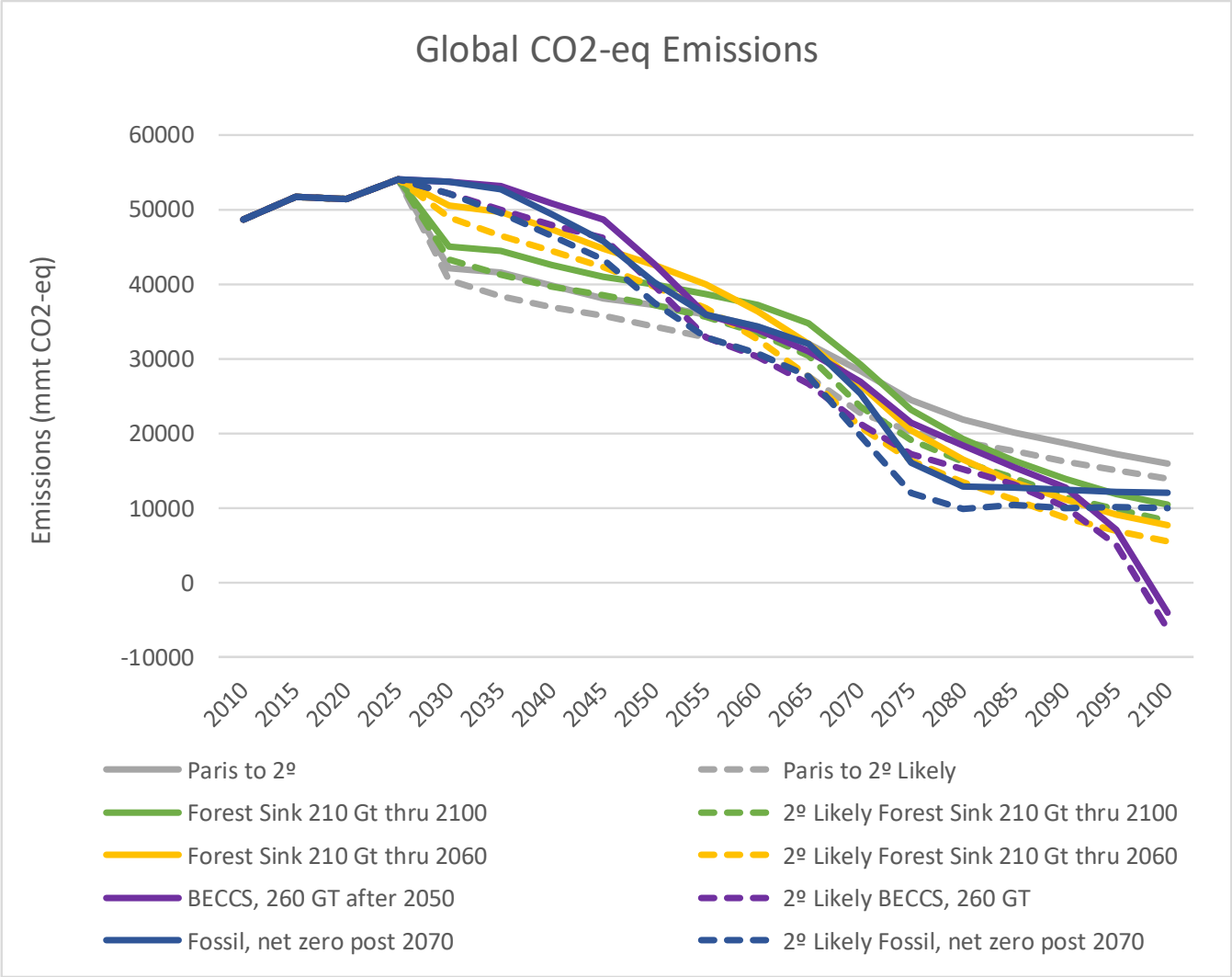


# Emissions Pathways: 2C vs. 2C Likely



# Carbon Prices: 2C vs. 2C Likely

| | 2030 Emissions Price ($/mmt CO2-eq) | |
|---|---|---|
| **Pathway to 2C** | **2º** | **2º Likely** |
| 2º Tax($50,64) starting in 2020 | 74 | 95 |
| Paris to 2º | 106 | 121 |
| Forest Sink 210 Gt thru 2100 | 86 | 98 |
| Forest Sink 210 Gt thru 2060 | 50 | 59 |
| BECCS, 260 GT after 2050 | 38 | 42 |
| Fossil, net zero post 2070 | 37 | 42 |

# Summary

- Is Paris consistent with 2° C path?
  - Yes, more or less if optimistic about net zero, BECCs, forest or land use sinks in the post 2050 period
  - Or some more modest combinations of these assumptions.
  - And we need a comprehensive global carbon policy starting soon that goes well beyond the Paris Agreement
- However, if we could do more sooner, the needed $CO_2$ price would be ~$30/tonne lower.
- But if we want to increase the likelihood of remaining below 2° C to 67%, then it makes job harder, adding $5-$20 to the starting carbon price (less if there is more headroom in early years).

Thank You

# Emissions Pathways and Temperature Change