

Action Forms

September 2012

Freight transport



Voluntary commitments Charter Reducing CO₂ emissions Road freight transport



**The following translation of the original
ADEME “Fiches Actions”
was performed In June 2013 by**

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The Action Forms are available in French on www.objectifco2.fr

The original French version remains
The only Official Version
(**dated September 2012)**

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1 Introducing Action Forms

1.1 Introductory presentation: “CO₂ Objectives Charter – Transport Operators Commit Themselves”

In a context where addressing climate change issues and constant fuel price rising trends is everyday business, the transport of merchandise sector disposes of a wide array of solutions allowing operators to reduce fuel consumption of their vehicles, thus the CO₂ emissions.

Solutions can be of technology kinds (focused on the vehicle and fuel use), organizational kinds (optimizing loads and flows) and of behavioural kinds (centred on the driver). However, none, taken individually, is capable of delivering a satisfactory potential. Each action only comes as a complement to another one.

The CO₂ Objectives Charter – Transport Operators Commit Themselves programme was therefore conceived with this in mind by the **Ministry for Ecology, Energy and Sustainable Development (MEDDE)** and **ADEME (French Environment and Energy Management Agency)** in cooperation with the professional organizations of this sector.

The ADEME CO₂ Charter was a logical follow-up to the Grenelle environmental conference agreements and addresses in particular Article 10 of the Grenelle 1 round of agreements.

This charter is based upon voluntary participation and commits each participant and signatory to an individualized action plan, in view of abating fuel consumption and as a result CO₂ emissions.

Each operator committing to the programme and taking the decision to sign on for it, must perform a CO₂ audit as a prerequisite (on the base of predefined specifications). This audit within the chosen perimeter of activity, has several purposes:

- Set a calculated objective – three years ahead – for the two Environmental Performance Indicators (EPI) namely gCO₂/km and gCO₂/t.km (*where g stands for grams – t for tonne – km for kilometre*).
- Write out a Plan of Action for a three-year time span, total duration.
- Set the appropriate indicators and objectives to attain, for each identified action chosen.

The results of this CO₂ audit are then posted on the Internet site www.objectifco2.fr which is to be used by each transport operator during the three-year programme.

1.2 Objectives of the Action Forms

Designed as a decision-making resource, the Action Forms are aimed at informing, in an independent and unbiased manner, transport operators on all the solutions that are available on the market, and which will have a positive impact on fuel consumption and CO₂ abatement issues.

The www.objectifco2.fr tool integrates them in its section dedicated to evaluation of the potential volumes of fuel reductions as well as CO₂ emissions, in order to allow each transport operator to proceed with simulations and design a Plan of Action specific to his own specific activities.

1.3 Selection grid of the Action Forms

Action Forms are organized around four Focuses:

- **VEHICLE FOCUS** which regroups all the actions concerning the vehicle and the semitrailer (accessories, engine options, tyres, etc.);

- **FUEL FOCUS;** actions on the power engine energy of the vehicles (follow-up of consumption, biofuel, hybrid and electric vehicles, etc.);
- **DRIVER FOCUS:** gathering all actions to be taken enhancing the driver's behaviour (Eco-Drive, good practice for the temperature-controlled transport sector);
- **ORGANIZATION OF TRANSPORT FLOWS FOCUS:** all action relative to the optimization of the loading process, to the utilization of other alternative modes of transport, and raising the awareness of customers and road transport subcontractors.

Each transport operator will have to make a personal reading of the Action Forms, one that will be in line with his own situation, having undertaken beforehand a CO₂ audit, on the basis of predefined specifications.

It is to be noted that the actions and solutions proposed are recommendations, which need to be analysed first as to their relevance when confronted to the kind of transport trade, the means utilized, the operational needs, the regulatory context as well as the level of performance of each transport operator involved.

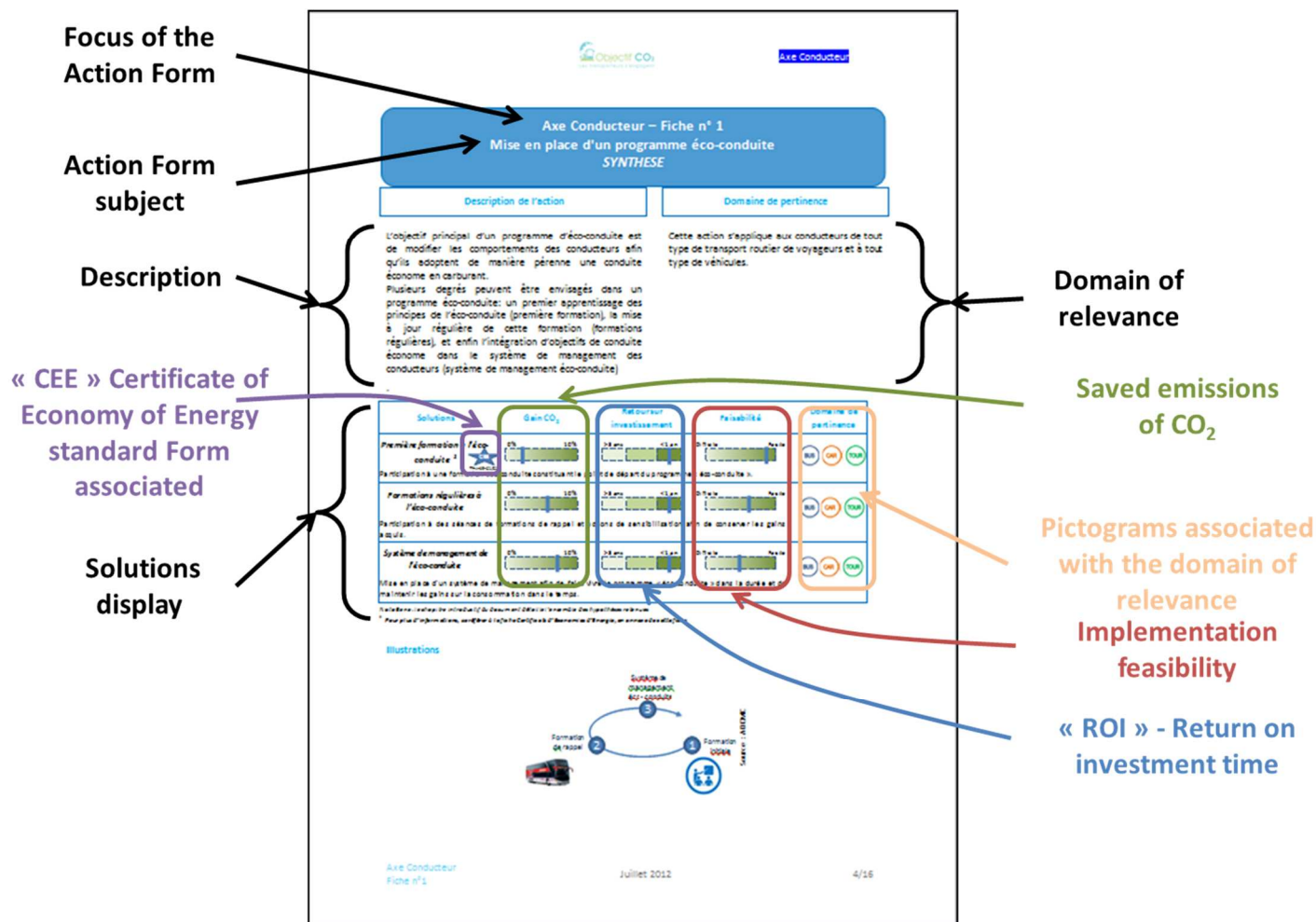
This is the reason why, in order to facilitate reading, each Action Form is structured around a summary form along with a more detailed form, in which the following headings are to be found.

1.3.1 Summary Form

The purpose of the Summary Form is to summarize on one page each action and its associated optimized solution. For each operator, the aim is to permit immediate identification of the relevance of the proposed solutions, or not, given the specificity of the situation they face.

Each Summary Form is organized in the following manner:

- A brief description of the action;
- Its domain of relevance;
- Solutions associated to the action mentioned, summary and visual, with a cursor that situates their performance level as regards;
 - Expected savings in terms of CO₂ emissions
 - ROI or Return On Investment time
 - Degree of feasibility when implementing the recommended solution.



SYNTHETIC FORM PRESENTATION SUMMARIZING PROPOSED SOLUTIONS

The farther the cursor is situated to the right-hand side of the green shaded cell, the more relevant it is. The position was calculated in the following manner:

- **CO₂ SAVINGS:** savings in terms of carbon dioxide associated with the implementation of the proposed solution, as regards the standard situation. Savings are generally expressed in a percentage figure that spans from 0% to 10%. However for savings over 10%, the scale was modified in order to allow for differentiation of the actions that generate the most important savings. On the detailed form, CO₂ savings of each solution is specified for four categories of vehicles (see 1.3.2 of this document).
- **ROI TIME:** takes into account all the necessary implementation for each solution (namely cost difference between standard and specific equipment, the extra operational or implementing costs, etc.), together with the savings on fuel consumption, lubricants, etc. associated with the solution. The return on investment is calculated given a cost of €1.1 per litre of diesel fuel. It is then expressed in relative period of time considered *rapid* if found < 1 year, *medium term* if found between 1 and 3 years and *long term* if found > 3 years duration.
- **FEASIBILITY:** it represents the ease of implementation for a transport operator. A feasibility level materialized by a tag between **1** (*difficult*) and **3** (*easy*), has been assigned to each identified solution.
-

Tagging takes into account the following aspects:

- **Implementation time:** what are the major steps and the necessary amount of time taken to implement the considered solution (study and preliminary analysis, validation test, negotiation and communication with other parties involved in the operator's organization system, etc.)
- **Difficulty** to determine what is the optimal solution; do we have to launch preliminary studies? is the present array of existing products or services diversified enough?
- **Organizational** aspects: complexity and number of personnel involved;
- **Conducting change:** are transport companies going to rapidly integrate the proposed solutions (drivers' behaviour towards new technology change, need to receive training on the new solution's implementation process, etc.)
- **Market availability:** are the solutions offered – products or services – available on the market?
- **Taking into account constraints linked with the solution once operational:** use of specific equipment, need for training, and need for control or specific maintenance required, etc.

1.3.2 Action forms in detail

- In this section, the transport operator will find detailed information on each action and identified solution, structured in the following way:
- Context and associated regulatory enforcement (see next page)

The diagram illustrates the structure of the 'Axe Conducteur - Fiche n° 1' form. The form is divided into a header section (Axe Conducteur) and a main content section (FICHE DÉTAILLÉE). The main content section is further divided into 'Contexte et réglementation' and 'Focus of the Action Form'. The 'Contexte et réglementation' section is linked to 'Context and regulatory measures' via a bracket. The 'Focus of the Action Form' section is linked to 'Subject of the Action Form' via a bracket.

Contexte et réglementation

Depuis 2000, les conducteurs salariés des entreprises de transport de voyageurs sont soumis à des obligations de formation visant à développer la qualité, la sécurité et les conditions de travail.

Si la réglementation française n'impose pas, à proprement parler, de formations à l'éco-conduite, des notions sont en partie incluses au sein des formations obligatoires, notamment la Formation Continue Obligatoire (FCO).

Pour rappel, il existe deux types de formations obligatoires :

- La Formation Initiale Minimum Obligatoire (FIMO) qui concerne tout salarié occupant pour la première fois un emploi de conducteur routier ou affecté à la conduite d'un véhicule de plus de 3,5 tonnes de PTAC ou de plus de 9 places assises, conducteur compris. La FIMO comporte 140 heures de formation.
- La Formation Continue Obligatoire (FCO) qui concerne tout salarié occupant un emploi de conducteur routier ou affecté à la conduite d'un véhicule de plus de 3,5 tonnes de PTAC. Cette formation doit être renouvelée tous les cinq ans. Depuis le 10 septembre 2008, date d'application de la Directive européenne 2003/91/CE du 10 juillet 2003, la FCO est passée de 9 à 9 jours. Cette directive a été transposée en droit français par le Décret 2007-1340 du 11 septembre 2007 « relatif à la qualification initiale et continue », et le contenu de la formation a été précisé dans l'arrêté du 3 janvier 2008. 1 des 4 thèmes abordés dans la FCO est le thème 1 appelé « Perfectionnement à la conduite rationnelle axée sur les règles de sécurité » d'une durée de 11 h dont 6h consacrées au perfectionnement de la conduite. Ce thème aborde les points suivants :

- la prise en compte des caractéristiques techniques du véhicule ;
- les principes d'utilisation des différentes boîtes de vitesses ;
- le perfectionnement à une conduite sûre et économique, les possibilités de l'informatic embarquée, l'optimisation de la consommation du carburant ;
- le chargement, le respect des consignes, la bonne utilisation du véhicule ;
- l'application pratique de la conduite en situation normale comme en situation difficile.

Si le sujet de l'éco-conduite peut être abordé au sein de la FCO (dans un format réglementé et le plus souvent en formation inter-entreprise, non adaptée aux spécificités de chaque entreprise), cette FCO n'a pas les mêmes finalités que la formation éco-conduite définie dans la solution n°1 à l'formation à l'éco-conduite.

Des formations spécifiques « éco-conduite » sont ainsi proposées pour s'adapter aux besoins des entreprises de transport, le plus souvent en format intra-entreprise.

Une fiche CEE existe pour la formation à l'éco-conduite [CEE n°TRA-06-01] : le calcul du gain associé est basé sur un gain de 3% par an sur 3 ans.

Une fiche CEE existe également pour la formation à l'éco-conduite pour les véhicules légers [CEE n°TRA-06-02] : dans ce cas, le calcul du gain associé est basé sur un gain de 7% la première année.

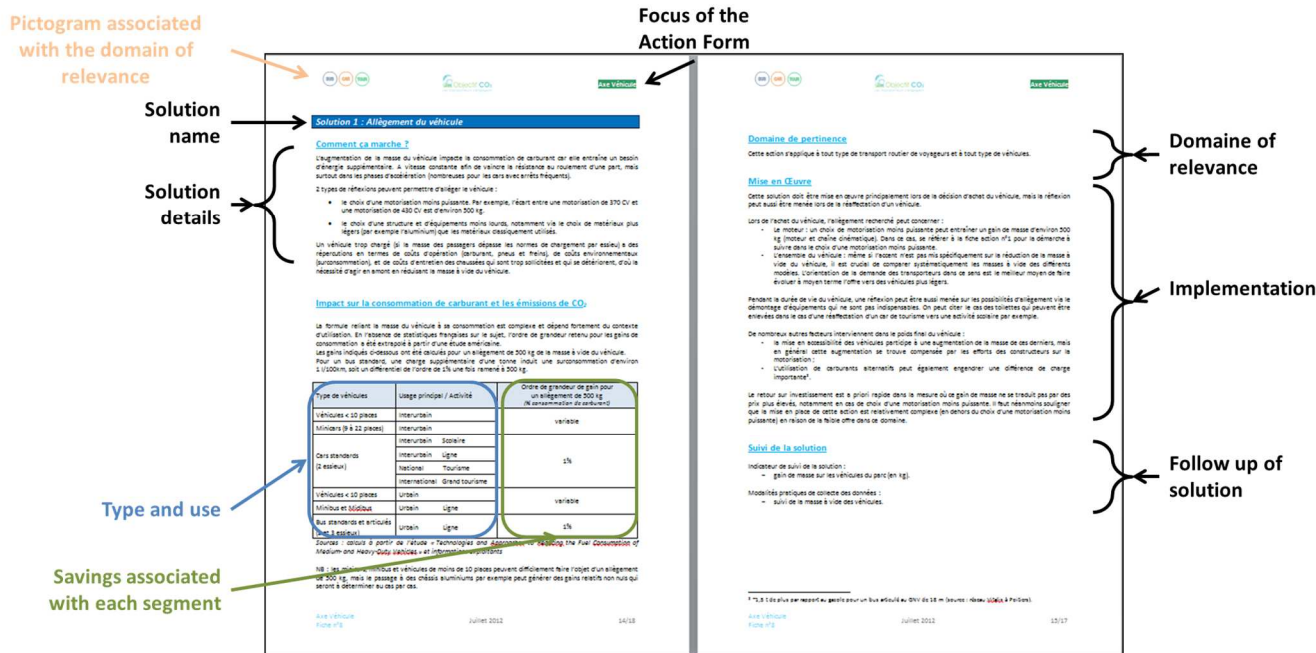
Pour plus de renseignements, se référer aux fiches CEE en annexe de cette fiche action.

Focus of the Action Form

Subject of the Action Form

Context and regulatory measures

Presentation of the first page of the Detailed Form.
Following pages are organized per solution offered:



Presentation of each solution in the Detailed Form.

Each solution has been analysed using the five following headers: “How does it work?”, “Impact on fuel consumption and CO₂ emissions”, “Domain of relevance”, “Implementing the solution”, and “Solution follow-up”.

HOW DOES IT WORK? this section aims to describe the solution from a tutorial point of view;

Impact on fuel consumption rate and CO₂ emissions: the savings on the volume of fuel and CO₂ emissions have been considered as indicators of scale data. They come from evaluations carried out by ADEME, from leading professional feedback, or from more theoretical studies. Data sources are *always* explained in detail.

Actual savings can differ from the average estimations made and will vary with the type of vehicle used, operator profile, specific activity in the transport operator sector, geographical situation and in general will depend on its initial situation at the time of involvement into the programme.

FOUR SEGMENTS OF VEHICLE which associate a certain body structure to its main usage and to its **MGW**¹ have been selected. This segmentation allows, when relevant, to differentiate between the different CO₂ potential of savings.² Each vehicle segment is represented by a coloured circle pictogram. In turn these pictograms allow, in each action form, for rapid identification of the domain of relevance, for each proposed solution.

Vehicle size	Main use considered	Max Gross Weight	Pictograms
LCV Light Commercial Vehicle	Urban	≤3.5 tonnes	
Rigid Small Truck	Urban	3.6 - 12 tonnes	
Rigid Large Truck	Regional	> 12 tonnes	
Semitrailer	Long Distance	40 tonnes	

¹ Maximum Gross Weight

² When justified, potential CO savings are differentiated in the text according to the trade – on call urgent, small parcel, short distance in case of LCVs operating in urban operation).

The Light Commercial Vehicle (LCV) has been defined in the CO₂ Charter Programme, as a vehicle performing public transport service for outside parties (not for internal use). It has a **MGW** that is equal to or less than 3.5 tonnes. In compliance with road regulations, it can be operated by anyone carrying a “B” type driving license. For information, the broad majority of vehicles of the “cabin-over-frame” type have a **MGW** of 3.5 t.

Companies using fleets of LCVs for their own account are not included in the perimeter of the programme. This is due to the fact that unlike transport operators who uses heavy-duty trucks, for which the identifiable sure trade is transport (apart from internal use vs. public transport usage segmentation), the same does not apply to LCVs because an important share of professional users have a personal usage, which is a totally different use and purpose than the transport of merchandise use.

This is the case namely in one-man operator trade, service companies like dry cleaners, food delivery “catering” service, gas and electricity distribution and telecom operators.



RIGID SMALL TRUCK has been defined as a truck (internal use or public transport third party use) with **MGW** over 3.5 tonnes and lower than or equal to 12 tonnes, conceived or adapted to be equipped with a body or a technical add-on to its frame; tilter, platform, retractable arm, tanker, waste, cement mixer, and some types of cranes.



RIGID LARGE TRUCK has the same general definition as a small rigid truck, but its **MGW** is > 12 tonnes and includes the 19-tonne and 26-tonne types).



SEMITRAILER or “ARTICULATED TRUCK” has two sections: the tractor to which a semitrailer is connected by a turn plate. Its **MGW** is usually over 40 tonnes and limited to 44 tonnes. It is utilized either for internal transport for own account or for public transportation.



Source: companeo.fr

Semitrailer

Hypothesis made for the calculation of theoretical savings and average valuation figures used

Vehicle size	Main use considered	MGW or MCW	Average payload (tonnes)	Maximum Gross Weight (tonnes)	Average speed (km/h)	Average yearly distance covered (km)	Average fuel consumption (litres/100 km)
LCV (Light Commercial Vehicle)	Urban	≤3.5 t	0,8	2,2	40	18 200	10
Rigid Small Truck	Urban	3.6-12 t	4	7	40	50 000	20
Rigid Large Truck	Regional	>12 t	10	15	65	80 000	25
Semitrailer	Long distance	40 t	18	33	68	113 500	34

Sources:

- For LCV vehicles: Commissariat Général au Développement Durable – Chiffres et Statistiques – “Les véhicules utilitaires légers au 1er janvier 2011” – n° 310 – April 2012.
- For other segments: survey of the “Comité National Routier” (www.cnr.fr, 2010 sample).

- **DOMAIN OF RELEVANCE:** it is specified in which case it will be relevant to implement the considered solution (specific activity, vehicle categories and usage...).
- **IMPLEMENTING THE SOLUTION:** practical advice is given on the solution implementation. When information is accessible, a cost or extra-cost indication is given.
- **FOLLOW-UP OF THE SOLUTION:** for each solution provided, the associated indicator(s) of performance which are to be used are given, together with the practical dispositions for data collection needed to implement the solution in an effective manner and assure follow-up in the web tool at www.objectifco2.fr.

1.4 The rule of cumulative savings

Most solutions presented are independent from one another, which in turn allow cumulative savings to happen. Indeed the objective of the actions taken in a CO₂ charter is to minimize the CO₂ quantity per tonne transported. Which can be summarized by the following formula:

$$\text{CO}_2 = (\text{tCO}_2/\text{litre of fuel used}) \times (\text{litre}/100 \text{ K}) \times (100 \text{ K}/\text{tonne transported merchandise})$$

EFFECTIVENESS



It must be noted that savings which are relative to several solutions do not add to each other, but they multiply. As an example, three solutions added together, each allowing a 10% reduction on CO₂ do not have cumulative savings of **30%** (10% +10%+ 10%) but of **27%** (1-(1-10%) x (1-(1-10%) x (1-(1-10%))).

This rather simplified vision has however to be fine-tuned: some of the proposed solutions have identical objectives. Even if they are chosen by the operator adds on to each other's, cumulating associate individual savings would lead us to *over-estimate* the global potential of savings.

Besides, certain solutions constitute a pre-requisite for other solution: this is the case for Action Form N° 1 of the VEHICLE FOCUS of the Action Form N° 3 of the FUEL FOCUS and the Action Form n° 1 of the DRIVER FOCUS.

The chart hereafter illustrates the principal relations between solutions.

The solution of data collecting pertaining to the fuel is in fact a prerequisite for the most advanced solutions of the Eco-Drive Form (ongoing training and Eco-Drive Management System).

The first Eco-Drive solution is a prerequisite for the onboard telematics solution.

Savings following onboard telematics and robotized gear boxes are savings linked to the VEHICLE; they are technology solutions that come to help the driver perform satisfactory Eco-Drive: in that sense, they cannot add to the maximum savings attributed to Eco-Drive (10%) but they can be accumulated to intermediate solutions (first training phase and permanent training phase).

Nevertheless, due to the fact that savings figures are indicative (based on average figures) and due to the fact that the perimeters of choice of action sometimes differ, it becomes extremely complicated to predict how the actions taken are going to interact with one another, at first guess.

Only the practical reality of implementation of the actions will finally allow identifying the actual global savings that have been realized.

			AF Veh. 1	AF Fuel.3			AF Driver.1		
			Automated Gearbox	Data collecting process	On board Telematic System (consumption)	Data monitoring and management	First step Eco-Drive training	Recurrent training	Eco-Drive Management System
			3%	indirect	5%	indirect	3%	6%	10%
AF Vehicle. 1 : Modernizing & fleet's adjustment to vehicle use	Automated Gearbox	3,0%		3%	8%	3%	6%	9%	10%
AF Fuel 3 : Enhancement of consumptions follow-up	Data collecting process	indirect	3%				3%	6%	10%
	On board Telematic system (consumption)	5,0%	8%				8%	10%	10%
	Data monitoring and management	indirect	3%				3%	6%	10%
AF Driver 1 : Eco-Drive Program implementation	Eco-Drive First Step training	3,0%	6%	3%	8%	3%			
	Eco-Drive Recurrent training	6,0%	9%	6%	10%	6%			
	Eco-Drive Performance Management System	10,0%	10%	10%	10%	10%			

 Combination pre-requisite for savings to happen

Note: Savings indicated in the chart above are relevant to semitrailers. Rule of cumulative savings would apply just the same for rigid vehicles and LCVs.

1.5 Energy Savings Certificates (ESCs)

The ESC scheme has the main objective of encouraging the introduction of energy-efficient solutions. It is based upon an obligation by the government, imposed on all entities selling energy called “obligated parties” (electricity, gas, heat, cooling, fuel) to achieve energy savings.

ESCs are attributed, under certain conditions, to any market operator that achieves energy savings. Energy sellers can satisfy their obligations holding certificates of same value, certificates obtained further to action taken by the operators themselves, **or they can buy from other operators who carried out same actions**. Energy savings achievements can in some cases, lead to complement valuation through ESC selling to the obligated parties or intermediates.

Processing demand certificates of ESCs is now the entire responsibility of the Pôle National des Certificats d’Economies d’Energie (PNCEE)³ created in October 2011.⁴ In order to simplify the registration process of energy savings files, a standard operation form have been created (ESC Form), some pertaining to transport, in order to identify the eligibility conditions and the valuation of energy savings, processing current operations. Among the transport forms, some correspond to the CO₂ Objectives – Transport operators get involved programme, like the Eco-Drive training form, the use of energy-saving lubricants or the optimized tractor. The number of ESC forms pertaining to transport is less than the number of Action Forms of the CO₂ Charter. This can be explained by the fact that some solutions are CO₂-relevant but they happen to be less (or not at all) energy-relevant.

Transport operators are working on new ESC forms.

³ pole-national-cee.dgec@developpement-durable.gouv.fr

⁴ Government order of 30 September 2011 “portant création du pôle national des certificats d’économies d’énergie” supplementing decree n° 2011-1215 of 30 September 2011.

Each time a Charter solution corresponds to an existent ESC form, a special logotype signals it in front of the concerned solution, in order to let the transport operator know that this solution could receive additional financing.



The corresponding ESC form is displayed at the end section of the detailed form.

For more information on ESCs in transport please see the following Internet page:

<http://www.developpement-durable.gouv.fr/5-le-secteur-des-transports.html>

1.6 SUMMARY PRESENTATION OF THE ACTION FORMS

The recap chart pages 13-14-15 displays the overall solutions and actions which have been identified, focusing on:

- The domain of relevance for each solution in terms of vehicle category concerned.
- Actions to be taken when renewing the vehicle.
- Existence (or not) of an applicable Energy Savings Certificate (ESC).
- Savings in terms of CO₂ emissions, the ROI time and the feasibility level. Data gap corresponds to the statistical dispersion between the various categories of vehicles.

Legend

Temperature-controlled Transport - specific form	
Implement when turning over vehicles	
"CEE" * Form associated to solution	
Domain of relevance	

Return On Investment (ROI) Time	Long (>3 years)	> 3 years
	Intermediate	1-3 years
	Short (<1 year)	< 1 year
	Non applicable	-

CO ₂ emissions saved	< 2,5%
	2,5 - 5%
	≥ 5%

Feasibility	Difficult	+++
	Intermediate	++
	Easy	+

* "CEE": Certificate of Economy of Energy

Action Forms	Solutions	Domain of relevance	Renewing vehicle or trailer	"CEE"Form (Certificate of Economy of Energy)	CO ₂ emissions saved	Return on Investment (ROI) time	Feasibility
Focus Vehicle							
AF Vehicle 1 : Modernization and adjustment of the fleet to its use	Engine power size optimization		↻		3 to 5%	< 1 year	+
	Automated gearboxes option		↻	★	3 to 7%	1-3 years	+
	Powertrain optimization		↻		2,5%	< 1 year	+
AF Vehicle 2 : Technical solutions for speed restraint and automated cut-off of engine idling	Voluntary reduction of vehicle maximum speed				1,2 to 5%	< 1 year	+
	Engine cut-off when idling				1 to 6%	< 1 year	+
AF Vehicle 3 : Using energy saving lubricants	Using energy-saving lubricants			★	1,25%	< 1 year	+
AF Vehicle 4 : Using accessories reducing air drag resistance	Tractor and Cabin accessories			★	0,5 to 10%	1-3 years	+
	Trailer and compartment accessories				0,5 to 4%	1-3 years	++
AF Vehicle 5 : Enhancing vehicle maintenance (not including tyres)	Implementing a follow-up maintenance system				2%	< 1 year	+
	Creating a driver's Logbook				indirect	-	++
AF Vehicle 6 : Managing the tyres	Low rolling resistance tyres			★	0,8 to 4%	< 1 year	+
	Tyres re-treading and re-grooving			★	1%	< 1 year	+
	Pressurizing tyres			★	1 to 2,5%	< 1 year	+
	Optimizing wheel geometry				1,5%	< 1 year	+
FA Vehicle 7 : Air conditioning	Evaporative air-conditioning system				3%	1-3 years	+++
AF Vehicle 8 : Reducing vehicle weight empty	Voluntarily reducing vehicle's weight		↻		0,5 to 20%	-	++
AF Vehicle 9 : Reducing fuel consumptions - other than traction power related needs	Optimizing power feeding auxiliary equipments		↻		Variable	-	+++
AF Vehicle 10 : Temperature controlled activity : choice of the appropriate refrigerated power unit	Defining vehicle usage for appropriate size of refrigerated power unit		↻		Variable	-	+
	Refrigerated power unit with a plug in - to electricity public network - capacity		↻		5 to 10%*	-	+
	High Efficiency Energy power refrigerated unit		↻	★	50%*	> 3 years	+
	Using vehicles with CO ₂ cryogenic or liquid azote gases - indirect injection type - power unit		↻		75%*	> 3 years	+++
	Using vehicles with CO ₂ cryogenic or liquid azote gases - direct injection type - power unit		↻		65%*	> 3 years	+++
	Refrigerated vehicles equipped with eutectic boards or "by accumulation" system unit		↻		97%*	< 1 year	++
AF Vehicle 11: Temperature controlled activity : choosing the isotherm compartment	Equipments and specific maintenance allowing reduction of cold volumes leakages				15 to 25%	< 1 year	+
	Maintenance of refrigerated equipment				5%	-	+

* as a % of the refrigerated unit consumption

Action Forms	Solutions	Domain of relevance	Renewing vehicle or trailer	"CEE "Form (Certificate of Economy of Energy)	CO ₂ emissions saved	Return on Investment (ROI) time	Feasibility
Focus Fuel							
AF Fuel 1 : Choosing the propulsion mode	Stop & Start				1 to 5%	< 1 year	++
	Hybrid vehicles				10 to 15%	> 3 years	++
	Electric vehicles				94%	> 3 years	+++
AF Fuel 2 : Using alternative fuels	Using B30				< 13,6%	> 3 years	++
AF Fuel 3 : Maintaining clean the feeder and injection circuits of diesel engines	Maintaining in clean conditions the feeder and injection circuits & the combustion chambers of diesel engines				4,4%	< 1 year	+
AF Fuel 4 : Enhancing consumption follow-up	Data collect				Indirect	-	++
	On board Telematics (consumption)			★	5%	< 1 year	++
	Managing and monitoring data				Indirect	-	++
Focus Driver							
AF Driver 1 : Implementing an Eco-Drive Program	Eco-Drive training first step			★	3%	< 1 year	+
	Eco-Drive recurrent training				6%	< 1 year	+
	Eco-Drive PMST Performance Management System Training				10%	< 1 year	++
AF Driver 2 : Economy focused attitude and good practice temperature-controlled activities	Limiting leakages of cold volumes during compartment openings sequences				Variable	-	+

Action Forms	Solutions	Domain of relevance	Renewing vehicle or trailer	"CEE"Form (Certificate of Economy of Energy)	CO ₂ emissions saved	Return on Investment (ROI) time	Feasibility
Focus Organization of Transport flows							
AF Organization 1 : Using no road surface transport modes	Using Sea-Road modal combined transport				16%	-	++
	Using River-Road modal combined transport			★	48%	-	++
	Using Rail-Road modal combined transport			★	94%	-	++
AF Organization 2 : Software tools for routes optimizing	Software tool for creating Transport Plan				5 to 15%	1-3 years	++
	Software tool for Geolocalizing				1 to 10%	1-3 years	++
AF Organization 3 : Loading optimization of vehicles	Otimizing Volume/Weight ratio of shipments				3 to 20%	< 1 year	++
	Resource sharing of transport means between several customers				7 to 10%	< 1 year	++
	Using a loading system with double floor capacities				14 to 21%	1-3 years	++
	Using software for improving load coefficient				7 to 14%	< 1 year	+
	Trailer equipped with a road mobile container unit				Variable	1-3 years	+
	Counter flow transport system				Variable	-	++
	Replacing a standard refrigerated truck by a multi temperature		↻		20 to 30%	1-3 years	++
AF Organization 4 : Teamworking with customers for optimization	Information on the CO ₂ emissions generated by transport services				Indirect	-	++
	Shared resources Transport Plan with customers				Variable	-	+++
	Changing palletization process				3 to 7%	-	++
	Implementing delivery and pick-up appointments				Variable	-	+
AF Organization 5 : Communication to road sub-contractors	Informing subcontractors on the good practice				1 to 2%	-	+
	Proposing use of "KPI" Key Performance Indicators				Indirect	-	++
	Proposing to join the CO ₂ Reduction Objective Charter Program				5%	-	+
AF Organization 6 : Urban delivery of merchandise transport optimization	Optimized logistic schemes for urban deliveries				Variable	-	+++

1 Action Forms

1.1 VEHICLE FOCUS

- 1.1.1 Modernization and adjustment of fleet to its use
- 1.1.2 Technical solutions for speed restraint and automated cut-off of engine idling
- 1.1.3 Using energy-saving lubricants
- 1.1.4 Using accessories reducing air drag resistance
- 1.1.5 Enhancing vehicle maintenance (not including tyres)
- 1.1.6 Managing the tyres
- 1.1.7 Evaporative air conditioning
- 1.1.8 Reducing vehicle weight (OWE - operating weight empty)
- 1.1.9 Reducing consumption related to other than traction power related needs
- 1.1.10 Temperature controlled: choosing the refrigerated power unit
- 1.1.11 Temperature controlled: specific equipment and maintenance

1.2 FUEL FOCUS

- 1.2.1 Choosing the propulsion mode
- 1.2.2 Using alternative fuels
- 1.2.3 Additive combustion products keeping clean feeder and injection systems and combustion chambers of diesel engines
- 1.2.4 Enhancing consumption follow-up

1.3 DRIVER FOCUS

- 1.3.1 Implementing an Eco-Drive Programme
- 1.3.2 Economy focused attitudes and good practice temperature controlled activities

1.4 ORGANIZATION OF TRANSPORT FLOWS FOCUS

- 1.4.1 Using no road surface transport modes
- 1.4.2 Software tools for route optimizing
- 1.4.3 Loading optimization of vehicles
- 1.4.4 Team working with customers for optimization
- 1.4.5 Communication to road subcontractors
- 1.4.6 Urban delivery of merchandise transport optimization

Vehicle Focus – Form N° 1

Modernization and adjustment of the fleet to its use

SUMMARY FORM

Action description

When proceeding to fleet turnover, three main items are used to find out the correct size of the vehicle; power engine, gearbox, and transmission. These three elements have to be adapted to the vehicle use profile.

This action has to be implemented as soon as the purchasing process is initiated, with maximum interaction with truck makers; since it concerns the vehicle its life long, it is indeed of critical importance.

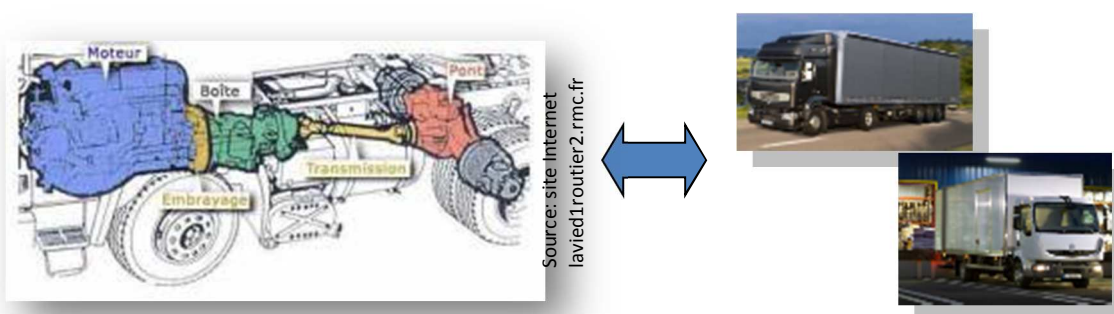
Domain of relevance

This action is appropriate to all transport activities. Most actions of the vehicle focus are to be studied in coherence with this action on the fleet adjustment.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Power Optimization Choice of appropriate engine power, adapted to needs	0% 10% 3% to 5%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI
Choice of an automated gearbox Automated gearboxes equipment	0% 10% 3% to 7%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI
Powertrain optimization Choice of an adapted to needs powertrain	0% 10% 2,50%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Vehicle Focus – Form N° 1
Modernization and adjustment of the fleet to its use
DETAILED FORM

Context and regulatory measures

One can observe a constant average increase of the trend of engine power on the heavy-duty fleet segment of the French market, which today is around 450 hp for the articulated trucks, operating long distance transport. Three factors explain this increase: the proactive sales attitude of truck makers to offer their customer “always more” options, driver’s comfort, and the capacity to dispose of enough power to maintain acceptable speed on hilly profile road condition. More recently, an operational speed-reduction trend is observed, in alignment with low fuel consumption considerations: on a EURO5 vehicle, the cruise rpm is 1 280 rpm against 1 380 rpm on a EURO4. For an LCV with a maximum gross weight of 2 t the optimal torque is obtained between 1 750 rpm and 2 500 rpm.

