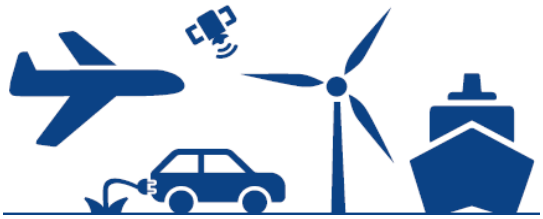
WS 1 Fact check passenger and goods transport

Not only raw materials, components, clothing or food are transported around the world, animals and people are also mobile. The prerequisite for global trade is a well-developed and efficient transport infrastructure. It is an important factor in the consideration of life cycle analyses. Time and freight volumes determine the energy requirements and emissions and thus the costs of transporting goods and people.



Transport systems are part of the transport infrastructure of a country. A distinction is made between public transport and individual transport:

- public transport of goods include maritime transport, inland waterways (inland waterways), railways (local and long-distance railways), air freight
- public passenger transport with public transport and long-distance passenger transport, air traffic (airports), road traffic (roads), shipping traffic (waterways), navigation radio transmitters for air and sea vehicles
- Individual transport with traffic routes, footpaths, cycle paths, etc.

In order to be able to determine the **environmental impact of infrastructure, the** requirements for the construction, operation, service life and dismantling of, for example, railway tracks, bridges, tunnels, locks, port facilities and stations must be compiled. This also includes the land, water and energy requirements and the emissions released in the process. The expenses for road lighting and marking as well as the burdens for weed control and maintenance of green strips or snow clearing and road salt requirements are also taken into account!

In order to be able to determine the **environmental impact of the means of transport** itself, data must also be collected. They include all requirements and emissions for the production, operation, wear and tear, utilisation and ultimately disposal of the truck or aircraft.

These complex data collections are the basis for the standardisation of so-called **primary energy factors (PEF).** PEFs are indicators for describing energy efficiency. In addition to the actual <use energy requirement of a synthesis or a process, they also include the amounts of energy required in upstream process steps.

Reference values:
Passenger transport: 1 pkm (passenger-kilometre) and 1 fkm (vehicle-kilometre)
Freight transport: 1 tkm (tonne-kilometre) and 1 fkm (vehicle-kilometre)

The simplifications make it possible - depending on the type of vehicle and its payload, the length of the transport route, the type of fuel used and its source - to make comparisons, for example, between regional and international delivery routes or different means of transport.

- Sources: https://ecoinvent.org/ I https://nexus.openlca.org/search/query=transport I https://simapro.com/
- Statista https://de.statista.com/statistik/studie/id/6329/dokument/transport-und-logistikbranche-deutschland-statista-dossier/
- Frischknecht R., Stucki M., Flury K., Itten R. and Tuchschmid M. (2012) Primary energy factors of energy systems, version 2.2, July 2012. commissioned by the Swiss Federal Office of Energy BfE, ESU-services Ltd, Uster, CH.

WS 2 Primary energy factors and environmental impacts of PERSON transport services [per tkm].

The table lists energy consumption and environmental impacts associated with the operation of a vehicle, the required transport infrastructure (construction, maintenance, dismantling) and the vehicle itself (manufacture, maintenance and disposal).

Primary energy factors take into account the energy loss that occurs during the production, conversion and distribution of an energy source (fossil, nuclear, renewable) in megajoule equivalents. They therefore show how much energy comes from which source in order, for example, to drive a school class one kilometre with a bus.

The **environmental impact is** given in [kg CO_2 equivalents], and the share from fossil sources is shown separately. The environmental impact points indicate the extent to which a type of transport has a negative impact on the environment. The smaller the value here, the more sustainable the form of transport.

PRIMARY ENERGy EFFECTS AND ENvIRONMENTAL IMPACTS FOR PERSONAL TRANSPORTATION		Aircraft	Passenger Train ICE	Passenger Train regional	METRO streetcar	Bus	CAR fossile	CAR electric	CAR Biogas	Scooter
Reference value	kilometer per personen [pkm]									
Primary Energy Factor total	[MJ-eq]	**2.23**	**1.04**	**1.29**	**1.21**	**1.66**	**3.31**	**2.66**	**1.72**	**1.56**
fossile		2.11	0.71	0.11	0.27	1.54	2.85	0.89	0.87	1.5
nuclear		0.09	0.27	0.69	0.77	0.1	0.37	1.43	0.68	0.04
total renewable		0.03	0.06	0.49	0.17	0.02	0.09	0.34	0.17	0.02
from waste/waste heat		0	0	0	0		0	0	1.9	0
CO_2-equivalents	[kg CO_2-eq]	0.14	0.06	0.01	0.02	0.1	0.19	0.05	0.09	0.12
CO_2 fossile	kg	0.14	0.05	0	0.02	0.09	0.18	0.05	0.05	0.09
UBP (Environmental impact points)	UBP 06	157	63.5	52	55.5	147	216	163	154	271
avarage workload	[t]	280	309	46	53	17	1.6	1.6	1.6	1.1

The figures for air freight apply to freight-only aircraft without passenger transport.

