COP21 in Paris: What does it mean for Denmark?

At the Sustainable Development Summit on 25 September 2015, UN Member States will adopt the 2030 Agenda for Sustainable Development, which includes a set of 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030.

The SDGs, otherwise known as the Global Goals, build on the Millennium Development Goals (MDGs), eight anti-poverty targets that the world committed to achieving by 2015. The MDGs, adopted in 2000, aimed at an array of issues that included slashing poverty, hunger, disease, gender inequality, and access to water and sanitation. Enormous progress has been made on the MDGs, showing the value of a unifying agenda underpinned by

THE GREAT ACCELERATION

SOCIO-ECONOMIC TRENDS

REFERENCE: Steffen, W., W. Broadgate, L. Deutsch, O. Gaffney and C. Ludwig (2015), The Trajectory of the Anthropocene: the Great Acceleration, Submitted to *The Anthropocene Review.*

MAP & DESIGN: Félix Pharand-Deschênes / Globaïa

Planetary Boundaries: Exploring the safe operating space for humanity in the Anthropocene (*Nature*, 461 : 472 – 475, Sept 24 - 2009)

nature

FEATURE

Vol 461|24 September 2009

A safe operating space for humanity

Identifying and quantifying planetary boundaries that must not be transgressed could help prevent human activities from causing unacceptable environmental change, argue **Johan Rockström** and colleagues.

SUMMARY

- New approach proposed for defining preconditions for human development
- Crossing certain biophysical thresholds could have disastrous consequences for humanity
- Three of nine interlinked planetary boundaries have already been overstepped

Although Earth has undergone many periods of significant environmental change, the planet's environment has been unusually stable for the past 10,000 years[1–3]. This period of stability — known to geologists as the Holocene — has seen human civilizations arise, develop and thrive. Such stability may now be under threat. Since the Industrial Revolution, a new era has arisen, the Anthropocene[4], in which human actions have become the main driver of global environmental change[5]. This could see human activities push the Earth system outside the stable environmental state of the Holocene, with consequences that are detrimental or even catastrophic for large parts of the world. During the Holocene, environmental change occurred naturally and Earth's regulatory capacity maintained the conditions that enabled human development. Regular temperatures, freshwater availability and biogeochemical flows all stayed within a relatively narrow range. Now, largely because of a rapidly growing reliance on fossil fuels and industrialized forms of agriculture, human activities have reached a level that could damage the systems that keep Earth in the desirable Holocene state. The result could be irreversible and, in some cases, abrupt environmental change, leading to a state less conducive to human development[6]. Without pressure from humans, the Holocene is expected to continue for at least several thousands of years[7].

Planetary boundaries

To meet the challenge of maintaining the Holocene state, we propose a framework based on 'planetary boundaries'. These boundaries define the safe operating space for humanity with respect to the Earth system and are associated with the planet's biophysical subsystems or processes. Although Earth's complex systems sometimes respond smoothly to changing pressures, it seems that this will prove to be the exception rather than the rule. Many subsystems of Earth react in a nonlinear, often abrupt, way, and are particularly sensitive around threshold levels of certain key variables. If these thresholds are crossed, then important subsystems, such as a monsoon system, could shift into a new state, often with deleterious or potentially even disastrous consequences for humans[8,9].

Most of these thresholds can be defined by a critical value for one or more control variables, such as carbon dioxide concentration. Not all processes or subsystems on Earth have well-defined thresholds, although human actions that undermine the resilience of such processes or subsystems — for example, land and water degradation — can increase the risk that thresholds will also be crossed in other processes, such as the climate system.

We have tried to identify the Earth-system processes and associated thresholds which, if crossed, could generate unacceptable environmental change. We have found nine such processes for which we believe it is necessary to define planetary boundaries: climate change; rate of biodiversity loss (terrestrial and marine); interference with the nitrogen and phosphorus cycles; stratospheric ozone depletion; ocean acidification; global freshwater use; change in land use; chemical pollution; and atmospheric aerosol loading (see Fig. 1 and Table).

