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Successful online learning for sustainable last mile logistics

CHAPTER 2: Last Mile Distribution logistics operation and impacts

UNIT 1: The equipment & tools of urban logistics

Capsule 2.1.2

Internal combustion engine vehicles in LMD

Co-funded by the Erasmus+ Programme of the European Union

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To be done prior to this capsule:	2.1.1
Capsule linked with:	2.1.3, 2.5.1
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Objectives of the Capsule

The goal of this capsule is to present learners what is an internal combustion engine (ICE), and what fossil fuels are used to put it into operation. Also, it will be explained which urban distribution vehicles work with fossil fuels combustion engines.

Category	Document, source	EQF		
		4	5	6
		X	X	X

Exercises included	YES

Effort for the capsule	Content 10 Min.	Exercises 2 Min.	Extra material 5 Min.

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Contents

Instructions for source revision

This capsule begins by defining what it means for a vehicle to run on internal combustion, and that it uses fossil fuels for its operation.

Thus, and as the main source of this capsule, the Eurostat website will be used, where the concept of fossil fuels is defined and where the list of all those that exist is detailed.

Analyzing this list, special mention will be made of Natural Gas and Hydrogen, since it is considered important that some particularities of these two fuels be assimilated.

Next, the data and sales forecasts for combustion vehicles made by the consulting firm Bloomberg will be used as a source.

To finish, some exercises are included to ensure that the explained concepts have been internalized.

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1. What is internal combustion engine?

- As a very simple definition, we can say that Internal combustion engine (ICE) **means that fuel is burned inside the engine.**

- According to Regulation (EU) 2016/1628 Article 3 (1):

"'internal combustion engine' or 'engine' means an energy converter, other than a gas turbine, designed to transform chemical energy (input) into mechanical energy (output) with an internal combustion process "

- **ICEs are typically powered by fossil fuels**

Video about the origin of the internal combustion engine:
HowStuffWorks. (2014, September 21). *The Internal Combustion Engine: Where did it come from?*.

https://youtu.be/NB6mliEkdz0

2. Fossil fuels used in internal combustion engine

Source (web site in EN): Eurostat. (2019). *Glossary: Fossil fuel*.

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Fossil_fuel

Browsing on the web of Eurostat, you will find the definition of fossil fuels and also the large list of different fuels that exist:

Definition of Fossil fuel:

- It is a **generic term for non-renewable energy sources** such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes
- These fuels come from plants and animals that existed millions of years ago
- Fossil fuels can be also made by industrial processes from other fossil fuels (for example in the oil refinery, crude oil is transformed into motor gasoline)

It is estimated that roughly 80% of all manmade CO_2 and green-house gas emissions originate from fossil fuels combustion.

2. Fossil fuels used in internal combustion engine

List of fossil fuels (List directly translatable on the Eurostat website):

1. Solid fossil fuels (aka coal)
2. Manufactured gases
3. Peat and peat products
4. Oil shale and oil sands
5. Oil and petroleum products (excluding biofuel portion)

-Crude oil, Natural Gas Liquid, refinery feedstocks, additives and oxygenates and other hydrocarbons

-Oil products (excluding biofuel portion), such us: Motor gasoline (excluding biofuel portion); Gas oil and diesel oil (excluding biofuel portion); Lubricants; etc.

6. Natural gas
7. Non-renewable waste

2. Fossil fuels used in internal combustion engine

There is one important point to be highlighted related to “fossil fuels” and “alternative fuels”. Although capsule 2.1.3 will explain what are considered “clean vehicles” and “alternative fuels” according to European institutions, you should know, that **some fossil fuels are also alternative fuels.**

For example, natural gas, listed in the previous slide.

Compressed natural gas (CNG)
Liquefied natural gas (LNG)

