Aquaponics and Sustainability

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Resource depletion

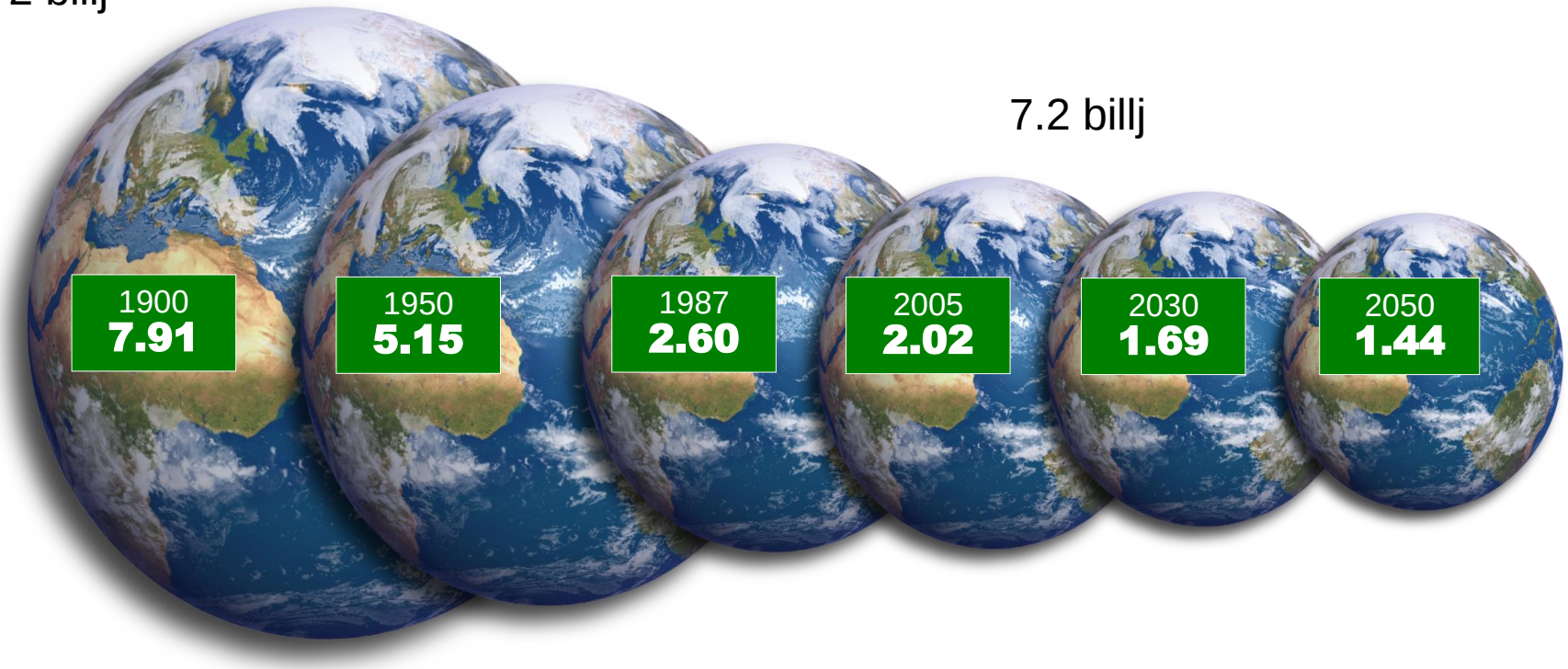
- Man is a geologic force!!!
  - We move annually 10x more than nature
  - Now have biological extinction period
    - 25% of mammals endangered
      - Thousands of species become extinct every year
      - Ecosystems on land and in oceans endangered
  - In 30 years
    - We have used up 1/3 of Earth´s resources!
      - Destroyed 30% of forests, lost 25% of soil, 50% of oil, 50% of phosphorous…
      - Metals are becoming scarce