Three items have to be considered:⁵

- 1/ the engine itself that sets the parameter of maximum power
- 2/ the gearbox that optimizes powertrain
- 3/ the transmission assembly which transmits power to the wheels and insures the capacity of the vehicle operating at different speeds.

Context is much different in the case of LCVs;⁶ the Council of the European Union has adopted by May 11th 2011 a regulation N° 510/2011 which limits CO₂ emissions of new fleet entrant LCVs – to an average 175 gCO₂/km as from 2017. This demanding specification will be progressively extended to all makers between 2014 and 2017. The average figure concerns new incoming vehicles on the market, with a certain tolerated range of emission exception, according to the vehicle body type. In case specifications are exceeded, a financial penalty will have to be paid for by the user for excess emissions. Looking at 2020, the regulatory objective is 147 gCO₂/km for the LCVs (in 2013 a revision on the feasibility of this specification will be carried out, defining the update regulations and eventually making modifications).

LCV CO₂/Km emissions 2014-2017

LCV's (Tons)	Objective (Grams/Km)
1,5	156
2	202
2,5	249
3	295
3,5	342
	175

Source: European regulation n°510/2011 May 11th 2011

For comparison purposes, the average consumption of an LCV in France in 2011 was 8.1 litre/100 km, corresponding to 213 gCO₂/km (working on the base of 2.63 Kg CO₂/litre of diesel fuel).

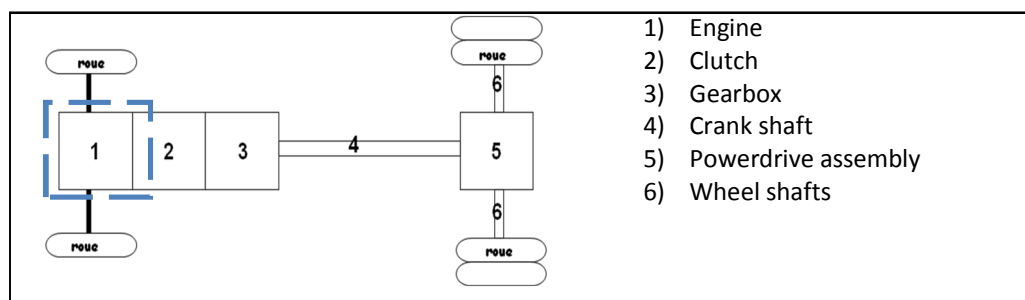
For all operators concerned, this regulation represents a strong incitation to optimize their LCV fleets.

⁵ It is important to note that Euro Norms do not relate to GHG gases and have no direct link with fuel consumption. They set the thresholds for emissions of nitrogen oxide (NOx), carbon monoxide (CO), hydrocarbons (HC) and particles.

⁶ CGDD – Chiffres et Statistiques – “Les véhicules utilitaires légers au 1^{er} janvier 2011” – n° 310 – April 2012.

Solution 1: Power optimization

How does it work?



Engine power option is the first parameter that will have direct effect on fuel consumption. In fact, engine power in excess is a consumption factor on three levels:

- Using the engine in its lower work rpm range (below 1 100 -1 200 rpm) does not allow for efficiency optimization.
- Power excess in turns means engine and kinematic chain overweight (e.g. ACTION FORM 8 Reducing Vehicle Weight).
- Last, excess of engine power tends to be used by drivers irrespective, whether they actually need it or not.

The challenge is therefore to reduce unnecessary comfort, while providing service constraints in terms of logistics and safety performance. It is considered that at cruise-control speed on a flat profile, an articulated vehicle needs only 120-130 kW (or 160-170 hp) in order to maintain speed: additional power is used for acceleration phases as well as hilly road profile; it is therefore both a safety and comfort item.

In the case of an LCV on a standard road profile, engine power needed is usually between 60 hp (compact LCV) to 130 hp. (long body LCV).

Impact on fuel consumption and CO₂ emissions

Fuel consumption trend grows with the vehicle engine power in a significant manner (long body LCV).

Power (Cv or hp)	Average Consumption (litres/100 km)
60-130	10.2
131-170	21.0
171-230	23.2
231-310	30.5
311-380	33.4
381-480	34.7

Data Source:

- For the LCV type (60 – 130 hp (CV) category): www.guidetopten.fr ⁷ et www.ate.ch ⁸
- For heavy duty: Data is based on 1 300 tests on a representative panel of vehicle of all categories (rigid small and large, semitrailers) based on results from the Energeco consumption comparison tool. ⁹

⁷ Guide Topten is an initiative of WWF-France and consumer association CLCV. This purchase evaluation tool, developed from the Swiss site www.topten.ch, is supported by ADEME and is part of the European network Euro-Topten www.topten.info, itself supported by the European Commission.

⁸ Association Transports et Environnement (ATE) has been working since 1979 in favour of mobility optimization. The EcoMobiliste tool gives tangible recommendations for vehicle purchases taking the environment into account.

⁹ www.energeco.org

The chart above shows that in the heavy-duty segment, 50 to 80 hp power reduction choice allows savings of 5% to 10% (i.e. 2 litres/100 km). Given the fact that these savings are the result of both weight and engine power reduction with similar payload on board, it seems preferable to take into account only the lower figure of this estimation, i.e. 5%.

In the case of LCVs, the expected savings estimate is around 3%. In proportion the consumption difference is smaller, due to the fact that engine power difference is also smaller.

Vehicle size	Main use considered	MGW (or MCW)	Savings associated to a power reduction of 50 hp (CV) (% of consumption in L/100 km)
LCV Light Commercial Vehicle	Urban	≤3.5 t	3%
Rigid Small	Urban	3.6-12 t	5%
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Sources:

- Calculated average based on data from www.energeco.org (for heavy-duty trucks)
- Manufacturer's estimate (for light commercial vehicles)

Domain of relevance

This action is relevant to all transport activities.

Some of the route profiles used can be a constraint for implementing this solution. When geographic road-level changes are important, extra power has a justification, because it maintains sufficient commercial speed.

This solution will be all the more relevant when vehicles are dedicated to specific routes allowing this kind of optimization.

In the case of LCVs which are mainly used on urban routes profiles, it is important to take into account the type of load transported, thus the specificity of the transport activity, to optimize power.

- When transporting voluminous goods (merchandise with a low weight-to-volume ratio) a moderate engine power will do and we can stay in the lower part of the engine power range for a given type of vehicle. On top, to encourage low consumption results, it is recommended to compromise, combining a long kinematic powertrain with a modest engine power.
- On the opposite, if the vehicle carries heavy loads, and its total MGW – Gross Maximum Weight usually reaches its regulatory maximum weight accepted on the road, it is recommended to dispose of an extra engine power available.

On the contrary, with LCVs running long distance travels, it is necessary for the driver to dispose of enough power to prevent overconsumption situations, in particular on hilly profiles with cruise-control equipped vehicles. For a van, a minimum power of 120 hp is a must.



Implementing the solution

This action should be taken while organizing vehicle turnover.

First step is to carry out a fuel consumption survey taking into account the vehicle engine power, given same payload and usage. Second step would be in-depth interacting exchanges with truck makers, selecting cautiously the engine power adapted, in relation with the transport operator specific trade and the missions assigned to the vehicle.

Some truck makers offer vehicle testing in real conditions, which can represent an efficient way of validating the required engine power and at the same time, proceed to the assessment of the vehicle fuel consumption, performed under real operating conditions.

This solution has a short ROI of less than a year, since the purchase price level is usually cheaper for vehicles equipped with a less powerful engine.

The feasibility of this solution is to be found somewhere between easy and intermediate: if it does not necessitate for organization change, the optimal solution is not always an obvious choice, and also, it could be limited, once confronted to the multipurpose tasks needs required by certain fleets.

In the case of LCVs €1 500 have to be budgeted per option, for each additional 25 hp.¹⁰ Furthermore, it is essential that the buyer in charge of LCV fleet, gets well documented in detail prior to purchase, namely on the future vehicle range evolution in the incoming years.

EURO 5 vehicles on the market nowadays have a consumption which is slightly over the EURO 4 category. A EURO 5 van of 120 hp will take 2 L/100 km more fuel than a EURO 4 of the same power.¹¹

Knowing this, if an operator wants to change an LCV of 120 hp assigned to long distance, he is better off selecting a 150 hp that won't be subject to over consuming, while operated on hilly profiles.

Follow-up of the solution

Follow-up indicators:

- Number of turnover vehicles with a reduced engine power for same missions performed.
- Differences in the fuel consumption of entrant vehicles against vehicles leaving the fleet (in litre/100 km)

Practical data collecting process:

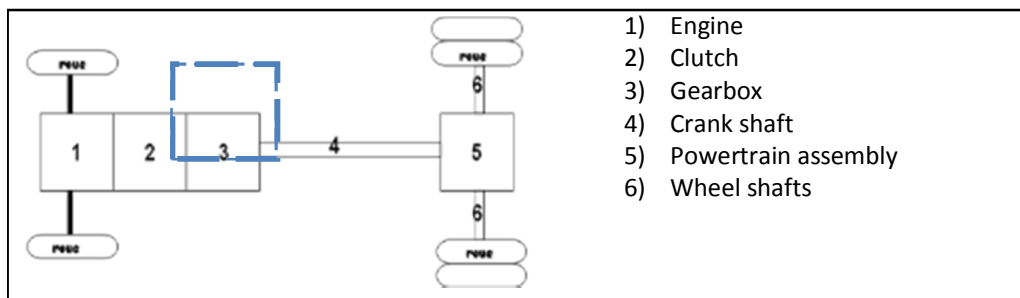
- Making a double entry chart showing the fleet organized by engine power range and by activity performed (missions assigned to the vehicles, geography of operations, etc.).
- Follow-up chart of new vehicles purchase: power rating, **MGW** Gross Maximum Weight, gearbox type and powertrain options used...

¹⁰ Manufacturer data (LCVs from 100 hp to 125 hp).

¹¹ Manufacturer data

Solution 2: Choice of an automated gearbox

How does it work?



Three gearbox types are on the market: manual, automatic and robotized types.

Automatic and robotized gearboxes both permit automatic gear selection, but use different technologies:

- In the automatic option a torque converter replaces the clutch. This converter needs energy activation, calling for small fuel overconsumption.
- In the robotized option (with or without synchronizer) an electro-hydraulic robot is added to the manual gearbox. It performs electronically monitored clutch movements as well as gear selection. It can be said that a robotized gearbox functions mostly as a manual – yet assisted – gearbox.
- Two operating modes can be distinguished:
 - Sequential gearboxes that command a gear change in sequence;
 - Impulse gearboxes that allow shifting one gear change to another, without having to use intermediate gears.

Benchmark advantages of automatic gearbox are numerous: energy loss is lower and maintenance costs less. As compared to the manual gearbox, this solution also brings additional driving comfort and safety.

Some options also offer add-ons, optimizing the gear box. Robotized gearboxes now are standard on all heavy-duty vehicles, and as an option on lighter vehicles of **> 2.5 Tonnes** Gross Weight.

Impact on fuel consumption and CO₂ emissions

The attractiveness of robotized gearboxes is that they propose clutch and gear shifting automation, at a limited energy cost.

However, robotized gearboxes will not replace the driver's roadmanship and art for anticipation.

As an example, approaching uphill, the driver will bring the gears down before the robotized gearbox.

Some electronic drives integrate parameters which are external to engine (slope change conditions for instance).

Concerning the heavy-duty trucks industry, results of test organized by ADEME and one transporter at two leading sites and involving 11 articulated trucks of 40 tonnes MGW each, over 6 to 12 months, are the following:

- Average consumption reduction 1.2 L/100 km;
- Drivers consumption standard deviation is gradually narrowing to just 2.5 litres/100 km;
- High-performance drivers; same fuel consumption performance or even slightly higher;
- Low-performance drivers experience a high reduction of their own fuel consumption.

In the case of light vehicles, robotized gearboxes are well adapted to urban traffic conditions. Impact on fuel consumption makes for an overall smoothed-out fuel performance (all performance approaching the average).

On urban routes, a 40% difference on fuel performance can be observed between drivers. For a “pedal to metal” driver, robotized gearboxes will bring substantial fuel savings. On the contrary, an already high performing driver will not see any major reduction in fuel consumption when using an automated gearbox.

The following chart shows the savings associated to this solution:

Vehicle size	Main use considered	MGW (or MCW)	Savings associated to the solution (% consumption in L/100 km)
LCV light commercial vehicle	Urban	≤3.5 t	7%
Rigid small	Urban	3.6-12 t	4%
Rigid large	Regional	>12 t	3.5%
Semitrailer	Long Distance	40 t	3%

Sources: ADEME, interviews with manufacturers

Domain of relevance

Savings linked to robotized gearboxes option, will be greater on route profiles that demand a lot of gear changes (urban sections, route profile with constant change in hilly environment, etc.). Applied to heavy-duty trucks, robotized gear boxes tend to become standard on long-haul distances (7 out of 10 trucks are now pre-equipped).

Implementation

This action can be carried out when performing vehicle fleet turnover. It can't be done afterwards, because it would prove too costly. Extra cost on a robotized gearbox is generally between €2 000 € and €4 000. For an LCV like a van for instance, extra cost estimate will be around €1 500. Specific driver training has to be planned, since changing gearbox type calls for driver behaviour adaptation, as the new driving style is significantly different.

This action can be envisaged with the Eco-Drive action and fuel consumption follow-up action. It makes less sense to involve already high performing drivers and rather, can be proposed to the less good ones, those who encounter practical difficulties in handling their gearbox.

In the cost context above listed, the ROI time is an intermediate one, of one to three years.

The feasibility of this solution is quite high since all truck makers now offer robotized gearboxes.

Solution follow-up

Follow-up indicator:

- Number of vehicles equipped with a robotized gearbox

Practical data collecting process:

- Chart listing new vehicles: engine power, MGW, gearbox and powertrain option types.

Information sheet: Energy Savings Certificates for optimized trailer trucks



Certificats d'économies d'énergie

Opération n° TRA-EQ-15

Tracteur routier optimisé

1. Secteur d'application

Transport routier professionnel.

2. Dénomination

Remplacement d'un tracteur routier pour véhicule articulé existant par un tracteur routier pour véhicule articulé neuf optimisé (le tracteur optimisé doit avoir un Poids Total Roulant Autorisé supérieur à 40 tonnes).

3. Conditions pour la délivrance de certificats

Le tracteur routier neuf optimisé respecte les normes environnementales en vigueur, à savoir Euro 5, et comporte les trois technologies suivantes :

- boîte de vitesse robotisée ;
- équipements pour l'aérodynamisme : déflecteur toit, carénage latéral de l'interface et carénage latéral du châssis tracteur ;
- pneus basse résistance au roulement : ils doivent avoir une classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C (classification au sens du règlement européen n° 1222/2009).

Le demandeur présente :

- la facture d'achat du tracteur routier optimisé indiquant et détaillant les trois technologies demandées (pneus basse résistance au roulement de classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C ; pack aérodynamisme précisant les équipements installés qui sont au minimum : déflecteur de toit, carénage latéral de l'interface et carénage latéral du châssis tracteur ; boîte de vitesse robotisée) ;
- une copie de sa nouvelle carte grise ;
- une copie de la carte grise barrée du tracteur routier remplacé et si celui-ci a une date de première mise en circulation antérieure au 1^{er} janvier 1996, l'attestation de mise à la casse du véhicule.

Valable pour les opérations engagées jusqu'au 30 décembre 2013 (la veille de la mise en place d'Euro 6).

4. Durée de vie conventionnelle

10 ans.

5. Montant de certificats en kWh cumac

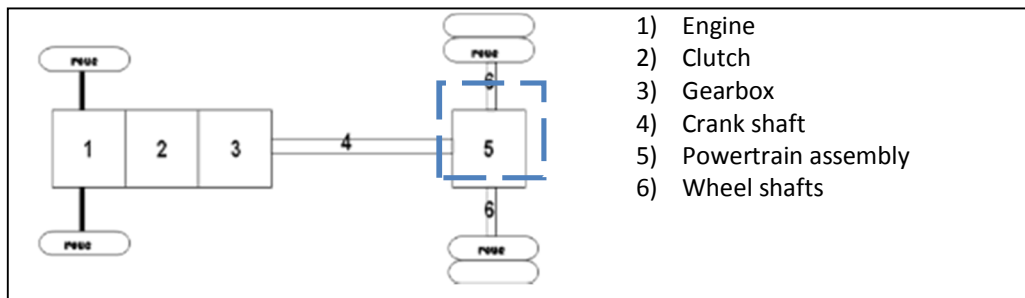
Année de mise en circulation du tracteur routier existant	Montant en kWh cumac / tracteur routier
Jusqu'à 1992	850 000
1993 à 1995	570 000
1996 à 2000	460 000
2001 à 2005	330 000
2006 à 2008	220 000
2009 à 2011	150 000

X

Nombre de tracteurs routiers existants remplacés
N

Solution 3: Optimizing powertrain assembly

How does it work?



Powertrain equipment insures transmission of energy from the engine to the wheels. The powertrain drive type is the rotation ratio between the driving shaft and the transmission speed to the wheels. It is included between 1;2.2 (rapid, “long” powertrain drive) and 1;2.8 (slow or “short” powertrain drive).

A long drive type powertrain is adequate for long distance runs at stabilized speed, but downshifting will be less effective. On the other hand, a powertrain with short drive option will be adequate to frequent gear change driving conditions. Manufacturers of LCVs have a tendency to go for the long drive powertrain because they can then claim fuel reduction performances. Consequences are insufficient torque when going uphill – in order to gain velocity, driver has to go to the 3rd or 4th gear, which in turn has a negative impact on fuel consumption.

In urban conditions, this is less important since the driver can always shift down, in order to produce a plain acceleration.

Impact on fuel consumption and CO₂ emission

For heavy-duty trucks, the gap between the least and the most satisfactory situation in terms of powertrain adjustment, is around 5%. Savings associated to this action are estimated 2.5%. Average savings linked to a short drive type powertrain used on a propulsion type LCV is of the same estimation as for heavy-duty trucks.

Vehicle size	Main use considered	MGW (or MCW)	Savings associated to the solution (% consumption in L/100 km)
LCV light commercial vehicle	Urban	≤3.5 t	2.5%
Rigid small	Urban	3.6-12 t	
Rigid large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Sources: www.energeco.org, interviews with manufacturers

Domain of relevance

This action is relevant to all vehicle types. The adjustment of the powertrain must be discussed with truck makers, adapted to the maximum speed and route profile taken by each vehicle. This solution will prove all the more efficient if vehicles are used on recurrent identical routes, which then allows optimization of that particular vehicle.

As regards LCVs, only propulsion types are concerned by this solution.¹² Truck makers have now a natural tendency to offer the powertrain drive with only one option.

Some 3.5 tonne LCVs with propulsion are nevertheless proposed with two drive options: a standard “normal” one and a long drive one, given that the long drive is only appropriate to long-haul distances (general cargo transport, on-call urgent individualized transport).

Implementation

This action should be taken when renewing fleet vehicles, since afterwards modification will prove costly. To implement this solution, it will be useful to ask the manufacturer for a specific simulation study.

In order to carry out this study, the manufacturer will need important data such as routes taken (uphill profile grade, maximum speed, number of stops, traffic conditions....).

With this information available, the manufacturer will be in a position to designate the optimum power drive option to choose. It is important to note that the optimum drive options are associated with specific type of routes taken. Any alteration in the type of route taken or in the use conditions, will have an effect on vehicle performance.

This solution has a very short ROI (< 1 year) since there is no specific cost attached.

Lastly, the feasibility of the solution can be considered from easy to intermediate: if it does not call for organizational change, the optimal solution is not always easy to determine because its limit is given by the need for multitask usage of the vehicles in the fleet.

Follow-up of the solution

Follow-up indicators of the solution:

- Number of vehicles which have been through powertrain optimization by manufacturer;
- Average savings (litre/100 km) estimated by the manufacturer further to optimization.

Practical data collection process:

- Chart tracking new vehicles: engine power, maximum gross weight MGW, gearbox type, power drive option (short type, long type).

¹² Most LCVs of the van type or cabin-over-frame are proposed in the propulsion mode (rear wheels), or traction mode. In the latter case, there is no powertrain.

Vehicle Focus – Form N° 2

Technical solutions for voluntary speed reduction and automated “Stop-and-Start” and anti-idling device

SUMMARY FORM

Action description

Speed reduction action consists in deciding voluntarily for a limitation or defining a maximum vehicle speed. This figure will present the best compromise between fuel consumption and the operational constraints which must be met (delivery time). The choice for the maximum speed must be taken only when a set of iterative tests have been completed. Exact speed must be selected monitoring data with a one kilometre maximum gap only, between 80 and 90 km/h for heavy duty, and 110 km/h for the LCVs type. Automated anti-idling device consists of electronic equipment which – programmable and adjustable in minutes – will cut off the engine within a pre-determined time span, further to a stop en route or immediately after pulling the parking break.

Domain of relevance

Deciding on a voluntary maximum speed option is particularly relevant for long runs at stabilized cruise control speed.

Automatic engine cut-off idling is appropriate to multiple stops of a certain duration profile (pickup and delivery cycle).

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Deciding speed limitation Limiting vehicle maximum speed	0% 10% 1,2% to 5%	> 3 years <1 year	Difficult Easy	LCV RL SE MI
Cutting off when engine idling Automated, time regulated engine cut-off, engine idling	0% 10% 1% to 6%	> 3 years <1 year	Difficult Easy	RS RL SE MI

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Source: ADEME



Source: ladepeche.fr



www.123savoir.com

Vehicle Focus – Form N° 2
Technical solutions for voluntary speed reduction
and automated “Stop-and-Start” and anti-idling device
DETAILED FORM

Context and regulatory measures

Speed restraint action

Heavy-duty trucks are nowadays submitted to speed limit regulations, which are defined in Art. R.413-7 and following of the Driving and Traffic Rules:

- 90 km/h on major highways (80 km/h for dangerous goods transport);
- 80 km/h on secondary roads (70 km/h for dangerous goods transport).

These speed limit regulatory decisions will naturally lead manufacturers to calibrate their engine and vehicles in such a way that they will show optimized fuel rate consumption when reaching the 90 km/h speed.

Giving the engine a restraint limitation below the regulatory one is a voluntary decision which displaces the usual operational performance benchmark.

In the case of LCVs, vehicle speed with a MGW of 3.5 t, is limited, beyond urban zones, to 130 km/h on highways, 110 km/h on two-lane roads separated by a raised band of earth running in the middle, and 90 km/h on all other roadways.¹³

In urban zones, maximum vehicle speed is limited to 50 km/h (speeds up to 70 km/h can be allowed only on road sections where access for local residents exist as well as pedestrian crossings, in a limited number, and protected by appropriate urban equipment) and 80 km/h on the Paris ring road— on the inside and outside lanes.

Automatic engine cut-off when idling

Unlike Canada or the United States of America, where all unproductive idling is prohibited by law, French and European regulations as a whole, do not mention, let alone address, this point.

¹³ Article R.413-2 et R.413-3 Road Regulations

Solution 1: Voluntary speed restraint

How does it work?

Understandably, speed has an effect on aerodynamic resistance, which calls for extra engine power and therefore leads to higher fuel consumption. Reducing the standard operating – commercial – speed will then produce fuel savings in a direct and tangible manner. This action is to be linked to “Modernization and fleet adjustment to usage”, VEHICLE FOCUS ACTION FORM N° 1.

In effect, the kinematic chain of a heavy-duty truck can be optimized for a speed close to 90 km/h (namely choosing the correct power drive option), in which case restraint action may in some cases lead to an increase in fuel consumption. In the case of heavy-duty trucks, tuning for optimal operating speed can be determined directly with the truck manufacturer. The objective will be to approach engine rotation comprised between 1 100 rpm and 1 200 rpm for this optimal speed on the highest gear, which produces optimal efficiency, reducing fuel consumption at the same time.

In the case of LCVs, speed restraint can be envisaged as from 110 km/h on a standard route. On the contrary, if the vehicle is used in urban route configuration, restraining speed is not going to deliver any significant savings at all (although it could be justified for safety reasons).

Good practice

It is indispensable that transport operators concerned undertake a collective communication action directed at all drivers on the topic of respecting maximum speed limit. This sole action can in certain cases avoid any additional speed restraint decision, or else it can be taken together with a speed restraint action.

Impact on fuel consumption and CO₂ emissions

Savings for different types of vehicles and various usages are particularly significant on long-haul distances, where the percentage of travel at maximum legal speed is highest. For regional use, this percentage is of course lower and expected savings in turn will also be lower. Lastly, for urban use, savings can be rated insignificant, because the percentage operated at maximum operating speed is to be neglected. For LCVs assigned to long-haul route profiles, savings for speed restraint at 110 km/h is 5%.¹⁴ It can be much more, depending on driver behaviour.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings associated to speed restraint (% reduction CO ₂ emissions)		
			Limited from 90 to 80 km/h	Limited from 90 to 85 km/h	Limited to 110 km/h
LCV Light Commercial Vehicle	Urban	≤3.5 t	-	-	5% (for long highway runs)
Rigid Small	Urban	3.6-12 t	-	-	-
Rigid Large	Regional	>12 t	2,5%	1,2%	-
Semitrailer	Long Distance	40 t	5%	2,5%	-

Source: manufacturers

¹⁴ Source: vehicle manufacturer

N.B. Speed restraint can cause, in certain situations, a deterioration of the fuel consumption rate. In effect, a speed restraint set too low, can cause the driver to over-use downshifting, and find himself in the higher rpm range most of the time. It will therefore be necessary to obtain in detail the time spent on each gear in order to identify the possible negative impact of the speed restraint.

Illustration: Tests results on heavy-duty trucks (ADEME and transport operators)

An impact test on speed restraint actions (80/85/88 km/h) effect on fuel consumption was performed on 77 vehicles (articulated type trucks) and lasted for two months.

Three groups of drivers were formed, given the recorded average consumption of their truck:

Group 1: Drivers < than 32 litres/100 km: impact of speed restraint was nil

Group 2: Drivers situated in a 32-35 litres /100 km range: 88 km/h restraint brought 1 litre/100 km savings on volume; 85 km/h restraint brought 1.5 litre/100 km savings on volume.

Group 3: > 35 litres/100 km: 80 km/h speed restraint brought 6 litres/100 km and was the most efficient.

Domain of relevance

Speed restraint action is relevant to long-distance runs made at relatively high legal speed and stabilized condition.

Implementation

In a first step, a review can be organized with the truck manufacturer in order to find the vehicle optimization point, as well as the relevance, if any, for considering a speed restraint action. A test can then be carried out on a sample of vehicles, keeping as a reference base the vehicles with no restraint (if the size of the sample is large enough, several operating restraint speeds can of course be tested). Consumption analysis will rapidly give validation to start speed restraint action, on part or all of the fleet.

Before this solution is implemented, it is advisable to analyse the impact that it will have.

An economic study can be performed, segmented by activity in order to show on one hand the savings expected, and on the other hand the potential negative effects that lower speed operation could bring: increasing the time to reach customers, longer amortization of the trucks involved and more operational driving hours.

The acceptability side of the solution is to be tested on drivers. Lastly, it will be important to validate beforehand with customers the implementation of this solution (for more information please see ACTION FORM ORGANIZATION OF TRANSPORT FLOWS N° 4 "Cooperative teamwork with customers for better transport optimization").

There are two items that will facilitate the implementation of this solution: it can be easily adjusted (going backwards is simple and hardly costs anything) and tests can be carried out over a relatively short period of time.

A simple test can consist of comparing during one to two months in operation, the fuel consumption of two vehicles – one with speed restraint and the other with no speed restraint – of the same type and same maximum gross weight, on very similar routes.

For these two reasons, the solution has been rated as an easy one to implement.



Lastly, switching to speed restraint mechanical operation hardly costs anything. Average time spent is 20 minutes of garage work and minor labour costs to set the new parameters. Given the estimation of savings and costs presented above, the ROI time will definitely be short (< 1 year).

Follow-up of solution

Follow-up indicator:

% of vehicles recently switched to speed restraint in the fleet, indicating the speed limit option that was taken.

Practical data collection process:

Following the fuel consumption of the vehicles which were switched to speed restraint.

Solution 2: Automated cut-off while engine idling

How does it work?

Engine idling when a vehicle is stationary can have several causes:

- the driver's habit to "warm up" the engine (no longer necessary with today's technology);
- the need to keep working auxiliary equipment such as the air conditioning or the heating system;
- congested road traffic conditions;
- waiting times during loading or unloading of the vehicle;
- forgetting all about the engine idling situation.

It is feasible to install a retrofit device that will automatically cut off the engine of an idling vehicle. The system will accept parameter programming and at the end of a given period of time (a few minutes) when the vehicle is stationary and the parking break is on, then the engine will be automatically cut off.

The system can be fitted once the vehicle has been purchased: for recent vehicles, manufacturers can set the parameters on the electronic system of the vehicle. For older vehicles, a specific add-on electronic box can be retrofitted to activate the anti-idling device.

However, the best solution is to teach drivers correct standard engine use, and make it a priority goal (DRIVER FOCUS – ACTION FORM N° 1 ECO-DRIVE).

Impact on fuel consumption rate and CO₂ emissions

Average fuel consumption of a heavy truck idling is 3 litres/hour. Since it is a common thing that the engine of a truck runs two to three hours idling every day with the vehicle stationary, the extra fuel consumption generated can amount to 6%. Average figures provided by manufacturers show 1.5% extra consumption engine idling which represents 300 hours accumulated yearly.

Figures given are for general information only and are therefore subject to great change according to the duration of each stop (the more the idling of course, the more the expected savings).

A 2% to 6% savings potential is expected on multiple stops, long idling situation route type, while savings will only be 1% to 3% on routes with only a few stops planned.

Vehicle Size	Main use considered	MGW (or MCW)	Gains linked to automatic engine cut-off when idling (% reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	1-6%
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: ADEME experts, calculations based on interviews with manufacturers and transport companies



Domain of relevance

This solution is relevant for vehicles making numerous and long stops for pickup and delivery. It is not relevant for LCVs operating in urban conditions.

Implementation

This action is to be performed in three steps: follow-up and analysis of engine idling, communication to drivers and then fitting the appropriate automated solutions.

It is therefore essential to begin with a consistent follow-up action observing engine idling overall record: a reliable solution is to collect all data via onboard telematics systems. In the case where permanent data collecting does not exist, an estimate can be done, sampling the various routes fairly representative of the activity, asking drivers to take note of idling times, or check-riding with them for a certain period of time.

A simple communication action can prove sufficient to obtain a corrected behaviour from drivers.

A Good Practice Guide can be handed out, as well as specific training and a reminder memo, coaching drivers to cut off the engine when idling perception is over the 30-second threshold.

Follow-up of the solution

Follow-up indicator of the solution:

- Idling hours % trend observed going downwards.

Practical data collection process:

- Follow-up of fuel consumption connected to idling and/or follow-up of number of hours spent in operation with idling engine situations.

Vehicle Focus – Form N° 3

Using energy-saving lubricants






SUMMARY FORM

Action description

Nowadays, energy-saving lubricants are available on the market, contributing to abatement of fuel consumption, reducing the loss of energy due to metal-on-metal friction.

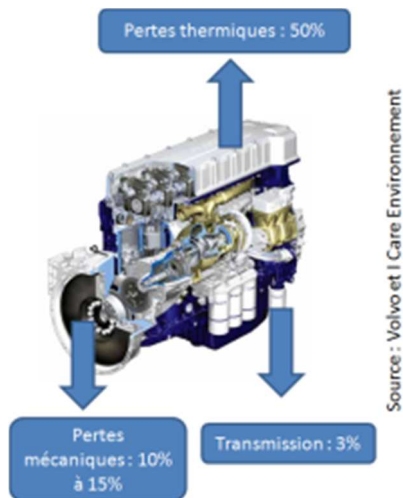
Domain of relevance

This action is relevant to all merchandise transport activities.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Using energy-saving lubricants  TRA-EQ-04 TRA-EQ-13 Using energy-saving lubricants for engine				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

¹ For more information, please refer to the form "Certificats d'Economies d'Energie" annexed to present form



Energy losses breakdown in a thermal engine

Vehicle Focus – Form N° 3
Using energy-saving types of engine lubricants
DETAILED FORM

Context and regulatory measures

The major role played by vehicle lubricants is reducing the friction between various parts in motion (shafts, pistons, casings, distribution, etc.).

Lubricant uses are as follows:

- Protection of parts
- Reducing temperature
- Cleaning parts
- Reducing friction situations.

These objectives are met when a thin oil film is interfaced between the parts in motion. Three categories of lubricants exist: mineral, synthetic and semi-synthetic, the latter being the most frequently used nowadays.

Lubricants are then classified by grades, corresponding to their degree of viscosity. The most used classification is the Society of Automotive Engineers (SAE) system. It is structured around an “x-W-y” type of classification where:

X: viscosity index under cold conditions. A low value means satisfactory fluidity at low temperature.

Y: viscosity index under hot conditions (100 – 150 °C), representing the viscosity during engine functioning.

For heavy-duty trucks, the viscosity index under hot conditions is the most important, due to long-haul running operations and therefore engine functioning under hot conditions most of the time.

It has to be noted that the type of lubricant most used in France is 15W-40.

For 10 years now, the energy savings parameter has been taken into account in R & D programmes. The purpose is to optimize the three main parameters of lubricants: effective duration (in order to progress on the time span between two oil replacement servicings), level of protection of the engine, and improved friction coefficient in order to reduce waste of energy linked to internal friction.

Since some of these specifications are antagonistic, optimization calls for major R & D efforts to determine the right formula for these lubricants.

Lastly, if lubricants with energy specifications exist for engines, power transmission and gearboxes, this action form focuses on the engine lubricants only, because that is where they are the most significant.

2 ESC Forms (Energy Savings Certificates) ESC-TRA-EQ-13 for heavy-duty truck and ESC-TRA-EQ-04 for LCVs exist for the lubricants with energy saving specifications, based on the assumption that they deliver fuel savings which are greater than 1% (for more information please see the ESC Forms annex to this action form).

Solution 1: Energy-saving engine lubricants

How does it work?

Energy efficiency specifications for engine lubricants can be obtained in two ways:

-Working on oil viscosity: optimizing the viscosity curve in relation to temperature, pressure and shearing strength effect specifications, aiming to obtain a lower grade of viscosity without wear or gripping risks.

-Through incorporation of additives called “friction modifiers”.

Energy-efficient lubricants are those where fuel consumption performance is higher than the reference lubricant 15W40. Energy-efficiency lubricants are available in all oil types and categories (mineral, semi-synthetic and synthetic).

Impact on fuel consumption rate and CO₂ emissions

Fuel consumption savings can be obtained through various tests:

- Bench tests conducted on dynamic roll-bars in standardized conditions;
- Tests conducted on fleets of vehicles in real operating conditions.

Lubricant suppliers publish fleet tests on vehicles, claiming up to 2%-3% savings, but static engine bench tests show (according to the related ESC forms) that today’s commercial lubricants in fact deliver between 1% and 1.5%.

We therefore propose that a 1.25% figure be retained for this solution for heavy-duty trucks.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated to this solution (% fuel consumption in L/100 km)
LCV Light Commercial Vehicle	Urban	≤3.5 t	1.25%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

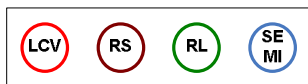
Source: Manufacturers, ADEME (estimation for light commercial vehicles).

Domain of relevance

Energy-saving engine lubricants are applicable to all usages in merchandise transportation.

Implementation

The choice of the lubricant must be in conformity with the manufacturer’s requirements: the transport operator should control that they are not using a lubricant which would be below the required viscosity grade and specifications under hot conditions, for instance by choosing a type of oil that would be too fluid.



Lubricant options are operated either by the transporter, or by the service company dealer carrying out engine maintenance, if the operator has opted for external engine maintenance.

In which case the maintenance contract specifications must mention exactly which lubricants have to be used by the operator providing this service.

The lubricants budget cost is relatively “secondary” in the overall cost structure of a transporter (between 0.5% and 1%), that is why savings generated can pay for the extra cost of energy-efficient lubricants.

In the case of heavy-duty trucks, making an estimation of €0.25/litre of lubricant and given a 0.05 L/100 km consumption (30 litres oil servicing every 60 000 km), the extra cost is €0.01/100 km.

Given the 1% savings on an average consumption of 35 litres/100 km, given a litre of diesel fuel at €1.1, savings come to €0.38/100 km.

As a consequence, the ROI time is a very rapid one (< 1 year).

In the case of LCVs, given a working estimation of a lubricant consumption of 0.05 litre/ 100 km (15 litres oil servicing for every 30 000 km), extra cost is also €0.01/100 km.

With a 1% savings on 10 litres/100 km fuel consumption rate, diesel fuel price 1.1 €/litre, savings of €0.11/100 km are expected. The ROI time is also very rapid (< 1 year).

Feasibility of this solution is an easy one: products are available on the market and their implementation does not call for any organizational change in the transport operator system.

Follow-up of the solution

Follow-up indicator:

- % of energy-efficient lubricants used in the fleet.

Practical data collection process:

- Energy-efficient lubricant consumption in the fleet, per lubricant type (direct use or through a subcontractor service operator).

