



Lomonosov Moscow State University
Business School

Global Limits of Economic Growth

*Lomonosov Moscow State University,
Inter-Departmental Course, 2024-2025, Spring Fall*


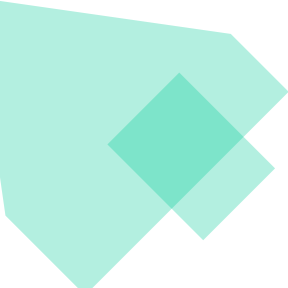
Course Reader:

Evgeniya Anatolyevna Shvets, PhD.

e.shvec@edu.mgubs.ru

Learning Schedule

- Our classes will take place on Wednesdays at 15:00 be addressed 3 months (12 weeks)
- Communication with the course reader:
 - During classes
 - Via e-mail
 - All administrative issues should be addressed via **your Personal Account**
- There will be some **Pre-Reading** through your Personal Account



Global Limits of Economic Growth (GLOEG)



Lomonosov Moscow State University
Business School

Pre-Reading and Food-for-Thought Assignment before Session 1

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*

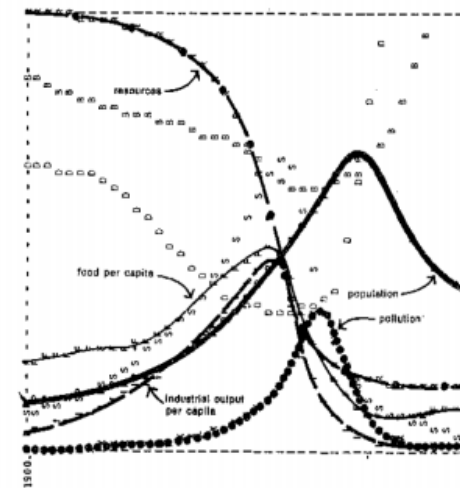
Our world model was built specifically to investigate five major trends of global concern – accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment. The model we have constructed is, like every model, imperfect, 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

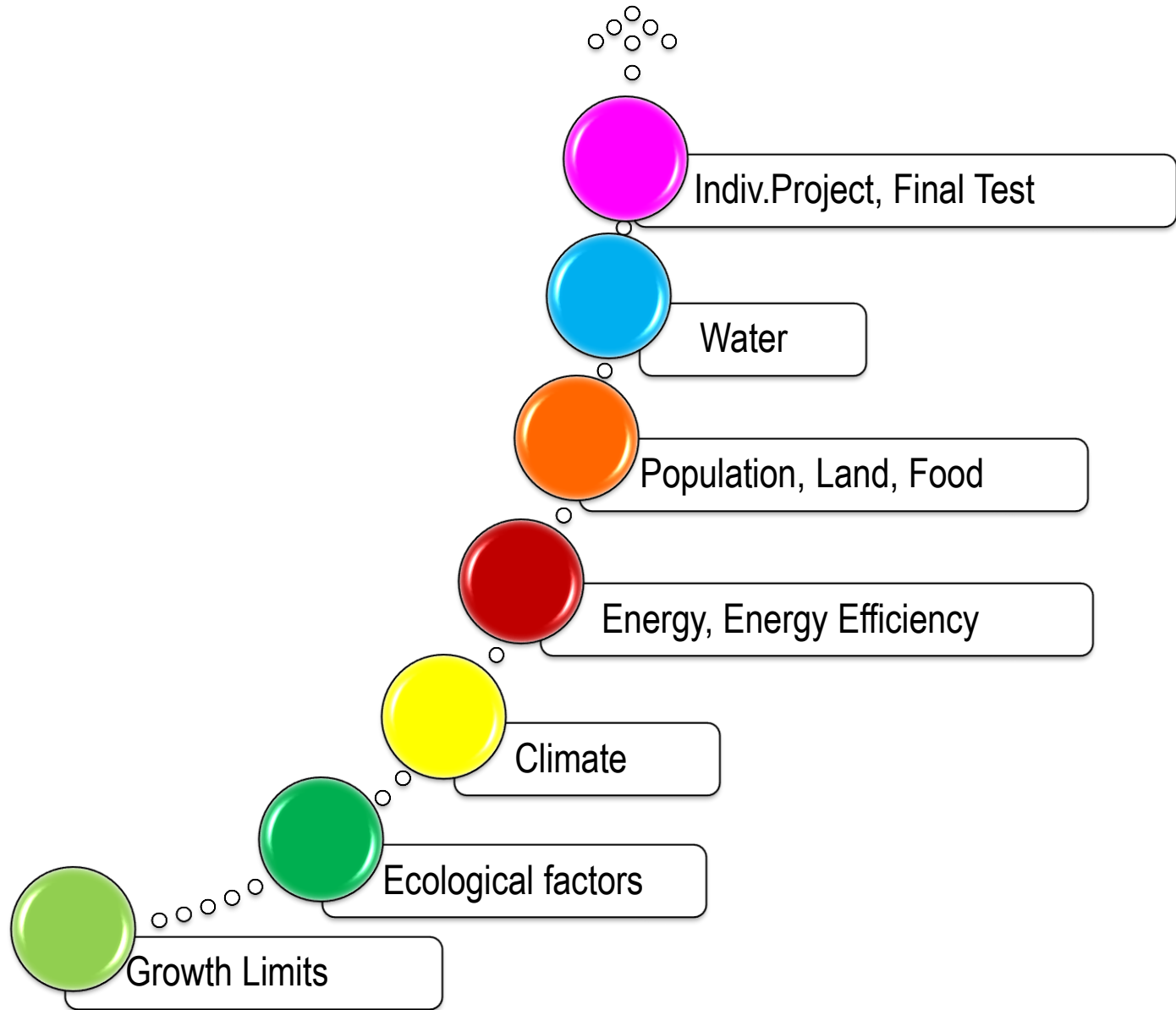
Course “Global Limits of Economic Growth” aims to:

- 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



General Scheme for Resource Limitations Analysis



Scheme for the Individual Project (1 student 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 | ... | ... | ... | ... | ... | ... |

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 min. to complete the survey

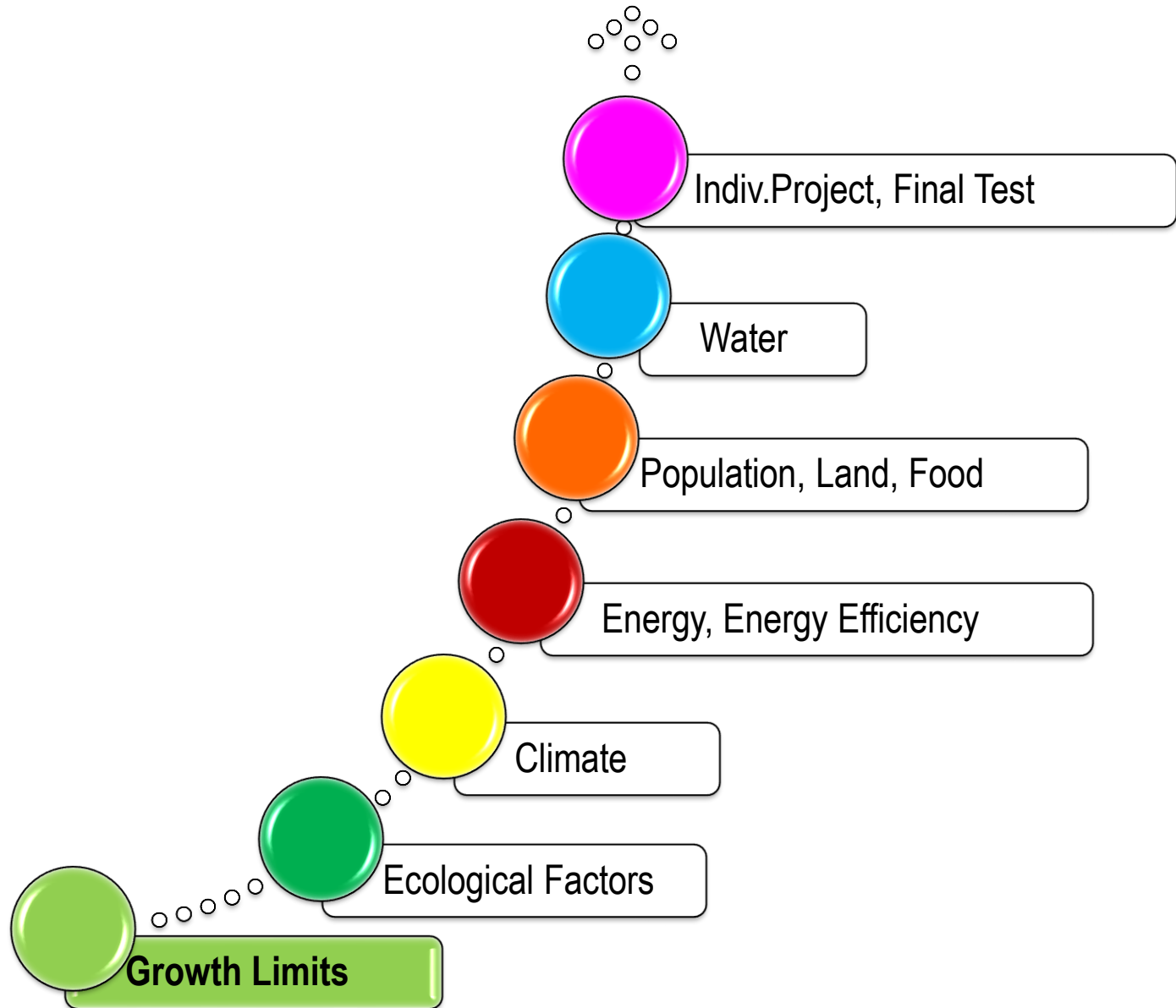


Session 1

Resource Limitations of Economic Growth

19.02.2025

Course Route



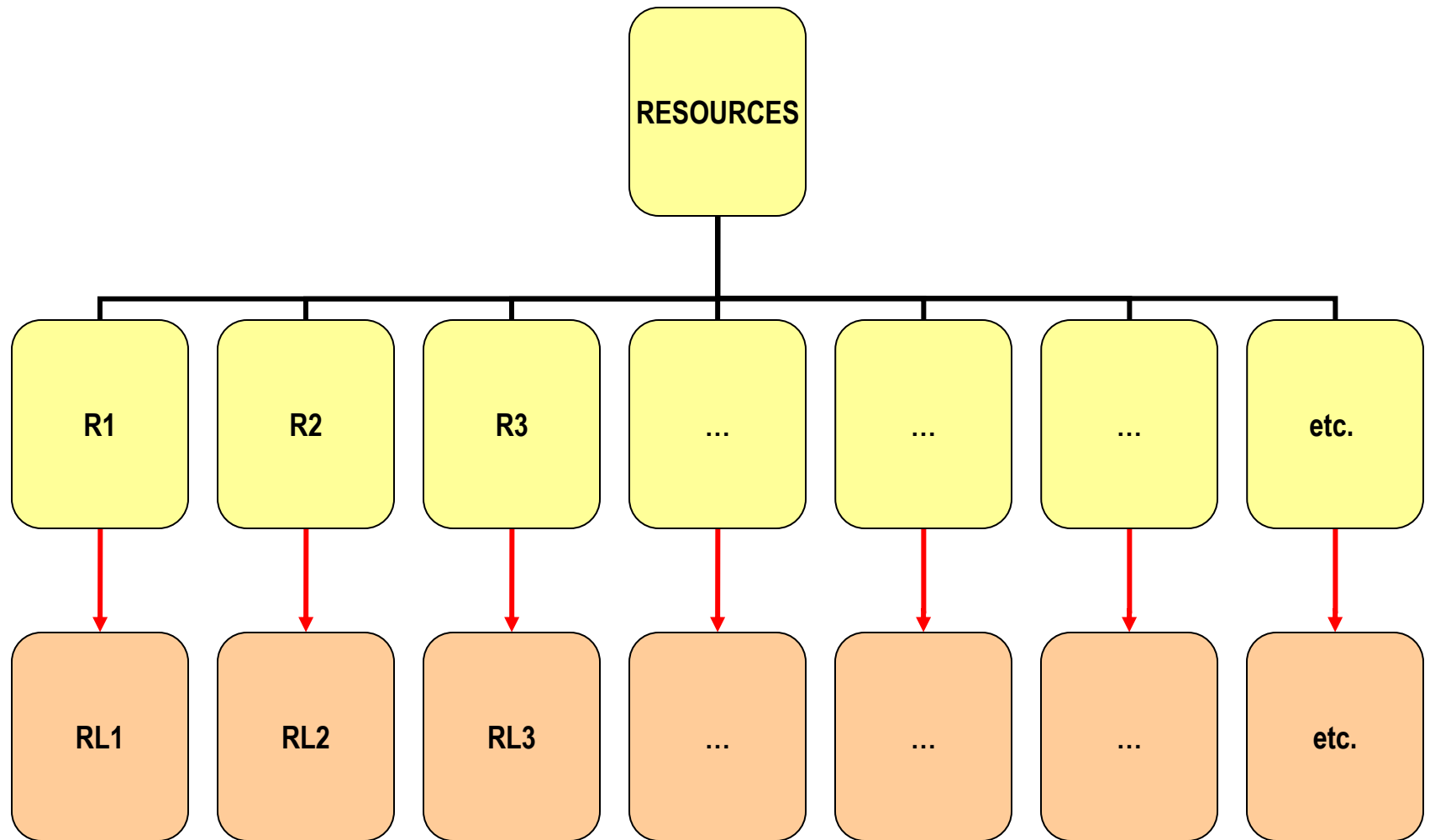
The Aims of Session 1

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. Theories about Scarcity of Resources
 - Thomas Malthus's Theory
 - The Tragedy of Commons Theory
 - Limits to Growth Theory + other Club of Rome Forecasts
 - Sustainable Development Theory + Ecological Economics
 - Peak Resource Theories
 - Other contemporary studies

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 | |
| • Change of the resource quality | |
| • Natural catastrophes | |
| • Uneven resource distribution | |
| • Geopolitical factors | |

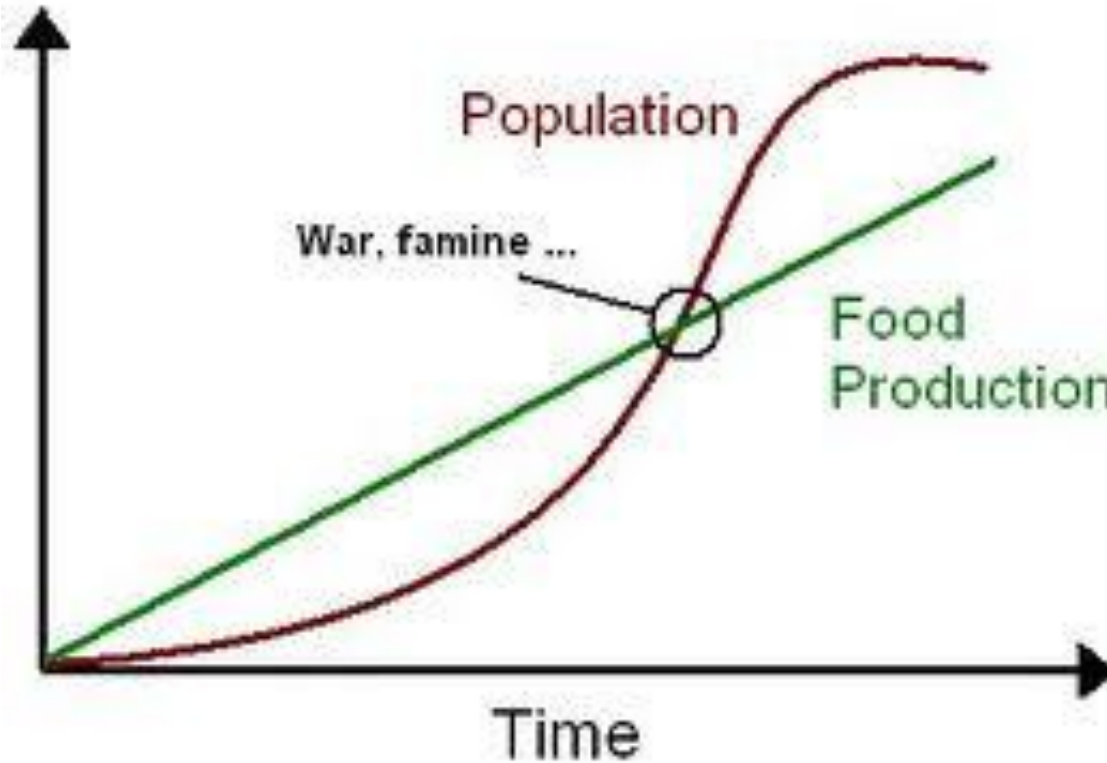
THOMAS MALTHUS'S THEORY

Around 1798

Population and Food Production according to Malthus



1766-1834

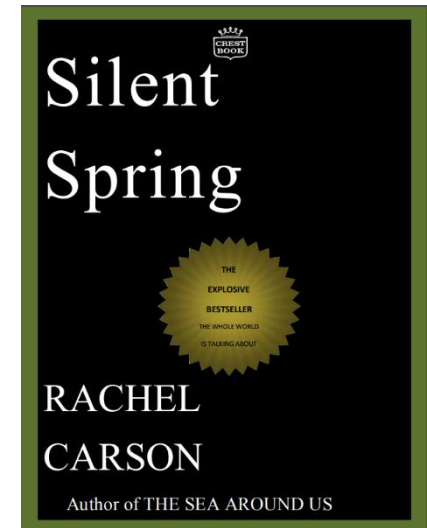


- The level of resources exploitation in 1870-1970 has grown in 5 times
- For how long will we have non-renewable resources?

THE THEORY OF GENERAL TRAGEDY (THE TRAGEDY OF COMMUNITIES)

1968

- Rachel Carson “Silent Spring” (1962-63)



- **Garrett Hardin, the article “The Tragedy of the Commons” (1968)**

The Tragedy of the Commons

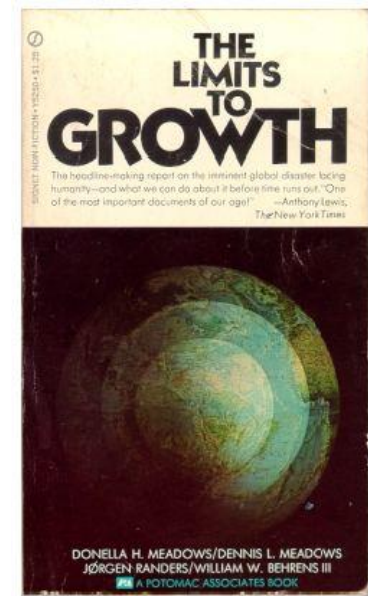
Garrett Hardin

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

THE LIMITS TO GROWTH THEORY

1972

Club of Rome report
“The Limits to Growth” (1972)



- **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.

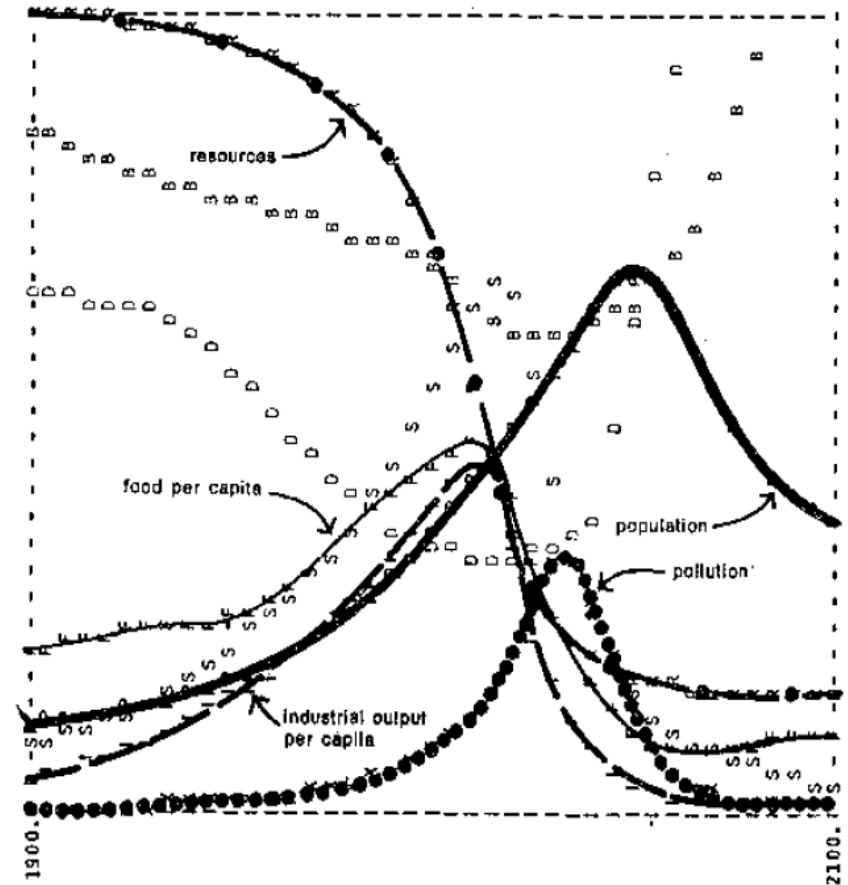
1972 - The Limits to Growth

1992 – Beyond the Limits

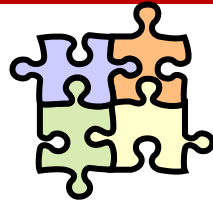
2002 – The Limits to Growth: the 30-year Update

- 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)

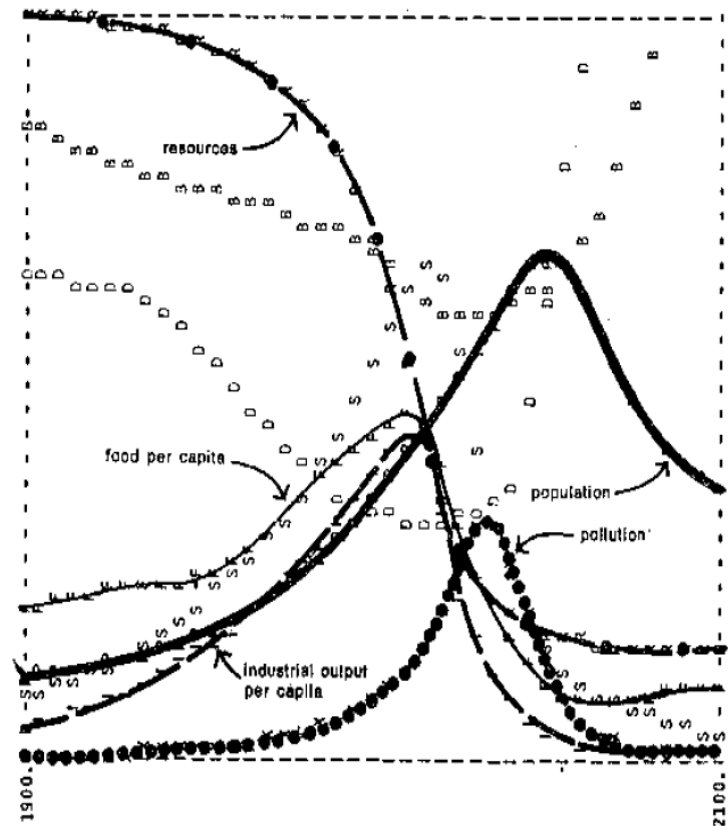
- What are the basic simplifications (presumption) of the world model standard run?
- Think of critique arguments of the model proposed, add yours.

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

Conclusions:

- 1) We need fundamentally different philosophies for our lives: *there's no way finite systems can support limitless growth, so stop growing*
- 2) It's possible to establish a condition of economic and ecological stability that is sustainable far into the future

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 THEORY AND ECOLOGICAL ECONOMICS

From the end of the 20th century: 1987

* The Ecological Footprint Theory is part of an Ecological Economics and will be discussed later

- **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?

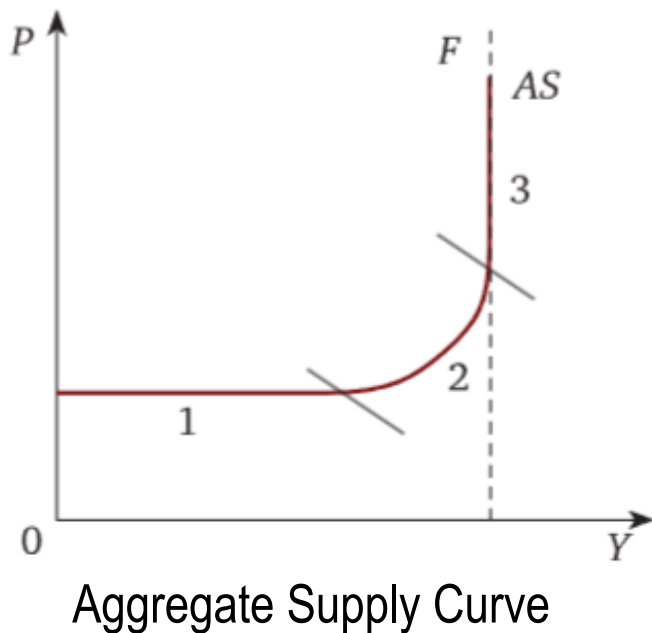
- + Are the Sustainable Development Goals legally binding?

- + 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.

Economic AD – AS model: Potential Output (GDP)



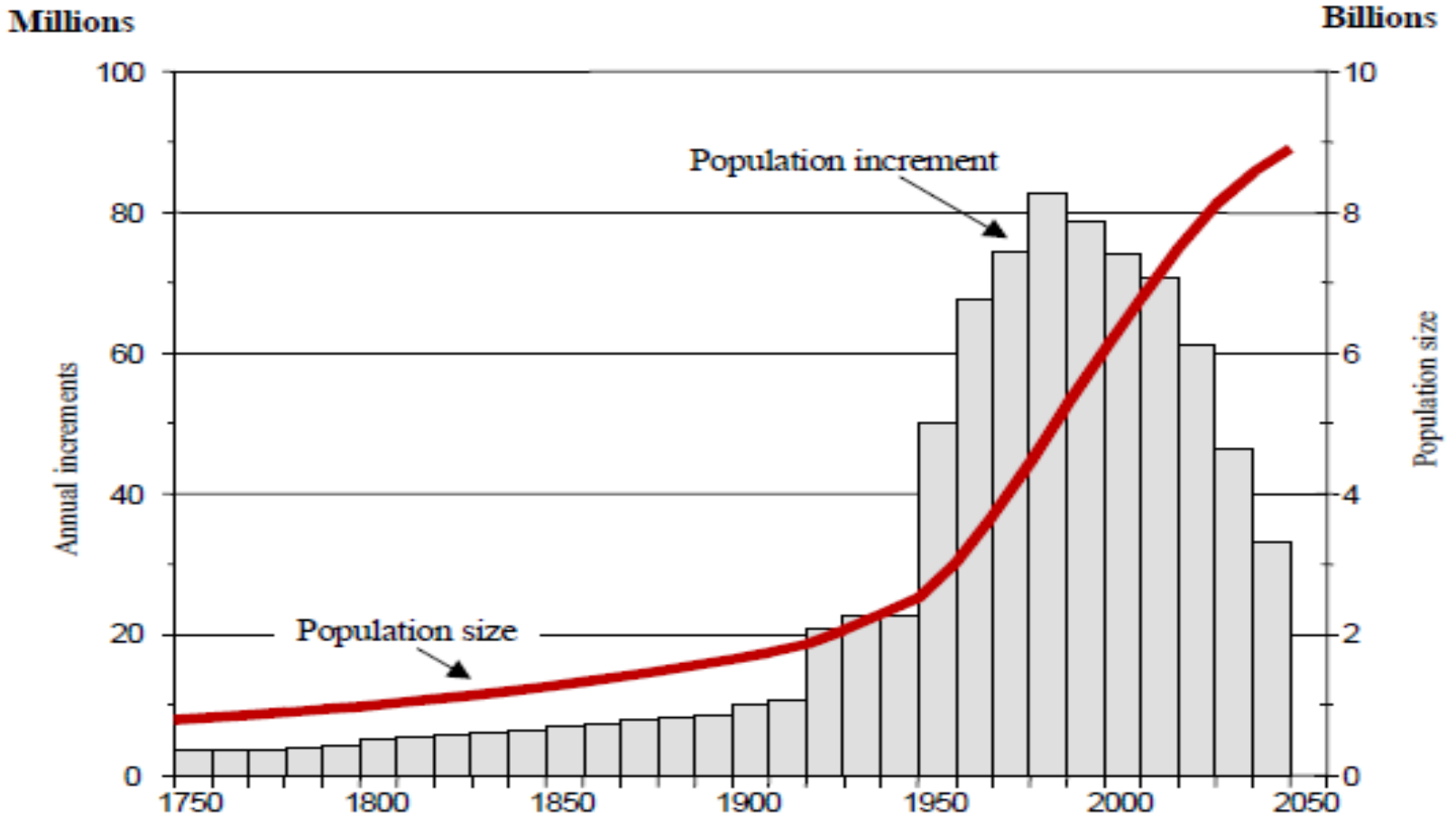
Potential output is the output that can be produced using all the resources available in the economy within the framework of existing production technologies.

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

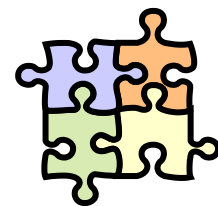
What usually acts as a marginal resource in developed countries and in developing ones?

Is potential GDP variable or constant?

Long-term world population growth, 1750-2050

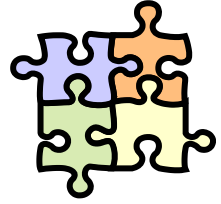


Source: United Nations Population Division.



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.



POLICY STUDY
September 2023

SDGS FOR ALL: STRATEGIC SCENARIOS

EARTH4ALL SYSTEM DYNAMICS
MODELLING OF SDG PROGRESS

Working Paper version 1.0



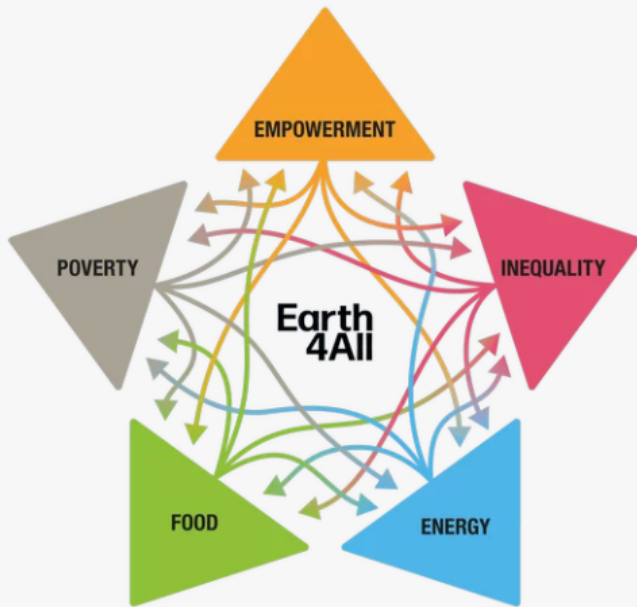
Johannah Bernstein, David Collste,
Sandrine Dixson-Declève, Nathalie Spittler



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

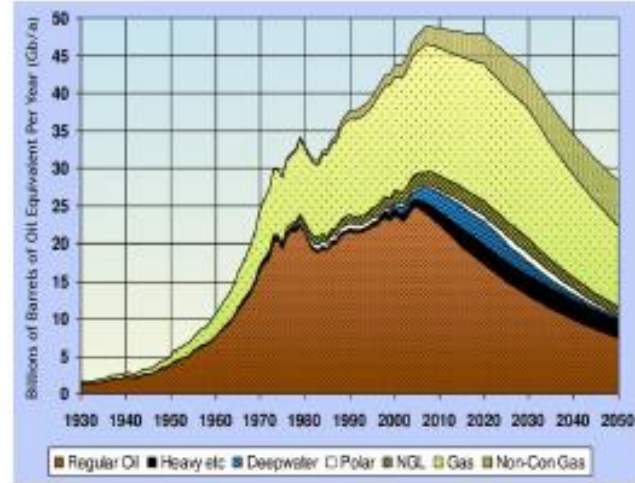
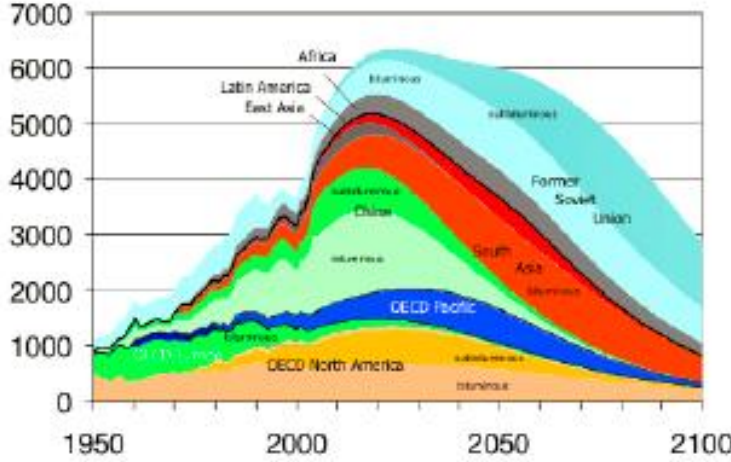
Earth4All has identified five extraordinary turnarounds needed to create wellbeing for all on a (relatively) stable planet. These five turnarounds hold the potential to bring about real systems change and can be achieved by implementing key policy goals. Five turnarounds to rethink economic growth as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

PICK RESOURCE BLOCK OF THEORIES

1956 +

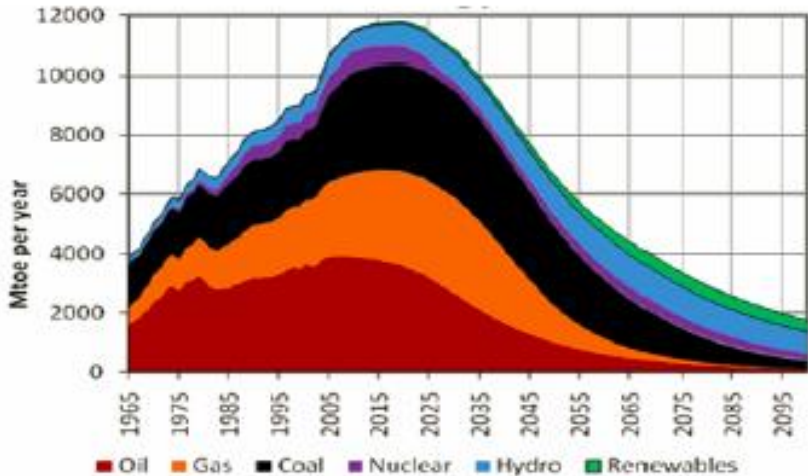


Peak energy



2015

2007



2018

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 |

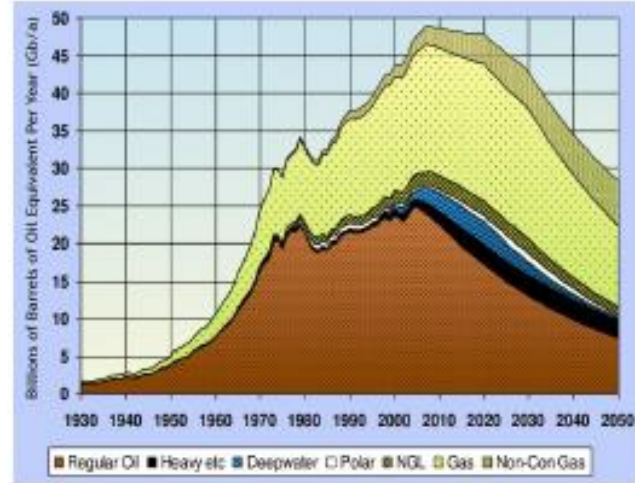
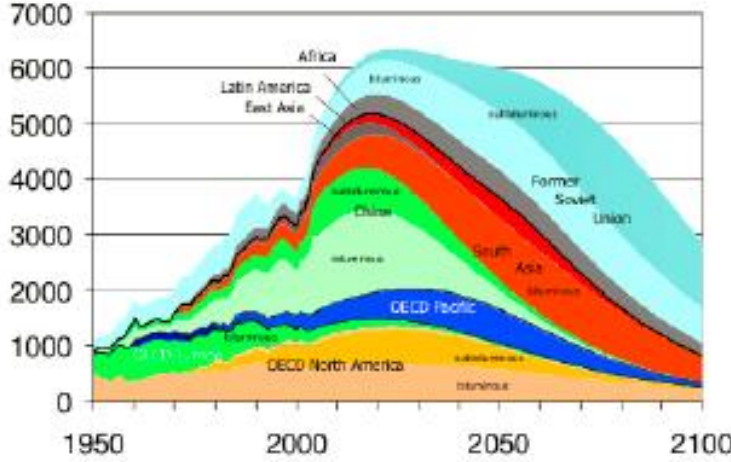
Data from BP Statistical Review of World Energy 2019.

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

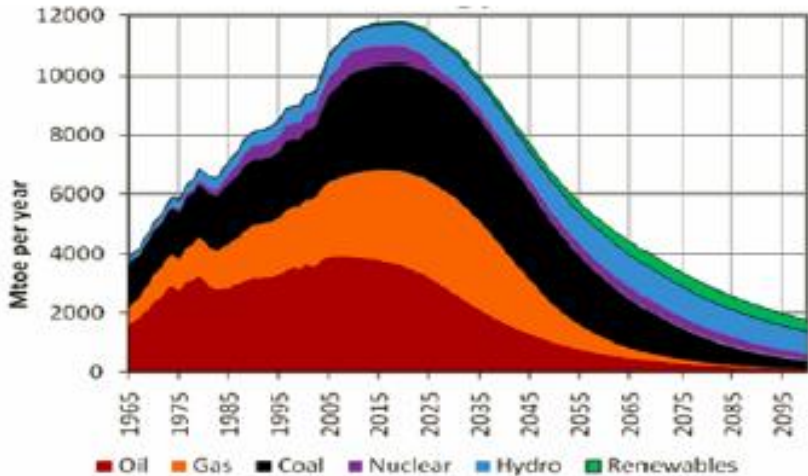


Peak energy



2015

2007



2018

- **“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”**

- **“Peak metals, minerals, energy, wealth, food and people towards the end of the golden age; considerations for a sustainable society”, 2011**
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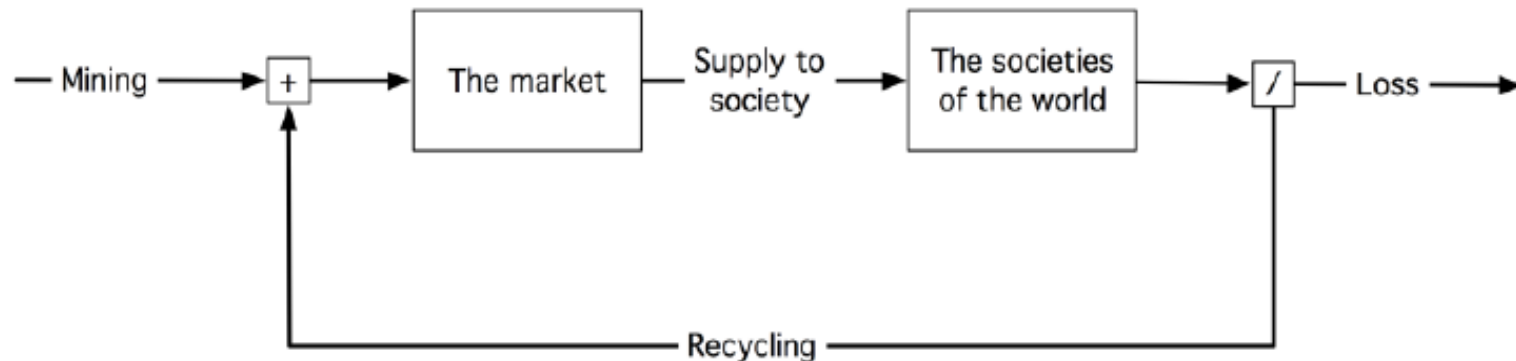


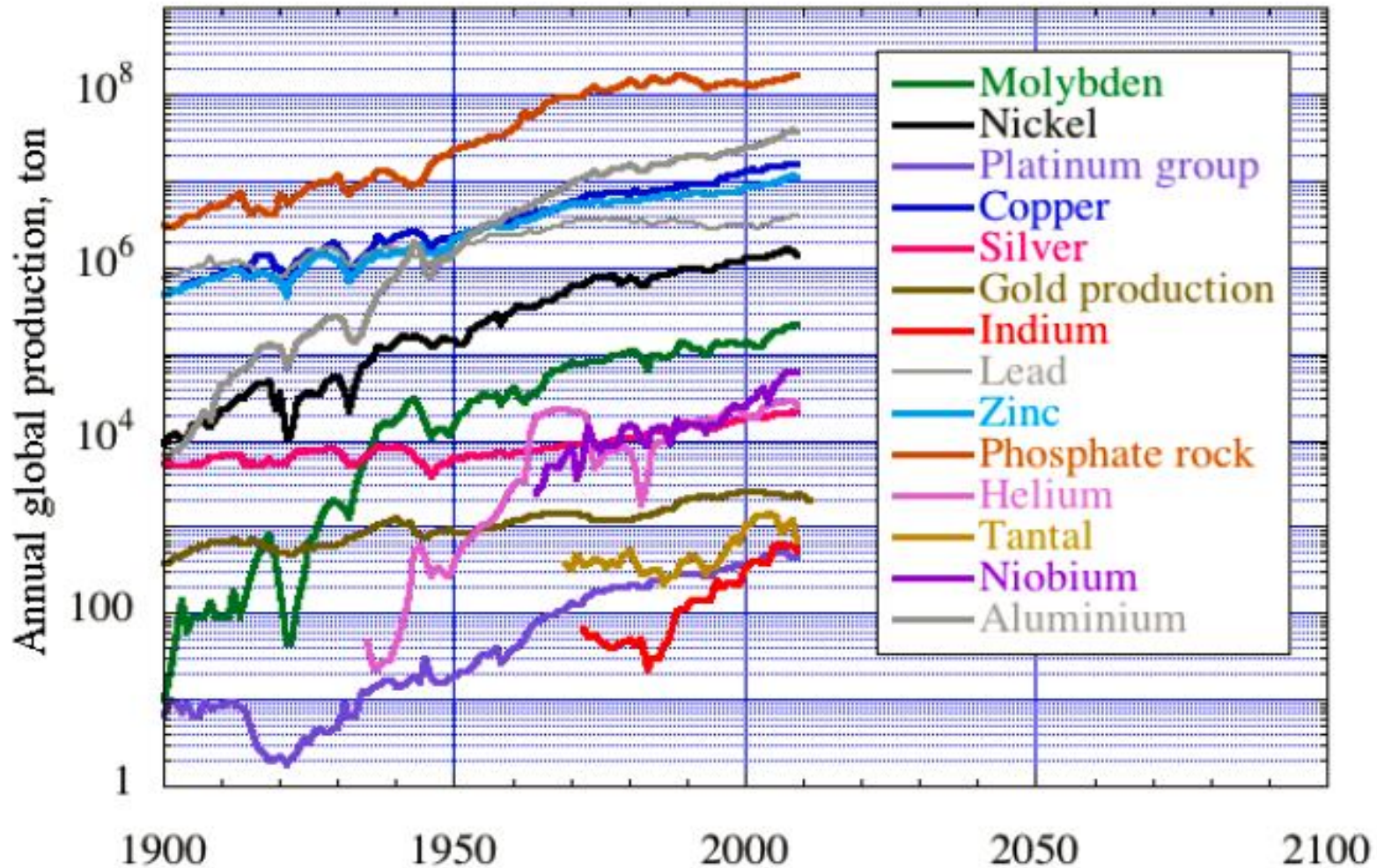
Figure 6. *The effect of recycling. This flow diagram shows that recycling can maintain input to society, but decrease the input from finite resources through mining. The real flow to society becomes amplified by recycling, because part of the outflow becomes returned to the inflow.*

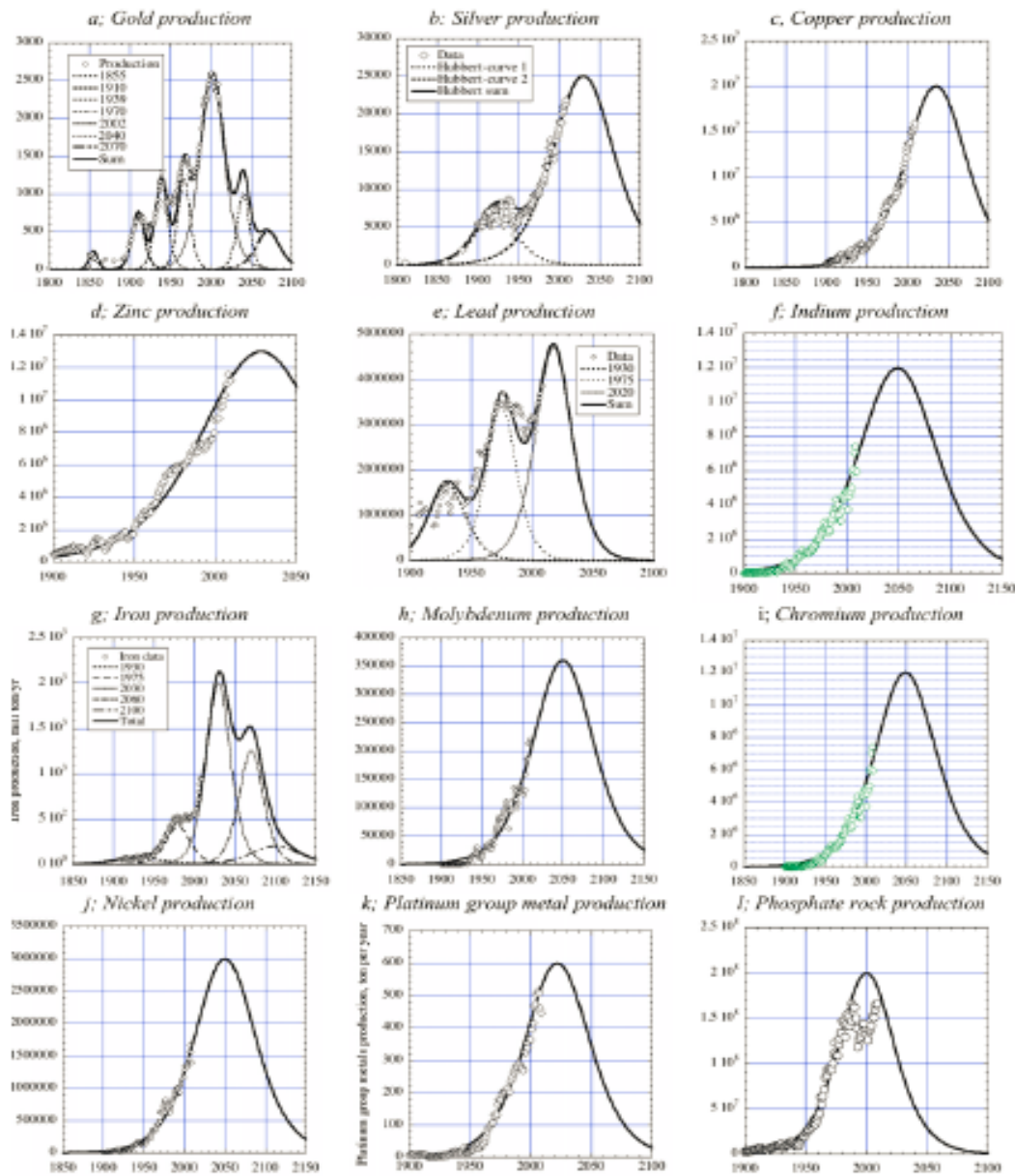
Recycling example

- Recycling of 1 t of ferrous metals gives economy of 3,8 t of iron ore + 1 t of coal
 - The cost price of such metal is 20 times less than of usual metal made from iron ore and coal
 - Emissions are cut by 7,5 times
 - Water pollution – 4 times less
 - Total waste generated – 16 times less

In fact, less than 1% of materials in clothing are recycled into new textiles and fibers, even though they can be.

Exponential growth forever



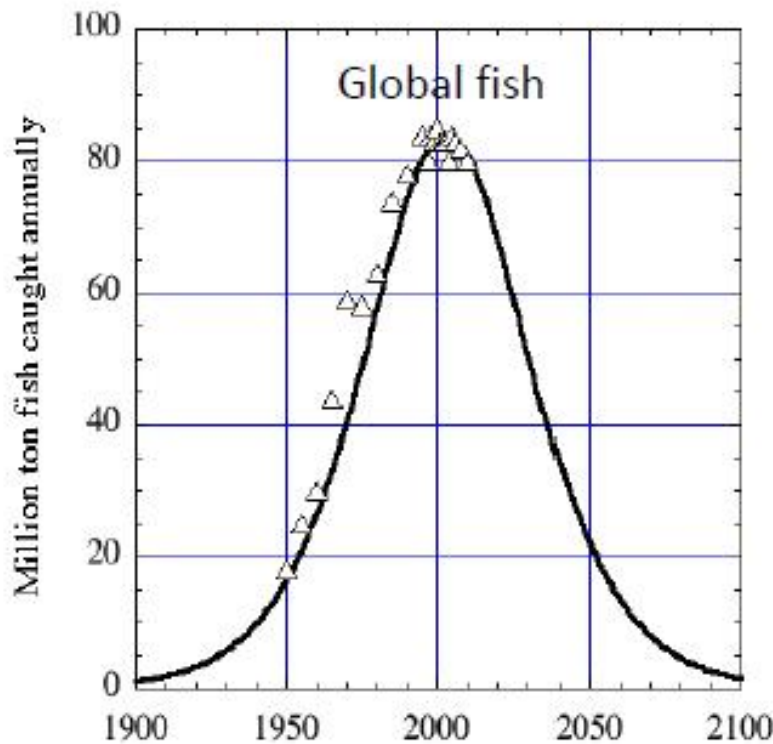
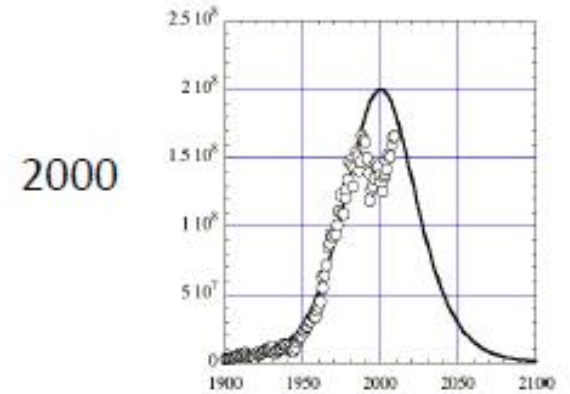


Hubbert's curves for 12 key metals and materials

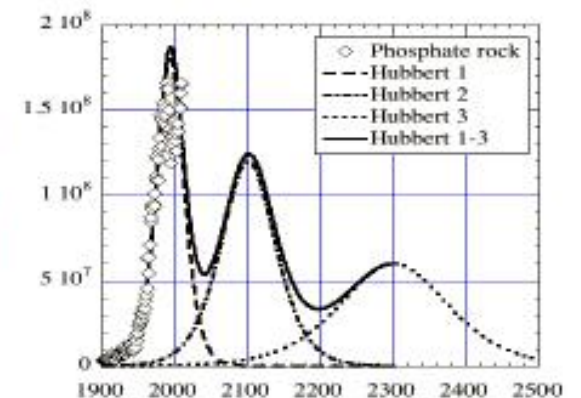
Figure 8. Hubbert-curve fittings for gold (a) silver (b), copper (c), zinc (d) lead (e), indium (f), iron (g), molybdenum (h), chromium (i), nickel (j), platinum group metals (40% Pt, 43% Pd, 5% Rh, 5% Ru, 5% Ir, 2% Os) (k) and (l) that shows a one-curve phosphorus plot. We can see that the data suggest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

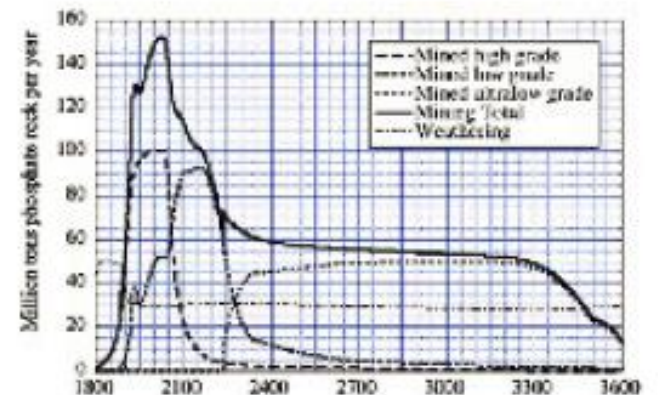
Phosphorus



1992
2100
2300

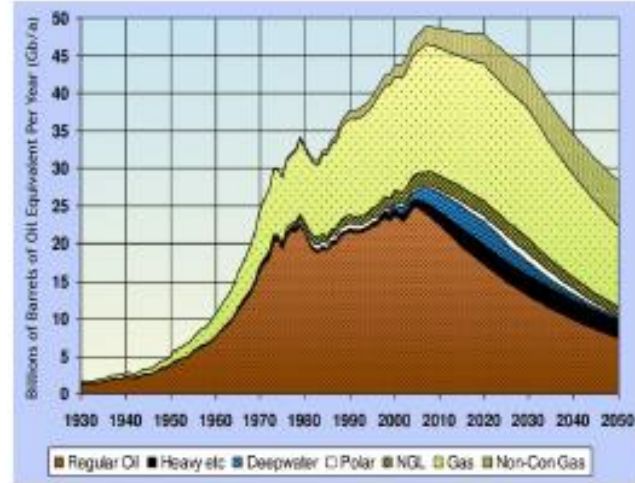
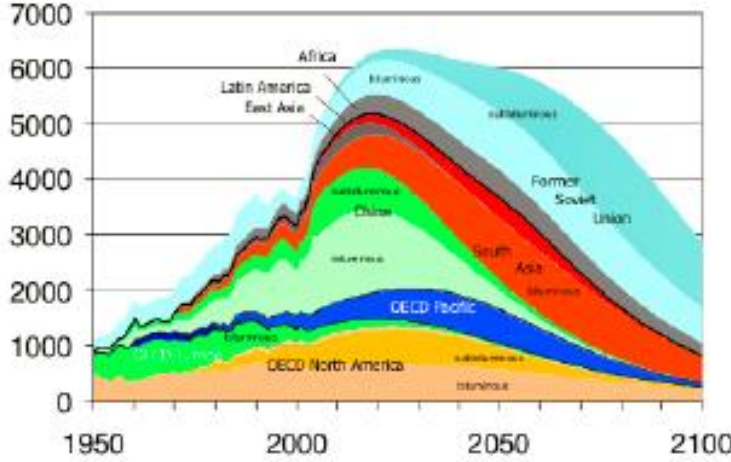


2040



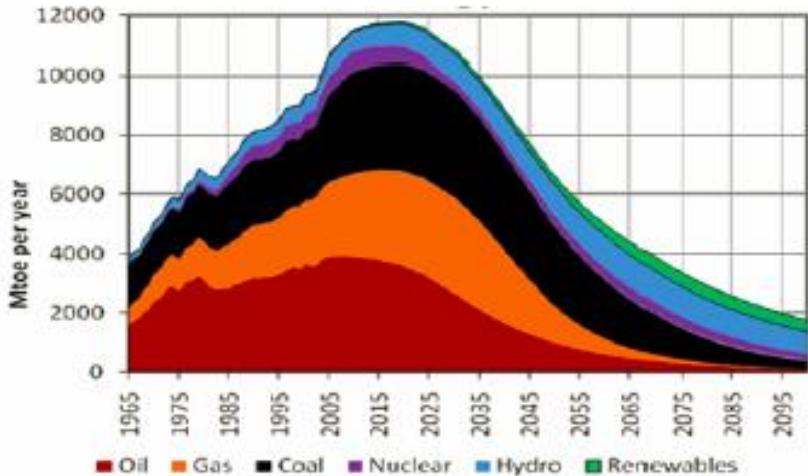


Peak energy



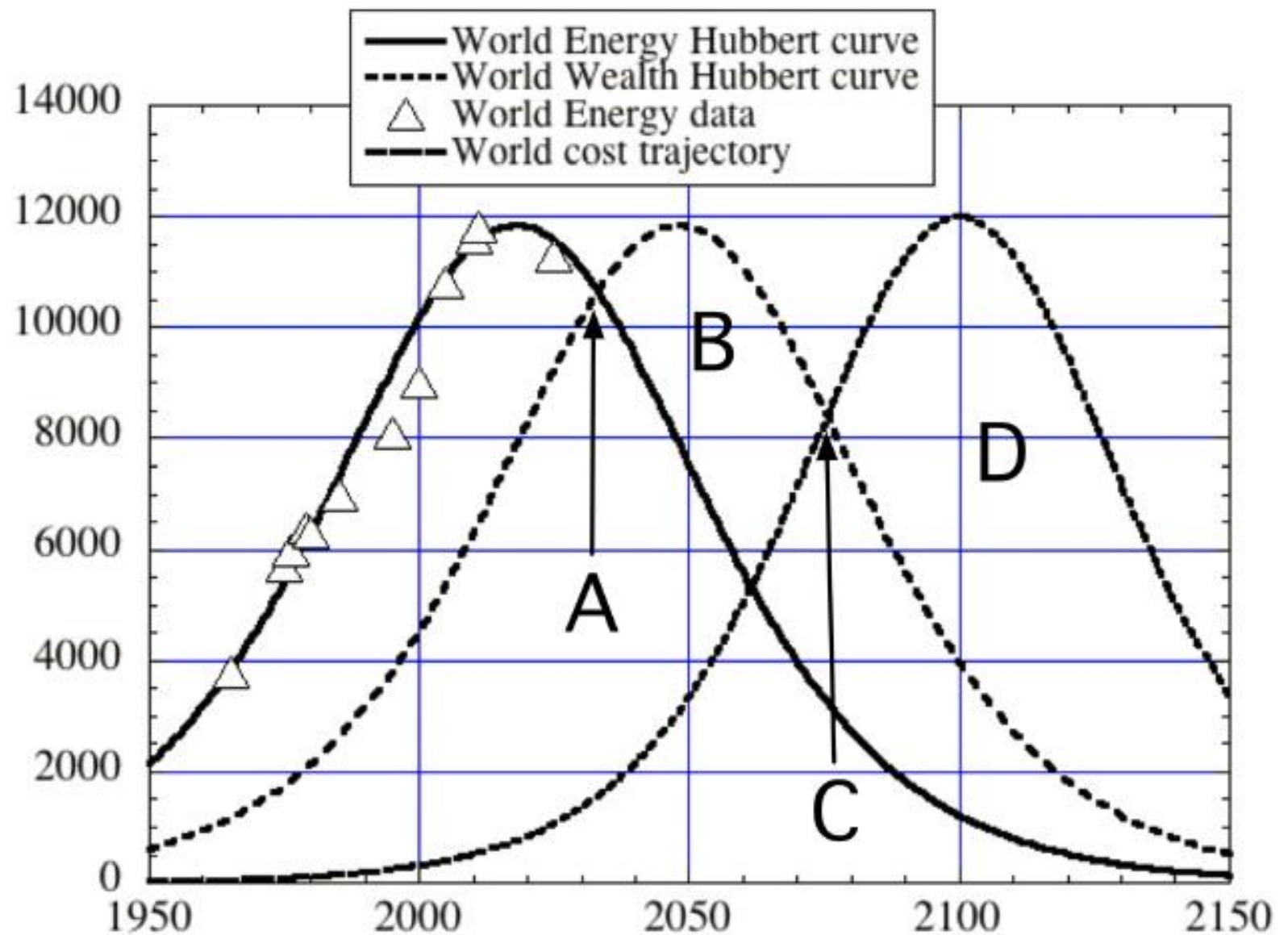
2015

2007

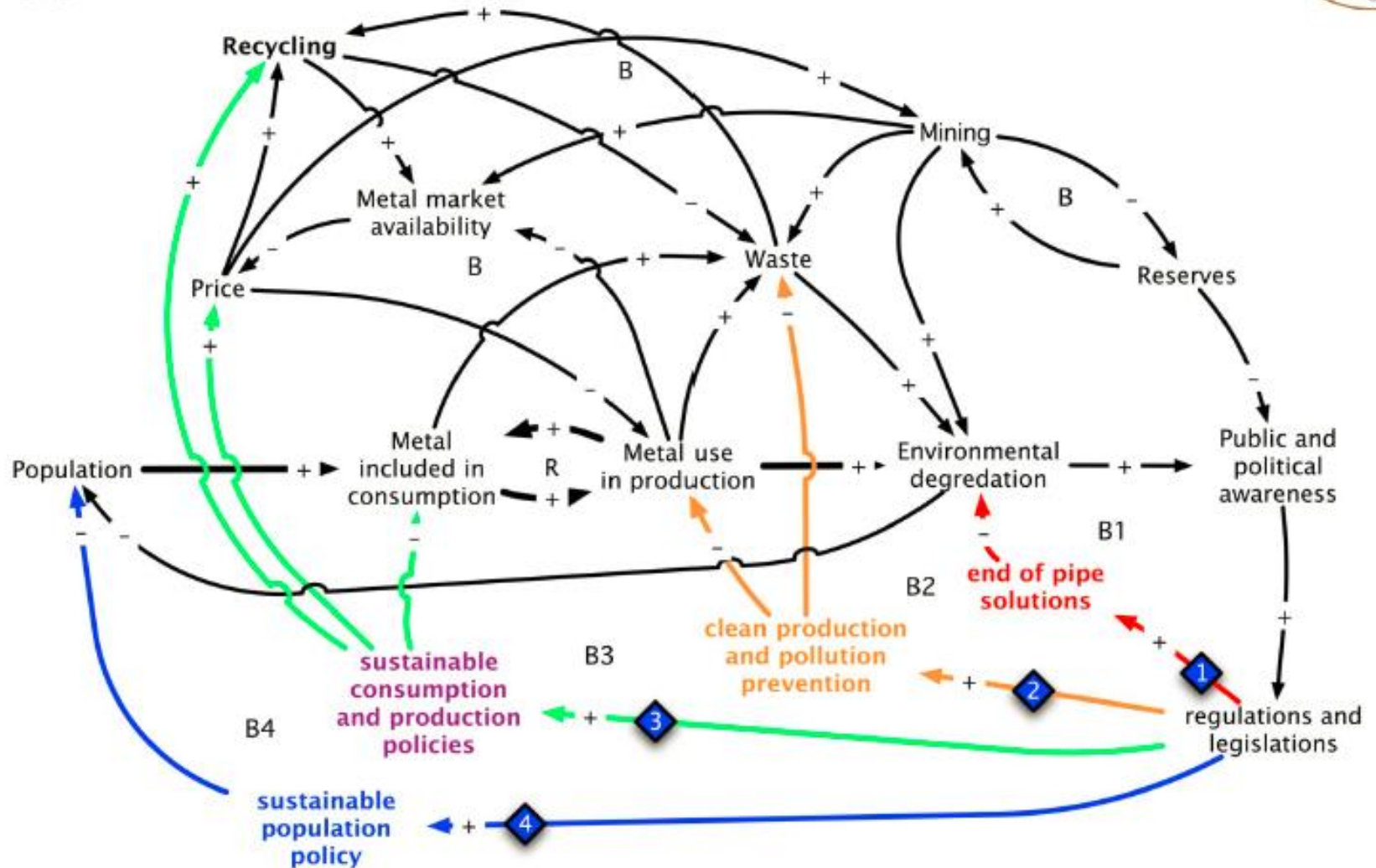


2018

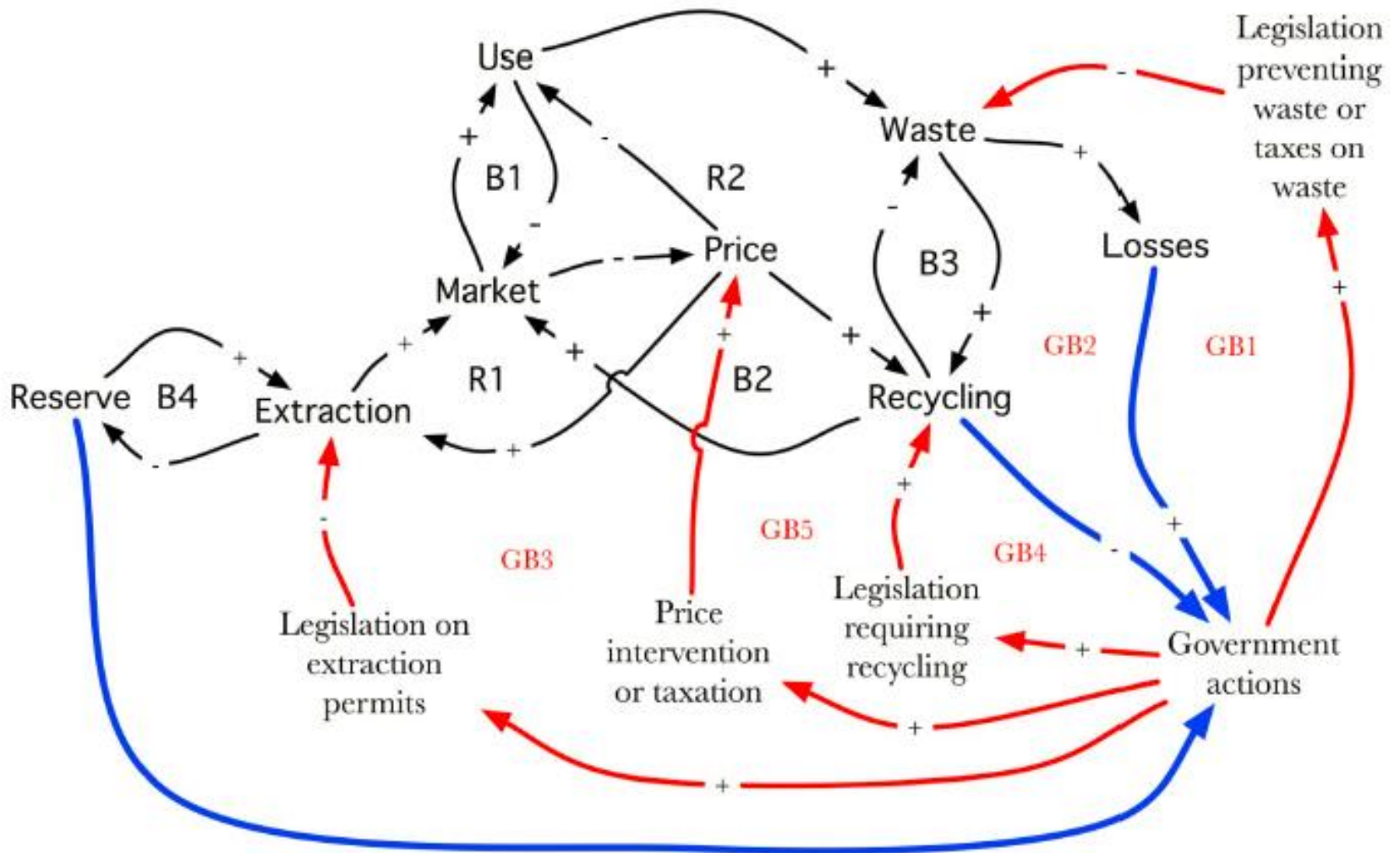
Peak resources, wealth and society



Causal chains....



Policy interventions

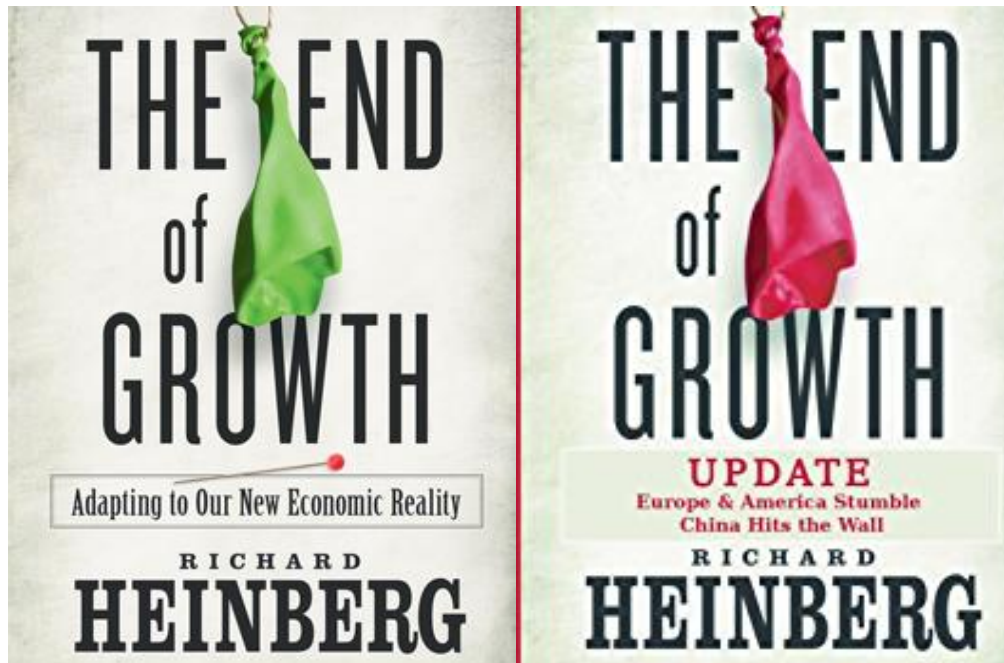


OTHER CONTEMPORARY STUDIES

20th century

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.

