Grappling with atmospheric concentration pathways for CO_2 using GTEMLR

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Question:

How would paths of global emissions and atmospheric concentration of CO_2 look like by 2100 if the world economic growth follows SRES A1 path?

We answer the question under the following three scenarios:

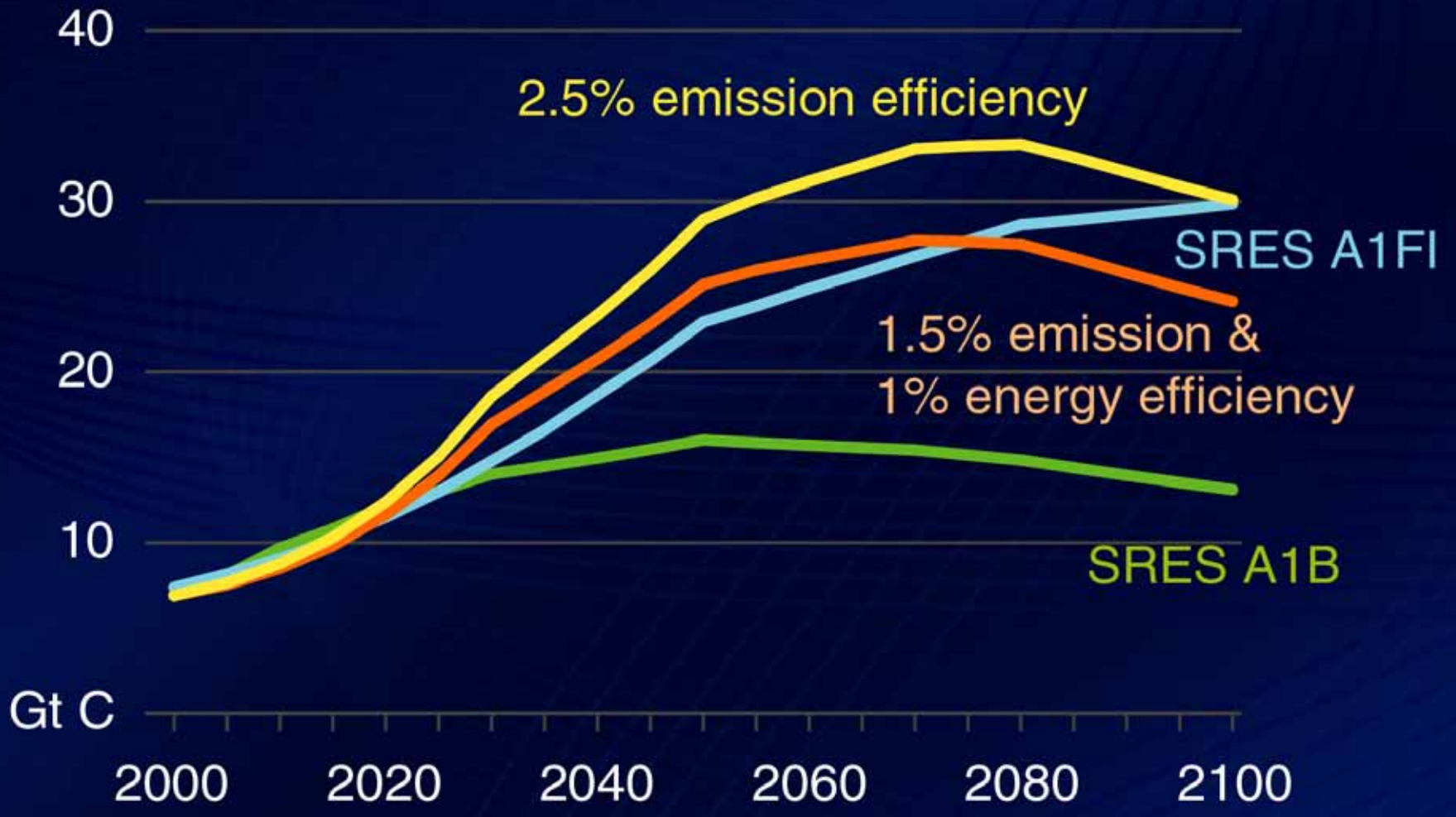
- Emissions efficiency improves globally by 2.5% per year
- Emission intensity of non-OECD regions catches up the intensity of OECD 2000 by 2040 and maintain EEI at 2.5% pa
- Non-OECD regions delay until 2020 and then maintain EEI at 2.5% pa