Information sheet: Energy Savings Certificates for energy-efficient engine lubricants



Certificats d'économies d'énergie

Opération n° TRA-EQ-04

Lubrifiant économiseur d'énergie pour véhicules légers

1. Secteur d'application

Véhicules légers.

2. Dénomination

Utilisation d'un lubrifiant économiseur d'énergie.

3. Conditions pour la délivrance de certificats

La performance « Fuel Economy » du lubrifiant doit avoir été mesurée selon la norme d'essai CEC-L-54-T-96 par un laboratoire agréé. Elle doit être supérieure ou égale à 1 %.

Le demandeur doit établir le montant des volumes de lubrifiant économiseur d'énergie utilisés par ses clients.

Seules les actions engagées à partir du 1^{er} janvier 2010 donnent lieu à la délivrance de certificats d'économies d'énergie.

4. Durée de vie conventionnelle

1 an

5. Montant de certificats en kWh cumac

Type de véhicule	Montant des ventes de lubrifiants en m ³	Performance « fuel economy » du lubrifiant, mesurée selon l'essai CEC-L-54-T-96	Montant en kWh cumac
Véhicules légers diesel	X1	Y1	= 39 000 *X1*Y1%
Véhicules légers à essence	X2	Y2	= 22 000 *X2*Y2%



Certificats d'économies d'énergie

Opération n° TRA-EQ-13

Lubrifiant économiseur d'énergie pour des véhicules de transport en commun de personnes ou de transport de marchandises

1. Secteur d'application

Transport routier professionnel

2. Dénomination

Utilisation d'un lubrifiant économiseur d'énergie dans un véhicule de transport en commun de personnes de catégories M2 ou M3 ou dans un véhicule de transport de marchandises de catégories N2 ou N3 selon l'article R. 311-1 du Code de la route.

3. Conditions pour la délivrance de certificats

La performance « Fuel Economy » du lubrifiant (ou gain de consommation du lubrifiant) doit avoir été mesurée selon l'essai OM501FE par un laboratoire agréé, par rapport à une huile moteur de grade 15W-40 répondant au standard ACEA E7. Cette performance (Y%) est mesurée en pourcentage et doit être supérieure ou égale à 1 %.

Le demandeur doit établir le montant des volumes de lubrifiant économiseur d'énergie utilisés.

4. Durée de vie conventionnelle

1 an.

5. Montant de certificats en kWh cumac

$$48\,700 * X * Y\%$$

Avec :

X = volume de lubrifiants en m³.

Y% : performance « Fuel Economy » du lubrifiant.

$$Y\% = Y2\% - Y1\%$$

Y1% : économie de carburant de l'huile de référence 15W-40 ACEA E7 utilisée, mesurée par rapport à l'huile étalon de l'essai OM501FE (Y1 : valeur attendue négative).

Y2% : économie de carburant de l'huile à tester, mesurée par rapport à l'huile étalon de l'essai OM501FE (Y2 : valeur attendue positive).

Exemple : un gain constaté de 1,5 % correspond à $48\,700 * 1,5 = 73\,050$ kWh par mètre cube de lubrifiant.

Vehicle Focus – Form N° 4

Using accessories to reduce aerodynamic resistance

SUMMARY FORM

Action Description

Special accessories reduce the aerodynamic air resistance flow against the vehicle body, thus allowing reduction in fuel consumption.

Amongst the various existing accessories seen on the market can be observed those fitted on the forward section of the vehicle (tractor or cabin) which will reduce interface air turbulence and those fixed at the rear section of the vehicle (rigid truck or semitrailer).

Domain of relevance

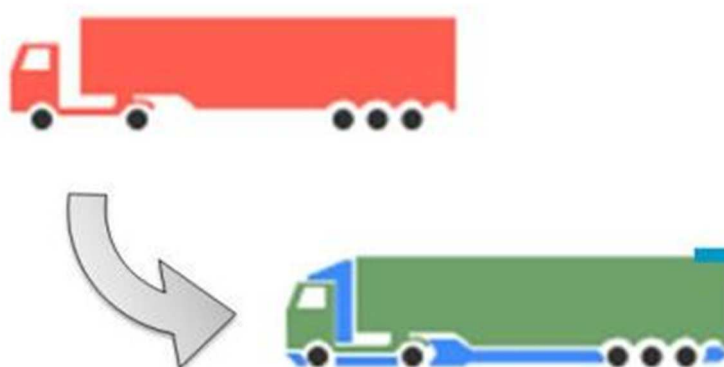
This action can apply to cabin-over-engine LCVs, to rigid truck types and articulated trucks.

Its effectiveness will prove optimal on vehicles of a high body profile structure, that maintain cruise control at the maximum legal speed level.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Tractor and Cabin accessories <small>Using cabin fixed accessories</small>				
Trailer accessories <small>Using trailer fixed accessories</small>				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Source: ADEME

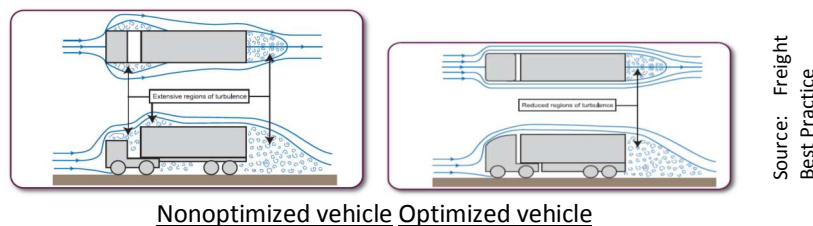
Vehicle Focus – Form N° 4

Using accessories to reduce aerodynamic resistance

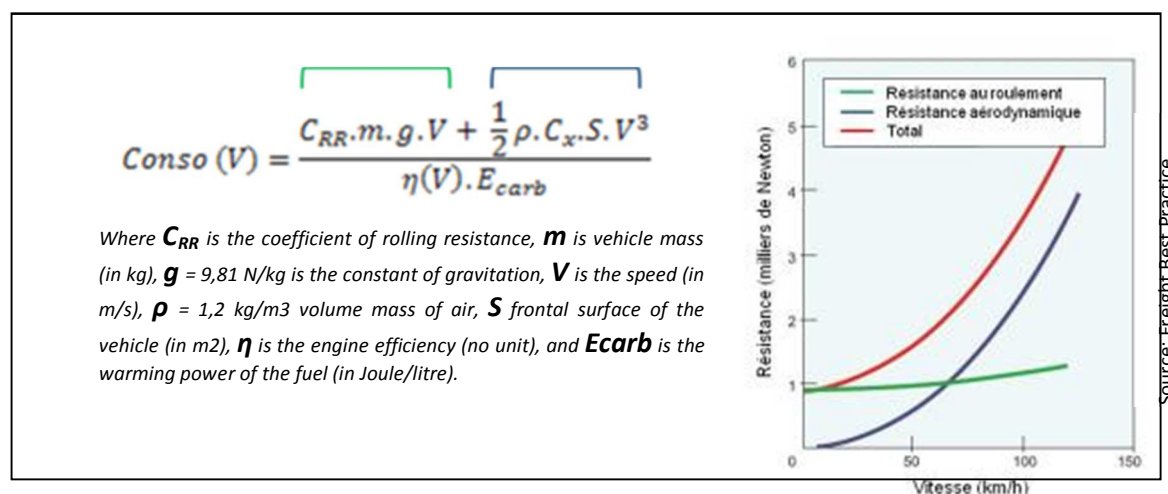
DETAILED FORM

Context and regulations

When a vehicle is in motion, air pushes on the vehicle with a force opposite to its direction of movement. This force (called aerodynamic resistance) has a significant impact on the fuel consumption of the vehicles concerned.



The formula below gives an estimate of consumption at cruise control speed – i.e. vehicle stabilized. It shows that the resistance depends upon the shape of the vehicle body, the front surface it presents to air and its speed.



This aerodynamic power (also called aerodynamic resistance, improperly) increases as the cube of speed and therefore increases drastically with speed increase. Manufacturers and body stylists take into account aerodynamics in new products but the interface section (between tractor and trailer) is not always optimized. Accessories reduce the aerodynamic resistance generated by air and therefore can reduce the air drag (known as the "Cx" and close to 0.75 for a heavy truck) and at the same time fuel consumption. Optional accessories used must of course respect maximum authorized overall dimensions, which are given in Art. R.312 10 to R. 312-13 of the Driving Rules but no specific regulation exists for accessories.

By fitting equipment to both tractor and trailer 7% to 8% global fuel savings can be obtained.

Solutions described in this action from provide in detail the breakdown graph of savings associated to each equipment accessory.

Solution 1: Tractor and cabin accessories

How does it work?

Top wind draft diverters mounted on the roof divert air flow from hitting head-on the higher part of the trailer or body, and insures a continuous aerodynamic air flow between the forward and rear parts of the vehicle. Lateral accessories (lateral wind draft diverter interface and frame) reduce air turbulence all around the vehicle. Such equipment is relevant for articulated tractor and trailer, as well as for rigid trucks.

Wing for articulated truck



Source: FBP

When the height of the trailer (or body of the vehicle) overhangs the tractor (or cabin), the rooftop wind draft diverter will ease up the flow of air situated on the forward section of the vehicle. Wind draft diverters are often used for articulated tractor-trailers, also known as the "Tautliner" type.

Draft deflector for an LCV (cabin-over-frame type)



Source: Procar



Source: Procar

Lateral interface wing



Source: FBP

The aim of a lateral wind draft diverter device is to fill the gap section between the tractor or cabin and the trailer or body. Similar to rooftop wind draft diverters, these accessories are well used for Tautliner tractors, but manufacturers are also developing equipment for specific trucks and tanks for the transport of liquids. In general they prove relevant as soon as a 10 cm gap exists between the forward part (cabin) and the rear part of the vehicle (trailer section).

Side skirts of the tractor frame



Source: FBP

The frame side skirt will reduce turbulence around the forward part of the vehicle. It will reorganize the air flow on the sides of the vehicle, situated between the two forward axles. It is justified when a discontinuous zone exists between the two axles.

Impact on fuel consumption and CO₂ emissions

For heavy-duty trucks, savings associated with full equipment is not significant in urban conditions, and is situated around 3% in interurban and 4.5% for long-haul national routes.

For the LCVs of the cabin-over-frame type, savings associated to a rooftop wind draft diverter are not significant in urban conditions, and estimated at 8% to 10% for interurban or national long-haul conditions. The impact is very positive on the cabin-over-frame type, since the gap between the cabin and the body is generally an large one.

A specific analysis will be necessary, taking into account the route profiles driven.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to rooftop draft diverter (% of reduction of CO ₂ emissions)	Savings linked to interface skirt (% of reduction of CO ₂ emissions)	Savings linked to frame skirt (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	8%	negligible	negligible
Rigid Small	Urban	3.6-12 t	negligible	negligible	negligible
Rigid Large	Regional	>12 t	1.5%	1.5%	negligible
Semitrailer	Long Distance	40 t	2%	2%	0.5%

Sources: communication with manufacturers and the study "Freight Best Practice UK – Aerodynamics for Efficient Road Freight Operations" (extrapolation of long distance data to urban and regional usage). For cabin-over-frame: communication with manufacturers.

Domain of relevance

Aerodynamic accessories are particularly relevant for long-haul operations, with articulated tractor-trailer configuration, rigid trucks or LCVs operating long runs at cruise controlled and high average operating speed conditions. The aerodynamic resistance figure will be higher than for urban and regional transport. In the case of LCVs, rooftop wind draft diverter can prove efficient on the cabin frame and for Tautliner configuration (sliding cover structure), on long-distance route profiles. This solution will prove efficient on vehicles where the profile is discontinuous; large gap between tractor and trailer or forward and rear section, non-aerodynamic geometry between axles.

Implementation

Accessories aimed for the forward section are available for new tractors or new rigid trucks, but can also be retrofitted after purchase. They are distributed by truck bodywork stylists and manufacturers. It has to be noted that if the trailer operates not connected, the global aerodynamic resistance of the tractor will be a lot greater, unless the wind draft diverter is positioned horizontally. Some wind draft diverters are adjustable and can therefore adapt precisely to the trailer section of the articulated truck (in terms of height and depth). Costs on the market are generally the following: €1 000 for a rooftop wind draft diverter, €2 500 for a rooftop and lateral wind draft diverter kit, and €1 000 for a lateral frame wind panel draft diverter.

The relatively high cost of this solution means a long ROI time. Based on a complete accessories kit, it would be of around three years. In terms of feasibility, this solution is fairly accessible, because most manufacturers package the forward section accessories, but it is necessary to carry out an inventory of existing equipment, and ask the relevant questions for each vehicle (e.g. taking into account the frequency of the connecting-disconnecting frequency of the trailer) and in some cases, spending time adjusting wind draft diverters.

Follow-up of the solution

Follow-up indicator: -% of equipped vehicles, specifying each type for the tractor and cabin.

Practical data collection process:

- Follow-up of the number of equipped vehicles.

Information sheet: Energy Savings Certificates for optimized tractor trailers



Certificats d'économies d'énergie

Opération n° TRA-EQ-15

Tracteur routier optimisé

1. Secteur d'application

Transport routier professionnel.

2. Dénomination

Remplacement d'un tracteur routier pour véhicule articulé existant par un tracteur routier pour véhicule articulé neuf optimisé (le tracteur optimisé doit avoir un Poids Total Roulant Autorisé supérieur à 40 tonnes).

3. Conditions pour la délivrance de certificats

Le tracteur routier neuf optimisé respecte les normes environnementales en vigueur, à savoir Euro 5, et comporte les trois technologies suivantes :

- boîte de vitesse robotisée ;
- équipements pour l'aérodynamisme : déflecteur toit, carénage latéral de l'interface et carénage latéral du châssis tracteur ;
- pneus basse résistance au roulement : ils doivent avoir une classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C (classification au sens du règlement européen n° 1222/2009).

Le demandeur présente :

- la facture d'achat du tracteur routier optimisé indiquant et détaillant les trois technologies demandées (pneus basse résistance au roulement de classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C ; pack aérodynamisme précisant les équipements installés qui sont au minimum : déflecteur de toit, carénage latéral de l'interface et carénage latéral du châssis tracteur ; boîte de vitesse robotisée) ;
- une copie de sa nouvelle carte grise ;
- une copie de la carte grise barrée du tracteur routier remplacé et si celui-ci a une date de première mise en circulation antérieure au 1^{er} janvier 1996, l'attestation de mise à la casse du véhicule.

Valable pour les opérations engagées jusqu'au 30 décembre 2013 (la veille de la mise en place d'Euro 6).

4. Durée de vie conventionnelle

10 ans.

5. Montant de certificats en kWh cumac

Année de mise en circulation du tracteur routier existant	Montant en kWh cumac / tracteur routier
Jusqu'à 1992	850 000
1993 à 1995	570 000
1996 à 2000	460 000
2001 à 2005	330 000
2006 à 2008	220 000
2009 à 2011	150 000

X

Nombre de tracteurs routiers existants remplacés
N

Solution 2: Trailer and compartment accessories

How does it work?

Accessories designed for the rear part of the vehicle will limit the air turbulences situated on the side and the rear end of the vehicle.

Impact on fuel consumption and CO₂ emissions

Rear draft diverter



The rear-mounted draft diverter forces the flow of air downwards the trailer or body which then reduces the turbulence zone situated behind the trailer. This system can be mounted only on trailers with a rear top angle section presenting a flat surface.

Lateral wind draft diverter for frame trailer or compartment bodywork



The frame's draft diverter will reduce turbulence around the rear part of the trailer, organizing the lateral air flow of the vehicle, situated between the axles of the trailer. It is justified in case of discontinuous space zones between axles.

Relevant savings are displayed here under:

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to rear draft diverter (% of reduction of CO ₂ emissions)	Savings linked to frame skirt (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-	-
Rigid Small	Urban	3.6-12 t	3%	negligible
Rigid Large	Regional	>12 t	3%	negligible
Semitrailer	Long Distance	40 t	4%	0.5%

Sources: manufacturers communication, solution suppliers and the study "Freight Best Practice UK – Aerodynamics for Efficient Road Freight Operations" (extrapolation of long distance data to urban and regional use)

Rear section packages do not really exist; each solution has to be found according to the trailer or cabin profile.

Domain of relevance

Aerodynamic accessories are particularly relevant for long-haul distances; articulated trucks or rigid trucks running long distances at a high commercial average speed.

This solution will also prove efficient on long vehicles; the longer the vehicle, the greater the efficiency and savings potential of the aerodynamic accessories for reducing air flow resistance.

For LCVs, this solution does not bring significant savings.

Implementation

Accessories which are designed for the rear section of the vehicle (trailer or bodywork) are already available on new trailers or rigid trucks, and they can also be retrofitted afterwards. They are distributed through truck body stylists or by aerodynamic specialists, concerning the rear “top corner angle” draft diverters.

Costs are generally around €1 000 for a lateral draft diverter and €800 for the rear “top corner angle” draft diverter.

They can be fixed easily on trailers with nuts and bolts supplied with the product. The transport operator will have to check that the “new” trailer dimensions comply with regulatory specifications (“new” trailer width and height).

Lastly, drivers must be well documented and instructed, giving them basic knowledge of the vehicle aerodynamics, and the heavy impact that it has on their fuel consumption; they must check that the tarpaulins are cautiously and permanently closed, secured with the appropriate tension so that no strap is left loose, floating in the wind.

The ROI time is an intermediate one (with 1 to 3 years): it will be 1.5 years in case of long-haul domestic distances and routes (calculated given savings expectations and costs mentioned above).

The feasibility of the solution is to be considered intermediate: the rear top corner draft diverter is easy to install, while trailer specificities mean consulting a large supplier’s catalogue, in order to identify the best solution for each aerodynamic add-on accessory and spend time validating their relevance.

Follow-up of the solution

Follow-up indicator:

- % of vehicles on which are mounted forward and/or rear aerodynamic equipment.

Practical data collection process:

- Follow-up of the number of vehicles equipped.

Vehicle Focus – Form N° 5

Enhancing vehicle maintenance (excluding tyres)

SUMMARY FORM

Action description

Drawing up a maintenance plan taking into account all vehicles, is an efficient way of enhancing the maintenance level and ensuring appropriate follow-up.

Daily driver check-up will also contribute to the maintaining engine efficiency.

Domain of relevance

Maintenance enhancement programme concerns all transport firms and all types of vehicles.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Setting-up of a maintenance enhancement program	0% 10% 2%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI
Working out a follow up of maintenance processes (already done & programmed) for all vehicles in the fleet				
Creation of a Driver's Logbook	0% 10% Indirect	> 3 years <1 year Indirect	Difficult Easy	LCV RS RL SE MI
Creation of a Logbook recording drivers' observations				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Source: www.back.ac-rennes.fr

Vehicle type	CO ₂ savings	Return on investment	Feasibility	Domain of relevance
LCV	✓	✓	✓	✓
RS	✓	✓	✓	✓
RL	✓	✓	✓	✓
SE	✓	✓	✓	✓
MI	✓	✓	✓	✓

Source: www.qtuorthgatesacramento.com

Vehicle Focus – Form N° 5
Enhancing vehicle maintenance (excluding tyres)
DETAILED FORM

Context and regulatory measures

Maintenance programmes recommended by manufacturers generally consist of compliance with recommendations formulated, which are based – whichever event comes sooner – either on distance thresholds (60-80-90 000 km for heavy duty vehicles, 30 000 to 40 000 km for LCVs) or on the time span in between two major servicing operations (2 to 3 years).

This maintenance programme should also take into consideration the replacement of all major common parts that suffer wear and tear (brake plates, disk brakes, air filters and oil filter, etc.).

Following up on the maintenance of each vehicle will ensure satisfactory engine efficiency.

Bearing that in mind, the driver can perform daily preventive maintenance avoiding total breakdown situations, or make a demand for a supplementary maintenance visit, anticipating on the programmed one.

No regulatory disposition indicates mandatory maintenance frequency. Only once yearly technical control is mandatory for the > 3.5 tonnes segment (Art. 27 July 2004 related to heavy-duty trucks technical maintenance).

Regulations concerning LCVs¹⁵ (N1 Category¹⁶) are the same as for passenger vehicles, as regards technical controls. Vehicles > 4 years of age have a mandatory check-up which has to be renewed every two years.

The check-up date must happen in the six months span the fourth year anniversary date, i.e. when the vehicle was first validated as roadworthy.

¹⁵

<http://www.legifrance.gouv.fr/affichCodeArticle.do?idArticle=LEGIARTI000020572753&cidTexte=LEGITEXT000006074228>

¹⁶ "Vehicle conceived and constructed for merchandise transport with a maximum weight below or equal to 3.5 tonnes."

Solution 1: Implementing a maintenance follow-up organization

How does it work?

In order to optimize vehicles operating while following a rigorous maintenance plan for each of them, it is crucial to set up processes that will identify rapidly the level of maintenance reached, maintenance records and what needs to be undertaken in the future.

This solution also offers simple tools (such as spreadsheets or paper) implemented by the technical manager, in order to list all maintenance operations to be performed (including “spot” repairs) and programmed either on kilometre base data, or taking into account the time span between two overall servicing operations (2 to 3 years). This personalized follow-up of vehicles will allow the manager to anticipate the future deadlines and schedule maintenance tasks, within the manufacturer’s recommended time span as required, thus avoiding engine efficiency deterioration. Maintenance planning and vehicle maintenance “warning dates” are generally proposed by manufacturers, given they are all equipped with a system managing all the engine parameters (acceleration rate, total time spent braking in a day, etc.).

These tools permit, through an automated warning sign for each vehicle, to notify the truck driver of the next scheduled “routine” maintenance dates, taking his driving style and records into account, sometimes anticipating on the deadlines dates (FUEL FOCUS – ACTION FORM N° 3, solution N° 2).

Impact on fuel consumption and CO₂ emissions

Even if savings from this solution are sometimes difficult to evaluate, it is estimated that a wrong maintenance organization on a 40-tonne vehicle can generate as much as 2 litres /100 km extra fuel consumption, thus a 5% ratio of extra consumption (excerpt from the BEET report on controlling fuel consumption in Road Transport of Merchandise, and exchanges with manufacturers.)¹⁷ As an example, here are some pro-active maintenance actions, preventing fuel overconsumption:

- Loss of lubricant quality will eventually generate engine efficiency deterioration.
- A consistent choice of lubricant and appropriate service frequency will make a 1 litre difference (more or less)/100 km;
- Deterioration of the gearbox normal working condition will eventually cause 2 litres/100 km extra fuel consumption, thus 6% overconsumption (see www.energeco.org).

It has to be considered that a formalized maintenance and fleet management plan will contribute to avoiding this "overconsumption" situation. Average savings for this solution are 2% (corresponding to 50% of the maximum savings expected of the action, delivering 1 litre/100 km).

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings linked to maintenance management system implementation (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	2%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: BEET document and communication with manufacturers

¹⁷ BEET: Benchmarking Energy Efficiency in Transport

Domain of relevance

This action is adapted to all operators who do not manage their maintenance or do not follow up with a formal maintenance plan.

Implementation

- In order to achieve a formal maintenance plan (using paper, spreadsheet or other automated data software), it is advisable in a first step to:
- Make an inventory of all vehicles and their specifications (categories, manufacturer, engine power, kilometres, and first year on the road, etc.);
- Make a validation of all the records maintenance operations performed (tracking parts changes, control check-lists, oil servicing, etc.) using an individual maintenance vehicle logbook or the records of the maintenance service operator involved;
- Register the manufacturer maintenance recommendations.

This follow-up organization can even mention and schedule all check-up points to be made, in particular:

- Controlling and tackling air-compressor leaking;
- Checking out that fuel tanks, fuel caps and pipes are tightly sealed;
- Filters are clean (air, oil, fuel) and the maintenance of particle filters;
- Ball bearings and rotating parts: checking out the gripping points;
- Grease amounts laid on the turn plate;
- Grease in the steering wheel, the suspensions and transmissions;
- Oil servicing of the engine;
- Cooling system working properly;
- Controlling exhaust pipe fumes opacity;
- Checking fan belts and electric circuitry;
- Topping up CFC gases (refrigerated vehicles).
-

In the case of externalized maintenance management, the transport operator can ask the service operator to give the cost per vehicle, display the maintenance procedures, the overall and per vehicle reporting. In the case of internal maintenance management, the transport operator will record all the maintenance operations performed. The implementation cost of this type of solution is minimal, if a spreadsheet is utilized. If a maintenance software programme is used, cost could prove to be a little higher, which is the price to pay for overall process reliability. In any case, the implementation costs are minimal compared to the expected savings of 2%, thus making for a short ROI time (< 1 year).

Implementing this solution means an investment in time, in order to define the follow-up process. Feasibility is intermediate.

Follow-up of the solution

Follow-up indicator:

- % of vehicles followed by a maintenance spreadsheet software programme
- % of vehicles checked before deadlines.

Data collection process:

- Operating the follow-up system described in this action form.

Solution 2: Creating a logbook for driver's use

How does it work?

The transport operator may take the initiative of writing out a logbook for each driver, listing all major vehicle parameters, via which the driver can communicate his feedback to the maintenance manager.

These observations can be done before leaving the premises, and along the operated route; they will be of use detecting incoming bugs that can be taken care of when maintenance operations are carried out.

Impact on fuel consumption and CO₂ emissions

This is a typical preventive solution and resulting savings are difficult to evaluate.

Domain of relevance

This action is adapted to all transport activities and all types of vehicles.

Implementation

Writing out a driver's logbook needs internal resources use, but the main task will be to motivate drivers around the maintenance issues, on which they have influence and in which they can participate actively.

Thus, each driver is requested to, on a daily basis:

- Check the general apparent aspect of his entire vehicle;
- Take a note of all engine lubricant discrepancies (wrong level found, leaking, etc.);
- Notify maintenance about any miscellaneous engine "unusual" behaviour;
- Detect dirty spot anomalies;
- Feedback on ventilator activation (if it is indeed disengageable!).

This solution does not give immediate savings and cannot therefore, be associated with any ROI time. Implementing this solution will need some organizational changes, and the involvement of the driving team; its feasibility is intermediate.

Follow-up of the solution

Follow-up indicator:

- Number of drivers who have received a pep talk and are in permanent possession of their individual logbook.

Practical data collection process:

- Follow-up of the pep talks to drivers and number of drivers in permanent possession of their individual logbook.

Vehicle Focus – Form N° 6 Tyre management programme SUMMARY FORM

Action description


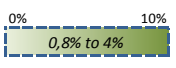




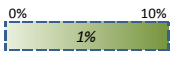




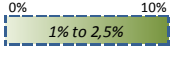




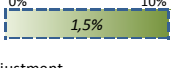



This action aims at optimizing the general tyre operating conditions, on several aspects: acquisition of low-resistance tyres, hollowing-out process, getting the right pressure at all times, and geometry adjustment issues.

Appropriate maintenance their life long will bring important fuel consumption savings, at the same time increasing tyre life..

The four solutions can be used separately or may open the way for a full enhancement programme, especially in the case of a service operator in charge of general tyre maintenance.

Domain of relevance

This action applies to all vehicles and transport activities, with the exception of regrooving or retreading, that do not apply to LCVs – Light Commercial Vehicles.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Low rolling resistance tires  <small>TRA-EQ-06 TRA-EQ-15</small>	 0,8% to 4%	 > 3 years to < 1 year	 Difficult to Easy	
Vehicles equipped with low resistance to rolling tyres				
Tyres re-treading and regrooving  <small>TRA-SE-05</small>	 1%	 > 3 years to < 1 year	 Difficult to Easy	
Tyres re-treading and regrooving				
Tyres pressurizing  <small>TRA-SE-04</small>	 1% to 2,5%	 > 3 years to < 1 year	 Difficult to Easy	
Maintenance of optimal pressurizing & follow up of fleet's tires				
Optimizing wheel geometry  <small>TRA-SE-04</small>	 1,5%	 > 3 years to < 1 year	 Difficult to Easy	
Tyres maintenance of optimal geometry adjustment				

Nota Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



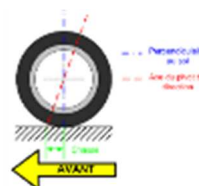
Source: www.tinkuy.fr



Source: www.fleetfirst.eu



Source: www.fleetfirst.eu



Vehicle Focus – Form N° 6
Tyre management programme
DETAILED FORM

Context and regulatory measures

European regulation n° 661/2009 gives the definition of tyre energy classification which is based on rolling resistance coefficient, expressed in kg/t.

European regulation n° 1222/2009 gives a reference tyre class chart, with an energy classification associated tag by class of tyre (class “A” type to class “G” type, ranking according to their rolling resistance coefficient), which gives information as to the impact on the fuel savings, adherence during wet conditions, and the rolling noise made by the tyres (perceived external sound expressed in dB).

This last regulation cited, which is applicable as of November 2012 Europe-wide, will make it mandatory for tyre manufacturers to display some of the information and make it accessible on the tyres’ lateral sides.

The objective is to increase safety, economic and environmental efficiency in the world of road transport, promoting safe, low-decibel, fuel-efficient tyres. The tag will address three parameters which are critical when making a choice:

- Impact on fuel consumption – Class “A” to Class “G”;
- Adherence, driving under wet conditions;
- External rolling noise, measured in db.

This action gathers several leverage controls, which can be activated or not, according to the activity of the transport operator. Tyre management can be performed internally, or externalized; solutions can be implemented indirectly by the tyre service operator or directly by the transport operator.

Solution 1: Reducing tyre rolling resistance

How does it work?

Every time a wheel makes a complete rotation, the rolling tread of the tyre is modified when it comes into contact with the road, and then loses contact with the ground again. The rubber shape modification dissipates energy by heating up, causing 90% of the rolling resistance. A low-resistance tyre is a tyre that has a low rolling Coefficient of Resistance (COR). The COR can be modified using different tyre blends (especially adding silica to the rubber materials) or by modification of the body of the tyre. Thus a reduction of approximately 1 kg/t can be achieved.



Source:
www.michelin.mu

Impact on fuel consumption and CO₂ emissions

At cruise control stabilized speed, vehicle consumption can be expressed by the following formula:

$$Conso (V) = \frac{C_{RR} \cdot m \cdot g \cdot V + \frac{1}{2} \rho \cdot C_x \cdot S \cdot V^3}{\eta(V) \cdot E_{carb}}$$

With: **m** being the vehicle mass (in kg), **g** = 9.81 N/kg gravitation constant figure, **V** being the speed (in m/s), **ρ** is = 1.2 kg/M air volume mass, **C_x** is the drag coefficient (0.75 for a heavy-duty truck), **S** the frontal surface of the vehicle (in sq. meters), **η** is the efficiency of the engine (no unit), and "**E_{carb}**" is the fuel warming power (in Joule/litre units).

The link between the COR – Coefficient of Resistance – and fuel consumption is a complex one, since many parameters come in line at the same time: vehicle type, route profile type, number of axles, the number of low rolling resistance tyres used, etc. In order to proceed to calculation of average resistance, it is necessary to break down the impact of each axle according to the weight supported, standard weight breakdown being the following:

- LCVs and Rigid Trucks: 35% on the driving axle and 65% on the engine axle;
- Articulated truck complete tractor trailer: 15% on the driving axle, 25% engine axle, 60% other axles (called the drag axles).

Referring to heavy-duty trucks, the “average” tyre tag for rolling resistance is the “D” class tag (COR coefficient ranges between 6.1 and 7 kg/tonne). Two types of tyres have to be distinguished: the long-haul distance use one and the regional use one. The long-haul category usually has a lower rolling resistance (5.5 to 6 versus 6.5 to 7 kg/tonne), since the resistance needs are also lower (fewer curves and lower braking needs, road coating usually of better quality, etc.).

Tyres are usually credited with taking away as much as 35% of the fuel consumption of a heavy-duty truck. Savings which have been set and presented below have been obtained after a theoretical calculation, based on equipment estimations allowing 10% resistance to rolling reduction on the whole set of tyres used on urban and regional profiles, and 5% for the long-distance route profiles. The above formula is only relevant at stabilized cruise control speed; an adjustment was made in order to obtain representative savings for each usage. These savings are general ones and commonly put forward by tyre manufacturers.

In the case of LCVs, tyres usually account for taking away 25% of the fuel consumption. The ESC Form TRA-EQ-06 on “tyres for light vehicles low rolling resistance” concerns the purchase of tyres having an energy

classification of at least the “C” category, used for renewing LCV tyres inside a fleet.¹⁸ It is estimated that a COR saving of 1 kg/t on all four tyres leads to a fuel saving of 0.08 litre/100 km, a figure that will fluctuate according to the road profile used (urban, semi-urban, highway only, etc.), and therefore brings 0.8% fuel reduction for a van type of vehicle.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings linked to low rolling resistance type of tyres (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	0,8%
Rigid Small	Urban	3.6-12 t	1%
Rigid Large	Regional	>12 t	3%
Semitrailer	Long Distance	40 t	4%

Source: theoretical calculation by ADEME based on manufacturers' input.

Domain of relevance

This solution will be all the more relevant given that the vehicle use is on long distances with a stabilized speed. Inversely, it will be less applicable to operations in difficult road conditions that require maximum adherence: adverse road conditions, roads with important downhill grade, vehicle use on public construction works conditions, etc.

Implementation

For heavy-duty trucks, low-resistance tyres are becoming first choice in certain vehicle classes, with “economy” and “standard” versions, at usually 1% extra purchasing cost, compared to a standard tyre version. For LCVs the extra cost for low-resistance tyres will generally be about 4% over standard version cost.¹⁹

Prior to purchasing decisions, it is recommended to carry out an audit or a diagnosis by an expert, in order to find out the average resistance to rolling coefficient in the fleet considered. In the case of externalized management of tyres, the service operator in charge will be instructed to use the lowest possible rolling resistance tyres, as long as safety rules are respected. This point must be mentioned in contract documents and followed up afterwards during operations. In case of internal management of tyres, this action means performing a precise follow-up in order to equip certain vehicles with low-resistance tyres. This solution has a short ROI (< 1 year) given the estimation of savings and cost above mentioned, and can be considered of reasonable feasibility since no particular difficulty is to be expected (diagnosis is simple, products are available, rapid implementation, etc.).

Follow-up of the solution

Follow-up indicator:

% of vehicles equipped with low rolling resistance tyres, specifying the vehicle class (LCVs, small rigid, large rigid or articulated trucks).

- Average COR of the fleet (if available from the tyre service operator).

Practical data collection process:

- Follow-up of tyres used per vehicle and trailer (internal garage follow-up): type of tyres mounted per axle, per vehicle, duration of use of each tyre, etc.

¹⁸ Classification in the sense of European regulation n° 66 1/2009.

¹⁹ Manufacturer information.

Information sheet: Energy Savings Certificates for low rolling resistance tyres for light vehicles



Certificats d'économies d'énergie

Opération n° TRA-EQ-06

Pneus de véhicules légers à basse résistance au roulement

1. Secteur d'application

Flottes professionnelles de véhicules légers.

2. Dénomination

Acquisition et montage de pneumatiques ayant une classification énergétique, au moins égale à C, pour le renouvellement sur des véhicules légers d'une flotte.

3. Conditions pour la délivrance de certificats

Les pneumatiques ont une classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C (classification au sens du règlement européen n° 661/2009).

Le demandeur présente les factures d'achat des pneumatiques stipulant la quantité de pneumatiques livrés et montés par classe énergétique.

Le demandeur apporte des éléments justifiant le kilométrage annuel moyen parcouru par les véhicules légers de la flotte considérée (éléments issus de l'outil de gestion et de suivi de la flotte). Le kilométrage annuel moyen d'un véhicule pour la flotte considérée est égal à la somme des kilométrages de tous les véhicules de la flotte divisée par le nombre total de véhicules de la flotte. Cette valeur est déterminée sur l'année calendaire précédant la demande de certificats.

4. Durée de vie conventionnelle

1 an.

5. Montant de certificats en kWh cumac

Classe énergétique des pneumatiques installés	Montant en kWh cumac	X	Nombre de pneumatiques	X	Nombre de kilomètres annuels
A	0,011		N		Y
B	0,008				
C	0,006				

Information sheet: Energy Savings Certificates for optimized tractor trailers



Certificats d'économies d'énergie

Opération n° TRA-EQ-15

Tracteur routier optimisé

1. Secteur d'application

Transport routier professionnel.

2. Dénomination

Remplacement d'un tracteur routier pour véhicule articulé existant par un tracteur routier pour véhicule articulé neuf optimisé (le tracteur optimisé doit avoir un Poids Total Roulant Autorisé supérieur à 40 tonnes).

3. Conditions pour la délivrance de certificats

Le tracteur routier neuf optimisé respecte les normes environnementales en vigueur, à savoir Euro 5, et comporte les trois technologies suivantes :

- boîte de vitesse robotisée ;
- équipements pour l'aérodynamisme : déflecteur toit, carénage latéral de l'interface et carénage latéral du châssis tracteur ;
- pneus basse résistance au roulement : ils doivent avoir une classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C (classification au sens du règlement européen n° 1222/2009).

Le demandeur présente :

- la facture d'achat du tracteur routier optimisé indiquant et détaillant les trois technologies demandées (pneus basse résistance au roulement de classification énergétique au moins égale à C ainsi qu'une classification en adhérence sur sol mouillé au moins égale à C ; pack aérodynamisme précisant les équipements installés qui sont au minimum : déflecteur de toit, carénage latéral de l'interface et carénage latéral du châssis tracteur ; boîte de vitesse robotisée) ;
- une copie de sa nouvelle carte grise ;
- une copie de la carte grise barrée du tracteur routier remplacé et si celui-ci a une date de première mise en circulation antérieure au 1^{er} janvier 1996, l'attestation de mise à la casse du véhicule.

