



Lomonosov Moscow State University
Business School

Global Limits of Economic Growth

*Lomonosov Moscow State University,
Inter-Departmental Course, 2023-2024, Spring Fall*


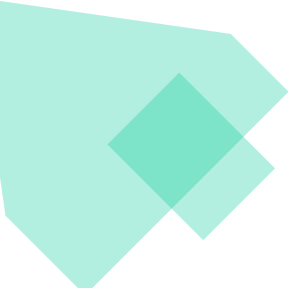
Course Reader:

Evgeniya Anatolyevna Shvets, PhD.

e.shvec@edu.mgubs.ru

Learning Schedule

- Our classes will take place on Wednesdays at 15:00 during 3 months (12 weeks)
- Communication with the course reader:
 - During classes
 - Via e-mail
 - All administrative issues should be addressed via **your Personal Account** (личный кабинет)
- Before each session you will receive **Pre-Reading and Food-for-Thought Assignment** through your Personal Account



Global Limits of Economic Growth (GLOEG) - 2024



Lomonosov Moscow State University
Business School

Pre-Reading and Food-for-Thought Assignment before Session 1 (Febr., 7th)

LIMITED GROWTH MODELS


Read abstracts from E.Pestel “The Limits to Growth” and D.Meadows “The Limits to Growth: The 30-Year Update”.

Think about:

What factors were considered for these limitation models and why?

What are model preconditions (*предпосылки/допущения модели*)?

How do reports conclusions change with time (in 30 years)?



The Limits to Growth

*Abstract established by Eduard Pestel. A Report to The Club of Rome (1972),
by Donella H. Meadows, Dennis I. Meadows, Jorgen Randers, William W. Behrens III*

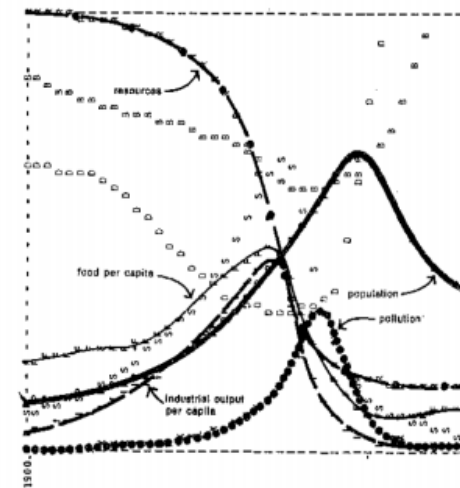
Our world model was built specifically to investigate five major trends of global concern – accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment. The model we have constructed is, like every model, imperfect, oversimplified, and unfinished. ... We feel that the model described here is already sufficiently developed to be of some use to decision makers.

Our conclusions are :

1. If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.
2. It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential. If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success.

All five elements basic to the study reported here--population, food production, and consumption of nonrenewable natural resources--are increasing. The amount of their increase each year follows a pattern that mathematicians call exponential growth. ... None of the five factors we are examining here is independent. Each interacts constantly with all the others. We have already

Figure 35 WORLD MODEL STANDARD RUN



1

2

3

4

Requirements to Pass the Course

- 1) At least 50% of sessions are attended (6 sessions)
- 2) At least 60% points for the final course test
- 3) Individual Project (Presentation) is done properly and delivered in time

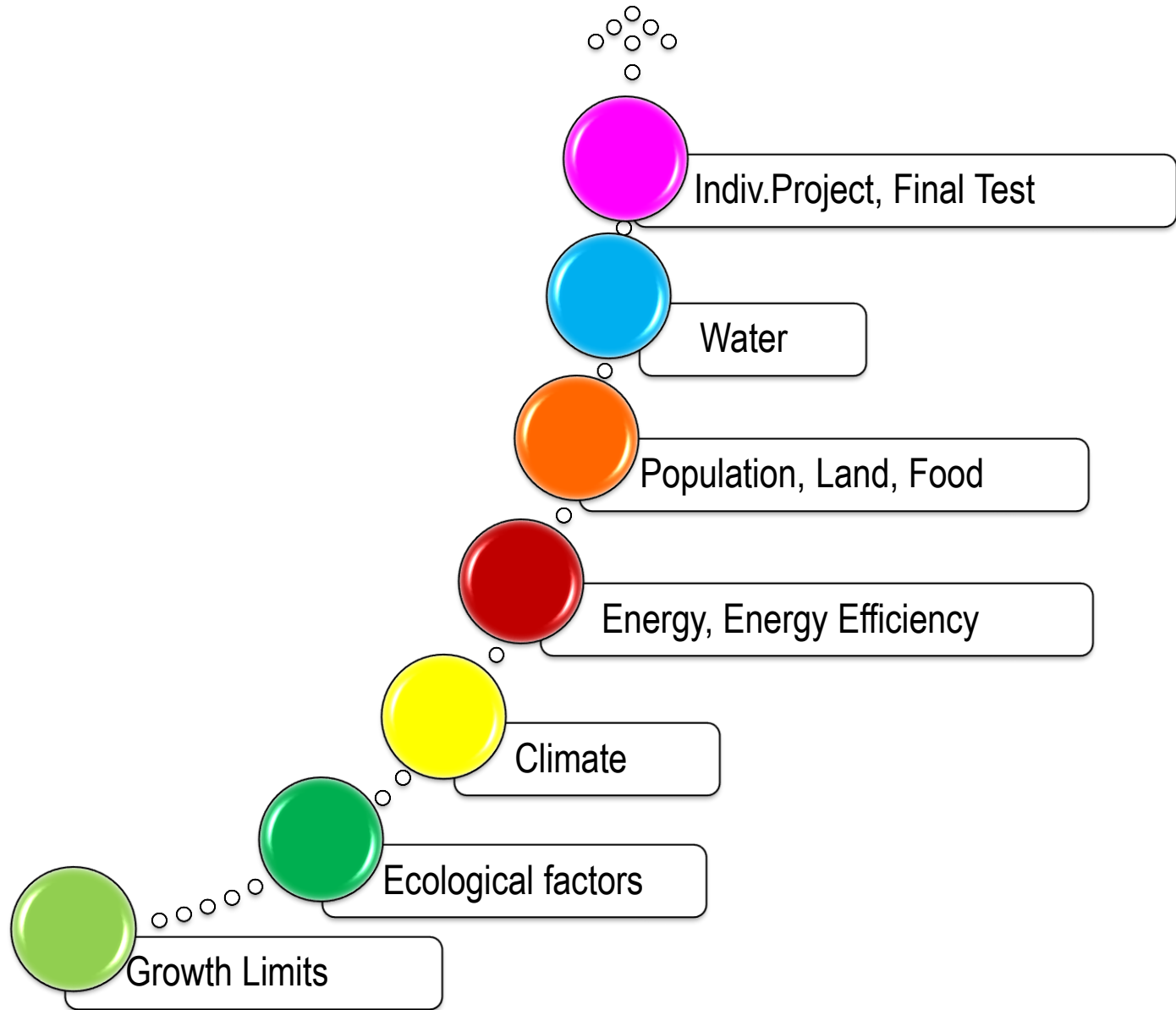
Course “Global Limits of Economic Growth” aims to:

- Improve your’ awareness of global challenges and elicit critical thinking on economic, social and environmental issues raised by contemporary global environment
- Develop your ability to analyze global problems impact on economic environment and understand how it’s possible to assess risks
- Provide understanding how some natural resources factors can be managed and mitigated in the most appropriate way on the level of companies, countries and international institutions

General Scheme for Resource Limitations Analysis

# Resources		Steps of Analysis					
		Step 1	Step 2			Step 3	Step 4
		Role/ Importance	Limitations produced for			Ways used to overcome existing limitations	Suggestions how to improve these ways of coping with limitations
World economy	National economy		Industries/ Business				
1
2
3

Course Route



On completion of the course, students should be able to:

- Understand the general context of global resource limitations for national development and key resource limitation issues for business activity
- Have basic understanding how to develop an individual approach to undertake key global challenges for different actors like international organizations, national governments and private companies
- Evaluate possible consequences of specific kind of resource limitations for different businesses
 - Apply theory to practice by emphasizing how global issues can be handled and how they can potentially contribute to the creation of positive economic or social change and to the development of a sustainable future on national and international levels.

General Scheme for Resource Limitations Analysis



Scheme for the Individual Project (1-2 students per 1 project)

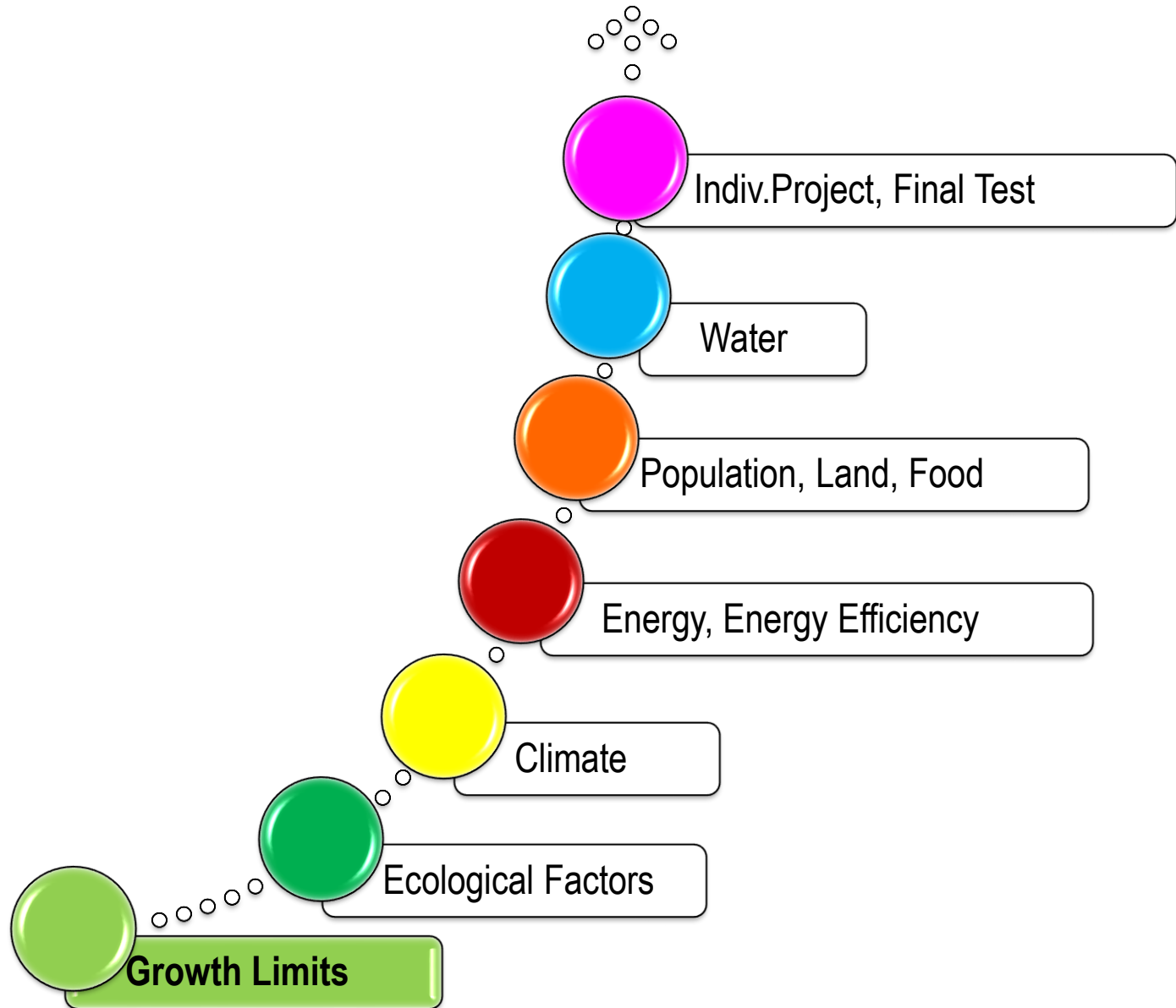
Resources	Steps of Analysis					
	Step 1	Step 2			Step 3	Step 4
	Role/ Importance	Limitations produced for			Ways used to overcome existing limitations	Suggestions how to improve these ways of coping with limitations
	World economy	National economy	Industries/ Business			
Unique Resource or Problem selected by you Scale: world or a country or an industry

Session 1

Resource Limitations of Economic Growth

07.02.2024

Course Route



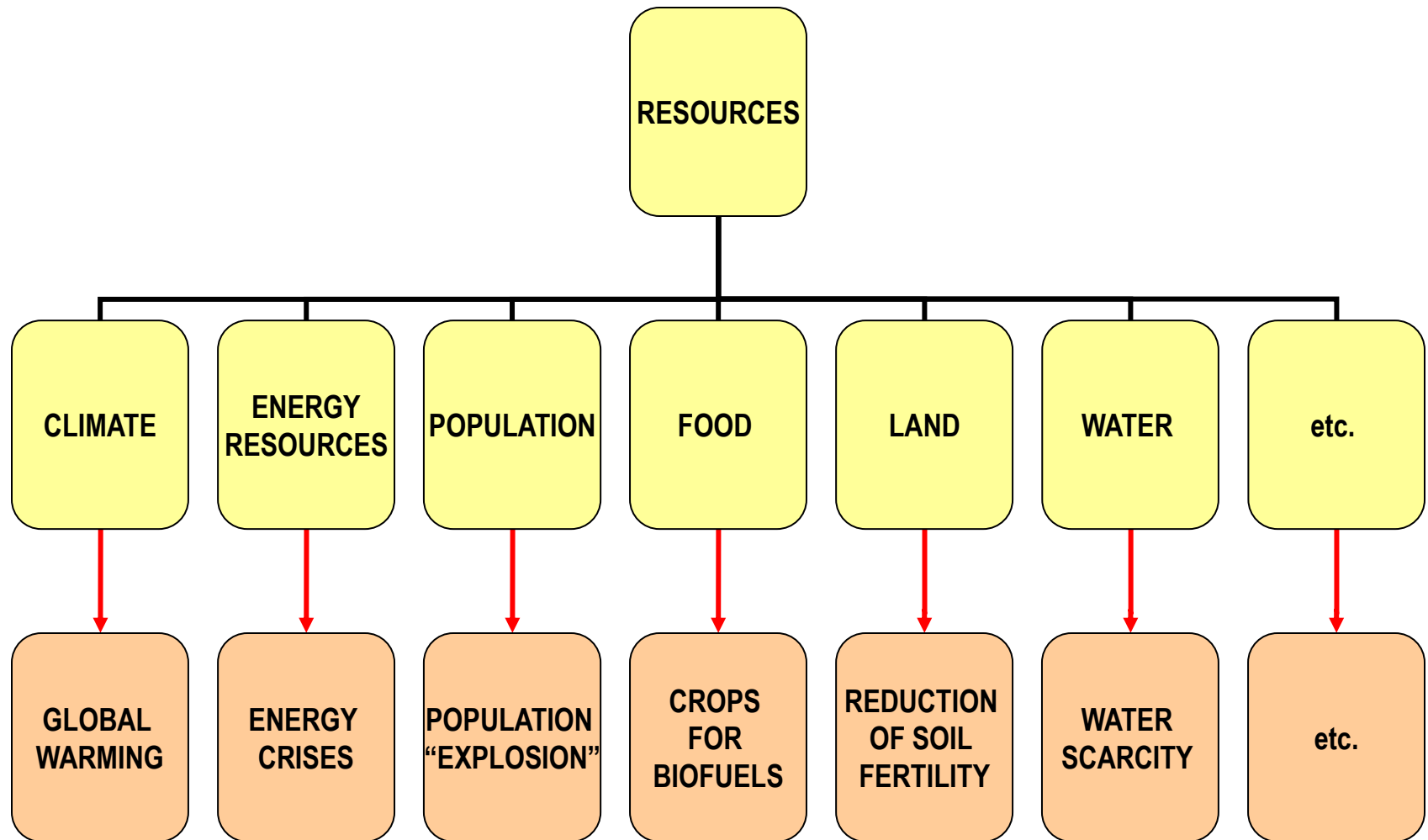
The Aims of Session 1

1. To introduce you to the modern context of limited resources theories
2. To know different approaches how to create a model of limited energy resources based on real data
3. To understand the opportunities for economic growth with limited natural resources

Session 1. Resource Limitations of Economic Growth

1. Resource Limitations, Types of Resources and Their Role in the Economic Development
2. Club of Rome Forecasts
 - Discussion of the articles “The Limits to Growth” by E.Pestel and “The Limits to Growth: The 30-Year Update” by D.Meadows.
 - From the first similar ideas (Malthus) till the latest similar complex studies (“Challenging the planetary boundaries II” by Sverdrup H.U.)
3. Peak of oil – Calculating Exercise
4. The Venus Project by Jacque Fresco

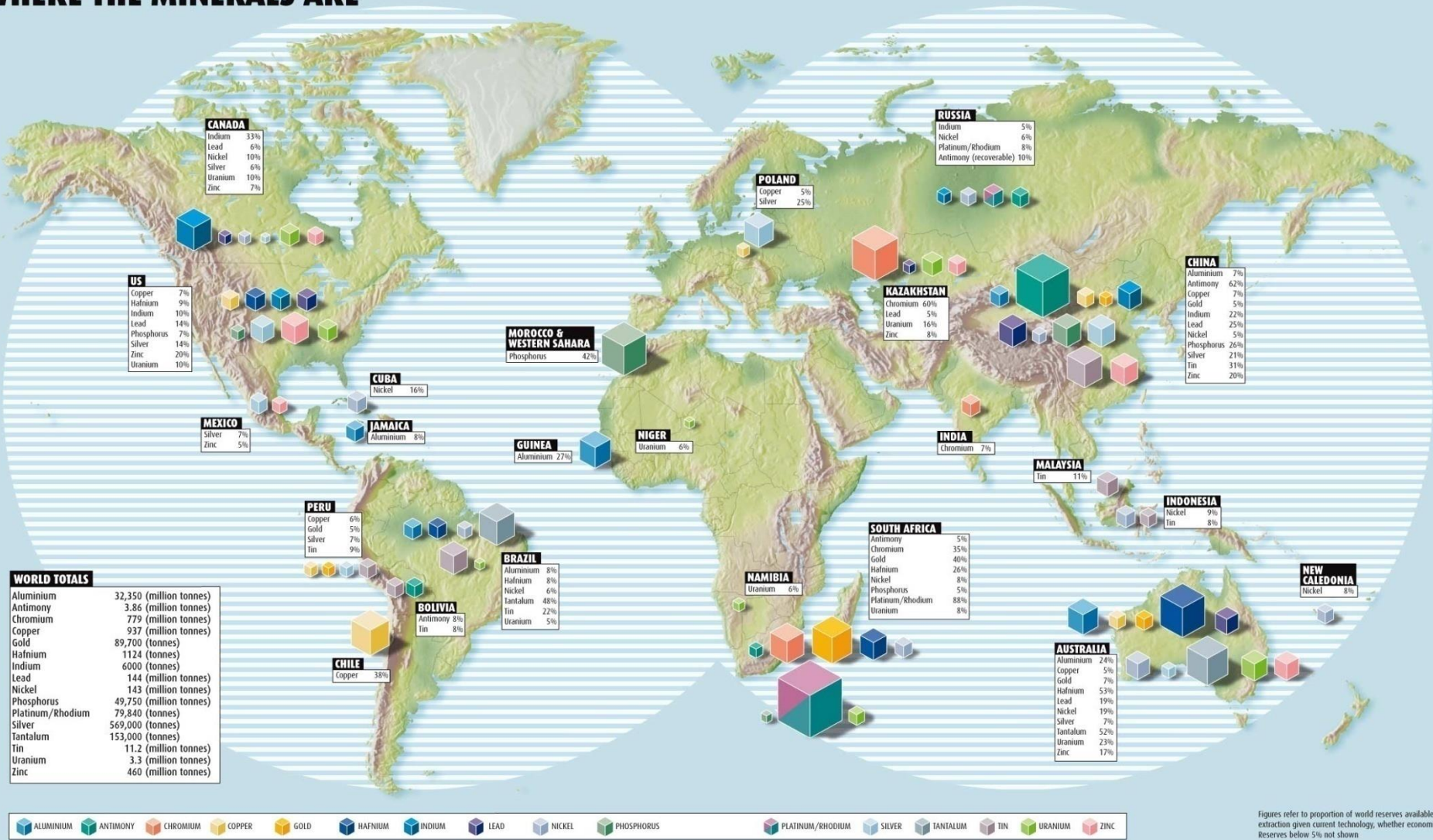
Resources (R) and Resource Limitations (RL)



Types of Resource Limitations	What can we do with these limitations?
• Pollution of different types (natural, technological, ...)	
• Irrational use, overuse → Depletion	
• Natural catastrophes	
• Uneven resource distribution	
• Geopolitical factors	

Example of Resource Limitations: Their Geographic Allocation

WHERE THE MINERALS ARE



Figures refer to proportion of world reserves available for extraction given current technology, whether economic or not. Reserves below 5% not shown.

Source: <http://www.newscientist.com/data/images/archive/2605/26051201.jpg>

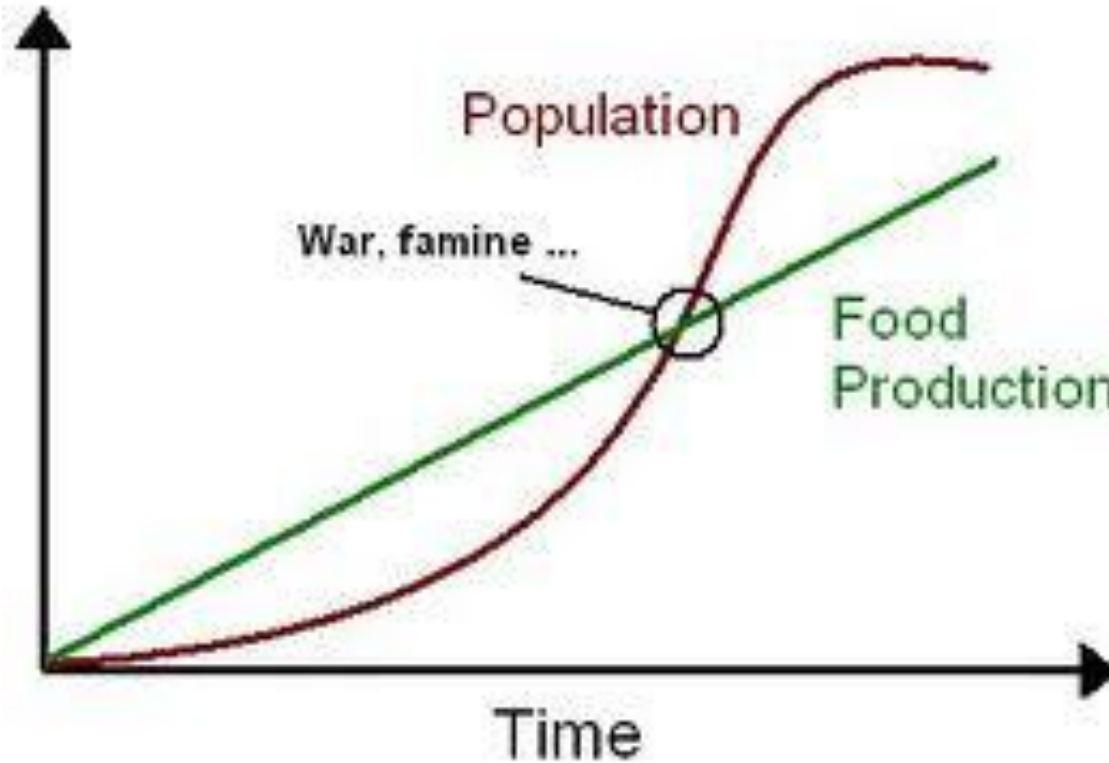
Rich mineral resources are not benefits only, but also the source of many problems.

What are these problems?

Population and Food Production according to Malthus



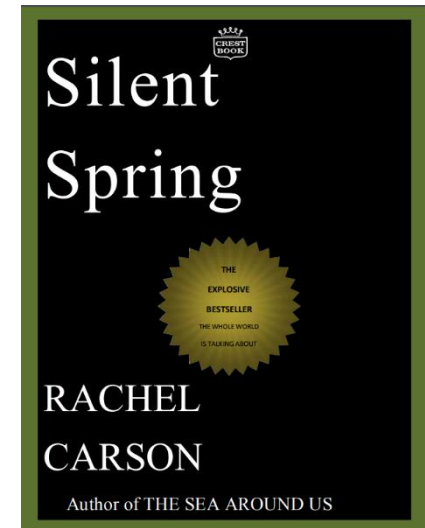
1766-1834



- The level of resources exploitation in 1870-1970 has grown in 5 times
- For how long will we have non-renewable resources?

Alarm Time in terms of Resources Available: 60-70-s

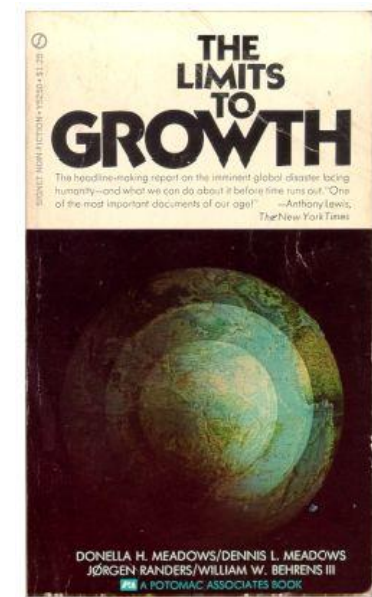
- Rachel Carson “Silent Spring” (1962-63)
- Garrett Hardin, the article “The Tragedy of the Commons” (1968)
- Club of Rome report “The Limits to Growth” (1972)



The Tragedy of the Commons

Garrett Hardin

The population problem has no technical solution; it requires a fundamental extension in morality.



- **The Club of Rome (CR)** is a not-for-profit organization, independent of any political, ideological or religious interests.
- **Its mission is** "to act as a **global catalyst for change** through the identification and analysis of **the crucial problems facing humanity** and **the communication of such problems** to the most important public and private decision makers as well as to the general public."



For more information see: <http://www.clubofrome.org/eng/home/>



- In April **1968**, Italian industrialist Aurelio Peccei and Scottish scientist Alexander King gathered a small international group of professionals from the fields of diplomacy, industry, academia and civil society.
- In **1972** the first report to the Club of Rome: "The Limits to Growth" that explored a number of scenarios and stressed the choices open to society to reconcile sustainable progress within environmental constraints.

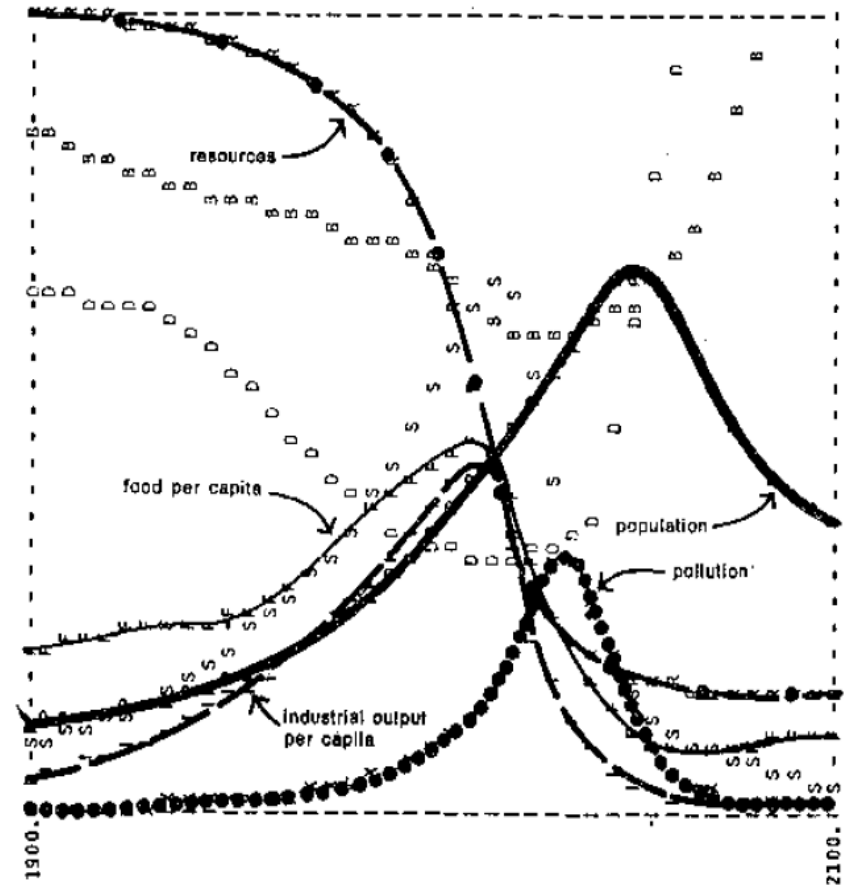
1972 - The Limits to Growth

1992 – Beyond the Limits

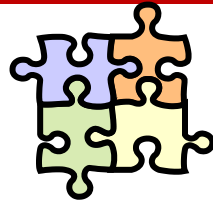
2002 – The Limits to Growth: the 30-year Update

- A 'dynamic systems' world model had 5 main variables:
 - **Population**
 - **Production**
 - Production is specified in industrial, services and agricultural production and available land for agriculture
 - **Food consumption**
 - **Nonrenewable resources consumption**
 - **Pollution**
- As an input for the model they used real-life data and reasonably optimistic estimates to create a 'standard run'

Figure 35 WORLD MODEL STANDARD RUN



➤ Explain the interaction between model factors (try to draw up a scheme)



The Limits to Growth (1972)

- What are the basic simplifications (presumption) of the world model standard run?
- Think of critique arguments of the model proposed, add yours.

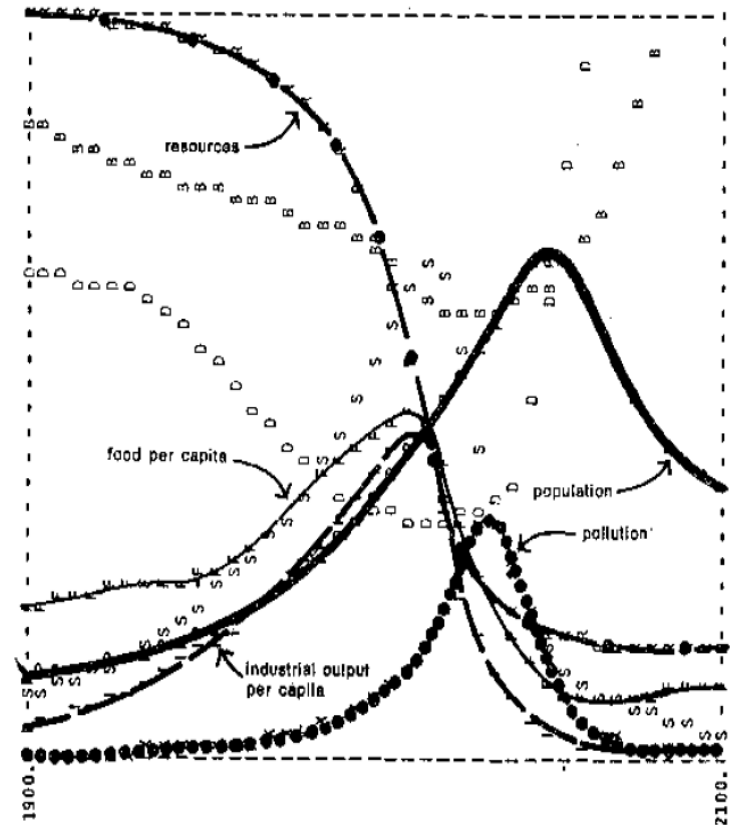
Uncontrolled Growth Breeds Disaster



- The aim was to see what happens to the variables for the period 1900 – 2100 under the simplification that *no changes in policy are made*.

Conclusions:

Figure 35 WORLD MODEL STANDARD RUN



Resources VS Reserves

- **Resources** are natural substances somewhere in/ on/ beneath the Earth surface
- **Reserves** are economic assets, they can be technically extracted and are economically profitable to extract
 - What can limit the growth of reserves?

What can limit the growth of reserves?

- Level of technologies (R&D) and competencies
- Institutional conditions (growing state/private investments)
- Economic conditions (prices, costs)
- Ecological restrictions (pollution, environmental recultivation possibilities)
- General economic opportunities of the humanity

=> Oil reserves are constantly growing.

Sustainable Development

- **Sustainable Development** is not an end in itself, it's a process
- (1) A **Sustainable Society** is one that meets the needs of the present without compromising the ability of future generations to meet their own needs. (*World Commission on Environment and Development, 1987*)
- (2) It's about balanced development of the **society** that tries to anticipate new **contradictions** and resolve existing ones on the base of **matching its needs with the capabilities of the biosphere** to be in a sustainable state and save vital resources for future generations.
- **Sustainable Development Concept** is about solving actual problems that will help to avoid future complications.

Sustainable Development Goals



- The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future.

<https://sustainabledevelopment.un.org/>

- + What is sustainable development?

- + How will the Sustainable Development Goals be implemented?

- + How will the Sustainable Development Goals be monitored?

- + How much will the implementation of this sustainable development agenda cost?

- + How does climate change relate to sustainable development?

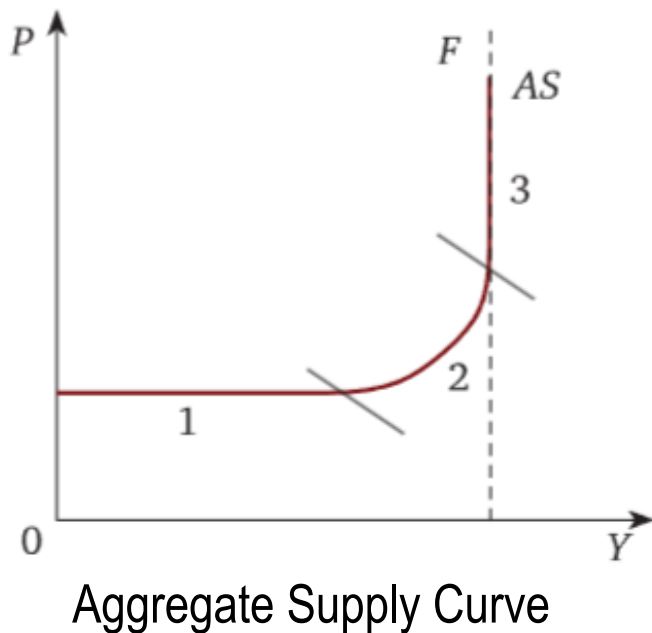
- + Are the Sustainable Development Goals legally binding?

- + How are the Sustainable Development Goals different from the MDGs?

- What is sustainable development?

- Sustainable development has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Sustainable development calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet.
- For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social inclusion and environmental protection. These elements are interconnected and all are crucial for the well-being of individuals and societies.
- Eradicating poverty in all its forms and dimensions is an indispensable requirement for sustainable development. To this end, there must be promotion of sustainable, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, and promoting integrated and sustainable management of natural resources and ecosystems.

AD – AS model: Potential Output (GDP)



Potential output is the output that can be produced using all the resources available in the economy within the framework of existing production technologies.

The value of potential GDP is determined by the last unit of the marginal (most scarce) resource.

What usually acts as a marginal resource in developed countries and in developing ones?

Is potential GDP variable or constant?

World Population Milestones

World Population reached:

1 billion in	1804
2 billion in	1927 (123 years later)
3 billion in	1960 (33 years later)
4 billion in	1974 (14 years later)
5 billion in	1987 (13 years later)
6 billion in	1999 (12 years later)

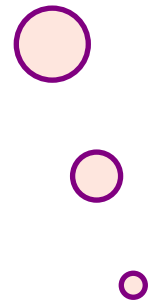
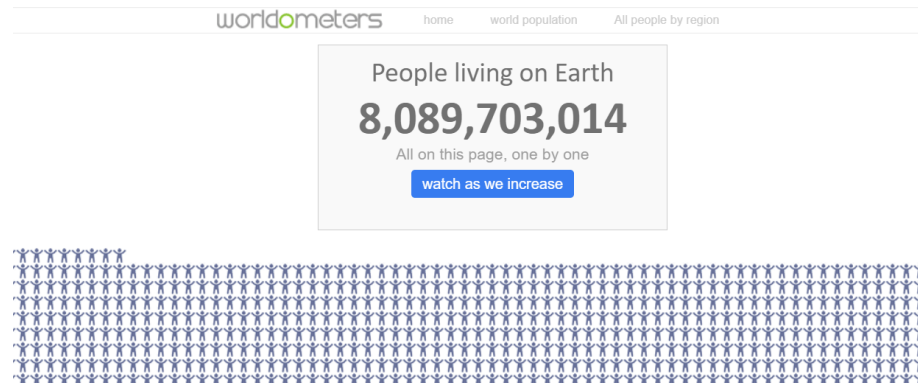
World Population may reach:

7 billion in	2013 (14 years later)
8 billion in	2028 (15 years later)
9 billion in	2054 (26 years later)
10 billion in	2183 (129 years later)

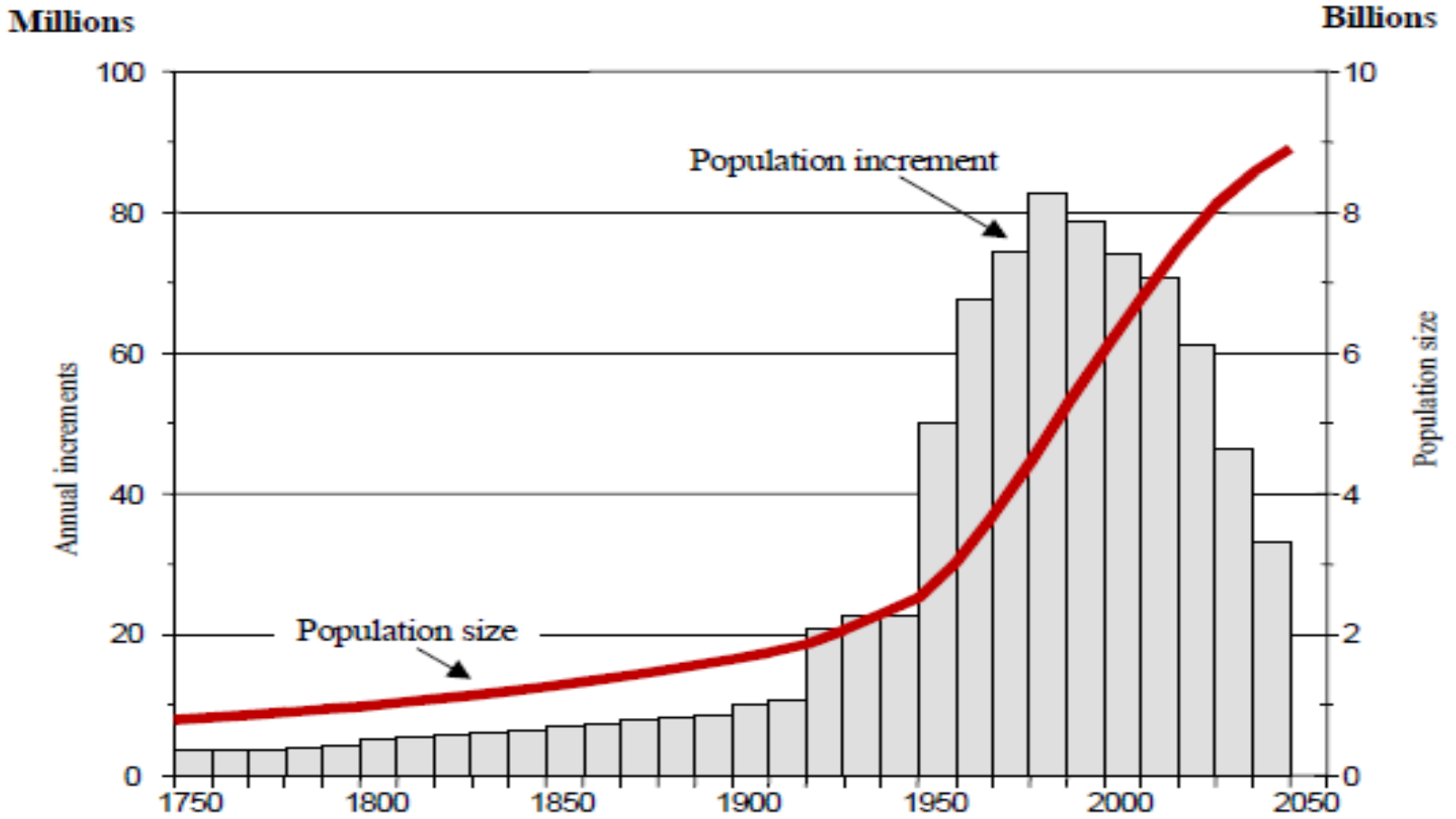
Source: United Nations Population Division.

Numbers can vary

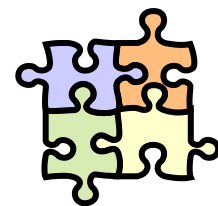
(<https://www.worldometers.info/world-population/>)



Long-term world population growth, 1750-2050

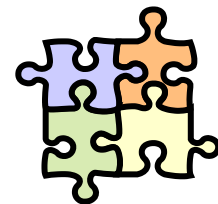


Source: United Nations Population Division.



The Limits to Growth: the 30-year Update (2002)

- Are the authors more optimistic or pessimistic?
- What are the basic preconditions of the model World 3?
- What changes did occur from 1972 to 2002 in the authors concern of human society future?
- Is the report (2002) oriented more to solution proposing or stating the facts?



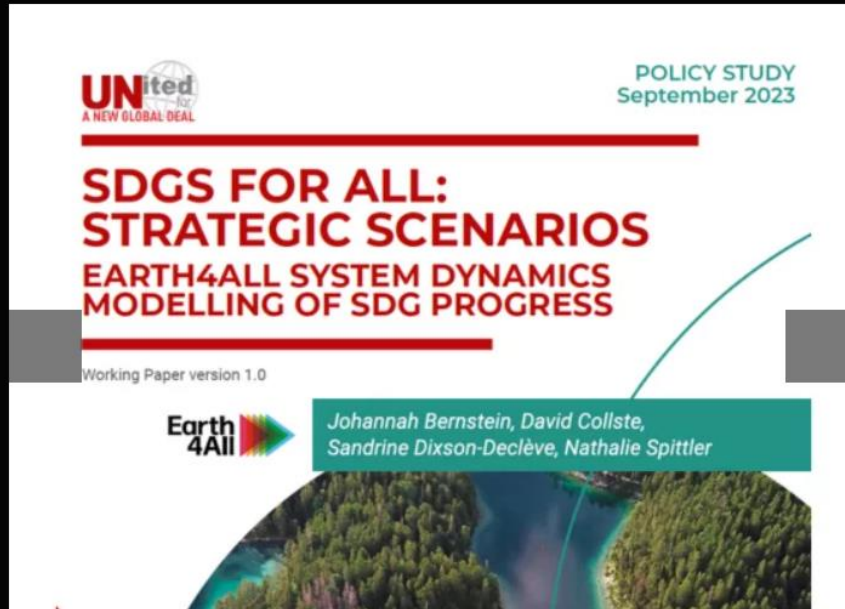
The Limits to Growth: the 30-year Update (2002)

- What is the distinction between sustainable growth and zero growth?
- What kind of growth is suggested in the report **The Limits to Growth: the 30-year Update** for the human society and why?
- According to the articles, is sustainable society possible?



Reframing Economics

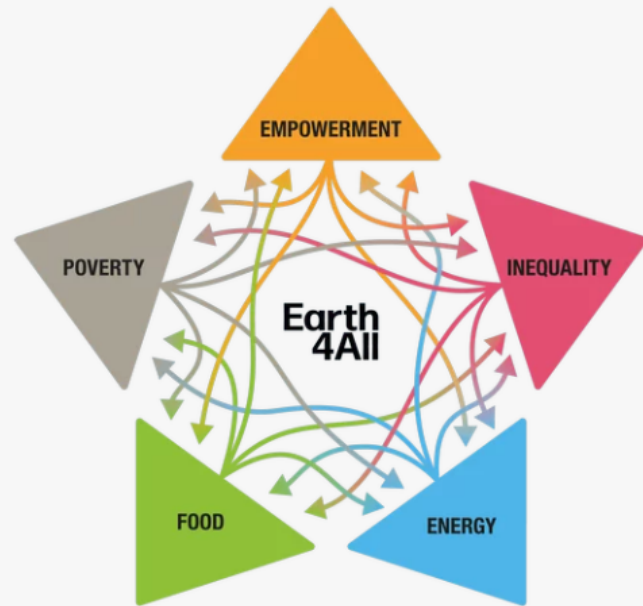
The Reframing Economics Impact Hub is a collaborative effort aimed at transforming our economic systems to achieve wellbeing for all while acknowledging the planetary boundaries and the finite nature of our planet. It seeks to challenge traditional economic models that prioritise unlimited growth and consumption, and instead explore and co-create policies that respect the natural limits of our environment.



News

New foresight report identifies urgent policy actions needed to put SDGs back on track

Ahead of the UN's SDG Summit (18-19 September), groundbreaking analyses shows how by enacting five 'extraordinary turnarounds' SDGs implementation can be accelerated.



The five extraordinary turnarounds to achieve the Giant Leap scenario

Earth4All has identified five extraordinary turnarounds needed to create wellbeing for all on a (relatively) stable planet. These five turnarounds hold the potential to bring about real systems change and can be achieved by implementing key policy goals. Five turnarounds to rethink economic growth as a measure of progress and set our societies on a safe pathway to wellbeing for all.

