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Aalto University  
School of Engineering

# Sustainability Science and policies

*WAT-E2140 Sustainability in Environmental Engineering*  
30.10.2020  
Meeri Karvinen

# Agenda for today

## Sustainability science and policies

- Introduction to the day (10 min)
- Group work on the articles, phase 1 (15 min)

----- BREAK (10 min) -----

- Group work on the articles, phase 2 (50 min)

----- BREAK (15 min) -----

- Wrap-up & Insights on sustainability (30 min)

----- BREAK (5 min) -----

## Tasks 1 & 2 (20-30 min)

- Instructions for the Task 1 learning diary
- Getting to know your group
- Introduction to & instructions for Task 2

# Learning outcomes of the theme 1

**After science & policy session (+ learning diary) you should be able to:**

- Follow the global scientific and political discourse on the *need for* and *implementation of* sustainable development
- Understand how complex large-scale challenges can be implemented in political level and in practice
- Define what aspects relate to sustainability as a concept
- Locate yourself as a professional in the global framework and understand how your field can contribute to it

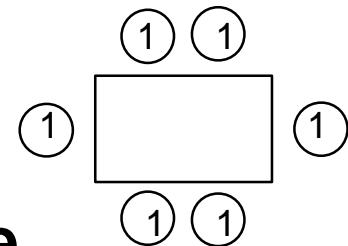
# The articles

# Sustainability discourse

## Four concepts in your papers:

1. Planetary boundaries (PBs), 2015 (originally from 2009)
2. The Oxfam Doughnut, 2012
3. The SDGs - Science perspective, 2015 (SDGs)
4. Implementation – The Nexus model, 2011

# Group work

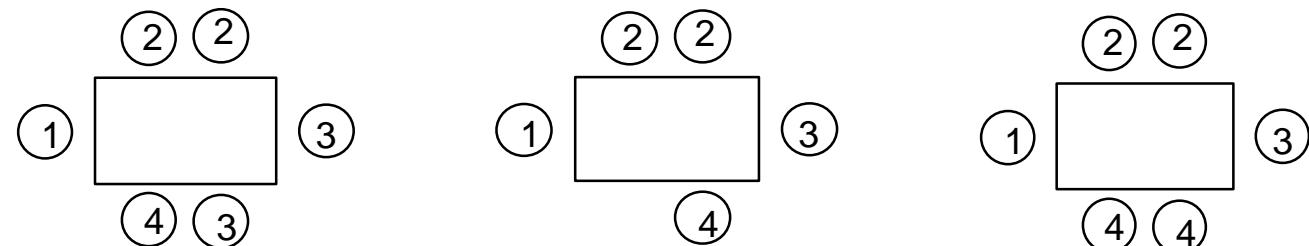


## Phase 1 (15 min): Students who read the same article

- Generate joint understanding of your article, support each other's learning for the next phase

## Phase 2 (50 min, 10min/paper + 10min/discussion): Mixing the groups → these are also your course groups!

- Teach the others your article's main points and contents (4 x 10 min)
- Discuss together what you learned or if something remained unclear, was it interesting, beneficial etc., coming up with questions for joint discussion (10 min)

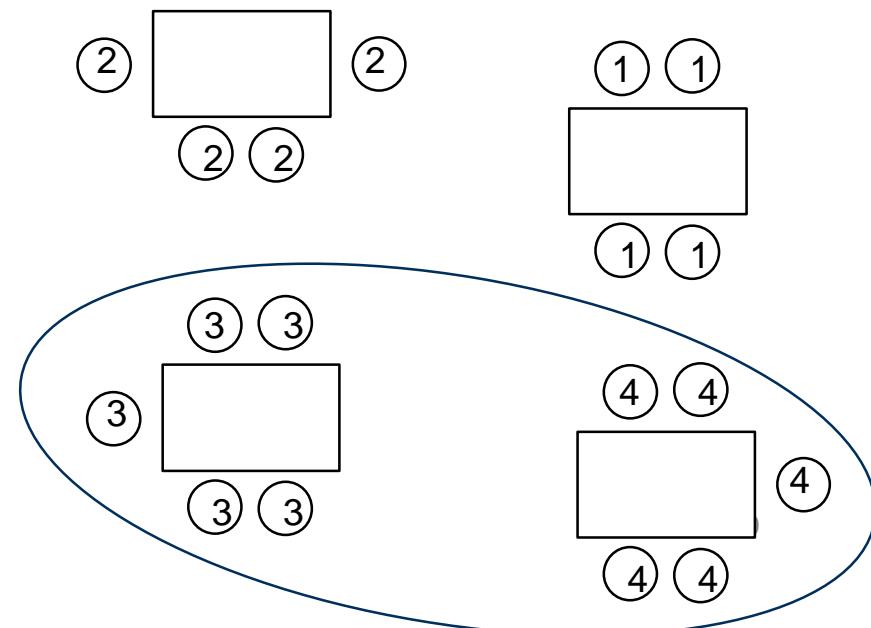


# Guiding questions for phase 1, 15min

With students who read the same paper

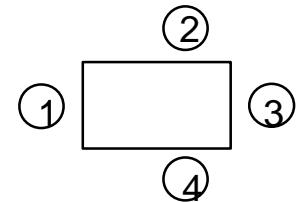
Remember to  
introduce  
yourselves ☺

- What is the purpose of the paper (why it has been written)?
- What is the framework and background of the paper?
- What is the main message/outcome of the paper?
- What kind of arguments/material the author(s) present to justify their key message(s)?
- Who has written the paper?
- To whom the paper is targeted to?
- Would you define the paper as contributing to sustainability science or policies, or both? Why?



# Break 10 min

## Phase 2, 50 minutes, mixed groups (= course groups)



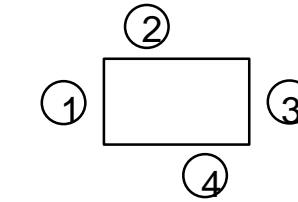
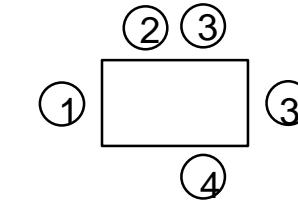
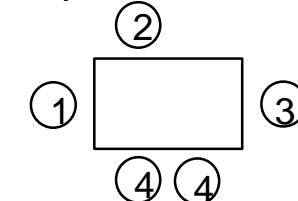
Teach the others your article's main points and contents (4 x 10 min)

Presentation order:

1. Planetary boundaries (10 min)
2. The Doughnut model (10 min)

**Small break exercise together** (breakout rooms will be closed)

3. SDG targets, science perspective (10 min)
4. Implementation – The Nexus (10 min)
5. Discussion: what you learned, what remained unclear, was it interesting, beneficial etc. Do you have questions for joint discussion (10 min)



