SSD

SCIENCE FOR A SUSTAINABLE DEVELOPMENT

CLUSTER OF THE TRANSPORT RELATED PROJECTS PROMOCO, LIMOBEL, BIOSES AND CLEVER

"PROLIBIC"

I. De Vlieger, I. Mayeres, H. Michiels, M. Vanhulsel, D. Gusbin,
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(SSD)

Transport and Mobility

FINAL REPORT

CLUSTER OF THE TRANSPORT RELATED PROJECTS

PROMOCO, LIMOBEL, BIOSES AND CLEVER

PROLIBIC

SD/CL/08

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LIST OF ABBREVIATIONS

B30	Biodiesel with a volume percentage of 30
B100	100% biodiesel (FAME)
BAU	Business-as-usual
BEV	Battery Electric Vehicle
BIK	Benefit in kind
CGE	Computable general equilibrium
CNG	Compressed natural gas
CR function	Concentration-response function
CVO	Corporate Vehicle Observatory
DCW	Digital chart of the world
E85	Fuel mix of 85% ethanol and 15% gasoline
ED95	Pure ethanol with ignition improvers, so it can be used as diesel fuel
EMS	Emission Registration and Monitoring of Shipping
FAME	Fatty Acid Methyl Ester
FC	Fuel consumption
FCEV	Fuel cell electric vehicle
GDP	Gross domestic product
GWP	Global Warming Potential
HDF	Heavy duty freight vehicle
HDP	Heavy duty passenger vehicle
HDV	Heavy duty vehicle
HEVD	Hybrid electric vehicle diesel
HEVG	Hybrid electric vehicle gasoline
HVO	Hydro-treated vegetable oil
ICE	Internal Combustion Engine
IPCC	Intergovernmental Panel on Climate Change
IIT	Information integration technology
IWW	Inland waterways
kEUR	Kilo EUR = 10^3 EUR
LDV	Light duty vehicle
LHS	Left-hand side
LPG	Liquified petroleum gas
MEC	Marginal external costs
MEUR	Million EUR = 10^6 EUR
NREAP	National renewable action plan (in the frame of the Renewable Energy Directive)
NST/R	Nomenclature uniforme des marchandises pour les Statistiques de Transport, Revisée
NUTS	Nomenclature of territorial units for statistics
O-D	Origin-Destination
PHEV	Plug-in hybrid electric vehicle
PHEVD	Plug-in hybrid electric vehicle diesel
PHEVG	Plug-in hybrid electric vehicle gasoline
PIT	Personal income tax
pkm	Passenger-kilometre
PPO	Pure plant oil
RHS	Right-hand side

SAM	Social accounting matrix
SUT	Supply and Use table
tkm	Tonne-km
TTW	Tank-to-wheel
VA	Value added
VAT	Value added tax
vkm	vehicle-km
WTT	Well-to-tank

LIST OF SYMBOLS

CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
H_2	Hydrogen
HC	Hydro carbon
N_2O	Nitrous oxide
NH_3	Ammonia
$Nitr_{2.5}$	Nitrate aerosols with an aerodynamic diameter ≤ 2.5µm
NMVOC	Non-methane volatile organic compounds
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
O_3	Ozone
Pb	Lead
PM_{10}	Particulate matter with an aerodynamic diameter ≤ 10µm
PM_{10} pr	Primary particulate matter with an aerodynamic diameter ≤ 10µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter ≤ 2.5µm
$PM_{2.5}$ pr	Primary particulate matter with an aerodynamic diameter ≤ 2.5µm
PM_{coarse}	Particulate matter with an aerodynamic diameter 2.5-10µm
SO_2	Sulphur dioxide
$Sulph_{2.5}$	Sulphate aerosols with an aerodynamic diameter ≤ 2.5µm
TSP	Total suspended particles

1. SUMMARY

1.1. Context

Within the research programme ‘Science for a sustainable Development’ (SSD), cluster projects are defined. These clusters aim at gathering knowledge from different individual projects as well as giving support to policy makers. Energy is one of the core research fields. Furthermore, transport is one of the major energy consumers.

1.2. Objectives

The aim of the PROLIBIC project is to bring together acquired knowledge from 4 projects carried out within the research programme SSD: PROMOCO (Professional mobility and company car ownership), LIMOBEL (Long-run impacts of policy packages on mobility in Belgium), BIOSES (Biofuels Sustainable End uSe) and CLEVER (Clean Vehicle Research: Life Cycle Analysis and Policy Measures). It concerns results on both transport activities and environmental impact.

The second focus of the project consists of defining two scenarios, for which model runs are also performed with the LIMOBEL models.

Furthermore, we aspire to disseminate the results acquired within PROLIBIC and the 4 underlying projects with policymakers at both the national and regional level.

1.3. Policy conclusions

1.3.1. Lessons learned from the reference scenario (REF)

By 2030, all modes of transport – for both passengers and freight – will face an important increase in activity. The number of tonne-kilometres (tkm) increases by 68% and the number of passenger-kilometres (pkm) increases by 20% (compared to 2008). This evolution is the result of, among other things, the growing population and the increasing economic activity.

By 2030, 71% of the tkm are transported by trucks or vans and 80% of the pkm are transported by cars. This increase in road transport activity leads to additional costs related to congestion and the environment. Compared to 2008, the average speed on the road network decreases by 29% in the peak period and by 16% in the off-peak period. This fall implies longer travel times, which in turn generate economic costs and a loss of competitiveness, or additional difficulties with regard to the accessibility of economic activities.

The environmental impact is significant. Road transport is responsible for the majority of greenhouse gas emissions by transport (97% in 2030) and for local transport-related pollutants. In 2030, cars represent 73% of vehicle-kilometres (vkm) on the road, as opposed to only 15 % for trucks and vans. However, due to the introduction of Euro standards, the reference scenario projects lower direct emissions of local pollutants in 2030 compared to 2008. GHG emissions increase by 12% in comparison with 2008. The effect related to the increase in transport activity dominates the effect related to technological improvement aimed at advancing fuel efficiency (and, consequently, CO_2 emissions).

1.3.2. Lessons learned from the policy scenario (POL)

The POL scenario includes a basket of measures to reduce external transport costs, and environmental costs in particular. The impact of each of those measures on external costs goes through different channels. Road pricing plays a role in the modal choice and stimulates a modal shift towards more environmentally friendly transport modes. This modal shift leads to less vkm on the road, and, consequently, to less road congestion. The increase in excise duties on diesel up to the level of petrol is intended to better capture the higher local pollution generated by diesel cars compared to petrol cars. This measure leads, in particular, to a shift from diesel cars to petrol cars. It should be noted that direct injection gasoline vehicles makes its appearance. The share of Euro 6 direct injection gasoline vehicles may be important. This can be a bad thing for the emission of harmful ultrafine particles. This was not taken into account in the emission prognoses. A higher penetration rate of alternative motor fuel technologies acts directly on the composition of the car stock and on the related emissions. By introducing (exogenously) more cleaner cars in the car stock or more biofuels, emissions fall through technological improvement for the same passenger transport activity.

The results of the POL scenario show a positive impact on the congestion environment. Speed on the road increases by 23% in the peak period and by 3% in the off-peak period. This is explained, for passengers transport, by a modal shift from the road modes to other modes: the decrease in the number of passenger-kilometres by car solo (-7%) is compensated by an increase in pkm by train (+8%), tram (+13%), bus (+24%) and car pooling (+7%). As for freight transport, the POL scenario leads to a reduction in the number of tkm by LDV (-4%), which is compensated by an increase of the number of tkm by HDV (+1%). Owing to an increase in the load factor in the POL scenario, the number of vkm by HDV decreases, which reduces congestion. As a result of lower congestion and the introduction of an environmental tax on trains and barges, the number of tkm transported by these two modes decreases. The decline in the competitiveness of barges and trains could be avoided by raising the level of the road pricing at a level closer to the external marginal cost of road transport. However, such a sensitivity analysis has not been examined in the framework of this project. The POL scenario also leads to welfare improvement.

The impact of the POL scenario on GHG emissions, as presented in Figure 11, could be used in the political discussion on the reduction of transport-related greenhouse gas emissions. At least, it shows the significant environmental impact of a basket of measures.

However, we point to an issue related to the available infrastructure for public transport and inland navigation. By 2030, the number of tkm transported by barges and trains, although lower than the REF scenario, is more important than today. For passenger transport, the expected increase in the number of pkm transported by public transport is also not negligible and even more important in the POL scenario. Whether the available infrastructure will be sufficient to absorb the supplementary tkm and pkm transported is another question which cannot be answered by the PLANET model but needs (further) investigation.

To get a better insight in the results of the POL scenario, a detailed analysis of each of the policies included in the POL scenario should be performed. The welfare analysis could also be improved by taking into account tax recycling. This lies outside the scope of this project. The individual analysis of each policy and a deeper analysis of the welfare could be carried out in the future.

In addition, although national renewable energy action plans promised a strong increase of biofuels in transport, the current market conditions indicate that it will not be easy to reach these targets. There are high discussions whether crop based first generation biofuels need further support, and roll-out of cellulose based second generation biofuels seems to stay below expectation. So, the ambitious goals on biofuel share in transport in the POL scenario may be overestimated. Consequently a clear policy will be necessary to still achieve the postulated objectives on biofuels.

1.3.3. Company cars

The main lesson learned from the analysis on company cars is that the attention for the environment is growing, a phenomenon which is triggered by the fiscal pressure on CO_2 emissions and list prices, the financial crisis and the fact that companies want to be engaged in corporate social responsibility. Company car policies are thus in the first place determined by cost savings determined by the beneficial treatment of cars with lower CO_2 emission levels, with lower list prices or with cleaner fuels and technologies. In 2012 for example, we observe the first shifts away from diesel. This financial pressure has thus induced a mental shift towards greater environmental awareness and a rationalization of company car fleets. This has stimulated that company cars gain a more strategic position within companies and that CO_2 emission levels have decreased significantly. In order for the green transition to continue in the future and expand towards hybrid and electric vehicles, it is important that alternative fuel technologies are further improved and that environmental efforts remain rewarded by cost savings and/or revenue gains. In a broader context of social responsibility, it can be important for companies to consider other types of fringe benefits than the company car alone, for example by granting a mobility budget. However, the legal framework to support such systems is currently lacking, which forces such initiatives to stay small-scale phenomena for now.

1.4. Keywords

Transport model, transport policies, Ecoscore, environmental impact, company cars

2. INTRODUCTION

2.1. Context

Within the research programme ‘Science for a sustainable Development’ (SSD), cluster projects are defined. These clusters aim at gathering knowledge from different individual projects as well as giving support to policy makers. Energy is one of the core research fields.

The transport sector is an important energy-guzzler in the EU27. It accounts for about one third of all final energy consumption and for more than one fifth of greenhouse gas emissions. It is also responsible for a large share of urban air pollution as well as noise nuisance (EEA, 2012). Furthermore, the transport sector is nearly entirely dependent on oil products (98%). Annual energy consumption from transport grew continually between 1990 and 2007 in EEA member countries. Between 2007 and 2009, the total energy demand from transport fell by 4%, but the upward trend can easily be resumed due to economic growth.

Therefore, it makes sense to set up a cluster project bringing together expertise from different transportation projects.

2.2. Objectives

The aim of the PROLIBIC project is to bring together acquired knowledge from 4 projects carried out within the research programme SSD: PROMOCO (Professional mobility and company car ownership), LIMOBEL (Long-run impacts of policy packages on mobility in Belgium), BIOSES (Biofuels Sustainable End uSe) and CLEVER (Clean Vehicle Research: Life Cycle Analysis and Policy Measures). It concerns results on both transport activities and environmental impact.

The second focus of the project consists of defining two scenarios, for which model runs are also performed with the LIMOBEL framework.

Furthermore, we aspire to disseminate the results acquired within PROLIBIC and the 4 underlying projects with policymakers at both the national and regional level.

2.3. Bookmarker

The structure of this report is as follows:

Chapter 3: description of the project structure and the applied models, together with the general assumptions.

Chapter 4: definition of the reference scenario (REF) and presentation of the simulation results.

Chapter 5: presentation of the policy scenario (POL) followed by the discussions of the results.

Chapter 6: discussion of the analyses on company cars, including the effect of measures decided in autumn 2011 by the Federal Government.

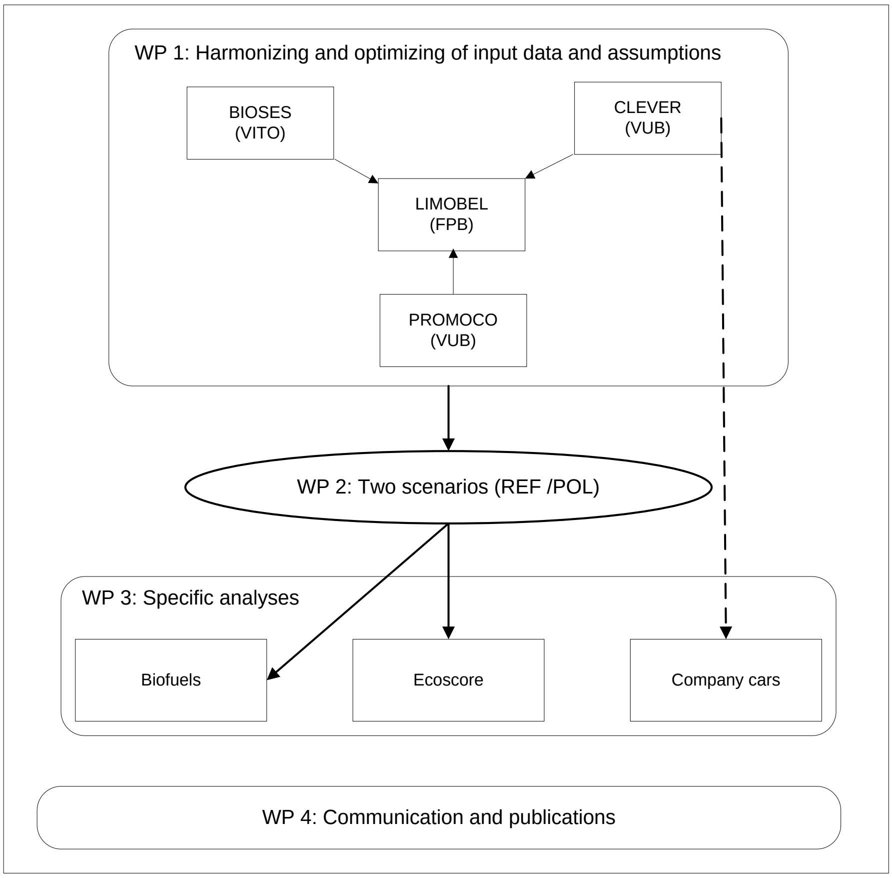
Chapter 7-9: overview of the dissemination and valorisation activities, together with the publications that were realised in the context of the PROLIBIC and the 4 underlying projects.

3. METHODOLOGY

3.1. Project structure

Figure 1 presents the flowchart of the cluster project PROLIBIC and the interaction between the different work packages and partners.

Figure 1: Flowchart of the PROLIBIC cluster



Work package 1 aims at converting the results of the different underlying projects into workable input for PROLIBIC. In work package 2, two scenarios are defined. Decisions are made consulting the follow-up committee of the project and stakeholders. The time horizon for the projections is 2030. In contrast to LIMOBEL, the effects of baskets of measures are quantified instead of those of individual measures. Next, in work package 3 specific analyses are performed to include bio-fuels and the environmental performance of the passenger car fleet in Belgium. Regarding company cars, the required data to introduce company cars in PLANET are not available. Therefore, a specific study on company cars based on the PROMOCO project and recent policy (2011) is included in this project.

Communication toward policy makers and a broader group of stakeholders (work package 4) is carried out by consulting the follow-up committee and by organizing two stakeholder workshops.

3.2. Model refining

3.2.1. The PLANET model

a. General overview

The PLANET model is a model of the Belgian Federal PLANning Bureau (developed thanks to a collaboration agreement with the SPF Mobility& Transport) that models the relationship between the Economy and Transport. The aim of the model is to produce:

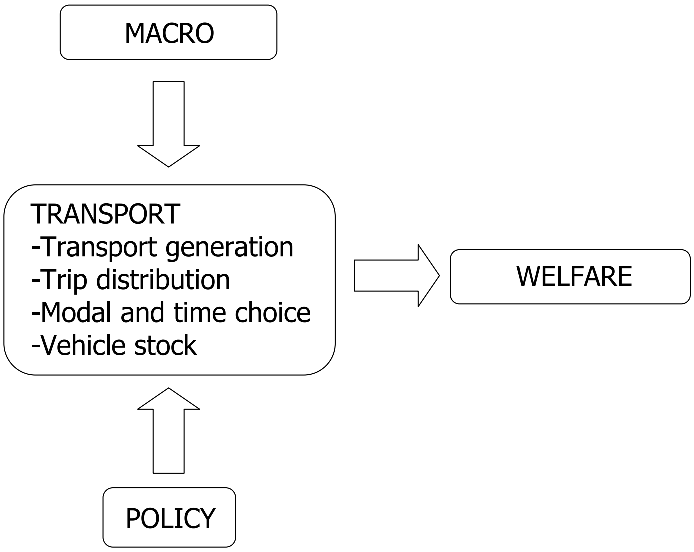
- medium- and long-term projections of transport demand in Belgium, both for passenger and freight transport;
- simulations of the effects of transport policy measures;
- cost-benefit analyses of transport policy measures.

The main strengths of the model lie in the long term horizon of PLANET, the simultaneous modelling of passenger and freight transport and the welfare evaluation of policies. The effects of transport on the environment are also highlighted in the model. An implication of the strategic nature of PLANET is that it necessarily operates at a more aggregate level than some of the other models generally used in transport analysis. In this section the main features of the PLANET model are shortly described.

The PLANET model consists of seven interrelated modules: Macro, Transport Generation, Trip Distribution, Modal and Time choice, Vehicle Stock, Welfare and Policy. For more details we refer to Desmet et al. (2008) and Mayeres et al. (2010).The relationships between these modules are summarised in Figure 2 and Figure 3.

The *Macro module* provides macro-economic projections at the level of the NUTS3 zones (“arrondissementen/arrondissements”) for Belgium. This is done by spatially disaggregating results of HERMES and MALTESE, two national projection models developed by the FPB. This information is supplemented by demographic and socio-demographic projections.

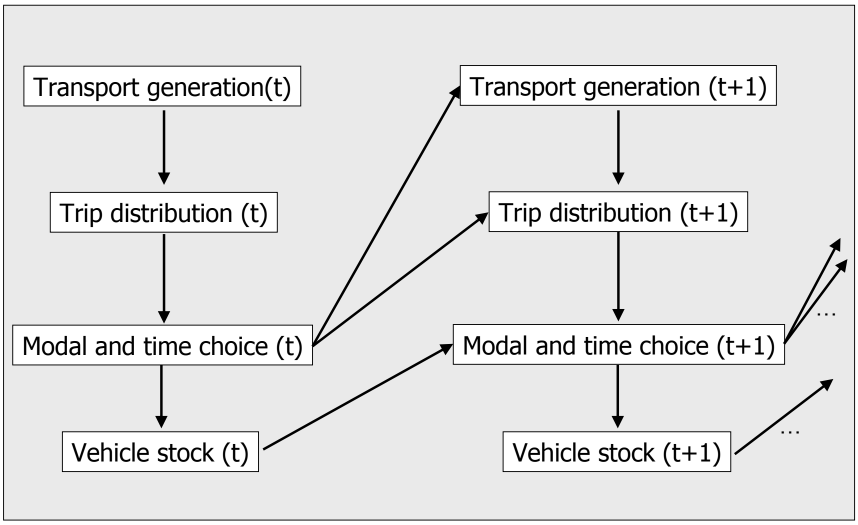
Figure 2: The PLANET modules



The *Policy module* summarises the policy instruments that are used in the business-as-usual and alternative scenarios. These consist of transport instruments (such as fuel taxes, ownership taxes or road pricing).

The transport core of PLANET consists of four modules (see also Figure 3). The *Transport Generation module* derives the total number of commuting and school journeys produced in and attracted to each NUTS3 zone. In addition, it makes a projection of the total number of passenger trips for “other” purposes and of the total tonnes lifted for national and international freight transport. The results of this module are fed into the *Trip Distribution module* which determines the number of trips taking place between each of the zones. In the next step *the Modal and Time Choice module* derives the modes by which the trips are made and the time at which the trips take place (in the case of road transport). These choices depend on the money and time costs of the different options. Travel time for the road modes is determined endogenously, by means of the speed-flow function that gives the relationship between the average speed of the road transport modes and the road traffic levels. The Modal and Time Choice module also provides information on the net government revenue obtained from transport. The *vehicle stock module* calculates the size and composition of the car stock. Its output is a full description of the car stock in every year, by vehicle type, age and (emission) technology of the vehicle. The vehicle stock is represented in the detail needed to compute transport emissions. The integration of the vehicle stock module in PLANET allows to better capture the impact of changes in fixed and variable taxes levied on cars. Among these impacts, the effect on the environment is of particular interest.

Figure 3: The link between the TRANSPORT modules in PLANET



Some of the outcomes of the four transport modules for year *t* are assumed to influence transport demand in year *t*+1. First of all, the demand for passenger trips for "other" purposes and of tonnes lifted in Belgium by transit freight transport (determined in the Transport Generation module) depends on the average generalised cost of these transport flows in the previous year (determined in the Modal and Time Choice module). Secondly, the generalised transport costs resulting from the Modal and Time Choice module influence trip distribution in the next year. Finally, the composition of the road vehicle stock has an impact on the monetary costs of road transport in the next year.

The *Welfare module* computes the effects of transport policy measures on welfare. It produces a cost-benefit analysis of the transport policy reforms summarised in the Policy module. It takes into account the impact on the consumers, the producers, the government and environmental quality.

b. Statement of the hypotheses

The version of the PLANET model (v3.2) used for the PROLIBIC project benefits from a complete update of the reference scenario realized within the collaboration agreement with the SPF Mobility and Transports. The update concerns:

- the macroeconomic and socio-demographic hypotheses;
- the transport data: the model has been calibrated on a more recent year – 2008. The origin and destination matrix for passengers and freight transport have been consequently updated;
- for freight transport, the use of the NST 2007 classification;
- an update of the costs of vehicles.

The new reference scenario will be published in September 2012. The publication will include a detailed description of the evolution of transport activity (passenger and freight) in Belgium up to 2030. A description of the hypotheses will also be included. Some of them have been defined within the PROLIBIC project, based on recent researches made by VITO. These are described in section 4.1.

The PLANET model (v3.2) integrates also the updated emission factors and environmental costs associated to each type of vehicles, as provided by the VITO in the framework of the LIMOBEL and PROLIBIC frameworks (see next section). In the PLANET model they are therefore considered as inputs.

c. Real Life Ecoscore

Within the PROLIBIC project, the Real Life Ecoscore has been integrated into the car stock module. This extension allows to describe the car stock with respect to the real life Ecoscore and to give an evolution of the Real Life Ecoscore in parallel to the evolution of the car stock. For more details, see section 3.2.3

d. CLEVER and PROMOCO as inputs for PLANET?

One of the objectives of PROLIBIC was to enrich the PLANET model with the use of particular inputs from the CLEVER and the PROMOCO projects. Unfortunately, except for the Real Life Ecoscore, none of them has been integrated by lack of compatibility. More particularly, the ‘policy pricing model’ from the CLEVER furnishes a set of price elasticities of switching to an environmentally friendlier car with respect to several tax instruments: registration tax, annual circulation tax, kilometre charge... In the current version of the PLANET model, environmentally friendlier cars are set exogenously by a share in the total sales of new cars. The choice of switching from an internal combustion engine to a cleaner car is not endogenously modelled. As concerns company cars, they are not considered in PLANET as a particular type of cars. The required data in order to introduce company cars in PLANET are not available. Consequently, a specific study on the company cars based on the PROMOCO project has been realized. The results are presented in Chapter 6.

3.2.2. The E-Motion model

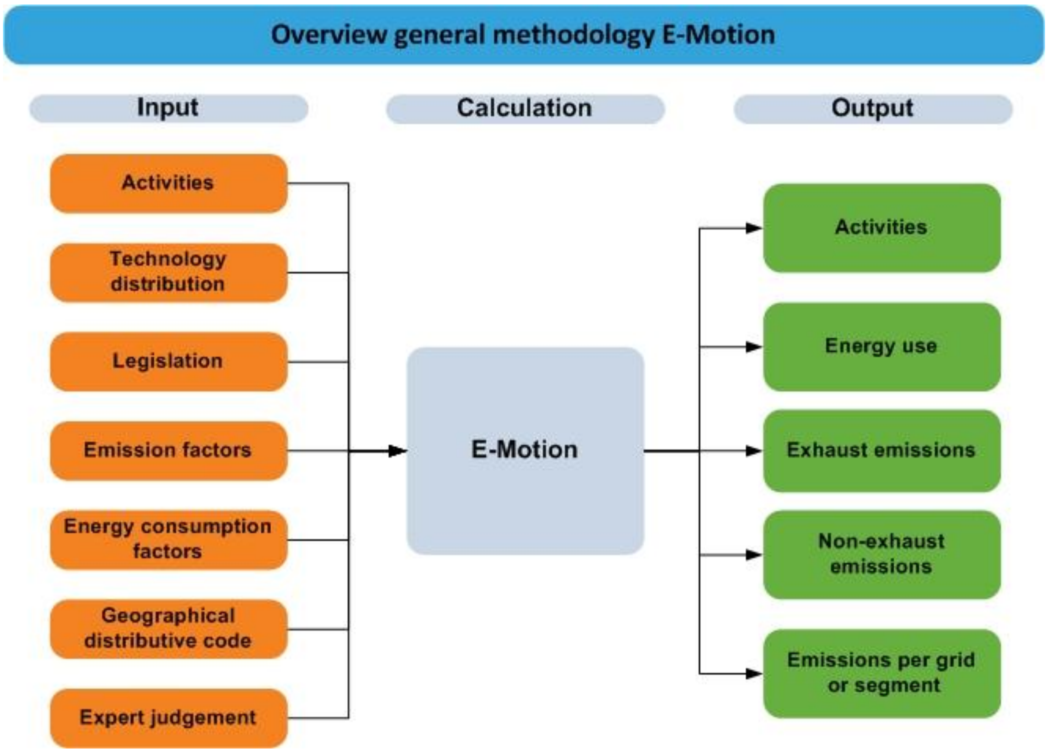
a. General overview

E-Motion is a framework to calculate energy consumption and emissions for road, rail, inland navigation and maritime transport, and off-road machinery and vehicles. It is developed by VITO with the support of the Flemish Environmental Agency, the Flemish Government (Environment, Nature and Energy Department) and the Belgian Science Policy Office.