Valable pour les opérations engagées jusqu'au 30 décembre 2013 (la veille de la mise en place d'Euro 6).

4. Durée de vie conventionnelle

10 ans.

5. Montant de certificats en kWh cumac

Année de mise en circulation du tracteur routier existant	Montant en kWh cumac / tracteur routier
Jusqu'à 1992	850 000
1993 à 1995	570 000
1996 à 2000	460 000
2001 à 2005	330 000
2006 à 2008	220 000
2009 à 2011	150 000

X

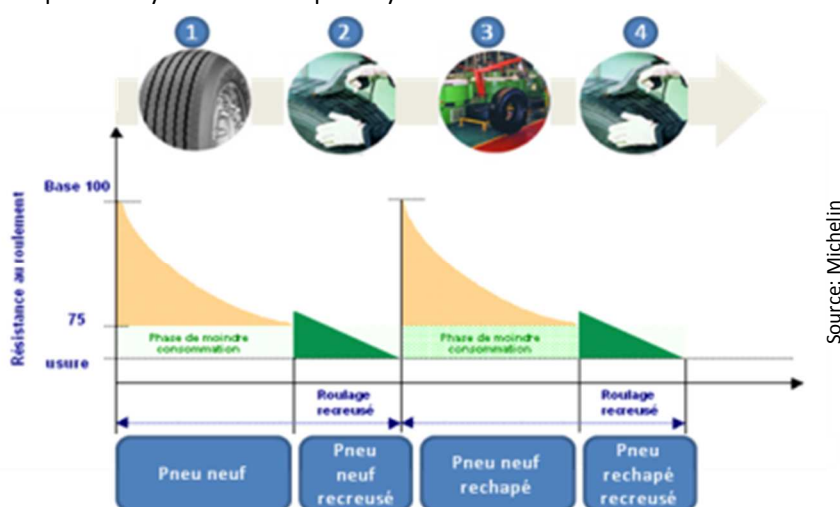
Nombre de tracteurs routiers existants remplacés
N

Solution 2: Tyre regrooving and retreading

How does it work?

Regrooving consists of reworking the grooves of the tread when their depth is lower than 2 to 3 mm. The purpose is to lengthen the overall life of each tyre. Authorized by road regulations and recommended by tyre manufacturers, regrooving action restores the tyres to the required adherence conditions, increasing in a significant manner the efficiency per kilometre, by the same token contributing to savings on fuel consumption, because the tyres' duration is thus lengthened at a specific "critical" moment, when its resistance to rolling coefficient is the lowest.

Retreading consists of renewing – back to normal situation of tyre use – the used tread of tyres by replacement, or by replacing both the tread structure and sidewalls of the tyres, again increasing the tyre's total lifespan. Tyres can potentially follow a 4-step life cycle:



As indicated above, resistance to rolling (and thus fuel consumption) diminishes following the wear and tear of the tyres. Regrooving will extend tyre life positively; when it reaches its "lowest" fuel consumption point (with least rubber thickness on the tread).

Impact on fuel consumption and CO₂ emissions

Savings in terms of reduction of fuel consumption, as of the regrooved phase of life, is estimated at 1.5 litre/100 km (roughly 4, 5%). Savings can only be counted for this phase which represents 25% of the total life cycle, meaning that the corrected figure will be 1% fuel consumption reduction with regrooved tyres.

Savings figures will not be modified by the vehicle class, type, or usage.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings linked to regrooving (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	Nonapplicable
Rigid Small	Urban	3.6-12 t	1%
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: manufacturers

Domain of relevance

In order to be regroovable, the tyres concerned must bear a “regroovable” or “U” sign symbolizing the same, placed on the tyre sidewall.

Regrooved tyres can be placed on any of the axles of the vehicle, unlike retreaded tyres which **must never be placed on the power distribution axle of the vehicle.** Retreaded and regrooved tyres are destined for vehicles over 3.5 tonnes MGW.

In the case of LCVs, not only is this solution is inapplicable, **it can be dangerous** to implement it.

Implementation

Given as an indication only, the first regrooving will happen when the vehicle’s odometer reads 180 000 to 220 000 km for long- haul distance use tyres, 110 000 to 120 000 km for regional usage tyres (source: exchange of communication with tyre manufacturers).

Tyre manufacturers publish regrooving designs to be strictly followed when regrooving their products, with respectively the appropriate recommended width and depths under the surface of the original tread (e.g. after regrooving no cord should be apparent).

Regrooving has to be absolutely performed using state-of-the-art skills by professionals only.

Average regrooving cost for one tyre is roughly €25.

The ROI time for regrooving is short (< 1 year) given the above estimations of savings and costs. This solution does not present any particular implementation difficulty and can be considered has having a good feasibility.

Follow-up of the solution

Follow-up indicator:

- % of the fleet operating with regrooved tyres.

Practical data collection process:

- Follow-up of the fleet per axle and per vehicle; tyre type, clearly identified steps of the life cycle (first regrooving, etc.) and kilometres travelled follow-up.

Information sheet: Energy Savings Certificates for regrooving of tyres for heavy-duty trucks



Certificats d'économies d'énergie

Opération n° TRA-SE-05

Recreusage des pneumatiques de poids lourds

1. Secteur d'application

Transport routier professionnel.

2. Dénomination

Recreusage de pneumatiques neufs ou rechapsés de poids lourds de plus de 7,5 tonnes.

3. Conditions pour la délivrance de certificats

Le recreusage est effectué par un réseau de négociants multimarques ou par des prestataires techniques externes.

La demande de certificats comporte les factures de prestation de recreusage avec l'indication du nombre et du type de pneumatiques recreusés. Il est nécessaire, pour chaque pneumatique recreusé indiqué sur la facture, de pouvoir identifier le type de véhicule concerné (poids lourds de plus de 7,5 tonnes).

4. Durée de vie conventionnelle

1 an.

5. Montant de certificats en kWh cumac

Catégorie	Montant en kWh cumac / pneumatique recreusé		Nombre de pneumatiques recreusés
Pneumatiques de poids lourds	305	X	N

Solution 3: Tyre pressurizing

How does it work?

Insufficient tyre pressure subjects the body section of a tyre to an undesired flexion effect, which in turns causes the overheating of the tyre, increasing rolling resistance and leading to premature wear and tear of the whole structure of the tyre.

One of the alternative solutions used by transport operators to reduce constraints linked with permanent correct tyre pressure, is pressurizing using nitrogen gases.

Rubber aggregates are in fact more nitrogen-tight than airtight. Although a nitrogen pressurized tyre will leak nitrogen gas slower than it will leak air, it will also need a constant surveillance. All the rules and recommendations given for air pressurized tyres remain the same with nitrogen gases.

Impact on fuel consumption and CO₂ emissions

Inappropriate – lower than required – tyre pressure will have a immediate 2.5% extra fuel consumption effect, on long-haul distances.²⁰ In the case of heavy-duty trucks, savings appearing in the chart below correspond to an average ratio of under-pressurization of 15%.

In the case of LCVs, the ESC Form N° TRA-SE-04 “Pressurizing for LCVs and passenger vehicles” indicates that operating with under-pressurized tyres increases the rolling resistance coefficient of the tyres and therefore increases fuel consumption.

Specific studies on the matter shows that 0.3 Bar (or 4.35 Psi) lower than expected pressure generates a 0.05 litre/100 km – with reference to the standard UTAC test (meaning an increase of 6% in rolling resistance) and for a missing 1 bar (or 14.51 psi), and extra consumption of 0.23 litre/100 km is recorded (meaning 30% more rolling resistance). This corresponds to an extra consumption of between 1.2% and 6%, according to the insufficient pressure measured.

Furthermore, in an impact study carried out by the European Commission, it is found that across the European Union, a correct tyre pressure situation would save 2.5% of all European fuel consumption.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to optimized pressurization of tyres (% of reduction of CO ₂ emissions) ²¹
LCV Light Commercial Vehicle	Urban	≤3.5 t	2.5%
Rigid Small	Urban	3.6-12 t	1%
Rigid Large	Regional	>12 t	1%
Semitrailer	Long Distance	40 t	1,5%

Source: manufacturers, Energy Savings Certificates information sheets.

²⁰ In addition, the life of the tyre will be increased. Under-pressurizing by 10% means wear and tear increase of 10%.

²¹ For vehicles over 3.5 tonnes, under-pressurizing is lower than for LCVs, thus CO₂ savings are lower.

Domain of relevance

This action applies to all transport domains. It will prove more efficient for vehicles making long-haul distances, and when under-pressurized situations are important. Nitrogen pressurizing is relevant for all types of vehicles.

Implementation

This action takes for granted constant tyre pressure surveillance. In practice, a monthly check is needed.²² For a heavy-duty truck, the pressure of tyres mounted on the driving axle is usually found between 6.5 to 8.5 bar (94.32 and 123.34 psi) and on the trailer will be of 7 to 9 bar (or 101.57 to 130.59 psi).

For an LCV, pressure will be found between 3 to 5.8 bar (or 43.53 to 84.16 psi).²³

In the case of externalized tyre maintenance service operator, all tyres must be checked at least every two months. Furthermore, after any intervention on a tyre, tyre pressure levels must also be checked for all other tyres.

On average this will slightly increase by 5% gap, compared to the recommended pressure, therefore no extra fuel consumption will occur.

The nominal pressure must be adjusted to vehicle use, taking into account the average load transported and the road profile used.

To carry out an internal tyre management programme (TMP) several processes exist:

- Systematic pressure control when the vehicle goes through any garage maintenance;
- Dynamic control, with the use of manometers on each vehicle;
- Automatic warning devices (installing LED or electronic pressure sensors).

The ROI time for controlling tyre pressure on a systematic basis is short. This solution can necessitate, in case of internal management, to put in place a follow-up process, either manual or automatic, therefore this solution is intermediate as far as feasibility goes.

In order to pressurize all tyres with nitrogen gas, the purchase of a 200 bar (2902 psi) bottle is around €50..

Calculated per pressurized tyre, the cost impact is therefore insignificant.

Follow-up of the solution

- % of the tyres which are checked at least every two months.
(N.B. Frequency of control has to be increased should the controls show a permanent result of > than 10% gap measure in the controlled pressures).

Practical data collection process:

- Chart with the follow-up of all tyre pressures recorded.

²² ESC sheet T912: Tyre pressurizing for passenger cars and LCVs.

²³ <http://www.conti-online.com>: Technical Manual "Continental" Tyres for LCVs.

Information sheet: Energy Savings Certificates for tyre pressure in passenger cars and light commercial vehicles



Certificats d'économies d'énergie

Opération n° TRA-SE-04

Gonflage des pneumatiques pour véhicules légers et véhicules utilitaires légers

1. Secteur d'application

Véhicules légers et utilitaires légers (maximum 3,5 tonnes).

2. Dénomination

Mise en place de nouvelles stations de gonflage ou maintien des installations existantes conformément au cahier des charges Travaux de Normalisation des Pneumatiques pour la France (TNPF).

3. Conditions pour la délivrance de certificats

Dans le cas de l'installation d'une nouvelle station, le demandeur fournit :

- la copie du contrat d'entretien et la procédure de contrôle quotidien (procédure écrite dans un référentiel d'exploitation ou de qualité) ;
- les factures de matériels et les attestations de travaux relatives à l'implantation de la station de gonflage.

Dans le cas du maintien d'une installation existante, le demandeur fournit :

- la copie du contrat d'entretien et la procédure de contrôle quotidien (procédure écrite dans un référentiel d'exploitation ou de qualité).

Le contrat d'entretien garantit le remplacement des organes défectueux dans un délai raisonnable.

4. Durée de vie conventionnelle

1 an.

5. Montant des certificats en kWh cumac

Trois types de stations de gonflage sont définis :

Stations de gonflage de type A : implantées sur des autoroutes ou des voies de grande circulation de type autoroutier avec des aires de stationnement/repos.

Stations de gonflage de type B : implantées sur des zones urbaines ou des agglomérations (zones industrielles, d'activité, parkings grands publics) et hors agglomération, hors parkings privés d'entreprises ou de collectivités locales.

Stations de gonflage de type C : implantées dans les parkings privés d'entreprises ou de collectivités locales, ces parkings hébergeant les véhicules des employés et/ou ceux appartenant à l'entreprise ou à la collectivité locale (dans le sens de flotte professionnelle).

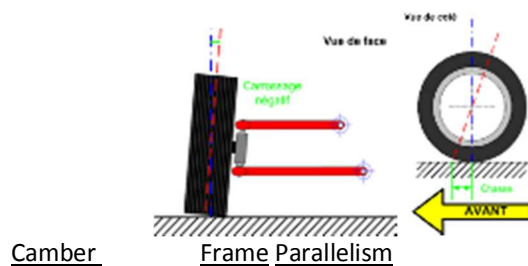
Type de stations	Total du gain en kWh cumac / station
Type A	520 000
Type B	140 000
Type C	40 000

Solution 4: Wheel geometry optimization

How does it work?

Several angles give the definition of geometry: camber angle, pivot angle, frame angle and parallelism; these angles must be harmonized in such a way that they avoid premature wear and tear and fuel overconsumption:

- Camber is the grade of inclination of the wheel compared to vertical focus
- Pivot is the angle formed by the pivot focus and the vertical seen facing the vertical
- Frame is the angle that is formed by the pivot focus and vertical but seen from the side
- Parallelism is the angle formed by the surface plane of the wheel and the longitudinal focus (alongside the vehicle).



Source:
www.autotekno.com

Incorrect adjustment of one of these parameters will increase the rolling resistance coefficient and will lead to fuel overconsumption.

Impact on fuel consumption and CO₂ emissions

Fuel overconsumption through poor wheel geometry adjustments can translate to 1 litre/100 km. Following communication with manufacturers, the figure of 0.5 litre/100 km was agreed upon, thus giving 1.5% fuel overconsumption.

Savings are not affected by the vehicle type or type of transport activities.

Vehicle Size	Main use considered	MGW (or MCW)	Savings linked to optimization of wheel geometry (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	1.5%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: manufacturers

Domain of relevance

This solution is appropriate to all vehicles and transport activities.



Implementation

Checking wheel geometry must be performed by a professional. The usual cost for a geometry check-up amounts to 150 €.

On top of geometry adjustment, it is possible to obtain tyres wear and tear optimization, by swapping the exterior tyres for the interior ones, and vice-versa. Tyres situated on the power axle can thus gain 10% in life span.

The ROI time of surveillance of the geometry is short (< 1 year), in accordance with costs and savings above mentioned. The solution feasibility is intermediate (needs a professional either internal or external).

Follow-up of the solution

Follow-up indicator:

- % of vehicles for which the wheel geometry is checked at least once a year.

Practical data collection process:

- Chart giving all the geometry controls performed; diagnosis per axle and per vehicle and all necessary adjustments made for satisfactory wheel geometry adjustments.

Vehicle Focus – Form N° 7

Evaporative air conditioning system

SUMMARY FORM

Action description

The objective of this action is to offer a solution of emission reduction associated with air conditioning use.

Replacing a standard air-conditioning system with an evaporative system will avoid using refrigerant gases, which have an important negative impact and contribute heavily to global warming.

Domain of relevance

This action is appropriate to all transport domains, and to all vehicles equipped with an air-conditioning system.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Evaporative air-conditioning system	0% 10% 3% to 3,3%	> 3 years <1 year	Difficult Easy	<div> <div>LCV</div> <div>RS</div> <div>RL</div> <div>SE MI</div> </div>
Equipment with an evaporative air-conditioning system				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Source: AEREL

Vehicle Focus – Form N° 7
Evaporative air conditioning system
DETAILED FORM

Context and regulatory measures

Use of air-conditioning systems in vehicles has brought more comfort and safety in the cabin for drivers.

However, at the same time this technology has increased greenhouse gas (GHG) emissions for two reasons:

- Air conditioning means the use of a compressor, the engine of the truck providing the energy which in turns increases fuel consumption and therefore increases CO₂ emissions.
- Air-conditioning circuits are not 100% leak-proof and the leaked refrigerant gases have a very negative effect, making global warming worse than it already is (some gases have 1 430 times the warming power of CO₂!).

Usually refrigerant gases for vehicle use are the R-134-a type. Up to now, this technology – by compression – has been widely spread by the manufacturer's brands, and is present on the original fitting of vehicles.

Good practice and correct handling

In addition to optimizing action linked to air conditioning, it is essential that the transport operator communicate "Eco Practice" to drivers (see DRIVER FOCUS ACTION – FORM 1 – SOLUTION 2).

Communication can consist of adhering to appropriate practices such as:

- Parking in the shade whenever this is possible;
- Opening windows to evacuate the heat before switching the air conditioning "ON";
- Close windows while the air conditioning is "ON";
- Not setting more than 4° to 5 °C difference with outside temperature;
- Switching "OFF" the automatic air conditioning when it is not yet too warm;
- Recycling the air in the cabin when it is too hot.

Solution 1: Evaporative air conditioning system

How does it work?

In the case of evaporative air conditioning, the hot and dry outside air is filtered, refreshed and rehydrated using water evaporation, then sprayed into the cabin.

This technology specification is that it works adding air, without recycling the interior air volume, while filtering and purifying external air used.

Evaporative air conditioning technology has gone through validation tests and operating under real conditions through hundreds of times in use, for some years, which confirm users' satisfaction.

From an environmental point of view, evaporative technology has the cumulative advantages of not using any refrigerant gases with negative impact on global warming while reducing fuel consumption, generated by air conditioning energy needs, at the same time.

Impact on fuel consumption and CO₂ emissions

A classic air conditioning system will use about 1 kg of refrigerant gases, and the leakage emission ratio will be around 17% a year.

Over a year's time, these refrigerant emissions correspond to 240 kg of CO₂-equivalent (or 2 grams of CO₂ per kilometre for a vehicle running 120 000 km yearly).

On top, the extra fuel consumption generated by air conditioning system needs will be around 5%. Evaporative air conditioning being three times more efficient, this action will bring an estimated 3% fuel consumption reduction. In the chart below, the fuel savings have been separated from the CO₂ savings.

In the second case, the two environmental advantages of evaporative air conditioning can be cumulated (no refrigerant gases and limited effects on fuel overconsumption).

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated with air conditioning evaporative system, compared to standard air conditioning ²⁴	
			(% of reduction of fuel consumption)	(% of reduction of CO ₂ emissions including emissions of refrigerant fluids)
LCV Light Commercial Vehicle	Urban	≤3.5 t	3%	3.3%
Rigid Small	Urban	3.6-12 t		
Rigid Large	Regional	>12 t		
Semitrailer	Long Distance	40 t		

Source: ADEME

²⁴ Yearly average. Savings from 20% to 25% in operational conditions.

Domain of relevance

Using evaporative air conditioning, temperature reduction in the cabin is less than with classic air conditioning (9 to 13 °C lower – given an external temperature of 35 °C); therefore the transport operator has to envisage relative comfort deterioration of the drivers' work conditions.

Nevertheless, the volume of air in the cabin is rehydrated, and the discomfort of the dry air feeling of standard air conditioning will disappear.

Implementation

In order to opt for the implementation of evaporative air conditioning, it is essential for the transport operator to obtain several financial estimates and proposals from its potential suppliers, on the two existing technologies (standard air conditioning on one hand, evaporative on the other) with answers to the following questions:

- What is the precise nature of the refrigerant gases used?
- What is the exact quantity (nominal initial charge) of gases in each solution?
- How much energy is used for each of the air conditioning solutions offered?

Investment in an evaporative solution system for a cabin is around €1 500 (retrofitted on a new vehicle).

Usage cost is divided by three for the evaporative air conditioning solution when compared to a standard one (that needs power of between 5 to 6 hp).

Given the cost and savings estimates above mentioned, the ROI time of such a solution is **1.5 year**.

Feasibility is intermediate.

In the case of an order submitted to a regional authority, for public market submission and evaluation, it is possible to activate the order article on sustainable development, which allows separate orders for vehicles either not equipped with air conditioning on one side, or fitted with the evaporative air conditioning on the other side.

It must be underscored that evaporative air conditioning has certain implementation constraints, namely installing it on a roof that is not always perfectly flat. Also the aerodynamics are modified once installed which cause extra fuel consumption. Lastly, when in use, it needs nearly daily topping up of the water tank for the air conditioning to start working.

Follow-up of the solution

Follow-up indicator:

- % of vehicles in the fleet equipped with evaporative air conditioning.

Practical data collection process:

- Technical follow-up of the air conditioning equipment.

Vehicle Focus – Form N° 8

Reducing vehicle tare weight

SUMMARY FORM

Action description

This action aims to reduce the tare weight of the vehicle entity, considered as a whole (tractor and trailer for articulated trucks).

Reducing tare weight lowers the rolling resistance coefficient when the vehicle is volume saturated and gains in the payload capacity when the vehicle is weight saturated.

Domain of relevance

This action is particularly relevant for transport made with specific trailers on which weight reduction can potentially be performed.

Low body-weight LCVs also exist, for the cabin-over-frame vehicle type.

Study must be made prior to new vehicle purchase.

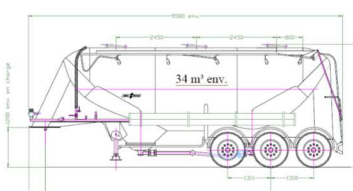
Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Cutting off on vehicle's weight	0% 10% 0,5% to 20%	> 3 years <1 year Very variable	Difficult Easy	LCV RS RL SE MI
Choice of a lighter body (tractor & trailer) vehicle				

Main Benefit: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Source: www.samro.fr



Source: www.spitzer-eurovac.fr



Source: www.europe-miniatures.com

Vehicle Focus – Form N° 8 Reducing vehicle tare weight DETAILED FORM

Context and regulatory measures

Maximum Gross Weight (MGW) limits for goods-transport vehicles are listed below:

- 3.5 t for an LCV that can be operated with a type “B” driving license
- 19 t for 2 axles
- 26 t for 3 axles
- 32 t for 4 axles (or more)
- 40 t for articulated trucks (tractor + trailer) known as “semis”: 7 t tractor + 8 t trailer + Maximum Payload of 25 t.

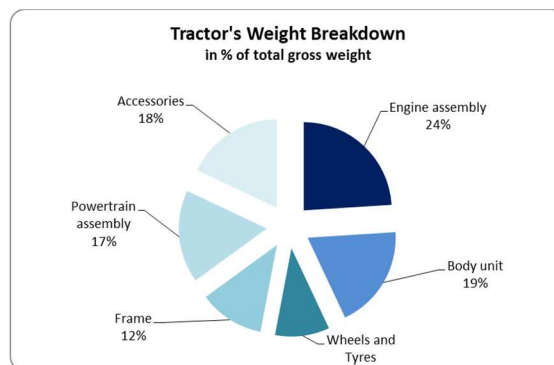
Average tare weights are in the 1 t to 15 t range, according to the MGW category of the vehicle.

This represents 60% of the MGW for LCVs and 40% for the articulated trucks;

Maximum Gross Weight Category (Tons)	Average MGW of the Category (Tons)	Average Weight Empty (Tons)	Average Maximum Payload (Tons)
< 1,5	1,3	0,9	0,4
1,5 TO 2,5	1,8	1,1	0,7
2,51 TO 3,5	2,9	1,7	1,2
3,5	3,5	2,1	1,4
3,51 TO 5	4,74	2,37	2,37
5,1 TO 6	5,67	2,84	2,84
6,1 TO 10,9	8,8	4,11	4,69
11 TO 19	16,32	6,53	9,79
19,1 TO 21	19,37	7,75	11,62
21,1 TO 32,6	26,87	10,21	16,66
Semitrailers	40	15	25

Source: Guide of Emissions Units, Bilan Carbone® Version 6.1

For the articulated trucks, the tractor’s weight represents 50% of the tare weight, broken down as follows:



Source: Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles

Solution 1: Reducing vehicle tare weight

How does it work?

The weight of a vehicle not only impacts fuel consumption but also impacts the required power to be used in uphill profiles or during acceleration. Making the choice of using lighter materials, it is possible to reduce vehicle tare weight.

Impact on fuel consumption and CO₂ emissions

Two situations can be observed:

Vehicle is saturated in volume

- Reducing tare weight will reduce fuel consumption (litre/100 km) since the vehicle weight can generate extra consumption.



Source: ADEME

Vehicle is weight saturated (to the limit of its MGW)

In this case, consumption in litre/100 km will not be modified but reducing weight will allow an increased payload which will improve the **gCO₂/t.km** ratio.



Source: ADEME

Besides, fuel consumption will be reduced in both situations, in case of operating the vehicle empty or with a vehicle that is saturated neither in weight nor volume.

In the case of heavy-duty trucks, the savings indicated below have been calculated with a gain of 500 kg on the tare weight of the vehicle. This objective will prove achievable in most cases. These gains in weight have been calculated for a rigid 20-tonne vehicle and an articulated 40-tonne vehicle.

For LCVs of the cabin-over-frame type, weight gains linked to the use of a lightened body can reach 400 kg approximately (a standard body 14 mm thick will weigh 800 kg and a 20-mm thick thermoplastic one will weigh 400 kg).²⁵ Fuel consumption will be reduced by 2 to 3 litres/100 km.²⁶

Vehicle Size	Main use considered	GMW (or GCW) in Tons	Cas de la saturation en volume : gains liés à un allègement de 500 kg (litres/100 km)	Weight saturated : savings due to 500 kg lighter weight (Liters/ Ton.km)
LCV Light Commercial Vehicle	Urban	≤3,5 t	-	Up to 20%
Rigid Small	Urban	3,6-12 t	-	-
Rigid Large	Regional	>12 t	1%	4%
Semitrailer	Long Distance	40 t	0,5%	2%

Sources: communication with users, theoretical calculation and the study "Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles", National Research Council, 2010.

²⁵ Manufacturer communication.

²⁶ Manufacturer communication, on the basis of initial reports on experience.

Domain of relevance

This action is relevant to all types of transport. The most appropriate specific actions will concern the trailer in particular. Weight being one major marketing differentiation item, trailer manufacturers will make several proposals in that field.

In the case of cabin-over-frame LCVs, one solution is to equip the area situated under the frame with an aluminium structure and an “all in one piece” thermoplastic body.²⁷ The additional payload gain generated can therefore reach 45%. Apart from their mechanical characteristics and specifications, the thermoplastic bodies are recyclable.

On the other hand, in case of damage, repairs can prove more difficult to achieve and all personnel concerned must receive appropriate instruction in order to reduce hazardous situations. This solution is not appropriate to LCVs like small vans.

Implementation

This solution has to be implemented during the vehicle purchase phase. The gain of weight can concern:

Tractor or Rigid truck: in the case the weight item has to be considered in the global choice made (as in ACTION FORM VEHICLE N° 1). According to usage, if regional transport operations are performed, then no sleep berth will be needed for the driver(s) and no other auxiliary equipment, gaining weight on the tractor, reducing consumption and increasing payload by the same amount.

A basic comfort cabin will of course be lighter.

Trailer: it is necessary in the purchasing process, to take into account the specifications of the transport operator, in terms of the offer of transport. In particular, trailer dimensions have to be finely calibrated in order to avoid any loading inconvenience (a few inches can significantly affect the loading ratio).

Besides, the choice of additional height adjustment equipment will permit trailer to be adapted to the payload and to the tractor, thus limiting the aerodynamic drag resistance.

Numerous situations exist and suppliers' offerings are diverse. Each solution will have to be specific and well adapted to its use and context. The main categories of trailers are the following: equipped with a cover tarpaulin (called “Tautliner”), tanks and tilters.

The action of gaining on weight is intermediate in terms of feasibility.

While organizational changes are expected to be modest and implementation time short, seeking an optimal solution will prove time-consuming and products available on the market are not always immediately adaptable to the specific use of the transport operator. Extra costs generated by lighter materials are also difficult to estimate due to the various situations found. The ROI time will be variable. A case study must be done by the transport operator, covering each particular situation.

In the case of cabin-over-frame LCVs, extra cost due to purchasing a thermoplastic “one body one material type” will be – maximum estimate – 10% of the vehicle cost.

The ROI time is very short, with three-months' amortization time, according to experience records.

²⁷ Most cabin-frame bodies are made of stratified plywood and are nonrecyclable (wood + polyester + glue).

Follow-up of the solution

Follow-up indicator:

- weight gains on new vehicles in the fleet (kg) with an indication of the situation (saturated in volume or saturated in weight).

Practical data collection process:

- follow-up of the tare weight figures for vehicles in the fleet.

Vehicle Focus – Form N° 9

Consumption reduction other than traction-related needs

SUMMARY FORM

Action description

Auxiliary fuel consumption (pumps, cranes, etc.) can be reduced optimizing the efficiency needed to produce this energy: engine (main or secondary unit) or battery (main one or autonomous one).

Technical solutions are specific to each type of transport activity and it is therefore difficult to define cost and savings for this solution.

Domain of relevance

This solution is adapted to all specific transport types, such as bulk liquid, removal, etc., and to all types of transport where an auxiliary – energy consuming – unit, is mounted.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Optimizing equipment's power sources	0% 10% Variable	> 3 years <1 year Variable	Difficult Easy	<div> <div>LCV</div> <div>RS</div> <div>RL</div> <div>SE MI</div> </div>

Solutions presentation for auxiliary equipment's power sourcing & optimization of associated solutions

Nota Bene: the introduction section of the document provides all details on chosen hypothesis

Illustration



Source: site Internet fr.academic.ru



Source: site Internet hellopro.fr

Emptying Pump

Vehicle Focus – Form N° 9
Consumption reduction other than traction-related needs
DETAILED FORM

Context and regulatory measures

Several energy sources can be used to power the auxiliary units of merchandise transport vehicles: the engine or the battery of the vehicle, or an autonomous unit. All these various solutions for feeding power each have their strong point and depending on use, one solution will be preferred to another.

For example, if this equipment has a purpose of operating while the vehicle engine itself is not, an autonomous engine or a battery will prove more adapted, thus avoiding any engine use when idling.

European and French laws do not have binding regulations concerning use of an engine when the vehicle is at a standstill.

To the contrary, in other parts of the world, abusive use of engine idling can be prosecuted (USA, Canada). This action comes a complement to ACTION FORM DRIVER N° 1 – “Setting up an Eco-Drive Programme”.

Solution 1: Optimizing power of auxiliary equipment

How does it work?

Numerous types of auxiliary equipment exist, either fed by a separate – autonomous or not – power source or battery of the vehicle: cement-mixer, tilter, crane arm, mixing machine, pump, etc. Specifications will widely vary, from one given use to another. A solution adaptation will have to be studied for each particular case. The least “power-thirsty” solution will definitely be the battery of the vehicle as the feeder (when the engine of the vehicle is on the “OFF” position), or else an auxiliary battery when possible.

A second solution to be promoted is the use of a separate engine; however this solution will prove efficient only if the hourly fuel it takes is less than the idling engine fuel consumption.

Last, if none of the first two solutions can be implemented, it could be of interest to organize talks with the manufacturers on the choice of the engine and adjustments to be made, which could permit optimization of the two vehicle uses: traction power and auxiliary equipment power.

Impact on fuel consumption and CO₂ emissions

When switching to a separate engine instead of the vehicle’s own, fuel reduction will be the difference of consumption between the two engines; idling consumption being around 2 litres per hour, the separate engine consumption will have to be less. Battery use saves idling engine consumption (2 litres/hour) or more if the necessary power to the auxiliary equipment is greater than the power delivered by the idling engine.

Making the right choice amongst various solutions, the weight of the auxiliary power unit is to be watched closely: additional weight can lead to extra fuel consumption during road travel (thus partly erasing the savings made by auxiliary fuel consumption, especially when stationary).

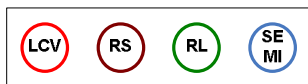
As an example, the following chart shows power delivered and the linked consumption, for the equipment:

Type	Average operating hours (in hours yearly)	Power (in kW)	Diesel fuel consumption (in litres/hour)
Tilter truck	100	20 - 50	4 - 10
Cement mixer truck	100 - 280	40 - 90	8 - 17
Crane equipped truck	100 - 280	20-30	4 - 6
Cement pump equipped truck	200 - 800	160 - 220	40 - 170

Source: Scania “Selection of auxiliary movement power and average consumption of a self-propelled unit”

Domain of relevance

This solution is applicable to all vehicles fitted with auxiliary equipment, powered – or not – by a separate engine.



Implementation

The first thing is to assess auxiliary equipment fuel consumption in order to seek an appropriate supplier. For this purpose, the transport operator can get the support of onboard electronic measuring devices that will, when the vehicle is stationary, record fuel consumption linked to auxiliary equipment.

When such devices are not utilized, the transport operator can estimate the total appropriate power to be supplied, working from the nominal individual power of each energy-consuming unit, ending in a first result expressed in litres/hour: bearing in mind that this second approach is nevertheless a very approximate one.

Each optimization solution is unique. The transport operator will have to approach the different suppliers in order to switch to a technology that will be both appropriate from a technical and economical point of view, as well as from an energy point of view.

Only the supplier will be in a position to estimate both cost and feasibility, when switching to a new technology.

Follow-up of the solution

Follow-up indicator:

- Fuel (or electricity) consumption of all auxiliary units before optimization (in litres/hour or in kWh);
- Fuel (or electricity) consumption of all auxiliary units after optimization (in litres/hour or in kWh);
- Yearly operating hours of the equipment.

Practical data collection process:

- Getting knowledge of the hourly consumption of fuel, in order to separate data on auxiliary equipment;
- Follow-up of the number of hours used by the auxiliary equipment.

Vehicle Focus – Form N° 10

Temperature controlled: making the right choice for the refrigerated unit

SUMMARY FORM

Action description

When buying a temperature-controlled vehicle, the technology choice as well as correct size will have a significant impact on fuel consumption and emissions of CO₂.

The latest technologies now available allow significant savings.

Domain of relevance

These solutions can be applied to all temperature-controlled types of transport.

Solutions	CO ₂ Savings ¹	Return on investment ¹	Feasibility	Domain of relevance
Focusing on vehicle usage finding the correct size for the refrigerated unit Choice of a refrigerated unit which power is adapted to the vehicle use				
Refrigerated power unit with an electric plug-in option Connecting the refrigerated power unit to the electric public network when vehicle is static				
High Efficiency Energy refrigerated power unit Choice can be made for an autonomous - or not - unit				
Using vehicles fitted with cryogenic power unit of CO₂ or liquid azote gases direct injection process Using CO ₂ or liquid azote gases as direct injection system refrigerant gases				
Using vehicles fitted with cryogenic refrigerated power unit, using direct injection liquid azote gases Using liquid azote gases as direct injection system for refrigerant gases				
Refrigerated vehicles equipped with eutectic boards or unit working with accumulation of cold Using a refrigerated unit accumulating cold in eutectic profiled boards, plugging to the electricity network				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

¹ Savings and "ROI" time here presented concern CO₂ emissions & costs associated to the refrigerated unit

² For more information, please refer to the form "Certificats d'Economies d'Energie" annexed to the present form

Vehicle Focus – Form N° 10

Temperature controlled: making the right choice for the refrigerated unit

DETAILED FORM

Context and regulatory measures

Transporting foodstuff products under temperature-controlled conditions will generate direct greenhouse gas (GHG) emissions, due to fuel consumption of the vehicles used and to the refrigerated power controlled unit, but also due to the leaks of refrigerant gases involved, which are powerful contributors to global warming.

CO₂ emission potential reduction is potentially very important because nationally refrigerated vehicle fleet turnover is 11 000 vehicles yearly, of which 30% are articulated, 15% rigid trucks and the remaining 55% are LCVs of under 3.5 tonnes. This important turnover means an important potential for emission reduction, given that close to 20% of these emissions of CO₂ by temperature-controlled vehicles (traction and production of cooling) are generated by the cooling unit production power alone (ADEME data source).

In the case of vehicles dedicated to urban distribution, cooling unit power production will represent as much as 30% of the total emissions produced.²⁸

	Ventilation system of each technology by vehicle size				Number of vehicles in France
	Rigid Small up to 5 tonnes	Vehicle between 5 t to 26 t	Trailer and Semitrailer	Total	
Cooling - mechanically provided Nonautonomous	92%	11%	1%	40%	44 400
Cooling - mechanically provided - autonomous	3%	82%	99%	54%	60 300
Cooling - by accumulation system	5%	5%	0%	3%	3 900
Cooling - cryogenic system	0%	1%	1%	1%	700
Total	41%	29%	31%	100%	111 000

Number of vehicles	45 000	32 000	34 000	109 140
Renewal ratio	13%	5%	10%	10%
Number of renewed vehicles	6 000	1 500	3 500	11 000

Status French fleet, 2007, source: manufacturers and professional federations

The transport of foodstuffs under controlled regulated temperature is the responsibility of ATP (agreement relative to all international transport of perishables and special equipment to be used for such transport) which sets a European standard, if not a world standard.

²⁸ Source: ANR PREDIT, project "TRUE": Truck Refrigeration for Urban Environment (2007-2011, LUTB label 2015): Reducing energy consumption of a refrigerated vehicle, through global approach including study of the production of cooling and minimizing thermal sources (cited by François Clavier Conseil: "Bonnes Pratiques Energétiques pour la Distribution Urbaine de Denrées Périssables" – UNTF-TF, 26 January 2011). During 7h operation, vehicle covers 100 km using 30 litres/100 km and refrigerated unit works during 5 hours at 3 litres/hour (15 litres). Power unit consumption = 33% of total consumption (15/45).

