

Concepts of Economic development & Human development. Sustainable Development

Rajaratnam Shanthini
University of Peradeniya
Sri Lanka

CP551 Sustainable Development (SD)

How can we all live well and live within
the means of one planet?

This is the research question
of the 21st century.

If we do not design ways to live within
the means of one planet,
sustainability will remain elusive.

Module 2:

Concepts of economic development &
human development.

Economic development indices & their critique.

Human development index & its critique.

Discussion on sustainable development indices.

Group Assignment 2.1:

What is economic development?

Why do we need economic development?

Is there a cost for economic development?

What is human development?

Does economic development helps human development?

If yes, in which way?

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Sri Lanka's **economy** is estimated to **grow** by 6.0 percent in 2009

- Friday, January 2, 2009, Sri Lanka News Portal, Sri Lanka News Online

Sri Lanka Central Bank predicts 2009 **GDP growth** to be 6.0 percent

- Friday, January 2, 2009, 15:37 GMT, ColomboPage News Desk, Sri Lanka.

Economic growth = GDP growth?

What is GDP?

- GDP is abbreviation for Gross Domestic Product.
- GDP is a measure of a nation's total economic activity.
- GDP is simply the addition of annual monetary value of all goods and services produced within a country.
- GDP reflects activities related to production and consumption of goods and services within a country.

GDP = Consumer spending
+ Government spending
+ Investment made by industry
+ Net exports

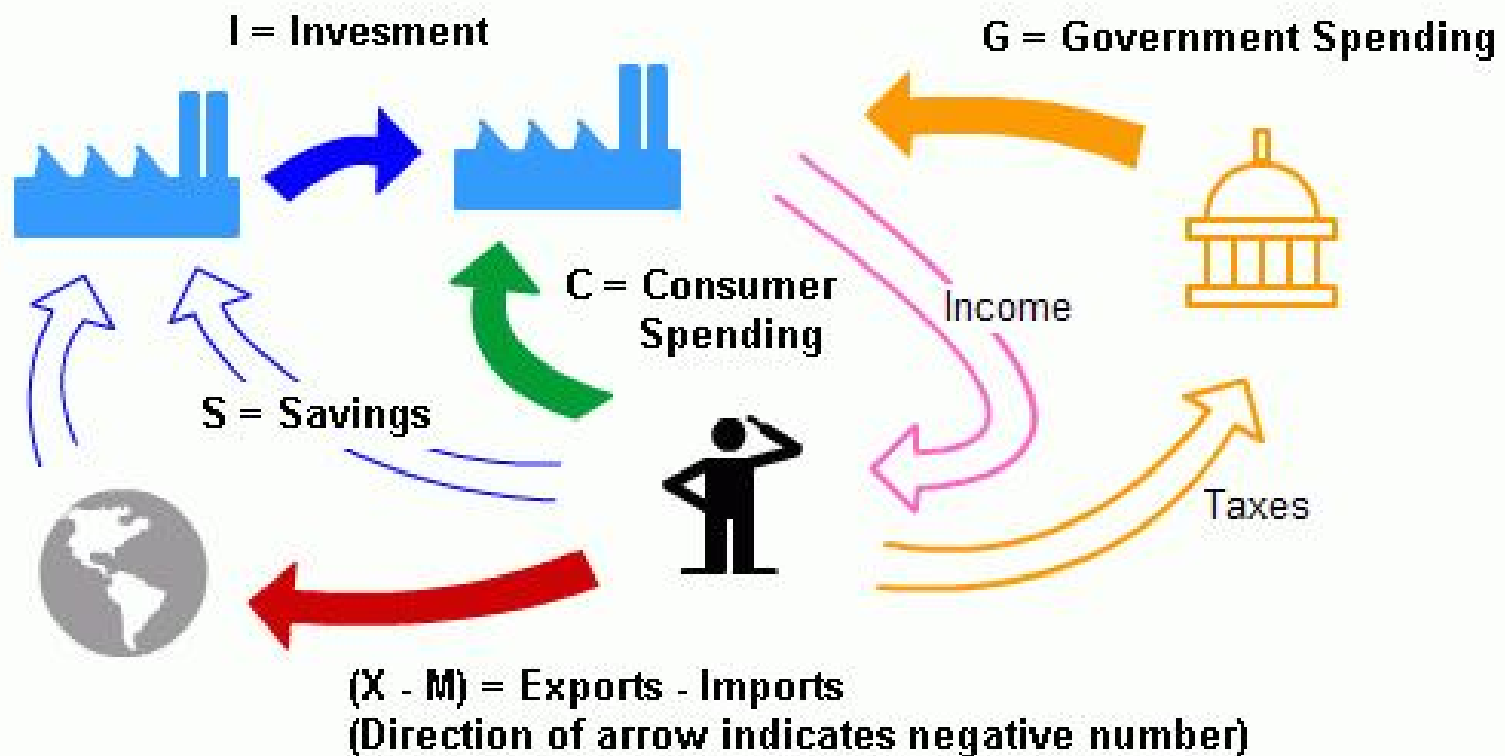
durable goods
food and clothing
services

exports are added
imports are deducted

Defense
Roads
Schools
Salaries

Spending on plants and equipment
Homes
Business inventories

**GDP = Consumer spending
+ Government spending
+ Investment made by industry
+ Net exports**



Atoll K is small island nation. Its population total is 400, and it has 100 wage earners who earn an average of \$50 per year. Each wage earner spends \$40 per year buying local goods and services and \$2.50 buying imports. The island exports a total of \$800 worth of goods. The Government tax rate is 10% and all government money is spent on building infrastructure and supporting schools. There is only one industry (uranium mining) on the island and it employs every wage earner. The industry spends \$600 each year on new mining equipment. What is the GDP?

$$\begin{aligned}\text{GDP} &= \text{Consumer spending} + \text{Government spending} \\ &\quad + \text{Investment made by industry} + \text{Net exports} \\ &= \$40 \times 100 + 0.10 \times (100 \times \$50) + \$600 + \$800 - \$2.50 \times 100 \\ &= \$5650\end{aligned}$$

Economical Status indicators

high GDP
per capita

good
income
distribution

measured by
Gini Index

Gini Index is a measure of income distribution in a country

Gini Index = 0 means absolute equality

Gini Index = 100 means absolute inequality

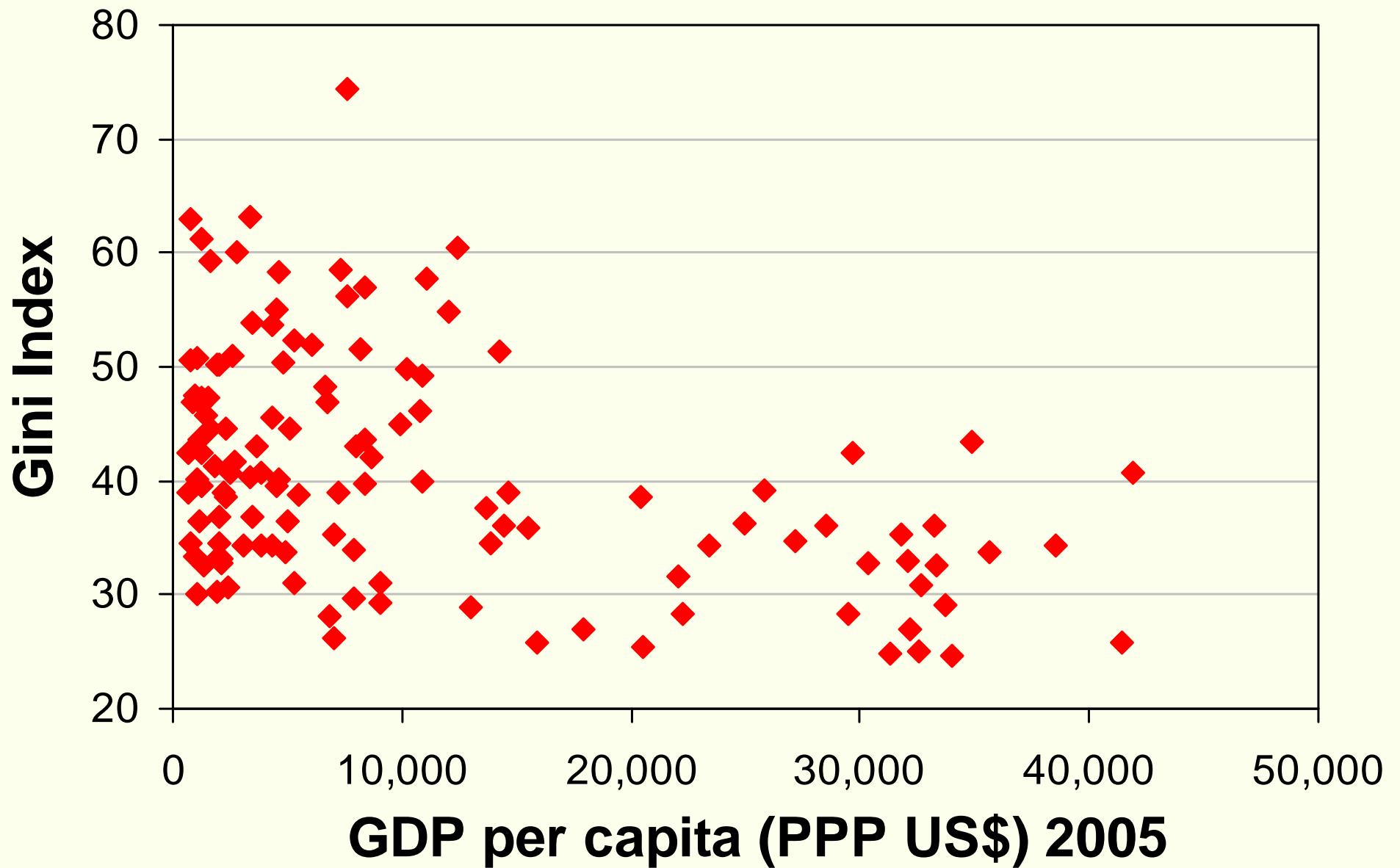
	US	Sweden
GDP per capita (PPP US\$) in 2005		
Gini Index in 2000		

Gini Index is a measure of income distribution in a country

Gini Index = 0 means absolute equality

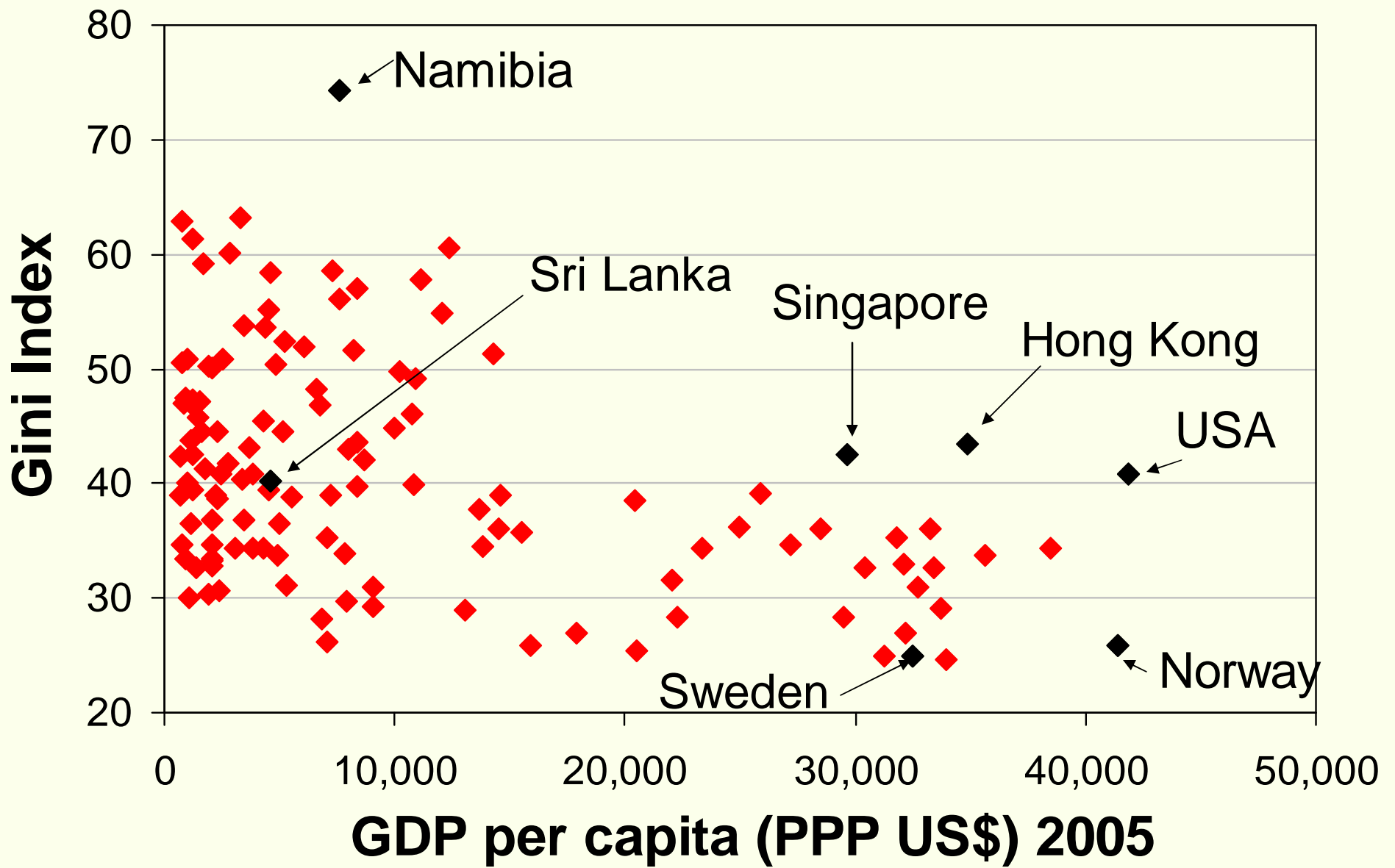
Gini Index = 100 means absolute inequality

	US	Sweden
GDP per capita (PPP US\$) in 2005	41,890	32,525
Gini Index in 2000	40.8%	25%



