Biophysical Limits to Growth

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Professor, Biology Dept, Towson University, USA

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Co-Editor-in-Chief, *Current Research in Environmental Sustainability*

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We witness unsustainable human-ecosystem interactions

- How could people make such serious mistakes in the past and why does society continue to repeat such mistakes today?
- Is it inevitable that the environment must be degraded to satisfy human needs?

Why environmental resources have been poorly conserved in the past?

1. *Nature's rate of return of ecosystem services leads us to over exploitation*
   - Living off the flow is too slow, for how we want to grow
   - Poor understanding of growth, exponential growth
2. *Externalities*
   - Indirect cost not paid for by producer and consumer as part of a transaction
   - When a decision (for example, to pollute the atmosphere) causes costs or benefits to individuals or groups other than the person making the decision
3. *Pressure for resource consumption*
   - Economic and institutional growth paradigm
   - Victor Lebow (1955): our enormously productive economy demands that we make consumption our way of life, that we convert the buying and use of goods into rituals, that we seek our spiritual satisfactions, our ego satisfactions, in consumption
   - Marketing

Drivers of Unsustainability

- HUMAN POPULATION INCREASE
  - Agriculture
  - Shelter
  - Mobility
  - Stuff

Use Energy and Material Resources causes
- Land use change
- Habitat loss
- Deforestation
- Alter biogeochemical cycles

Leads to

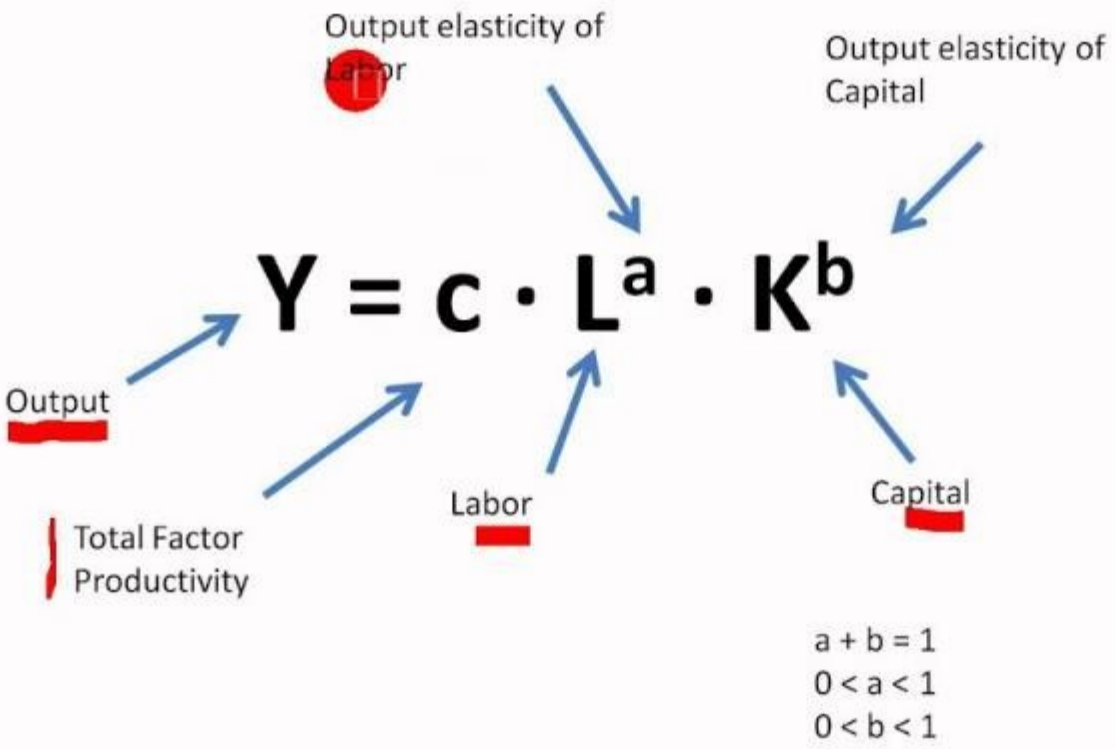
Climate Change
Eutrophication
Acid precipitation
Ozone Depletion
Smog
…

Economics

- Economics is one the main organizing forces in society
- Many decisions are made based on cost-benefit analysis but true costs (direct + indirect) to individual, society, or environment are often not known

Economic Growth Models

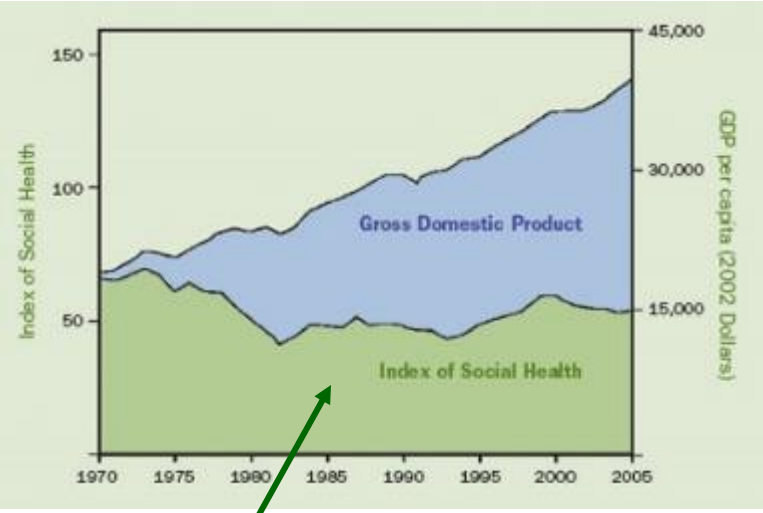
Cobb-Douglas Production Function



WHERE IS ENVIRONMENT?

What is the purpose of growth?

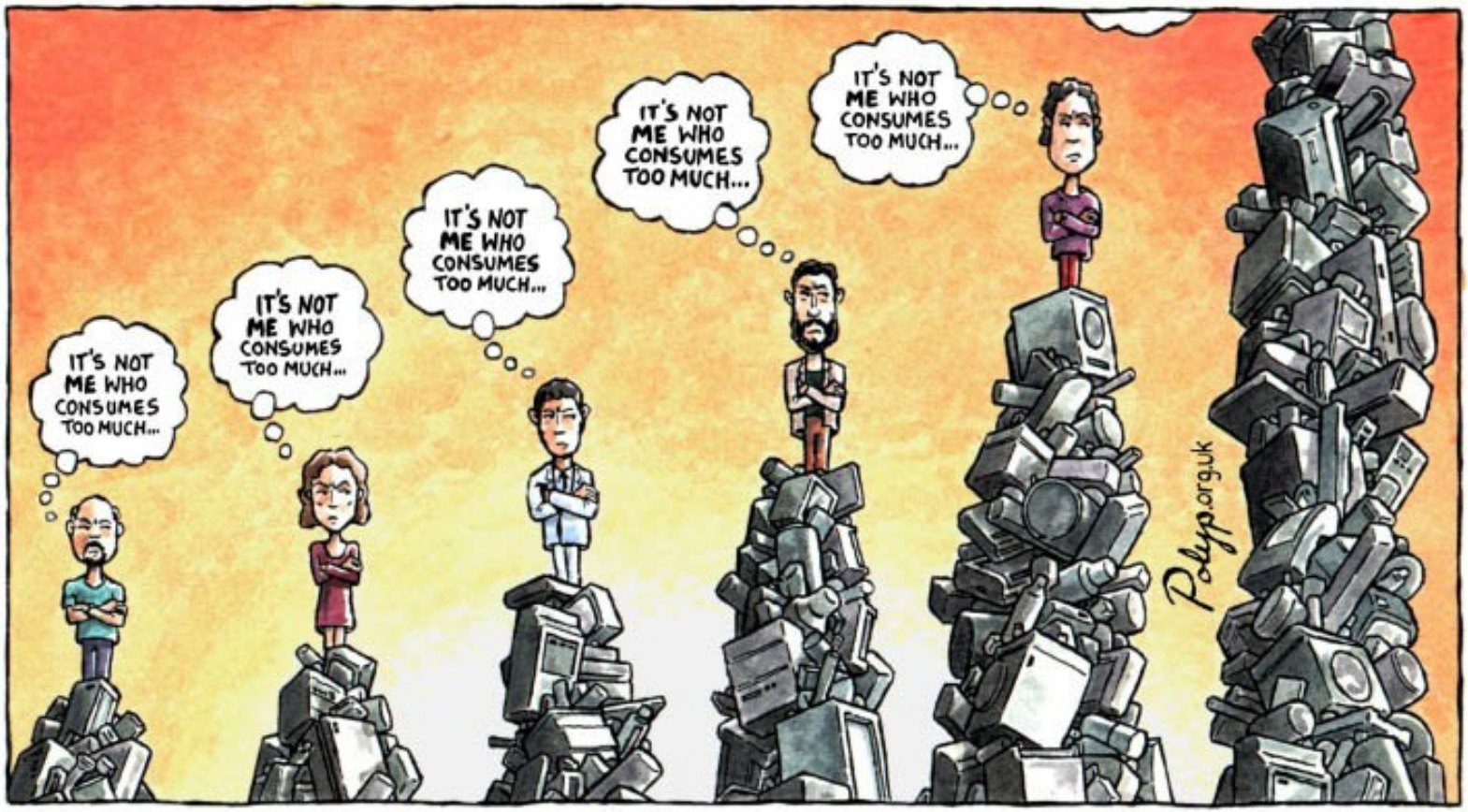
Does bigger always mean better?



