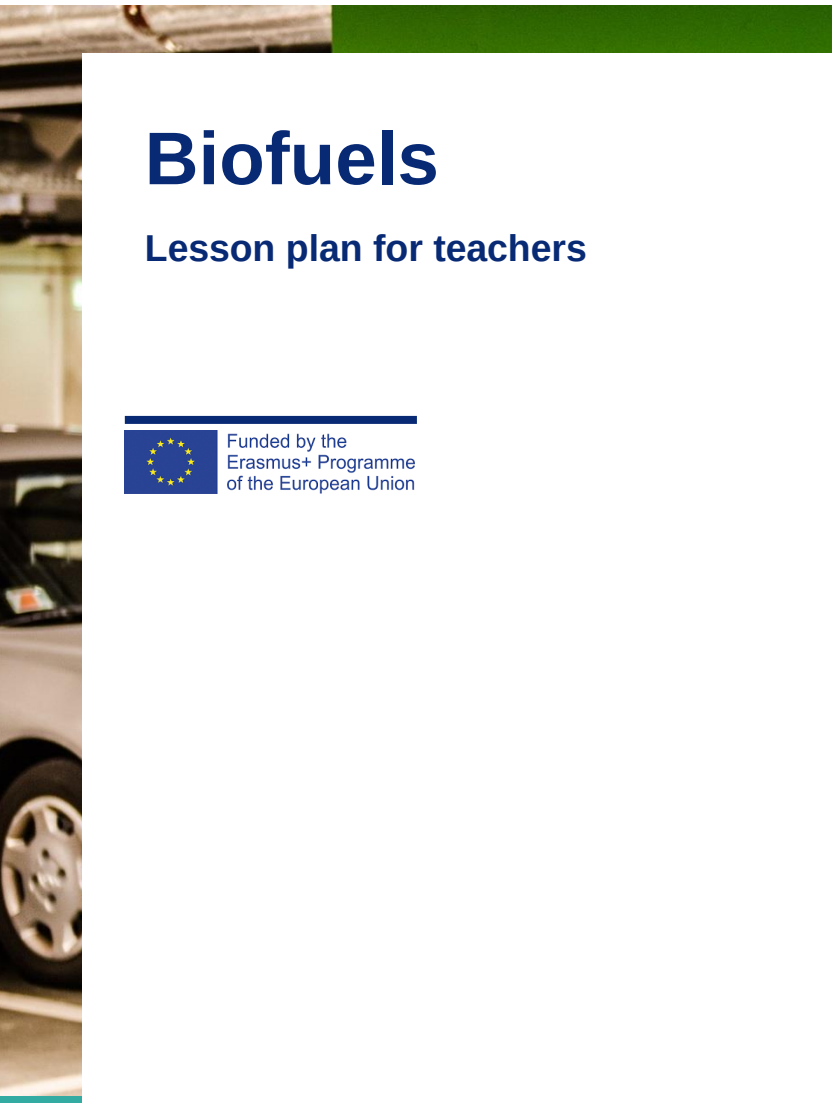

Biofuels

Lesson plan for teachers

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STEP AHEAD II

The support of Professional development of VET teachers and trainers in following of New trends in Automotive Industry
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Biofuels

The aim of the lesson:
Let students recognize the basic differences between fossil fuels and biofuels and their impact on the environment.

Activity No. 1 Part of the lesson: **EVOCATION**

The aim of the activity: Recognizing the plusses and minuses of fossil fuels and biofuels

Step 1	Brief description of the activity	Let students work in pairs. Let each pair together write down everything they know about biofuels and the difference from the fossil fuels. Writing time is 3 minutes. They should use full time for writing, without going into deep discussions about the topic now and without interruptions. Let them just write. You use free typing method. Example of information that students can come up with: Fossil fuels like diesel and petrol are the products of natural oil which are refined for a product of chemical consumption, efficient for combustion engines. Fossil fuels are diesel, petrol, natural gas. Biofuels have been around for longer than cars, but cheap gasoline and diesel have kept them on the fringe for long. Reason why we are looking for new kind of fuels for cars are climate change, increase of the price for fossil fuels, less fossil fuels, pollutions and emissions from fossil fuels. *Examples:* CNG, LPG, H2O
	Instruction (what you need to tell the students)	Work in pairs. Each pair together please write down everything you know about biofuels and the difference from the fossil fuels. Writing time is 3 minutes. Please use the full time for writing, without going into deep discussions about the topic now. Just write anything you can think about… After you are finished, each pair will present what you wrote.