As a reminder & support, you can check the guiding questions from phase 1

# Break 15 min

# Insights on sustainability: short history and some perspectives

	Never heard	I know the basics	I know very well	Have applied the concept in practice (in work / course), please specify in the textbox how	Keskiarvo	Mediaani
Planetary boundaries	38,46%	38,46%	15,39%	7,69%	1,92	2
Sustainable development goals (SDGs)	0%	38,46%	23,08%	38,46%	3	3
Oxfam Doughnut Model	76,92%	23,08%	0%	0%	1,23	1
Nexus approach	92,31%	7,69%	0%	0%	1,08	1
History of sustainable development -concept	46,15%	53,85%	0%	0%	1,54	2
Values and perspectives of sustainability	15,38%	61,54%	23,08%	0%	2,08	2

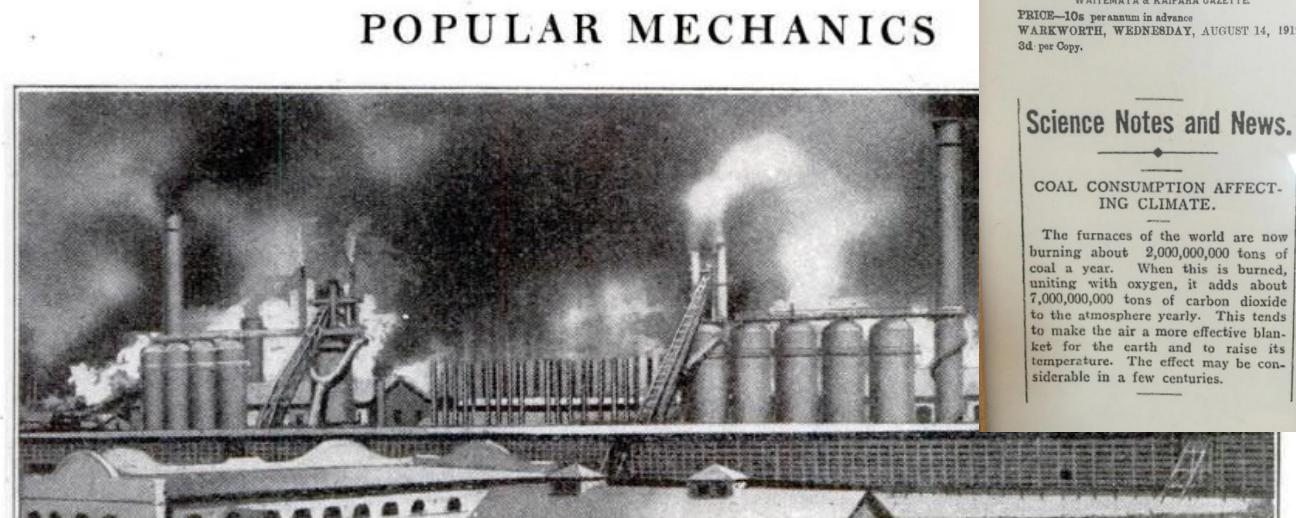
# From environmental awakening to sustainable development 1/2

Discussion on the connection between carbon acid and global temperature has a long history:

Arrhenius, S. 1896. On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground. Philosophical Magazine and J. of Science Series 5, Vol. 41, 237-276.

[http://www.rsc.org/images/Arrhenius1896\\_tcm18-173546.pdf](http://www.rsc.org/images/Arrhenius1896_tcm18-173546.pdf)

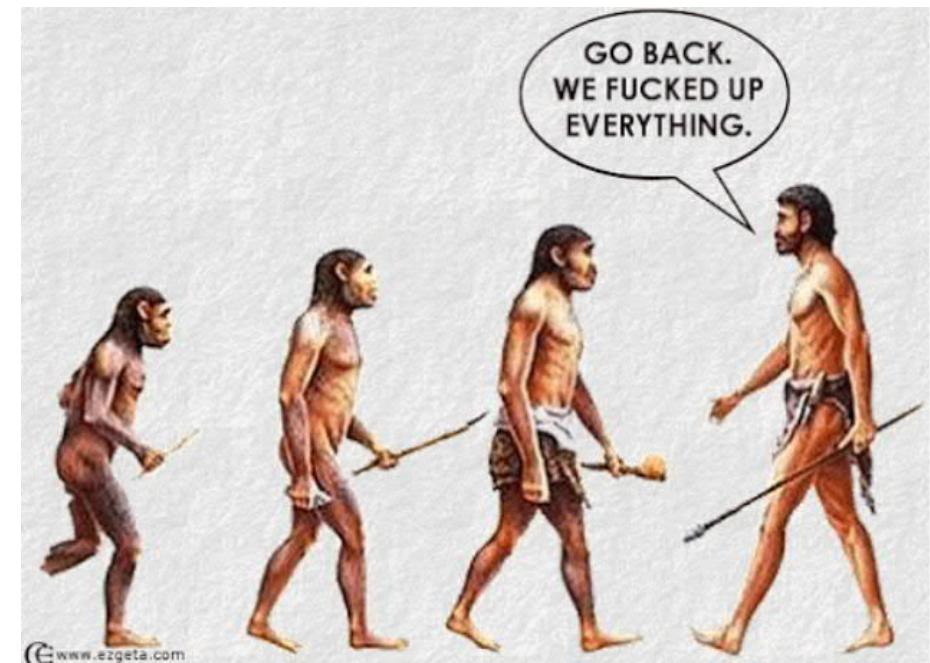
Molena, F. 1912: : “Remarkable Weather of 1911: The Effect of the Combustion of Coal on the Climate — What Scientists Predict for the Future”. Popular Mechanics, March 1912



