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CLIMATE STRATEGY

# The Limits to Growth and a Global Forecast for the Next Forty Years

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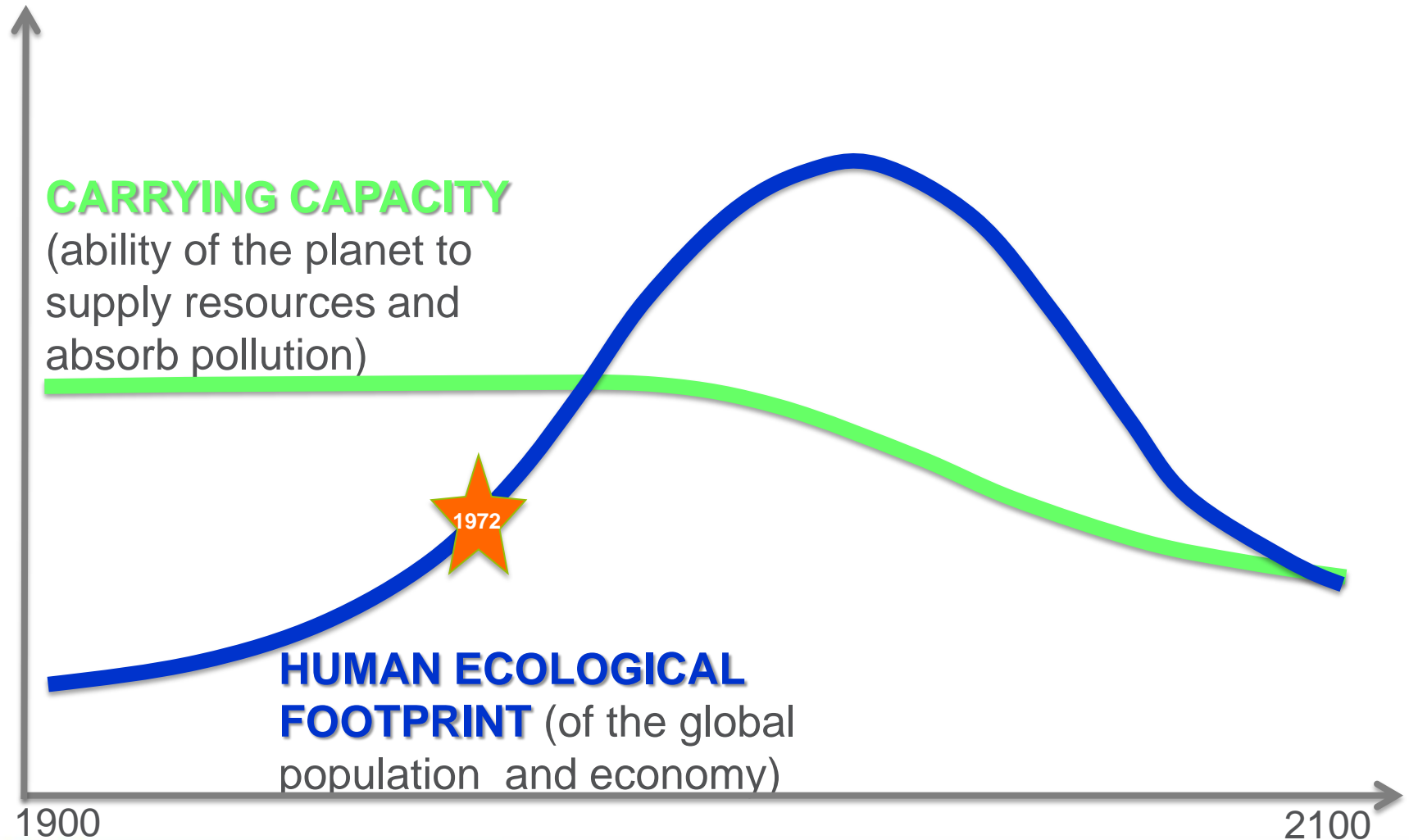
Brasilia

May 17<sup>th</sup>, 2012

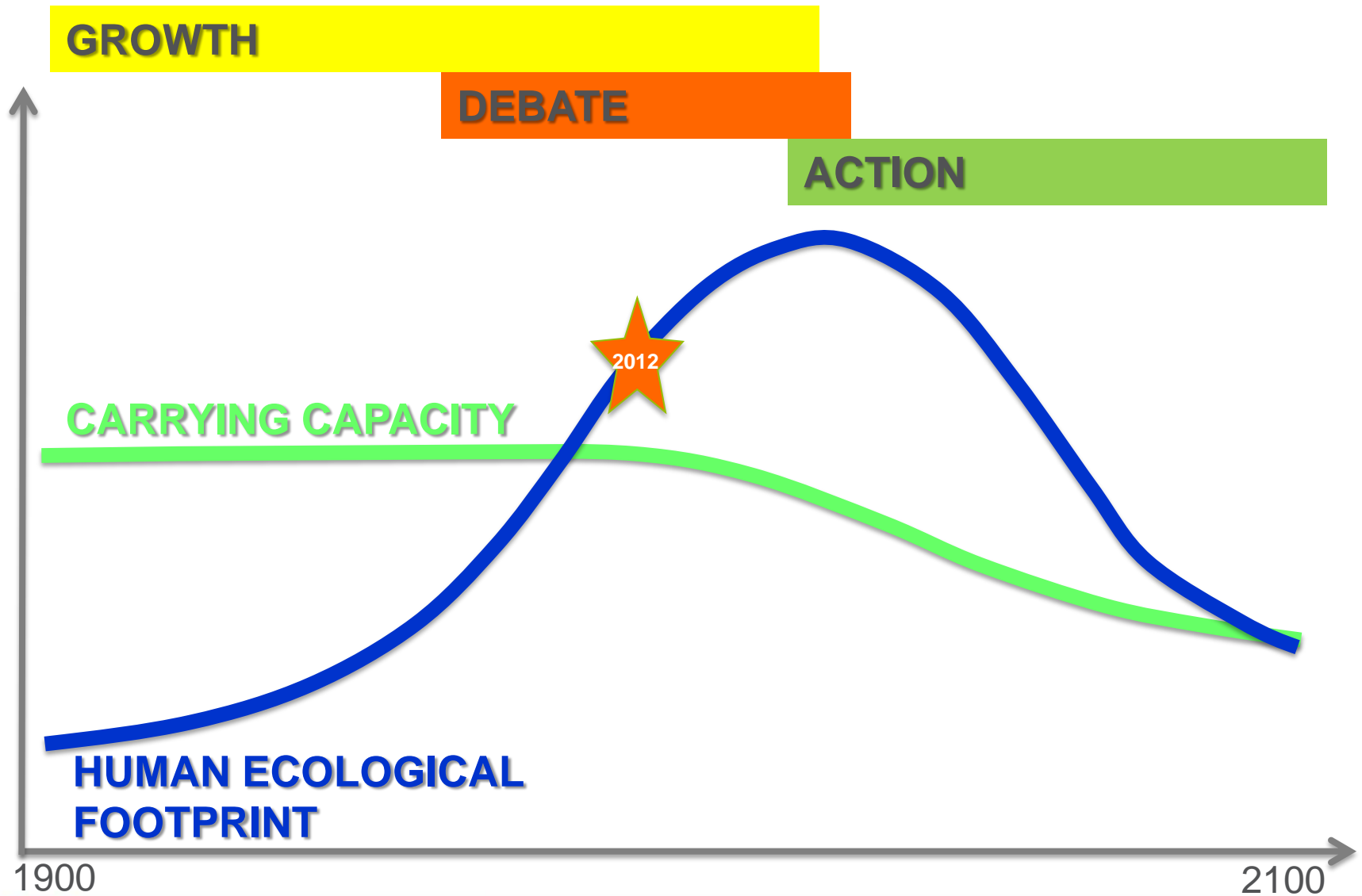
# My perspective: A small and fragile world