= Because of consumption

The Earth is **shrinking**

2 billj

7.2 billj

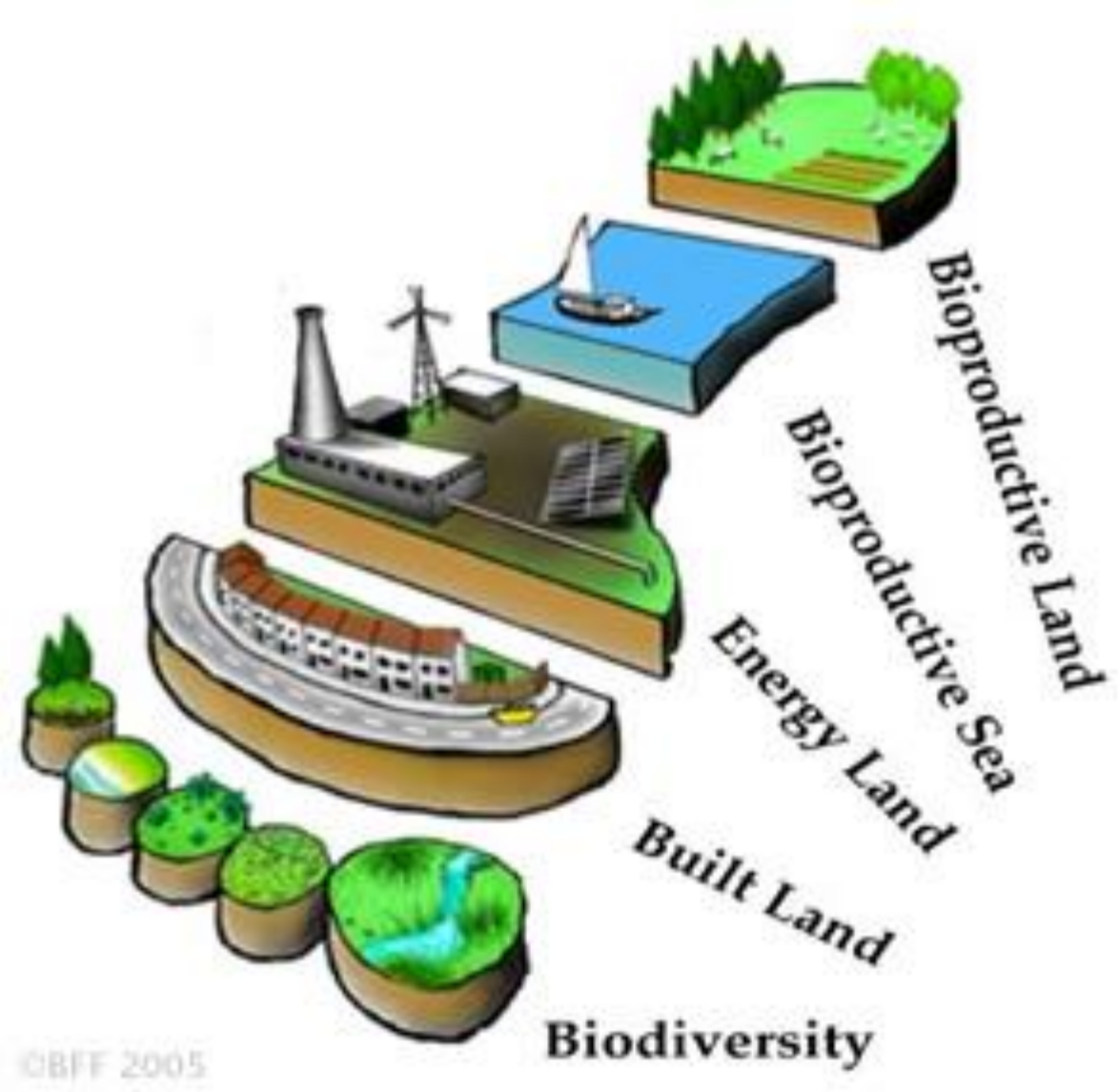


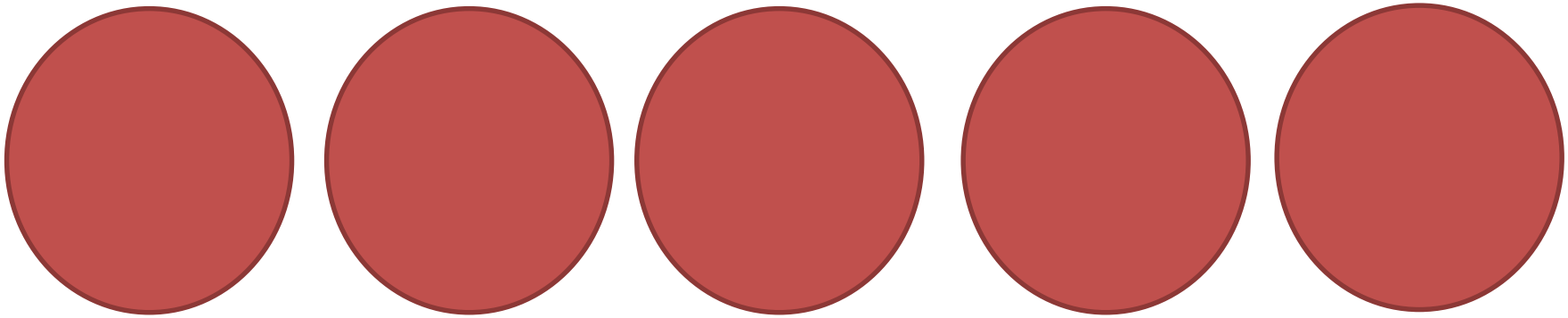
YEAR

Hectares of surface per person

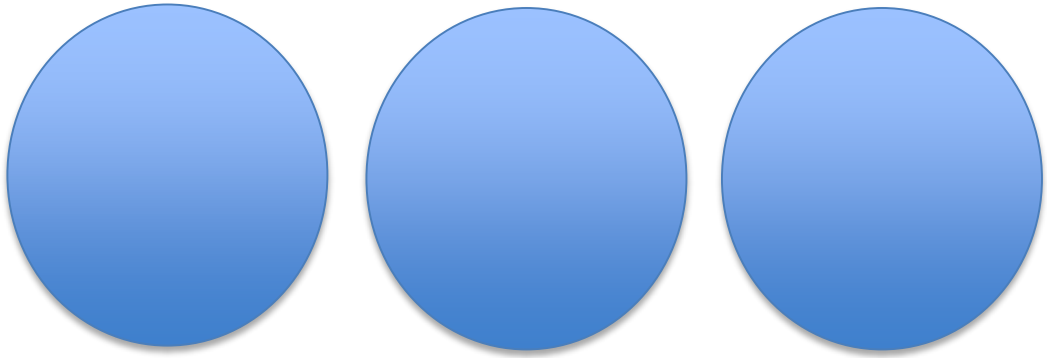
Ecological footprint = the land we need to provide daily needs and take up the waste.
Now we are using 1.5 Earths per year.