Solution 1: Definition of vehicle usage, determining the appropriate refrigeration power unit size**How does it work?**

A refrigerated vehicle is equipped with an isotherm body and a power unit producing refrigeration, in order to be capable of transporting perishables (fruit, vegetables, meats...), chemical products, or any other product that is either temperature-controlled, or under constant temperature-critical surveillance monitoring. The choice for a refrigerated power unit has to be determined from the requested volume of cooling being generated for:

- Complying with the absolute respect of regulatory temperatures,
- Adapting to the operating use of temperature-controlled vehicles,
- Taking into account the progressive obsolescence curve of the materials involved, their average life cycle duration,²⁹
- Respecting regulations of the ATP Agreement which stipulates that “the actual refrigeration power delivered will be superior to the thermic loss – when the system is working permanently – that appears through the walls of the body for the considered class, multiplied by a factor of 1.75”.³⁰

In consequence of which the transport operator, when purchasing a refrigerated vehicle, must define the thermal specifications, allowing the supplier to provide the right thermal dimensions of the refrigerated power unit, appropriate to its use.

This information is gathered in a specifications booklet that will take into account:

- The nature of the goods being transported;
- The required regulatory temperature, at which the goods have to be kept;
- Type of distribution profile in order to evaluate the number of transshipments required (door openings, distances).

According to these specifications, the transport operator must check they have been taken into consideration by his supplier. Moreover he has to make sure that the cooling power unit size option taken and its energy efficiency throughout all the utilization range is indeed well adapted to its predetermined use.

Impact on fuel consumption and CO₂ emissions

On long-distance transport, it is relevant to consider that the time spent during door openings is limited.

Given these conditions, dimensioning the refrigerated power unit “as closely as possible to operating conditions” is relevant to limit the energy consumption of the power unit, and thus its CO₂ impact. However such a refrigerated vehicle, given different usage conditions, may not be capable of producing the regulatory volume of refrigeration, one which ensures that the refrigeration chain will not be broken.

Savings in terms of reducing fuel consumption and CO₂ emissions will vary according to the different situations encountered.

²⁹ The coefficient of obsolescence of the isotherm body of the vehicle, is 5% approximately each year for 12 years for articulated trucks (“semis”), 4.5% for rigid trucks and 3.5% for LCVs (Data source: “Cémafroid”).

³⁰ ATP agreement, revised January 2nd 2011

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated to this solution (% of reduction of the refrigerated power unit consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	Variable

Domain of relevance

This action is appropriate to refrigerated vehicles involved on long-distance type of profile, with a small number of door-openings during travel.

Implementation

Each situation is to be considered as a specific one: it is recommended that the transport operator approach manufacturers of power refrigerated units for an optimal technology that will reconcile both the technical and economic aspects. The supplier of the equipment will then estimate the cost and the feasibility in order to provide the suitable equipment. The ROI time is to be calculated for each case.

Follow-up of the solution

Follow-up indicator:

- Fuel consumption of power refrigerated units, for which usage is not taken into consideration for dimensioning, or used under conditions which differ from the recommended ones.
- Fuel consumption of power refrigerated units, for which usage is taken into consideration for dimensioning, or used under conditions which match the recommended ones.

Practical data collection process:

- knowing exactly the hourly consumption of power refrigerated units;
- follow-up of the number of hours in use for the power refrigerated units.

Solution 2: Refrigerated power units fitted with an electric connection capacity while in stationary use

How does it work?

During operating time, vehicles are kept in depots for 10/15% of their time. Some refrigerated power units have a connection capability with the public electricity network in stationary use. This connection will allow switching the engine powered by GNR diesel fuel or by the usual diesel fuel to electric mode when the vehicle is at a standstill. In the case of autonomous electric power units, it is not necessary to have additional electric equipment.

Inversely, for mechanical type power units, an additional electrical engine will be required. This operation is appropriate while on loading or unloading cycles, on a logistics platform for instance, during the phase producing refrigeration, and also on highways parking lots and "Ro-Ro" vessels, when accessible with the adapted electric lead.

The efficiency of this solution is also linked to the behaviour of the driver, who must be informed what is at stake, and that he has to remember to plug the power unit into the public electricity network, whenever appropriate equipment is available to do so.

Impact on fuel consumption and emissions of CO₂

Assuming that a refrigerated power unit works 10/15% of the time with electricity from the public network, it is possible to reduce by the same ratio its fuel consumption, which is 0.4 litre/hour for an initial consumption of 2.8 litres/hour. However substituting electricity for fuel also has an impact.

Considering that the refrigerated power unit needs 4 kWh hourly, associated emissions of CO₂ will be an estimated 370 g CO₂eq using the electricity network.³¹ This impact can be reduced using a renewable source of energy. Global reduction of CO₂ is then situated between 5 to 10%.

For LCV vehicle, savings are in the same range (power unit consumption of 1.5 to 2 kWh).

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated with this solution (% reduction of CO ₂ emissions linked to the refrigerated power unit use)
LCV Light Commercial Vehicle	Urban	≤3.5 t	5 – 10%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: ADEME calculation based on hypothesis data selected from the ESC information sheets

³¹ Considering average CO₂ emissions in France, generated by the production of 1 kWh (including line losses), i.e. 92 g of CO₂ in 2010 – Data Source: Bilan Carbone v6.1



Domain of relevance

This technology is adapted to all vehicles.

Implementation

This technology will be applicable once sockets are installed at parking places of logistic platforms. It could prove practical to convince shippers to have them installed at their delivery premises.

Adding an electrical engine or a compressor always constitutes an option and has to be paid for, bearing an important extra cost in some cases. This extra cost is variable and the ROI time will have to be calculated for each envisaged solution. Taking into account the availability on the market of the associated technologies, the work process changes of plugging in the power unit and fitting the feeder sockets, the feasibility is between easy and intermediate.

In the case of LCVs, this technology is available for an extra cost of approximately €400.

Follow-up of the solution

Follow-up indicator:

- % of power units that are autonomous and can be plugged into the electricity network, operating in stationary mode.
- Number of hours running when the vehicle is stationary, before adopting this solution.

Practical data collection process:

- Knowledge of the various technologies used on the fleet;
- Follow-up of the number of vehicles replaced by a new one, equipped with a refrigeration power unit that can be plugged in directly to the existing public electricity network.

Solution 3: Refrigeration power unit with high energy efficiency

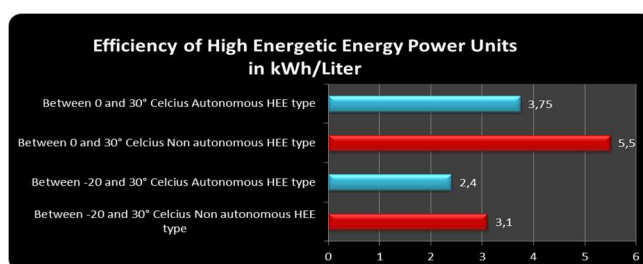
How does it work?

When making the acquisition of a refrigeration power unit, a choice can be made between two high energy efficiency options:

High energy efficiency – autonomous units: the principle is an independent diesel engine which will power the compressor, producing the required refrigeration volume. Dispositions to be taken to reach high energy efficiency are detailed in the ESC TRA-EQ -11 information sheet.

The efficiency ratios to be reached are 3.75 kWh/litre between 0 °C and 30 °C and 2.4 kWh/litre between -20 °C and 30 °C.

High energy efficiency – nonautonomous units: the principle of a nonautonomous unit is based upon the use of the engine of the vehicle that will in turn power the energy converter producing the required energy and the required refrigeration volume. Dispositions to be taken in order to reach high energy efficiency are detailed in ESC TRA-EQ-12.³² The efficiency ratios to be reached are 5.5 kWh/litre between 0 °C and 30 °C and 3.1 kWh/litre between -20 and 30 °C.



Impact on fuel consumption and CO₂ emissions

The use of a high energy efficiency unit will lead to a reduction of the units energy than can reach 50% as compared to the solutions in use nowadays. Considering a 2.8 litres/hour, expected savings are 1.4 litre per hour and therefore 4 k CO₂eq/hour (source: ESC sheet on average consumption).

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated to this solution (% of reduction <u>consumption of the refrigeration power unit</u>)
LCV Light Commercial Vehicle	Urban	≤3.5 t	50%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: ESC information sheet

Ratio of fuel consumption for refrigeration is between 10% and 30%, and depends on numerous parameters (type of vehicle, organization); switching to a high energy efficiency power unit will reduce global fuel consumption by 5% to 15%.

³² No ESC sheet exists for LCVs.

Domain of relevance

High efficiency units are adaptable to all temperature-controlled vehicles, and all types of transport.

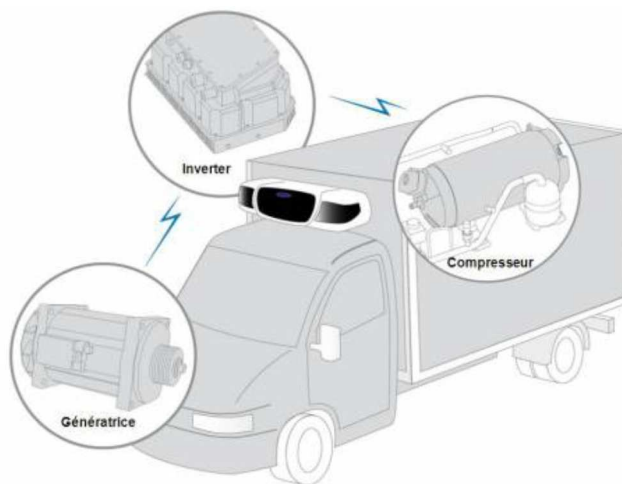
The offer for LCVs is restricted, however. For this type of vehicle, technology known as “nonautonomous – electrically powered” constitutes an interesting alternative (see box below).

A solution adapted to heavy urban use: nonautonomous unit electrically powered solution

This recent technology is based on the following: power delivered by the engine shaft is transformed into electricity by a converter which generates electrical power.

The electric power is regulated by an “inverter” according to the refrigeration needs and transmitted to an hermetic compressor which rotates at different and adjustable speeds, according to the power delivered by the inverter.

The refrigeration capacity is constant throughout all refrigeration phases.



This technology is well suited for temperature-controlled LCVs, with frequent stops (multiple door openings while delivering, congested traffic, etc.). It allows a focused control of the “refrigeration chain” by delivering a constant level of refrigeration, whatever the engine rpm value.³³

Maximum refrigeration power is reached at 1 000 rpm, offering “constant level of cold” delivery conditions.

In addition, since the system producing refrigeration is a hermetic type one, emissions of CO₂ due to leaking refrigerated fluids are cut by as much as 75% when compared to a conventional power unit group.

³³ Source: <http://www.carrierpulsor.com/?lang=fr>



Implementation

Using these technologies has to be anticipated as soon as entering the vehicle purchase process.

Costs associated to the **nonautonomous unit with high energy efficiency** are the following:

- For vehicles with a **MGW** Maximum Gross Weight between 5.5 tonnes and 26 tonnes the pricing range is very large, from €14 000 to €30 000 according to configuration uses and compartments. Cost of this solution will also vary, according to the size of vehicles.
- For the articulated 40 t vehicles: price range is between €22 000 and €38 000 according to configuration uses and compartments.

Concerning the purchase of an **autonomous unit with high energy efficiency**, associated costs are the following:

- for vehicles between 5.5 t and 26 t **MGW**, the cost range is between €10 000 and €24 000;
- for vehicles of 40 t MGW, the cost range is between €15 000 and €28 000.

The extra cost – compared to today's technology – of the power unit, depends upon the technology used, and can be expected in a very large range between 5% and 70%. The ROI time will therefore be a long one. This solution is at this moment not always available on the market (only a limited number of suppliers offer this solution) and it does not have an effect on the organization change, the feasibility can therefore be considered between easy and intermediate.

Follow-up of the solution

Follow-up indicator of the solution:

- % of the power unit groups fitted with a high efficiency energy technology;
- Number of running hours of the refrigeration units;
- Fuel consumption of the autonomous refrigeration units.
-

Practical data collection process:

- Knowing the technologies used by the fleet;
- Follow-up of the number of vehicles replaced by a new vehicle equipped with a high efficiency energy unit.

Solution 4: Using vehicles equipped with a cryogenic refrigerated unit of CO₂ or indirect injection liquid nitrogen gases

How does it work?

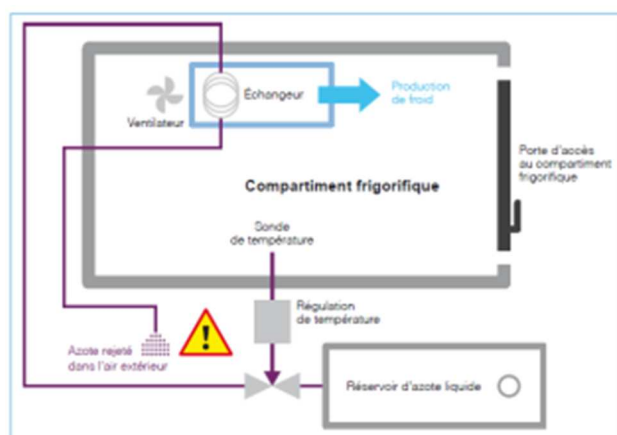
In this type of device, the compression unit containing the HFC refrigerant fluids as in standard version, is replaced by a cryogenic unit with direct injection of CO₂ or liquid nitrogen gases (the CO₂ used comes from industrial processes and is known as "fatal" CO₂). CO₂ or liquid nitrogen gases are kept in special tanks placed directly on the vehicle, and circulate to a thermal exchanger, that plays the role of an evaporator. This exchanger is fixed in the loading area and fitted with air circulation equipment, thus allowing air temperature inside to be directed down inside the chamber, at the desired temperature. Heat extracted from the air permits, in the first place, a complete evaporation of the cryogenic liquid (CO₂ or liquid nitrogen gas) in circulation in the exchanger, then the temperature is raised to a level that is very close to the temperature of the circumference. The cryogenic fluid coming out of the exchanger is then released outside, having delivered a maximum of cooling energy power. This device allows for greater temperature speed of descent than with a diesel unit, and it runs silently.

Case of liquid CO₂ with indirect injection system

Articulated semis or rigid trucks are equipped with a 330 or 430 litres CO₂ tank , weighing respectively 373 kg and 489 kg. An experiment carried out both in the Paris and Normandy regions, with rigid trucks transporting deep-frozen products (-18 °C), has shown an average CO₂ consumption of 34 kg/hour yearly, to be compared with a fuel consumption of 2.4 litres of diesel fuel per hour for the refrigeration units surveyed. In such a context, the autonomy of the vehicle is 10 to 14 hours with a CO₂ recharging time of approximately 12 minutes.

Case of liquid nitrogen gas indirect injection system

Vehicles are equipped with a 300 to 1 000 litres capacity tank of liquid nitrogen (LN). Consumption is according to configuration (type of vehicle, mono- or multi-temperature, door openings, etc.). The average consumption of liquid nitrogen gas can extend from 20 litres to 30 litres/hour for a truck with these parameters. Fill-up time is less than 10 minutes.



Principle of the indirect exchange process using liquid nitrogen

Diagram from "Camions frigorifiques refroidis à l'azote liquide" (ED 6124). © INRS

Impact on fuel consumption and CO₂ emissions

As compared to a standard system producing cooling, cryogenic technology reduces CO₂ emissions due to nonfossil energy when operating the unit, and has no CO₂ leaks due to HFC fluids.

Global CO₂ emissions for this technology depend only on the necessary energy source for producing the fluid, CO₂ or liquid nitrogen, and transporting the refrigerant to its place of use.

Case of liquid CO₂ with indirect injection system

Compared to a standard system producing cooling, this technology reduces CO₂ emissions by 60% to 90%, depending on the place of production of the cryogenic CO₂ and its origin, taking into account the production and transportation emissions for the cryogenic CO₂.

Hourly gains in CO₂ emissions when the system is "ON" are estimated at 75%.

Vehicle Size	Main use considered	MGW	Gains linked to cryogenic unit with indirect liquid CO ₂ injection (% reduction for CO ₂ emissions))
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	75%
Semitrailer	Long Distance	40 t	

Source: Life Cycle Analysis of temperature controlled foods by truck transport – CIT Ekologik AB – October 2002

Case of liquid nitrogen with indirect injection system

This solution does not use any fuel and uses liquid nitrogen gas instead, but does not produce local emissions of CO₂. Taking into account CO₂ emissions during the production and transportation phases, as compared to a standard system producing cooling, this technology reduces from 60% to 90% the CO₂ emissions in France, for every hour of cooling.

Hourly gain of CO₂ emissions – when the system is "ON" – is estimated to 75%.

Vehicle Size	Main use considered	MGW	Gains linked to the liquid nitrogen solution (% reduction for CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	75%
Semitrailer	Long Distance	40 t	

Source: Based on 2010 data, Annual Sustainable Development Report, Air Liquide.

Domain of relevance

This technology is adapted to rigid trucks, and semitrailers. The CO₂ is not directly distributed in stations; recharging fluids may prove inconvenient on national and international routes.

In the case of LCVs, this solution is not relevant since the volume up taken by the system reduces drastically the available loading space.

Implementation

Referring to implementation of this solution, several points must be examined:

- **The fluid supply** (CO₂ or liquid nitrogen gases) can prove to be a real inconvenience on national or international routes due to the fact that it is not distributed in the service station network. Nevertheless, transport operators can set up an organization, installing tanks at their logistic bases.
- Monthly rental cost of a 20 to 50 m³ tank is around €800. Delivery cost is around €50-60 for fill-ups.
- Using this technology does not bring extra cost compared to a standard vehicle, since the average cost of one kilo of CO₂ is around €0.13 and the average consumption of a unit is 34 kg/hour, The average cost of a litre of liquid nitrogen is around €0.10 cent and the average consumption of the unit is 30 litres/hour.
- **The weight of the group and vehicle** are the same as a standard refrigeration unit. The cryogenic unit weighs 35 kg, without the tank. The total gross weight (including tank) is very close to the weight of a standard refrigerated unit. The weight repartition in the vehicle being different (the centre of gravity is lowered with this system), a vehicle equipped with a cryogenic unit will prove more stable in curves.
- This technology requires that an **auxiliary reheating unit** be put in place, working either with electricity, diesel fuel or natural gas power, for all vehicles equipped with indirect nitrogen cryogenic solution, and for semis equipped with a CO₂ cryogenic system.
- For the rigid trucks equipped with a CO₂ cryogenic solution, the heating is provided by a derivation pipe placed on the engine water circuit.
- Operating costs of the system are comparable to a standard one, given the following parameters:
 - o The indirect liquid cryogenic system is the same price as a diesel unit and its lifespan is 14 years instead of 7 years for a diesel unit.
 - o Maintenance cost is divided by 2.
 - o Possibility to place air volume, door contact, wind draft diverter on the roof and organize a specific training session for drivers.
- It is recommended to **train drivers** in the use of these new technologies and their specific aspects in order to optimize the expected gains.

Follow-up of this solution

Follow-up indicator:

- -% equipped power units either with the CO₂ cryogenic type or the indirect injection of liquid nitrogen gases.
- Ratio tonne transported/operating costs compared.

Practical data collection process:

- Knowledge of the technologies used in the fleet;
- Follow-up of the number of vehicles replaced by a new one equipped with a cryogenic group, using CO₂ or liquid nitrogen gases.

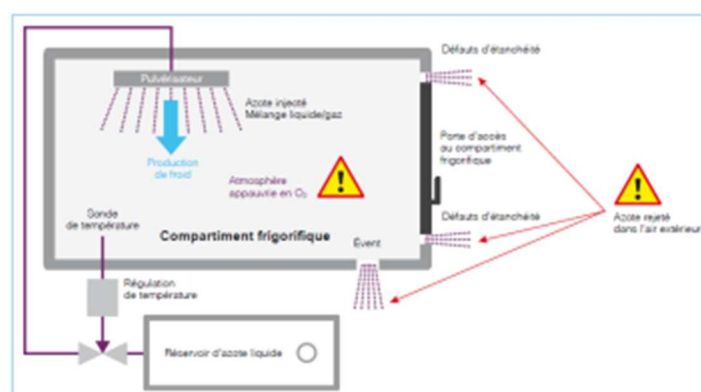
Solution 5: Using vehicles fitted with a cryogenic refrigeration – direct injection nitrogen gas – power unit

How does it work?

Liquid nitrogen gas, which is obtained by distilling liquid air, is used as a refrigerant replacing HFC gases. Gases are stored on the vehicle tank and are released by evaporation all delivery day long, inside the isotherm body of the vehicle.

This system allows a quicker temperature descent cycle than the classic unit and is also a lot less noisy in operation. An additional electric source is needed to power a control and safety system, ventilating the inside of the vehicle when offloading. Semis are equipped with one or two tanks of liquid nitrogen gas of 650 litres each, or one of 1 000 litres capacity. Rigid trucks are equipped with a 450-litre or 650-litre tank.

Average liquid nitrogen gas consumption is 20/30 litres per hour, i.e. allowing 2 to 3 days autonomy.



Principle of the indirect nitrogen injection process

Diagram from "Camions frigorifiques refroidis à l'azote liquide" (ED 6124). © INRS

Impact on fuel consumption and CO₂ emissions

CO₂ emissions are released only the production phase of the liquid nitrogen gas, and during transportation to the point of use. As compared to a standard cooling system, this technology will reduce CO₂ emissions by 40% to 90% – per hour of cooling – depending on the production place of the liquid nitrogen gases. Bearing in mind an average 65% reduction of CO₂ per hour of production. In the case of LCVs, this solution is not relevant since the volume taken up by the system installation reduces drastically the available loading space and increases the weight of the vehicle (tank).

Vehicle Size	Main use considered	MGW	Gain linked to the solution (% reduction of consumption by the cooling unit)
LCV Light Commercial Vehicle	Urban	3.6-12 t	-
Rigid Small	Urban	>12 t	65%
Rigid Large	Regional	40 t	

Source: "Energy life cycle assessment in truck refrigeration" – MWH – January 2007

Domain of relevance

This technology is adapted to large rigid trucks and semis. Liquid nitrogen gas is not directly distributed in stations, and the recharging process can present a problem on national and international routes. This technology is not suited to the transport of living organisms (like plants) due to the air scarcity created by the fact that nitrogen is directly injected into the vehicle body part compartment.

Implementation

Concerning the implementation of this solution a few points must be examined:

- Recharging in fluids can present a problem on national and international routes, due to the fact that liquid nitrogen gas is not distributed in stations. Nevertheless, transport operators can set up an organization where tanks are installed at their own logistic bases. The rental cost of a tank of 20 to 50 m³ is around €800 monthly while the cost of a delivery is €60. The average cost of one litre of nitrogen is €0.10 cents the average consumption of a group is 30 litres/hour, and the use of such technology does not bring extra cost compared to a standard technology vehicle.

This technology demands the set-up of an auxiliary heater working on propane gas.

- Before offloading, it is mandatory to distribute air ventilation into the body compartment, as nitrogen gas reduces the proportion of oxygen in the air and can provoke an anoxic risk for the driver or handler.
- The offer in terms of cryogenic solutions is quite limited and implementing this solution does create organizational changes in the transport operation, due to the specific conditions under which the power unit operates (recharging and managing the supply of fluids in particular).

For further information see the brochure "Camions frigorifiques refroidis à l'azote liquide" – Institut National de Recherche et de Sécurité (INRS) – ED 6124 – February 2012, downloadable at:

<http://www.inrs.fr/accueil/produits/mediatheque/doc/publications.html?refINRS=ED%206124>

Follow-up of the solution

Follow-up indicator:

- % equipped power units either with the CO₂ cryogenic type or direct injection;
- Ratio tonne transported/operating costs compared.

Practical data collection process:

- Knowledge of the technologies used in the fleet;
- Follow-up of the number of vehicles replaced by a new one equipped with a cryogenic group using liquid nitrogen gas.

Solution 6: Refrigerated vehicles equipped with eutectic boards or with accumulated cooling power unit

How does it work?

Eutectic boards

Cooling is produced by mechanical compression powered by the public electricity network (night time preferably) and accumulated in boards, called eutectic profiles. The accumulated cold is then redistributed throughout delivery, as long as there is any reserve of cold left. Such technology calls for the boards to be preconditioned, before operating the vehicle, using a system that is independent – or not – from the power unit.

Its working principle is the same as transporting a cooler to the beach during summer. It restrains the power needs after the body compartment has been opened, cold being maintained directly on the refrigerated products by the eutectic boards.

Producing cold via dry ice (solid carbon dioxide)

This technology is based on a different concept than the eutectic boards, in terms of accumulation of cold, since the production of cold is due to dry ice in granulated form (stored in a central tank), which is loaded in the vehicle before the beginning of each delivery cycle.

Impact on fuel consumption and CO₂ emissions

Compared to an autonomous or nonautonomous power unit, this technology does not need energy to produce cooling during transportation, since the boards release the cold accumulated. The savings are then 100% in the case of mechanical compression powered by the electric network, and 95% concerning CO₂ emissions due to the fact that between 1 kg and 1.6 kg of CO₂eq are produced through the electricity usage (cumulative capacity is between 18 and 30 kWh).³⁴

However, the savings will be less if bringing the eutectic board to necessary temperature needs thermal energy (for example using a self-propelling unit). It will be autonomous for 4/6/8 hours according to the type chosen. The eutectic board's weight is superior to the mass of a system by compression, which in turn generates fuel consumption for positioning the device and limits its payload accordingly.

Vehicle Size	Main use considered	MGW	Savings associated to this solution (% of reduction consumption of the refrigeration power unit)
LCV Light Commercial Vehicle	Urban	≤3.5 t	97%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	-

Source: Manufacturers

Fuel share taken by the refrigeration power unit will vary between 10% and 30%, depending on many parameters (type of vehicle, organization), but switching to a refrigeration by accumulation unit will reduce fuel

³⁴ Considering average emissions of CO₂ generated by the production of 1 kWh in France (including line energy losses), 53 g de CO₂eq in 2012 (Source: Base Carbone 2012).

consumption by 9 to 28%. Moreover, before the purchase, it will prove necessary to calculate the impact of the eutectic boards which will reduce the payload of the vehicle in the same proportion.

Domain of relevance

This solution is adapted to urban distribution of deep-frozen products with LCVs and small-sized rigid trucks. Frequent door openings will not impact due to the thermal inertia technology. Technology of eutectic boards is well adapted in situations where the vehicle must be temperature-controlled and secured. This is the case in ice-cream product deliveries, as well as frozen breakfast products (croissants, scones, etc.).

Dry ice cooling technology is well suited when the light vehicle is used to the limit of its maximum payload, this system being 3 to 4 times lighter than eutectic boards. It is also well adapted to refrigerate compartments of small volume in multi-compartment vehicles (see ORGANIZATION FOCUS – ACTION FORM N° 3, Solution 7).

Implementation

This solution only needs limited maintenance. But eutectic boards have the drawback of being heavy and of limiting payload. Besides maintaining the eutectic board's efficiency, any ice must be removed from the surface as soon as it appears.

Cost of the boards is between €3 000 and €12 000 for small vehicles up to 5 tonnes and €8 000 to €12 000 for small-sized rigid trucks. Considering the savings and cost in this form, the ROI time will be short (<1 year).

This solution is, for the time being, not widely used on the market and creates organizational changes for the transport operator, due to the specificity of the refrigeration power units (recharging and managing the supply of fluids in particular); the feasibility of the solution will then be an intermediate one.

Cooling via dry ice technology calls for a detailed analysis study, due to the need for central storage. It is only justified for fleets of more than 10 vehicles.

Follow-up of the solution

Follow-up indicator:

- % of refrigerated devices in the vehicle fleet that dispose of the accumulated cold power units.

Practical data collection process:

- Inventory of the technologies used in the fleet;
- Following up of the number of vehicles replaced by a new device equipped with a refrigeration power unit.

Information sheet: Energy Savings Certificates for autonomous high energy efficiency refrigeration units



Certificats d'économies d'énergie

Opération n° TRA-EQ-11

Groupes frigorifiques autonomes à haute efficacité énergétique pour camions, semi remorques, remorques et caisses mobiles frigorifiques

1. Secteur d'application

Transport.

2. Dénomination

Acquisition d'un groupe frigorifique à haute efficacité énergétique de type autonome monté sur un camion, une semi remorque, une remorque ou une caisse mobile frigorifique neuve de plus de 3,5 tonnes.

3. Conditions pour la délivrance de certificats

a - Acquisition d'un tracteur ou porteur neuf, destiné à tracter la semi remorque, la remorque ou la caisse mobile neuve équipée du groupe frigorifique à haute efficacité.

b - Éléments à fournir par le constructeur du groupe frigorifique :

- numéro du rapport d'essai du groupe frigorifique, établi par un centre d'essais indépendant agréé ATP (Accord relatif aux Transports internationaux de denrées Périssables) ;
- puissances frigorifiques à vitesse nominale (kW) ;
- consommations pour les régimes de température 0°C/30°C et -20°C/30°C.

c - Rendements globaux minimum à respecter pour un groupe frigorifique autonome :

Définition du rendement global Rg :

Type de véhicule frigorifique**	Définition des rendements globaux (Rg), en kWh/L
Véhicule équipé d'un groupe frigorifique diesel autonome	$\frac{\text{Puissance frigorifique (kW)}}{\text{Consommation (L/h)}}$



Ce rendement est calculé :

- soit à partir des seules valeurs du rapport d'essai ATP, correspondant à un fonctionnement à vitesse nominale ;
- soit en prenant en compte les valeurs à charge partielle si celles-ci sont disponibles : le rendement global sera alors pris comme la moyenne des rendements à vitesse nominale et à charge partielle.

** Pour les groupes multi température la consommation à prendre en compte sera celle de l'unité de condensation de référence.

Valeurs minimales à respecter pour les 2 régimes de température :

Régimes de température	Rg
0°C / 30°C	3,75 kWh / L
-20°C / 30°C	2,40 kWh / L

4. Durée de vie conventionnelle

9 ans.

5. Montant de certificats en kWh cumac

$$\left[41\,370 - 121\,010 / [(Rg \text{ à } 0^{\circ}\text{C} + Rg \text{ à } -20^{\circ}\text{C}) / 2] \right] \times 7,73 \text{ kWh cumac}$$

Information sheet: Energy Savings Certificates for nonautonomous high energy efficiency refrigeration units



Certificats d'économies d'énergie

Opération n° TRA-EQ-12

Groupes frigorifiques non autonomes à haute efficacité énergétique pour camions, semi remorques, remorques et caisses mobiles frigorifiques

1. Secteur d'application

Transport.

2. Dénomination

Acquisition d'un groupe frigorifique à haute efficacité énergétique de type non autonome monté sur un camion, une semi remorque, une remorque ou une caisse mobile frigorifique neuve de plus de 3,5 tonnes.

3. Conditions pour la délivrance de certificats

a – Acquisition d'un tracteur ou porteur neuf, destiné à tracter la semi remorque, la remorque ou la caisse mobile neuve équipée du groupe frigorifique à haute efficacité.

b – Éléments à fournir par le constructeur du groupe frigorifique :

- numéro du rapport d'essai du groupe frigorifique, établi par un centre d'essais indépendant agréé ATP (Accord relatif aux Transports internationaux de denrées Périssables) ;
- puissances frigorifiques à vitesse nominale (kW) ;
- coefficients de performance (COP) pour les régimes de température 0°C/30°C et -20°C/30°C.

c – Rapport d'essai ou certificat réalisé par un centre d'essais indépendant et accrédité, indiquant le rendement utile (R) sous conditions nominales ATP de production de froid du convertisseur d'énergie (alternateur, générateur, système hydraulique ...).



d – Rendements globaux minimum à respecter pour un groupe frigorifique non autonome :

Définition du rendement global Rg :

Type de véhicule frigorifique*	Définition des rendements globaux (Rg), en kWh / L
Véhicule équipé d'un groupe frigorifique à entraînement direct	$\frac{\text{Rendement convertisseur (R)} \times \text{COP}}{0,2 (L/kWh)}$

* Pour les groupes multi température la consommation à prendre en compte sera celle de l'unité de condensation de référence.

Valeurs minimales à respecter pour les 2 régimes de température :

Régimes de température	Rg
0°C / 30°C	5,5 kWh / L
- 20°C / 30°C	3,1 kWh / L

4. Durée de vie conventionnelle

9 ans.

5. Montant de certificats en kWh cumac

$$\left[41\,370 - 121\,010 / [(Rg \text{ à } 0^{\circ}\text{C} + Rg \text{ à } -20^{\circ}\text{C}) / 2] \right] \times 7,73 \text{ kWh cumac}$$

Vehicle Focus – Form N° 11

Temperature controlled: specific equipment and maintenance issues

SUMMARY FORM

Action description

Looking beyond the technology choices for cooling (power unit) and conservation (body section) in refrigerated transport, a transport operator can also make the choice to put in place some specific solutions (power unit automatic stop, door opening detectors, etc.), and also closely follow vehicle performance in order to prevent any malfunction in cooling or conservation.

Domain of relevance

These solutions can be adopted by all temperature-controlled types of transport.

Solutions	CO ₂ Savings ¹	Return on investment ¹	Feasibility	Domain of relevance
Special equipment reducing losses of cold volumes	0% 100% 15% to 25%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI
Setting up curtains & making right choice of door openings adapted to the vehicle and type of transportation				
Maintenance of refrigerated equipment	0% 100% 5%	> 3 years <1 year Variable	Difficult Easy	LCV RS RL SE MI
Creation of a management system following up (already achieved and programmed maintenance) for all vehicles transporting under temperature controlled conditions				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

¹ Savings and "ROI" time here presented concern CO₂ emissions & costs associated to the refrigerated unit

Illustrations



Vehicle Focus – Form N° 11
Temperature controlled: specific equipment and maintenance issues
DETAILED FORM

Context and regulatory measures

Concerning the demanding specifications linked to thermal performances and airtightness, vehicles (body and power unit) must comply with the regulations set by the ATP.³⁵

Each power unit must bear a valid ATP certificate or, when this is not required, show the evidence of an equivalent evaluation certificate, ensuring the same level of compliance.

ATP specifications are themselves audited, according to regulations applied in France under Decree No. 2007-1791.

³⁵ ATP is an agreement that concerns the international transportation of perishables and the equipment that has to be used to ensure such transportation.

Solution 1: Equipment and maintenance reducing cold air leakages

How does it work?

Frequent door openings for long time sequences while delivering can cause important losses of the cold produced. When closing the door, the refrigeration power unit will have to compensate by cooling in order to bring back the body to normal temperature. This production of cooling will generate extra energy consumption. However, adapted equipment can be added in order to reduce the losses of cold in the loading or offloading sequences.

The transport operator can make a choice amongst several solutions:

- Equip the door threshold with “liner” curtains of plastic, an air curtain or rear section screen limiting hot and humid air entry into the refrigerated body section, at each door opening;
- Operate a choice of door sections adapted to transport and vehicle type. The transport operator has to make sure that the doors are adapted to loading and offloading the logistic units being delivered (carton, roll, and pallet) in order to limit their opening time. According to the various conditions, it could be wise to make lateral door openings or rear doors openings equipped with a hydraulic platform;
- Fit the door openings with an opening sequence detector: on each door opening the refrigeration power unit will cut off, stopping the cold flow of air blowing outside;
- Plan an easily accessible, dedicated storage area where trolley and other lifting equipment are placed, which will reduce door openings.

(Source: Syndigel and Cémafroid).

The transparent plastic strip curtain remains a safe solution, even it generates restraints for the delivery personnel. The wear and tear over time of the plastic strips must be under control, as well as the correct adjustment of the strips' length, in order to make sure they reach the truck's floor surface, under normal open air temperature conditions.

Impact on fuel consumption and CO₂ emissions

Savings associated with this solution will vary according to the final choice made by the transport operator. The following chart shows which savings are associated to the various types of equipment used:

Equipment	Savings associated to this solution (% of reduction consumption of the refrigeration power unit)
Strip curtain	14%
Sensors allowing refrigeration power unit cut-off	14%
Adapted door openings	8%
One easy access space, gathering all delivery equipment	7%

Source: ADEME and François Clavier Conseil

Implementing at least two of these solutions will allow 25% savings in the case of heavy-duty trucks. For LCVs, air curtains are not adapted to van type of vehicles, due to the low volume offered.

Moreover, door detectors can't be envisaged due to fact that power units in their vast majority, are nonautonomous power units. The best solution will consist in fitting plastic transparent strips, combined with an adapted door opening.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated to this solution (% of reduction consumption of the refrigerated power unit)
LCV Light Commercial Vehicle	Urban	≤3.5 t	15%
Rigid Small	Urban	3.6-12 t	25%
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Sources: ADEME, François Clavier Conseil, data from Fleet Rental Companies

Domain of relevance

This solution is adapted to all temperature-controlled transportation which happens to have frequent and important thermal exchange situations while delivering. In particular, it is recommended for LCVs distribution delivery on urban routes.

Implementation

When purchasing the body compartment of the vehicle, the transport operator will have to approach the manufacturer in order to choose the equipment that is best adapted to his activity, taking into account the thermal performance of the equipment.

But drawbacks linked to the strip curtain solution (cost €80) must also be taken into consideration (discomfort, hygiene) while loading and offloading (communicating to drivers the advantages and drawbacks of these solutions seems appropriate).

Air curtains and sensor solutions do not need specific training for drivers.

In terms of ROI time, it will be short since the equipment has a very low cost compared to the purchase price of the vehicle. The feasibility of the solution is relatively easy, since all types of equipment mentioned are available.

Follow-up of the solution

Follow-up indicator:

- Number of vehicles equipped with curtain strips or air curtain volume;
- Number of vehicles fitted with the adapted door openings;
- Number of vehicles equipped with sensors;
- Number of vehicles equipped with a special storage area for the trolley and delivery equipment;
- Fuel consumption linked with the production of cooling.

Practical data collection process:

- Knowing the equipment in existence in the fleet;
- Follow-up of the consumption linked to production of cooling, before and after implementation.

Solution 2: Maintenance of refrigeration equipment

How does it work?

In order to maintain at the required level the performances of cooling production and refrigeration storage, it is mandatory to follow exactly the rules recommended by the manufacturers and to regularly check the specific equipment. Refrigeration power units that contain more than 2 kg of refrigerant fluids are submitted to the mandatory obligation of performing network air- water- and gas-tightness tests at periodical intervals, and of rapid repair in case a leak has been detected.³⁶

In addition, efficient and global maintenance of all refrigeration devices contribute to the energy efficiency of the whole installation, ensuring respect of the required sanitary transport conditions (checking body tightness, cleaning the internal evaporators, engine maintenance of the lubricants of the truck power unit).

All equipment in service governed by the Ministry Regulation of July 1st 2008, are submitted to a 6/9/12-year life cycle successful test, renewing at the same time their Certificate of Technical Conformity.³⁷

This test consists of an overall visual test checking the body compartment isotherm conditions, and a test performed on cooling temperature descent and then maintaining temperature conditions at a certain given level.

Procedures and specifications to be met are described and available on www.cemafroid.fr

Impact on fuel consumption and CO₂ emissions

Optimizing the maintenance of the production of cooling and refrigeration storage equipment will allow equipment performance to remain within acceptable conditions. Savings associated with this solution vary greatly. For example, checking the curtain strip wear and tear condition and functioning (curtain length adapted to the body compartment) allows 5% fuel savings on the power unit.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated with this solution (% of reduction consumption of the refrigerated power unit)
LCV Light Commercial Vehicle	Urban	≤3.5 t	5%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: ADEME and François Clavier Conseil

Domain of relevance

This solution is adaptable to all temperature-controlled transport.

Implementation

³⁶ Environment Code Articles R.543 – 75 through 126.

³⁷ AM 1st July 2008 setting the technical control process for the transport of perishables products.



In order to make for more efficient maintenance, it is recommended to schedule all check-up actions that have to be performed on each vehicle as a systematic routine. In order to implement an efficient maintenance programme, the following steps will have to be taken:

- perform a vehicle fleet inventory and their specifications (category, power unit type, body type, name of manufacturer, power performance, kilometres, on the road date, etc.);
- perform a maintenance inventory of all the actions performed (parts changed, cooling circuitry checks, de-icing if relevant, etc.), using the maintenance log book or the relevant data collected by the servicing operator in charge of maintenance;
- record all the manufacturers' recommendations.

The cost for implementing this solution is variable to a wide extent. The solutions provided will reduce all leaks and overconsumption situations, reducing the frequency of the purchase of all refrigerant gases.

As a consequence, the ROI time is also variable.

Follow-up of the solution

Follow-up indicator:

- % of the fleet followed up with a Vehicle Maintenance Logbook (VML).

Fuel Focus – Form N° 1

Choosing the mode of propulsion

SUMMARY FORM

Action description

The choice of the propulsion mode will have to be made upon vehicle purchase. Two alternatives to diesel transport are now available, for a limited usage: hybrid power and electric power types.

Engines can also be equipped with “Stop & Start” devices.

Domain of relevance

Three solutions described in this action form are exclusively focused on urban usage, with frequent stops.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Stop & Start Engine option including a "Stop & Start" system	0% 100% 1% to 5%	Long Short	Difficult Easy	LCV RS
Hybrid Vehicles Using Hybrid Vehicles for urban delivery cycles	0% 100% 10% to 15%	Long Short	Difficult Easy	RS RL
Electric Vehicles Using electric vehicles for last kilometre in urban deliveries	0% 100% 94%	Long Short	Difficult Easy	LCV RS

Nota Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Source Mercedes



Source: Modec

Fuel Focus – Form N° 1
Choice of the mode of propulsion
DETAILED FORM

Context and regulatory measures

Several solutions exist, presenting sound alternatives to diesel engines.

Most are based, or partly based, upon the substitution of the consumption of fossil fuels by using electricity: Stop & Start solutions, hybrid or electric engine, last two being emerging solutions which do not cover the full range of merchandise transport vehicles.

These technologies do present strong points in terms of environmental management, namely on CO₂ emissions and pollutants, and also in terms of noise control. Using electricity-based technologies in replacement of fossil fuels permits the direct elimination of pollutants (for the part that is based on electricity use) and CO₂ emissions.

This topic could become of primary importance in the future since decisions have been discussed and are on their way, in order to create Zones of Priority Action for Air areas (ZAPAs), for all urban cities with more than 100 000 inhabitants.³⁸ ZAPAs are defined in Article L.228-3 of the Environment Code (article created by Law N° 2010-788 of July 12th 2010, art. 182).

The principle is the exclusion of traffic in the concerned area, for certain categories of vehicles, according to environmental criteria which have been previously specified.

Application procedures of this principle will be further detailed, following experimentation tests conducted in certain cities. Furthermore, beyond the creation of these areas, some urban entities have already implemented regulations aimed at using totally clean vehicles in urban areas.

Since Jan 1st 2007, transport professionals carrying deliveries in Paris must abide by a regulation taking into account the environmental principle, stating that only clean vehicles can deliver on a 24/24-hour basis.

Concerning daytime deliveries, the regulation stipulates that deliveries have to be made between 17:00 and 22:00,³⁹ only for clean vehicles like electric vehicles, gas vehicles, hybrids and vehicles that respect the EURO norm.⁴⁰

Other propulsion modes than the ones described in this action form are the subject of intensive R & D and could be on the market in the years to come (fuel cell vehicles, bi or tri-mode propulsion, etc.).

However, taking into consideration the market configuration for the time, only the following solutions have been presented: Stop & Start, hybrid engines and electrical engines.

³⁸ For more information on ZAPAs, see the ADEME website:

<http://www2.ademe.fr/servlet/getDoc?cid=96&dm=3&id=73612&ref=23980&dp1=B>

³⁹ Charter of Good Practice –Transport and Deliveries, City of Paris.

⁴⁰ With a floor surface area less than 23 m².

Solution 1: Stop & Start

How does it work?

The Stop & Start technology means the engine is automatically cut off as soon as the vehicle is idling (at a red light or stuck in traffic congestion for example), then it will re-ignite on its own, once the brake pedal is released. This corresponds to the first level of hybrid adaptation.⁴¹ The system works using an electric device called an alerno-starter.

Impact on fuel consumption and CO₂ emissions

In order to assess the impact of this solution, one must know the total cumulated idling hours per year for the vehicle (estimated or given by onboard telematics). The chart below shows the savings linked with the frequency of stops of the vehicle.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated with	
			5 stops of 10-60 s/h (92 hours yearly)	10 stops of 10-60 s/h (183 hours yearly)
(% reduction of CO ₂ emissions)				
LCV Light Commercial Vehicle	Urban	≤3.5 t	2.5%	5.0%
Rigid Small	Urban	3.6-12 t	1.0%	2.0%
Rigid Large	Regional	>12 t	-	-
Semitrailer	Long Distance	40 t	-	-

Sources and estimations: Rigid small size: average idling consumption of 1.1 litre/hour, 50 000 km per year average, 20 litres/100 km fuel consumption. Number of days in operation yearly: 220. (Source CNR – Comité National Routier, Paris). LCV type: manufacturer data engine bench static testing, with a 125 hp engine, urban cycle, 2 litres/hour idling, 18 400 km yearly, 10 litres/100 km consumption.

Domain of relevance

Stop & Start technology is often in use on LCVs and rigid small-sized trucks, for frequent stop use (red lights, traffic congestion, deliveries). Savings will be all the more significant that the route taken includes many idling engine situations.

Savings will be greater in the case of a delivery route than a point-to-point route. Apart from the fuel savings, Stop & Start systems are very much appreciated by the drivers, due to the silent work conditions they bring in the cabin (while the vehicle is stationary).

On the contrary, on mainly road profile routes with not many stops, this solution is of no interest.

Last, the Stop & Start system is not to be used for urban refrigerated transport – LCVs or rigid – equipped with a nonautonomous power unit, because its impact and effects on the power units would be counter-productive.

⁴¹ Report to the National Assembly: Definition and consequent implications of the Clean Car Concept.



Implementation

This system has to be chosen when purchasing the vehicle. Adaptation retrofit on a nonequipped vehicle would prove too costly. Moreover, it could cause problems due to the kinematic powertrain modifications that would have to be undertaken (new registration process) and the starter parts which must be reinforced (electric engine is directly connected to the flywheel).

Extra cost is less than €1 000 for a heavy-duty truck and is less than €500 for an LCV.

Stop & Start does not appear to have a negative impact on starter wear and tear, which is conceived for a high frequency of stops. Considering extra and potential savings presented above, the ROI can be considered as a rapid one (< 1 year) for a breakeven point situated at 5 minimum daily stops.

This solution is a relatively simple one to implement. Feasibility is high.

Follow-up of the solution

Follow-up indicator:

- % vehicles equipped with Stop & Start technology in the fleet.

Practical data collection process:

- Using the database of the follow-up of the vehicles in the fleet and time spent idling (slow motion).

Solution 2: Hybrid vehicles

How does it work?

Hybrid motorization consists of connecting – two types known as “series-hybrid” or “parallel-hybrid” connections – a thermal powered standard engine and an electrically powered engine. Two main functions are delivered through the electric engine; starting the vehicle and the optimization of the thermal engine in the event of important power needs (but reducing the need for power if compared to a pure thermal engine). Most of the time, the batteries of the electric engine are recharged either while using part of the thermal engine power, or during the deceleration phase.

The use of electricity as an energy source providing certain functions in road transport vehicles offers several advantages from an environmental point of view (no pollution in urban areas, reducing noise level). Moreover, and contrary to electric vehicles, hybrids do not need specific power supply infrastructure (with the exception of the “plug-in” types).

Impact on fuel consumption and CO₂ emissions

The more the hybrid vehicle is dedicated to urban transport with multiple stops, the greater the fuel savings. On the contrary, a hybrid that would be dedicated solely to highway driving with only a few stops, will make nonsignificant savings due to the fact that the electric part of the power will not be activated very much, and the extra purchase cost of the hybrid will not be compensated for by the fuel savings made.

Hybrid adaptation of a diesel engine will bring 10% to 30% fuel reduction, according to the technology used. Measurements made during real conditions in the field show that for parallel hybrid diesel electric vehicles, fuel consumption is reduced by 20% to 30% on peri-urban profiles and 3% on highway routes (source: ADEME).

The estimate here considered is 10% to 15% fuel savings, when switching from an urban diesel rigid to a hybrid of the same power category (Source: *Les poids lourds propres et économes* – Les évaluations de l’ADEME – CD Rom ADEME Opticamion 2006).

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated with this solution (% reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	10% - 15%
Rigid Large	Regional	>12 t	10% - 15%
Semitrailer	Long Distance	40 t	-

Domain of relevance

Hybrid vehicles bring a solution to professionals that operate on multistop urban routes. Moreover, contrary to electric vehicles, hybrids have no constraints as to their operating range, that would limit the feasible number of operational kilometres per day. The hybrid market offer is limited to vehicles of the 3.6 tonnes to 19 tonnes MGW categories. No offer exists as of today in the LCV vehicle segment.

Implementation

Commercial market offers of heavy-duty trucks equipped with hybrid power are under development and will grow again rapidly in the years to come. Associated cost will also evolve rapidly.

It is therefore advisable to approach different manufacturers and exchange with them on the cost evolution and benefits to be expected from their vehicles.

Therefore it is recommended to make technical and economic feasibility studies, before any implementation, in order to integrate all the usage contexts of these vehicles.

Lastly, the feasibility of this solution can be considered as medium due to the availability of the vehicles; the offer at the moment is quite a narrow one on the market.

Follow-up of the solution

Follow-up indicator:

- % of hybrid vehicles in the fleet

Practical data collection process:

- Follow-up of the fleet management data.

Solution 3: Electric vehicles

How does it work?

The operating principle of an electrical vehicle consists in storing energy in a specific storage system. This stored energy is then transmitted to the engine through a controller device that transforms the battery direct current into alternating current.

Charging the battery can be done via the public electricity network. The electric engine can also transform the kinetic energy of the vehicle into electricity during the deceleration and braking sequences, which contributes to battery recharging.

Impact on fuel consumption and CO₂ emissions

Although it does not generate any direct consumption of fossil fuels, an electric vehicle needs electric production, which contributes to GHG emissions.

However, due to the energy mix of the French production of electricity, it is estimated that the reduction of CO₂ emissions as compared to a similar vehicle running on diesel fuel is 95%.⁴²

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated with this solution (% reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	94%
Rigid Small	Urban	3.6-12 t	94%
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	-

Source: ADEME calculations for 3.5 t and 5.5 t vehicles.

Domain of relevance

Due to their limited range, 80 km to 100 km on average, electric vehicles are appropriate to urban deliveries, and short-distance operations. The commercial offer is at the moment restricted to vehicles under 7 tonnes: small-sized rigid, compact vans, vans and cabin-over-frame types of vehicles.

The relevance of use of light electric transport vehicles is closely tied to implementation of collaborative work with local authorities (see ACTION FORM – ORGANIZATION N° 6). In particular, the scarce availability and installation of adequate charging plugs in city centres causes a problem to operators concerned.

Implementation

The purchase cost of an electric vehicle is nowadays nearly double the cost of a diesel vehicle in the same category (battery cost included).

This said, once in operation, costs are reduced by 90% (not counting the renewal cost of battery elements). The cost of a battery for a 5.5 tonne truck is €30 000 with a lifecycle of eight years.

⁴² Considering average emissions of CO₂ generated by the production of 1 kWh in France (including line losses), 53 g of CO₂eq in 2012 (Source: Base Carbone 2012).

In the case of a compact van – with an 8-year battery life – monthly rental cost is €75 € (based on 15 000 km yearly).

The substantial extra purchase cost today constitutes a major negative point, and slows down getting a satisfactory ROI time. The offer for compact electric vans is relatively abundant. Average specifics of these vans are the following: payload 650 kg, volume offered between 3 m³ and 4.6 m³, logistic autonomy claimed by the manufacturers is 170 km on average.⁴³ Purchase price is between €15 000 and €17 000 without tax, according to the size of the vehicle (this amount takes into account the €7 000 bonus but does not include battery costs). Instead of buying an electric vehicle, most companies will rather rent it for long lease times. Monthly rental cost will be around €850, which is double the price of an equivalent diesel vehicle category (€450 to €500 monthly).

The ROI time for a compact electric van is around 3 to 4 years. The commercial offer of electric vans is just developing. It is less abundant than for compact vans, and manufacturers have not yet found the ideal compromise between volume and payload. Moreover, the frame profile of the vans does not allow for an easy installation of the battery. The whole interest of fitting electric power on cabin-over-frame vehicles is the fact that the cabin is lightweight and the battery more easily placed that in a van: with a MGW of 4.5 tonnes, a payload of 1.9 tonnes and a logistic autonomy of up to 100 km.

These vehicles are approved in France for 4.5 t (3.5 t + 1 t) due to the special regulations of the Clean Vehicles Act (that one can drive with a class B driving license). The maxi rigid electric types (heavy quadricycle) offer a volume of 1.8 m³ and 600 kg payloads, maximum speed of 45 km/hour and have 75 km logistic autonomy.⁴⁴ Prices vary between €9 000 second-hand, to €17 000 brand-new. Usage is still modest at the moment. Electric vehicles conceived specifically for refrigerated urban transport are beginning to appear on the market: 4 m³ to 8 m³ capacity vehicles, 450 Kg payload, using a dry-ice technology.

They can be used for deliveries to/from fast-food restaurants, for the foodstuffs sold via e-commerce, for delivering meals at home, or health product distribution.



Availability of battery recharging infrastructure

This is a critical point to check and scrutinize before purchasing an electric vehicle. Today it is sometimes difficult to find a garage or a depot that is equipped with public electricity plugging capabilities.

For many urban delivery transport companies, lack of recharging plugs is often a major obstacle to buying light electric vehicles.

⁴³ Feedback from operators using large fleets of LCVs.

⁴⁴ In regulatory terms, a heavy quadricycle is a 4-wheel thermal engine vehicle with total power less than or equal to 15 kilowatts, empty weight no more than 550 kg for quadricycles assigned to merchandise transport, payload no more than 1 000 Kg if for merchandise, and that does not respond to the definition of light quadricycle with an engine (Source: Livre 3 – Titre 1er Dispositions techniques, Article L.311-1 -1 to L.318-4, Articles R.311-1 to R.318-8 – Chapitre Ier – Décret R.311-1).

The purchase requests formulated to fleet managers are not easily given satisfactory approval.

Two types of solutions exist for transport companies that want to operate urban deliveries with electric vehicles:

- A privatized one which consists of renting a parking lot and installing the equipment;
- The public infrastructure solution, renting a plug-in socket that is ideally situated in a strategic place (public parking lot, etc.).

The payload of an electric vehicle is often reduced, compared with a standard vehicle. This can impact the organization of transport, increasing in some cases, the number of route segments to be operated. This aspect has to be taken into consideration by the user, when working out his solution analysis.

The need to implement a new transport organization (limited logistic autonomy, and recharging time needed) and thus the limited availability of these vehicles, makes it a relatively difficult one to implement.

Its feasibility is therefore rated between intermediate and difficult. Lastly, it is important to check that in case of lightweight electric vehicles, making urban deliveries with the help of a rear loading platform used intensively, the extra electric consumption generated by the use of the platform will prove incompatible with the battery power capacity of the vehicle.

This aspect has to be thoroughly examined with the manufacturer, before any purchase decision is made.

Follow-up of the solution

Follow-up indicator:

- Kilometres travelled with electric vehicles (km);
- Corresponding electricity consumption (kWh);
- Percentage of electric vehicles in the fleet (in % numbers).

Data collection process:

- Working on database of the vehicle fleet, follow-up of electric consumption of the vehicles.

Fuel Focus – Form N° 2 Using alternative fuels SUMMARY FORM

Action description

A type of diesel fuel is available at the moment in France for the transport of merchandise, without radical change of energy mode.

The B30 fuel contains 30% ester-methyl vegetable oils (against only 7% in the volume of standard diesel fuel) or made out of used domestic oil esters.

Using this biofuel can reduce CO₂ emissions from well to wheel, if it complies with EC directive 2009/28/EC and in the absence of effects that would be caused by the change in use of agriculture lands.

Domain of relevance

B30 can be used by all diesel vehicles from the Euro 2 – EU2 norm and upwards, to the EU5 – EEV now in force.

Not being distributed through commercial service station networks, these fuels are only accessible to companies that run an internal “captive” fleet and have access to their own privatized fuel storage.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Using B30	0% 100% < 13,6%	Long Short	Difficult Easy	LCV RS RL SE MI
Using B30 for a privately owned fleet				

***Note Bene:** the introduction section of the document provides all details on chosen hypothesis*

Illustrations



Source: site Internet vivelessvt.com



Source: site Internet partenaires-diestefr

Fuel Focus – Form N° 2
Using alternative fuels
DETAILED FORM

Context and regulatory measures

Instruction 2009/28/EC of the 23rd of April 2009 relative to the use and promotion of all energy produced from renewable sources (it is also known as the RE instruction) has set a 10% renewable resources objective – to the year 2020 – for the final consumption of energy used in transportation.

However this objective is conditioned by complying with the sustainability criteria of the various biofuels and to the availability of second-generation biofuels on the market. B30 is a biofuel blend of 70% diesel fuel by volume and 30% of methyl ester fatty acid (vegetable oils, used cooking oil from recycling, animal grease).

France is the second producer and consumer of biodiesel after Germany.⁴⁵ A total of 2.12 million tonnes of biodiesel were consumed in 2010 on the French market, a 6.7% share of national consumption (in energy content) of diesel and unleaded fuels.⁴⁶

At the same time, experiments are carried out on various other types of fuel, in particular the EEG40 emulsion which is a biofuel blend of 60% diesel, 27% ester of used cooking oils from recycling (waste oil methyl esters) and 13% water and additives.

Nota Bene: Gaseous fuels like natural gas for vehicles have not been selected in the present action form because they do not produce CO₂ emission savings as compared to diesel for efficiency reasons). But natural gas brings benefits concerning the other pollutants (NO_x, SO_x, etc.) and other concerns such as noise level. Using these fuels is quite possible with vehicles running on biogas (see Chart next page: Outlook: Natural gas/ Biogas).

⁴⁵ Source: "Etat des énergies renouvelables en Europe", 2009 edition, 9^{ème} Bilan EurObserv'ER.

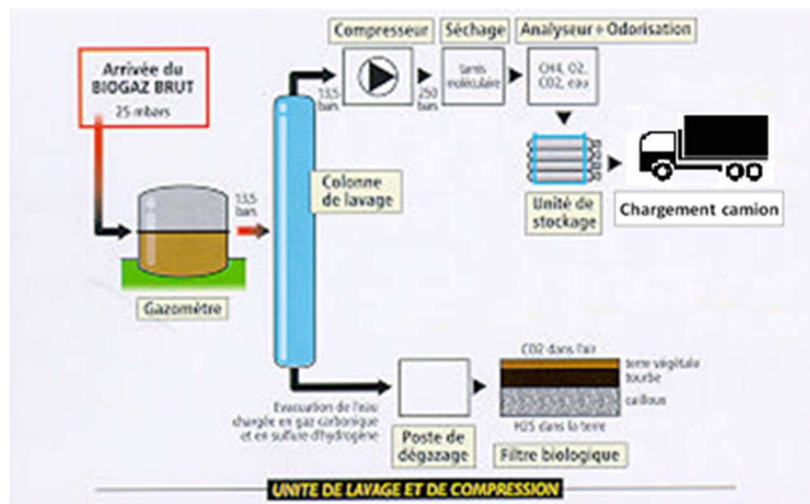
⁴⁶ Source: Rapport annuel DGEC industrie pétrolière et gazière, 2011.

Outlook: Natural gas/Biogas

“Biomethane”, also called “biogas”, comes from renewable sources (unlike natural gas which comes from fossil resources).^{47 48} This is the reason why it is so favourably considered, from a regulatory point of view. Since January 2012, important producers and companies holding important quantities of waste consisting in majority of organic waste (e.g. agri-food industries, restaurants, canteens, markets) have an obligation to set up a selective pickup of this waste, in view of recycling by means of methane processing or composting. Moreover, waste-oil-derived fuels are not subject to the TGAP levies. Lastly, not to attempt any waste sorting is an offence punished by a fine of €75 000 and two years in prison.

Biomethane comes from fermentation of organic matter in the absence of any oxygen, which can be spontaneous (which is the case in rubbish dumps for example), or produced through specific, airtight reactors called “digesters”: this is called methane processing or “methanation”.

This processing produces mixed gases called biogases and an effluent, called “digestate” (which is then reused as an agricultural fertilizer). Initial biogas obtained contains 50% to 75% methane gases. It is then filtered and compressed, in order to be used as a fuel.



Biomethane is a very promising solution. The fact of operating a vehicle with biomethane will neutralize the emissions that would have been otherwise produced by an all-diesel fleet. Biogas is a renewable fuel, to which no CO₂ emissions can be attributed. Taking into account the emissions linked to the production and the use of biogas, total savings of 90% are obtained (excluding the valuation process of the digestate) or 100% (including the valuation of the digestate).

Although biomethane is still unavailable for road transport, to this day, the situation could change quickly due to the installation of specific distribution stations in 2012 and thanks to the testing done by manufacturers on LCVs.

⁴⁷ Biomethane (or biogas) is a source of energy that comes from decomposition of organic matter in the absence of oxygen. It is a blend made of methane (CH₄), carbon dioxide (CO₂) but also (in lesser proportion) water, nitrogen, sulphured hydrogen, oxygen as well as aromatic organohalogen compounds and heavy metal residues. For more information, see: <http://www.biomethanecarburant.info/>

⁴⁸ Natural gas for vehicles comes from fossil resources, and compared to diesel fuel, allows particle emissions, NO_x, SO_x as well as noise. It does not bring significant CO₂ emission reduction for heavy-duty usage or LCVs (for reasons of efficiency). This is why it was not selected in this form.

Compression station projects are on underway in the Brittany, Toulouse and Alsace regions; biomethane produced will be re-injected into the public gas network.

Biomethane can be used either as a gas, compressed under 200 bars of pressure (2 902 psi), or in a liquid state (LNG at minus -160 °C).

On the French market, nearly 40 types of natural-gas-powered vehicles exist (rigid, cabin-over-frame, van) with a logistic autonomy of between 150 km and 400 km, and nearly 1 000 km using a combined mode (natural gas and diesel fuel), which could therefore use natural gas/biogas.

Several points have to be taken into consideration when implementing this solution for natural gas vehicles:

- -Availability of biogas: to be used as a fuel, biogas must have certain specifics that do not permit using any biogas type produced in France. The biogas fuel commercial offer is at the moment rather limited in France. On top, regulatory problems and administrative difficulties are to be anticipated (linked to added circuits for the biomethane);
- Biogas cost: the cost of biogas is lower than €0.75/m³ (produced from waste) against €0.80/m³ to €1/m³ for natural gas.
- Prices of the two fuels are close enough but biogas price will fluctuate according to the capacity of production of the sites and the nature of the waste raw material used (energy crops, liquid manure, waste). For example, the price of biogas produced from liquid manure is between €0.5/m³ and €1.5/m³;
- -Investment costs; the cost of a private distribution station of natural gas/biogas will have to be taken into account.
- Operations: introduction of the vehicles powered by biogas means organizational adjustments in the fuel supply and maintenance of the concerned vehicles. Covered areas where these vehicles will circulate must be equipped with adequate ventilation and gas detectors in the upper parts of the buildings.

Even if it is cheaper than diesel fuel, biogas means more expensive vehicles when purchasing and their maintenance costs are also higher, in the end an extra cost has to be taken in consideration.

Solution 1: Using B30 type biofuel

How does it work?

B30 is a blend of 70% diesel fuel and 30% of methyl ester of vegetal oils (fatty acid methyl ester, FAME). In France, colza (rapeseed) oil is in particular used (with a small fraction of sunflower oil, but also soya and palm oils) for FAME fabrication, obtained by a process called “transesterification” with methanol. Physics and chemical specifics of FAME are close to those of diesel fuel, which permit their use blended with a standard diesel fuel. Incorporation of 30% into the standard diesel fuel will have to be done to obtain B30.

A product derived from B30 today exists, made of ester of vegetal oils.

B30 WCME is a blend of 70% diesel and 30% methyl ester from used cooking oil (waste cooking oil methyl ester, WCME).⁴⁹ Chemical and physical specifics of WCME are identical in every aspect to FAME, are close to diesel specifications which allows mixtures with standard diesel fuel. 30% incorporation in standard diesel fuel will produce B30 WCME.

Impact on fuel consumption and CO₂ emissions

According to the ADEME report “Life Cycle Analysis as applied to first generation biofuels consumed in France”, published February 2010, the reduction of GHG emissions (in the absence of any effect linked to the final use of soils) linked to B30 usage as compared to pure diesel, is a gain of 13.6% in terms of kilometres.^{50 51} Standard diesel containing at most 7% of ester vegetal oil,, real reduction rate of the CO₂ emissions linked to B30 use will depend on the incorporation rate of biodiesel in standard diesel fuel (in any case, it will be lower than 17% per kilometre).⁵²

Considering an average incorporation rate of 6% by volume in diesel fuel,⁵³ CO₂ emissions reductions will therefore be 13.6%. B30 from waste oils permits CO₂ emissions reduction of 26% (“pit to wheel”) due to the use of recycled oil in place of a pure vegetal oil one.⁵⁴ Considering a 6% incorporation rate in standard diesel fuel, CO₂ reduction will then be 20.8%.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings associated with this solution (% reduction of CO ₂ emissions)	
			B30 vegetable oil	B30 waste oils
LCV Light Commercial Vehicle	Urban	≤3.5 t	13,6%	20,8%
Rigid Small	Urban	3.6-12 t		
Rigid Large	Regional	>12 t		
Semitrailer	Long Distance	40 t		

⁴⁹ Some variation is possible from animal fats. Market availability for B30 produced from used cooking oils or animal fats is not known precisely (information is only available at the moment at the distributor level).

⁵⁰ From rapeseed (colza) oil.

⁵¹ B30 is mainly prepared from diesel B0 (with no biofuel).

⁵² Standard diesel, corresponding to the one found at the pump and mainly for light vehicle use, can contain as much as 7% biodiesel: this rate is a maximum, not a fixed rate.

⁵³ Source: fuel maker.

⁵⁴ Savings are obtained either by using a pure biofuel, or a fuel incorporating only one source, as compared to additive ones which usually contain a blend of biofuels.

Domain of relevance

B30 can be used in all diesel-powered vehicles from the EU2 norm to the present EU5-EEV norm.

It is advised to check with manufacturers for acceptance of the warranty transfer and authorization.

Not being distributed in service stations, this fuel is only accessible to transport operators that run a captive fleet of vehicles, and that manage private storage equipment and sign a supply agreement with a fuel distributor.

Implementation

Since B30 is not available in stations, a special dedicated tank will have to be used on site. This means either using B30 from former diesel storage tank or building a new one that is dedicated entirely to B30.

In the first option, diesel tanks can take B30. But it is advised to clean the tank before the first delivery of B30 is made. In the case of the second option, the tank will have to be constructed complying to the ICPE norms. For a 40 m³ tank, construction cost would be an estimated €60 000.

Extra cost of B30 is 1% to 3% per kilometre.⁵⁵ For the time being, B30 average cost is similar to the diesel fuel price and B30 will generate a 1% to 3% extra fuel consumption (calculation made with fiscal conditions in 2011, without integrating transport costs).

It will be necessary to confirm valid manufacturer warranty of the vehicles, and plans for appropriate maintenance, especially of the oil filters; special surface treatment of the tanks has to be done and a reduction of the oil service frequency. In some cases, it could be wise to plan for additional pre-filters installation, fighting against bacteria such as salmonella. Managing the complexity of this solution will consist in succeeding in the special dedicated tanks installation and the supply of the vehicles.

This constraint being tackled, this solution will be easily integrated due to the engine compatibility. Feasibility is between easy and intermediate.

Implementing the B30 WCME follows the same procedure as for B30. There is no extra cost using the B30 WCME as compared to B30. Its average price today is the same as for B30 and B30 WCME generates extra fuel consumption of 5% (fiscal conditions 2011, transport costs not integrated).⁵⁶

Follow-up of the solution

Follow-up indicators:

- % of vehicles using B30 (%);
- % mileage made using B30 (%);
- Number of litres B30 used (litres).
-

Practical data collection process:

- Follow-up on the number of B30-powered vehicles;
- Follow-up B30 fuel consumption figures.

⁵⁵ Energy contained in one litre of FAME is estimated to be 33 MJ while one litre of pure diesel fuel contains close to 36 MJ. B30 use therefore generates a 9% overconsumption when compared to pure diesel.

⁵⁶ Source: fuel distributors

Fuel Focus – Form N° 3
**Additive combustion products to clean the feeding and injection circuits, and
combustion chambers of diesel engines**
SUMMARY FORM

Action description

This solution makes it possible to restore optimal engine working conditions.

Domain of relevance

This solution is appropriate to all domains of merchandise road transport, the product used suits all diesel engines.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Keeping clean the feeding & injection circuits of diesel engines				
Additive products that aim at recovering the original and optimal specifications of the engine				

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Fuel Focus – Form N° 3
**Additive combustion products keeping clean the feeding and injection circuits,
and combustion chambers of diesel engines**
DETAILED FORM

Context and regulatory measures

The purpose of fuel used in diesel engines is to transform thermal energy into propulsion power energy. This fuel (Norm EN 590) satisfies all specifications needed for optimized fuel combustion, recommended by manufacturers and engine makers.

Major constraints for using this fuel are:

- Obtaining an energetic efficiency that is the highest possible;
- Minimizing pollutant emissions.

Combustion in a diesel engine (similar to boiler combustion), is neither perfect nor complete when it occurs. It produces residues in the form of not completely burned fuels and carbon monoxide. Nitrogen gas contained in the air has a reaction with oxygen when temperature is high, creating nitrogen oxide gases (NOx).

All these products are pollutants, each with a certain degree of toxicity.

All post-treatment management systems of exhaust gases (oxidation catalysers, particles filters, NOx trapping systems, etc.) and technical dispositions taken directly on the engine such as EGR and SCR systems are all aimed at reducing pollutants.

But they do not entirely get rid of all pollutants and their efficiency diminishes with time, and this is especially the case when engines are used in a wrong manner or poorly maintained (dirty injector, exhaust or admission clogging, etc.).

On the market, high-performance products exist, modifying some of the specifications of standard fuels. Maintaining the supplied fuel quality is the top priority, without changing the standard, the purpose is to obtain a significant fuel reduction and to lower pollutant emissions.

Solution 1: Additive combustion products to clean the feeding and injection circuits, and combustion chambers of diesel engines

How does it work?

Reducing fuel consumption and polluting emissions can be obtained:

- Acting on the disintegration of dirty spots found in the transfer lines, injection system, combustion chamber, turbo fans and exhaust lines;
- Re-emulsion and stabilizing of the fuel in order to keep its base specifications when used, at all times.

This solution will restore standard engine conditions, delivering optimal specifications.

Impact on fuel consumption and CO₂ emissions

Additive distributors like to put forward fleet savings obtained in the transport field, with savings observed of variable amounts.

Fuel consumption savings will have to be validated by a certified laboratory following 60 NERV driving cycle (under ADEME protocol) with a laden vehicle:

CO₂ emissions and fuel consumption will have to reach a minimal 4.4% ratio.

Domain of relevance

This solution concerns all domains of merchandise road transport, the product used is appropriate to all diesel engines.

Implementation

This product does not alter specifications of the EN590 Norm.

Implementing and using the product can be done in two ways:

- Poured directly in the vehicle fuel tank
- Poured directly into the storage fuel tanks.

Product cost is estimate 1% to 1.5% of per litre cost, savings are of 3% minimum.

Products are available on the market and their usage does not necessitate complex organization, which could reduce benefits to user. Implementation time is short, < 1 year.

Follow-up of the solution

Follow-up indicator:

- Keeping an account of all the used products;
- Keeping track of fuel consumption.

Practical data collection process:

- Internal follow-up of product consumption.

Fuel Focus – Form N° 4

Enhancing the fuel consumption follow-up process

SUSMMARY FORM

Action description

Being capable of measuring and following up with precision fuel consumption (per vehicle and per driver) will allow the transport operator to perform an initial assessment of the situation, committing to a quantified and realistic objective, together with other targeted actions ("You can't manage it if you can't measure it!").

Three solutions are offered: fuel consumption data collecting, onboard vehicle telematics equipment (which is a special type of data collection), the process of monitoring and using the data collected.

Domain of relevance

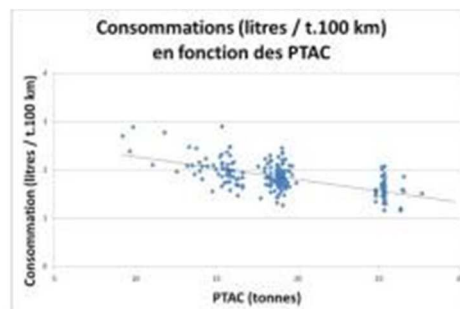
This action is appropriate to all road transport activities.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Data collecting Setting up a system following fuel consumptions per vehicle and per driver	0% 10% Indirect	> 3 years < 1 year Indirect	Difficult Easy	LCV RS RL SE MI
On board telematics systems (consumption)¹ Installation of telematics equipment allowing the follow up of fuel consumptions per vehicle and per driver	0% 10% Indirect	> 3 years < 1 year Indirect	Difficult Easy	LCV RS RL SE MI
Data Monitoring & Management Processing data collected	0% 10% Indirect	> 3 years < 1 year Indirect	Difficult Easy	LCV RS RL SE MI

Note Bene: the introduction section of the document provides all details on chosen hypothesis

¹ For more information, please refer to the form "Certificats d'Economies d'Energie" annexed to the present form

Illustrations



Fuel Focus – Form N° 4
Enhancing the fuel consumption follow-up process
DETAILED FORM

Context and regulatory measures

A growing number of transport operators now have the know-how to follow their fuel consumption data. This progressively intense focus is due to economic pressure and the increase in fuel prices, which should carry on in the same rising trend in years to come.

The fuel consumption account for the transport companies:

- Is the second in line with 26.3% just after wages, for long-haul activity (articulated 40-tonne vehicles).
- Is the third in line (17.9%) just after wages and material spending, for regional transport activities carried out by rigid trucks.
- The second or third in line (representing between 8% and 20%) for light vehicle activities, just behind wages, overheads and finance leases and rentals.

(Source: Comité National Routier (CNR), December 2010 and “Cahiers de l’Observatoire”, CNR 2003 – SNTL).

Fine-tuning management of fuel consumption is therefore a significant competitiveness asset.

