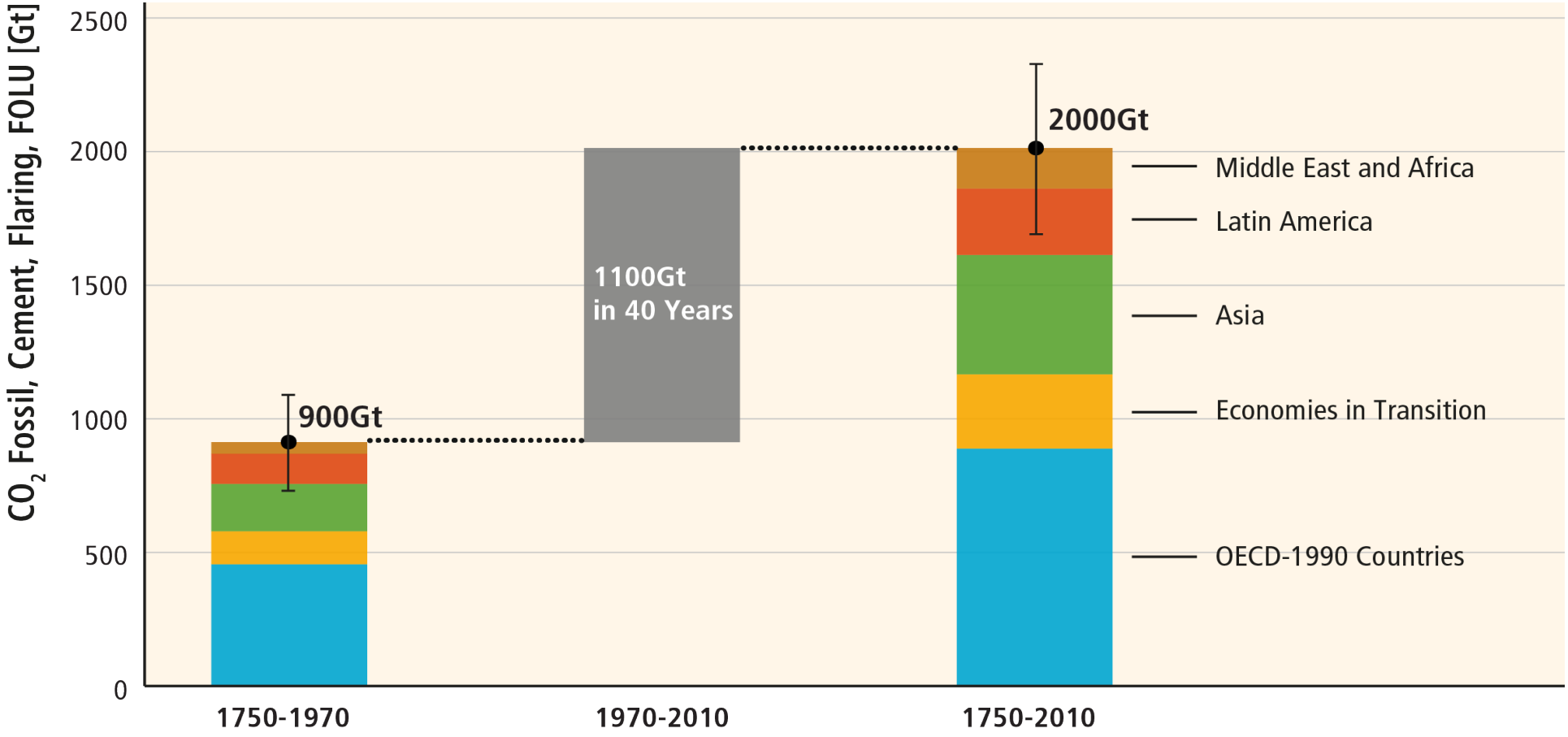
A global paradox

Despite increasing concern about climate change and a solid scientific evidence:

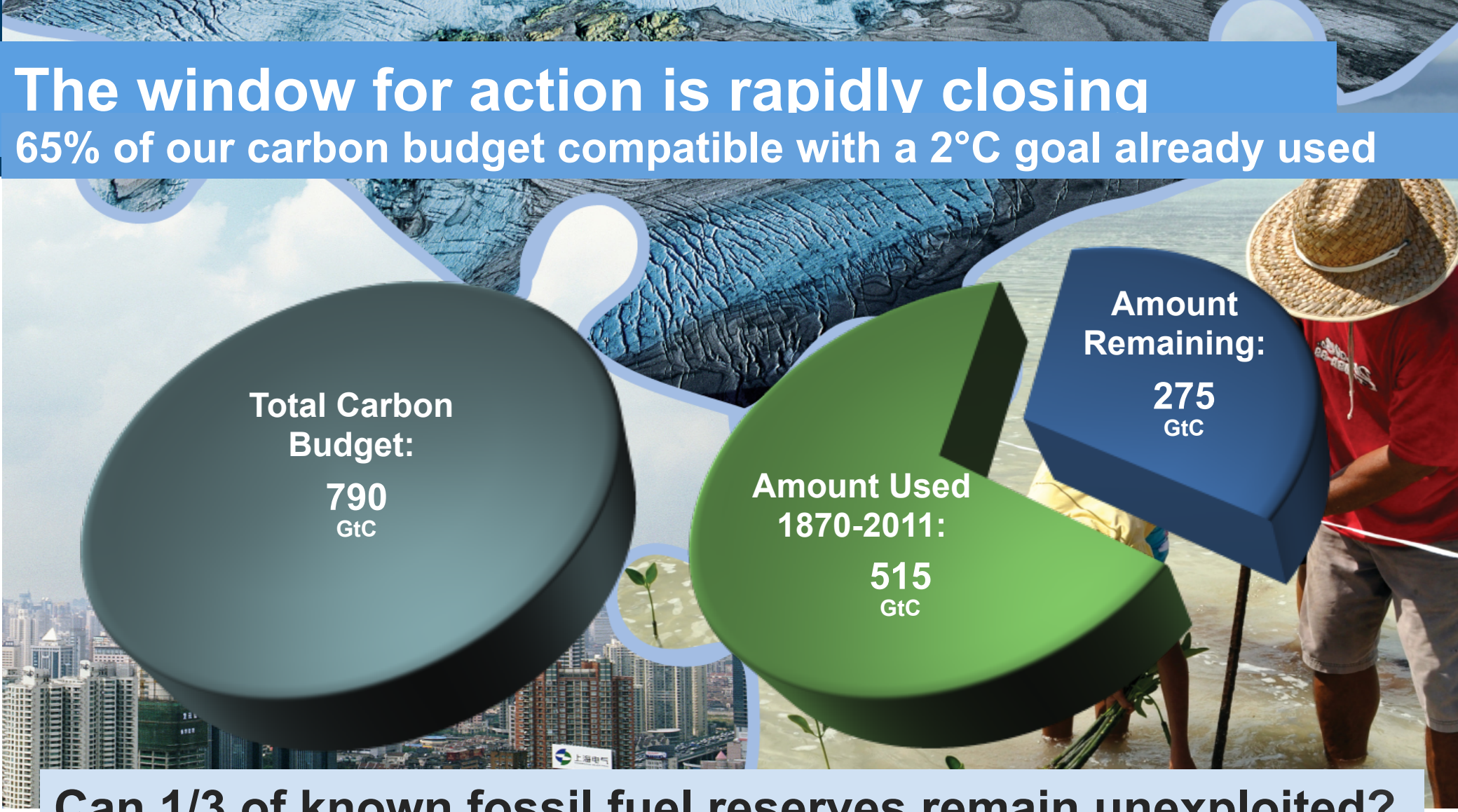
- Global emissions are steadily growing.
- The fossil fuel mix is not improving, with a revival of coal consumption, particularly in Europe.
- 2 degree target more and more difficult to be achieved, unless major technology breakthrough (in geo-engineering, CO2 removal in particular).
- Not surprisingly, over the years focus of negotiations moved from mitigation to adaptation, and then to loss and damages.
- What then will Paris COP 21 deliver?

27 years of IPCC, 23 years of UNFCCC negotiations …. but about half of the cumulative anthropogenic CO_2 emissions between 1750 and 2010 have occurred in the last 40 years….



The window for action is rapidly closing

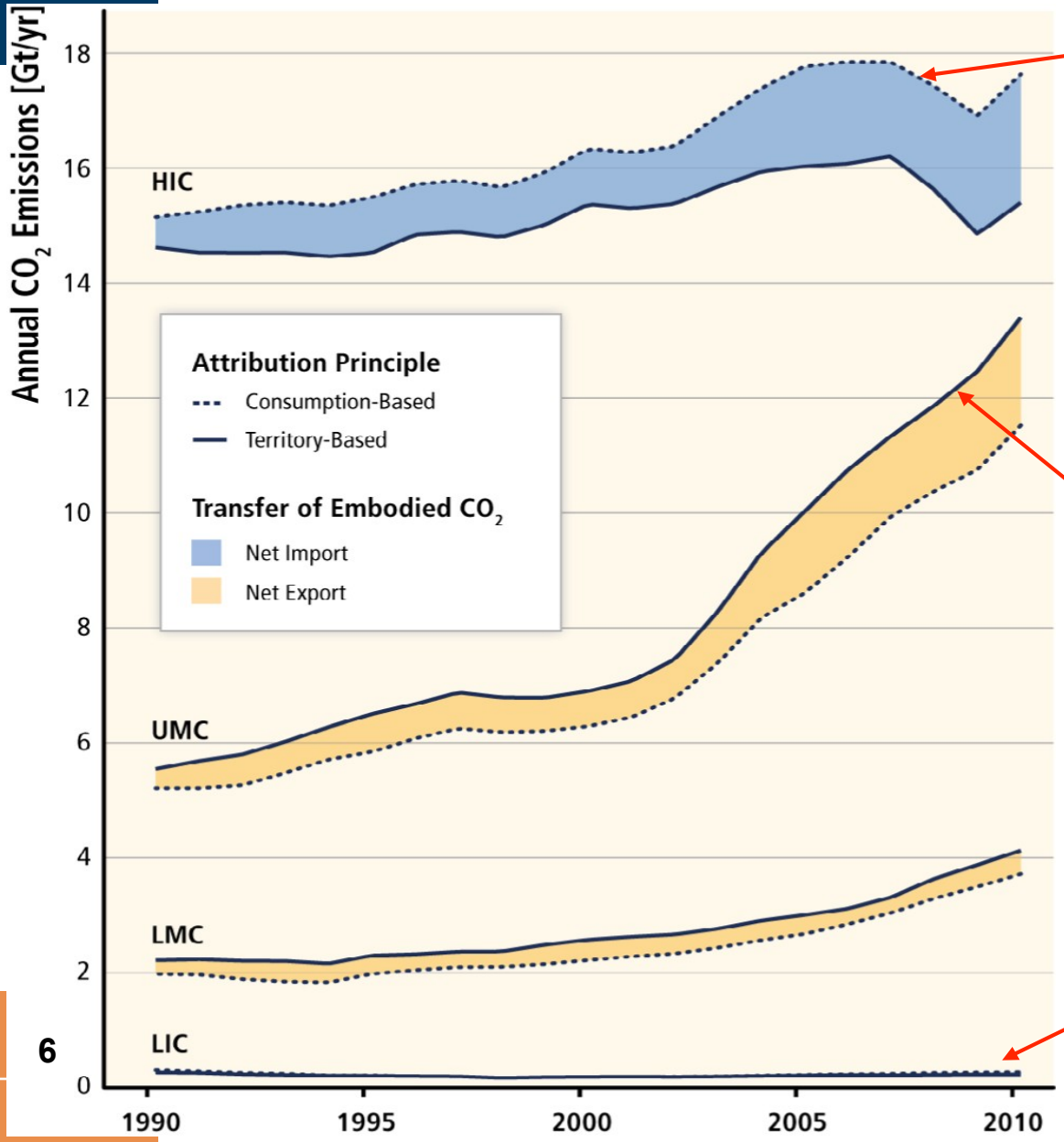
65% of our carbon budget compatible with a 2°C goal already used



Can 1/3 of known fossil fuel reserves remain unexploited?

ipcc INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Trajectory of Global CO_2 Emission by Region



High income countries
($12,616 and more)

Consumption-based CO_2 emissions do not decrease even in HIC.

