

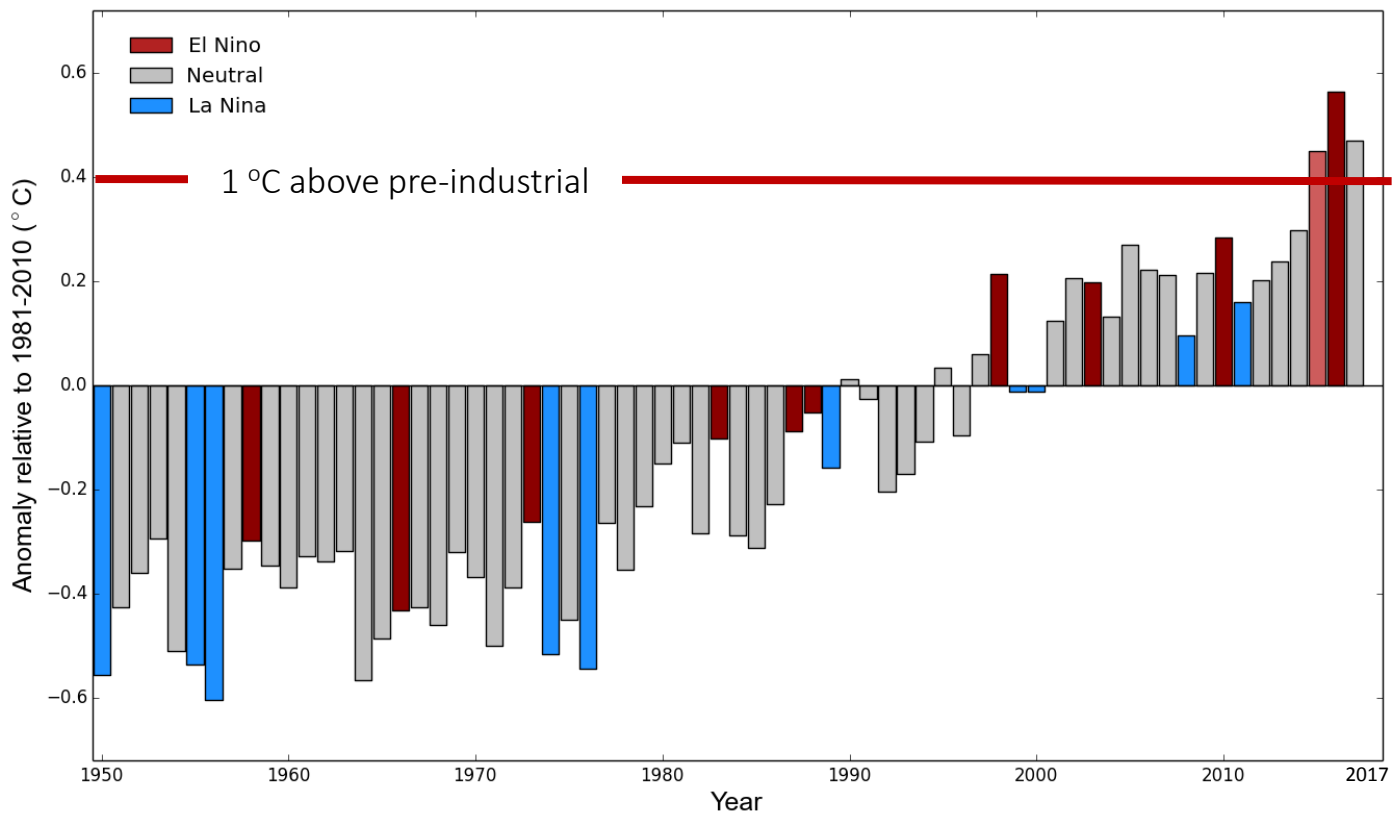
# Planetary Boundaries...Planetary Economics?

Norwegian Seminar on Green  
Economics  
30 May 2018

Professor Johan Rockström  
Executive Director, Stockholm Resilience Centre  
Professor of Environmental Science, Stockholm University

Photo: Yann Arthus-Bertrand







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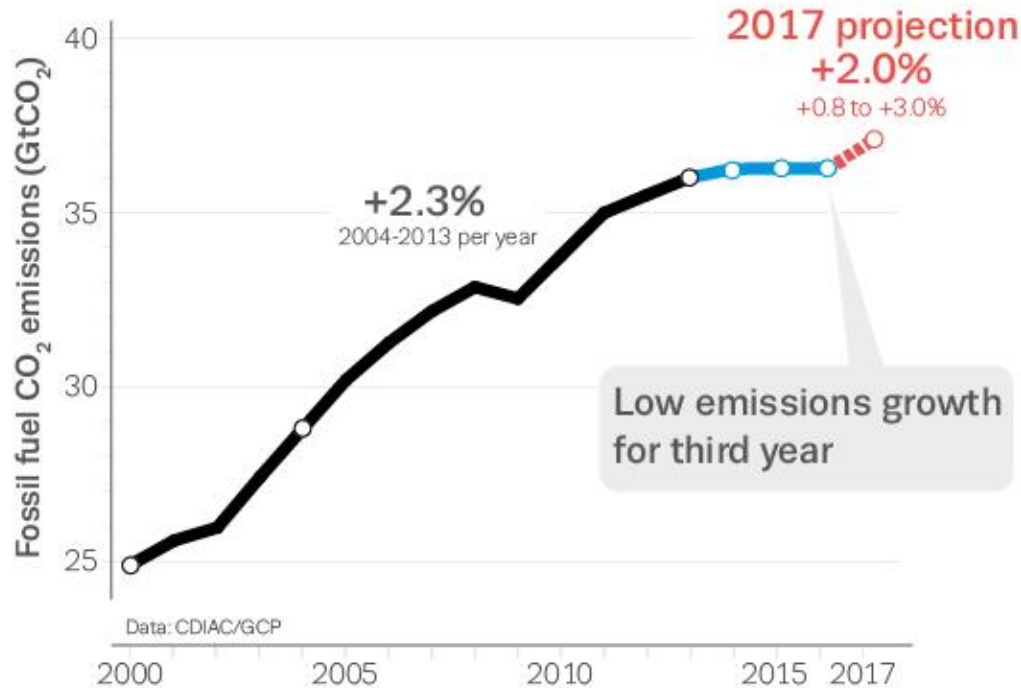
The **plateau** of last year was  
not peak emissions after all... **2% growth**



**37 billion tonnes**

In 2017, global carbon dioxide emissions from fossil fuels and industry will reach around 37bn tonnes of carbon dioxide.

Total emissions from all sources: approx 41GtCO<sub>2</sub>



# ... but atmospheric concentrations continue to rise

In 2016 atmospheric CO<sub>2</sub> levels reached **403 ppm**...

...and are projected to increase by 2.5 ppm in 2017  
(+2.0 to +3.0 ppm)