In general, planetary boundaries are values for control variables that are either at a 'safe' distance from thresholds — for processes with evidence of threshold behaviour — or at dangerous levels — for processes without

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries:exploring the safe operating space for humanity. *Ecology and Society* **14**(2): 32. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art32/

E&S

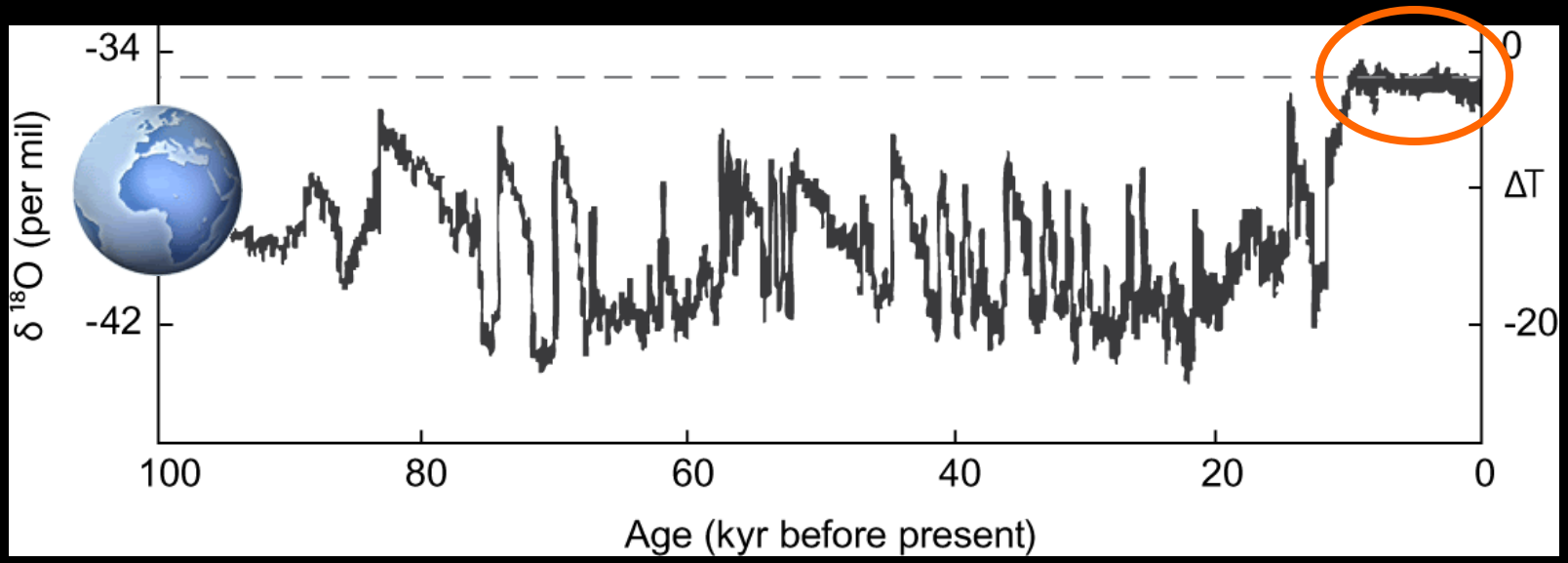
Research

Planetary Boundaries: Exploring the Safe Operating Space for Humanity

Johan Rockström [1,2], *Will Steffen* [1,3], *Kevin Noone* [1,4], *Åsa Persson* [1,2], *F. Stuart III Chapin* [5], *Eric Lambin* [6], *Timothy M. Lenton* [7], *Marten Scheffer* [8], *Carl Folke* [1,9], *Hans Joachim Schellnhuber* [10,11], *Björn Nykvist* [1,2], *Cynthia A. de Wit* [4], *Terry Hughes* [12], *Sander van der Leeuw* [13], *Henning Rodhe* [14], *Sverker Sörlin* [1,15], *Peter K. Snyder* [16], *Robert Costanza* [1,17], *Uno Svedin* [1], *Malin Falkenmark* [1,18], *Louise Karlberg* [1,2], *Robert W. Corell* [19], *Victoria J. Fabry* [20], *James Hansen* [21], *Brian Walker* [1,22], *Diana Liverman* [23,24], *Katherine Richardson* [25], *Paul Crutzen* [26], and *Jonathan Foley* [27]