Upper middle income countries
($4,086 to $12,615)
(China, Brazil, Iran, Malaysia, South Africa etc.)

Rapid increase in CO_2 emissions

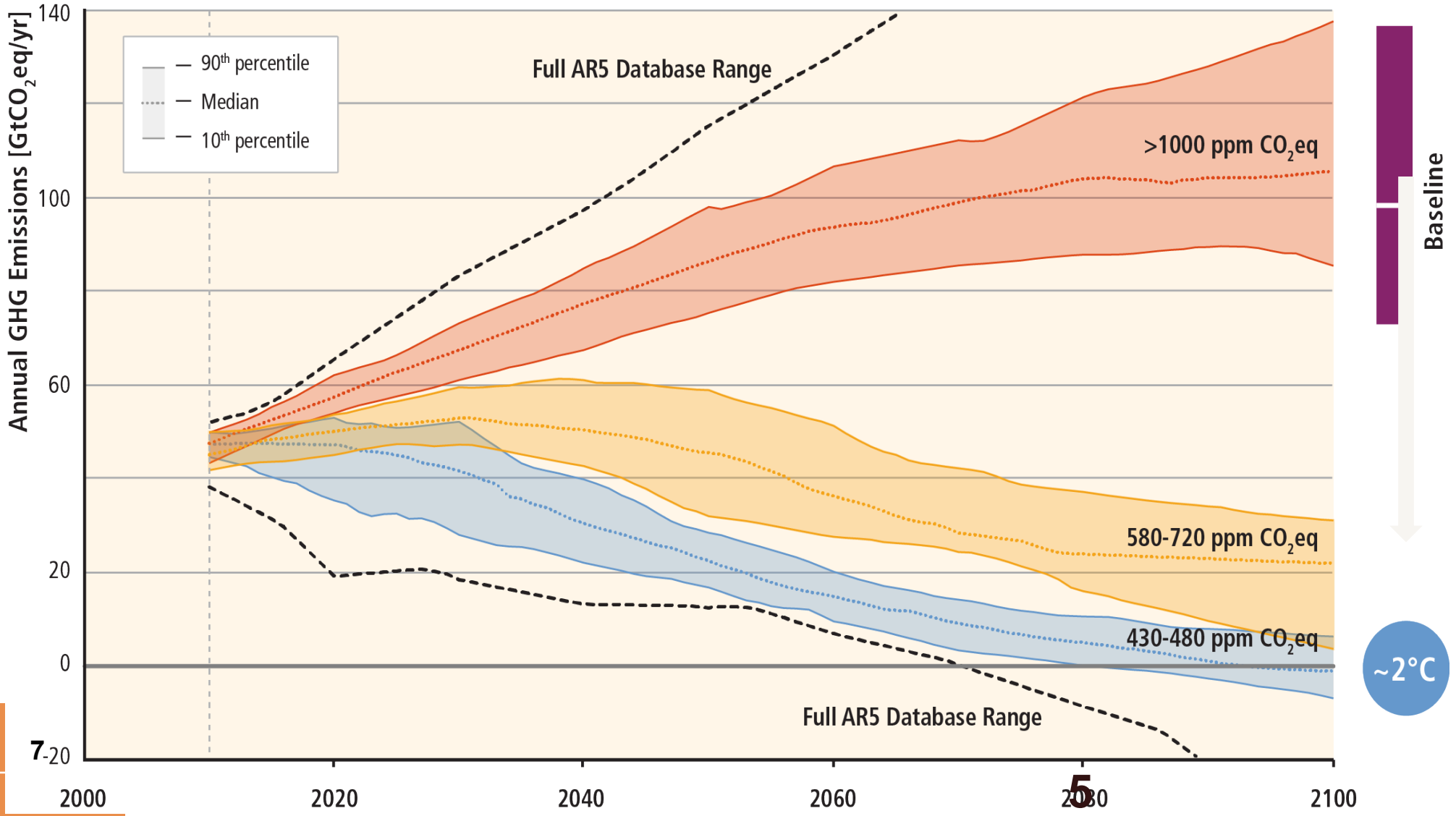
Lower middle income countries
($1,036 to $4,085)
(India, Indonesia, Philippine, Egypt etc.)

Tackling poverty; low priority of CO_2 emission mitigation

Low income countries
($1,035 and less)

Source) IPCC AR5, 2014

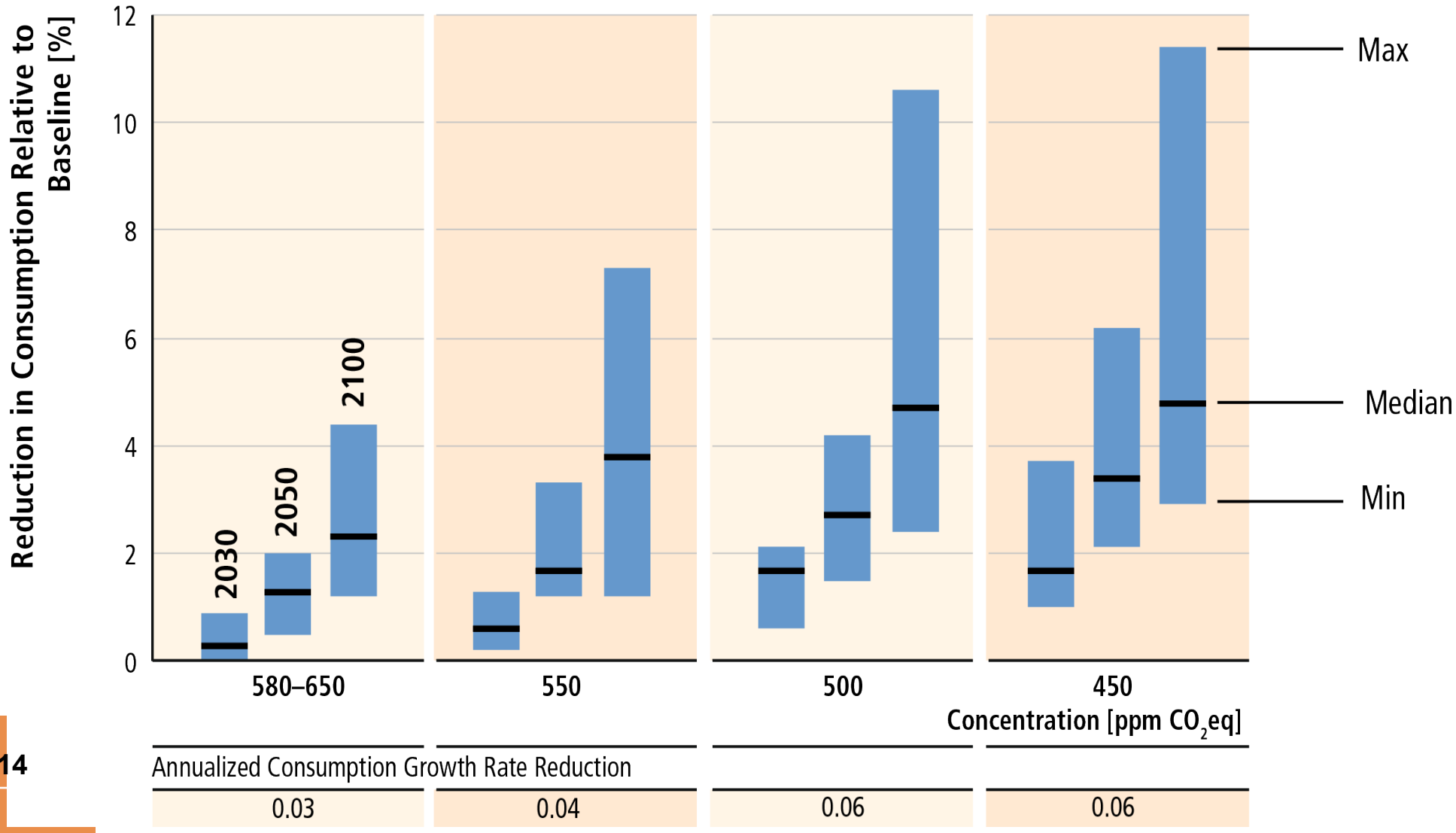
Stabilization of atmospheric GHG concentrations requires moving away from the baseline, regardless of the mitigation goal.