# From environmental awakening to sustainable development 2/2

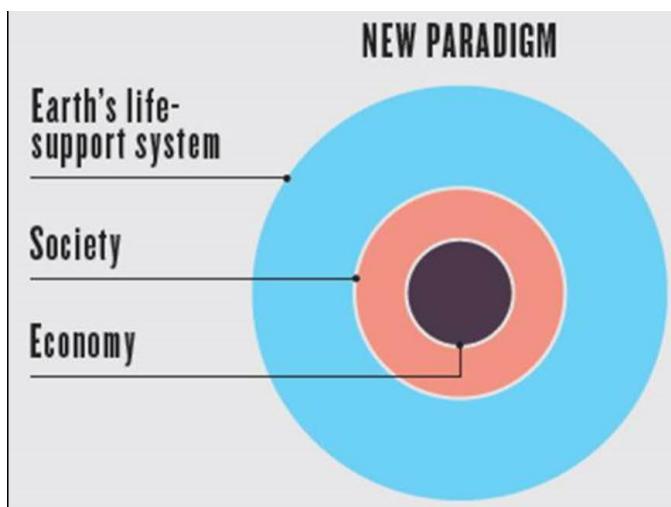
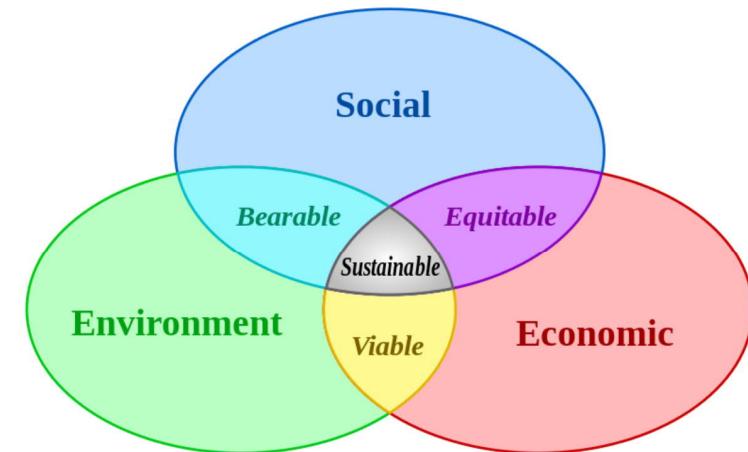
- World wars & ‘Trinity’, the first nuclear test
- Silent Spring by Rachel Carson
- 1970's oil and energy crisis
- Wide-spread environmental movement
- Club of Rome: Limits to growth  
(<https://www.clubofrome.org/report/the-limits-to-growth/>)
- Something needs to be done?

→ UN Stockholm Conference on the Human Environment 1972



# Sustainable development

*“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” –Brundtland commission 1987*



New Paradigm that takes into account the limits of the Earth's life supporting system

Rockström, J. et al. (2009): "Planetary boundaries: exploring the safe operating space for humanity." *Ecology and society* 14(2).

# PBs: Earth system sciences



M.Karvinen 2016

## Why to start the course from Earth System Sciences?

- Sustainability is about **spatial scales and perspectives**: to be able to *zoom in* (e.g. sustainability appraisal methods),  
**we need to be capable of zooming out (system level)**
  - Whatever we do in the lower scale has an effect in larger scale
  - Sustainability action plans and decisions cannot be made (only) in local level

# About system's thinking

- The Earth is a part of a planetary system, in which the different system components impact each other. The impact can be either balancing or reinforcing and directing → changes in the system.
  - The Earth system comprises of the soil, the seas, the atmosphere, the poles etc.
    - The system includes the flows of nutrient, energy, coal, water etc.
    - Also life on Earth is a component in the system and has an impact on the different flows (and has its own flows)
- Human with its modern society is at the moment working as a reinforcing driver, directing the system towards major changes
- The Anthropocene, a new geological epoch

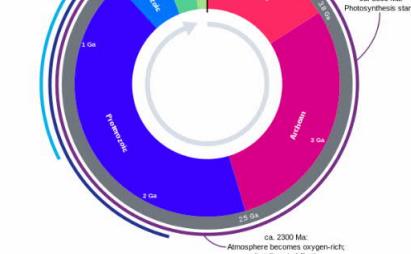
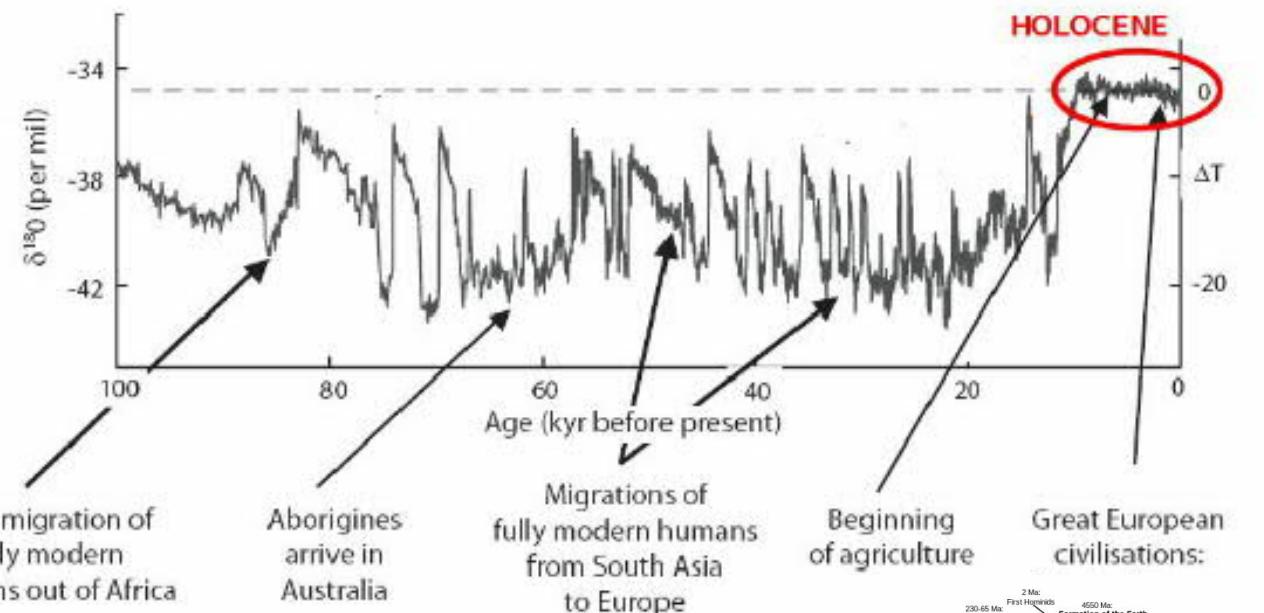
# Time

## Sustainability is about time:

In order to predict the future, you need to know the past and present  
→ *short-term low-cost decisions?*