Ecology and Society **14**(2): 32
http://www.ecologyandsociety.org/vol14/iss2/art32/

Humanity's 12,000 years of grace



”Planetary Boundaries 2.0”

Sciencexpress Research Articles

Planetary boundaries: Guiding human development on a changing planet

Will Steffen,[1,2*] Katherine Richardson,[3] Johan Rockström,[1] Sarah E. Cornell,[1] Ingo Fetzer,[1] Elena M. Bennett,[4] R. Biggs,[1,5] Stephen R. Carpenter,[6] Wim de Vries,[7,8] Cynthia A. de Wit,[9] Carl Folke,[1,10] Dieter Gerten,[11] Jens Heinke,[11,12,13] Georgina M. Mace,[14] Linn M. Persson,[15] Veerabhadran Ramanathan,[16,17] B. Reyers,[1,18] Sverker Sörlin[19]

(ii) updating the quantification of most of the PBs; (iii) identifying two core boundaries; and (iv) proposing a regional-level quantitative boundary for one of the two that were not quantified earlier (*1*).

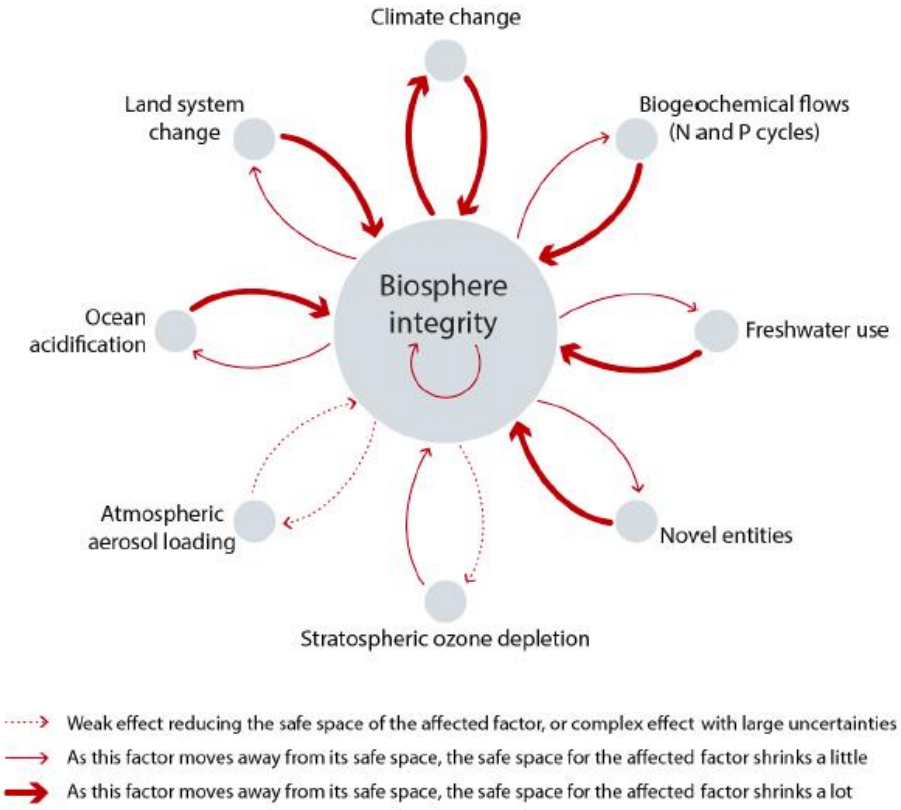
The basic framework: Defining a safe operating space

