Achieving Climate Stabilization Targets by efficient v. fragmented coalitions, with ETSAP-TIAM

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Supported by ETSAP

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11 Scenarios

- One Reference scenario (no climate objective)
- Five alternate Climate targets (of decreasing severity):
  - RF < 2.63 at all times; RF < 2.63 in 2100 (450 ppmv CO2eq)
  - RF < 3.70 at all times; RF < 3.70 in 2100 (550 ppmv CO2-eq)
  - RF < 4.60 at all times ; (650 ppmv CO2-eq)
- X Two regimes:
  - First Best: all countries cooperate and trade starting 2012
  - Second Best: groups of countries start acting (and trading) at different dates
    - Gr 1 (OECD) Starts acting and trading in 2012
    - Gr 2 (BRIC) Starts acting and trading in 2030
    - Gr 3 (ROW) Starts acting and trading in 2050
    - All groups act and trade after 2050
- = 11 scenarios: REF, FB1 to FB5, SB1 to SB5

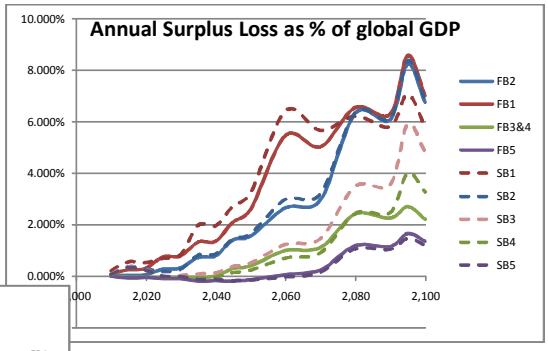
Additional assumption for late entrants

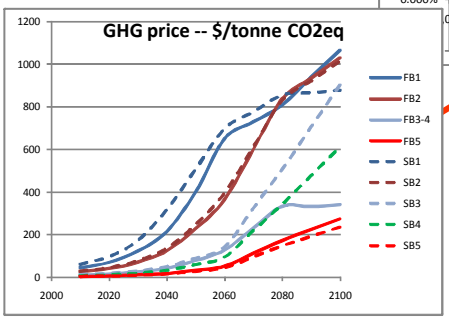
- In second best scenarios: when a region enters the coalition, it enters at the initial carbon price of Group 1 in 2012, and increases carbon price to reach the coalition's price after 20 years.

THIS CONDITION HAS NOT YET BEEN IMPLEMENTED
(Planned for March 2009)

I. Cost Story (as proxy for scenario severity)

- Second Best global costs are moderately higher than First Best costs
- Regional costs cannot be computed until permit allocations are defined





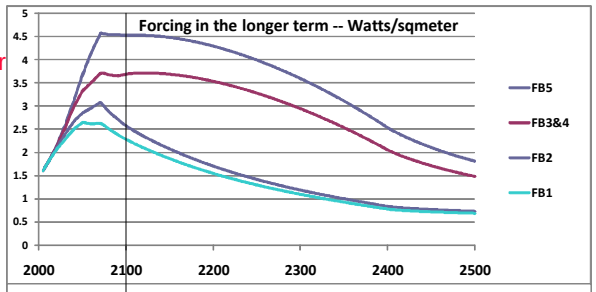
- Second Best GHG prices are moderately higher than First Best prices

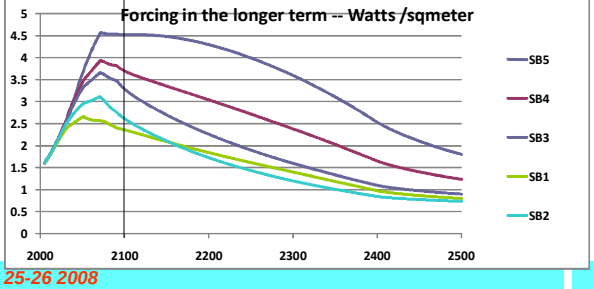
Conclusion: Late entry in coalition is not a huge impediment to attaining the climate targets

II. Long term Story (to year 2500)

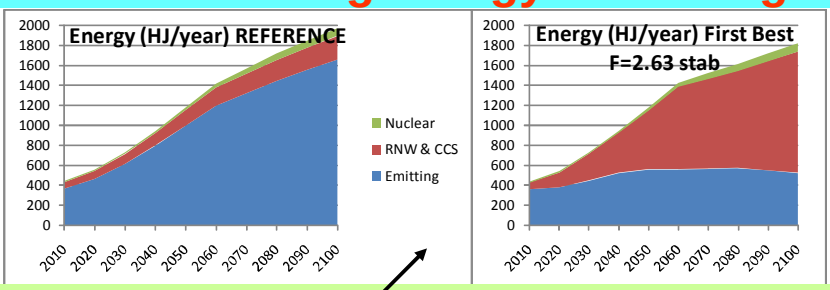
- Beyond 2100, an assumption on emissions is needed in order to calculate future forcing (and forcing peak).
- We assume conservatively that emissions decline linear to 0 from 2100 to 2400

Forcing peaks before 2100 in all cases except FB3-4

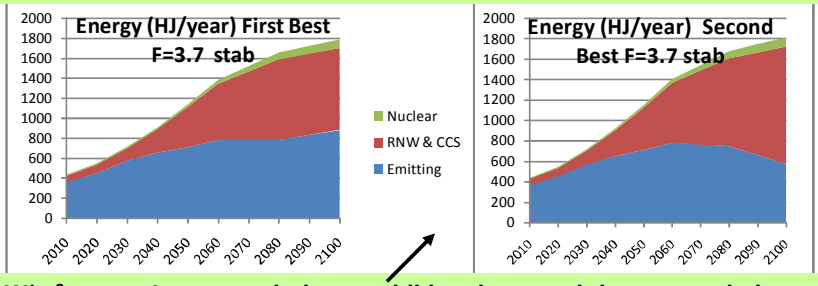




III. Non emitting energy technologies



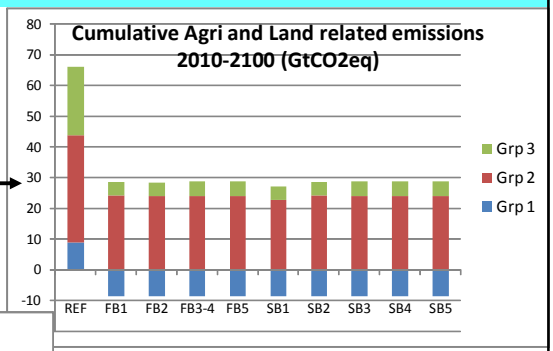
2.63 W/m² target : 10% more energy savings, and 70% non-emitting energy in 2100

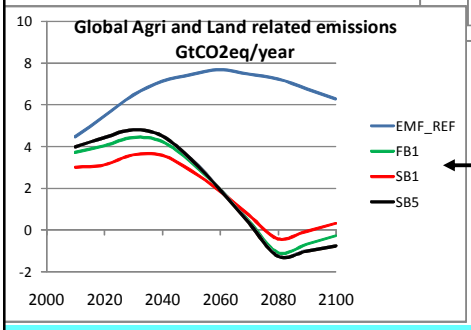


3.7 W/m² target: Late entry induces additional non emitting energy in late century

IV. AGRI and LAND related Emissions

1. Carbon pricing has a strong and uniform impact on *cumulative* land emissions in all 3 Groups





2. Carbon pricing has a differentiated impact on land emission *profiles* (mostly due to forestation options)

Achieving Climate Targets via emissions quotas: an ETSAP-TIAM W.I.P.

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From the PLANETS research programme

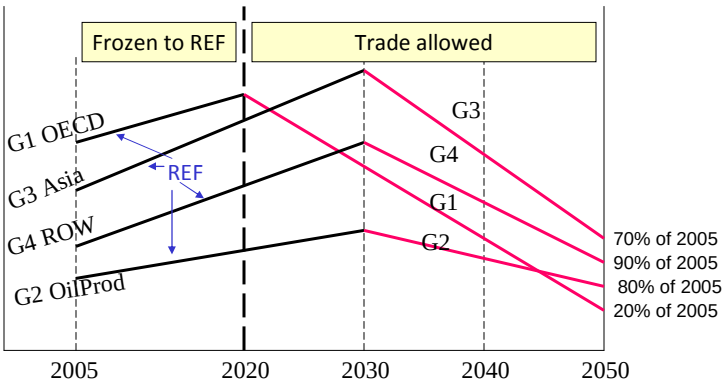
Scenario description

- One Reference scenario (no climate objective)
- Two alternate Climate targets (of decreasing severity)
- RF < 3.50 (at all times ?); 530 ppmv CO2eq
- RF < 3.25 (at all times ?) 506 ppmv CO2eq

Targets are for all LLGHG's (excluding aerosols, ozone, etc.)

- Regimes:
  - First Best: all countries cooperate and trade starting 2012
  - Second Best: each group of countries receives a cumulative emissions quota (cumulative commitment) over a specific period of time:
    - Gr 1 (OECD) commit. starts 2012 , ends 2050
    - Gr 2 (FSU+MIDEAST) commit. starts 2020 , ends 2050
    - Gr 3 (emerging ASIA) commit. starts 2020 , ends 2050
    - Gr 4 (ROW) commit. starts 2030 , ends 2050
    - All groups trade after 2020, and fully cooperate after 2050

Illustration of commitments



Remark 1: A group may use Banking and Borrowing. Hence only Cumulative Commitments matter

Remark 2: Groups may trade after 2020 only. Hence frozen to REF before 2020 (except EU)

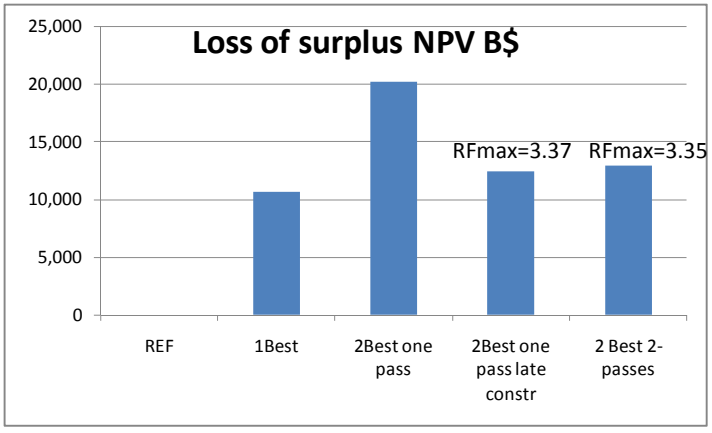
Remark 3: only Global commitments matter for TIAM (above example yields 458 GtC-eq over 2005-50

Possible approaches to simulate commitments AND targets

- Choose cumulative commitments (20%, 80%, 70%, 90%)
- Calculate Global commitment from 2005 to 2050 (458 GtCeq)
- Add a single constraint:

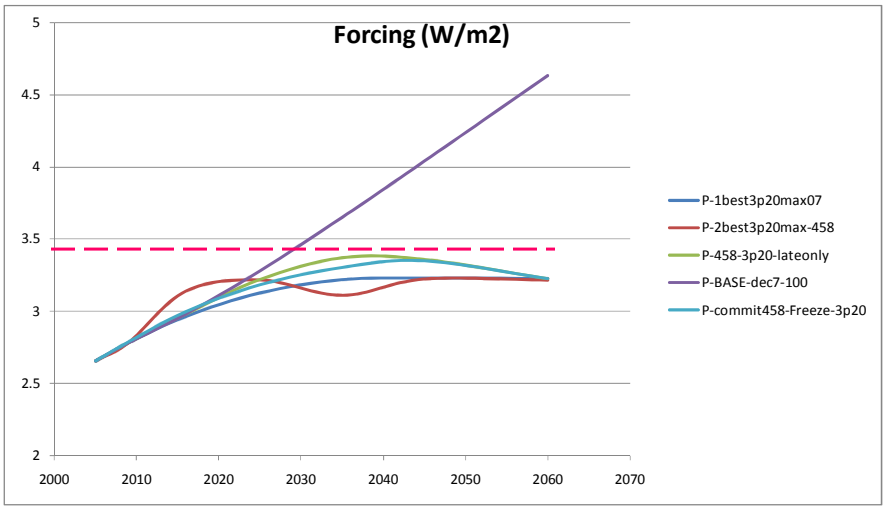
  Cum Global Emissions (2005-to-2050) = 458 GtCeq
- Freeze all actions from 2005 to 2020 (except EU)
- Choose a Forcing Target (3.25)
  - ONE PASS: Add a Forcing Constraint and solve over 2005-2100
    - RF Constraint at each period from 2010 to 2100 ?
    - RF Constraint only after 2050 ?
  - TWO PASSES: First optimize over 2005-2050 with cumulative commitment constraint ONLY, then freeze that solution over 2005-2050, and re-optimize over century with Forcing constraint

Results 1: costs



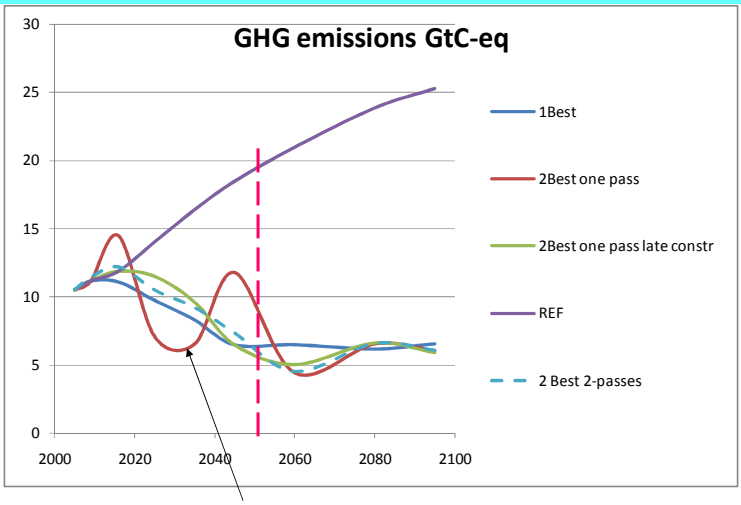
All scenarios respect the 458 GtC budegt
Only 1Best and 2Best-One-pass respect the Forcing constraint

Results 2: Forcings



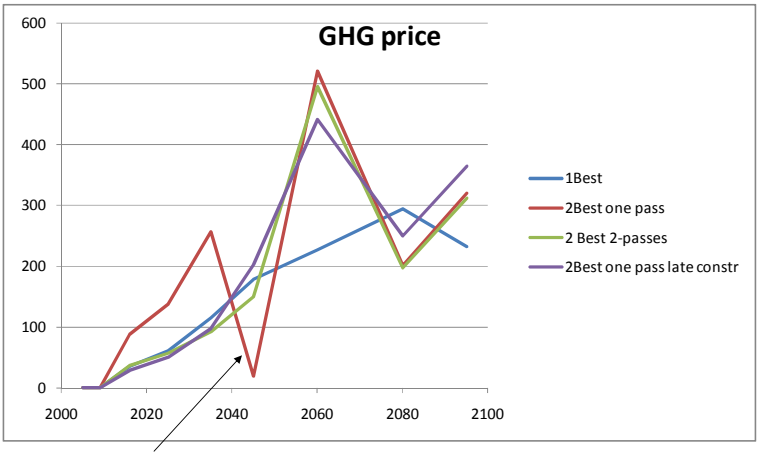
2Best-One pass respects the Forcing but has unstable profile

Results 3: GHG Emissions



Emission profile of 2Best-One pass is unrealistic

Results 4: GHG prices



Confirms the erratic behaviour of 2Best-one pass profile
2Best-one pass with late constraint has peak in 2060 to quickly reach RF=3.25
2Best-two passes also.

Lessons

1. Imposing a quota (2005-2050) and an early Forcing target (2005-2050) leads to schizophrenia: countries want to use their quotas but doing so and satisfying the Forcing constraint leads to unsteady and erratic decisions
2. Imposing a quota (2005-2050) and a late Forcing target (after 2050) leads to a reasonable set of results before 2050, and then a "catching-up" set of actions just after 2050. Forcing target is respected after 2050 but not before 2050
3. Solving the problem in two phases (first solve until 2050 with quotas only, then freeze, then re-solve for whole century and RF target after 2050) yields reasonable results that are close to approach 2, with cost slightly higher (as expected)
4. Both 2 and 3 are significantly more costly that 1Best (as expected)

Next steps

- Explore a number of commitments and two targets.
- Draw policy conclusions (eliminate bad combinations)