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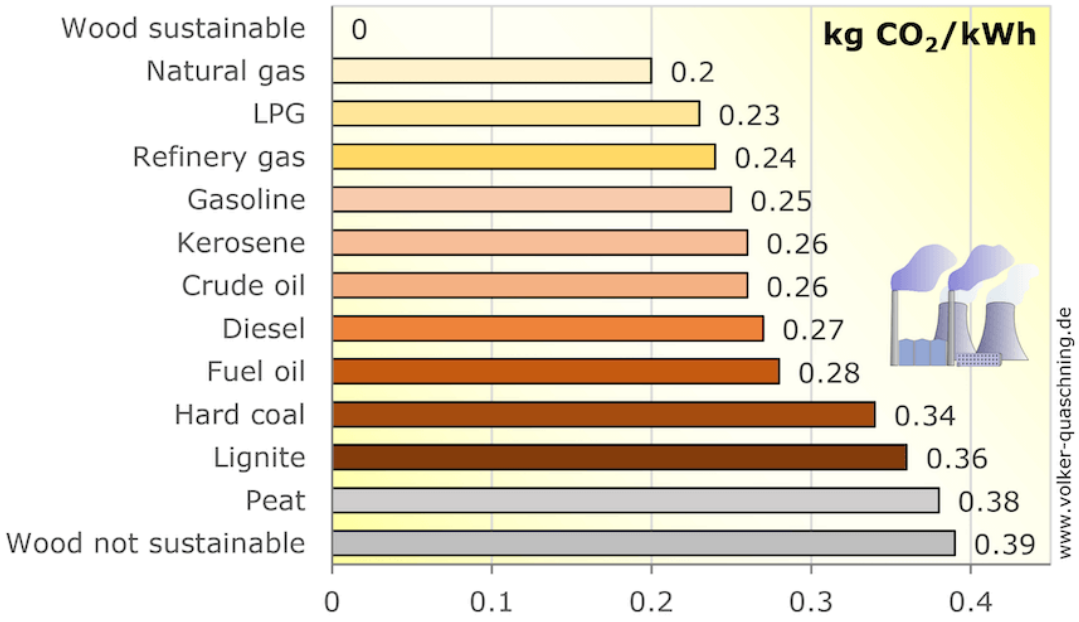
2. Fossil fuels used in internal combustion engine

Natural gas is considered an alternative fuel by the European Parliament as it pollute less than oil conventional fuels. There are two types:

- Compressed natural gas (CNG)
- Liquefied natural gas (LNG)



Source: Volker Quaschning. (2021, May). *Specific Carbon Dioxide Emissions of Various Fuels*. https://www.volker-quaschning.de/datserv/CO2-spez/index_e.php

If you want more information about differences between CNG and LNG, see this Video: ampCNG. (2015, February). *CNG 101 - CNG vs. LNG.*

https://www.youtube.com/watch?v=9viksf_M-xU

2. Fossil fuels used in internal combustion engine

There is another fuel to be highlighted too.

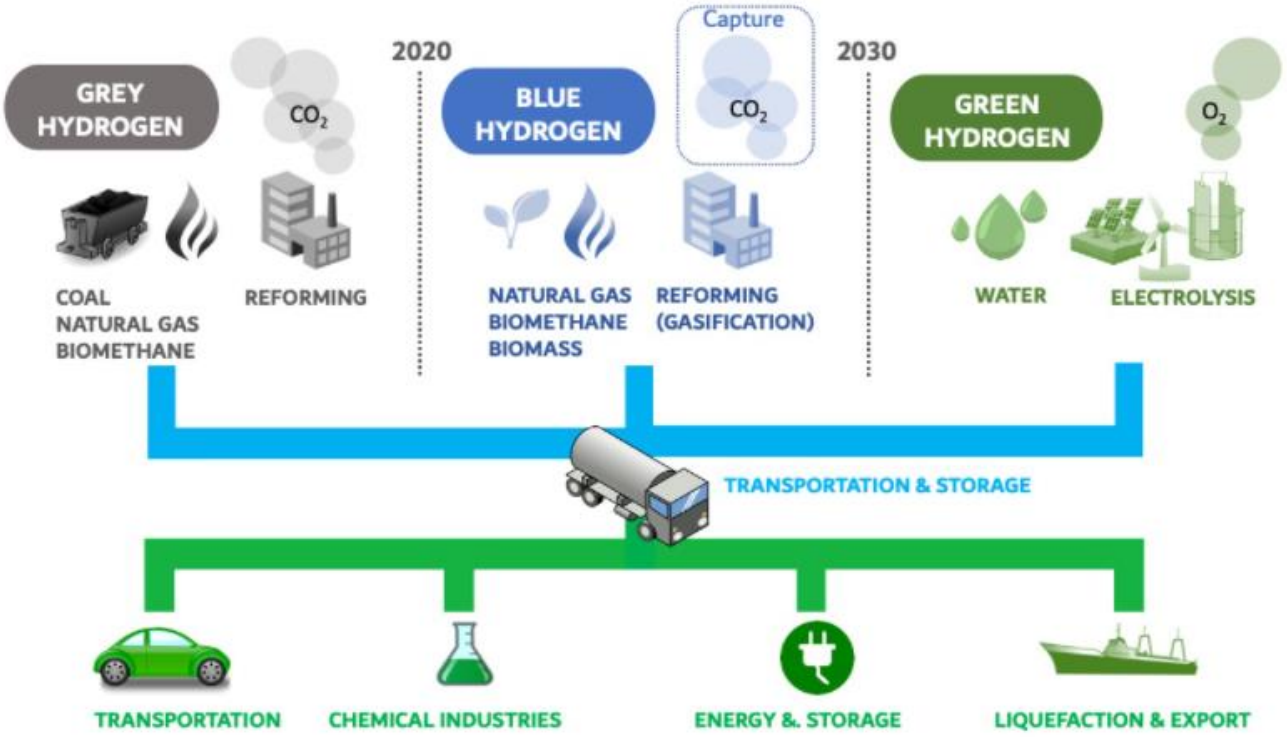
HYDROGEN

It is not included in the fossil fuel list, but it is not always a totally alternative fuel neither.