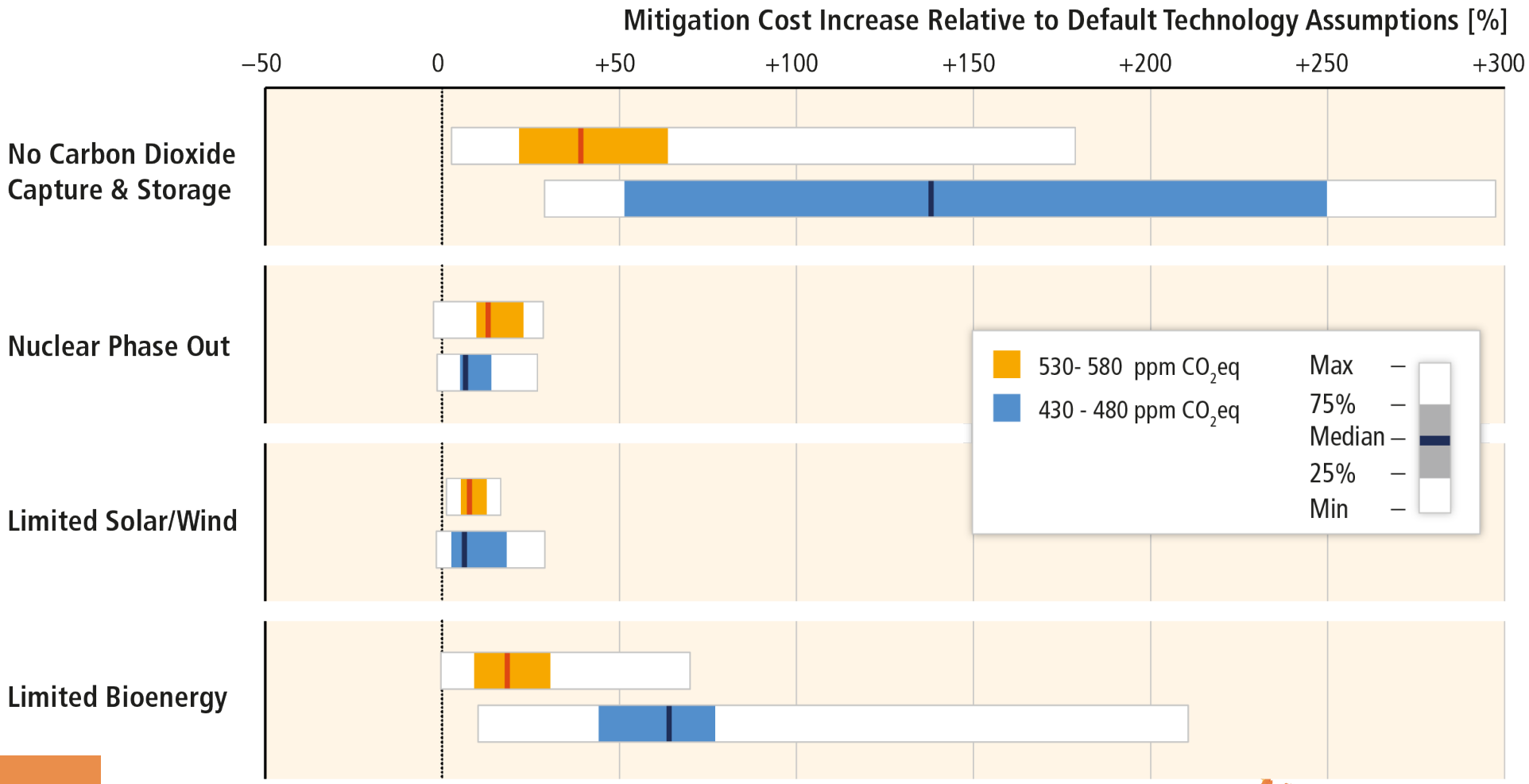
Are ambitious emissions reductions feasible?

- **Two degree target (equivalent to GHG concentrations at about 450 ppmv) can hardly be achieved:**
  - **Concentrations are already above 400 ppmv (515 GtC)**
  - **The remaining carbon budget is therefore about 275 GtC.**
  - **And GHG emissions increase at 10 GtC per year...**
  - **No large scale CO2 absorption technology is currently available**
  - **Capture and storage plants allowing the use of coal and oil not yet operational**
  - **Large reserves of fossil fuel sources (at least 1/3) unlikely to be kept in the soil.**
  - **And high costs....**

Global costs rise with the ambition of the mitigation goal.

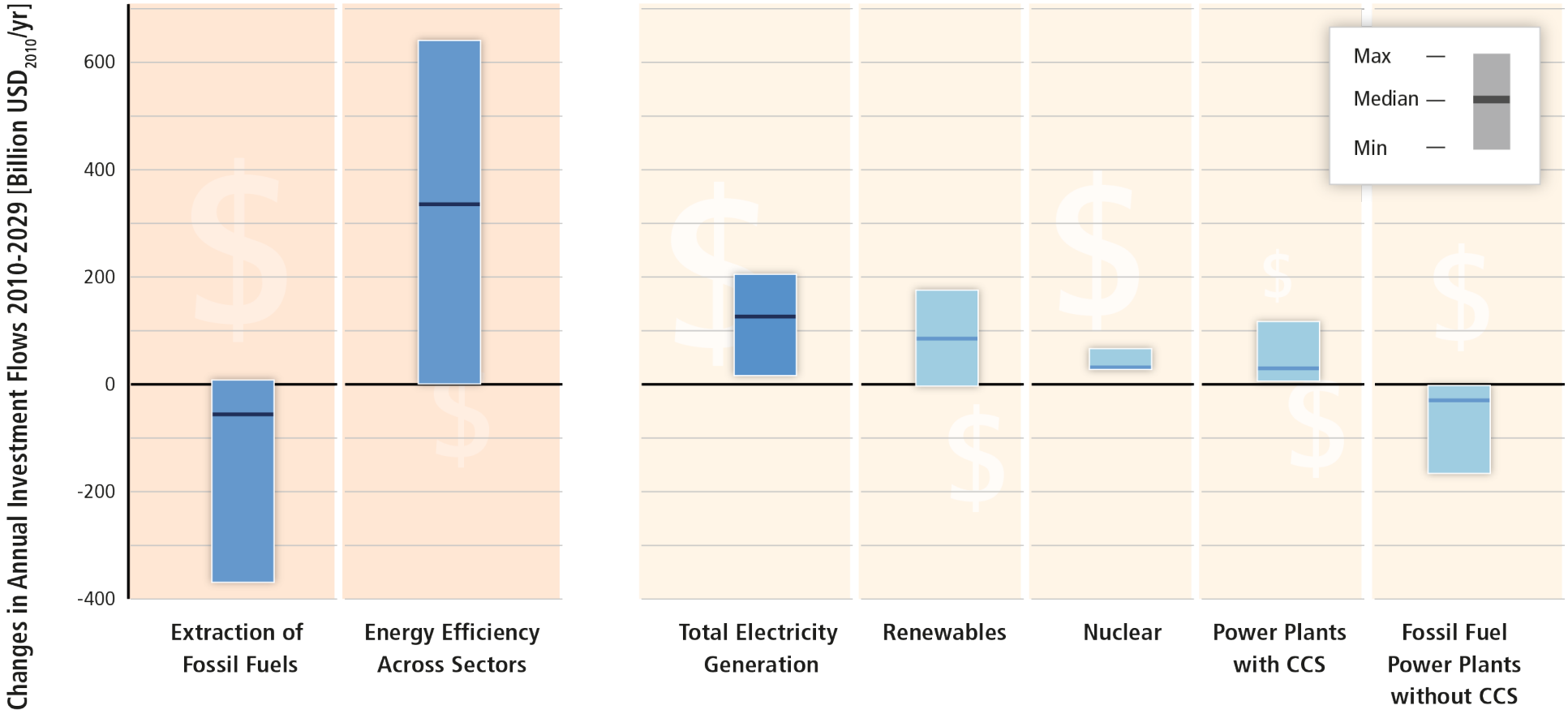


Limited availability of technologies can greatly increase mitigation costs.



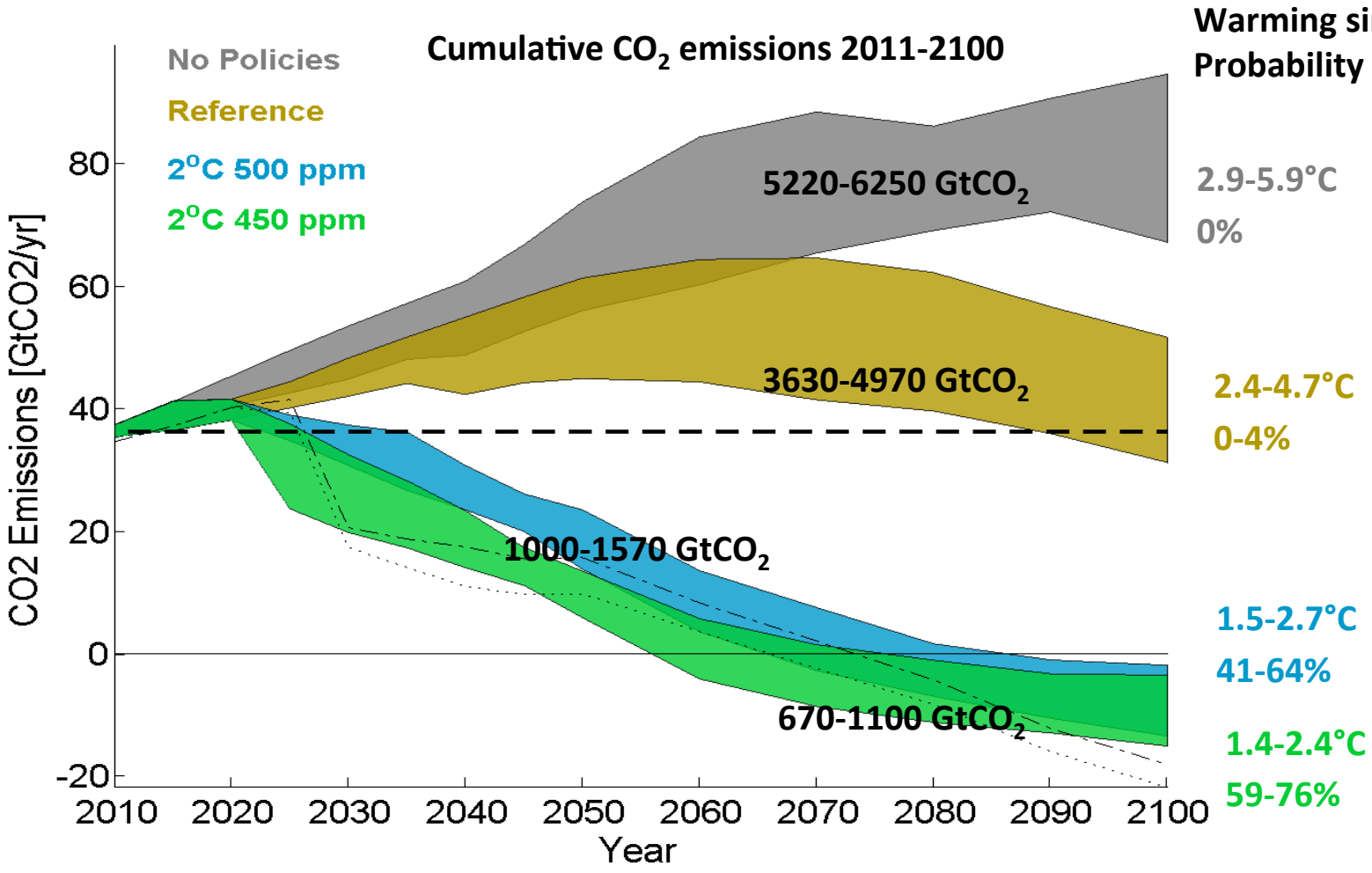
Source: IPCC AR5 - WG3 "The Mitigation of Climate Change" Summary for Policy Makers, 2014

Substantial reductions in emissions would require substantial changes in investment patterns.



