Carbon and Environmental Footprints in a Global Perspective

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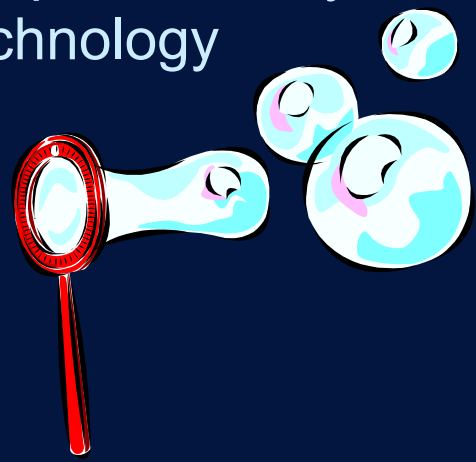
ENVIRONMENTAL FOOTPRINTING – THE BASICS

- Environmental footprints are very topical at the moment
- Environmental footprinting is a way of illustrating humanity's impact on the earth
- They are a simple, yet graphic measure of the resources consumed and the wastes produced by a given population under prevailing technology
- The 'Bubble Concept'



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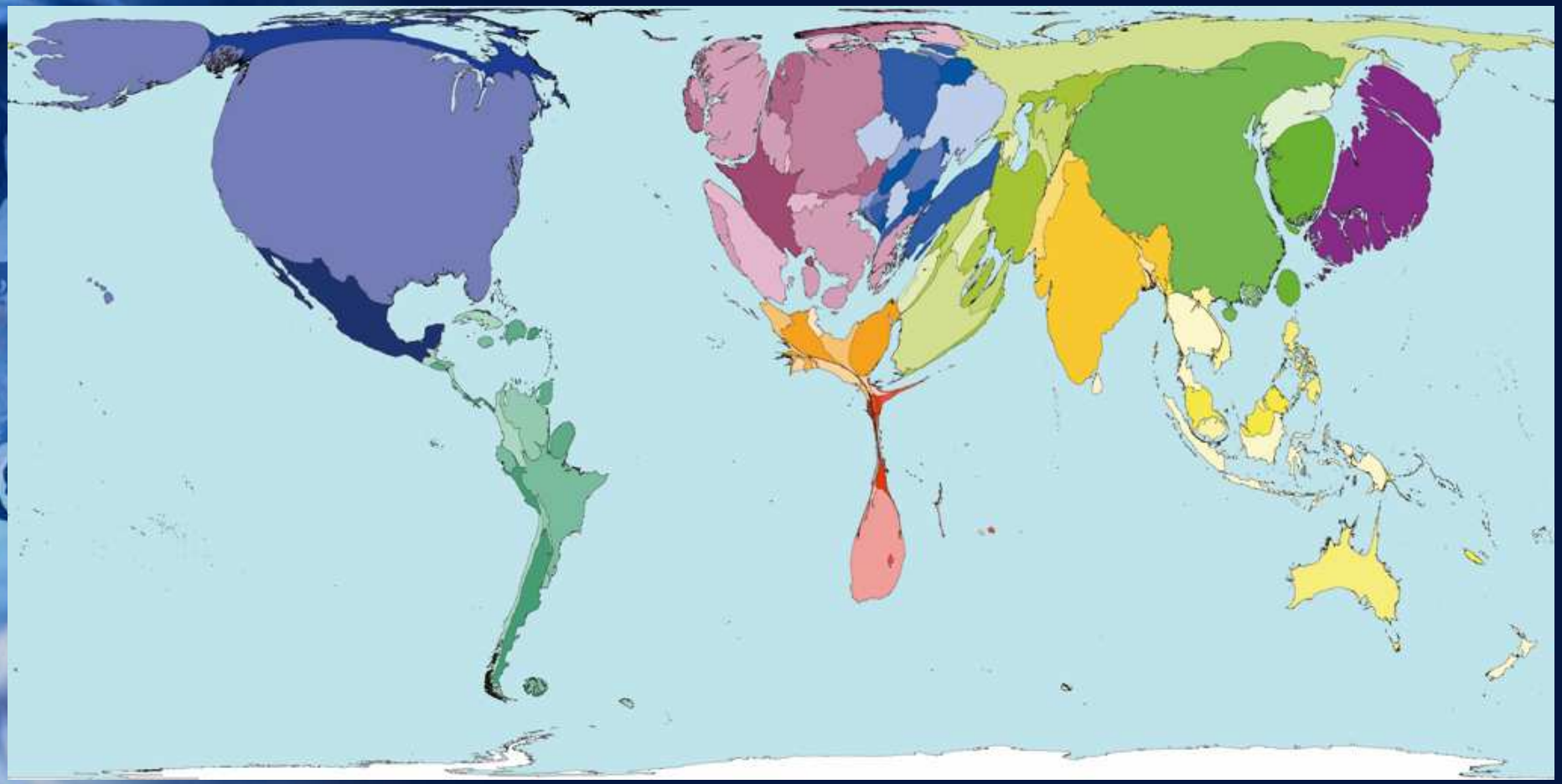
Source: Global Footprint Network

THE IMPORTANCE OF ENVIRONMENTAL FOOTPRINTING

- Environmental footprinting has become a popular tool and is often referred to in the media
- Widespread use in education, awareness campaigns, and in public policy development
- Footprinting has been accused of being nothing more than an attention grabbing tool

VARIATION OF NATIONAL ENVIRONMENTAL FOOTPRINTS



Source: WorldMapper

Carbon Dioxide emissions in 2000

ENVIRONMENTAL FOOTPRINTS OF NATIONS

- Environmental footprints vary between countries at different stages of economic development and geographic characteristics
- Hammond (2006) investigated the relative significance of population density, economic wealth, energy intensity and pollutant emission intensity for 1999 – 2000
- The present study re-examines the issues using a much wider range of possible determinants for 2003
- Dimensional analysis techniques were used to evaluate the determinants of the WWF national footprints