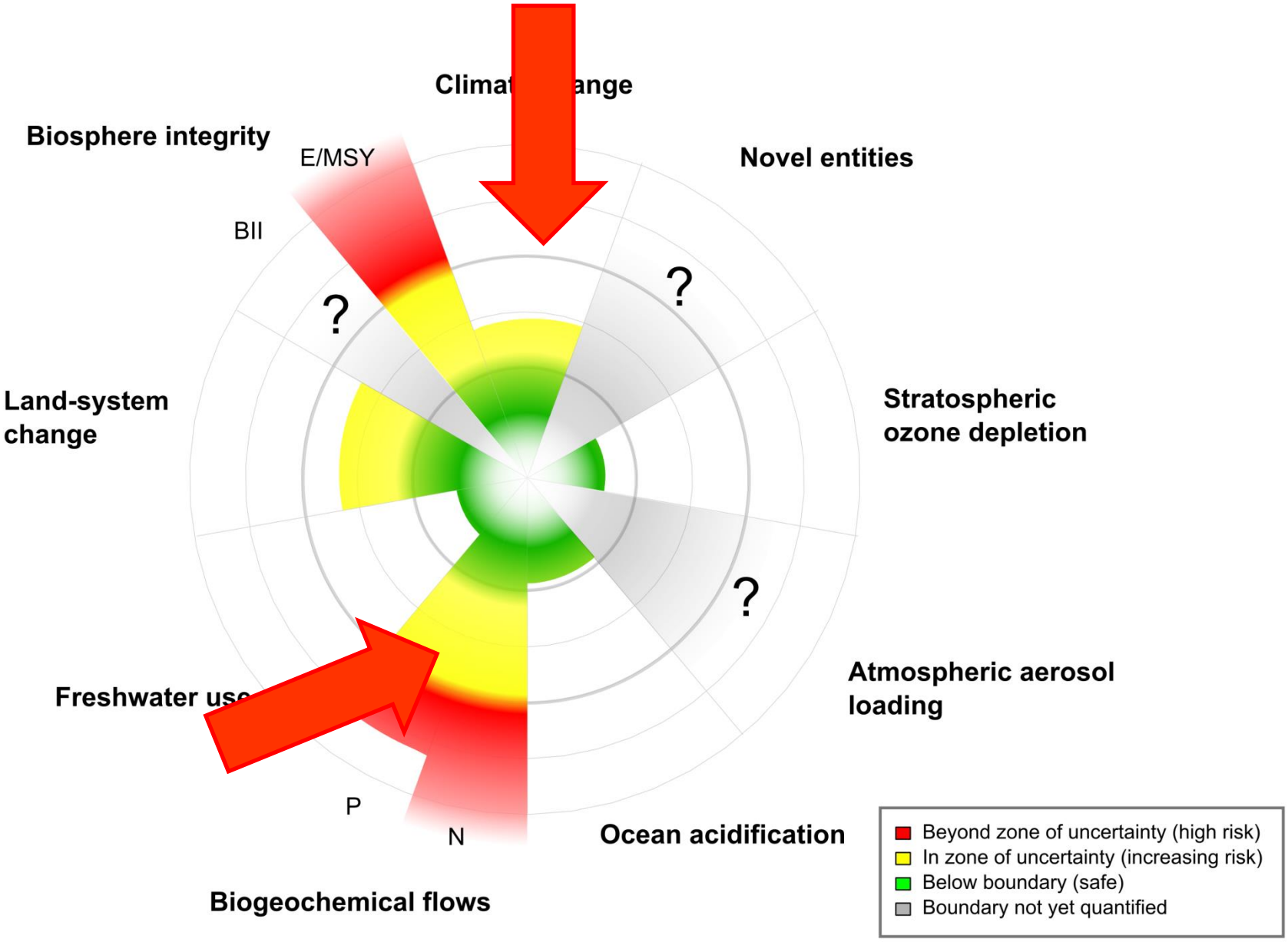
Throughout history, humanity has faced environmental constraints at local and regional