Fondazione Eni Enrico Mattei

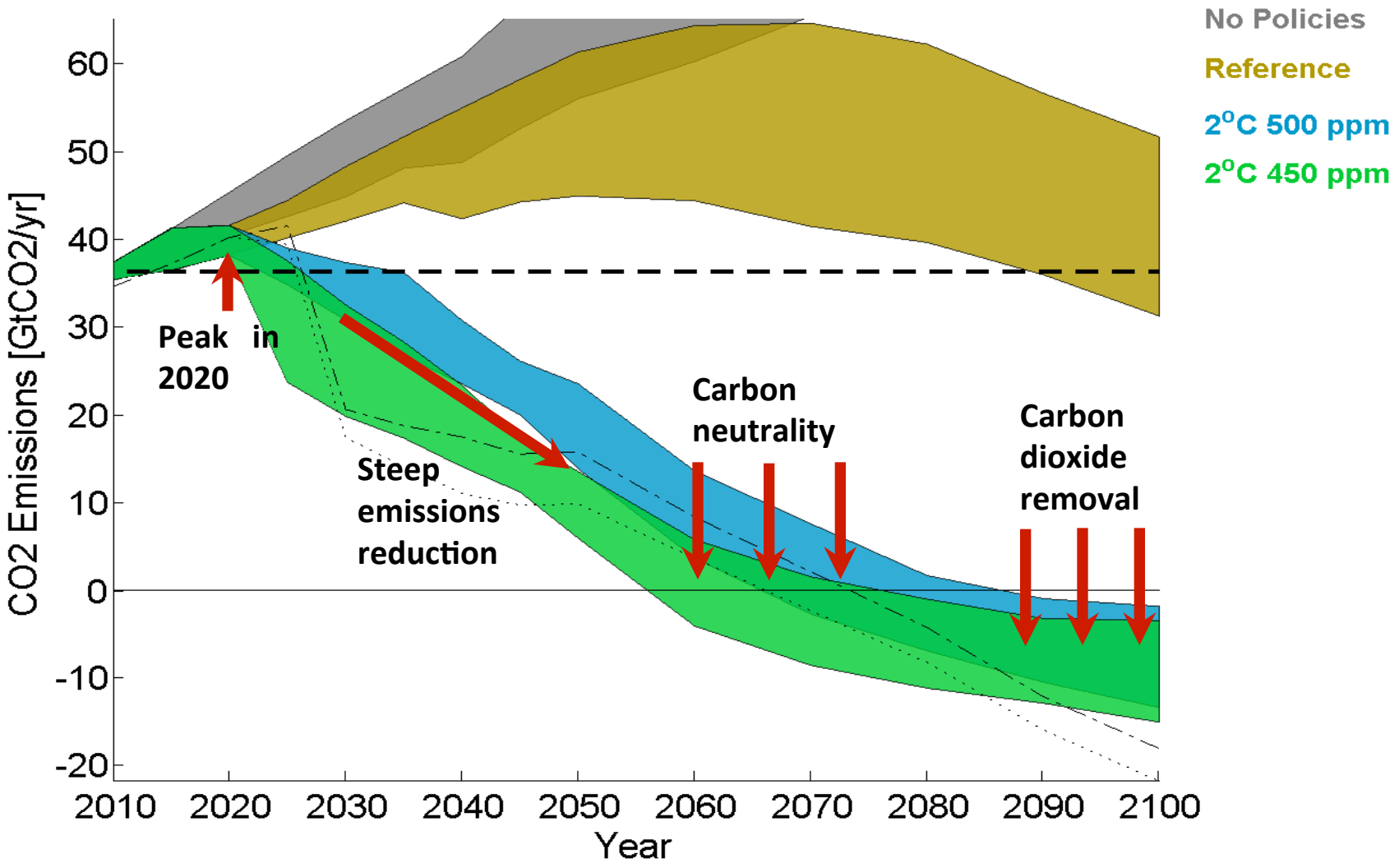
Global emission pathways and carbon budgets



Kriegler et al. (2013) *Climate Change Economics*

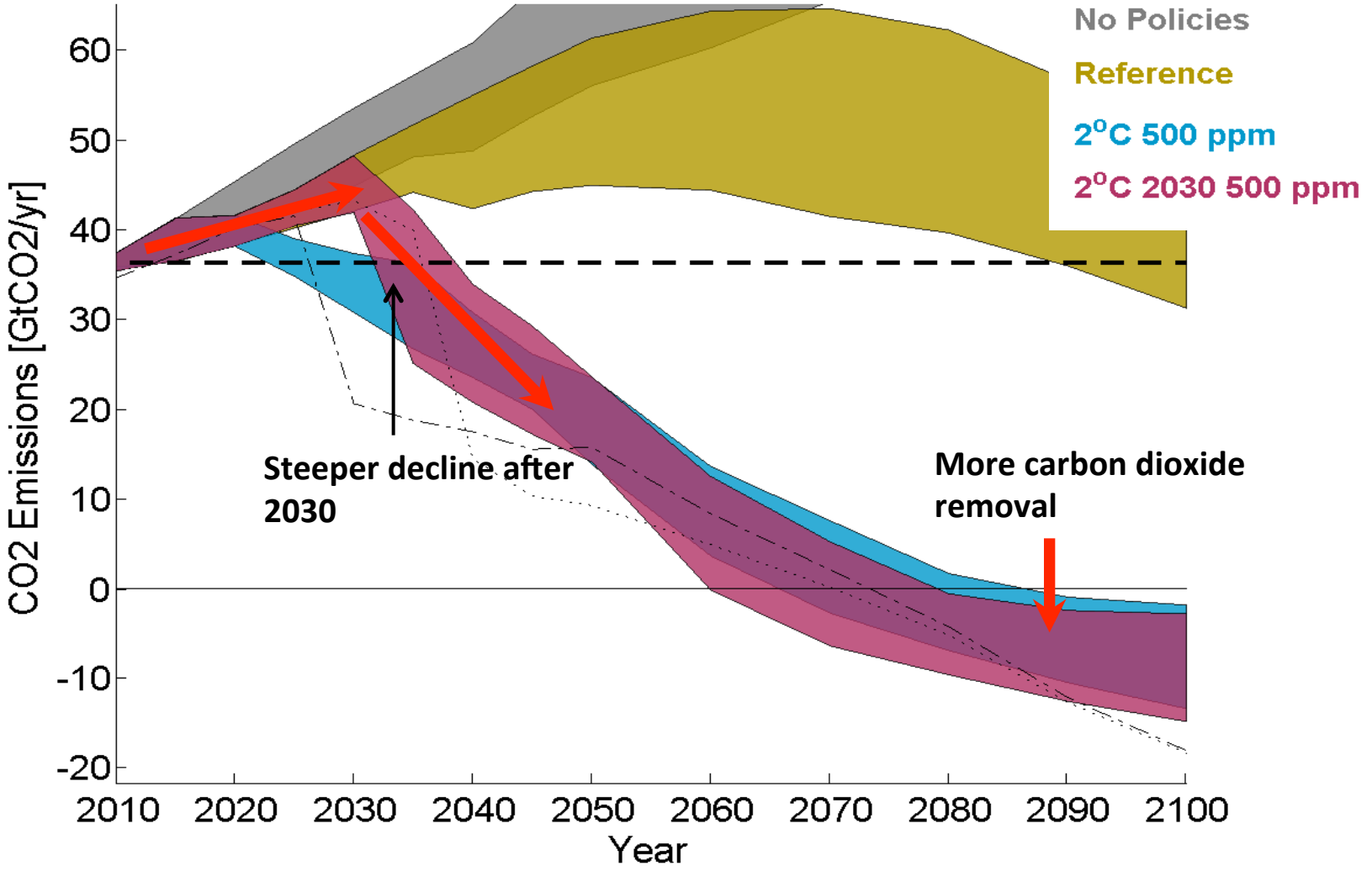
2°C requires early peaking of emissions, small CO2 budgets, and negative emissions

The 4 phases of 2°C pathways



Kriegler et al. (2013) *Climate Change Economics*

Delay until 2030 likely to put 2C out of reach



Kriegler et al. (2013) *Climate Change Economics*

The Paris compact

« The notion of a centralized policy signal has disappeared together with time tables and targets, including a global carbon price »

Laurence Tubiana, French Ambassador for Climate Change
(slide presented at WCERE 2014, Istanbul)

The Paris compact

A fundamental shift from a ‘logic of targets’ to a ‘logic of pathways’.

“Under a ‘logic of pathways’, countries would submit long-term, indicative, low emissions pathways, combined with operational multi-sector, multi-timeframe target packages”.

Laurence Tubiana, French Ambassador for Climate Change

Namely, the INDCs (Intended Nationally Determined Contributions) …

Submitted INDCs (as of June 1st)

Country	GHG emissions reduction target	Target year	Reference year	Period for implementation	Conditions for implementation	Use of international carbon credits (CDM) for achieving the target
Andorra	37%	2030	BAU	2016-2030		No
Canada	30%	2030	2005	2020-2030		"Canada may use international mechanisms to achieve its 2030 target, subject to robust systems that deliver real and verified emissions reductions".
EU	≥40%	2030	1990	2021-2030		No
Gabon	≥50%	2025	2000	2010-2025		No
Liechtenstein	40%	2030	1990	2021 – 2030	Subject to the approval of the Liechtenstein Parliament	Primary focus on domestic emission reductions, possibility to achieve reductions abroad which may be accounted towards Liechtenstein's 2030 target

Submitted INDCs (as of June 1st)

Country	GHG emissions reduction target	Target year	Reference year	Period for implementation	Conditions for implementation	Use of international carbon credits (CDM) for achieving the target
Mexico	22-36%	2030	BAU(from 2013)	2020-2030	The high end of the range is conditional on a global agreement	Only for meeting the conditional goal
Norway	≥40%	2030	1990	2021-2030		Depending on the result of negotiations with the EU
Russia	25-30%	2030	1990	2020-2030	Subject to the maximum possible account of absorbing capacity of forests; conditional upon a legally binding commitment by all emitters	N/A
Switzerland	50%	2030	1990	2021-2030	The commitment corresponds to a reduction of GHG emissions by 35% over the period 2021-2030	Yes, up to 20% of the total 50% reduction
USA	26-28%	2025	2005	2020-2025		No

Submitted INDCs (as of June 1st)

Country	GHG emissions reductions	Target year	Baseline
EU	- 40%	2030	1990
Mexico (conditional)	- 22-36%	2030	BAU
Norway	- 40%	2030	1990
Russia	- 25-30%	2030	1990
Switzerland	- 50%	2030	1990
USA	- 26-28%	2025	2005
Canada	- 30%	2030	2005
China	Peaking of CO2 emissions in 2030		

The evaluation of emission reduction efforts

- Within the Kyoto Protocol and subsequent negotiations, global emission reductions were decided first and then allocated among Annex I countries. National commitments were enforced legally.
- The post-2020 international framework for emission reductions will be pledge & review type (P&R).
- Therefore, it is important to implement a review system for the pledged emission reduction targets. Are pledged emission reduction efforts effective and equitable ?
- The INDCs (Intended Nationally Determined Contributions) will include targets having different base year, intensity targets, peak targets and emission reduction targets relative to BaU emissions.
- It is therefore important to adopt appropriate indicators to measure and compare emission reduction efforts across countries.

The evaluation of emission reduction efforts

1. Comparing emission reductions with respect to a base year
2. Comparing emission reductions with respect to a business as usual scenario
3. Comparing emission reductions with respect to a reduction benchmark
4. Comparing marginal abatement costs of emission reduction pledges
    1. By using energy system models
    2. By using economic models (implicit carbon tax)

An example: comparing EU, US and China INDCs

European Union

1) Targets for 2030:

•-40% in GHG emissions wrt 1990

•27% renewable share energy consumption

•"27% in energy efficiency improvement"

2) These objectives are added to the targets for:

•2020 → The 2020 climate and energy package (20-20-20)

•2050 → -80/95% in GHG emissions wrt 1990

United States

•-26/28% in GHG emissions in 2025 wrt 2005

China

•Peak in GHG emissions in 2030

•20% non fossil-fuel share in total energy consumption in 2030

Comparing INDCs with respect to the same base year: 1990

United States

- A -26/28% in GHG emissions in 2025 wrt 2005 becomes a **-16.3%** reduction compared with 1990 levels.