'STILL NOT HAPPY'

Alternative well-being indicators tell a different story

Humans are social animals, measuring in terms of others, not absolutes



'IT'S NOT ME'

The New York Times

TheUpshot

ECONOMIC TRENDS

We're in a Low-Growth World. How Did We Get Here?

Neil Irwin @Neil_Irwin AUG. 6, 2016

One central fact about the global econo… …e year's remarkable headlines: Eco… …ed nations has been weaker for lon… …ifetime of most people on earth.

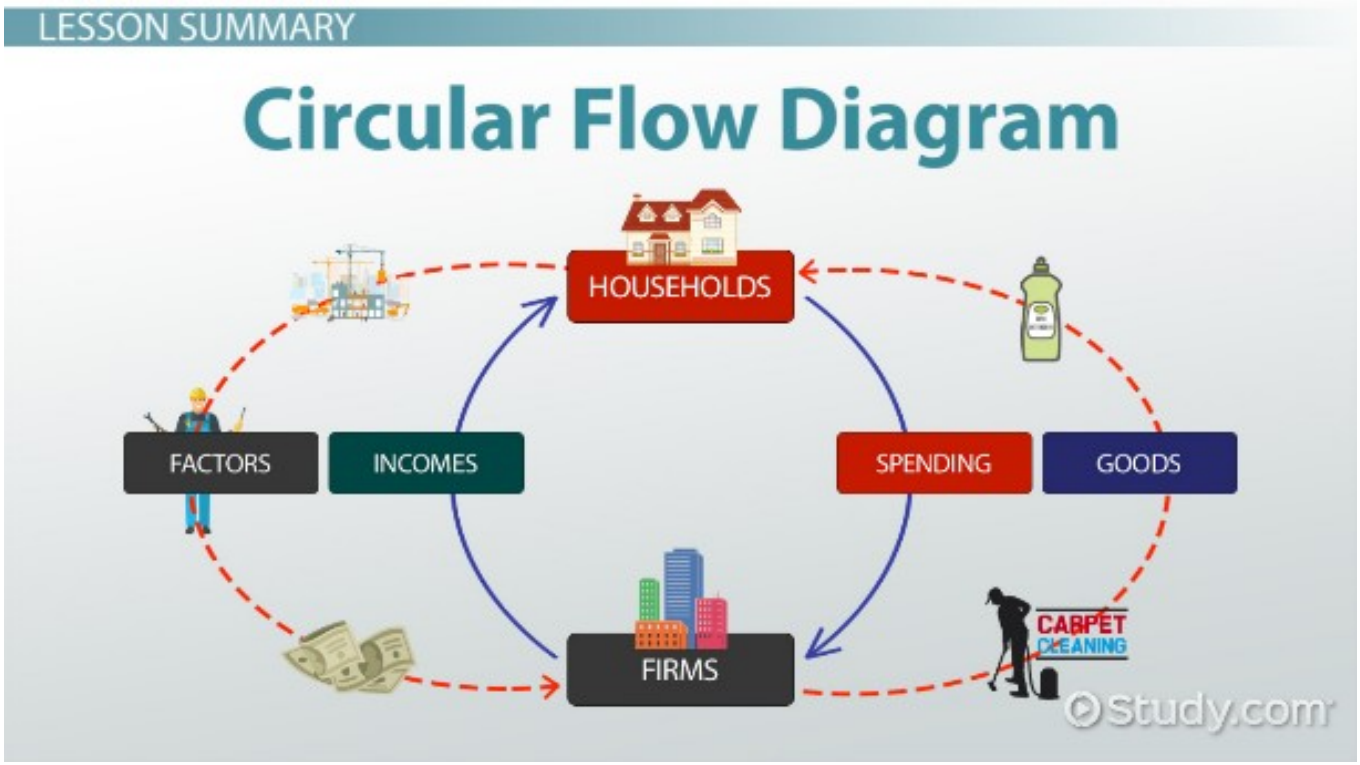
No mention of natural resources or environment

…t increasingly looks as if something fundamental is broken in the global growth machine — and that the usual menu of policies, like interest rate cuts and modest fiscal stimulus, aren't up to the task of fixing it (though some well-devised policies could help).

www.nytimes.com/2016/08/07/upshot/were-in-a-low-growth-world-how-did-we-get-here.html?hp&action=click&pgtype=Homepage&clickSource=story-heading&module=first-column-region&region=top-news&WT.nav=top-news&_r=0

Assumption error:

Economy as an isolated system



A better model:
Economy as an open system

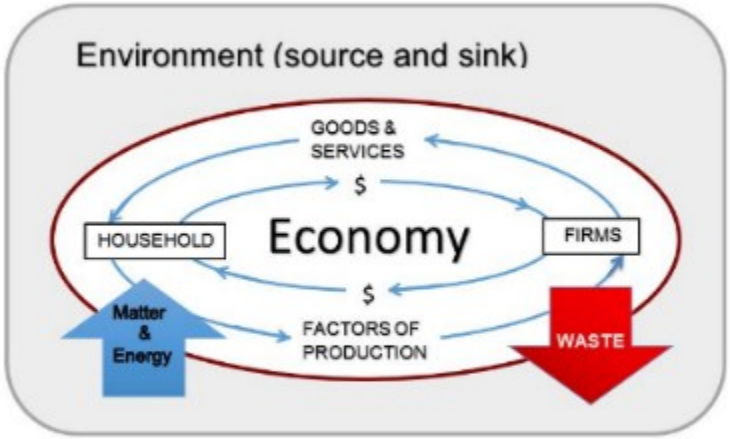
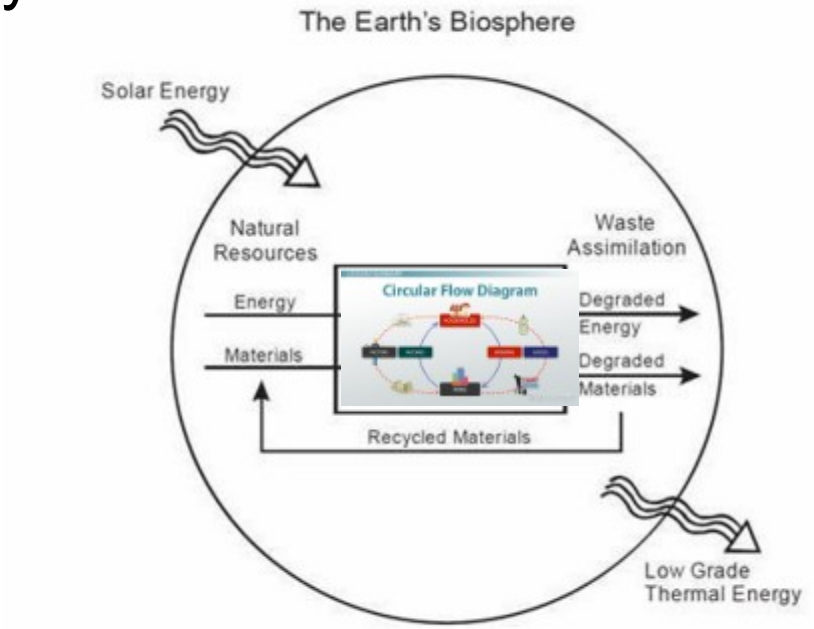