Ecological footprint





American way of life – 5 planets!



EU and
Norway
3 planets!

Iceland 10 Earths or 7!!

Climate change

Chemical pollution

Acidification of oceans

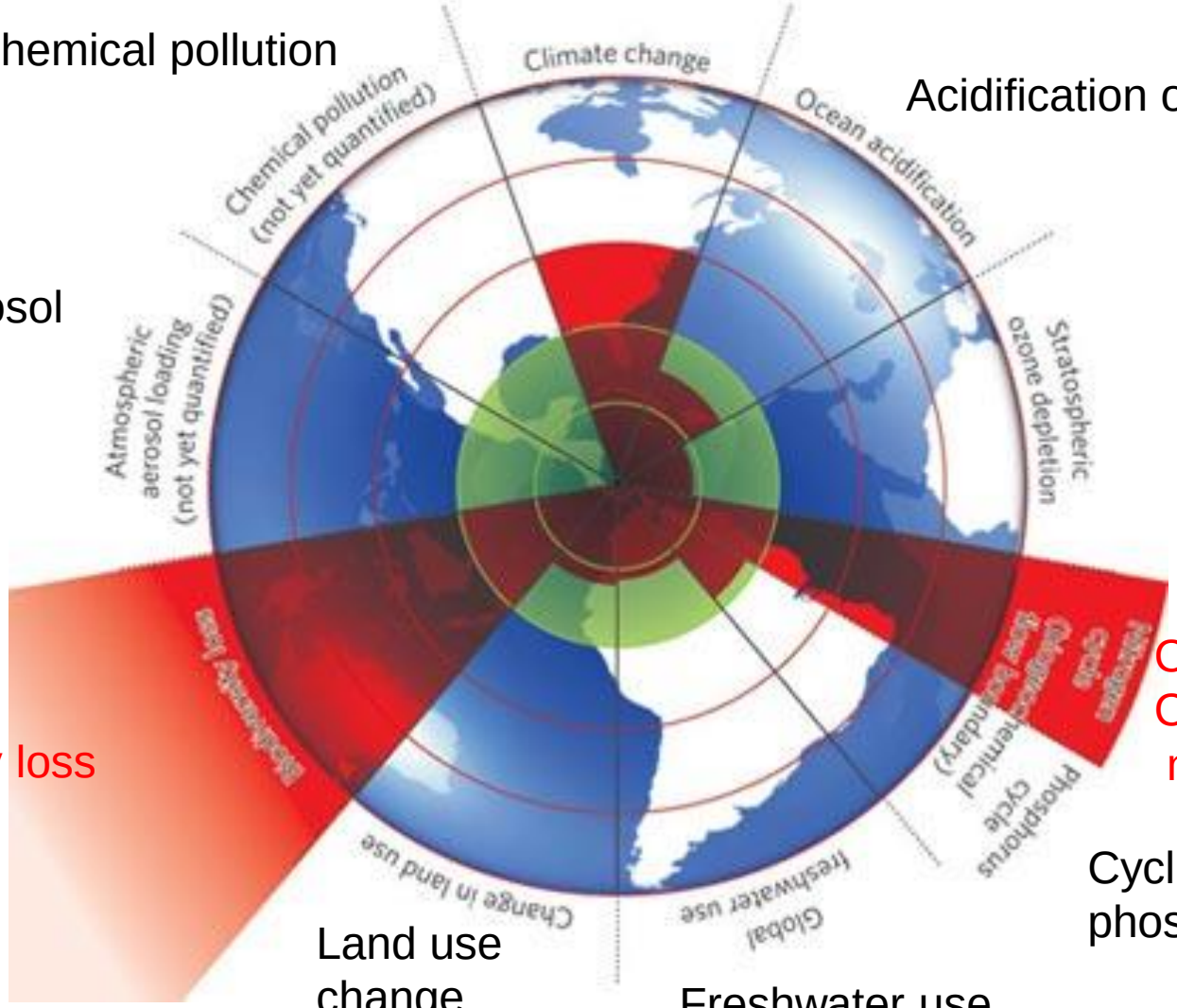
Atmospheric aerosol loading

Ozone in stratosphere

Cycling of
Cycling of
nitrogen

Biodiversity loss

Cycling of phosphorous



Land use change

Freshwater use

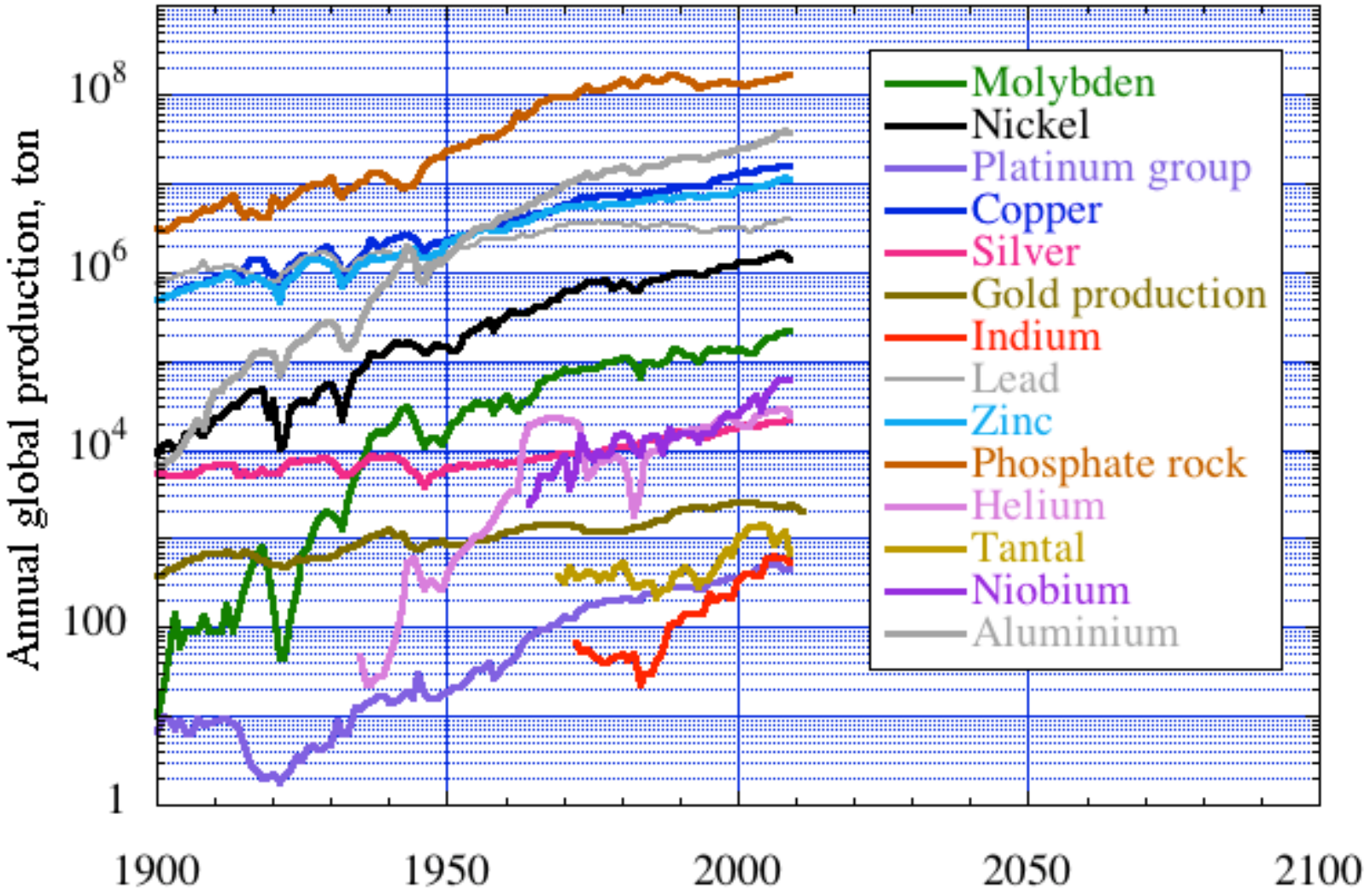
Planetary boundaries

We have surpassed 3 f 9

Rockström et al. 2009

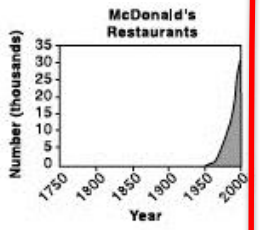
Sverdrup and Ragnarsdottir, unpublished

Exponential growth forever?