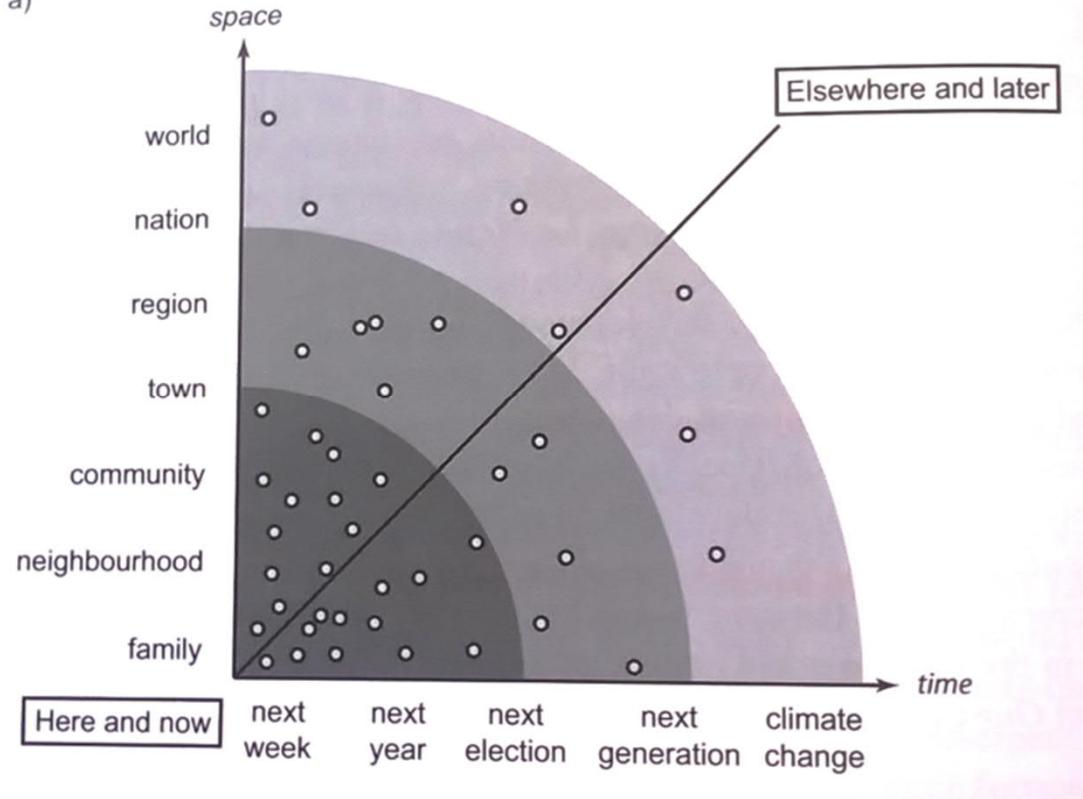
→ *long-term, more costly decisions that would ensure living in a safe and just space*

**Fig. 1.** The last glacial cycle of  $\delta^{18}\text{O}$  (an indicator of temperature) and selected events in human history. The Holocene is the last 10 000 years. Adapted from Young and Steffen (2009).

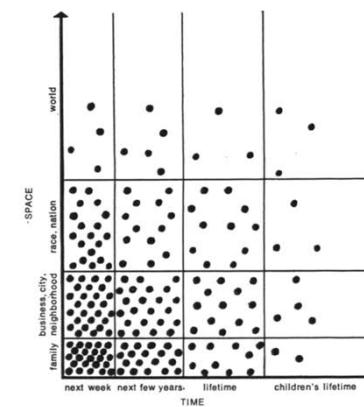


# Nested temporal and spatial scales

a)

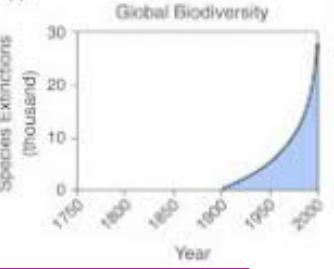
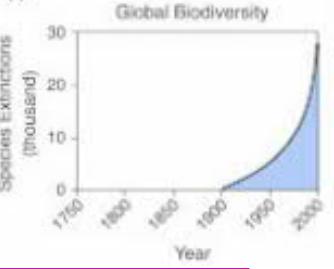
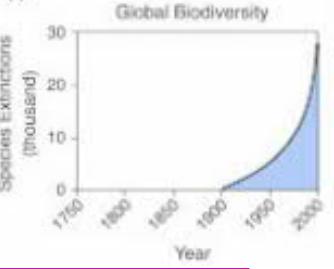
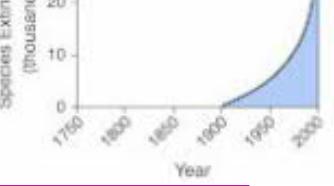
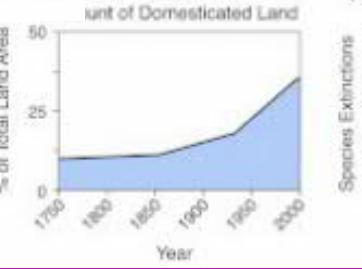
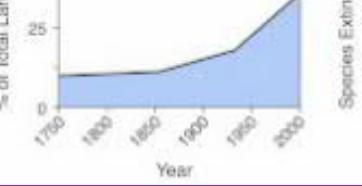
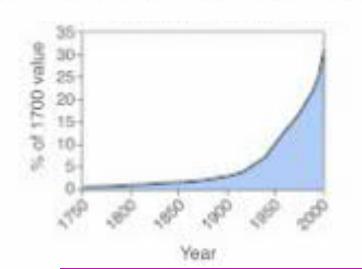
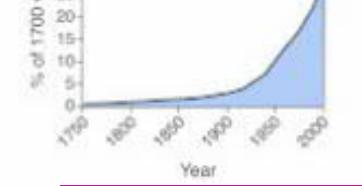
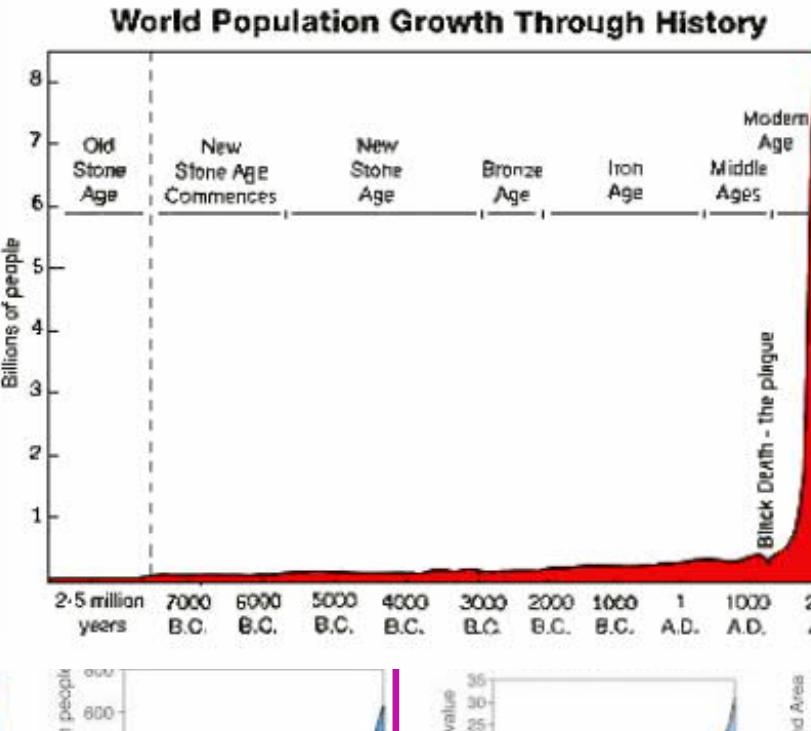
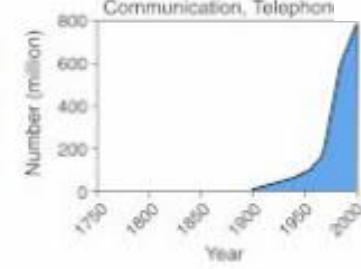
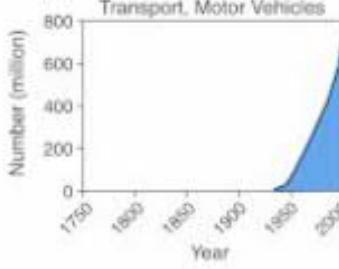
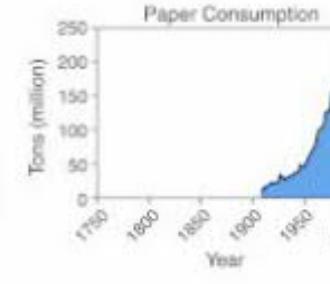
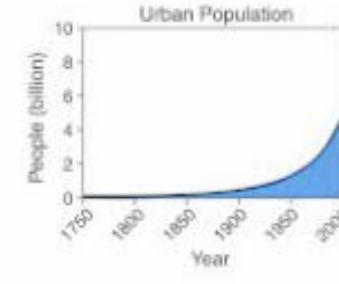
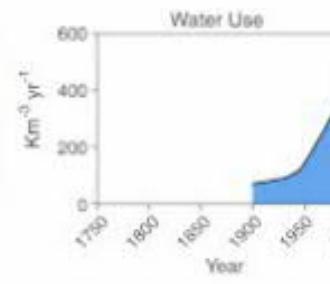
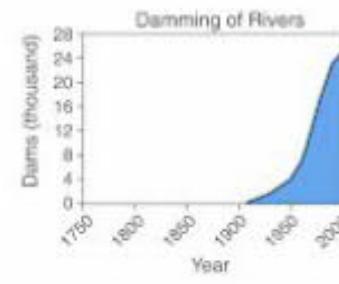
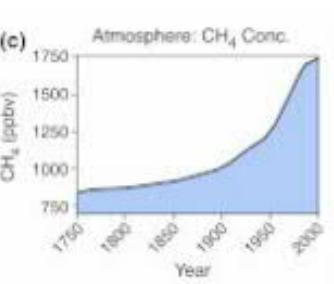
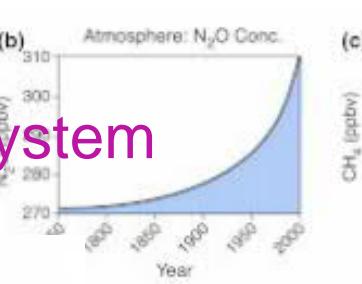
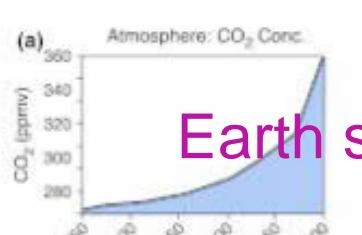
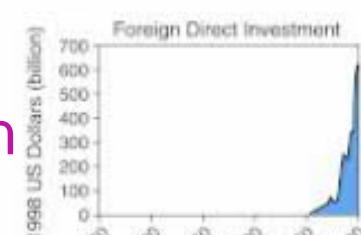
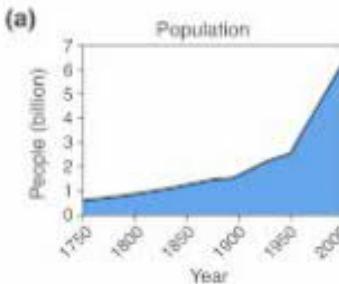