Although hydrogen is listed on the European Commission's web site as a zero-emissions alternative fuel, it depends on how it is produced. That is, what is the raw material that will be used to obtain the hydrogen, as three main raw materials can be used.

2. Fossil fuels used in internal combustion engine

There are three main types of hydrogen: grey (raw material are fossil fuels), blue (raw material also fossil fuels and biogas) and green (raw material is water).



Source: Rachel, A. (2022). *Blue, green, gray: the colors of hydrogen*. http://www.chem4us.be/blue-green-gray-the-colors-of-hydrogen/

3. Vehicles that works with fossil fuels

The first gasoline-powered automobile was invented by Karl Benz in 1885. Since then, the number of cars powered by fossil fuels has been increasing constantly. Currently this is changing as more environmentally friendly technologies such as hybrids, fuel cells, plug-in hybrids and battery electric are in the market.

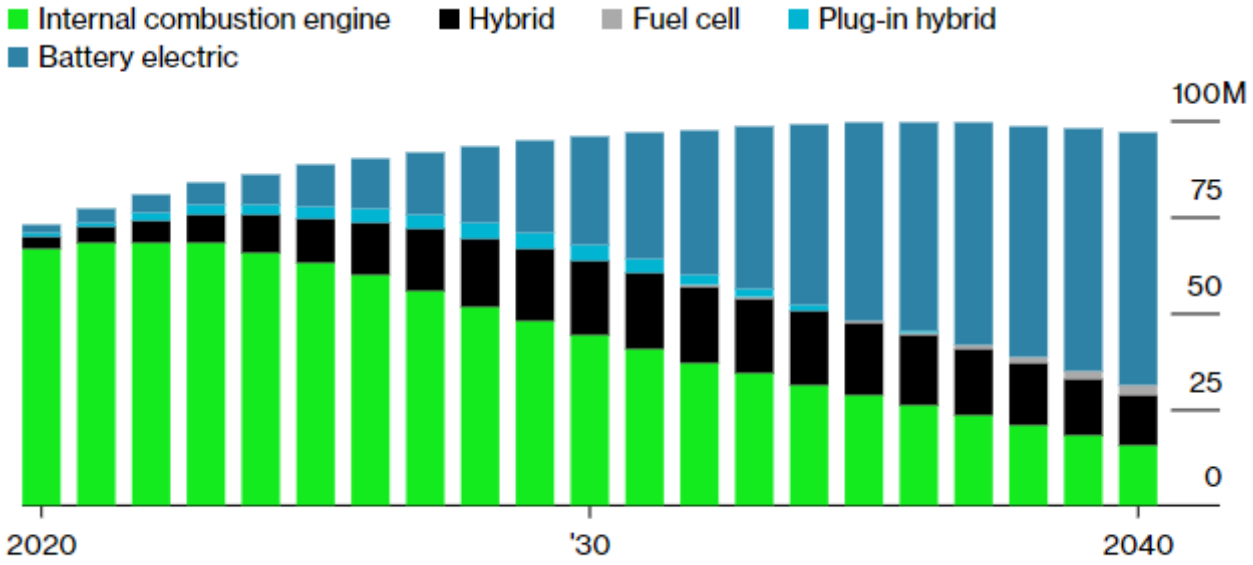
For the current market share of combustion vehicles and its evolution, Bloomberg data and forecasts will be used as a source in the next slide.

3. Vehicles that works with fossil fuels

Source (web site in EN): Nardelli, A. & Wingrove, J. (2021, June). *G-7 Eyes Ambitious Shift to Electric Cars and Away From Oil*. Bloomberg.

https://www.bloomberg.com/news/articles/2021-06-10/g-7-debates-cutting-gas-and-diesel-car-sales-to-minority-by-2030

The graph below shows vehicle sales according to the technology that powered them.



Source: BloombergNEF

Conclusion:
According to forecasts, combustion vehicles will still account for 50% of sales by 2028.

Exercises

Two topics are proposed to be discussed in class:

1- **The forecast of sales of combustion** vehicles.

- Are they agree?
- How is evolution perceived?

2- It is proposed to talk about **hydrogen and natural gas**, to know the opinion of the students about their categorization as alternative fuels.

References

(1) European Parliament. (2016, September 14). *REGULATION (EU) 2016/1628 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R1628