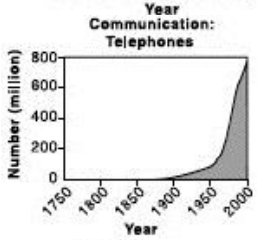
Exponential growth 1750-2000

McDonalds

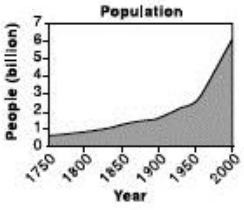


Tourism

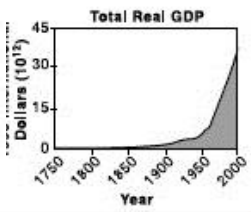
Number of telephones



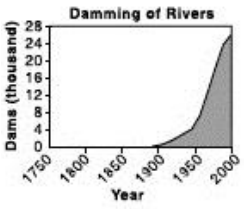
Polulation



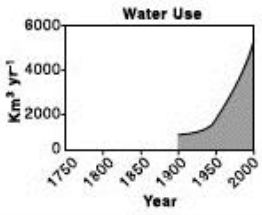
GDP



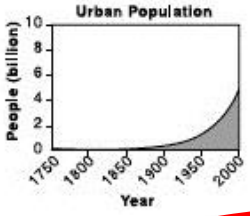
Dams on rivers



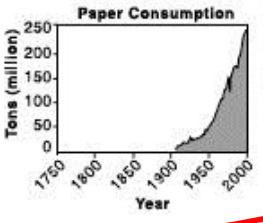
Water use



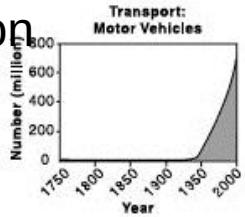
Urban population



Paper consumption



Car transport



Growth

"Anyone who believes that unlimited growth is possible in a limited world is either a madman or an economist"

Kenneth Boulding

Economist

"The greatest imperfection of mankind is that it does not understand the consequences of exponential growth "

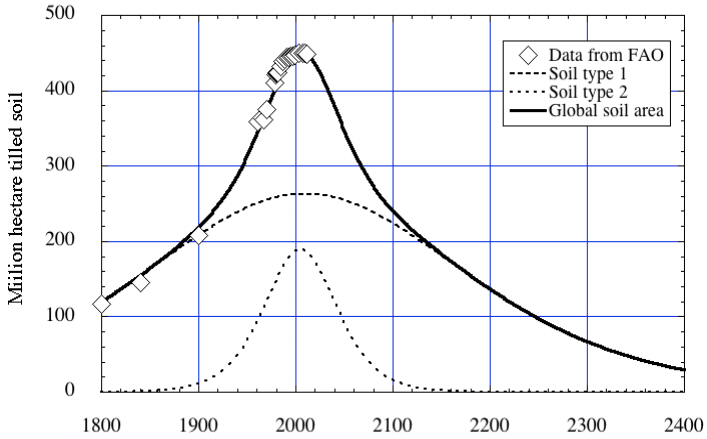
Albert Allen Bartlett

Mathematician

Both at University of Colorado, Boulder

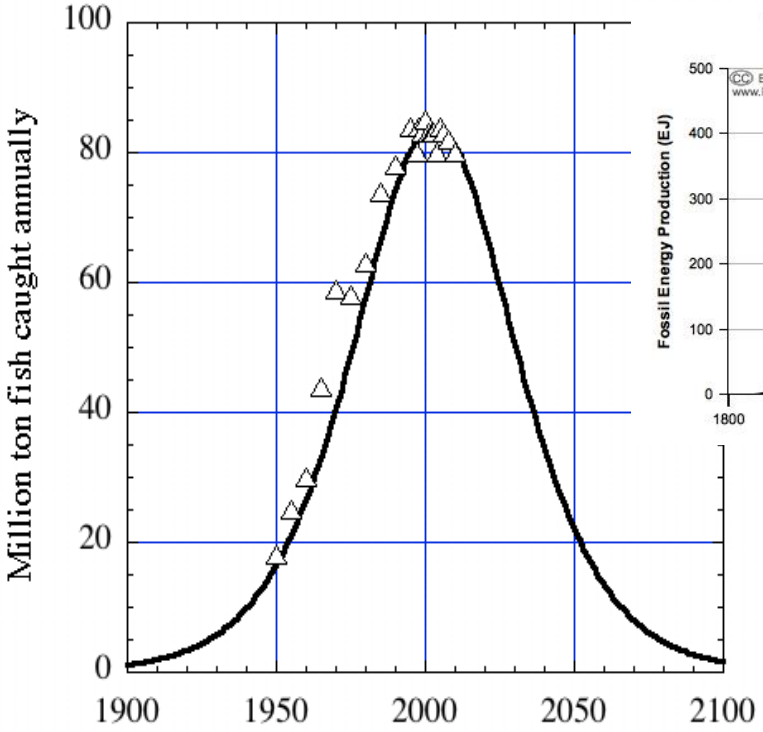
Peak fish, soil, phosphorus, oil

Soil



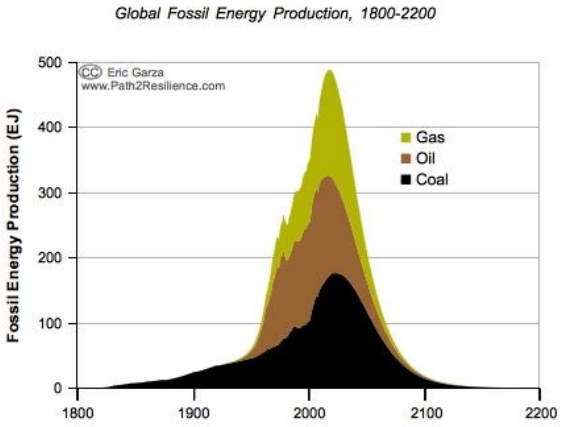
2000

Global fish catch



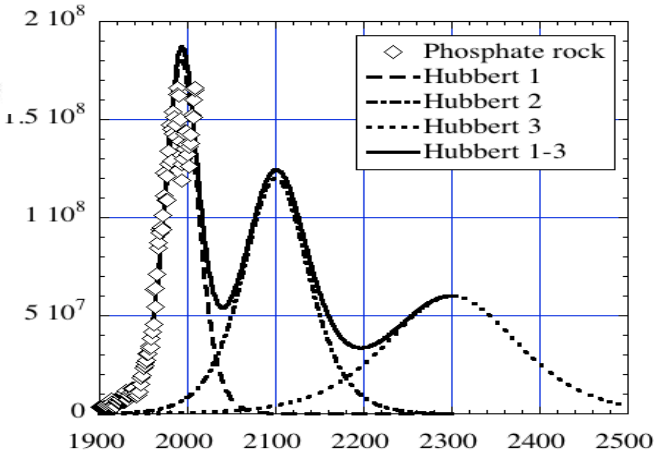
2000

Fossil fuels



Oil 2006
Gas 2015
Coal 2015

Phosphorous