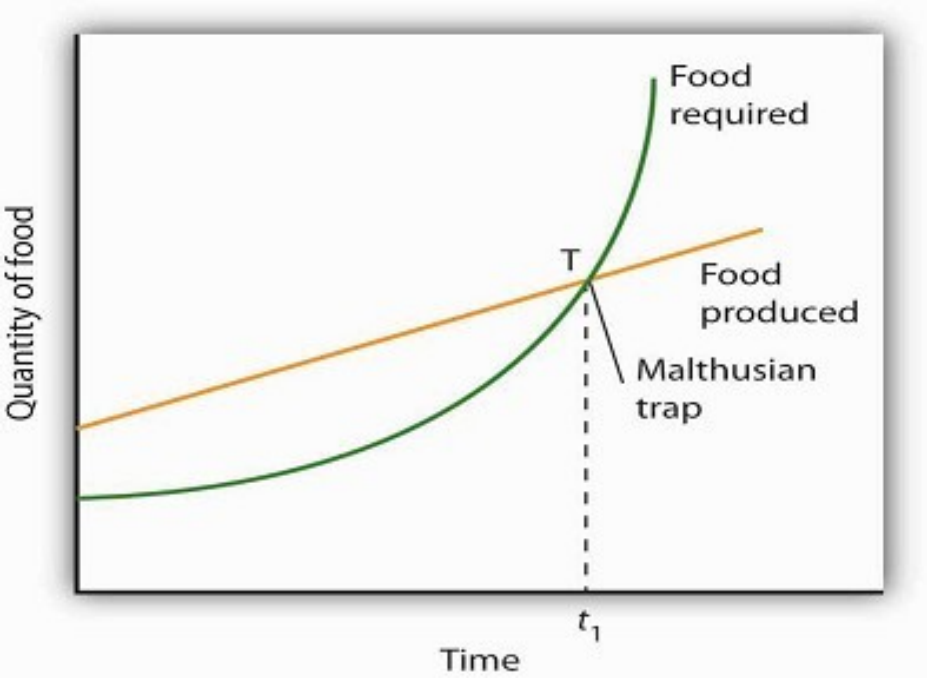
Fig. 2. Thermodynamic throughput model. Note the addition

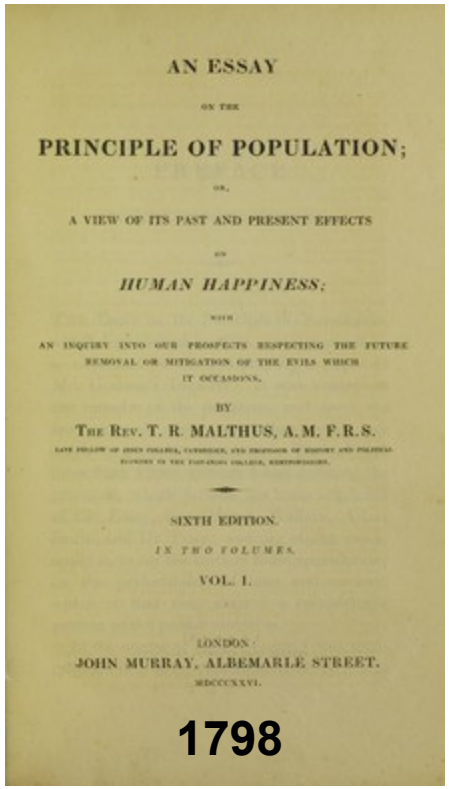


A look back at the history recognizing limits

Thomas Malthus

- Predicts eventually food and resources will run out as populations explode




AN ESSAY

ON THE

PRINCIPLE OF POPULATION;

OR,

A VIEW OF ITS PAST AND PRESENT EFFECTS

ON

HUMAN HAPPINESS;

WITH

AN INQUIRY INTO OUR PROSPECTS RESPECTING THE FUTURE REMOVAL OR MITIGATION OF THE EVILS WHICH IT OCCASIONS.

BY

THE REV. T. R. MALTHUS, A.M. F.R.S.

SIXTH EDITION.

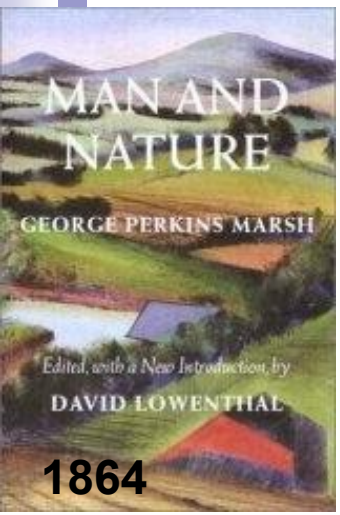
IN TWO VOLUMES.

VOL. I.

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1798

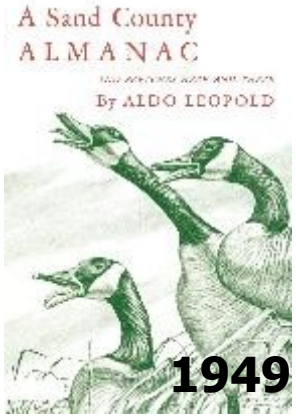


George Perkins Marsh

- "A certain measure of transformation of terrestrial surface, of suppression of natural, and stimulation of artificially modified productivity becomes necessary. This measure man has unfortunately exceeded."

- "The ravages committed by man subvert the relations and destroy the balance which nature has established…; and she avenges herself upon the intruder by letting loose her destructive energies…"

Aldo Leopold



- A Sand County Almanac – regarded as the most influential book on conservation ever written.
- The land ethic:
- "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."
- Enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

Rachel Carson

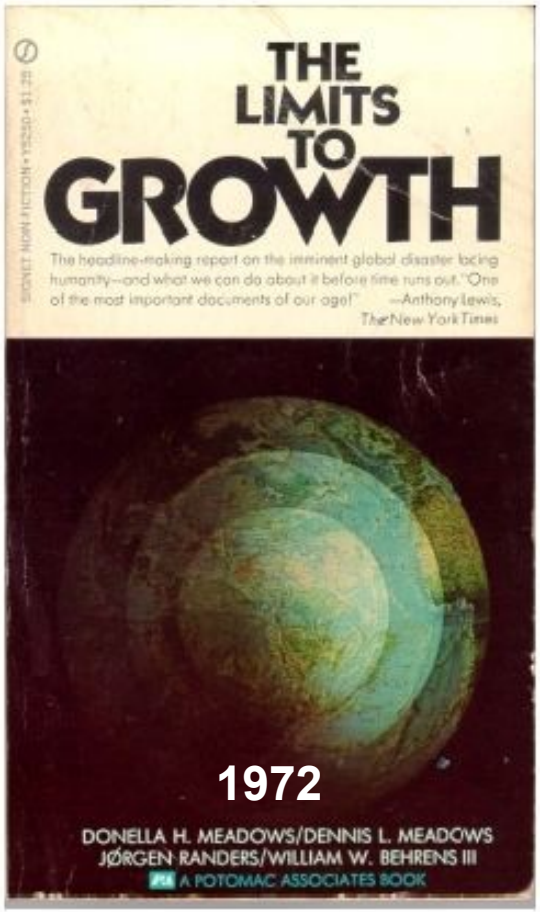
- 1960s – **The modern environmental movement is**

- 1962 *Silent Spring*
- Carson, writer and marine biologist, told how chemical use on farms, forests, and gardens, poison the environment. Insects were dying (not just the pest species) which meant no food for the birds. No birds, no bird song – a silent spring

