



# **ECODRIVING AND ENERGY-EFFICIENT DRIVING PRINCIPLES**

**Guide for drivers – how to ecodrive**



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**Published:** 30.12.2013

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## INTRODUCTION

The EU legislation in the Directive 2012/36/EU, amending Directive 2006/126/EC on driving licences, implements in a point 8.4.1 safe and energy-efficient driving as a compulsory part of driving licence exams since 2014. This measure brings not only cost benefits to vehicle operator, but it also reduces greenhouse gases emissions and increases safety on the roads. It is possible to save up to 20 % of fuel and greenhouse gases by energy-efficient driving. At the consumption of 7 l of petrol per 100 km, the saving of circa 1,4 l of petrol = ca 2 € = ca 4,0 kg CO<sub>2</sub> can be achieved. At 1000 km, up to 20 € and 40 kgCO<sub>2</sub>, can be saved, what is not negligible. How many kilometers do you drive a year and how much € and CO<sub>2</sub> could you save?

However, range of ecodriving is wider than energy-efficient driving. Ecodriving begins with considering of mobility, selecting the way of transport, choosing the right car at acquisition or leasing. It includes principles of energy-efficient driving and parking, smart use of air-conditioning, and it ends by environmentally friendly car washing, whereas environmental processing of the car at the end of its lifetime is solved by the national legislation of the EU member states.

## 1 BEFORE YOU START THE ENGINE

Before you get into a car, think about other ways of transport that could be better. An alternative could be faster than a car, mainly during rush traffic hours. Up to 1 km prefer walking, to 10 km prefer biking or city transport. Up to 100 km use public transport or car, up to 1000 km travel by train. Travelling by train or public transport for long distances has a lot of advantages – it is quick, safe and you do not have to drive. You can work on your laptop, read a book, watch countryside or just relax. Nowadays it is a standard that european high-speed trains (TGV, ICE, RAILJET, etc.) exceed the speed of 200 km per hour.

Car-sharing means to have an available car, but not to own it. This decreases the number of cars in the cities. More information you can find in the Technical report. Car-sharing is widespread in Germany and in Western Europe countries.

Carpooling means sharing of car journeys, so that more than one person travels in a car. It is cheaper and environmentally more friendly than the case when everybody drives their own car. Another benefit is connecting of people and helping each other.

## 2. CHOOSE THE RIGHT CAR

By choosing the right car at acquisition it is possible to influence substantially environmental pollution and also driving costs. The most environmentally friendly type of propulsion is electricity (optimal from renewable sources), then gas - LPG, CNG (optimal from biogas plants generating biogas from waste, sewage), hybride (electricity/petrol) and at the end petrol. The dirtiest propulsion is diesel, because of carcinogenic particle matters originating in the combustion process.

The EU Legislation focused on vehicle emissions (Regulation EC 443/2009) sets limits on CO<sub>2</sub> emissions for passegger cars at 130 g/km in 2015 (ca 4,5 l of petrol per 100 km; 4,0 l of diesel per 100 km) and at 95 g/km in 2020 (ca 3,3 l of petrol per 100 km; 2,9 l of diesel per 100 km). Nowadays a lot of car types with CO<sub>2</sub> emissions of about 100 g/km are produced, there are also some mass-produced small cars under 80 g/km. The limits for vans are set at 175 g CO<sub>2</sub>/km in 2017 (ca 5,4 l of diesel per 100 km).

Production of engines with gasoline direct injection system (GDI) has started recently. Without efficient particle filter this type of engines is more harmful than the diesel one.

When you own an older or second-hand car, keep the engine in good condition. At acquisition prefer gas (LPG, CNG) or petrol variant to diesel notably if you intend to use your car for short drives and for urban driving. Diesel cars have to be equipped with particulate filter (DPF). Older diesel cars without filter should be retrofitted.