European Union

-Though notable, the US target is decidedly less than the about **-30%** reduction decided by the EU for 2025 (recall that the EU committed to reduce its GHG emissions by -40% from 1990 levels by 2030).

China

- A peak of GHG emissions in 2030 corresponds to an increase of emissions from 3,000 Mton CO2eq in 1990 to 16,000 Mton CO2eq in 2030, namely + 433% with respect to 1990. It would be **+ 380%** in 2025.

Comparing INDCs wrt to a benchmark: WITCH scenario exercises

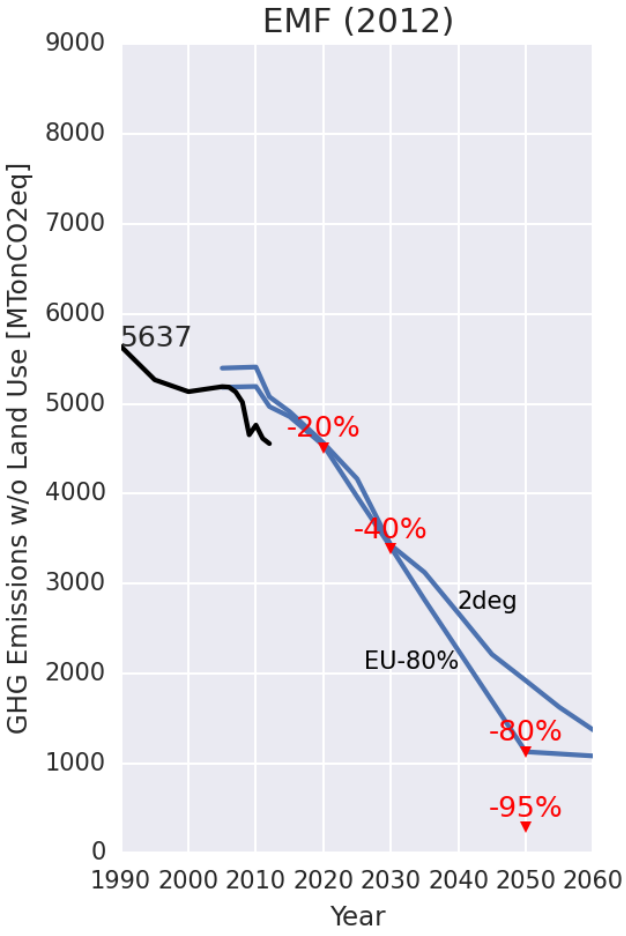
	US (2025): -26 to 28% relative to 2005	EU (2030): -40% relative to 1990	Russia (2030): -25 to -30% relative to 1990	China (2030): Peak-out (emissions estimated by authors)
GHG emissions [$MtCO_2eq/yr$]	5204 to 5349	3380	2354 to 2523	14496 to 15552
Relative to 1990 [%]	-16 to -14	-40	-30 to -25	+265 to +291
Relative to 2000 [%]	-26 to -24	-34	+15 to +23	+167 to +187
Relative to 2005 [%]	-28 to -26	-35	+10 to +18	+76 to +89
Relative to 2010 [%]	-24 to -22	-29	+6 to +14	+28 to +37
GHG/Population [$tCO_2eq/capita$]	14.5 to 15.0	6.6	17.9 to 19.1	9.8 to 10.5
GHG/GDP [$kgCO_2eq/US\$$]	0.30 to 0.31	0.27	1.98 to 2.12	1.11 to 1.19
Δ(GHG/GDP)				
Relative to 1990 [%/yr]	-3.0 to -2.9	-2.8	-3.7 to -3.5	-4.7 to -4.5
Relative to 2000 [%/yr]	-3.3 to -3.2	-2.7	-4.6 to -4.4	-4.3 to -4.0
Relative to 2005 [%/yr]	-3.6 to -3.5	-2.9	-4.5 to -4.2	-5.0 to -4.7
Relative to 2010 [%/yr]	-4.2 to -4.0	-2.9	-5.0 to -4.6	-5.4 to -5.0

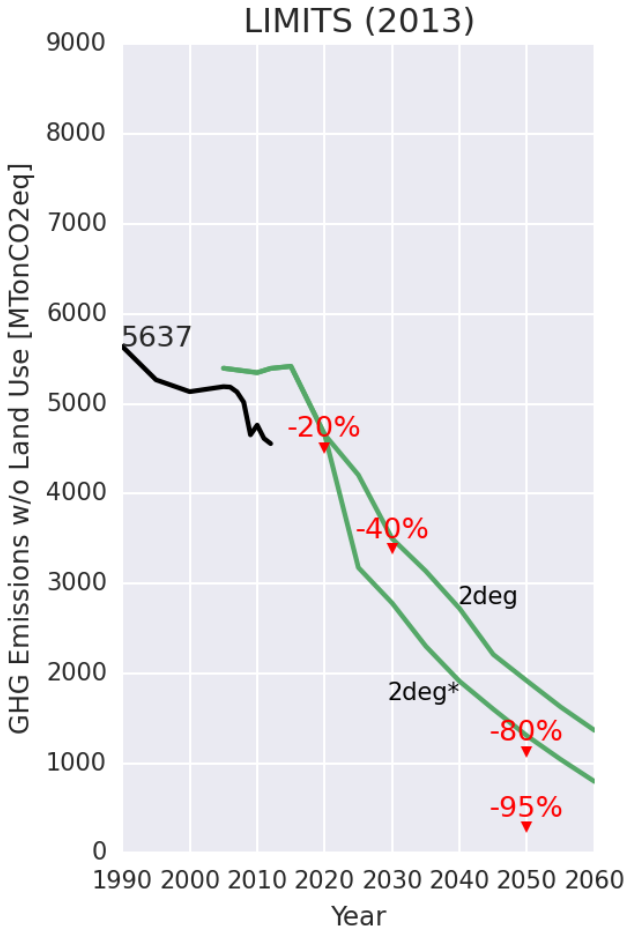
Source: Aldy et al. 2015

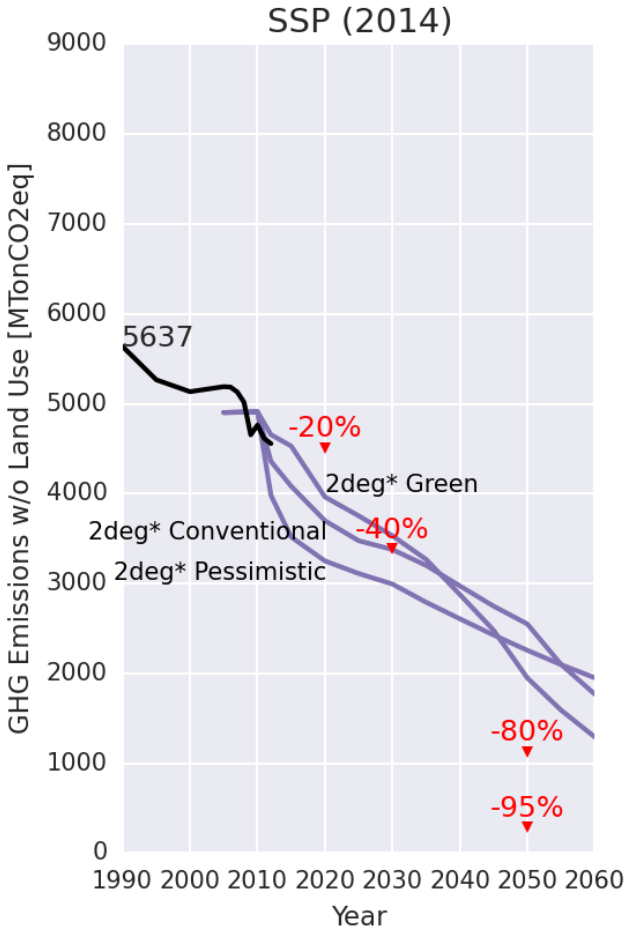
Comparing INDCs wrt to a benchmark: WITCH scenario exercises

Exercise	Year	Focus
EMF27 / EMFEU28	2012	Energy technologies
LIMITS	2013	2 degrees
SSP	2014 (ongoing)	Socio-economic pathways