The acronym E-Motion stands for 'Energy- and emission MOdel for Transport with geographical distributION'. E-Motion thus allows geographically distribute energy consumption and emissions from all transport modes for Flanders, the Walloon region and the Brussels-capital region. Not only for inventory studies, but also for scenarios emissions and energy consumption can be estimated.

Figure 4 gives an overview of the general methodology of all modules in E-Motion. Each module corresponds to one transport mode. E-Motion accounts for future technologies in all modules.

Figure 4: Overview of the overall 'E-Motion' model structure



E-Motion uses a bottom-up approach to quantify the environmental impact of different transport modes. Detailed statistical activity data – i.e. mobility and fleet data

- are transformed into the right format for the emission calculations. At this moment activities from the year 1990 up to 2010 are included in the model for all transport modes. Close watch on the evolution in technologies and mobility makes it possible to set up different scenarios for future years. Different scenario evaluations up to 2030 (De Vlieger et al., 2009) (Pelkmans et al., 2011) and vision exercises up to 2060 (Michiels et al., 2011) have already been performed.

The basic formula for calculating energy consumption and emissions from different transport modes is:

$$Emission_i = \sum_{t=0}^{n} activity_{t,i} \times emission\ factor_t$$

$$Energy\ consumption_i = \sum_{t=0}^{n} activity_{t,i} \times energy\ consumption\ factor_t$$

With *i = year*

t = technology

Emission and energy consumption factors are technology specific, e.g. fuel type, age, after treatment, retrofit are taken into account. The introduction level of new technologies, as well as the energy consumption level of new technologies, strongly depends on present and future legislations. The model calculates exhaust emissions and non-exhaust particulate matter and metal emissions. The following paragraphs elaborate more on mode-specific details of each module.

E-Motion **Road** relies on the COPERT 4 energy consumption and emission methodology for the conventional fuels (diesel, petrol and LPG) (EMEP/CORINAIR, 2007). For alternative fuels, VITO has integrated its own expertise (based on measurements and literature) and international network. Furthermore, we consider the effect of the CO_2 legislation for new passenger cars.

E-Motion **Rail** is founded on the methodology applied in Ex-TREMIS on the one hand (Chiffi et al., 2008), and on the methodology forwarded in EMMOSS on the other hand (Vanherle et al., 2007). The modules for **inland navigation** and **maritime navigation** are inspired by the Emission Registration and Monitoring of Shipping (EMS) protocols (Ministerie van Verkeer en Waterstaat, 2003a; Ministerie van Verkeer en Waterstaat, 2003b). Both have been updated with the latest available knowledge (De Vlieger et al., 2011).

Besides exhaust and evaporative emissions, E-Motion also provides emissions released during the production and transport of the different energy carriers for transport, also referred to as indirect emissions.

All modules in E-Motion not only aim at calculating total emission evaluations, but also calculate geographically distributed emissions. This is a necessary step to quantify the impact of traffic flows on air quality. Therefore, VITO made a tool for each transport mode to compute emission results for a specific part within a region, e.g. city, province, own definition of a grid, ... without having to define the corresponding activity data for this specific region.

Furthermore, user friendly databases are used to consult the results of scenario calculations and emissions factors, e.g. an SQL browser is used. Within PROLIBIC, these databases have been applied by VITO to provide input to FBP on fuel consumption and emission factors in both scenarios.

For more details on the E-Motion model we refer to the LIMOBEL study (De Vlieger et al., 2011).

b. Statement of hypotheses

In general, the assumptions on the *penetration of alternative motor fuel and vehicle technologies* in the fleet have been adopted from the LIMOBEL project. We did so, as no better insights were available to improve the uncertainty on the current assumptions. For *biofuels*, minor adjustments have been made to match updated historic numbers up to 2010 (see 4.1.3).

In general, *energy values and emission factors* applied within LIMOBEL have been adopted within the PROLIBIC scenarios. However, two important adjustments have been made concerning:

- NO_x emission factors for Euro 5 and 6 diesel cars
- Energy consumption of electric vehicles.

Recent literature on the environmental performance of *modern diesel cars* shows that the *NO_x emissions* of Euro 5 cars in real traffic situations are not lower than those of Euro 4 vehicles (Hausberger, 2010) (Weiss et al., 2011). Furthermore, for diesel cars, Hausberger (2010) reports an increase in NO_x emissions from Euro 1 to Euro 3, while Euro 4 NO_x emissions drop compared to the Euro 3 NO_x level. However, NO_x emissions of Euro 5 cars would be at the level of Euro 2 to 3. For other pollutants (HC, CO and PM) Euro 5 vehicles perform well.

According to Vonk and Verbeek (2010) Euro 6 diesel cars emit over 70% less NO_x in real traffic compared to Euro 5 diesel technology. Yet, they notice that these results are based on a limited sample of vehicles falling into a higher price range and only having a low mileage. So, the representativeness of this sample for the entire fleet in the long term is unknown. Still, we expect that the exhaust aftertreatment systems for NO_x reduction for Euro 6 diesel cars will be efficient enough to comply with the imposed Euro 6 limit in real traffic.

As a result, we have adjusted the NO_x emission functions for Euro 5 diesel cars to equal the average of Euro 2 and 3. For Euro 6 diesel cars we have implemented the NO_x limit value (0.08 g/km).

With regard to the *electric energy consumption factors* applied within LIMOBEL, we noted that these were rather low compared to figures reported in a recent European study (Kampman et al., 2011). Therefore, we screened recent literature on energy consumption of electric vehicles and analyzed the (limited) on-the–road measurements of electric vehicles conducted by VITO.

It appears that energy consumption of electric vehicles reported in the literature are typically refer only to the electricity required for the propulsion of the vehicle. Furthermore, the electric consumption is often measured in a theoretical test cycle, but not in real traffic conditions. Consequently, we have introduced a correction factor of 1.25 on electric energy consumption used for BEV and PHEV with respect to LIMOBEL.

In addition, minor modifications were made for inland navigation. First, due to a recently published article on the uncertainty of the operational performance of cruise control on inland navigation ships (Franckx et al., 2011), we have decreased the fuel improvement ratio attributed to the implementation of cruise control from 10% to 7%. Additionally, the sulphur content in the fuel has been adjusted based on new insights. Up to 2011, a maximum of 1000 ppm is assumed. As from 2011, a maximum of 10 ppm is adopted, according to the prevailing standard EN590.

Furthermore, in PROLIBIC the *indirect emission factors* from BIOSES have been applied for all fuel types in the PLANET model, instead of only for conventional fuels as was the case for the LIMOBEL model runs. An exception is electricity for which the assumptions are based on a FPB study (see 4.1.2).

3.2.3. The Real Life Ecoscore module

The Ecoscore (www.ecoscore.be) is an environmental indicator for vehicles. Its aim is to indicate the overall environmental friendliness of a vehicle. Therefore, various damage classes are considered: global warming, air pollution (impacts on human health and on ecosystems) and noise nuisance. In this section we start by presenting the Ecoscore methodology. Next, we describe how it has been implemented within PROLIBIC.

a. Description of Ecoscore

The well-to-wheel methodology is the basic principle underlying the Ecoscore: both tank-to-wheel (TTW; exhaust emissions resulting from driving a vehicle) and well-to-tank emissions (WTT; resulting from producing and distributing the fuel, whether this is gasoline, diesel, LPG, CNG or electricity) are taken into account. The methodology allows to compare vehicles with different propulsion technologies and using different fuel types. The emissions related to the production and recycling/waste processing phase of the vehicle are not included in the Ecoscore.

The Ecoscore is a number between 0 and 100: the higher the score, the smaller the impact on the environment. It is computed by considering greenhouse gas emissions, air pollutants, and noise. These categories receive a weight of 50%, 40% and 10%, respectively, while the effects from air pollution are further subdivided into impacts on human health (20%) on the one hand and impacts on ecosystems (20%) on the other hand.

The following greenhouse gases are considered: CO_2, CH_4 and N_2O. They are given a weight according to their global warming potential (GWP) as suggested by the IPCC. Furthermore, the Ecoscore considers the following air pollutants: PM, NO_x, CO, HC and SO_2. The weight of each of these pollutants is defined by using external cost figures (expressed in EUR/g of emission) from ExternE (Bickel et al., 2005). By attributing these weights, we take into account an average mix urban/extra-urban for the TTW emissions and we consider all WTT air pollutant emissions to take place outside the urban environment. The final variable necessary to calculate an Ecoscore is the engine noise during driving, expressed in dB(A).

More in particular, the following formula allows to calculate the Ecoscore:

$$Ecoscore = 100 * exp\left(-0.00357 * \left(A * CO_2 + B * HC + C * NO_x + D * CO + E * PM + F * FC + G * dB(A)\right) + H\right)$$

This formula replaces the earlier, more complicated method based on the comparison of each car with a reference vehicle (Timmermans et al., 2006). Within the new formula mentioned above, the required pollutant data (CO_2, HC, NO_x, CO and PM) should all be expressed in g/km, as mentioned on the vehicle's certificate of conformity. The variable 'FC' stands for the fuel consumption in l/100km for conventional cars (m^3/100km for CNG vehicles) and in kWh/100km for full-electric vehicles. As mentioned earlier, the driving noise variable is expressed as a number of dB(A), i.e. a unit taking into account the human ear sensitivity's dependence on the noise frequency.

The table below contains the coefficient values as they are used in the Ecoscore formula. These values are valid for all Euro standards, unless indicated otherwise by means of superscripts.

Table I: Ecoscore coefficients dependent on fuel type and Euro standard

	A	B	C	D	E	F	G	H
Gasoline	0.36	23.17	101.88	0.011	1407.75	7.01	0.333	-12.63*/-10.26†/-11.77**/-12.63‡
Diesel	0.36	23.17	101.88	0.011	1407.75	5.19	0.333	-10.34*/-13.03†/-12.71**/-12.39‡
LPG	0.36	23.17	101.88	0.011	1407.75	2.91	0.333	-11.55*,†/-11.87**/-12.63‡
CNG	0.36	23.17	101.88	0.011	1407.75	2.44	0.333	-10.68*,†/-11.00**/-11.76‡
Electricity	0	0	0	0	0	2.17	0.333	-13.33

Legend
* valid for Euro 0
† valid for Euro 1
** valid for Euro 2
‡ valid for Euro 3-6

The Ecoscore does not take into account biodiesel blends. The most important reason for this is that the blend percentage remains fairly low (5.47% volumetric blend in 2010 in Belgium). Only by using 100% biodiesel, emissions of PM would decline by about 50% and emissions of NO_x would increase by ca. 10%, whereas there will probably always be discussions about the CO_2 neutrality of biofuels. Consequently, so far, the Ecoscore formula does not take into account any biodiesel blend, so impacts are calculated using 100% conventional diesel. The same applies for bio-ethanol in petrol, where impacts are calculated using 100% conventional petrol.

b. Implementation of a Real Life Ecoscore

On the Ecoscore website, the indicator is calculated on the basis of the information on the certificate of conformity of each individual car. The emission factors and fuel consumption per km are based on test cycle results (type approval test for new vehicles).

In order to implement the Ecoscore within PROLIBIC, we have made two changes. First of all, since the PLANET model considers vehicle classes, rather than individual vehicles, the Ecoscore methodology has been applied to these classes. Secondly, we have used real life rather than test cycle emission factors and energy efficiency. This information is taken from the E-Motion model.

3.2.4. Policy pricing model

In the framework of the CLEVER project, a model was developed to evaluate whether separate and combined pricing measures, based on the environmental performance of vehicles, could bring along a substantial change in purchase behaviour towards environmentally friendlier cars.

For that purpose, a multidisciplinary approach was elaborated by applying the Contingent Valuation method according to the principles of the psychological Information Integration Theory (IIT) (Anderson, 1981, 1982, 1996, 2001, 2009). IIT is a theoretical and methodological framework that algebraically describes the sequence from the presentation of multiple information carriers (i.e., multiple pricing measures) to an actual behavioural response (i.e., purchase of an environmentally friendlier car). This combination has resulted in a ‘policy pricing model’ which enables the decision maker to estimate the population distribution willing to switch to an environmentally friendlier car based on different pricing levels of combined policy measures (registration tax, annual circulation tax, kilometre charge, congestion charge, parking tariff, fuel prices, scrapping premium) (Turcksin et al. , 2011). The model has been formalised as an equal weights averaging model, where scale values are based on the WTP values of each individual pricing measure (derived from CV method) and weight values are used to denote the importance of the pricing measure in the purchase decision (through elicitation on a 0-10 rating scale) (see Table II).

Table II: Policy pricing model (Realistic scenario, CLEVER)

Policy measure	Price Level	Switch	Weight
Registration tax (Euro)	500	30.61	4.63
Annual circulation tax (Euro/year)	500	31.02	5.03
Urban congestion charge (Euro/entrance)	-1	0	0
Kilometre charge (Euro/year)	-1	0	0
Parking tariffs (Euro/hour)	-1	0	0
Fuel prices (Euro/l)	1.5	18.07	5.94
Total switch (%)		**25.967**	

Note: The pricing levels and the associated switch are based on the WTP results of the individual measures. The weights are based on the weight elicitation on the 0-10 scale. The total switch (here 26%) is the switch that consumers would make to a more environmentally friendly vehicle with lower CO_2 emissions (cfr. Clean vehicle in the realistic scenario) if the level of the registration tax is 500 €, the level of the annual circulation tax is 500 €/year and fuel prices are 1,5 €/l.

This model enables to measure the adoption rate of environmentally friendly vehicles in several cases (e.g., in case where a kilometre charge could be introduced, vehicle taxes would be reformed based on the environmental performance of the car, etc.). However, the model results largely depend on the specifications of the pricing measures, the scenarios (e.g., realistic, progressive, etc.) and the definition of a ‘clean vehicle’ (e.g., low CO_2 emitting car, alternative fuel or drive train) that have been surveyed in the framework of the CLEVER project. That is why the ‘policy pricing model’ could not be integrated in the PLANET model.

3.3. Purchase prices alternative vehicles

The PLANET model needs to incorporate vehicle prices in order to estimate the monetary cost of cars. Purchase prices for conventional diesel en gasoline vehicles are widely available. However, finding typical purchase prices for vehicles with alternative (i.e., relatively new) propulsion technologies is less straightforward. We conducted a literature review in order to find acceptable alternative vehicle purchase prices, extended with future estimates. This subtask is described in more detail in Annex 1.

We estimated current (2010) and expected (2015 till 2030, in 5-year steps) purchase prices for alternative vehicles, i.e. vehicles using relatively new propulsion technologies. The technology types studied include battery-electric vehicles (BEV), fuel-cell electric vehicles (FCEV), hydrogen vehicles (H2ICE), hybrid electric vehicles (HEVG and HEVD for gasoline and diesel, respectively), and plug-in hybrid electric vehicles (PHEVG and PHEVD). They are compared to conventional gasoline (ICEG) and diesel (ICED) cars. We defined a lower and an upper limit for each of the resulting price levels. For each year, prices are displayed as an index compared to a conventional gasoline vehicle. For conventional diesel vehicles, we further distinguished between the different cylinder classes defined by COPERT (<1.4, 1.4-2.0, >2.0l).

A recent paper by Thiel et al. (2010) was used as the base document for our analysis, for several reasons. First of all, their cost analysis was based on a transparent cost breakdown for various technologies. Secondly, the numbers they report for 2010 are perfectly in line with real-life prices. Finally, their numbers are very close to the lower limits proposed by Edwards et al. (2007). The latter report was very useful for finding upper limit price levels as well. The paper by Pasaoglu et al. (2011) has proved to be a useful help when estimating certain price projections. The result of this literature review is the price matrix given in Table III, which should be interpreted as follows. For example, based on this literature review, we expect that a BEV will be 24-61% more expensive than a corresponding direct injection gasoline vehicle (ICEG) in the year 2020. The complete reasoning behind the composition of this table can be found in Annex 1.

Please remark that Table III contains price indices compared to the ICEG vehicle. This ICEG price index is each year normalized to 1. However, this does not imply that the absolute price level of the ICEG vehicle cannot change. The assumed absolute price fluctuation of the ICEG vehicle is listed in Table IV. By combining Table III and

Table IV, we are able to calculate an absolute (future) price estimate for each of the technologies considered within one specific COPERT vehicle class[1].

Table III: Price indices (upper and lower level where applicable) for various technologies compared with the ICEP reference vehicle (for which the value is annually normalized to 1)

technology\year	2010	2015	2020	2025	2030
ICEG	1	1	1	1	1
ICED <1.4l	1.18	1.18	1.18	1.18	1.18
1.4-2.0l	1.09	1.09	1.09	1.09	1.09
>2.0l	1.09	1.09	1.09	1.09	1.09
BEV	1.77-2.12	1.51-1.88	1.24-1.61	1.20-1.61	1.15-1.61
FCEV	1.55-2.13	1.51-2.13	1.24-1.98	1.20-1.98	1.15-1.98
H2ICE	1.21-1.26	1.14-1.26	1.08-1.24	1.08-1.24	1.08-1.24
HEVG	1.19-1.45	1.13-1.41	1.06-1.38	1.06-1.38	1.06-1.38
HEVD	1.28-1.55	1.22-1.52	1.15-1.50	1.15-1.50	1.14-1.50
PHEVG	1.55-1.86	1.38-1.73	1.21-1.57	1.18-1.57	1.15-1.57
PHEVD	1.64-1.97	1.46-1.83	1.24-1.61	1.20-1.61	1.15-1.61

Table IV: Suggested absolute price figures (EUR excl. VAT, in real terms) for the ICEG reference vehicle, split for the three COPERT vehicle classes (based on DIV and Thiel et al. (2010))

COPERT class\year	2010	2015	2020	2025	2030
<1.4l	10,429	10,304	10,179	10,092	10,005
1.4-2.0l	17,822	17,608	17,395	17,246	17,097
>2.0l	33,142	32,745	32,347	32,070	31,793

As concerns PLANET, the purchase costs and their evolution for ICEG and ICED cars come from the MIRA report which assumes an increasing purchase cost (De Vlieger et al., 2009). This growth is explained by the automotive industry’s legal obligation to increase the fuel efficiency of cars. For alternative motorisations, an additional cost is attributed in comparison with vehicles with internal combustion engine. This additional cost corresponds to the upper bound price indices presented in Table III. The upper bound seems to be the most suitable option for a reference scenario (conservative choice).

[1] For example, the average small (<1.4l) ICED vehicle is assumed to be 18% more expensive than an equivalent ICEG vehicle in the year 2030, whereas a BEV is expected to be 15-61% more expensive than the average (mid-size) ICEG reference vehicle at that time.

4. REFERENCE SCENARIO (REF)

In this section we first describe the assumptions made in the reference scenario (REF). Next, we present the simulation results of the REF scenario.

4.1. Description of REF scenario

As mentioned earlier, the version of the PLANET model (v3.2) used for the PROLIBIC project benefits from a complete update realized within the collaboration agreement with the FPS Mobility and Transport (FPB & FPS Mobility and Transport, 2012).

The reference scenario (REF scenario) assumes a continuation of current transport policies and the implementation of decided European policies such as more stringent emissions standards for motor vehicles and the introduction of biofuels. The macroeconomic projections underlying the scenario are taken from the HERMES (until 2020) (BFP, 2011a) and the MALTESE (CSF, 2011) models (from 2021 to 2030). From those projections, the reference scenario assumes an average annual GDP growth rate of 1.7%. Energy prices are based on the long-term energy projection for Belgium up to 2030 (BFP, 2011b). The energy mix for Belgian electricity production is also based on the long-term energy projection for Belgium up to 2030. As for the infrastructure, the REF scenario presupposes a constant capacity for road infrastructure. For rail and inland navigation, the existing network capacity is taken to be large enough to accommodate additional transport while keeping speed constant.

A detailed description of the reference scenario and of the related hypotheses have been published in September 2012 by the BFP and the FPS Mobility and Transport. The present report details only the hypotheses which have been defined within PROLIBIC and which are more particularly of interest for the objective of this project (the impact of transport on the environment).

4.1.1. Direct emissions

Table V presents the average direct emission factors for CO_2, NO_x en $PM_{2.5}$ for road transport in 2008 and their evolution by 2020 and 2030 (in % compared to 2008). The decreasing evolution is linked to the legal obligation of producing cleaner vehicles and to improve fuel efficiency. The impact of biofuels is also integrated in these average fleet emission factors.

The increase in NO_x emission factors for motorcycles may seem strange, but is a consequence of the emission legislation for these vehicles (97/24/EC; 2002/51/EC). Initially, the legislation focuses on reducing VOC emissions, to the detriment of the NO_x emissions. The applied COPERT (2007) emission functions give a very strong increase in the NO_x emissions from Euro 0 to Euro 1 (Stage I) and Euro 2 (Stage II) motorcycles.

Table V: Average direct emissions factors for road transport

Vehicles	Pollutants	2008 (g/ vkm)	2020 (variation in % w.r.t 2008)	2030 (variation in % w.r.t 2008)
Moto	CO_2	84.8	-13.4	-16.1
	NO_x	0.19	27.6	35.6
	$PM_{2.5}$	0.07	-52.3	-69.0
cars	CO_2	160.8	-16.3	-27.2
	NO_x	0.63	-51.3	-86.0
	$PM_{2.5}$	0.03	-73.3	-84.4
LDV	CO_2	222.3	-13.00	-16.5
	NO_x	1.07	-50.9	-71.2
	$PM_{2.5}$	0.08	-84.4	-96.5
HDV	CO_2	679.3	-8.2	-8.5
	NO_x	6.8	-85.1	-91.7
	$PM_{2.5}$	0.14	-88.7	-91.4

Source : VITO and PLANET V3.2

Similarly, Table VI presents the average direct emission factors for CO_2, NO_x and $PM_{2.5}$ associated to inland navigation and rail transport in 2008 and their evolution (in % compared to 2008). For trains, the decreasing evolution is explained by the increase in energy efficiency of diesel locomotives and by the technological evolution imposed by the Rail energy project (UIC, 2006) and by the European Directive 2004/26/EC. For barges, the decrease in direct emissions factors is generated by technological improvements.

Table VI: Direct emissions factors for inland waterway and rail transport

vehicles		Pollutants	2008	2020 (variation in % w.r.t 2008)	2030 (variation in % w.r.t 2008)
Barges	g/tkm	CO_2	27.5	-8.3	-8.5
	g/tkm	NO_x	0.48	-38.5	-44.9
	g/tkm	$PM_{2.5}$	0.01	-33.4	-40.2
trains – freight	g/tkm	CO_2	9.46	-4.69	-4.71
	g/tkm	NO_x	0.16	-22.35	-22.32
	g/tkm	$PM_{2.5}$	0.003	-16.29	-16.21
Trains - passengers	g/pkm	CO_2	3.54	-7.3	-7.3
	g/pkm	NO_x	0.03	-65.2	-65.2
	g/pkm	$PM_{2.5}$	0.001	-73.9	-73.9

Source: VITO and PLANET v3.2

4.1.2. Indirect emissions

The well-to-tank emissions of conventional fuels are as follows:

Table VII: Emission factors related to production and transport of energy forms (Belgian market) (in g/MJ)

Energy		CO_2eq			NOx			PM		
carrier	Source	2010	2020	2030	2010	2020	2030	2010	2020	2030
diesel	crude oil	14.5	16.0	17.5	0.021	0.018	0.018	0.002	0.002	0.002
petrol	crude oil	12.9	14.6	16.4	0.026	0.022	0.022	0.003	0.003	0.003
LPG	crude oil	8.1	8.5	8.9	0.020	0.017	0.017	0.002	0.002	0.002
kerosene	crude oil	14.2	16.1	18.1	0.299	0.256	0.256	0.002	0.002	0.002
diesel oil	crude oil	11.5	12.7	13.9	0.017	0.014	0.014	0.002	0.002	0.002
HFO	crude oil	10.1	11.3	12.6	0.017	0.014	0.014	0.002	0.002	0.002
biodiesel	mix	44.6	35.3	32.8	0.143	0.090	0.036	0.033	0.021	0.008
FT-diesel	farmed wood		6.9	6.9	0.101	0.063	0.025	0.021	0.013	0.005
bio-ethanol	mix	40.8	33.9	27.0	0.178	0.111	0.044	0.192	0.120	0.048
CNG	natural gas	12.6	15.0	17.4	0.011	0.011	0.011	0.001	0.001	0.001
biogas	mix	20.5	18.6	16.7	0.022	0.014	0.005	0.005	0.003	0.001
hydrogen	mix	112.8	139.0	126.1	0.078	0.084	0.090	0.003	0.005	0.007

For greenhouse gases (CO_2, CH_4 en N_2O), well-to-tank emissions are based on JEC (2008). JEC (2008) makes a distinction between different production and transport paths. In addition, for other pollutants we consulted (den Boer et al., 2008) for conventional fuels and Boureima et al. (2009) for biofuels and biogas. Gaps were completed with figures from SUSATRANS (De Vlieger et al., 2005).