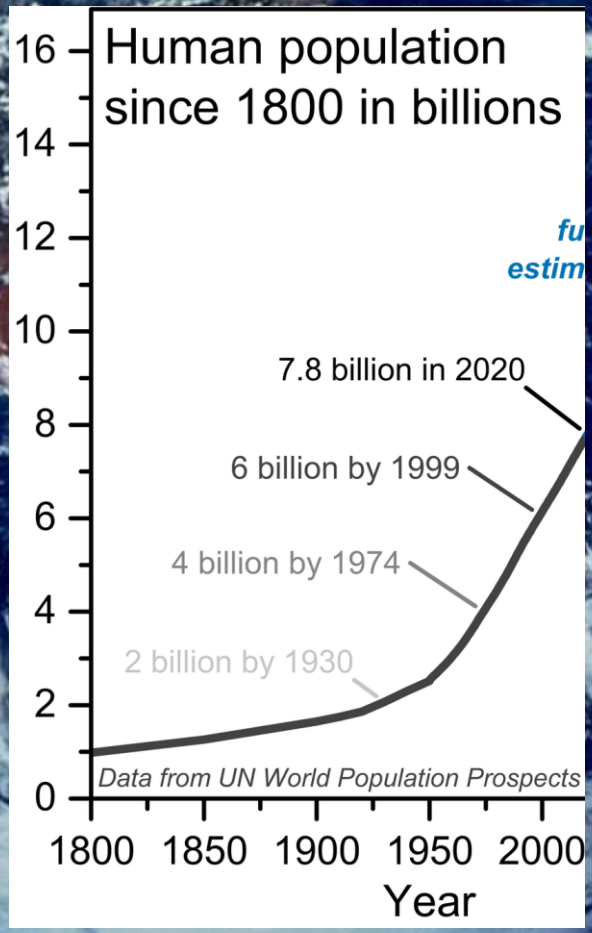
- Public awareness that humans are damaging environment

1st Earth Day 1970

Donella Meadows and Club of Rome



Importance of scale



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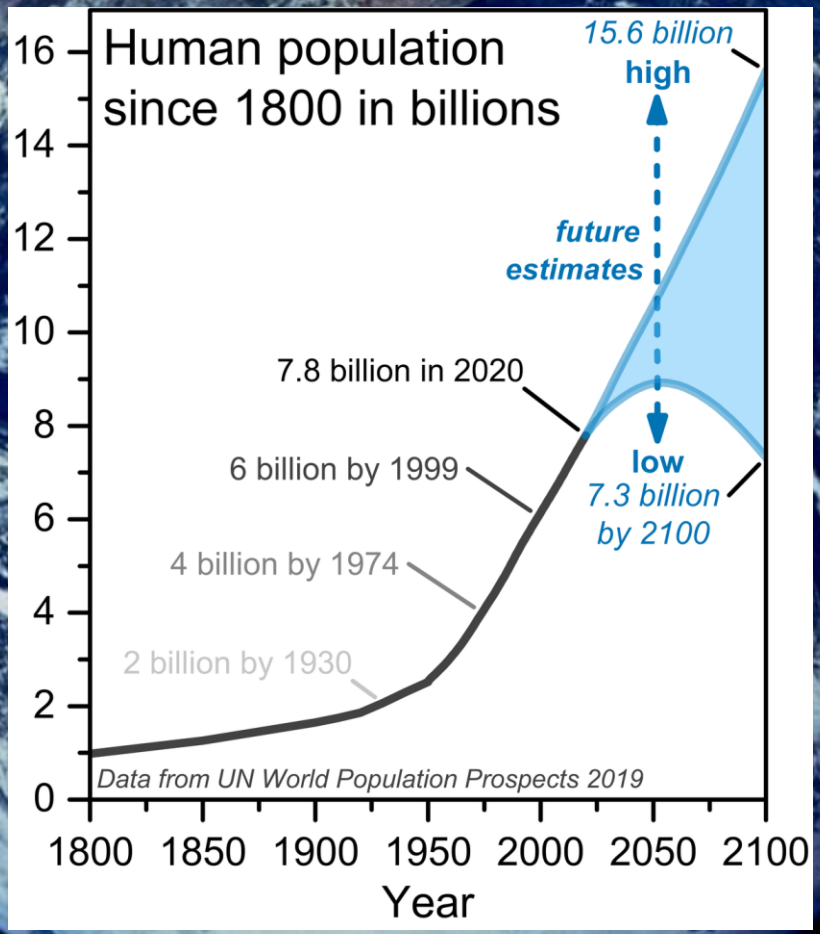
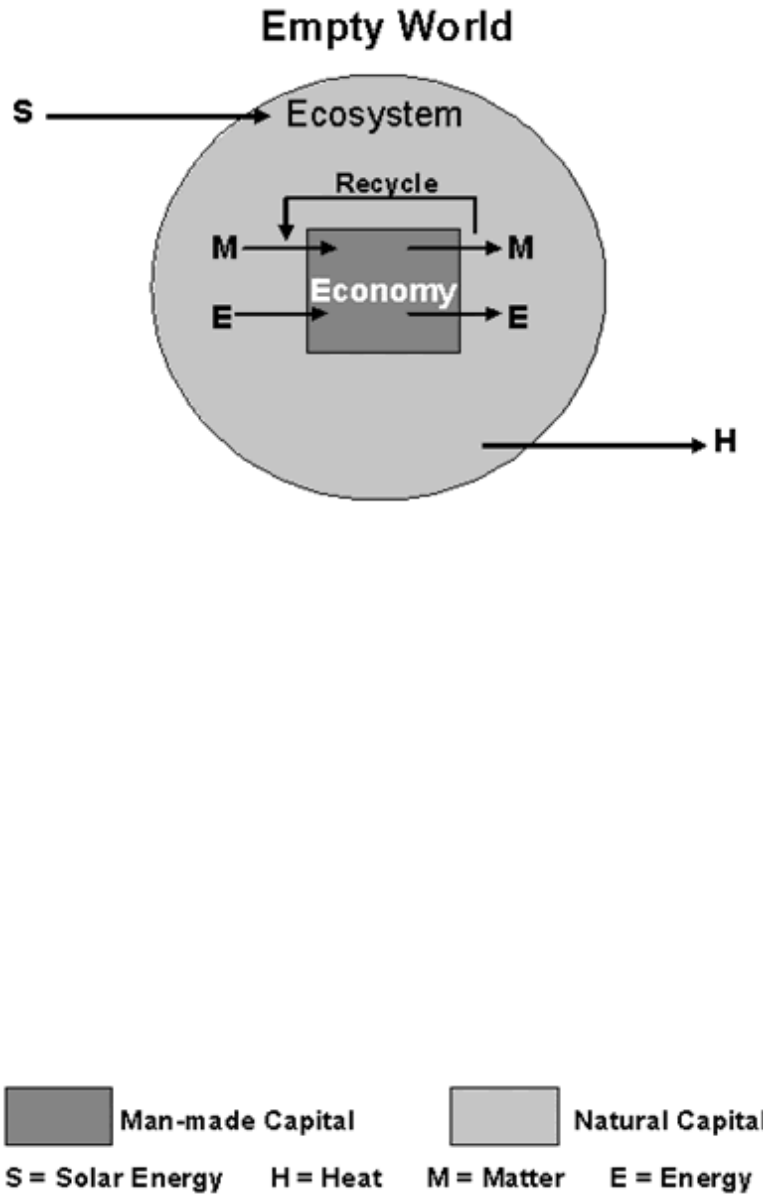


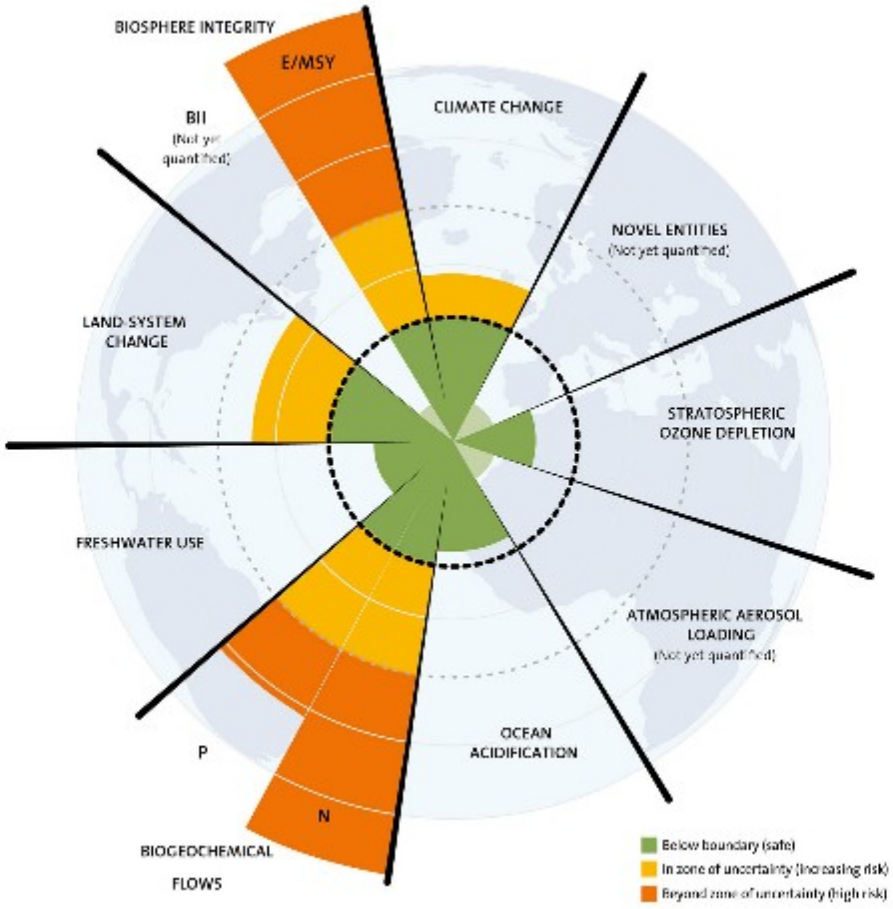
Emergence of humans, from a minor component of natural system to predominant occupant

