Institute and Faculty of Actuaries

Resource and Environmental Limits to Economic Growth

National Association of Pension Funds, Leeds

Oliver Bettis, FIA FCII
Dan O'Neill, PhD

18th March 2014

Introduction

- In January 2014 the Institute and Faculty of Actuaries established a Resource and Environment (R&E) Board
- Why? The IFoA has identified resource depletion (e.g. high oil price) and environmental issues (e.g. climate change) as being important issues for investigation.
- Research was commissioned on limits to economic growth, reporting in January 2013.
- The IFoA does not assert that growth/discount rates need to be changed now – just this is an area for investigation.
- The IFoA has no position on steady state economics.

Agenda

Part 1. Oliver Bettis, Chair of IFoA's Resource and Environment Board

- Resource and environmental constraints: Including extracts from the IFoA's research report from January 2013

- What could this mean for pension funds?

Agenda

Part 2. Dan O'Neill, Leeds University

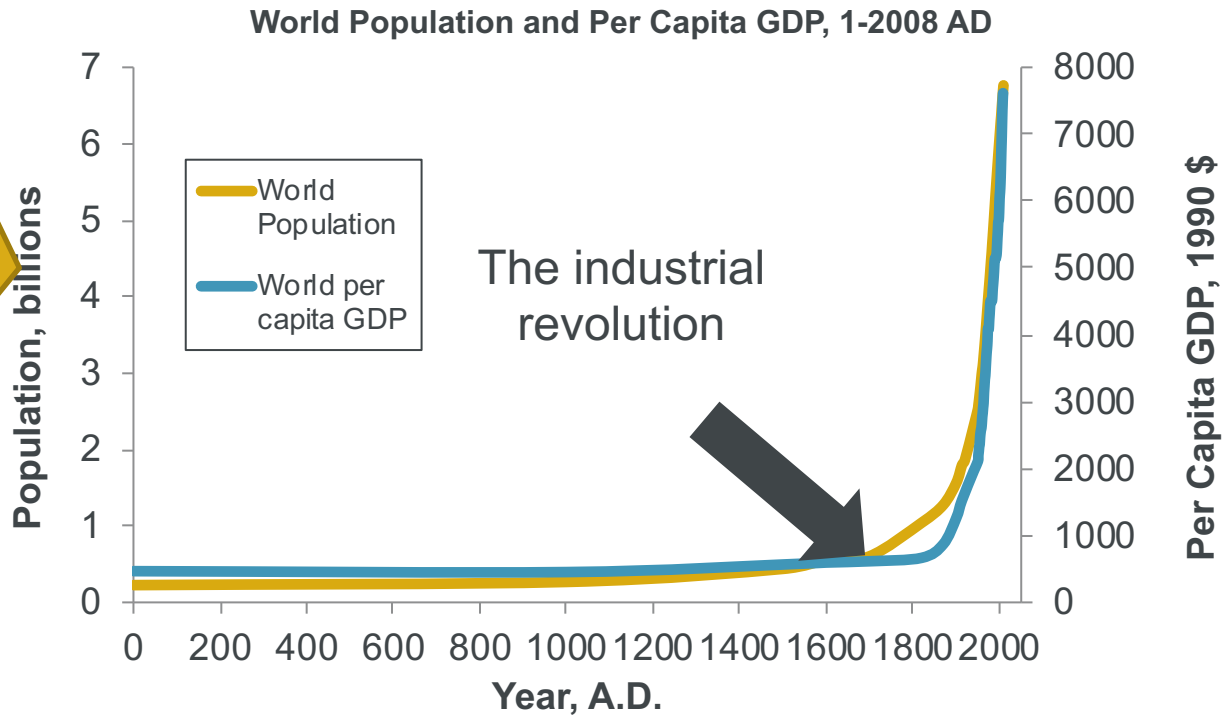
- Steady State Economics
  - What is it?
  - Is it feasible?

Exponential Growth

Exponential Growth

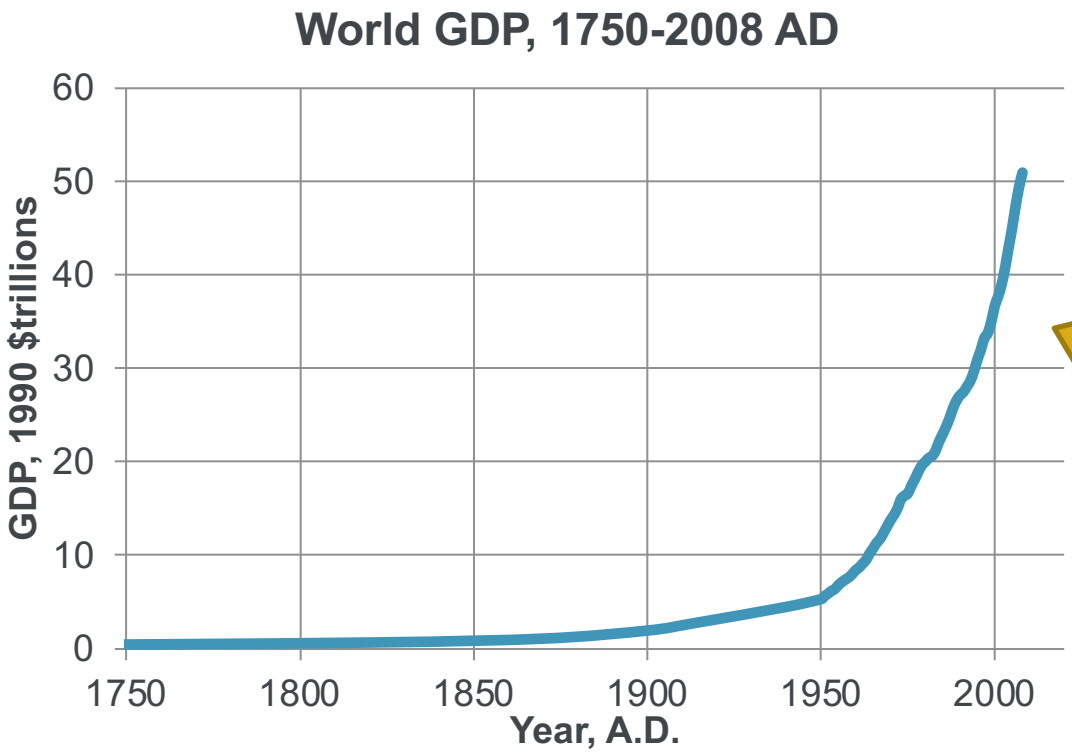
Until recently, global population has exhibited exponential growth.

Likewise the per capita GDP has been growing exponentially.



Source: http://www.albartlett.org
There is a great presentation about exponential growth at this web address.

Exponential Growth

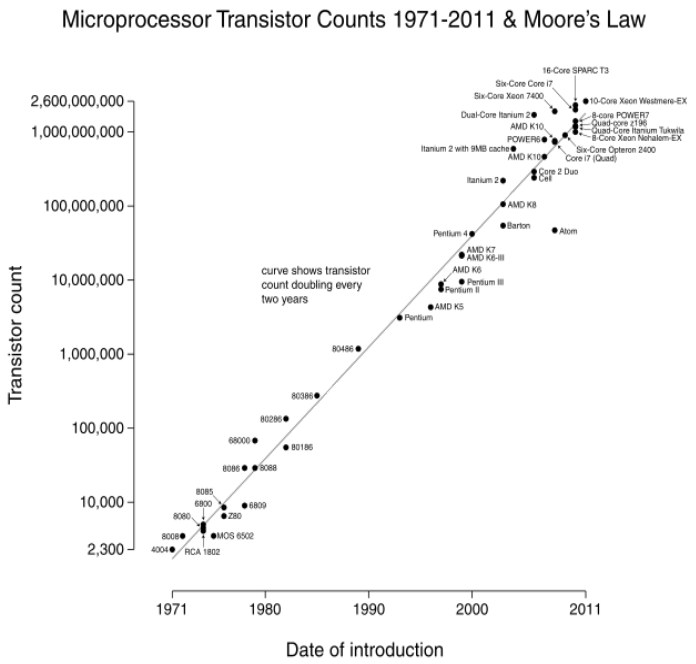


Exponential Growth

World GDP growth has been exponentially growing.

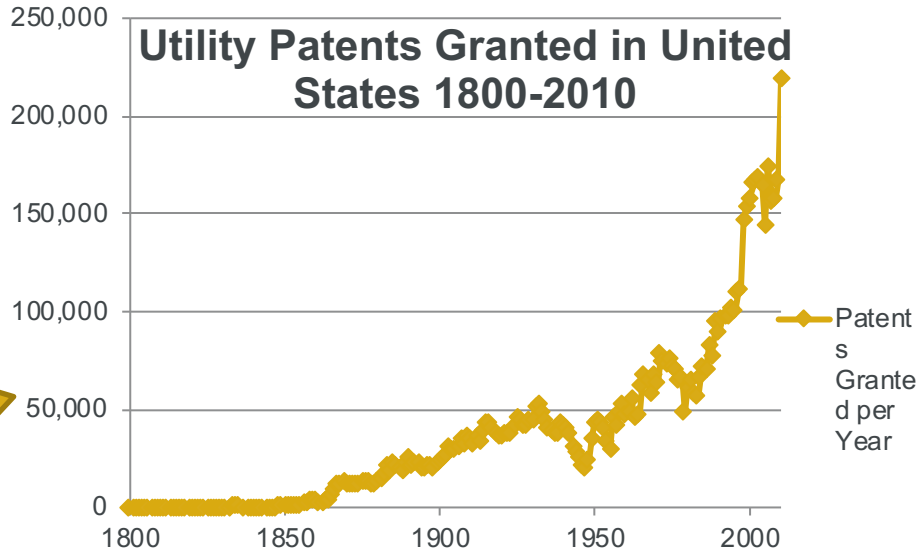
- In real terms world GDP has grown at average rate of c.3% per year in recent decades = doubling time 23 years.
- 2012 to 2100 is almost 4 doubling periods.
- If 3% growth continues, world economy would grow 14 times as large in 2100 as it is now.

Growth in Knowledge



Moore's Law

The number of transistors that can be placed inexpensively on an integrated circuit doubles approximately every two years.