For more information about the assumptions and calculation of indirect emissions we refer to the LIMOBEL and BIOSES reports (De Vlieger et al., 2011; Pelkmans et al. 2011).

Here, we give a short summary of the hypotheses from the PLANET reference scenario:

- CNG: the starting point are the IEA projections for gas supply in the EU. The share of European gas should drop from +/- 70% in 2005 to 25% in 2030, while the share of natural gas imported by pipeline should increase from 7% to 46%. One half of that should come from West-Siberia and the other half from the Caspian Sea area. The remaining part should be imported in the form of LNG.
- For biofuels, a large range of production paths also exist. In addition, there is a big difference between biofuels of the first and second generation. The reference scenario is a conservative scenario in which biofuels of the second generation are not yet included.

Indirect emissions related to electricity production are based on the long-term energy projection for Belgium up to 2030 (BFP, 2011b). The scenario assumes a gradual phasing out of Belgian nuclear energy. In 2030, electricity is produced from gas (40%), coal (32%), renewable energy sources (25%) and gasoil (3%). The emission factors from this scenario are summarized in Table VIII.

Table VIII: Emission factors related to electricity production (in g/kWh)

	2010	2020	2030
CO_2	183	201	332
NO_x	0.14	0.16	0.24
$PM_{2.5}$	0.02	0.03	0.05

Source: BFP, 2011b

Assumption: gradual phasing out of Belgian nuclear energy.

4.1.3. Biofuels

The share of biofuels in petrol and diesel consumption is presented in Table IX. Up to 2020, the evolution is based on the study “Support in the development of the Flemish

Climate Plan" (Cools et al., 2012). From 2021 onward, the level is maintained at the level of 2020. No biofuels are introduced for rail and IWW.

Table IX: Share of biofuels in gasoline and diesel consumption (in litre)

	2008	2015	2020	2025	2030
Petrol	1.21%	6.12%	6.48%	6.48%	6.48%
Diesel	1.36%	5.52%	5.78%	5.78%	5.78%

Sources : observation until 2010 (EUROSTAT), 2011-2020 : VITO based on Vlaams Klimaatplan, 2021-2030 level of 2020.

4.1.4. Share of cleaner vehicles in the total sales of new cars

The reference scenario assumes an increasing penetration rate of alternative vehicles (especially from 2020 onward). In 2030, the reference scenario takes into account a penetration rate of 15 % for petrol hybrids, 17 % for diesel hybrids and 5% for full electric vehicles in total new car sales (Table X). As for the hybrid cars, the reference scenario assumes a 10 % share of rechargeable hybrids in 2015, running up to 75% in 2030 (Table XI).

Table X: Share of hybrid and full electric cars in total new cars sales (in %)

	2010	2015	2020	2025	2030
Hybrids – petrol	0,6	5,60	10,00	13,60	15,00
Hybrids – diesel	0,0	0,80	5,50	11,40	17,30
Full electric	0.009	0.0	0.0	2.5	5

Sources : 2010 : DIV, SPF Mobility and Transport ; from 2015 based on MIRA REF (De Vlieger et al., 2009).

Table XI: Share of rechargeable and non rechargeable in the share of hybrid cars (in %)

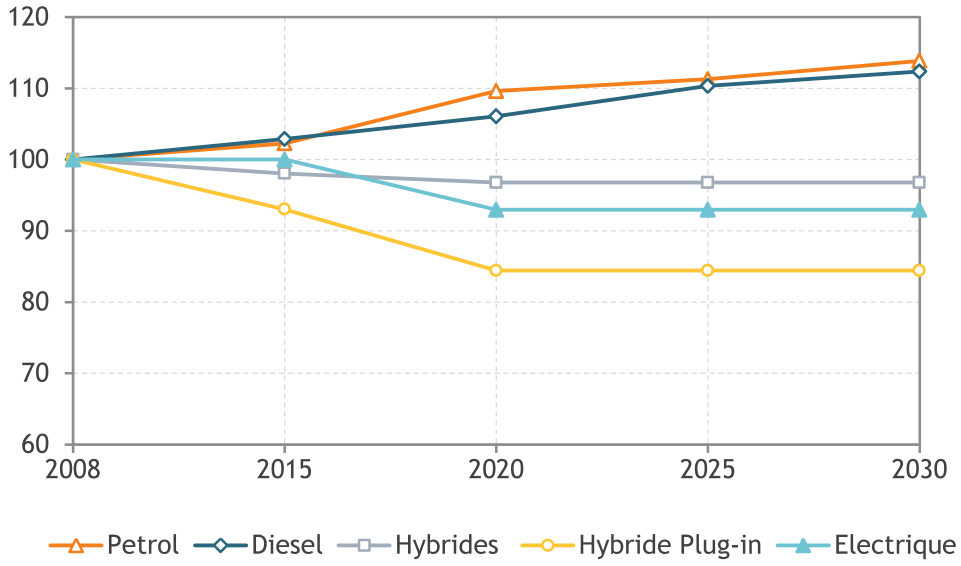
	2010	2015	2020	2025	2030
Non rechargeable	100	90	75	50	25
Rechargeable	0	10	25	50	75

Source : MIRA–S (2010) (De Vlieger et al., 2009). .

4.1.5. Cost evolution of cars

The hypotheses concerning the evolution of the purchase cost by car type are summarized in Figure 5. For diesel and petrol cars, the purchase cost increases in the future: 14 % for a petrol car and 12 % for a diesel car between 2008 and 2030 (FPB calculation based on MIRA). This growth is explained by the automotive industry's legal obligation to increase the fuel efficiency of cars. For alternative motorisations, an additional cost is attributed in comparison with vehicles with an internal combustion engine. This additional cost follows a downward trend up to 2030. Consequently, the purchase cost diminishes respectively by 3%, 16% and 7% for non-rechargeable hybrids, rechargeable hybrids and electrical cars (see section 3.3). Even with this decreasing trend, the purchase cost for cars with alternative motorization remains higher than for diesel or petrol cars.

Figure 5: Evolution of the purchase cost of cars



Source: PLANET V3.2

4.2. Results of the simulation

Preliminary remark: A detailed description of the reference scenario is given in FPB & FPS Mobility and Transport (2012). This section focuses on the variables which are of particular interest in the framework of the PROLIBIC project (general evolution of passengers and freight transport activity, emissions from transport, car stock and ecoscore).

4.2.1. Transport Activity

The reference scenario projects a substantial growth in both freight and passenger transport in Belgium (Table XII). From 2008 to 2030, the total number of pkm increases by 20%. This evolution is the result of a 40% increase of the pkm for school, 21% for 'other purposes' and 11% for commuting. Seven means of transport are considered for passengers: car, motorcycle, train, tram, bus, metro and nonmotorized transport. For transport by car, a distinction is made between cars with one occupant (car solo) and cars with at least 2 occupants (car pool).

Table XII: Transport projections between 2008 and 2030 – Reference scenario

	2008	2030	Increase (in%)
Passenger transport			
Passenger-km in Belgium (billion)			
Commuting	33.7	37.4	11%
School	8.6	12.1	40%
Other purposes	79.7	96.7	21%
Total	122.0	146.2	20%
Share of transport modes in passenger-km in Belgium			
Car with 1 passenger (car solo)	50	54	
Car with at least 2 passengers (car pool)	31	26	
Train	7	9	
Bus	6	4	
Tram	0.8	0.8	
Metro	0.4	0.6	
Non-motorised	2.8	3.9	
Motorcycle	1.4	1.4	
Freight transport			
Tonne-km in Belgium (road, rail, inland navigation)(billion)			
National	27.5	41.6	52%
From the rest of world to Belgium	13.8	24.3	76%
From Belgium to the rest of the world	14.3	27.8	94%
Transit without transhipment	10.1	16.9	67%
Total	65.7	110.7	68%
Modal share in tonne-km in Belgium			
Truck	71	67	
Van	4	4	
Train	11	15	
Barges	13	14	

Source: PLANET V3.2, FPB & FPS Mobility and Transport (2012)

The dominant position of the car in passenger transport should not change between 2008 and 2030 (81% of pkm in 2008 and 80% of pkm in 2030). Between the two years, there is a slight modal shift from car pool towards car solo. The share of car pool pkm decreases from 31% in 2008 to 26% in 2030 and the share of pkm driven by car solo increases from 50 % in 2008 to 54 % in 2030. From 2008 to 2030, the shares of rail and of non-motorised modes grow respectively from 7% to 9% and from 3% to 4%.

The total number of tkm in Belgium increases by 68% in 2030 compared to 2008. This growth is explained by an increase in both tkm transported for national transport (+52%) and tkm transported from and to Belgium (+76% and +94%, respectively) and by an increase in transit without transhipment (+68%).

As for the modal share of tkm transported on the Belgian territory, road transport remains dominant over the projection period, with however a small reduction between 2008 and 2030 (75% in 2008 and 71% in 2030). The small reduction is compensated by an increase in the share of tkm transported by trains (11% in 2008 and 15% in 2030) and by barges (13% in 2008 and 14% in 2030).

4.2.2. Emissions

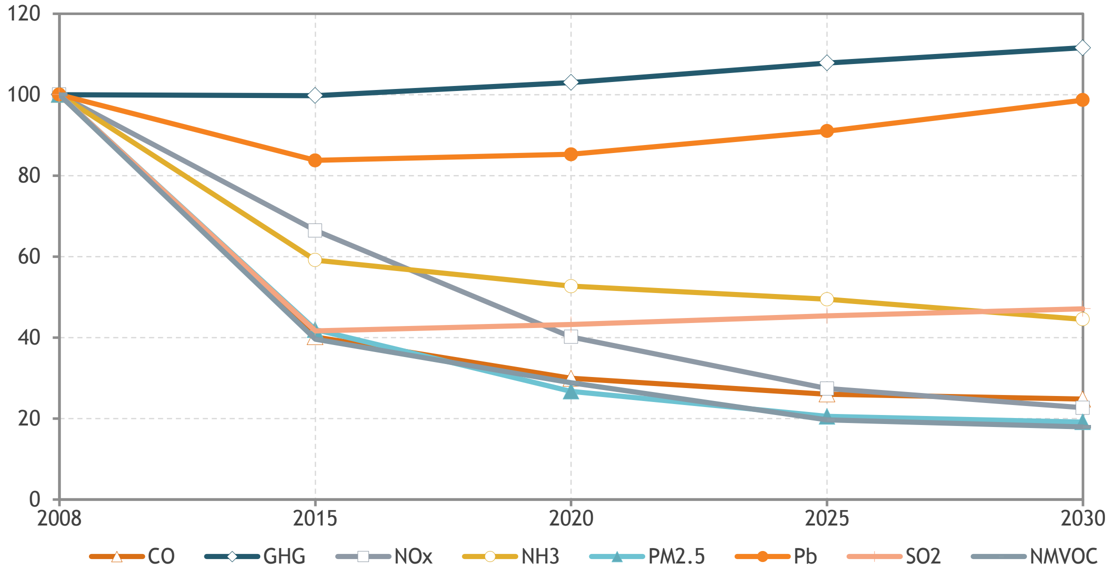
The evolution of *direct emissions*, including the impact of biofuels, related to freight and passenger transport is presented in Figure 6. During the first years of the projection, direct emissions of local pollutants (CO, NO_x, NMVOC, $PM_{2.5}$, SO_2 and Pb) decrease due to the implementation of environmental policies (European emission standards or “euro standard” in short and fuel specifications). Thereafter, the increase in transport activity outweighs technological improvement and then emissions start to increase or remain at a stable level. Beside the introduction of a very limited amount of alternative motor fuel technologies, no tightening of the emission standards (euro 6/VI) is assumed. Direct emissions of local pollutants, however, remain lower than the 2008 level on the whole period. GHG emissions (CO_2, CH_4, N_2O) increase immediately to attain a level which is 12% higher in 2030 than in 2008. The effect related to the increase in the transport activity dominates the effect related to technological improvement aimed at reducing CO_2 emission for transport.

Contrary to direct emissions, the evolution of *indirect emissions* (Figure 7) follows immediately the increase in the transport activity. The increase in indirect emissions is also linked to the energy production process which assumes a gradual phasing out of Belgian nuclear energy. For NO_X, NMVOC and SO_2, the 2030 level remains equal or slightly higher than the 2008 level.

For particulate matter and GHGs, an increase by respectively 33 % and 62 % in 2030 (in comparison with 2008) is projected.

Figure 6: Evolution of direct emissions related to freight and passenger transport (road, rail and inland navigation) – reference scenario

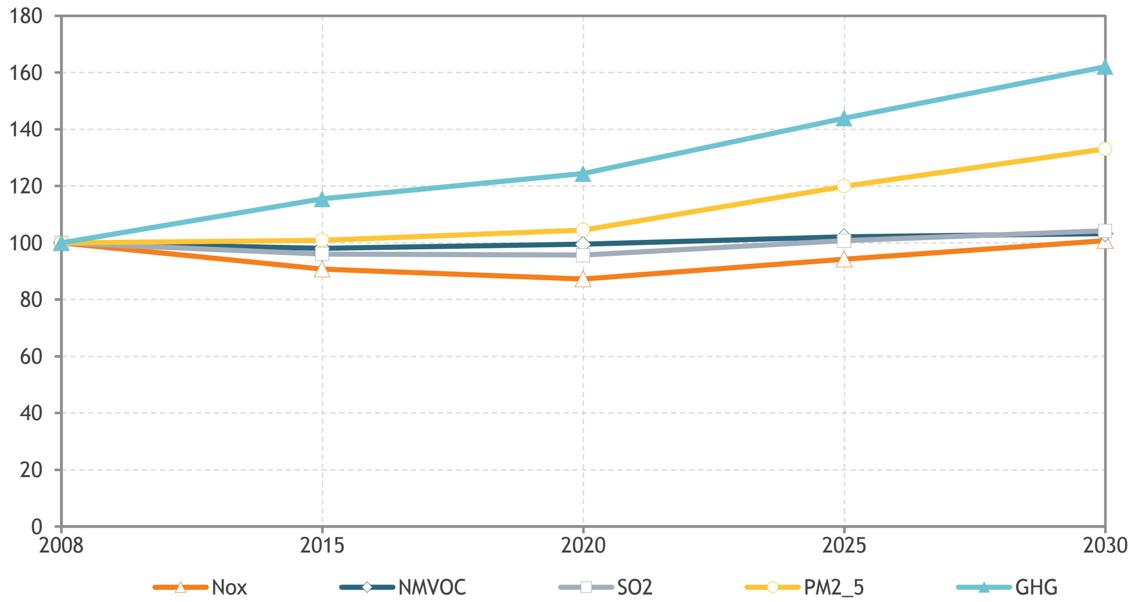
2008=100



Source: PLANET V3.2, FPB & FPS Mobility and Transport (2012).

Note: from 2009 on, figures are projections, not statistics. The projection includes the impact of biofuels.

Figure 7: Evolution of the indirect emissions related to freight and passenger transport (road, rail and inland navigation) – Reference scenario

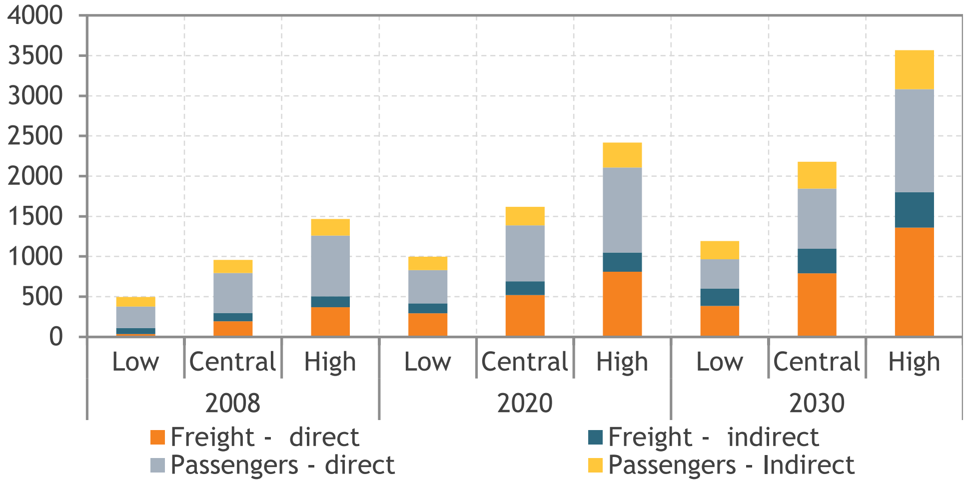


Source: PLANET V3.2, FPB & FPS Mobility and Transport (2012)

Note: from 2009 on, figures are projection, not statistics

Finally, Figure 8 presents the evolution of the external environmental costs between 2008 and 2030. A distinction is made between the costs related to the direct and indirect emissions of passenger and freight transport. In 2010, the environmental costs range between 496 and 1466 depending on valuation (low, central, high) for greenhouse gas emissions. In 2030 these costs are projected to be 128% to 143% higher according to the valuation of the greenhouse gas emissions. The growth is mainly due to the increase in damage costs over time (due to changes in background concentrations, population and GDP per capita) and to the increase in the greenhouse gas emissions.

Figure 8: Evolution of the external environmental costs (MEUR) related to transport – Reference scenario

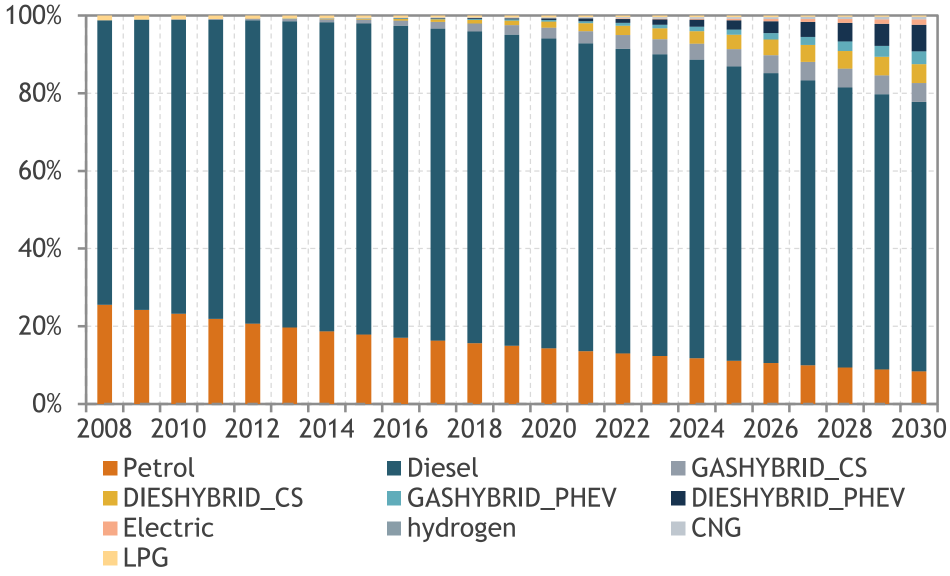


Source: PLANET V3.2

4.2.3. Car Stock

Figure 9 shows the evolution of the distribution according to the car type in the total number of vehicle-km. The share of internal combustion engines (petrol and diesel) is decreasing as they are being replaced by cleaner cars. Remember that the evolution of the share of alternative cars is dependent upon the penetration rate of these cars, which is exogenously defined (see section 4.1.4).

Figure 9: Repartition of the types of cars in the total number of vehicle-km – Reference scenario



Source: PLANET V3.2, FPB & FPS Mobility and Transport (2012).

5. POLICY SCENARIO (POL)

In this section we first describe the policy measures taken in the policy scenario (POL). Next, we present the simulation results of this scenario and make a comparison with the REF scenario. We also discuss the Real Life Ecoscore, biofuels and environmental and social welfare.

5.1. Description of POL scenario

The scenario corresponds to a basket of policy measures described below:

1. **Harmonisation of excise duties on petrol and diesel**. The excise level (€/l) of diesel increases up to the level of petrol in 2015, namely 0.60 €'08/l. The motivation is related to the fact that the environmental cost related to diesel consumption is often higher than that related to petrol use.
2. **Road and environmental pricing**. From 2015 on, road pricing for trucks (HDV), vans (LDV), cars and motorcycles is introduced. The tax differentiates between peak periods (P) and off-peak periods (OP) and applies to the complete road network. The levels of road tax are presented in Table XIII. The euro-vignette is abolished, but the registration tax and the annual circulation tax are maintained. As from 2015, the POL scenario assumes also an environmental tax for rail and inland navigation which corresponds to their respective environmental cost.

Table XIII: Level of the road tax in the POL scenario

Transport mode	Period	Level of the road tax
HDV	P	0.3 €/km
	OP	0.07 €/km
LDV	P	0.24 €/km
	OP	0.06 €/km
CAR	P	0.14 €/km
	OP	0.02 €/km
Motorcycle	P	0.10 €/km
	OP	0.01€/km

3. **Share of alternative motor fuel technologies (cars).** The penetration rate of alternative motor fuel technologies in new car sales is based on the MIRA-EUROPA scenario[2]. The hypotheses selected for the POL scenario are presented in Table XIV.

[2] Due to methodological specificities of the PLANET model, the hypothesis of the MIRA-EUROPA scenario cannot be exactly reproduced.

Table XIV: Share of alternative motor fuel technologies (cars) in new car sales – POL scenario

%

	2020	2030
Hybrids – petrol	21	24
Hybrids – diesel	8	25
Full electric	0	7

Source: FPB on the basis of EUR scenario of MIRA-S (2010)

4. **Biofuels**. The POL scenario assumes a higher share of biofuels and also considers second generation biofuels. The evolution, based on the NREAP and on the BIOSES project, is presented in Table XV. However, in PROLIBIC, E85[3] through promotion of flexfuel vehicles and fuel infrastructure is not included, maintaining the share of bioethanol in petrol at about 15vol%, which is only 10% energy-based.

Table XV: Share of biofuels in the POL scenario (%vol)

In %vol	Generation	2015	2020	2025	2030
biodiesel	First	7.4	9.4	11.0	11.0
	Second	0	0.9	2.1	5.3
bio-ethanol		13.0	14.7	14.7	14.7

Sources: 2015-2020: NREAP; 2025-2030: BIOSES

5.2. Results of the simulation

This section presents the impact of the POL scenario on passenger and freight transport, speed, congestion, tax revenues, emissions, the Real Life Ecoscore and welfare. The results are presented for the year 2030 in percentage change compared to the reference scenario. Note that the change in transport activity is mainly due to the introduction of road pricing and, to a lesser extent, to the harmonisation of excise duties on petrol and diesel. The impact on emissions is caused by the four policies included in the POL scenario.

5.2.1. Transport activity

a. Passenger transport

The impact of the POL scenario on the passenger transport is presented in Table XVI.

[3] E85= petrol blend containing 50-85vol% bioethanol

Table XVI: Impact of the POL scenario on passenger transport in 2030

Difference in % compared to the reference scenario

		Reference scenario (absolute value)	POL scenario (difference in %)
Passenger-km	Total	146153	-0.3%
(mio.)	Foot/bicycle	5697	-6.1%
	Rail	12830	7.9%
	Car solo	79386	-6.8%
	Car pool	38230	7.0%
	Bus	5982	24.4%
	Tram	1102	12.8%
	Metro	813	-6.5%
	Moto	2112	6.5%
	Peak	42960	-0.9%
	Off-peak	103193	-0.0%
Vehicle-km (1000 per day)	Total	261508	-4.5
Peak	Car solo	62613	-11.1%
	Car pool	5738	8.9%
	Bus	167	48.8%
	Tram	14	31.9%
	Moto	1280	8.8%
Off-peak	Car solo	154884	-5.1%
	Car pool	31827	6.8%
	Bus	407	8.6%
	Tram	72	5.7%
	Moto	4506	5.9%

Source: PLANET V3.2

The basket of measures induces a modal shift from car solo (-7%) to trains (+8%), car pooling (+7%), bus (+24%) and tram (+13%). Due to the increase in average speed on the road (see Table XIX), the number of pkm by foot or bicycle and in metro both decreases by 6%. This decrease is explained by the fall in relative time cost associated to road transport and by the fact that transport by foot or bicycle and by metro is particularly sensitive to the time cost. The 6% increase of pkm by motorcycle is explained by the decrease in the time cost (increase in the speed), which is higher than the increase in the monetary cost (introduction of a tax per kilometre). Due to the differentiation of road pricing by period, the decrease in the number of vkm by car solo during the peak period (-11%) is higher than during the off-peak period (-5%).

b. Car stock

The changes in the share of each car type in the total number of vkm are presented in Table XVII in percentage point compared to the reference scenario. By definition in the POL scenario, the penetration rate of alternative motor fuels technologies is higher than in the REF scenario. Consequently, their respective share in the total number of vkm increases, at the expense of internal combustion engines (petrol and diesel). Due to higher excise duties on diesel, the share of vkm by diesel internal combustion engines decreases even more than the share of petrol. There is a transfer from ICE diesel to ICE petrol internal combustion engines. This is further illustrated by pie charts for the years 2008 and 2030 (see Figure 10).