<table>
<tr><td rowspan="2">Step 2</td><td>Brief description of the activity</td><td>Short summary of what students know and come up with in Step 1. Continuing with using a T – graph for sorting the fossil fuels and biofuels plusses and minuses into a simple chart. For each pair of students, please use Annex 1/or ask students to draw a table in their exercise books.

<table><tr><td>fossil fuels +</td><td>fossil fuels -</td><td>biofuels +</td><td>biofuels -</td></tr><tr><td></td><td></td><td></td><td></td></tr></table>

Example of plusses and minuses of the Fossil fuels and biofuels that students may come up with:
Fossil fuels pluses: good network for transportation and productions and filing the tank for automobiles
Minuses of fossil fuels: production of CO2, decreasing natural oils at world level resources. Currently we need fossil fuels for next generation of big factories for having an energy, because we do not have other alternative energy for them nowadays yet with cleaner alternatives. What do you think, how many photovoltaic panels would you need for getting the energy for your school building? Using products produced from natural oil as diesel and petrol at cars are not effective and not sustainable. We are decreasing the world resources of oil supplies for next generations.

Pluses of biofuels: Decreased production of carbon dioxide, growing the plants used for biodiesel production are transforming CO2 to oxygen and thus supporting cleaner environment.
Minuses: Biodiesel is produced from fats such as vegetable oil, animal fat, and recycled cooking grease so at the fields if we plant and harvest for biofuels and not for food, and as the population increases, and there are millions of people without food already now, there might be a problem with not enough food supplies and soil supplies to grow the food on in the future.</td></tr>
<tr><td>Instruction (what you need</td><td>After we summarized what you wrote, please, in pair again, sort the fossil fuels and biofuels plusses and minuses into a simple chart:

<table><tr><td>fossil fuels +</td><td>fossil fuels -</td><td>biofuels +</td><td>biofuels -</td></tr></table></td></tr>
</table>

	to tell the students)	<table><tr><td></td><td></td><td></td><td></td></tr></table> Also, please try to match following fuels into the correct category. Do they belong to fossil fuels or biofuels? Diesel, LPG, CNG, H2O, petrol
Tools for the activity (everything you need to take to the classroom)		Pen and paper, blackboard/flip, T - graph sorting table for each pair of students/Annex 1
Estimated time (max. 40 min.)		15 min
Notes		

Activity No. 2 Part of the lesson: **APPRECIATION**

The aim of the activity: Deepening the knowledge on the topic of biofuels

Step 1	Brief description of the activity	Working with 3 different texts on biofuels in 3 different groups. Each group receives one text/Annex 2. Understanding the text, explanation of the meaning of the text and basic terminology to other students. / Teaching the others.
	Instruction (what you need to tell the students)	Split in 3 groups. Each group receives a text. Your task in the group is to study the basic terminology and present it/explain to the other groups. To present, you can use mind map or create a poster.

Step 2	Brief description of the activity	After finishing, please let students prepare the explanation on what they read, to other students.
	Instruction (what you need to tell the students)	When you finished your work in the groups, please explain what you learnt and teach your fellow students about it. If there is anything unclear, we´ll together find the answers and try to clarify.
Tools for the activity (everything you need to take to the classroom)		Annex 2 texts photocopied for the groups
Estimated time (max. 40 min.)		20 min
Notes		https://www.nationalgeographic.com/environment/global-warming/biofuel/

Activity No. 3 Part of the lesson: **REFLECTION**

The aim of the activity: Reflection on the information gained in the previous parts of the lesson and practical use of it

Step 1	Brief description of the activity	Reflection on the new information gained in the previous steps. Practical use of this information through explanation of basic principles of operating process of the vehicle using biofuels and fossil fuels to the neighbour student. Work in pair.
	Instruction (what you need to tell the students)	Imagine you are a head technician in a workshop. Your task is to explain to your fellows the basic principle of operating process of the vehicle using biofuels and fossil fuels. Draw the basic structure of the 3 types of the differences.

