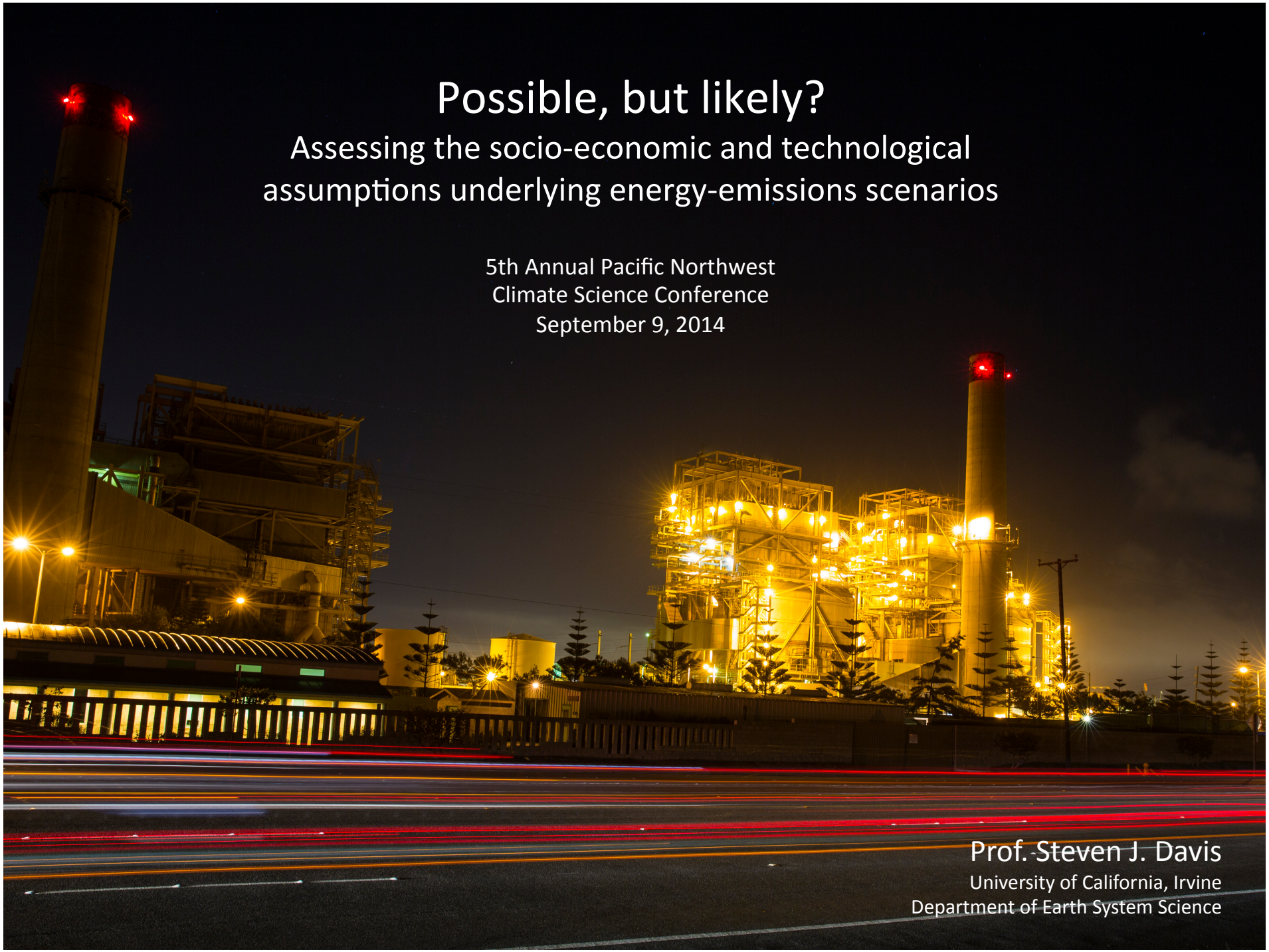


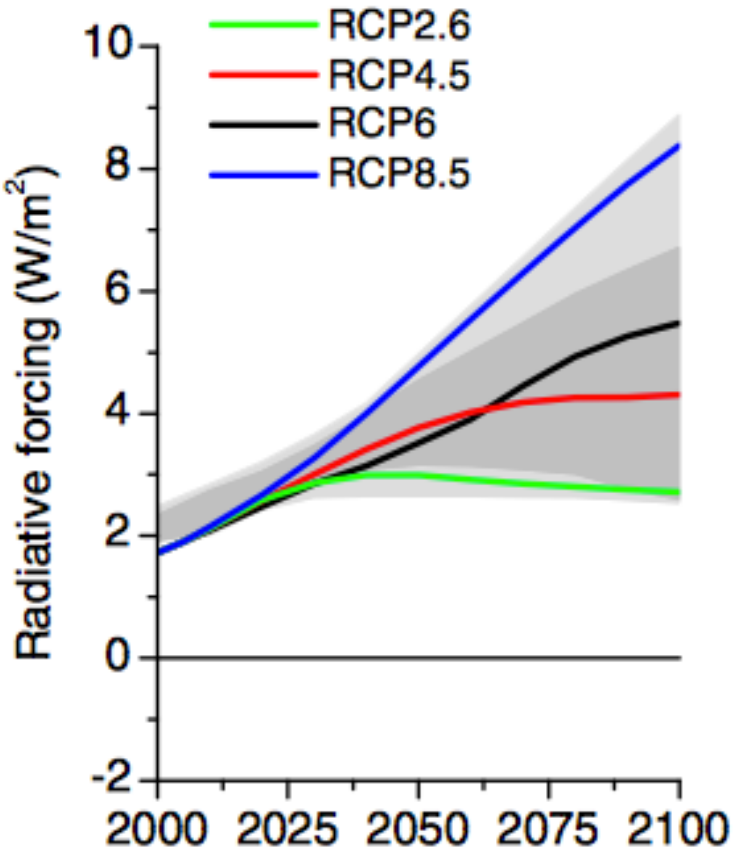
Possible, but likely?

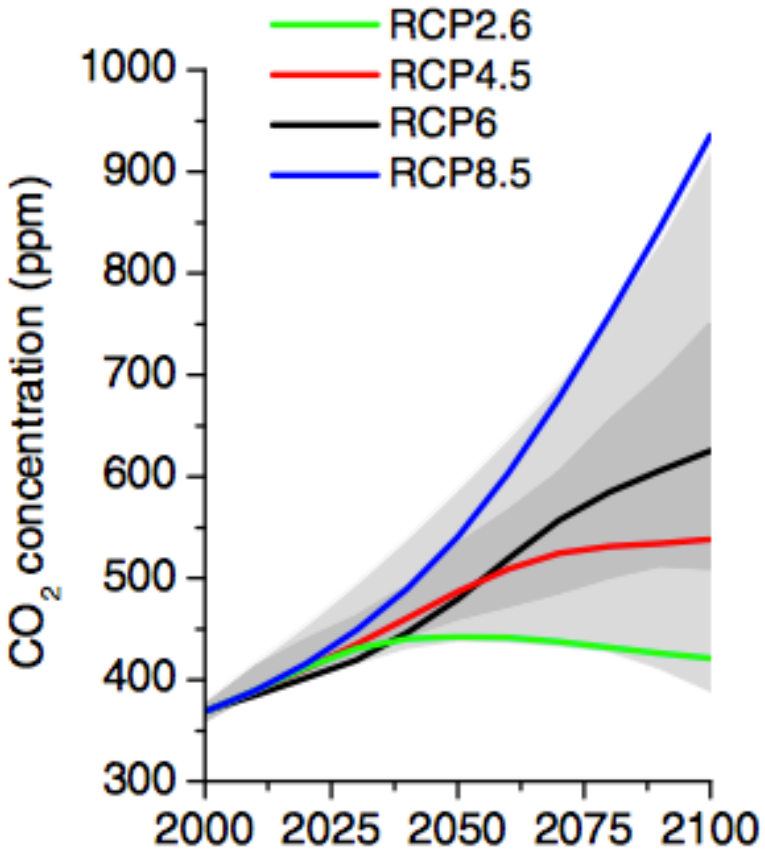
Assessing the socio-economic and technological assumptions underlying energy-emissions scenarios

5th Annual Pacific Northwest
Climate Science Conference
September 9, 2014

Prof. Steven J. Davis
University of California, Irvine
Department of Earth System Science

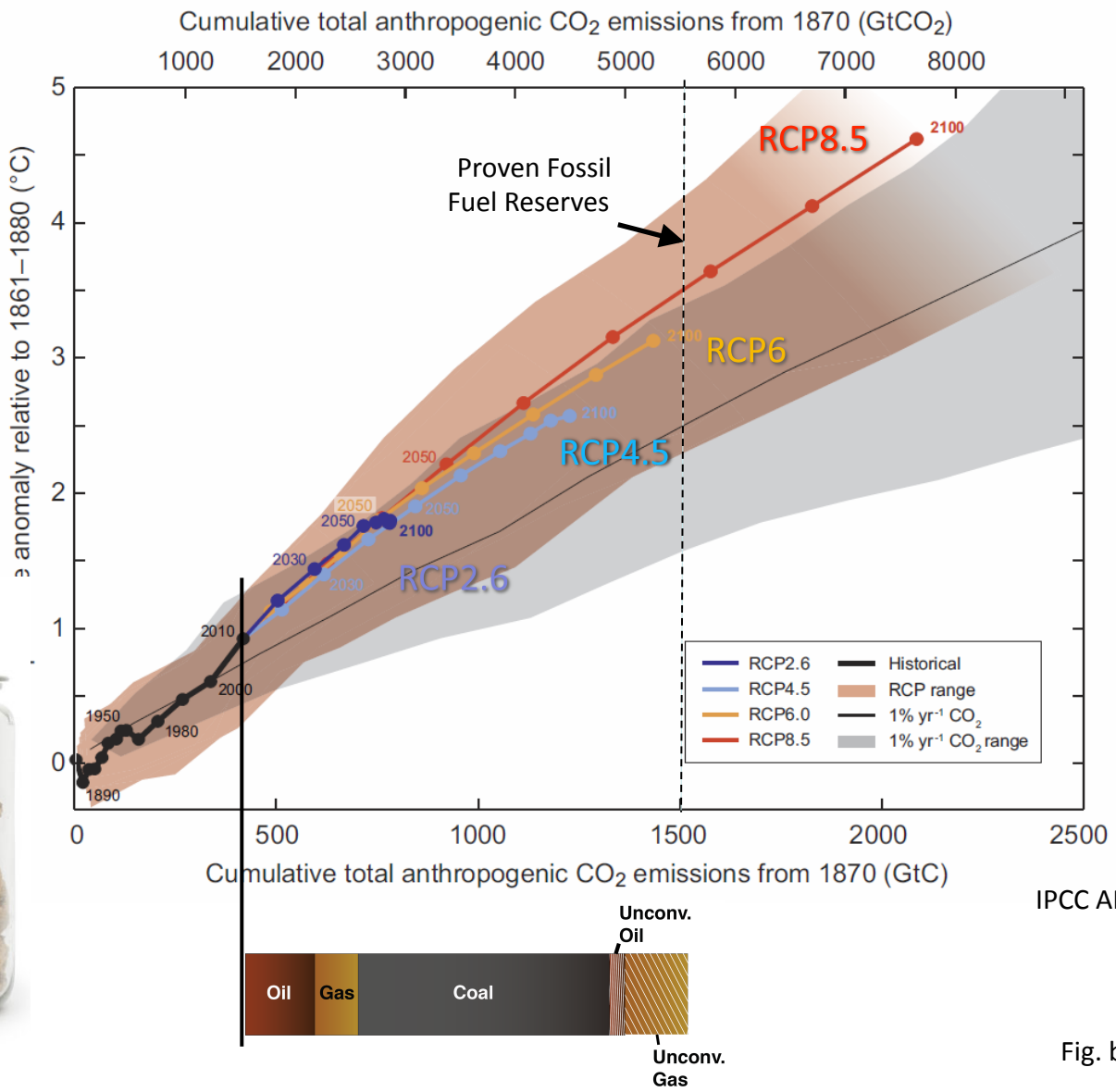
Representative Concentration Pathways (RCPs)