This action can be linked to other actions, namely:

-“Information on CO₂ emissions” – ORGANIZATION FOCUS – ACTION FORM N° 4 on transport flows. With a reliable follow-up of consumption, it is possible to organize a display of CO₂ emissions related to transport;

-“Setting up an Eco-Drive Training Management” – DRIVER FOCUS – ACTION FORM N° 1.

Following a focus on drivers’ fuel consumption, one can identify those who need to follow Eco-Drive Training sessions.

Solution 1: Collecting data

How does it work?

The various information collection channels are the following, from the simplest to the most sophisticated:

	Method	Positive points	Drawbacks	Uncertainty level
1	Communication of volumes by the drivers each time they pick up fuel	<ul style="list-style-type: none"> Investment close to nil 	<ul style="list-style-type: none"> Low reliability Needs implementing a control system 	<ul style="list-style-type: none"> 20%
2	Consumption feedback by distributing fuel stations	<ul style="list-style-type: none"> Allows data control transmitted by the drivers 	<ul style="list-style-type: none"> Necessary homogeneous data between suppliers Possible errors in adding up kilometres 	<ul style="list-style-type: none"> 10%
3	Data monitoring of internal consumption (fuel tanks – company owned)	<ul style="list-style-type: none"> Automated process 	<ul style="list-style-type: none"> Relevant to internal fill-up only Possible errors in distances totals 	<ul style="list-style-type: none"> 7%
4	Telematics on board (cf. solution 2 of the present action form)	<ul style="list-style-type: none"> Allows direct transmission of consumption Will allow adding complementary modules: driving parameters, position of the vehicle, etc. 	<ul style="list-style-type: none"> Cost Could necessitate training by the suppliers of the solution in order to support drivers during use experience curve 	<ul style="list-style-type: none"> 5%

Impact on fuel consumption and CO₂ emissions

Collecting data has no direct impact in terms of savings on fuel consumption. Yet it has been observed within transport companies that whenever drivers happen to know that their vehicle consumption is being monitored, one can see the start of reduction of fuel consumption (at least for a certain amount of time).

Moreover, for logistics managers of transport operators, a precise knowledge of per-driver fuel consumption will constitute the base for further optimization measures to be taken (Eco-Drive, bonus/malus evaluation system).

Last, putting in place a Fuel Management System (FMS) is the first step to reducing consumption, saving on CO₂ emissions at the same time.

Domain of relevance

This solution is appropriate to all domains of road transport.

Implementation

Each method needs a different implementation approach:

- **Method N° 1** – Via the drivers: In order to implement this method, all drivers are asked to take note at each refuelling, of the data related to fuel volumes as well as kilometres shown on the odometer when the refuelling was done.
- **Method N° 2** – Via the fuel distributors system: Fuel distributors provide individual fuel badges, attributed per vehicle or per driver. These badges can consolidate the billing process and therefore fuel consumption.
- **Method N° 3** – Via a fuel tank data recording system: Fuel tanks have to be equipped with sensors that will produce records of the used volumes.
- **Method N° 4** – Via onboard telematics system: This method requires an important investment. It sometimes includes the additional functionalities allowing global fleet management optimization (example: geodetection, driver task time management, etc.). A telematics system costs €1 000, to which a monthly rental cost – variable in multiples of ten euros – has to be added, according to the service required by the transport operator (see solution N° 2 of the present action form – “Onboard telematics”).

This solution does not generate direct fuel savings and cannot as such, be associated with any ROI time. Whatever the chosen method, a certain number of personnel have to be involved, feasibility is intermediate.

Follow-up of the solution

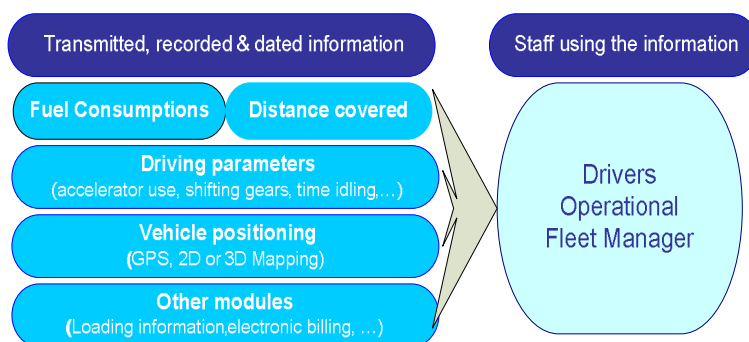
Follow-up indicator:

- Record which methods have been implemented (N° 1 to N° 4 listed above) and the degree of precision they (expressed in %).

Solution 2: Onboard telematics system (consumption)

How does it work?

The word “telematics” covers a very wide range of tracking systems, but in general it designates support devices to assist transport operation that combine information technology and modern telecommunication tools, with the dual objective of a better control over vehicles as well as enhanced driver follow-up. An efficient use of these devices will also generate significant progress in terms of safety and productivity. About 50 companies are in competition in this market, usually coming from the data system or the telecommunication world, along with vehicle manufacturers who generally propose comprehensive systems in original or retrofit options.



Information nature and persons concerned

Three types of users are concerned by onboard telematics systems and can benefit from the transmitted information: the drivers (with feedback on their personal driving style), operations personnel (organizational help) and lastly the fleet manager (optimizing maintenance process).

In this solution we will focus ourselves exclusively on the function pertaining to fuel consumption follow-up, a part of the whole telematics system.

Such products allow optimization of fleet management.

They are intended for the use of operator managers or owners, enabling them to obtain the following information record, per vehicle or per driver:

- Following up fuel consumption, kilometres and the rpm figures
- Following up fuel consumption, kilometres and emissions of CO₂ ratio
- Automated maintenance management (recap of service planning, instant warning in the event of technical default of the vehicle)
- Performance training tool, that is oriented at the same time on the fleet manager and the driver, allowing him to receive relevant alerts in case of engine rotation found over or under the expected rpm range, in case the vehicle is found over the acceptable speed limit, or if the driver's braking style is found too harsh.

Impact on fuel consumption and CO₂ emissions

This solution will reduce fuel consumption only if it is twinned with the Eco-Drive Programme (EDP) for drivers.

The synthetic Energy Savings Certificate (ESC) information sheet entitled “Onboard Telematics for the driving follow-up of the vehicle”, domain of relevance covering professional vehicles, gives a definition of the minimum data recordings to be fed back by telematics: vehicle consumption, kilometres, use of the accelerator pedal, use of brakes, rpm of the engine and cumulated idling time.⁵⁷

Fuel consumption reduction ratio credited to telematics is estimated at 5%.

Vehicle Size	Main use considered	MGW (or MCW) in tonnes	Savings associated to onboard telematics (% of reduction of CO ₂ emissions), If this solution is twinned with Action Form Driver N° 1 Implementing an Eco-Drive Programme
LCV Light Commercial Vehicle	Urban	≤3.5 t	5%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Domain of relevance

This solution will be very appropriate to long-haul vehicles as well as vehicles where the driver’s consumption is too high, hence the equipment ROI time will then be reduced.

However, due to recent technology progress and to reduced cost of equipment, this solution has become equally interesting for LCVs on urban routes.

Eco-Drive training, data recording devices and corrective measures downstream constitute a “one package” solution, which cannot be dissociated.

Implementation

For the transport operator, the global cost of implementing an onboard telematics device is the accumulation of the installation cost for each vehicle (€100 estimate), and of the rental cost (less than €30/vehicle /month).

Since 2000, the share of the equipment cost has increased year over year, now reaching 10%. Incoming data from the vehicle are generally treated through a server, monitored either by the truck maker or the provider of the telematics system. This service is nowadays integrated into the global maintenance contract.

This solution will deliver the expected results only if implementation is coupled with Eco-Drive.

It is recommended to install all telematics before the training session in order to create a zero base starting level, from which savings can be surveyed and drivers can be directed to the appropriate complementary training according to their respective behaviours.

⁵⁷ Calculation Form TRA-EQ-03



Upstream, the drivers must be fully involved in the project of the onboard telematics system analysis phase. An appropriate form has to be filled out by the transport operator and sent to the national commission on data collection and personal freedoms (French acronym CNIL).

The expected ROI time of such a solution is estimated at one year (costs are high but so are the savings made). Its feasibility is intermediate. Installing all the onboard telematic devices can have several organizational impacts (organizing the data monitoring department, managing new incoming data streams, etc.).

When making the acquisition of such a system, the transport operator will have to check out whether the fuel consumption reductions currently claimed by the supplier of the system have proven realistic, and check the method through which the savings were calculated.

It is advised to benchmark different offers from suppliers.

Follow-up of the solution

Follow-up indicator:

- % of vehicles equipped with onboard telematics (including a special module recording fuel consumption).

Practical data collection process:

- Follow up of the number of vehicles equipped with telematics (including a special module recording fuel consumption).

Solution 3: Monitoring and managing data collected

How does it work?

One can observe three different fine-tuning levels that will allow progressive comprehension of the fuel consumption recorded:

Minimal level: process the analysis of litres/100 km and compare them to standard consumption (i.e. websites www.energeco.org or www.cnr.fr)

Intermediate level: give each route its specificity (average speed, route profile, type of merchandise transported), give detailed consumption figures by vehicle category (articulated trucks, small and large rigid trucks) and analyse them;

Maximum level: taking into account all road operation parameters (speed, rpm range of use, torque, using the hydraulic retarder, brakes and clutch, etc.) but also parameters like the vehicles and the conditions of operation (vehicle MGW or MCW, type of transport activity, traffic congestion, and type of road network,...). Carry out an estimate of fuel consumption in litres/tonne.km.

Impact on fuel consumption and CO₂ emissions

Similar to fuel consumption data collection, there is no direct impact, but a detailed analysis of consumption will identify the potential savings and help select the most appropriate actions to be carried out.

Fuel consumption analysis can also input the driver training programme, which has to be tailor-made to his onroad performance.

Domain of relevance

This solution concerns all domains of road transport activities.

Implementation

Implementing a report and analysis system on fuel consumption requires a significant time investment and eventually calling on dedicated resources. The transport operator can progressively increase the analysis level using the “How does it work” section above.

This graduated analysis will allow detailed understanding of parameters influencing fuel consumption and their relative weight. Time to be invested is closely related to fleet size as well as to the range of activities of the transport operator. As an indication a full-time person is justified and has to be dedicated to this task when the fleet is over 100 vehicles, if a maximum management level of surveillance is to be reached. This solution does not have a direct impact on fuel consumption savings and or on ROI.

It requires organizational changes since human additional resources have to be dedicated to monitoring and managing data: this solution is intermediate in terms of feasibility.

Follow-up of the solution

Follow-up indicator:

- Indicate the level of management of the data received (level 1, 2 or 3).

Information sheet: Energy Savings Certificates for the installation of onboard telematics



Certificats d'économies d'énergie

Opération n° TRA-EQ-03

Télématique embarquée pour le suivi de la conduite d'un véhicule

1. Secteur d'application

Flottes de véhicules professionnels.

2. Dénomination

Installation d'un équipement de télématique embarquée et accès aux analyses comportementales par les conducteurs et par les gestionnaires de flotte.

3. Conditions pour la délivrance de certificats

Les équipements de télématique installés fournissent les données minimales suivantes :

1. la consommation du véhicule ;
2. le kilométrage ;
3. l'utilisation de l'accélérateur ;
4. l'utilisation des freins ;
5. le régime moteur ;
6. les temps d'arrêt avec moteur fonctionnant.

4. Durée de vie conventionnelle

4 ans.

5. Montant des certificats en kWh cumac

Type de véhicule	Montant en kWh cumac par opération de télématique installée
Véhicules légers	2 000
Véhicules utilitaires légers	2 900
Poids lourds	33 000
Autocar ou autobus	19 000

Driver Focus – Form N° 1 Implementing an Eco-Drive Programme (EDP) SUMMARY FORM


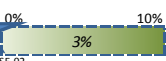



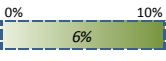







Action description

The principal purpose of an EDP is to modify driver behaviour, so that they adopt an ongoing fuel savings focused attitude.

Different levels can be reached in an EDP: a first acquisition of Eco-Drive principles (first training level), followed by ongoing update of the initial training (ongoing training level), and finally integrating the driving style savings in the driver management process (Eco-Drive Management, EDM).

Domain of relevance

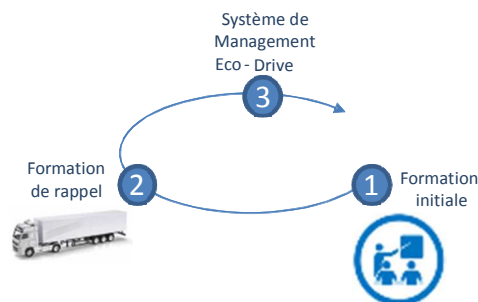
This action is appropriate to all drivers.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Eco-Drive training first step  Eco-Drive training session, start point of the whole Eco-Drive Program				
Recurrent Eco-Drive training Recall training sessions, sensitizing in order to keep the savings acquisition already achieved				
Eco-Drive Performance Management Training Implementation of a sustainable Eco-Drive Management System, on a long term basis, preserving savings made in future time				

Nota Bene: the introduction section of the document provides all details on chosen hypothesis

¹ For more information, please refer to the form "Certificats d'Economies d'Energie" annexed to the present form

Illustrations



Source: ADEME

Driver Focus – Form N° 1
Implementing an Eco-Drive Programme (EDP)
DETAILED FORM

Context and Regulatory measures

Mandatory Training

Since 1995, drivers from the public transport of merchandise sector have to follow mandatory training sessions on quality, safety and work conditions. Instruction of November 8th 2004 has broadened this training programme to the drivers of all companies making private (for their own account) transportation, whatever their activity.

If the French regulation system does not make – as such – Eco-Drive mandatory, ED notions are included in mandatory training such as ongoing training programmes.

As a reminder, two training cycles exist, both are mandatory for drivers:

Initial Training (Formation initial minimum obligatoire, “Mandatory Minimum Initial Training”) which is intended for all incoming people wishing to become professional drivers or dedicated to driving vehicles of more than 7.5 tonnes MGW. Mandatory initial training is a 140-hour cycle.

Ongoing Training (Formation continue obligatoire, “Mandatory Continuous Training”) is intended for all personnel already holding a professional driving license or driving vehicles of more than 3.5 tonnes MGW. This training session must be attended every other five years. As from September 10th 2008, the date of the implementation of the European Instruction 2003/59/EC of July 15th 2003, ongoing training time has been extended from three to five days.

This Instruction has been adapted under French Law with Decree N° 2007-1340 of September 11th 2007 relative to initial and ongoing training, and training content has been specified in the January 3rd 2008 law. One of the four main subjects covered by the ongoing training programme is called “Improving Rational Driving, based on safety rules”, an 11-hour course of which six hours are dedicated to enhancing driving skills.

The following points are covered:

- Taking into account the technical specificities of the vehicle;
- Improving for a safe and economy-oriented driving style, onboard telematics capabilities and optimizing fuel consumption;
- Loading, lashing, respect of instructions, using the vehicle in an appropriate manner;
- Practical driving in both normal and difficult situations.

While the Eco-Drive Programme subject is covered in ongoing training (within an inter-operator regulatory formatted training, not adapted to the specific needs of each operator), this ongoing training does not necessarily respect the standard conditions of an Eco-Drive Programme as defined in the solution N° 1 above (Eco-Drive Programme).

Moreover, the ongoing training programme does not cover LCV vehicles.

Eco-Drive Programmes, tailor-made and usually organized in intra-operator instruction modules, are organized and adapted to transport companies alone.

Two ESC sheets exist for EDP (ESC N° TRA-SE-01), intended for LCVs and heavy-duty vehicles (see the ESC sheets annex to the present Form): calculation of the associated savings is based on 3% savings, year following the training and 0% the following years (except if the driver follows a recall training session).

Please see the ESC sheet in annex.

Status and special training for urban delivery drivers

To this day, no mandatory training exists for delivery drivers that hold a “B” type driving license.

At the same time a high demand for this type of specific training can be observed from the urban deliveries transport community, as well as for defining a real status and training dedicated to the “delivery driver in urban cycle”, which would define good practice and the prerequisites needed for urban deliveries, with a real commitment on behalf of drivers on different aspects of the trade (various types of users found on the roads, how to adapt to other road users, etc.) and on the regulations specific to the delivery process (use of the roads, lanes of circulation, parking, offloading, etc.).

In order to make up for this training gap, some delivery companies using LCVs have taken the initiative of organizing a dedicated driver’s diploma, usually with the cooperation of a training centre. This diploma, for which the curriculum is often certified by State authorities, allows bettering the consideration that is given by customers to the drivers of the transport firm.

Even if the specific urban delivery training cycle does not concern the Eco-Drive Programme as such, it would constitute an important way of raising awareness among both drivers and operators, and multiple benefits could be taken from it: reducing aggressive driving, sharing the road with other users on urban profiles, managing stress at the wheel, reacting to emergency situations. Above all, granting professional status to the trade of urban cycle delivery driver (regional and national), would contribute to nationwide harmonization.

Regional authorities, the State and professional bodies all have a decisive role to play in giving birth to such a status, and in determining the conditions of acquisition of this status.

With estimated duration of a week initial training for drivers of LCVs (≤ 3.5 tonnes MGW) will be centred on three subjects:⁵⁸

- Basic acquisition knowledge of the driver of an LCV
- Implement the good practice of driving focused both on safety and rational driving techniques
- Professional behaviour appropriate to the environment.

The chart below indicates the breakdown of the instruction modules.

Subject	Duration
Opening welcome and presentation of the training session	1 h 00
Enhancing rational driving focusing on safety regulations	13 h 00
Respecting regulations	10 h 30
Health considerations, road and environmental safety	7 h 00
Service, logistics	2 h 00
Knowledge appraisal and training debriefing	1 h 30
Total duration	35 h 00

⁵⁸ Source: AFT-IFTIM.

Solution 1: Eco-Drive first step training

How does it work?

Initial Eco-Drive training is the first step for developing a full Eco-Drive Management (EDM) Programme. It is a voluntary programme based on the operator's initiative, and is distinct from mandatory professional training (initial and ongoing). An Eco-Drive Management Programme is articulated around a theoretical part (indoor lectures) completed by a practical part (driving a vehicle).

It must take into account the following aspects:

The theoretical part consists in bringing to drivers the necessary awareness as to what is at stake when we speak of Eco-Driving and also on the various ways to achieve a thrifty driving style.

The subjects approached must be the following:

- Recalling of what is at stake when talking about CO₂ and transport, the importance of the fuel budget in a transport operator's global cost structure
- Presenting the technical specifics of modern engines : principles of engine basics: torque, power, fuel consumption, injection, Euro Norms, etc.
- Presenting the technology parameters of the vehicle: gear box and power train, aerodynamics and tyres, etc.
- Presenting all the tools contributing to fuel reduction: gearbox handling, acceleration, anticipation rules, outlook of the vehicle, using the air conditioning and the heating systems, limitation of engine idling situations, etc.

The practical part of the training is organized around four Focuses:

- A first observation of the driver part, by an experienced professional, together with data recording of the driving sequences (time, fuel consumption, engine and braking sequence records) on a predefined route.
- Secondly, a close study of the driver's behaviour and attitude in the course of his trade: modifications to be made, communicating the necessary technical information for the driver to become aware of the logic behind the behaviour changes to be made.
- Phase three of the driving is a part with comments, on exactly the same route section where the driver drove in his own style, in order to practice all the techniques studied.
- A final phase of positive re-enforcement of the savings made.

This practice phase allows the driver to observe in a very pragmatic manner the effects of the Eco-Drive Management Programme on fuel consumption.

It can be completed by the use of calculation modules that record consumption parameters and illustrate the difference between the before and after Eco-Drive training implementation, and the effect on fuel consumption.

It is important to focus the driver's attention on the equipment that he will find when he returns to his daily driving tasks, and on which he will have to act.

Impact on fuel consumption and emissions of CO₂

The Benchmarking Energy Efficiency in Transport (BEET) project that was realized by the AFT-IFTIM school (in partnership with NEA and with the cooperation of Renault Trucks) quantified the savings realized using the Eco-Drive techniques while operating heavy-duty trucks.

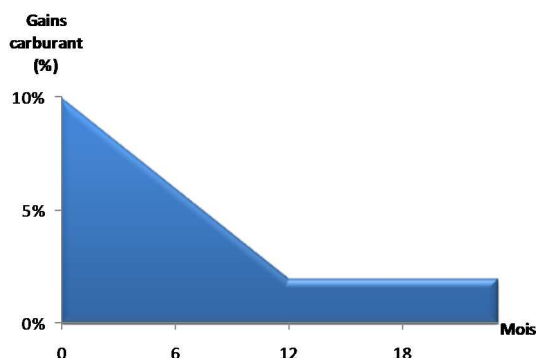
Further to training, an average reduction of fuel consumption of 5.25 litres/100 km was observed. Taking into account the diminishing savings over time, the BEET report made a conclusion of a potential permanent savings of between 3.5 to 4 litres/100 km, however under the absolute condition of organizing regular and updated trainings.

The savings represent about 10% fuel reduction, given 35 litres/100 km as an average consumption (corresponding to an articulated 40-tonne truck).

It can be considered that the first level of the Eco Drive Management Programme training generates initial significant savings of between 5% and 15% (10% average) according to the type of activity in transport.

It is those activities where gear changes are the most frequent (such as public construction work transport or urban routes) which have the greatest savings potential.

These savings will fall off nearly completely (80%) in the year following the training if no regular complementary training is organized (recall training or setting up a future proper Eco-Drive Management Programme).



Average savings for the first year are 6% then 2% the two following years, i.e. an average 3% on the three years considered.

In the case of LCVs, ESC sheet TRA-SE-02 entitled “Training an LCV driver in Eco-Drive techniques” covers internal private fleets. In order to grant an initial training certificate, organized by the transport operator or by an appointed training entity, training must include a theoretical part integrating engine operations and Eco-Drive principles (anticipation and appropriate usage of the mechanical parts) as well as a practical part at the wheel of the vehicle.

In the case of in-house training not delivered by an appointed training body, it is mandatory to validate both the theoretical and practical parts of the training programme developed. In practice, the savings associated with Eco-Drive training will mostly depend upon the use of the vehicle (long-distance on-call transport, preplanned delivery routes), its maintenance programme, age and of course the driving style of the professional at the wheel.

For certain types of drivers, with initially nonconventional and nonrational styles, final savings may amount to 15%.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Average 3 years savings (% fuel consumption in litres/100 km)
LCV Light Commercial Vehicle	Urban	≤3.5 t	3%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Domain of relevance

This solution is adapted to all drivers.

Implementation

Prior to the training session, it is necessary to organize a follow-up of the consumption of each driver, measuring the savings made after training.

Several training bodies offer Eco-Drive training sessions, focused on heavy-duty truck drivers. These training modules are specific. Some are organized on an inter-operator basis: in which case they are held on the premises of the training operator, using their own fleet of “school” vehicles when driving.

Others are organized on intra-operator basis, using the site of the transporter and his fleet of vehicles, placed in operational conditions, as close as possible to everyday operations. In that sense, it can be said that the specific in-house training sessions are more efficient than the inter-operator ones.

The duration format of these modules is usually of 1 to 1.5 days, and the cost between €300 and €500 per day/trainee.

Training bodies also offer training sessions focused specifically on the transport operator’s own coaching personnel (train the trainer programmes). Disposing of one or several trainers is particularly relevant, and the bigger the size of the fleet, the more so.

A shared instructor can also be a solution, transport operators grouping themselves and sharing the cost of the trainer who can then lecture for each of them. In order to maintain a high level of fuel saving performance, it is strongly recommended to go beyond initial training (i.e. solutions 2 and 3).

Given the savings and cost mentioned above, this solution has a short ROI time (<1 year) and feasibility is good: training offers are abundant and can be implemented rapidly.

Moreover, transport companies can integrate these trainings into their official Annual Training Plan: thus a part of the expenses will be partly or totally financed by government funding (for more information, contact the Organisme Paritaire Collecteur Agréé, OPCA).

Follow-up of the solution

Follow-up indicator:

- % of the drivers who received initial Eco-Drive Training (%).

Practical data collection process:

- Managing the follow-up training sheets of the drivers.

Solution 2: Eco-Drive regular follow-up training

How does it work?

Considering the fact that, when no regular follow-up training is organized, fuel consumption savings rapidly disappear, it is important to maintain transport operator savings level via follow-up training sessions as well as communication “pep talks” on some focused aspects.

Training personnel estimate that a once yearly follow-up training session is optimal. To remain efficient, those drivers showing the loss of benefit of Eco-Drive training must be called in first for another training session. At the moment specific programmes for these follow-up sessions do not exist, i.e. for drivers who have already followed initial Eco-Drive training. In the case of companies with a significant fleet that allows creating a trainer’s job internally, the best solution is certainly to organize permanent sessions with trainers that already know the driving performance record of each driver.

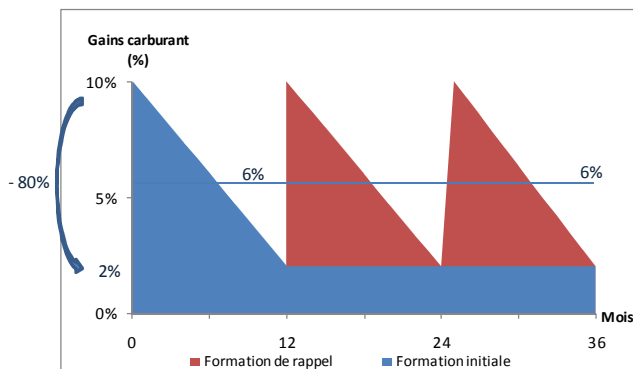
The trainer can dispense his advice in a personalized way, given the strengths and weaknesses of each driver. Onboard electronic modules will also help driving technique acquisition. Directly plugged into the engine they will inform the driver on his driving style and will give him a first level of advice (i.e. ACTION-FORM FUEL FOCUS N° 3, “Enhancing the follow-up of fuel consumption”, Solution onboard telematics). These systems will of course not replace the expertise and assistance of an Eco-Drive trainer.

Beyond the follow-up Eco-Drive training sessions, actions dedicated to awareness of the specific points which have been developed during the training sessions can be organized, e.g. engine idling, optimizing air conditioning usage, checking tyre conditions, etc. (please see the implementation section).

Impact on fuel consumption and CO2 emissions

Just as in the case of initial Eco-Drive training sessions, immediately after training 10% savings are obtained, and then diminish during the year after training.

By reinforcing pep talks on engine idling, air conditioning uses, an average savings of 6% can be maintained during three years.



Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Average 3-year savings (% fuel consumption in litres/100 km)
LCV Light Commercial Vehicle	Urban	≤3.5 t	6%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Domain of relevance

The follow-up training sessions are aimed particularly at drivers where a close follow-up has been set in place and whose initial savings have been vastly impacted and diminished with time.

General pep talks, focusing on certain specific aspects, can be organized.

Implementation

Even more than at the initial training session level, the implementation of a close follow-up of fuel consumption per vehicle and per driver, is necessary in order to organize a constant training scheme, where the training will be well adapted to the needs of each driver.

Training firms that offer initial Eco-Drive training usually offer follow-up modules.. The cost of this training is similar to the first stage. As mentioned before, internal trainers will prove to be the most efficient approach. Apart from pure driving techniques, drivers must be aware of the use of other process like reducing engine idling situations and the appropriate use of the air conditioning.

Such subjects are often considered of less importance during training and in some cases, forgotten all together, although they do present a very important savings potential.

Equipment supporting Eco-Drive Management

Individual and easy to use Eco-Drive aids can be used allowing the driver to get instant data feedback on his fuel consumption, according to his driving style. The device supplies the driver with information on the braking style, the right direction taken, congested traffic ahead.

The driver can also be made aware of his "Eco-Drive Scoring". These devices are very precious for LCVs where inappropriate acceleration is totally prohibitive in terms of fuel use, and their "Cx" aerodynamic coefficient is usually high.

This system easily allows 10% savings on fuel consumption. Cost is about €40/vehicle (portable applications, developed standard on mobiles). For LCV drivers, this system will permit drivers to ease tension during their urgent calls or deliveries in urban cycle profile, taking curbs at appropriate speed, saving on tyre wear and tear.

Operators will, however, have to check the social acceptability of these tracking systems, which are often perceived with mistrust by drivers.

Optimizing the usage of air conditioning systems

Use of air conditioning in vehicles increases greenhouse gas emissions for two reasons:

- Operating air conditioning systems needs a compressor, powered by the thermal engine of the vehicle, which increases fuel consumption (and thus CO₂ emissions): studies have shown that the permanent use of air conditioning systems increases the average consumption by 1 litre to 1.4 litre/100 km, records based on one year usage.⁵⁹
- Air conditioning circuits are not perfectly airtight and the refrigerant fluids that leak are very harmful greenhouse gases, their global warming power can be between 1 000 and 3 000.⁶⁰

A simple communication action can be sufficient to implement this action. It could also be made formal by writing out an internal booklet or integrated into a training session on Eco Gestures and Practice. This training can be focused on very basic professional practices:

- Park in the shade when possible;
- Open windows for the heat to leave the cabin before switching on the air conditioning;
- Have all windows shut as soon as the air conditioning is working;
- Do not set the air conditioning to more than 4 °C or 5 °C below outside temperature;
- When heat is bearable switch off the air conditioning;
- Recycle the air of the cabin when it is extremely hot outside.

Given the cost and the savings estimates above, this solution has a rapid ROI time. Its feasibility is considered intermediate, because it does make it compulsory for a special organization inside the transport operator (close follow-up of the fuel consumption and if need be, internalizing the training function).

As for initial Eco-Drive training, this training can be integrated into their official Annual Training Plan scheme. In doing so, transporters will be totally or partly financed by government funding (for any additional information please check with your local OPCA organism).

Follow-up of the solution

Follow-up indicator:

- % of drivers having followed a follow-up training session and attended specific pep talks (in %).

Practical follow-up process:

- Monitoring the driver's training files.

⁵⁹ Refrigeration power units and air conditioning, ADEME, 2006

⁶⁰ Global Warming Power (GWP) is the impact on climate change caused by greenhouse gases as compared to the CO₂ effect. For example, a GHG gas with a GWP of 1 000 will have 1 000 times more impact than CO₂, which means that emission of 1 kg of this gas will have the same effect as 1 tonne of CO₂.

Solution 3: Eco-Drive Management performance programme

How does it work?

In order to secure Eco-Drive savings over the long term, it makes sense to go beyond initial training and communication steps.

In order to durably change driver behaviour, the transport operator management must fully integrate this principle in daily routine, preventing Eco-Drive objectives from coming into conflict with other objectives pursued by the driver (service level, on-time deliveries or pickups), and in fact valued by other parameters such as the driver's positive esteem reinforcement inside the transport operator and adequate wage level.

Various incentive solutions can be implemented in order to integrate fully Eco-Drive into the operator management style; the list below is by no means exhaustive:

- A weekly and monthly review of the fuel consumption of each driver, including an individual communication if the figures are rising;
- Display all drivers' fuel consumption curve, showing the individual and average trend for each driver;
- Putting in place individual fuel consumption reduction schemes, with if needed, a specific support programme for each driver (additional training, equipment, etc.);
- Setting up a global fuel reduction objective within the operator;
- Organizing an Eco-Drive challenge inside the operator, in order to encourage emulation:
 - Set up objectives per truck category (truck and activity performed);
 - Display driver's individual results on a quarterly basis;
 - Annual perks and incentives for the drivers with the best performance, by category.
- Financial rewards for drivers, taking their performance into account, or a global incentive programme with all drivers involved, aimed at two groups: drivers and administrative personnel.
The rewards could be a bonus amount, reaching the level of a full month's salary, based on three performance items: fuel consumption, the yearly accident profile of the vehicle (with fewer than four recorded incidents yearly, attributable directly to the driver), and the cleanliness of the vehicle, outside and inside the cabin.

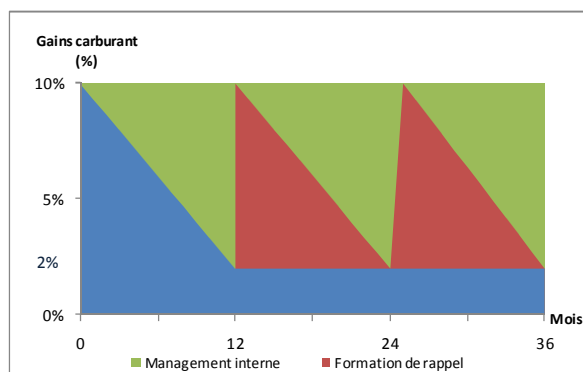
The ongoing training acquisition system fighting knowledge obsolescence, by creating a link between the training event and the job description, can also maintain Eco-Drive savings over the long term. In such a context, drivers do not wait for their individual fuel consumption to start drifting upwards, their follow-up training is already programmed upstream.

This iteration of information inside the workplace (after three or four iterations, information is fully integrated by drivers in the learning process) optimizes knowledge acquisition: repeating without impacting the hours of work (online solutions during short periods and with high frequency), repeating with training diversity (using different angles of approach), personalized follow-up sessions (moving from one subject to another according to the learner's capacity to integrate data) and long-term repeating scheme granting credit points as well as attendance and level of knowledge points, which are later transformed).

Impact on fuel consumption and CO₂ emissions

Setting up an Eco-Drive Management programme will support the training's positive effects in the long term, "protecting" the initial savings made.

A 10% durable savings level (yearly average) can be achieved.



Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Average 3-year savings (% fuel consumption in litres/100 km)
LCV Light Commercial Vehicle	Urban	≤3.5 t	10%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Domain of relevance

This solution is appropriate to all professional drivers and transport companies.

Implementation

In order to achieve maximum efficiency, this solution can be coupled with an human resources policy and general management directives. The system of perks or incentives programmes must be coherent and consistent with the general policy of the operator.

Given the cost and savings estimates mentioned above, this solution has a rapid ROI time. Feasibility is between intermediate and complex, because it needs permanent management focus, as well a project centred around the Eco-Drive Management Programme, which demands employee participation and a change from the "business as usual" attitude.

Follow-up of the solution

Follow-up indicators:

- Description of the follow-up level of the Eco-Drive Management Programme;
- % of the Eco-Drive savings redistributed to the drivers (in bonus money).

Information sheets: Energy Savings Certificates for Eco-Drive training for drivers



Certificats d'économies d'énergie

Opération n° TRA-SE-01

Formation d'un chauffeur de transport à la conduite économique

1. Secteur d'application

Transport routier professionnel.

2. Dénomination

Formation d'un chauffeur à la conduite économique.

3. Conditions pour la délivrance de certificats

La formation, réalisée par une entreprise ou un centre de formation agréés au titre de la formation professionnelle, comporte :

- une partie théorique portant sur le fonctionnement du moteur et les principes de la conduite économique (anticipation, juste sollicitation de la mécanique) ;
- une partie pratique sur véhicule comprenant une analyse commentée de la conduite de la personne formée.

4. Durée de vie conventionnelle

3 ans.

5. Montant de certificats en kWh cumac

Type de véhicule	kWh cumac / personne formée		Nombre de personnes formées
Véhicules destinés au transport de marchandises de catégories N2 ou N3	15 000	X	N
Véhicules destinés au transport en commun de personnes de catégories M2 ou M3	8 500		

Les catégories de véhicules se rapportent à l'article R. 311-1 du Code de la route.

Information sheets: Energy Savings Certificates for Eco-Drive training for drivers (passenger cars and light utility vehicles)



Certificats d'économies d'énergie

Opération n° TRA-SE-02

Formation d'un chauffeur de véhicule (voitures particulières et camionnettes) à la conduite économique

1. Secteur d'application

Flottes professionnelles de véhicules répondant à la définition des voitures particulières ou camionnettes selon l'article R. 311-1 du Code de la route.

2. Dénomination

Formation d'un chauffeur à la conduite économique.

3. Conditions pour la délivrance de certificats

La formation, réalisée par une entreprise ou un centre de formation agréés au titre de la formation professionnelle, doit comporter :

- une partie théorique portant sur le fonctionnement du moteur et les principes de la conduite économique (anticipation, juste sollicitation de la mécanique) ;
- une partie pratique sur véhicule comprenant une analyse commentée de la conduite de la personne formée.

4. Durée de vie conventionnelle

3 ans.

5. Montant de certificats en kWh cumac

Type de véhicule	kWh cumac / personne formée		Nombre de personnes formées
Voitures particulières	4 200	X	N
Camionnettes	3 300		

Driver Focus – Form N° 2

Savings-focused attitudes and good practice in relation to temperature-controlled transport

SUMMARY FORM

Action description

Various good practice attitudes can be adopted by the drivers of temperature-controlled trucks, apart from the vehicle driving style itself, alternative technological solutions for standard refrigeration power units (VEHICLE ACTION FORM N° 10) and specific equipment (VEHICLE ACTION FORM N° 11).

It is wise to implement a good-practice programme within the transport company, focused on refrigerated units, especially the number of door openings and controlling the duration of the door opening sequences.

Domain of relevance

This action is appropriate to all drivers and all temperature-controlled transport companies.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Limiting door openings and door-opening sequences	0% Variable 10%	> 3 years Variable <1 year	Difficult Easy	LCV RS RL SE MI
Sensitizing drivers to what is at stake in terms of cold volume loss, during door-openings sequences				
<i>Nota Bene: the introduction section of the document provides all details on chosen hypothesis</i>				

Illustrations



Source: VitTransport



Source: Hellopro

Driver Focus – Form N° 2
Savings-focused attitudes and good practice in relation
to temperature-controlled transport
SUMMARY FORM

Context and regulatory measures

Action based solely on the behaviour of the driver (apart from driving techniques) is already covered in some Eco-Drive programmes, however attitudes related to temperature-controlled activity are rarely analysed during these training sessions. It is therefore appropriate for transport companies in this sector to set up and organize communication action that will act as a reminder on environmental and economic issues at stake, and that are directly associated with the driver's behaviour.