Scale of humanity has increased greatly putting pressure on all natural resources

The changes have come so fast our customs ethics, and religious patterns may not have adapted to them.

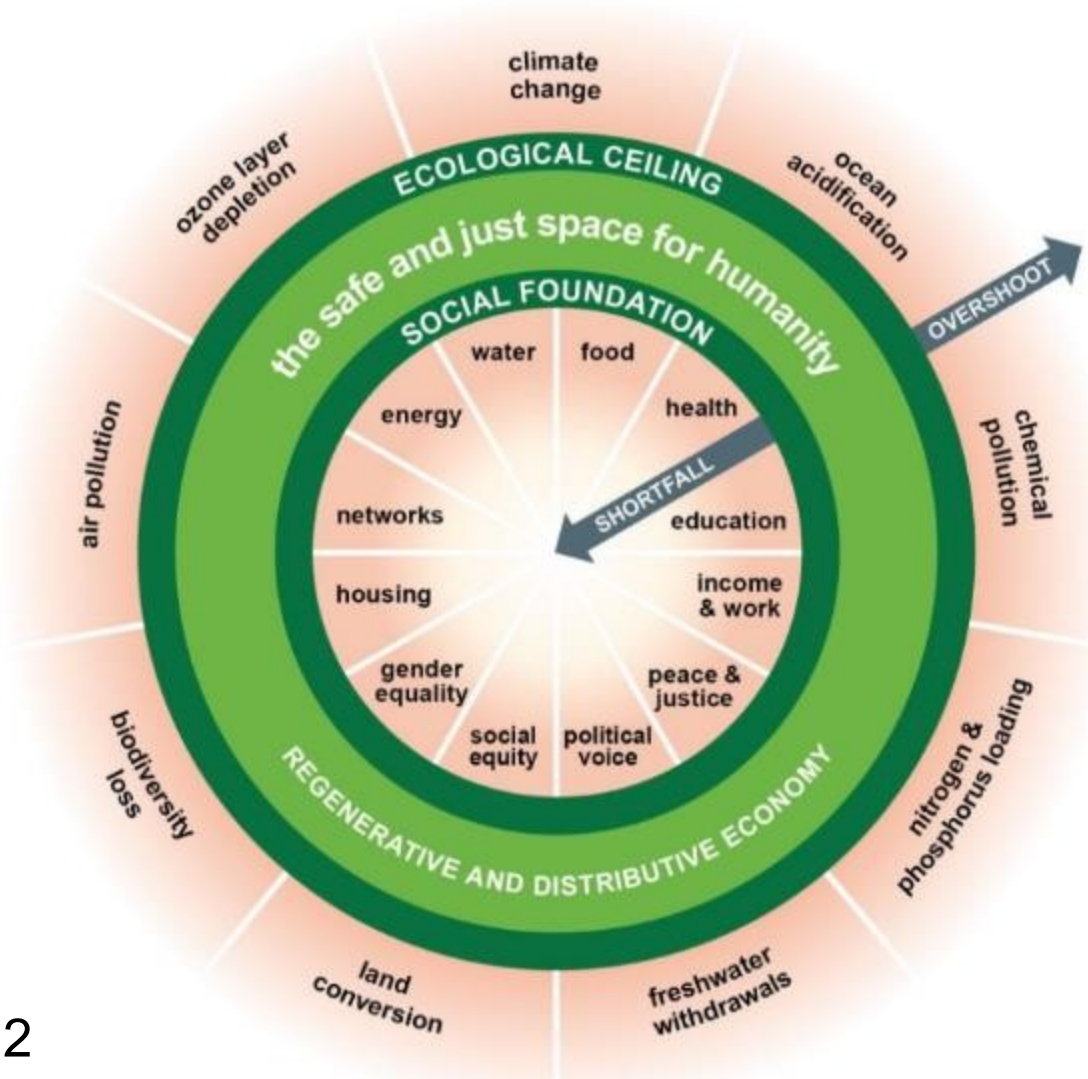


Planetary Boundaries – Stockholm Resilience Centre



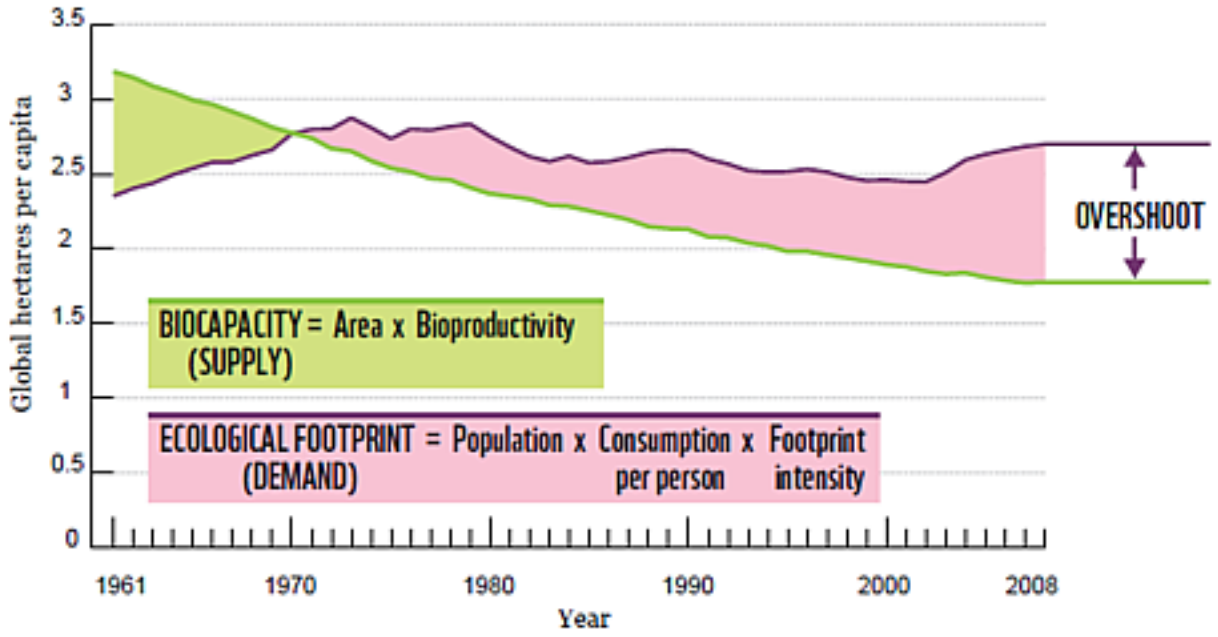
2009

Donut Economics – Kate Raworth

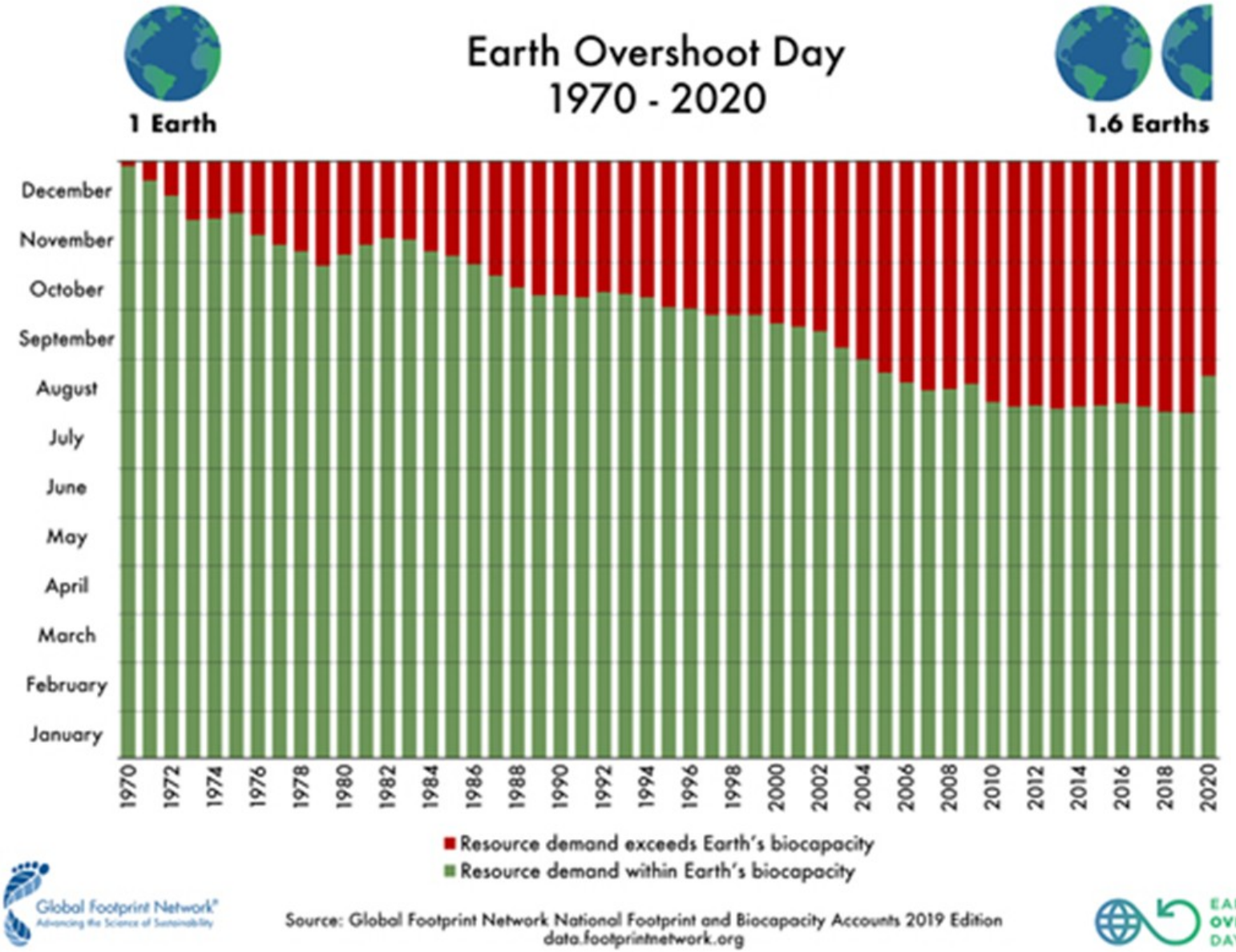


2012

Overshooting the limits



Overshooting the limits


Earth Overshoot Day
1970 - 2020
1 Earth
1.6 Earths
December
November
October
September