A lot of European cities have established low emission zones (LEZ) in central parts of the cities, where is not allowed to enter by car, which do not meet specific emission standards. Diesel cars without particulate filter usually do not meet these standards. E. g. in Berlin, the standard is EURO 4, what means that only cars made after 2005 which meet EURO 4 or higher or retrofitted cars may enter into the central part of Berlin.

Every year CEPTA evaluates economic and environmentally friendly cars offered at Slovak market by way of the ECO-car competition. The cars were evaluated for the first time in 2013. The results are available at CEPTA website. In Germany this kind of survey is done annually by VCD. More information is at:

<http://www.cepta.sk/index.php/sk/clean-air-ciste-ovzdušie-projekty-736/514-eko-soferovanie>.

## 3. BEFORE DRIVING

By good trip planning you can save time and fuel. Take into consideration:

- **Avoid traffic jam.** „Stop and crawl” driving under hard traffic conditions in crowded roads consumes a lot of fuel and time.
- **Do not get lost.** When planning unfamiliar journeys try to reduce the risk of getting lost and check the traffic news before you leave. For urban driving we recommend to use GPS navigation, but it is good always to verify proposed route.
- **Combine short trips.** Cold starts use more fuel, so it pays out to combine errands such as small shopping or collecting the kids. On short trips the engine does not reach its optimal operating temperature, the wear is increased and the durability is reduced.

Before the trip do not forget to:

- **Clean junk from your trunk.** Extra weight means extra fuel, so if there is anything in the boot you do not need on the journey, take it out. Driving with unnecessary things makes the vehicle heavier and the vehicle consumes more energy for maneuver. Every 100 kg of extra weight consume 0,5 l of fuel per 100 km.
- **Remove unused roof racks and boxes,** if you do not need them. Such accessories increase aerodynamic drag what means higher fuel demands. Roof rack with skis increases fuel consumption up to 2 l per 100 km at the highway. Roof box increases consumption of ca 1 l per 100 km.
- **Check tire inflation regularly.** Underinflated tires cause high rolling resistance what increases fuel consumption and wear of tires. By keeping of right pressure you can save 3 – 5 % of fuel.
- **Maintain your vehicle.** You save fuel, the air from exhaust and you also increase safety of driving. If the engine is not adjusted correctly, fuel consumption is higher and it can also consume oil. Change oil, spark plugs (gasoline engines) and oil filter regularly. Air filter must be clean, check it. If the vehicle is in good condition, you can save 4 - 10 % of fuel.
- **In winter clean your vehicle off snow and ice.** Removing snow and ice from the vehicle not only increases safety on the road, but it is economical, too. Snow layer on bonnet increases aerodynamic drag and means an extra load. 1 m<sup>2</sup> of 10 cm snow layer weighs about 10 - 60 kg (depending on water content). Defrosting ice by using electric defrosters (rear window) is energy demanding. Therefore fuel consumption of uncleaned vehicle is higher.

- **Car washing** – do not use hardly degradable detergents and chemicals, which burden waste water and environment. It is forbidden to wash a car directly in lake or watercourse. There are car washes with low water consumption, some of them use biodegradable detergents on the natural basis (soap nuts, coconuts oil derivatives, sugar tensides, etc.). Be informed, watch used car detergents or ask for information in car washes.

## 4. EMISSIONS CONTROL TECHNOLOGIES, PARTICULATE FILTERS

For the reduction of air pollution by **gasoline vehicles**, the use of 3-way catalyst is widespread. The catalyst turns emissions of CO, NO<sub>x</sub> and HC into harmless products N<sub>2</sub>, H<sub>2</sub>O and CO<sub>2</sub> by additional catalytic burning at the catalysts (platinum, rhodium). Cars with GDI engines (Gasoline Direct Injection), which are on the market since 2012/2013, should be equipped with GPF (Gasoline Particulate Filter). If the GPF is not a part of new car exhaust system, you should retrofit it with GPF additionally. The EU legislation set no particulate limits for GDI cars in time of placing this new technology on the market.