Van Vuuren et al., *Climatic Change*, 2011

Warming Will Be Proportional to Cumulative CO_2 Emissions



IPCC AR5, WG2 SPM, 2014

Fig. by Davis, BGR Data

~84% of Our Energy Still Comes from Fossil Fuels

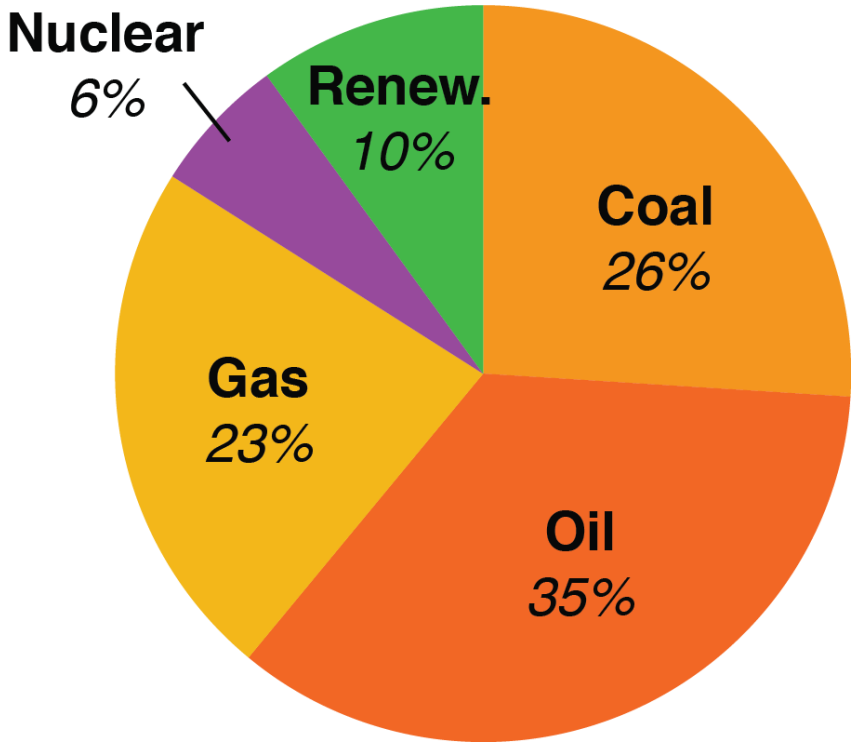


Fig. by Davis
EIA Data, 2010

Energy Demand is Expected to Grow a LOT in RCPs

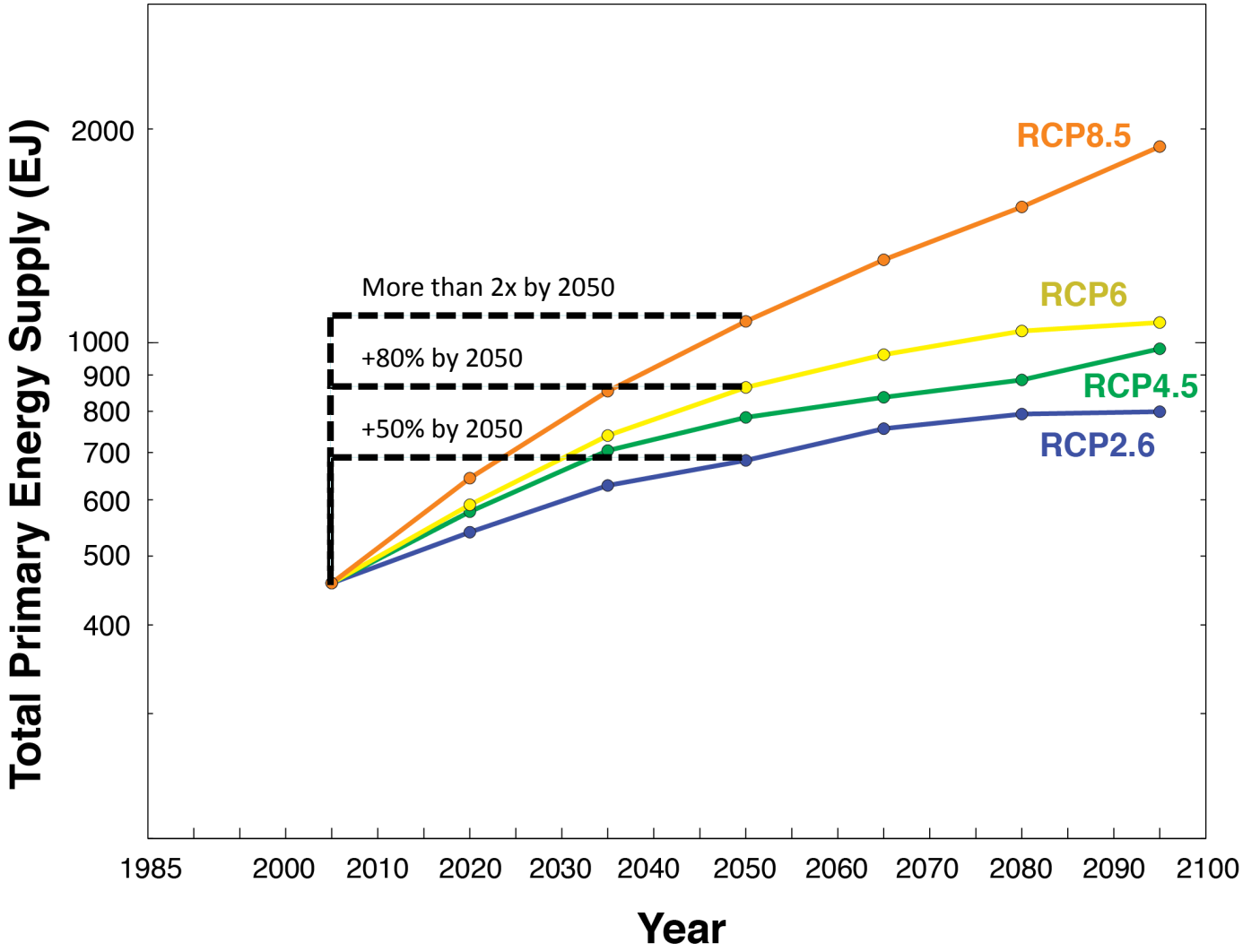