- **“Peak metals, minerals, energy, wealth, food and people towards the end of the golden age; considerations for a sustainable society”, 2011**
- Harald U. Sverdrup (University of Lund) and Kristin V.Ragnarsdottir (University of Iceland)



Sverdrup H.U.
“Challenging the planetary boundaries II”

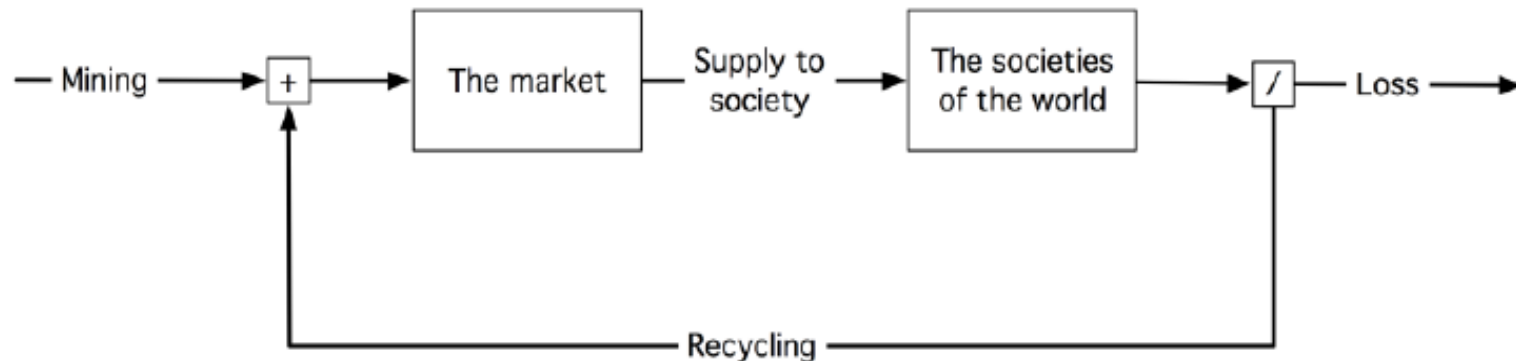
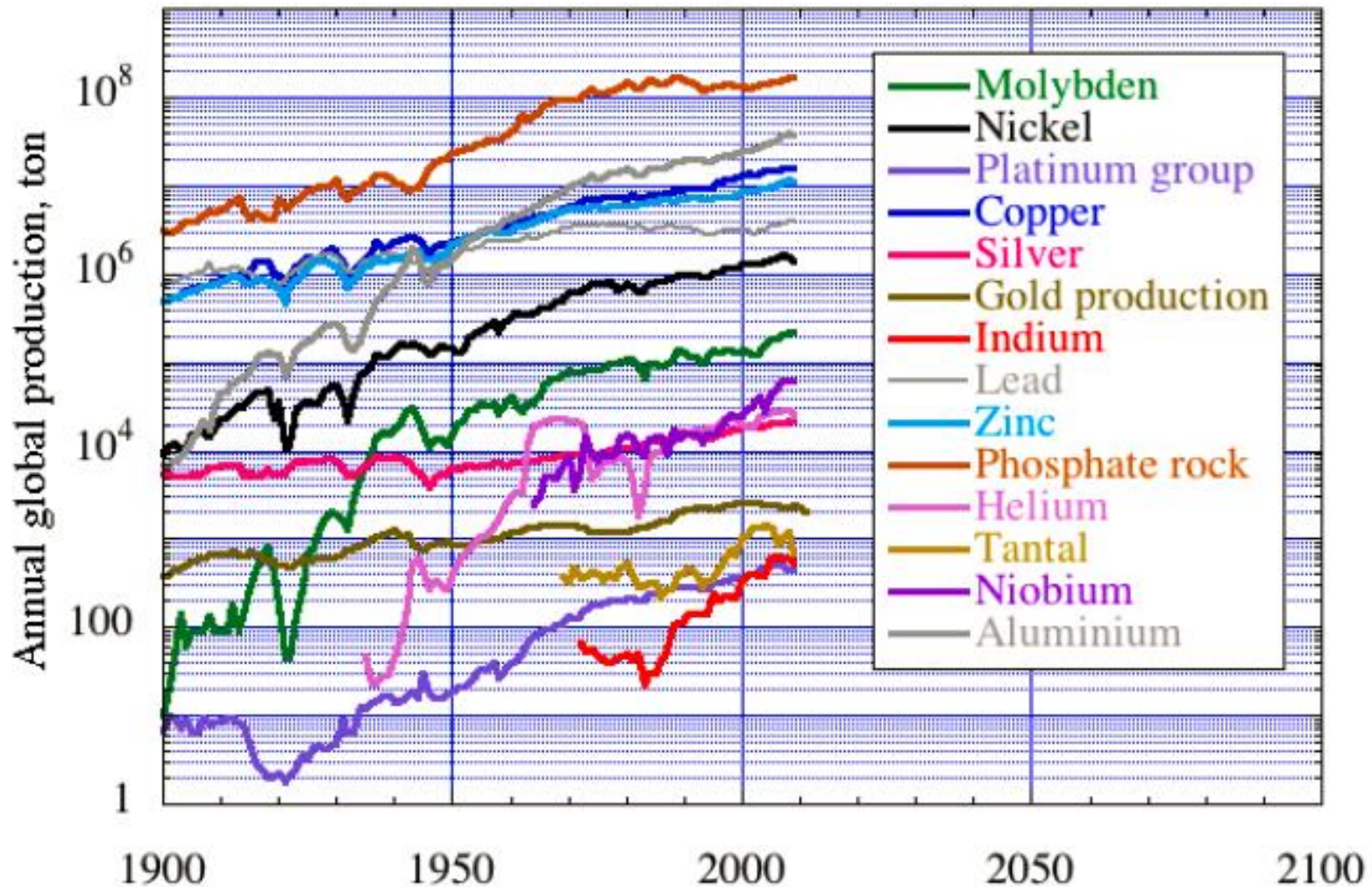
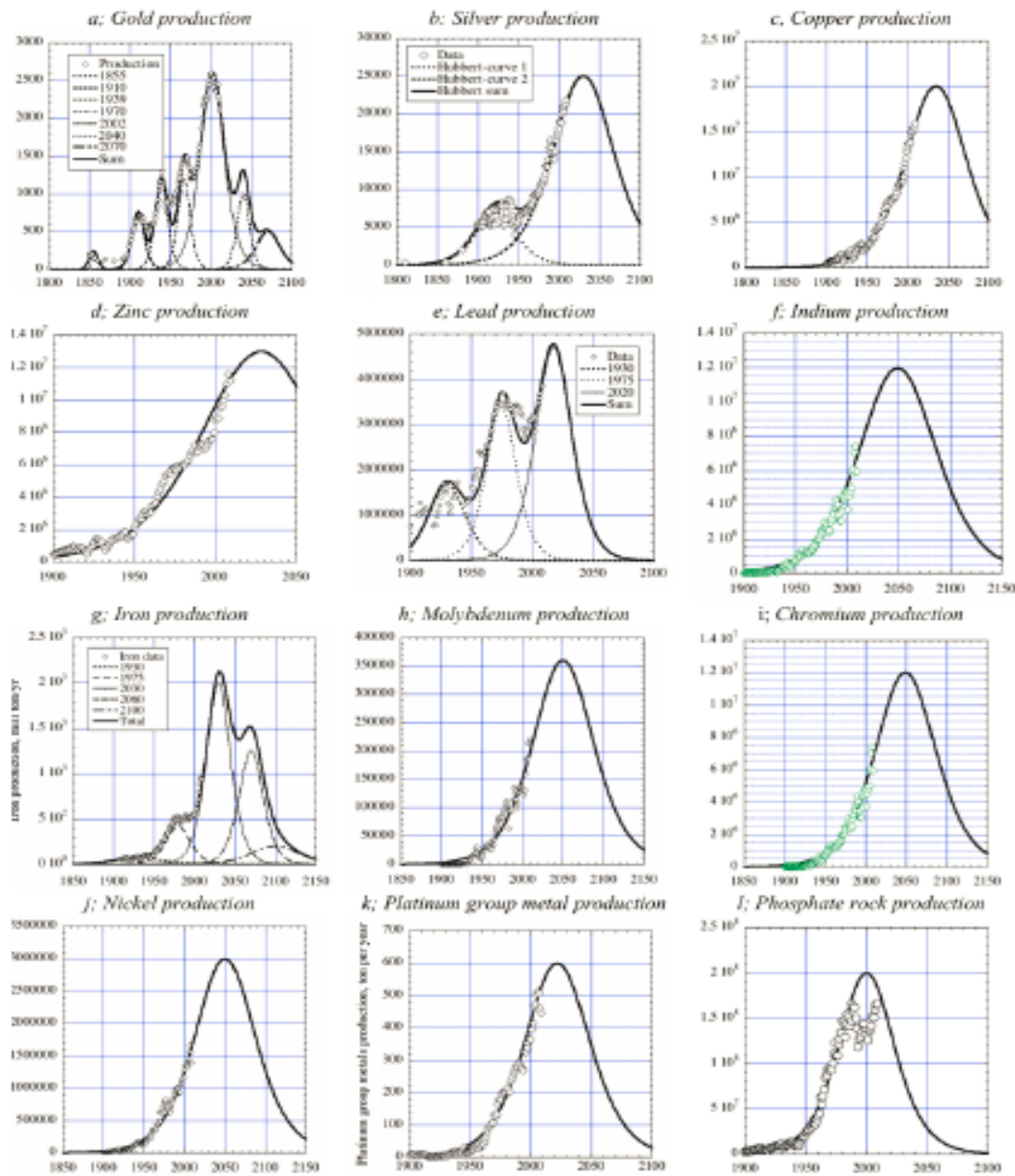


Figure 6. *The effect of recycling. This flow diagram shows that recycling can maintain input to society, but decrease the input from finite resources through mining. The real flow to society becomes amplified by recycling, because part of the outflow becomes returned to the inflow.*