De Vries (2013): Sustainability science



Although the perspectives of the world's people vary in space and in time, every human concern falls somewhere on the space-time graph. The majority of the world's people are concerned with matters that affect only family or friends over a short period of time. Others look farther ahead in time or over a larger area—a city or a nation. Only a very few people have a global perspective that extends far into the future.

Meadows et al. (1972): Limits to growth



# Changing the game



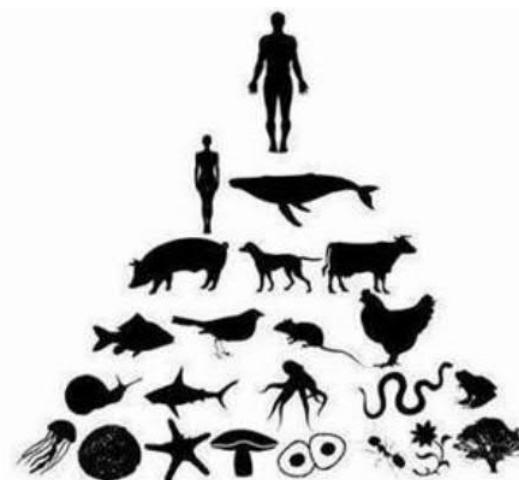
Science does change the world.  
Sometimes slowly – but surely.

Sustainability implementation relies on **actors** who make things happen.

But:

Sustainability is very much about **worldviews and values**, which may differ between different actors.

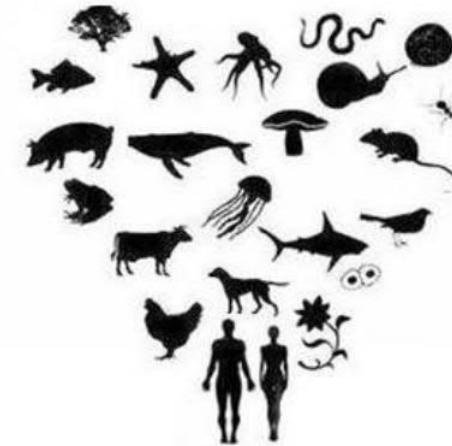
# Political decisions are compromises influenced by worldviews and values