Step 2	Brief description of the activity	Lift pitch. Let students continue working in pairs. One student in the pair is a family friend. The other wants to persuade him/her in 30 seconds to buy a car using biofuels, explaining all the benefits. Preparation of arguments is limited to 1 minute. After a while the roles in the pair change. Some pairs can present their arguments in front of the class.
	Instruction (what you need to tell the students)	Work in pairs. One of you is a biofuel vehicles expert, the other is a family friend who wants to buy a new biofuel car. Prepare the arguments supporting the purchase of biofuel car. Preparation time is 1 minute, presentation time/argumentation is 30 seconds. After a while change your roles in the pair. Volunteers can present their argumentation in front of the class.
Tools for the activity (everything you need to take to the classroom)		
Estimated time (max. 40 min.)	5 min	
Notes	Other sources: https://www.britannica.com/technology/biofuel https://www.energy.gov/eere/bioenergy/biofuels-basics https://www.studentenergy.org/topics/biofuels https://biofuels-news.com/news/swedish-waste-power-plant-switches-from-fossil-oil-to-biofuel/	

ANNEX 1

fossil fuels +	fossil fuels -	biofuels +	biofuels -

ANNEX 2

Source:
https://www.nationalgeographic.com/environment/global-warming/biofuel/
Promising but sometimes controversial, alternative fuels offer a path away from their fossil-based counterparts.

BY CHRISTINA NUNEZ

Group 1

Biofuels, explained

Biofuels have been around longer than cars have, but cheap gasoline and diesel have long kept them on the fringe. Spikes in oil prices, and now global efforts to stave off the worst effects of climate change, have lent new urgency to the search for clean, renewable fuels. Our road travel, flights, and shipping account for nearly a quarter of the world's greenhouse gas emissions, and transportation today remains heavily dependent on fossil fuels. The idea behind biofuel is to replace traditional fuels with those made from plant material or other feedstocks that are renewable.
But the concept of using farmland to produce fuel instead of food comes with its own challenges, and solutions that rely on waste or other feedstocks haven't yet been able to compete on price and scale with conventional fuels. Global biofuel output needs to triple by 2030 in order to meet the International Energy Agency's targets for sustainable growth.

Biofuel types and uses

There are various ways of making biofuels, but they generally use chemical reactions, fermentation, and heat to break down the starches, sugars, and other molecules in plants. The resulting products are then refined to produce a fuel that cars or other vehicles can use.
Much of the gasoline in the United States contains one of the most common biofuels: ethanol. Made by fermenting the sugars from plants such as corn or sugarcane, ethanol contains oxygen that helps a car's engine burn fuel more efficiently, reducing air pollution. In the U.S., where most ethanol is derived from corn, fuel is typically 90 percent gasoline and 10 percent ethanol. In Brazil—the second-largest ethanol producer behind the U.S.—fuel contains up to 27 percent ethanol, with sugarcane as the main feedstock.
Alternatives to diesel fuel include biodiesel and renewable diesel. Biodiesel, derived from fats such as vegetable oil, animal fat, and recycled cooking grease, can be blended with petroleum-based diesel. Some buses, trucks, and military vehicles in the U.S. run on fuel blends with up to 20 percent biodiesel, but pure biodiesel can be compromised by cold weather and may cause problems in older vehicles. Renewable diesel, a chemically

different product that can be derived from fats or plant-based waste, is considered a "drop-in" fuel that does not need to be blended with conventional diesel. Other types of plant-based fuel have been created for aviation and shipping. More than 150,000 flights have used biofuel, but the amount of aviation biofuel produced in 2018 accounted for less than 0.1 percent of total consumption. In shipping, too, adoption of biofuel is at levels far below the 2030 targets set by the International Energy Agency. Renewable natural gas, or biomethane, is another fuel that potentially could be used not only for t transportation but also heat and electricity generation. Gas can be captured from landfills, livestock operations, wastewater, or other sources. This captured biogas then must be refined further to remove water, carbon dioxide, and other elements so that it meets the standard needed to fuel natural-gas-powered vehicles.

Group 2

What is biofuel?

Biofuels are fuels produced from renewable organic materials. These fuels can be used for a range of reasons but in recent years they have played a growing role in transportation — including providing an alternative fuel for cars. There are two main types of biofuel used in cars: bioethanol and biodiesel. Bioethanol is an alcohol made from corn and sugarcane, whereas biodiesel is made using vegetable oils and animal fats. Both offer alternatives to non-renewable crude-oil derived fuels like petrol and diesel.

Is biofuel good for the environment?