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Source: HDR2007/08, <http://hdr.undp.org/en/statistics/data/>



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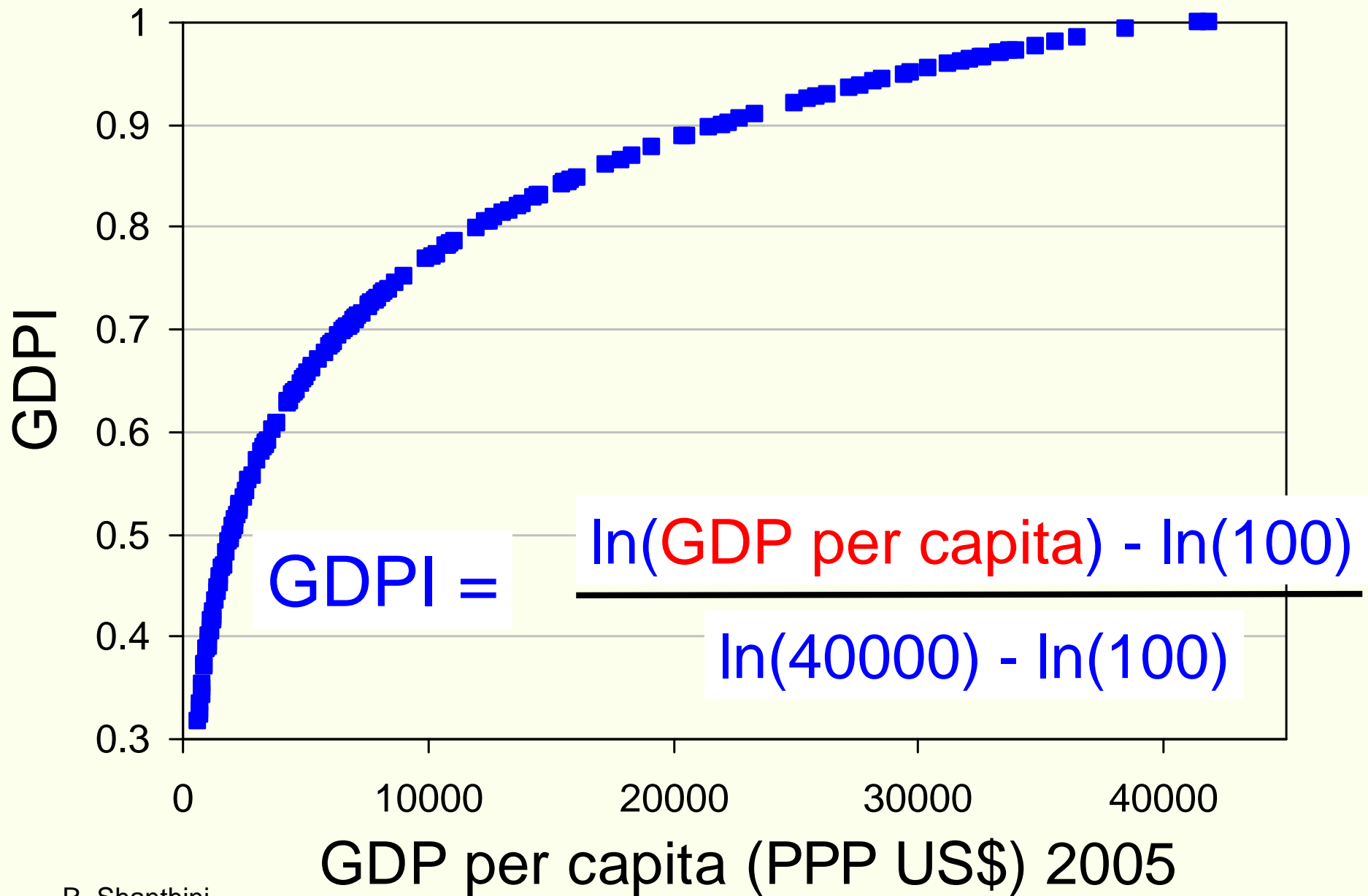
GDP per capita is an average measure.

It alone does not represent the economic status of an average citizen in a country.

Gini Index must be incorporated into
GDP per capita
to get a good idea
of the economic status
of an average citizen in a country.

How to do that?

$$\text{GDPI} = \frac{\ln(\text{GDP per capita}) - \ln(100)}{\ln(40000) - \ln(100)}$$

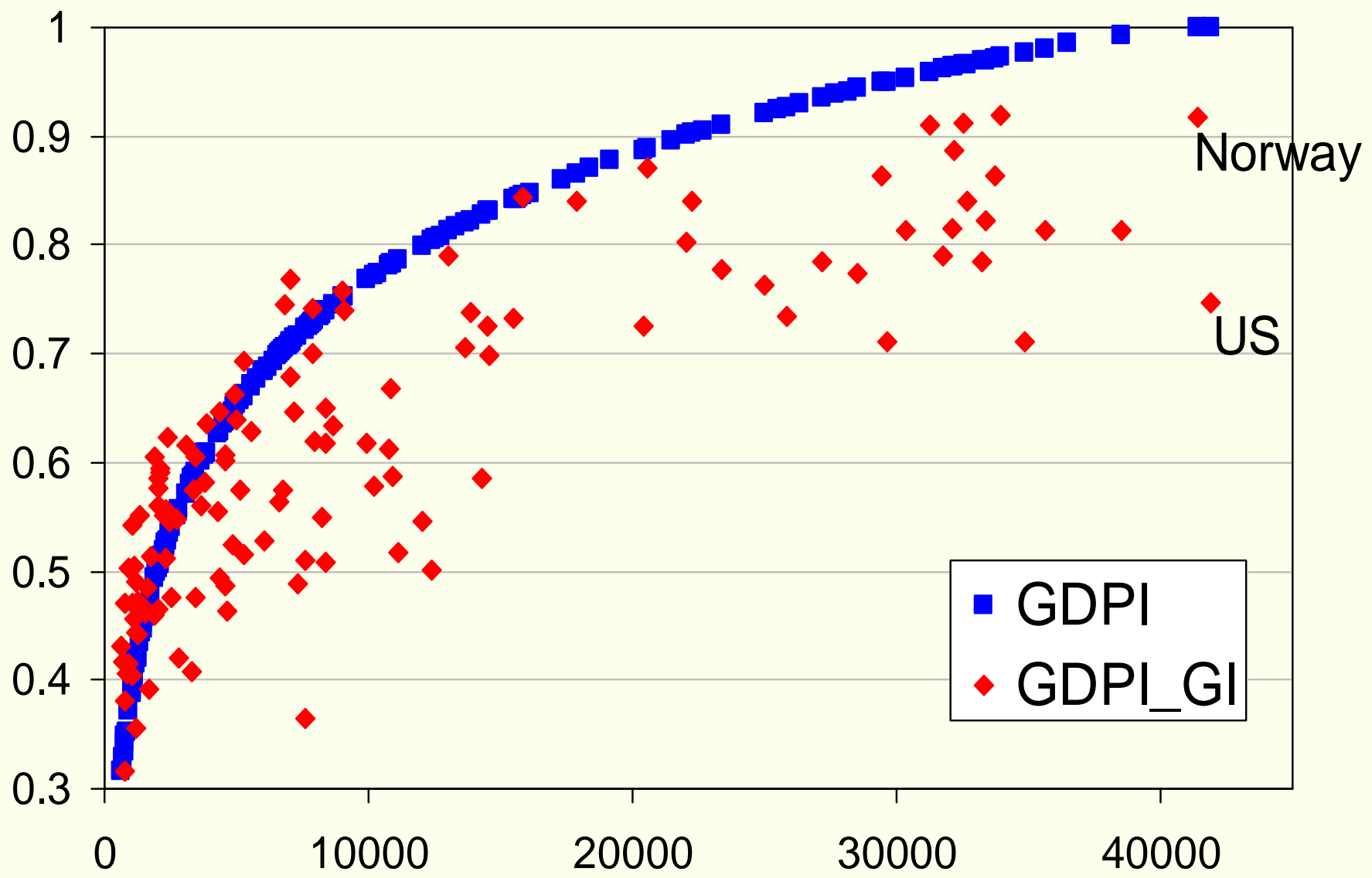


$$\text{GDPI} = \frac{\ln(\text{GDP per capita}) - \ln(100)}{\ln(40000) - \ln(100)}$$

$$\text{EQI} = \frac{\ln(100) - \ln(\text{Gini Index})}{\ln(100) - \ln(20)}$$

$$\text{GDPI_GI} = \sqrt{\text{GDPI} * \text{EQI}}$$

Socially responsible
GDP per capita index



GDP per capita (PPP US\$) 2005

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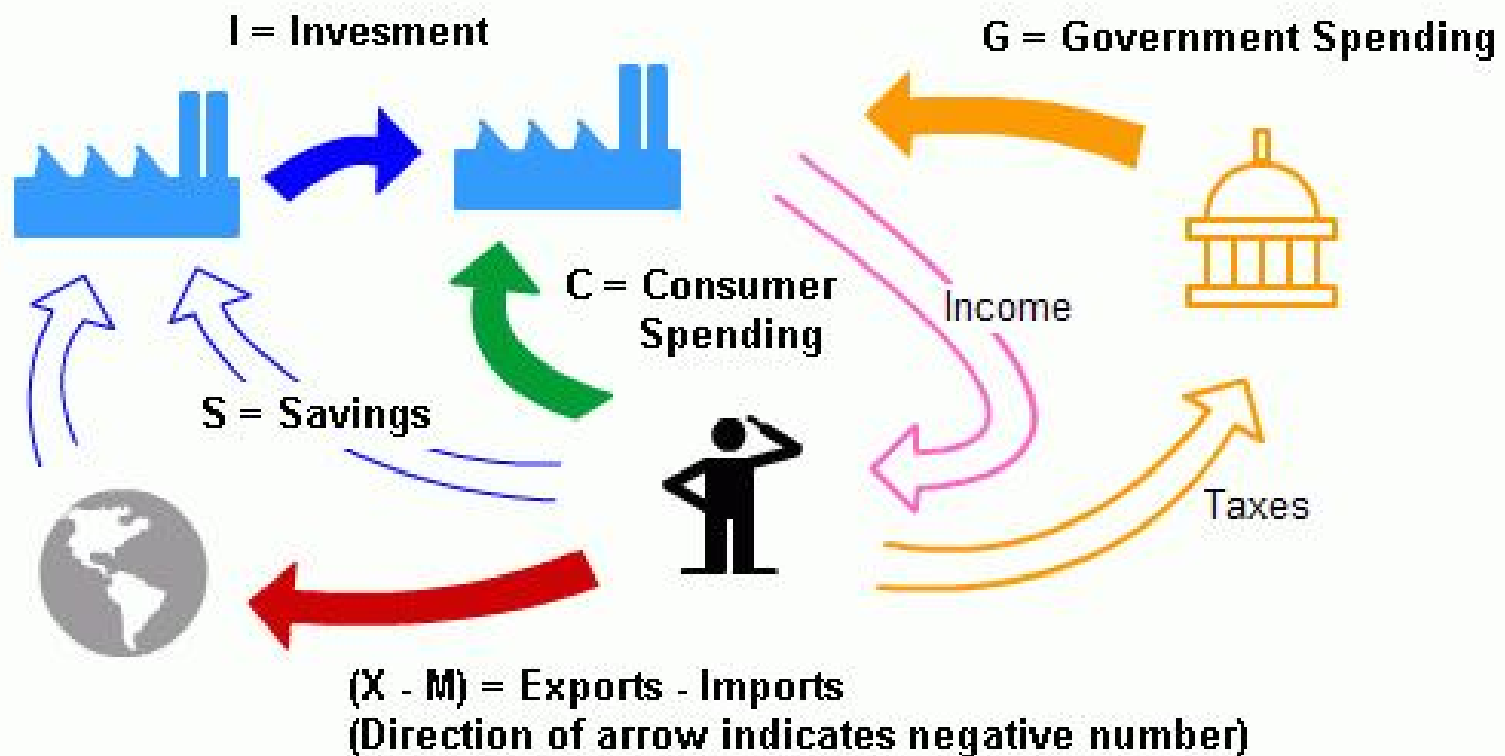
Source: my calculations

GDP growth (even with a very low Gini Index) measures only the economic growth of a nation.

GDP growth does not necessarily reflect the improvement in the well-being of the citizens of a nation.

- Simon Kuznets,
the inventor of the concept of the GDP,
noted in his very first report
to the US Congress in 1934.

**GDP = Consumer spending
+ Government spending
+ Investment made by industry
+ Net exports**



What else could be done
to improve the measure of
economic development
which could truly reflect the
well-being of an average
citizen in a nation?