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.

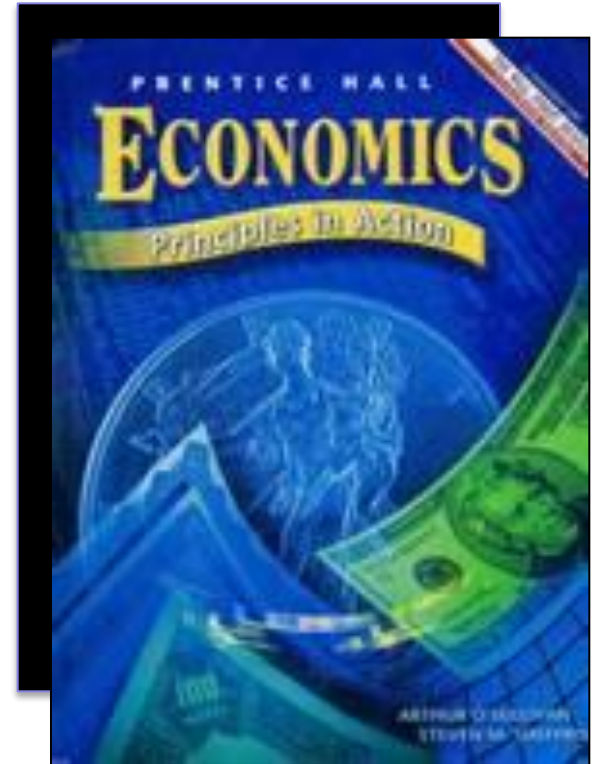
Once you overcome scarcity, most [social] problems will be gone”.



“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.



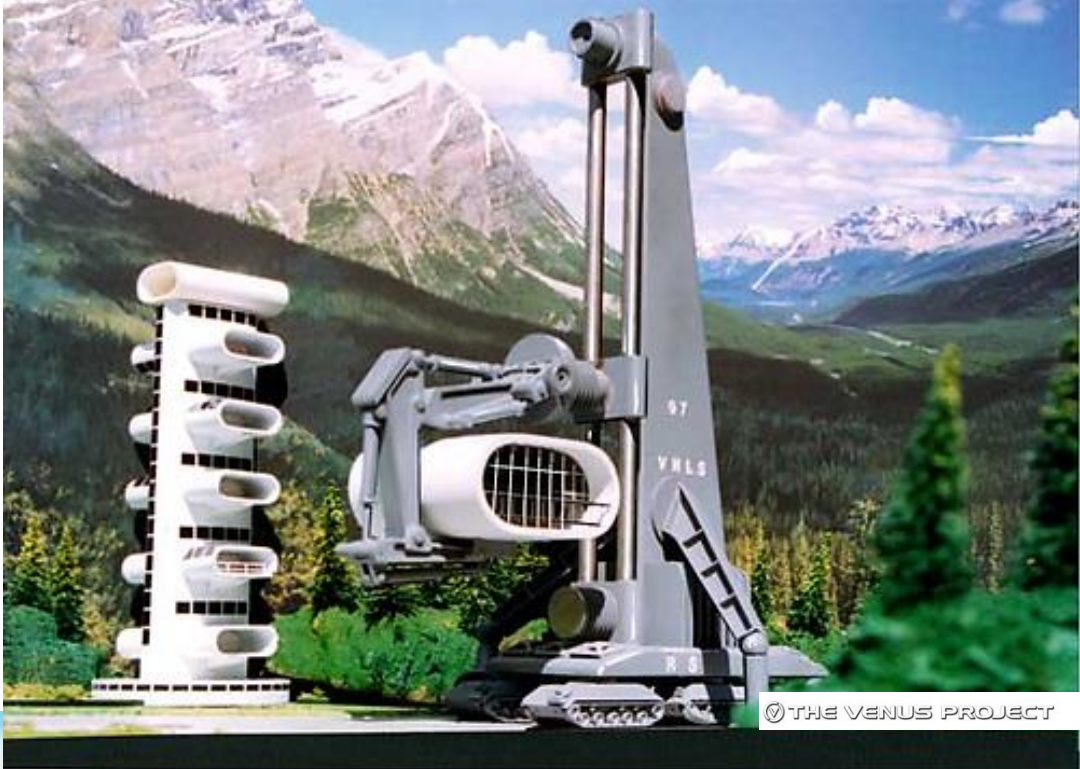
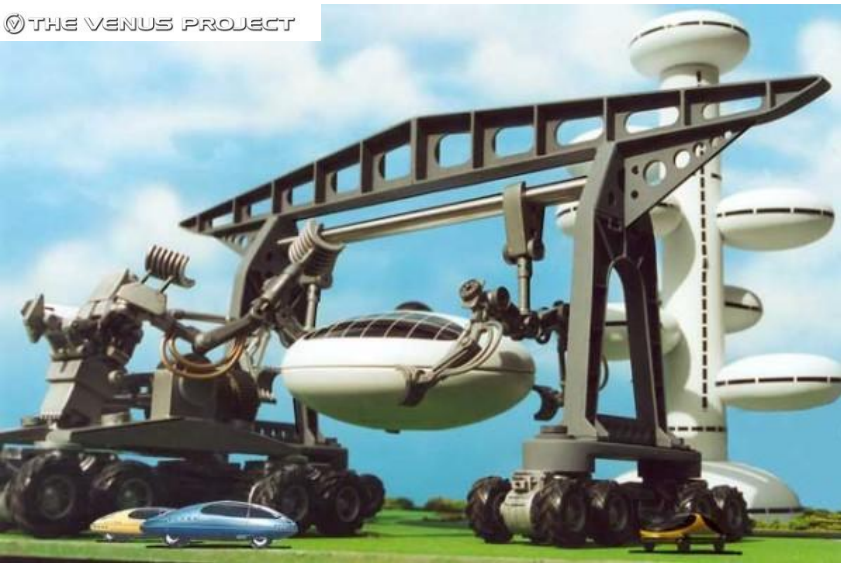
- **How the intelligent management of Earth's resources can be created, on what principles?**



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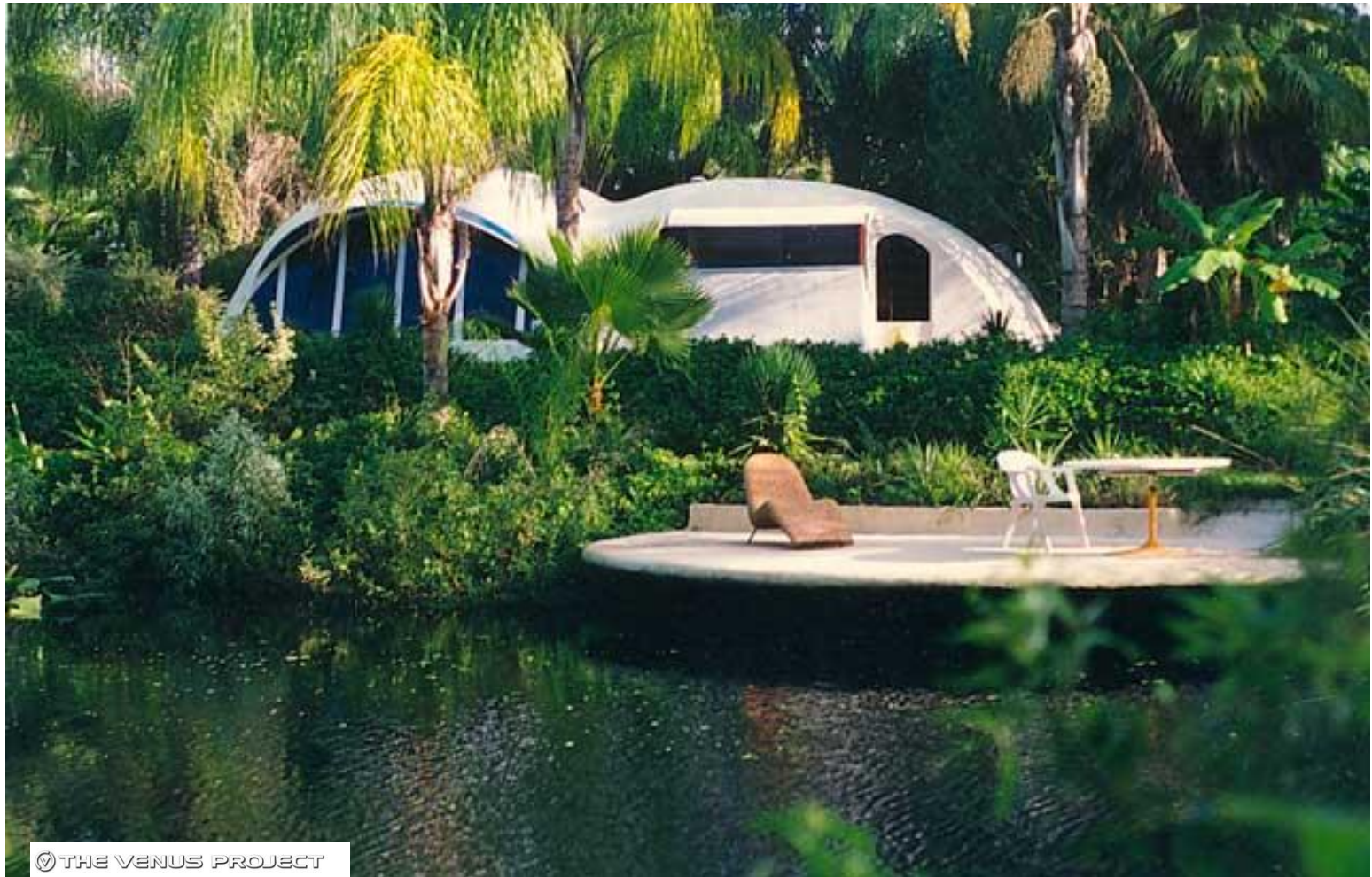
**Where technology is
used intelligently to
replace human labor**



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**



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

Checking 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