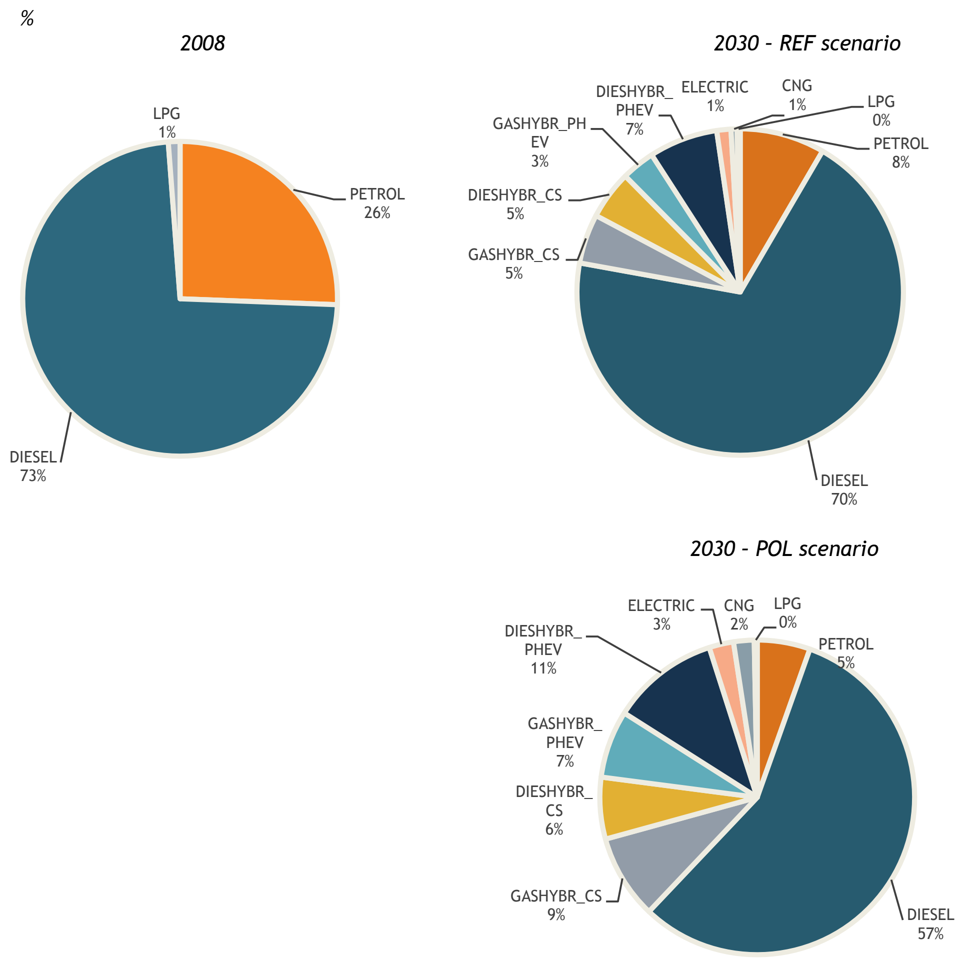
Table XVII: Share of each car type in the total number of vkm in 2030

(Difference in percentage compared to the. reference scenario)

	REF (%)	POL (difference in percentage point)
Internal combustion engine – petrol	8.4	-2.9
Internal combustion engine –diesel	69.3	-12.9
Hybrids non rechargeable - petrol	4.9	3.7
Hybrids non rechargeable -diesel	4.8	1.5
Hybrids rechargeable - petrol	3.3	3.6
Hybrids rechargeable -diesel	6.8	4.2
Full electric	1.4	1.0
CNG	0.6	1.4
LPG	0.3	0.0

Source: PLANET V3.2

Figure 10: Share of each car type in the total number of vkm in 2008 and 2030 (POL scenario)



Source: PLANET V3.2

c. Freight transport

The impact of the POL scenario on freight transport is presented in Table XVIII. The POL scenario, and road pricing in particular, leads to a modal shift from LDV (-4%) to HDV (+1%), mainly because trucks have higher load factors. Due to higher speed on the road (see Table XIX) and the introduction of an environmental tax for rail and inland navigation, transport by train and by barge becomes less attractive (-6% and -16%, respectively). The more important fall in tkm transported by barge (compared to train) is partly explained by the higher environmental tax. The POL scenario also has an impact on the average vehicle load. More particularly, due to road pricing, the average load of HDV increases by 11% in the peak period and by 3% in the off-peak period. Similarly, the average load of LDV increases by 23% in the peak period and by 6% in the off-peak period.

Table XVIII: Impact of the POL scenario on freight transport in 2030

Difference in % compared to the reference scenario

		Reference scenario (absolute value)	POL scenario (difference in %)
Tonne-km in Belgium (mio.)	Total	110651	-2.6%
	HDV	74219	1.1%
	LDV	4555	-4.5%
	Inland Nav.	15596	-16.1%
	Rail	16281	-6.1%
Vehicle-km in Belgium	Total	31193	-8.7%
	Peak - HDV	2580	3.9%
	Peak- LDV	3966	-19.0%
	Off-peak HDV	10395	-4.8%
	Off-peak LDV	14253	-11.1%

Source: PLANET V3.2

5.2.2. Congestion, external marginal cost and tax revenues

Table XIX shows the impact of the POL scenario on speed, external marginal cost and tax revenues. The average speed on the road increases by 23% in the peak period and by 3% in the off-peak period. The marginal external congestion cost per vkm by car logically follows the same trend: -30% during the peak period and -8% during the off-peak period. These reductions result from the lower total number of car vehicle-km on the road due to the introduction of road pricing. Not surprisingly, owing to road pricing and, to a lesser degree, to higher excise on diesel, yearly tax revenues increase by 171% for passenger transport and by 116% for freight transport. Note that the introduction of alternative motor fuel technologies decreases, ceteris paribus, tax revenues from diesel and petrol. However, this revenue loss is marginal compared to the gain related to road pricing.

Table XIX: Impact of the POL scenario on speed, external marginal congestion cost and tax revenues in 2030.

Difference in % compared to the reference scenario

		Reference scenario (absolute value)	POL scenario (difference in %)
Speed (km/h)	Peak	26.9	23.5%
	Off-peak	60.7	3.1%
Marginal external congestion cost per vkm - €'08 per car vkm	car peak	1.7	-30.1%
	car off-peak	0.2	-7.8%
Yearly tax revenues on passengers transport (mio. €'08)	Total	2672	171.5%
	Car pool	676	102.5%
	Car solo	3915	103.2%
	Moto	110	78.6%
	Bus	-741*	19.3%
	Tram	-271*	10.8%
	Metro	-133*	-3.6%
	Rail	-885*	7.8%
Yearly tax revenues on freight transport (mio. €'08)	Total	3921	116.0%
	HDV	3207	89.3%
	LDV	713	226.2%

Source: PLANET V3.2

*: the negative amounts correspond to subsidies. As the transport by bus, tram and train increases in the POL scenario, the subsidies increase too. On the contrary, the transport by metro decreases and the subsidies also.

5.2.3. Environment

The impact of the POL scenario on emissions (direct, indirect, non-exhaust and total) is presented in Table XX. Except for CH_4, total emissions decrease significantly in the POL scenario (from -5% to -28%, depending on the pollutant). The total impact consists of the sum of the individual impact of each of the four policies. Road pricing mainly impacts emissions through modal shift, higher load factors for HDV and LDV and higher car occupancy rates. The harmonization of diesel and petrol excises increases the share of petrol cars in the total stock. Note, however, that a higher share of petrol cars induces more CH_4 emissions. A more important penetration rate of alternative cars results in lower emissions related to passenger transport. Finally, increasing the share of bio-fuels also impacts the environment, independently of the other policies.

Table XX: Impact of the POL scenario on the emissions in 2030

(Difference in % compared to the reference scenario)

	Direct	Indirect	Non-exhaust	Total
CO_2	-23.8	-5.2	0	-19.3
CO	-11.5	0	0	-11.5
NO_x	-12.0	-11.5	0	-11.9
NMVOC	-4.3	-15.6	0	-14.3
N_2O	-28.5	0	0	-28.5
CH_4	1.7	0	0	1.7
SO_2	-14.7	-14.9	0	-14.9
TSP	0	0	-5.0	-5.0
PM10	0	0	-5.1	-5.1
PM2.5	-22.1	-7.6	-5.3	-9.6
Pb	-17.0	0	0	-17.0
NH_3	-9.7	0	0	-9.7

Source: PLANET V3.2

Figure 11 focuses on greenhouse gas emissions. The line in this figure represents the evolution of direct GHG emissions of the transport sector (road, inland navigation and rail) in the reference scenario. The evolution of these emissions in the POL scenario is visualized by bar charts per means of transport. This figure highlights the significant impact of the POL scenario on the GHG emissions. While in the reference scenario, GHG emissions of transport increase by 12% in 2030 (compared to 2008), the POL scenario leads to a 15 % decrease of GHG emissions (compared to 2008). This decrease is mainly attributable to the reduction of GHG emissions related to cars. Note that GHG emissions related to HDV and to a lesser extent to LDV, still increase in the POL scenario, but not sufficiently enough to offset the decrease caused by cars.

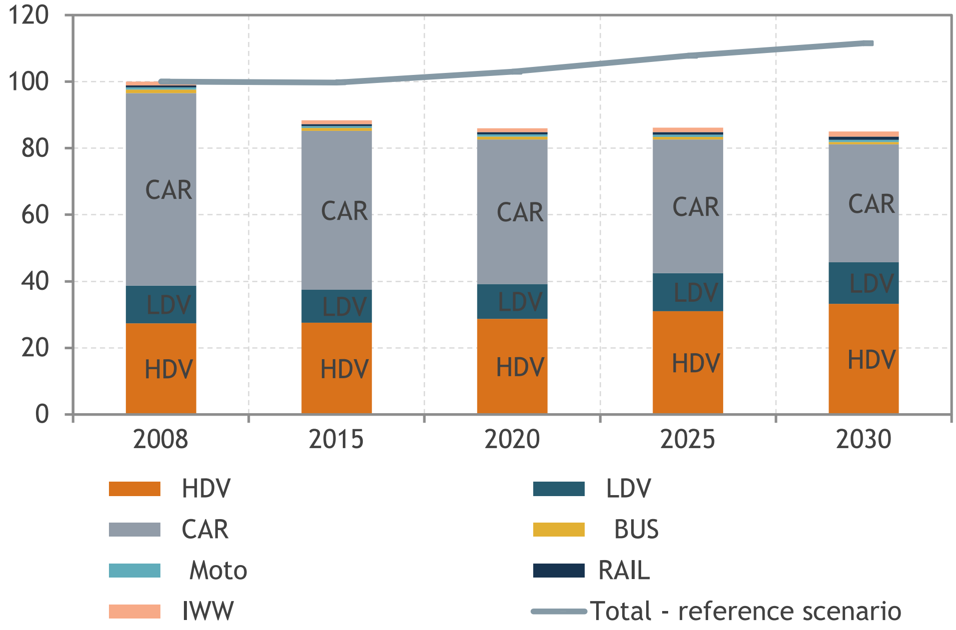
Although emission estimates for the whole transport sector are not performed, it is interesting to verify the evolution of GHG emissions from road transport, rail and inland navigation to the indicative reduction percentages mentioned in the White Paper (EC, 2011). In this paper, the European Commission points to the need to reduce GHG emissions from transport by at least 60% by 2050 with respect to 1990. The mid rate GHG reduction would be 20% in 2030 compared to the 2008 level.

In addition, we note that these indicative reduction percentages are figures at EU27 level and not for each member state separately. However, it is interesting to check how Belgium is doing in terms of GHG reduction in transport.

Figure 11 illustrates that even within the POL scenario a 20% reduction by 2030 is not achieved (exceeded by 5 % in absolute terms). Consequently, short term policy makers should take further measures such as managing traffic and promoting public transport and co-modality, but also further stimulating low carbon fuels and more efficient vehicle technologies.

Figure 11: Impact of the POL scenario on the direct GHG (CO_2, CH_4, N_2O) emissions

ktonnes (total 2008=100)



Source: PLANET V3.2

5.2.4. Real Life Ecoscore

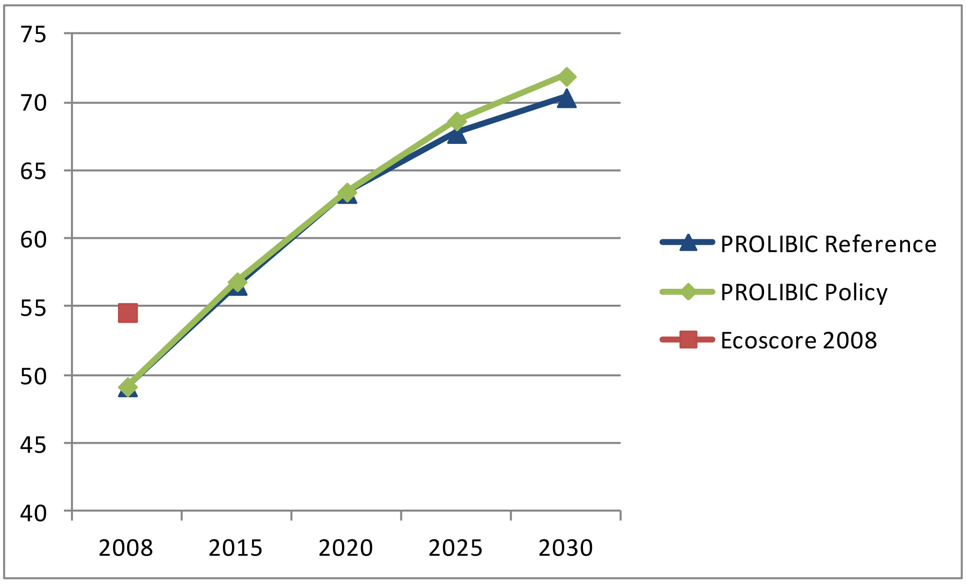
The evolution of the average Real Life Ecoscore of the total car stock in the PROLIBIC reference and policy scenario is presented in Figure 12. Also the Ecoscore of the car fleet in 2008 based on the test cycle emissions (54.6) is plotted.

In the reference scenario the Real Life Ecoscore passes from 49.2 in 2008 to 70.4 in 2030. This positive evolution is explained by the introduction of Euro 5 and Euro 6 emission standards, the increased fuel efficiency (which decreases emissions) and the introduction of cleaner cars.

Within the policy scenario the Real Life Ecoscore rises to 71.9 in 2030. This is slightly higher (+1.5) than in the reference scenario. That is due to increased share of alternative motor fuel technologies in the policy scenario and to a lesser extent the harmonisation of excise duties on petrol and diesel. The small difference between the ecoscore of REF and POL scenario is explained by the application of the same emission limits for new vehicles (euros 6/VI technology remains valid as final standard). By 2030, most of the fleet are euro 6/VI vehicles in both scenarios. Furthermore, in the POL scenario the share of alternatives in newly purchased vehicles is higher than in the REF, but due to the smaller number of kilometres less new (environmentally friendly) vehicles are purchased in the this scenario.

Comparing the Real Life Ecoscore for the historical year 2008 with the Ecoscore of that year, one determines the Real Life Ecoscore is 5.4 units (10%) lower than the Ecoscore. This is explained by the use of more realistic emission factors for the calculation of the Real Life Ecoscore (COPERT) compared to the emission factors of the type approval test of new vehicles. These type approval figures forms the basis for the common Ecoscore of vehicles.

Figure 12: Evolution of the average Real Life Ecoscore of the car fleet – Reference versus Policy scenario



Source: VITO and PLANET V3.2

5.2.5. Biofuels

Current Belgian legislation on biofuels is focused on the general introduction of low blends of biodiesel with diesel and bio-ethanol with gasoline through a tax reduction system for a specific producer quota. As the system was not working properly, from mid 2009 the Belgian government introduced an obligation system to blend at least 4% by volume biodiesel with diesel, and at least 4% by volume bio-ethanol with gasoline.

For 2020 the targets will be seriously higher, with 10% renewable energy in transport for all European countries. The lion’s share of this is expected to be fulfilled with biofuels. The Belgian administrations have prepared a National Renewable Energy Action Plan (NREAP), and supplied it to the European Commission in 2010. The separate targets for the different biofuel types were largely based on input from the BIOSES project.

It is anticipated that by 2020 most gasoline will contain 10%vol ethanol, and most diesel will contain 7% biodiesel (FAME). The biodiesel share may partly be complemented with Hydrogenated Vegetable Oils (HVO). This general blending will however not be enough reach the 10% target, which is defined on energy basis. Additional support programmes will be necessary: (1) to promote the introduction of advanced biofuels, based on cellulose and waste, (2) to promote the application of higher blends (B30, E85) or dedicated biofuels (bio-methane, B100, PPO, ED95) in certain (niche) markets, and (3) to support the introduction of electric and plug-in hybrid vehicles powered by green electricity (renewable energy).

In the medium term (up to 2020), it is still expected that current „1st generation" biofuels (biodiesel, bio-ethanol) will be the main biofuels in the market. By 2030, the contribution of advanced ligno-cellulose based biofuels and electric mobility will become significant. Availability of sustainable food-crop based biofuels will reach saturation and importance of cellulose based biofuels will increase, potentially reaching a 1/3 share of biofuels in 2030 (all biofuels together may reach a share of 15% in transport energy) (Mertens & Pelkmans, 2011).

New market insights:

The current Belgian biofuel policy (biofuel quota in combination with tax reductions, complemented with a blending obligation systems) runs until 2013. Federal administrations are currently preparing policy for after 2013.

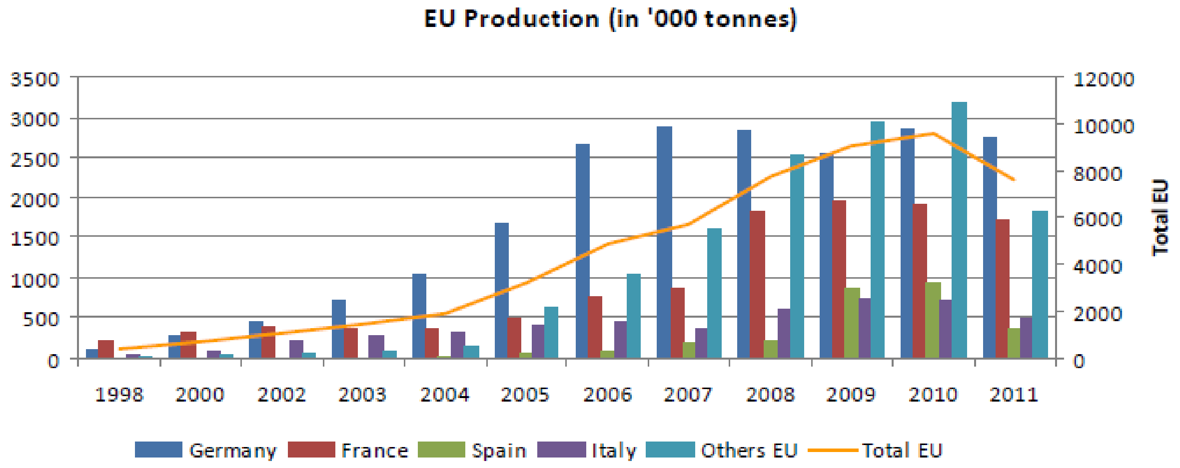
All European Member States have published their national renewable energy plans in 2010, also including targets for biofuels for transport. It was anticipated that consumption of conventional '1st generation' biofuels would double by 2020 on European level; conventional biodiesel would represent around 2/3 of 2020 biofuels. However first indications for 2011 show that there is currently a declining trend of biodiesel production in Europe, as indicated in Figure 13.

Some background on these trends:

- The sector is awaiting the EC decision on how to deal with indirect land use change (iLUC). An iLUC greenhouse gas factor could in fact rule out all agricultural crop based biofuels, as they may not reach the GHG threshold anymore. It was announced that the EC would publish a report by December 2010 on the impact of iLUC on GHG emissions and how to minimize the impact. The EC however has difficulty reaching internal agreement on this, and so far has postponed this communication. This creates a lot of uncertainty in the biofuel sector and most investment decisions are postponed.
- Imports from outside the EU, producing biofuels from cheaper feedstocks, are gaining market share. This puts European producers at stress.

- With all discussions on potential problems related to sustainability of biofuels, Member States are hesitating to support biofuels further, despite their NREAPs. Moreover in the current economic climate most MS try to save on governmental expenditure.

Figure 13: Trend in EU biodiesel production 1998-2011 (source: EBB, 2011)



Note: 2011 figures are first estimations

Beside the uncertainty on crop-based 1st generation biofuels, the introduction of lignocellulose based ('2nd generation') biofuels seems to stay below expectation. Production facilities for these fuels generally require high investment, which is difficult to acquire in the current economic climate. Moreover sustainability discussions are also emerging for the use of lignocelluloses feedstock, in particular in relation to wood harvesting (carbon debt). Bearing in mind lessons learned from 1st generation biofuels where sustainability discussions emerged after large investments were made, investors are now less inclined to go along in the 2nd generation pathway. This can only be overcome through high subsidy schemes, from EC and member state level.

While national action plans promised a strong increase of biofuels in transport, the current market conditions indicate that it will not be straightforward to reach these targets. There are high discussions whether crop based first generation biofuels need further support, and roll-out of cellulose based second generation biofuels seems to stay below expectation.

Above findings suggest that the rather ambitious goals on biofuel share in transport in the POL scenario may be overestimated. In addition, a clear policy will be necessary to still achieve the postulated objectives.

5.2.6. Welfare analysis

The impact of the POL scenario on welfare is presented in Table XXI (in difference compared to the reference scenario). Welfare is the sum of consumer surplus, producer surplus, tax revenues from transport activities and environmental benefits. It also takes into account the subsidies or the fiscal deductions accorded by the government for the purchase of cleaner cars. Note that the subsidies for the purchase of low CO_2 emission cars are abolished as from 2012 in the reference scenario and in the POL scenario. Table XXI does not yet take into account the additional welfare impacts that could be obtained by using the increased tax revenues for reducing distortionary taxes, raising transfers or financing public goods. The positive impact of the POL scenario on welfare (+66 937 Mio.€'08) is mainly explained by the additional tax revenues (+93101 Mio.€'08) from road pricing and, to a lesser extent, from the higher excise on diesel. The environmental benefits (2 918 Mio.€'08) also contribute to welfare improvement. The loss of consumer and producer surplus (-21 396 Mio.€'08 and -7 389 Mio.€'08, respectively) and the additional burden related to the fiscal deduction for the purchase of electric vehicles (+296 Mio.€'08) are insufficient to annihilate the positive impact related to tax revenues and environmental benefits.

Table XXI Impact of the POL scenario on welfare for the period 2010-2030 (difference compared to the reference scenario)

Mio.€'08, net present value in 2010)

		2030
Consumer surplus	A	-21396
Producer surplus	B	-7389
Taxes revenues related to transport	C=a+b+c	93101
Taxes - Commuting trips	a	35995
Taxes - Other passenger trips	b	23799
Taxes - Freight	c	33307
Fiscal deduction for purchase of electric vehicles	D	297
Environmental Benefits		
Direct emissions*	E	2918
Welfare impacts	F=A+B+C-D+E	66938

Source: PLANET V3.2

We only take into account the environmental benefits related to direct emissions, since indirect emissions are not under the control of the transport users.

6. SPECIFIC ANALYSIS ON COMPANY CARS

The number of company cars offered to employees as a benefit in kind has steadily grown over the last two decades in the EU. This is mainly encouraged by a favorable tax treatment. Although tax rules differ from country to country, they generally lead to under-taxation and provide for corporate tax arrangements that allow companies to deduct company car costs (purchase/leasing, insurance, maintenance and fuel) from taxable profit. The benefit in kind related to the private use of the company car is generally taxed by adding a certain amount to the taxable income of the user (Kageson, 2005). In most countries this amount is a fixed cost, unrelated to the actual car use. These tax arrangements not only result in more company cars, but also encourage the choice for larger cars (Naess-Schmidt & Winiarczyk, 2010) and stimulate company car users to make excessive use of their car. This aggravates environmental issues like CO_2 emissions, air pollution, noise nuisance and congestion, which is contradictory to national and EU objectives to promote energy savings and reduce environmental damage.

Within the PROMOCO project, the aim was to gather information on the impact of these company cars on our daily mobility. In this PROLIBIC cluster project, the objective is to further explore company cars from a more sustainable transport use perspective by analyzing the impact of recent fiscal policy measures on the environmental-friendliness of company cars. Given that company cars are not included in the PLANET model as a separate vehicle class, an alternative study was performed to analyze the evolution of company cars with respect to environmental-friendliness. The key research questions for this analysis are:

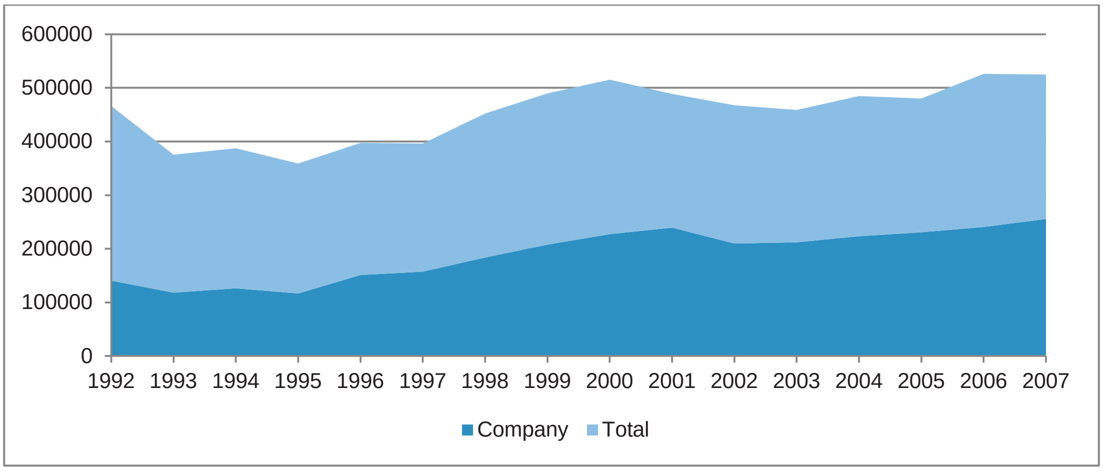
- Which policy measures have been taken in 2010 to improve the environmental-friendliness of company cars and their use?
- What is the impact of these measures on company car use and on the company car fleet?