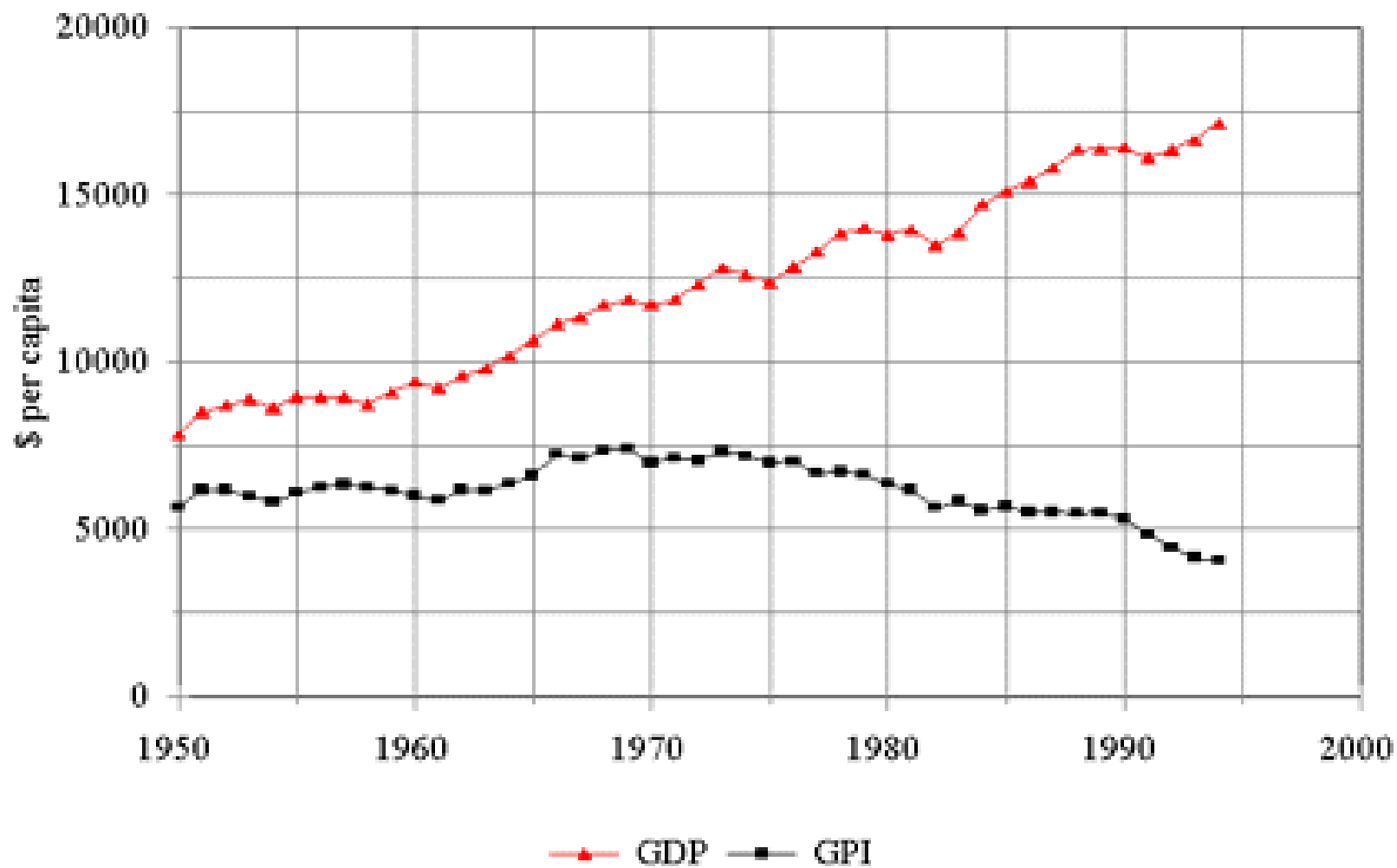
Genuine Progress Indicator (GPI):

Green/welfare economists have suggested to replace GDP by GPI as a measure of economic growth.

GPI is an attempt to measure whether a country's growth (increased production of goods and expanding services) have actually resulted in the improvement of the well-being of the people in the country.

Note that $GPI = 0$ if the financial costs of crime and pollution equal the financial gains in production of goods and services.

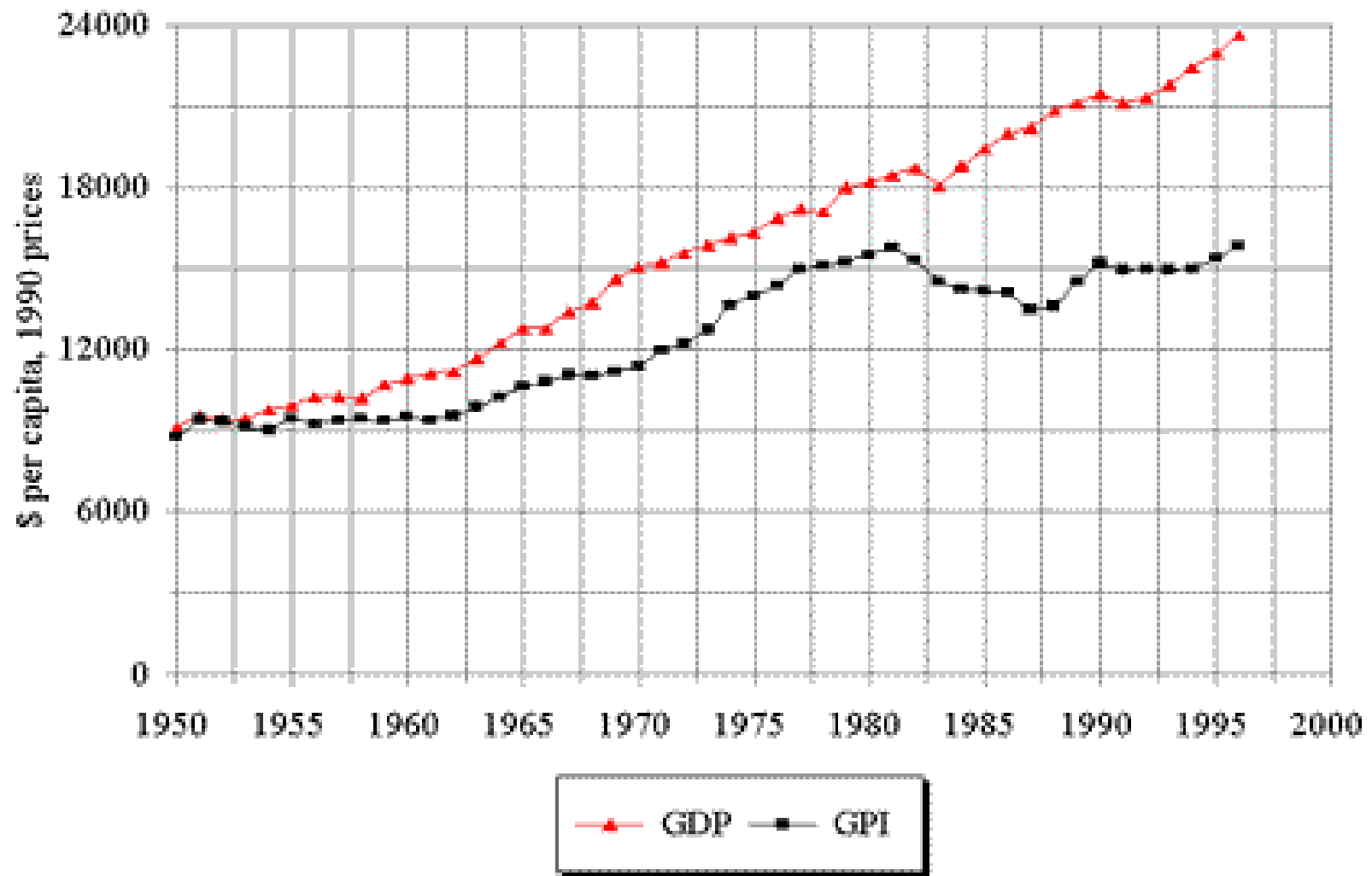
USA Genuine Progress Indicator



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Source: <http://www.foe.co.uk/community/tools/isew/international.html>

Australian Genuine Progress Indicator



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Source: <http://www.foe.co.uk/community/tools/isew/international.html>

stable
job

well paid
job

low infant
mortality

life free of
avoidable
morbidity

low
inflation

Measures of human well-being

long life

adequate
nutrition

adequate
housing

high GDP
per capita

civil
liberties

care of the
environment

good
education
level

free
markets

good
income
distribution

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Human development Indices:

Level of Living Index (Drewnowski and Scott, 1966) includes nutrition, housing, health, education, environment, and others

PQLI: Physical Quality of Life Index

(Morris, 1970) includes infant mortality, literacy rates and life expectancy

QLI: Quality of Life Index (Ferrans and Powers, 1980) includes health and functioning, psychological/spiritual domain, social and economic domain, and family

Human development Indices:

GNH: Gross National Happiness (Bhutan's former King Jigme Singye Wangchuck, 1972; Med Yones, 2006) includes economic, environmental, physical, mental, workplace, social and political Wellness

GPI: Genuine Progress Indicator (Marilyn Waring, 1980)

HDI: Human Development Index (UNDP, 1990) includes literacy rate, longevity, school enrolment and GDP per capita

and much more.....

Take a close look at the UNDP defined Human Development Index (HDI)

$$\text{Life Index (LI)} = \frac{\text{Life Expectancy} - 25}{85 - 25}$$

Education Index (EI)=

$$\frac{2}{3} \frac{\text{Adult Literacy}}{100} + \frac{1}{3} \frac{\text{School Enrollment}}{100}$$

$$\text{GDP Index (GDPI)} = \frac{\ln(\text{GDP per capita}) - \ln(100)}{\ln(40000) - \ln(100)}$$

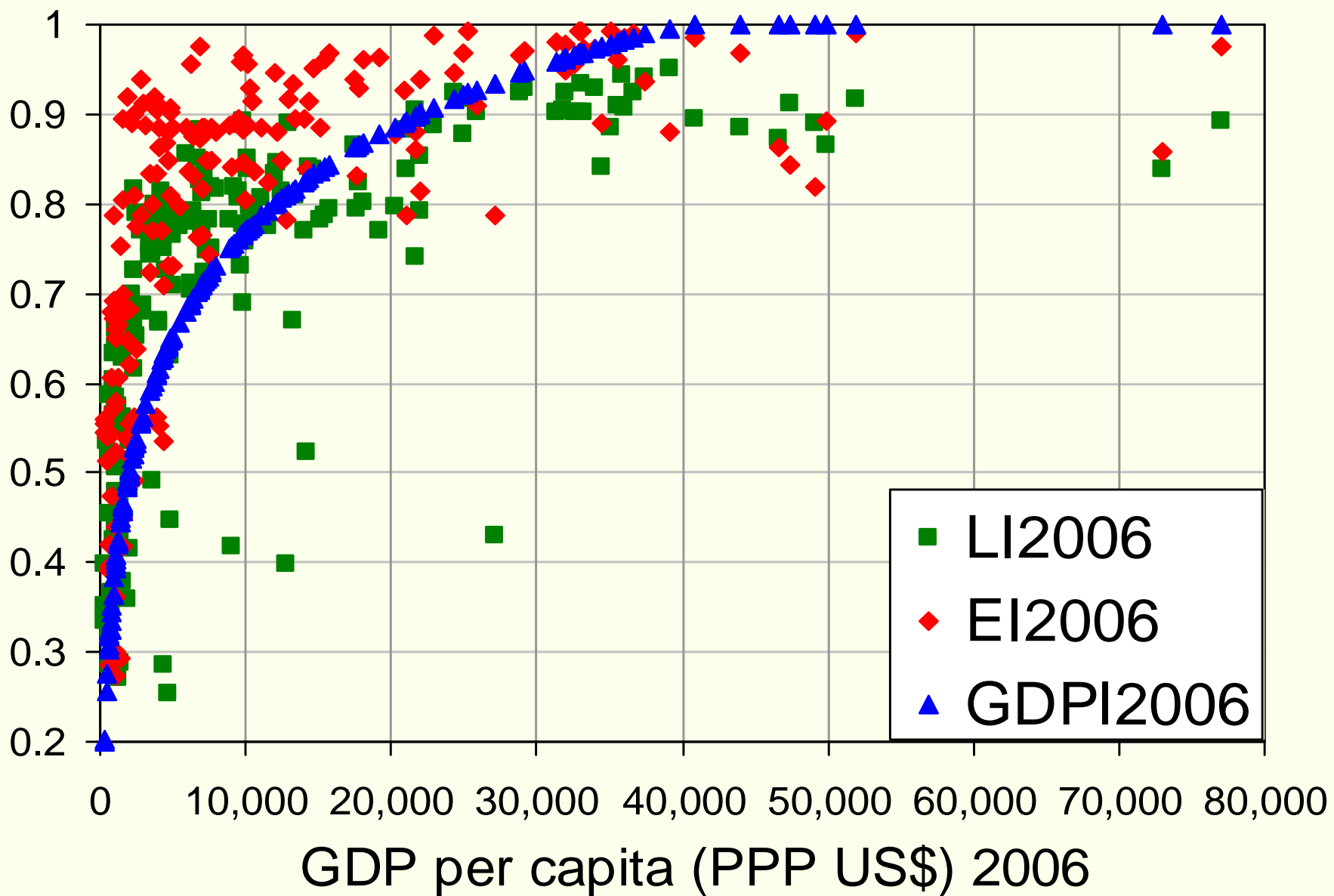
$$\text{HDI} = \frac{\text{LI}}{3} + \frac{\text{EI}}{3} + \frac{\text{GDPI}}{3}$$