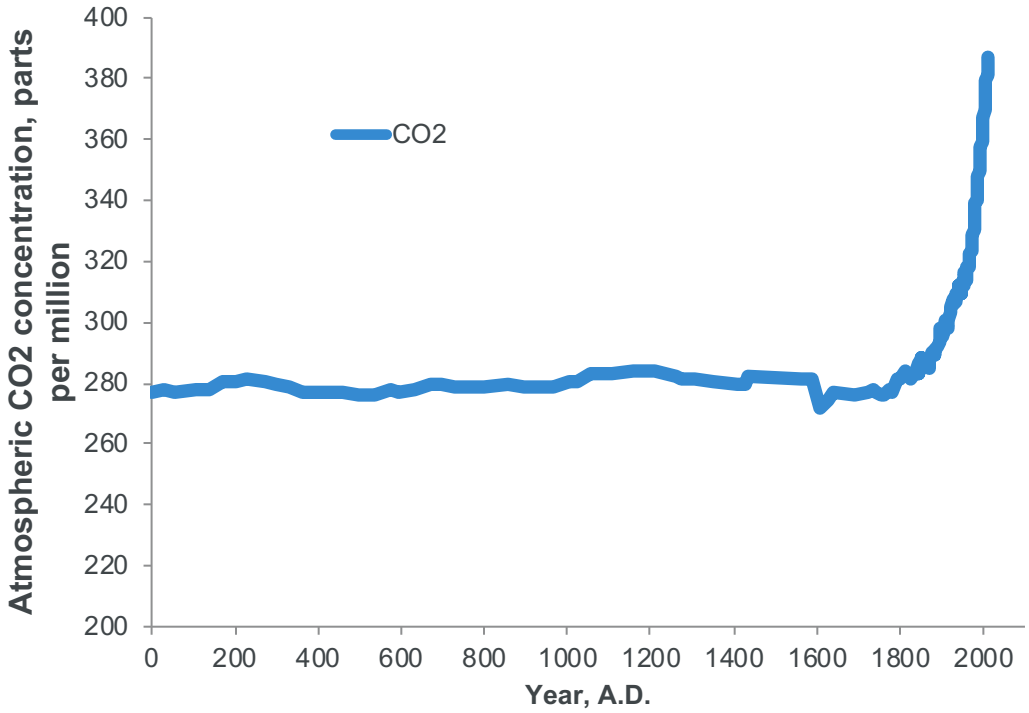
Intellectual Property

No. of patents granted illustrates the explosive growth in human knowledge.

Growth has a downside

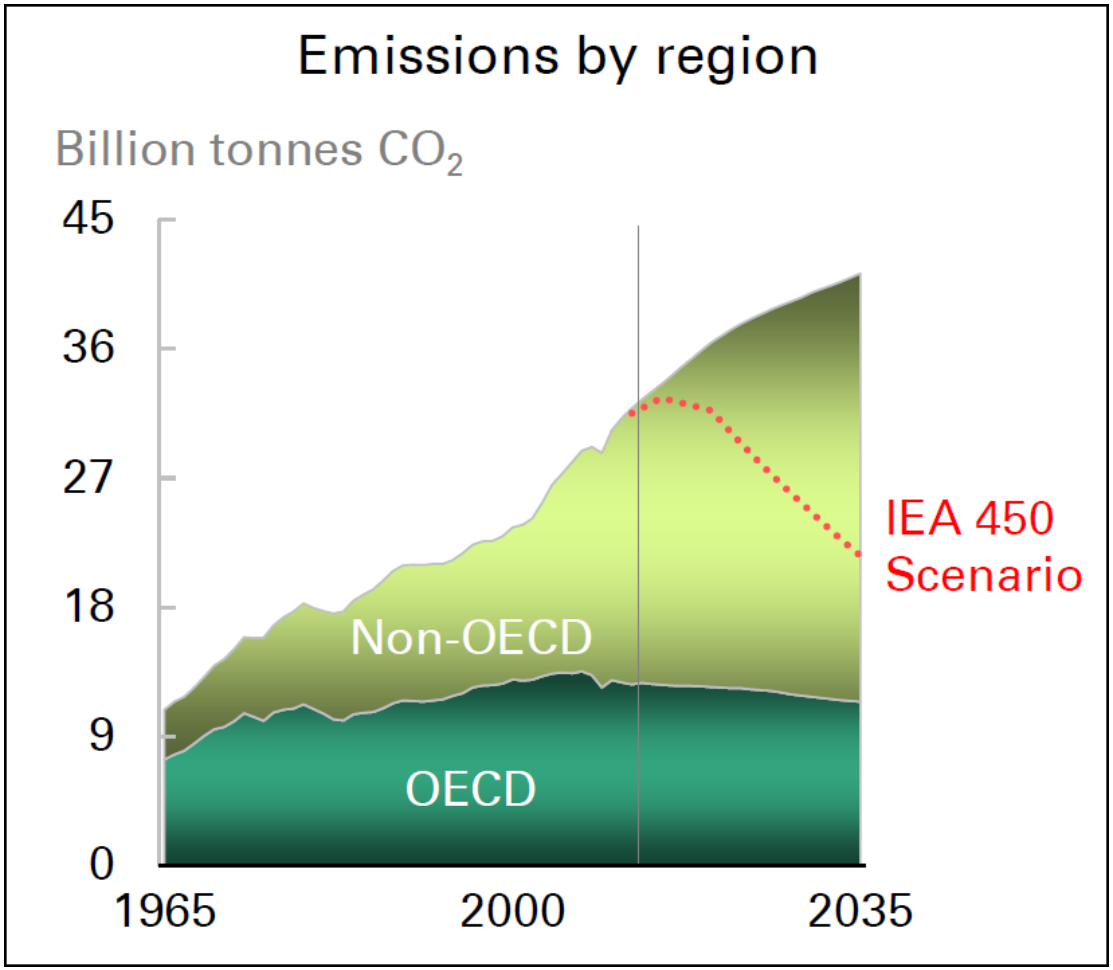
Carbon Dioxide

Not everything that grows exponentially is that great.



Source: Scripps Institution of Oceanography (SIO) CO2 Program http://scrippsco2.ucsd.edu R. F. Keeling, S. C. Piper, A. F. Bollenbacher and S. J. Walker

CO2 Emissions not on a sustainable path



Source: BP Energy Outlook 2035 – January 2014

Physical Limits to Growth?

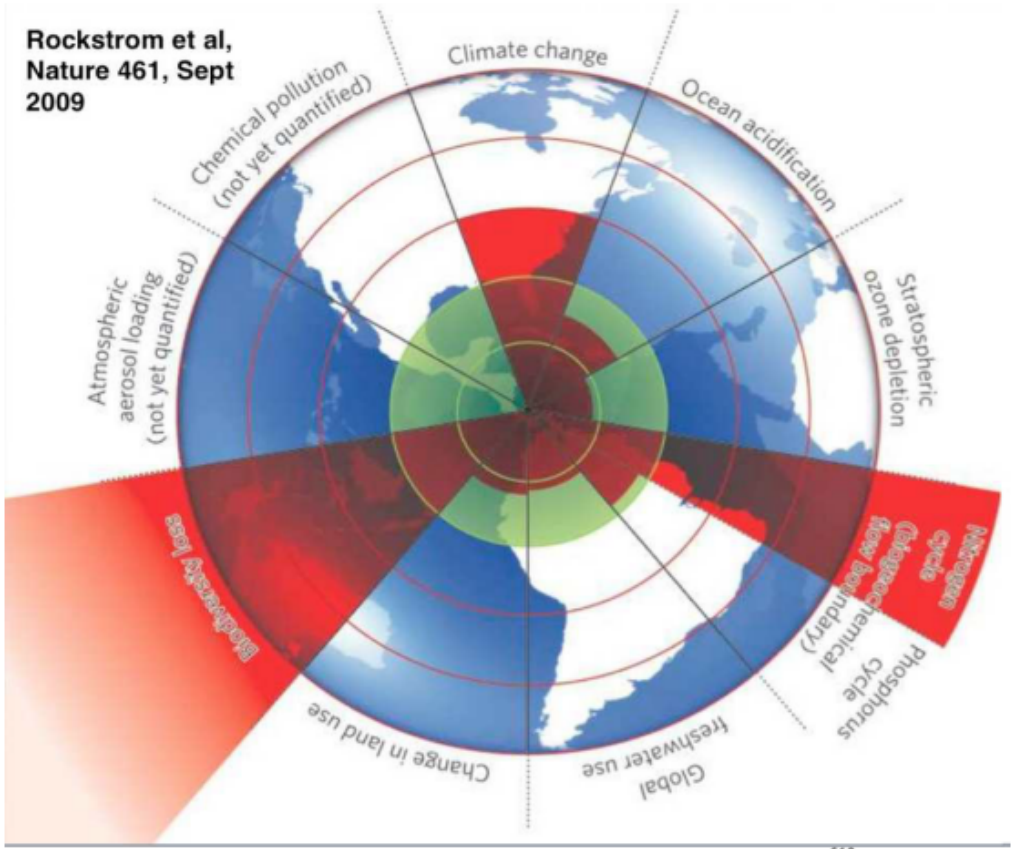


Figure 50: The 9 planetary boundaries of the Stockholm Resilience Centre. [619]

Stockholm University Resilience Centre (Planetary Boundaries)

This is the info-graphic (from 2009) showing the planetary thresholds and boundaries.