**315 ppm**

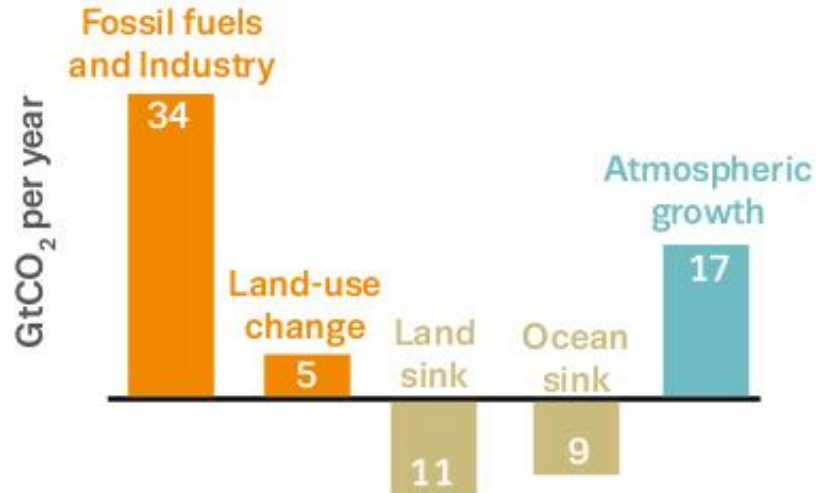
Data: Scripps/NOAA-ESRL

1960

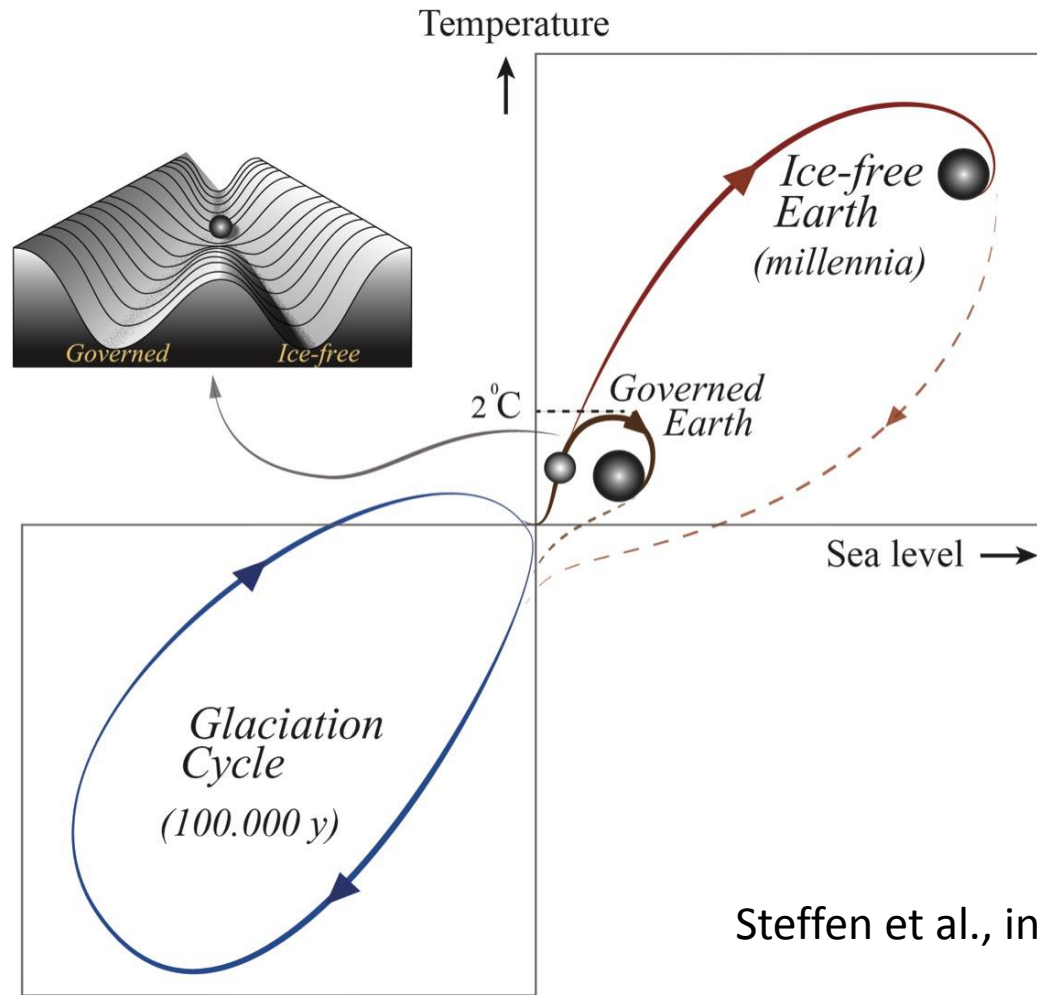
2016

# The land and ocean absorb around half the emissions

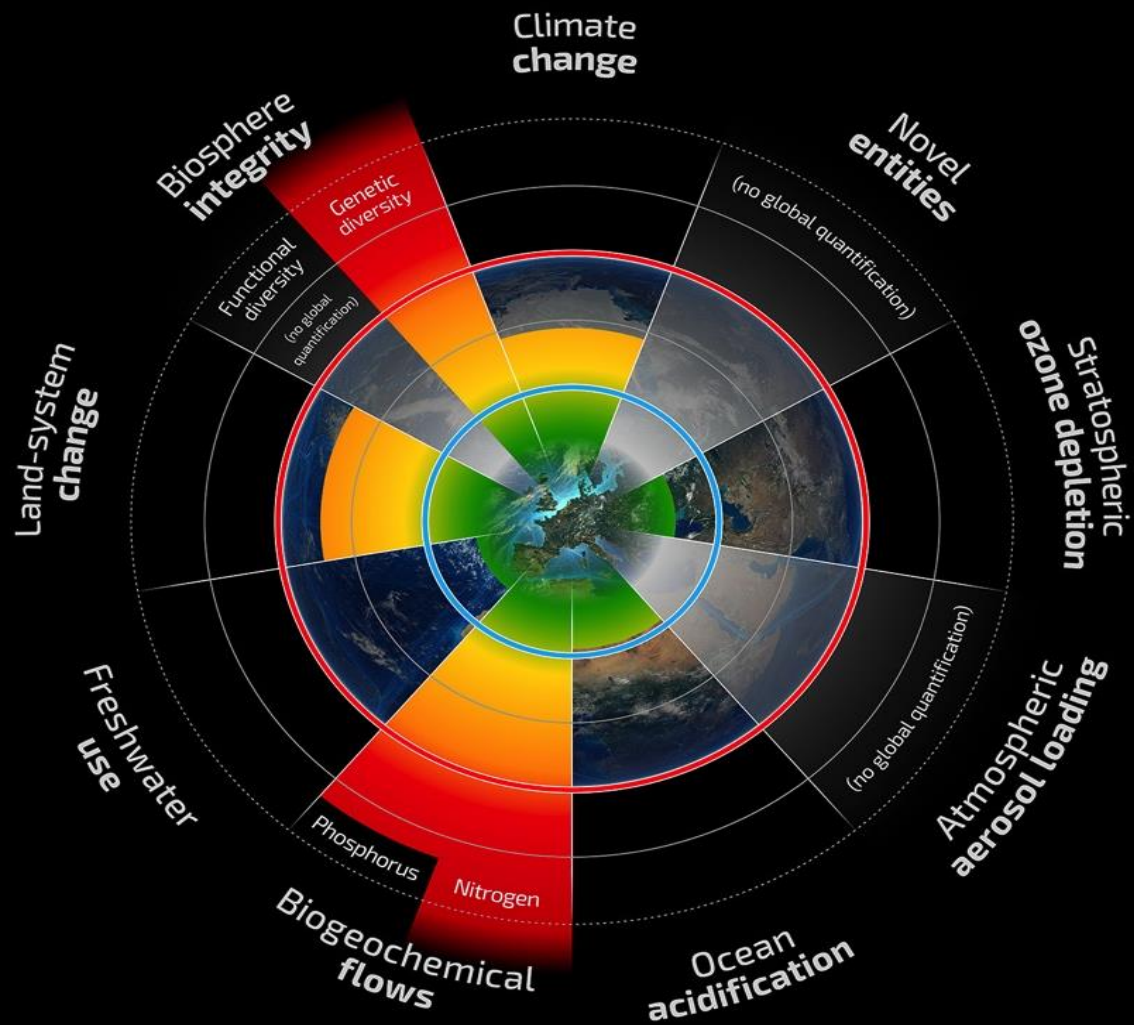
The carbon cycle has both **emissions sources** and **carbon sinks**, and their difference is the **atmospheric growth** (2007-2016)



# Risk of Tipping the Earth System away from Manageable Inter-glacial?



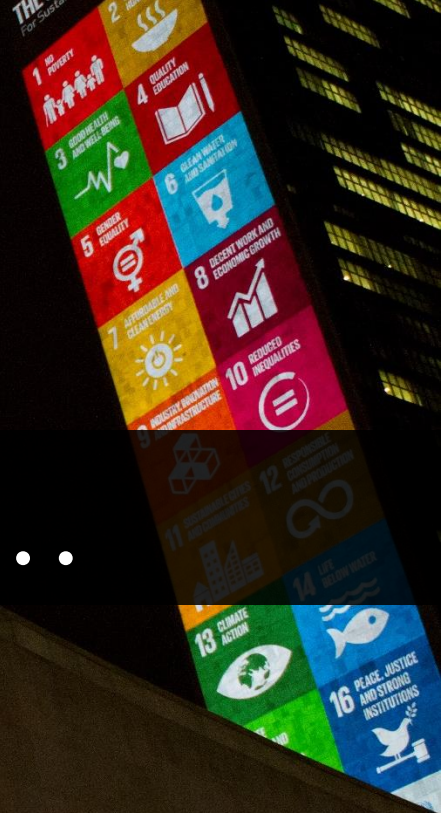
Steffen et al., in prep





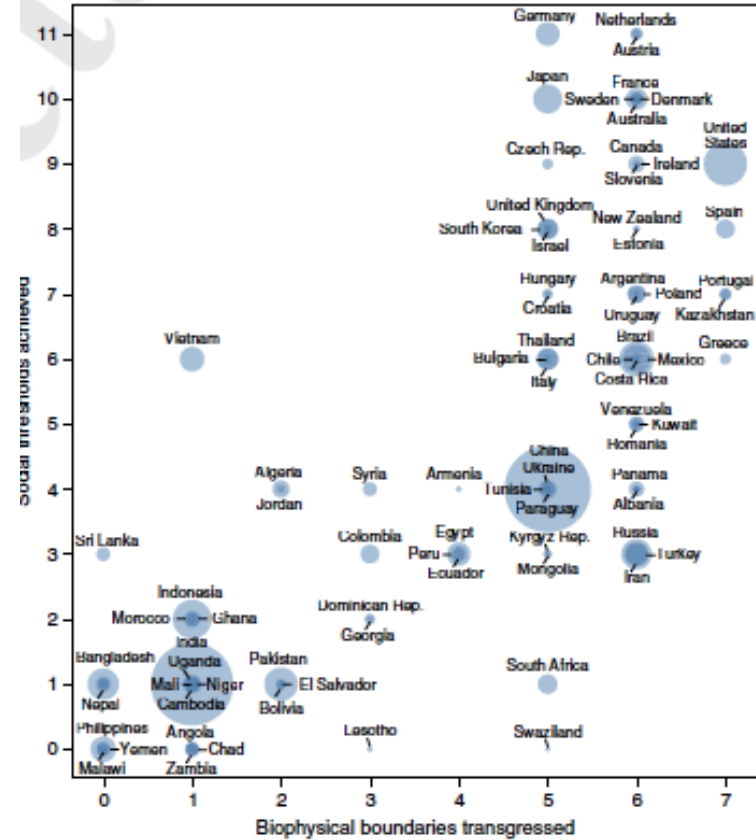
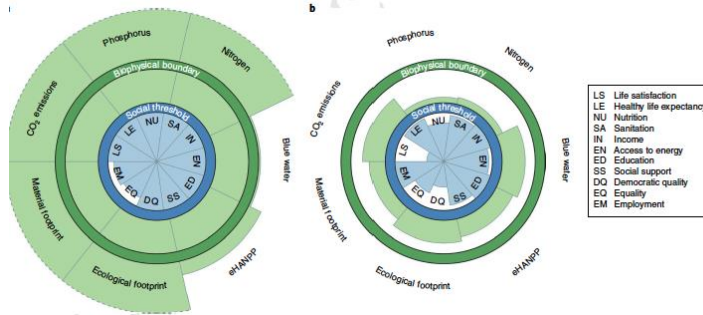
# Planetary Economics...

