Teachers Teaching with Technology™

T³ EUROPE

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Education for Sustainable Development

Complementary Material and Hints for the UN SDG no 07

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SDG no 07: Affordable and Clean Energy

Ensure access to affordable, reliable, sustainable and modern energy for all

1. Introduction to the topic

Energy production has a long history (1). With every invention or introduction of a new energy type, the face of the society changed. It started up with the invention of fire (ca. 700'000 years ago), the use of coal (by Chinese 2000 BCE), windmills which came up in the Persian empire more than 1000 years ago, refining petroleum (by Chinese) and the wheel for its use as an accelerator of the grindstones or saw blades. With the invention of the coal-burning steam engine, which allowed to transform heat energy into mechanical work, the Industrial Revolution began.

With the invention of the internal combustion engine, gas and oil were used as energy resources. Henry Ford for example invented the gas-powered tractor. (2). Inventions went on and with the still easier access to energy and with the steadily growing population, the trend to use still more energy kept on-until today.

Still more powerful energy sources were in demand and were found in the capacity of nuclear power. In the 50ties, it became for the first time available as an energy source for producing electricity.

The oil crisis in the 1970s led to a certain rethinking. It was suddenly no longer so self-evident that oil will always be available. On the one hand, this gave a certain boost to nuclear power sites, but on the other hand, voices became louder calling for alternative, renewable energies. In this context I think it is important to remember, that Jimmy Carter, former president of the USA, was asking in 1977 for renewable energy resources for his country. He envisioned having 20 percent of the power for his country coming from solar power generation by the year 2000, and he started by putting solar panels on the White House. (2). In this time, another memorable happening wrote history: the meetings and publications of the „Club of Rome" with for example its first publication of the book „The limits of Growth" (1972) (4) and the book published in 1976 of Mihajlo D. Mesarovic: „Mankind at the Turning Point". (3)

Another interesting fact, from the point of view of today is, that most patents for solar technologies have been already bought up by big oil companies in the late 1970ties.(2)

Once more, this SDG, too should not be addressed in isolation, but should always be studied and taught in a multidisciplinary way. Therefore STEM-teachers are asked to reach out to their colleagues of different fields to work together:

For this SDG no 11, one can connect with colleagues in subjects like:

History	Computer Science	Sociology	Economics
Ethics / Philosophy	Ecology / Biology	Geography	Psychology

(The order of the topics is random and has no implication of a ranking!)

If you click on one of the hyperlinked words, it will lead you to ideas for a multidisciplinary teaching in the text. With such a precious potpourri of fields and competences, you can introduce your students to the very much multifactorial aspects of a sustainable production and use of energy, giving them enough possibilities to rethink their own dependence on energy and tools which transfer energy.

SOURCES

1. INFOGRADES, History of Energy: https://www.infograde s.com/history-events-infographics/history-development-energy-source/ , last accessed: 2021/04/21

2. SCIENCE CLARIFIED, a brief history on power use: http://www.scienceclarified.com/scitech/Energy-Alternatives/The-Development-of-Energy.html , last accessed: 2021/04/21

3. MIHAJLO D. Mesarovic: https://en.wikipedia.org/wiki/Mihajlo_D._Mesarovic , last accessed: 2021/04/21

4. The Limits of Growth. Club of Rome: https://en.wikipedia.org/wiki/The_Limits_to_Growth , last accessed: 2021/04/21

2. How to implement SDG 07 with STEM education?

a. Science

- In today's modern societies, new inventions are appreciated and applauded. Especially in the field of STEM. But every invention has for its own whole life-cycle (from Cradle to Grave a more or less high energy need. Inventions are even created which conflict with today's ethical, ecological, social standards. The dichotomy in natural science, that „what one can think of, should be realized" has led to some great and indispensable inventions, but in many cases to some very hazardous ones, with long lasting effects, too; for example the atom bomb.

- Discuss with a colleague of **Philosophy** (more Philosophy) the following inputs:
  - Should the above-mentioned dichotomy not be questioned and abandoned?
  - What impact would this have on our future?

Acting in a sustainable way and using energy carefully, is about knowledge and conscience. Therefore:

- What is the essence of being?
- What do we really need for a happy life?
- Is consumption *the* way to happiness?
- How long does this happiness last?
- Is happiness, felt after consuming things, may be only possible because many people fail to find their proper meaning of life?
- Is consumption and possession a substitution for complacency?

Try to motivate them to try for a certain period (1-2 week) not to consume anything which was not made using locally available energy and resources (even food). Encourage them to write a diary for this period. After, let them tell the experience they had during this experiment. What did they miss? What did they gain? Could they find out easily, where the energy came from? And if it was renewable or not?