15 January 2015

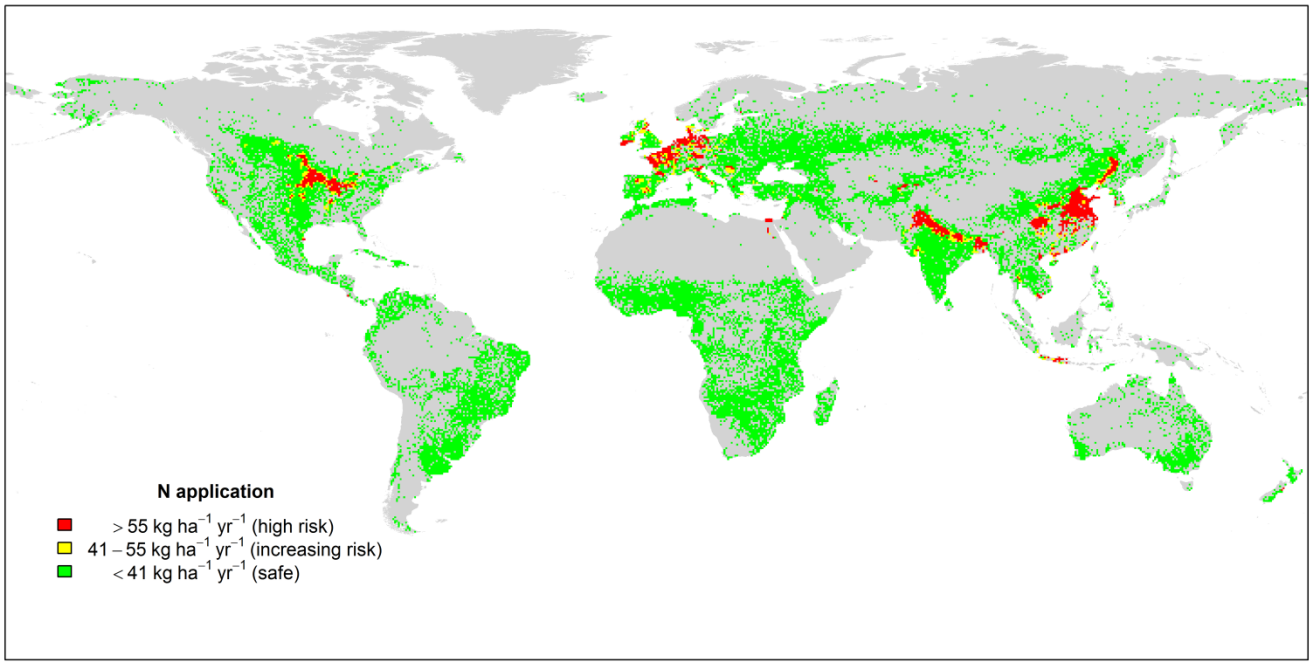
Two ”CORE” boundaries:

Climate **Biosphere Integrity**

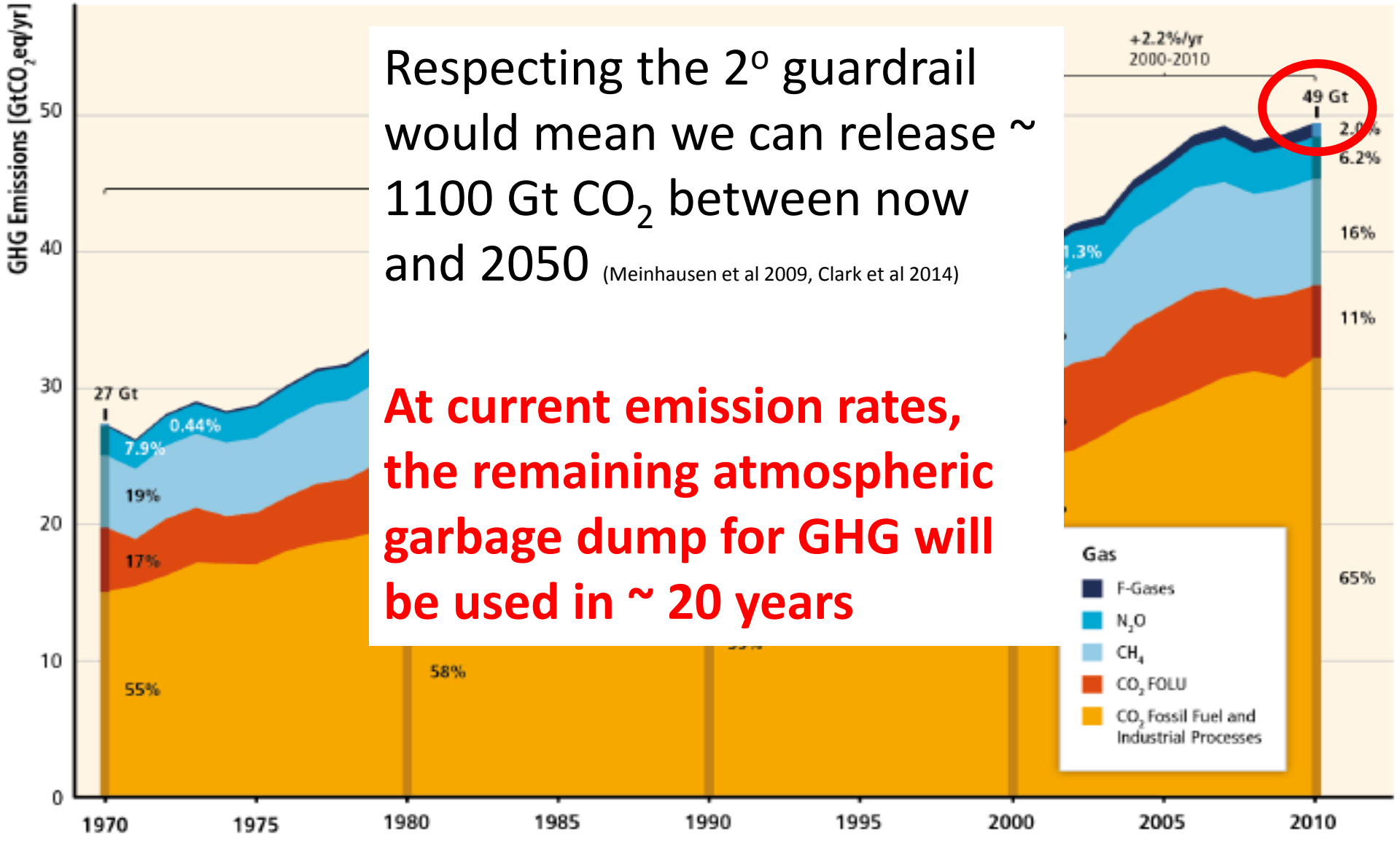



Climat ange
Biosphere integrity
E/MSY
BII
Novel entities
?
?
Land-system change
Stratospheric ozone depletion
?
Freshwater use
Atmospheric aerosol loading
P
N
Ocean acidification
Biogeochemical flows
Beyond zone of uncertainty (high risk)
In zone of uncertainty (increasing risk)
Below boundary (safe)
Boundary not yet quantified

Nitrogen application:



Development in global emissions over time



Respecting the 2° guardrail would mean we can release ~ 1100 Gt CO_2 between now and 2050 (Meinhausen et al 2009, Clark et al 2014)

At current emission rates, the remaining atmospheric garbage dump for GHG will be used in ~ 20 years

To achieve the goal of holding human-caused global warming to < 2º:

-39% reduction by 2030 (from 2010 levels)

-72% reduction by 2050

How much known fossil fuel reserve needs to remain unburned up to 2050 to remain within the 2° guardrail?

Table 1 | Regional distribution of reserves unburnable before 2050 for the 2 °C scenarios with and without CCS

	2 °C with CCS						2 °C without CCS					
	Oil		Gas		Coal		Oil		Gas		Coal	
Country or region	Billions of barrels	%	Trillions of cubic metres	%	Gt	%	Billions of barrels	%	Trillions of cubic metres	%	Gt	%
Africa	23	21%	4.4	33%	28	85%	28	26%	4.4	34%	30	90%
Canada	39	74%	0.3	24%	5.0	75%	40	75%	0.3	24%	5.4	82%
China and India	9	25%	2.9	63%	180	66%	9	25%	2.5	53%	207	77%
FSU	27	18%	31	50%	203	94%	28	19%	36	59%	209	97%
CSA	58	39%	4.8	53%	8	51%	63	42%	5.0	56%	11	73%
Europe	5.0	20%	0.6	11%	65	78%	5.3	21%	0.3	6%	74	89%
Middle East	263	38%	46	61%	3.4	99%	264	38%	47	61%	3.4	99%
OECD Pacific	2.1	37%	2.2	56%	83	93%	2.7	46%	2.0	51%	85	95%
ODA	2.0	9%	2.2	24%	10	34%	2.8	12%	2.1	22%	17	60%
United States of America	2.8	6%	0.3	4%	235	92%	4.6	9%	0.5	6%	245	95%
Global	431	33%	95	49%	819	82%	449	35%	100	52%	887	88%

FSU, the former Soviet Union countries; CSA, Central and South America; ODA, Other developing Asian countries; OECD, the Organisation for Economic Co-operation and Development. A barrel of oil is 0.159 m^3; %, Reserves unburnable before 2050 as a percentage of current reserves.