Exponential growth forever



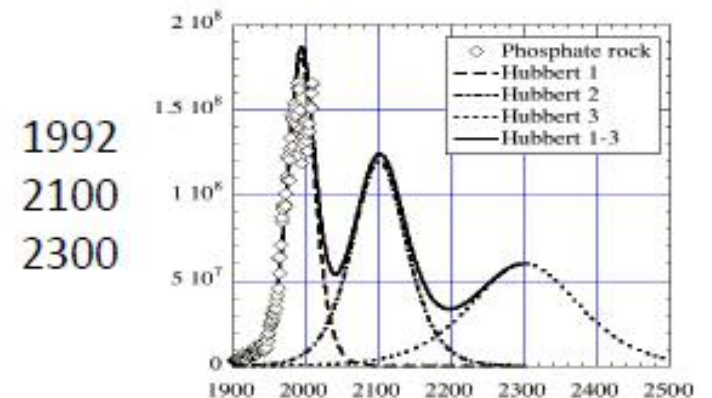
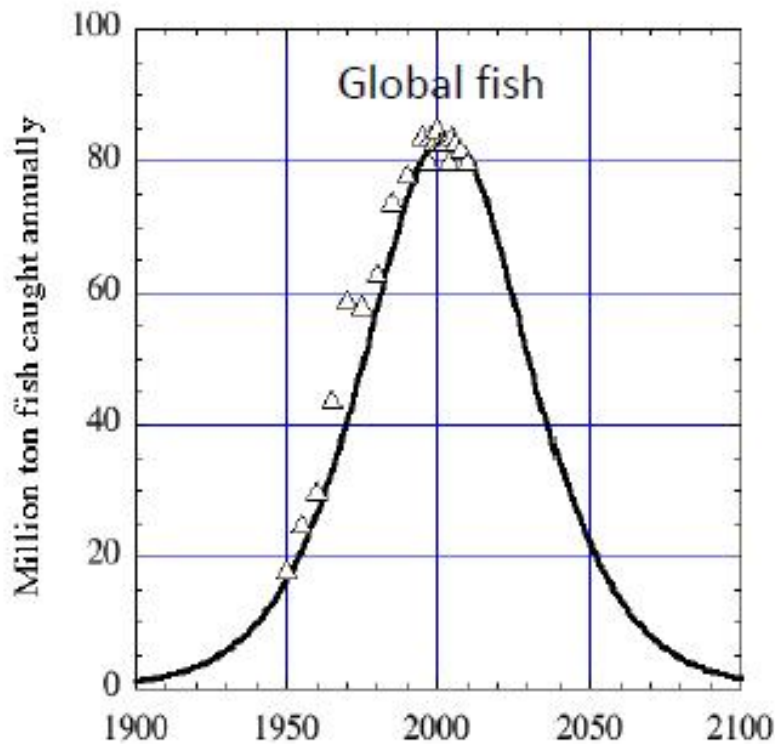
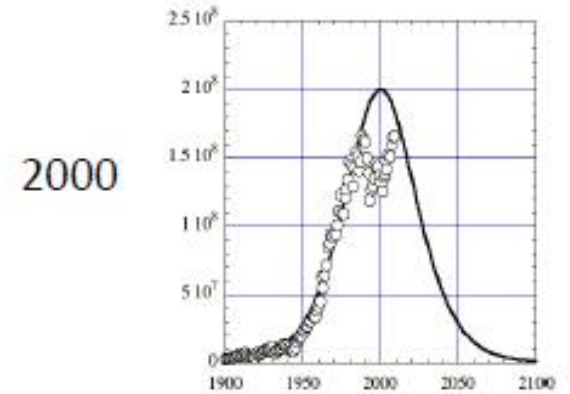


Hubbert's curves for 12 key metals and materials

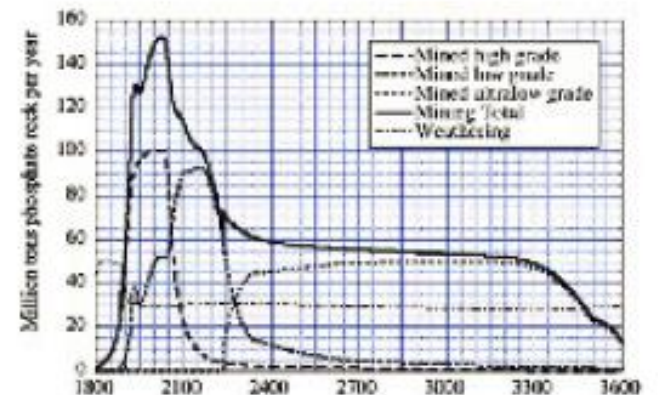
Figure 8. Hubbert-curve fittings for gold (a) silver (b), copper (c), zinc (d) lead (e), indium (f), iron (g), molybdenum (h), chromium (i), nickel (j), platinum group metals (40% Pt, 43% Pd, 5% Rh, 5% Ru, 5% Ir, 2% Os) (k) and (l) that shows a one-curve phosphorus plot. We can see that the data suggest 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/>

Peak fish, peak phosphorus, escalating prices.....

Phosphorus

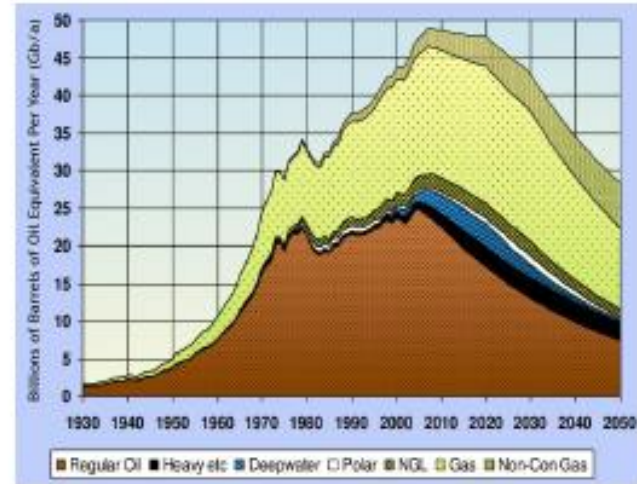
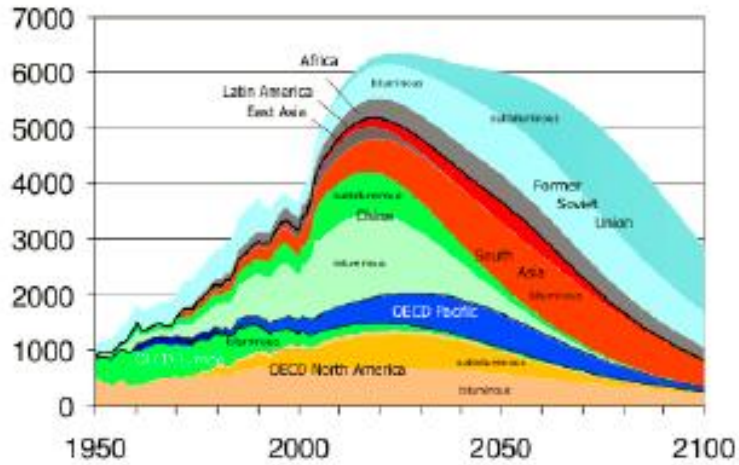