**THE GLOBAL GOALS**  
For Sustainable Development



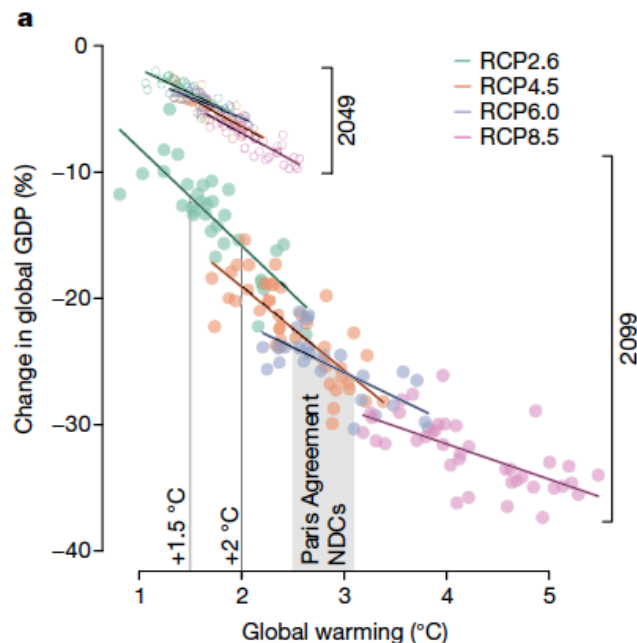
# A good life for all within planetary boundaries

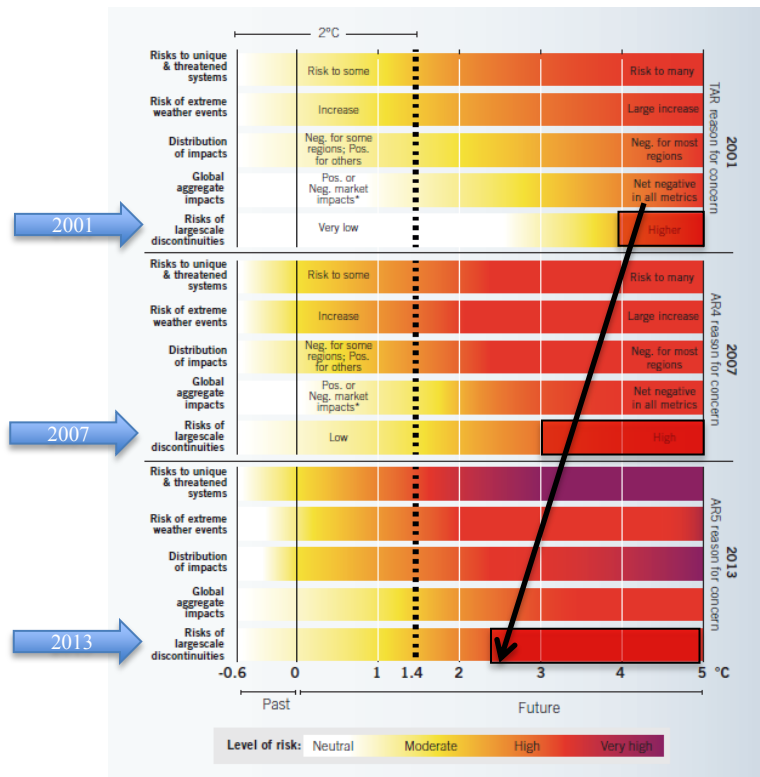
Daniel W. O'Neill<sup>1\*</sup>, Andrew L. Fanning<sup>2</sup>, William F. Lamb<sup>2</sup> and Julia K. Steinberger<sup>1</sup>



## Large potential reduction in economic damages under UN mitigation targets

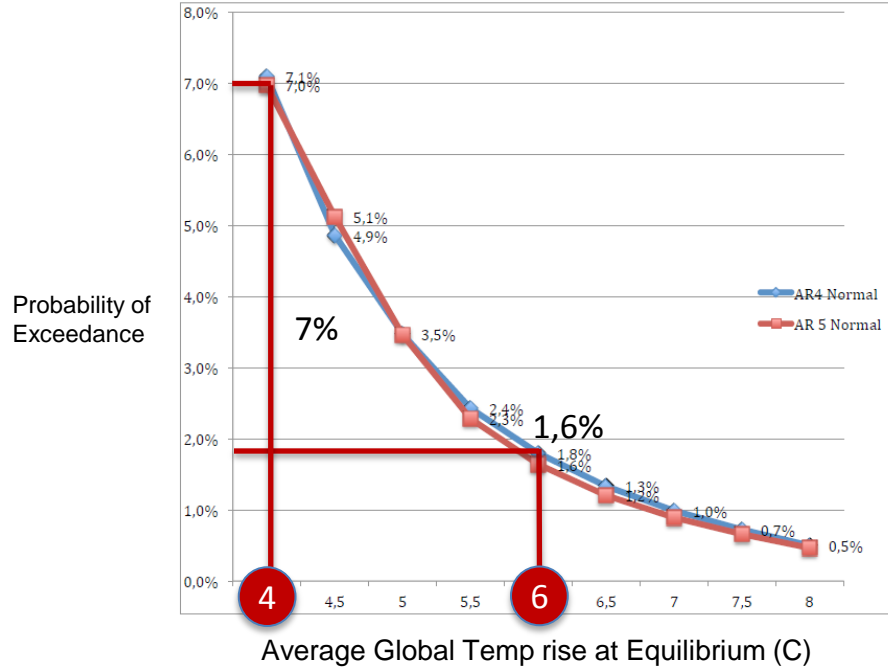
Marshall Burke<sup>1,2,3\*</sup>, W. Matthew Davis<sup>2</sup> & Noah S. Diffenbaugh<sup>1,4</sup>





(IPCC TAR, AR4, AR5)

# Risks related to agreed global goal of 450 ppm



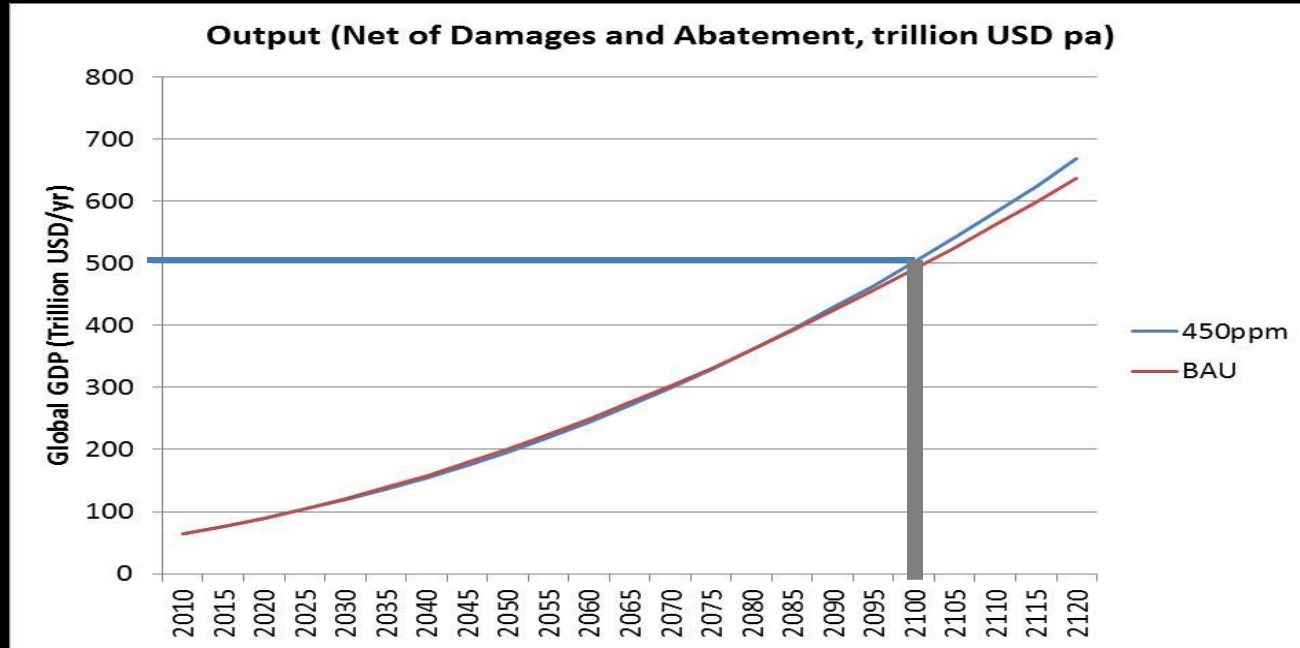
Global Challenges Foundation



GLOBAL  
RISK AND OPPORTUNITY  
INDICATOR

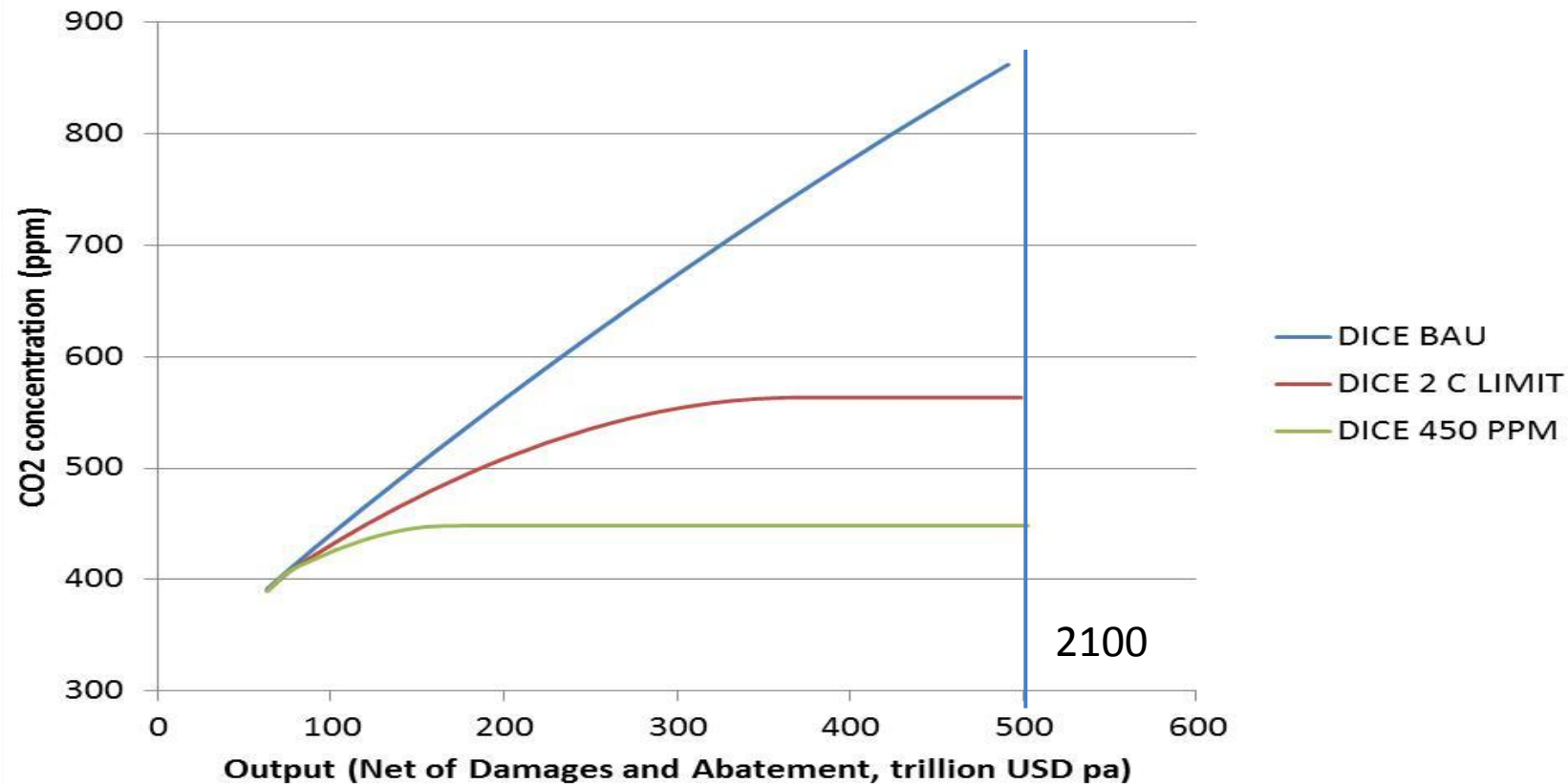


# Economic Growth and Climate Change – the conventional macro-economic approach

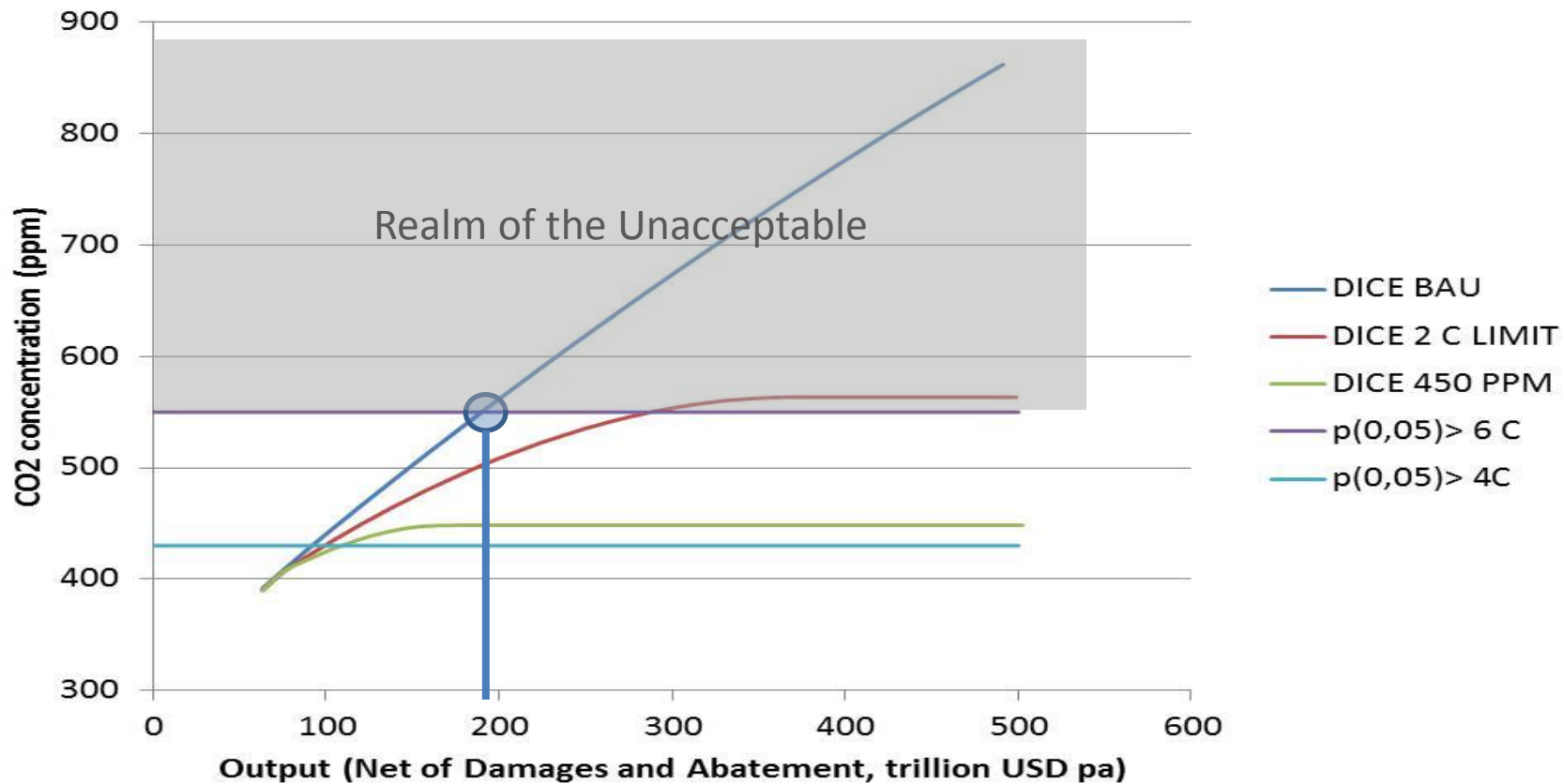


(Applying DICE, 2014)

**CO2 emissions versus Global Economic Growth 2010-2100**



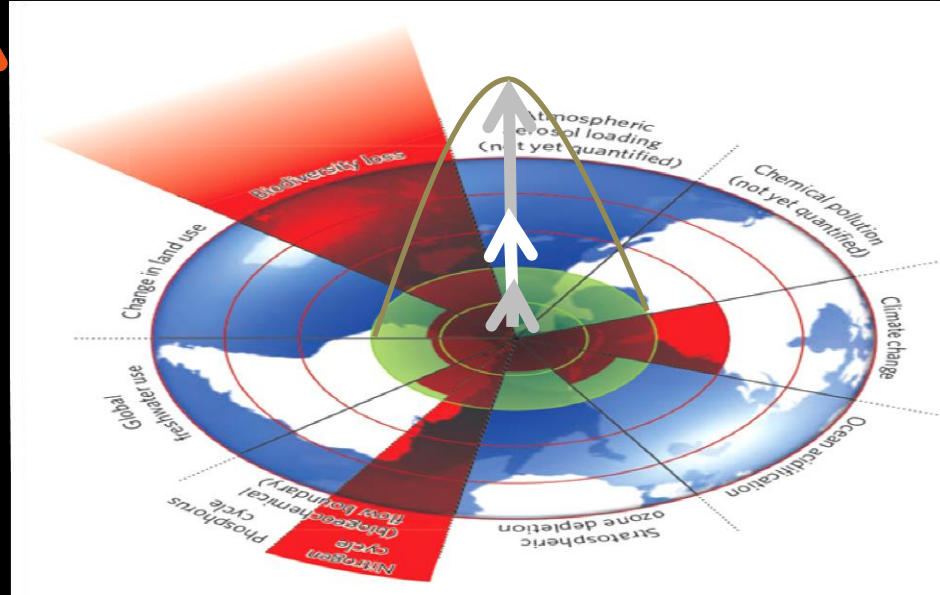
## CO2 emissions versus Global Economic Growth 2010-2100



# A Planetary Soufflé

*Human Prosperity within Planetary Boundaries*

Economic  
Growth





# The Carbon Law – A Moore's law for climate stability



[illegible]

sistent with the trajectory of the past decades (see the figure, bottom left). All sectors (e.g., agriculture, construction, finance, manufacturing, transport) need comparable transformation pathways. In addition, in the absence of viable alternatives, the world must aim at rapidly scaling up CO<sub>2</sub> removal by technical means from zero to at least 0.5 GtCO<sub>2</sub>/year in 2020, 2.5 by 2040, and 5 by 2060. CO<sub>2</sub> emissions from land-use must decrease along nonlinear trajectory from 4 GtCO<sub>2</sub>/year in 2020, to 2 by 2050, 1 by 2040, and 0 by 2030 (see the figure, bottom right). The endgame is for cumulative CO<sub>2</sub> emissions since 2017 to be brought back from around 700 GtCO<sub>2</sub> below 200 GtCO<sub>2</sub> by the end of the century (see the figure, top) and atmospheric CO<sub>2</sub> concentrations to return to 380 ppm by 2100 (currently at 400 ppm).

through to meet a collective challenge, a "bottom-up" approach that would allow the economic emissions-escape deadweight, co-benefits to be shared by all industry sectors, could help promote disruptive, nonlinear technological change. The "bottom-up" approach would rely to some extent on a carbon law that is a dual one that pushes renewables and other energy sources to the fore, while also pushing a dissemination trajectory, while simultaneously pulling fossil-based value propositions from the market. Thus, the transformation would be driven by a combination of forces other than by inertia imposed by incumbent technologies (see the figures, bottom left).

Second, a bottom-up approach would encourage a narrative in four dimensions: innovation, institutions, infrastructure, and investment—to provide evidence of feasibility and viability of a new paradigm. The narrative stays on a carbon-law trajectory. The narrative provides no guarantees but identifies critical steps, grounded in published scenarios or evidence, that would be required to achieve the two parts: actions for rapid near-term emissions reductions, and actions for systematic, sustained emissions reductions in the next steps. Such a narrative, specifically designed with deadweight targets and incentives, would provide key elements for national and

24 MARCH 2017 • VOL. 155 ISSUE 6041 1249



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The Opinion Pages | OP-ED CONTRIBUTOR

## By JOHAN ROCKSTROM MARCH 23, 2017

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## Decarbonization pathway consistent with the Paris agreement

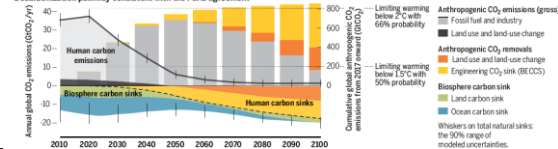
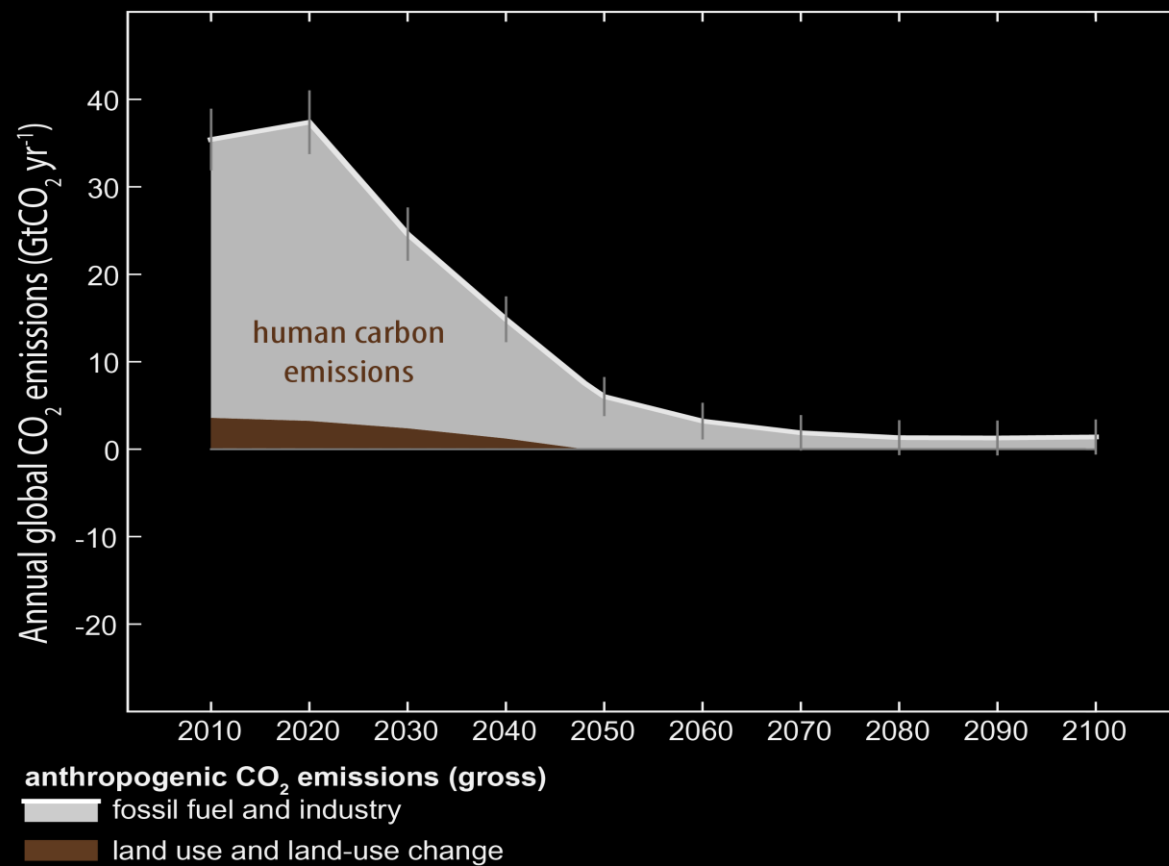
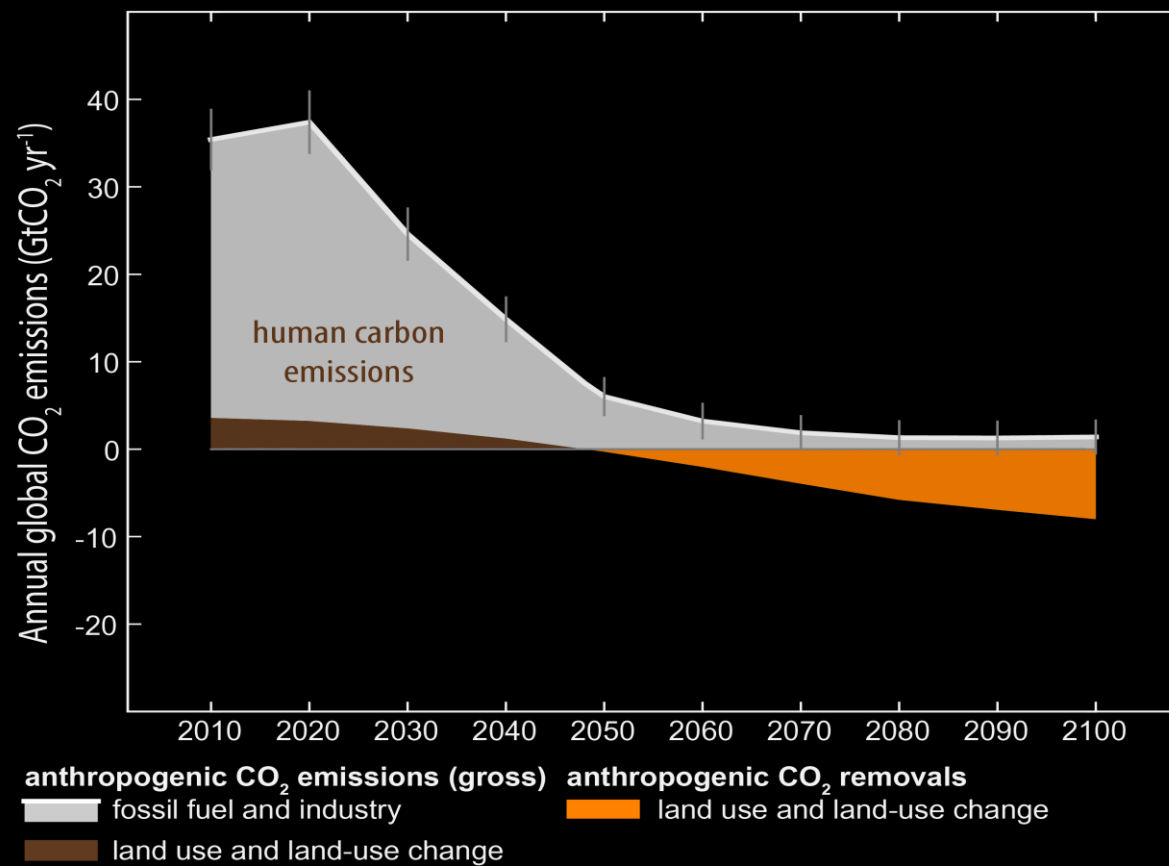
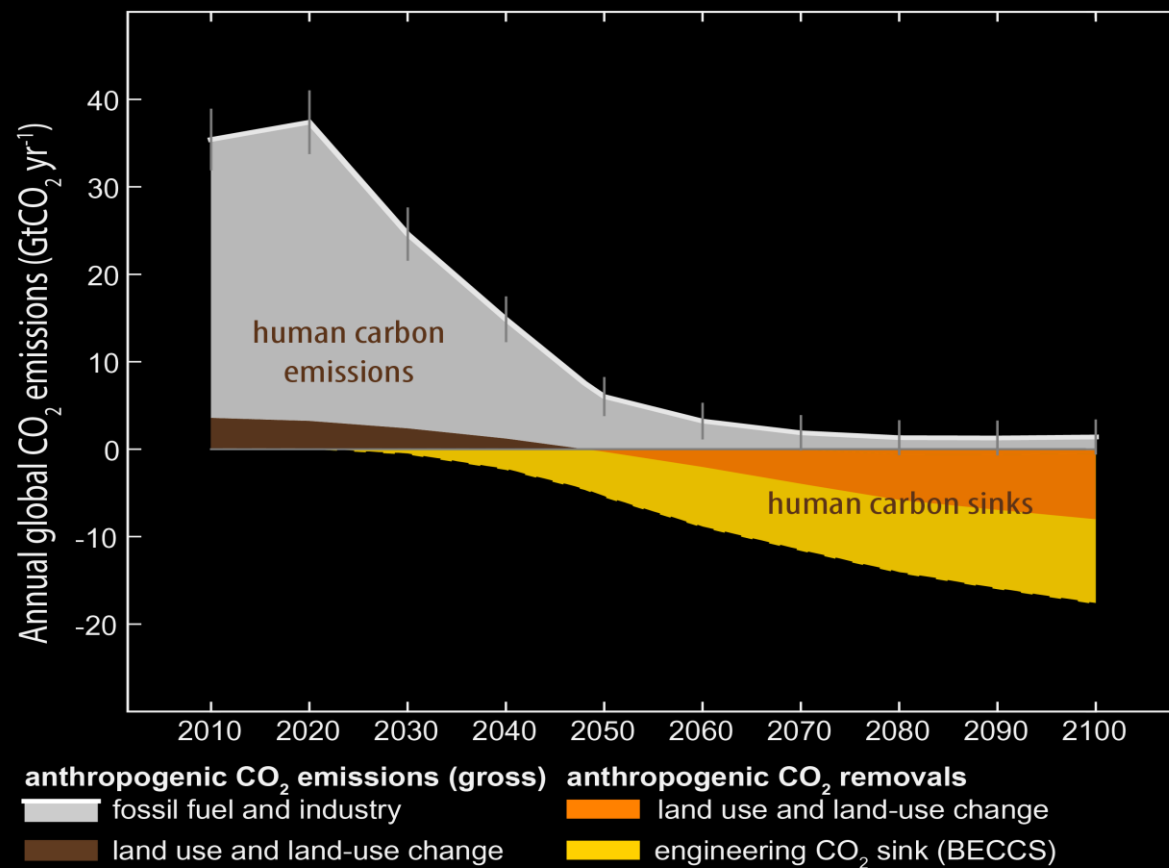


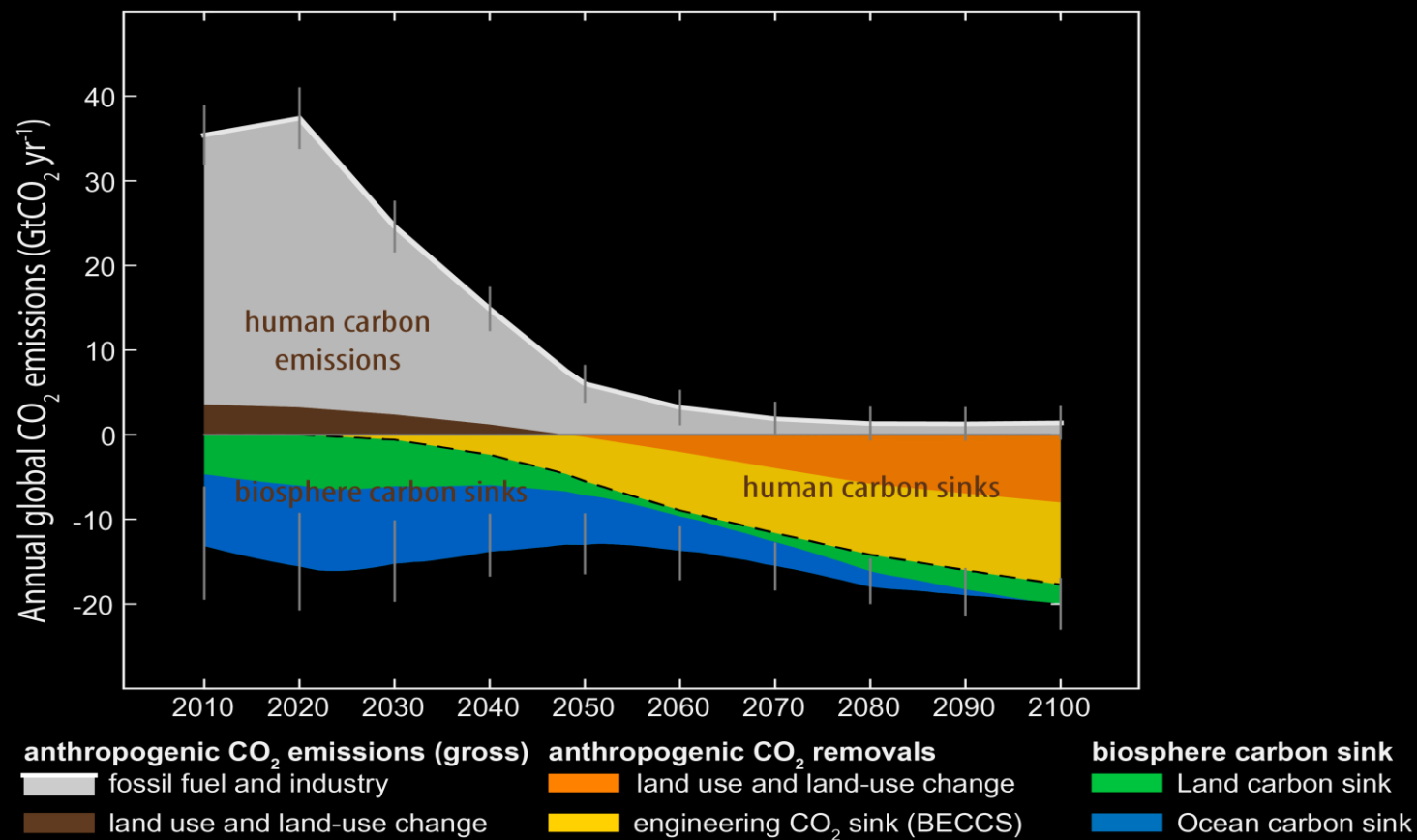
Figure 1 is a line graph showing the projected share of primary energy by source from 2000 to 2100. The y-axis represents the 'Share of primary energy (%)' from 0 to 100. The x-axis represents years from 2000 to 2100. The graph includes a dashed line for 'Constant annual growth' and solid lines for 'Increasing annual growth' at rates of 1%, 2%, 3%, 4%, and 5%. A shaded area represents 'Renewables'. A 'Period of doubling (years)' is indicated from 2000 to 2030. The sources shown are Coal, Oil, Gas, Hydro Nuclear, and Renewables.

Year	Global CO <sub>2</sub> emissions (GtCO <sub>2</sub> /yr)	CO <sub>2</sub> removal (GtCO <sub>2</sub> /yr)	CO <sub>2</sub> emissions from land use (GtCO <sub>2</sub> /yr)
2020	40	0	5
2030	20	0	2
2040	10	2	1
2050	5	5	0