This section is structured as follows; first we describe the evolution of company cars over the last two decades (6.1). Next, an overview is made of the fiscal policy measures taken in 2010 in Belgium with regard to company cars (6.2). After that, we analyze the impact of these fiscal policy measures on the environmental-friendliness of company cars (6.3). Given the modification of the fiscal policy regarding company cars in 2012, additional attention is paid to these recent developments in 6.4, followed by some prospects for the future (6.5) and the final conclusions resulting from this company car analysis (6.6).

6.1. Company car fleet evolution

Recent data on the share of company cars in the Belgian car fleet indicates that the proportion of company cars has doubled to almost 10% and even 15% if cars registered by independents are also taken into account (Febiac, 2008). The increase of company cars can be illustrated by the evolution of the number of cars registered in the name of a company (Figure 14) and the evolution of the number of cars being rented by means of long term leasing contracts (Figure 15).

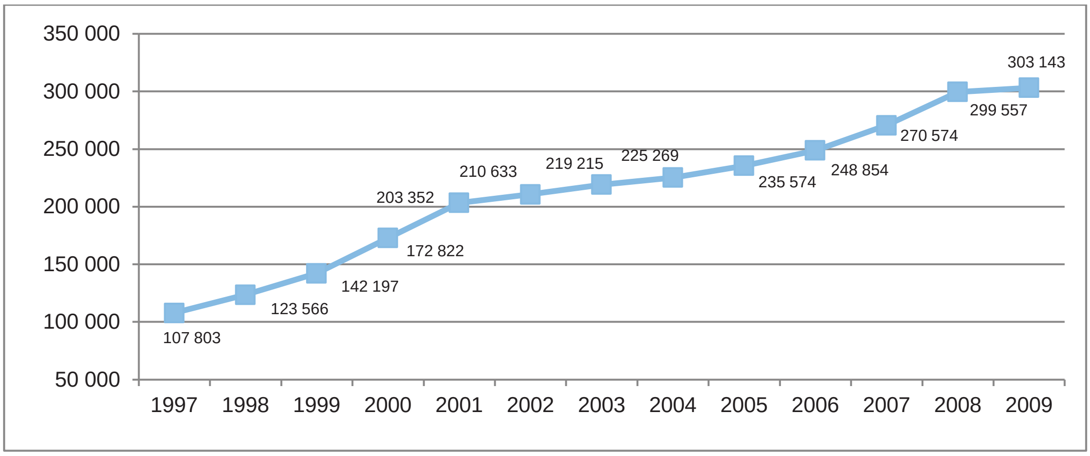
Figure 14: Evolution of the share of cars registered in the name of a company in total amount of newly registered cars from 1992 to 2007.



Source: FGOV Mobility and Transport – Febiac, 2008.

In 1992, the share of company cars rose up to 30% of the total amount of newly registered cars. Fifteen years later, the amount of newly registered cars in 2007 stands at 524.795, of which 255.493 or 48,7% are registered in the name of a company (Figure 14). As far as the renting contracts evolution is concerned, data available from the annual report of the Belgian Federation of Vehicle Renters (Renta), which covers almost 100% of the long term rental market, shows that there has been a large increase in the number of cars being the subject of long term rental contracts concluded between 1997 and 2009 (Figure 15).

Figure 15: Evolution of the car fleet for long term rental contracts from 1997 to 2009.



Source: Renta, 2009 & Renta, 2010.

Because of the increasing popularity of company cars, measures aimed at making company cars more environmental-friendly will help introducing more environmental-friendly cars on the Belgian roads. Moreover, after amortisation, company cars end up on the second hand car market, where they will contribute to the replacement of older second hand cars by environmental-friendlier ones.

6.2. Fiscal policy measures

The increasing attractiveness of company cars during the last two decades was mainly triggered by the under-taxation of company cars, which was not only a Belgian phenomenon, but common practice within the entire European Union. Although there are substantial variations among membership states with regard to company car taxation rules (Fleet Europe Magazine, 2008), in a number of cases employees are encouraged by subsidies to choose more expensive and larger cars and to use their company car more intensively because fuel use is not or barely taxed. As a result, taxation rules often stimulate the private use of company cars which aggravates environmental issues (Naess-Schmidt & Winiarczyk, 2010).

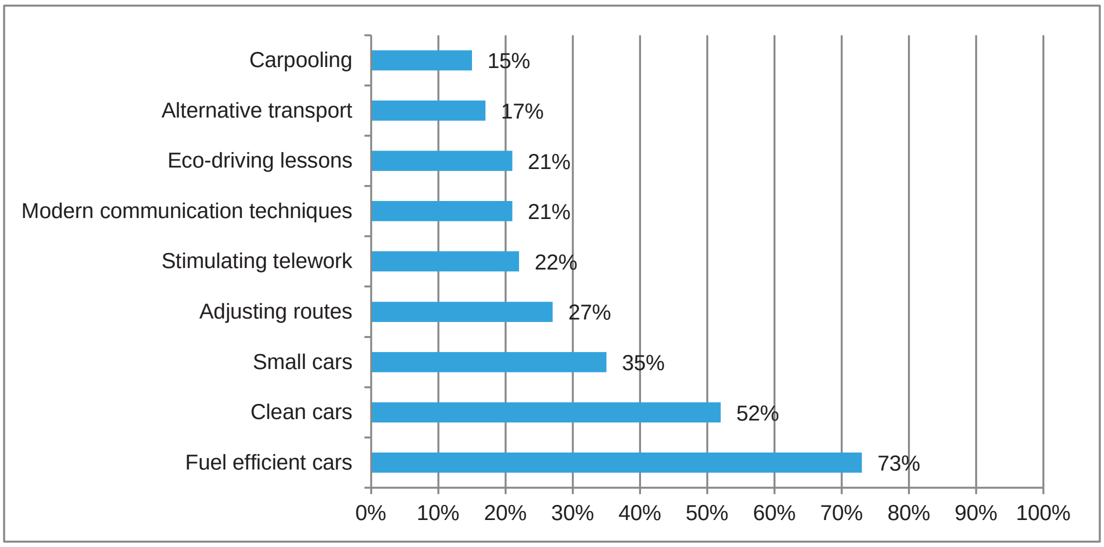
Given that this is contradictory to national and EU objectives to promote energy savings and reduce environmental damage, member states are moving forward and are taking initiatives to include environmental objectives in the taxation of company cars. The United Kingdom, for example, introduced a tax reform in 2002 where company cars are still taxed based on list price and mileage, but where the tax percentage is determined by the CO_2 emission level of the car. As a result, the energy efficiency of company cars increased, while its total number decreased. Another example concerns Denmark, where higher taxation of company cars resulted in a down-sizing of company cars rather than a reduction of its total number (Naess-Schmidt & Winiarczyk, 2010).

As from 1 January 2010, the following three measures were introduced in Belgium to stimulate the environmental-friendliness of company cars (Mobimix, 2010a):

- Adjustment of solidarity contribution on company cars in function of the CO_2 emission level of the vehicle
- Adjustment of the fiscal deductibility of company cars in function of the CO_2 emission level of the vehicle
- Calculation of the ‘benefit in kind’ based on CO_2 emission level instead of fiscal horsepower.

Before the introduction of these measures, the Corporate Vehicle Observatory (CVO) published an overview of measures planned by companies to help saving the environment in their yearly observatory report (CVO Barometer, 2009). As Figure 16 shows, these measures are in first place related to the characteristics of the cars, by planning to use more fuel efficient cars, cleaner cars and smaller cars as a reaction to the implementation of the 2010 fiscal policy measures.

Figure 16: Company measures planned to react to new fiscal policy measures.



Source: CVO Barometer, 2009

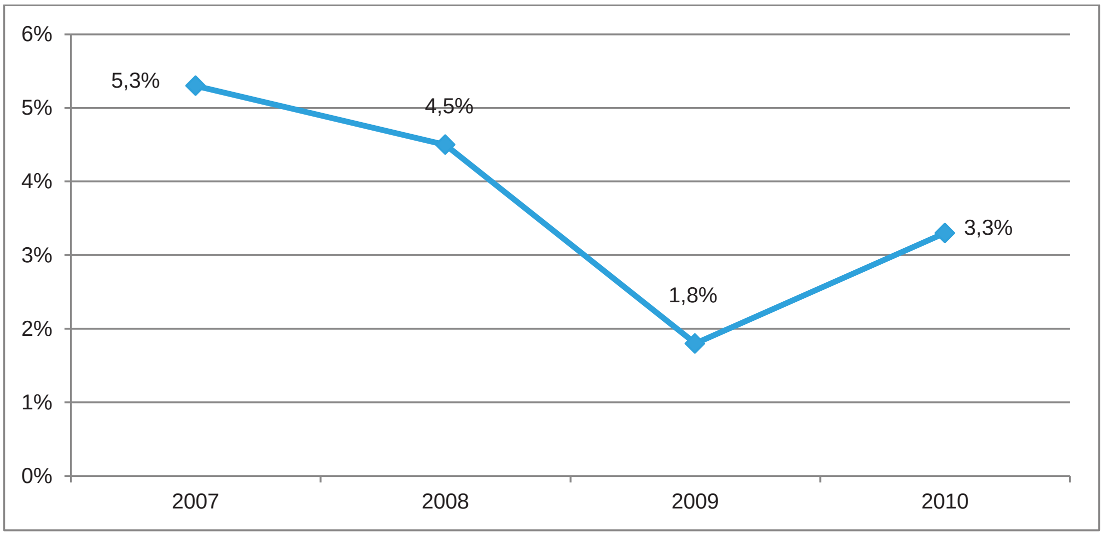
6.3. Impact of fiscal policy measures

In order to determine the actual impact of the fiscal policy measures taken in 2010, different indicators will be analyzed. First, we will take a general look at company car fleet growth and the evolution of CO_2 emission levels. Second, we focus on how companies react to these measures in terms of cleaner car use, company car policies and company car financing.

6.3.1. Belgian company car fleet

The introduction of the 2010 fiscal policy measures has not decreased the demand for company cars. Although the growth has temporized in 2009, because of the financial crisis, 2010 is again characterized by an increase in the growth of the company car fleet Figure 17.

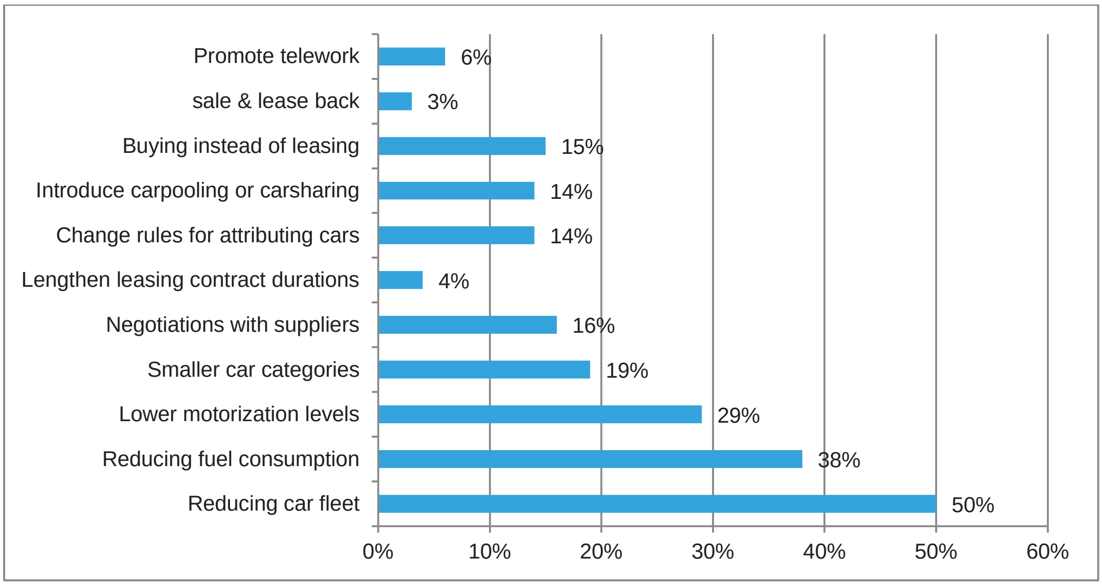
Figure 17: Average growth of the Belgian company car fleet.



Source: CVO Barometer 2011, based on Febiac (2010).

Given that the financial crisis only just preceded the introduction of the fiscal policy measures in 2010, it is important to highlight which measures were taken by companies to deal with the financial crisis. As Figure 18 illustrates, all of these measures are aimed at cutting back expenses, but some of them are also related to the environment. It should therefore be kept in mind that both occurrences (crisis and fiscal policy) contribute to a more environmental-friendly approach of company cars, in a way that makes it impossible to determine their individual contributions.

Figure 18: Company measures taken to react to the financial crisis.

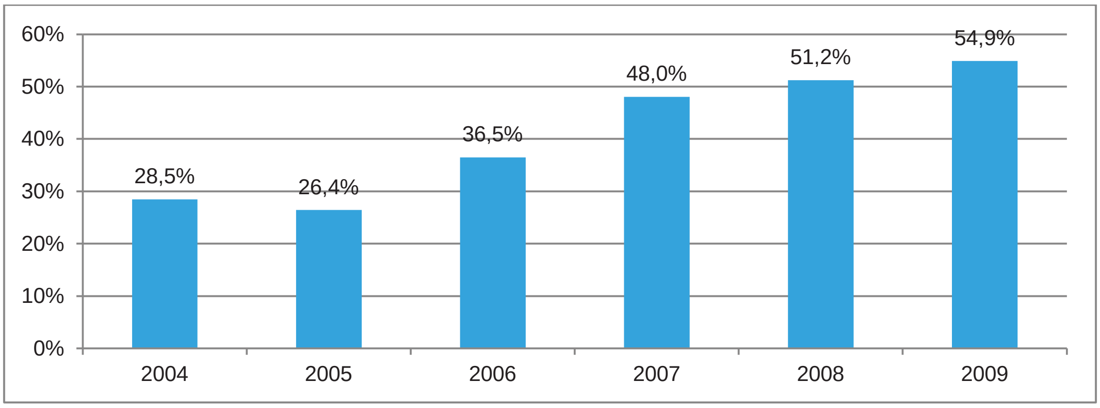


Source: CVO Barometer, 2010

The most important measures taken in reaction to the financial crisis are reducing the size of the company car fleet, reducing fuel consumption levels of company cars and choosing company cars with lower engine powers.

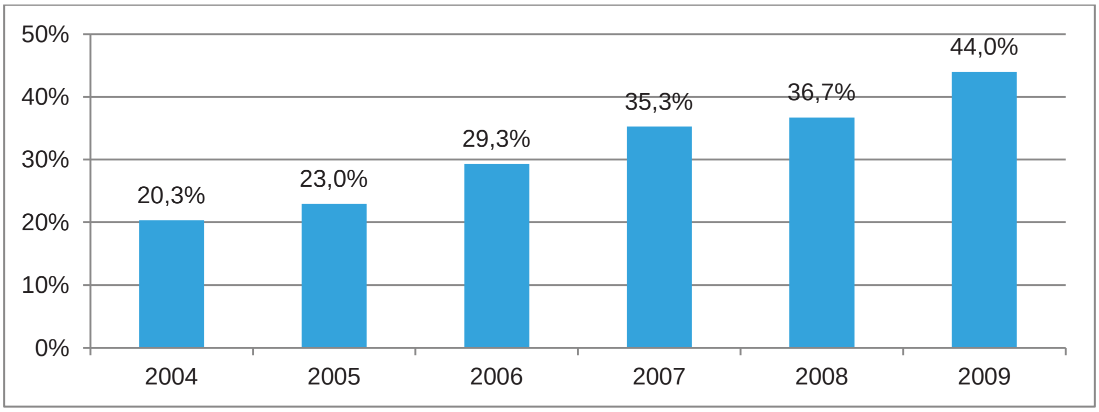
As far as the CO_2 emission level of the Belgian car fleet is concerned, Figure 19 and Figure 20 illustrate that over the last decade, CO_2 emission levels have been reduced, for both petrol and diesel cars, as a result of cleaner technologies and the integration of environmental effects in the companies' car policies. The share of petrol cars with less than 160g CO_2 emissions per km has grown from less than 30% in 2004 to almost 55% in 2009. A similar growth rate of nearly 25% is found for diesel cars, where the share of diesel cars with less than 145g CO_2 emissions per km rose from 20% in 2004 to almost 45% in 2009.

Figure 19: Evolution CO2 emission levels Petrol cars in terms of % < 160g/km CO2.



Source: Renta, 2010

Figure 20: Evolution CO2 emission levels Diesel cars in terms of % < 145g/km CO2.



Source: Renta, 2010

More recent figures from Febiac indicate that the sale of environmental-friendly cars has never been as high as in 2010. The sale of cars with less than 115g/km CO_2 has increased with 86% compared to 2009 whereas the sale of cars with less than 105g/km CO_2 even increased with 204% from 2009 to 2010 (Mobimix, 2010b). When these CO_2 emission levels are divided over different types of users, it becomes clear that especially private car users are concerned with the environment in their car purchase decision, although this is greatly influenced by the fiscal stimulation to switch to cleaner cars[4]. In 2009, the average CO_2 emission level for new private cars equalled 138 g/km. But also company cars were getting cleaner as the average CO_2 emission level of company cars attributed in long term rental contracts was only 3 g/km higher and equalled 141 g/km. This is much better than company cars that are not part of a long term leasing contract (155 g/km) and independent company cars (146 g/km) (Renta, 2010).

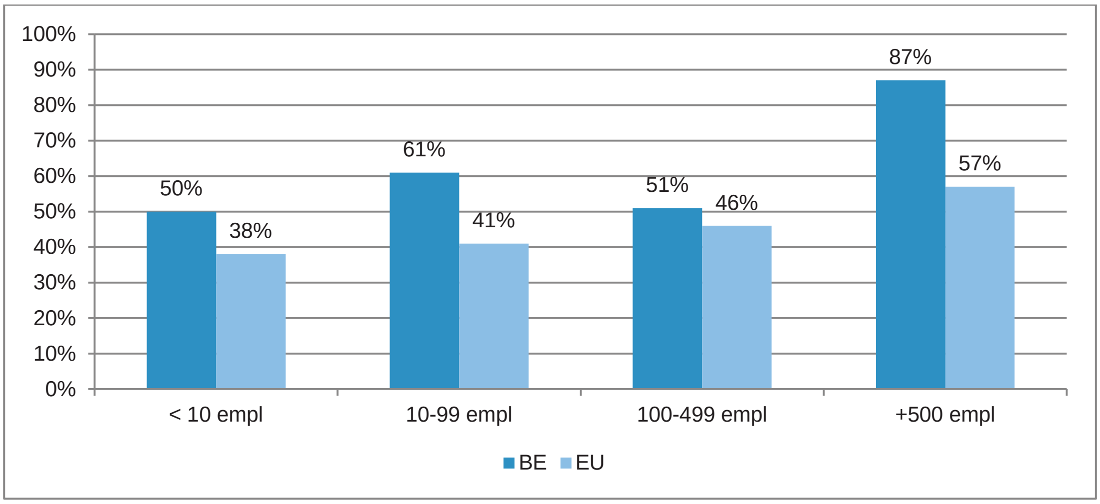
In 2011 the average CO_2 emission level of newly bought passenger cars in Belgium has further decreased to 127 g/km. This is already below the 130 g/km CO_2 EU-target for 2015. Again private cars have the lowest CO_2 levels (123 g/km) compared to leased company cars (126 g/km) and company-owned cars (142 g/km) (Bron: DIV, 2011).

6.3.2. Company car policies

In this section, the focus will be on the impact of the fiscal policy measures on company decisions and policies. The environmental consciousness is becoming more apparent in the company car policies, where measures are included with regard to the environment and CO_2 emissions. As shown in Figure 21, Belgium performs better than the European average in this area.

[4] It is worthwhile to mention at this point that the fiscal premium for environmental-friendly cars will be abolished as from 2012 due to budgetary measures taken by the Federal Government.

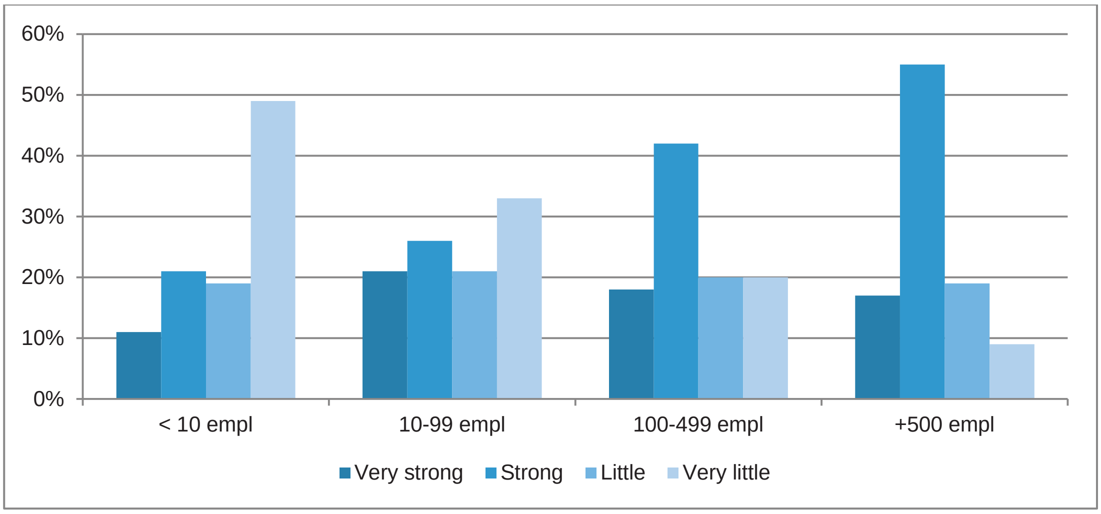
Figure 21: Impact of fiscal policy measures on company car policy (CO2 emissions).



Source: CVO Barometer, 2011

When CVO questioned companies about how strong the impact of fiscal policies on company car choice is, they found that the impact is perceived to be stronger among larger companies Figure 22 (CVO Barometer, 2010).

Figure 22: Impact of fiscal policy measures on company car choice.

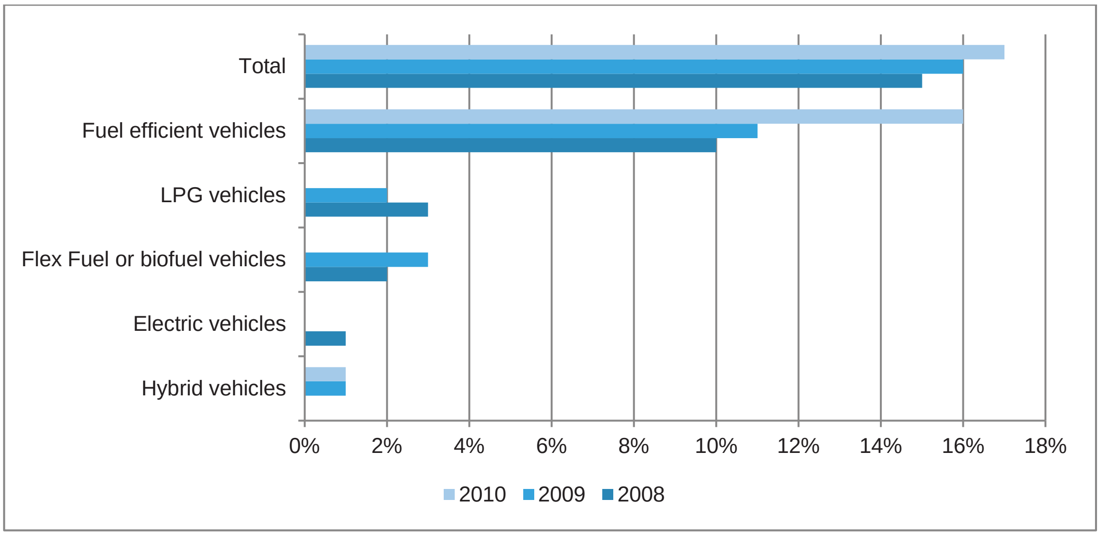


Source: CVO Barometer, 2010

Figure 23 and 24 demonstrate evolutions in terms of green car use and car financing. It should be mentioned that these evolutions are most probably not only the result of fiscal policy measures, but of a combination of different driving forces, such as technological evolution, cost cutting measures, etc.

With regard to the use of green cars, a positive tendency can be noticed over the past three years. Companies are more often choosing energy efficient labeled cars. As shown in Figure 23 the total share of green cars rose from 15% in 2008 to 17% in 2010. Especially fuel efficient vehicles take up a large part in the total share of green cars.