Fig. by Davis

Actual Energy Use is Greater than in RCP8.5

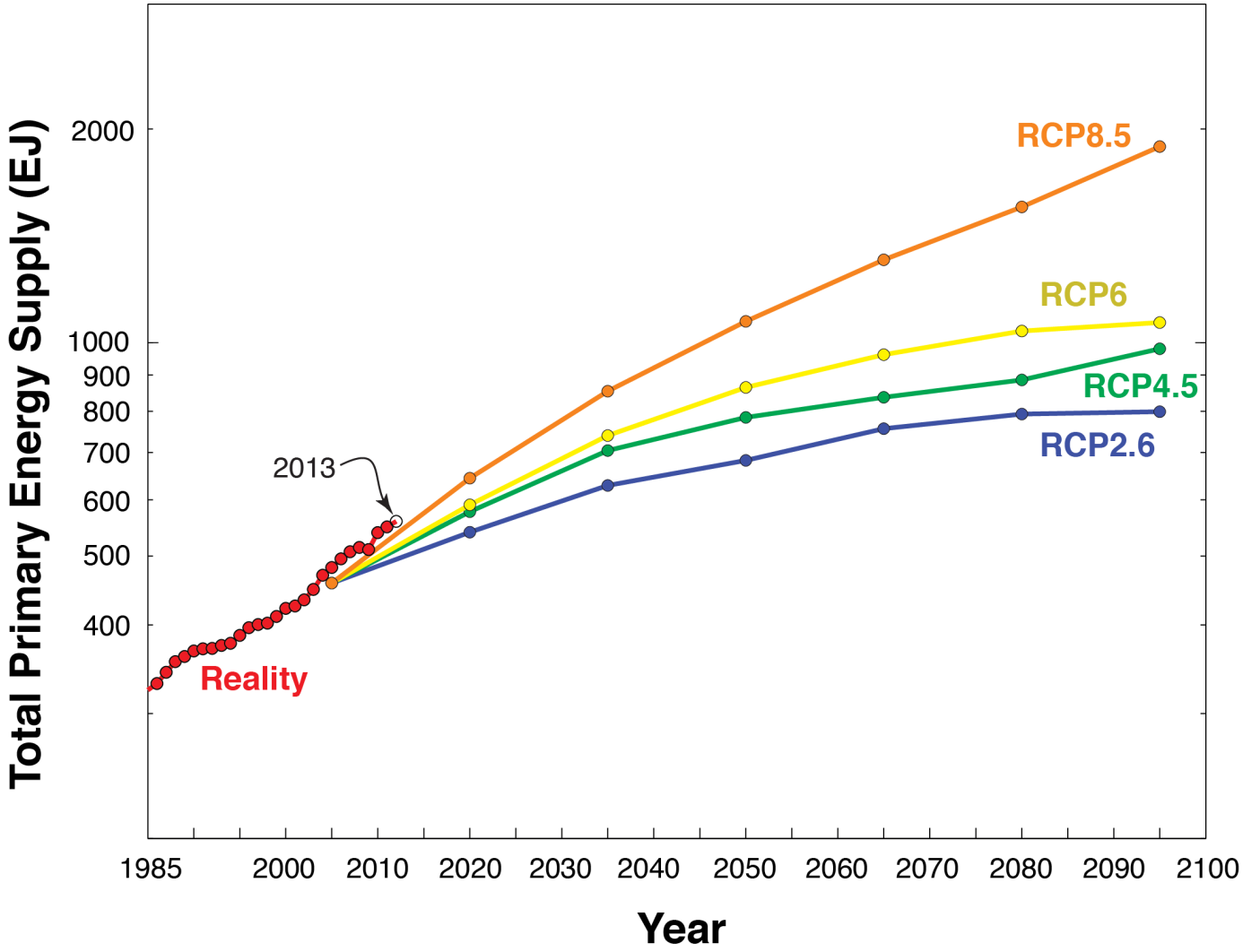


Fig. by Davis,
IEA Data, 2013

Annual Emissions in the RCPs

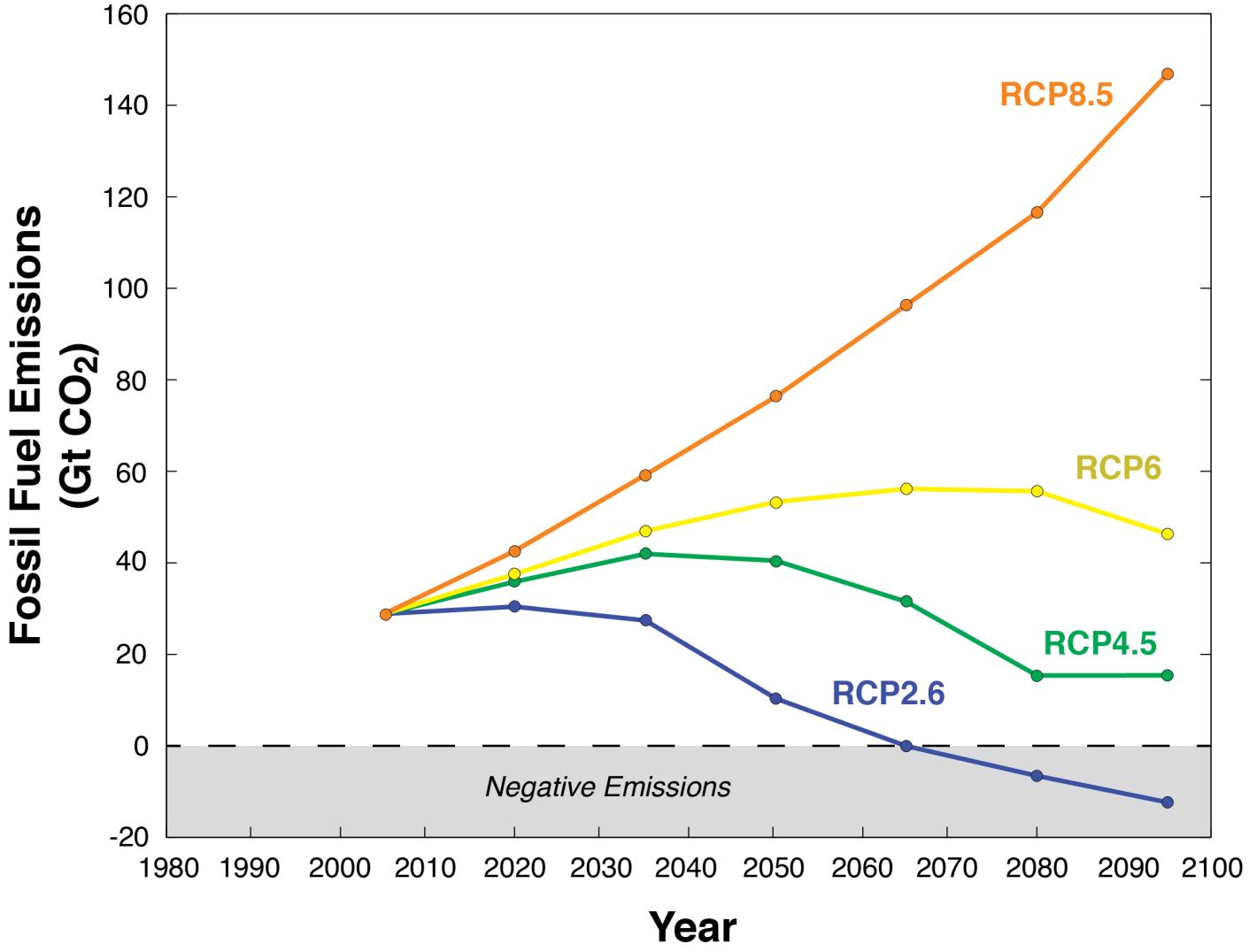


Fig. by Davis

Actual Emissions Are Following RCP8.5

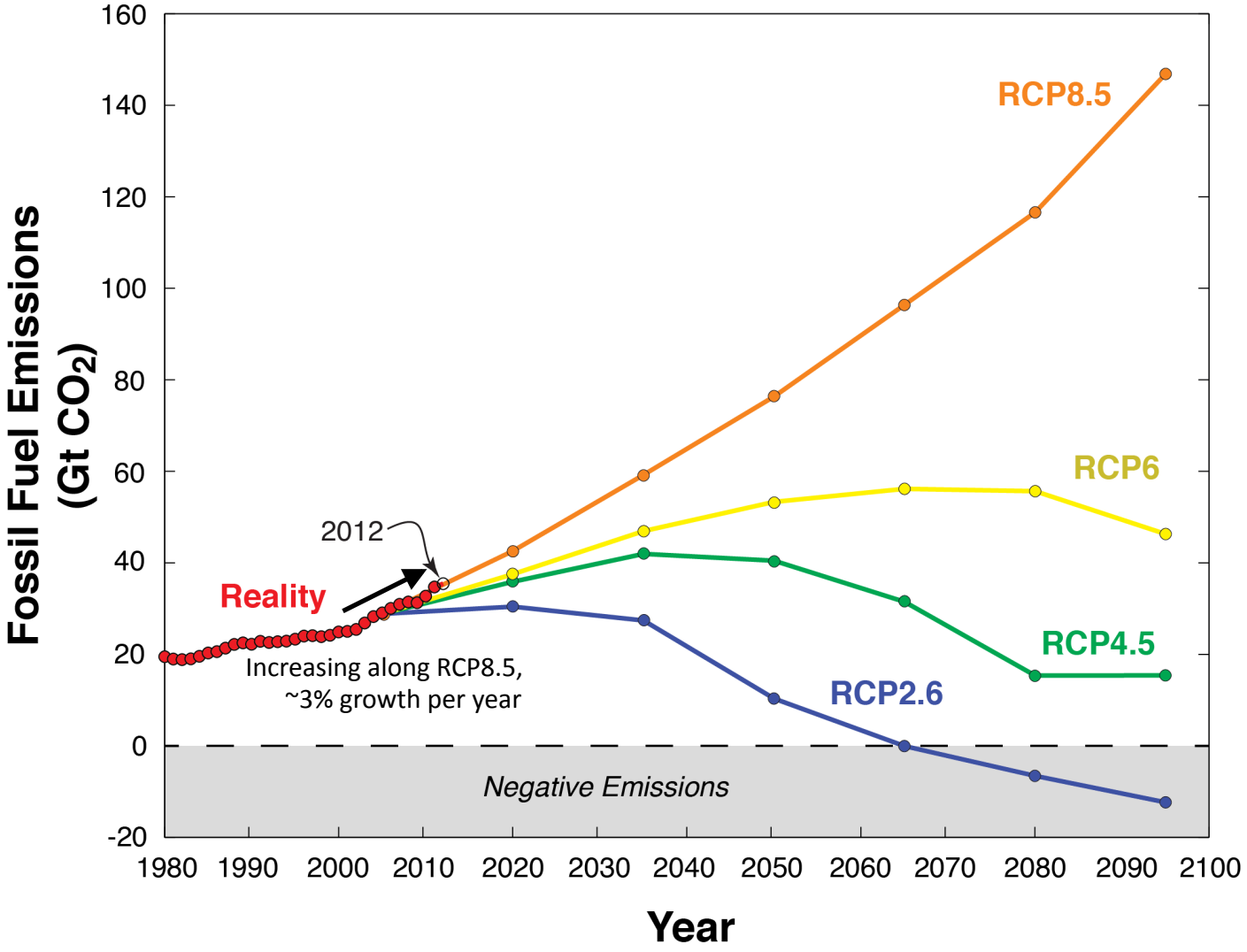


Fig. by Davis,
CDIAC Data, 2012