EU emission pathways to achieve the 2C target

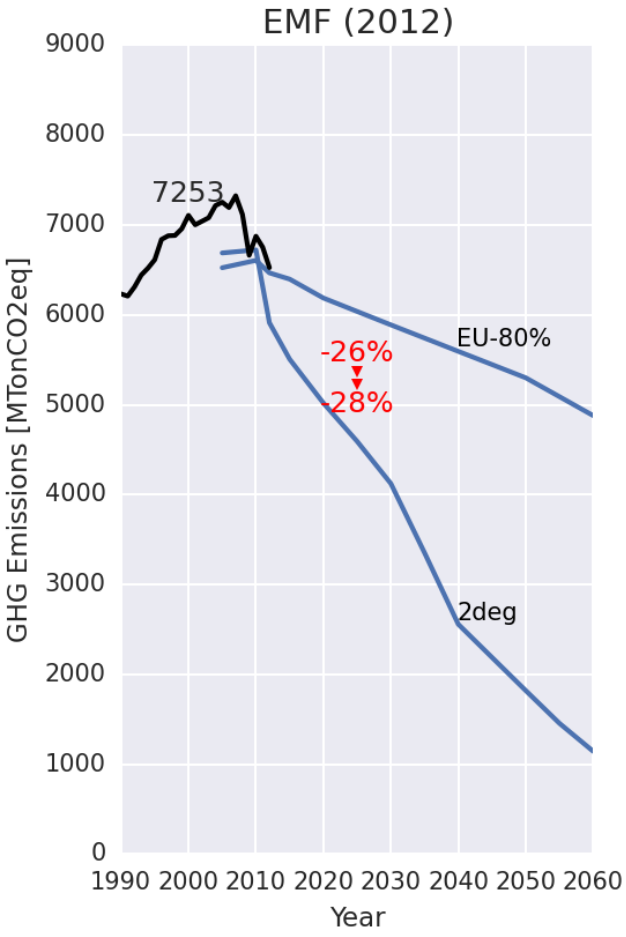


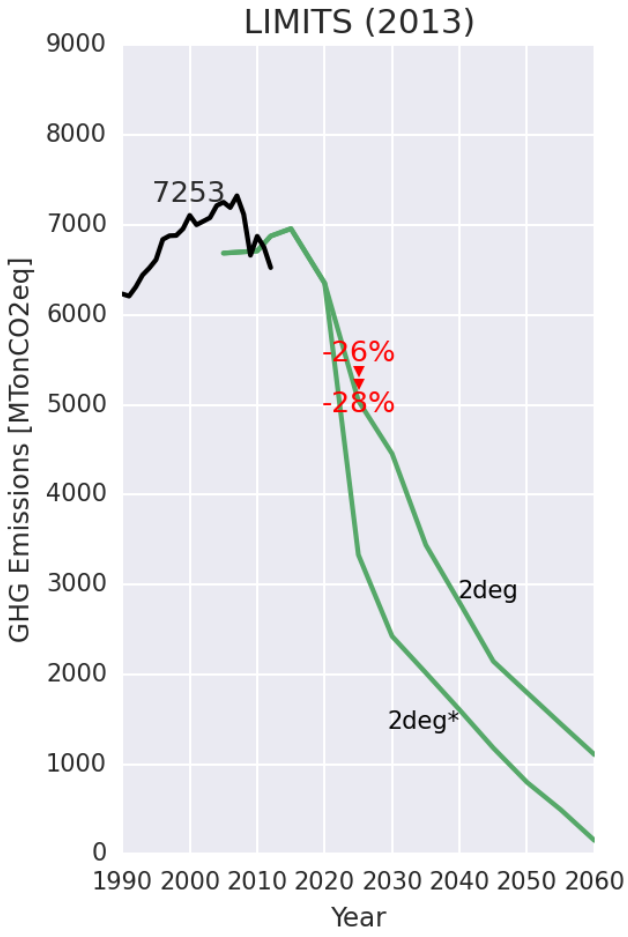


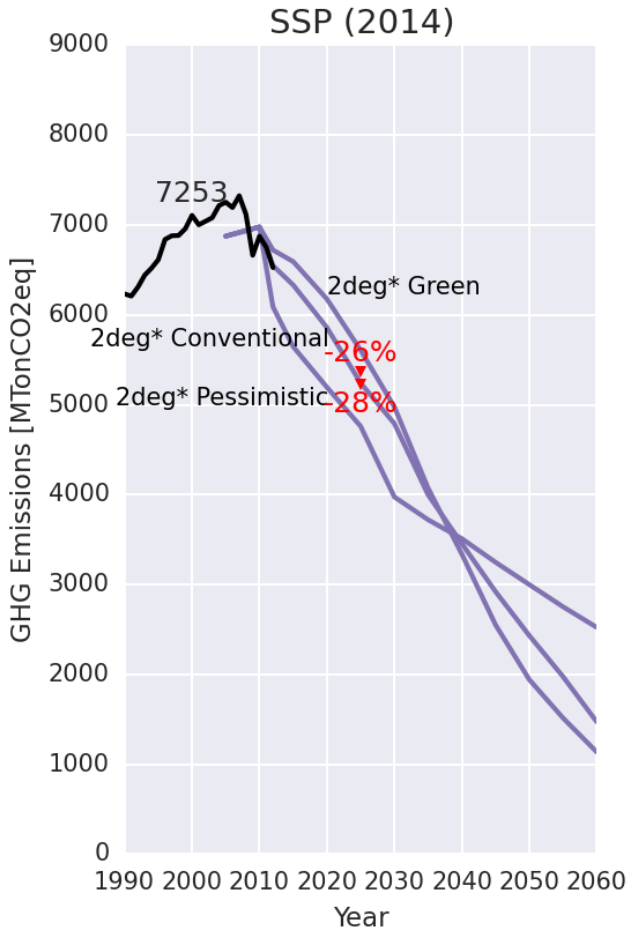


FONDAZIONE ENI ENRICO MATTEI

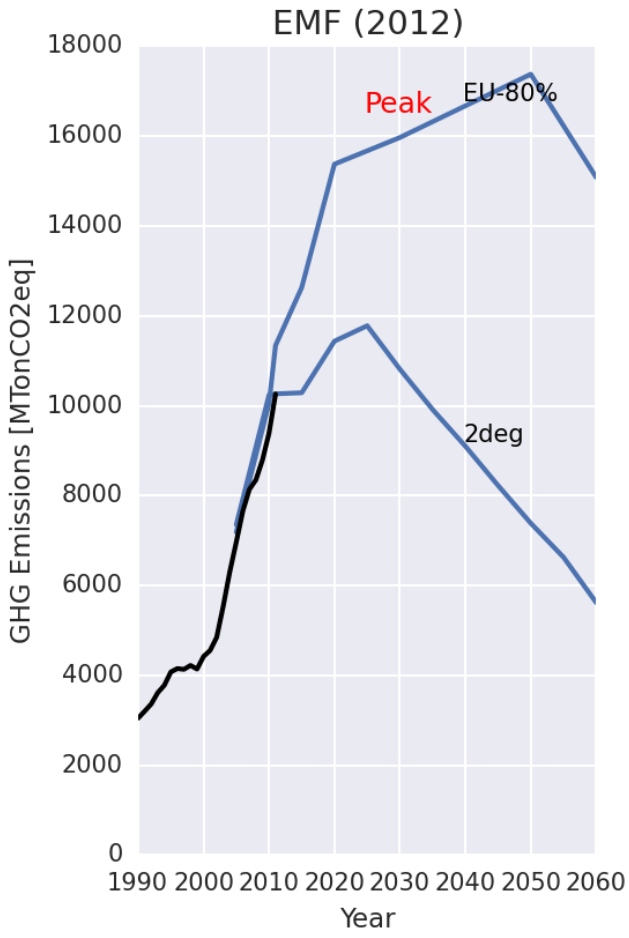
US emission pathways to achieve the 2C target

