

Mobility – Course 2

MOOC

SEEING THE AUTOMOBILE DIFFERENTLY



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ECHO-Tourism

An Erasmus+ Project



ECHO-Tourism

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INTRODUCTION

Whether it's for daily journeys, work, holidays or weekends with the family, it's hard to do without your four-wheeled vehicle. The automobile has the advantage of greatly facilitating the transportation of people since it allows any driver to get from point A to point B easily and quickly. What's more, its comfortable interior offers protection against external hazards to the point where one could almost forget being propelled at over 100 km/h.

The future of the automobile could have been quite different and reduced to the interest of its use as a means of transport. However, the representation of the car in the imagination of our societies takes on a completely different face. The history of the automobile is a perfect representation of the evolution and industrialisation of our societies.

The car has long been synonymous with success, autonomy and social emancipation for several generations. Even today, the motorist continues to project in his car part of the image he wants to give of himself. With the massification and spread of the automobile, the very idea of the privilege of owning one's own personal vehicle has spread to all classes of society. Far from having only an impact on the transport industry sector, the automobile has become so democratised that it has transformed the face and urbanisation of our cities over the years. Today, over short distances, it is sometimes more practical to use the car rather than two-wheeled vehicles or public transport.

However, the representation of the private car in the imagination of the new generations is changing. The need to be free from the "all-car" is being felt. The codes are evolving, the power is fading away in favour of the hybrid. Alternative modes of transport are emerging, and aim to replace, or at least reduce, the excessive use of cars.

Sometimes, however, it is not possible or conceivable to do without one's motor vehicle. Solutions exist to continue to use one's car in a reasoned and responsible manner. This course presents different practices to be applied in the field of tourism to enable everyone to reduce their daily or holiday use without drastically changing their lifestyle. As expressed in the famous quote from Mahatma GANDHI, I quote "You can shake the world in a gentle way".

1. Lesson 1 - The carbon impact of motor vehicle consumption

LIFE CYCLE ANALYSIS (LCA) OF AN AUTOMOBILE



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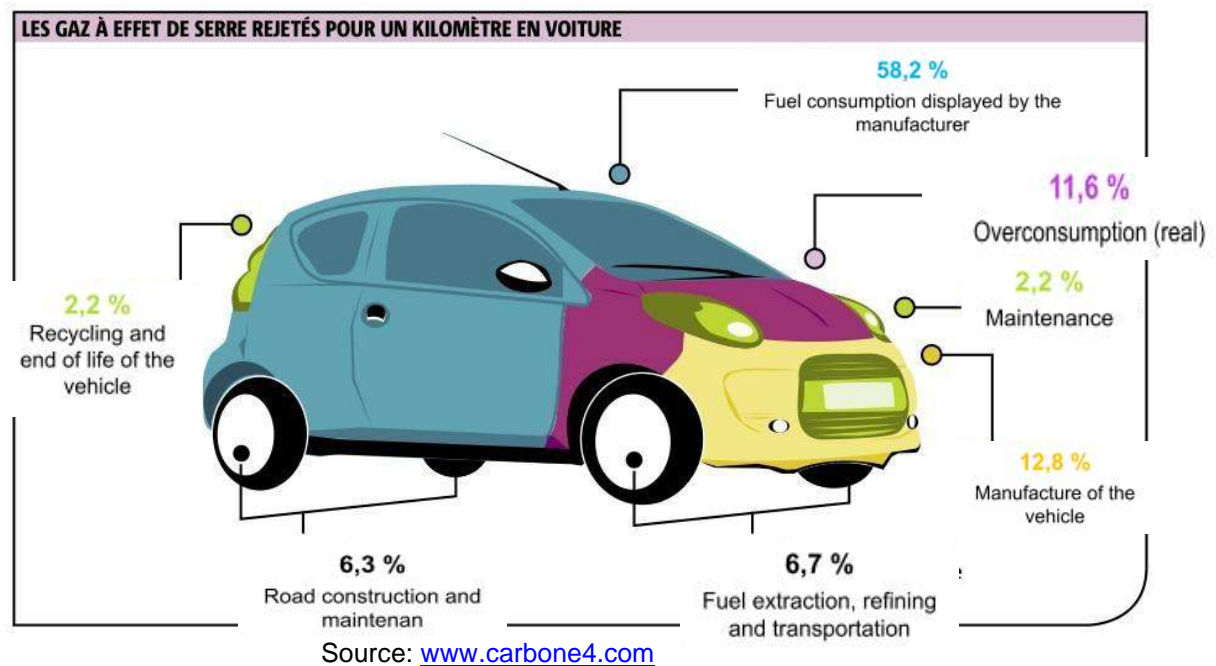
All the products and services we consume on a daily basis have an impact on the environment. Raw materials are extracted and processed during the manufacturing process. Energy is consumed in manufacturing, transporting and storing them from the point of sale to the place of use. The Life Cycle Assessment (LCA) approach makes it possible to quantify all the impacts linked to these stages in the life of a vehicle, "from cradle to grave". Cars don't just emit greenhouse gases from the exhaust pipe. As symbols of pollution, means of transport are often singled out for their direct release of greenhouse gases into the atmosphere. A normal vehicle emits an average of 200 grams of CO₂ per kilometre (gCo₂/km).