**The 3-way catalyst** requires unleaded petrol, because Pb is catalyst poisoning. Lifetime of the catalyst is also decreased when unburned petrol gets into the catalyst. It can happen while the engine is misfired, or while long starting or lugging of the vehicle to start without starter. Combustion of the petrol inside the catalyst can increase its temperature above 1 400 °C, what destroys the catalyst. Lifetime of the 3-way catalyst is about 80 – 160 thousand km.

For reduction of air pollution by **diesel vehicles**, filters or other technologies (DOC, SCR, EGR, DPF etc.) are used. Diesel motors produce 200-times more particulate matters (PM) than gasoline motors, so PM must be removed. For their removing DPFs are frequently used. As PM are very fine soot particles with health detrimental effect, correct operation and maintenance of DPF is very important.

### Correct operation and maintenance of DPF:

**Diesel Particulate Filter (DPF)** needs low-sulphur diesel using only. Content of sulphur in diesel should not exceed 15 mg/kg. During right running of the car, regeneration of DPF takes place as a part of normal operation cycle, when caught soot particles are burnt to enable normal working of the DPF and prevent clogging. **If you use your diesel car for urban driving and short trips only (cold starts), it is necessary from time to time, at the latest when onboard control signalises a problem with the filter, to drive at least 10 minutes continuously (optimal on a highway) at 2000 – 3000 RPM to enable regeneration of the filter and burning of soot particles.**

The DPF must be cleaned from noncombustible particles and ash periodically in professional cleaning services. The cleaning is required every 6 to 12 months – depending on the vehicle use. The filter should be cleaned if regeneration process is done too often.

For long lifetime of the DPF, the engine must be kept in a good condition, too. Co-burning of oil in the engine damages DPF. When the DPF is cleaned (mentioned above), engine control is also recommended. If DPF operation and maintenance is correct, DPF works during all vehicle lifetime.

Short trips are not good for diesel vehicle, because diesel engine warms up much more slowly than gasoline engine. Cold diesel engine consumes more fuel and produces much more PM than the warmed one. DPF is quickly clogged with PM and it has no time to regenerate. So at acquisition if you plan to use your car for short drives and for urban driving, prefer gas or petrol variant to diesel. Moreover, petrol vehicle can be retrofitted to LPG, what reduces fuel costs by half and also decreases harmfulness of car emissions.

## 5. FUEL TYPE

Fuel type influences significantly air pollution and also economy of driving. CO<sub>2</sub> emitted by combustion of 1 l of fuel is much lower in case of LPG (Liquid Petroleum Gas) and CNG (Compressed Natural Gas) than in case of petrol or diesel car.

Petrol car can be retrofitted to LPG rather easily. On the market, there are also cars with a combined fuel type - petrol and LPG or petrol and CNG.

### Advantages of LPG/CNG car:

- Decreasing fuel costs of about 40 – 50 %.
- Lesser engine wearing out. As there is no carbon tar sedimentation in the engine (like in petrol or diesel propulsion), oil change interval can be prolonged by 50 %.
- Considerably lower exhaust emissions, almost no PM, low CO<sub>2</sub> production.

### Disadvantages of LPG/CNG car:

- Initial investment to the retrofitting (return after 2 years at 1000 km per month).
- Reduction of boot beause of LPG/CNG tank.
- Ban of parking in closed spaces (garage, parking house etc.).

## 6. ECODRIVING TIPS WHILE DRIVING AND PARKING TIPS

Driver behaviour can influence significantly fuel consumption and enviromental effect of driving. For fuel savings the following principles of ecodriving are important to be kept:

- **Set off just after starting the engine.** The engine is getting warm by driving more efficiently than idling. During the first 5 minutes, the idling cold engine in winter consumes 0,15 l of fuel.
- **Minimize idling.** Turn off the engine if you are going to be stopped for more than 30 seconds. Turning off the engine and starting again consumes less fuel than when the engine is idling. Fuel consumption while warm engine is idling is ca 0,5 – 1 l per hour.
- **Avoid aggressive driving, minimize braking and acceleration.** Driving style influences substantially the fuel consumption. It is very important to foresee the driving situation and to have in-time and right reactions. Drive fluently with traffic flow, without excessive braking and acceleration. Apply the rule: „*Drive as if your brakes were damaged*“. Every braking means an extra work of the engine during successive acceleration. Maximize using of vehicle inertia. Aggressive driving (braking and acceleration) increases fuel consumption by about 20 %.
- **Use the engine as a brake.** Release the accelerator quickly - as soon as you see a red signal or a stop signal or also while driving downhill. If the accelerator is released when driving at a high speed, the fuel supply to the engine will be halted automatically. The vehicle is slowing down, because of braking force of the engine. There is no fuel consumption in this mode and you also save brake pads. When the engine speed is lowered, approximately as much fuel as necessary for idling will be supplied again.



- **Shift up early.** Use the highest possible gear. Do not drive at high RPM, put the car in higher gear at 2 000 RPM in a diesel car and 2 500 RPM in a petrol car. Driving at 50 km/h in 3<sup>rd</sup> gear consumes by 1 l per 100 km of fuel more than using 5<sup>th</sup> gear.
- **Drive at optimum speed and fluently.** Maintain safe distance between vehicles and avoid changing speed often. Driving too fast, but also too slow, increases fuel consumption. The lowest consumption is at 50 – 70 km/h (depending on vehicle type) in the highest gear and low RPM. Aerodynamic drag increases exponentially with speed. Fuel efficiency can be improved by 10 to 30 % by driving at 80 km/h. Driving at 115 km/h uses up to 9 % more fuel than at 95 km/h and up to 15 % more than at 80 km/h. Cruising at 130 km/h can use up to 25 % more fuel than at 115 km/h.
- **Close the windows.** Open windows increase aerodynamic drag – especially at high speed, so the vehicle consumes more fuel to keep the same speed. There is a rule: „*Under 65 km/h open windows, over 65 km/h use air conditioning or ventilation.*“. If you wish to open a window, do not have more than 2 cm gap.
- **Driving in good weather is more economical** than driving while it rains or driving at snow or on ice. Water, snow or slush on the road surface can dramatically increase rolling resistance what leads to fuel consumption increase.
- **Turn off electrical appliances,** if you do not need them. Every 100 watts of input power increase fuel consumption up to 0,1 l/100 km. Fan of ventilation system (not air conditioning) has input about 170 W, hi-fi booster up to 400 W! Turned-on fog lights can increase fuel consumption by about 0,2 l/100 km.
- **Use the „corridor effect“.** Driving at a constant speed within a flow of traffic (in the same direction) is more efficient than going the same speed in isolation because of lower aerodynamic drag. But be careful of keeping safe distance considering current speed you are driving and other circumstances on the road.
- **Close the sunroof at higher speeds.** It decreases aerodynamical drag and therefore fuel consumption.
- If you are **driving in traffic jam**, leave as much space ahead of you as possible. This allows you to drive fluently though slowly. Maximize using of vehicle inertia and coasting driving (in neutral). Minimize repeated braking and acceleration.
- **Minimize driving with a trailer.** Trailer towing increases aerodynamic drag and also rolling resistance because of trailer axles. Trailer increases fuel consumption by about 1 l/100 km at a speed of 90 km/h. If it is not possible to avoid to drive with a trailer, minimize towing speed, check tire inflation (minimize rolling resistance) and adjust your drive technique to account for the extra momentum the trailer and its load will add.

The way of parking and departing from parking place also influences the fuel consumption. You should keep the following principles:

- **Park in the shade in summer,** if it is possible. This ensures pleasurable interior environment and helps to minimize use of air conditioning.
- **Park in the periphery.** Choosing a parking place in the "periphery" of a busy site will be more efficient than navigating the rows of traffic/pedestrians to get as close as possible to the building or destination.
- **Avoid excessive maneuvering while parking.** The most economical is to drive to the parking place fluently and later leave the parking place without reverse and maneuvering.
- **Start up not until you are adjusted.** When you are going to leave the parking place, do not start the car until you are settled in (e.g. seat, mirrors adjusted), fasten your seatbelt, passengers are settled in as well.

## 7. SMART USE OF AIR-CONDITIONING

Air-conditioning (MAC – mobile air-conditioning) belongs to the most energy demanding devices in cars and it can increase fuel consumption by more than 2 l/100 km. Therefore you can save a lot by smart use of air-conditioning. Here are some tips which should be kept:

- **Park in the shade.** Cooling of overheated vehicle, parked at the sunshine place, is much more energy demanding than cooling the vehicle parked in the shade.
- **Ventilate well before driving in summer.** This reduces the interior temperature (mainly if a car is parked at the sunshine place) and energy need for cooling will be lower [46]. Activating of air-conditioning in overheated car can increase fuel consumption by 2,5 – 4,2 l/100 km transitorily.
- **Turn off air-conditioning for the short trips,** when it does not manage to cool down the car interior.
- **Do not activate air-conditioning automatically,** but only when you really need it. Activating air-conditioning and cooling the car interior by 1 °C increase fuel consumption by as much as 14 %. Cooling down to 24 °C (at ambient temperature of 35 °C) increases fuel consumption by 38 %.
- **Keep windows closed after starting your journey.** Set the fan to medium speed in the first minutes of driving, and turn on recirculation. This prevents warm fresh air constantly coming in from outside.
- **Do not set the temperature too low.** The difference between outside air and interior temperature should not exceed 6 °C. Big temperature difference increases fuel consumption dramatically and there is a risk of diseases emergence (colds, inflammations etc.).
- **Turn off air-conditioning before the end of your journey** to enable humidity to evaporate from the air-conditioning system. You will also utilize accumulated coldness without any additional fuel consumption.
- **Regular maintenance is important.** No maintenance is necessary during the first 4 years. Subsequently, having the air-conditioning system checked every 2 years is recommended to measure the loss of refrigerant. If the loss is not compensated for, the air-conditioning system must bear higher load and it wears out more quickly. If you never switch the system on, its lifetime will also be reduced. Cleaning and disinfection of air-conditioning system should be done yearly (filters replacement etc.)
- **Ask for information.** When buying a new car, ask about used refrigerant and the air-conditioning technology, as well as the additional fuel consumption to be expected.

## AT THE END

Technical progress heads on very fast so ecodrivers should be interested in new knowledge, materials, technologies from automobile industry. If it is possible we recommend to take part in reconditional training of ecodriving once per 10 years. More about the trainings can be found at our webpage. During a few hours of training you will learn or refresh your ecodriving techniques, it will remove your wrong habits and move you towards the energy-efficient, environmentally friendly and safe driving.

More information and sources used in this guide you can find in [Ecodriving - Technical report summary](#) at CEPTA website.



## ABOUT US

This guide was created as a part of the Clean Air, project by nine European environmental organisations that fight for clean air in European cities. Despite the existing legislative framework and the citizens' right to clean air, continuing violations of air pollution limits remain a problem in many cities. Air pollution threatens health, environment and climate. It is time to take action!

[www.cleanair-europe.org](http://www.cleanair-europe.org)

Started in 2009, the associated campaign "Sootfree for the Climate" aims to reduce diesel soot emissions, which accelerate climate change and pose a threat to public health. To this day twelve European NGOs have joined the campaign.

[www.sootfreeclimate.org](http://www.sootfreeclimate.org)

a project by



co-financed by the  
EU's LIFE financial  
instrument



associated  
campaign