TASKS:

Compare the data in the table using the following questions:

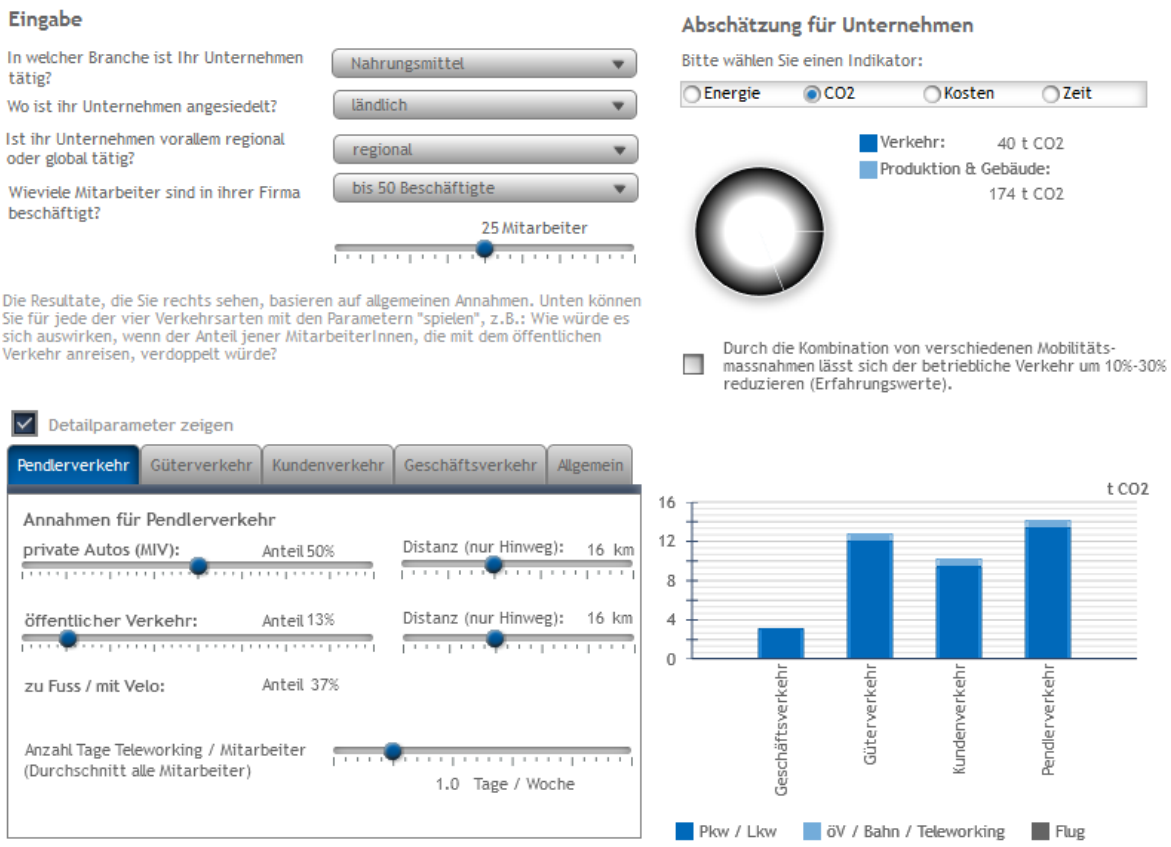
1. Which means of transport can carry the largest number of people?
2. Discuss the pros and cons of airplane and long distance train for a trip from Berlin to Stuttgart.
3. How does the ICE perform? Go back to the raw data in the Excel file.
4. Discuss the possibilities of public transport in terms of range, infrastructural requirements and capacity utilisation. Calculate the primary energy factors and the resulting environmental impact.
5. Compare the primary energy factors and the resulting environmental impact for PWK with fossil and electric drive.
6. Looking for a solution: Commuter needs 1.5 hours to get from home to work by public transport in the city - how could it be faster?

- Sources: https://ecoinvent.org/ I https://nexus.openlca.org/search/query=transport I https://simapro.com/
- Statista https://de.statista.com/statistik/studie/id/6329/dokument/transport-und-logistikbranche-deutschland-statista-dossier/
- Frischknecht R., Stucki M., Flury K., Itten R. and Tuchschmid M. (2012) Primary energy factors of energy systems, version 2.2, July 2012. commissioned by the Swiss Federal Office of Energy BfE, ESU-services Ltd, Uster, CH.

WS 3 Become an entrepreneur yourself!

Flexible working, mobility concepts for commuters have CO_2 saving potential. The MOBICHECK - an online tool for companies - can be used to simulate various business scenarios and their effects on the environmental impact caused by passenger and freight transport.

Follow the link https://www.mobitool.ch/de/tools/mobicheck-v2-0-24.html of the Swiss ESU Institute.



TASKS:

Play through different scenarios and pay attention to the relevant parameters for sustainable mobility planning: energy, CO_2 , costs and time. Use the world map and determine the routes and distances with Google Maps. Enter the key figures in the table and discuss the results:

Company Agglomeration means conurbation	**Energy**	**CO_2**	**Costs**	**Time**
	MWh	**t**	**in CHF**	**h**
Bakery, rural, regional, 25 employees				
Pizzeria, city, regional, 10 employees				
Pharmaceutical company, agglomeration, global, 300 employees				