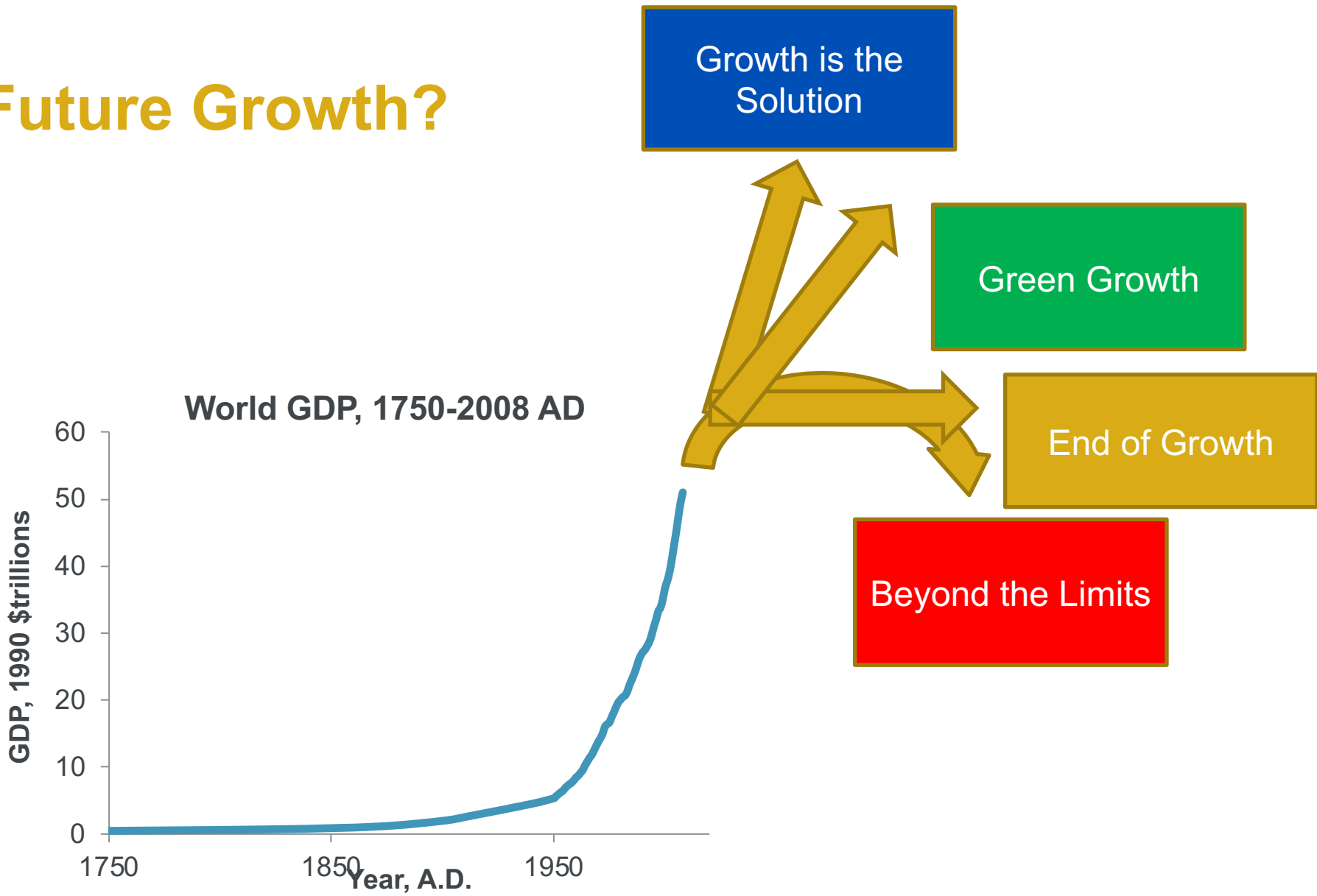
Beyond Boundary

- Climate Change

Beyond Threshold

- Rate of Biodiversity Loss
- Changes in Nitrogen Cycle

Future Growth?



Opinions: Growth is the Solution

Growth is the Solution

Madison (Contours of the World Economy) predicts 2003-2030 will be the fastest growing period in history – 2.25 fold increase in GDP.

Ridley (The Rational Optimist) speaks of the ability of humankind to adapt to new challenges – i.e. inventiveness and innovation will ensure growth.

Opinions: Green Growth

Green Growth

UNEP International Resource Panel says costs of growth now outweigh benefits. **Global resource usage grew 2x fast as population but not as fast as GDP – so some decoupling of GDP observed**.

OECD Towards Green Growth Framework calls for a move to green growth will foster economic development and continue to provide natural resources. Follows Green Growth Declaration signed by 34 ministers in June 2009.

Resource Revolution (McKinsey Global Institute). **Price falls over 20C wiped out by last 10 years of price rises**. Next 20 years we will have 3bn more middle class consumers . They offer two scenarios. productivity static (supply expansion) + productivity response (most demand met by productivity). Latter scenario needs a good deal more investment but neither avoid 2 degree warming. Third scenario "climate response case" – move to low carbon energy, reforestation, land restoration, carbon capture,

Shell have two scenarios Scramble (energy efficiency left until supplies tight + greenhouse gas emissions cut when climate change happens) and Blueprint (local actions to ensure growth, deliver energy security and mitigate environment). 2011 updates suggests messages mixed whether we are following Scramble or Blueprint . **Shell actively supports Blueprint**

IEA produced scenarios "Current Policies", "New Policies" and "450" – the former two suggest significant global warming – the latter one. **Advocate increasing nuclear, gas and renewables**. In 450 scenario - 4/5 of carbon allowed until 2050 is locked in already.

Opinions: End of Growth

Limits to Growth stressed (reiterated) that humanity is on course to overshoot.

Based on a systems dynamics world view – interconnections, feedback loops, delays, event interactions.

They conclude overshoot caused by…

- Rapid Change
- Limits / barriers to change
- Errors / delays in perceiving limits / controlling change.

Concludes that physical growth will ultimately cease completely whether we like it or not.

Limits to Growth – Predictions

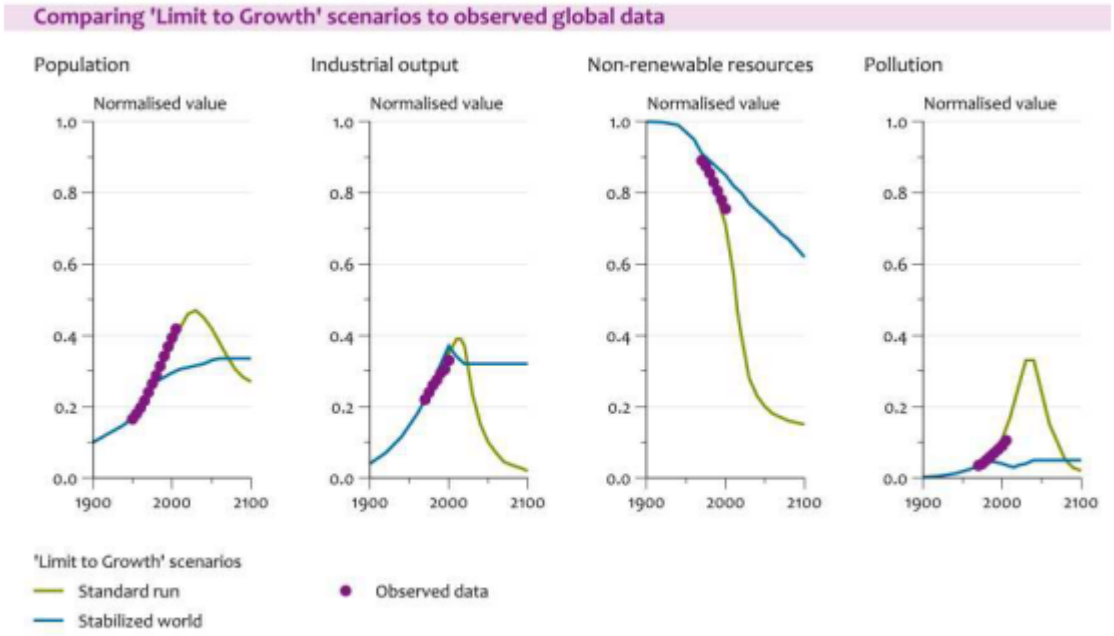


Figure 1: Comparison of World3 Limits to Growth scenarios to observed data. [13]

Limits to Growth (30 Year Update)

The 1972 LtG paper used a systems dynamics model (World 3) to explore the feedback between;

- Population
- Industry
- Food
- Non-renewable resources
- Pollution system.

The green lines represent the "standard scenario" – which is a business as usual (growth agenda).

The purple observations show the realised observations.

Netherlands Environmental Assessment Agency / Turner (2008)

Why so many views?

Fatalistic	**Hierachic**
Individualistic	**Egalitarian**

Cultural Theory of Risk

Anthropology has something to say about this.

That there are 4 *social constructions* of risk that affect the way people perceive risk taking.

Ref: Michael Thompson, IASA 2008

Evidence for Resource Limits

- Fossil fuels (Oil, coal and gas)
- Land, soil and food
- Fresh water
- Uranium
- Commodities (e.g. copper, iron, zinc, rare Earth metals)

Oil

This graph from the IEA (International Energy Agency) 2008 World Energy Outlook – shows significant dependence on fields yet to be developed.

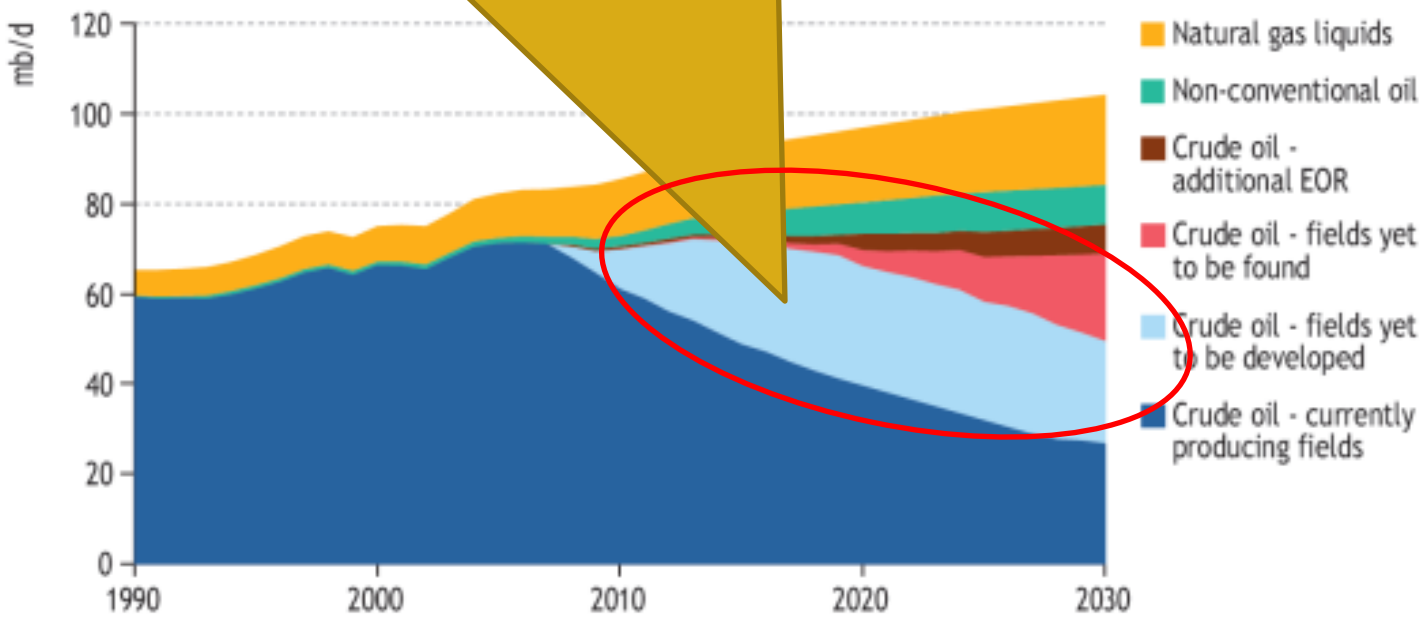


Figure 7: World oil production by source in the 2008 Reference Scenario[224]