August
July
June
May
April
March
February
January
1970
1972
1974
1976
1978
1980
1982
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2016
2018
2020
Resource demand exceeds Earth's biocapacity
Resource demand within Earth's biocapacity
Global Footprint Network
Advancing the Science of Sustainability
Source: Global Footprint Network National Footprint and Biocapacity Accounts 2019 Edition
data.footprintnetwork.org
EARTH OVERSHOOT DAY

ELSEVIER

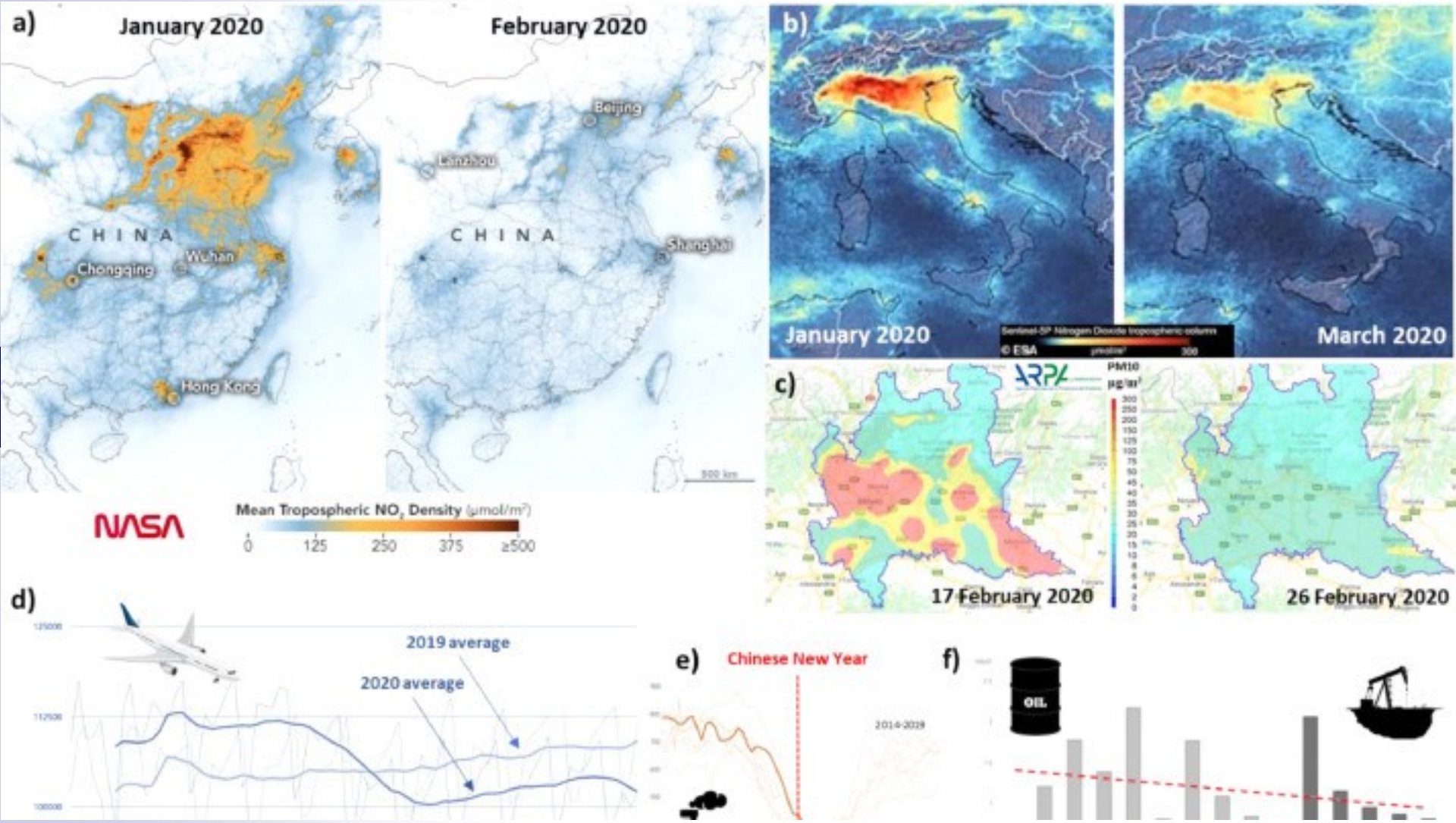
Ecological Modelling
Volume 426, 15 June 2020, 109075