Biofuels are seen as a good medium-term solution to traditional fuels as we move towards a world where electric vehicles are the norm. They are made from more sustainable energy sources than either petrol or diesel.
Bioethanol is classed as carbon-neutral, as any carbon dioxide released during production is removed from the atmosphere by the crops themselves. Biodiesel recycles otherwise unusable waste products, such as animal fats and cooking oil.
When used, biofuels produce significantly fewer pollutant emissions and toxins than fossil fuels. Bioenergy Australia estimates that biodiesel could cut emissions by over 85% compared to diesel, while bioethanol could reduce emissions by around 50%.
However, it is important to note that the scale of these environmental benefits is dependent on how the specific biofuels are actually produced and used.

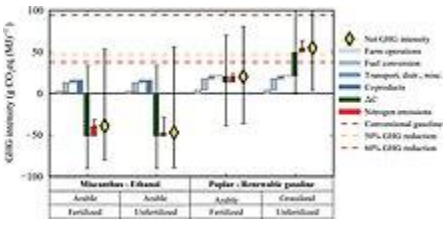
Group 3

A biofuel is a fuel that is produced through contemporary processes from biomass, rather than a fuel produced by the very slow geological processes involved in the formation of fossil fuels, such as oil. Since biomass technically can be used as a fuel directly

(e.g. wood logs), some people use the terms biomass and biofuel interchangeably. More often than not however, the word biomass simply denotes the biological raw material the fuel is made of, or some form of thermally/chemically altered solid end product, like torrefied pellets or briquettes. The word biofuel is usually reserved for liquid or gaseous fuels, used for transportation.
The EIA (U.S. Energy Information Administration) follow this naming practice.[1]
If the biomass used in the production of biofuel can regrow quickly, the fuel is generally considered to be a form of renewable energy.

Biofuel logo

Biofuels can be produced from plants (i.e. energy crops), or from agricultural, commercial, domestic, and/or industrial wastes (if the waste has a biological origin). [2] Renewable biofuels generally involve contemporary carbon fixation, such as those that occur in plants or microalgae through the process of photosynthesis.
Some argue that biofuel can be carbon-neutral because all biomass crops sequester carbon to a certain extent – basically all crops move CO2 from above-ground circulation to below-ground storage in the roots and the surrounding soil. For instance, McCalmont et al. found below-ground carbon accumulation ranging from 0.42 to 3.8 tonnes per hectare per year for soils below Miscanthus x giganteus energy crops,[3] with a mean accumulation rate of 1.84 tonne (0.74 tonnes per acre per year), [4] or 20% of total harvested carbon per year. [5]



GHG / CO2 / carbon negativity for Miscanthus x giganteus production pathways. Relationship between above-ground yield (diagonal lines), soil organic carbon (X axis), and soil's potential for successful/unsuccessful carbon sequestration (Y axis). Basically, the higher the yield, the more land is usable as a GHG mitigation tool (including

relatively carbon rich land.) However, the simple proposal that biofuel is carbon-neutral almost by definition has been superseded by the more nuanced proposal that for a particular biofuel project to be carbon neutral, the total carbon sequestered by the energy crop's root system must compensate for all the above-ground emissions (related to this particular biofuel project). This includes any emissions caused by direct or indirect land use change. Many first generation biofuel projects are not carbon neutral given these demands. Some have even higher total GHG emissions than some fossil based alternatives.[6][7][8]

Some are carbon neutral or even negative, though, especially perennial crops. The amount of carbon sequestrated and the amount of GHG (greenhouse gases) emitted will determine if the total GHG life cycle cost of a biofuel project is positive, neutral or negative. A carbon negative life cycle is possible if the total below-ground carbon accumulation more than compensates for the total life-cycle GHG emissions above ground. In other words, to achieve carbon neutrality yields should be high and emissions should be low.

High-yielding energy crops are thus prime candidates for carbon neutrality. The graphic on the right displays two CO2 negative Miscanthus x giganteus production pathways, represented in gram CO2-equivalents per megajoule. The yellow diamonds represent mean values. [9]

Further, successful sequestration is dependent on planting sites, as the best soils for sequestration are those that are currently low in carbon. The varied results displayed in the graph highlights this fact. [10] For the UK, successful sequestration is expected for arable land over most of England and Wales, with unsuccessful sequestration expected in parts of Scotland, due to already carbon rich soils (existing woodland) plus lower yields. Soils already rich in carbon includes peatland and mature forest. Grassland can also be carbon rich, however Milner et al. argues that the most successful carbon sequestration in the UK takes place below improved grasslands. [11] The bottom graphic displays the estimated yield necessary to compensate for related lifecycle GHG-emissions. The higher the yield, the more likely CO2 negativity becomes.

The two most common types of biofuel are bioethanol and biodiesel.

NOTES: