Environmental aspects of energy – introduction and systemic approach

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Clasroom ethics

- Cameras turned on
- Muted while not speaking
- Interruptions allowed (turn on your mic and speak)
- Full name on screen

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State of the global environment

Five essential trends:

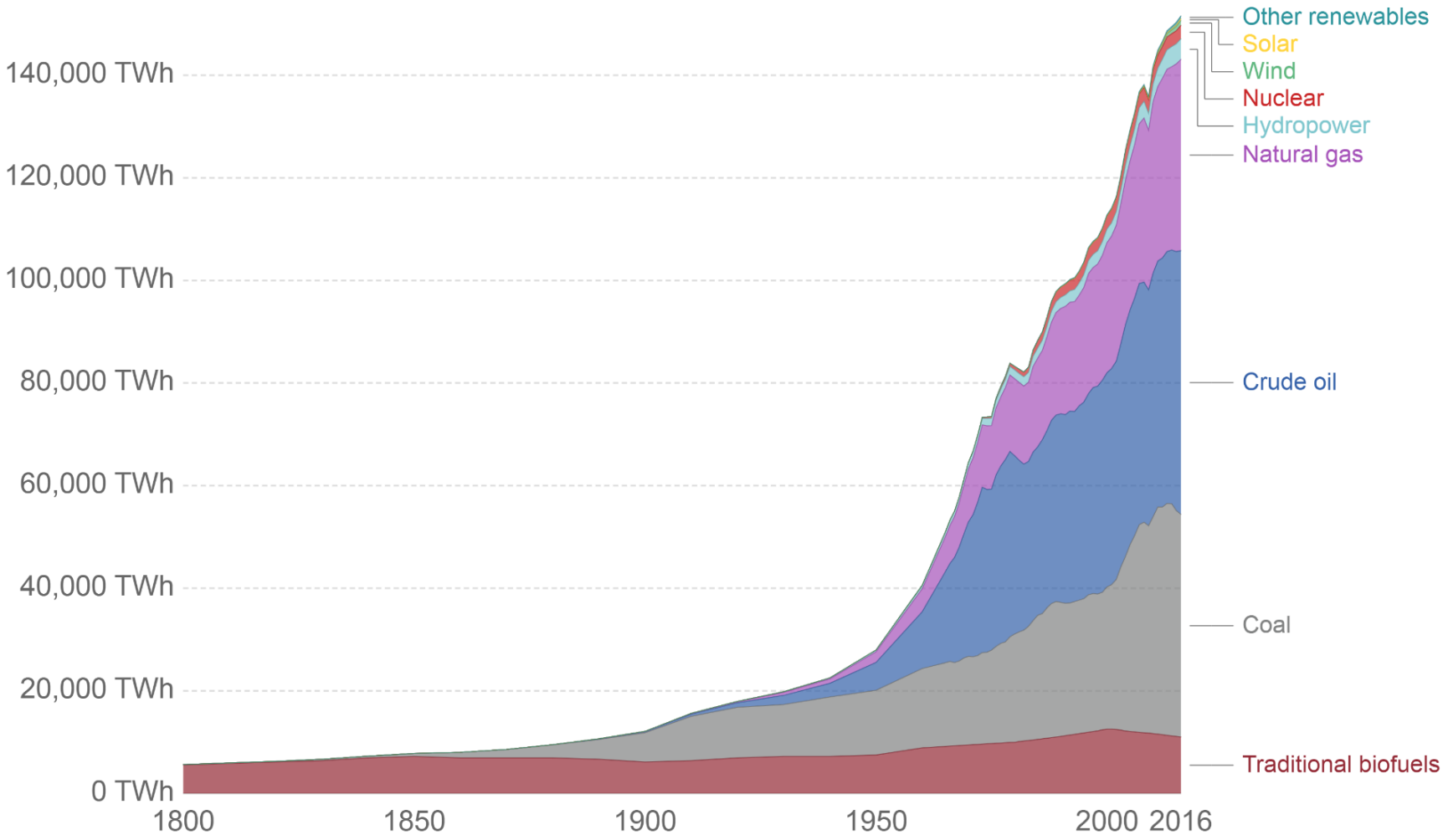
- 1) Population growth
- 2) Economic development
- 3) Decline of life support ecosystems
- 4) Global atmospheric changes
- 5) Loss of biodiversity (variety and variability of life)

- Fossil fuels facilitate these trends.

Global Primary Energy Consumption, World

Global primary energy consumption, measured in terawatt-hours (TWh) per year. Here 'other renewables' are renewable technologies not including solar, wind, hydropower and traditional biofuels.

Our World in Data



Source: Vaclav Smil (2017) and BP Statistical Review of World Energy

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Requirements of the course

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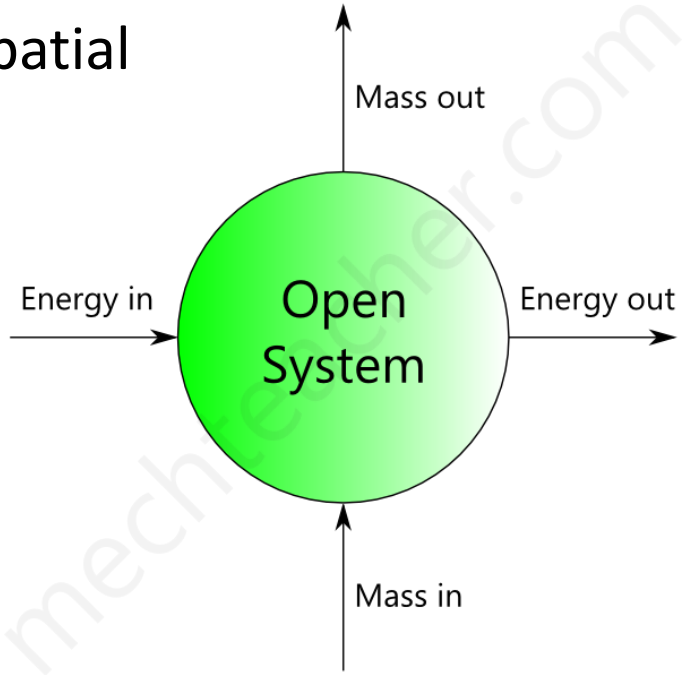
System theory

- System = any set of interacting components that influence one another by exchanging energy or matters.
- Separated from the environment by spatial and temporal boundaries.
- Matter or energy is exchanged among components of the system and its environment.
- Reservoir – storage of material.
- Inputs – outputs = net flux

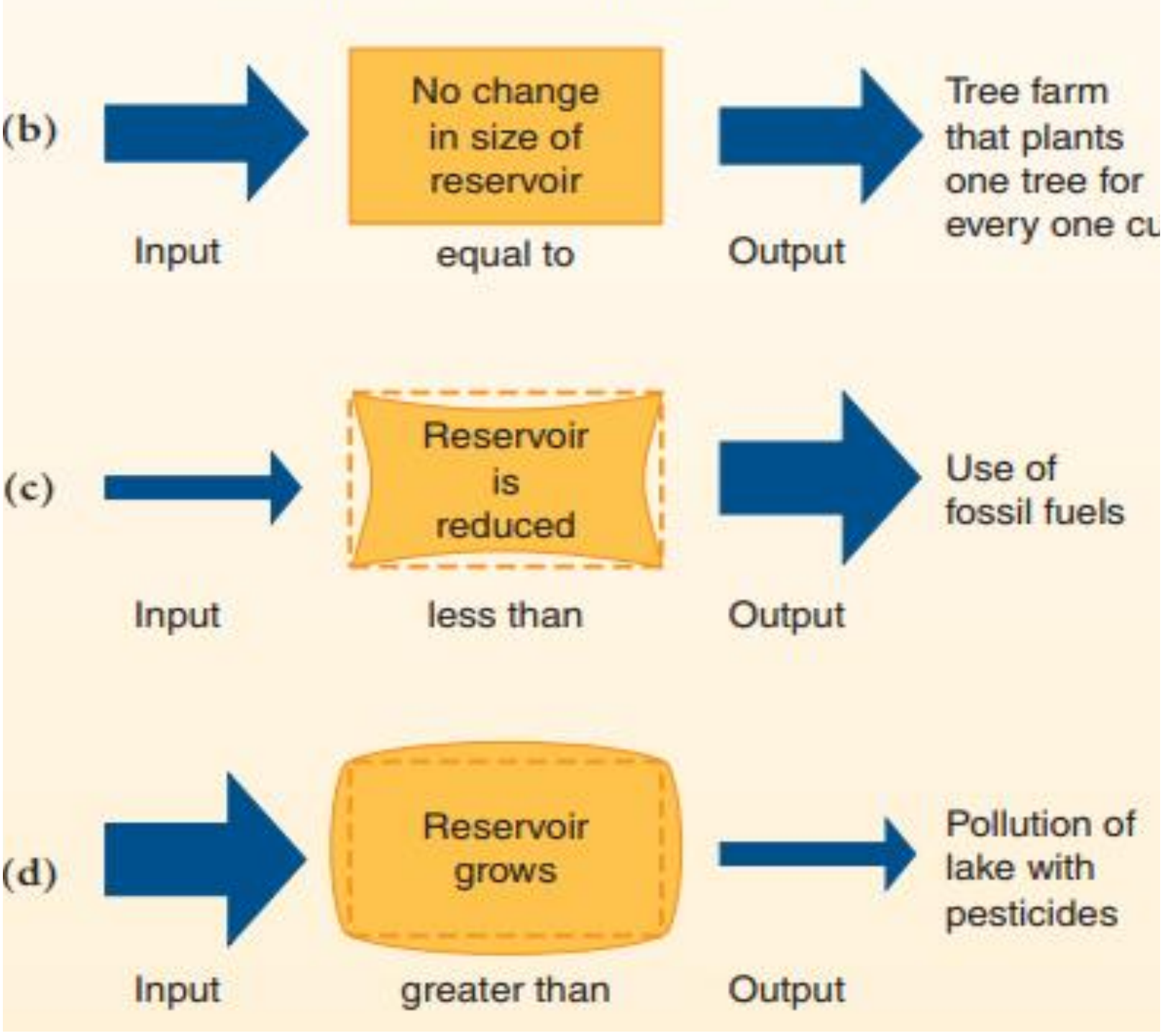


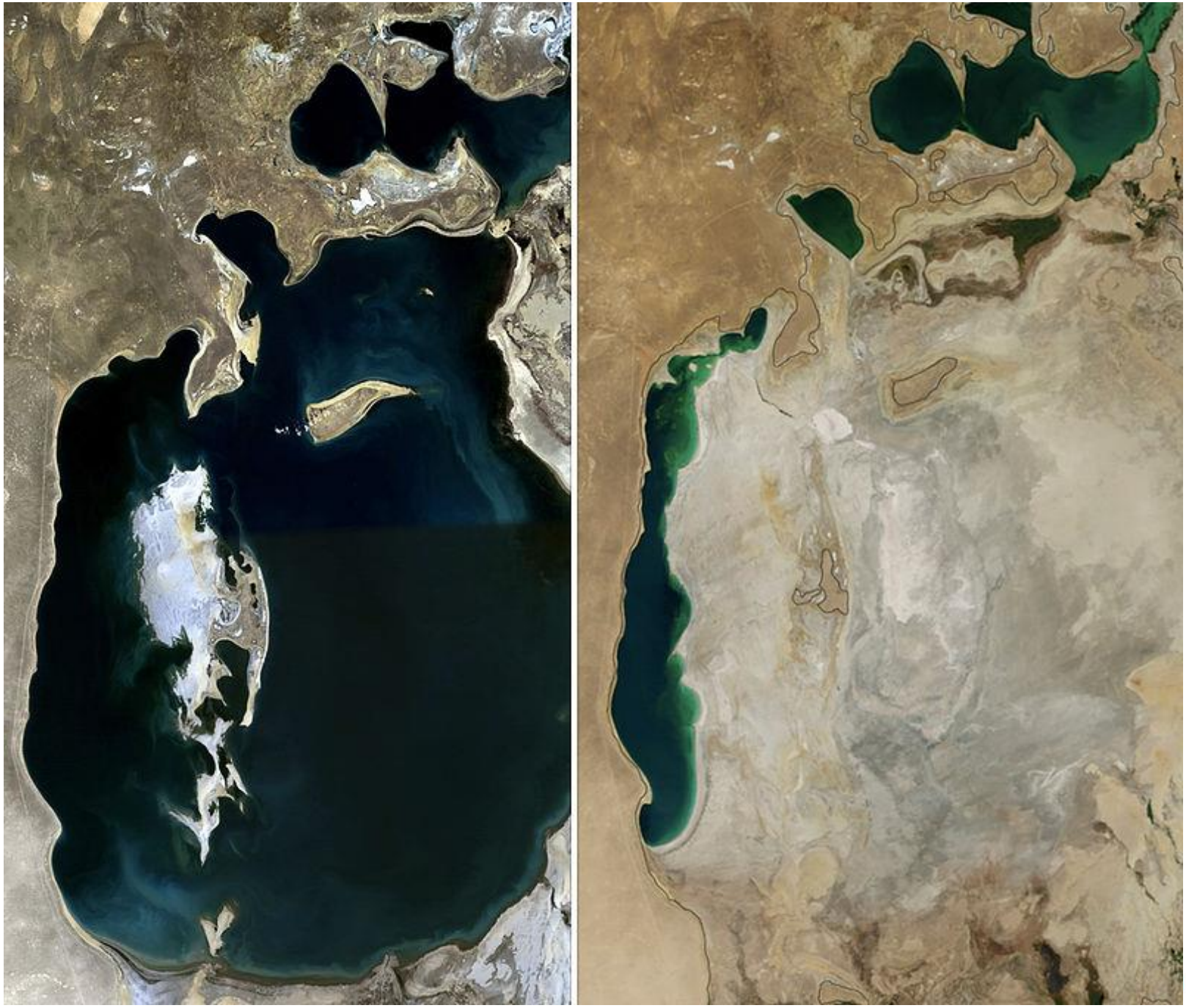
Systems

- Steady state – when net flux = 0
- Mean Residence Time (MRT) – average time a typical molecule remains in the systém (volume of the pool/flux in or out).
- Resilitence – tendency of the system to return or remain in the steady stat.
- A tipping point – a treshold where the system cannot return to the steady state.
- Natural or man-made.
- Open vs. closed systems.
- Earth as a system.

System theory

- System theory: framework to study the (complex) systems.
- Study of the imputs, outputs and changes in a systém under various conditions