If we consider that a vehicle travels an average of about 10,000 km per year, the equivalent GHG emission per vehicle can be reduced to **2 tonnes of CO₂ per year** (tCO₂/year). 70 to 80% of this emission is attributable to fuel consumption.

The newer the vehicle, the lower this share falls. This is also the case if the vehicle is hardly ever used. There is no point in parting with your old vehicle to get a new one if you do not have to drive it. Replacing a working vehicle with a newer one is not always justifiable from an environmental point of view. The policy of taking back old vehicles that are considered "polluters" is mainly driven by economic interests.



ACV OF A NEW AND RECENT VEHICLE



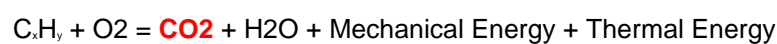
The action of making a 1-tonne car emits an average of 5.5 tonnes of CO₂ into the atmosphere, the equivalent of 2 or 3 years of fuel (for an average distance travelled of 10,000 km). This shows the importance of keeping vehicles that are little used for as long as possible. For the purchase of a new car to be justified, it is necessary to measure a CO₂ emission per kilometre higher than 30 g CO₂/km at a similar distance travelled.

PRINCIPLE OF OPERATION OF A COMBUSTION ENGINE

The operating principle of a combustion engine on a vehicle is simple. A Fuel (petrol, diesel...) is mixed with an oxidant (oxygen from the air) to be burnt to release energy. This combustion energy, produced during the chemical reaction, is recovered in the form of heat and mechanical force.

The chemical reaction can be reduced, for simplification and as an example, to the following equation:

(Petrol type fuel) **C_xH_y** + (oxygen in the air) **O₂** = **CO₂** (carbon dioxide) + **H₂O** (water vapour) + **Mechanical Energy** (wheel rotation) + **Thermal Energy** (Heat)



When you use a car, you try to move around and therefore to recover as much mechanical energy as possible. However, a high-performance combustion engine allows a maximum recovery of 40% for models running on diesel and 35% for petrol engines. This is called engine efficiency. The greenhouse gases emitted by the vehicle are the result of the combustion of the engine and are therefore directly linked to its level of efficiency. The lower the efficiency, the higher the level of unburned hydrocarbons and CO produced.



For 1 L of fuel consumed, we generally recover:

- **2/3** of the energy in the form of heat wasted and evaporated in nature
- **1/3** of the energy used to move the car forward

It is easy to understand after this short demonstration that:

... moving a human being weighing 60-90 kg,

... in a 1-ton vehicle with 4 seats,

... using fossil fuels such as oil extracted on the other side of the planet, sometimes more than 20,000 km away,

... then transformed into fuel by chemical processes which will itself be used in an engine that wastes 66% of the energy produced,

.... it is not virtuous for the environment.

2. Lesson 2 - Encouraging eco-driving

To reduce the impact of driving, nothing is more effective and easier than to adopt a more responsible driving style. It's good for the environment and for your wallet. In order to encourage the implementation of good practices, it is necessary to raise awareness and make people aware of their importance. In the context of the activities of a tourist establishment, this may concern either the tourists benefiting from a service offered or made available to them, or the employees of the establishment. In order to ensure that the vehicles provided are used in the most appropriate way, the following precautions should be taken:

OFFER VEHICLES ADAPTED TO THE NEEDS OF USERS AND THE NATURE OF THEIR JOURNEYS.

The more varied the fleet is, the more precisely you will meet the needs. A small note of intent on eco-driving can be used to argue and present the approach. An awareness-raising leaflet can be placed in each vehicle to present responsible actions.

ENSURING THAT VEHICLES ARE NOT USED TOO OFTEN IN OVER-REVVING.

Rental or company cars made available can be equipped with automatic gearboxes to limit the vehicle's consumption. Gears change automatically according to engine speed. Driving habits are very different from one driver to another. Sometimes the equipment suffers as a result. Investing in vehicles with automatic gearboxes can be a profitable investment in the long term.