DETERMINANTS OF ENVIRONMENTAL FOOTPRINTS

National Environmental Footprints (*ef*) [gha] as a function of

- Economic growth (GNI) [per capita $]
- Population density (PD) [people per hectare]
- Energy Intensity (EI) [MJ/$]
- Carbon Emissions Ratio (CR) [μg C/J]
- Temperature Ratio (Temp R) [-]
- Precipitation Ratio (PR) [-]
- Yield Ratio (YR) [-]
- Technology Ratio (Tech R) [-]
- Soil Fertility Ratio (SF) [-]
- Terrain Ratio (Terr) [-]
- Latitude (L) [º]
- Fertiliser Ratio (FR) [-]
- Irrigation Ratio (IR) [-]

CORRELATING NATIONAL FOOTPRINTS 1

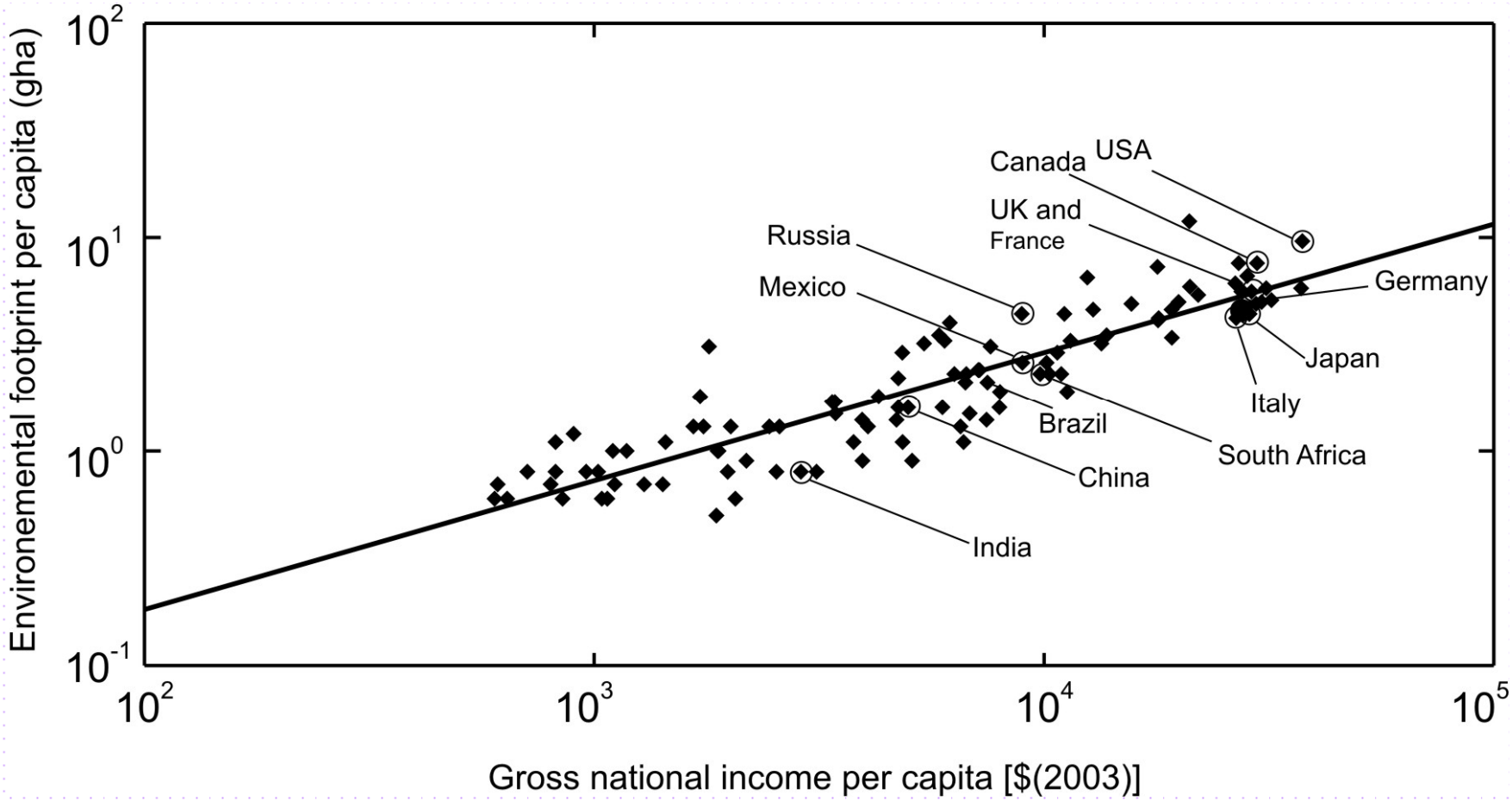
- A ‘power-law’ correlating equation allowed analysis of each determinant

$$ef = \text{constant} \{(GNI)^a (PD)^b (EI)^c (CR)^d (\text{Temp } R)^e (PR)^f (YR)^g (\text{Tech } R)^h (SF)^i (\text{Terr})^j (L)^k (FR)^l (IR)^m\}$$

- Each parameter was plotted against *per capita* environmental footprint to determine the strongest power-law dependency

- Economic wealth was the dominant factor

$$ef = 0.0093\ GNI^{2/3}\ PD^{-1/10}$$


Environemental footprint per capita (gha)
10^2
10^1
10^0
10^{-1}
10^2
10^3
10^4
10^5
Gross national income per capita [$(2003)]
Canada
USA
UK and France
Russia
Mexico
Germany
Japan
Italy
Brazil
South Africa
China
India

CORRELATING NATIONAL FOOTPRINTS 2

- Focused on G8+5 nations
- The scatter associated with the data is acceptable
  - Broad spread of countries
  - Uncertainty associated with international datasets
  - Quality and comparability of data from developing countries
- Factors which displayed close dependence (cross correlation) upon economic welfare were eliminated
- This avoided double accounting for the effects of economic wealth