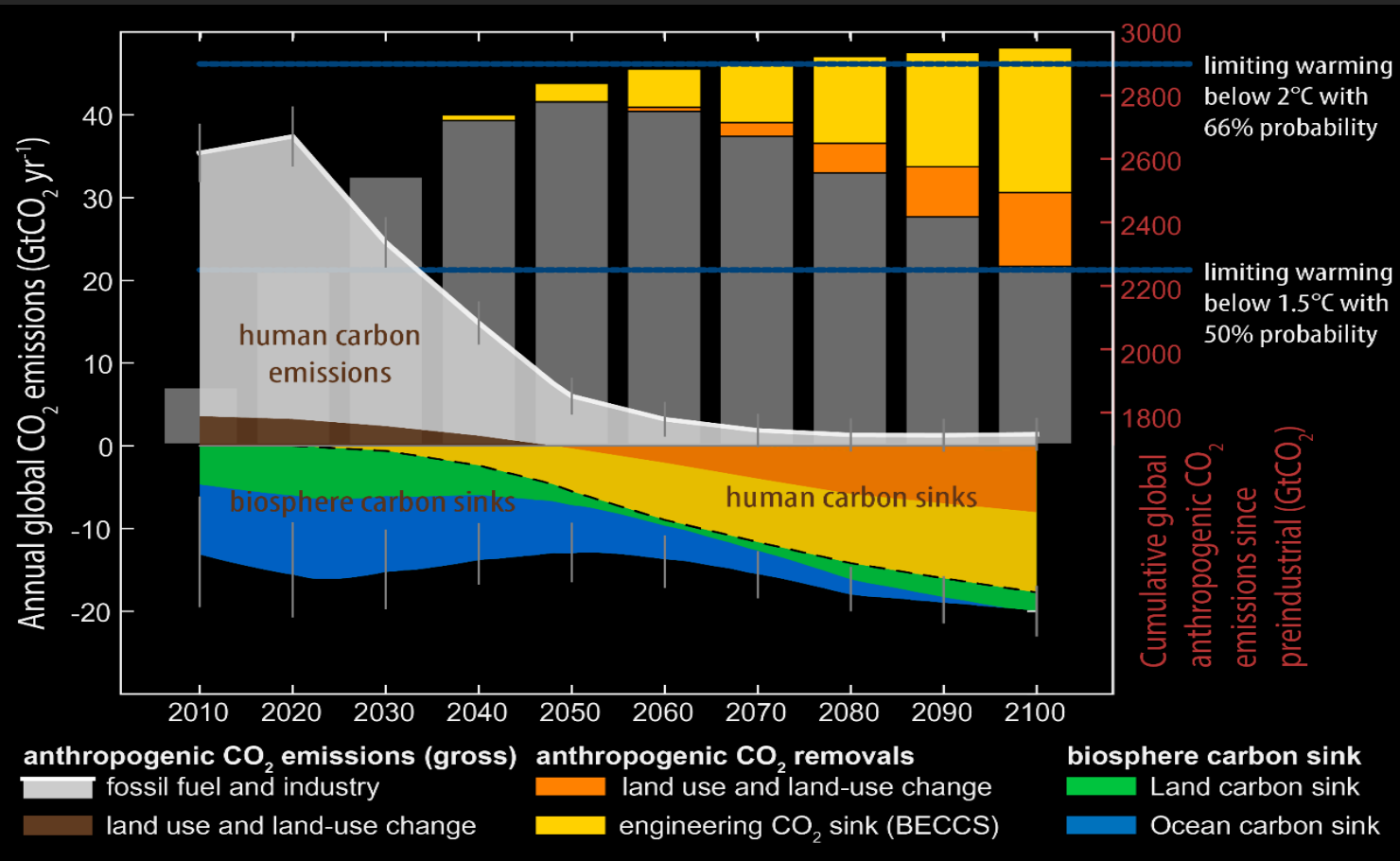






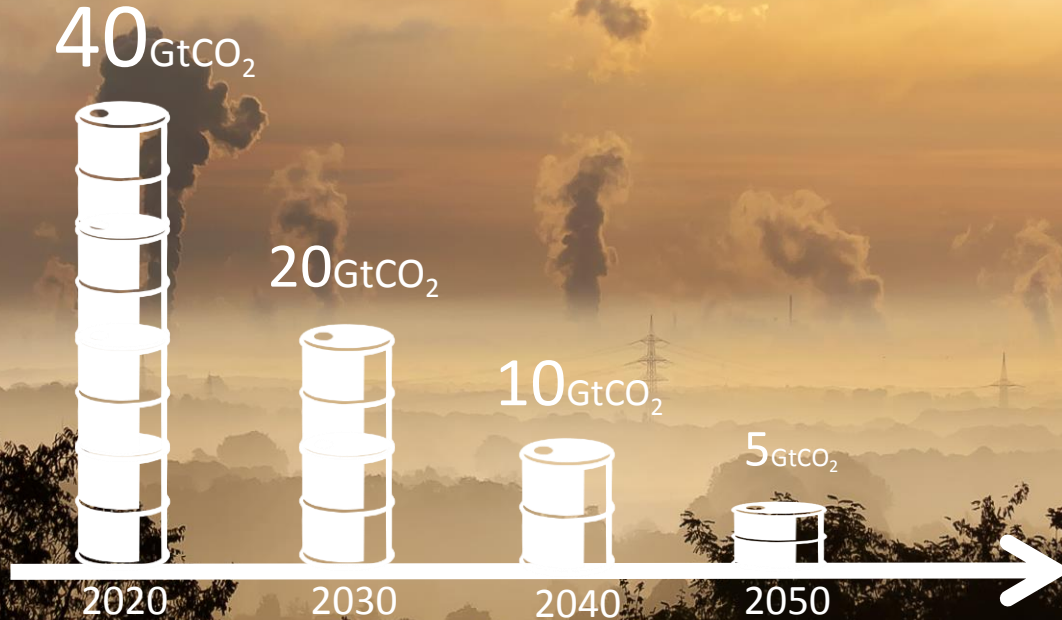






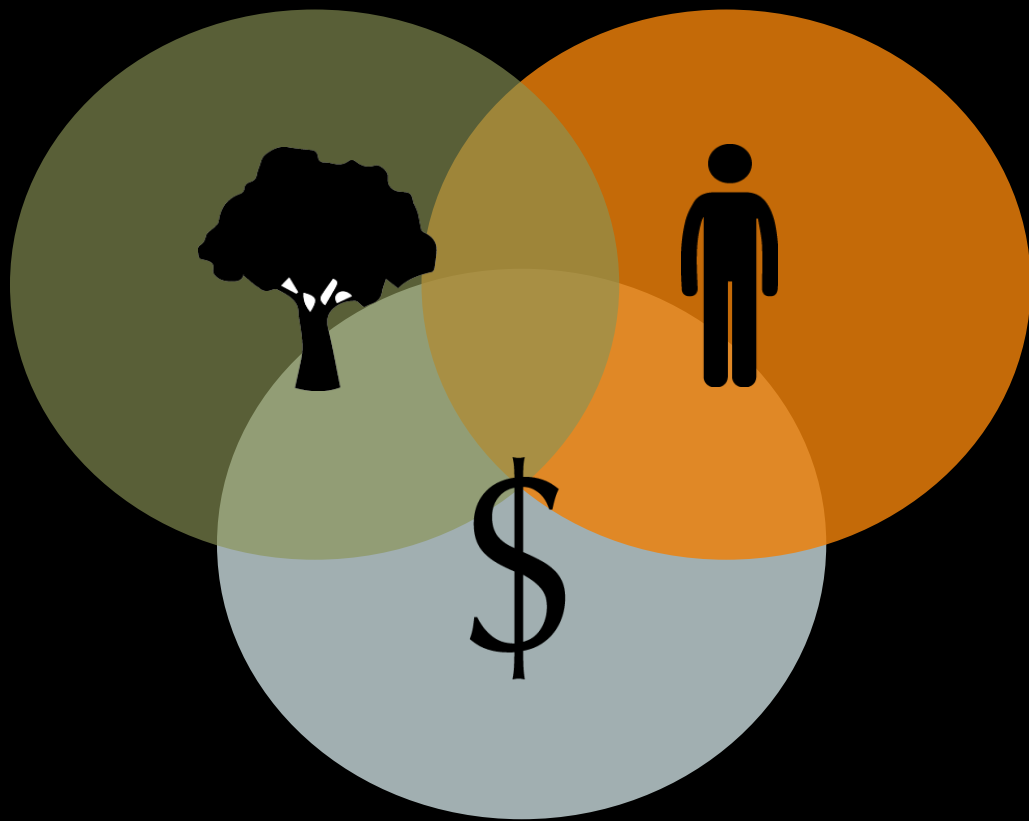
# A Global Carbon Law

## Halving Emissions Every Decade



# Planetary Governance

**THE GLOBAL GOALS**  
For Sustainable Development







# SUSTAINABLE DEVELOPMENT GOALS

**1** NO POVERTY



**2** ZERO HUNGER



**3** GOOD HEALTH AND WELL-BEING



**4** QUALITY EDUCATION



**5** GENDER EQUALITY



**6** CLEAN WATER AND SANITATION



**7** AFFORDABLE AND CLEAN ENERGY



**8** DECENT WORK AND ECONOMIC GROWTH



**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE



**10** REDUCED INEQUALITIES



**11** SUSTAINABLE CITIES AND COMMUNITIES



**12** RESPONSIBLE CONSUMPTION AND PRODUCTION



**13** CLIMATE ACTION



**14** LIFE BELOW WATER



**15** LIFE ON LAND



**16** PEACE, JUSTICE AND STRONG INSTITUTIONS



**17** PARTNERSHIPS FOR THE GOALS

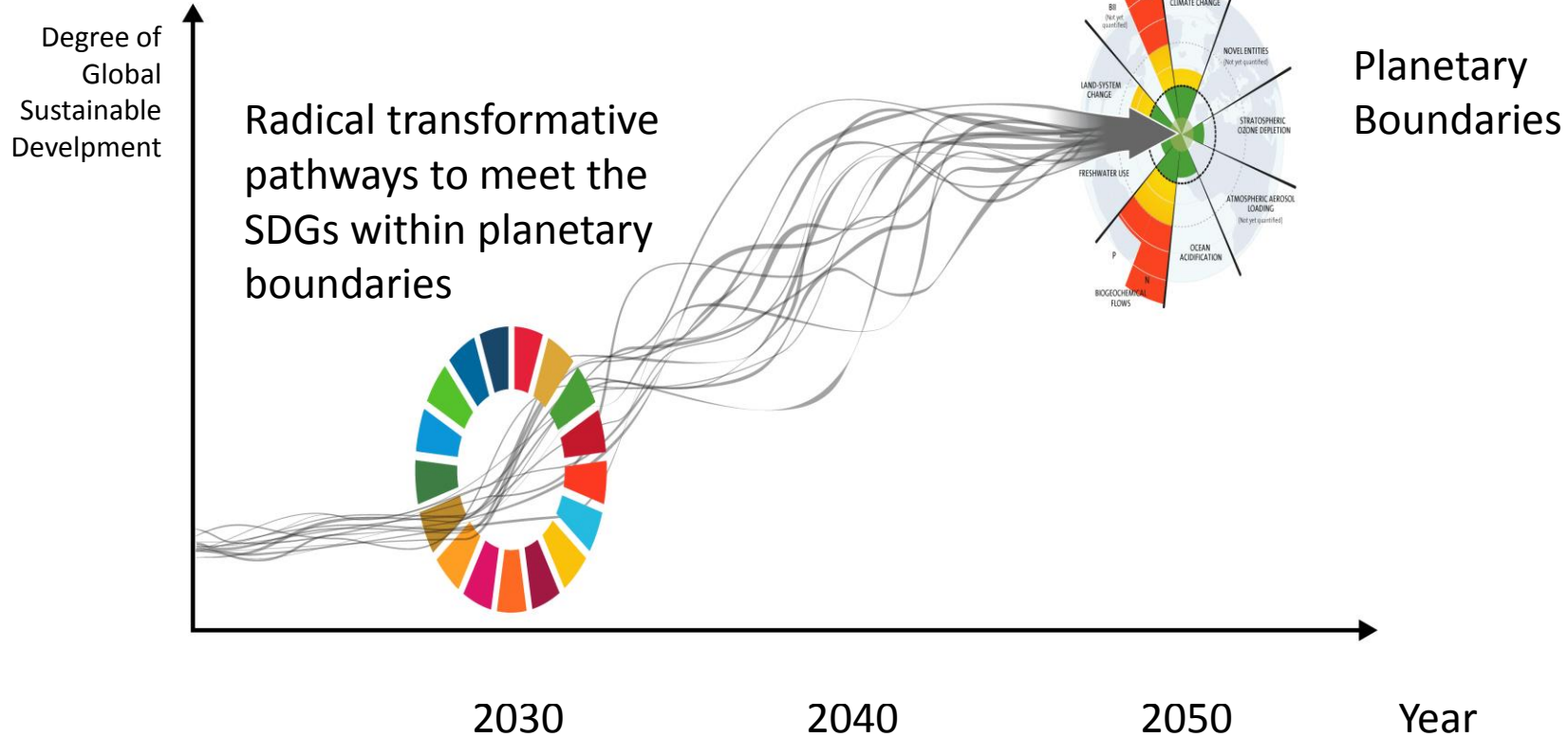


SUSTAINABLE  
DEVELOPMENT  
GOALS





# The World In 2050





SCIENCE  
BASED  
TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION



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COMPANIES TAKING ACTION

SET A TARGET

NEWS & EVENTS

FAQS

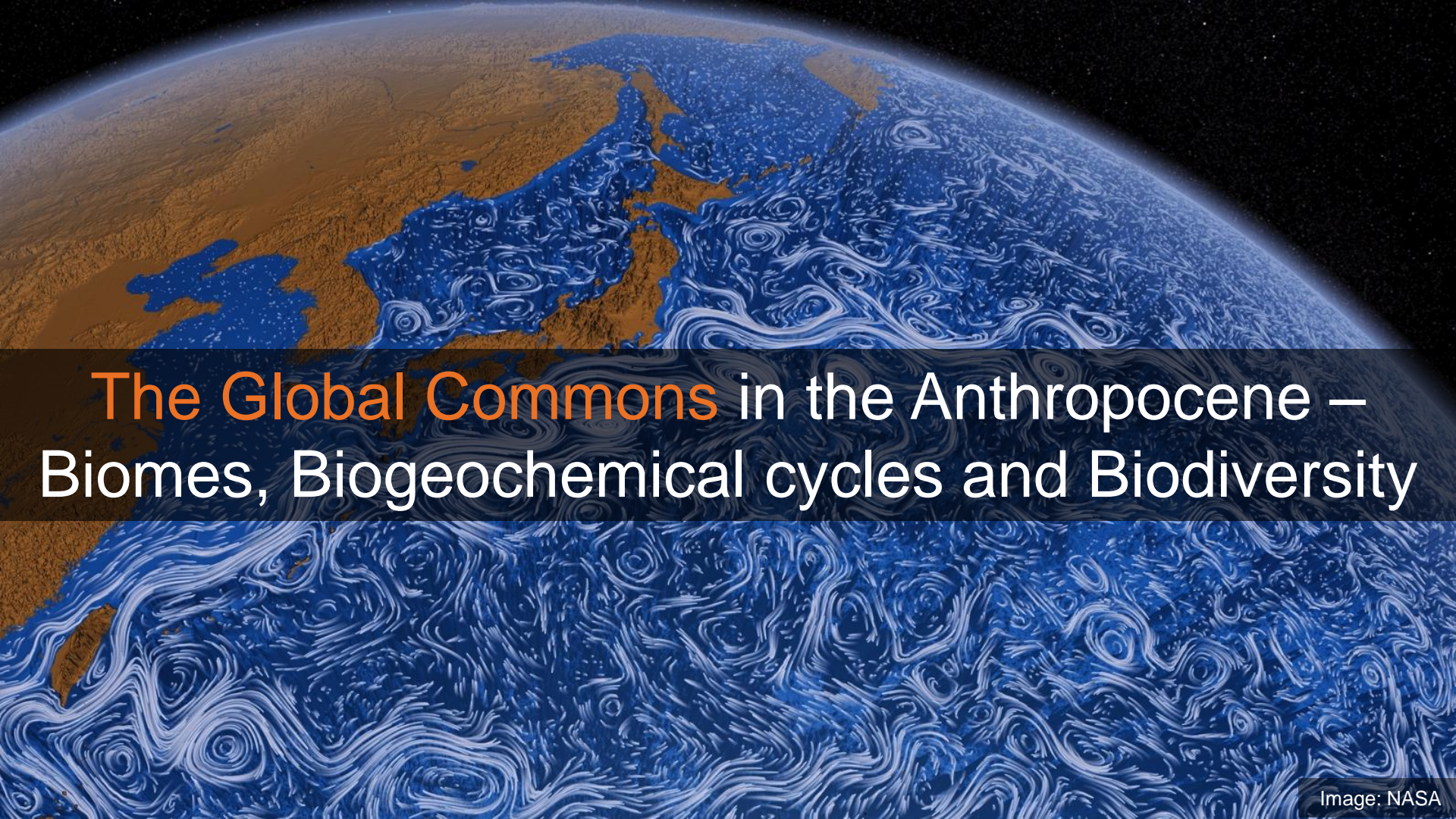
CONTACT US

**Over 100 companies have  
set science-based targets**

**Explore the data**

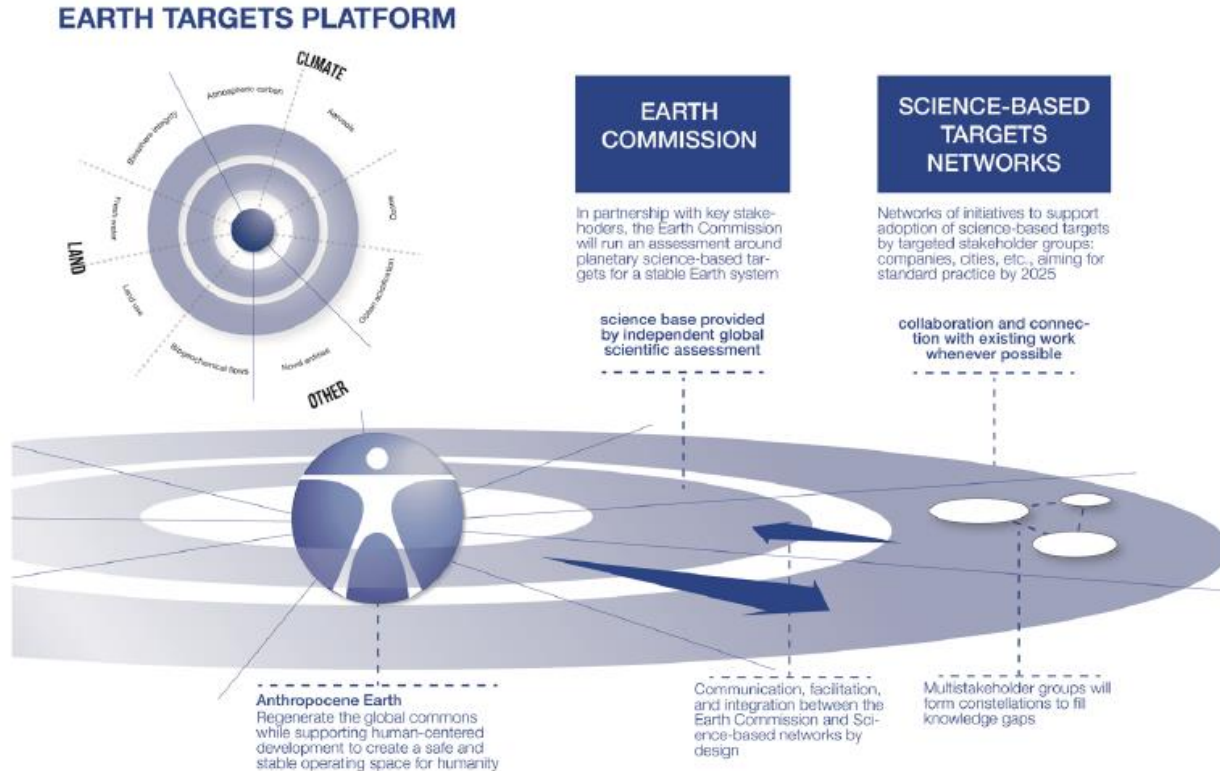
Setting greenhouse gas emission reduction targets in line with climate science is a great way to future-proof growth.





# The Global Commons in the Anthropocene – Biomes, Biogeochemical cycles and Biodiversity

# Science Based Targets for the Earth System





## **Unprecedented Risk**

We can no longer exclude destabilizing the entire Earth system



## **Unprecedented Opportunity**

We must, we can and we gain social benefits and economic development from a world transformation to global sustainability

## **Sustainable Development**

Prosperous and socially inclusive world within safe operating space of Planetary Boundaries on Stable and Resilient Earth





# Thank you

[www.stockholmresilience.su.se](http://www.stockholmresilience.su.se)

Photo: O.Henriksson/Azote

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