Carbon Intensity of Energy in the RCPs

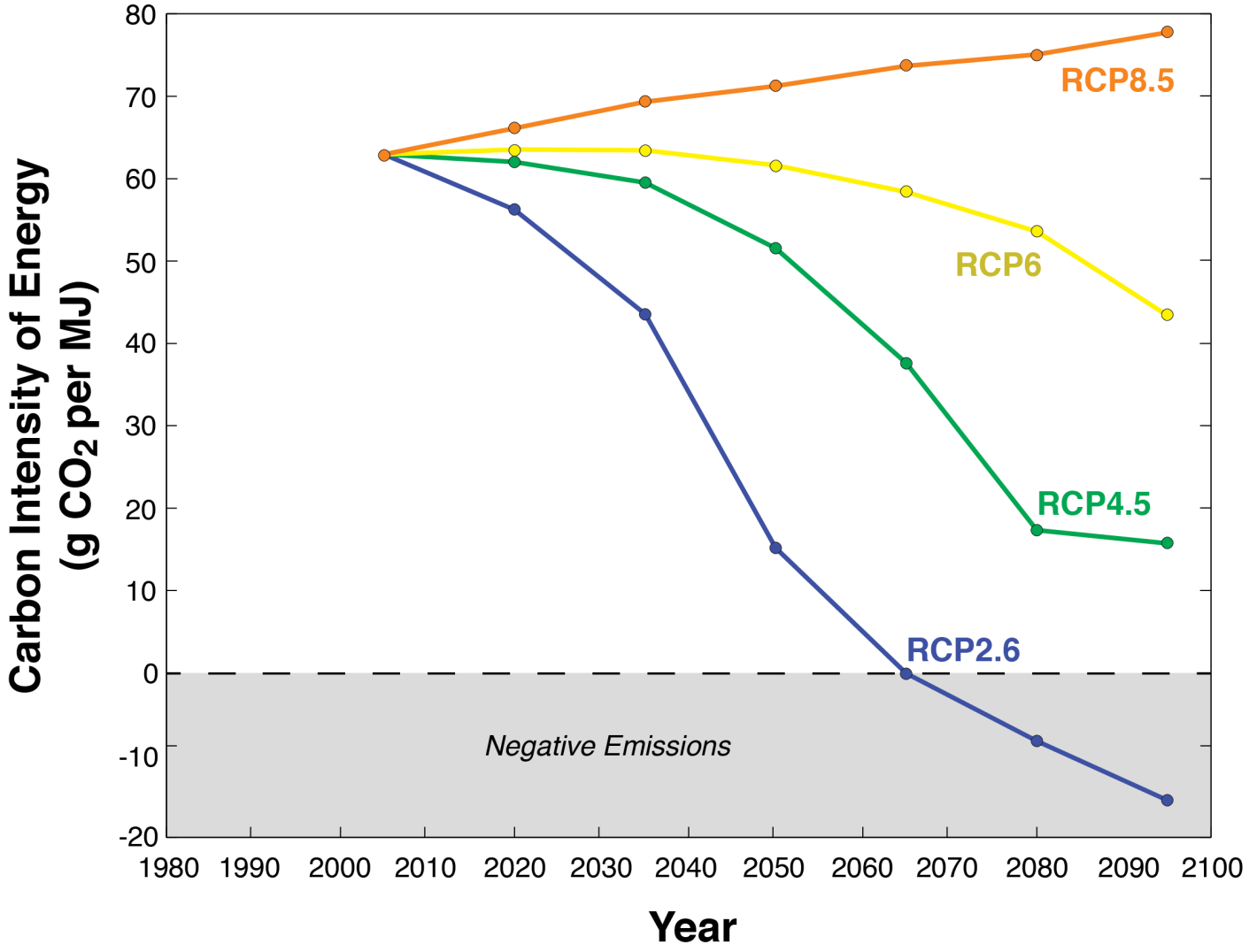


Fig. by Davis

Actual C Intensity Is Following RCP8.5

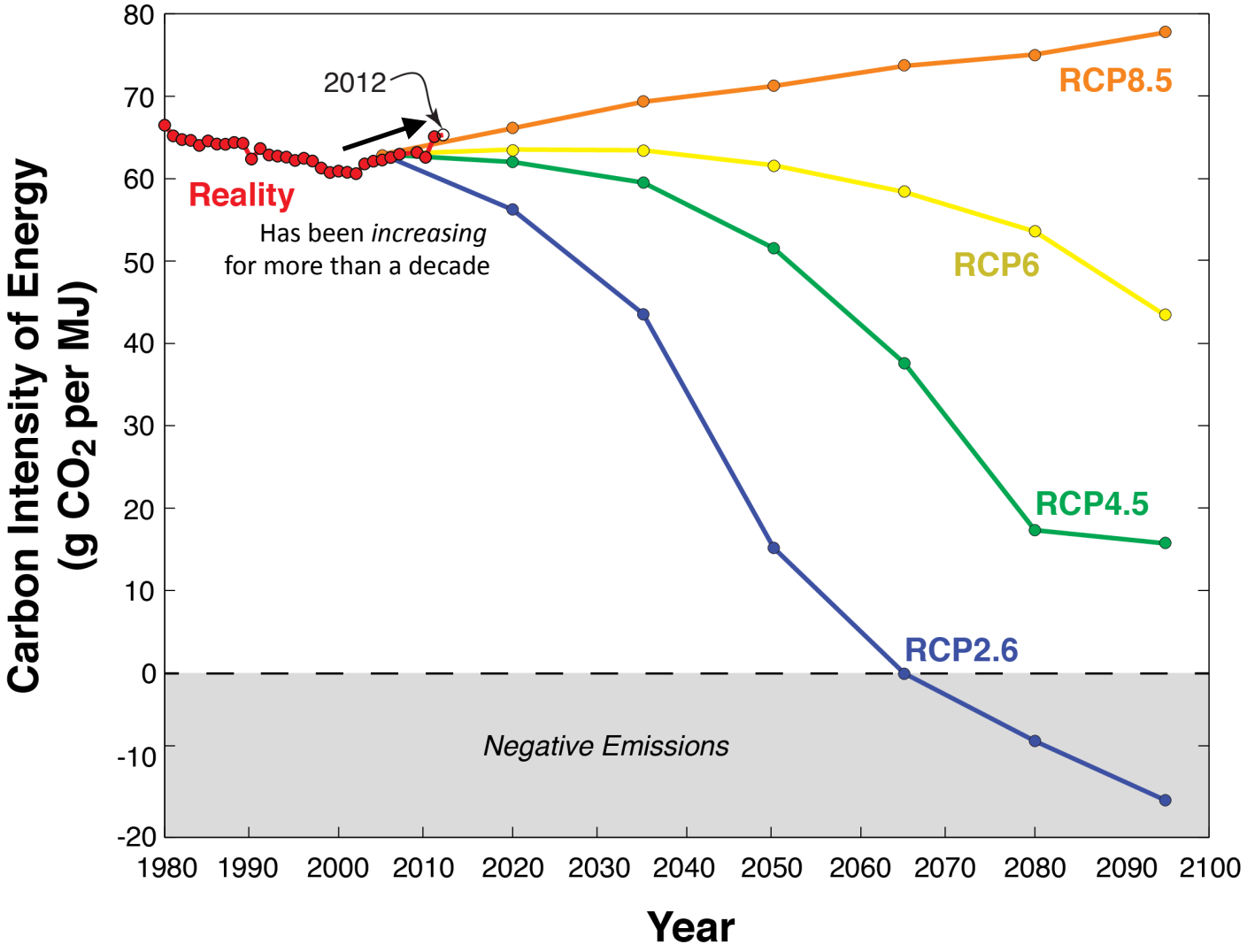


Fig. by Davis,
CDIAC and IEA Data

Renewable Energy (Hydro, Solar, Wind, Biomass) in the RCPs

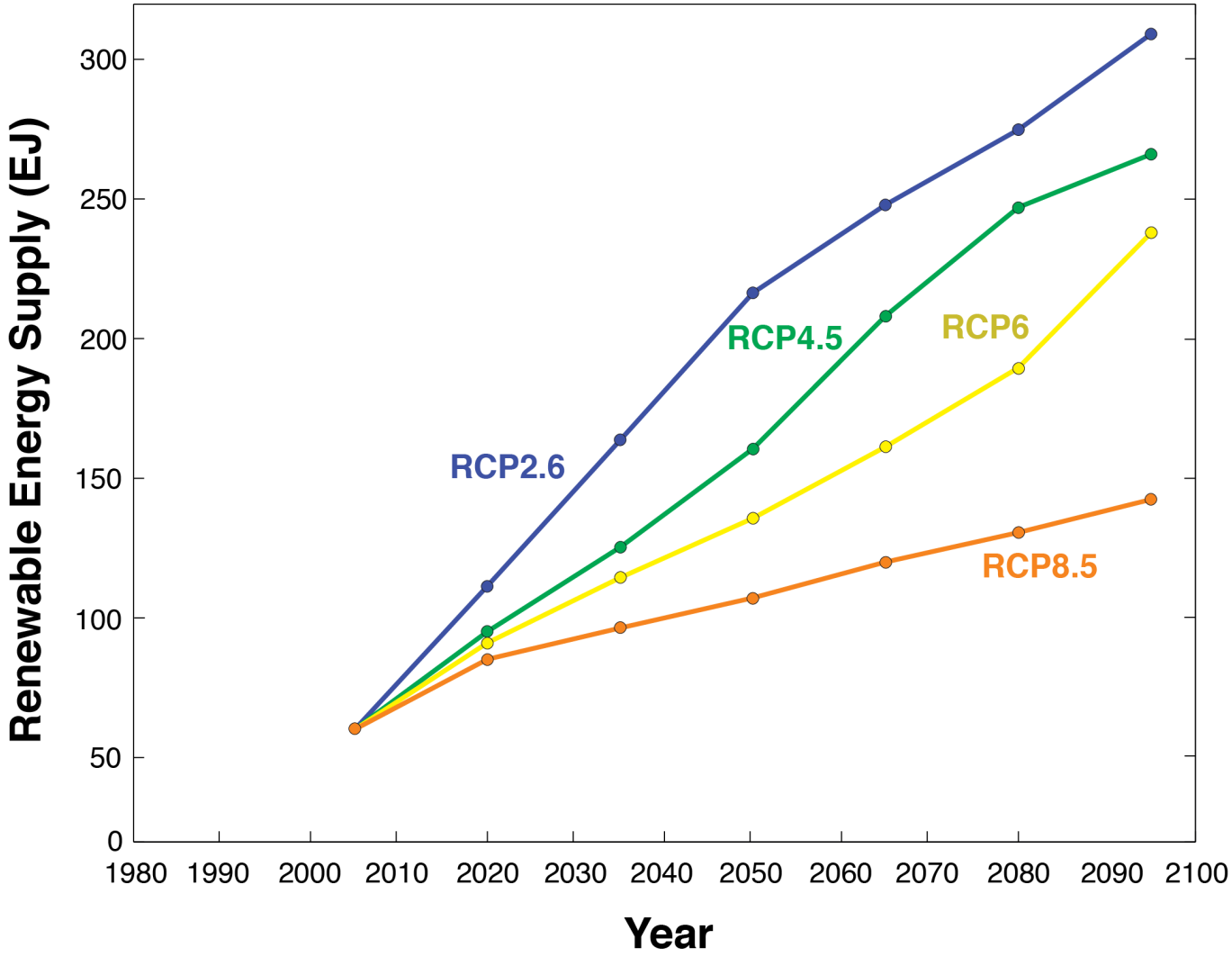


Fig. by Davis