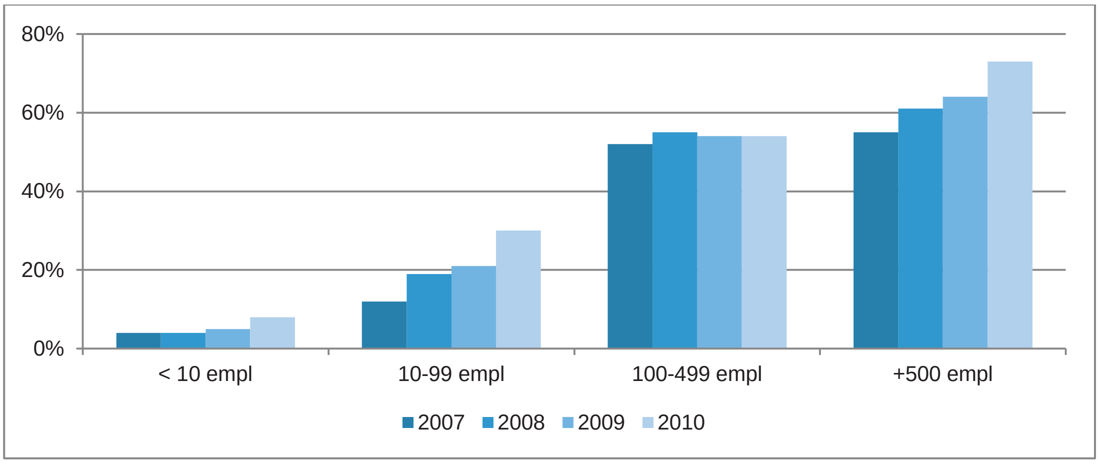
Figure 23: Evolution of green car use.



Source: CVO barometer, 2008, 2009 & 2010

As far as the financing aspect of company cars is concerned, more companies choose operational leasing because of the additional advice and services they provide Figure 24.

Figure 24: Evolution of company car financing (operational leasing).



Source: CVO Barometer, 2007, 2008, 2009 & 2010

6.4. Recent developments

At the end of 2011, the Federal Di Rupo Government decided to modify company car taxation as from 1 January 2012. This reform was largely driven by budgetary constraints: the Federal Government estimated that the modification of the company car taxes could bring in an additional 200 million euros, distributed between employers and employees.

More in particular, the new measures taken with regard to company cars are the following:

- The calculation of the 'benefit in kind' (BIK)[5] received by employees will no longer be based on the combination fuel type/CO_2 emissions/flat amount of private mileage (5,000 or 7,500 km/year). From the 1st of January 2012, the monthly BIK (EUR) is based on the combination of fuel type, CO_2 emissions (g/km) and company car retail price (incl. VAT) (website FOD Financiën):

$$BIK\ diesel = \frac{price \times \left(\left(CO_2 - 95 \right) \times 0.1 + 5.5 \right) / 100 \times \frac{6}{7}}{12}$$

$$BIK\ gasoline, LPG, CNG = \frac{price \times \left(\left(CO_2 - 115 \right) \times 0.1 + 5.5 \right) / 100 \times \frac{6}{7}}{12}$$

$$BIK\ electricity = \frac{price \times 4/100 \times \frac{6}{7}}{12}$$

  The BIK base amount comes to 5.5% of the new retail price when CO_2 emissions are equal to or below 95 g/km (for diesels) or 115 g/km (for gasoline/LPG/CNG cars). The BIK can never be lower than 100 EUR/month. Until the beginning of 2012, it was not exactly clear what was meant by the 'price' parameter, and how it would evolve over time. In the mean time, the Finance Minister has clarified some issues: the retail price is the list price of the new car, VAT and optional equipment included, but without deducing possible discounts granted upon purchase. Moreover, this list price value is assumed to drop by 6% annually, with a minimum of 70% of the initial price below which the list price cannot fall. The result is that older company cars will be taxed on a (slightly) smaller BIK. Currently, the large difficulty is to arrange a database containing reliable data on list prices of all new vehicles, including optional extras.

[5] This 'benefit in kind' occurs as a result of the fact that the employee is able to drive his/her company car for non-professional purposes

- Besides the BIK for employees, employers have to book 17% of this BIK as 'disallowed expenses'. This measure did not exist before.
- Moreover, employers offering company cars to their employees need to pay a solidarity contribution (SC) based on CO_2 emissions (g/km) and fuel type of the particular vehicle. The monthly amount payable is given below and can never plunge below the minimum value of 24.25 EUR/month (also applicable to 100% electric vehicles).

$$SC\ \ diesel\ = 1.1641 \times \frac{CO_2 \times 9\ EUR\ \ - 600}{12}$$

$$SC\ \ gasoline\ = 1.1641 \times \frac{CO_2 \times 9\ EUR\ \ - 768}{12}$$

$$SC\ \ LPG, CNG\ = 1.1641 \times \frac{CO_2 \times 9\ EUR\ \ - 990}{12}$$

$$SC\ \ electricity\ = 24.25\ EUR$$

- Since 2011, the three Belgian regions are authorized to set and collect traffic taxes in their respective territory. The Flemish Region was the first Belgian region to actually adapt car registration taxes (RT) in 2012. As such, a car registered by a private individual or a company car owned by the company itself is subject to this new RT as from March 2012. The new RT replaces the old system based on the combination cylinder capacity/engine power in Flanders. Remark that the registration of leased vehicles in Flanders, and the registrations of all vehicle types in the other two regions, is still subject to the old RT system. The (Flemish) new method takes into account CO_2 emissions (g/km), fuel type (~f), Euro standard (~c), vehicle age (~LC), and registration year (~x), according to the following formula:

$$BIV = \ \frac{CO_2 \times f + x}{250}^{6} \times 4500 + c\ \ \times LC$$

  For a detailed discussion on the specific values to be used for each of these parameters, we refer to the relevant decree published in the Belgian law gazette (website Vlaamse Overheid).

- Corporate tax deductibility for company cars (by the employer) has not been changed since January 2010. The percentages are given in Table XXII below. Remark that for self-employed persons taxable by income taxes instead of corporate taxes, a 75% flat rate company car tax deductibility applies, irrespective of fuel type and CO_2 emissions.

Table XXII: Corporate tax deductibility of company cars since January 2010

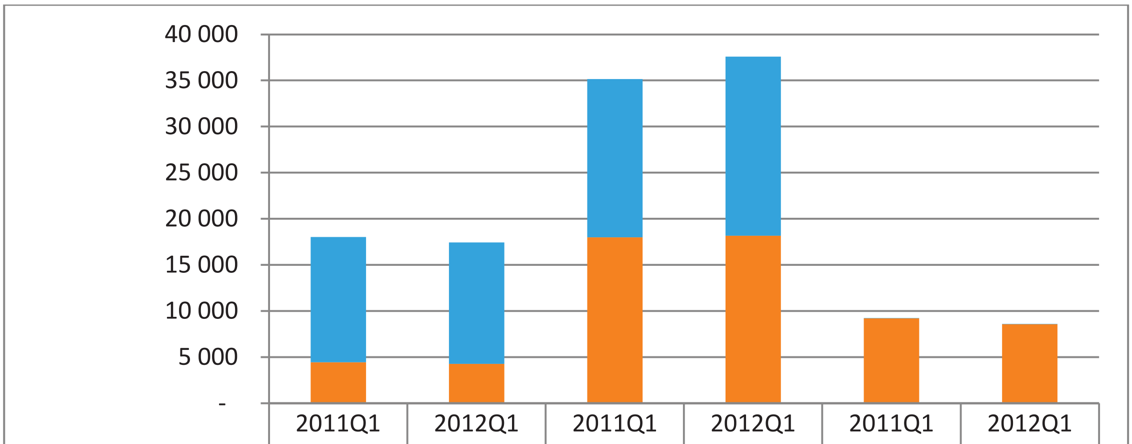
CO_2 emission diesel (g/km)	CO_2 emission gasoline/LPG/CNG (g/km)	CO_2 emission 100% electric (g/km)	Fiscal deductibility (%)
		0	120
0-60	0-60		100
61-105	61-105		90
106-115	106-125		80
116-145	126-155		75
146-170	156-180		70
171-195	181-205		60
>195	>205		50

In summary, we expect that the new measures discussed (BIK, disallowed expenses, SC, RT) will impact the company car's registration patterns. It is not within the scope of this report to perform a detailed analysis to distinguish each of the measures' impact separately. Therefore, we evaluate the impact of the aggregate of these measures on the company car registrations. Remark that as the tax deductibility percentages for company cars have not changed since 2010, we expect the behavioral change resulting from this measure to be zero.

In what follows, we compare the company car registrations in the first three months of 2012 (2012Q1) with similar data from 2011 (2011Q1).

Figure 25 indicates the total number of Belgian company car registrations in the first quarter of 2012 (2012Q1) compared to the first quarter of 2011 (2011Q1), split per region and per ownership type. We distinguish between cars owned by the company itself ('company-owned') on the one hand and leased vehicles ('leased') on the other hand. Compared to 2011Q1, a modest increase in the total number of company car registrations can be noticed (+2.0%). Especially the Flemish leased car registrations have grown compared to 2011Q1 (+13%). Remark that a distinction between the regions combined with a distinction between the ownership types is not so meaningful, because leased cars are always registered at a company's head office. That is why almost all leased cars driving around in Wallonia are registered in the Brussels Capital Region or Flanders.

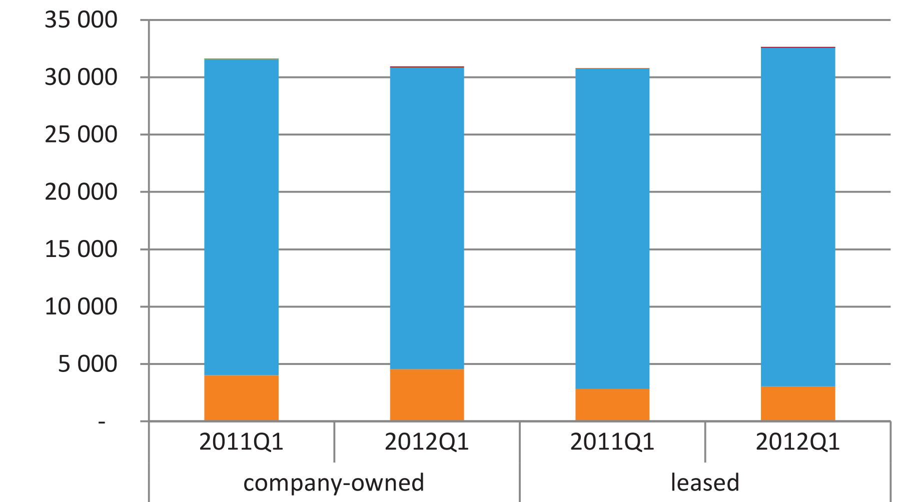
Figure 25: New company car registrations in Belgium



	BRU		FL		WAL	
	2011Q1	2012Q1	2011Q1	2012Q1	2011Q1	2012Q1
leased	13 594	13 181	17 166	19 443	6	9
company-owned	4 422	4 248	17 989	18 144	9 188	8 559

The company car registrations can also be classified according to the fuel type used. In absolute terms, it is clear from Figure 26 that there is a small shift from diesel to gasoline company-owned cars in 2012Q1 compared to 2011Q1. This is also the case in relative terms: an evolution from 87.2 to 85.0% for diesel and from 12.7 to 14.7% for gasoline. Regarding leased cars, on the other hand, no significant shift is observed because both the number of diesel and gasoline vehicles increase in absolute terms.

Figure 26: New company car registrations in Belgium, split per fuel type



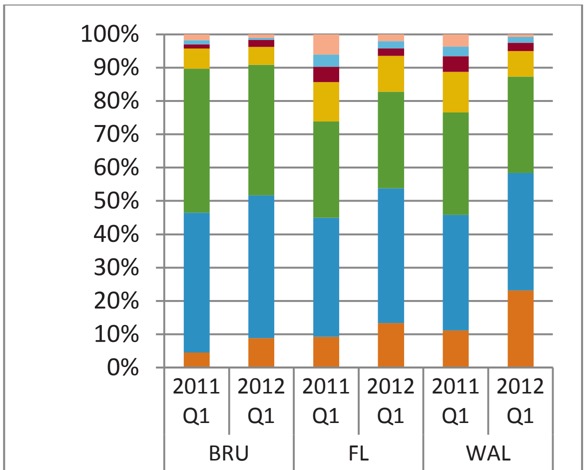
	company-owned		leased	
	2011Q1	2012Q1	2011Q1	2012Q1
electricity	14	77	15	59
CNG	3	5	1	4
LPG	12	15	4	4
diesel	27 544	26 293	27 898	29 509
gasoline	4 019	4 557	2 843	3 057

Have the measures described earlier pushed company car decision makers to cars with less CO_2 emissions? We try to answer this question with the help of the following two figures.

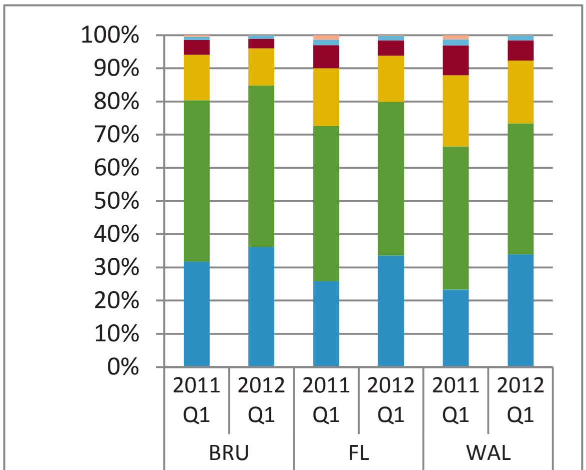
The first one (Figure 27) displays the new gasoline and diesel company car registrations per region, subdivided over the different CO_2 emission classes (note that the European CO_2 emission labels differ between diesels and gasoline cars). Concerning gasoline vehicles (left-hand side of Figure 27), a clear trend towards lower CO_2 emission levels can be noticed in all regions when we compare 2012Q1 to 2011Q1. The categories above 130 g/km are all losing ground, while gasoline cars emitting 130 g/km or less are becoming more popular in all regions. Especially the shift from 11 to 23% in the class ≤ 100 g/km in Wallonia is remarkable. A similar trend towards lower CO_2 levels is observed for diesels (right-hand side of Figure 27). While the category 86-115 g/km significantly grows, all diesel categories > 145 g/km seem to go down rather quickly.

The second figure (Figure 28) shows the CO_2 distribution of new gasoline and diesel company car registrations per ownership type. Regarding gasoline vehicles (left-hand side of Figure 28), we notice a clear evolution towards lower CO_2 emissions for both ownership types. Nevertheless, the transition is more spectacular within the leased category. This is of course due to the rather strict car policies with which most lease car users need to comply nowadays. For example, the group 131-160 g/km significantly drops for leased cars (from 43 to 35%), while this group still grows within the company-owned registrations (31 vs 29%). Although a small increase in the leased group 161-190 g/km is observed (from 3 to 4%), we should not give too much attention to this result as it concerns only very few vehicles (Belgian lease cars are rarely gasoline vehicles). Regarding diesel cars (right-hand side of Figure 28), the category 86-115 g/km has become increasingly popular, especially at the expense of the group > 145 g/km within the company-owned cars and the group > 115 g/km within the leased cars.

Figure 27: New gasoline (LHS) and diesel (RHS) company car registrations per region, split per CO2 emission class (g/km)

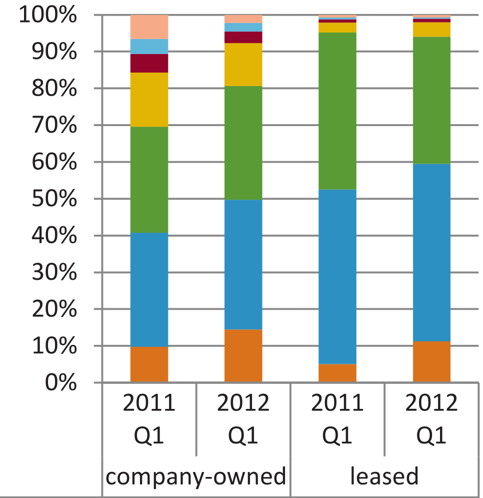


	BRU 2011 Q1	BRU 2012 Q1	FL 2011 Q1	FL 2012 Q1	WAL 2011 Q1	WAL 2012 Q1
>250	2%	1%	6%	2%	4%	1%
221-250	1%	1%	4%	2%	3%	2%
191-220	1%	2%	5%	2%	5%	3%
161-190	6%	5%	12%	11%	12%	8%
131-160	43%	39%	29%	29%	31%	29%
101-130	42%	43%	36%	40%	35%	35%
<=100	5%	9%	9%	13%	11%	23%

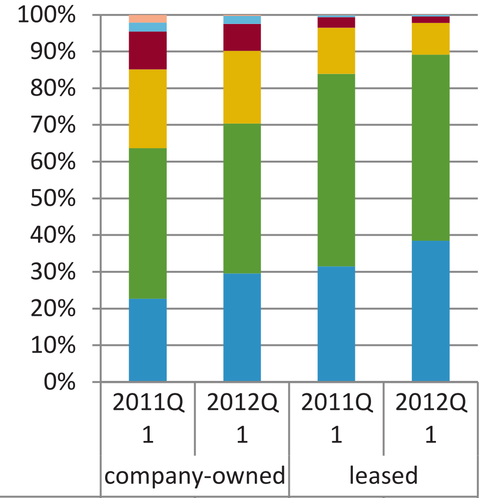


	BRU 2011 Q1	BRU 2012 Q1	FL 2011 Q1	FL 2012 Q1	WAL 2011 Q1	WAL 2012 Q1
>235	1%	0%	1%	0%	1%	0%
206-235	1%	1%	2%	1%	2%	1%
176-205	4%	3%	7%	5%	9%	6%
146-175	14%	11%	17%	14%	22%	19%
116-145	49%	49%	47%	46%	43%	39%
86-115	32%	36%	26%	34%	23%	34%
<=85	0%	0%	0%	0%	0%	0%

Figure 28: New gasoline (LHS) and diesel (RHS) company car registrations per ownership type, split per CO2 emission class (g/km)



	company-owned 2011 Q1	company-owned 2012 Q1	leased 2011 Q1	leased 2012 Q1
>250	7%	2%	1%	1%
221-250	4%	2%	0%	0%
191-220	5%	3%	1%	1%
161-190	15%	12%	3%	4%
131-160	29%	31%	43%	35%
101-130	31%	35%	47%	48%
<=100	10%	14%	5%	11%



	company-owned 2011Q1	company-owned 2012Q1	leased 2011Q1	leased 2012Q1
>235	2%	0%	0%	0%
206-235	3%	2%	1%	0%
176-205	10%	7%	3%	2%
146-175	21%	20%	13%	9%
116-145	41%	41%	52%	51%
86-115	23%	30%	32%	39%
<=85	0%	0%	0%	0%

A general remark regarding this shift towards lower CO_2 emission levels (Figure 27 and Figure 28) should be made. It is very difficult to distinguish how much of this ‘green shift’ is attributable to ‘normal’ technological progress on the one hand and to a ‘genuine’ behavioral change (as a result of changed policy measures) on the other hand. However, this analysis was considered to be outside the scope of this report.

Because the new BIK regulation takes into account the vehicle’s purchase price, it is an interesting exercise to see whether companies already adapted their car policies in the direction of cheaper cars. One way[6] to do this is looking at the share of premium car brands[7] as a percentage of total company car registrations. This is depicted in Figure 29. Looking at the results, the new BIK regulation does not seem to have an influence on the (declined) choice for premium car brands.

The share of premium within the company-owned registrations even climbs in 2012Q1 (29.2%) compared to 2011Q1 (25.5%). For leased vehicles, this premium

[6] The premium/non-premium variable is a(n imperfect) proxy for the list price

[7] According to our own expert judgement, the following car makes are considered to be ‘premium’ by the majority of consumers: Aston Martin, Audi, Bentley, BMW, Ferrari, Fisker, Infiniti, Jaguar, Lamborghini, Land Rover, Lexus, Lotus, Maserati, Maybach, McLaren, Mercedes, Porsche, Rolls-Royce and Tesla. In the Netherlands, where list prices have already been taken into account for the calculation of the BIK for some time, the share of premium (e.g. Mercedes, BMW, Audi, etc.) in total company cars as well as the number of optional extras is significantly smaller than in Belgium (Mobimix, 2011).

share remains practically the same (28%). Remark that this figure only measures a potential shift between premium and non-premium car brands. As a result, shifts within the group of premium brands (e.g. a shift from a BMW 5-series to a BMW 3-series) are not measured here, although they could be significant.

Figure 29: New company car registrations per ownership type, distinction between premium and non-premium car makers

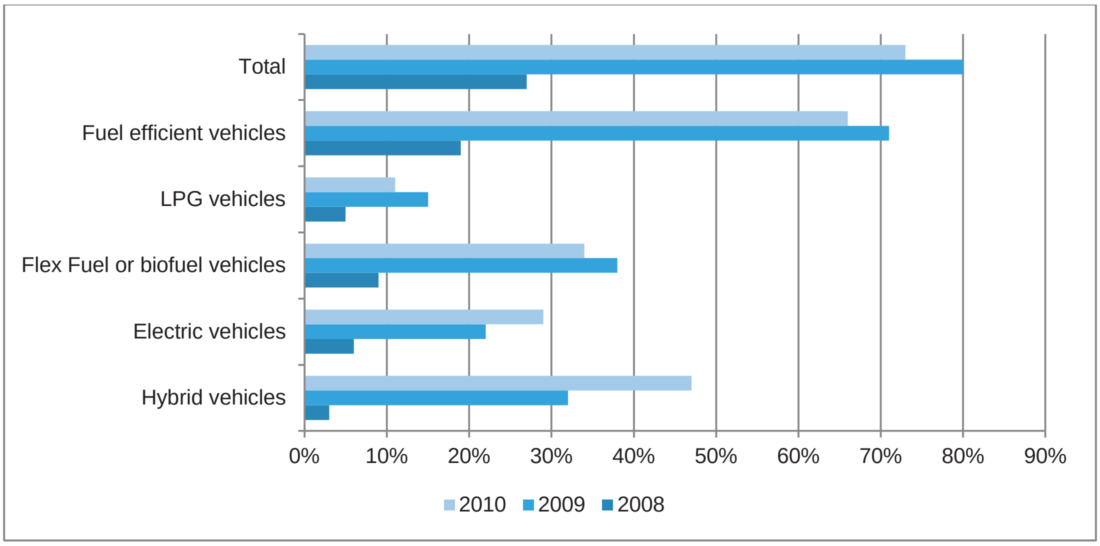
	company-owned 2011Q1	company-owned 2012Q1	leased 2011Q1	leased 2012Q1
non-premium	74,5%	70,8%	72,0%	72,1%
premium	25,5%	29,2%	28,0%	27,9%

These quarter-on-quarter analyses (2012Q1 vs 2011Q1) need to be put into perspective in the sense that usually, a large amount of time elapses between the moment of choosing a car (and possibly taking into account the existing legal framework) and the actual registration of that car. That is the reason why the impacts observed in our analysis remain rather limited: by constraining the analysis to the first three months of the year, the results could be quite heavily biased by registrations for which the purchase/lease decision was already made in 2011 (i.e., before the implementation of the new measures discussed earlier). In future work, a more thorough analysis could be performed by comparing company car registration numbers of the whole of 2012 with those of 2011.

6.5. Future prospects

Future prospects for the use of green cars indicate that companies believe that the share of green cars will increase substantially over the coming three years. In 2008 the share for the next three years was believed to grow to 27%. In 2009 and 2010, expectations for the future are even higher with respectively 80% and 73% market share for green cars over the next three years (Figure 30). Fuel efficient vehicles would still take up the largest share, but it is expected that hybrid, flex fuel or biofuel and electric vehicles will gain importance (CVO, 2008-2009).

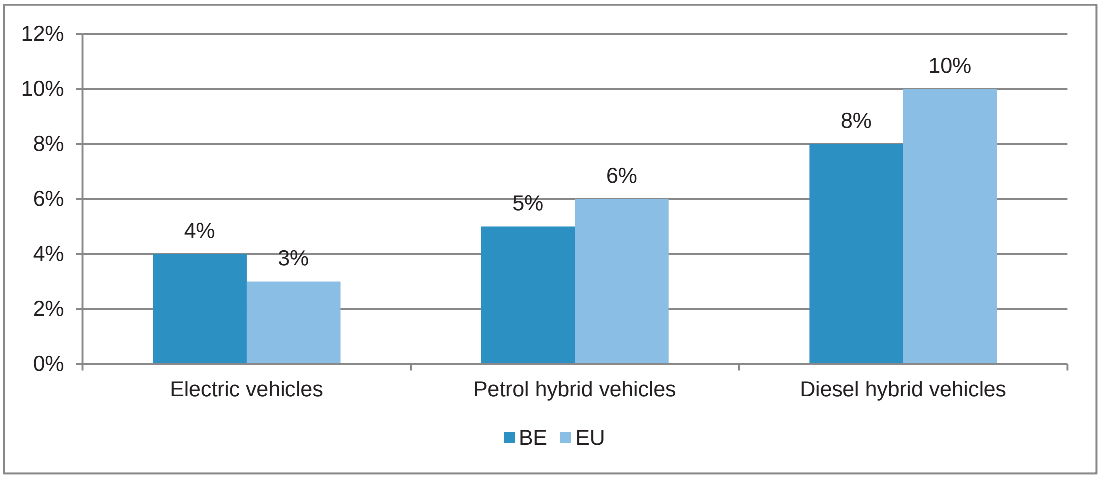
Figure 30: Future prospects for green cars.



Source: CVO Barometer, 2008, 2009 & 2010

When CVO asked companies more recently about how they perceive the potential for electric and hybrid vehicles for the coming three years, it appears that the potential for electric vehicles remains quite low because of obscurities about the capacity and lifetime of the battery. More is expected from hybrid cars, especially diesel hybrid vehicles (CVO, 2011). Nevertheless, the biggest market share will still be absorbed by traditional combustion engines (Figure 31).