Letter to the Editor

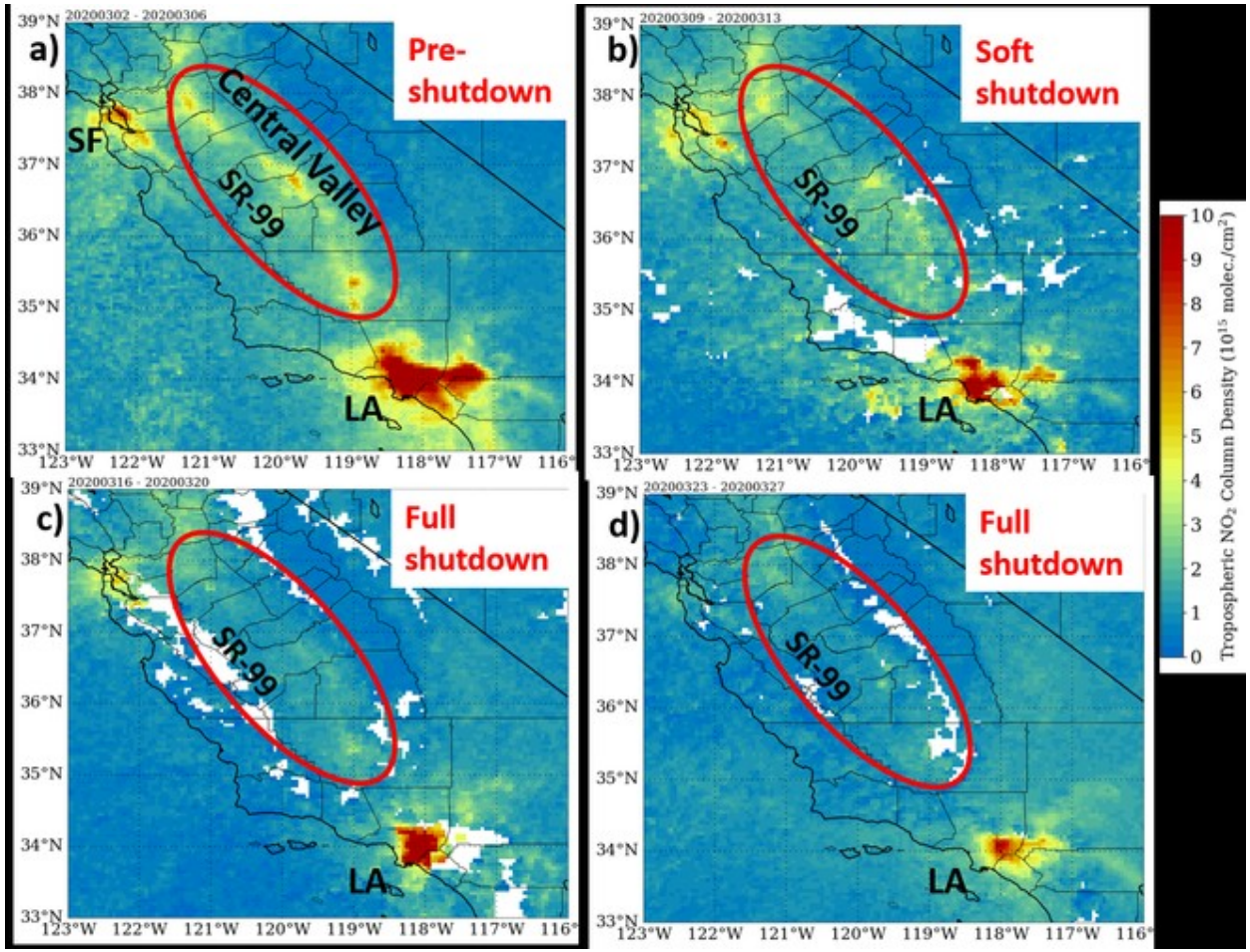
Coronavirus outbreak is a symptom of Gaia's sickness

Roberto Cazzolla Gatti [a, b]

https://doi.org/10.1016/j.ecolmodel.2020.109075



www.flightradar24.com/blog/then-and-now-visualizing-covid-19s-impact-on-air-traffic/



nasasport.wordpress.com/2020/04/04/new-generation-satellite-observations-monitor-air-pollution-during-covid-19-lockdown-measures-in-california/

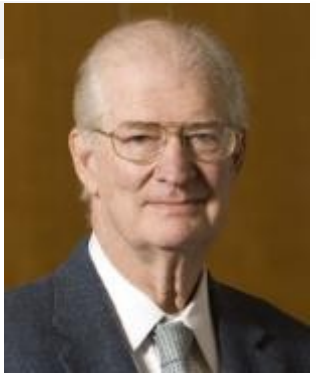
Venice, Italy

Alternative Economic Systems…

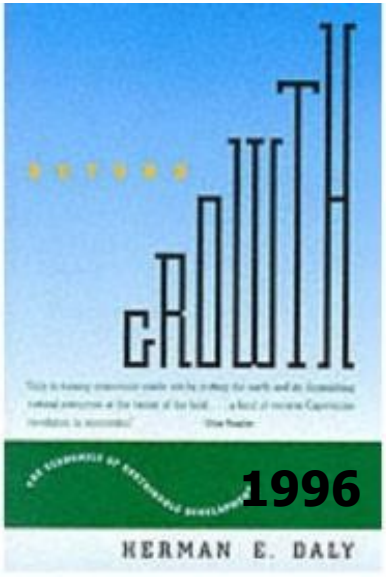
One mistake of the 2007 financial crisis was the rush to put the system back as it was, flaws and all

Use Covid to Build back better

Herman Daly



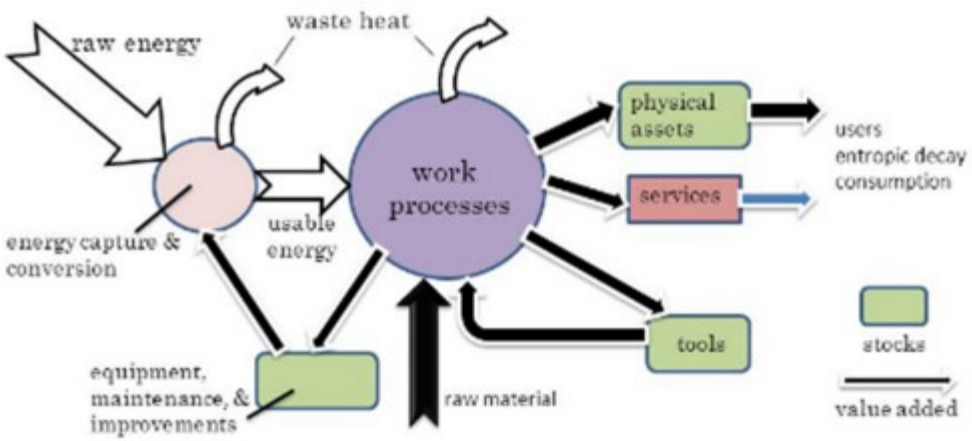
- **Beyond Growth: the economics of sustainable development**
  - The first and second laws of thermodynamics must be the starting point of economics
  - Neither the sources of useful inputs nor the sinks for polluting waste outputs are infinite.



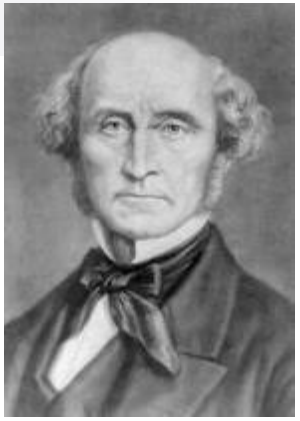
Nicolas Georgescu-Roegen

- *The Entropy Laws and the Economic Process* (1971)
  - Wealth is an open system, a structure maintained in the midst of throughput
  - It begins with the depletion of useful matter/energy and ends with the return of an equal quantity of spent matter/energy back to the environment.

- The Economy: Energy, work, and goods/services



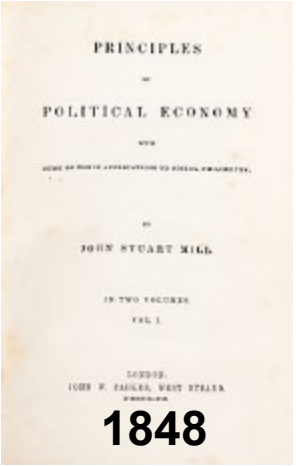
John Stuart Mill



- British philosopher, political economist and civil servant (1806-1873)
- Considered “the most influential English-speaking philosopher of the nineteenth century"

“Perpetual growth in material well-being is not possible or desirable.”

Mill argued that the logical conclusion of unlimited growth was destruction of the environment and a reduced quality of life. He concluded that a stationary state could be preferable to unending economic growth



WHY HAVE WE NOT LEARNED THIS LESSON?