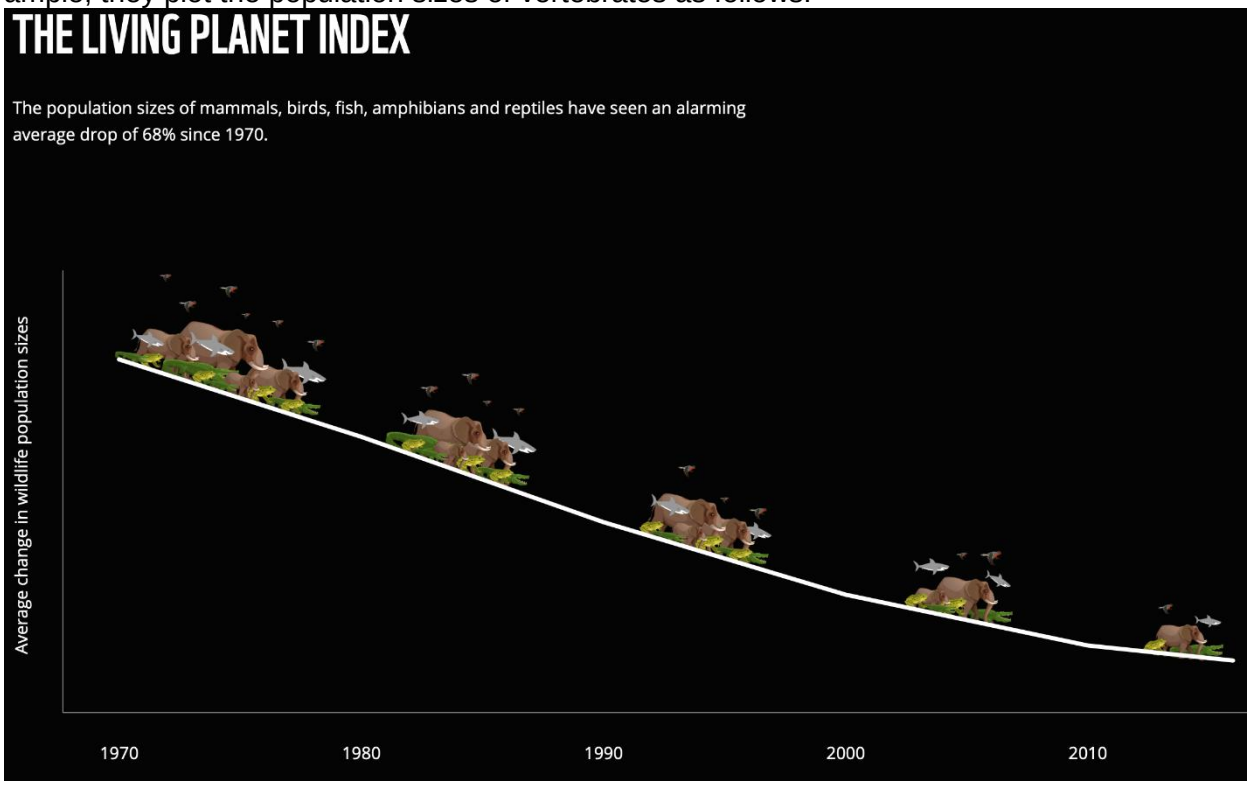
Methodological hint

Maybe they could make a Vlog (individually) to keep track on their experiences and feelings and present it on Social Media…

Together with a **Biologist** you can explore, how energy production is related to steadily shrinking ecosystems and biodiversity.