Oil

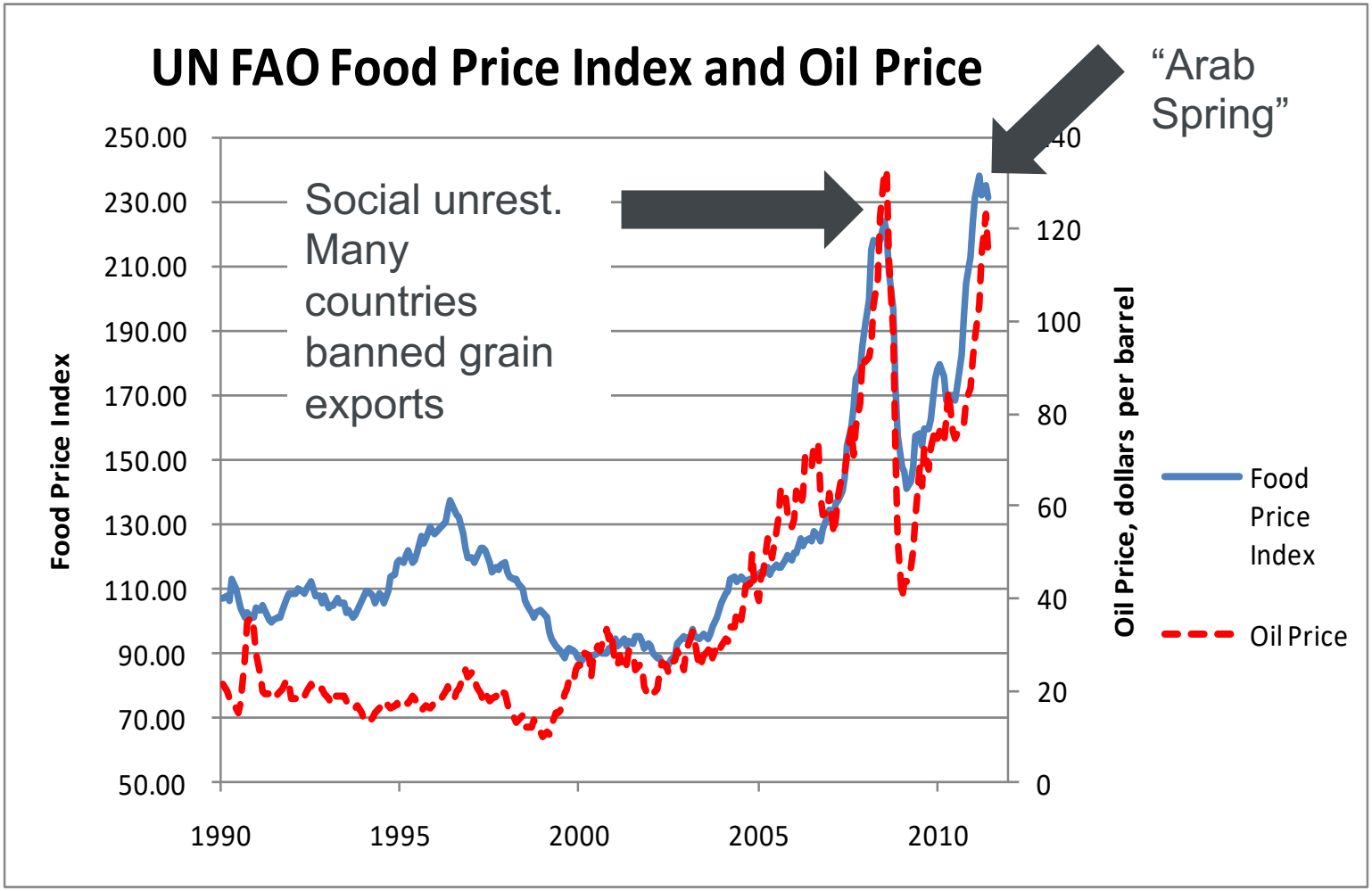
Issues

- New fields are smaller – and therefore run off faster.
- EROEI (energy returned on energy invested) is falling.
- Many national oil companies – oil set to become more of a political issue

When will Peak Oil occur?

According to some it has occurred already (e.g. Macquarie Group) – according other others it is a long way off (e.g. Exxon Mobil).

Limits interact e.g. oil, food prices and civil unrest



Sources: http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/
http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=rbrte&f=m

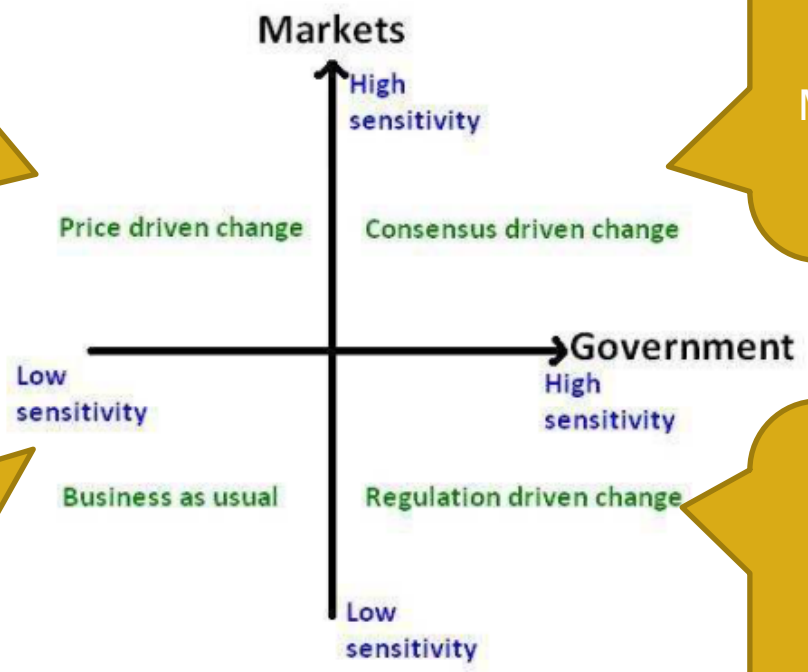
Actuarial – Scenarios in the Paper (Briefly)

Government NOT sensitive to long term projections.

Markets sensitive to long term projections.

Government sensitive to long term projections.

Markets sensitive to long term projections.



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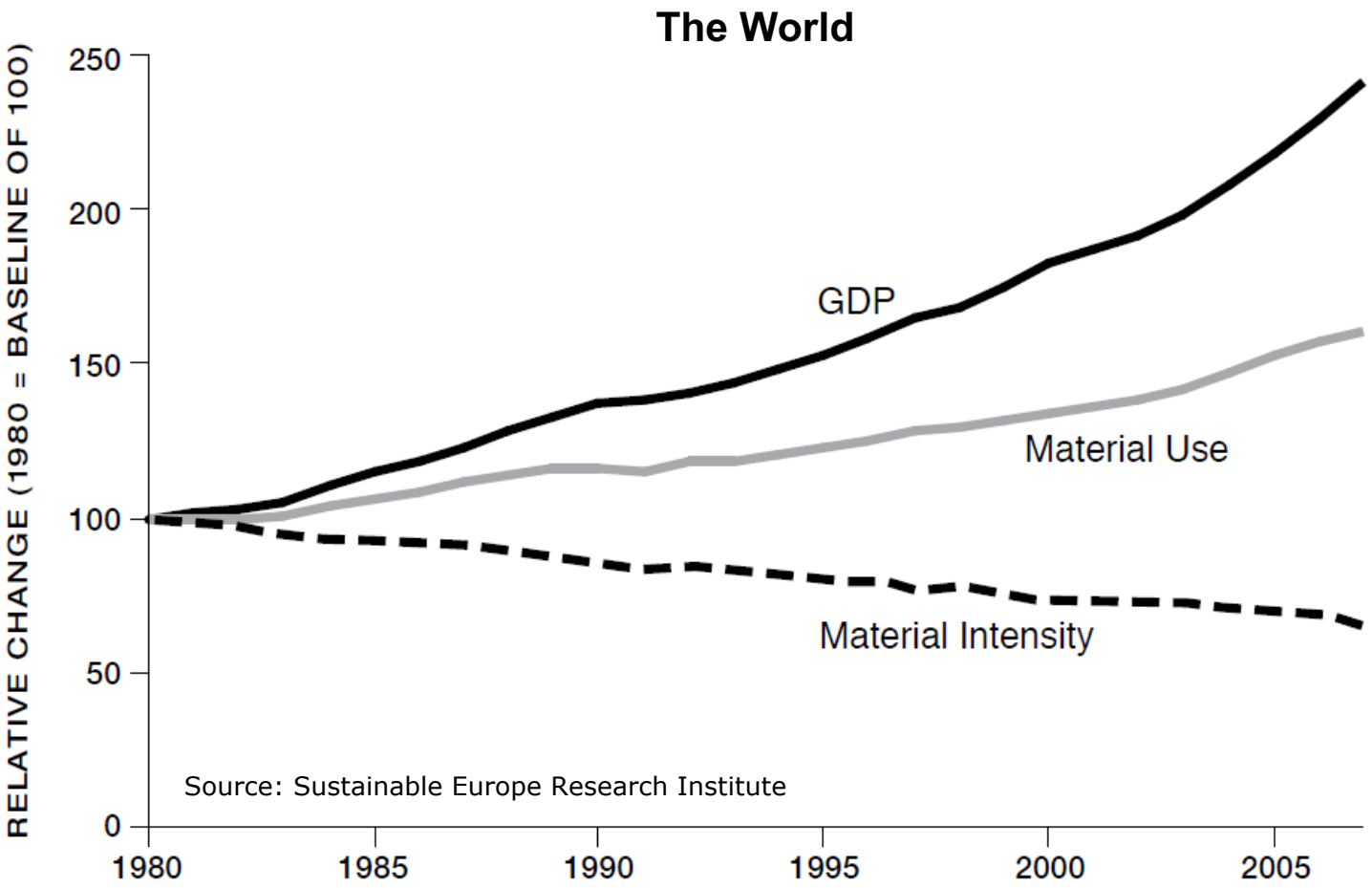
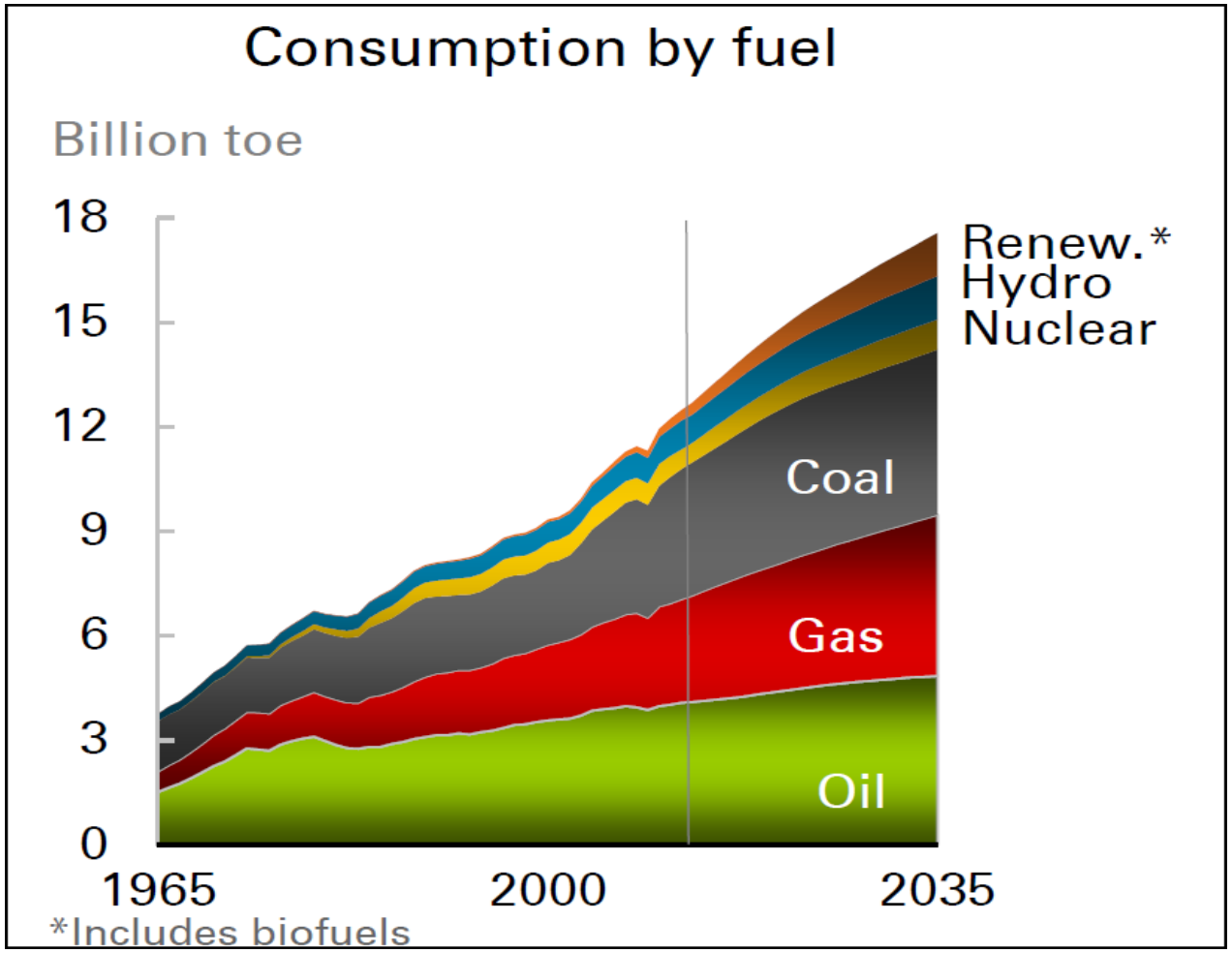
Can Technology Save Us?