Actual Renewable Supply Between RCPs 8.5 and 6

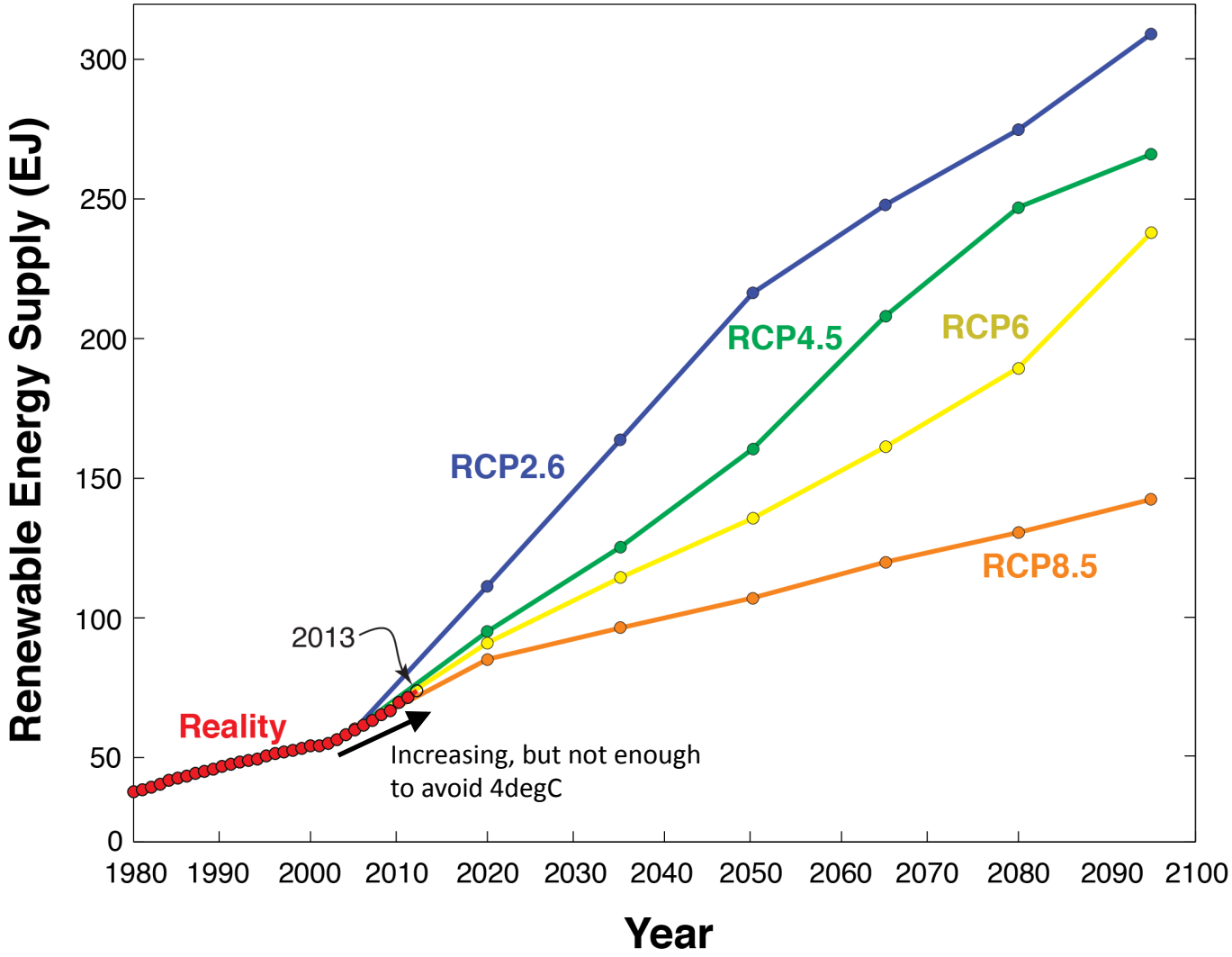


Fig. by Davis,
IEA Data

Decarbonization (decrease in emissions per $GDP) in the RCPs

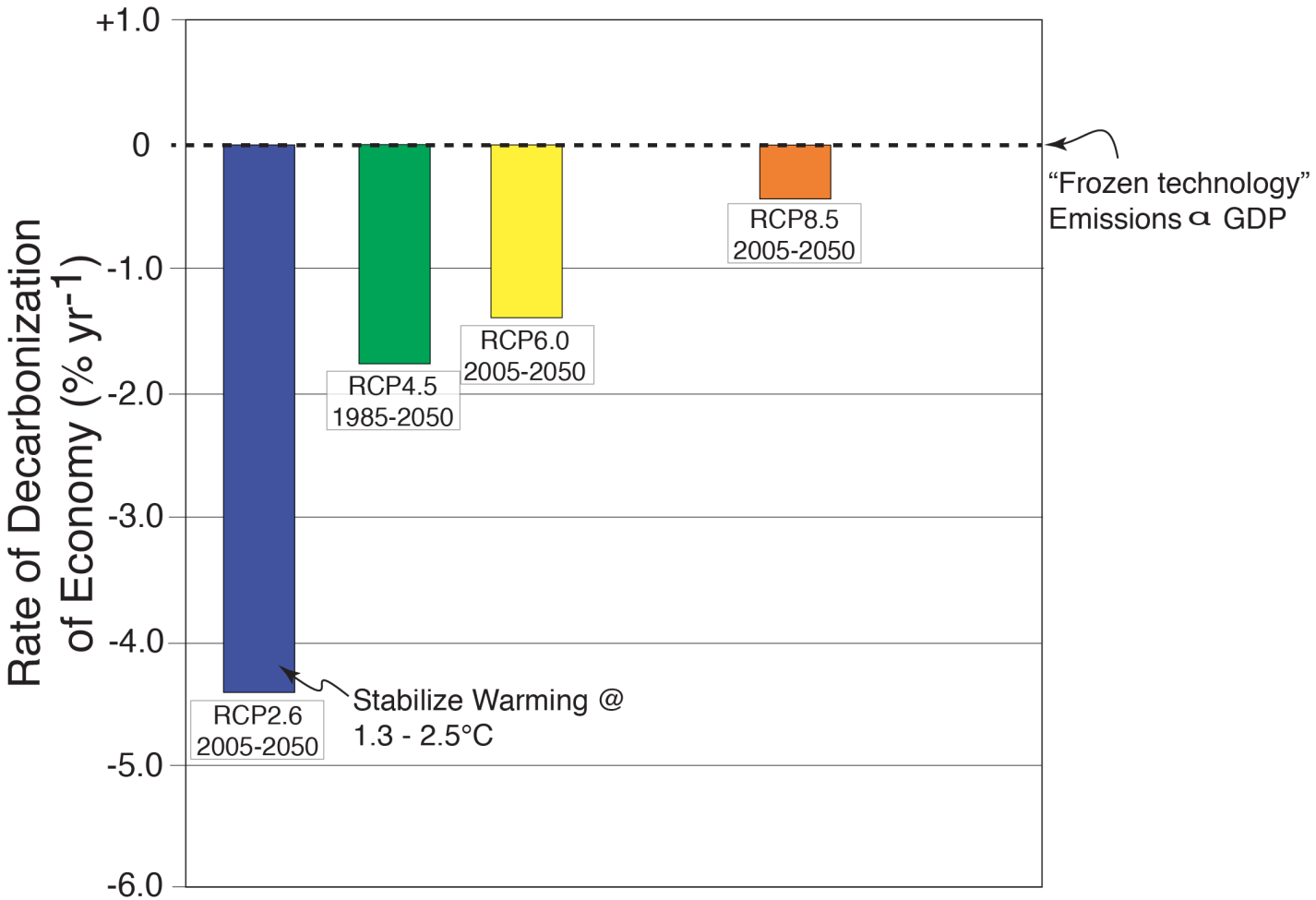


Fig. by Davis

Actual Trend 2000-2010 is *Re*-carbonization

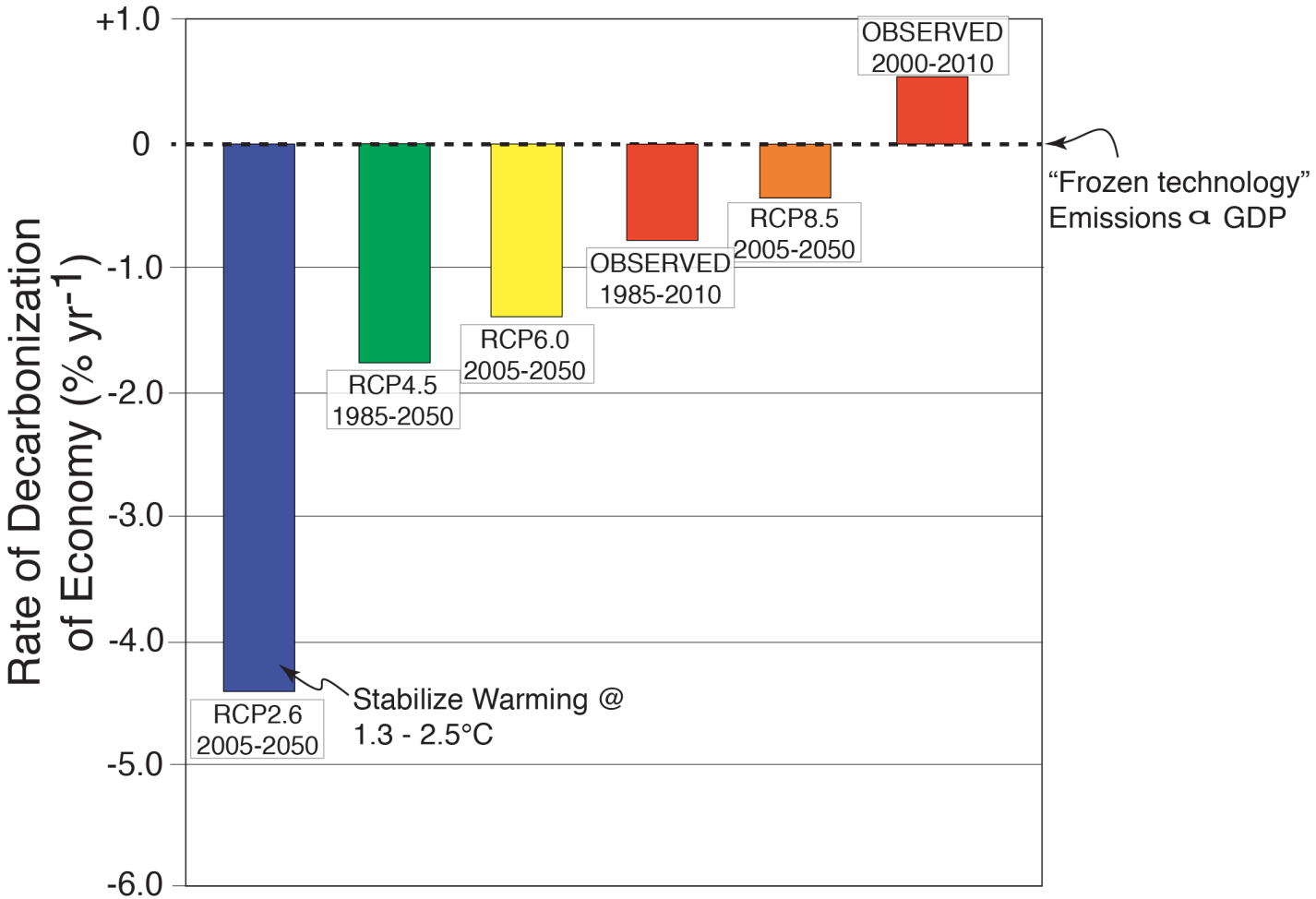
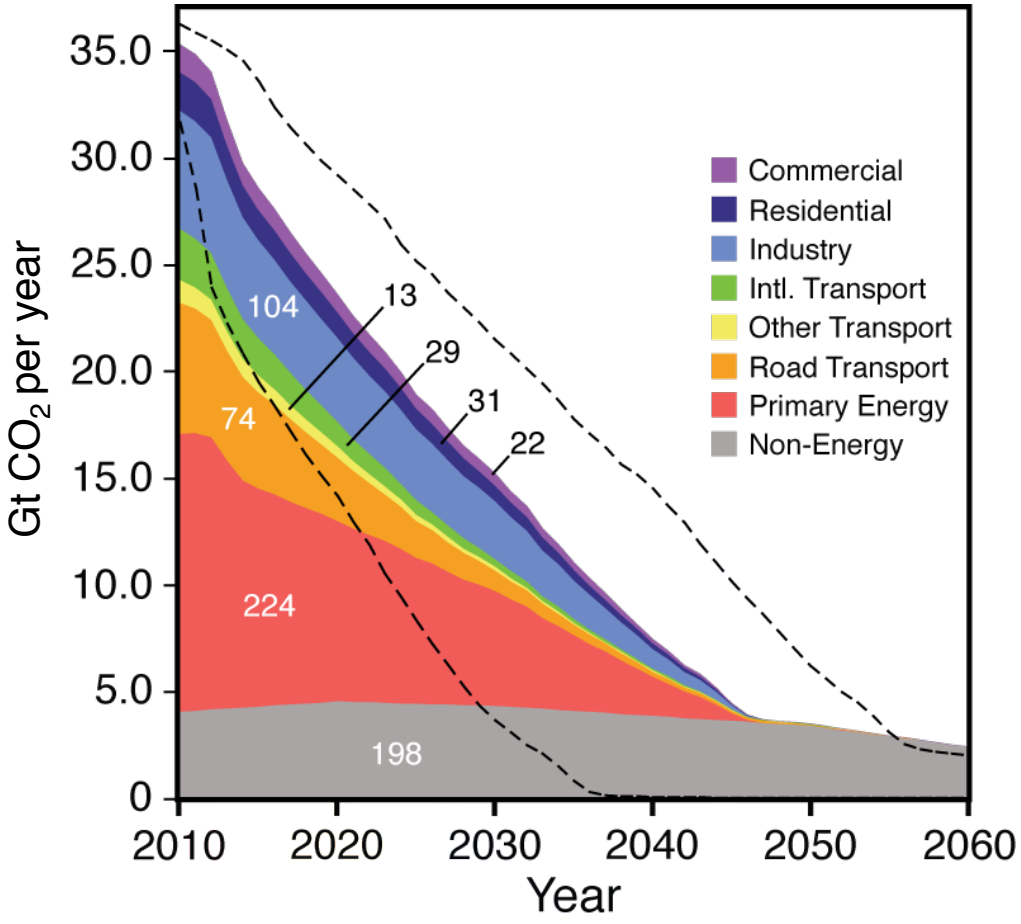


Fig. by Davis,
CDIAC and World Bank Data

Recent Trends Are Especially Concerning Because of Socio-economic Inertia

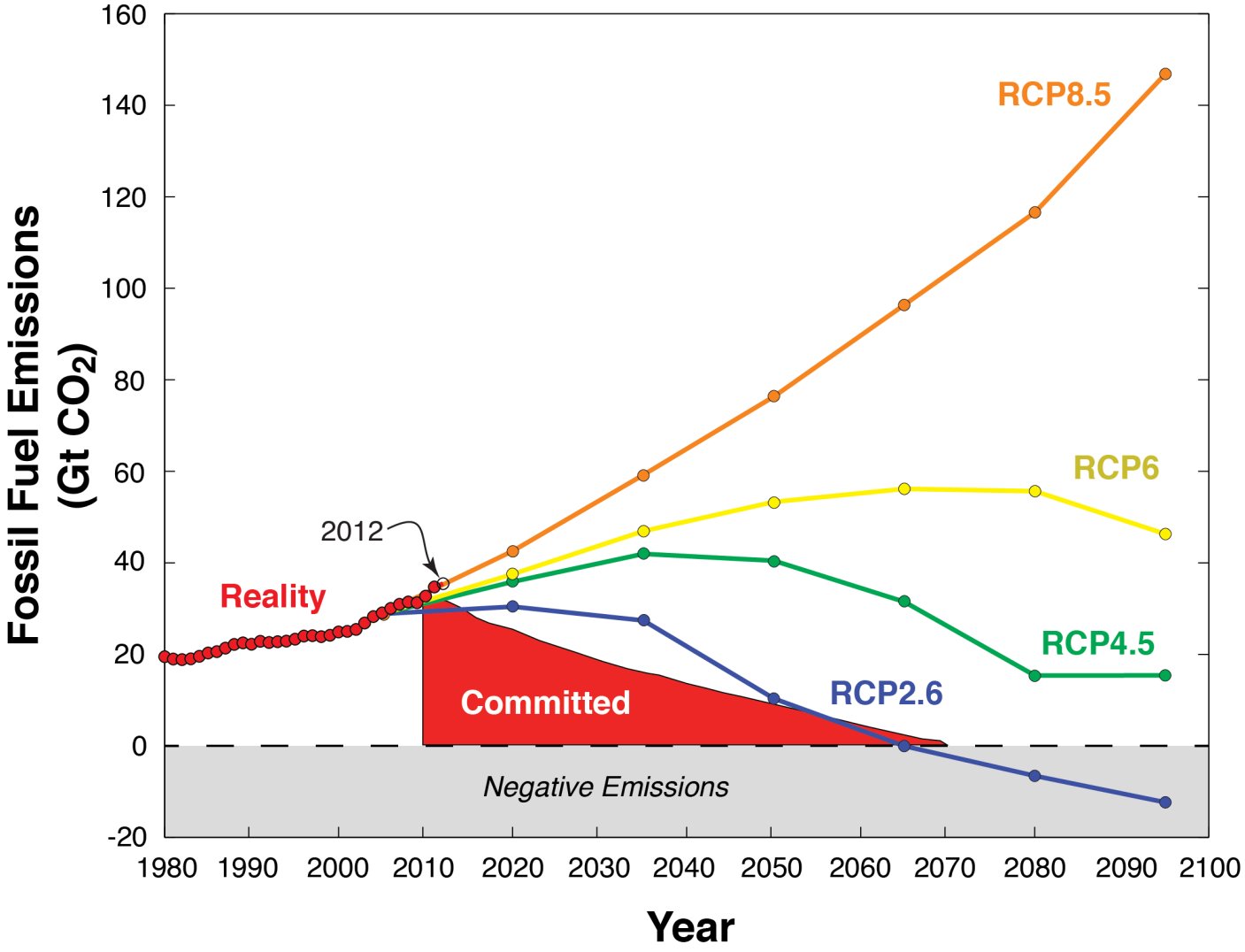
Long-lived Infrastructure Means Decades of Emissions Are "Locked-in"