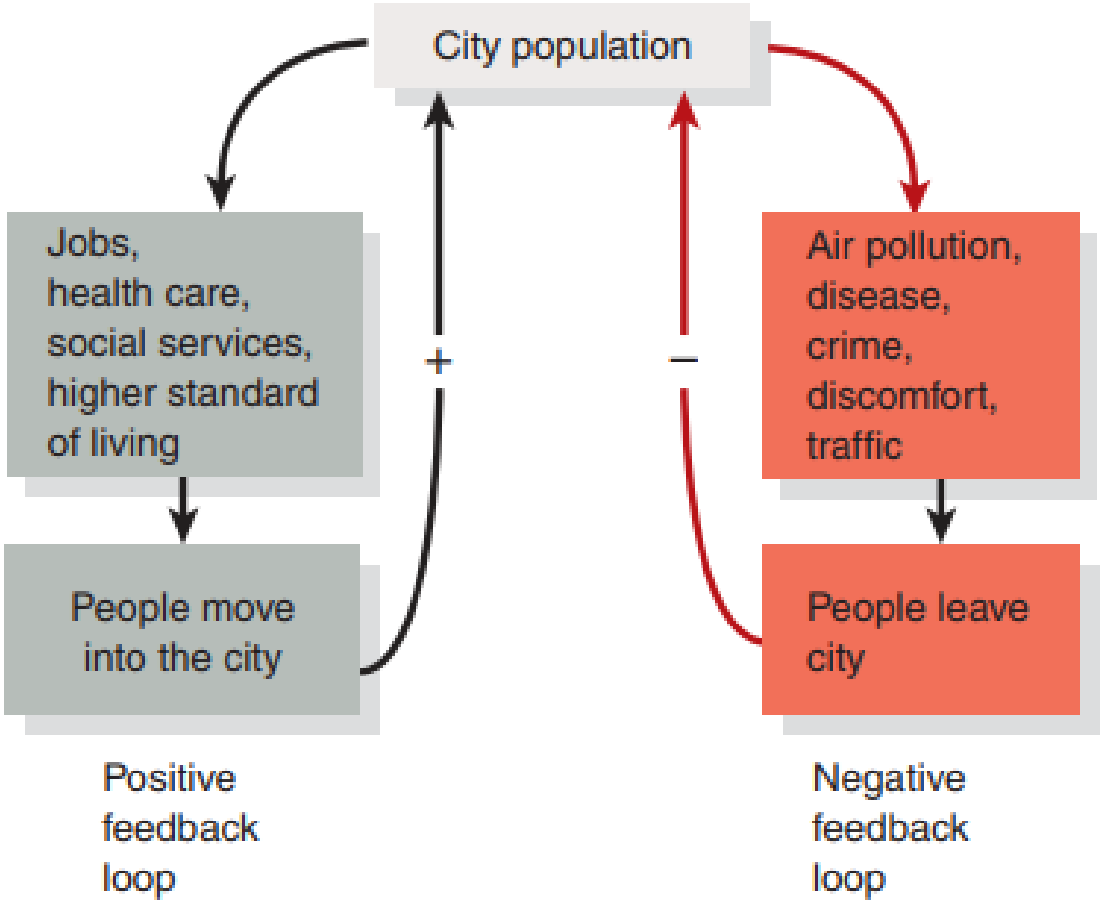

(b)
No change in size of reservoir
Tree farm that plants one tree for every one cu
Input
equal to
Output
(c)
Reservoir is reduced
Use of fossil fuels
Input
less than
Output
(d)
Reservoir grows
Pollution of lake with pesticides
Input
greater than
Output



Human population in large cities (feedbacks)

- Systems tend to dynamic equilibrium, from time to time disrupted by natural and human-induced disturbances → changes over time.
- Feedback – adjustments in input or output rates caused by changes to a systém.
- Positive – amplifies change by causing further increase or decrease
- Negative – resists change by returning to original state/slowing rate of change.

Human population in large cities (feedbacks)



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(Environmental) future of the society

- How society responds to the environmental challenges?
  - Positive feedback – intensification of environmental problems as shortages of commodities and services people start to hoard them.
  - Negative feedbacks – knowing the problem people change the way environment is utilized.

Source: Česká televize

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What to think about

- Is a current conceptualization of the problem (exponentional growth with limited resources) right?
- How society and economy responds to scarcity?
- What is (should be) the role of political system in controlling environmental problems?
- Do our obligations to future generations conflict with our desire to increase our living standards?
- Is sustainable development feasible? And what is sustanable development in the first place?

Sources

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- Botkin, D.B.; Keller, E.A.: Environmental Science: Earth as a Living Planet.
- Teach the Earth: Complex systems. https://serc.carleton.edu/NAGTWorkshops/complexsystems/index.html
- Dartmouth College: Introduction to Environmental Science (Systems and Feedbacks) – Dart.ENVS.01.X
- Tietenbert, T.; Lewis, L.(2012): Environmental and Natural Resource Economics.

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