Projected Energy Demand to 2035



Source: BP Energy Outlook 2035 – January 2014

The Rebound Effect

THE

COAL QUESTION;

AN INQUIRY

CONCERNING THE PROGRESS OF THE NATION,

AND THE

PROBABLE EXHAUSTION OF OUR COAL-MINES.

W. STANLEY JEVONS, M.A.

FELLOW OF UNIVERSITY COLLEGE, LONDON;

CORRESPONDING PROFESSOR OF POLITICAL ECONOMY IN OWENS COLLEGE, MANCHESTER.

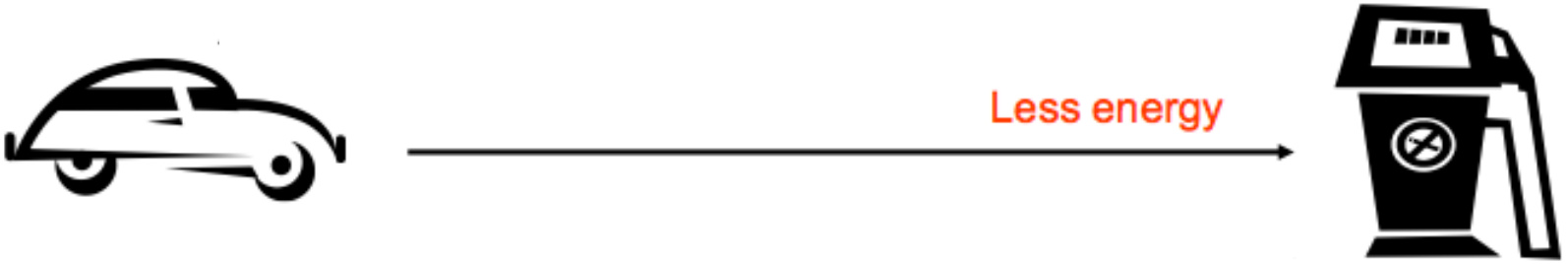
SECOND EDITION, REVISED.

London:

MACMILLAN AND CO.

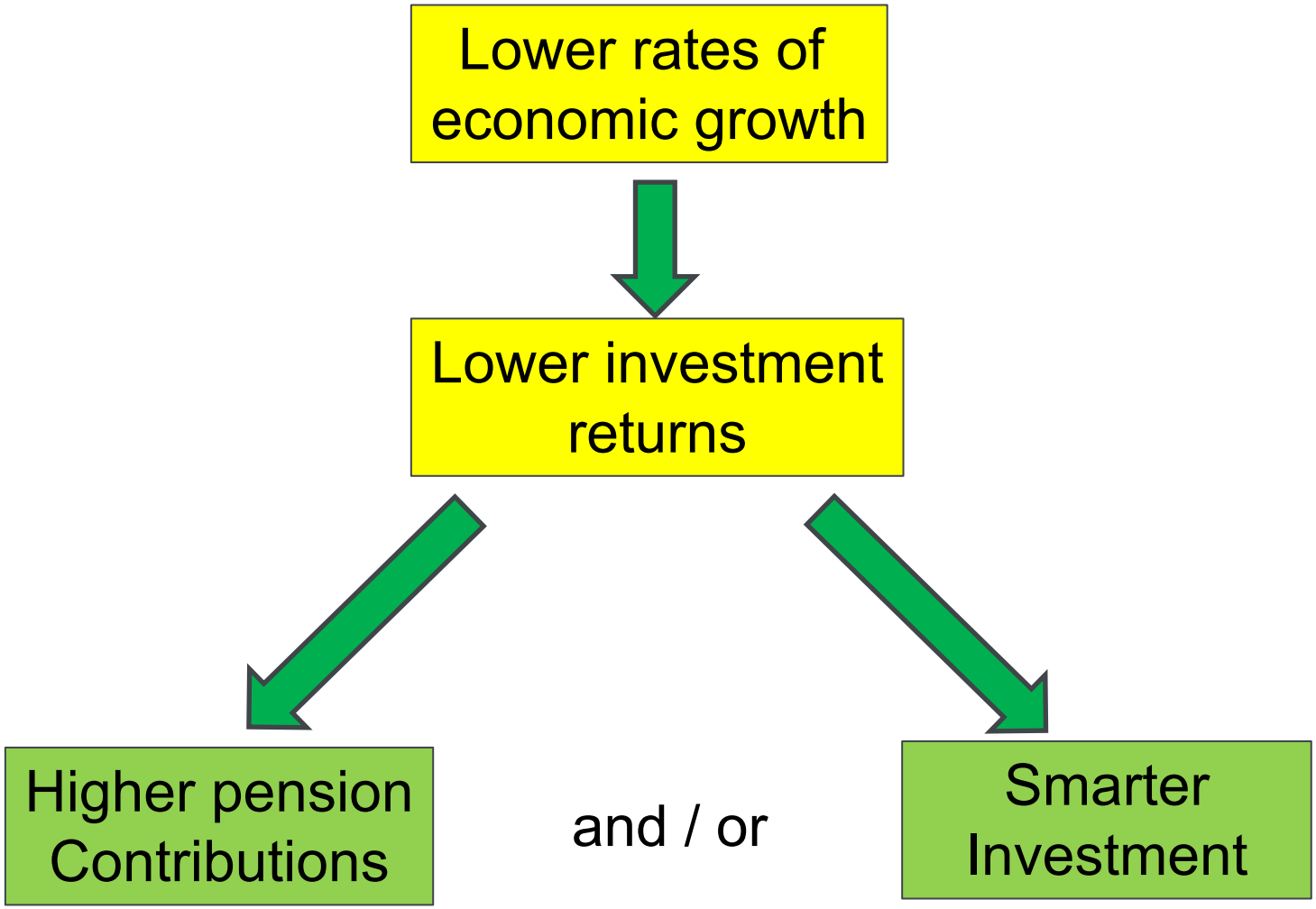
1866.

The Rebound Effect



UKERC

What Could This Mean for Pensions?



The Danger of Stranded Carbon Assets

- Many fossil fuel companies are valued assuming all resources will be extracted and consumed
- Consumption of proven fossil fuel reserves could yield over 5 times the safe level of carbon emissions

- If governments act faster on climate to hold temp, the value of these assets will decline sharply
  - 60-80% of coal, oil and gas reserves are potentially unburnable and therefore of no value
- This “carbon bubble” has not been widely recognised by investors