FACTORS HAVING LITTLE INFLUENCE 1

- Many other determinants had little impact upon national environmental footprints
- National environmental footprints are
  - Strongly dependent on economic prosperity
  - Weakly dependent on population density

$$ef = 0.0093\ GNI^{2/3}\ PD^{-1/10}$$

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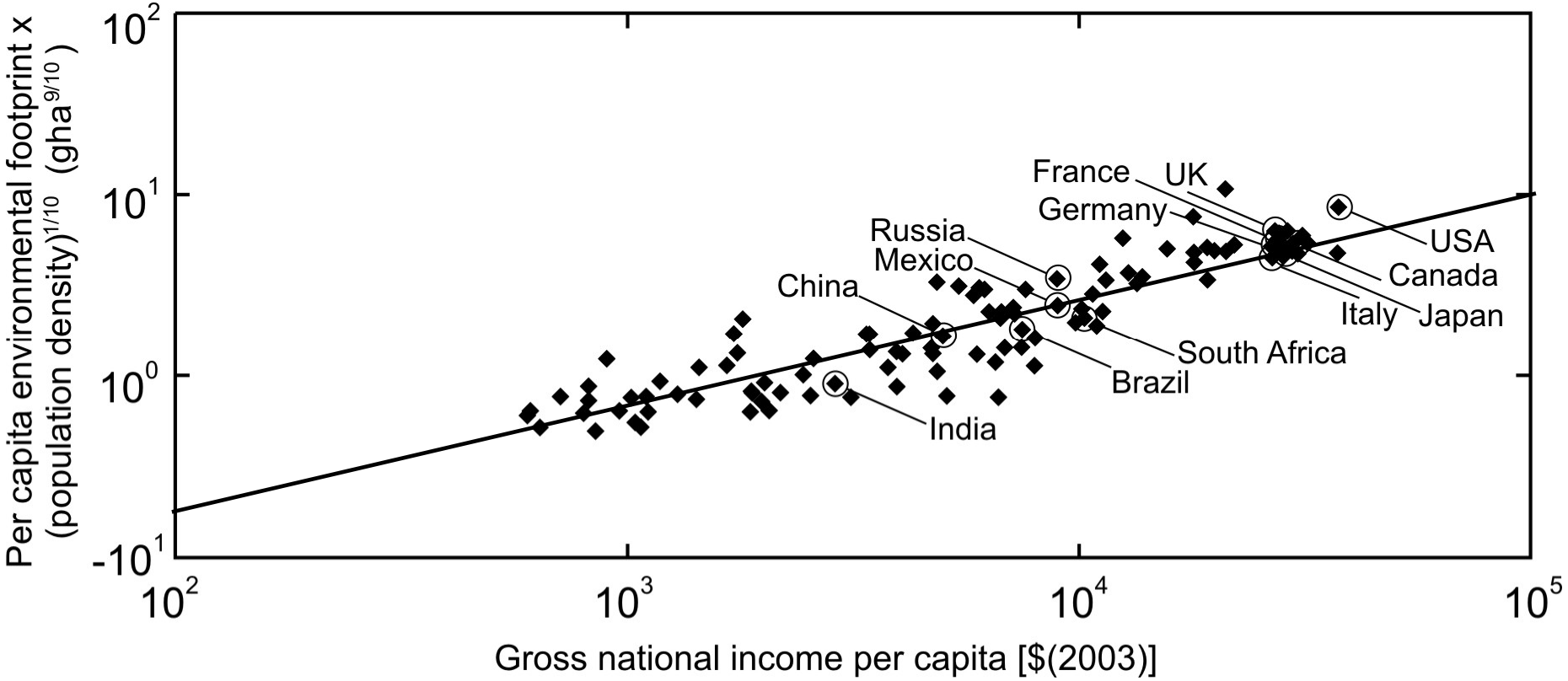
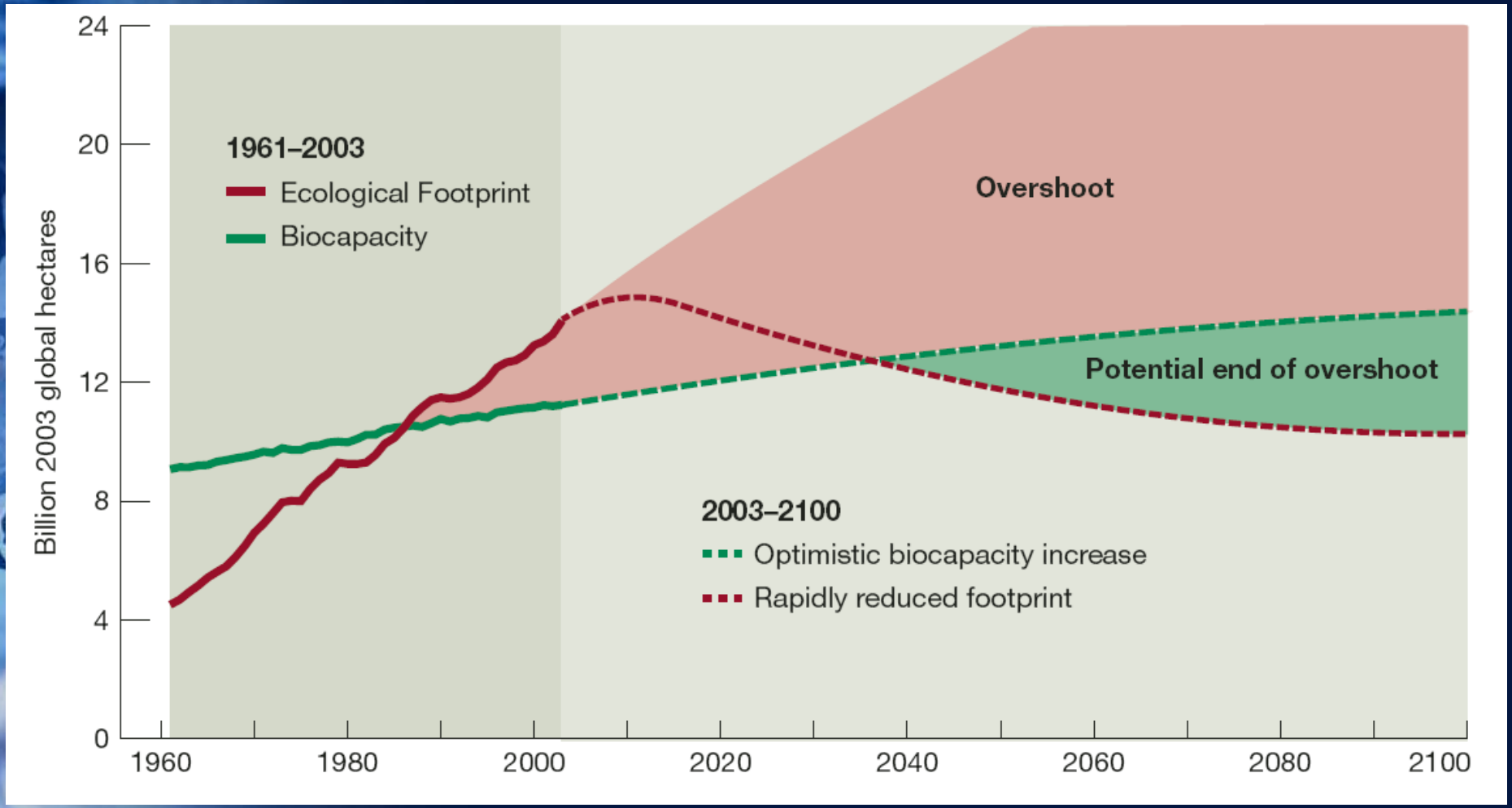

Per capita environmental footprint x (population density)^1/10 (gha^9/10)
10^2
10^1
10^0
-10^1
10^2
10^3
10^4
10^5
Gross national income per capita [$(2003)]
France
UK
Germany
Russia
Mexico
China
USA
Canada
Italy
Japan
South Africa
Brazil
India

‘POWER-LAW’ CORRELATING EQUATION

- The curve indicates whether a country is profligate or frugal in terms of their “natural capital” usage
  - Those above the power law curve are profligate or wasteful
  - Those below are frugal or more sparing in terms of their natural resources

BIOCAPCITY AND OVERSHOOT



Source: Living Planet Report

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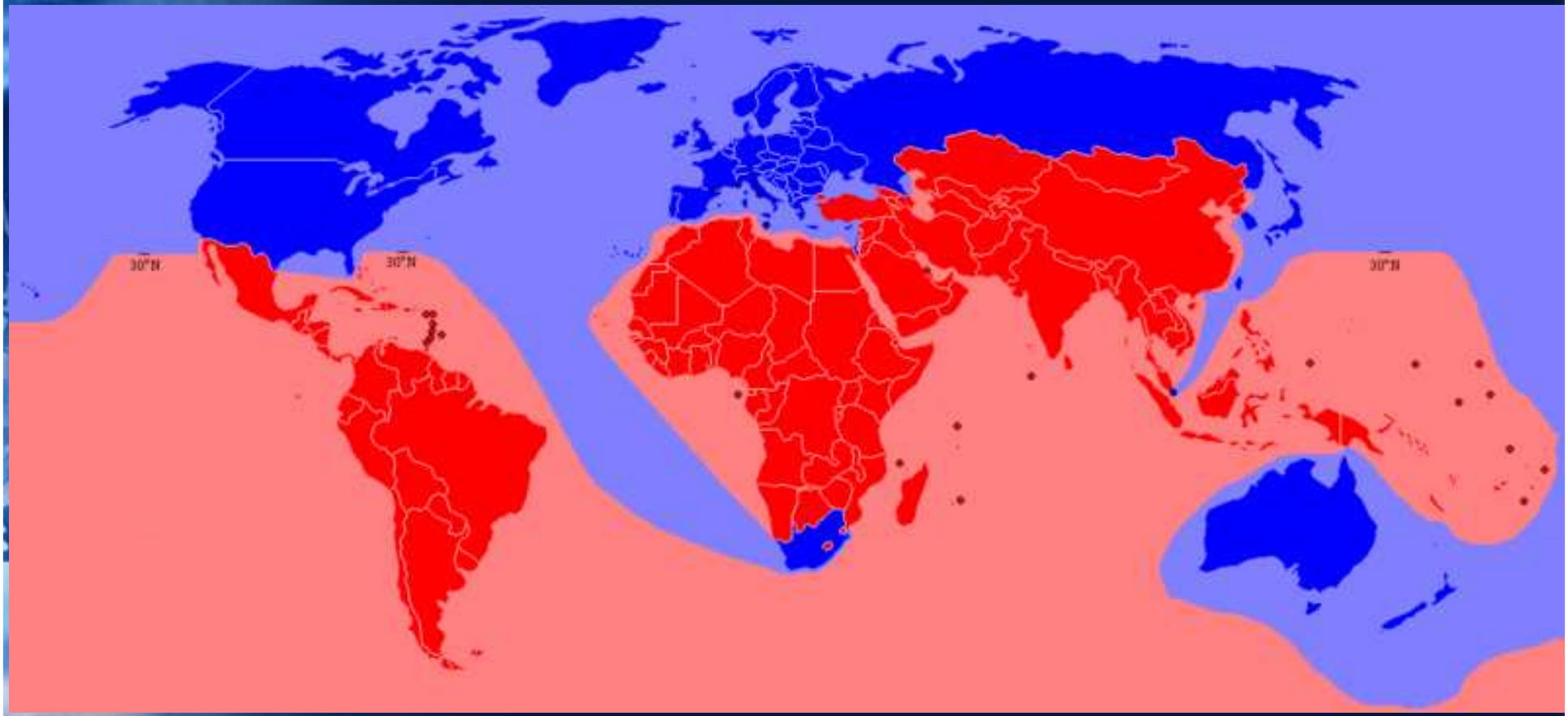
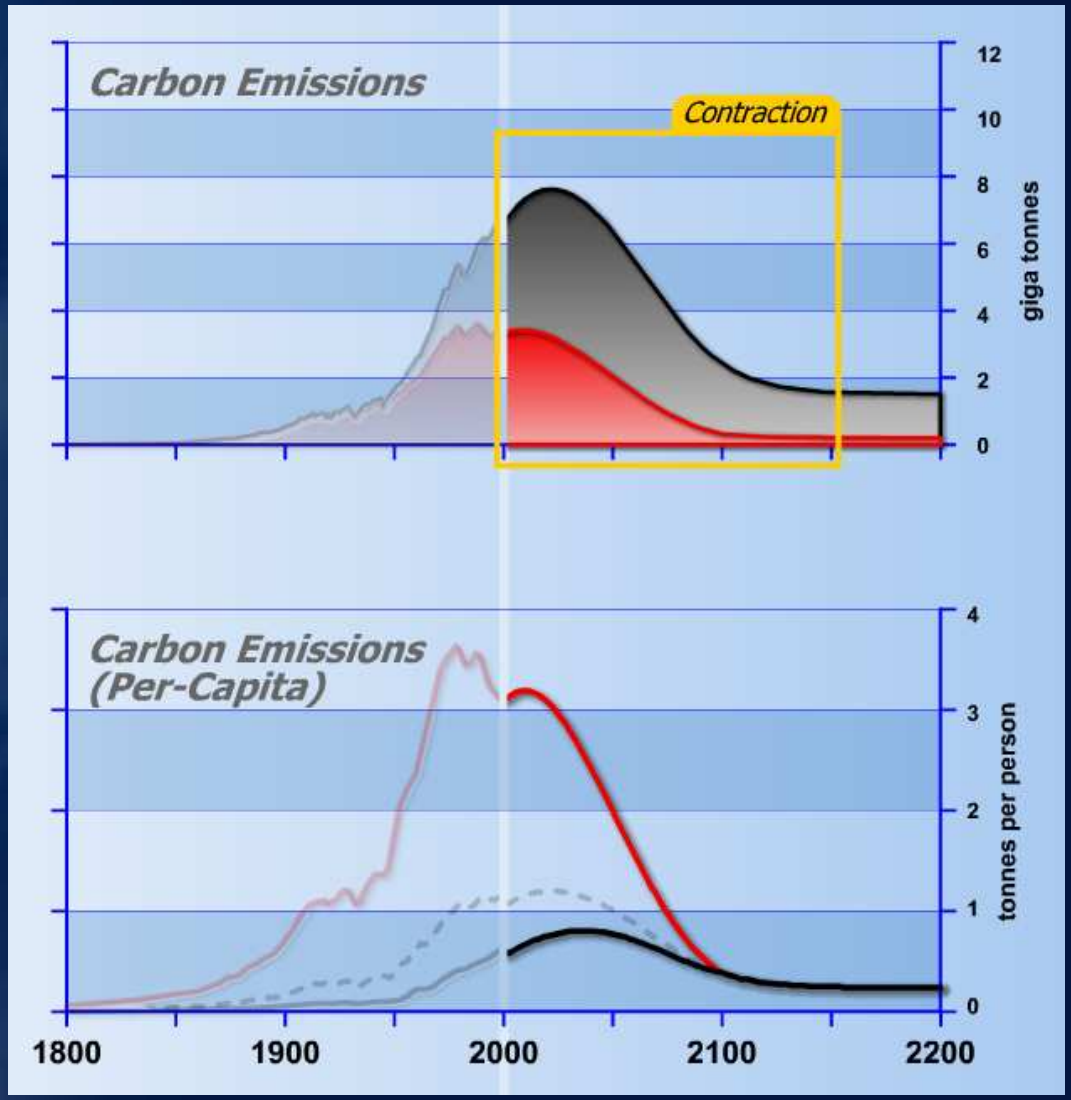
NORTH AND SOUTH FOOTPRINT ANALYSIS