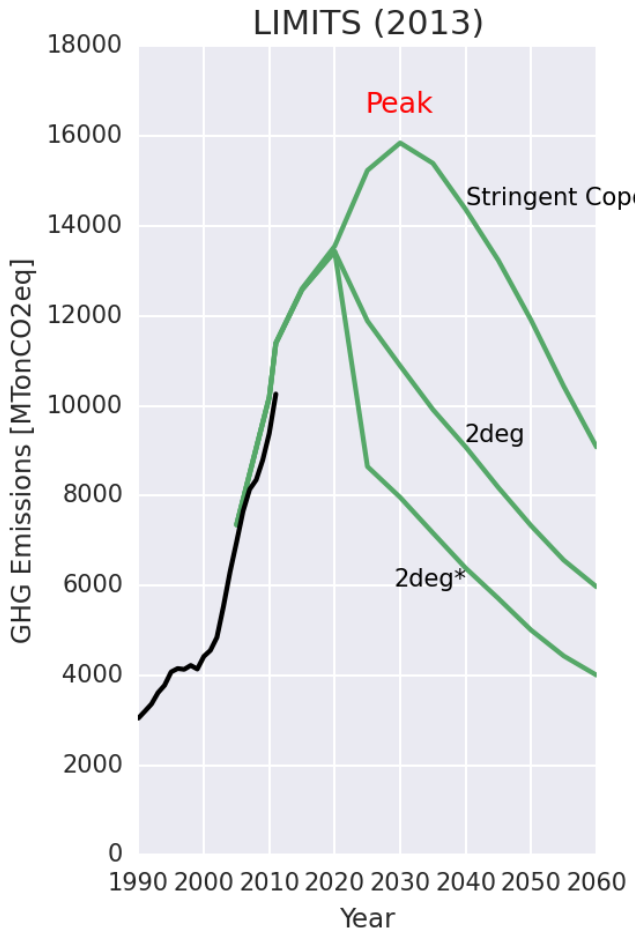


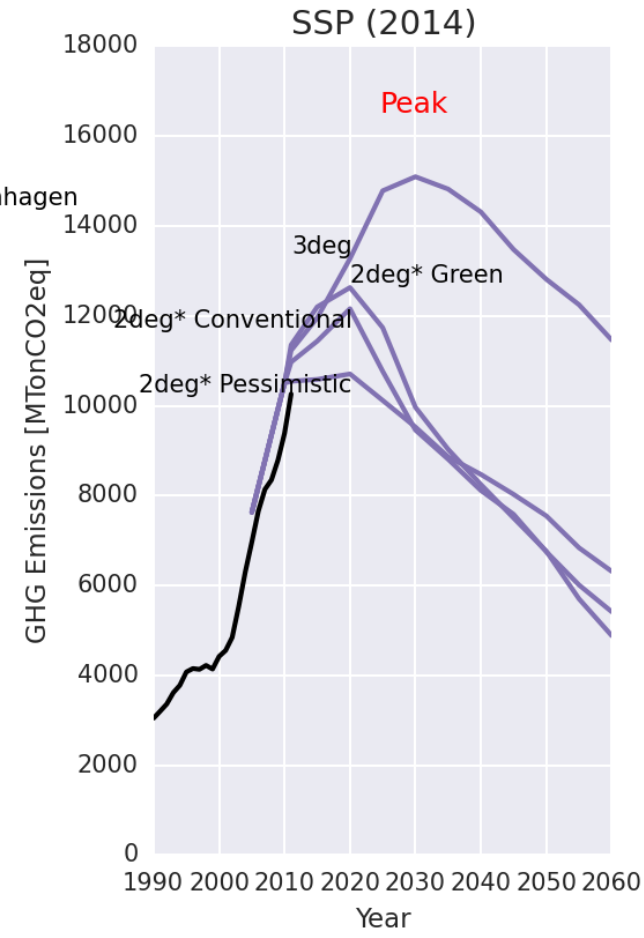




China emission pathways to achieve the 2C target



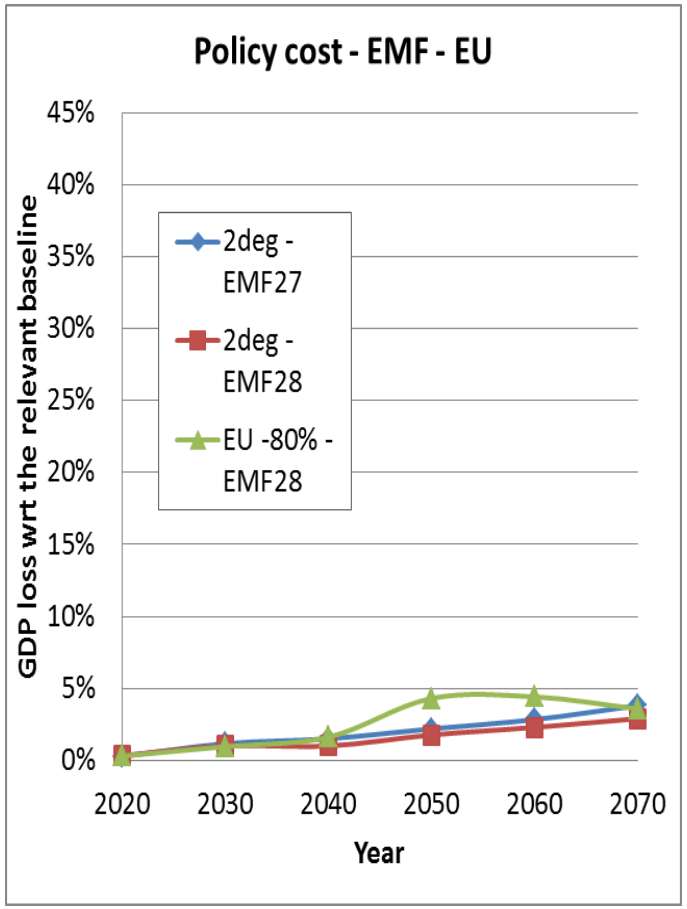


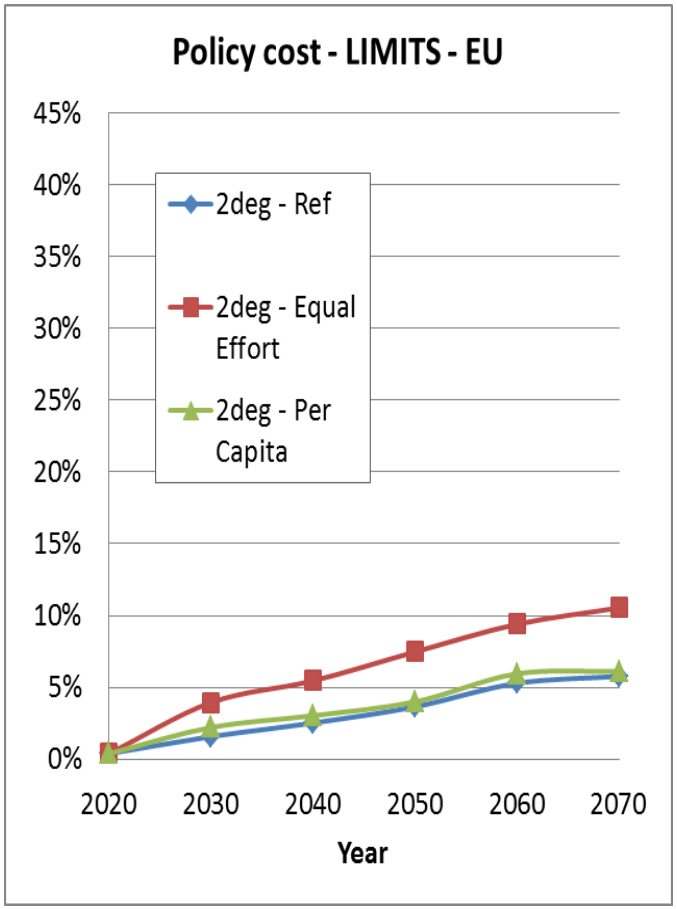


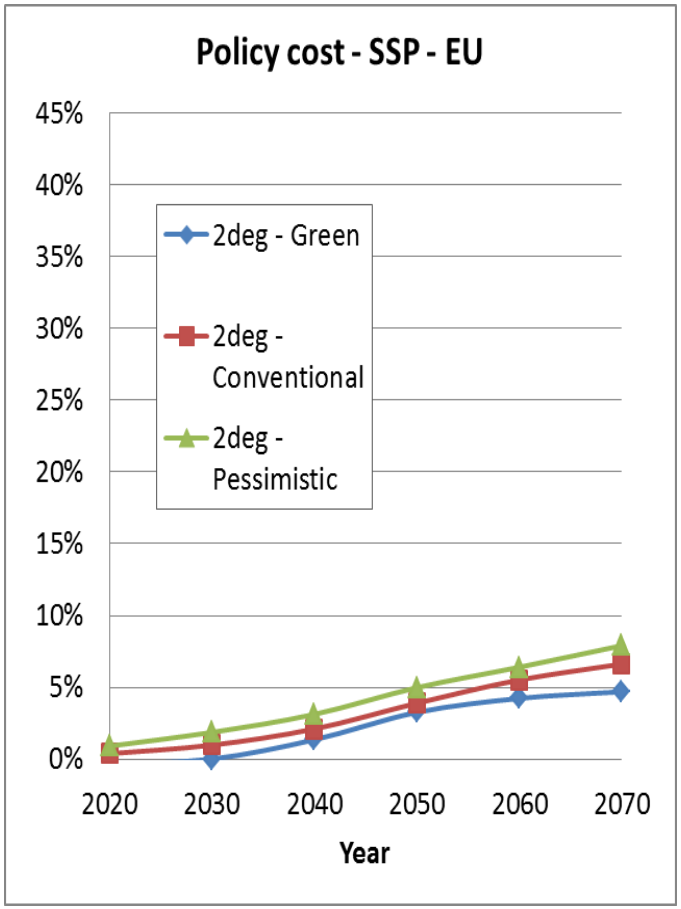
China emission pathway is not very ambitious, however…

- China emission pathway is not consistent with 2C target
- However, consistency with 2 degrees would be too costly for China
- Fairness of INDCs is at least as important as their effectiveness

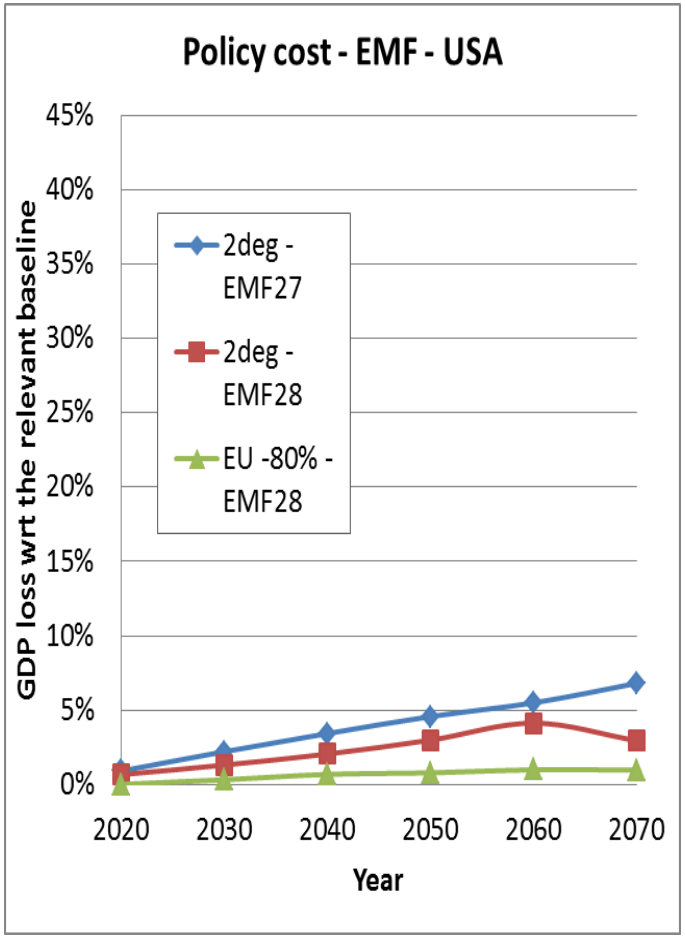
Comparing 2C pathway wrt to a BaU scenario: EU policy costs