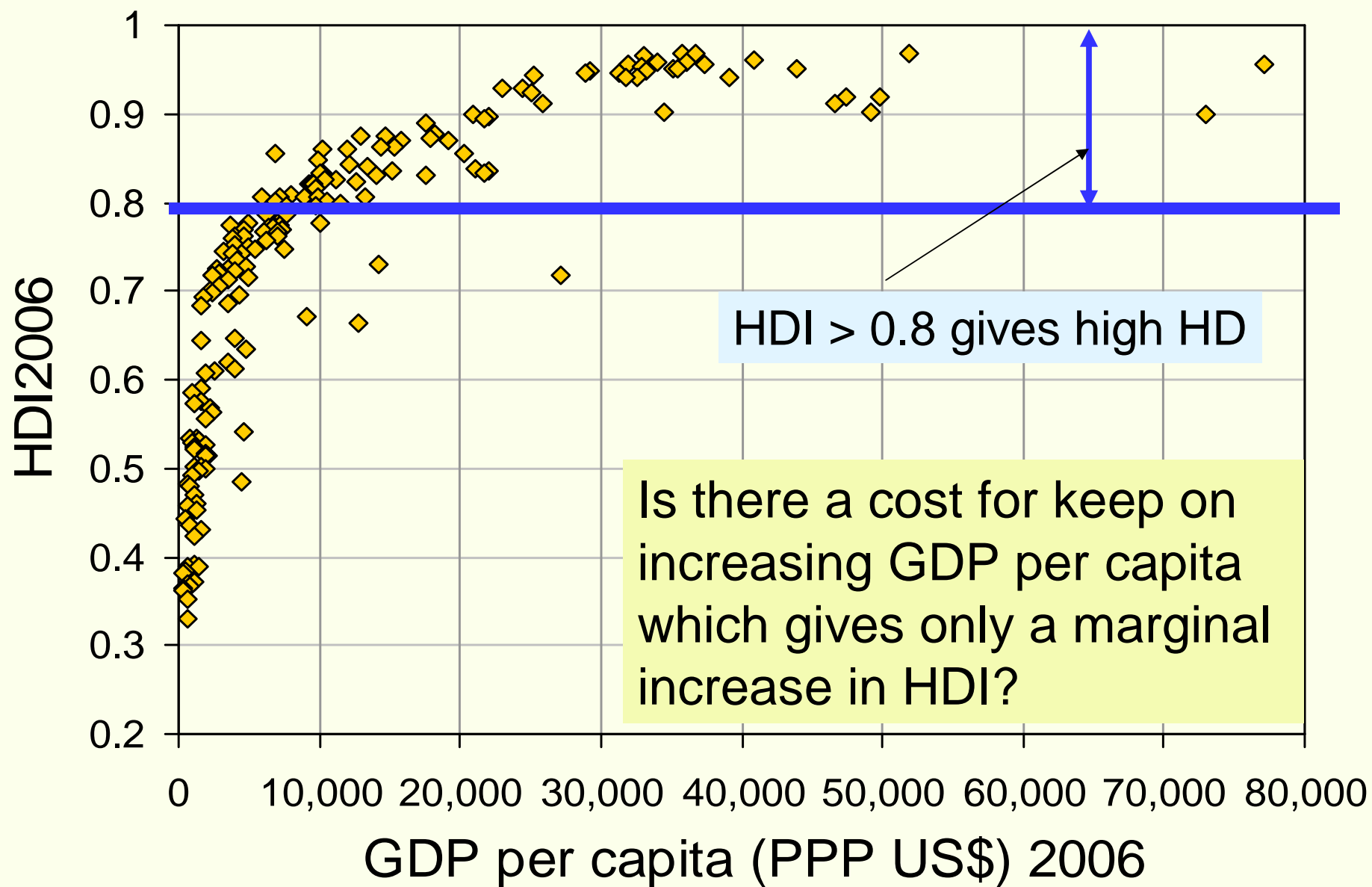
In 2006	Spain	United States
Life Index	0.928	0.884
Education Index	0.971	0.968
GDP per capita (PPP US\$)	29,208	43,968
HDI Rank	16	15

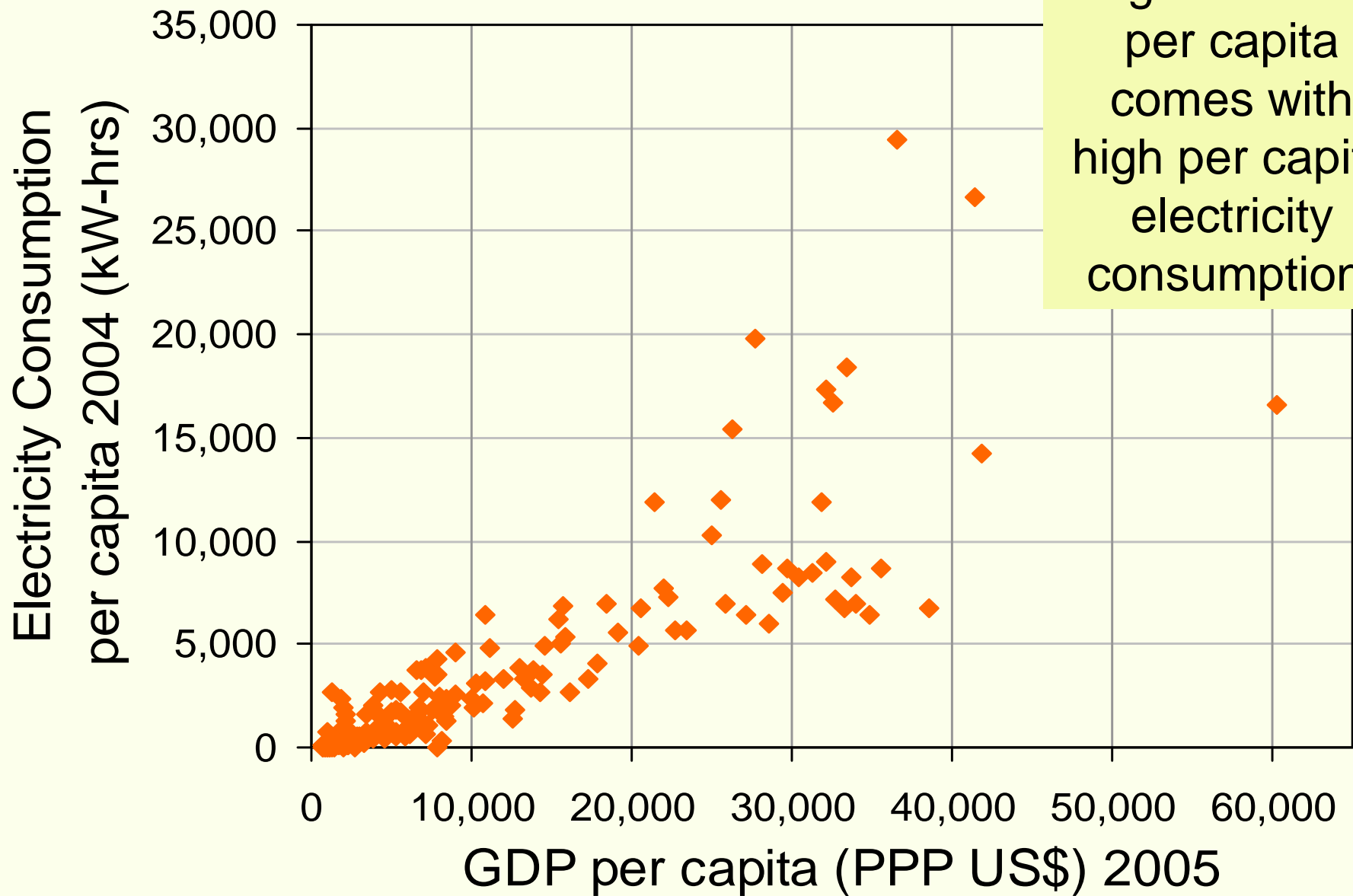
In 2006	Sri Lanka	Turkey
Life Index	0.781	0.776
Education Index	0.834	0.824
GDP per capita (PPP US\$)	3,896	11,535
HDI Rank	104	76

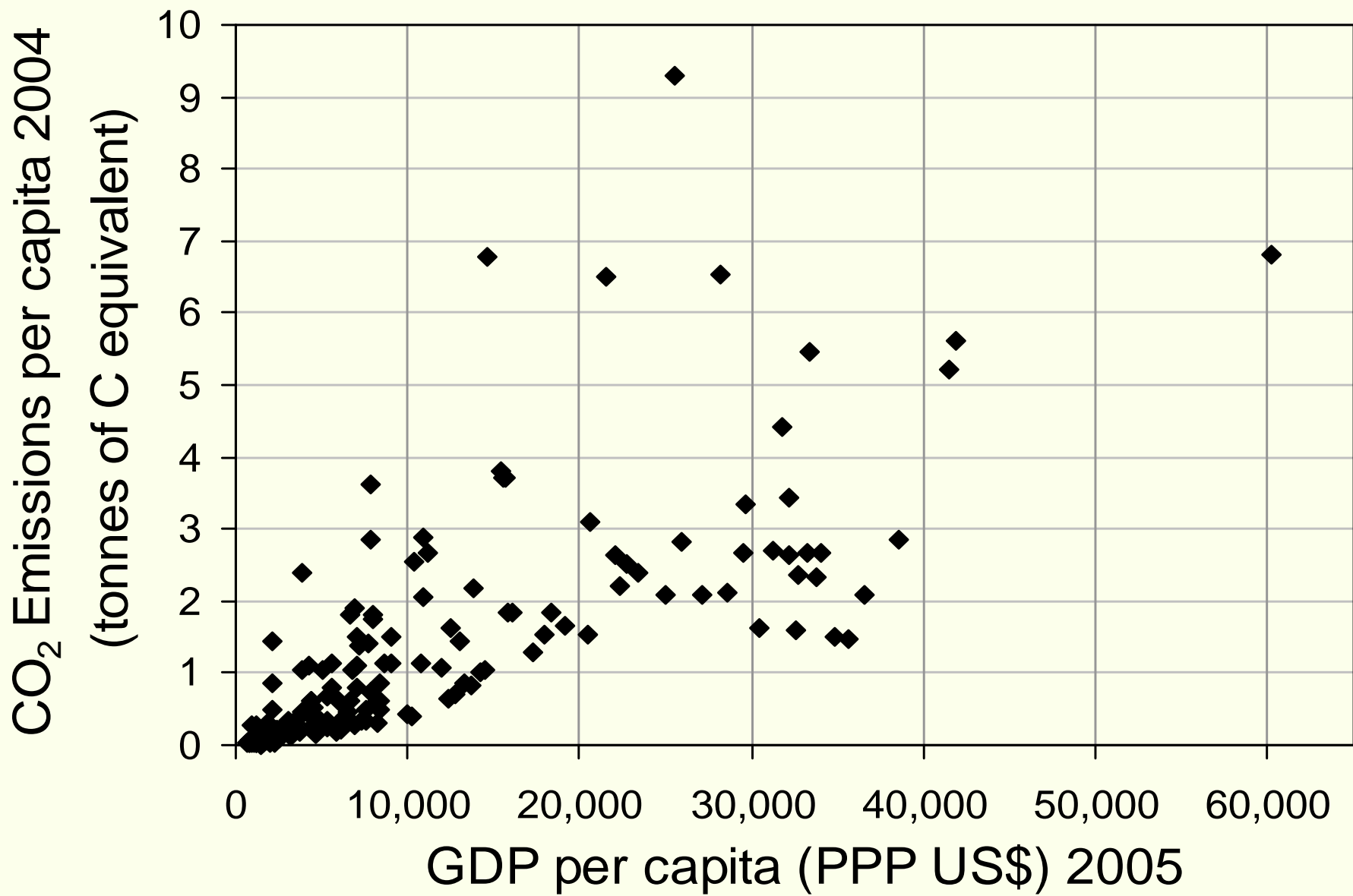
GDP per capita has
strong influence on the HDI.

How important is
GDP per capita in
Human Development?









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Sources: http://hdrstats.undp.org/buildtables/rc_report.cfm

Calculation of Global Sustainable Limiting Rate of Carbon Dioxide Production:

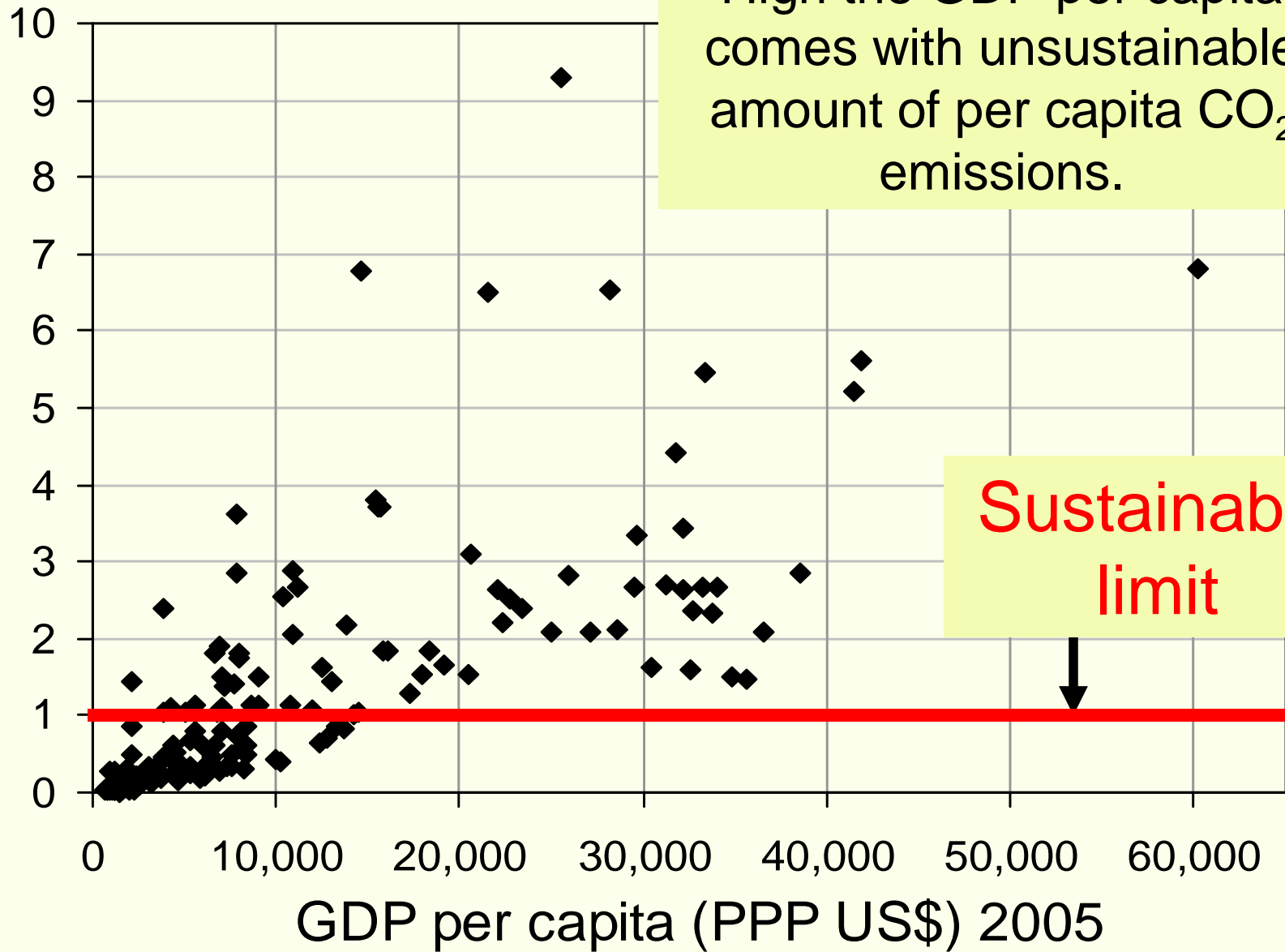
1. Virgin material supply limit: To stabilize the atmospheric CO₂ concentration below approximately 550 ppmv by the year 2100, global anthropogenic emissions must be limited to about 7 to 8 x 10¹⁵ g (= 7 to 8 giga metric tonnes) of C per year (IPCC, 1996).