2040



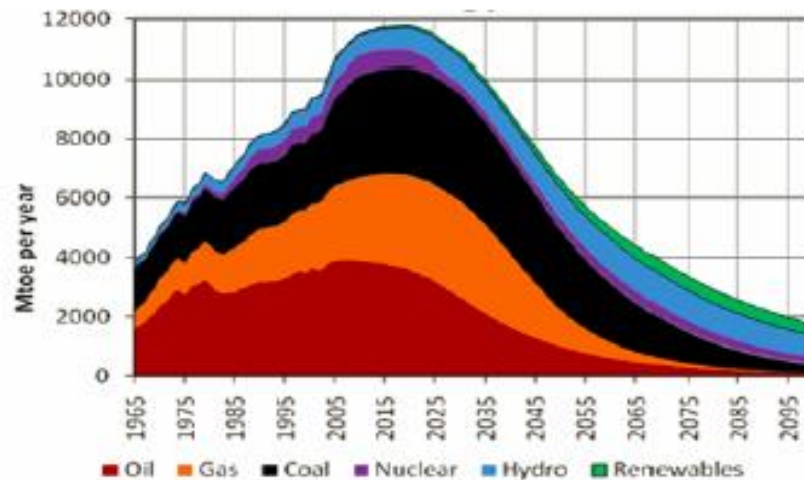


Peak energy



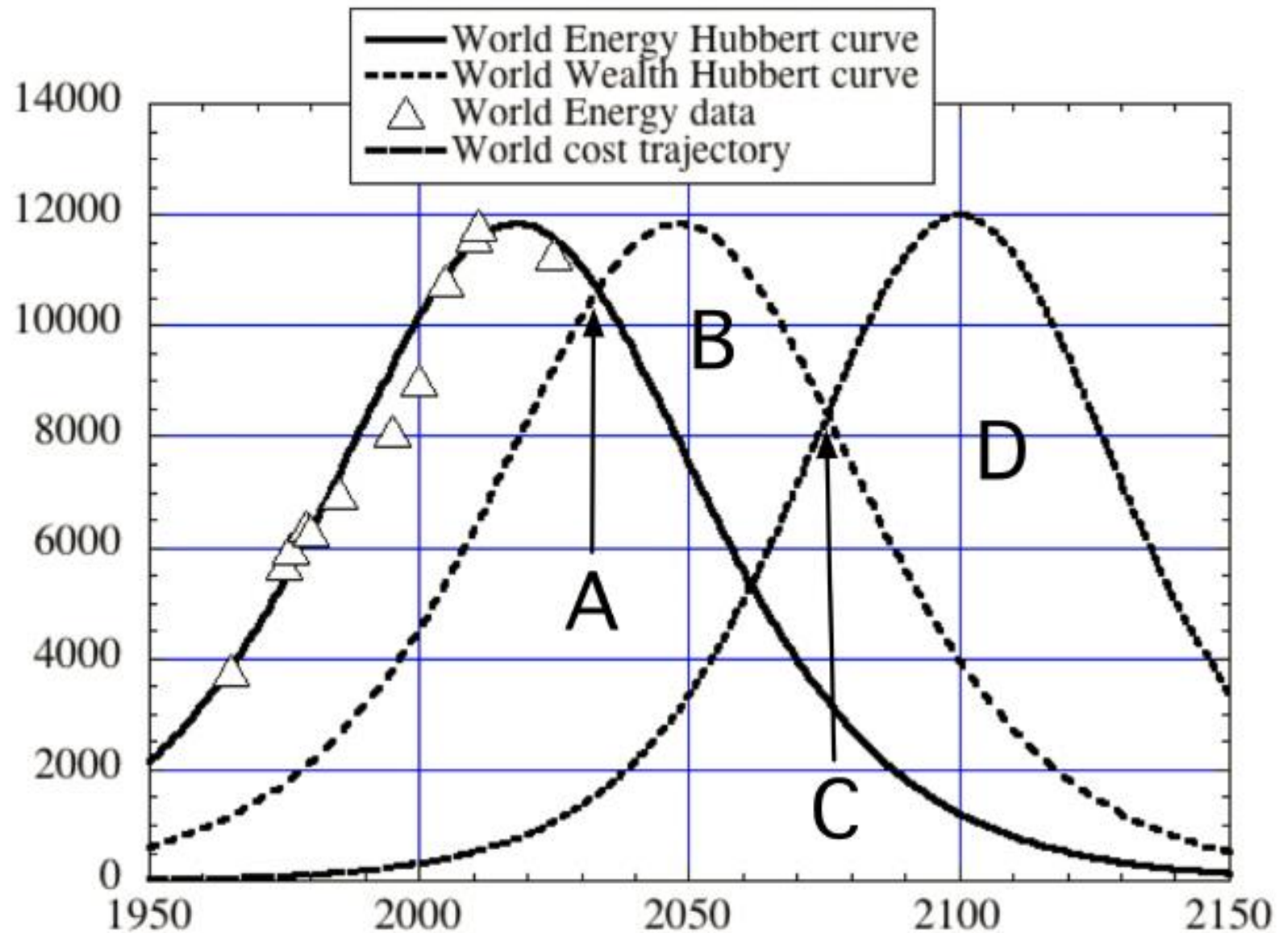
2015

2007

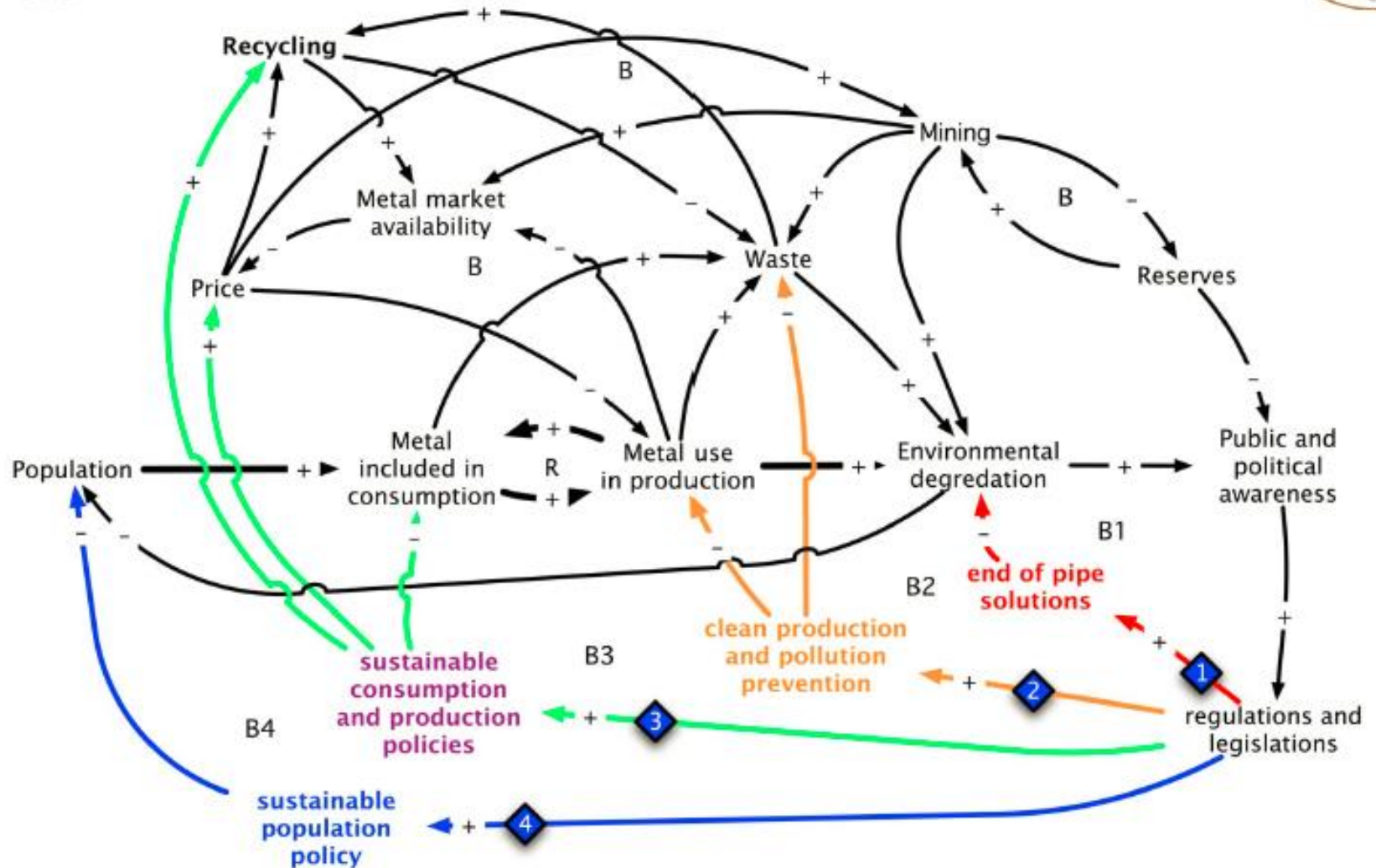


2018

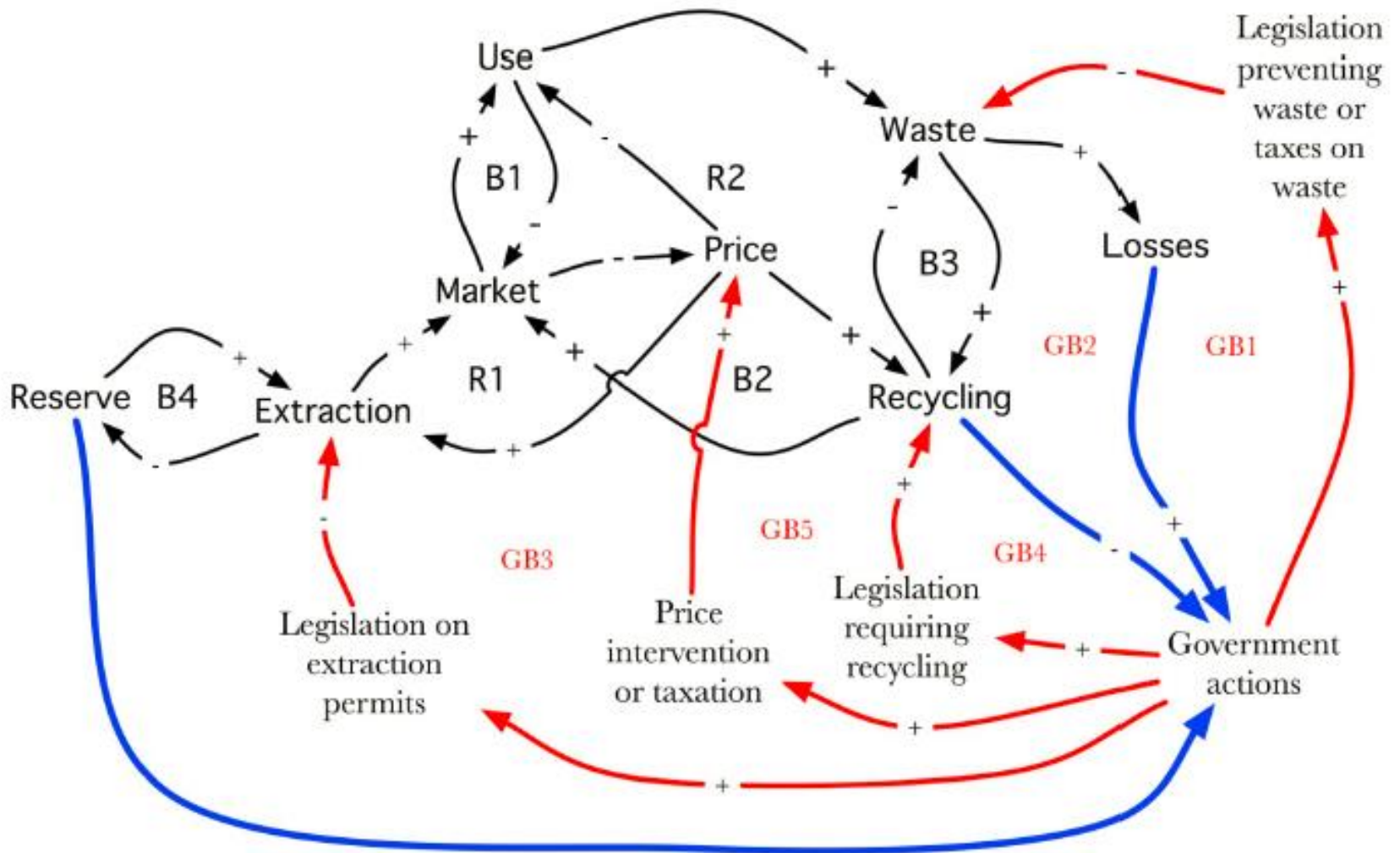
Peak resources, wealth and society



Causal chains....

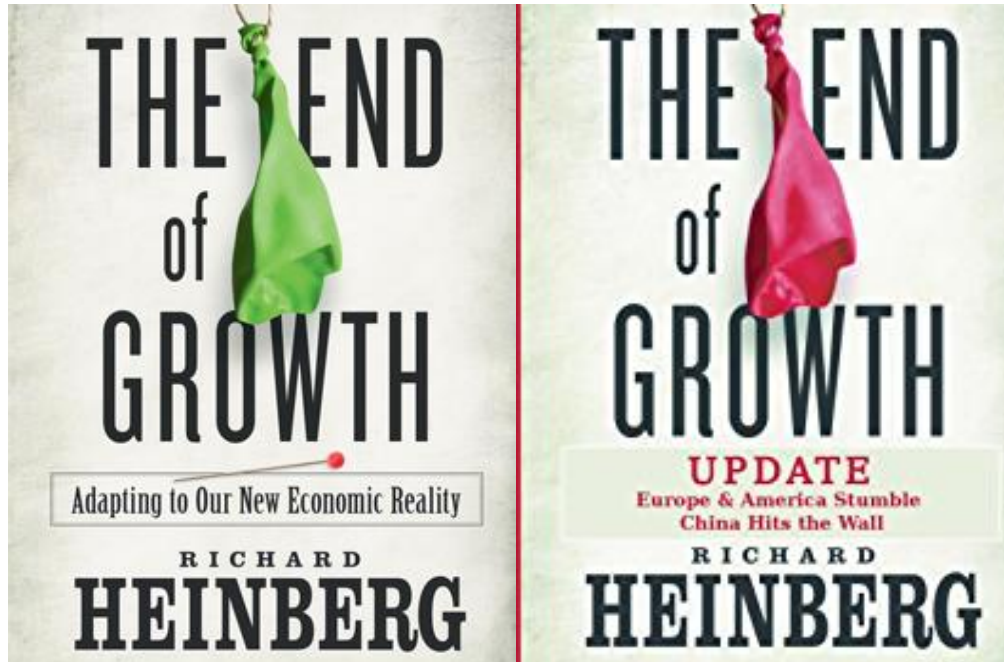


Policy interventions



Alarming Trends Continue: Richard Heinberg

- Richard Heinberg “The End of Growth: Adapting to Our New Economic Reality” (2011)
- Video resume: <https://youtu.be/EQqDS9wGsxQ>



- Reasons of the End of Growth:
1. Resources depletion
 2. Environmental impact
 3. System failure of monetary and financial systems

More works of R.Heinberg at <http://www.postcarbon.org/our-people/richard-heinberg-2/>



Last Books

- 2019 : *Growth: From Microorganisms to Megacities.*
- 2017 : *Energy and Civilization: A History.*
- 2015 : *Natural Gas: Fuel for the 21st Century.*
- 2015 : *Power Density: A Key to Understanding Energy Sources and Uses*
- 2013 : *Making the Modern World: Materials and Dematerialization*
- 2013 : *Made in the USA: The Rise and Retreat of American Manufacturing*
- 2013 : *Should We Eat Meat? Evolution and Consequences of Modern Carnivory*
- 2013 : *Harvesting the Biosphere; What We Have Taken from Nature*
- 2012 : *Japan's Dietary Transition and Its Impacts*

- Economic growth has to end, humans could consume much lower levels of materials and energy.
- There will not be a rapid transition to clean energy, it will take much longer than many predict.

Calculating Oil Collapse Year

Calculating the year of the possible world oil collapse

Table 1. World Oil Data

<u>Year</u>	<u>Proved Reserves</u> (Thousand million barrels per year)	<u>Production</u> (Thousand barrels daily)
2000	1299.8	74519
2001	1306.4	74763
2002	1356.2	73990
2003	1363.4	77161
2004	1370.1	80822
2005	1376.7	81793
2006	1388.4	82518
2007	1425.0	82391
2008	1493.8	83069
2009	1535.4	81410
2010	1641.5	83255
2011	1677.6	84009
2012	1687.3	86228
2013	1694.1	86647
2014	1697.2	88736
2015	1684.3	91547
2016	1691.6	91822
2017	1727.5	92502
2018	1729.7	94718

Data from BP Statistical Review of World Energy 2019.

Calculating Oil Collapse Year

- The basic formula used for calculating the compound annual growth rate is:

$$\text{CAGR}(t_0, t_n) = \left(\frac{V(t_n)}{V(t_0)} \right)^{\frac{1}{t_n - t_0}} - 1$$

- where, $V(t_0)$ indicates the start value, $V(t_n)$ indicates the finish value, $(t_n - t_0)$ refers to the number of years.

The Rule of 70

- The rule of 70 is a way to estimate the number of years it takes for a certain variable to double.
- To estimate the number of years for a variable to double, take the number 70 and divide it by the growth rate of the variable (in %).
 - 1% of growth rate of $X \rightarrow 2*X$ in $(70/1)=70$ years
 - 2% of growth rate of $X \rightarrow 2*X$ in $(70/2)=35$ years
 - 5% of growth rate of $X \rightarrow 2*X$ in $(70/5)=14$ years

The Venus Project

(the futurist Jacque Fresco)



<https://www.thevenusproject.com/learn-more/documentaries/>



Jacque Fresco

“We must achieve a level of production that is so high that scarcity no longer exists.

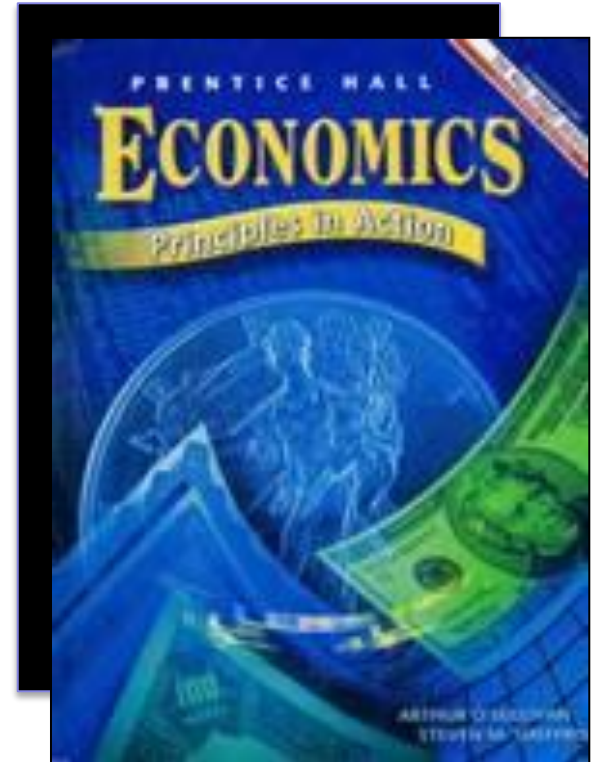
Once you overcome scarcity, most [social] problems will be gone”.



“You will find economics defined in terms of *scarcity* in every textbook on the subject, usually in the opening chapter.

Without scarcity, some of them candidly admit, there would be no need for economics.”

— *John A. Waring*,
“*Technocracy and Humanism*”, *Section 3 Newsletter*, Feb. 1985, No. 18 and Mar. 1985, No. 19.



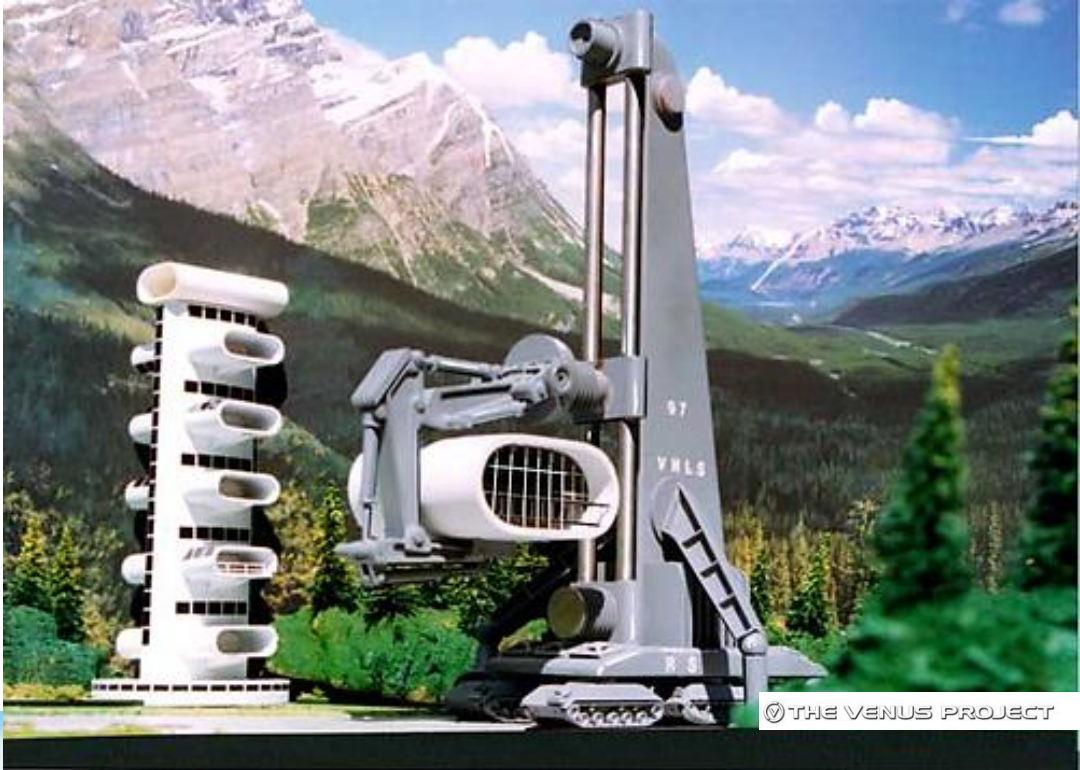
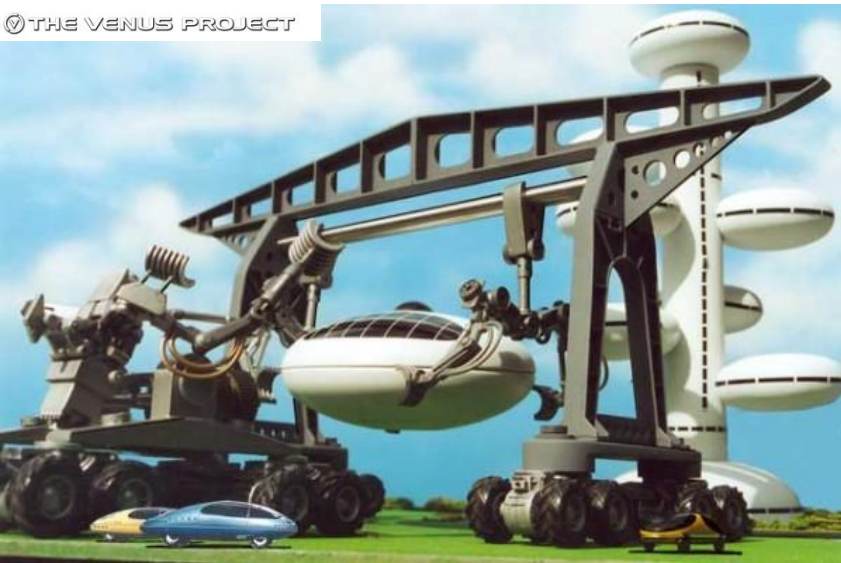
- **How the intelligent management of Earth's resources can be created, on what principles?**



Resource-Based Economy

All goods and services are available
without the use of money, barter,
credit, debt, or servitude of any kind.

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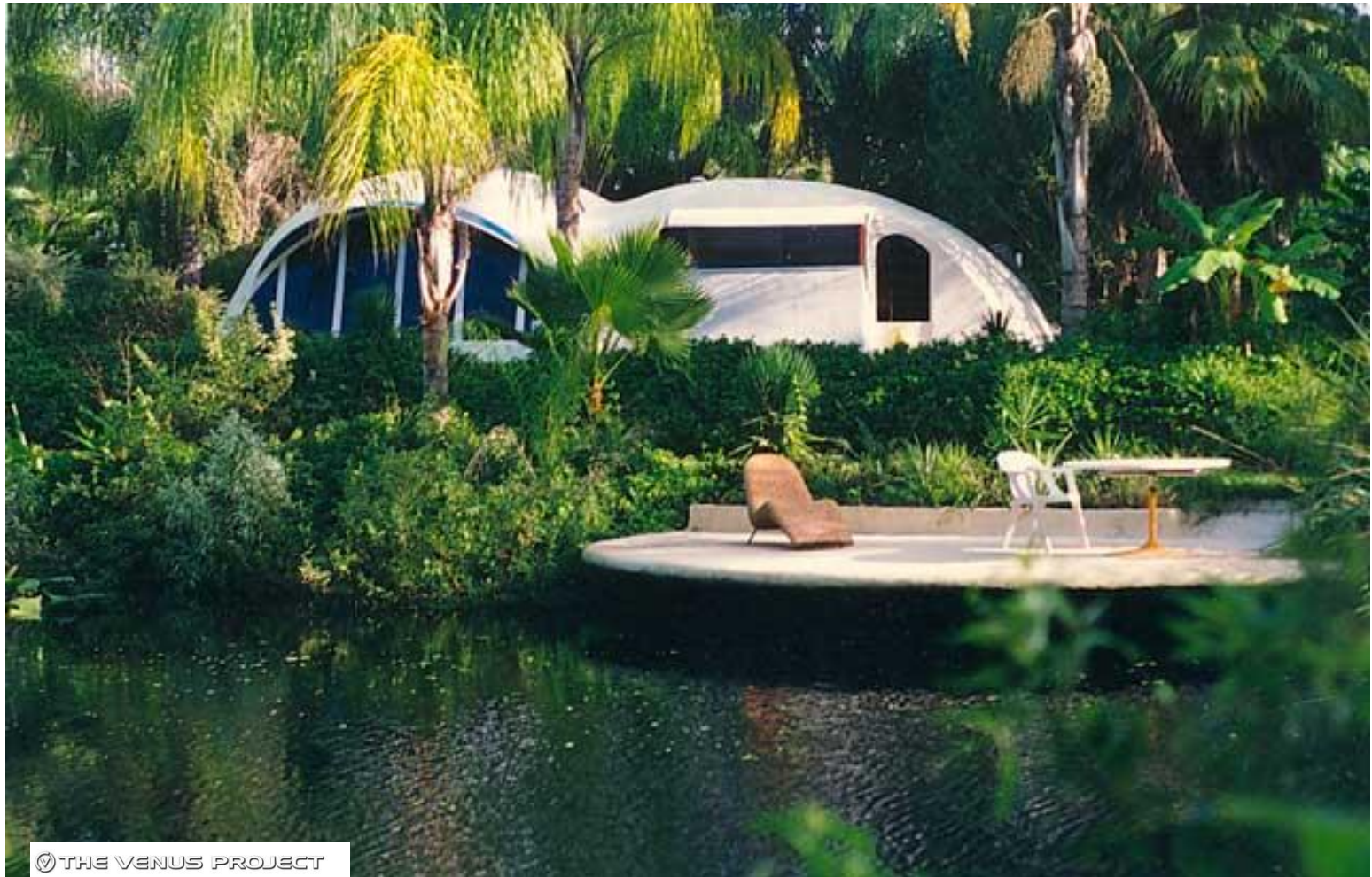
**Where technology is
used intelligently to
replace human labor**



Where weather-safe housing includes lighting, heating, and cooling systems



**And complete cities
are designed to
provide a high
standard of living
for all residents**



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Our highly advanced technology can provide all the world's people with free food, clothing, housing, medical care, and energy.



“The intelligent use of science and technology are the tools to achieve a new direction that will serve all people, and not just a select few.”

Jacque Fresco

1st SURVEY on sustainable-oriented activities

What do you think about sustainability?

This is the survey about your opinions on sustainability-related issues. By sustainability-related issues we understand the complex of umbrella concepts like Sustainable Development, Green Economy and Circular Economy.

Please answer the questions as honestly as possible, in a way that shows what you really think or feel at the moment.

- We ask your name just for processing the results. It will be coded and used for technical purposes only. No personal data will be disclosed or shared in any way.
- 2 times survey: at the beginning of the course + at the end
- Follow the link: <https://forms.gle/vVYUHJSQvvFtAuANA>
- Put your real name!
- Up to 5-7 min. to complete the survey



It is necessary to pass this survey
for all students of the course.