SUSTAINICUM COLLECTION
LEHRMATERIALIEN FÜR BILDUNG ZUR NACHHALTIGKEIT

Ecological Footprint for Electricity and Heat

(Resource ID: 112)

Prof. Michael Narodoslawsky
Michael Eder
michael.eder(at)tugraz.at
This teaching resource is allocated to following University:
TUG - Graz University of Technology

http://www.sustainicum.at/en/modules/view/112.Ecological-Footprint-for-Electricity-and-Heat

---

Individual work
Work in pairs
Group work

Independent of the number of students

Up to 3 lecture units

Internet connection necessary

English, German

The web-based calculator for electricity and heat allows teachers to demonstrate the ecological impact of different types of electricity and heat and what it means to reduce the amount of energy. Due to the direct comparison of the current energy supply at home and possible alternatives the huge scope of action towards ecological sustainability becomes clear. The results show the ecological footprint (calculated with the Sustainable Process Index - SPI®) as well as the carbon footprint.

The idea of the ecological footprint is to provide an easily understandable measure for the pressure human activities exert on nature. Simply put, the more resources an activity requires as input and the more emissions it generates (which may diminish the ability of the natural compartments soil, water and air to provide services due to degradation and loss of

biodiversity), the greater the ecological footprint of the activity becomes.

This leads directly to the concept of a "natural budget" that is at the disposal for each person to cover his/her life style. If a person creates for all his/her activities, services and products an ecological footprint larger than the area statistically available for one person, the life style pursued is not sustainable.

The SPI is one method to calculate ecological footprints that takes emissions to air, water and soil besides resource provision into account. The method compares anthropogenic and natural flows according to the following sustainability criteria:

Principle 1: Anthropogenic mass flows must not alter global material cycles;

Principle 2: Anthropogenic mass flows must not alter the quality of local environmental compartments.

The SPI is a tool based on these criteria and is compatible to the modus operandi described in the ISO 14000 standard for life cycle assessment. It calculates ecological pressures for all technologies from the generation of their resources to the emission the whole life cycle generates until providing the product or service in question. It aggregates different ecological pressures to one number; this single number is the area necessary to embed a process or service sustainable into the ecosphere, in accordance with the tenets of the concept of "strong sustainability" that requires sustainable development to be based on the natural income rather than allowing for unrestricted substitution of different kinds of natural and human capital. As the natural income of our planet is mainly the energy radiated from the sun to the surface of our world, human (and natural!) processes will compete for "surface" as the basic resource to utilise this natural income. This is the normative background of all Ecological Footprint calculations and also of the SPI.

This leads directly to the concept of a "natural budget" that is at the disposal for each person to cover his/her life style. If a person creates for all his/her activities, services and products an ecological footprint larger than the area statistically available for one person, the life style pursued is not sustainable.

In addition to that the SPI also takes the quality of life supporting ecological compartments (soil atmosphere and water) into account as degradation in their quality will diminish the ability to utilise our natural income. It therefore focuses on aspects of environmental sustainability

based on material and energy fluxes that processes exchange with their environments. The corresponding data for natural systems are the sedimentation rate of carbon in oceans, the natural concentrations of substances in soil and water, the exchange rates per area unit of airborne pollutants between forests and air as well as the replenishment rates for soil and water.

In addition to that the SPI also takes the quality of life supporting ecological compartments (soil atmosphere and water) into account as degradation in their quality will diminish the ability to utilise our natural income. It therefore focuses on aspects of environmental sustainability based on material and energy fluxes that processes exchange with their environments. The corresponding data for natural systems are the sedimentation rate of carbon in oceans, the natural concentrations of substances in soil and water, the exchange rates per area unit of airborne pollutants between forests and air as well as the replenishment rates for soil and water.

Using the results for fossil resource consumption calculated by the SPI evaluation the software will calculate the Carbon Footprint as an auxiliary measure to discuss the specific climate change impact of the touristic activities in question. By using the same data base for the SPI and the Carbon Footprint the software guarantees compatibility of both evaluations. The calculation uses the partial area for fossil carbon as a reference. This area refers to the sedimentation to the ocean bed, the major process that replenishes the long term storage of carbon (from which fossil resources are drawn) within the global carbon cycle. The current imbalance between the (natural) flow to the long term carbon storage and the (anthropogenic) flow of carbon dioxide from burning fossil resources is at the heart of global climate change.

In the calculator the natural sedimentation flow is set to 73 kg CO_2 equivalent per hectare and year. A car that runs 10,000 km per year and emits 2,800 kg CO_2 (considering the whole life cycle and also the road infrastructure for example) has an ecological footprint of 38 ha (equal to 35 soccer fields). The statistical area that an Austrian person may use as ecological footprint is 6.6 ha (including the aliquot sea area) for comparison.

The calculator considers data for heat and electricity. For the user it is possible to define the current situation and to compare it with an alternative one. For electricity the user can put in the exact data coming from his or her provider in terms of the distribution of the different energy

carriers. Electricity can come from renewable, fossil or nuclear sources. The share of these components varies from country to country and from provider to provider. One kilowatt-hour (kWh) of the average Austrian electricity mix is 131,8 m^2 and is much lower than the average EU27-mix with 284,2 m^2. A provider with a high portion of renewable sources can be even much lower than the average Austrian electricity mix.

In the section for heat space heating and hot water is considered. Similar to electricity there are big differences between the different energy carriers that provide the heat. Fossil ones have a significant higher ecological footprint than renewable ones.

The results show the ecological footprint as well as the CO_2-emissions for the two sections heat and electricity and the comparison of the current and the alternative energy supply.

Teaching Tools & Methods

Computer program

Learning Outcomes

The objective of the calculator is to provide students with insight to the ecological impact incurred by the amount and the type of energy consumed at home. It allows to question one`s life style with regard to energy consumption by comparing the current energy supply with an alternative supply. So it provides orientation on how life styles may be changed in order to achieve sustainability.

Relevance for Sustainability

From a sustainability and climate protection point of view the question how electricity and heat is produced (fossil or renewable) is very sensitive. The calculation of the ecological pressure of the different types of energy is crucial for the understanding of sustainable development and is therefore suitable for many fields of education.

Related Teaching Resources

No specific previous knowledge / related resources required

Preparation Efforts

Low

Access

Free

Sources and Links

http://www.fussabdrucksrechner.at/en/calculation/energymix

Funded by

Funded by the Austrian Federal Ministry of Science and Research within the framework of the call "Projekt MINT-Massenfächer" (2011/12)