- Assessment of the Industrialised ‘North’ and the Developing ‘South’
- A variety of scenarios have been developed
- The IPCC SRES scenarios are commonly accepted
- Not predictions, but a suggestion of future alternatives

NORTH AND SOUTH DIVIDE



CONTRACTION - CONVERGENCE



Source: Global Commons Institute

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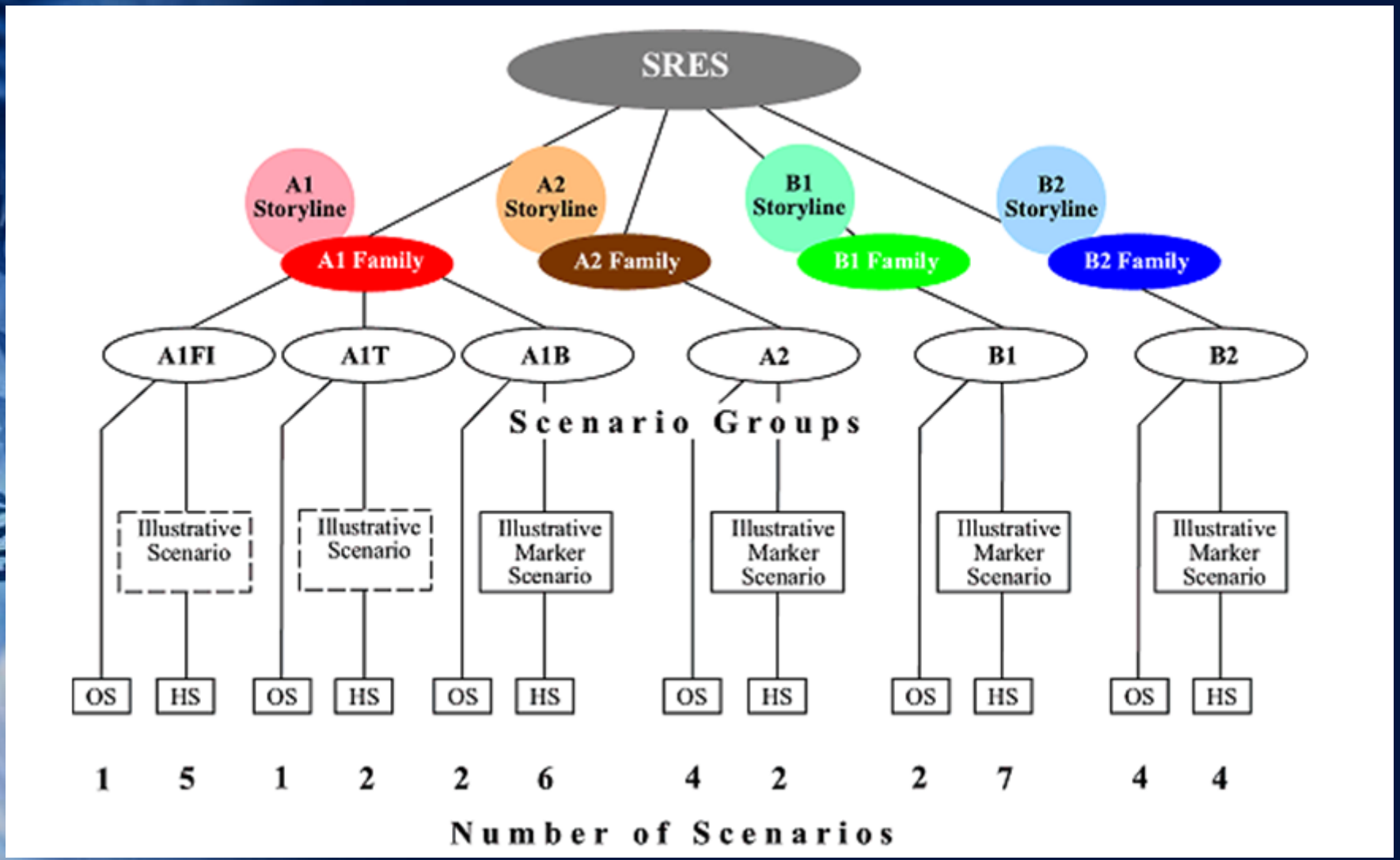
IPCC SPECIAL REPORT ON EMISSIONS SCENARIOS



Source: IPCC

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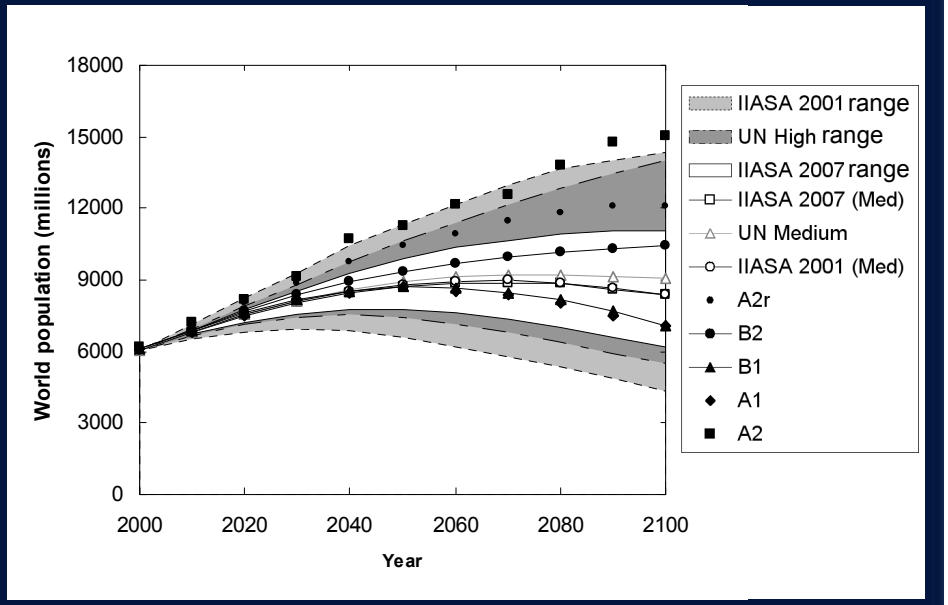
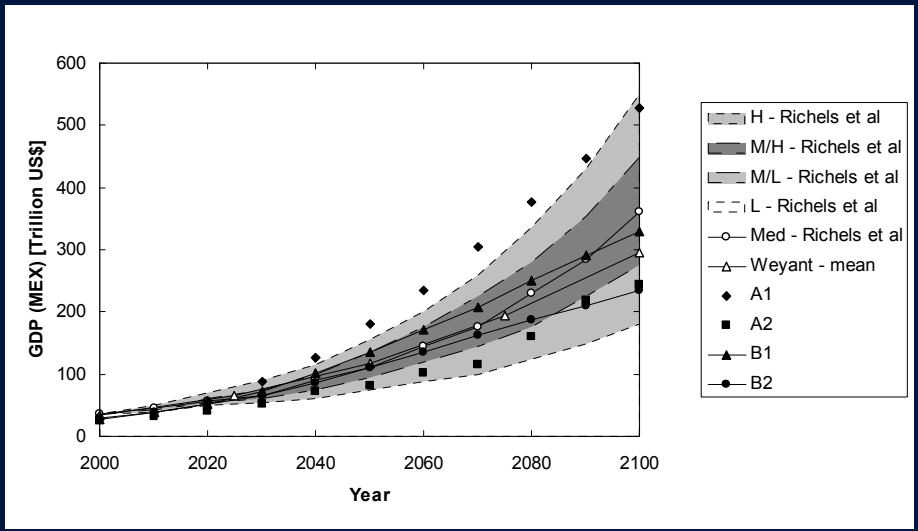
LIMITATIONS AND UPDATED FORECASTS

- The IPCC scenarios have been challenged as outdated
  - Population and Economic Growth
- Comparison with other databases confirmed the use of IPCC trajectories





UPDATED CORRELATING EQUATION FOR FUTURE SCENARIOS

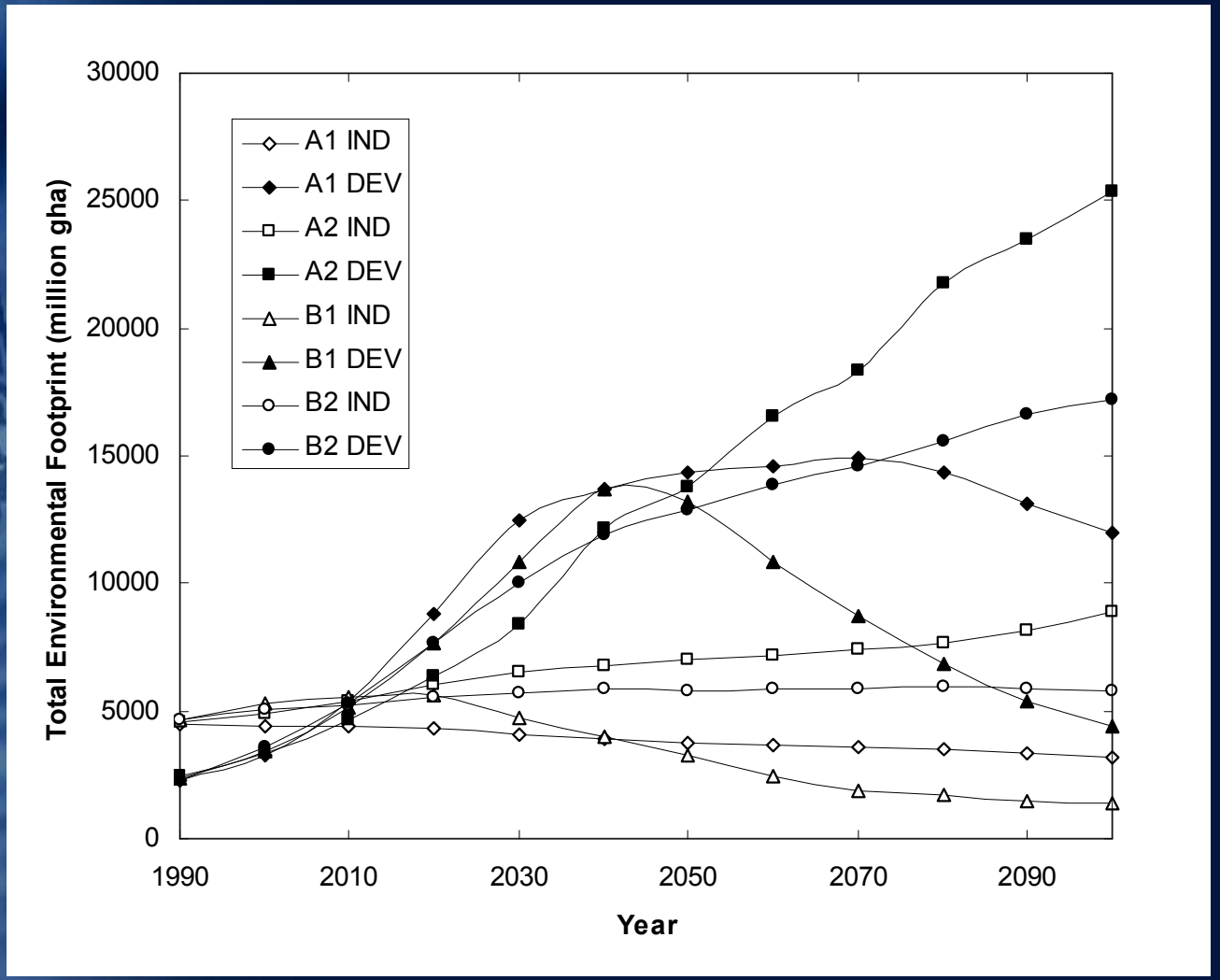
$$ef = K\ GNI^{2/3}\ PD^{-1/10}\ EI^{m}\ CR^{n}$$

Scenario	m	n	K
A1	4/3	1/10	0.00022
A2	1	1/2	0.000199
B1	2/3	2	0.000006
B2	1	1/8	0.00056

EF FOR DEV AND IND MARKER SCENARIOS (1)

- Currently Industrialised countries have higher total EF; this changes in approx. 2015
- Developing world has a more rapid growth than Industrialised countries, with 75% share of total world EF by 2100
- Unlikely to see convergence between industrialised and developing regions before end of century
- B1 and A1 scenarios showed a reduction in total footprint

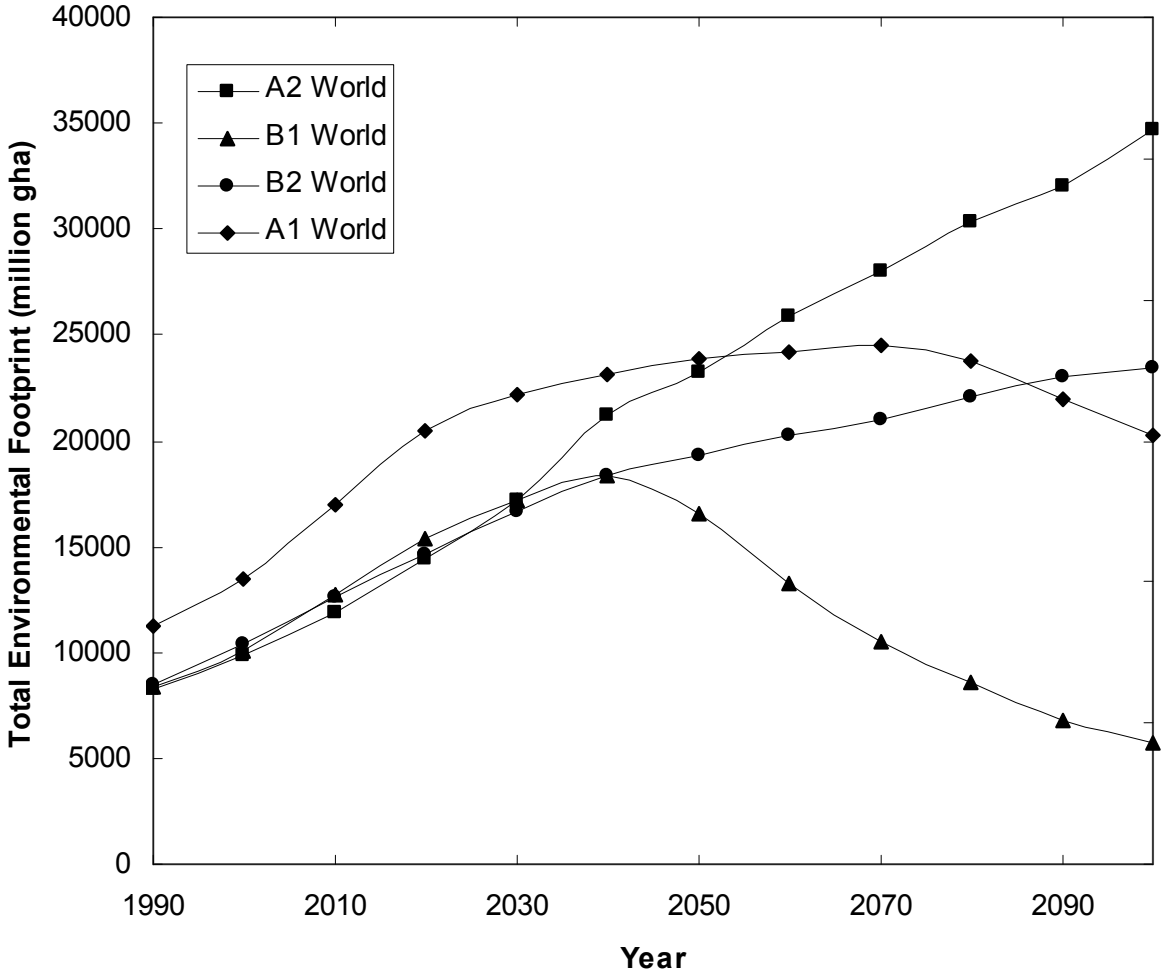
EF FOR DEV AND IND MARKER SCENARIOS (2)



EF FOR WORLD MARKER SCENARIOS (1)

- The general trend is that the A1 and B1 scenario storylines suggest the possibility of a diminishing EF from approximately 2040 onwards
- The scenarios with large population growth, such as the A2 scenario, have lower *per capita* environmental footprints
- This masks the overall impacts of the total, far larger footprints that are associated with such high growth scenarios.

EF FOR WORLD MARKER SCENARIOS (2)



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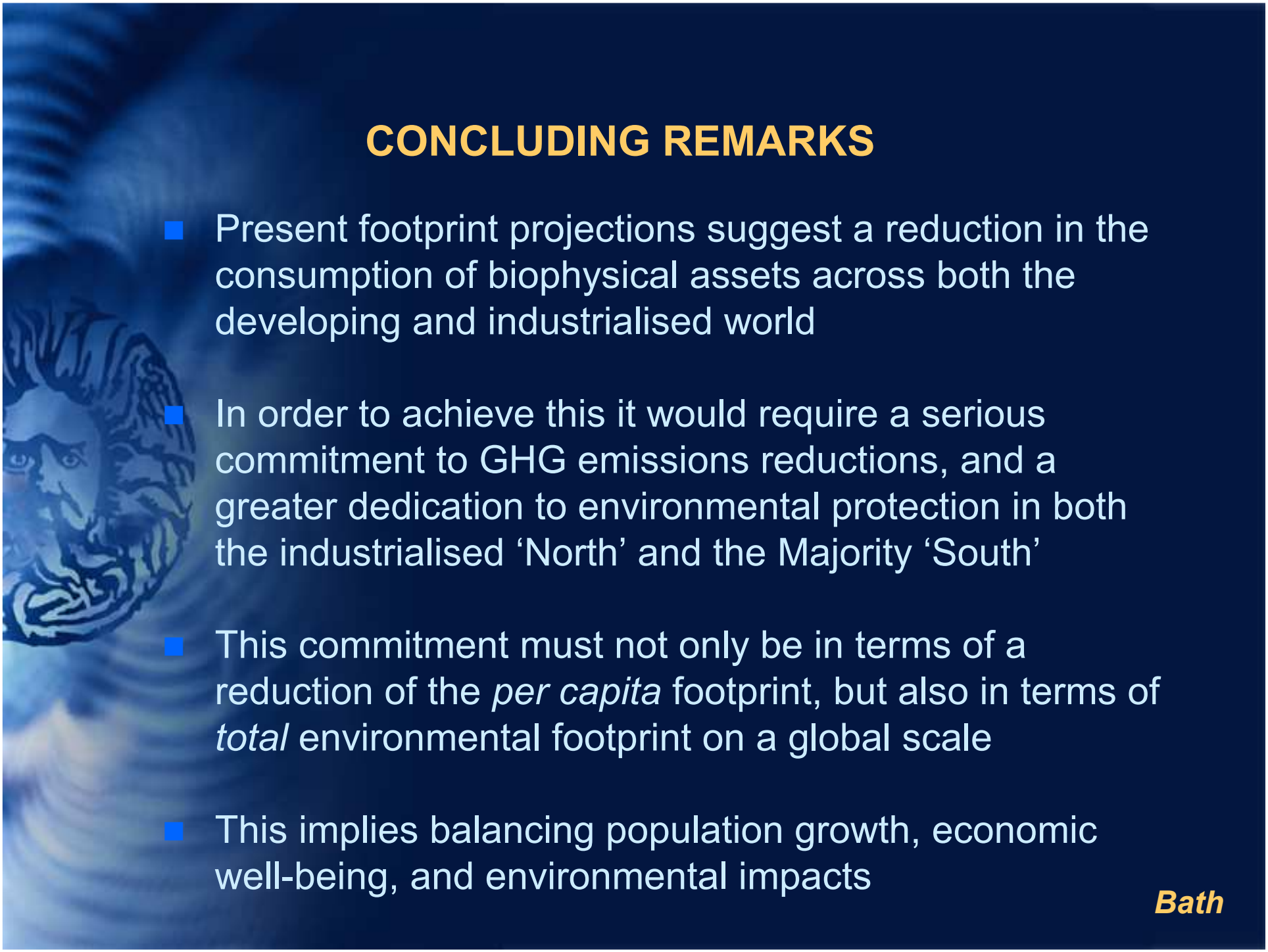

CONCLUDING REMARKS

- Present footprint projections suggest a reduction in the consumption of biophysical assets across both the developing and industrialised world
- In order to achieve this it would require a serious commitment to GHG emissions reductions, and a greater dedication to environmental protection in both the industrialised ‘North’ and the Majority ‘South’
- This commitment must not only be in terms of a reduction of the *per capita* footprint, but also in terms of *total* environmental footprint on a global scale
- This implies balancing population growth, economic well-being, and environmental impacts


Thank you for your attention
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