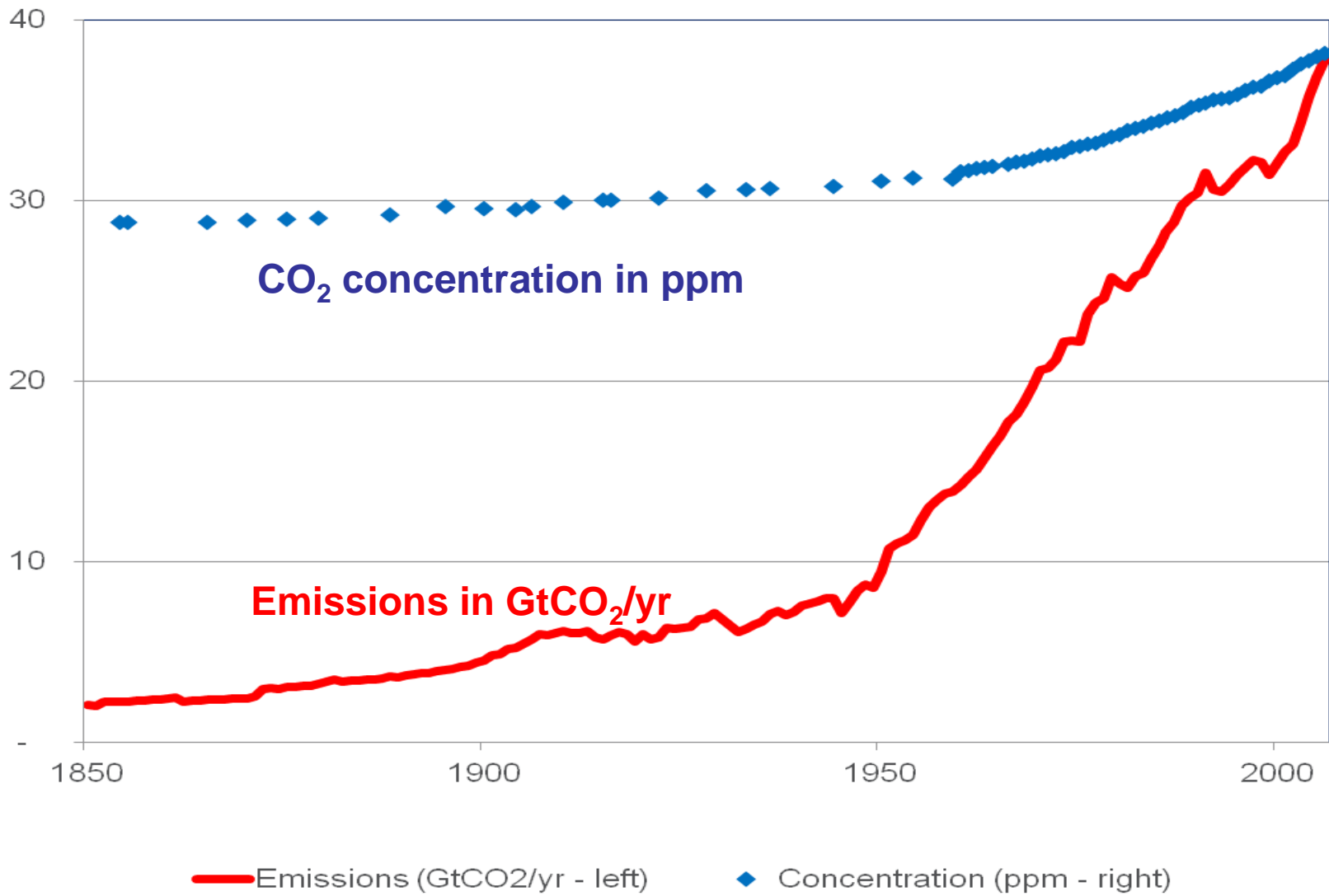
# The LTG warning: Overshoot and collapse



# Slow global response has allowed overshoot



# Human CO<sub>2</sub> emissions and its effect



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*

For all numerical data  
and the forecast model,  
consult  
the book website  
[www.2052.info](http://www.2052.info)

# 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
<b>Sum world</b>	<b>6,9</b>	<b>67</b>	<b>10</b>

(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

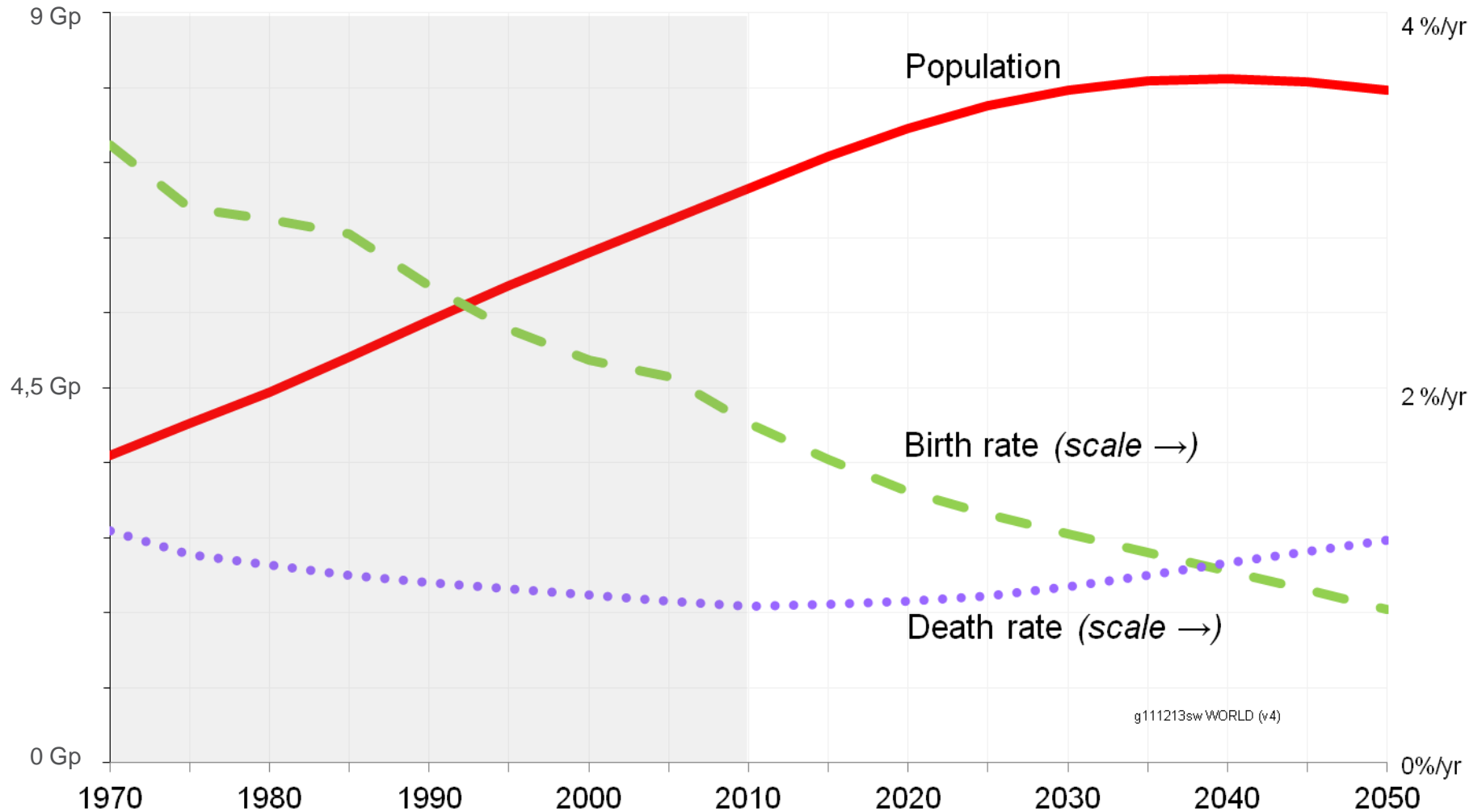


Figure 4-1 Population – World 1970 to 2050  
Scales: Population (0 – 9 billion people), Birth and death rate (0 – 4 % per year)



# Global GDP growth will slow down

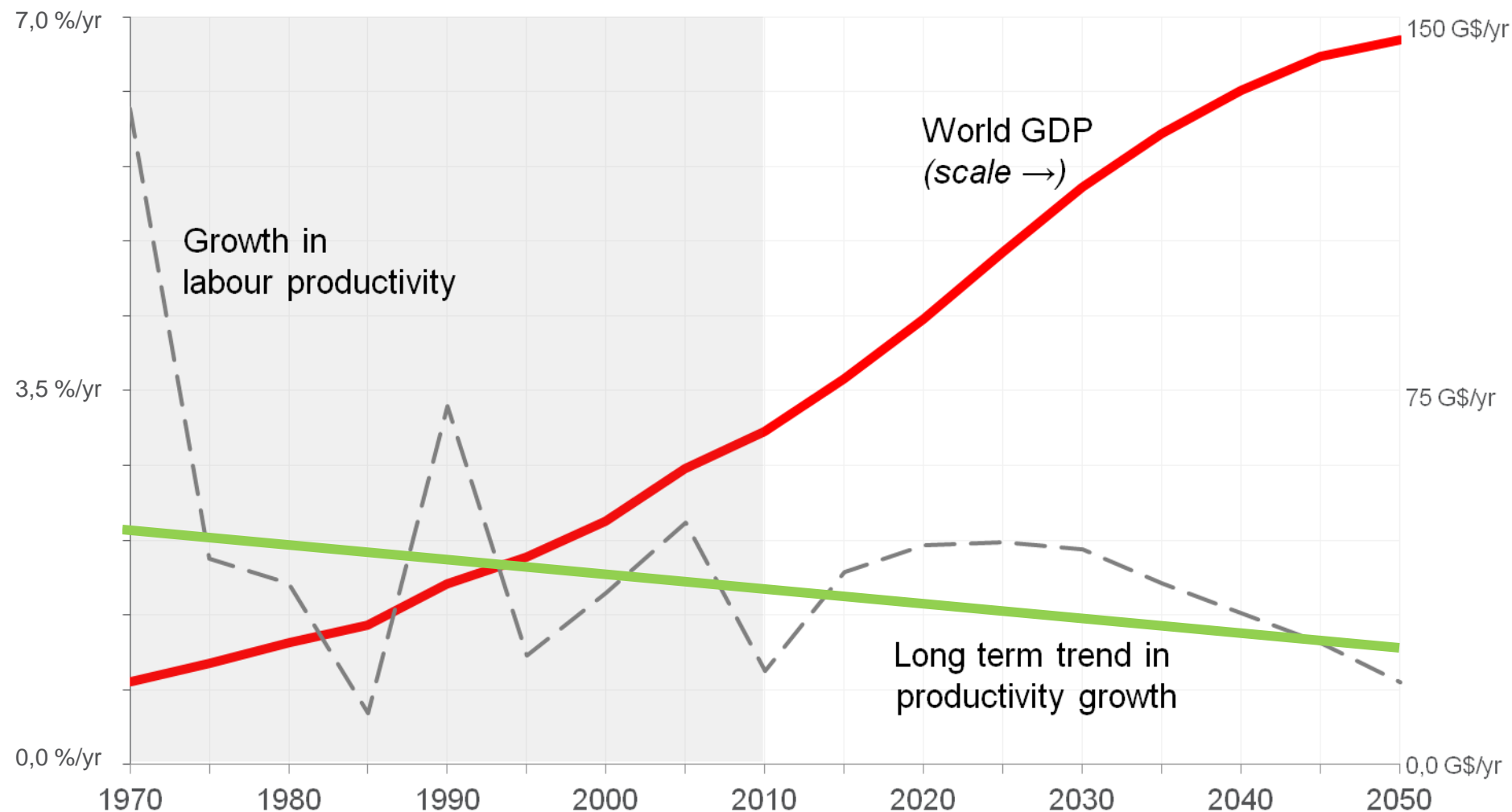


Figure 4-3a: GDP and Labour Productivity – World 1970 to 2050

Definition: Gross labour productivity = GDP divided by People aged 15 to 65 years

Scales: GDP (0 – 150 trillion \$ per year), Growth rate and trend in productivity (0 – 7 % per year)

# Energy use will peak in 2040

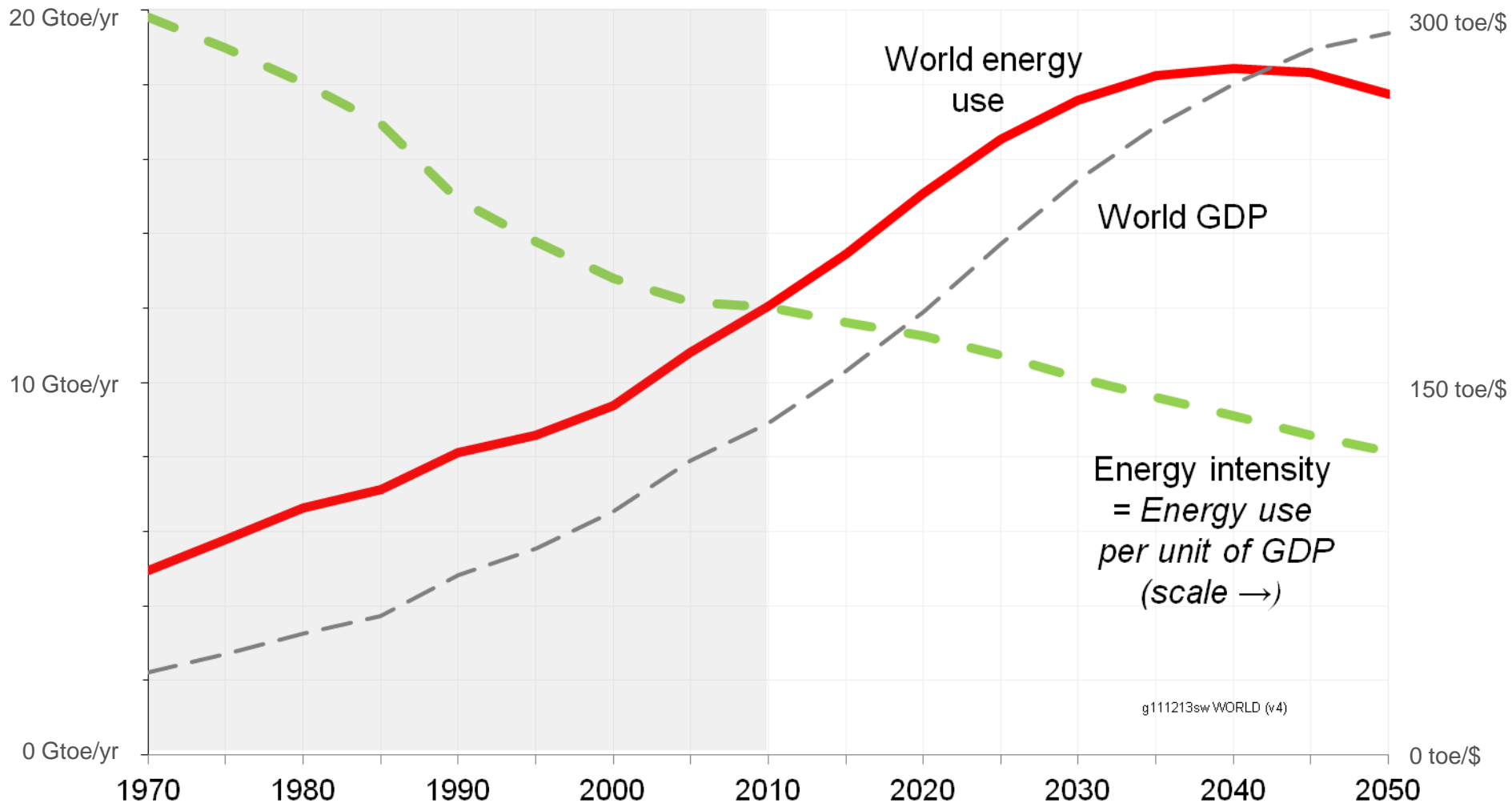


Figure 5-1: Energy Use – World 1970 to 2050

Scales: Energy use (0 – 20 billion tons of oil equivalents per yr), GDP (0 – 150 trillion \$ per year), Energy use per GDP (0 – 300 tons of oil equivalents per million \$)

# World CO<sub>2</sub> emissions will peak in 2030

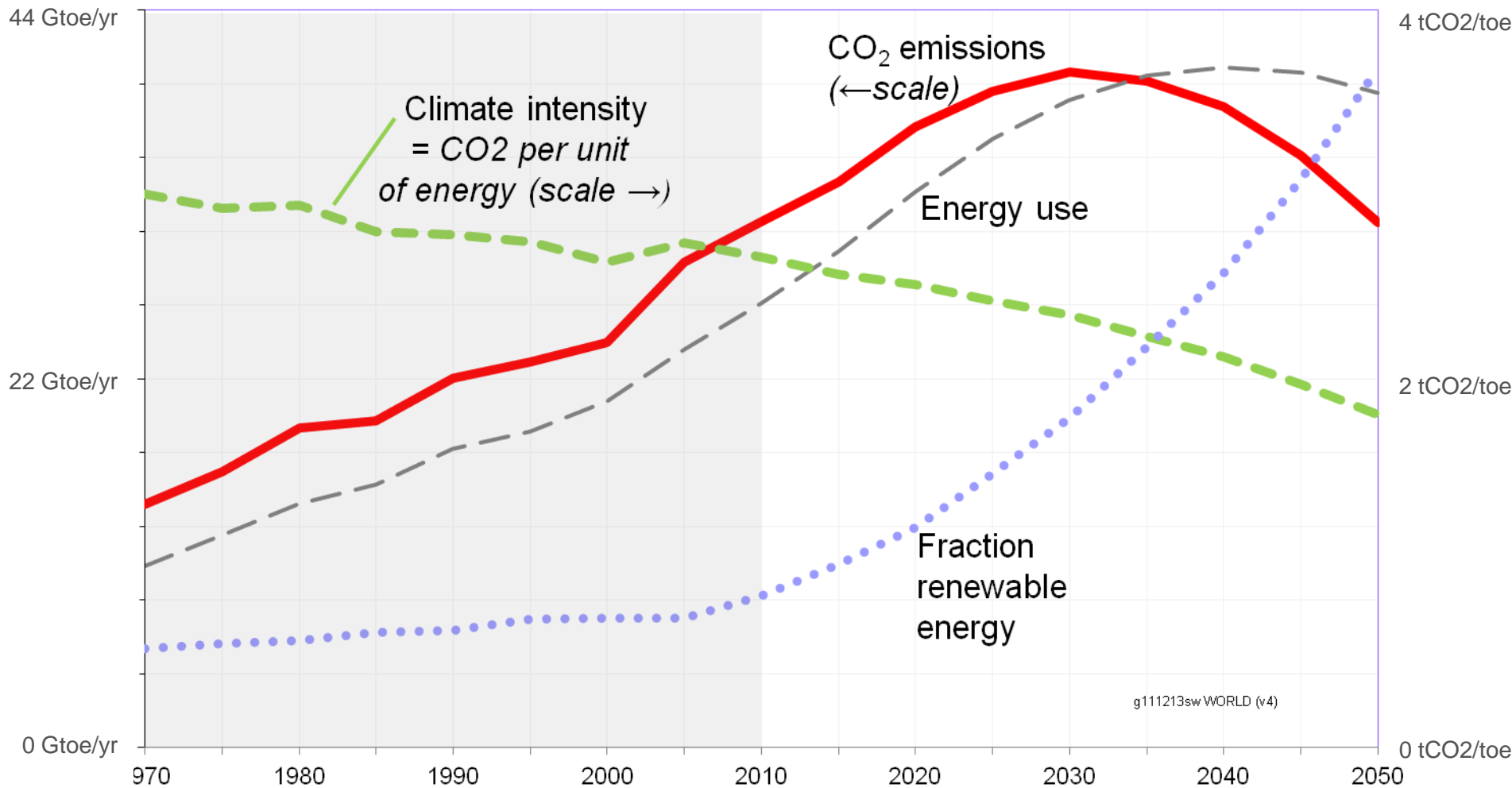


Figure 5-3: CO<sub>2</sub> Emissions from Energy Use – World 1970 to 2050.

Scales: CO<sub>2</sub> Emissions (0 – 45 billion tons of CO<sub>2</sub> per year), Energy use (0 – 20 billion tons of oil equivalents per year), Climate intensity (0 – 4 tons of CO<sub>2</sub> per ton oil equivalent), Fraction renewable energy (0 – 40 %)

# Temperature and sea-level will rise

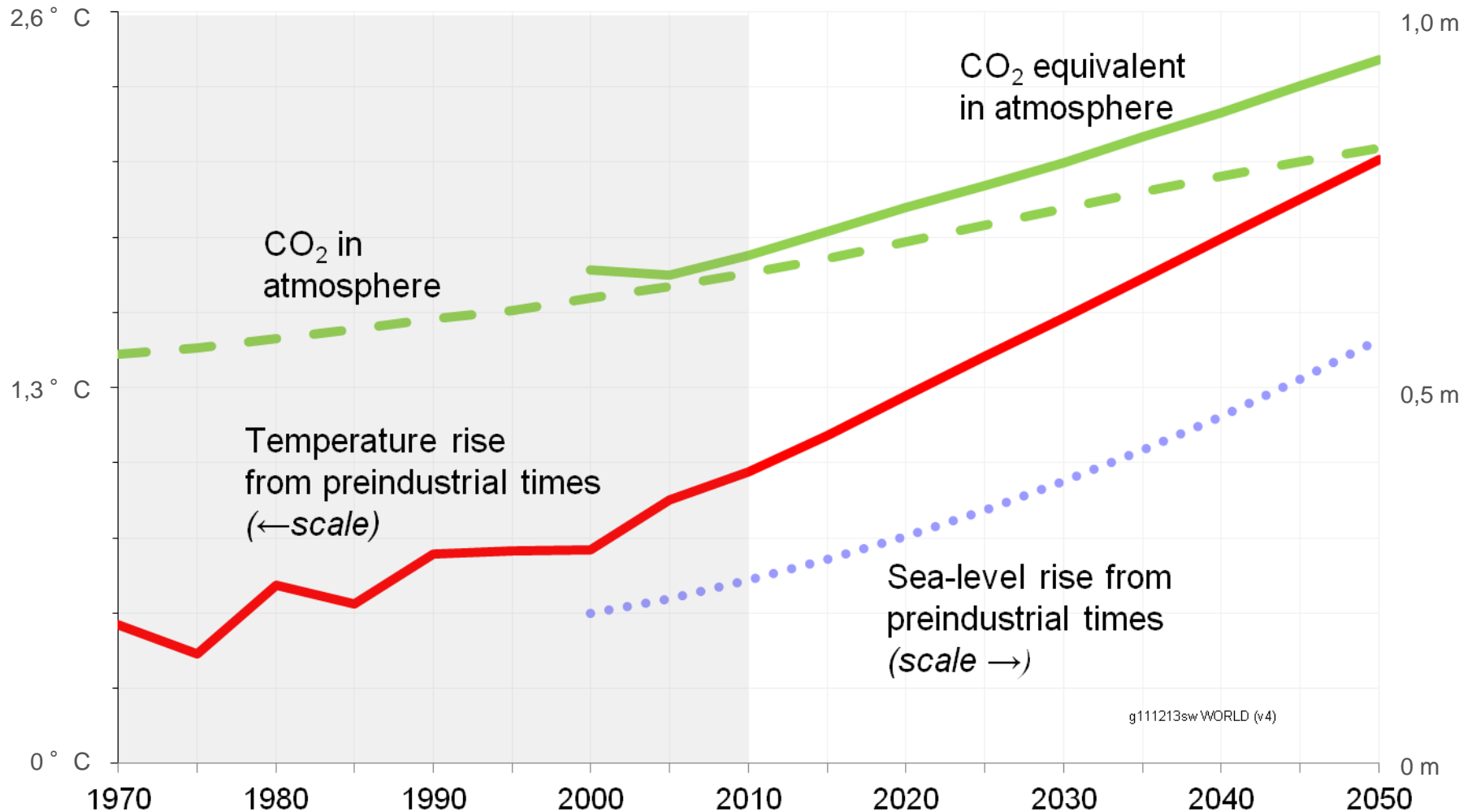


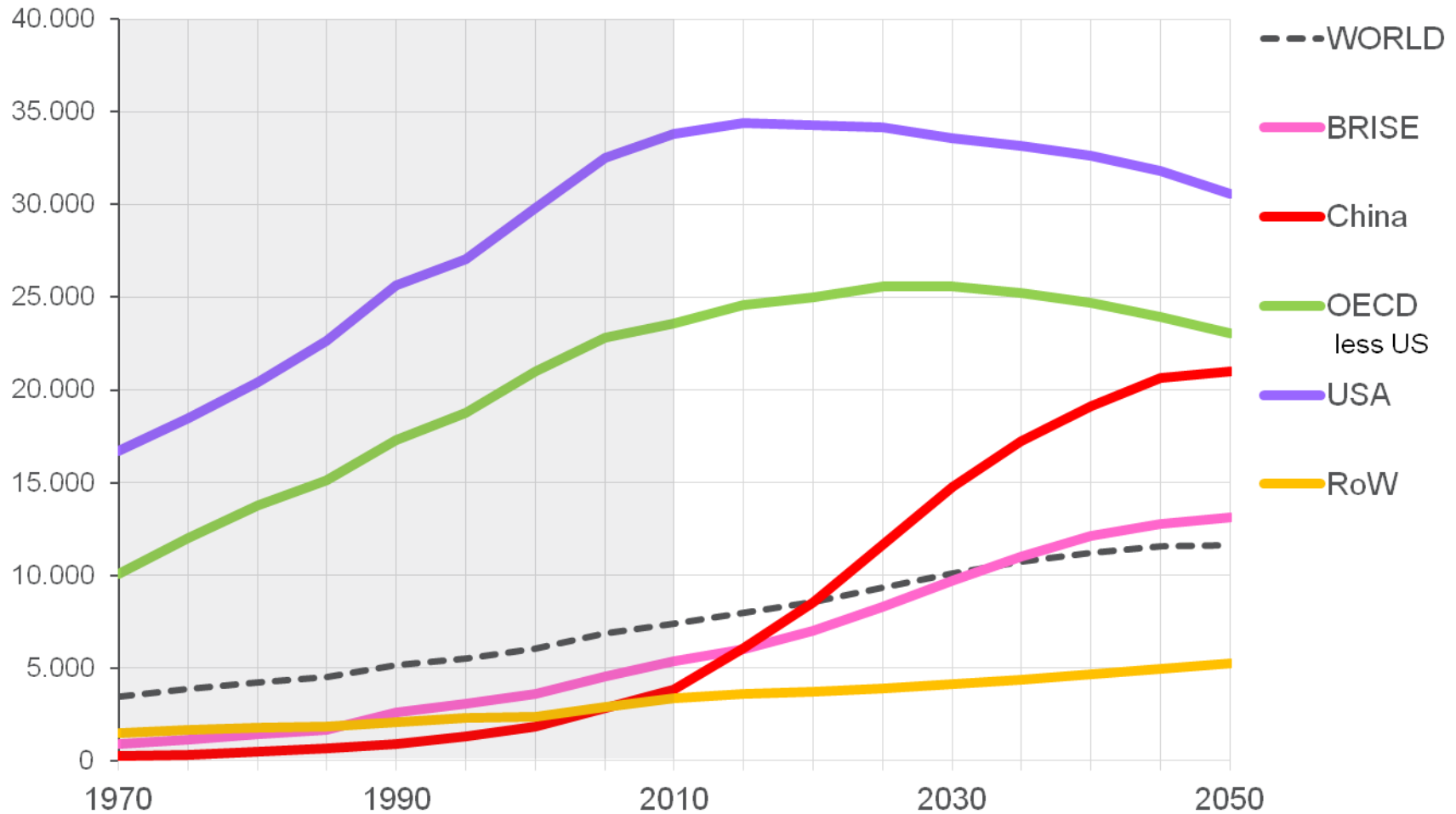
Figure 5-4: Climate Change – World 1970 to 2050

Scales: Temperature rise from preindustrial times (0 – 2.5 deg C), Sea level rise from preindustrial times (0 – 1 meter), CO<sub>2</sub> in atmosphere (0 – 600 ppm), CO<sub>2</sub> equivalent in atmosphere (0 – 600 ppme)

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# Average disposable income – 1970 to 2050

(in 2005 PPP \$ per person-year)



# Share of GDP in investment will grow

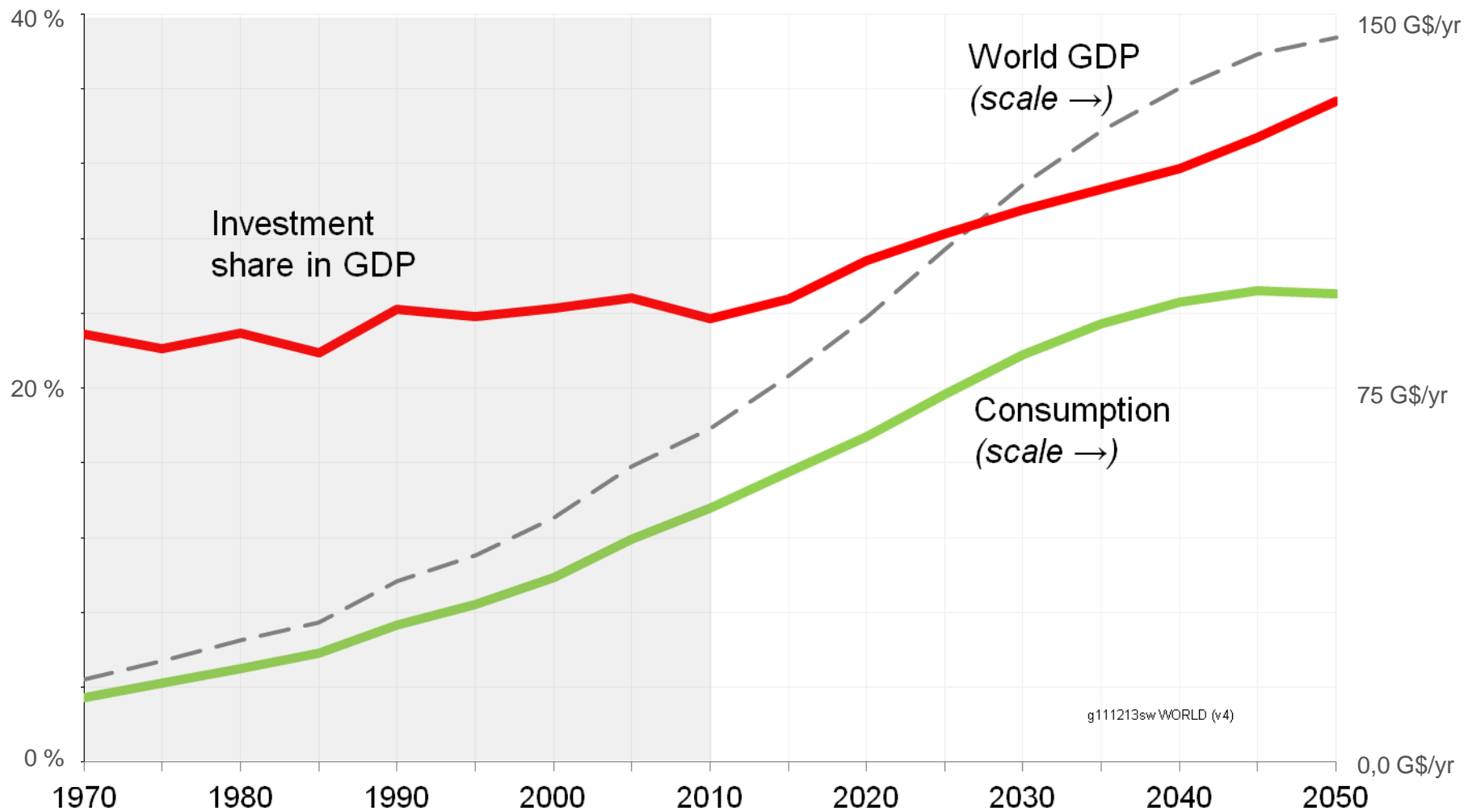


Figure 4-4: Production and Consumption – World 1970 to 2050  
Scales: Consumption and GDP (0 – 150 trillion \$ per year), Investment share (0 – 40 %)

# Democratic decision making takes time



# Fertility decline in EU-15 – 1950 to 2010

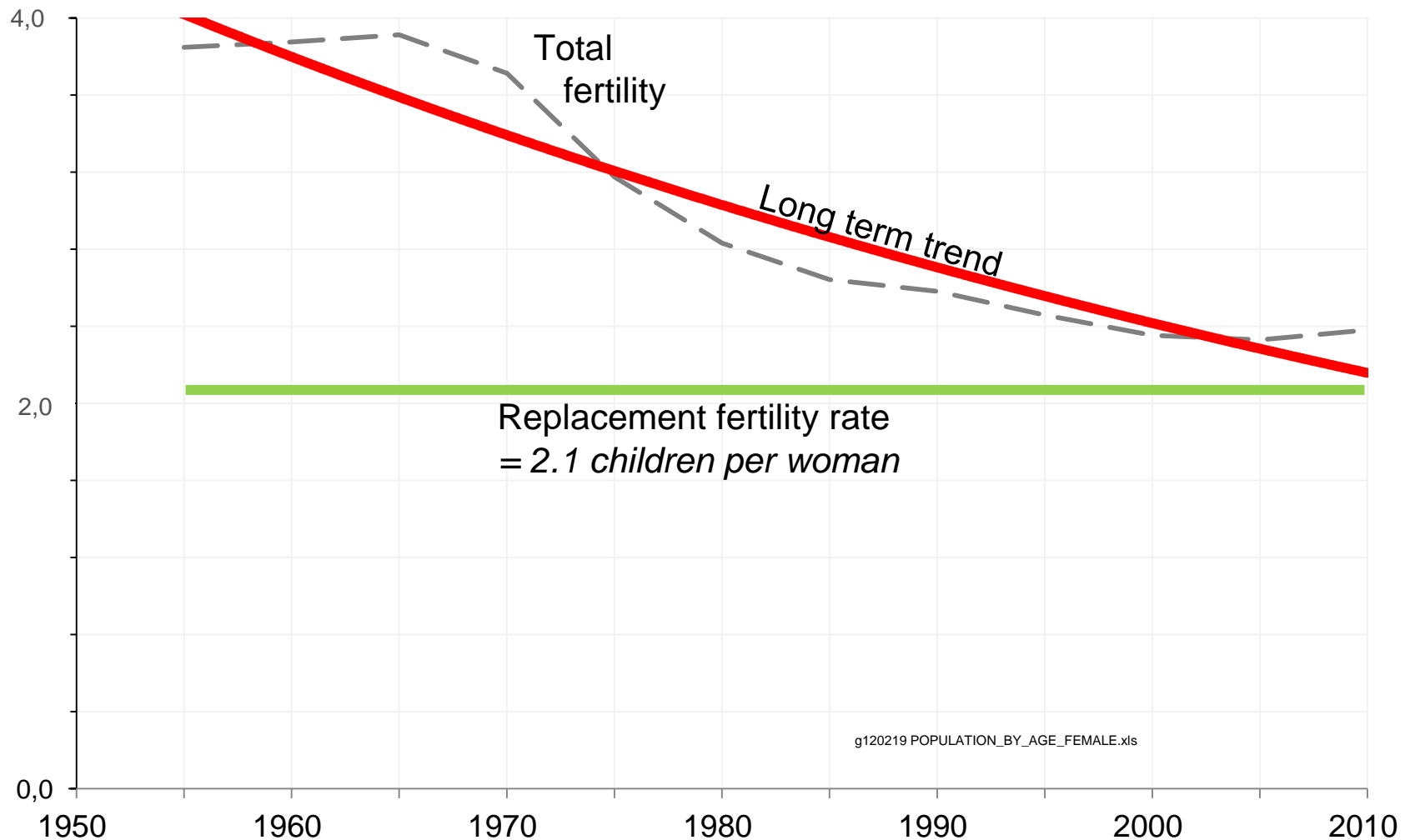


Figure A4-1 Total Fertility – EU15 1950 to 2010

Definition: Total fertility = Number of children born to each woman on average through her fertile life

Scales: Total fertility (0 – 4 children per woman)



# Slowing productivity growth, US 1950-2010

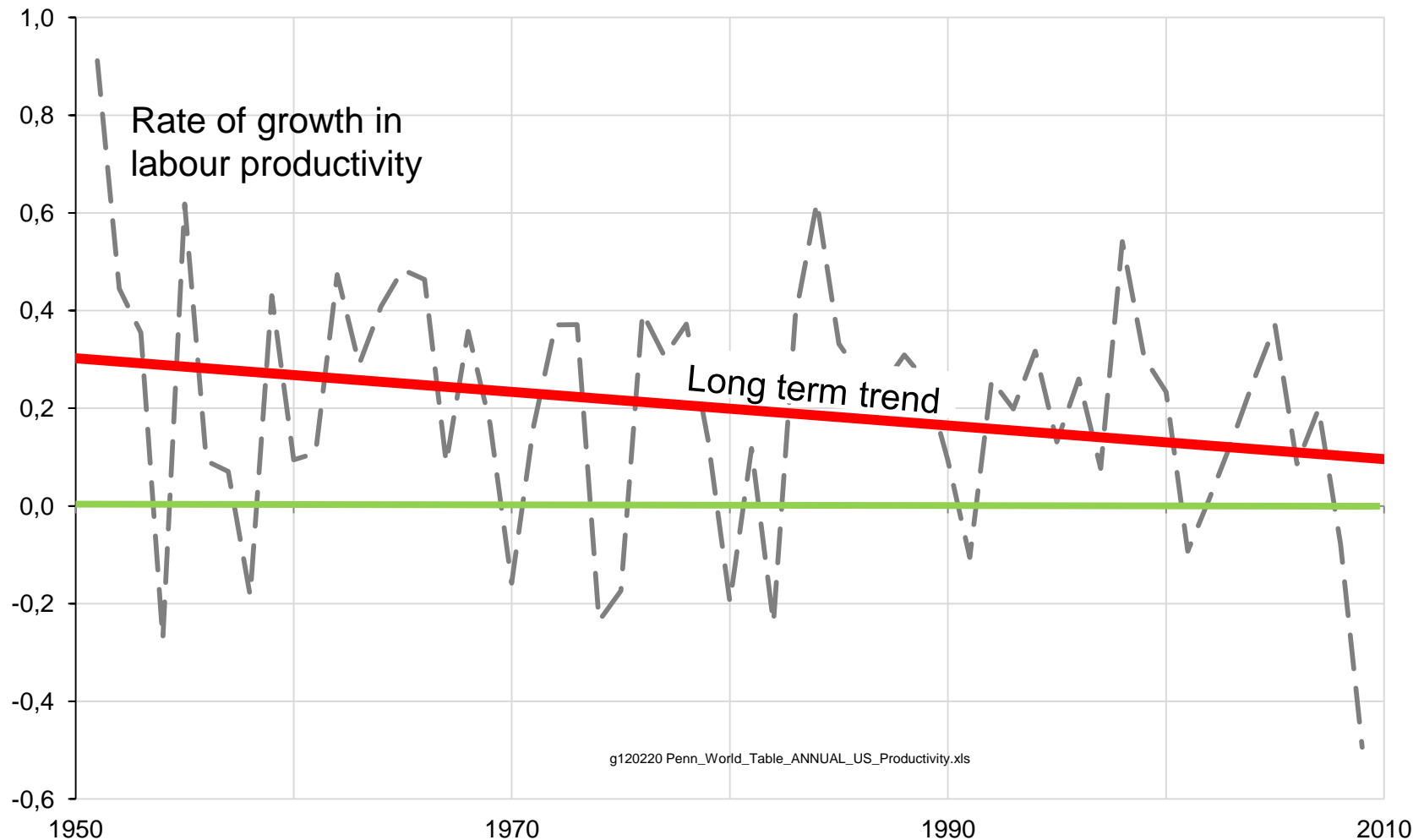


Figure A4-2 Change in gross labour productivity – US 1950 to 2010  
Definition: Labour productivity = GDP divided by People aged 15 to 65  
Scales: Change in labour productivity (-6.0 to 10.0 % per year); GDP (0 – 14 trillion \$)

# Food will satisfy demand – but not need

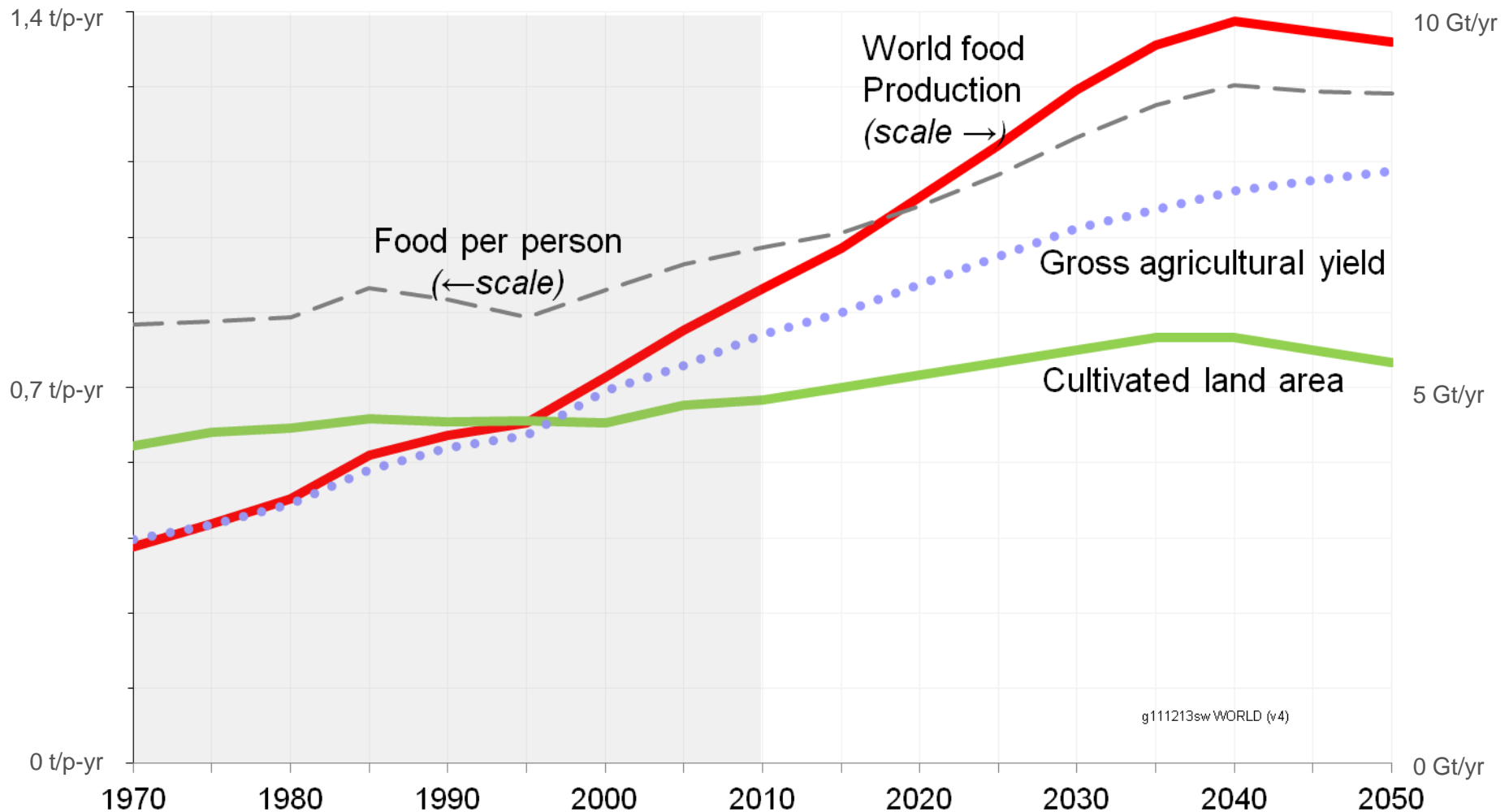


Figure 6-1: Food Production – World 1970 to 2050

Scales: Food production (0 – 10.5 billion tons per year), Cultivated land (0 – 3 billion hectares), Gross yield (0 – 8 tons per ha-year), Food per person (0 – 1.4 tons per person-year)

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# Fossil fuels will prevail

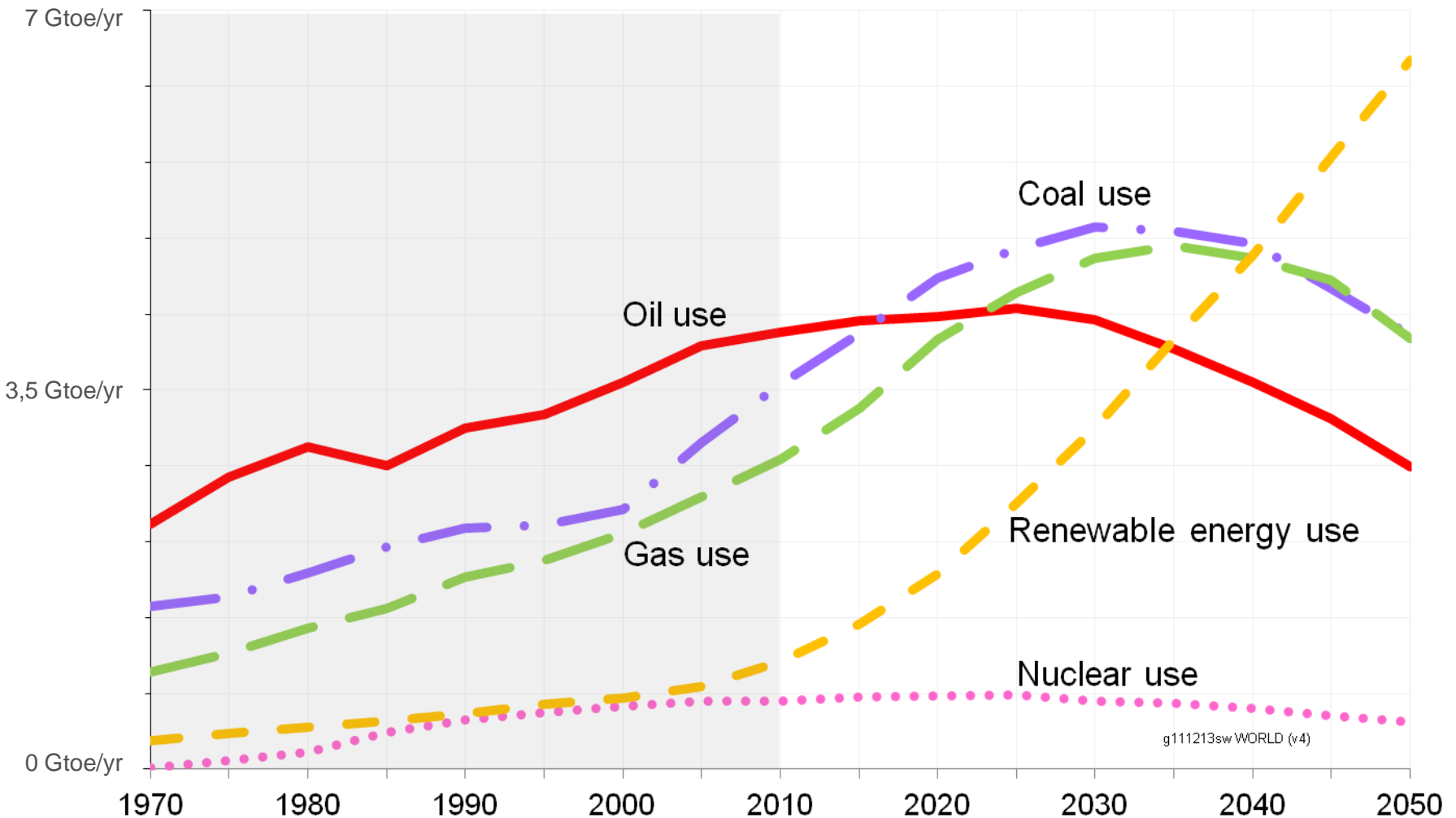


Figure 5-2: Energy Uses – World 1970 to 2050  
Scales: Energy uses (0 – 7 billion tons of oil equivalents per year)

# Unused biocapacity (“nature”) will plunge

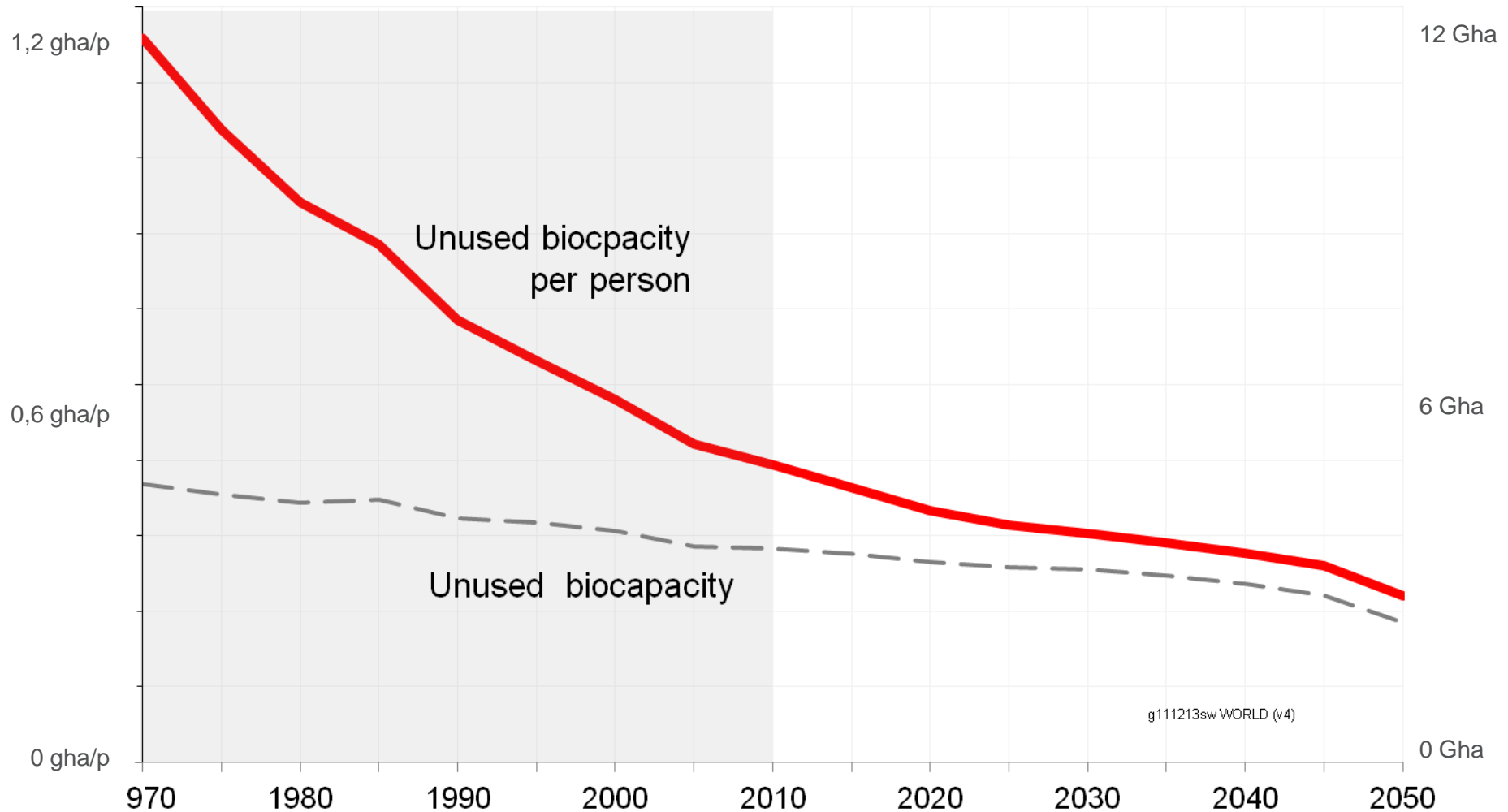


Figure 6-2: Biological Capacity – World 1970 to 2050  
Scales: Unused biocapacity (0 – 12.5 billion global hectares),  
Unused biocapacity per person (0 – 1.3 global hectare per person)

# What to do – improve global governance

To create a better world for our grandchildren:

- ◆ Strengthen the ability of the institutions of *capitalism and democracy* to include long term effects when making decisions
- ◆ Increase the *willingness of the voter* to support solutions with beneficial long term effects
- ◆ Promote *supranational governance*, to counter national short-termism
- ◆ In short: gain some *societal control over investment flows* so they are guided by need, not only by profitability

# What to do – reduce human footprint

## To create a better world for our grandchildren

- ◆ Have fewer children, especially in the rich world
- ◆ Reduce the ecological footprint, first by reducing the use of coal, oil and gas
- ◆ Construct a low-carbon energy system in the poor world, paid for by the rich
- ◆ Create global institutions that can act fast

**This is simpler if there is full employment and limited income disparity**

# What to do - the Brazil case

- ◆ Be a world leader in forest protection
- ◆ Ensure the sustainability of Brazilian agriculture
- ◆ Push sugar-cane bio-ethanol
- ◆ Promote a new architecture for global climate gas reductions  
(Commit to cut when Brazil CO<sub>2</sub>/person-yr exceeds rich world CO<sub>2</sub>/person-yr, and convince G70 to do the same.)

# I don't like what I see!





# World state of affairs – 1970 to 2050

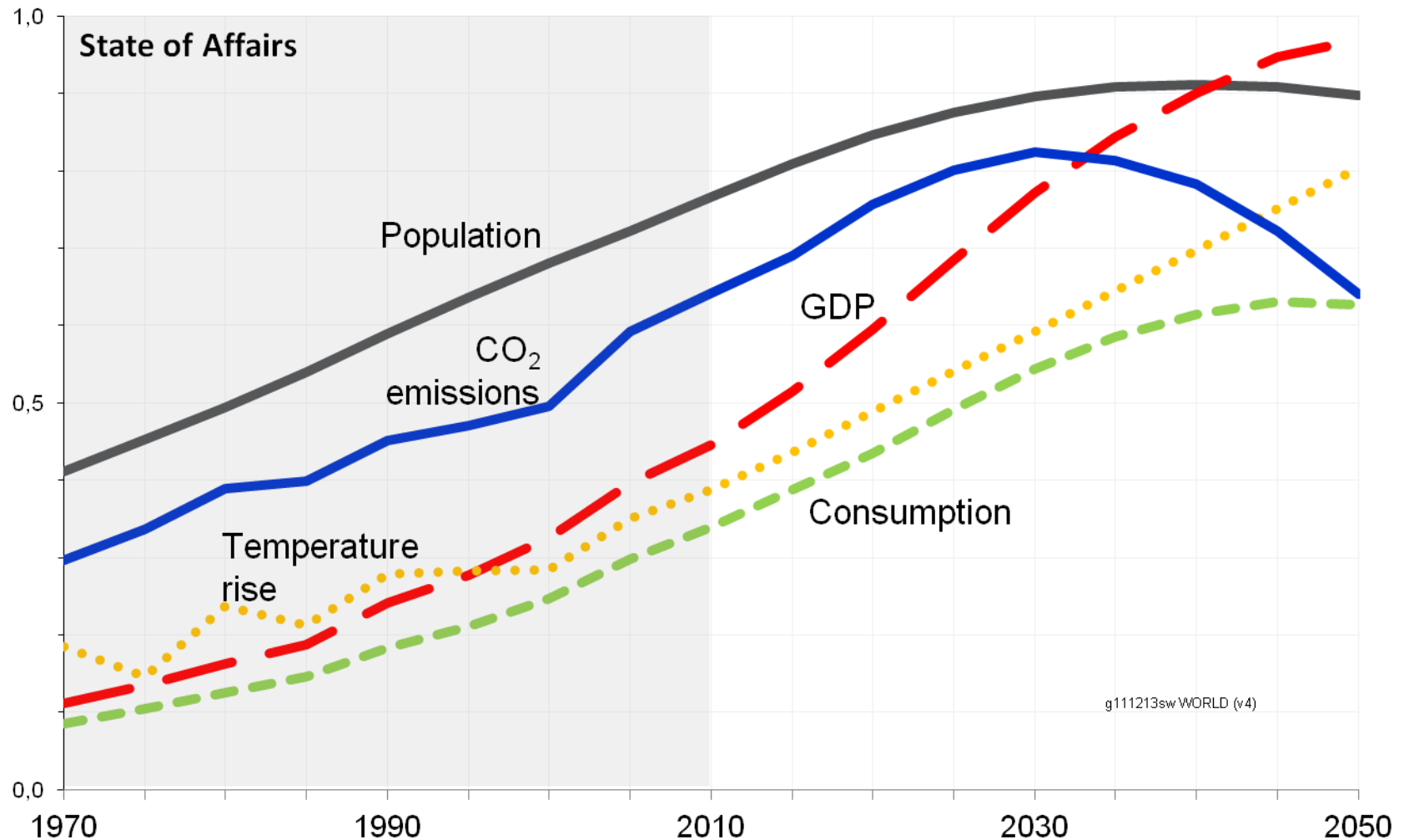


Figure 9-1a: Past and future World - State of Affairs -1970 to 2050

Scales: Population (0 – 9 billion people), GDP and Consumption (0 – 150 trillion \$ per year), CO<sub>2</sub> Emissions (0 – 50 billion tons CO<sub>2</sub> per year), Temperature rise (0 – 2.5 ° C)

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# BRISE state of affairs – 1970 to 2050

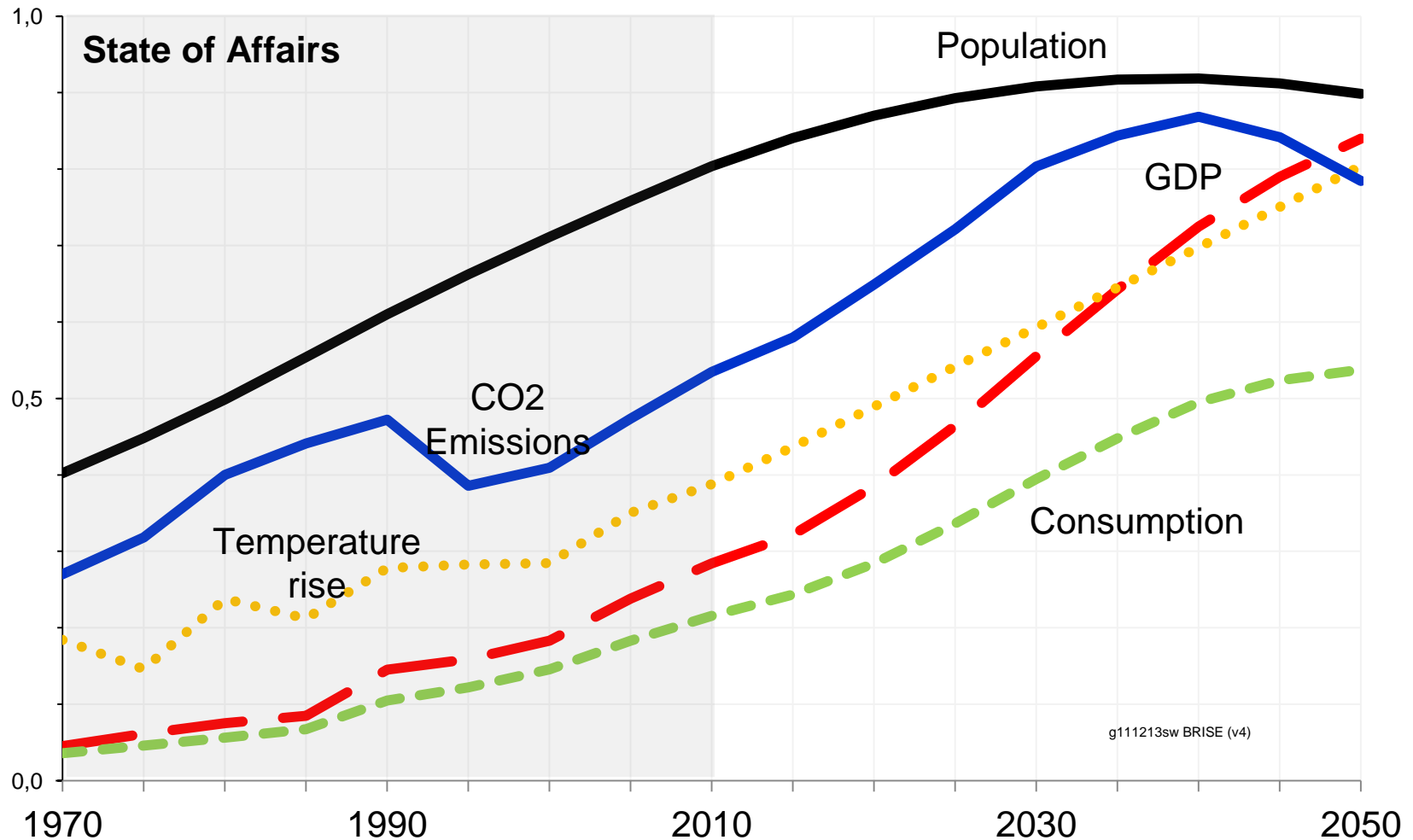


Figure 10-4a: Past and future BRISE – State of Affairs – 1970 to 2050

Scales: Population (0 – 3 billion people), GDP and Consumption (0 – 50 trillion \$ per yr), CO2 Emissions (0 – 13 billion tons CO<sub>2</sub> per yr), Temperature rise (0 – 2.5 ° C)

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