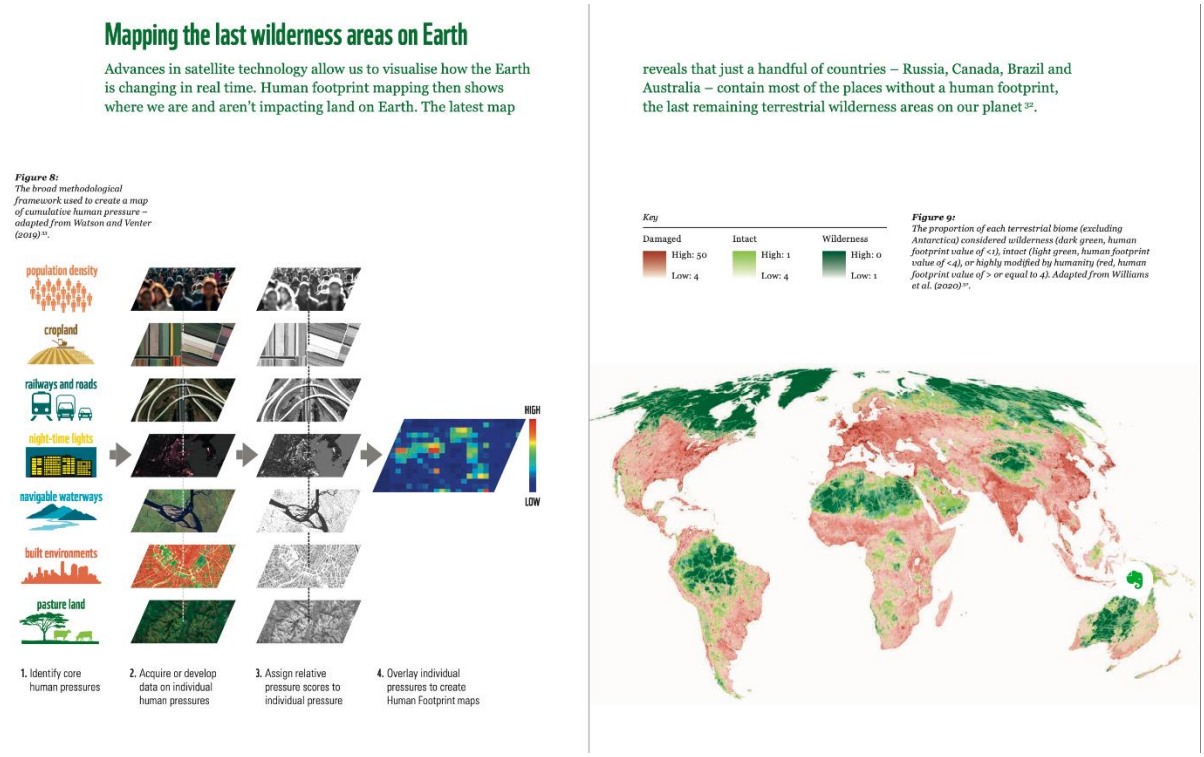
The living planet report 2020 of WWF

The actual situation of our planet is summarized by WWF in its Living planet report. For example, they plot the population sizes of vertebrates as follows:



Graph 1: (5)

- Let the students experience, how this actual situation, described by the two graphs, are related to energy production and use and foremost to their personal use.



The last wilderness areas on Earth: (Graph 2, page 22, 23) (6)

- Let the students find out, how this actual situation, described by these two graphs, is related to energy production and product consumption; especially their personal product consumption. For each consumed product you need to provide energy in different ways; mostly in form of electricity and/or kinetic.

- To gain this energy, you can use renewable energy resources like solar panels or wind turbines. In order to build such objects, you first have to extract all the essential material out of our soils. By doing this, you are losing soil, water quality and biodiversity. (see SDG 12, too)

- Can humans continue with their consumption habits?

Together with a colleague from **History** (more History) and **Psychology** Department:

About 150 years ago, Swiss people owned (in average) about 150 items in their household. Today, we are stuck with more than 10,000 items.

- Discover with your students, how many items they have / own; only in their own room (or shared room) and let them reflect on which objects they need and which they could not live without and why.
- Let them find out, from what material their objects are made and where they were produced.
- Discover the Graph 2 and let them mark the production sites of some their objects. Do they correspond with the red areas on this map?
- Let them describe and paint a world / their country of their dreams they would like to live in. To make their dream-world become a reality, does their behavior/attitude towards consumption fit in with this dream?

b. Technology

- Talking about Technology: how „clean“ energy production can be in terms of environmental threats? Discuss with an **Ecologist** about the pros and cons of wind-energy, big solar-energy farms, water-energy
- Together with a **Philosopher** and **Ecologist**, **Historian**: Why do people believe, that „Industry 4.0“ (7) will solve our problems? Can this be a reality, especially when considering the Material Input of all these objects? (See SDG 12)

Methodological hint

Form small groups. Each group is working on a different perspective to this subject. They have to formulate arguments, statements, points of view. In a second round, you can let them go into a dispute/discussion (maybe with audience). (—> Puzzle Method)

- How does the speed of a processor correlate with its energy need?
- Together with an **Economist**: Explore the energy-demand (8) of the Crypto-Currency trend and its impacts on Energy-production and on the consumers market.

c. Engineering

- Introduce the students to the different technologies of renewable Energy.
- Which one has the least Material Input when it is produced? (See SDG 12)
- Take an example of a renewable Energy-park in your country. Collect the data of how much energy this site is producing. Can you find out how much energy was used to build it? What is the material Input? For how many years must this power plant run to pay back its own energy-costs…
- Together with a colleague from **history**: find out why it happened that by the End of the 70ties, most patents for solar technology were bought by oil companies. What effect did this have on the development of the technology?
- Try to build your own solar energy power supply for your school. (9)

d. Math

- Explore the idea of a 2000-Watt (48 kWh) Society (9) (together with a **Sociologist**) with mathematical calculations on today's energy consumption of individuals and cities.
- Based on your calculations, what activities, what objects are no longer compliant with the idea of a 2000-Watt Society?
- In the SDG 12, the measure MIPS is introduced. Have a look on this concept and try to find out (together with a teacher of the **Computer Science** department) ways, how the Energy Input for a product could be calculated/discovered in an easy way for consumers.

SOURCES:

5. WWF, Living Planet Report 2020: https://livingplanet.panda.org/en-us/ , last accessed 2021/04/21

6. WWF, Living Planet Report 2020, Summary: https://f.hubspotusercontent20.net/hubfs/4783129/LPR/PDFs/ENGLISH-SUMMARY.pdf , (page 22, 23), last accessed 2021/04/21

7. TWI, Industry 4.0: https://www.twi-global.com/what-we-do/research-and-technology/technologies/industry-4-0 , last accessed 2021/04/21

8. TECHCRUNCH, Energy Consumptions on Cryptocurrency: https://techcrunch.com/2021/03/21/the-debate-about-cryptocurrency-and-energy-consumption/ , last accessed 2021/04/21

9. T³ EUROPE RECOURCES: *Solar Tracker Panels* – How to simulate a Sun tracker in order to optimize solar panels orientation (Alexandre Técher): https://resources.t3europe.eu/t3europe-home?resource_id=3142,

3. Connecting this SDG with other SDGs

Methodological hint

Encourage your students, to present the different links and dependencies in a *Concept Map*. This is a powerful tool, not only to show how things are linked together, but it shows you, if the student can make the links and name the dependencies.

Some ideas:

- SDG 01: Poverty —> Big cities can be the source of poverty or poor people migrate to big cities in the hope of being able to escape poverty
- SDG 03: Health —> Is it accessible for everybody?
- SDG 04: Adequate education —> Often a main reason for migration into cities: Are such promises true?
- SDG 06: In many cities, fresh water supply is a big issue
- SDG 07: Access to clean and affordable energy: is it possible?
- SDG 08: How can work and sustainable growth be guaranteed in big cities / mega cities?
- SDG 09: Infrastructure versus parks and green open space? How to find a balance?
- SDG 10: Are inequalities abundant in cities?
- SDG 12: Responsible consumption —> How can this supervised in a city?
- SDG 13: Many people want to engage in action for climate change.
- SDG 15: Land grabbing for enlarging the cities- violating our soil we are dependent on for constructing more buildings and infrastructure
- SDG 16: cities should contribute with institutions and organizations to this aim —> creating employment for all.

Trying to reduce the negative impact of humans on our planet with the help of the 17 SDG's, can be a really good idea to make positive impacts. There is a stumbling block to overcome: If enterprises, governments and individuals in their pursuit of following the SDG's are just focusing on one single or may be two SDG's, there will be a huge rebound effect with other goals. So, the crucial point really is, to have always all SDG's in mind, if a new project or idea is launched.

*How the **SDG 11** is affected, if one is only focusing on one of the following goals*:

- **SDG 01, 02:** The bigger the cities, the more people suffering from poverty and hunger, living in slums
- **SDG 06**: The bigger the cities, the more water consumption, waste and pollution will happen
- **SDG 07**: Any energy-producing unit has its own MIPS. It's not only about affordable and clean energy. It's about that we reflect our energy-consumption and that one keeps in mind, that any energy provision (renewable or not) has its own energy and CO_2 footprint; has its own MIPS.
- **SDG 08**: Many workplaces - and economic growth as a whole cannot be sustainable
- **SDG 09**: The more buildings, the more infrastructure, the bigger the MIPS
- **SDG 12**: Especially in cities people are mostly motivated to consume! Most kinds of consumption are not sustainable
- **SDG 15**: Cities are violating our land, pushing away the animals from their habitat and destroying a lot of native plants.

SOURCES:

7. Waterworld, Las Vegas, https://www.waterworld.com/drinking-water/distribution/article/14068676/las-vegas-isnt-gambling-with-water-supply, last accessed 2021/04/11

8. Vertical forests, https://urbannext.net/vertical-forest/ , last accessed 2021/04/08

9. Water Crisis in Las Vegas, https://www.geography.org.uk/write/mediauploads/download/ga_resources%20las%20vegas%20water%20crisis%20-%20pics,%20data,%20links%20-%20ga.pdf , last accessed 2021/04/08

10. 2000 Watt-Society, https://www.2000watt.swiss/english.html, last accessed 2021/04/08

11. T³-Europe_Resources: *Solar Tracker Panels* – How to simulate a Sun tracker in order to optimize solar panels orientation (Alexandre Técher).https://resources.t3europe.eu/t3europe-home?resource_id=3142