See: http://www.smithschool.ox.ac.uk/research/stranded-assets/

And http://www.carbontracker.org/carbonbubble

Investment Opportunities in a constrained World

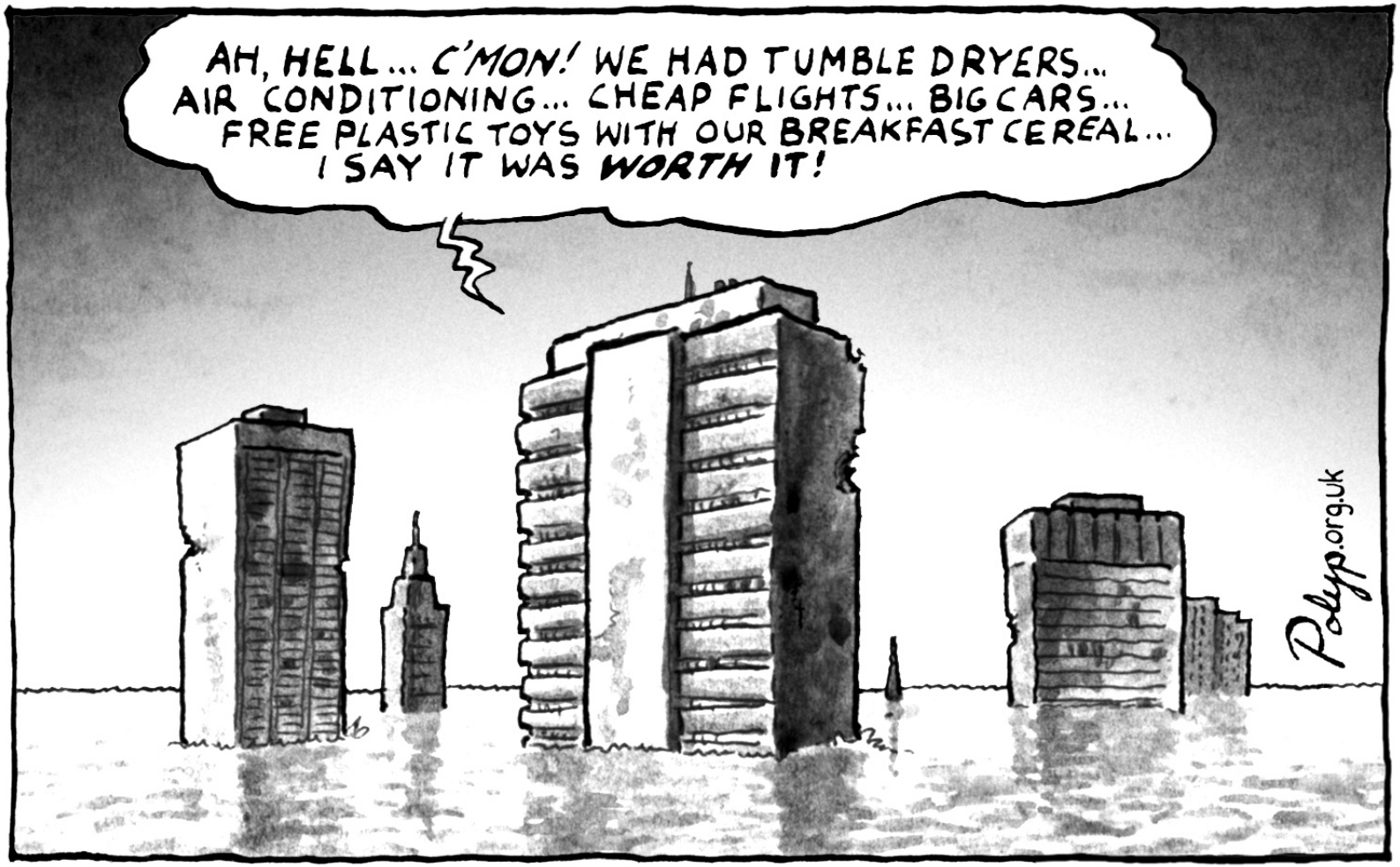
- Renewable energy
  - £300 billion required between now and 2030 in the UK (Blyth and McCarthy)
    - Large scale wind
    - Locally distributed generation
    - Energy efficiency improvements (e.g. Green Deal)
  - $35 trillion required globally (IEA)
- Sustainable transport technologies
  - Hybrid and electric vehicles, bus rapid transit
- Sustainable agriculture
- Ecosystem protection
  - Ecosystems provide tens of trillions of dollars worth of services to the world economy

Agenda

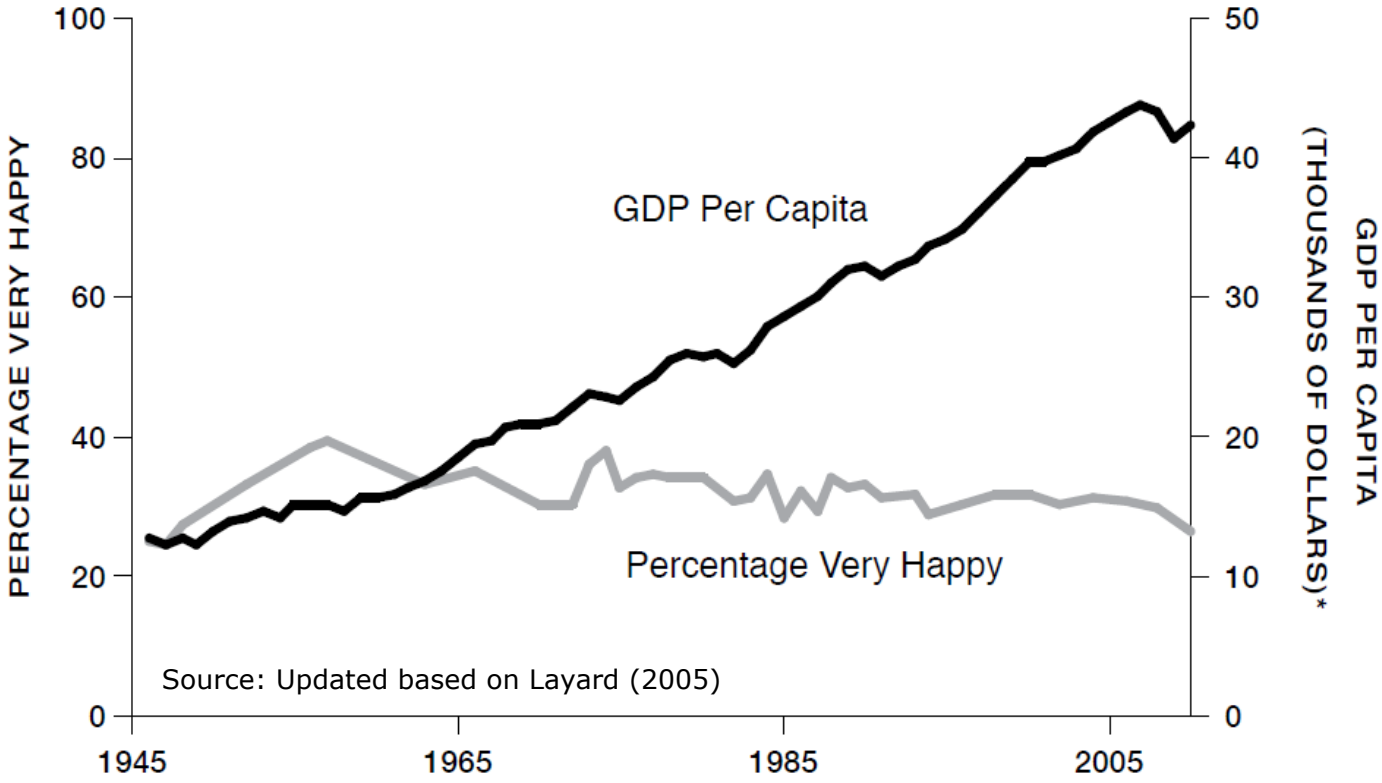
Part 2. Dan O'Neill, Leeds University

- Steady State Economics
  - What is it?
  - Is it feasible?

Part 2: Steady-State Economics



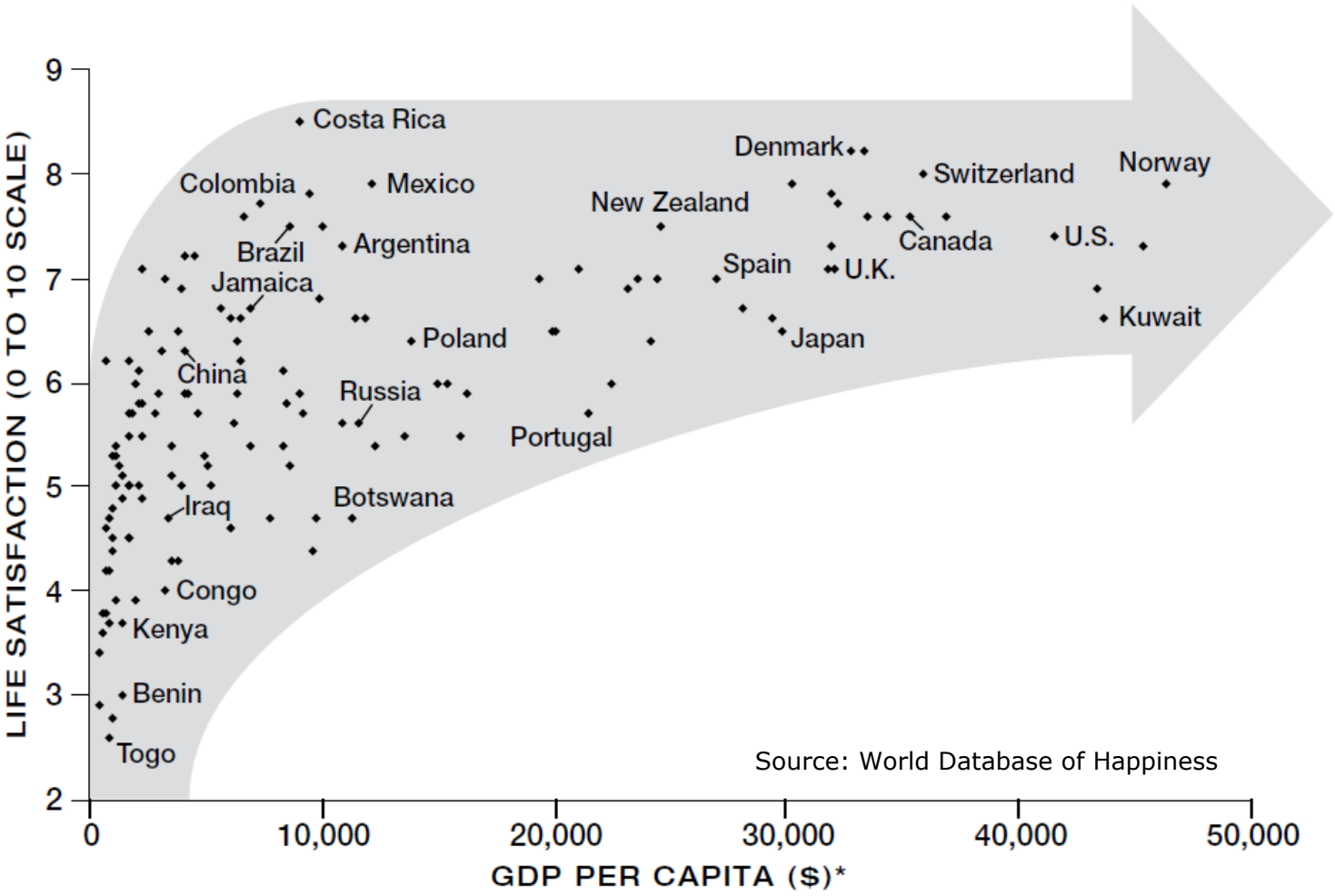
Happiness and GDP in the U.S.



*GDP per capita is adjusted for inflation and expressed in 2005 dollars.

"Americans have been more successful decoupling GDP from happiness than in decoupling it from material and energy" —*Peter Victor*

Happiness and GDP Across Countries



*GDP per capita is expressed in purchasing power parity (PPP) dollars for the year 2005.

What Are We Actually Measuring?