Steps forward

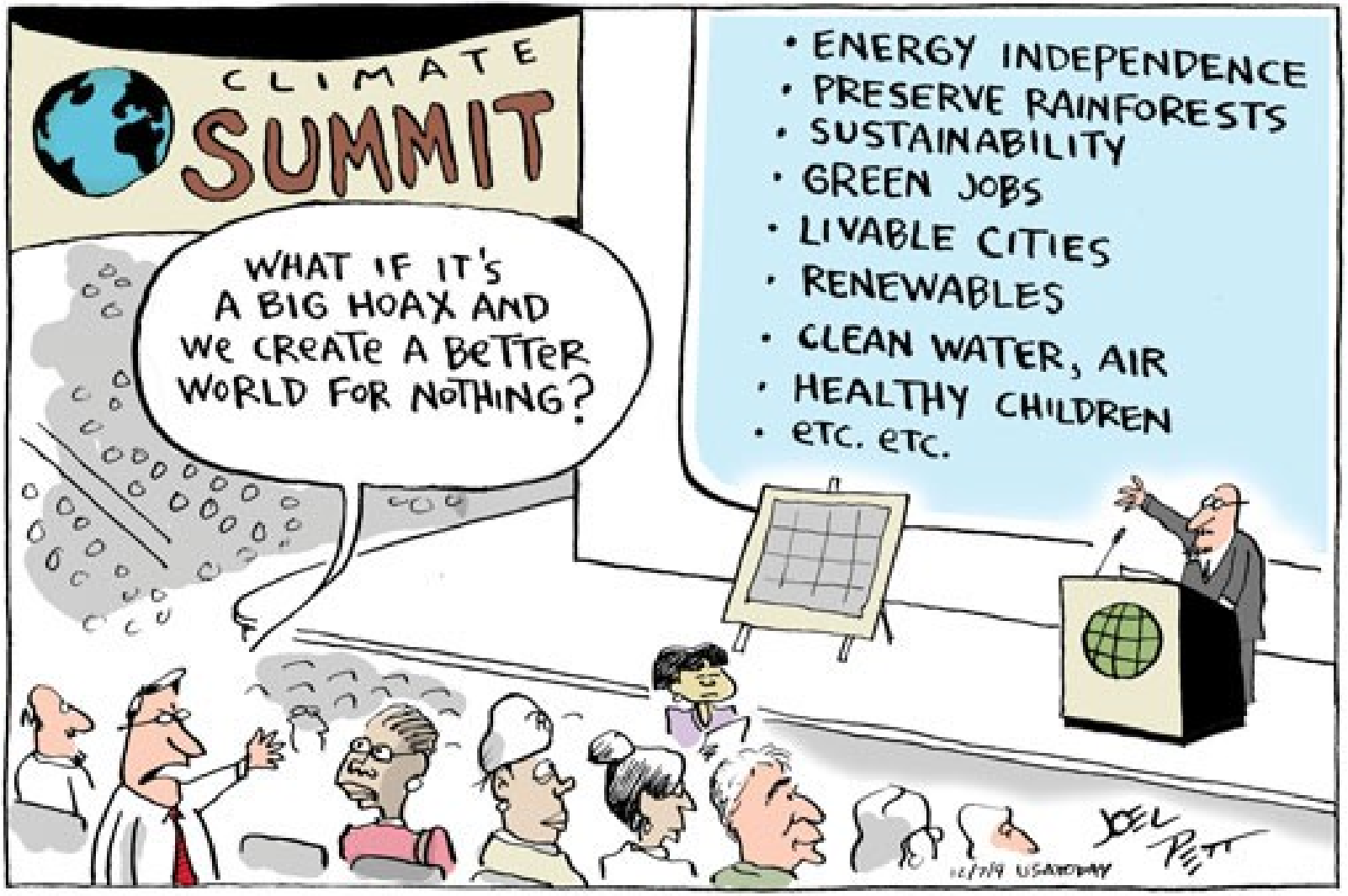
- Identify a shared common vision that respects planetary boundaries
- Enhance built environment by mimicking natural processes
- Systems thinking at all levels of decision-making
- Define sustainability and measure/monitor if current trends are heading toward or away from these trajectories

- Next generation initiates transformative change

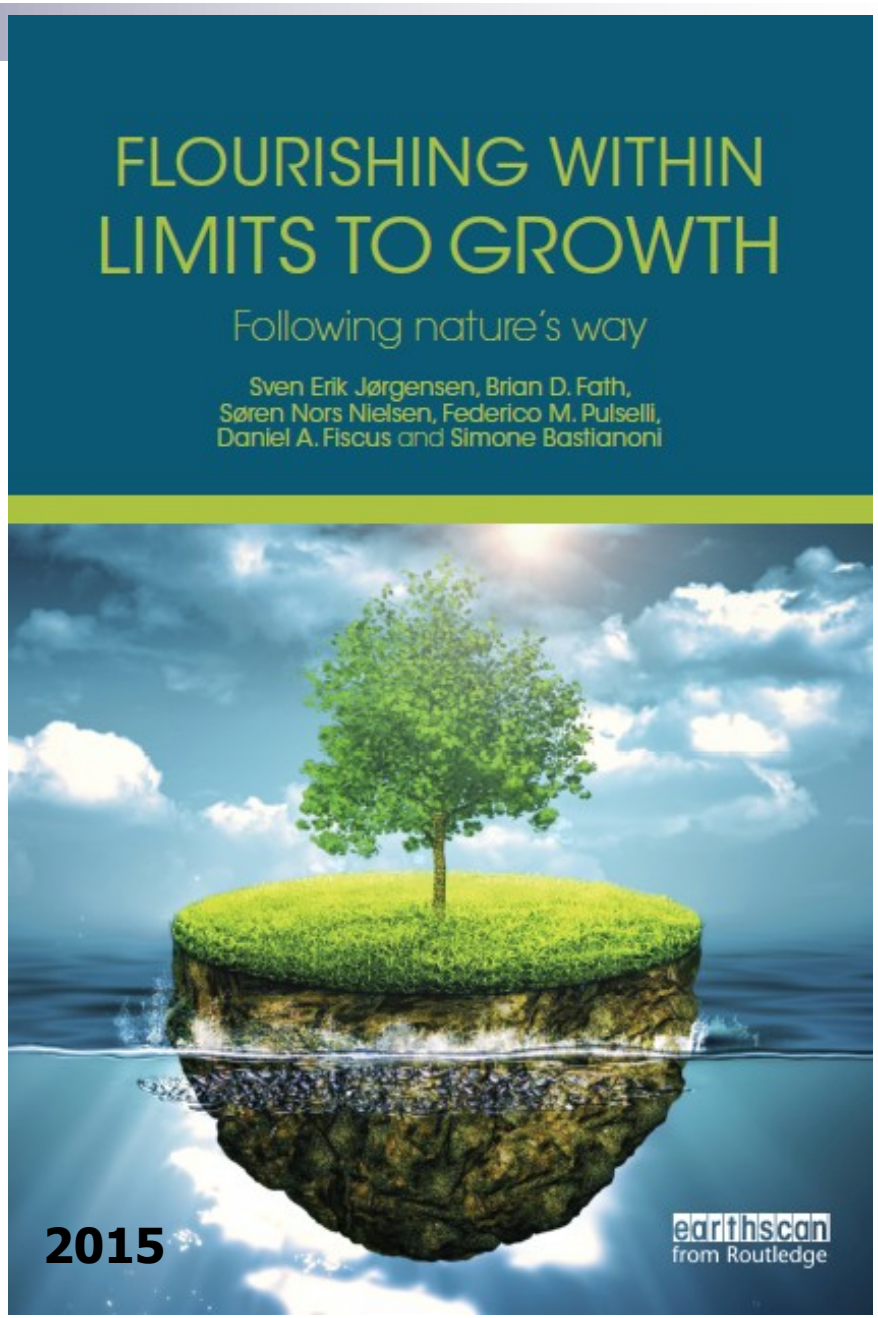
Greta Thunberg

- 2018 – School Strike for climate – Friday's for Future
- 2019 Spoke before UN Climate conference
- We will remember…

Sunrise Movement - 2017


CLIMATE
SUMMIT
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER, AIR
• HEALTHY CHILDREN
• ETC. ETC.
JOEL PETT

Ecosystems do quite well under constraints, let's learn from them



clubofsiena.eco-soft.dk

- ***"There are limits. Let's celebrate the limits, because we can reinvent a different future."***

Sunita Narain
This Changes Everything 2015