**World as a resource**  
**Anthropocentric**

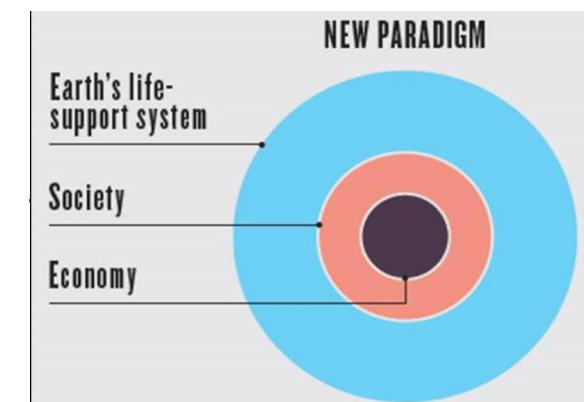
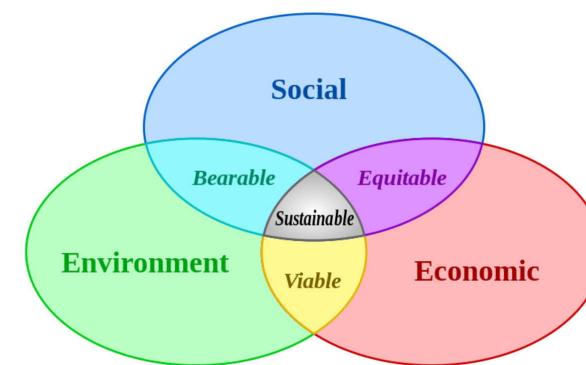


**Interconnected**

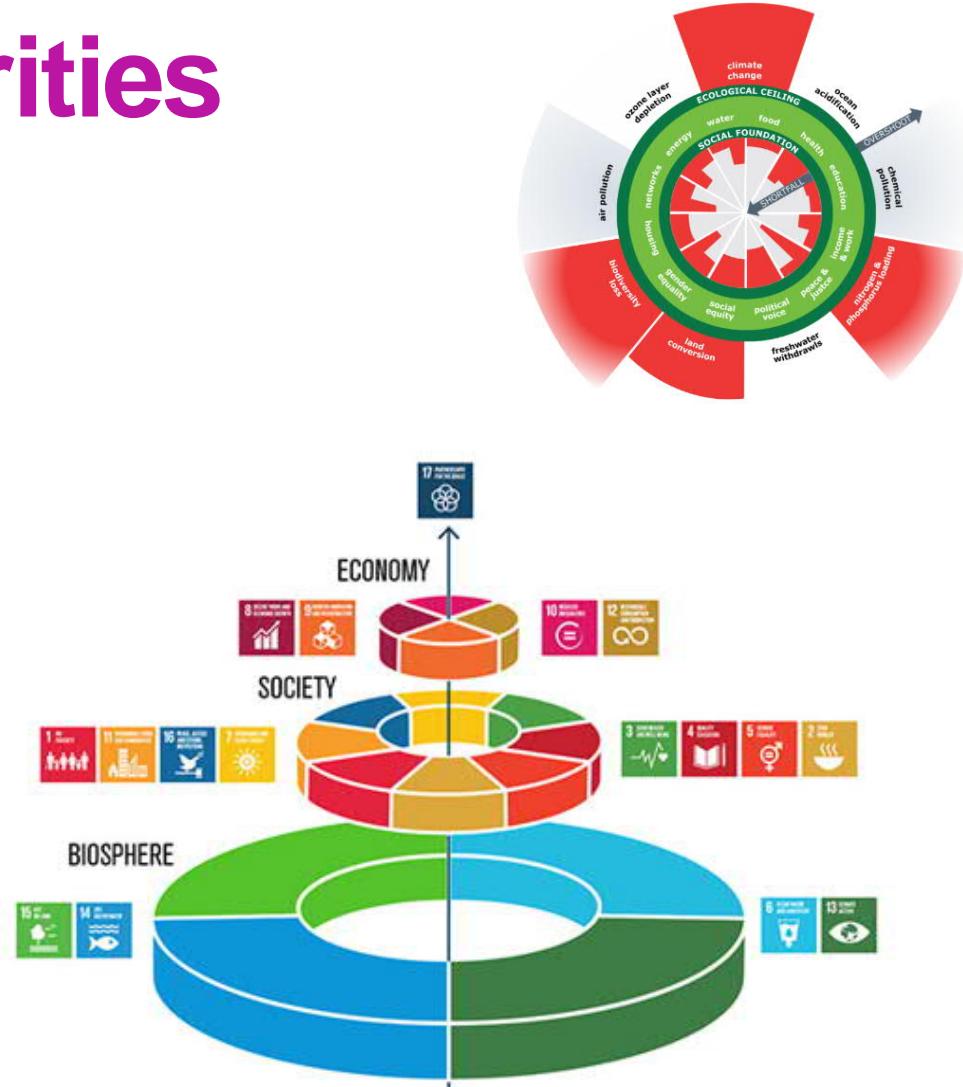


**Regenerative**  
**Ecocentric**

*“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” –Brundtland commission 1987*