	With CCS			Without CCS	
Oil	Gas	Coal	Oil	Gas	Coal
33%	49%	82%	35%	52%	88 %

Climate Change Science and society:

- **Societal perception of Climate Change**: *when the science is so "certain", why is there still so much doubt among non-scientists?*

- **Climate Change is usually communicated as a prediction problem.** *In fact it is a RISK problem*

The COP *process* is an exercise in developing mechanisms to manage environmental resources at the global level!

Regarded as part of a *process* COP 15 looks much more like a succes than the failure it was portrayed to be!

COP 21, Paris 2015

- **We GOT an agreement!!**
  - No binding agreement on emissions (pledges)
  - No binding agreement on financing
  - 2^{o} guardrail is reconfirmed (strengthened!)
  - ALL countries are ”equal” players
  - Some agreement on what and how to measure/report
  - An agreement to make new (more ambitious) pledges in the coming years

COP 21 provides a clear signal of the direction in which the international community is headed!

For Denmark:

EU Emission reduction goal of 80-95% in relation to 1990 by 2050

1990 emission sources:

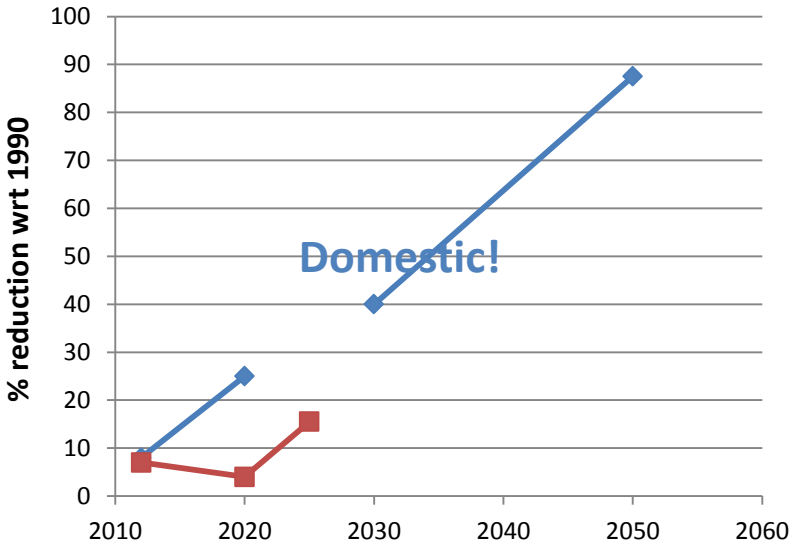
- **59% heat and electricity**
- 7% open environment
- 2% NS oil and gas
- **16% transport**
- **16% agriculture**

1. **Goal of removing fossil fuels from heat and electricity by 2050 MUST be retained!**
2. **An 80% cannot be achieved without a focus on TRANSPORT and AGRICULTURE!**

Is Denmark a climate "duks"??

An alternative view of the COP process:

EU and USA:



Emissions reduction targets ref 1990
EU, USA

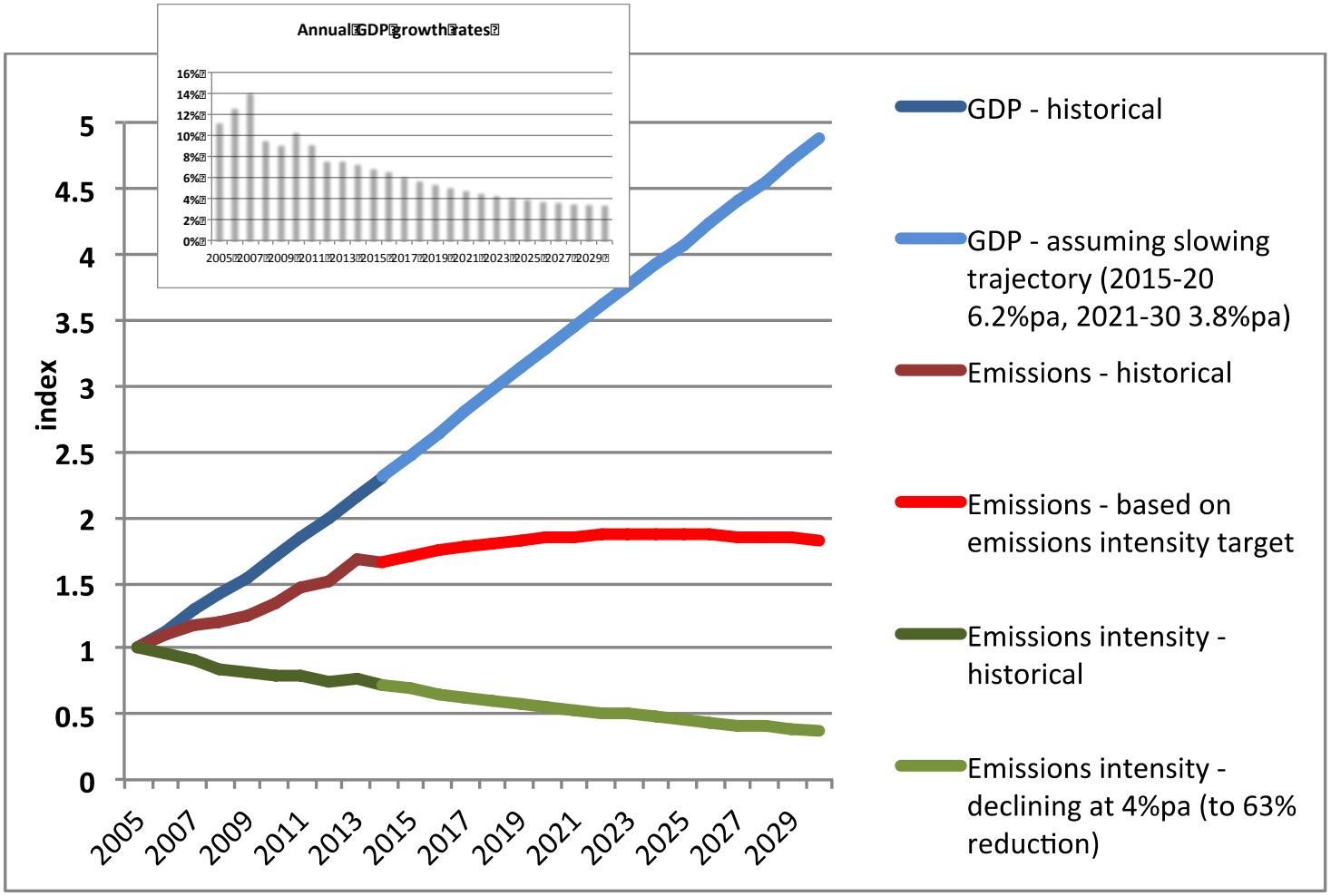
Increasing ambition level signalling:

- **Climate is taken seriously**
- **Decision-makers are beginning to believe in both the TECHNOLOGY necessary and the ECONOMY in addressing climate change.**

China is where it really gets interesting!

A scenario for China's 2030 emissions intensity target

(60-65% reduction in emissions intensity 2005-2030) *Source: Frank Jotzo, ANU*



- China's 2030 target implies that emissions intensity will fall ~4%pa from 2005 to 2030.
- This is historically unprecedented, but achievable given China's potential for energy efficiency, structural change and shifting away from coal. China is on track for this target, and for the 2020 target of a 40-45% emissions intensity reduction.
- The CO2 emissions trajectory could be quite flat, as in the example in the graph, in line with experience in developed countries.
- Motivations for decarbonization in China: improving air pollution and energy security, and leadership in new energy industries.

Environmental management at the global level??