500 ± 200 Gt CO_2

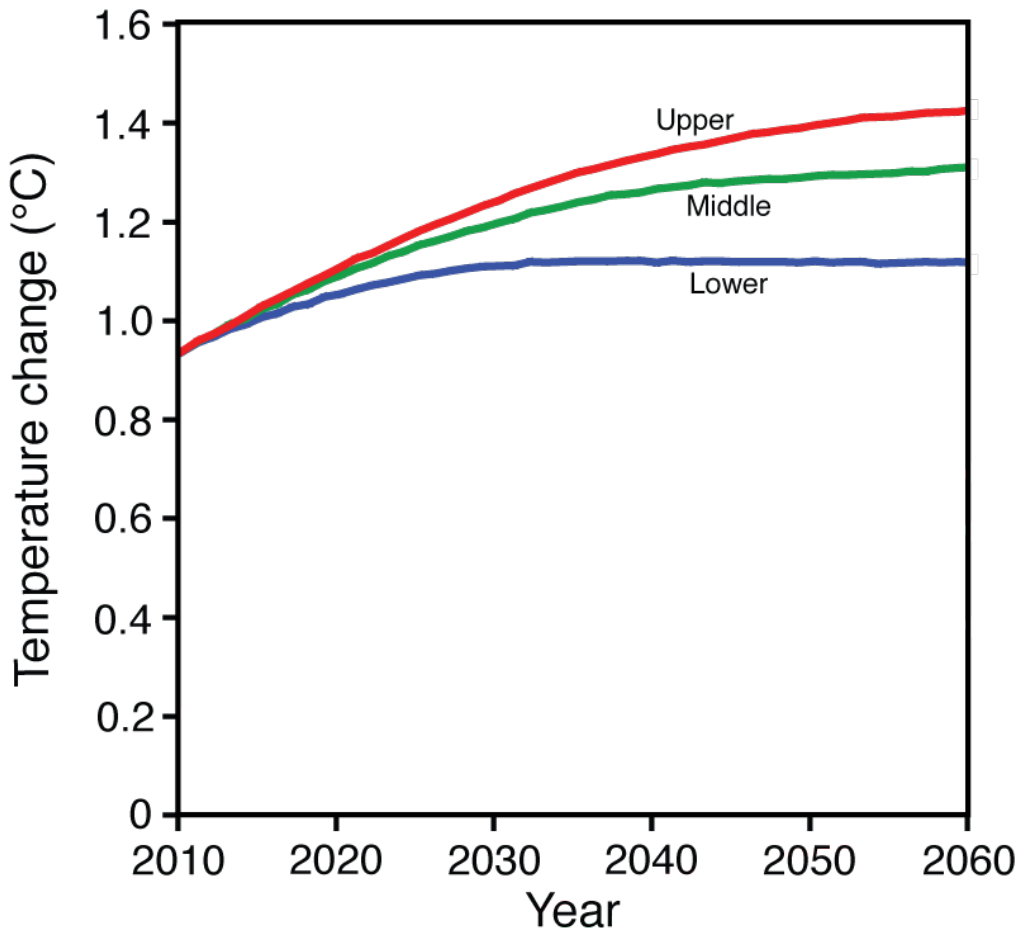
Davis et al., *Science*, 2010

These “Commitments” Are a Big Chunk of Emissions in Scenarios



Davis et al., *Science*, 2010

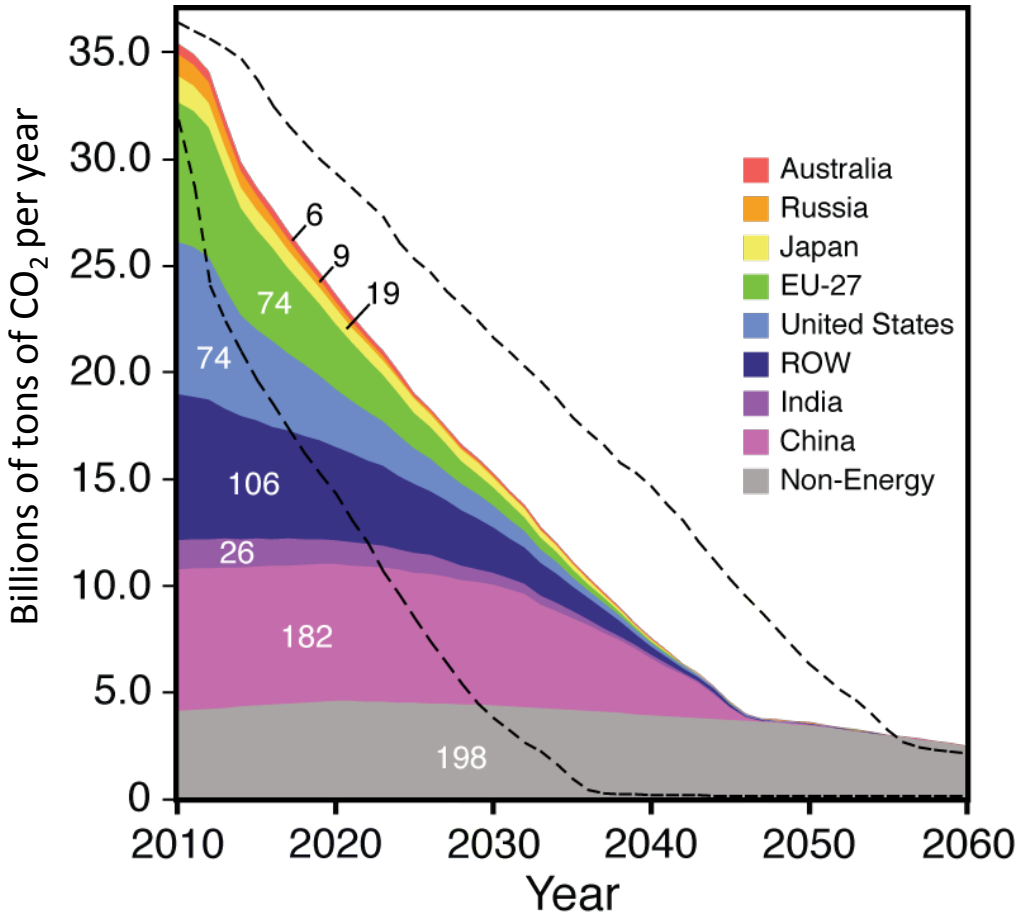
It’s Still Possible to Turn the Ship



< 1.5 °C

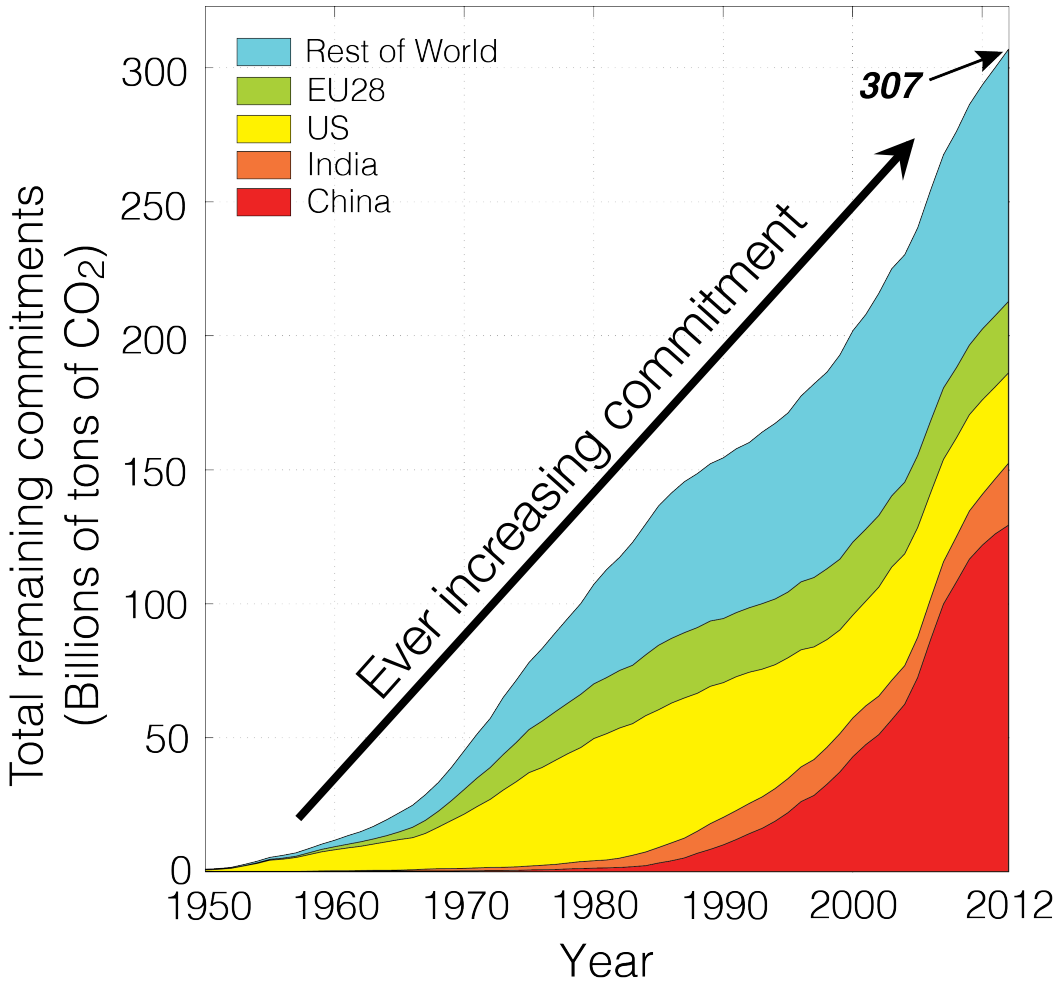
Davis et al., *Science*, 2010

What We Do Now Is Critical



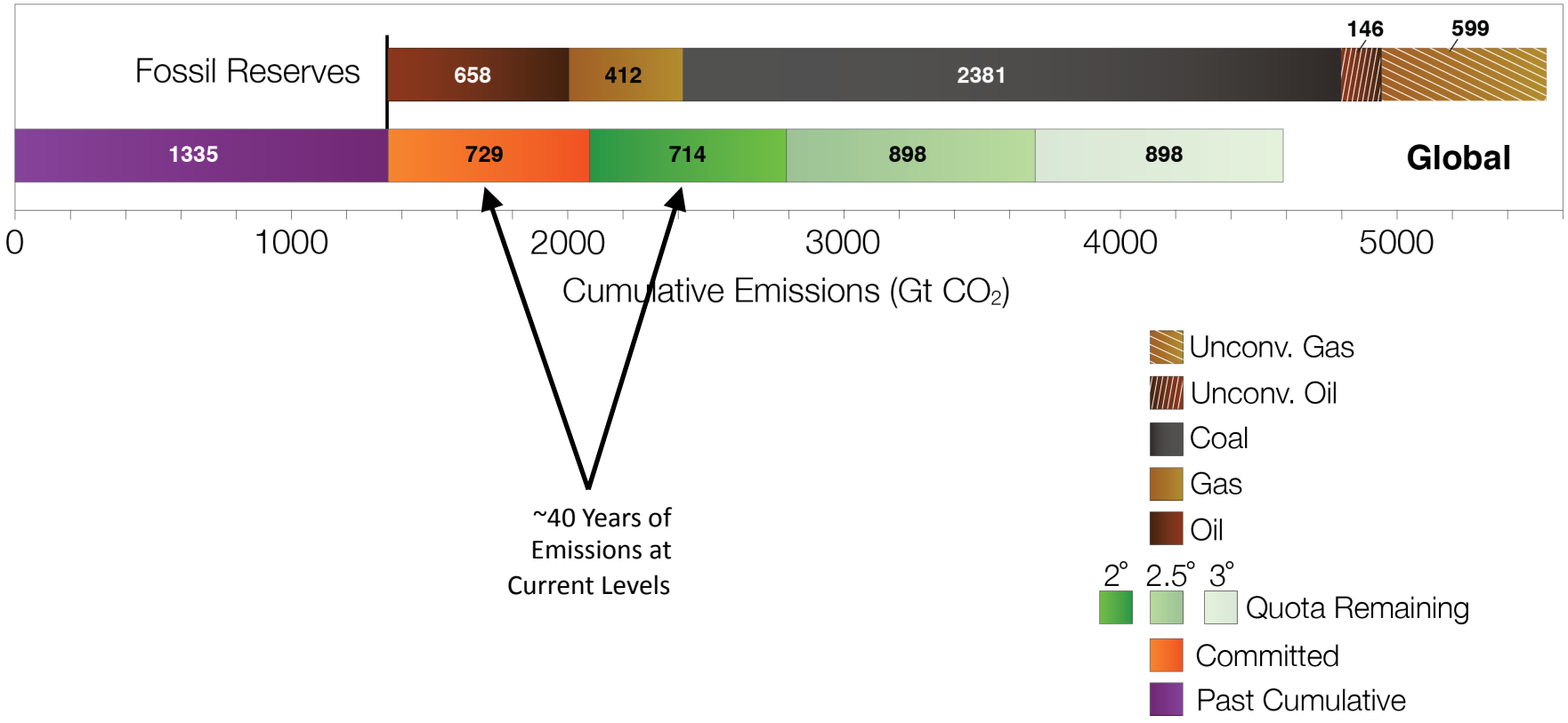
Davis et al., *Science*, 2010

Problem: Ship is Proceeding "Full Speed Ahead"