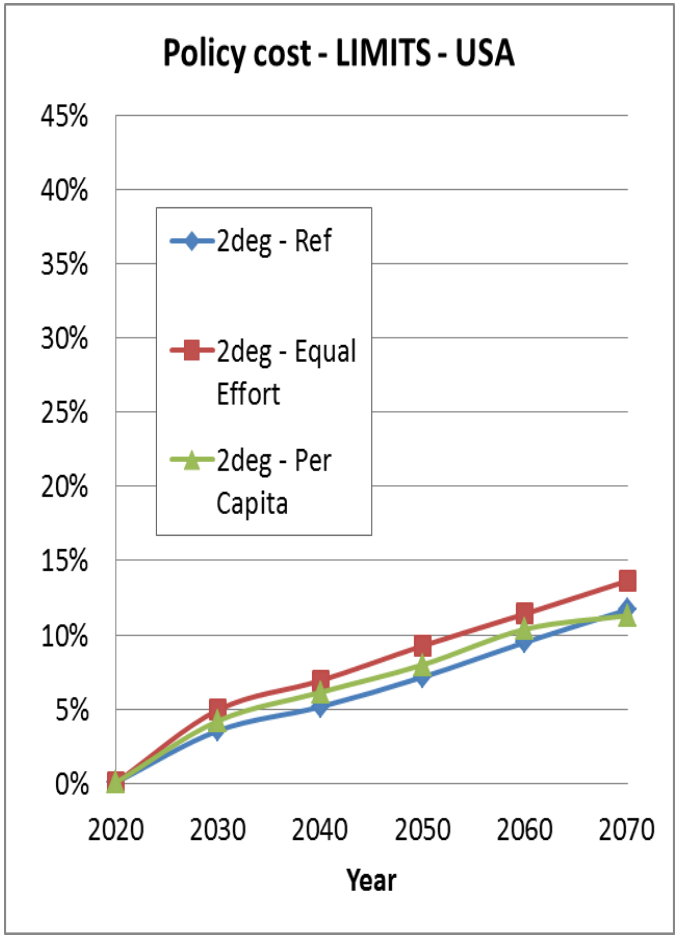


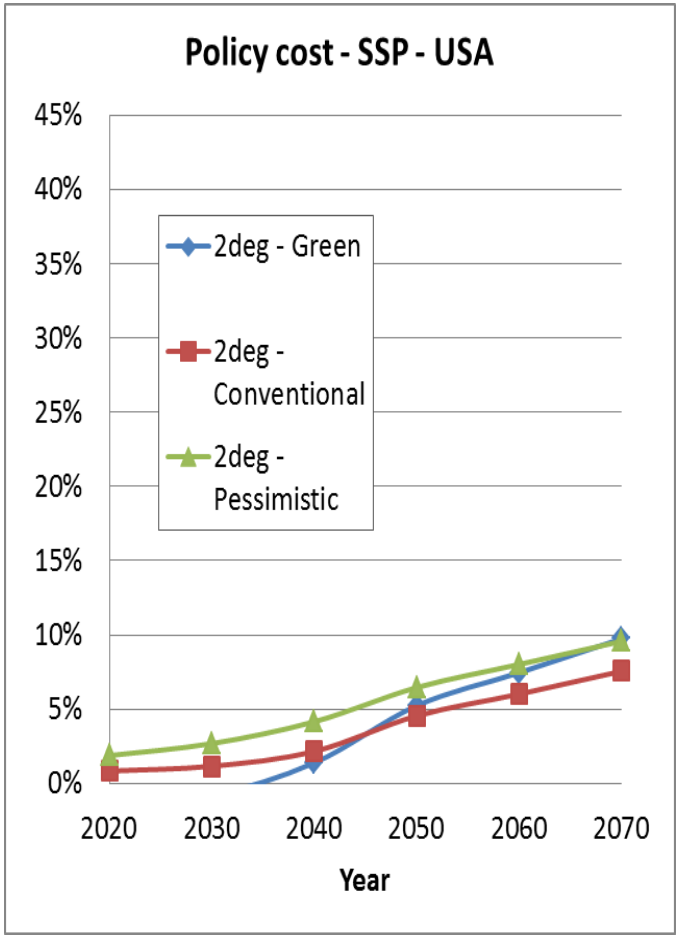




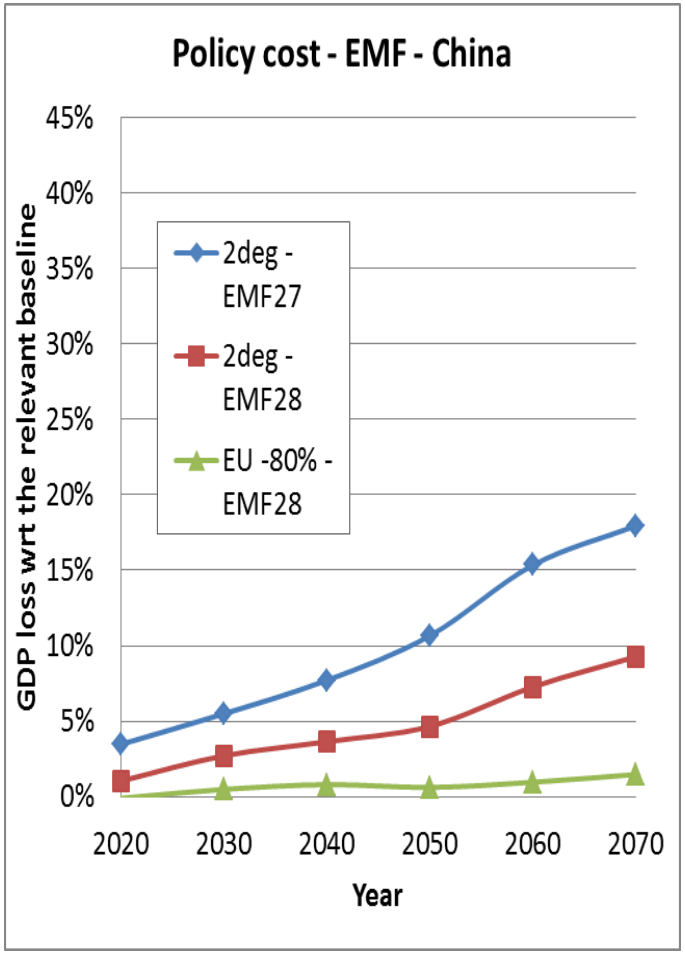
Comparing 2C pathway wrt to a BaU scenario: USA policy costs

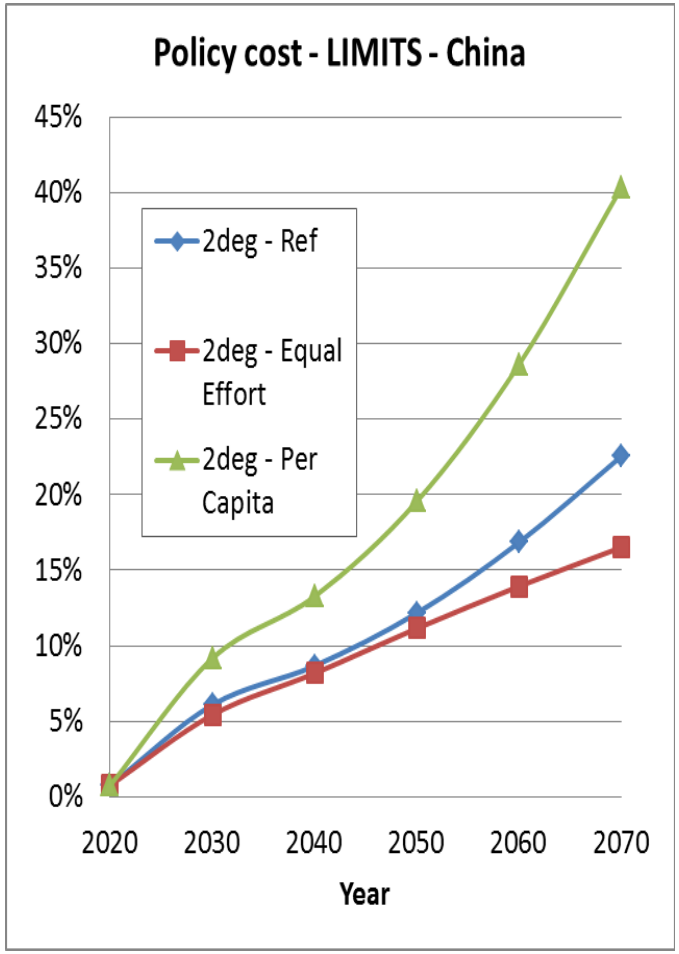


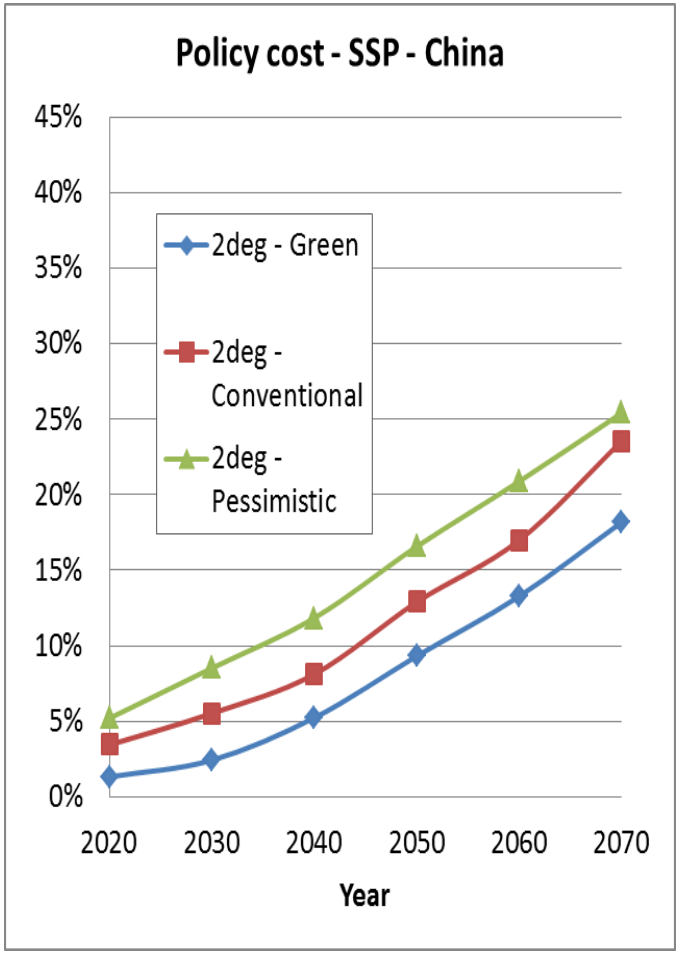




Comparing 2C pathway wrt to a BaU scenario: China policy costs







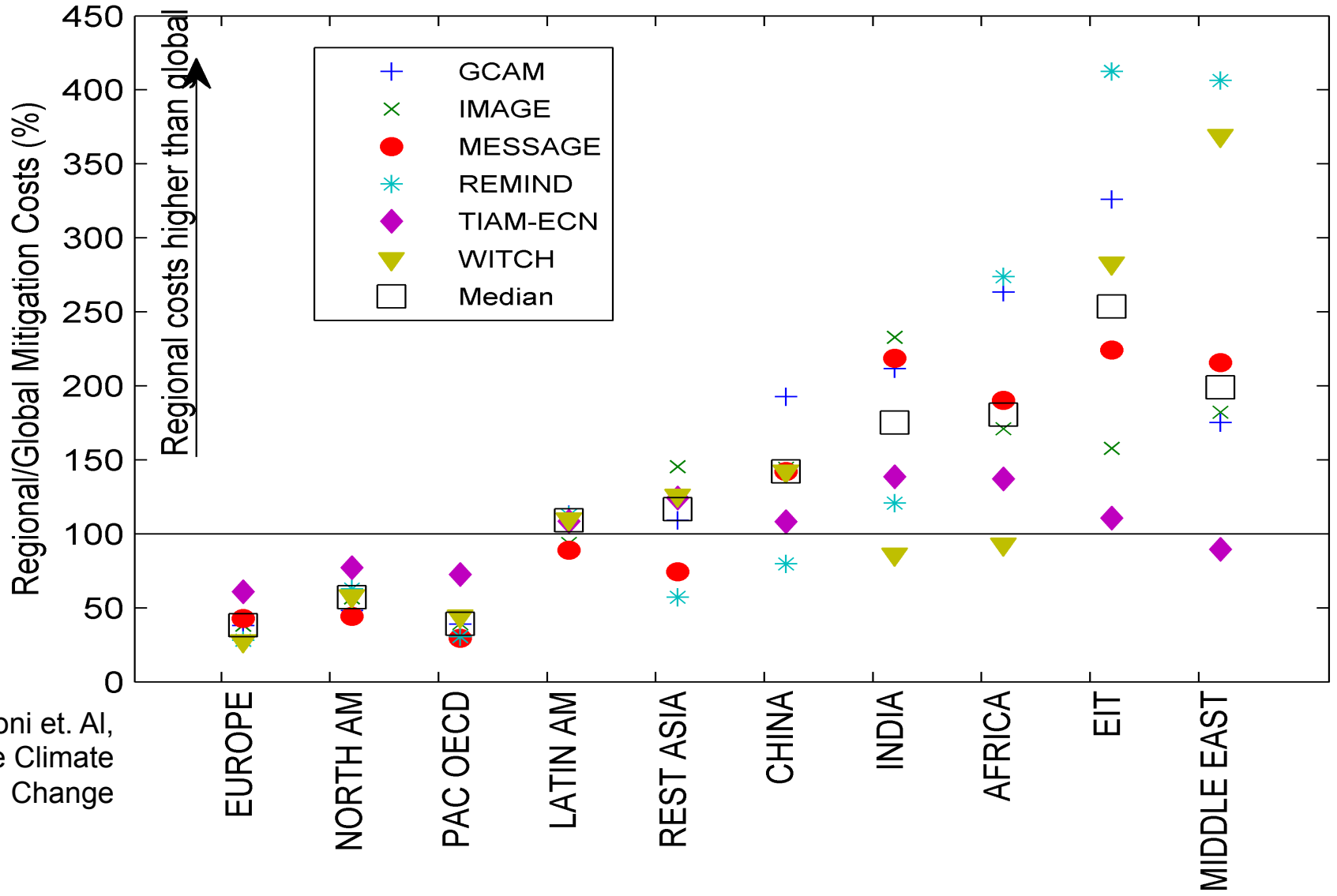
The distribution of mitigation costs to achieve a 2C target

- With uniform carbon pricing and no transfers, climate policies are likely to be regressive across regions, due to developing countries higher carbon intensity

- Costs likely to be higher in China than in the EU and US. But costs crucially depend on the estimated Business as Usual scenario (more than on many other assumptions….)

- When assessing INDCs (and then monitoring INDCs after Paris) fairness (equal burden) must be taken into account.

The distribution of mitigation costs to achieve a 2C target



Source: Tavoni et. Al, 2014, Nature Climate Change

Conclusions

- The Paris agreement will be a collection of voluntary pledges to reduce emissions. Similar to the Copenhagen agreement
- Unlikely to be effective in reducing GHG emissions (at least to get close to a 2.5 degree temperature change by the end of the century)
- Main goal will be to broaden the agreement and to increase the share of emissions under control. Future COPs will deepen the agreement and make it more effective
- Will emission reduction efforts be comparable/fair? To answer these questions a proper review system need to be implemented. Will Paris be able to deliver rules and procedures to verify and compare emission reduction efforts?