

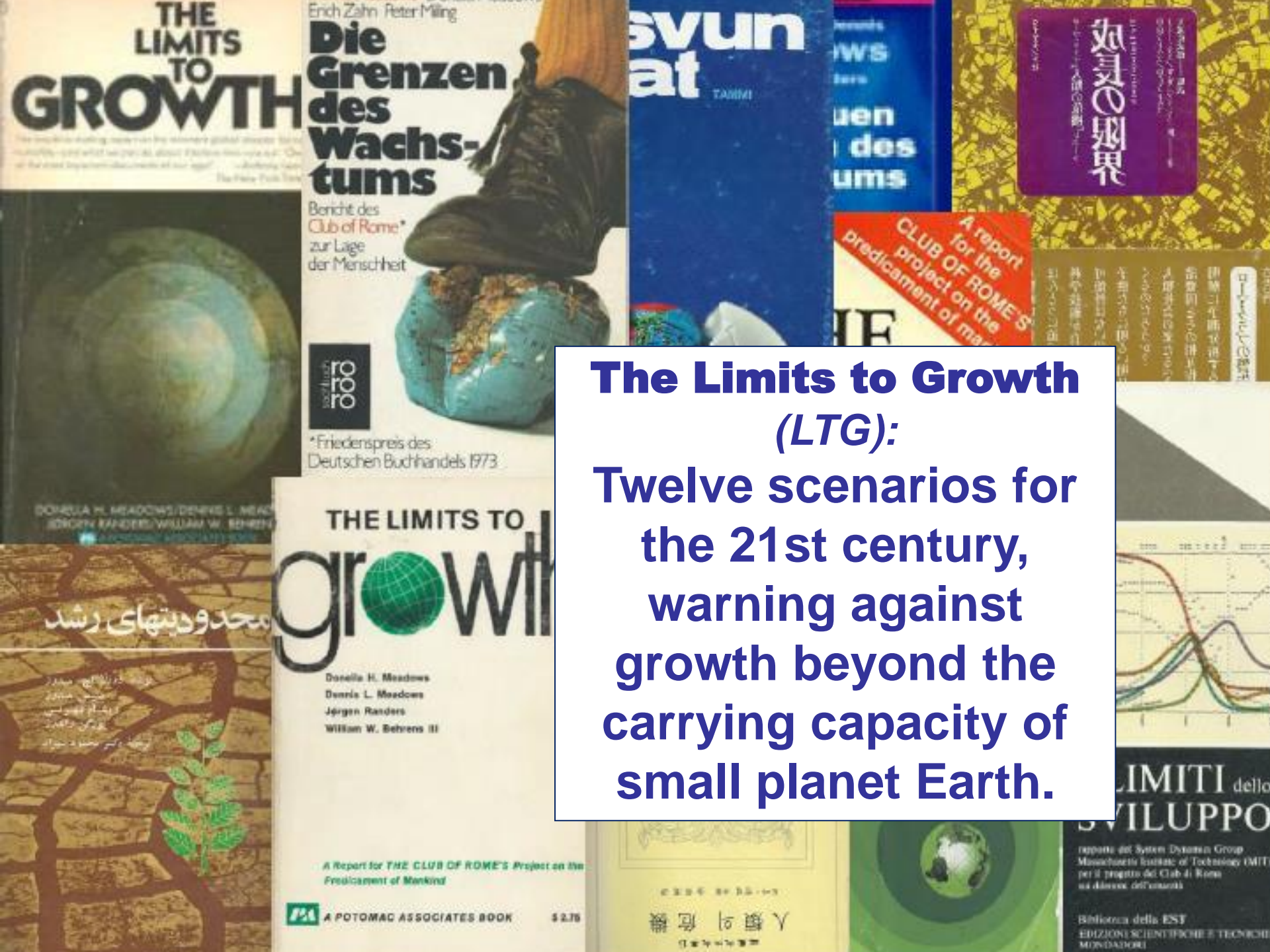


CENTER FOR
CLIMATE STRATEGY

The global energy system to 2052. What should universities do?

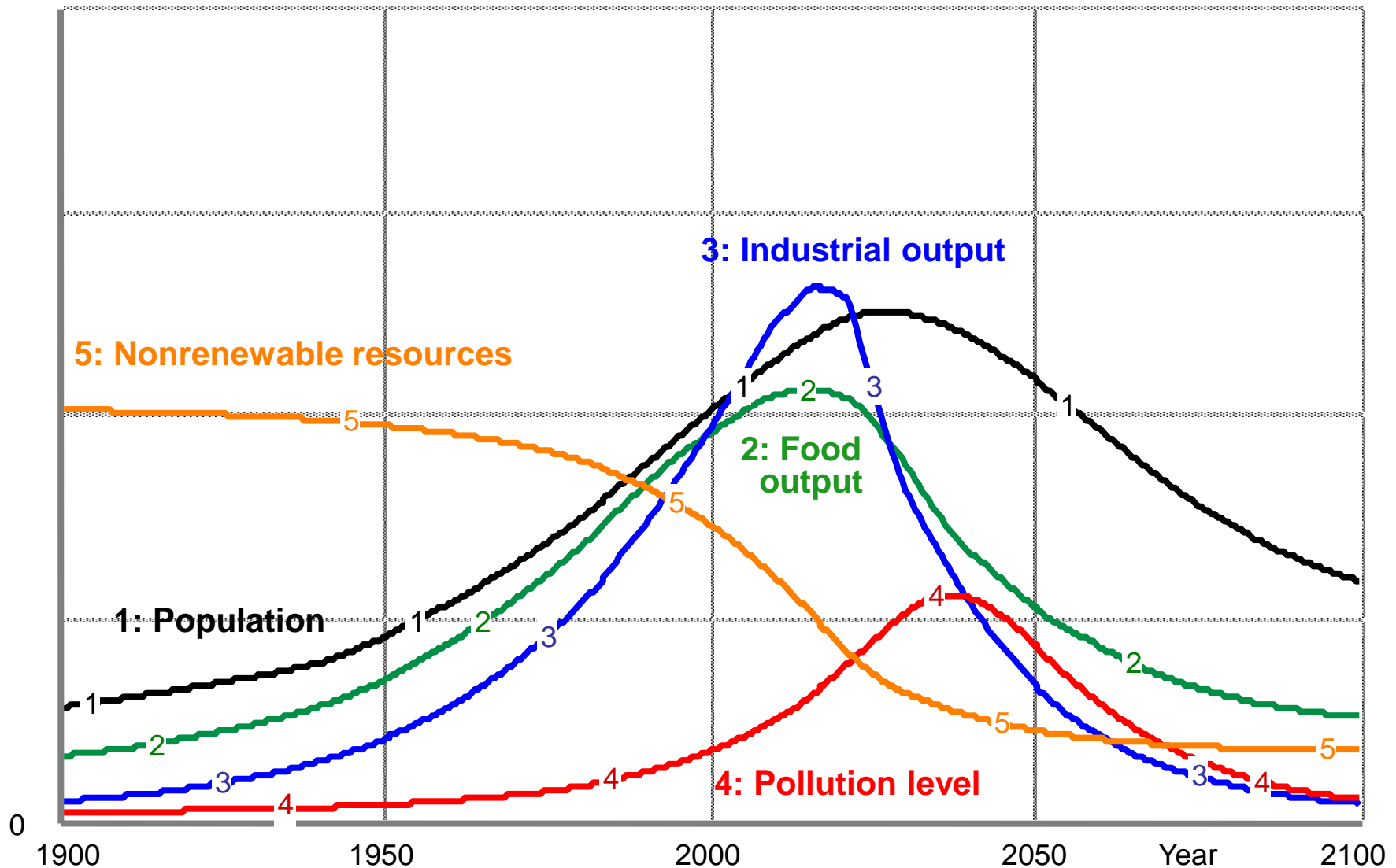
Jorgen Randers
Professor Emeritus
Center for Climate Strategy
BI Norwegian Business School