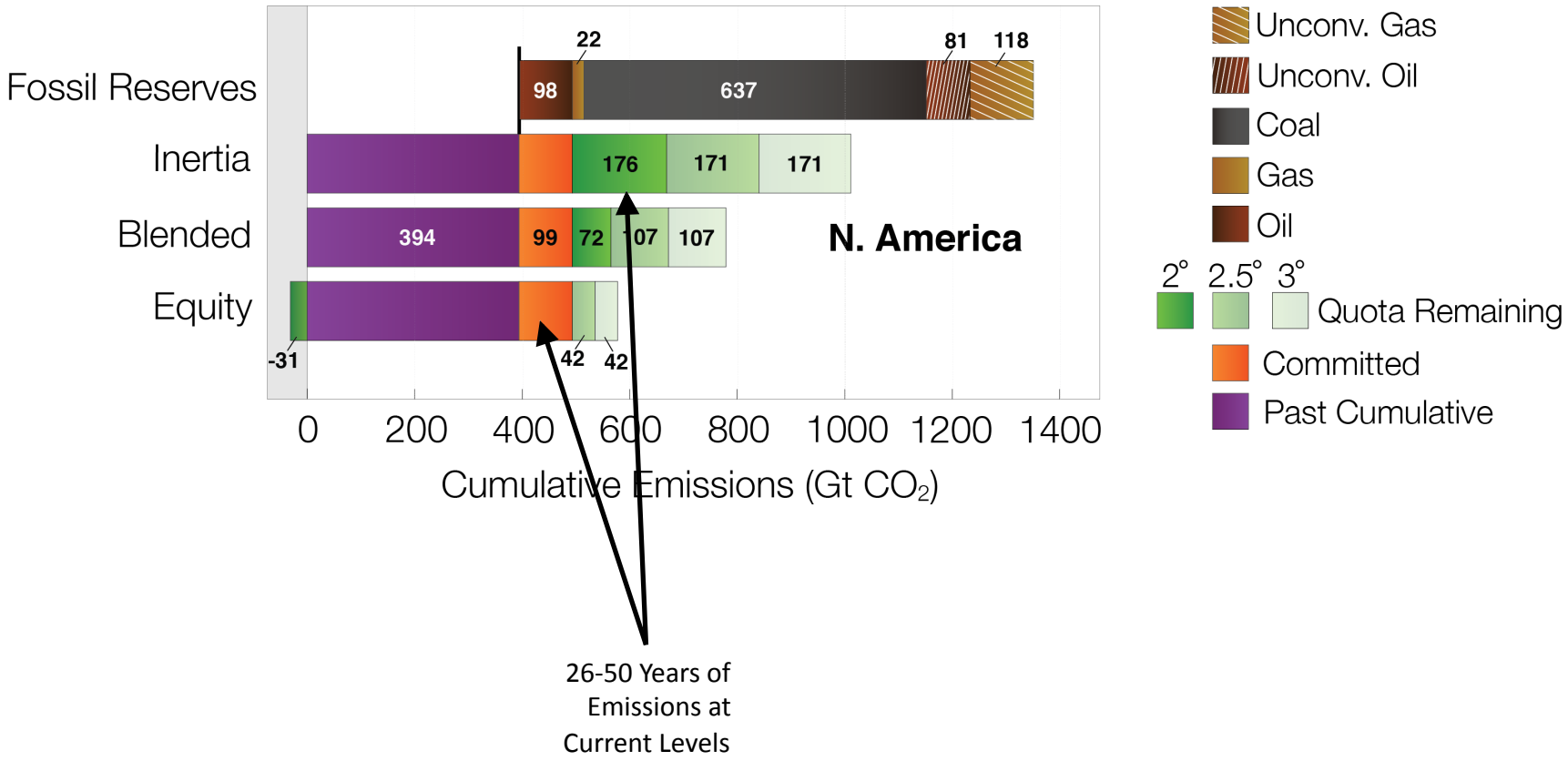
Davis and Socolow, *ERL*, 2014

Possible to Define a Quota of Cumulative Emissions



Raupach et al., *Nature Climate Change*, in press

And then Explore Quantitative Methods of Divvying Up that Quota



Raupach et al., *Nature Climate Change*, in press

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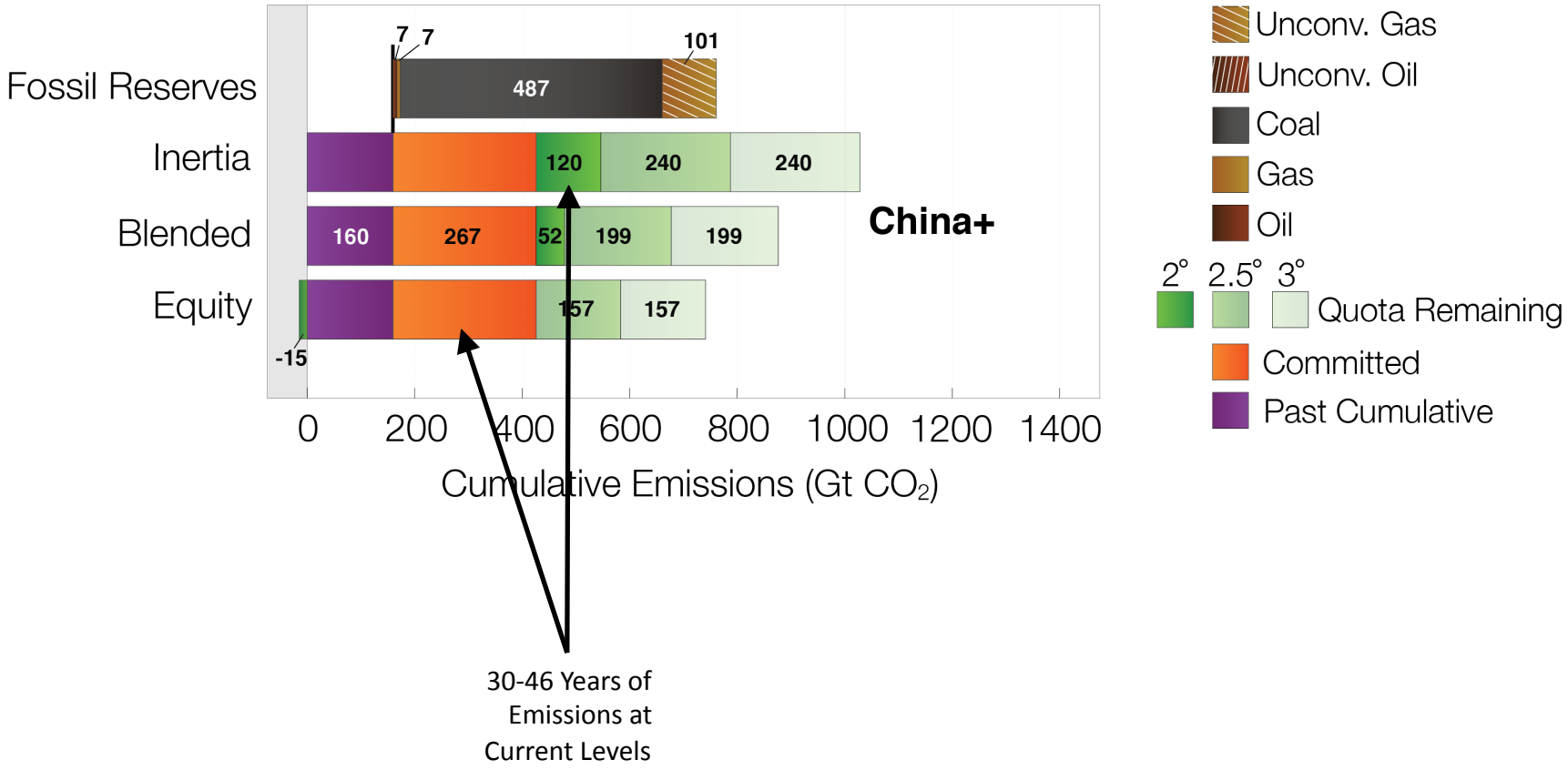

Raupach et al., *Nature Climate Change*, in press

Take Home Points

- All RCPs anticipate substantial growth in energy demand this century.
- They differ widely in the extent to which this demand is met with fossil fuels.
- Actual emissions and carbon intensity of energy are following the 'worst-case' RCP8.5 path.
- Although it's theoretically possible to change paths, this means fighting substantial inertia in the fossil energy system (not to mention political inertia).

- And that inertia is growing rapidly; we are still investing heavily in long-lived fossil infrastructure.
- There are positive signs in some areas of the world (e.g., emissions and commitments are down in the US), but the global outlook is not good.
- Given all of this, RCP8.5 seems considerably more likely than RCP4.5; RCP2.6 seems implausible.

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Kaya Identity

$$F = P\left(\frac{G}{P}\right)\left(\frac{E}{G}\right)\left(\frac{F}{E}\right) = Pgef,$$

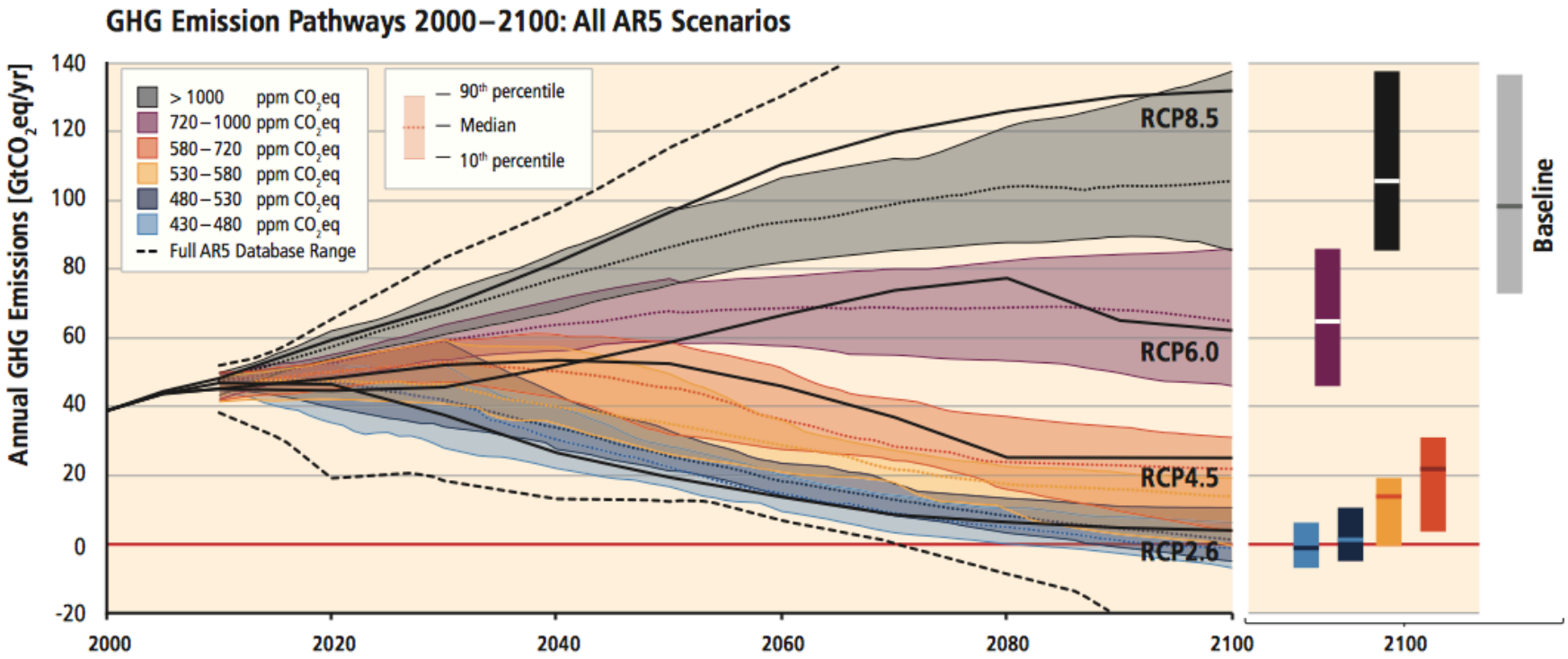
Population

GDP Per Capita

Energy Intensity of GDP

Carbon Intensity of Energy

Emissions Pathways span a very wide range



IPCC AR5, WG3 SPM, 2014

Emissions Pathways span a very wide range

CO_2eq Concentrations in 2100 (CO_2eq) Category label (concentration range)[9]	Subcategories	Relative position of the RCPs[5]	Cumulative CO_2 emissions[3] ($GtCO_2$)		Likelihood of staying below temperature level over the 21st century[8]			
			2011–2050	2011–2100	1.5 °C	2.0 °C	3.0 °C	4.0 °C
450 (430–480)	Total range[1, 10]	RCP2.6	550–1300	630–1180	More unlikely than likely	Likely	Likely	Likely
500 (480–530)	No overshoot of 530 ppm CO_2eq		860–1180	960–1430	Unlikely	More likely than not		
	Overshoot of 530 ppm CO_2eq		1130–1530	990–1550		About as likely as not		
550 (530–580)	No overshoot of 580 ppm CO_2eq		1070–1460	1240–2240		More unlikely than likely[12]		
	Overshoot of 580 ppm CO_2eq		1420–1750	1170–2100				
(580–650)	Total range	RCP4.5	1260–1640	1870–2440				
(650–720)	Total range		1310–1750	2570–3340		Unlikely	More likely than not	
(720–1000)	Total range	RCP6.0	1570–1940	3620–4990	Unlikely[11]		More unlikely than likely	
>1000	Total range	RCP8.5	1840–2310	5350–7010		Unlikely[26]	Unlikely	More unlikely than likely

IPCC AR5, WG3 SPM, 2014