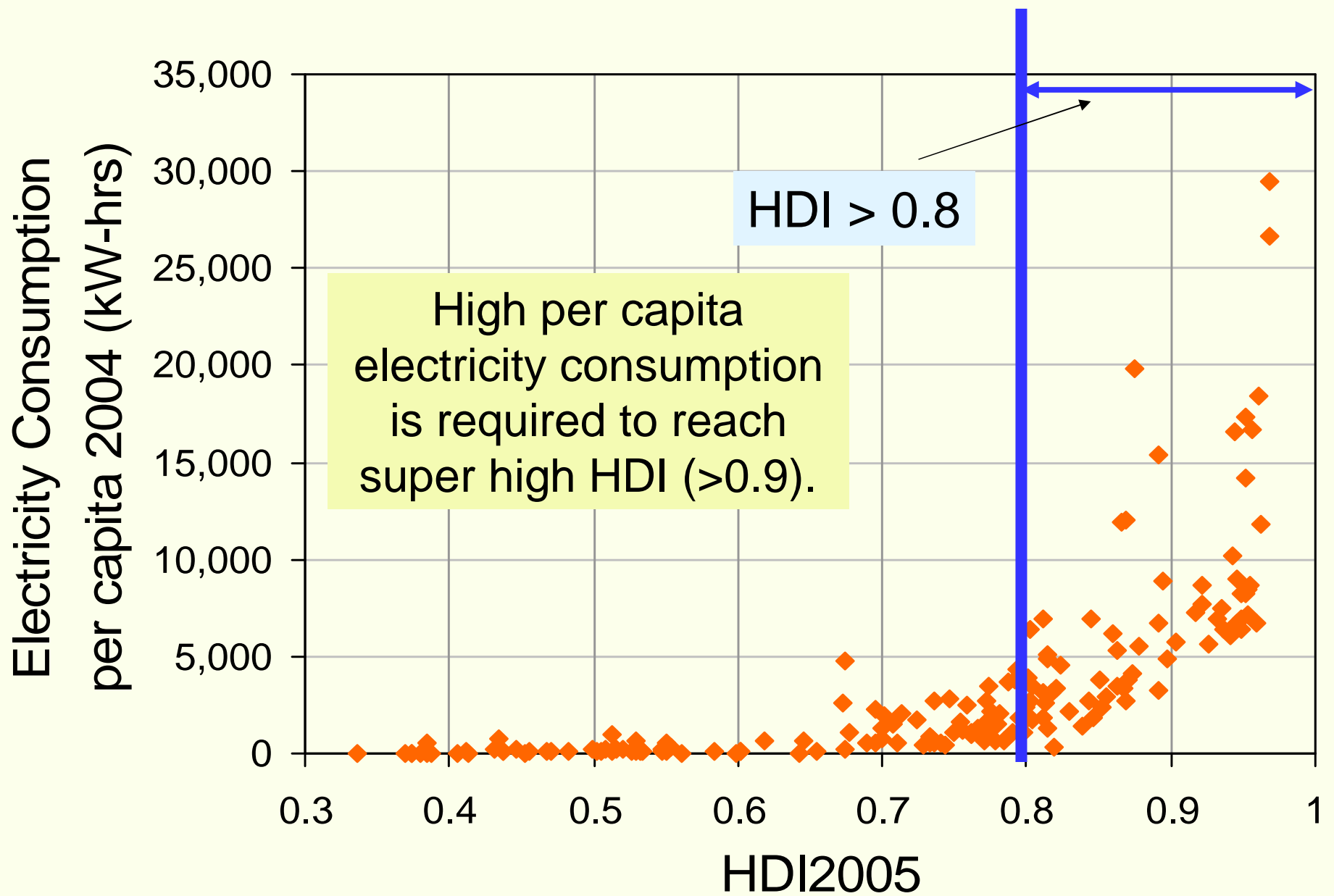
2. Allocation of virgin material: Each of the average 7.5 billion people on the planet over the next 50 years is allocated an equal share of carbon emissions.

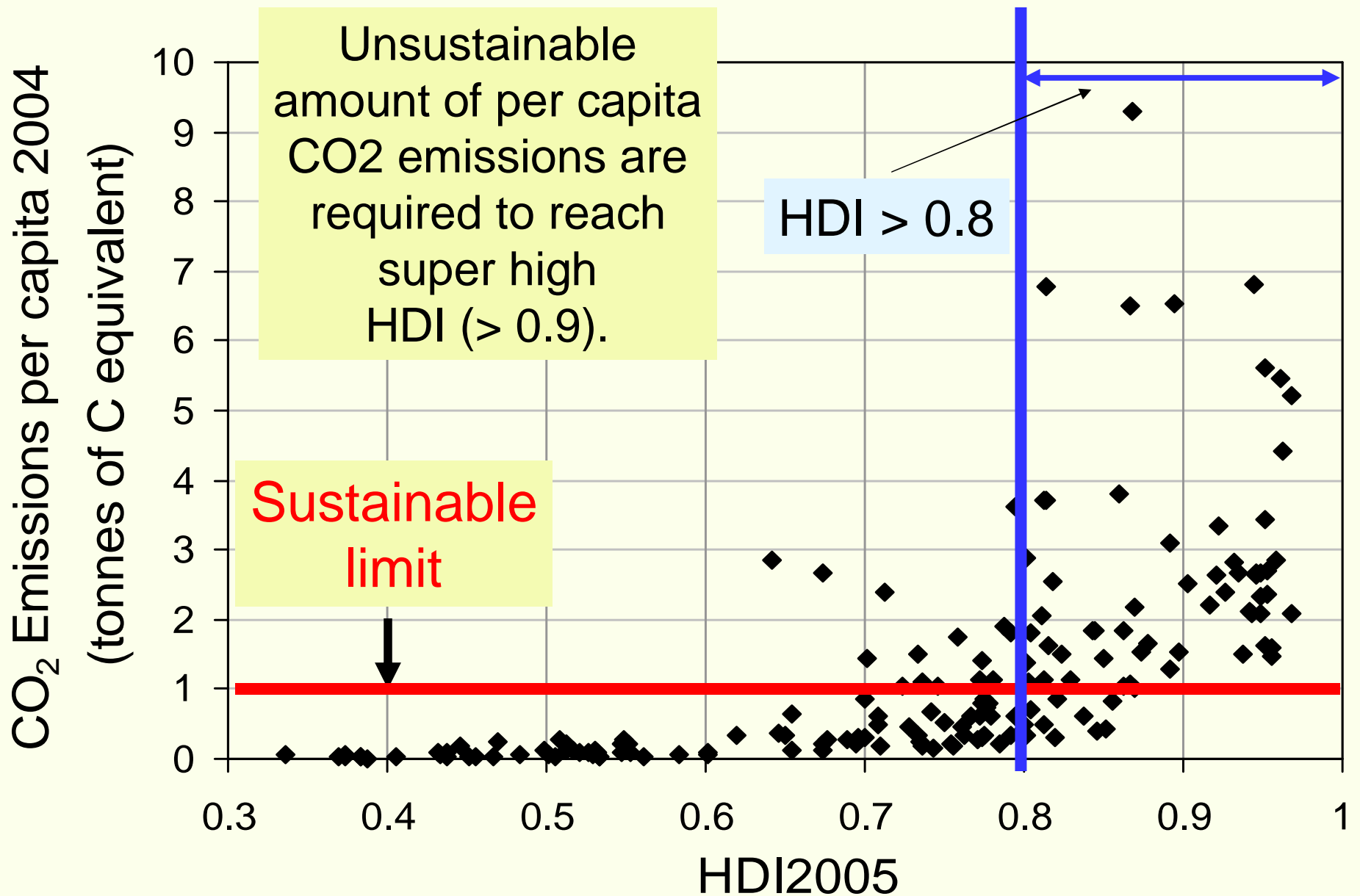
This translates to roughly 1 metric tonne of C equivalents per person per year.

CO₂ Emissions per capita 2004

(tonnes of C equivalent)







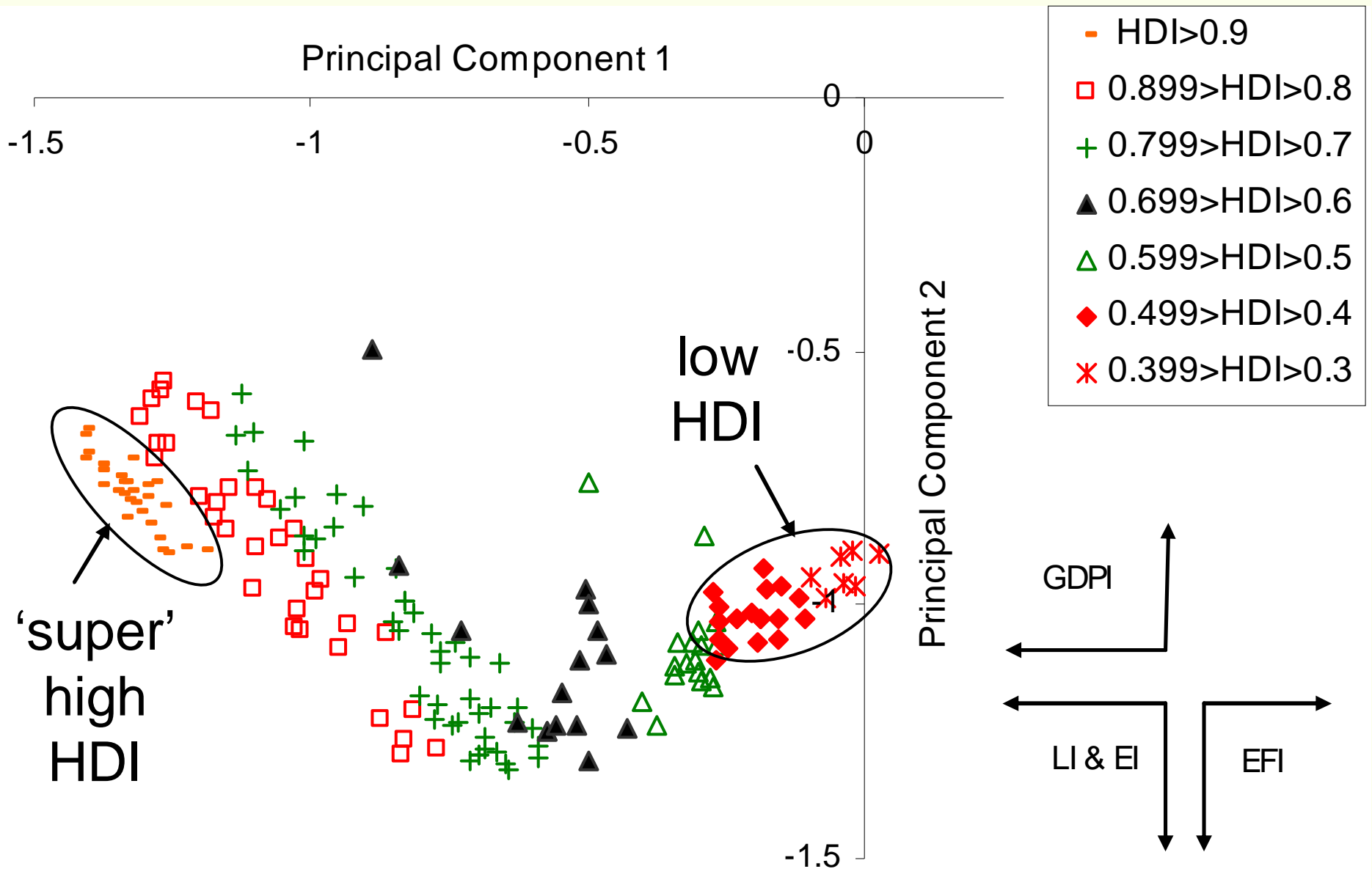
$$\text{Life Index (LI)} = \frac{\text{Life Expectancy} - 25}{85 - 25}$$

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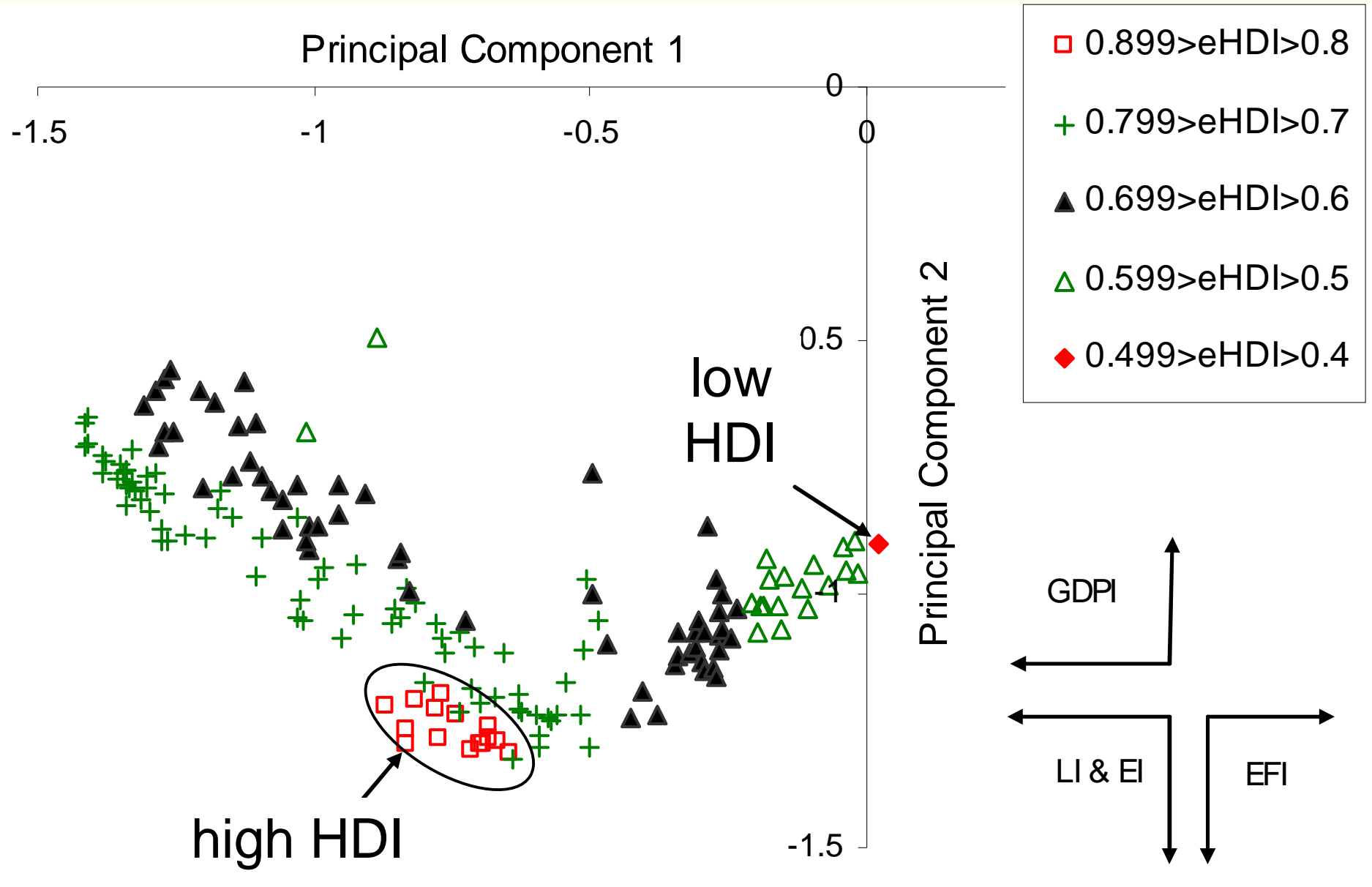
$$\text{Emission free Index (EFI)} = \frac{1}{(E/E_s)^2 + 1}$$

E = CO₂ emissions
 E_s = sustainable
CO₂ emissions



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$$\text{HDI} = \frac{\text{LI}}{3} + \frac{\text{EI}}{3} + \frac{\text{GDPI}}{3}$$



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$$eHDI = \frac{LI}{4} + \frac{EI}{4} + \frac{GDPI}{4} + \frac{EFI}{4}$$

UNDP defined HDI includes national averages of Life Expectancy, Adult Literacy, School Enrolment and the most criticized GDP per capita as components of human development.

It does not include the environmental component

UNDP defined HDI is therefore not a socially or environmentally responsible index to measure human development.

UNDP defined HDI is therefore not an index to measure sustainable development with.

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Ecological Footprint (EF)

- EF measures humanity's demand on nature.
- EF measures how much land and water area a human population requires to produce the resource it consumes and to absorb its wastes, using prevailing technology.
- EF does not include an economic indicator.

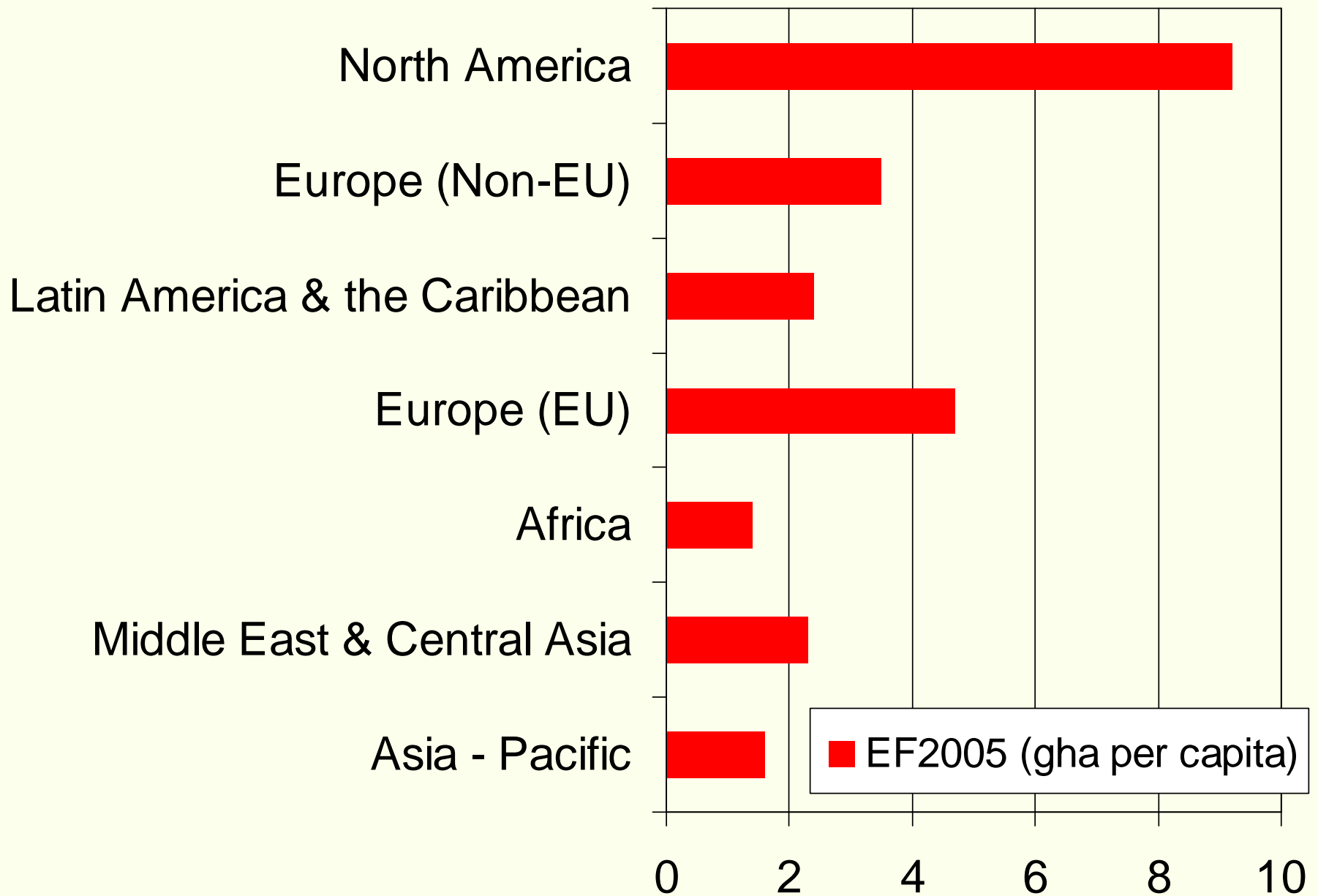
- Mathis Wackernagel & William Rees, 1990
University of British Columbia.

Ecological Footprint (EF)

- EF is measured in global hectare (gha)

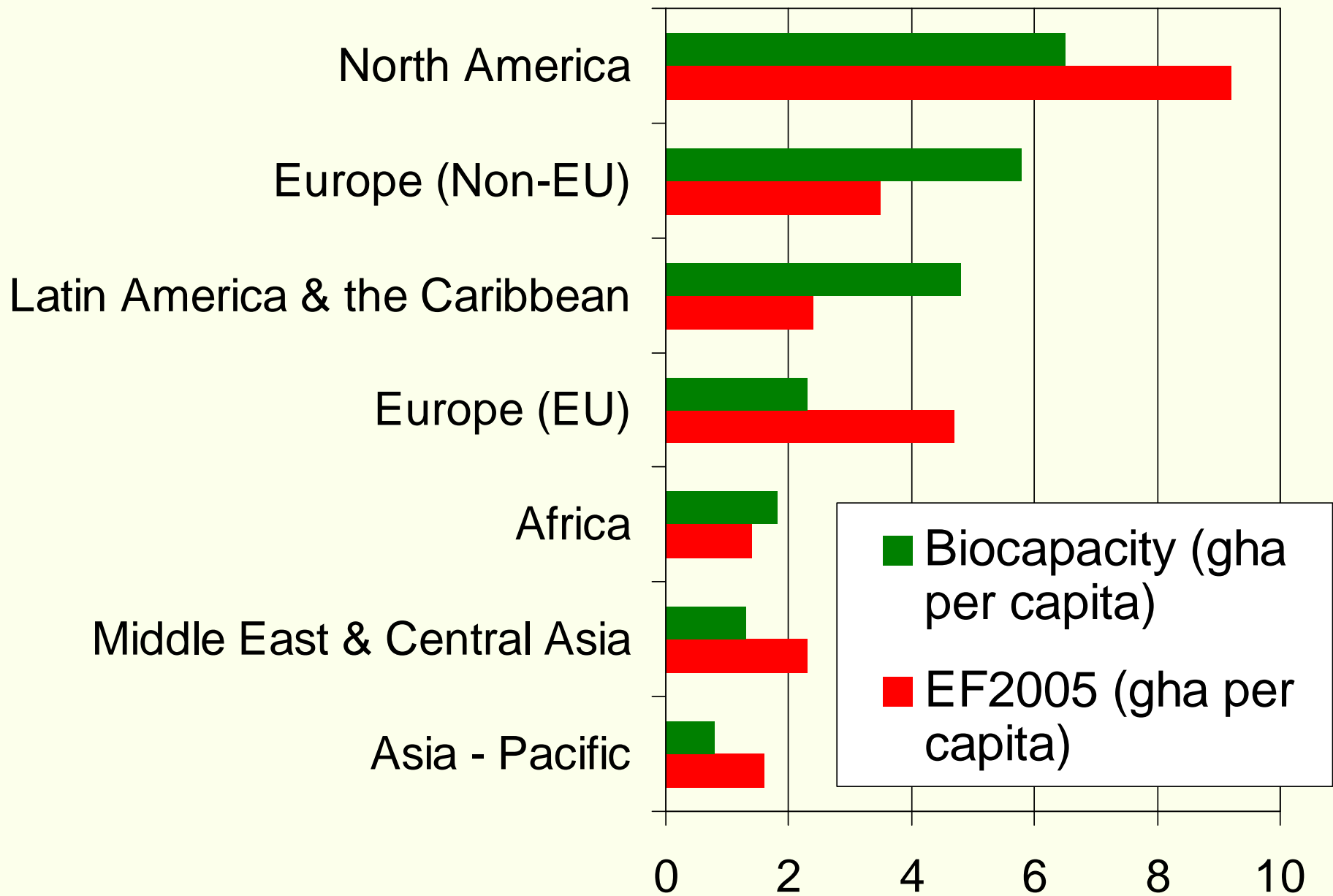
A global hectare (gha) is a common unit that encompasses the average productivity of all the biologically productive land and sea area in the world in a given year.

Biologically productive areas include cropland, forest and fishing grounds, and do not include deserts, glaciers and the open ocean.

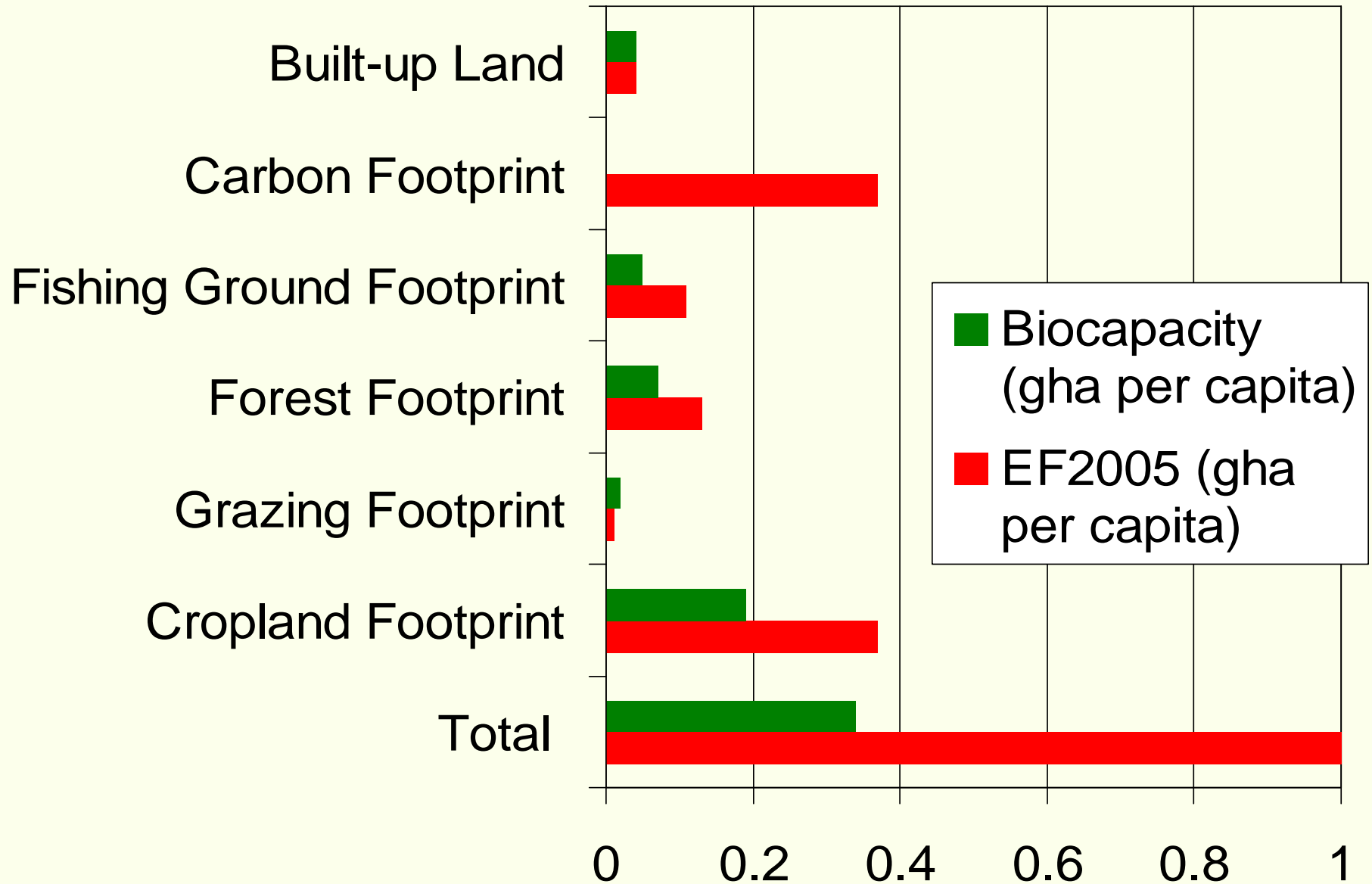


Biocapacity

- Biocapacity is shorthand for biological capacity, which is the ability of an ecosystem to produce useful biological materials and to absorb wastes generated by humans.



For Sri Lanka



Total global biocapacity

= 13.4 gha

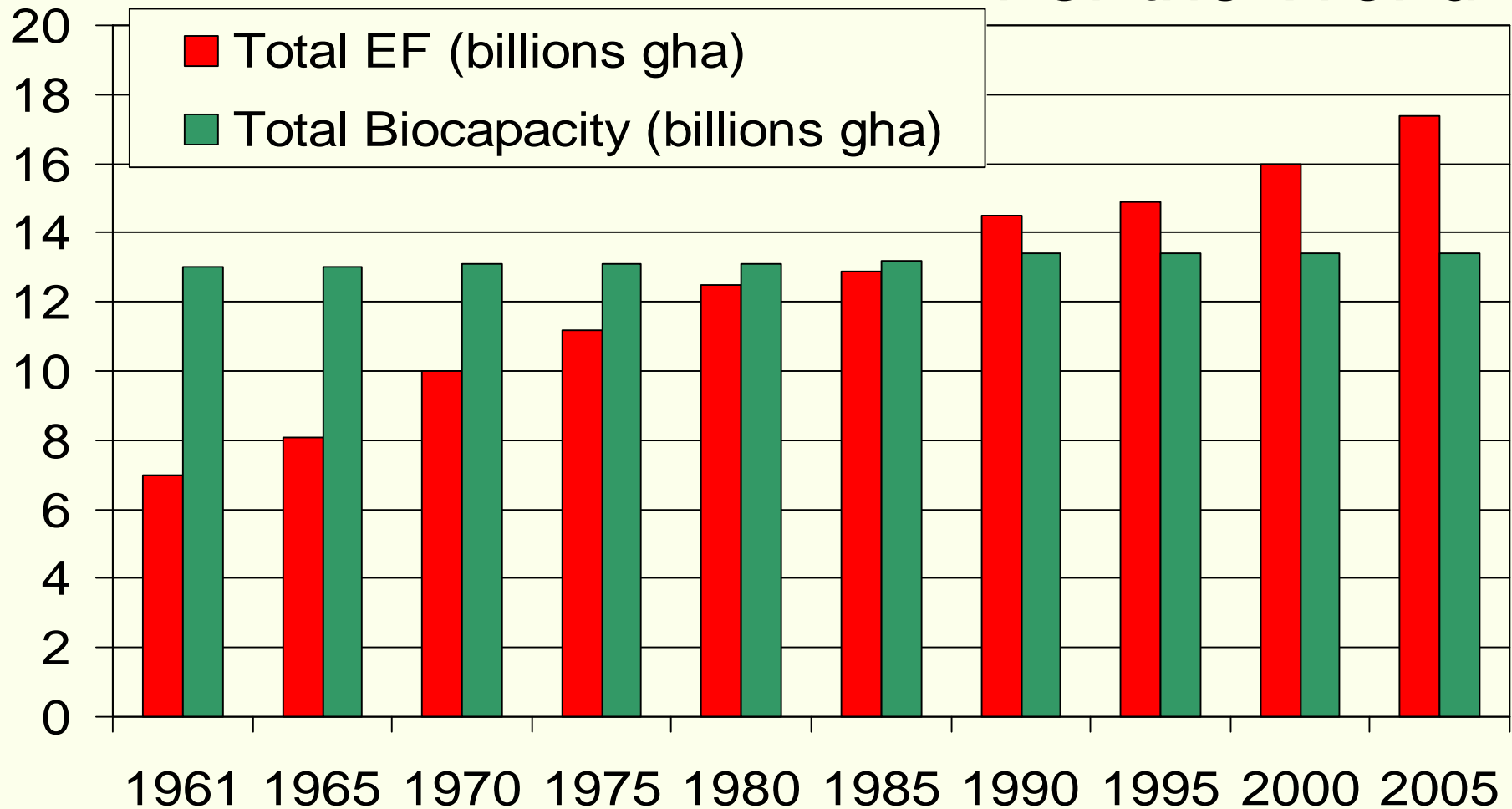
Total global biocapacity per capita

= 13.4 gha / 6.8 \approx 2 gha \approx 5 acres

Sustainable global EF per capita

= Total global biocapacity per capita
 \approx 2 gha per capita

For the World



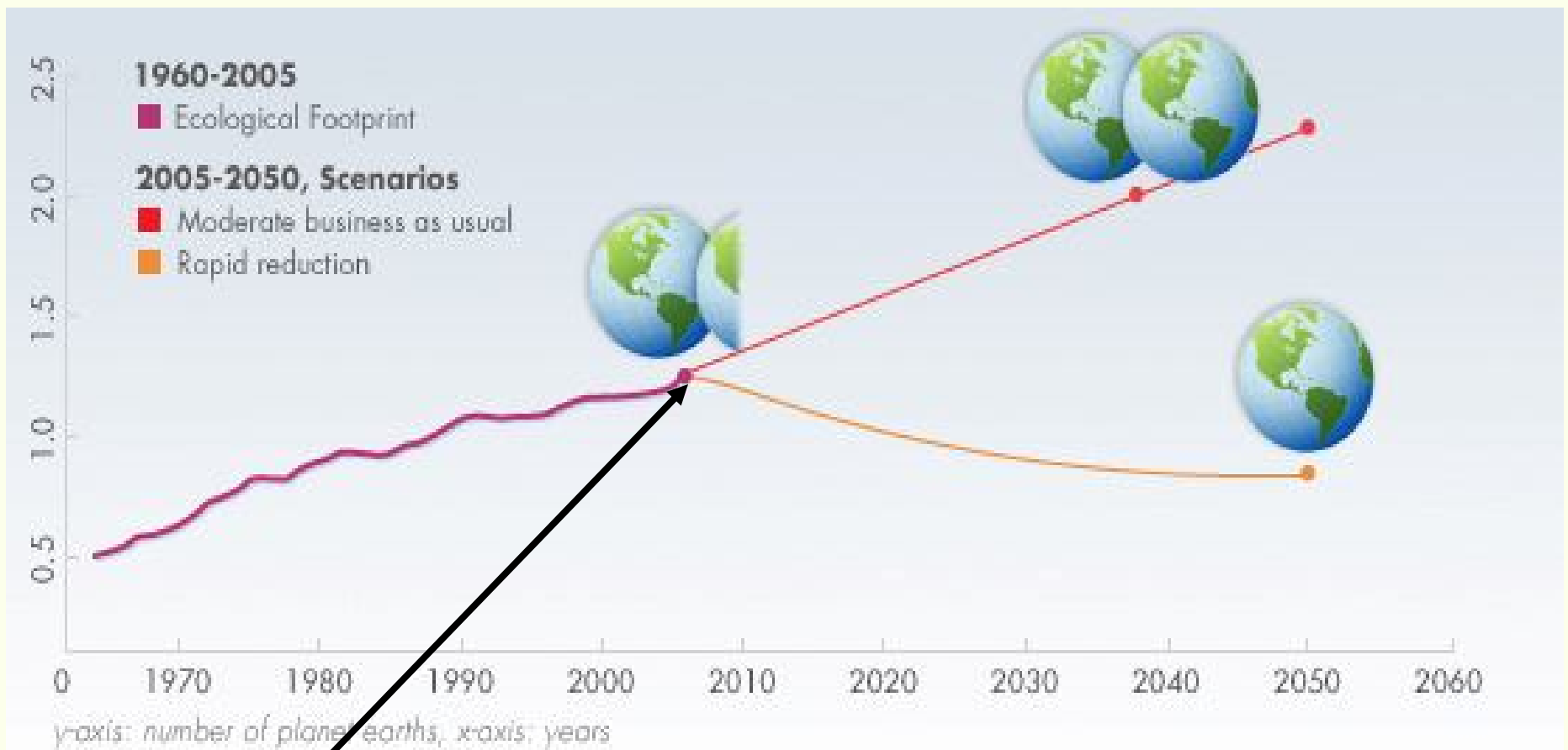
Before 1986, the world consumed resources and produced CO₂ at a rate consistent with what the planet could produce and reabsorb.

The day we have consumed resources equivalent to what the planet could produce in that year is known as the **Earth Overshoot Day** of that year.

In 1986, Earth Overshoot Day was at the end of December.

In 1996, Earth Overshoot Day was in November.

In 2008, Earth Overshoot Day moved forward to 23rd of September because we are now demanding resources at a rate of 40 percent faster than the planet can produce them.

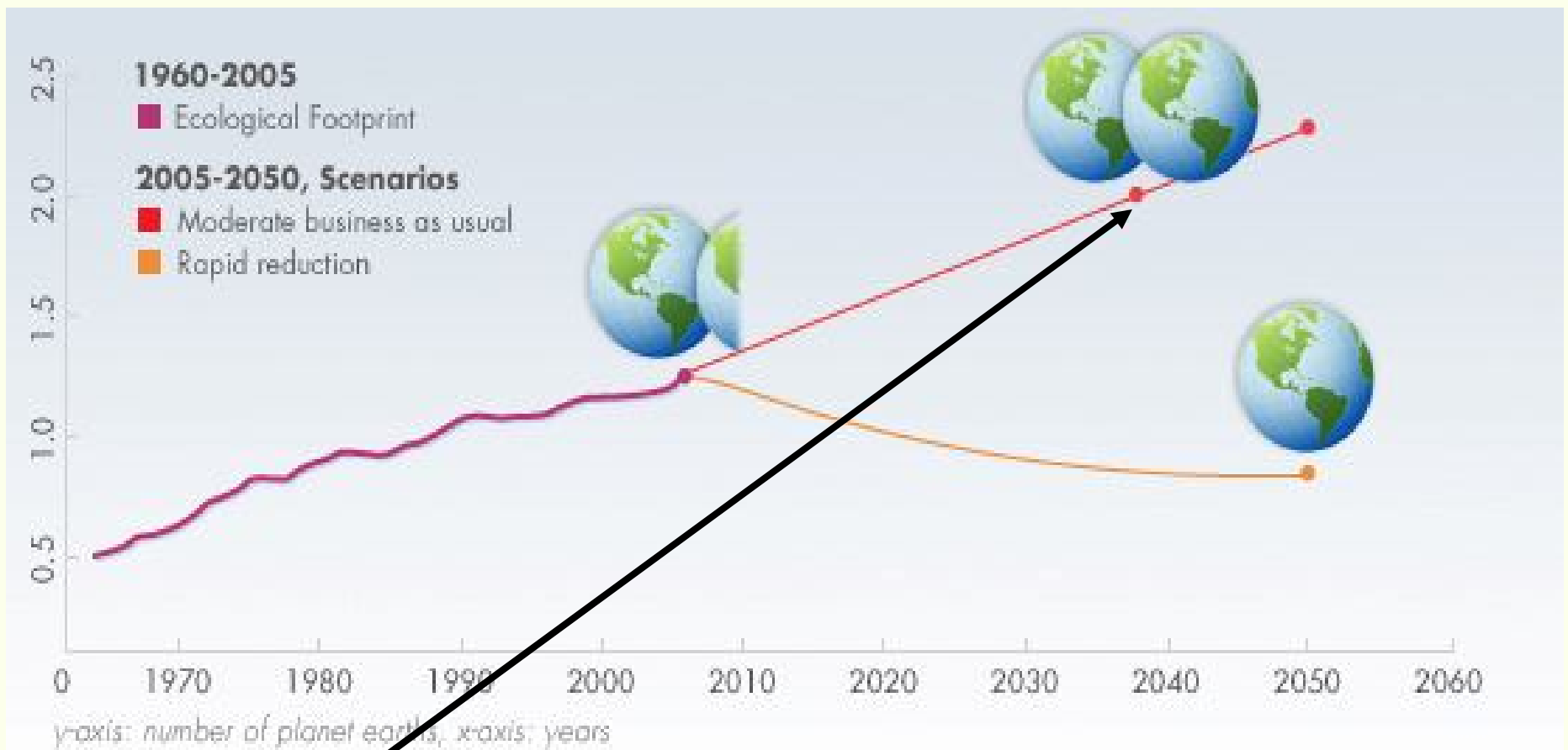


EF is 1.3 times the biocapacity in 2005. That is to say we need 1.3 planets to provide the resources we use and absorb our waste.

This means, in 2005, it took the Earth one year and four months to regenerate what we use in a year.

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Source: <http://www.footprintnetwork.org>

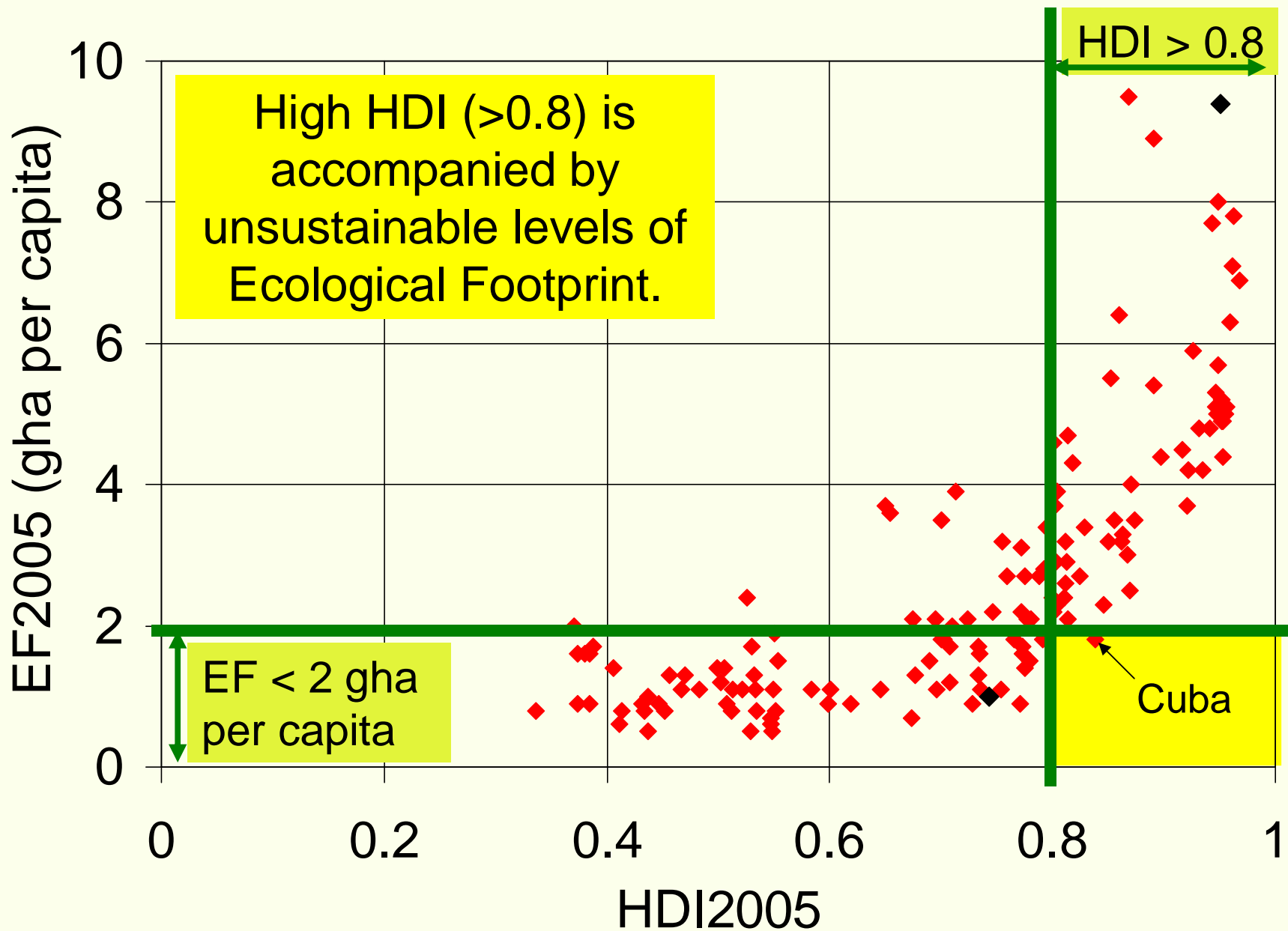


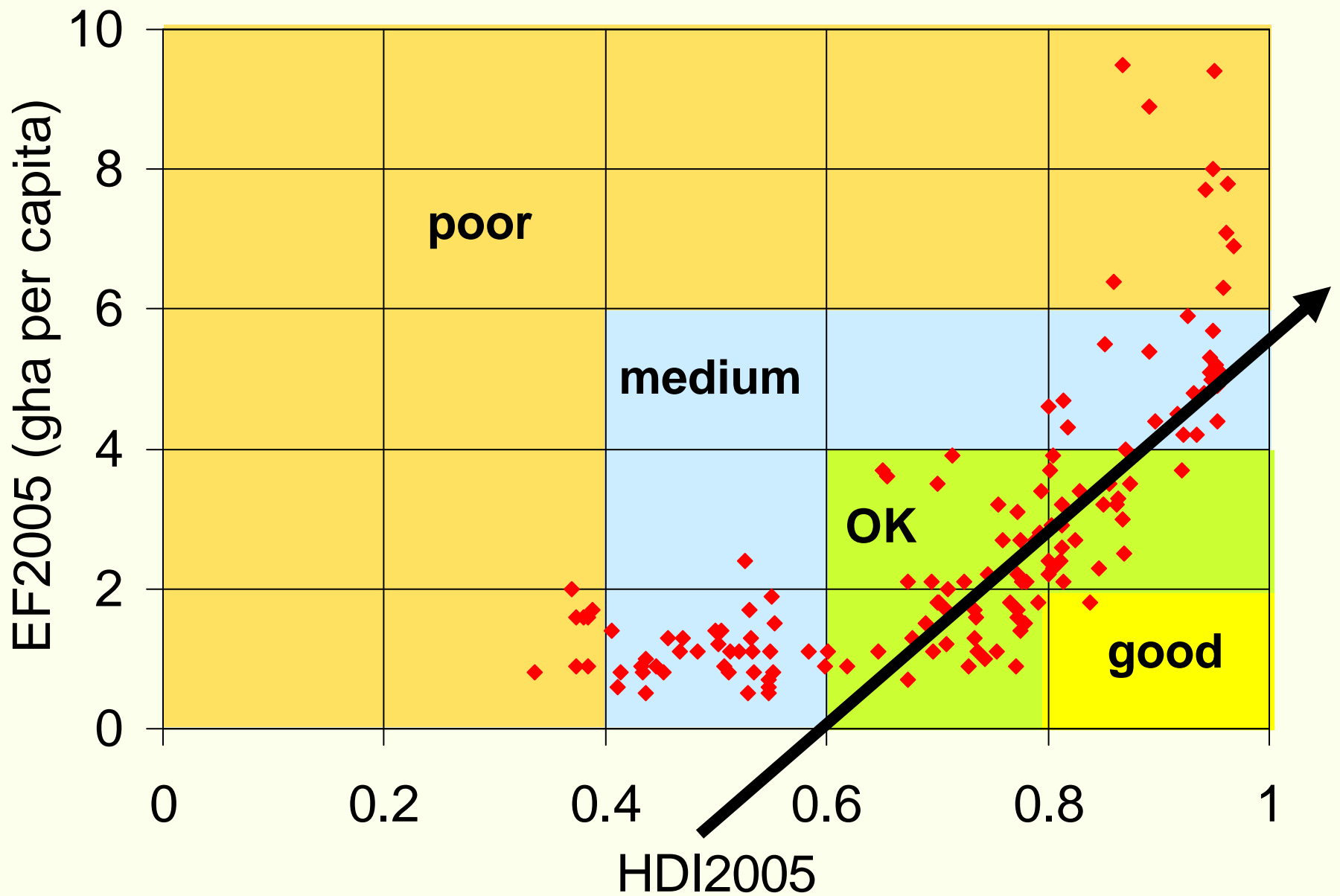
EF will be 2 times the biocapacity by the mid 2030 if current population and consumption trends continue according to moderate UN scenarios.

It means by the mid 2030s we will need the equivalent of 2 Earths to support us.

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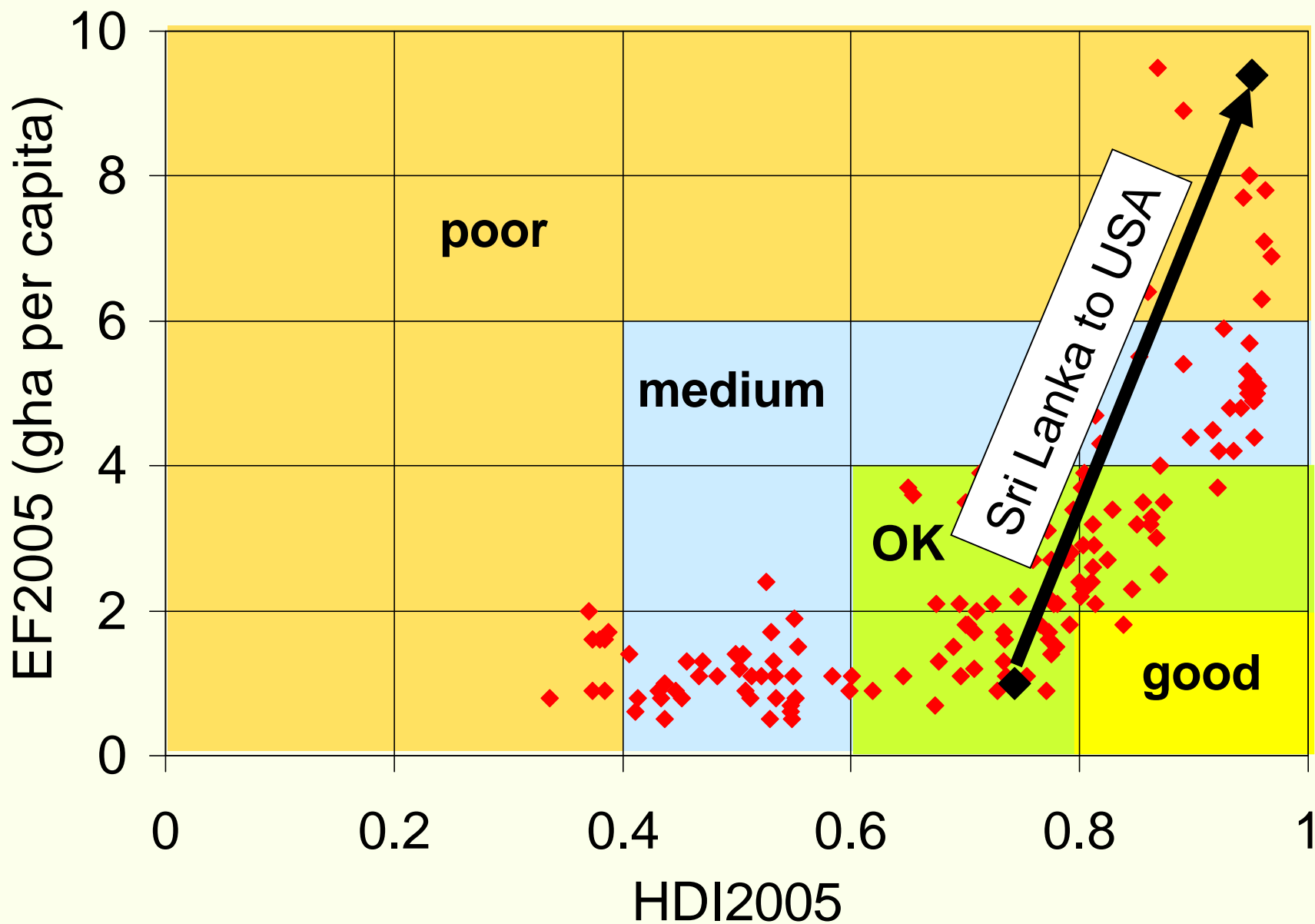
Source: <http://www.footprintnetwork.org>





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Source: <http://www.footprintnetwork.org> and
<http://hdr.undp.org/en/statistics/data/hdi2008>



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Source: <http://www.footprintnetwork.org> and
<http://hdr.undp.org/en/statistics/data/hdi2008>

How can we all live well and live within
the means of one planet?

The challenge ahead of us (engineers) is to
assist national and global development
to attain $HDI > 0.8$
while maintaining $EF < 2$ gha per capita.

HDI has flaws that must be rectified.
However, the above could be considered
as the first step towards SD

Other SD indices:

- Human Development Index (HDI)
- Ecological Footprint (EF)
- Living Planet Index (LPI)
- City Development Index (CDI)
- Environmental Sustainability Index (ESI)
- Environmental Performance Index (EPI)
- Environmental Vulnerability Index (EVI)
- Index of Sustainable Economic Welfare (ISEW)
- Well Being Index (WI)
- Genuine Savings Index (GS)
- Environmental Adjusted Domestic Product (EDP)

Refer to 'Measuring the Immeasurable: A Survey of Sustainability Indices' by C. Böhringer & P. Jochem
(made available at www.rshanthini.com)

Goals of Sustainable Development

Another way to define SD is in
what it specifically seeks to achieve

SD short-term (2015) Goals:

Millennium Development Goals (MDGs) of the United Nations

They are 8 international development goals

192 UN member states have agreed to achieve them by the year 2015

They were developed out of the 8 chapters of the UN Millennium Declaration

Signed in September 2000 at the Millennium Summit in 2000

Goal 1: Eradicate Extreme Poverty and Hunger

Goal 2: Achieve Universal Primary Education

Goal 3: Promote Gender Equality and Empower Women

Goal 4: Reduce Child Mortality

Goal 5: Improve Maternal Health

Goal 6: Combat HIV/AIDS, Malaria and Other Diseases

Goal 7: Ensure Environmental Sustainability

Goal 8: Develop a Global Partnership for Development

Goal 1: Eradicate Extreme Poverty and Hunger

Target 1:

Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day

Target 2:

Achieve full and productive employment and decent work for all, including women and young people

Target 3:

Halve, between 1990 and 2015, the proportion of people who suffer from hunger

Goal 2: Achieve Universal Primary Education

Target 1:

Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

Goal 3: Promote Gender Equality and Empower Women

Target 1:

Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015

Goal 4: Reduce Child Mortality

Target 1:

Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate

Goal 5: Improve Maternal Health

Target 1:

Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio

Target 2:

Achieve, by 2015, universal access to reproductive health

Goal 6: Combat HIV/AIDS, Malaria and Other Diseases

Target 1:

Have halted by 2015 and begun to reverse the spread of HIV/AIDS

Target 2:

Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it

Target 3:

Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases

Goal 7: Ensure Environmental Sustainability

Target 1:

Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources

Target 2:

Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss

Target 3:

Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation

Target 4:

By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers

Goal 8: Develop a Global Partnership for Development

Target 1:

Develop further an open, rule-based, predictable, non-discriminatory trading and financial system

Target 2:

Address the special needs of the least developed countries

Target 3:

Address the special needs of landlocked developing countries and small island developing States

Target 4:

Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term

Goal 8: Develop a Global Partnership for Development (continued)

Target 5:

In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries

Target 6:

In cooperation with the private sector, make available the benefits of new technologies, especially information and communications

SD long-term (beyond 2050) Goals:

The Great Transition of the Global Scenario Group

Conventional Worlds scenario:

capitalist values maintained and only market forces and incremental policy reform trying to curb environmental degradation.

Barbarization scenario:

environmental collapse leads to an overall social collapse.

The Great Transition scenario:

humanity changes its relationship with the environment.