First UNI SET Clustering Event
NTNU, Trondheim 25th February, 2016

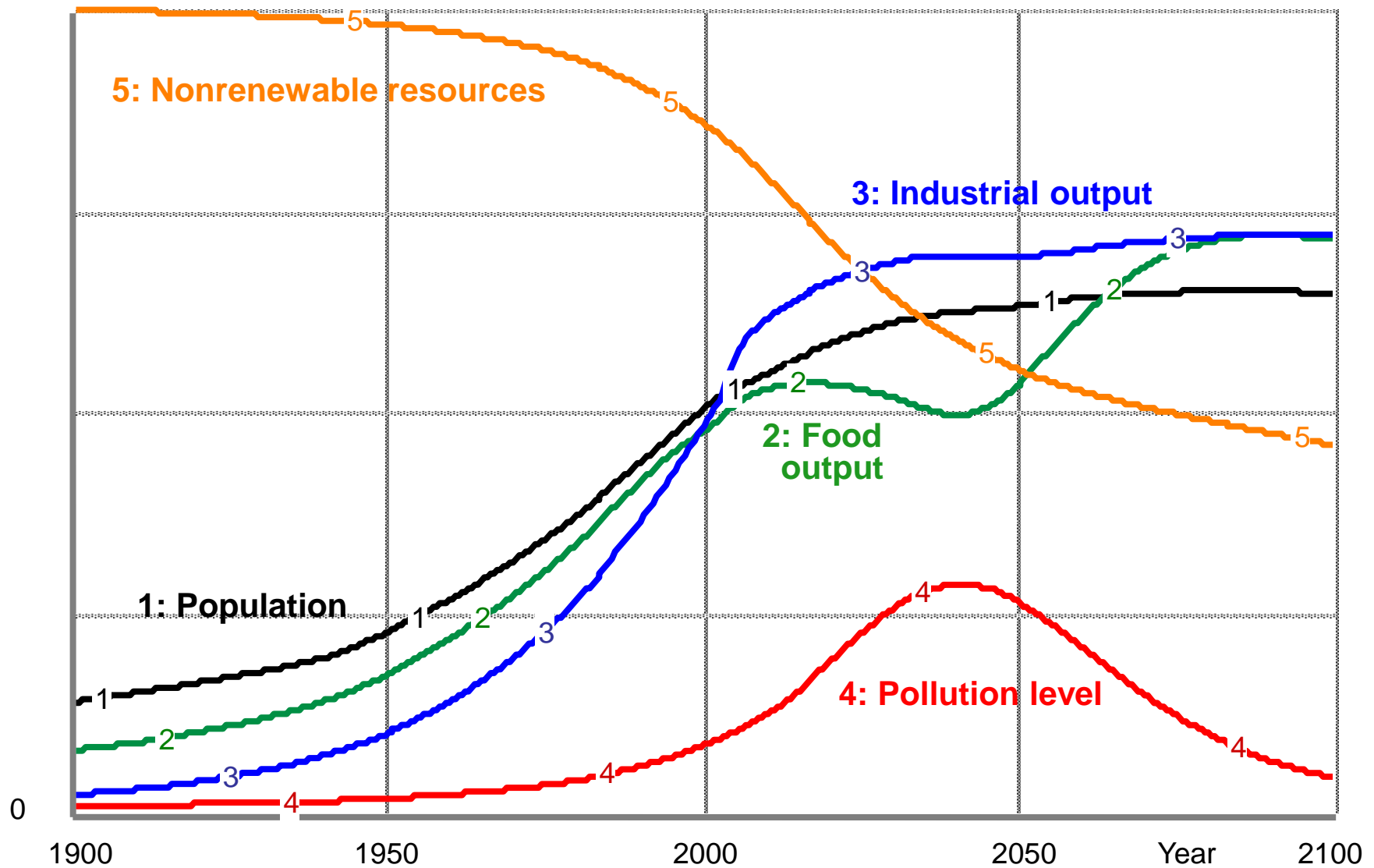


**The Limits to Growth
(LTG):**
Twelve scenarios for
the 21st century,
warning against
growth beyond the
carrying capacity of
small planet Earth.

One “sad” future: Resource crisis (LTG Sc 1)



A “better” future: Sustainability (LTG Sc 9)



A Global Forecast
for the Next Forty Years



Jorgen Randers

A REPORT TO THE CLUB OF ROME
COMMEMORATING THE 40TH ANNIVERSARY OF
The Limits to Growth

EINE GLOBALE PROGNOSE
FÜR DIE NÄCHSTEN 40 JAHRE



나은 미래는
계 오지 않는다

A Global Forecast for the Next Forty Years
검은 세계, 나와 내 아이는 어떤 하루를 살고 있을까
김종현 (著) | 김태현 (역)

2052 – A Global Forecast for the Next Forty Years

**A forecast of global
developments to 2052,
predicting that global
warming will exceed +2
deg C in mid-century**

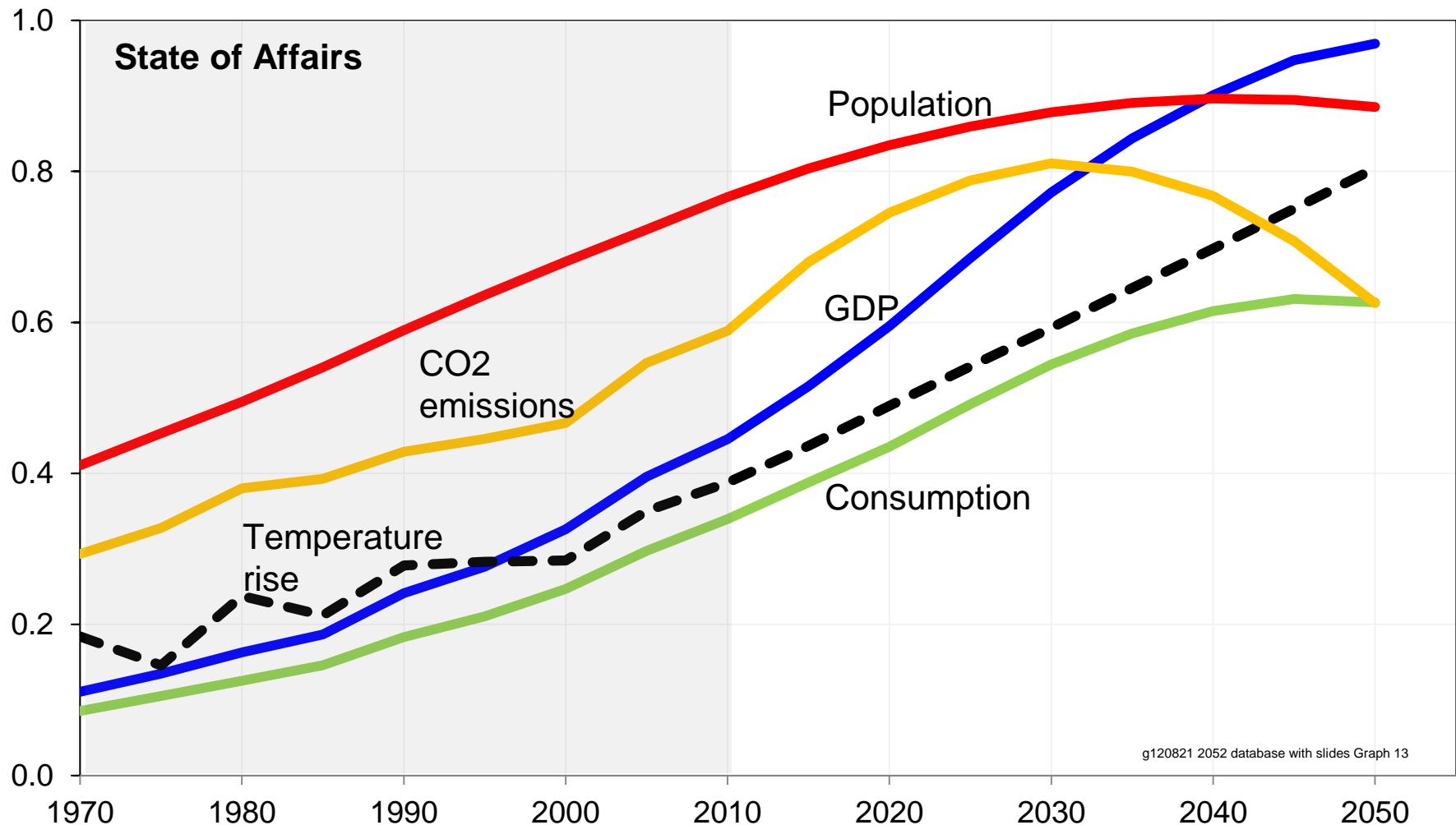
See www.2052.info

今後 40 年のグローバル予測

ヨルゲン・ランダース著
金田秀雄訳
2012年10月10日発行



World state of affairs – 1970 to 2050



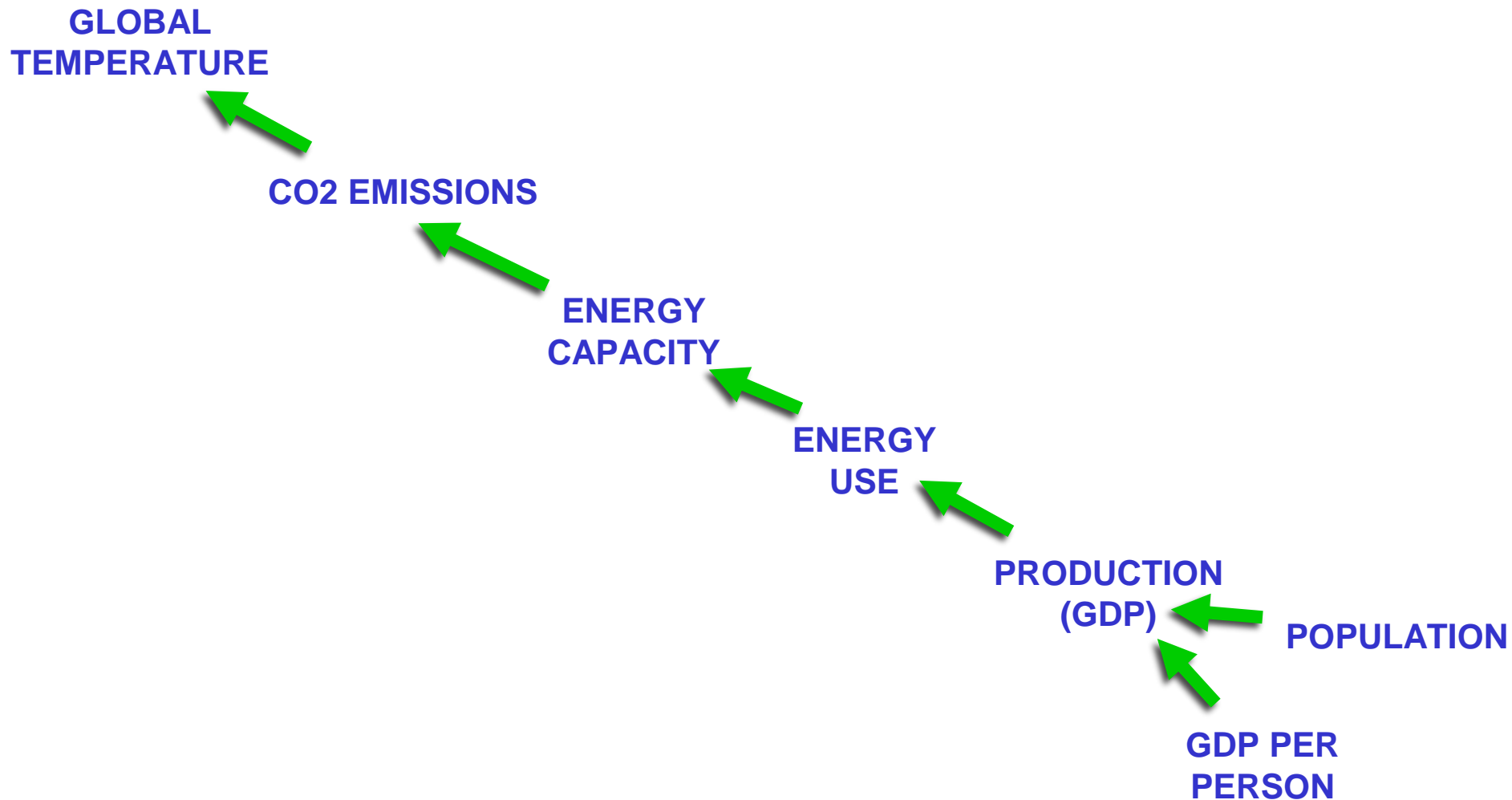
Max values **9 Gp**, **150 G\$/yr**, **50 GtCO2/yr**, **150 G\$/yr**, **2.5 deg C**

Figure 9-1a: Past and future World - State of Affairs -1970 to 2050

How such forecasts can help you

- 1.** Make a forecast of global energy system to 2052, assuming no extra-ordinary action
- 2.** Identify the problems that are likely to arise over the decades ahead
- 3.** Develop solutions to these problems, both technical and social
- 4.** Try to sell these extra-ordinary solutions to society

The drivers of installed energy capacity



The five regions used in the 2052 forecast

Region	Population 2010 (billion people)	GDP 2010 (trillion \$ pr year)	GDP per person 2010 (1000 \$ pr person-year)
US	0,3	13	41
China	1,3	10	7
OECD-less-US (1)	0,7	22	30
BRISE (2)	2,4	14	6
ROW (3)	2,1	8	4
Sum world	6,9	67	10

(1) Old industrial world, including EU, Japan, Canada, Australia, New Zealand etc

(2) Brazil, Russia, India, South Africa and the ten biggest emerging economies

(3) The remaining ca 140 countries of the world

World population will peak in 2040

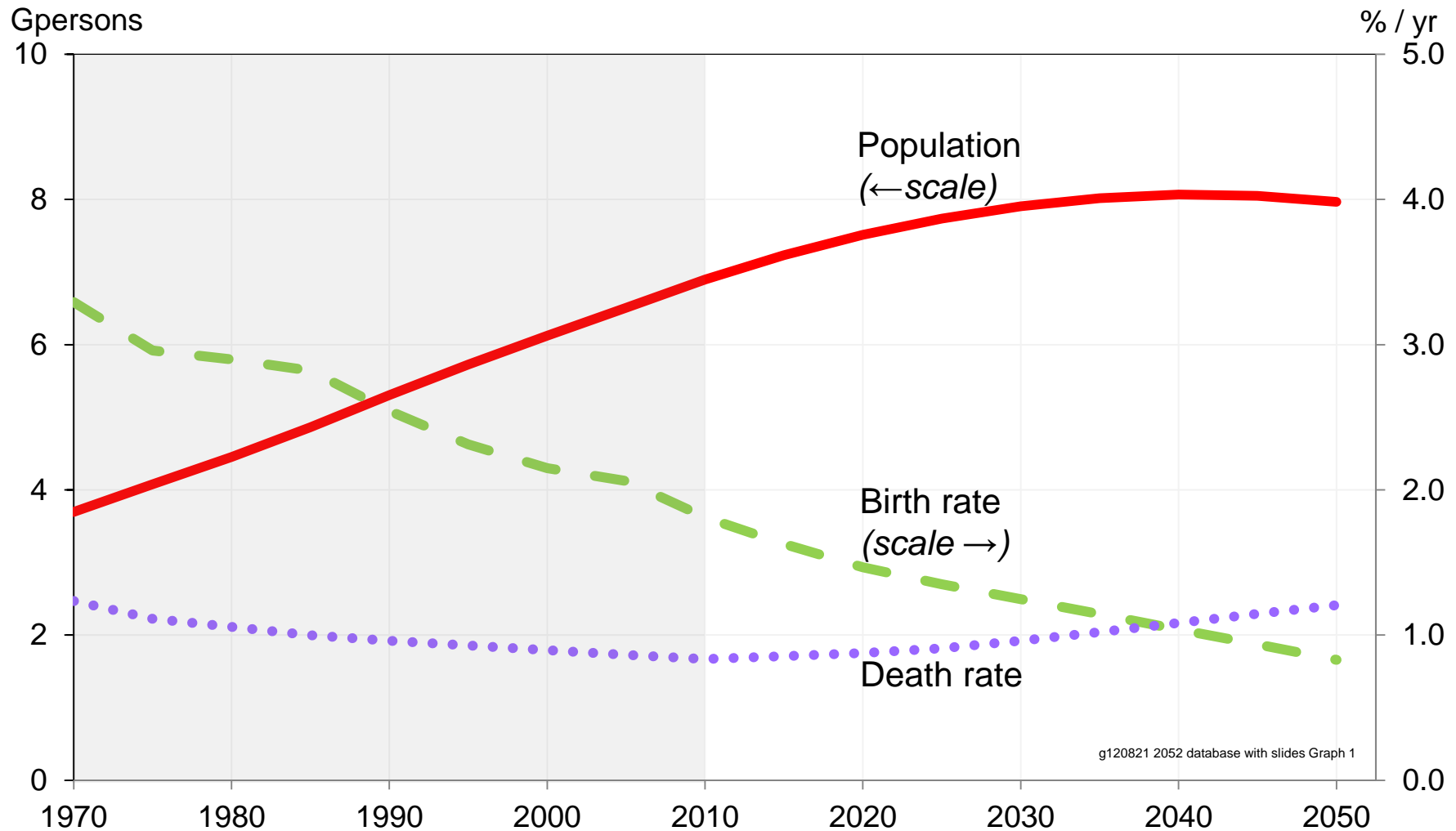


Figure 4-1 Population – World 1970 to 2050

World GDP growth will slow down

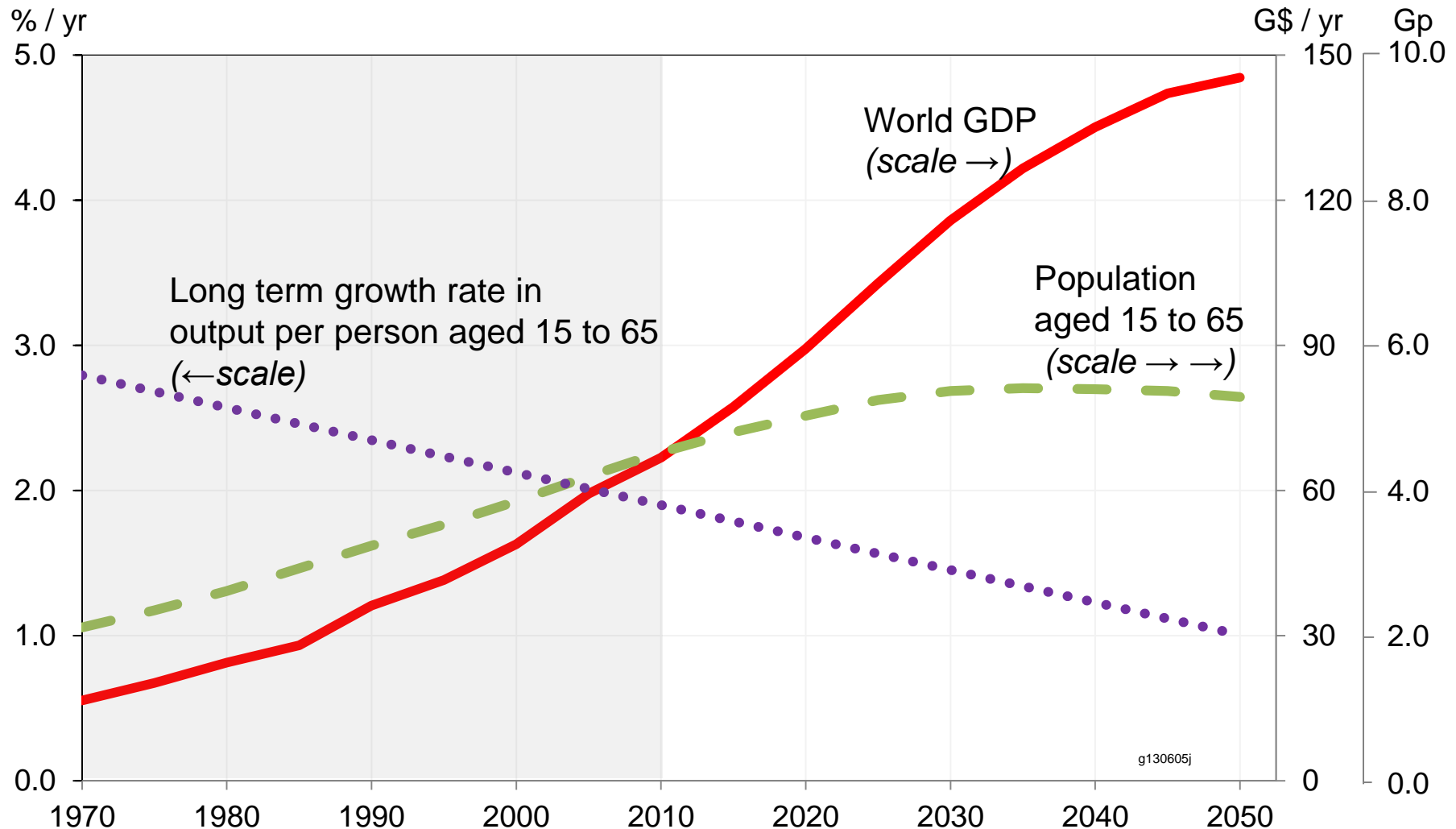


Figure 4-3b: Gross Domestic product – World 1970 to 2050

Definition: GDP = Population aged 15 to 65 years multiplied with Output per member of potential workforce

World energy use will peak in 2040

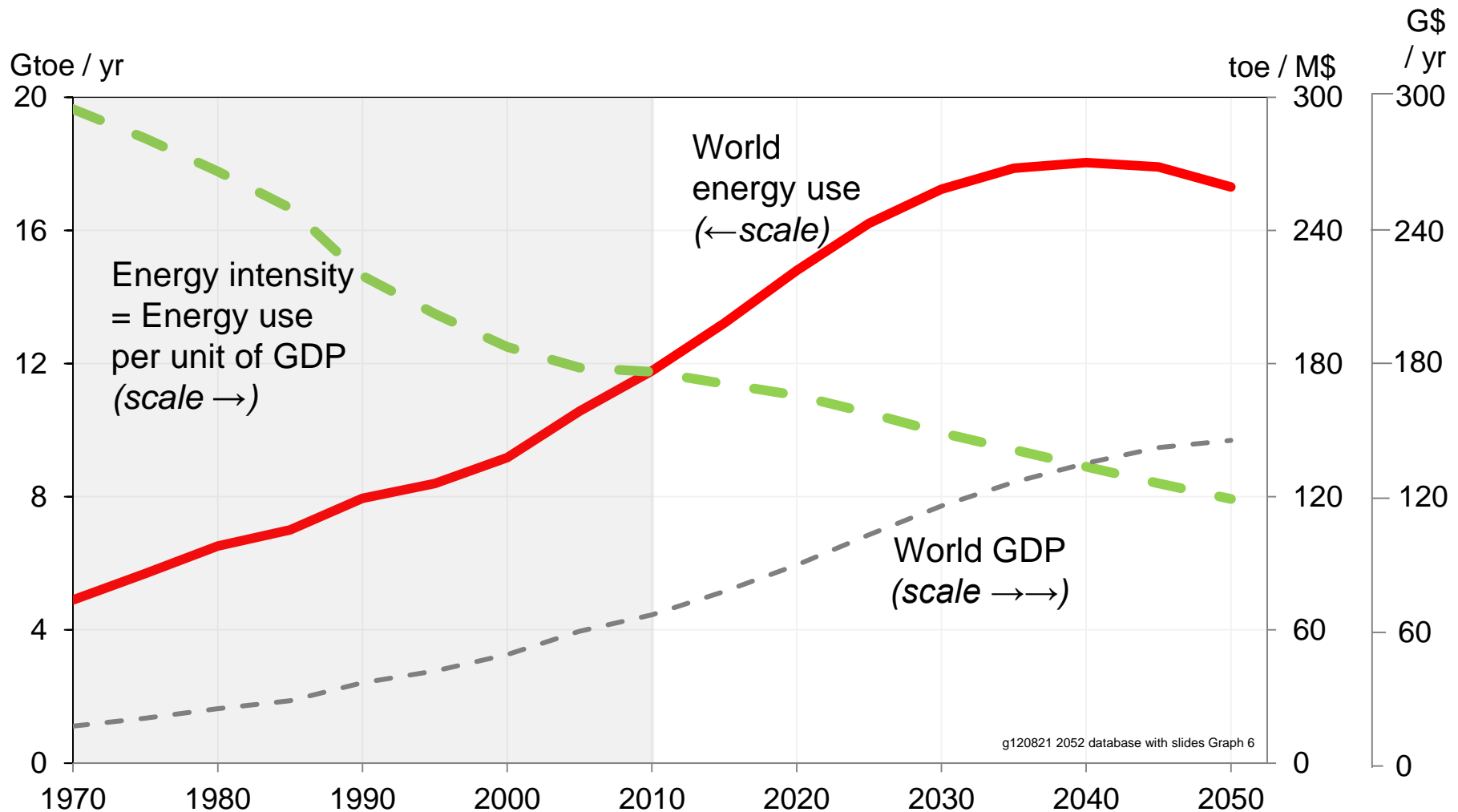


Figure 5-1: Energy Use – World 1970 to 2050

World use of fossil fuels will peak around 2030

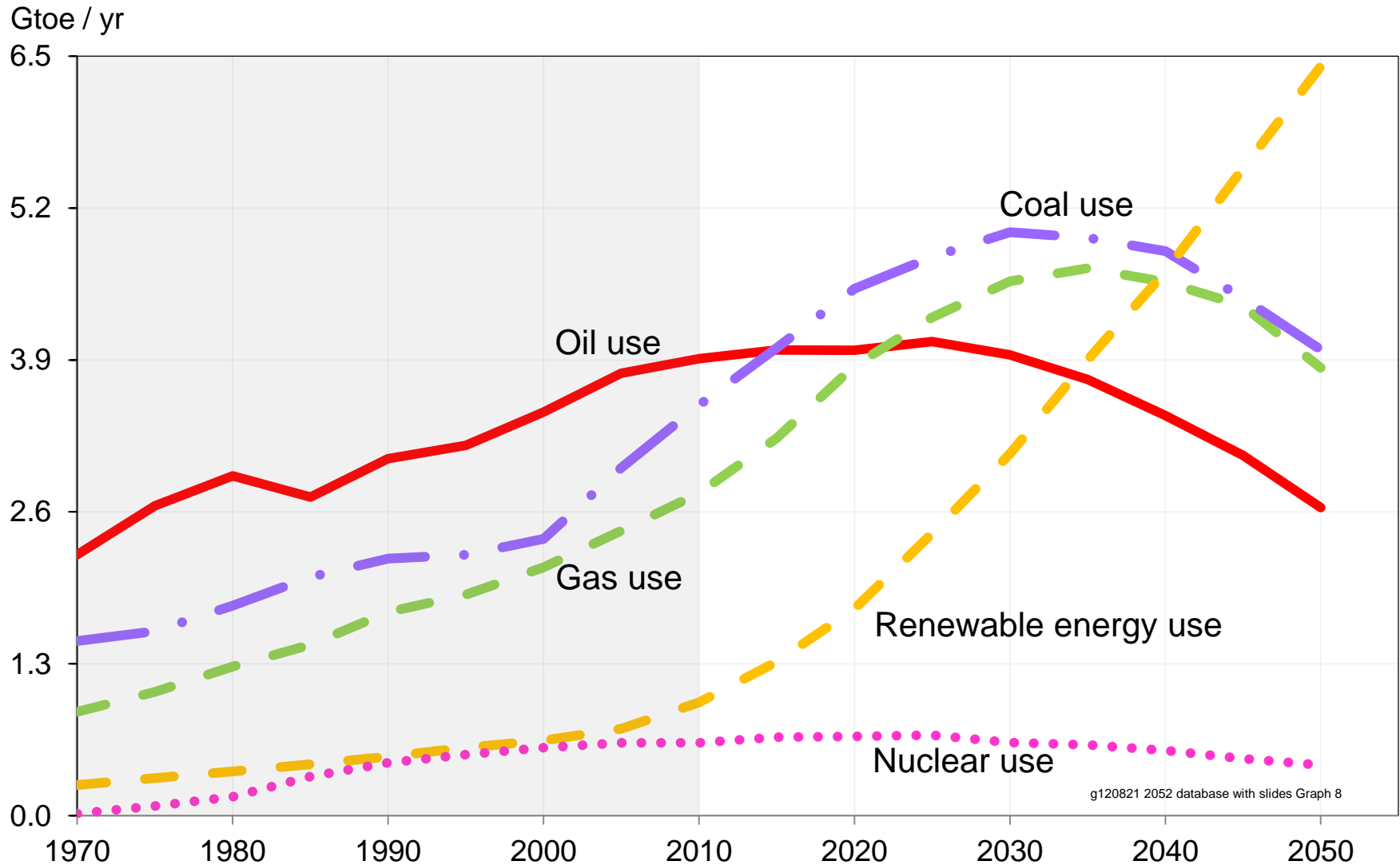


Figure 5-2: Energy Uses – World 1970 to 2052

World CO₂ emissions will peak in 2030

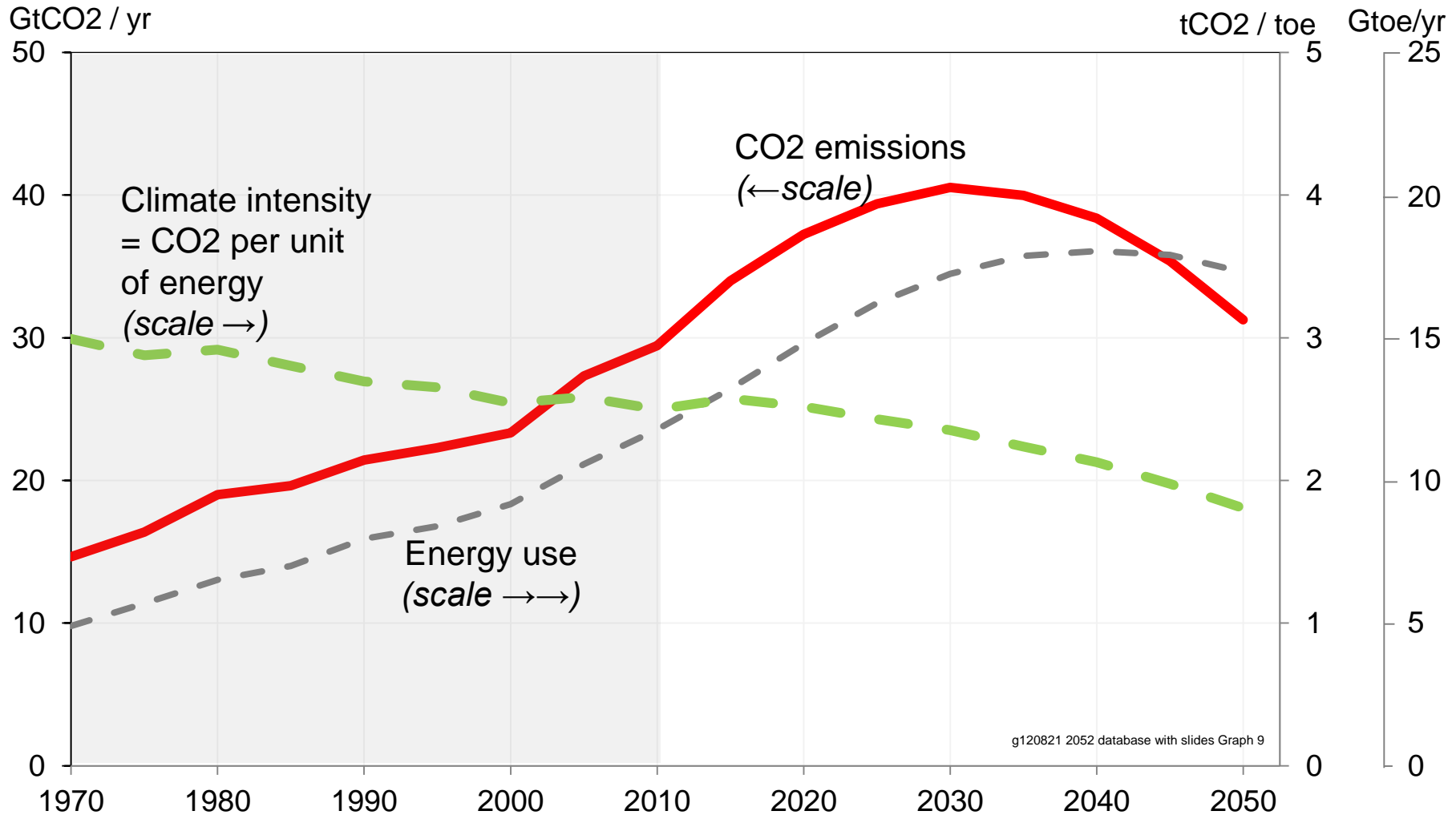


Figure 5-3: CO₂ Emissions from Energy Use – World 1970 to 2050.

Temperature will pass +2 degrees C in 2052

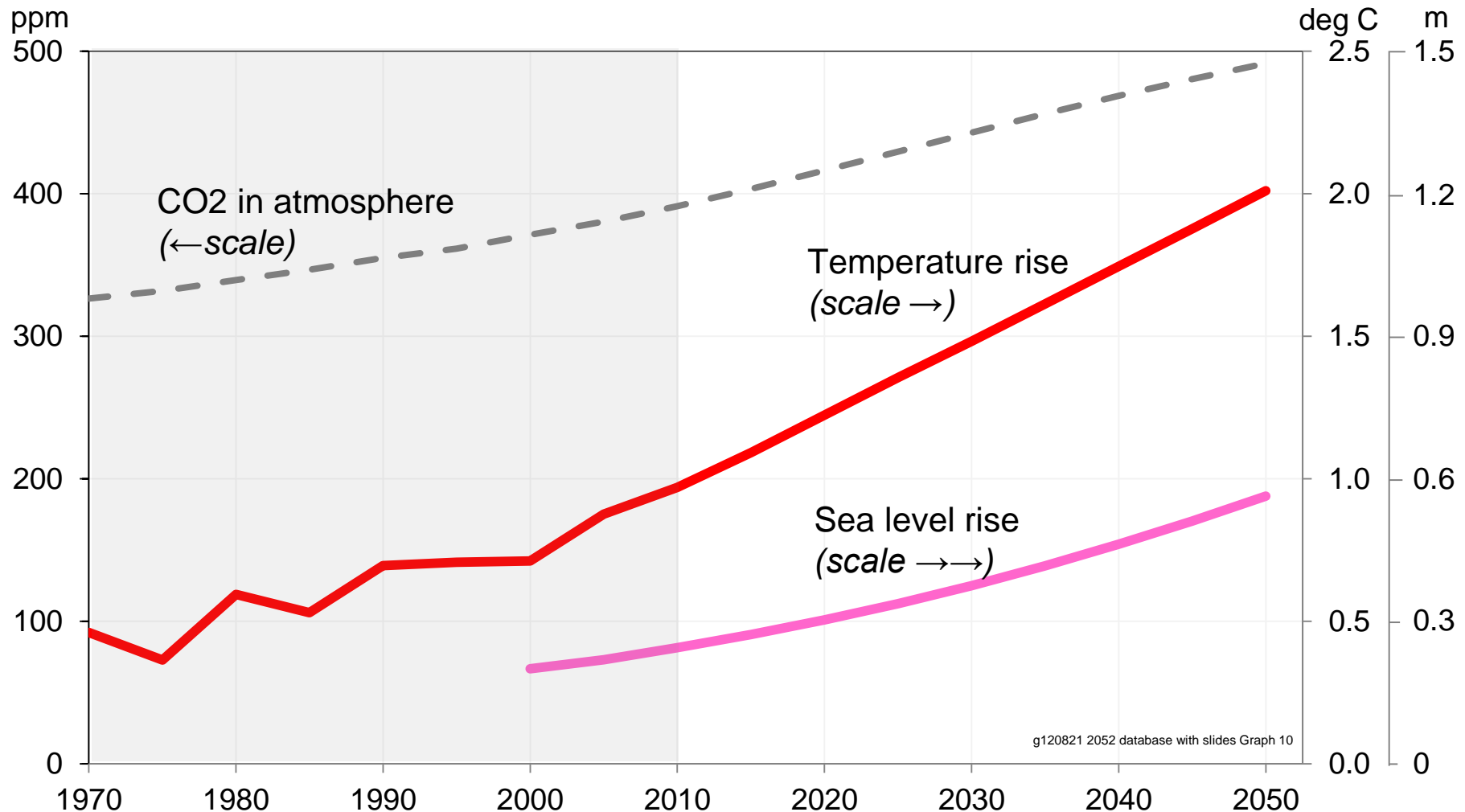


Figure 5-4: Climate Change – World 1970 to 2050

Main conclusions from the 2052 forecast

♣ World population and economy
will grow more slowly towards 2052
than most people expect
- but still fast enough to trigger a climate crisis

♣ Consumption will stagnate
because society will have to spend ever more
labour and capital
on repair and adaptation

♣ The short-term nature of man
- reflected in the short term focus
of democracy and capitalism -
is the root cause of this development