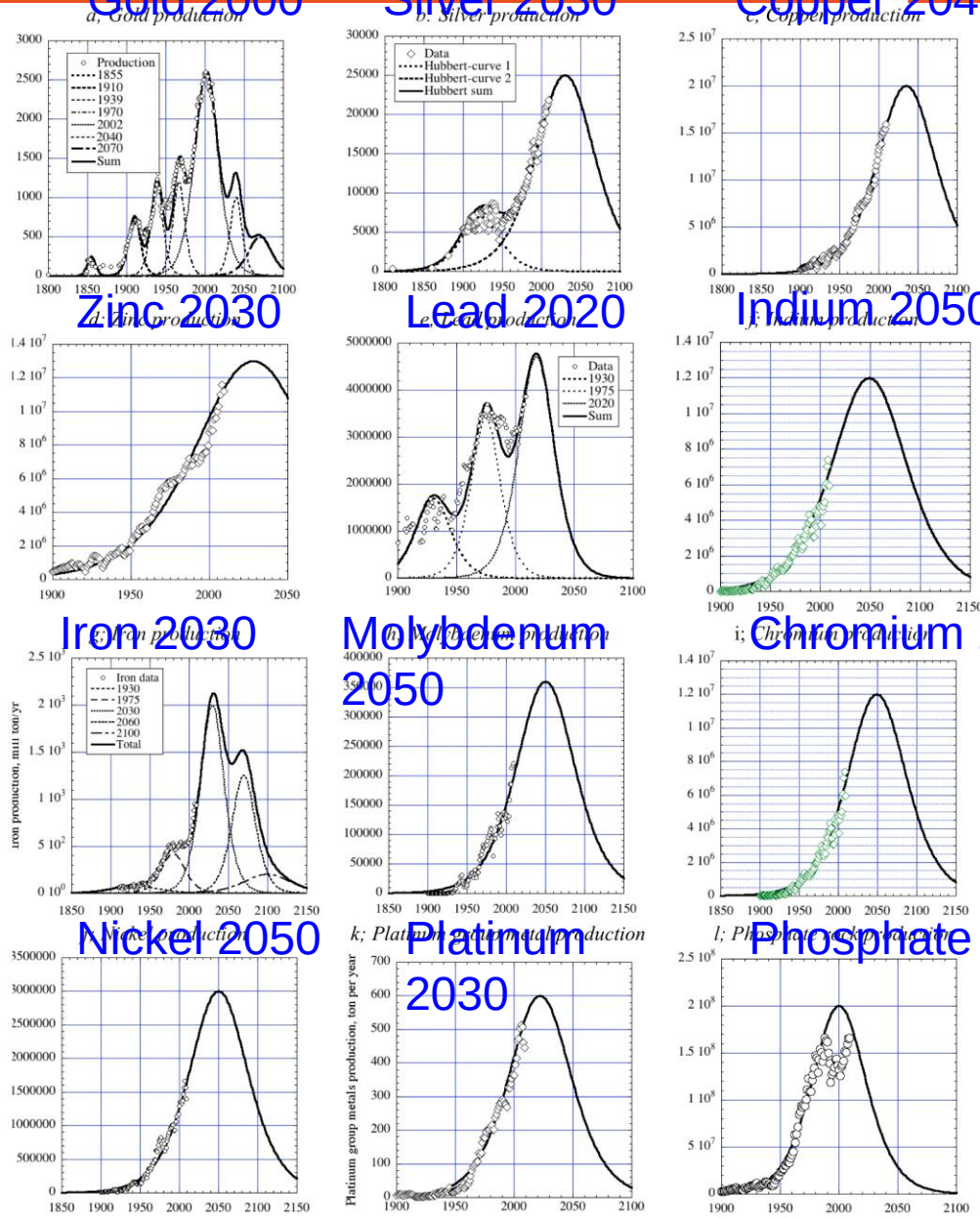


1992 2100 2300

Gold 2000

Silver 2030

Copper 2040



Zinc 2030

Lead 2020

Indium 2050

Iron 2030

Molybdenum 2050

Chromium 2050

Nickel 2050

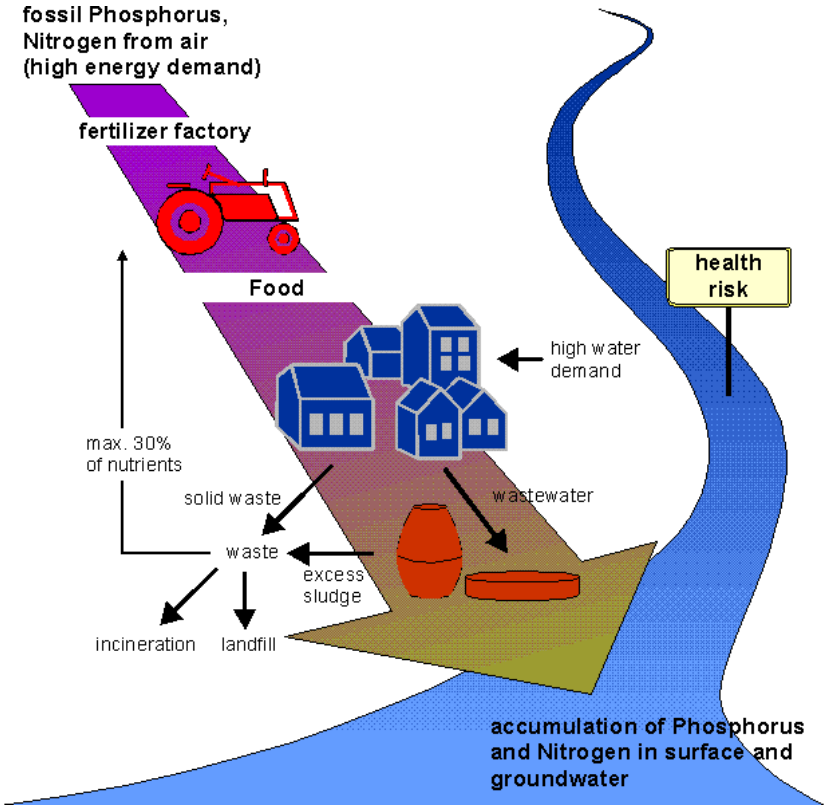
Platinum 2030

Phosphate 2000

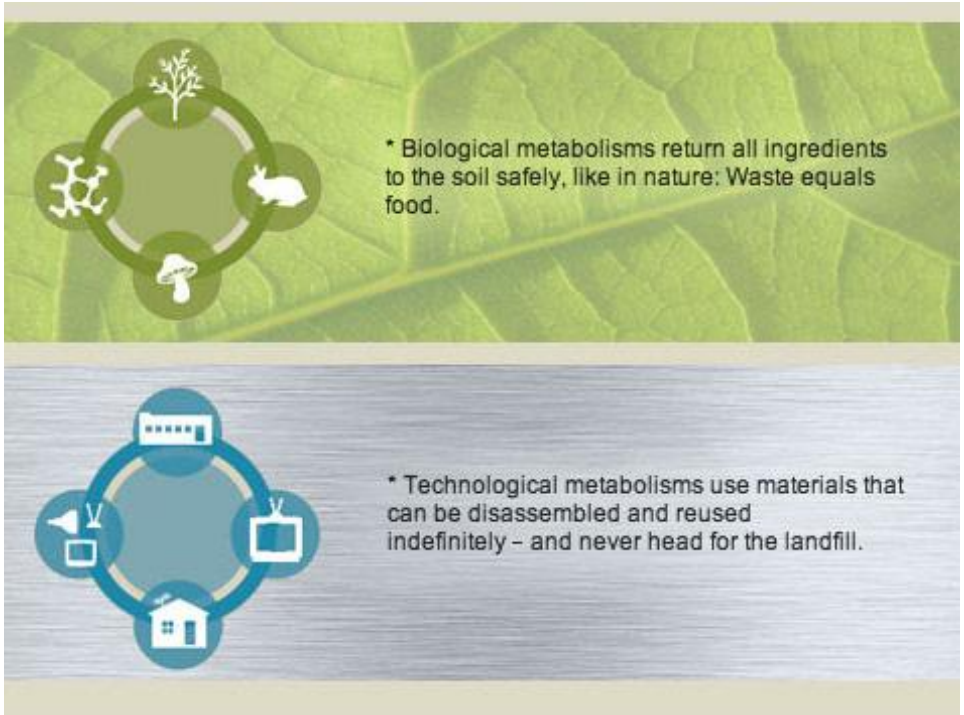
Figure 8. *Hubbert-curve fittings for gold (a) silver (b), copper (c), zinc (d) lead (e), indium (f), iron (g), molybdenum (h), chromium (i), nickel (j), platinum group metals (40% Pt, 43% Pd, 5% Rh, 5% Ru, 5% Ir, 2% Os) (k) and (l) that shows a one-curve phosphorus plot. We can see that the data suggest gold already passed the production peak. The scale on the Y-axis is production in ton per year, the x-axis is the year. Data:* http://minerals.usgs.gov/ds/2005/140/

Hubberts „peak" curves for 12 key metals and materials

From cradle to grave to cradle to cradle



Biomimicry – Cradle to cradle



Sustainability

Sustainability is..

A set of conditions and trends in a given system that can continue indefinitely

Sustainable development is..