Figure 31: Potential for the next 3 years for electric and hybrid vehicles.



Source: CVO Barometer, 2011

6.6. Conclusions

From the analysis on company cars, two major conclusions can be drawn. The first one is that there is a growing attention for the environment, which is triggered by the fiscal pressure on CO_2 emissions, the financial crisis and the fact that companies want to be engaged in corporate social responsibility. A second conclusion is that the recently introduced measures (2012) affecting company cars are possibly pushing companies even further in the direction of low CO_2-emitting cars[8]. New is that companies will probably be induced to pick cheaper/non-premium models than before as a result of the revised BIK regulation, although this is not yet clear from 2012 registration data. What we do observe in the 2012 data are the first steps towards a lower share of company cars running on diesel (in favor of gasoline).

Corporate cost savings are reflected in company car policy changes rather than in decreasing demand. Companies are taking measures to reduce fuel consumption, to lower the price-range of the company cars that can be chosen by their employees and to extend the duration of company car leasing contracts. Operational leasing contracts gain importance because of the additional services and advices they provide to help companies in their search for cost saving solutions and rationalization of their car fleet. This is a result of a mental shift towards greater environmental awareness, corporate social responsibility and rationalization of company car fleets, which has stimulated that company cars gain a more strategic position within companies.

Towards the future, it is expected that the strategic position of company car policies will induce further savings of costs and of the environment. If technology allows it, the green transition will continue and expand towards hybrid and electric vehicles. Lease companies will play an important advisory and supporting role in continuing this green transition, whereas policy makers will play an important steering role in stimulating the continuation of this process.

[8] The observed decrease in CO_2 emissions from company cars differs from the numbers recently published by Febiac on the increase of the average CO_2 emission of all cars (both private and company cars). The main reason provided for this increase is the abolishment of the federal premium for low CO_2-emitting cars purchased by private individuals (website FEBIAC). Nevertheless, we should keep in mind that although company cars make up a significant part of all new car purchases, they did not suffer from this abolishment.

7. POLICY SUPPORT

In this chapter we give an overview of our findings for the reference scenario (REF) and the policy scenario (POL), as well as the results from the analyzes about company cars.

7.1. Lessons learned from the REF scenario

By 2030, all modes of transport – for both passengers and freight – will face an important increase in activity. The number of tkm increases by 68% and the number of pkm increases by 20% (compared to 2008). This evolution is the result of, among other things, the growing population and the increasing economic activity.

By 2030, 71% of the tkm are transported by trucks or vans and 80% of the pkm are transported by cars. This increase in road transport activity leads to additional costs related to congestion and the environment. Compared to 2008, the average speed on the road network decreases by 29% in the peak period and by 16% in the off-peak period. This fall implies longer travel times, which in turn generate economic costs and a loss of competitiveness, or additional difficulties with regard to the accessibility of economic activities.

The environmental impact is significant. Road transport is responsible for the majority of greenhouse gas emissions (97% in 2030) and for local transport-related pollutants. In 2030, cars represent 73% of vehicle-kilometres on the road, as opposed to only 15 % for trucks and vans. However, due to the introduction of Euro standards, the reference scenario projects lower direct emissions of local pollutants in 2030 compared to 2008. GHG emissions increase by 12% in comparison with 2008. The effect related to the increase in transport activity dominates the effect related to technological improvement aimed at advancing fuel efficiency (and, consequently, CO_2 emissions).

7.2. Lessons learned from the POL scenario

The POL scenario includes a basket of measures to reduce external transport costs, and environmental costs in particular. The impact of each of those measures on external costs goes through different channels. Road pricing plays a role in the modal choice and stimulates a modal shift towards more environmentally friendly transport modes. This modal shift leads to less vkm on the road, and, consequently, to less road congestion. The increase in excise duties on diesel up to the level of petrol is intended to better capture the higher local pollution generated by diesel cars compared to petrol cars. This measure leads, in particular, to a shift from diesel cars to petrol cars. It should be noted that direct injection gasoline vehicles makes its appearance. The share of Euro 6 direct injection gasoline vehicles may be important. This can be a bad thing for the emission of harmfull ultrafine particles. This was not taken into account in the emission prognoses. A higher penetration rate of alternative motor fuel technologies acts directly on the composition of the car stock and on the related emissions. By introducing (exogenously) more cleaner cars in the car stock or more biofuels, emissions fall through technological improvement for the same passenger transport activity.

The results of the POL scenario show a positive impact on the congestion environment. Speed on the road increases by 23% in the peak period and by 3% in the off-peak period. This is explained, for passengers transport, by a modal shift from the road modes to other modes: the decrease in the number of passenger-kilometres by car solo (-7%) is compensated by an increase in pkm by train (+8%), tram (+13%), bus (+24%) and car pooling (+7%). As for freight transport, the POL scenario leads to a reduction in the number of tonnes-kilometres by LDV (-4%), which is compensated by an increase of the number of kilometres by HDV (+1%). Owing to an increase in the load factor in the POL scenario, the number of vehicle-kilometres by HDV decreases, which reduces congestion. As a result of lower congestion and the introduction of an environmental tax on trains and barges, the number of tkm transported by these two modes decreases. The decline in the competitiveness of barges and trains could be avoided by raising the level of the road pricing at a level closer to the external marginal cost of road transport. However, such a sensitivity analysis has not been examined in the framework of this project. The POL scenario also leads also to welfare improvement.

The impact of the POL scenario on GHG emissions, as presented in Figure 11, could be used in the political discussion on the reduction of transport-related greenhouse gas emissions. At least, it shows the significant environmental impact of a basket of measures.

However, we point to an issue related to the available infrastructure for public transport and inland navigation. By 2030, the number of tkm transported by barges and trains, although lower than the REF scenario, is more important than today. For passenger transport, the expected increase in the number of passenger-kilometres transported by public transport is also not negligible and even more important in the POL scenario. Whether the available infrastructure will be sufficient to absorb the supplementary tkm and pkm transported is another question which cannot be answered by the PLANET model but needs (further) investigation.

To get a better insight in the results of the POL scenario, a detailed analysis of each of the policies included in the POL scenario should be performed. The welfare analysis could also be improved by taking into account tax recycling. This lies outside the scope of this project. The individual analysis of each policy and a deeper analysis of the welfare could be carried out in the future.

In addition, although national renewable energy action plans promised a strong increase of biofuels in transport, the current market conditions indicate that it will not be easy to reach these targets. There are high discussions whether crop based first generation biofuels need further support, and roll-out of cellulose based second generation biofuels seems to stay below expectation. So the ambitious goals on biofuel share in transport in the POL scenario may be overestimated. Consequently a clear policy will be necessary to still achieve the postulated objectives on biofuels.

7.3. Company cars

The main lesson learned from the analysis on company cars is that the attention for the environment is growing, a phenomenon which is triggered by the fiscal pressure on CO_2 emissions and list prices, the financial crisis and the fact that companies want to be engaged in corporate social responsibility. Company car policies are thus in the first place determined by cost savings determined by the beneficial treatment of cars with lower CO_2 emission levels, with lower list prices or with cleaner fuels and technologies. In 2012 for example, we observe the first shifts away from diesel. This financial pressure has thus induced a mental shift towards greater environmental awareness and a rationalization of company car fleets. This has stimulated that company cars gain a more strategic position within companies and that CO_2 emission levels have decreased significantly. In order for the green transition to continue in the future and expand towards hybrid and electric vehicles, it is important that alternative fuel technologies are further improved and that environmental efforts remain rewarded by cost savings and/or revenue gains. In a broader context of social responsibility, it can be important for companies to consider other types of fringe benefits than the company car alone, for example by granting a mobility budget[9]. However, the legal framework to support such systems is currently lacking, which forces such initiatives to stay small-scale phenomena for now.

[9] Under such a contract, the employee gets a mobility budget to spend on a combination of mobility solutions that better fit his/her needs, and minimize environmental impacts. Possible modes from which users can choose are for example a bicicyle, a train season ticket, a car sharing subscription, etc.

8. DISSEMINATION + VALORISATION

8.1. Policy support

The PLANET model is used for policy support for the Belgian FPS Transport and Mobility. It is used to construct reference scenarios for the future development of transport in Belgium and for the evaluation of policy scenarios.

VITO used their models to contribute to the preparation of future scenarios for the environment and transport in Flanders. This was done in the framework of the new Mobility Plan (the Flemish administration, "Mobiliteit and Openbare Werken") and the Flemish Climate Policy Plan 2013-2020 (the Flemish administration, LNE).

The policy pricing model, that has been developed in the framework of the CLEVER project, has already been used for the Flemish region and the Brussels Capital Region to simulate the budgetary revenues of a new vehicle taxation scheme, based on the environmental performance of the car.

8.2. PROLIBIC workshops

In the spring of 2011 the final LIMOBEL workshop was organised to present the results of the project. This workshop was combined with a consultation of the stakeholders for the cluster project PROLIBIC in order to maximize the synergies between the two projects.

The final PROLIBIC workshop took place on the 18^{th} of September 2012. Again we opted for a double event: in the morning the FPB presented its results on the new long-term projection of transport in Belgium under a reference scenario. This research was commissioned by the Belgian FPS Transport and Mobility. VITO gave input to this scenario within the PROLIBIC project. In the afternoon the results of the PROLIBIC were presented and discussed.

8.3. Presentations at policy seminars/workshops

During the course of the PROLIBIC project, the PROLIBIC partners presented their work at a number of policy seminars and workshops. A selection is given below:

- Luc Pelkmans, Lara Mertens, Ina De Vlieger, Carolien Beckx (2011). The role of biofuels in long term transport policy. Proceedings of the 19th European Biomass Conference and Exhibition. Berlin, 6-10 June 2011. (Valorisatie BIOSES resultaten)
- Luc Pelkmans (2011). Biobrandstoffen, een duurzame oplossing voor de transportsector? Presentatie op de Landelijke Dag Milieuwetenschappen,

Open Universiteit Nederland/Vlaanderen, Utrecht, 21 mei 2011. (Valorisatie BIOSES resultaten)

- 26 April 2011: Life cycle cost analysis of conventional and clean vehicles, MOBIMIX and CLEVER workshop (L. Turcksin)
- 25 November 2010: “The Impacts of Different Theoretical Road Pricing Schemes in Belgium”, Seminar on “The internalisation of external transport costs: what are the prospects for after 'Eurovignette II?', European Economic and Social Committee (I. Mayeres and M. Vandresse)
- 3 June 2010: Feasible vehicle and fuel technologies for 2020, European Parliament, ALDE Seminar, Transport in Europe 2020. A key element for sustainable growth (I. De Vlieger)
- 15 December 2010: The MAMCA and its policy implications, BIOSES workshop (L. Turcksin)
- 12 May 2009: Professional Mobility and Car Ownership, PROMOCO Workshop (A. De Witte)

8.4. Presentations at scientific conferences/workshops

A list of the presentations at scientific conferences/workshops (in chronological order) is given below:

Lefebvre, W. & I. Mayeres (2012), EU air quality regulations over time, BIVEC-GIBET Eco-zones Seminar, Low Emission Zones for Transport in the Benelux?, March 2012

Turcksin, L., Mairesse, O., Macharis, C. (2011), The effect of combined pricing measures on green vehicle demand: a new multidisciplinary approach, NECTAR conference “Smart Networks – Smooth Transport – Smiling people”, May 18-20, Antwerp.

Mayeres, I. & S. Proost (2011), The Taxation of Diesel Cars in Belgium – Revisited, in BIVEC Transport Research Day 2011 (Valorisation LIMOBEL results)

Michiels, H., Denys, T., Beckx, C., Schrooten, L., & Vernaillen, S. (2011) Policy Pathways for a Cleaner Belgian Car Fleet, In BIVEC Transport Research Day 2011. (Valorisation CLEVER results)

Turcksin, L., Lebeau, K., Macharis, C., (2010), Evaluation of biofuel scenarios using the MAMCA, OR 52, September 7-9, London, United Kingdom.

Turcksin, L., Lebeau, K., Macharis, C., Boureima, F., Van Mierlo, J., Bram, S., De Ruyck, J., Mertens, L., Jossart, J.-M., Gorissen, L., Pelkmans, L. (2010), A multi-actor multi-criteria approach for the introduction of biofuels in Belgium, WCTR conference, 11-15 July 2010, Lisbon.

Pelkmans, L., Gorissen, L., De Vlieger, I., Jossart, J.-M., Mertens, L., Turcksin, L., Macharis, C., Boureima, F., Van Mierlo, J., Bram, S., De Ruyck, J. (2010), Policy options in Belgium to support biofuels towards the 2020 target of 10% renewable energy in transport. Proceedings of the 18th European Biomass Conference and Exhibition, Lyon, 3-7 May 2010.

De Vlieger, I., D. Dewaele, B. Jourquin, I. Mayeres, H. Michiels, L. Schrooten, M. Vandresse, A. Van Steenbergen (2010), LIMOBEL – Long-Run Impacts of Policy Packages on Mobility in Belgium: Development of a Modelling Tool, paper presented at the 12th WCTR Conference, Lisbon, Portugal.

De Witte, A. and Macharis, C. (2010), “Company cars and mobility behavior: 3 types of company car users”, 12th WCTR, July 11-15, 2010 - Lisbon, Portugal.

Mayeres, I., M. Vandresse and A. Van Steenbergen (2010), A Long-Term Regional CGE Model Focused on Transport Issues in Belgium, paper presented at the 12th WCTR Conference, Lisbon, Portugal.

Ramaekers, K., Wets, De Witte, A., Macharis, C., Cornelis, E., Castaingne, M., Pauly, X. (2010), “The impact of company cars on travel behavior”, 12th WCTR, July 11-15, 2010 - Lisbon, Portugal.

De Witte, A., Macharis, C., Cornelis, E., Castaingne, M., Pauly, X., Ramaekers, K. & Wets, G. (2009) “Exploring the issue of company cars.” In: Macharis, C. en L. Turcksin. (eds.) Proceedings of the BIVEC-GIBET Transport Research Day 2009. Brussel: VUBPRESS, pp. 315-334.

De Witte, A. and Macharis, C. (2009). “At the intersection of private and professional mobility: exploring the impact of company cars on mobility behaviours in Belgium”, 1st Transatlantic Network on European Communications and Transport Activities Research (NECTAR) Conference, 18-20 June 2009, Arlington, Virginia, USA.

9. PUBLICATIONS

9.1. Peer review

Macharis, C. & A. De Witte (2012), The typical company car user does not exist: the case of Flemish company car users, Transport policy, 24, 91-98.

Mayeres, I. & S. Proost (2012), The Taxation of Diesel Cars in Belgium – Revisited, Energy Policy, in press. (dissemination LIMOBEL results).

Michiels, H., I. Mayeres, L. Int Panis, L. De Nocker, F. Deutsch & W. Lefebvre, $PM_{2.5}$ and NO_x from Traffic: Human Health Impacts, External Costs and Policy Implications from a Belgian Perspective. Transportation Research Part D 17, 569-577. (dissemination LIMOBEL results)

Michiels, H., C. Beckx, L. Schrooten, S. Vernaillen & T. Denys, Exploring the transition to a clean vehicle fleet: from stakeholder views to transport policy implications, Transport Policy 22, 70-79.

Pelkmans, L., G. Lenaers, J. Bruyninx, K. Scheepers & I. De Vlieger (2011), Impact of biofuel blends on the emissions of modern vehicles. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering, September 2011 225: 1204-1220, first published on July 12, 2011. (dissemination BIOSES results)

Mairesse, O., C. Macharis, K. Lebeau & L. Turcksin (2012), Understanding the attitude-action gap: functional integration of environmental aspects in car purchase intentions, Psicologica 33, 547-574.

Turcksin, L., O. Mairesse, C. Macharis & J. Van Mierlo (2011), Encouraging environmentally friendlier cars via fiscal measures: General methodology and application to Belgium, EJTIR (submitted).

Turcksin, L., O. Mairesse & C. Macharis (2012), A policy based weighted averaging model to predict the purchase of environmentally friendlier cars, Journal of Transport Policy (in review).

Turcksin, L., C. Macharis, K. Lebeau, F. Boureima, J. Van Mierlo, S. Bram, J. De Ruyck, L. Mertens, J.-M. Jossart, L. Gorissen & L. Pelkmans (2010), A multi-actor multi-criteria analysis to assess the stakeholder support for different biofuel options: the case of Belgium, Journal of Energy Policy 39, 200-214.

Schrooten L., I. De Vlieger, L. Int Panis, C. Chiffi and E. Pastori (2009), Emissions of maritime transport: A European reference system, Science of the Total Environment 408, 318–323.

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Gusbin, D., D. Devogelaer and M. Vandresse (2011), The environmental impact of electric cars in Belgium: a transport system approach vs. an energy system approach, paper presented at the European Electric vehicle Congress (EEVC) , Brussels, Belgium, October 26-28, 2011.

De Vlieger, I., D. Dewaele, B. Jourquin, I. Mayeres, H. Michiels, L. Schrooten, M. Vandresse, A. Van Steenbergen (2010), LIMOBEL – Long-Run Impacts of Policy Packages on Mobility in Belgium: Development of a Modelling Tool, paper presented at the 12th WCTR Conference, Lisbon, Portugal.

Mayeres, I., M. Vandresse and A. Van Steenbergen (2010), A Long-Term Regional CGE Model Focused on Transport Issues in Belgium, paper presented at the 12th WCTR Conference, Lisbon, Portugal.

De Witte, A. and C. Macharis (2010), “Company cars and mobility behavior: 3 types of company car users”, 12th WCTR, July 11-15, 2010 - Lisbon, Portugal.

Ramaekers, K.; Wets, G.; De Witte, A.; Macharis, C.; Cornelis, E.; Castaigne, M. and X. Pauly (2010), “The impact of company cars on travel behavior”, 12th WCTR, July 11-15, 2010 - Lisbon, Portugal.

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De Witte, A. and C. Macharis (2009), “At the intersection of private and professional mobility: exploring the impact of company cars on mobility behaviours in Belgium”, 1st Transatlantic Network on European Communications and Transport Activities Research (NECTAR) Conference, 18-20 June 2009, Arlington, Virginia, USA.

9.3. Other

De Vlieger, I., D. Gusbin, B. Hoornaert, I. Mayeres, H. Michiels, M. Vandresse & M. Vanhulsel (2012), De milieu-impact van de evolutie van de transportvraag tegen 2030, Working Paper 11-12, Federaal Planbureau.

Turcksin, L. (2011), Stimulating the purchase of environmentally friendlier cars: a socio-economic evaluation, PhD dissertation, Vrije Universiteit Brussel, Brussel.

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12. ANNEXES

Annex 1 to the final report of the **PROLIBIC** project, study financed by the Belgian FPS Science Policy.

(Contract SD/CL/08)

PROLIBIC Annex 1

Purchase prices alternative vehicles

February 2012

Hans Michiels, Ina De Vlieger (Vito)

1. Introduction

The goal of this subtask was to feed the PLANET model with a matrix containing current (2010) and expected (2015 till 2030, in 5-year steps) purchase prices for alternative vehicles, i.e. vehicles using relatively new propulsion technologies. The technology types studied include battery-electric vehicles (BEV), fuel-cell electric vehicles (FCEV), hydrogen vehicles (H2ICE), hybrid electric vehicles (HEVG and HEVD for gasoline and diesel, respectively), and plug-in hybrid electric vehicles (PHEVG and PHEVD).

We define a lower and an upper limit for each of the resulting price levels. For each year, prices are displayed as an index compared to a conventional gasoline vehicle. Where possible, we make a distinction between the different cylinder classes defined by COPERT (<1.4, 1.4-2.0, >2.0l).

2. Background

First of all, we specify what is meant by the acronyms used. The various car technology abbreviations mentioned in the remainder of this report are listed in Table 23. The distinctive criteria include the presence of an internal combustion engine (ICE), an electric motor, and the possibility of external electricity recharging. We provided an example for each of these categories.

Technology	Acronym	Internal combustion engine?	Electric motor?	External electricity recharging?	Example
Internal combustion engine gasoline/diesel	ICEG & ICED	x	o	o	Renault Mégane
Battery-electric vehicle	BEV	o	x	x	Renault Fluence Z.E.
Fuel cell electric vehicle	FCEV	o	x	o	Honda FCX Clarity
Hydrogen internal combustion engine	H2ICE	x	o	o	Mazda RX-8 Hydrogen RE
Hybrid electric vehicle gasoline/diesel	HEVG & HEVD	x	x	o	Toyota Prius Hybrid
Plug-in hybrid electric vehicle gasoline	PHEVG & PHEVD	x	x	x	Toyota Prius Plug-In Hybrid

Table 23: Alternative car technology overview

Future price evolutions for alternative vehicles were already described in SUSATRANS (Verbeiren et al. 2003). However, their projected price evolution appears to be very modest. Especially hybrids and BEVs seem to be extremely cheap (even for historical prices). FCEV is the only category for which SUSATRANS displayed more realistic (i.e., higher) costs. We need to realize that the numbers used in SUSATRANS were based on state-of-the-art knowledge from the period 2000-2003. Moreover, SUSATRANS used ICED as a reference vehicle instead of ICEG, which could be another (partial) explanation of the low surplus costs on top of the reference vehicle. In conclusion, we can state that the expectations at that time were rather optimistic compared to current insights. The proposed actualization in the present annex takes into account new sources (2007-2011) and establishes a link with observed prices of newly bought vehicles in Belgium.

3. Methodology & results

In order to provide more reliable price estimates, we performed a literature review. The result of this literature review is displayed in two price matrices (Table 24 and Table 25): one displaying lower price limits and another one showing upper price limits. Quite logically, the uncertainty interval is higher for those technologies that are still in the pre-maturity phase. In a final stage, these matrices are slightly adapted in order to take into account the actual diesel/gasoline price difference on the Belgian market.

Our analysis took into account the following general assumptions:

- Prices from literature are generally valid for mid-size vehicles. Nevertheless, we assume that the prices displayed for all non-conventional technologies (all except ICEG and ICED) are valid for small and large cars as well. We come back to the prices of small and large conventional vehicles after the discussion of Table 24 and Table 25.
- Prices are relative to a direct injection ICEG reference vehicle (common reference point in the international literature)
- The price for the ICEG reference vehicle is normalised to 1 each year, notwithstanding the fact that prices for this vehicle can actually vary over the years

More specifically, we now describe the way in which Table 24 and Table 25 (below) are arranged. All numbers without superscript were taken from Thiel et al. (2010). We consider this paper as the base document for our analysis, for several reasons. First of all, the cost analysis was based on a transparent cost breakdown for various technologies. Moreover, the numbers they display for 2010 are perfectly in line with real-life prices and they are very close to the lower limits proposed by Edwards et al. (2007b). Thiel et al. (2010) started from a hypothetical generic car class (mid-size), with comparable specifications over all technologies. The various technology types differ on the specific technical parts involved. A price difference was then found as a result of learning effects (e.g. on motors, batteries, electric motors and electric upgrades), applied to their projected future sales figures. For the year 2030, they considered both a low- and a high-volume scenario, the latter representing a situation with higher PHEV and BEV sales figures (and in our case, the preferred scenario). A more detailed description of the assumptions used in this paper can be found in §4, as from page 7145.

We now explain how the other fields of the matrix (i.e., those carrying a superscript) are filled in. We subsequently focus on Table 24 and Table 25. Please note that the superscripts differ between both tables, i.e. they do not necessarily refer to the same sources. Let's first have a look at Table 24.

The numbers followed by a single asterisk (*) are just linear interpolations between the numbers from the previously cited paper (Thiel et al. 2010).

Cost figures for **FCEV and H2ICE** vehicles in 2010 (**) were based on Figure 8.2 in the CONCAWE well-to-wheel report (Edwards et al. 2007b), which builds on Edwards et al. (2007a). That figure displays cost figures for a variety of technologies compared to an indirect injection ICEG reference vehicle. Unfortunately, these data are not available in table format, which forced us to make an estimation based on the available figure. In order to be consistent with the numbers from Thiel et al. (2010), we divided the lower limit figures provided by Edwards et al. (2007b) by a factor 1.025 (2.5% was assumed to be the additional cost of a direct injection system compared to an indirect injection ICEG). It might seem strange that the resulting price index is below the one for BEVs, because we barely observe these technologies in Belgium. Nevertheless, we should realize that FCEV and H2ICE vehicles have already entered the market in countries like the US and Germany. Please remark that the FCEV cost figure found by Baptista et al. (2010) was not withheld in our overview, as their methodology seemed rather inconsistent towards the reference year used (2002 versus 2010).

Reliable price projections for future FCEV vehicles (†) are very scarce in literature. Nevertheless, taking into account the current development status, we expect that FCEVs will definitely not mature faster than BEVs. Therefore, the BEV lower limit prices were assumed to be a lower limit for FCEVs as well. Regarding H2ICE vehicles (‡), we assume the same future relative price decline (1.14/1.21 ≈ 1.13/1.19 ≈ 1.22/1.28) as with conventional hybrid vehicles (HEVG and HEVD), as both can be considered as technologies that can build on existing knowhow regarding internal combustion engines.

The figure indicated by a single ^ was estimated based on the absolute difference between HEVG and HEVD vehicles. The **PHEVD** markup on a PHEVG is therefore considered to be exactly as large as the markup of a conventional diesel hybrid (HEVD) on a conventional gasoline hybrid (HEVG).

Future prices of PHEVD vehicles (indicated by ^^) were assumed to follow the declining trend (relatively) of PHEVG prices. Nevertheless, we made sure that the

PHEVD price could never exceed those of BEVs (as such implying a price equal to a BEV as from 2020).