- GDP
  - Total expenditure on all goods and services produced within a country

- Adds to GDP:


- Also adds to GDP:


The Limitations of GDP

- Does not count many beneficial activities because no money changes hands
- Provides no information on income distribution

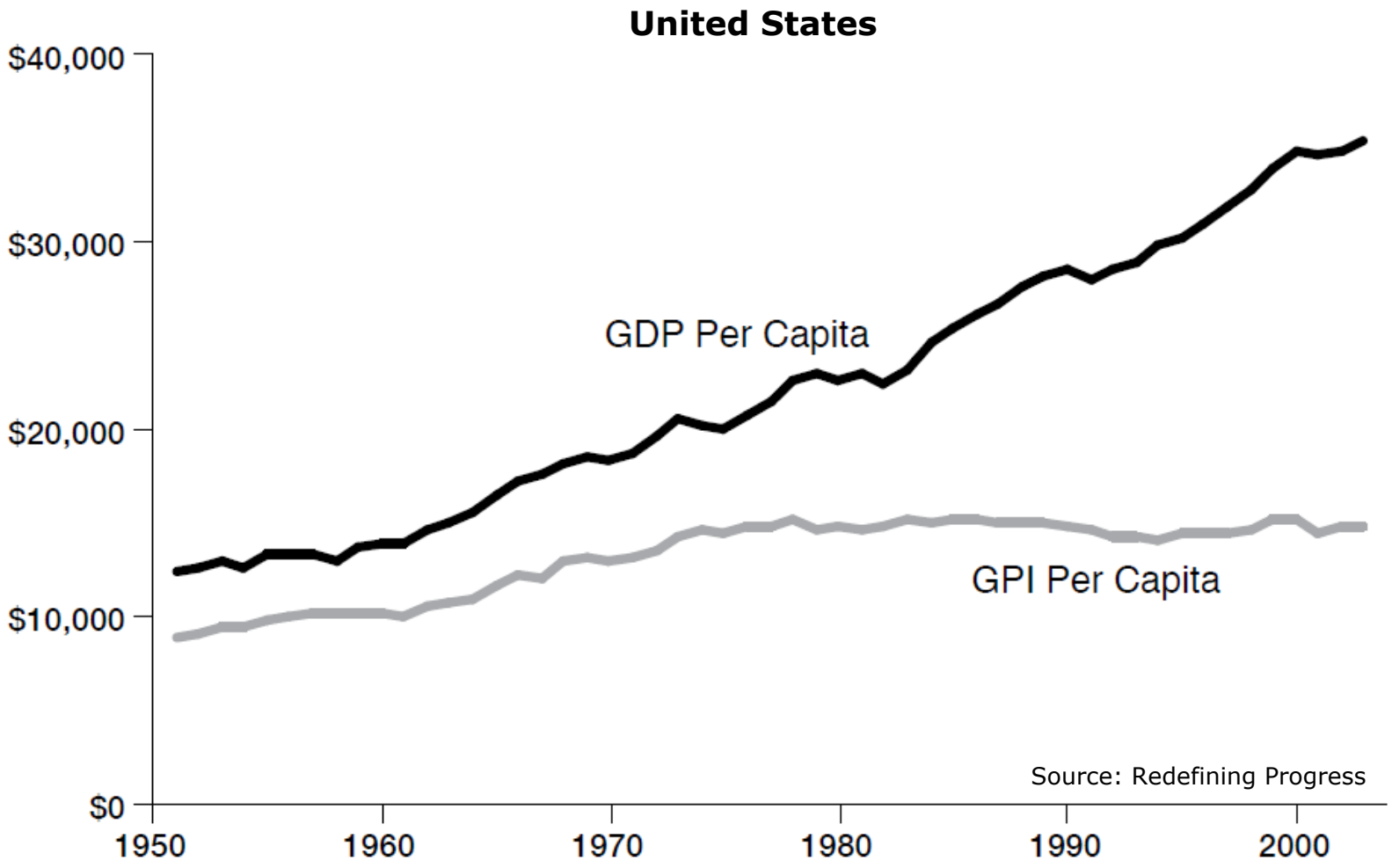
GDP "measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country. It measures everything in short, except that which makes life worthwhile."

— Robert F Kennedy (1968)

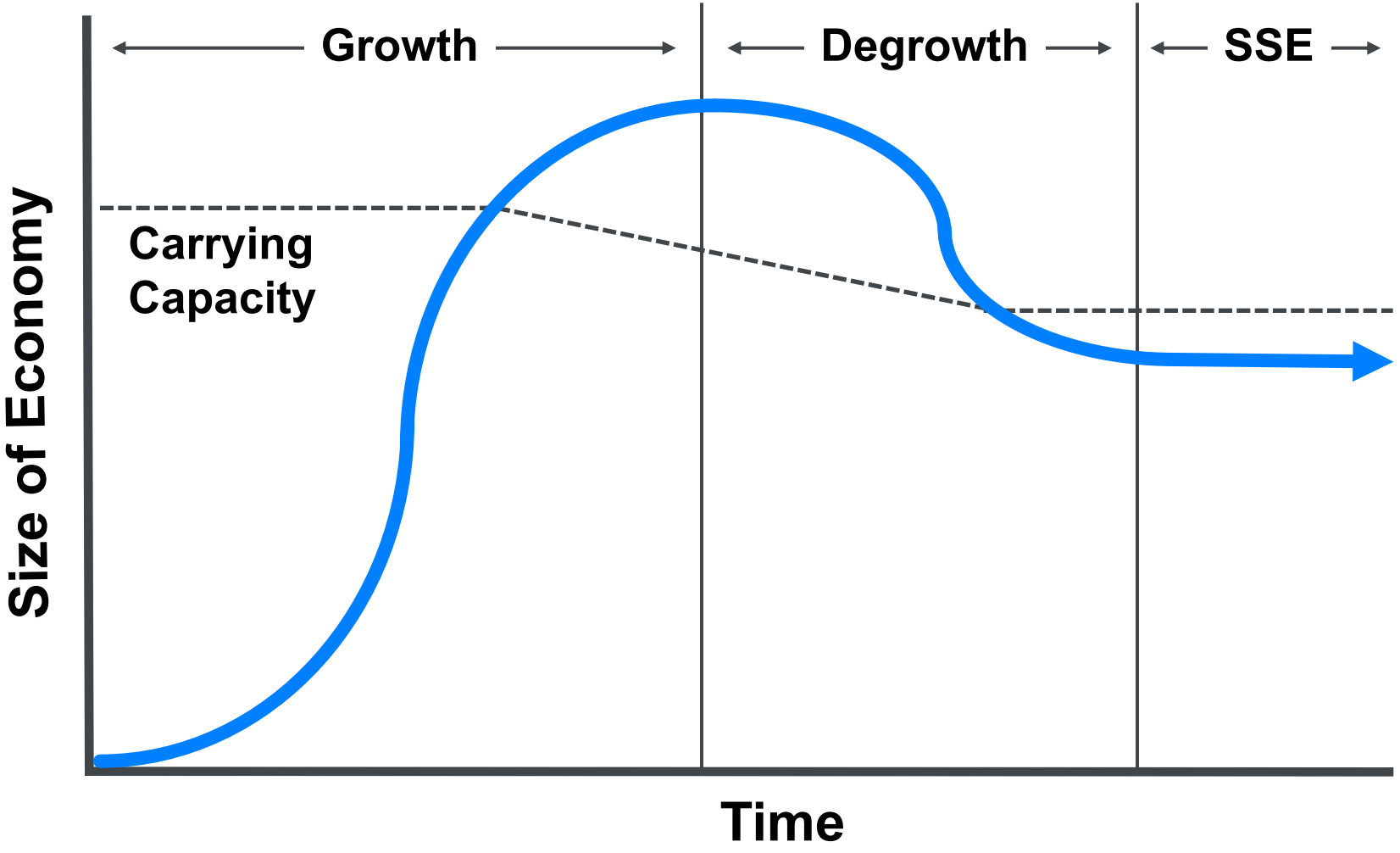
"GDP figures are almost useless as measures of long-term changes in human well-being."

— Adair Turner (2012)

Genuine Progress Indicator (GPI)



Transition to a Steady-State Economy

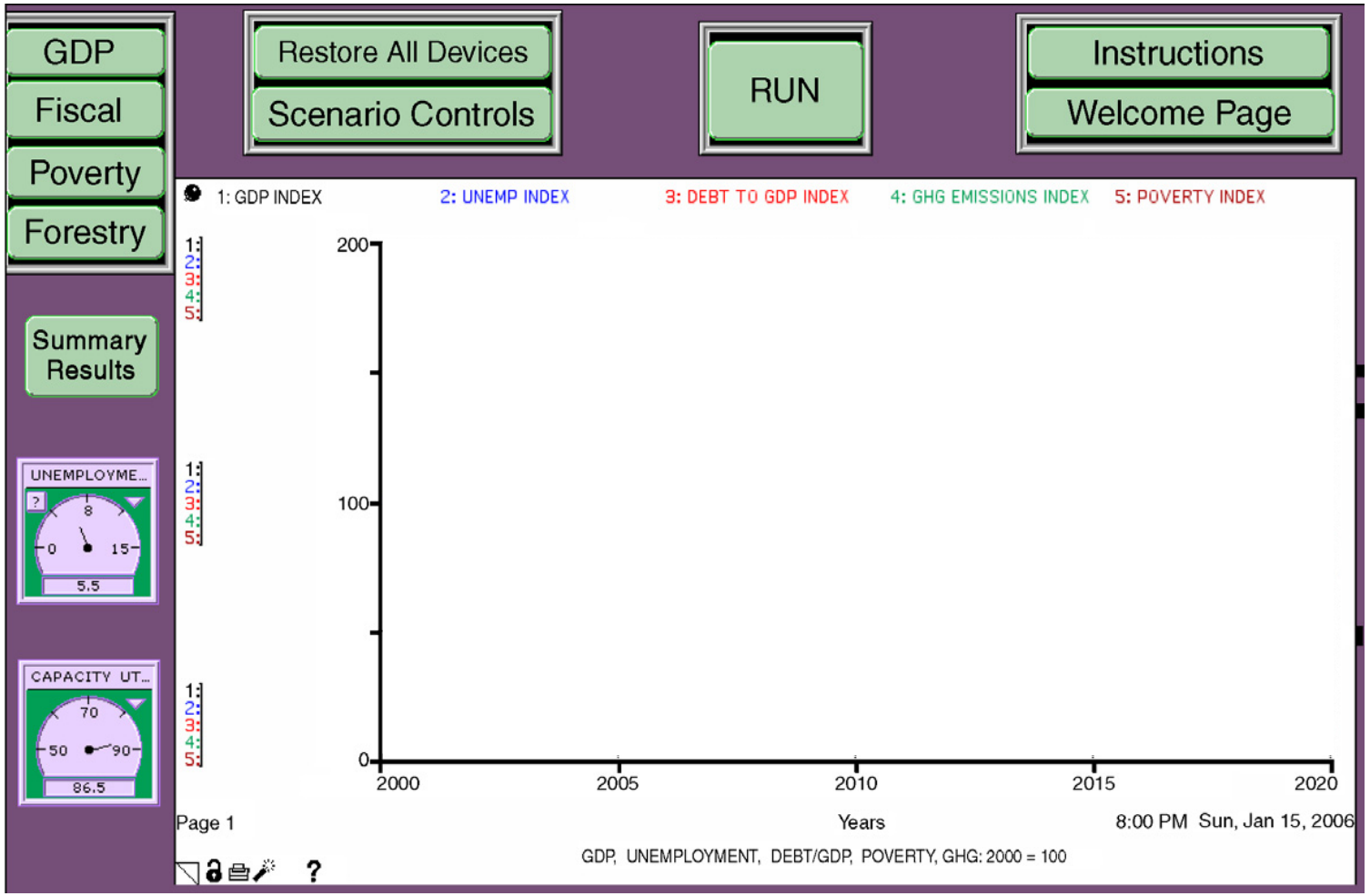


What Is a Steady-State Economy?