# Interconnections, priorities

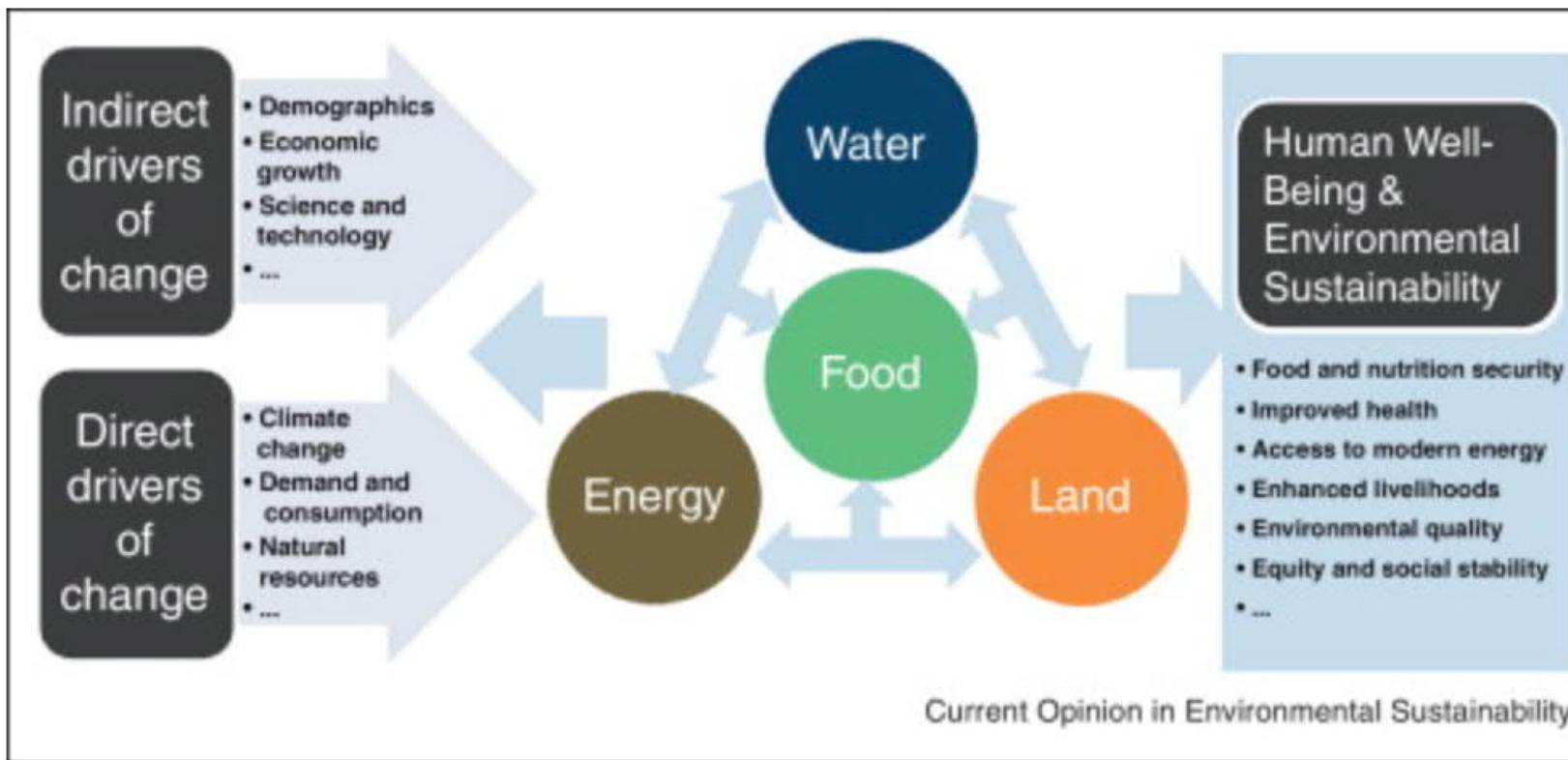


<https://www.stockholmresilience.org/research/research-news/2016-06-14-how-food-connects-all-the-sdgs.html>

# Ensuring the safe and just living space for all – Nexus approach

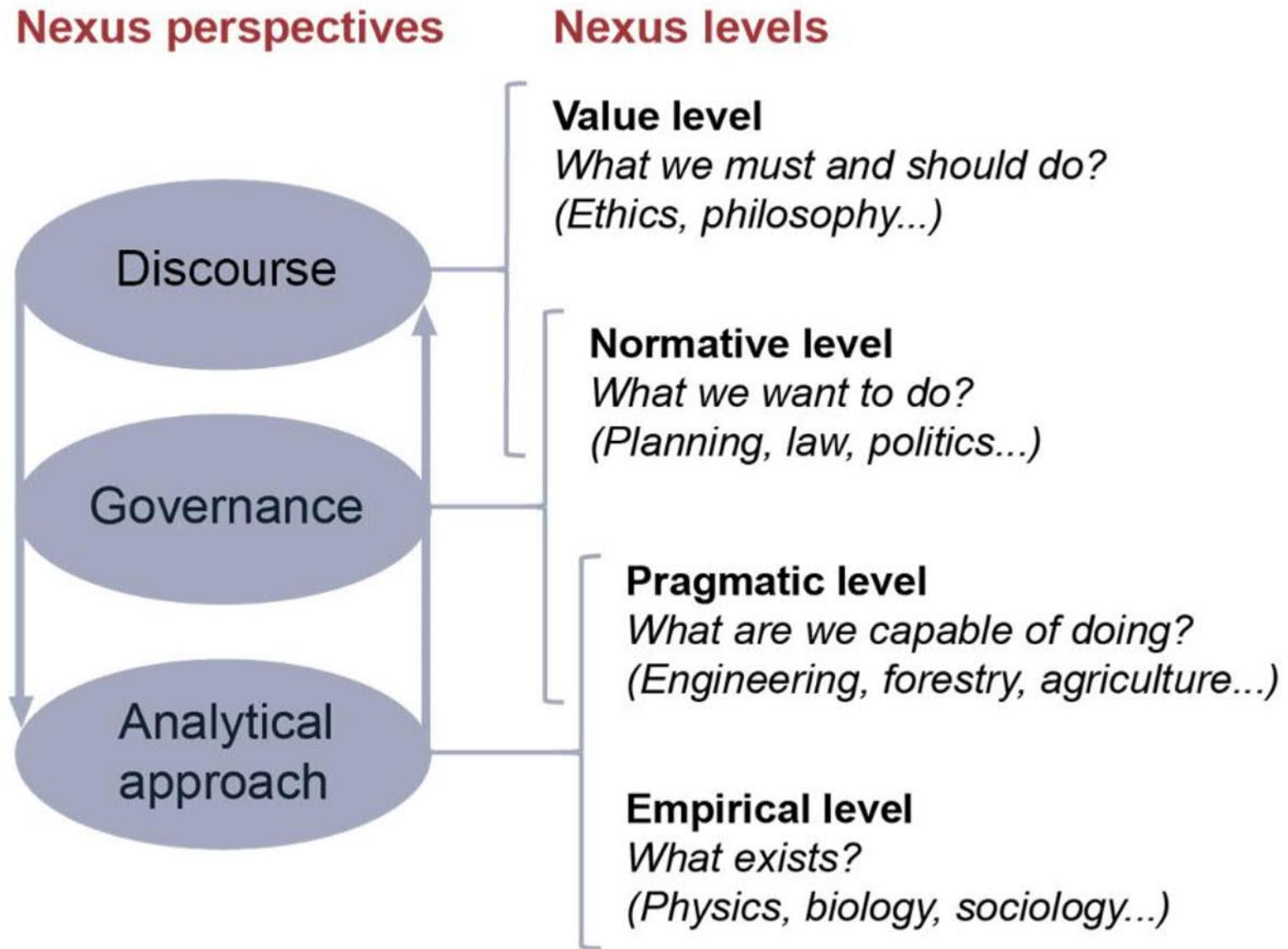
Balancing different resource user goals and interests – while maintaining the integrity of ecosystems

Recognizing the central connections between sectors



Ringler, C., Bhaduri, A., & Lawford, R. (2013). The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency?. *Current Opinion in Environmental Sustainability*, 5(6), 617-624.

**Everyone can find a role in the game!**



# To summarize

**Sustainability is about**

- **Spatial scale and perspective**
- **Time perspective**
- **Actors**
- **Values and worldviews**

**Science creates the knowledge and understanding. It also facilitates finding common goals and values when exploring and implementing solutions. We all have a role.**

# Task 1 learning diary

# Task 1, Learning diary

## Key points:

To reflect on how you comprehend sustainability and its implementation:

- How do you differentiate between science and policies?
- What was new / familiar to you in the given material?
- Was there something you didn't understand – what/why?
- How your learnings connect with your previous studies and experiences

Write at least 450 words (~150 words/guiding question). Do NOT write a summary of the article / teaching session, but use your own words and analyze your learnings.

