Energy comparison of means of transportation – information for teachers

1   Basic physics principles

1.1   Students' prior knowledge

The students should be able to work with the unit [kWh] and be familiar with the term CO_2 emissions.

2   Ideas for teaching

2.1   Learning objectives

The students will:
- learn to estimate the energy requirement for various means of transportation.
- know the differences in the ecological balance between various means of transportation (take into account the CO_2 emissions per seat kilometer).
- research and evaluate relevant information on specified questions.

2.2   Possible sequence

An open discussion about various means of transportation is suitable as an introduction. The means of transportation that students use, for example, to get to school, to go shopping, or to go on vacation, can also be discussed.
Each student should independently think about the estimated values. For the research, the students can work in pairs (in the school's computer lab) or individually (at home).
After the students work through the worksheet, reflection and another discussion are useful.

Some values are given below as a starting point for a possible solution:

Means of transportation	Maximum speed [km/h]	CO_2 emissions per kilometer [g]	Number of seats	Energy per kilometer [Wh]
Car	120	300	5	1,020
High-speed train*	320	13,500	460	25,000
Tour bus	80	1,080	60	3,660
Airplane (short haul)	800	24,700	130	39,780

* Source: Siemens Fact Sheet "Velaro D – New ICE 3 (Series 407)"

2.3   Motivation

The students travel every day using various means of transportation. This topic therefore has clear relevance to everyday life. The opportunity to find out for themselves how well the different means of transportation score can be interesting for the students. In particular, the critical comparison with their own estimated values solidifies the concept of the actual energy balance of these means of transportation.

2.4 Possibilities for variation

With the help of the values given for the high-speed train, each student in the class should be able to come up with estimated values for the other data. In classes with weaker students, working in pairs or in groups is useful for this task. If the entire class is somewhat weak, the data can be estimated as a group.
The research is primarily suited for homework. Additional incentive can be created for the students by having them add other means of transportation, such as a bicycle or motor scooter, to the table.