A directed process of continuous innovation and systemic change in the direction of sustainability

Atkisson 2008

Systems and sustainability

Steps towards sustainability

- Think long term
- Understand systems
- Know limits
- Protect nature
- Change commerce
- Show equity
- Support entrepreneurship

System thinker

- Looks for the big picture
- Looks for cycles, causes and effects
- Sees how things within the system change with time
- Looks for new angles
- Investigates causes of short-term and long-term actions
- Finds unexpected connections

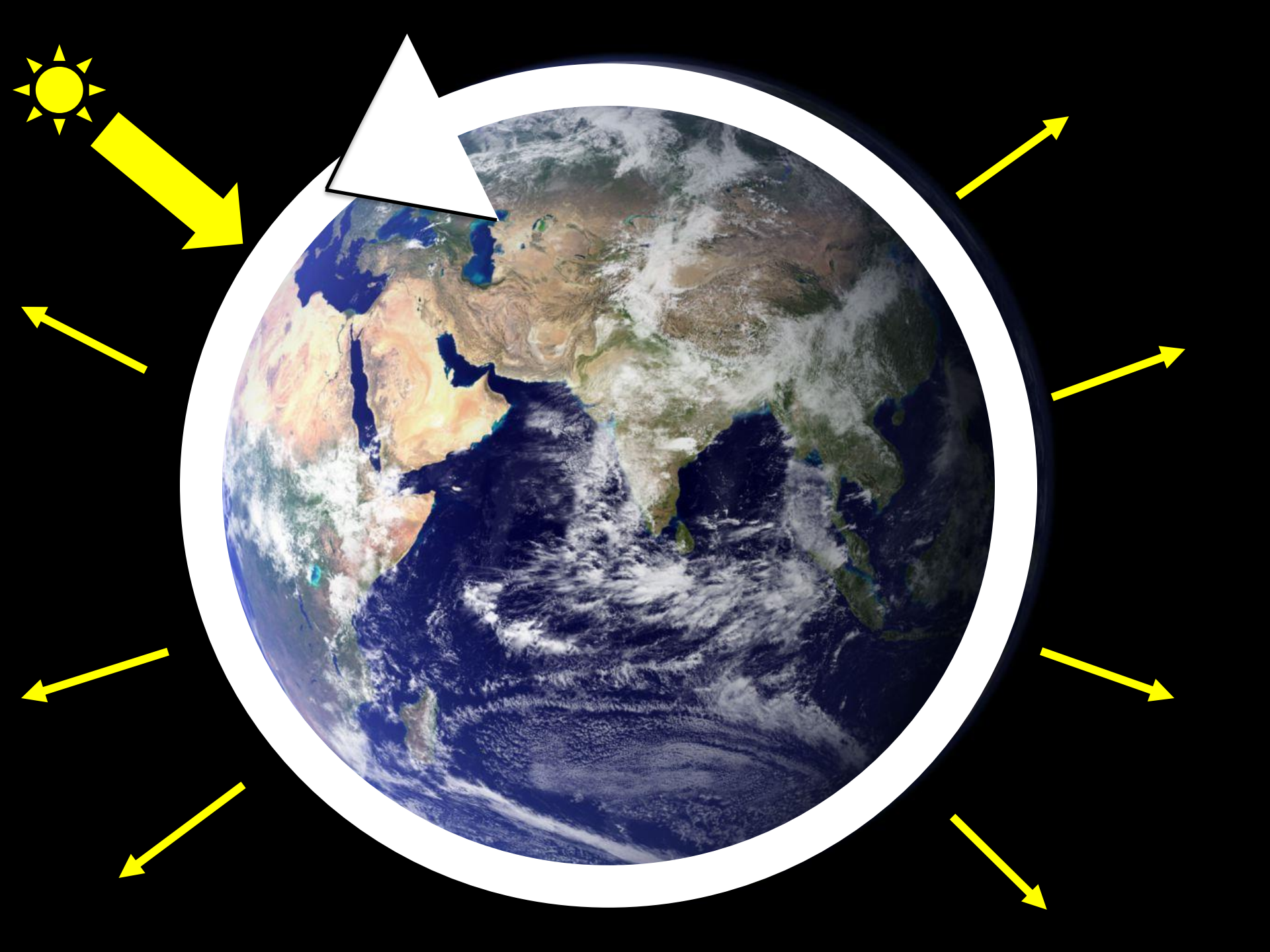
(AtKisson 2008)

Aquaponics

- Many available scales
  - Hobby at home in the garage
  - In schools
  - Community engagement
  - Mini production for local restaurants
  - Mega production for commercial purposes

Research/training needed for Aquaponics

- Urban agriculture, Sustainable cities
- Permaculture
- Operational
  - Feed for fish, flies, larvae, algae…
  - Closing nutrient cycles, modelling
  - Orgnic certification
- Economic
  - Feasibility
  - Green economy
- Environmental
  - Impact Assessment
  - Footprint – water, CO_2, energy..
- Sustainability Indicators
- System dynamic modelling
- Education
  - Open source
  - Community involvement
  - Vocationlal training



Conclusions

- Natural resources are being overused
- Learning from nature is a key to the future
- Aquaponics is one step in the right direction
- Good luck with all your efforts!

Thank you for listening!