Watch out for speed too! Accelerated starts, hard braking and high speeds lead to unnecessary fuel consumption. By equipping your vehicles with geolocation devices, each of these behaviours is tracked and the system can calculate an individual road behaviour score for each user. These results can then be used to drive improvement initiatives or organise challenges. The fuel score will become lighter and vehicle users will drive more safely.

Cruise control systems or speed limiters allow users of certain vehicles to limit their consumption. However, the use of a cruise control system does not always mean savings and should be considered carefully.



OFFERING ECO-DRIVING COURSES FOR PERSONNEL

AVOID UNNECESSARY ENGINE OPERATION

Some vehicle models are equipped with "Start and Stop (S&S)" technologies that turn off the engine when the vehicle is stationary for more than 5 seconds.

LIMITING VEHICLE LOAD

One of the solutions that can be envisaged in any type of hotel establishment is to offer storage and tidying facilities to enable tourists passing through to deposit luggage and personal effects that they do not need during their leisure trips.

In order to facilitate their use, these storage areas must be easily accessible and usable at any time of the day. Tourists should be able to use the storage facilities when reception staff are not available. Deposit lockers or clasps can be provided to avoid any risk of damage or theft. This service can be automated.

AVOID, IF POSSIBLE, EQUIPPING VEHICLES WITH AIR-CONDITIONING SYSTEMS.

Air conditioning in operation increases a vehicle's fuel consumption, but also increases maintenance costs. As soon as justified, the number of equipment options offered in rental or service vehicles is limited to a maximum. This ensures that users will not abuse them. In some temperate regions, the purchase of a vehicle equipped with air conditioning is not always justified. If the vehicle is not equipped with one, make sure, as a precaution, to regularly check the operation of the window-opening and ventilation systems.

3. Lesson 3 - Maintaining a vehicle to prevent it from polluting

Maintaining your vehicle on a daily basis is above all a guarantee of longevity and a successful investment. Keeping a vehicle in good condition extends its lifespan. A well-maintained vehicle also means less consumption and less pollution. Simple maintenance habits such as checking tyre inflation (pressure level), checking and replacing air filters and others are referenced in the practical guide on ecomobility.

Here are some points to consider in the operation of your establishment:

- **Set up regular monitoring of the mileage of its fleet of vehicles.** This can be retrieved by means of a small form to be filled in when the vehicle is loaned or used. Readings can also be taken on a regular basis.
- **Maintain the air-conditioning system** of the vehicles to prevent the refrigerant gas from evaporating into the environment.
- **Ensure that maintenance equipment is available in each car.** It is easy to provide a small user's manual for the loaner vehicle and all the tools necessary for its light maintenance (spanners, screwdriver, motor oil in a can, window washing product, etc.).



To preserve a vehicle over time, it is necessary to avoid driving too much when the mileage on the odometer is high. Keep this vehicle for short journeys.

To make sure that vehicle maintenance and all these points of vigilance are respected, it is advisable to appoint one or more people in charge among the staff.