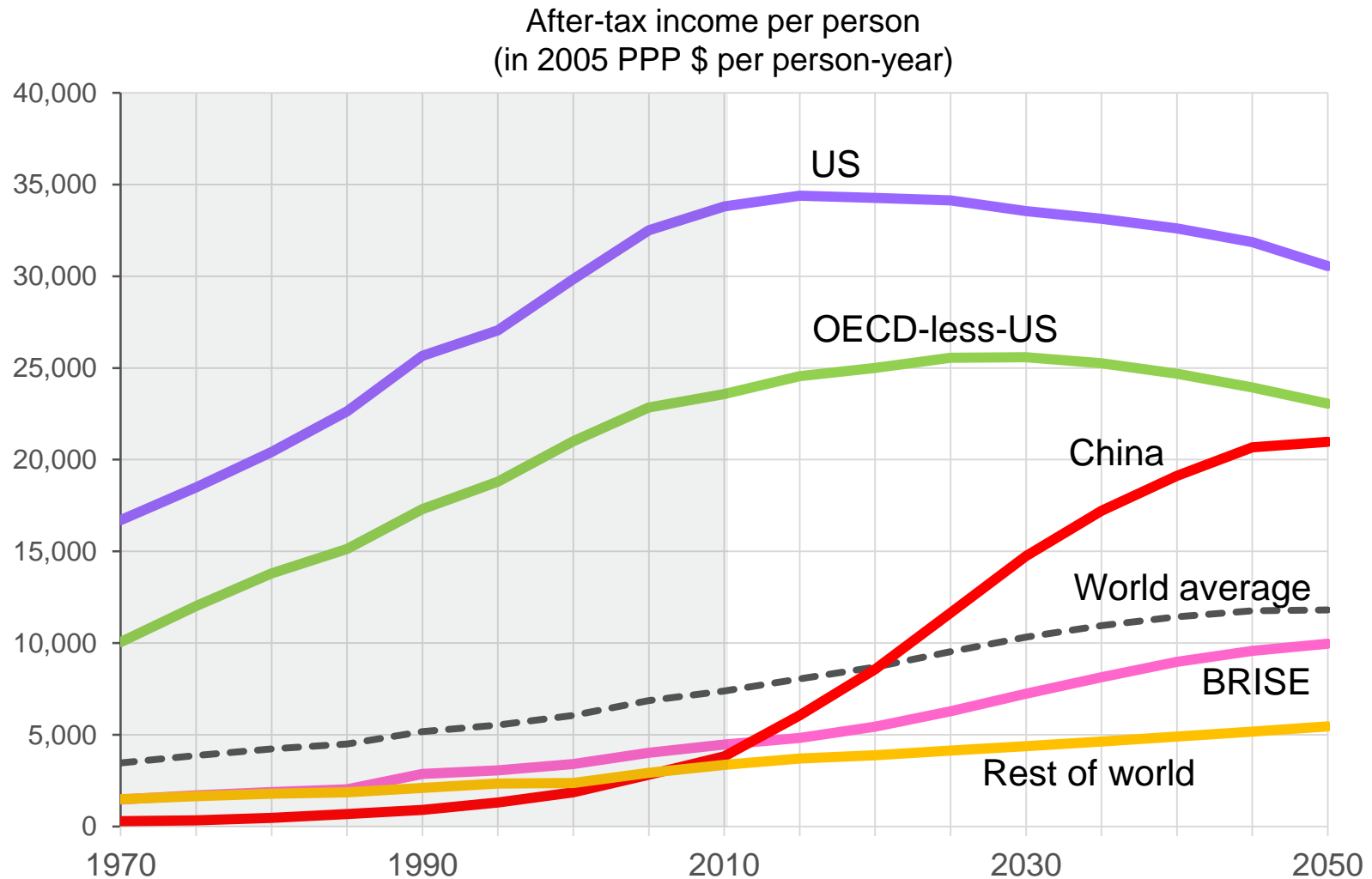
A much better future is possible

- 1.** Solving the climate challenge is not impossibly costly
- 2.** It requires a shift of 2 % of the world's labor and capital from “dirty” to “clean” sectors
- 3.** This solution will resisted by the incumbent workers and owners in the dirty sectors
- 4.** And by those who dislike higher taxes and more regulation
- 5.** The challenge is to find climate policies that also provide a short term benefit to a majority of the voters – that is increases well-being in the short term

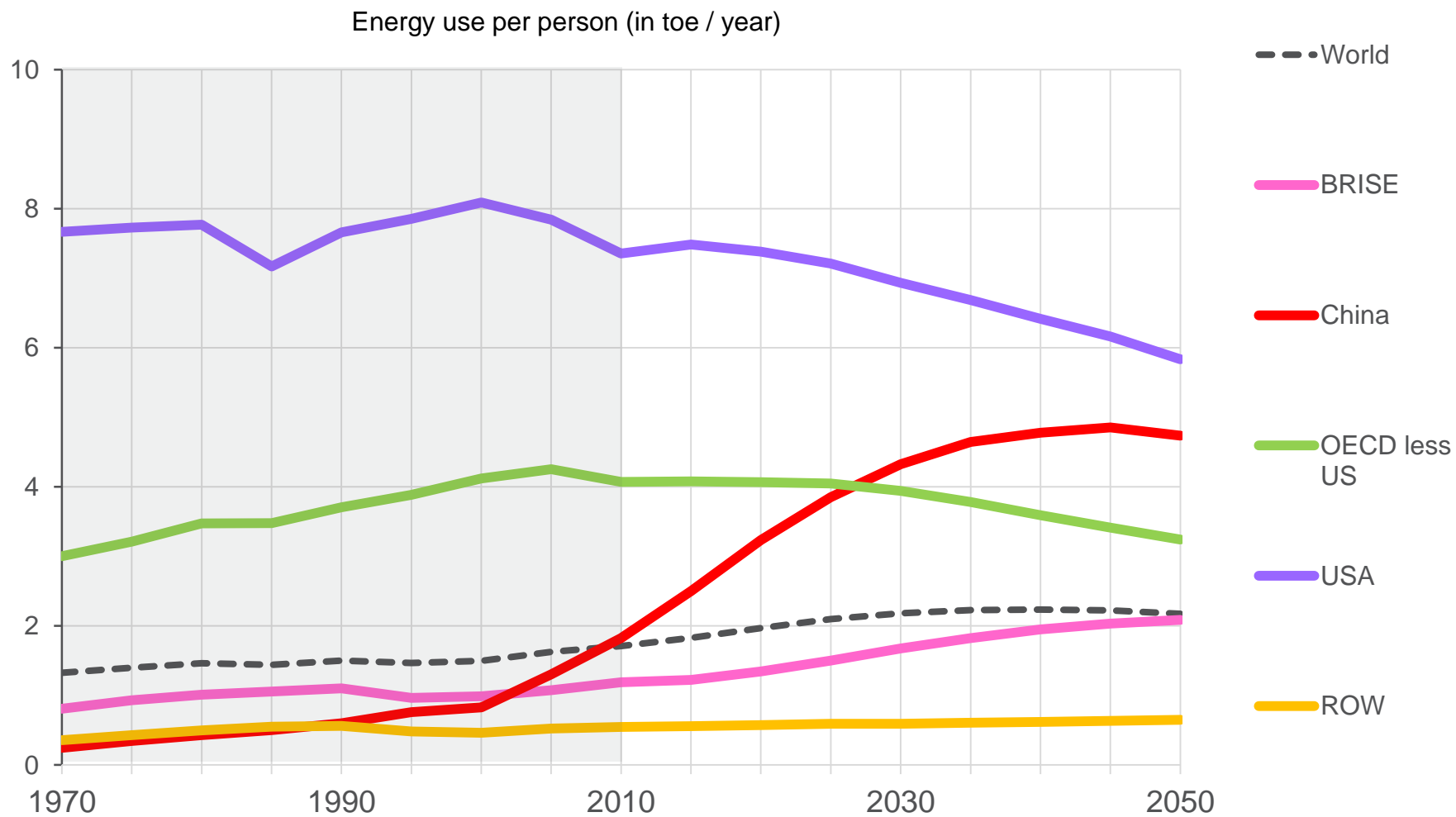
What should be done? - Ideally

1. Further slow population growth
Introduce 1-child policy – first in rich world
2. Cut CO2 emissions – first in the rich world
Ban the use of coal, oil and gas from 2026
3. Reduce poverty in the poor world
Give a climate-friendly energy system to the poor
4. Reduce the ecological footprint of the rich world
Legislate more compulsory vacation
5. Temper national short termism
Establish supra-national institutions
6. Reduce the focus on income growth
Establish “increased well-being” as the new goal