Scenario 1: Global emission intensity reduction by 2.5% pa

We consider the following 4 cases:

- Global emissions efficiency improvement of 2.5% pa
- Emissions efficiency improvement of 1.5% + energy intensity decline by 1% per year
- SRES A1FI
- SRES A1B

Global fossil fuel CO_2 emissions



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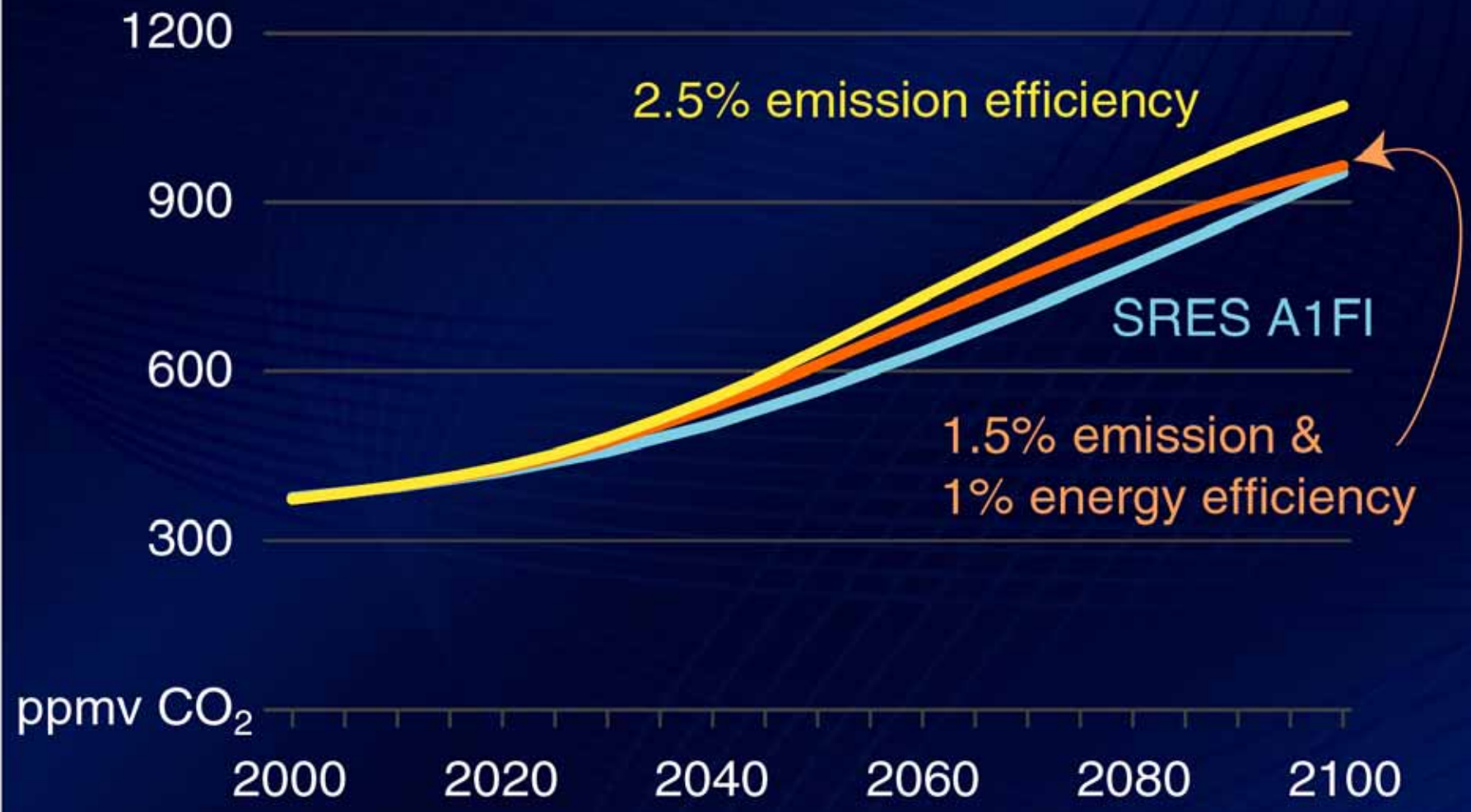
Atmospheric CO_2 concentration



Concentrations calculated using Maier-Reimer Hasselmann box model except SRES A1FI calculated using ISAM REF.