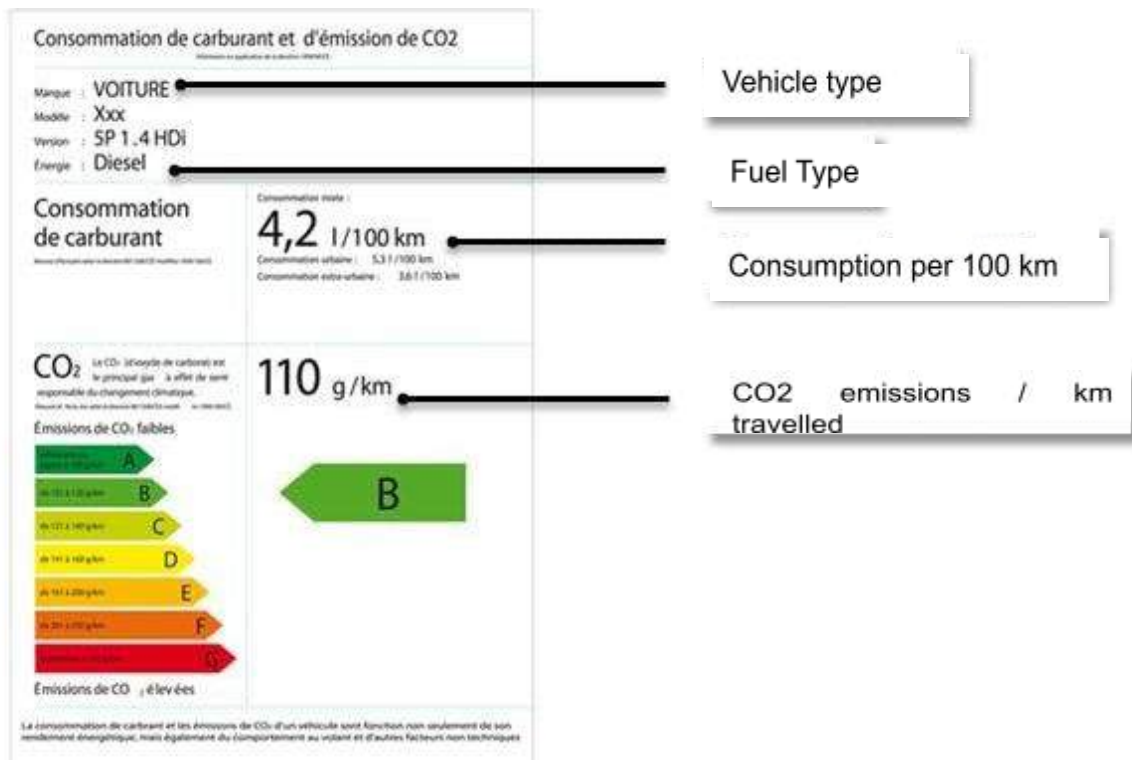
4. Lesson 4 - Buying responsibly

In order to help the car industry to evolve, environmental labels and regulations have been created in Europe, with the aim of limiting the circulation of overly polluting cars. Motor vehicle exclusion policies are mainly observed in cities where cars are gradually being banned from city centres.

Different levels of air quality certification such as the "Air Quality Certificate - Euro Standard" are being introduced to encourage the use of vehicles that pollute less and emit fewer particles into the air.

Some European countries such as France have adopted scoring systems inspired by the European energy label for household appliances to rank the performance achieved by new vehicles in terms of fuel consumption and greenhouse gas emissions.

New European "EURO" directives and standards relating to CO₂ emissions from cars and light commercial vehicles came into force on the 1st of January 2020. The average emission of new cars sold by manufacturers must not exceed 95 gCO₂/km. The average for new vehicles is currently 120 gCO₂/km, and 170 gCO₂/km for second-hand vehicles. By 2025, manufacturers will have to reduce their emissions by 15% compared to the 2021 requirements. By 2030, the reduction will be 37.5% for cars and 31% for light commercial vehicles.



BUYING RESPONSIBLY IS NOT JUST A QUESTION OF NEW PRODUCTS AND PERFORMANCE

Being responsible means above all buying and choosing your vehicle according to your needs. Why always use a 4-seater vehicle for business trips? Why buy new if I use the vehicle very little? Here are a few tips to help you be responsible when making your purchase.

Tip n°1: define the needs, to buy in consequence

According to the distance travelled per year (km/year):

Short or long journeys? => choose the type of fuel used accordingly.

If I only make short journeys, or if I use the vehicle very little, why not buy a second-hand vehicle? The weight in CO2 for the construction of a new vehicle weighs in the carbon balance!

Low or high annual mileage? => If buying second-hand, choose according to the vehicle's odometer reading.

Depending on the number and type of users:

Is the vehicle used as a company car? Family car? Or as a sports car?

Depending on the geographical context:

Is the vehicle mainly used in the city / countryside / mountains ...?

There is no reason to buy a 4 x 4 in a town or lowland area. This type of vehicle pollutes and consumes benefits. Why not opt for a city car in the city which is much easier to park?

When I offer vehicles for hire or self-service, I avoid buying just one type of vehicle. It makes more sense to offer a wide range of products to best suit the needs of users.

Tip n°2: limit weight, promote compactness

As demonstrated in physics by Newton's 2nd law, the energy consumed to produce a force on an object is expressed as a function of the mass (relative weight) of an object and its acceleration.

Newton's 2nd Law: (Energy) Force = Mass (weight) x acceleration (and speed)



The heavier the vehicle is, the more energy it will take to move it.
The higher the speed of the vehicle is, the more energy it will also take to keep it accelerating.

Nowadays, technological advances make it possible to improve the performance of automotive equipment, with better engine efficiency for example.

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However, the trend is towards consumer vehicles with four-wheel drive (4x4) or sporty models such as SUVs (Sport Utility Vehicles), which weigh between 1,700 kg and 3,000 kg.

The compactness and structure of the vehicle also affects its level of consumption. Why continue to accelerate when the vehicle is at the right speed? The frictional forces of the road and wind slow the vehicle down permanently. This effect is all the more important when the vehicle is pushed at higher speeds. This explains the elongated shape of racing cars such as Formulas one.

To sum up, to avoid consuming, prefer a light, aerodynamic mode of transport and moderate the speed.

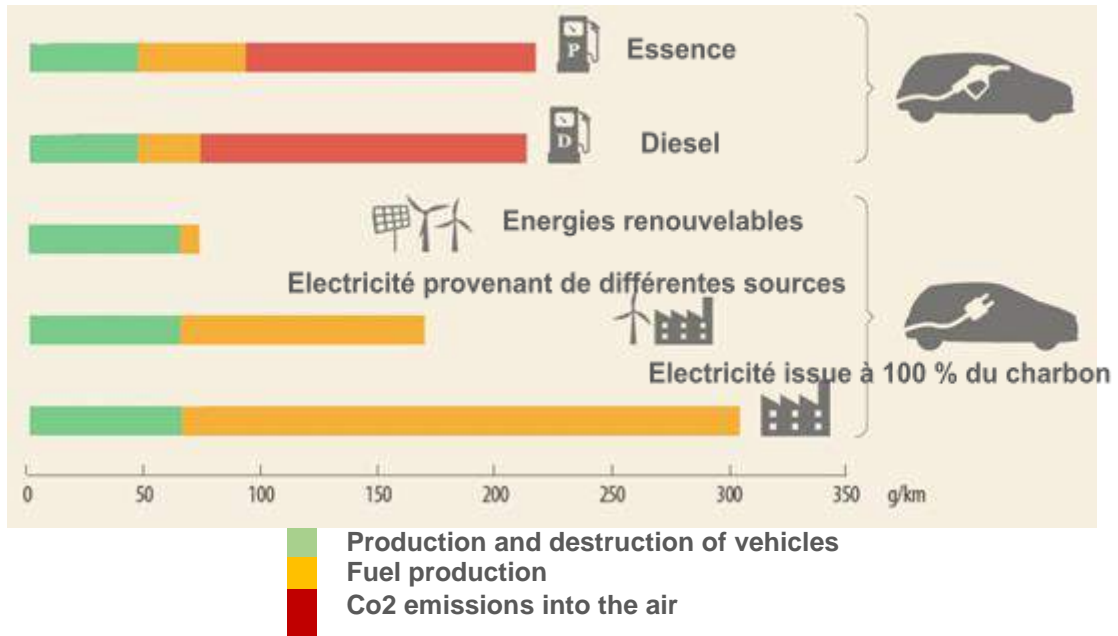
SWITCH TO CLEAN ENERGY

As previously mentioned, certain types of fuel, due to their composition, have a lower impact on the environment. Fuels containing biofuels such as ethanol have a lower impact in terms of kg CO₂ emitted per litre. Be careful, because for the same distance travelled, the consumption of the different fuels is not the same. A vehicle running on LGP is a consumer.

Fuel type	Exhaust emissions (kg CO ₂ /L)
Petrol	2,29
E10 (10 % ethanol + 90 % petrol)	2,21
E85 (85 % ethanol + 15 % petrol)	1,61
Diesel	2,66
B5 (5 % biodiesel + 95 % diesel)	2,65
B20 (20 % biodiesel + 80 % diesel)	2,62
LGP liquefied petroleum gas	1,66

Electric cars

The electric car has the advantage of being a means of transport that does not emit GHGs directly into the atmosphere. However, this image of a clean vehicle can be controversial if we consider its entire LCA. The main disadvantage of the electric car is its level of autonomy and the time needed to recharge the batteries. Recharging vehicles using solar energy for self-consumption is one of the most virtuous solutions. However, it involves functional constraints, particularly in terms of supply. Solar energy production is more abundant in the middle of the day. Today, more and more territories are equipping themselves with charging stations to encourage the democratisation of this mode of transport, which continues to be an ostentatious and technological asset (example of the Tesla brand).



Hydrogen vehicles

With the development of renewable energies, energy storage solutions such as fuel cells (e.g. hydrogen powered) have emerged. The development of this type of technology is widely promoted and financed by the EU. Several initiatives, such as the first public hydrogen stations, have been launched. The technology has also been developed in public transport. 100% hydrogen bus lines have been set up in Bethune, France since 2019. These buses have a range of 350 kilometres, emit only water and make very little noise.

Today, the main problem with hydrogen is its production. It is difficult to produce green hydrogen when the resource is fluctuating and, as with solar energy, has a production yield of 15-20%. The efficiency of electrolysis alone to produce hydrogen is around 70%. With an electrical efficiency that can vary from 15 to 50%, the hydrogen solution still competes with the combustion engine, whose efficiency is close to 30 - 35%. Today, most of this electricity comes from nuclear or carbon-based energy. The future of this technology needs to be closely monitored.

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