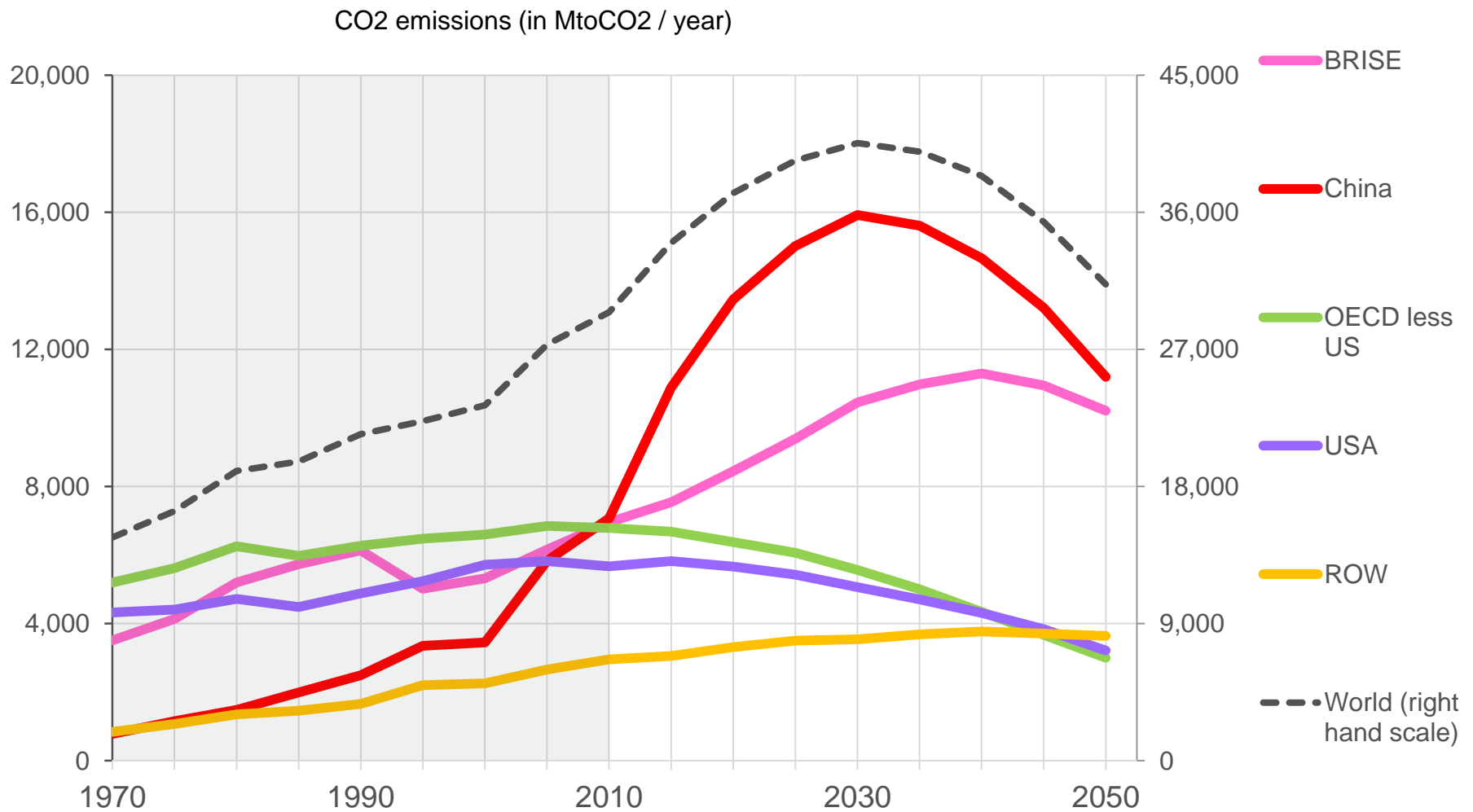
There will be huge regional differences



Energy use per person – 1970 to 2050



CO₂ emissions – 1970 to 2050



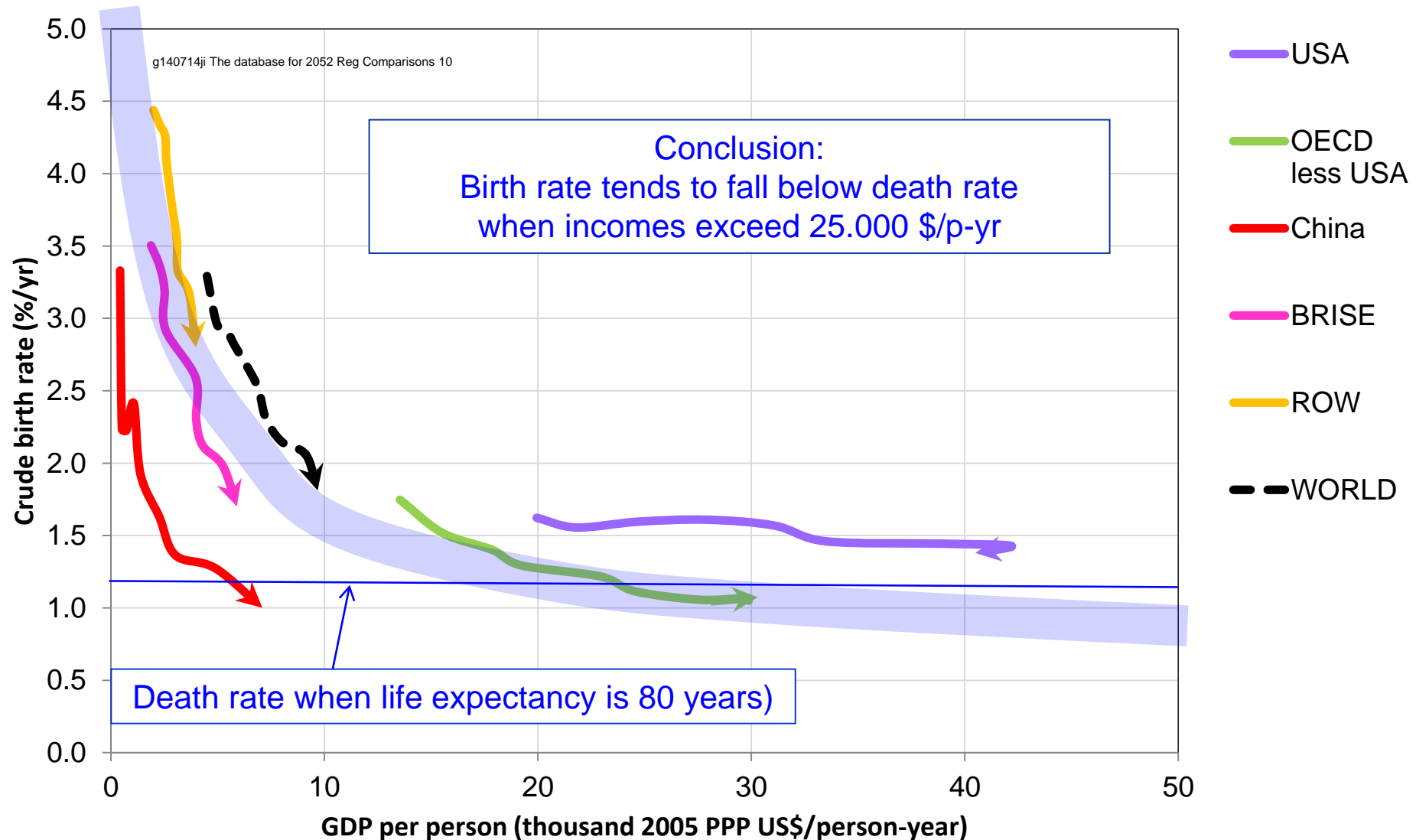
What can universities do?

- 1. Clarify the situation**
by studying the crucial assumptions that form the basis of any forecast to 2050 - through multi-disciplinary studies in a long-term perspective
- 2. Develop politically feasible solutions**
by identifying solutions that also provide a benefit to a majority of voters in the short term
- 3. Help save the world**
by accelerating the transformation of the global energy system – which will be of crucial importance

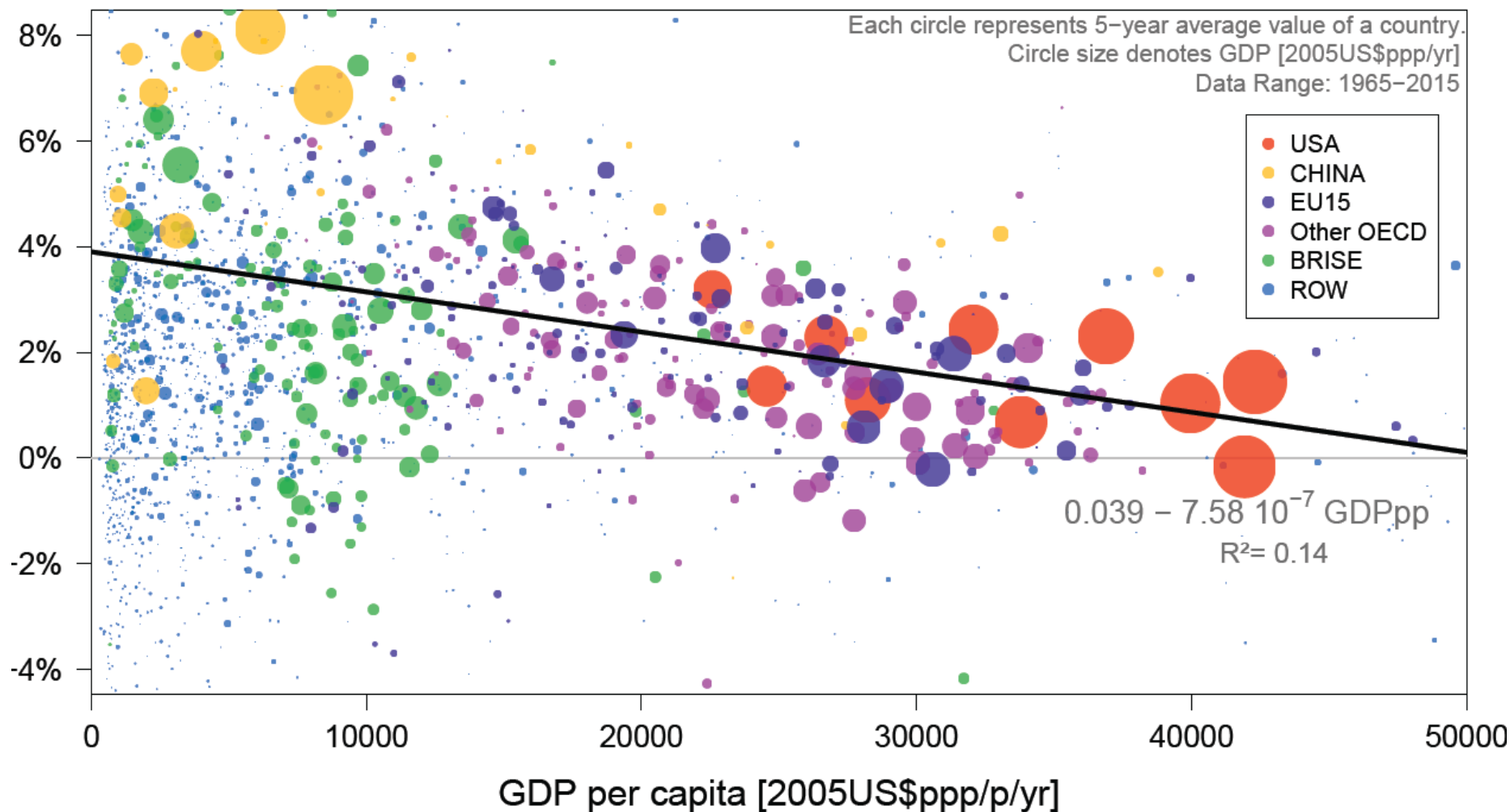
What are the critical assumptions?

- 1.** Average fertility will decline to 1,5 children per woman in 2050
- 2.** The rate of growth of GDP per person will decline to zero when economy exceeds 50.000 USD/person-year (in PPP 2005 dollars)
- 3.** The energy intensity (energy use per unit of GDP) will continue to decline at the traditional rate
- 4.** The CO2 intensity (CO2 emissions per unit of energy used) will continue to decline at the traditional rate
- 5.** Voters and the market will continue to be short term

Crude birth-rate versus GDP per person 1970 - 2010



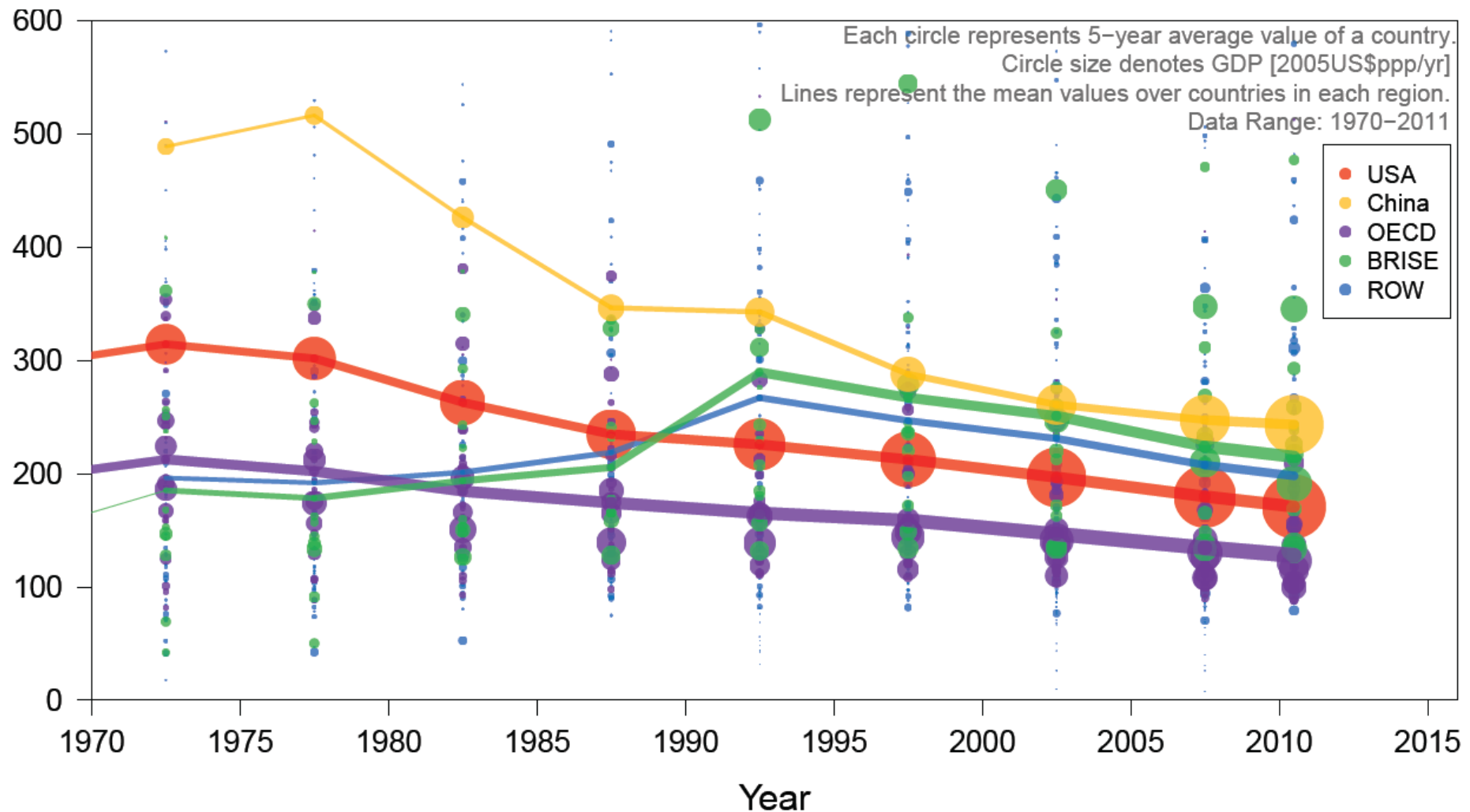
Growth rate in GDP per person (in % per year)



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Source: Gapminder

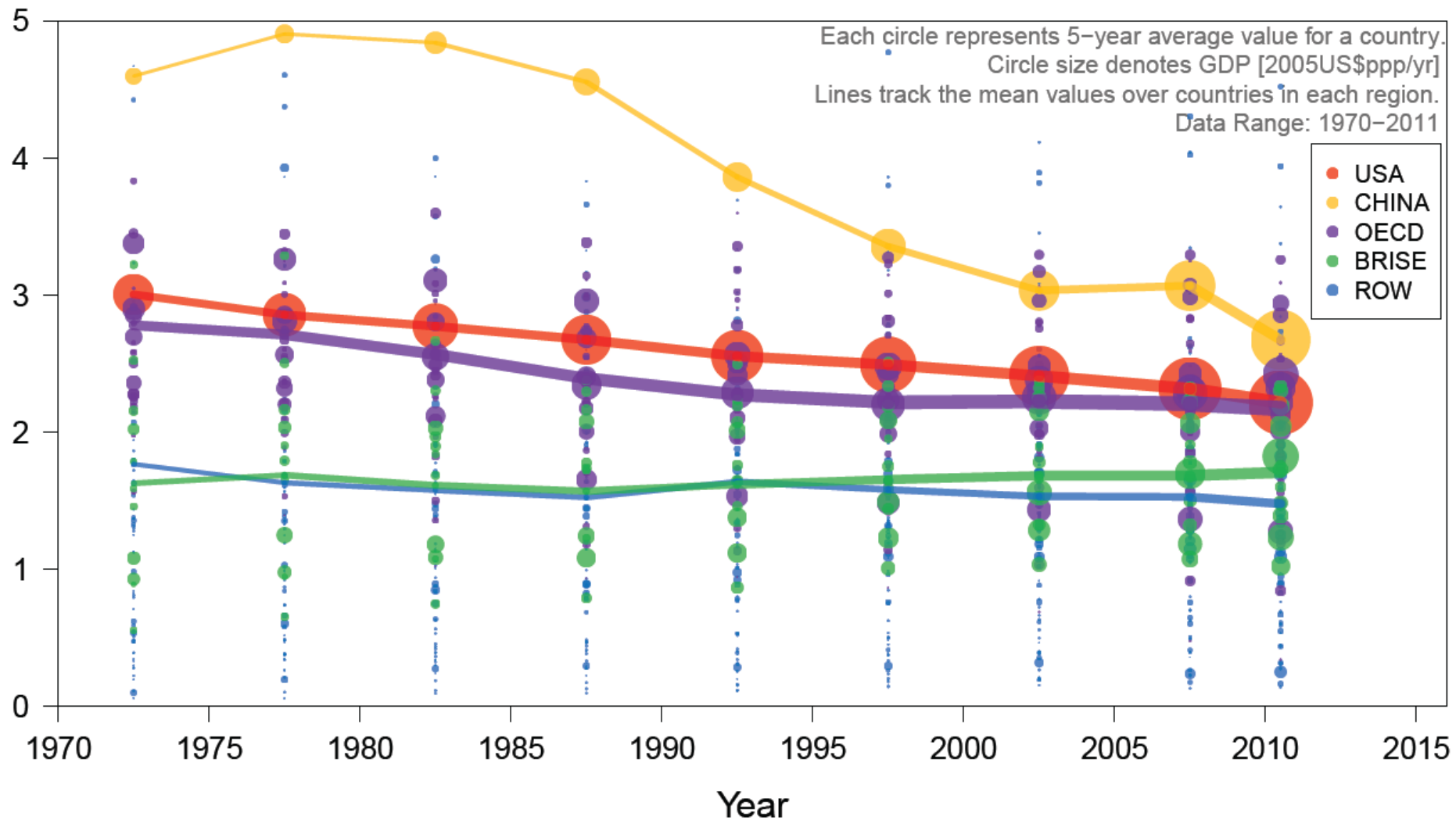
Energy per GDP (in tons of oil-equiv per mill \$ of GDP)



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Note: GDP is measured in 2005 PPP US dollars per year

CO2 per energy (in tons of CO2e per ton of oil equiv)



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Help society consider long-term effects



Local climate effects – e.g. melting tundra



Examples of important questions

1. Should we use gas in the transition to a renewable world?
2. How can one convince a majority to accept taxes on fossil energy?
3. How can we best give low-carbon technologies to the developing world?
4. Is there a role for CCS since it will be supported by the fossil industry and be needed after 2050 to suck CO₂ out of the atmosphere?
5. How can one make energy efficiency more sexy than new nuclear capacity?

We need an extra-ordinary solution. Soon!



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