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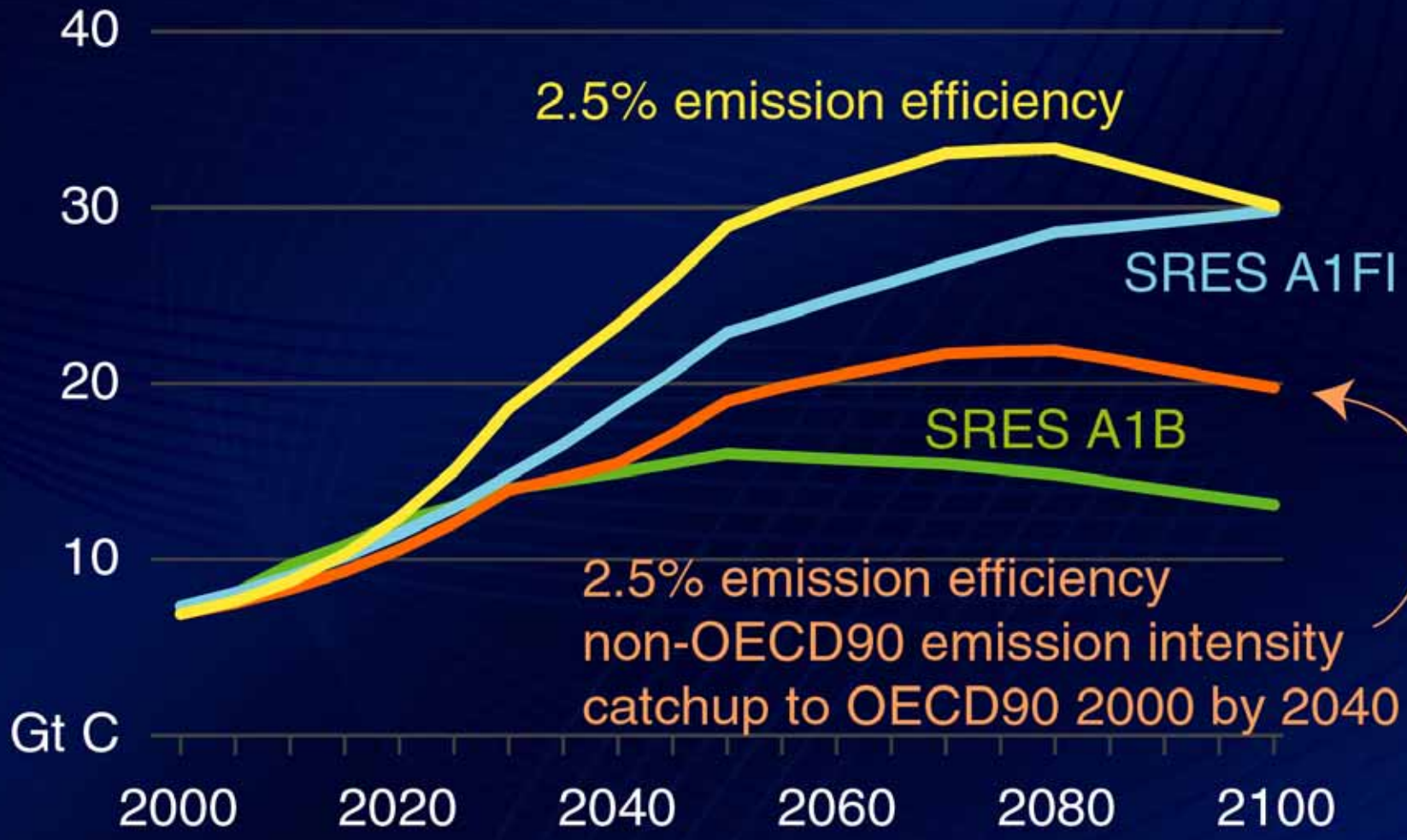
Scenario 2: Non-OECD regions Catch-up by 2040

We compare the following 4 cases:

- Global emission efficiency improvement (EEI) of 2.5% pa
- OECD with 2.5% pa EEI and non-OECD regions catching up OECD emission intensity of 2000 by 2040 and then maintain global average of 2.5% pa EEI
- SRES A1FI
- SRES A1B

Global fossil fuel CO_2 emissions



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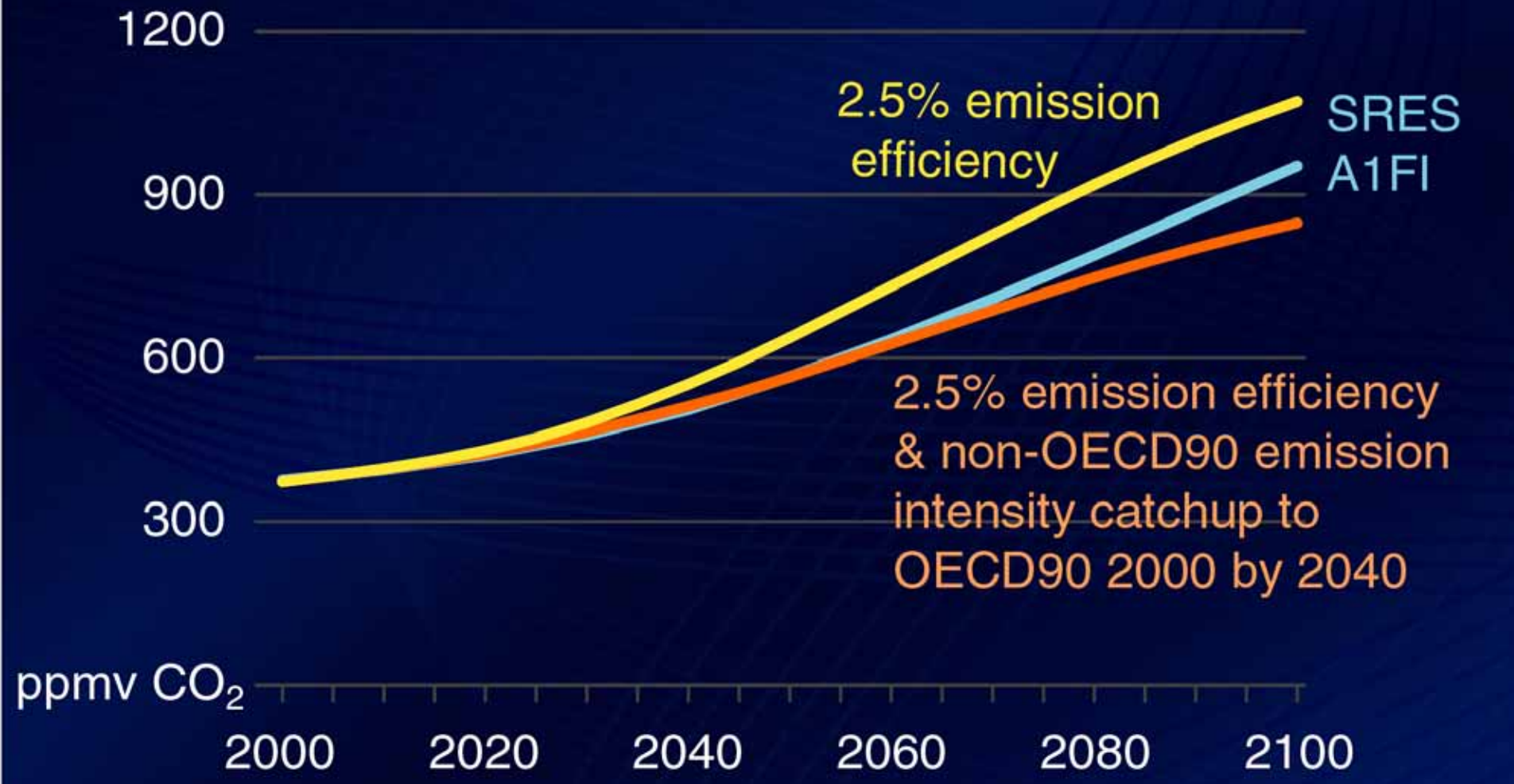
Atmospheric CO_2 concentration



Concentrations calculated using Maier-Reimer Hasselmann box model except SRES A1FI calculated using ISAM REF.

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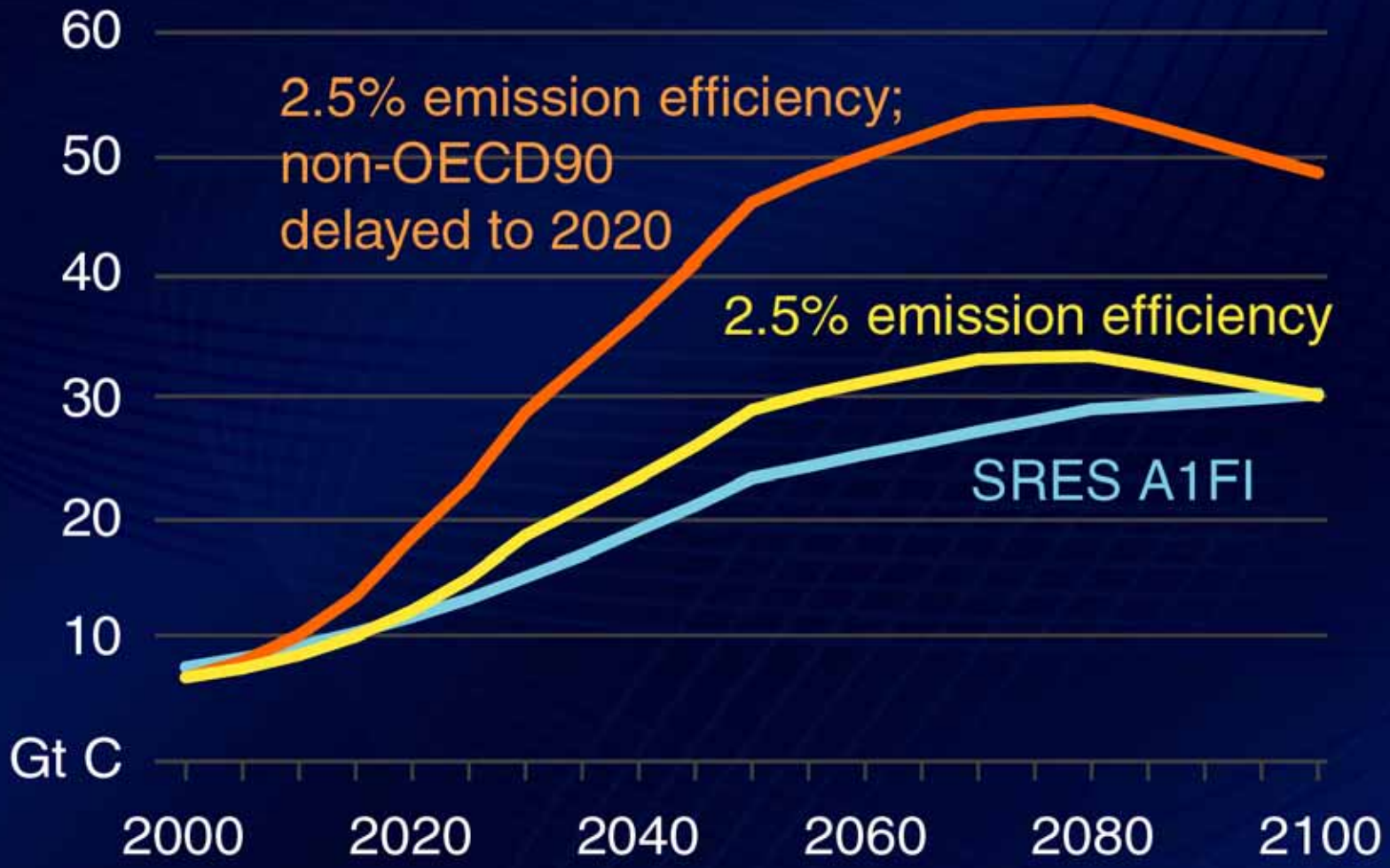
Scenario 3: Non-OECD regions delay until 2020

We compare the following 3 cases:

- Global emission efficiency improvement (EEI) of 2.5% pa
- OECD with 2.5% pa EEI and non-OECD regions delay actions until 2020 and then maintain 2.5% pa EEI
- SRES A1FI

Global fossil fuel CO_2 emissions



Atmospheric CO_2 concentration

Concentrations calculated using Maier-Reimer Hasselmann box model except SRES A1FI calculated using ISAM REF.

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Some observations

- Irrespective of the eventual technological path a 2.5% pa reduction in emission intensity is necessary to attain atmospheric concentration level of CO_2 below 1000ppmv by 2100, given SRES A1 growth path
- 1.5% pa reduction in energy intensity and 0.5% pa reduction in emission intensity has been historically observed (IEA 2002) – implies some additional action is required.

Some Observations…

- Taking into account thermal efficiency limits, emission intensity reduction via carbon capture, sequestration and cleaner technologies appear necessary.
- As a rough guide – reduction in emission intensity at a rate higher than the economic growth rate will lead to decline in total emissions
- Delayed action by any party adds to the burden

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