Let's now move on to Table 25, containing the upper limit price indices.

As the numbers found in Thiel et al. (2010) were already assumed to serve as a lower limit, we had to look for upper limits somewhere else.

Again, the CONCAWE report (Edwards et al. 2007b) was of great help when filling in the figures indicated by a double asterisk (**). This report provides upper limit estimates for ICE, FCEV, H2ICE, HEVG and HEVD vehicles in 2010. Lower limit prices of ICED vehicles remained unchanged towards 2020 and 2030 (see Table 24). We extend this assumption to the ICED upper limits in 2020 and 2030.

The upper limits indicated by a single circumflex (^) build on our own estimates this time: we assume a 20% uncertainty (i.e., a surplus price of 20% on top of the lower limit) in 2010, and a 5% increase of the uncertainty level each 5-year period. The resulting figures for **BEV and PHEV** in 2010 are still within the interval suggested by Pasaoglu et al. (2011). Remark that the numbers suggested by the latter build upon a concept called 'vehicle glider costs', i.e. the costs of a base vehicle without any propulsion system. They assume that each technology uses the same glider, the value of which we need to complete the price matrix. However, it seemed very difficult to reconstruct the value of this glider. Based on the information given there, we therefore made our own assumption that the glider cost amounts to 15,865 EUR, i.e. the cost of a 'base vehicle' for a BEV. We should not take the numbers from Pasaoglu et al. (2011) as a guideline for our 2020 figures either, as they suggest a higher cost for HEVGs than for PHEVGs, which is very counterintuitive. Furthermore, we made sure that the suggested upper limit cannot exceed the upper limit of 5 years earlier, because prices are expected to decrease over time.

The figures marked by a ‡ (future upper limits for **HEVG and HEVD**) are constructed based on a similar rationale. The only difference with the previous paragraph lies in the base figure (i.e., for the year 2010) used, which builds on Edwards et al. (2007b) this time.

The upper limit for **FCEVs** in 2010 seems to be situated approx. 40% above the lower limit from Table 24 (this follows directly from Edwards et al. (2007b)). As fuel cell technology is mostly considered as the least mature technology of all categories studied here, we decide to increase this uncertainty by 10%, each 5-year period (^^). This increased rate seems to be acceptable as Pasaoglu et al. (2011) even suggest a 80% uncertainty rate for FCEVs. As mentioned earlier, we apply an adaptation making sure that the upper limit cannot exceed the upper limit of 5 years before.

According to Edwards et al. (2007b), the upper limit for **H2ICE** vehicles is just 5% higher than the lower limit. The reason for this observation was already mentioned before: hydrogen ICE vehicles can found on the expertise built up during the development of conventional gasoline and diesel vehicles. Future price projections therefore further extend this relatively small markup, by increasing the uncertainty level by 5% each 5-year period. As usual, we enforce that prices cannot increase in the future.

In summary, we can state that following the assumptions provided above, we assumed a higher uncertainty level (and thus a higher relative difference between the upper and lower limit) for FCEVs (40% +10% every 5 years) than for BEVs, PHEVs and HEVs (20% +5). Prices for the latter three categories are on their turn assumed to be more uncertain than prices for H2ICE vehicles (5% +5). These numbers are within the limits suggested by Pasaoglu et al. (2011), i.e. a maximum uncertainty rate of 80% and 50% for FCEVs and BEVs/HEVs/PHEVs, respectively.

technology\year	***2010***	***2015***	***2020***	***2025***	***2030***
ICEG	*1*	*1*	*1*	*1*	*1*
ICED	*1.09*	*1.09**	*1.09*	*1.09**	*1.09*
BEV	*1.77*	*1.51**	*1.24*	*1.20**	*1.15*
FCEV	*1.55***	*1.51†*	*1.24†*	*1.20†*	*1.15†*
H2ICE	*1.21***	*1.14‡*	*1.08‡*	*1.08‡*	*1.08‡*
HEVG	*1.19*	*1.13**	*1.06*	*1.06**	*1.06*
HEVD	*1.28*	*1.22**	*1.15*	*1.15**	*1.14*
PHEVG	*1.55*	*1.38**	*1.21*	*1.18**	*1.15*
PHEVD	*1.64^*	*1.46^^*	*1.24^^*	*1.20^^*	*1.15^^*

Table 24: Lower limit price levels, ICEG as reference vehicle and annually normalised to 1 (* = linear interpolation; ** = based on Edwards et al. (2007b); ^, ^^, † and ‡ = own estimation)

technology\year	***2010***	***2015***	***2020***	***2025***	***2030***
ICEG	*1*	*1*	*1*	*1*	*1*
ICED	*1.09***	*1.09**	*1.09***	*1.09**	*1.09***
BEV	*2.12^*	*1.88^*	*1.61^*	*1.61^*	*1.61^*
FCEV	*2.13***	*2.13^^*	*1.98^^*	*1.98^^*	*1.98^^*
H2ICE	*1.26***	*1.26†*	*1.24†*	*1.24†*	*1.24†*
HEVG	*1.45***	*1.41‡*	*1.38‡*	*1.38‡*	*1.38‡*
HEVD	*1.55***	*1.52‡*	*1.50‡*	*1.50‡*	*1.50‡*
PHEVG	*1.86^*	*1.73^*	*1.57^*	*1.57^*	*1.57^*
PHEVD	*1.97^*	*1.83^*	*1.61^*	*1.61^*	*1.61^*

Table 25: Upper limit price levels, ICEG as reference vehicle and annually normalised to 1 (* = linear interpolation; ** = based on Edwards et al. (2007b); ^, ^^, † and ‡ = own estimations, based on Pasaoglu et al. (2011))

Ideally, the PLANET model is provided with purchase prices per technology (as done before), but also split per COPERT cylinder class. We distinguish three cylinder size classes: <1.4l, 1.4-2.0l and >2.0l. Nevertheless, these engine size classes are not relevant for all technology types: e.g. BEVs do not have an internal combustion engine, so they cannot be categorized into these COPERT classes[10].

[10] Please note that in VITO's emission model 'E-motion road', BEVs are actually categorized into three categories: small, medium and large cars. Nevertheless, making future price predictions regarding different size classes remains difficult for technologies that remain far from established.

A further subdivision of the price indices in Table 24 and Table 25 for the different COPERT cylinder classes only seems to be feasible for conventional gasoline and diesel cars (ICEG and ICED). It is to say, these are the only two categories for which we can provide an observed average price level from the Belgian fleet, subdivided by cylinder class. Average price levels for new car purchases in 2010 are given in Table 26. These numbers were found by processing DIV data regarding new Belgian car registrations in 2010. Please remark that these price levels reflect base prices (i.e., base versions without any optional extras), excl. VAT.

It is clear from Table 26 that the price indices of ICED vehicles in Table 24 and Table 25 are a fair approximation of the **medium-sized (1.4-2.0l)** car purchases in reality. The 9% markup of ICED compared to ICEG indicated in Table 24 and Table 25 was based on a technical comparison of individually equal vehicles. The 1% markup (18,074/17,822-1) resulting from Table 26, on the other hand, indicates that of all the medium-sized vehicles bought, diesels are only slightly more expensive than gasoline vehicles. Most probably, this is due to the fact that diesels are mostly purchased at the lower end of the 1,4-2.0l range, whereas gasoline engines are mostly bought at the higher end of that range (assuming that cars with larger engines are generally more expensive than cars with smaller engines). Nevertheless, the deviation of the difference in Table 26 from the 9% mentioned earlier does not seem large enough to adapt the values provided earlier (Table 24 and Table 25).

	Gasoline	**Diesel**	**Weighted gasoline+diesel**
<1.4	10,429	12,256	**11,063**
1.4-2.0	17,822	18,074	**18,051**
>2.0	52,078	33,611	**35,658**
Total	**13,656**	**18,723**	

Table 26: Average base price (EUR excl. VAT) of new cars bought in Belgium in 2010 (adapted from DIV)

Regarding the **smaller COPERT category (<1.4l)**, we observe a fairly high difference between diesel and gasoline cars (18% = 12,256/10,429-1). A possible explanation for this is the higher share of diesels at the higher end of this category (close to 1.4l) and the relatively high share of gasoline cars significantly below this upper limit (rather 1.2l or smaller). From Figure 32, it seems that this is indeed the case. We decide to adapt the ICED/ICEG ratio from 1.09 (in tables 2 and 3) to 1.18 in order to better reflect the actual purchase price differences within this COPERT category. We suggest to keep all other ratios in Table 24 and Table 25 unchanged. This modification implies that BEVs, HEVDs, PHEVs and FCEVs could become more affordable (based on the lower limit values) than an ICED vehicle, which is rather counterintuitive. However, we need to keep in mind that these (relatively new) technologies are very likely to break through primarily in the smaller (and thus cheaper) car segments, such that this seemingly paradoxical imbalance becomes more acceptable. There is another reason why small diesel cars could become more expensive than some alternatives. In order to comply with Euro 6 (effective as from Sept 2015), new diesels will need to be equipped with a rather expensive $DeNO_x$ catalyst. For smaller cars with (usually) smaller profit margins, this could directly result in an increase of retail prices.

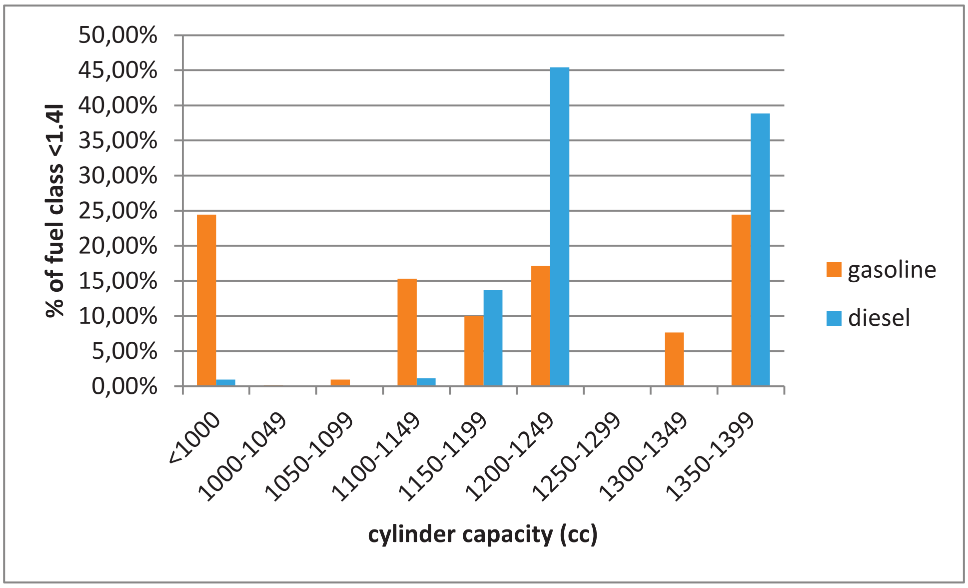

Figure 32: Cylinder capacity distribution of new car purchases in 2010, gasoline vs diesel (source: based on DIV)

Concerning the **largest engines (>2.0l)**, we observe a huge difference between gasoline and diesel cars. The average new Belgian diesel car >2.0l bought in 2010 is 35% cheaper than the average large gasoline car. Of course, this observation is completely caused by registrations of exclusive and expensive (sports) cars, almost exclusively equipped with a large gasoline engine. As these large gasoline vehicles only constitute <1% of all diesel and gasoline registration in 2010, the comparison with diesel vehicles falls short. Therefore, we decide not to adapt the 1.09 ratio for this large engine category.

4. Conclusions

In Table 27, we summarize the selected price levels for passenger cars. Engine size-dependent price levels are only provided for ICED vehicles. All the other values within one technology are ready to be applied to the three different COPERT classes (<1.4l, 1.4-2.0l and >2.0l).

We assume an absolute price level for the ICEG reference vehicle of 10,429 EUR or 17,822 EUR, depending on the COPERT class (<1.4l and 1.4-2.0l, respectively; cfr. Table 26). For the largest COPERT category (>2.0l), we assume an absolute reference price for the ICEG reference vehicle slightly cheaper than the ICED vehicle, where we start from the same ratio as observed for the medium class. We need to follow this alternative approach because the ICEG/ICED ratio for >2.0l vehicles in Table 26 is completely biased by a large share of exclusive vehicles (cfr. higher). The reference price for a large vehicle then becomes 33,611*17,822/18,074 = 33,142 EUR. All the absolute price figures mentioned are excl. VAT.

Regarding the evolution of these absolute price figures, we refer to the base paper mentioned earlier (Thiel et al. 2010). They suggest a real (i.e., in contrast with nominal) price decline for the reference vehicle of approx. 2.5% towards 2020 and 4% towards 2030. For the years lying in between (2015 and 2025), we apply a simple linear interpolation. The application of such a rationale results in Table 28.

By combining Table 27 and Table 28, we are able to calculate an absolute (future) price estimate for each of the technologies considered and for one specific COPERT class.

technology\year	***2010***	***2015***	***2020***	***2025***	***2030***
ICEG	1	1	1	1	1
ICED <1.4l	1.18	1.18	1.18	1.18	1.18
1.4-2.0l	1.09	1.09	1.09	1.09	1.09
>2.0l	1.09	1.09	1.09	1.09	1.09
BEV	1.77-2.12	1.51-1.88	1.24-1.61	1.20-1.61	1.15-1.61
FCEV	1.55-2.13	1.51-2.13	1.24-1.98	1.20-1.98	1.15-1.98
H2ICE	1.21-1.26	1.14-1.26	1.08-1.24	1.08-1.24	1.08-1.24
HEVG	1.19-1.45	1.13-1.41	1.06-1.38	1.06-1.38	1.06-1.38
HEVD	1.28-1.55	1.22-1.52	1.15-1.50	1.15-1.50	1.14-1.50
PHEVG	1.55-1.86	1.38-1.73	1.21-1.57	1.18-1.57	1.15-1.57
PHEVD	1.64-1.97	1.46-1.83	1.24-1.61	1.20-1.61	1.15-1.61

Table 27: Price indices (upper and lower level where applicable) for various technologies compared with the ICEG reference vehicle (for which the value is annually normalised to 1)

COPERT class\year	**2010**	**2015**	**2020**	**2025**	**2030**
<1.4l	10,429	10,304	10,179	10,092	10,005
1.4-2.0l	17,822	17,608	17,395	17,246	17,097
>2.0l	33,142	32,745	32,347	32,070	31,793

Table 28: Suggested absolute price figures (EUR excl. VAT, in real terms) for the ICEG reference vehicle, split for the three COPERT classes (based on DIV and Thiel et al. (2010))

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Annex 2 to the final report of the **PROLIBIC** project, study financed by the Belgian FPS Science Policy.

(Contract SD/CL/08)

PROLIBIC Annex 2

Minutes of the meetings with the PROLIBIC follow-up committee

September 2012

PROLIBIC Minutes of follow-up committee (13/09/2010)

Present:

Co-ordinator SPF

- Georges Jamart

Follow-up committee members

- Amélie Cuvelier (AWAC)
- Luk Deurinck (BPF)
- Michèle Pans (CRB)
- Caroline De Geest (VMM)
- Bart Thys (FOD Mobiliteit en Vervoer)
- Luc Vinckx (GM Europe)
- Pol Michiels (FEBIAC)
- Wilfried Goossens (MVG dep. MOW)
- Fré Maes (FOD Volksgezondheid)

Partners

- Marie Vandresse (FPB)
- Laurence Turcksin (VUB)
- Astrid De Witte (VUB)
- Ina De Vlieger (VITO)

Apologized:

- Cathy Macharis (VUB), Inge Mayeres (VITO), Laurent Demilie (SPF Transport et Mobilité), Ivo Cluyts (FOD Volksgezondheid)

Report

Mr. Georges Jamart, Programme Administrator PROLIBIC, gave an introduction on the context of the project. In fact the call for clustered projects last year was a continuation to SPSD 1 and 2 (Scientific support Plan for a sustainable Development policy). The call had a maximum budget of 600 000 EUR. The maximum budget per cluster amounts to 100 000 EUR. PROLIBIC fits within the theme ‘Energy prospects’.

There should be an active collaboration of the follow-up committee with the researchers. Advice of the committee should be taken into account in the activities and the reports.

PROLIBIC clusters four projects carried out or still running within the Research Programme SPSD 2. All four projects are dealing with the transport sector:

- PROMOCO (coordinator VUB): Professional mobility and company car ownership
- LIMOBEL (coordinator FPB): Long-run impacts of policy packages on mobility in Belgium
- BIOSES (coordinator VITO): Biofuels Sustainable End uSe
- CLEVER (coordinator VUB): Clean Vehicle Research: LCA and Policy Measures

The PowerPoint presentations in Annex give an overview of the defined approach for PROLIBIC and the contribution of the different researchers on the separate projects.

In the following we list some questions, comments and suggestions made by the follow-up committee:

- 2% electric energy for transport (on sum of diesel and petrol) realistic? Yes. The 0, 5% VITO puts forward refers only to renewable electricity taking into account a European average of 19% green electricity by 2020.
- RES (Renewable Energy Strategy) national action plan draft should be taken into account. There have been contacts between VITO and VEA (Ina checks with Luc P.)
- Available results & reports of the BIOSES project will be sent to the follow-up committee of PROLIBIC.
- In the baseline scenario we do not take into account the Renewable Energy Directive.
- Besides CO_2 taxes also scenarios on ETS. No.
- CLEVER focuses on end user and passenger cars.
- PROMOCO distinguished 3 types of company car users: representatives, commuters and Enjoyers. Policy has to be adapted to the type of user. E.g. greener fleet for representatives, mobility budget and/or telework for commuters and other incentives for the enjoyers.
- The importance of changes in company's policy up on company cars is stressed: combination of company cars and public transport should become common policy.
- We have no idea of the general use of company cars.

Actions

- Available reports of BIOSES to the follow-up committee PROLIBIC: Laurence/Luc.
- Scenario report of CLEVER when available to the follow-up committee PROLIBIC: Laurence/Tobias.
- Available results and reports of LIMOBEL to the follow-up committee PROLIBIC: Marie/Inge.
- Co-ordination, tuning and combine workshops BIOSES, CLEVER and PROLIBIC: Ina/Luc/Tobias.
- Summary PROMOCO project in CRB newsletter (September 2009): Michèle Pans ✓, see attachment French and Dutch version.

Workshop in Brussels

April-May 2011

PROLIBIC meeting of 29 March 2011: report

Present:

Amélie Cuvelier (AWAC), Ina De Vlieger (VITO), Astrid De Witte (VUB), Dominique Gusbin (BFP/FPB), Bruno Hoornaert (FPB/BFP), Georges Jamart (Belspo), Gilles Labeeuw (SPFMT-FODMV), Julien Matheys (Climact), Inge Mayeres (VITO), Pol Michiels (Febiac), Michèle Pans (CRB), Laurence Turcksin (VUB), Marie Vandresse (BFP/FPB), Luc Vinckx (General Motors)

Summary of the discussion

One of the tasks of the PROLIBIC project is to develop:
- a harmonized reference scenario, taking into account the results of LIMOBEL, BIOSES, CLEVER and PROMOCO
- a policy scenario.

During the meeting we went through a discussion note with the following content:
- Overview of the main assumptions of the LIMOBEL reference scenario that we will build upon
- Overview of the main results of the LIMOBEL reference scenario
- Proposals for changing the assumptions of the reference scenario in PROLIBIC
- Overview of the policy measures that can be integrated in the PROLIBIC policy scenario

The aim was to answer the following questions: (i) which assumptions of the reference scenario need to be adapted?, (ii) which policy package should be simulated within PROLIBIC?

The following comments were made about the discussion note:
- LIMOBEL reference scenario: it was asked to give more detail about some of the assumptions of the reference scenario; in addition some mistakes were pointed out. As an annex to this report we include the revised version of the discussion note, that already takes into account these comments.

- As regards the assumptions for the PROLIBIC reference scenario, it was proposed:
  - To include more recent projections about the oil prices
  - To allow for the introduction of alternative technologies for cars; this could be based on MIRA, BIOSES BAS or the recent report of the Federal Planning Bureau (that is distributed together with this report)

  - To use the KLEN scenario of LIMOBEL to calculate the indirect emissions electricity
  - To explore whether an average Ecoscore can and should be calculated - this could be interesting if the policy packages are expected to have a large impact on the vehicle stock composition
  - To explore whether the elasticity information that was obtained in CLEVER can be used in the car stock module of PLANET
  - To see whether the extra costs of alternative vehicles are still up to date.

- As regards the <u>policy packages for PROLIBIC policy scenario</u>
  - an overview was given of the policies that could be adapted;
  - No choice was made yet; it was decided that the consortium distributes a proposal by the end of May.

Update of the PROMOCO study:

- The results of the BELDAM inquiry will become available in September (at the earliest)
- The effect of recent measures (CO_2) related to company can already be analysed.

Actions:

- 29 April: distribute note with assumptions for the reference scenario (PROLIBIC consortium)
- 13 May: comments on this note (follow-up committee)
- 31 May: distribute proposal for policy package that will be simulated (PROLIBIC consortium)
- 17 June: comments on this note (follow-up committee)
- schedule meeting at the end of June to decide on assumptions of policy scenario (PROLIBIC consortium)

PROLIBIC meeting of 11 October 2011: report

Present

Ivo Cluyts (FOD Volksgezondheid, Veiligheid van de voedselketen en Leefmilieu), Amélie Cuvelier (AWAC), Georges Jamart (Belspo), Laurent Demilie (SPF Transport et Mobilité), Astrid De Witte (VUB), Laurence Turcksin (VUB), Dominique Gusbin (BFP/FPB), Bruno Hoornaert (FPB/BFP), Marie Vandresse (BFP/FPB), Inge Mayeres (VITO), Ina De Vlieger (VITO).

Summary of the meeting and discussion

First, a **global state-of the art** has been presented by Ina . The Realizations of the project until now are:

- Work package 1:
  - Results of the separate projects have been translated into workable input for PROLIBIC
  - PLANET has been extended with “real-life” Ecoscore for passenger cars.
- Work package 2:
  - PROLIBIC baseline has been defined
  - Suggestion for policy scenario.
- Work package 3:
  - Intermediary results on the study on company cars.
- Work package 4:
  - The LIMOBEL/PROLIBIC workshop on 29 March 2011 has been a success (± 100 participants).

The project will be **extended until 30 June 2012** due to maternity leave of two co-workers (1 FPB and 1 Vito).

A **final workshop/conference** at the end of PROLIBIC has been discussed. It seems difficult to organise this event before summer 2012 as the FPS Transport & Mobility will communicate after summer 2012 on the new long-term prospective for transport in Belgium: Reference scenario. As the “Baseline scenario of PROLIBIC” (Belspo) and “Reference scenario” (SPF Transports et Mobilité) is the same scenario and results from efforts performed within LIMOBEL and PROLIBIC are integrated in the Reference scenario, it seems obvious to organise a common event in September or October 2012. This option has to be confirmed by Mr. Jamart and Mr. Demilie.

Astrid presented the results on the isolated study on **company cars,** see slides in annex. For the analyses many data sources are used, the only source that is missing is Febiac. VUB hopes to receive the information soon.

Due to the financial crisis measures have been undertaken by the companies to lower the costs of company cars. This is done by prolongation of the leasing contract, measures to down-sizing of engines and lowering energy consumption, and negotiation with suppliers. Until now no comparison has been done between private car and company car fleet. This will be done within WP3 on the basis of the Escorte database of VITO.

No distinction could be made between diesel and petrol cars, but most of the company cars are diesel vehicles.

As the results on company cars is rather an isolated study, VUB will finish its work on this topic by the end of January 2012. There is no new template available for the PROLIBIC report compared to the PODO II projects, so the template of LIMOBEL will be used.

Concerning the **Baseline/Reference scenario** some changes are still possible:

- Share of biofuels in harmony with the assumptions of the Flemish Climate project.
- Cost technologies will change as VITO will update figure in January-February 2012. A distinction should be made between small, medium and large vehicles.
- In this scenario only decided policy is taken into account, so ongoing discussion on fuel taxes on the bases of energy content will only be taken into account in the policy scenario.

Updated emission factors and cost will be delivered by VITO to FPB in February 2012.

Due to the parallel trajectory of the PROLIBIC and FPS scenario, the Baseline scenario could not be presented in detailed and as stand-alone scenario. So, for the next PROLIBIC meeting focus will be on the policy scenario.

Furthermore, during the meeting we went through the definition and assumptions of the **policy scenario**, see VITO slides 11 to 16:

- Exogenous evolutions
- Emission factors and energy consumption
- Policy instruments

- Concerning the introduction of Battery Electric Vehicles (BEV) and Plug-in Hybrid (PHEV) Mr. Demilie is somewhat more pessimistic than the proposed figures. Diesel vehicles will stay the most important category. Comparison of the VITO figures to other international studies show that in policy scenarios about the same levels of BEV and PHEV are assumed;

- The timing of the introduction of road pricing for cars in 2015 seems to be too optimistic; therefore it is suggested to take a later date such as 2017;

- For the excise on diesel and gasoline it was decided to use the same excise per km on both car types (taking into account the difference in fuel efficiency);

- As regards the subsidies for fuel efficient diesel and gasoline cars it was decided to keep the average subsidy per car constant at the reference level (rather than increasing it, which would be the case when the share of the more fuel efficient cars in the registrations would increase). The subsidy scheme for BEV and PHEV also remains in the policy scenario.

Actions:

- 18 November: all, comments on the defined policy scenario
- November: Ina, template for PROLIBIC report
- 31/01/2012: VUB, contribution to final report
- February 2012: VITO new EF and cost technologies.