## Detailed instructions in MyCourses under Task 1

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# Guiding questions

1. How do I comprehend the *need for* and *implementation of* sustainable development based on the given reading material and Friday's teaching session (30<sup>th</sup> Oct)?
2. What did I learn about sustainability as a concept – any new insights, connection to your previous studies?
3. How do I locate my field and myself in the global sustainability framework: what is my field's and my own role in advancing a sustainable society?  
→ Directly linked to the learning outcomes (see Session 1 slides)

# Measuring sustainability, Task 2

# Getting to know your group (10 min)

1. Introduce yourselves to each other:
  - a) Who are you (name, background)?
  - b) Do you already have some key interest areas in your studies?
  - c) What is your motivation for taking the course?
  - d) What is your ambition level in this course and capabilities in terms of group work?
2. Agree on the communication channel(s) you will use in group work
3. Share your contact information
4. Agree on your first meeting date and time
5. Come up with a group name (I'll ask for it after the breakout rooms)

# **Objective of the task 2**

**To familiarize you with sustainability appraisal and some methods used in it.**

**Key learning objectives of the task:**

- To learn how sustainability can be measured and evaluated
- To Understand the limitations and uncertainties of the methods
- To learn finding and communicating the key contents of the material given to you

# Terminology

Sustainability assessment

Sustainability appraisal

Sustainability analysis

Integrated assessment

Sustainability impact assessment

→ All these mean practically the same process

# Generic about sustainability appraisal

- Involves value judgments (weighting), assumptions, scenarios and uncertainties
- Calls for a system-wide analysis → life cycle approach
- Has different levels (micro-macro) and purposes, involves different stakeholders
- Covers various approaches and variable methods

# Variability of sustainability analysis methods

## Qualitative –semi quantitative

- Check lists
- Scoring, tabulation
- Indicators

## Self-Assessment Checklist

**Envision Rating System  
Self-Assessment Checklist**

Category	Response	Percentage
Purpose	Yes	60%
	No	30%
QL 1.1 Improve Community Quality of Life	Yes	47%
	No	53%
QL 1.2 Stimulate Sustainable Growth and Development	Yes	67%
	No	33%
Climate & Risk	Yes	36%
	No	64%

**Quality of Life**

**1. Purpose**

**QL 1.1 Improve Community Quality of Life**

**Intent:** Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities.

**Metric:** Measures taken to assess community needs and improve quality of life while minimizing negative impacts.

**Assessment Questions:**

	Yes	No	N/A	
Are the relevant community needs, goals and issues being addressed in the project?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	?
Are the potentially negative impacts of the project on the host and nearby communities been reduced or eliminated?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	?
Has the project design received broad community endorsement, including community leaders and stakeholder groups?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	?

Total 3 of 3

**QL 1.2 Stimulate Sustainable Growth and Development**

**Intent:** Support and stimulate sustainable growth and development, including improvements in job growth, capacity building, productivity, business attractiveness and livability.

**Metric:** Assessment of the project's impact on the community's sustainable economic growth and development.

**Assessment Questions:**

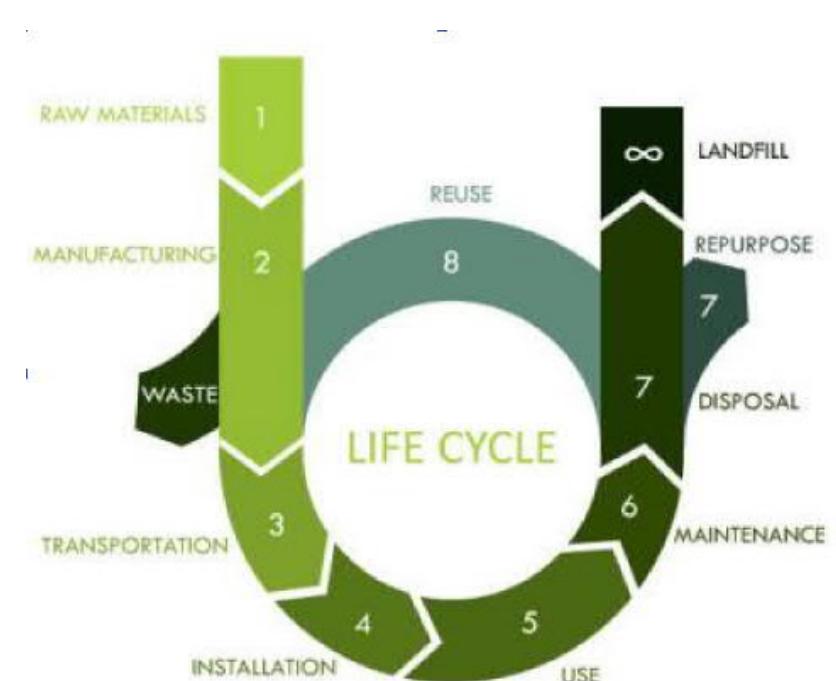
	Yes	No	N/A
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Design 5 / Scorecard / Quality of Life / Leadership / Resource Allocation / Natural World / Climate & Risk / Guidance

# Variability of sustainability analysis methods

## Quantitative

- Life-cycle analysis (LCA) and related methods (e.g. **MFA\***, **MIPS\***)
- Cost/risk – benefit comparisons (**CBA\***, **LCC...**)
- Foot/handprints (e.g. CO<sub>2</sub>, water, ecological)
- Methods based on multi-criteria (decision) analysis\* (**MC(D)A\***)



# Task 2: Articles II

- A. Read the article appointed to your group. Create a teaching session with your group: you will teach the method to the whole class on Fri 6<sup>th</sup> Nov. Use the guiding questions given in MyCourses when preparing. Presentation time is 20 minutes.
  - Submit to Discussion Forum by Fri 6.11. morning at 9.00
  
- B. After Fri 6.11. session, finalise the slides (if needed). Discuss and reflect with your group to comprise your group's joint learnings from all the presented methods. Attach your group reflection as the last slide to your presentation (around 250 words).
  - Submit to Task 2: Articles II, final submission by 10<sup>th</sup> Nov at 23.55.

# Guiding questions for presentation

- Describe the method: What is the primary sustainability appraisal method used/ described in the study and what are its theoretical bases and principles;
- Connection to other methods: Does the paper refer to and/or make comparison with any other methods to assess sustainability;
- Case study description to clarify how the method can be used: What is/are the case study/studies for which the assessment method was applied to;
- Comprehensiveness: How exhaustive the method is regarding the concept of sustainability and the SGD goals: are some elements perhaps missing (which?);
- Uncertainties: What kind of method-related uncertainties there are (if these have been brought forward in the paper);
- Evaluation: Did the paper awake any questions or doubts in you, e.g. related to the applicability of the method?

**Thank you for the first week!**

**Have a nice weekend ☺!**