- Sustainable Scale
- Fair Distribution
- Efficient Allocation
- High Quality of Life

Health, time,
prosperity,
and community

Can We Really Do This?



Source: Peter Victor, York University

The Steady State Economy Conference

Working Towards an Alternative to Economic Growth

Saturday, 19 June 2010 – Leeds, UK

But

www.steadystate.org/enough-is-enough

1. Limit Resource Use

2. Stabilise Population

3. Limit Inequality

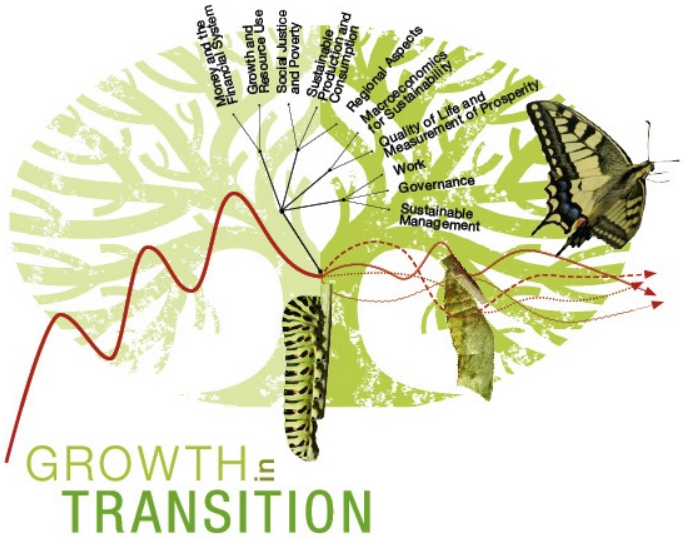
4. Reduce Working Hours

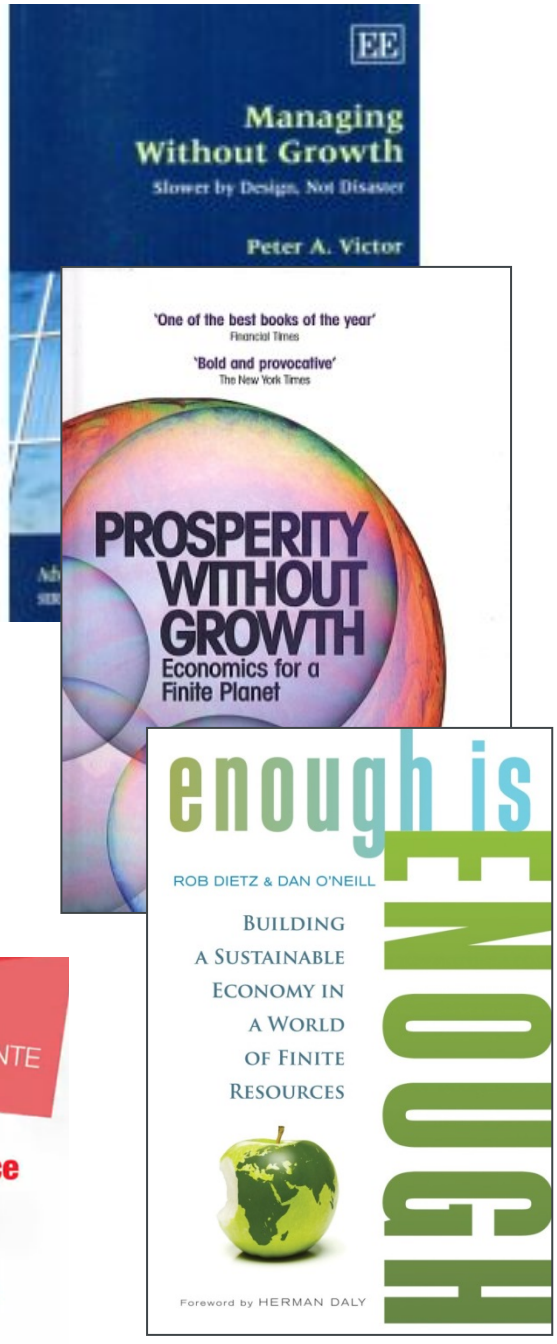
5. Reform the Monetary System

6. Rethink Commerce

7. Change How We Measure Progress

Entering the Mainstream

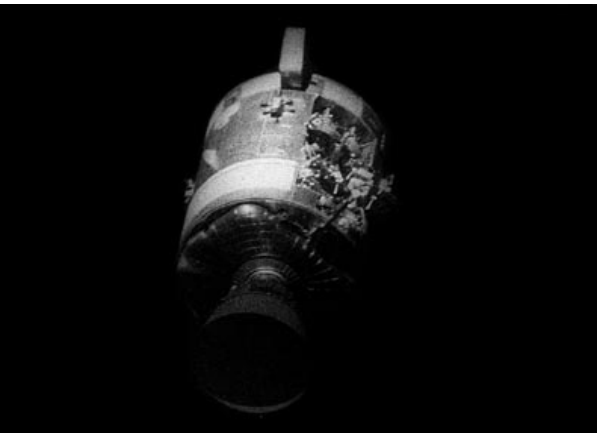


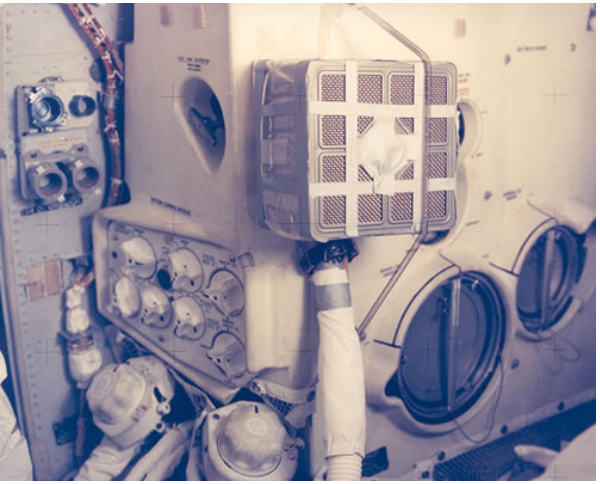


degrowth
conference Leipzig 2014

A Role for Pensions Funds

Creativity Driven By Limits





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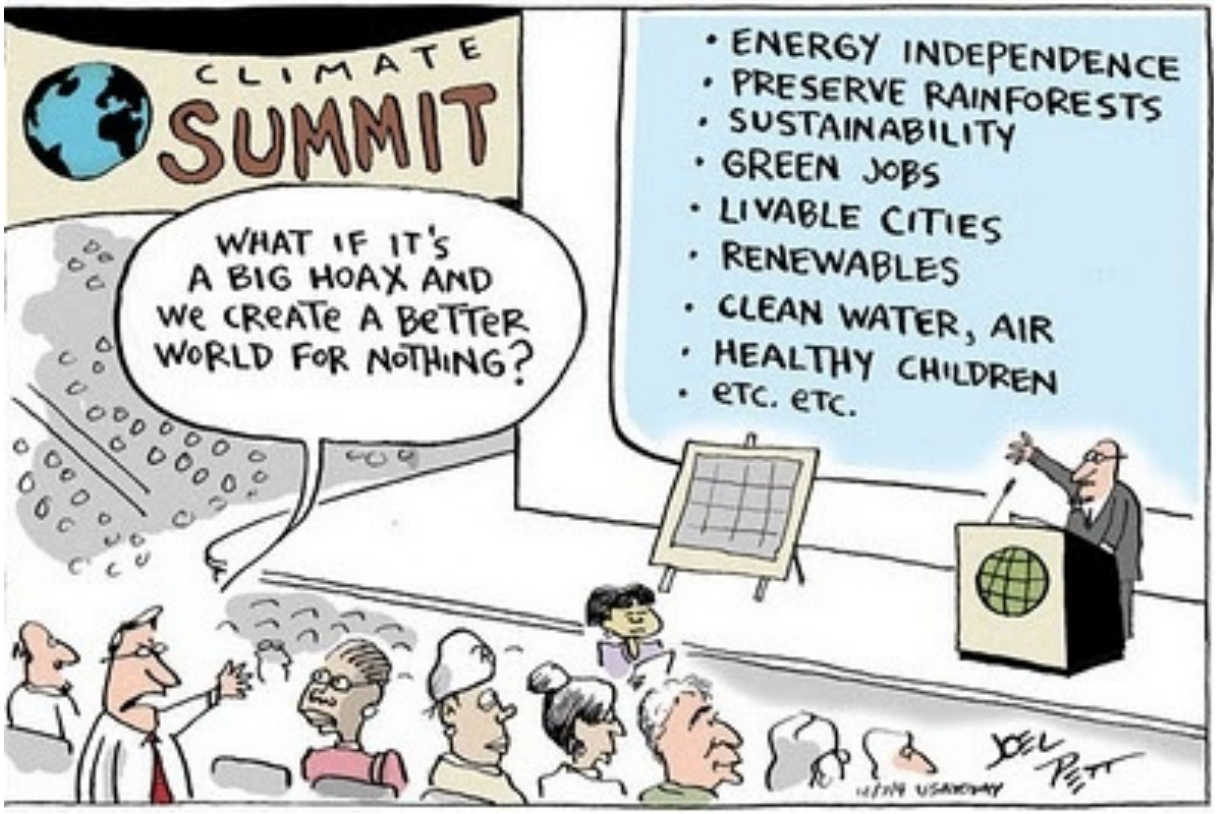

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www.steadystate.org/enough-is-enough