To complete these training sessions, special equipment can be implemented, such as air curtains or strip curtains, and door opening sensors. This equipment is shown in Solution 1 "Specific equipment to reduce cold air leaks" ACTION FORM N° 11 of the VEHICLE FOCUS "Temperature-controlled specific equipment and maintenance". A certain number of additional controls relative to maintenance are presented in solution N° 2 "Refrigeration equipment maintenance" of the VEHICLE FOCUS FORM N° 11 "Temperature-controlled specific equipment and maintenance".

As a complement it is useful and makes good sense to consolidate all the best practices identified by the transport operator, in a guide describing proactive economical attitudes and good practices.

Compiling such as guide is also good business sense, since all associated savings are cumulative (all actions are independent from each other).

Solution 1: Limiting cold air leakages during compartment opening

How does it work?

Frequent and long-lasting openings of the body compartment can generate important cold air leaks, if nothing is done to reduce them. In order to maintain all the products at a certain temperature, it will be necessary to produce more cold air after each door closing. Various solutions can be put in place to reduce these losses. Some are directly linked to routine work loading habits, but also to the drivers during product delivery cycles. The first reduction lever the driver can operate is limiting – whenever it is feasible – the opening times of the refrigerated body compartment, limiting the exchange of air between the inside of the truck and outside air. With that in mind, one solution is to train drivers to optimize loading and offloading times. For example, the initiative of organizing the loading sequence per customer served, but in the reverse order of deliveries (load last the products to be delivered first) will facilitate access to the body compartment and will reduce the offloading sequence time, thus the door-opening time. The second lever on which to act is to switch off the refrigerated power unit before each door-opening, in order to stop the warm air volume acceleration inside the body compartment. It has to be noted that the power unit sucks the air from inside the refrigerated compartment. Therefore, at each door-opening, the depression generates an acceleration of the incoming warm air flow.

Impact on fuel consumption and CO₂ emissions

Limitation of the openings of the compartment will in turn reduce the power unit use and therefore reduce the associated energy needed.

The link between the power unit working and the body opening will depend on several parameters: difference between outside and inside temperatures, total surface of the openings, equipment reducing the loss of cold air volume, etc. It is not possible to forecast the impact of the savings of the solutions in terms of fuel consumption or CO₂ emissions. However, by tracking refrigeration power unit fuel consumption, it will be possible to follow the reductions of consumption associated with this action.

Domain of relevance

This solution is applicable to all temperature-controlled transport activity.

Implementation

Communication can be integrated into the learning programme performed either by an external operator, or performed by an internal trainer. Taking into account the variable savings associated to this action, the ROI time will have to be analysed for each particular case. Furthermore, apart from the behaviour modification from the drivers, this action is rather simple to implement. Feasibility will be between easy and intermediate.

Follow-up of the solution

Follow-up indicators:

- Number of drivers to whom communication “pep talks” have been given;
- Refrigeration power unit consumption, before and after this action (in litres/hour).

Practical data collection process:

- Monitoring the driver training programme.

Organization of transport flows Focus – Form N° 1
Using non-road surface modes (Sea, Waterway, Rail)
SUMMARY FORM




Action description

Enhancement of the environmental aspect of merchandise transport cannot be done without intrinsic optimization of road transport in general, but also requires making use other modes such as the railways, the national river network and maritime shipping.

Of course, each transport mode has its strengths and weaknesses. Using a combination of these modes is a way to balance, in some cases, cost constraints, quality of service and environmental impacts.

Domain of relevance

This action is appropriate in particular for medium and long-haul distances, in order to balance routes between one-way and return volumes, making use of the infrastructure and service offers when they are available.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	
Using combined Sea-Road modal transport Using Maritime solutions as a complement to road transport	0% 100% 16%	> 3 years <1 year Variable	Difficult Easy	
Using combined River-Road modal transport ¹ Using River network solutions as a complement to road transport	0% 100% 48%	> 3 years <1 year Variable	Difficult Easy	
Using combined Rail-Road modal transport ¹ Using Rail solutions as a complement to road transport	0% 100% 94%	> 3 years <1 year Variable	Difficult Easy	

Nota Bene : the introduction section of the document provides all details on chosen hypothesis

¹ For more information, please refer to the form "Certificats d'Economies d'Energie" annexed to the present form

Illustrations



Organization of transport flows Focus – Form N° 1 Using non–road surface modes (Sea, Waterway, Rail) DETAILED FORM

Context and regulatory measures

Road transport of merchandise is today the dominant mode in the internal flow of trade nationwide, in France. In 2009, it represented close to 88% of the road surface traffic (pipelines excluded), rail had a 9.9% share and river transport 2.3%.

Modal split for merchandise (including transit)									
	1985	1990	1995	2000	2005	2006	2007	2008	2009
Road Transport	66,9	76,5	81	81,3	87	87,4	87,6	87,4	87,9
Rail Transport	29,2	20,6	16,9	16,6	10,9	10,6	10,6	10,6	9,9
Waterways	4	2,8	2,1	2,1	2,1	2	1,9	2	2,3
All modes combined (Gt-Km)	192,1	253,3	284,8	347,5	373,1	389,1	403,5	382,3	325,9

Source : MEEDDM/ Transport figures 2009(annex M2) Soes, VNF; Soes calculation

Study field: excluded oil pipelines, LCV's less than 3,5 Tons and Heavy Duty Trucks running under foreign flag.

For the remainings modes, Tons.Kilometres have been achieved on the French territory (inland transport), transit volumes excluded.

This dominant position has been gained thanks to flexibility, dependability and competitiveness. The high quality of the French road network, transport flow groupage reduction, and oil that was at the time cheap, were also major contributing change factors that supported road transport mode growth.

However, all the major actors of the transport world, road transport operators included, have to face challenges that they already need to anticipate:

- They are dependent on a nonrenewable fossil energy – oil – that is bound to become scarcer and that follows an increasing cost trend, year over year.
- Roads are gradually congested.
- Major challenges are to be faced in terms of greenhouse gases and pollutants.
- One of the Grenelle environmental forum objectives is to encourage all non-air and non-road transport modes, increasing their share from 14% today to 25% in 2022.

It can be observed that railway, river and maritime modes consume less fossil energy, allowing easing up of traffic density on major road routes, and their emissions of GHG and pollutants per t.km are less than the road and air transport modes.

However, these transport modes also have a less dense network infrastructure than the road mode network.

That is why on certain routes, combined modes of transport can be used. At least two different modes are to be utilized within the same transport chain, where due to the use of Intermodal Transport Unit (ITU) or semitrailers, there will be no disruption of the merchandise logistic chain. Major route segments are operated by rail, river or by sea, and pre- and postpositioning segments of the travel are operated by road.

Choosing a combined transport solution is a strategic move on the part of companies. Upstream, it is recommended to carry out a logistics **efficiency feasibility study**.

To start with, every transport flow has to be identified in terms of distances, merchandise types transported, technical constraints, frequency of service and transport deadlines. Then, the relevant flows of transport can be identified, and served by combined transport modes.

For this reason it will be necessary to get thorough knowledge of:

- Combined transport main actors (operators, road operators in charge of pre and postpositioning, rental equipment rental operators, etc.);
- Regulatory opportunities like the capability of using 44-tonne MGW vehicles;⁶¹
- Existing services and networks offered;
- Techniques and equipment involved, etc.

The Internet site www.viacombi.eu which is a European platform of combined modes (rail, river, and sea), gather – all in one place – information required for shippers and operators to make a decision. Visual and practical sections (photos and videos) are available for free: useful contacts, techniques and equipment, examples of user companies, mapping tool of the terminals and links served, comparative CO₂ calculator, etc.).

⁶¹ Article R.312-4 of French Road Regulations gives a definition of the specific cases of using a vehicle for which Gross Combined Weight can be over 40 tonnes (not exceeding 44 tonnes). This is the case for combined transport, rail highway or maritime and river ports as well as agricultural and agro foodstuffs. It will be important to check on existing regulations which integrate specific road conditions of 44-tonne vehicles.

Solution 1: Using combined modal sea-road transport

How does it work?

“Roll-on Roll-off” vessels also known as “Ro-Ro”, permit the loading of accompanied vehicles (tractor and trailer are forwarded) or non-accompanied (only the trailer part is being shipped).

The main difference with standard vessels is that they do not have to use cranes for cargo loading or offloading.



Impact on fuel consumption and CO₂ emissions

Merchandise transport using maritime modes (Ro-Ro or ferries) has GHG emissions of 28.6 and 85.2 gCO₂/t.km, on average, according to the type and power equipment utilized.⁶²

Considering the aggregated average emission factor of road transport in France for articulated 40-tonne trucks of 75.9 g CO₂/t.km, and the maritime transport with an optimized Ro-Ro mode of 63.6 gCO₂/t.km, CO₂ emission reductions stand at 16%.⁶³

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Making use of combined modal transport Sea-Road (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	16%

N.B. Emission factors for each mode are calculations based on a perimeter that go from “well to wheel” integrating: the upstream phase also called “well to tank” (representing the CO₂ emissions in CO₂ Equivalent for extraction, transport, transformation and distribution of the energy phases considered), and the usage phase, also called from “tank to wheel” (CO₂ emissions due to use of the energy).

Domain of relevance

This solution is adapted to all types of merchandise transport, using semitrailer (tractor + trailer) on routes according to the extended Ro-Ro vessel service, in particular sea crossings where maritime distances are shorter than road routes.

Implementation

⁶² “[Étude de l’efficacité énergétique et environnementale du transport maritime](#)”, report by MLTC and Tecnicas for MEDDTL/ADEME, 2009.

⁶³ “[Efficacité énergétique et environnementale des modes de transport](#)”, report by Deloitte for ADEME, 2005.

Using sea-road combined transport modes does not need specific equipment. Given the types of transport flows and organization, transport will be carried out:

- Either accompanied with the driver benefiting from time “off” when he is on the vessel;
- Or unaccompanied: drivers on each end of the travel segment will be able to utilize the tractor in an optimal manner, proceeding to other transport tasks. Only the loaded trailer is on board the vessel.

Concerning national territory, this solution will be appropriate for transport flows:

- Around the Atlantic arch (between a Portugal-Spain and France-Northern Europe line)
- on the Mediterranean arch (between Spain, France and Italy).

These lines are operated with scheduled frequencies between two ports and commercially exploited by maritime operators or ship owners (usually the actual owners).

For more information on scheduled lines operated and the various operators of this trade, please see

www.viacombi.eu and www.shortsea.fr

Follow-up of the solution

Follow-up indicator:

- % of combined sea-road transport mode in t.km

Practical data collection process:

- Follow-up of fuel consumption and kilometres performed by the pre- and postpositioning vehicles (upstream and downstream of vessel transport);
- Follow-up of the t.km figures for both road and maritime activities.

Solution 2: Using combined modal waterway-road transport

How does it work?

The most frequent configuration found is the expedition of maritime containers via the waterway mode between a maritime port and a waterway port. Pre- and postpositioning is operated by road or sometimes using rail. In which case the combined transport will be in the continuation of the maritime lines, using container-carriers.



Another type of transport chain, although less frequent, is now developing. Goods are loaded from the plant warehouse in containers or mobile containers and forwarded by road (or rail) to a waterway-road terminal. These ITUs are then transferred and forwarded by barge to the destination terminal. After they have been transhipped on a truck, they are delivered to the consignee(s).



Impact on fuel consumption and CO₂ emissions.

Transporting via the waterway network will emit between 25 and 51.2 gCO₂/t.km according to the waterway infrastructure and the power of the equipment (self-propelled barges, towboat).⁶⁴

Considering the average aggregated emissions figure of 75.9 gCO₂/t.km⁶⁵ of articulated trucks in France, and waterway transport emissions (all types of basin and equipment) of 39.1 gCO₂/t.km, the emission reduction is 48%.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Making use of combined modal transport Waterway-Road (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	48%

N.B. Emissions factors for each mode are calculations based on a perimeter that go from “well to wheel” integrating:

- The upstream phase also called “well to tank” (representing the CO₂ emissions in CO₂ Equivalent for extraction, transport, transformation and distribution of the energy phases considered)
- The usage phase, also called from “tank to wheel” (CO₂ emissions due to use of the energy).

⁶⁴ “[Etude sur le niveau de consommation de carburant des unités fluviales françaises – Efficacités énergétiques et émissions unitaires de CO₂ du transport fluvial de marchandises](#)”, report by TLA for ADEME and VNF, 2006,

⁶⁵ “[Efficacité énergétique et environnementale des modes de transport](#)”, report by Deloitte for ADEME, 2005.

Domain of relevance

This solution is appropriate for all types of merchandise, on transport streams that follows the major waterway basins in France (please see the Implementation section).

Implementation

Waterway transport streams are categorized by their clearance specifications (large, medium and small), and then by their class according to the heavy carrying capacity (maximum load capacities on waterway units) which can be allowed. Infrastructure and waterway networks are managed by Voies Navigables de France (VNF).

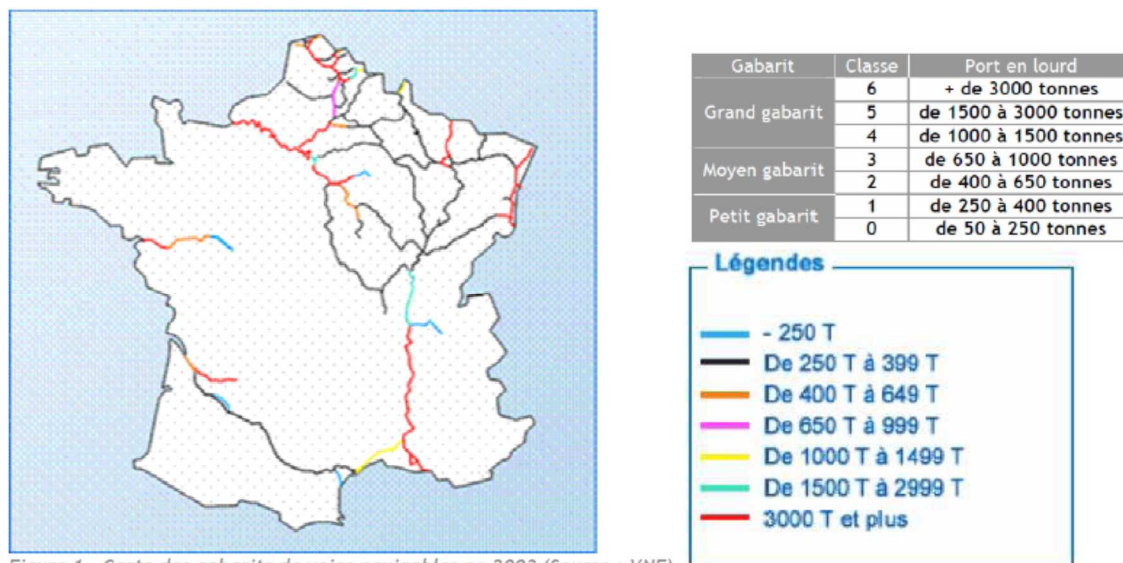


Figure 1 - Carte des gabarits de voies navigables en 2003 (Source : VNF)

Two types of road transport can be envisaged in the combined waterway-road transport:

1. Forwarding ISO-type of containers (20 ft. and 40 ft.) from and to maritime ports. In this case, the waterway operators that must be contacted are the ones running scheduled service on identified routes, between two ports. The operator has the same role as a ship owner. In general he is the actual proprietor of the waterway barges. A specific organization will have to be put in place, for the pre- and postpositioning using either his own vehicle and container frame, or via a subcontractor for the road traction part alone.
2. Massification transport merchandise from a production point or logistics platform, forwarded to a waterway port situated in an urban area, and then re-expedited by road. In which case, after having identified a waterway operator, ITUs will have to be bought or rented – specific mobile containers (financing can be obtained through the ESC scheme, please refer to the ESC information sheet annexed to this detailed form).

A special organization will have to be undertaken for pre- and postroad forwarding, either using the operator's own vehicles and container frame, or using subcontractors. For more information on the scheduled lines in operation, the different operators of this trade, different techniques and equipment, please see www.viacombi.eu or www.vnf.fr.

Follow-up of the solution

Follow-up indicator:

- % of use of combined waterway- road transport mode in t.km

Practical data collection process:

- Follow-up of consumption and kilometres travelled by the vehicles used in the approach segments to waterway port platforms;
- Follow-up of tonne.kilometres on the road mode and the waterway mode.

Solution 3: Using combined modal rail-road transport

How does it work?

In the **Rail-Road Combined Transport (RRCT)** of unaccompanied merchandise, goods are loaded from work plants or warehouses in containers, mobile containers or semitrailers and forwarded by road to a terminal. These ITUs are transferred and shipped by rail to the destination terminal. After they have been transshipped again onto a truck they are delivered to the consignee. Note also the technique called “light combined” (multi-cradle and polyrail as proposed to “Ecorail”) which does not need any transshipment platform.



By extension is also considered rail-road combined transport forwarding maritime containers via rail between a maritime port and a rail-road platform. In which case the combined transport is in the continuation of maritime lines using container-carriers.



The **RAIL HIGHWAY** mode (also called Road on Rail) belongs to the category of combined rail-road transport. Two configurations are possible:

- Accompanied mode (drivers, tractors and trailers travel in the train);
- The unaccompanied mode (where only the tractors or trailers are loaded, without the drivers).



Impact on fuel consumption and CO₂ emissions

Considering the average aggregated emissions figure of 75.9 g CO₂/t.km for 40-tonne articulated trucks in France, and the combined rail-road transport figure of 4.4 gCO₂/t.km,⁶⁶ CO₂ emissions reduction is 94%.⁶⁷

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Making use of combined modal transport Rail-Road (% of reduction of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	94%

N.B. emissions factors for each mode are calculations based on a perimeter that goes from “well to wheel” integrating:

- The upstream phase also called “well to tank” (representing CO₂ emissions in CO₂ Equivalent for extraction, transport, transformation and distribution of the energy phases considered)
- The usage phase, also called “tank to wheel” (CO₂ emissions for use of the energy).

⁶⁶ “Efficacité énergétique et émissions de CO₂ du transport ferroviaire de marchandises”, study for ADEME, 2006. Electric locomotives are employed for most rail traction for combined transport in France..

⁶⁷ “Efficacité énergétique et environnementale des modes de transport”, report by Deloitte for ADEME, 2005.

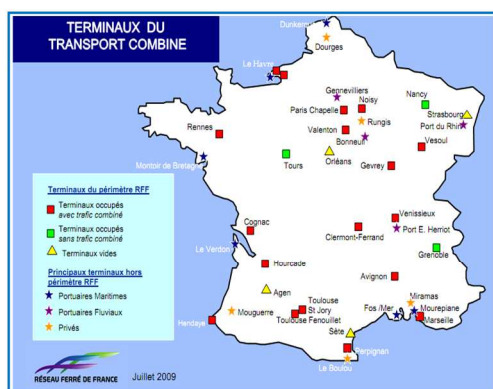
Domain or relevance

These rail-road solutions are appropriate to all types of merchandise and especially (but not exclusively) on >500 km long-haul distances, if possible with a load balance between outbound and inbound trips.⁶⁸

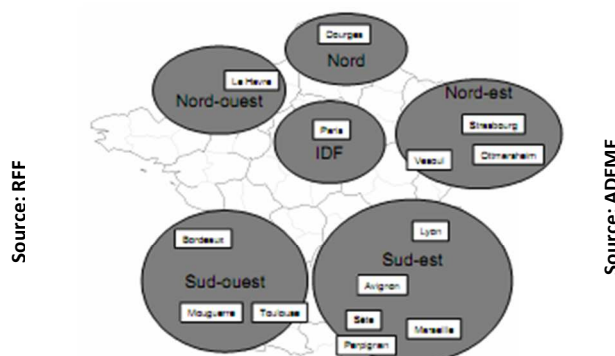
Implementation

The implementation and the rail network are managed by Réseau Ferré de France (RFF).

Two types of road transport can be envisaged for rail-road combined transport:



Terminals Map for Intermodal transport operations
<http://www.rff.fr/fr/le-reseau/cartes>



Main TCCR areas, map from Dashboard of combined Transport, ADEME, 2006

Two types of road transport can be envisaged for rail-road combined transport:

1. Forwarding maritime ISO containers (20 ft. and 40 ft.) coming from or sent to a maritime port.
2. Transport of merchandise (on pallets or not) between two industrial sites or logistics warehouses. In this case, ITUs will have to be bought or rented – mobile containers, specific containers or semitrailers equipped with lifting hooks (financing opportunities are available via the ESC mechanisms, for more information see the ESC information sheet annexed to the present detailed form).

A special organization will have to be put in place for the pre and postforwarding by road, either with the operator's own vehicles and frame or by subcontracting.

The road transport operator will contact combined transport running scheduled service on identified routes, between two rail-road terminals. These combined transport operators will manage the commercial aspects and operations of the rail transport and are situated at the terminals where the ITU transshipments are made. For more information on scheduled lines operation, the different operators of this trade, different techniques and equipment, please see www.viacombi.eu or www.vnf.fr.

Rail routes

The following chart represents the principal rail routes in Europe. Using the network does not make any specific equipment necessary. According to the service provided:

⁶⁸ "Tableau de Bord des Transports Combinés", ADEME, 2006.

Liaison	Système	Longueur (km)
Perpignan – Bettembourg (France – Luxembourg)	Modalohr	1060
Aiton – Orbassano (France Italie)	Modalohr	175
Freiburg – Novara (All. – Italie)	Petites roues	414
Basel – Lugano (Suisse – Suisse)	Petites roues	263
Singen – Milano (All. – Italie)	Petites roues	356
Wörgl – Brennersee (Autriche – Autriche)	Petites roues	94
Wörgl – Trento (Autriche – Italie)	Petites roues	233
Wels – Maribor (Autriche – Slovénie)	Petites roues	260

Main Rail Highways Lines in Europe, source MEDDTL



Source: MEDDTL 2011

France Rail Highways (in Red – Operational in Blue – Project in Green under study)

Using the network does not make any specific equipment necessary.

According to the service provided:

- Either accompanied; the tractor with the driver and semitrailer are transported on rail wagons. This is one feature of the Aitonne and Orbassano service (www.ferralpina.com),
- Either unaccompanied: only the semitrailers will be loaded on the wagons. A specific organization will have to be set up on pre and postroad forwarding, using the operator's own vehicles and frame or via subcontracting. Drivers situated at each end will make the most of the use of tractors in an optimal manner, since tractors can be assigned to other transport tasks at both ends. This solution is offered for the service between Bettembourg and Perpignan (www.lorry-rail.com), but also between Aitonne and Orbassano (www.ferralpina.com).

For more information on the scheduled lines in operation, the different operators of this trade, different techniques and equipment, please see www.viacombi.eu or www.rff.fr.

Follow-up of the solution

Follow-up indicator:

- Additional % of combined transport rail-road in t.km.

Practical data collection process:

- Follow-up of fuel consumption and kilometres covered by surface vehicles used in the approach to combined transport rail-road platforms;
- Follow-up of the tonne.kilometres travelled by road and/or by rail.



Certificats d'économies d'énergie

Opération n° TRA-EQ-01

Unité de transport intermodal (UTI)

1. Secteur d'application

Transport combiné rail-route appliqué au transport interurbain de marchandises.

2. Dénomination

Acquisition d'une unité de transport intermodal (UTI) neuve (caisse mobile ou semi-remorque à prise par pinces) dédiée au transport combiné rail-route (container maritime de type ISO exclu).

3. Conditions pour la délivrance de certificats

Codification de l'UTI effectuée par un opérateur de transport combiné rail-route.

Les voyages doivent se faire au départ ou à l'arrivée d'au moins un chantier de transport combiné localisé en France.

Relevé de trafic donnant le nombre de voyages réalisés en France par l'UTI concernée, sur une période d'essai de 12 mois consécutifs, à réaliser avant le dépôt de dossier de demande de CEE.

4. Durée de vie conventionnelle

12 ans.

5. Montant de certificats en kWh cumac

Longueur de l'UTI	Montant en kWh cumac / voyage
≥ 9 m	16 000
< 9 m	8 000



Certificats d'économies d'énergie

Opération n° TRA-EQ-07

**Unité de transport intermodal pour le transport combiné
fleuve-route**

1. Secteur d'application

Transport combiné fluvial-route appliqué au transport de marchandises.

2. Dénomination

Acquisition d'une unité de transport intermodal (UTI) neuve de toute taille dédiée au transport combiné fluvial-route, hors conteneur maritime de type ISO.

3. Conditions pour la délivrance de certificats

Le demandeur fournit à l'administration les éléments suivants :

- une copie des factures définitives d'acquisition des UTI et une copie de leur codification, effectuée par un opérateur de transport combiné ;
- un relevé de trafic, à réaliser avant le dépôt de dossier de demande de CEE, mentionnant le nombre de voyages effectués sur 6 mois consécutifs pour l'UTI achetée. Le relevé de trafic est certifié conforme par Voies Navigables de France. Les voyages doivent être réalisés sur le territoire français.

4. Durée de vie conventionnelle

12 ans.

5. Montant de certificats en kWh cumac

Ga x V

avec :

Ga = gain net actualisé du transport combiné en kWh cumac pour une UTI

Ga	Seine	Rhône	Nord Pas-de-Calais	Rhin/Moselle	Interbassin
Bateau DEK (1 000 t)	3 400	2 800	2 900	-	-
Bateau RHK (1 350 t)	7 200	6 800	3 600	-	5 200
Bateau Grand Rhénan (2 500 t)	7 700	7 100	4 200	3 700	6 000
Bateau Convois (4 400 t)	8 200	7 700	7 500	5 900	7 300

V = nombre de voyages relevés sur 6 mois sur l'UTI achetée x 2 (= nombre de voyages par an réalisés par UTI en transport combiné fluvial-route)

On considère que le trafic réalisé par les UTI sur 6 mois consécutifs est maintenu en moyenne sur la durée de vie des matériels.

Organization of transport flows Focus – Form N° 2

Route optimization using software management tools

SUMMARY FORM

Action description

Operational software tools available on the market allow for better organization of the various flows of merchandise, thus contributing to fuel consumption reduction as well as CO₂ emissions.

One can observe two types of software: one which allows the making of transport layout planning and one category will allow geopositioning of the vehicles.

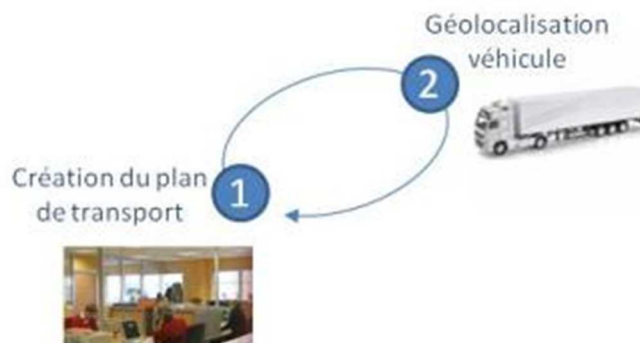
The first tool can be used upstream for route organization fine-tuning: the second type is an operational tool which allows instant route change design.

Domain of relevance

These tools are adapted to all types of transport. The more complex the transport plan and the more diversified the route profiles, the better.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Transport planning software	0% 10% 5% to 15%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI
Purchasing a Transport planning configuration software				
Geolocalization of vehicles software	0% 10% 1% to 10%	> 3 years <1 year	Difficult Easy	LCV RS RL SE MI
Purchasing a Vehicle Geolocalization software				

Nota Bene: the introduction section of the document provides all details on chosen hypothesis



Organization of transport flows Focus – Form N° 2
Route optimization using software management tools
DETAILED FORM

Context and regulatory measures

The fleet management software market consists of approximately 50 competitors, coming from the data processing or telecom sectors, as well as truck manufacturers who have an offer in the original version or via equipment retrofits.

Solution N° 2 “Geopositioning tools” is linked to solution N° 2 “Onboard telematics” of ACTION FORM N° 3 of the FUEL FOCUS relative to the follow-up and reduction of fuel consumption. Geolocalization can be proposed in the offer of telematics onboard systems.

Solution 1: Transport plan conception tools

How does it work?

Numerous solutions for optimizing delivery route planning now exist on the market. Interactive software exists which can be loaded with predetermined delivery constraints, taking into account the customers' expected delivery deadlines, vehicle payload and driver duty time management.

The delivery routes are organized according to the operator's own operation parameters, based on detailed geographic data, and integrate traffic profile specificities for heavy-duty truck operations (maximum height of bridges, tonnage constraints, etc.).

Impact on fuel consumption and CO₂ emissions

Implementing creative software for transport planning will support reorganizing delivery routes and reduces "non-revenue" kilometres. The following chart shows the types of savings that can be associated with this action and linked to reducing non-revenue kilometres.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Transport plan conception tools (in % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	5% to 15%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: ADEME

Domain of relevance

This solution is interesting in particular in the distribution sector (partial deliveries) and small package activity and when the delivery routes are complex and variable over time.

Implementation

The choice of the software is an important issue, which has to be carried out once customer needs have been well understood and written down on a precise specification chart. Four major steps can be considered:

1. Identification of needs (assessing the process, present and future needs);
2. Selecting the product and service software companies panel (market study, analysis of the cost to benefit for each examined solution, after-sales quality of service);
3. Implementation of the system (tests prior to launch, personnel training);
4. Follow-up and system enhancement (work in progress, adjustments to be made, etc.).



The acquisition of transport planning software has to be accompanied by focused and recurrent training, in order to get the maximum benefit out of the functionalities offered.

The primary objective is to train the users on the parameter settings of the software, according to the evolution of the trade, and then give 100% credit to the routes proposed, worked out by the system.

Everyday alteration attempts “based on experience” of the programmed routes will in fact lead to less performance and in the end, could eventually make the software useless.

While implementing such a tool, the role of the person in charge of route organizing will evolve: there is no point in “correcting” the software, but there is a point in getting to know better the operator’s organization and customers’ needs in order to find the right parameters upstream, in order to receive optimal suggestions from the software.

Cost is a very variable, and depends on fleet size.

The ROI time of such a tool creating transport planning is an intermediate one (1 to 3 years), both costs and savings are expected to be high.

It is therefore important to take into account that the ROI will depend on the management energy allocated to the deployment of the software, the follow-up and the training that precedes implementing this solution.

Due to the time necessary for the choice of an optimal solution, then for its implementation and the need for a general involvement of the operations personnel concerned, feasibility is intermediate.

Follow-up of the solution

Follow-up indicators:

- Follow-up of the number of routes which have been optimized;
- % of reduced non-revenue kilometres.






Practical data collection process:

- Follow-up of the software use;
- Analysing the distances made by the vehicles.

Solution 2: Geopositioning tools for vehicles

How does it work?

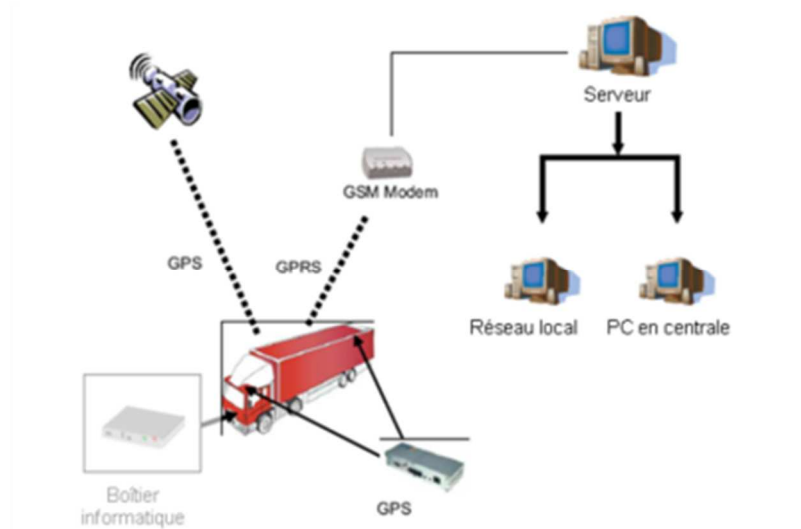
Different solutions for vehicle geopositioning exist:

-  • A mobile "GSM"; a simple mobile phone will make vehicle localization possible
-  • A "GPS/GSM" module which is the most common technology used in fleet geopositioning. A box receives the GPS receiver and a SIM badge. The GPS/GSM box can also be coupled with a "hands-free" Kit and a Personal Digital Assistant (PDA), i.e. a numeric assistant or an organizer.
-  • The PDA electronic agenda can be used to send and to receive data, through a telephone line (GSM, Wap or GPRS). Information is automatically transferred to a central server, as soon as the PDA is connected to its base.
-  • All tools allowing distant loading of the legal data transferred out of the chronotachygraph: these remote devices are available since the electronic version of the chronotachygraph has been introduced (remote identification with the badge of the operator) and can accept add-ons that will help geolocating.
-  • Onboard data treatment devices. Offer of products can serve as navigation aids and are equipped with a GSM and sometime a "hands-free" kit (on top tracking and surveillance functions of the vehicles).

A central monitoring system can be associated with geolocating the vehicles of the entire fleet. Three important features are associated with data centralization:

- Dynamic attribution of transport missions due to geolocalization: pickups can be attributed instantly to the vehicle which is situated nearest to the loading area, at any given moment.
- Readjustments can be made: a change of destination of vehicle A when vehicle B transporting the same load is closer to the delivery destination;
- Taking into account minute-to-minute road traffic conditions.

The scheme below shows the data exchange flows between each vehicle and the monitoring central system.



Data exchange scheme (GPS and onboard telematics)

Impact on fuel consumption and CO₂ emissions

Using these tools not only allows productivity savings, but also generates, under certain conditions, fuel consumption reductions. In effect fuel consumption will be reduced when vehicles limit non-revenue kilometres, or bypass a situation where the vehicle is caught up in traffic. For geolocalization to transform into real fuel consumption savings, information must first be available on time, in order to use an alternative route when traffic congestion occurs, the consumption fuel used by the new route used must be lower than the congestion consumption one.

Geopositioning tools are indeed simple to use. Apart from their obvious attractive features identifying congested traffic areas and shortening or bypassing routes, they also allow operations managers to observe routes used by the vehicles and debrief drivers accordingly on their choice, identifying eventual corrective measures to be made.

Moreover, some geolocalization software will indicate instantly, directly after input of the address of a new customer, where the nearest vehicle to the customer pickup point is.

These intelligent electronic roadmap systems allow in case of urban deliveries reduction of an estimated 10% of the monthly distance made by a vehicle, and a significant reduction on delivery times.⁶⁹ Fuel consumption savings are estimated to be of the same magnitude.

Fuel savings indicated in the chart below already integrate the distance reduction (estimated at 1% on the last three categories of vehicles) and the effect of bypassing congested traffic situations.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Geopositioning tools (en % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	10%
Rigid Small	Urban	3.6-12 t	2,5%
Rigid Large	Regional	>12 t	2%
Semitrailer	Long Distance	40 t	1%

Sources: ADEME et Bilan Carbone® calculations for bypassing traffic congestion and the study "Wayfinding Research Using Satellite Navigation to Improve Efficiency in the Road Freight Industry", conceived by Faber Maunsell for the Transport Department in 2006.
For LCVs: data provided by users.

Domain of relevance

This solution is particularly attractive on the distribution and individual parcel delivery sectors, where route planning is complex and variable and operated in areas which are subject to frequent traffic congestion. It is also interesting in case of follow-up of new station creation, or incoming drivers in the team. Lastly it is appropriate to all transport operators who want to optimize their route management. It will also prove useful in the case of urban route deliveries operated with LCVs, where drivers do not have the possibility to drive safely while optimizing their route at the same time, except if they know their urban territory very well, which is not always the case.

The geopositioning system for route optimization is appropriate to companies with over 30/40 LCVs in the fleet.

⁶⁹ User data.



Implementation

Professional drivers usually have a positive reaction to this solution which offers both time savings and comfort. Before integrating this type of system into the operator's organization, it is necessary to communicate with both drivers and the administrative personnel who will be in charge of the monitoring, in order to introduce them to the new tool and the style of use to be expected from them.

This preliminary step will overcome possible reluctance to using such tools. In the case of heavy-duty trucks, adaptation of the tool to road constraints must be integrated (heights of bridges, roads forbidden to vehicles of more than 3.5 tonnes, etc.), which can be of limited precision on the last kilometres.

The cost of a geopositioning system is estimated at €800 per vehicle not counting the monthly rental fees, to which €40 per month/vehicle have to be added, for a total €19 000 yearly for a 40-vehicle fleet. This amount includes the cost of fees to access the electronic map system, and telecommunications costs (€5 to €10 per box, monthly).

In the heart of the system, the installation of specific software will make it possible to display a global map showing all vehicles of the fleet. Personnel can also be dedicated to control and to monitor route planning changes. This solution is therefore interesting for both drivers and fleet managers alike.

The ROI time of such a solution is intermediate (1 to 3 years).

Complexity of implementation is also intermediate, choosing the most appropriate option can take time, and sometimes requires heavy intervention for parameter implementation (streets, drivers, vehicles, customers, loads, etc.). All this is consuming of personnel time.

Follow-up of the solution

Follow-up indicator:

- number of vehicles equipped with a geopositioning system;

Practical data collection process:

- inventory of the geopositioning equipment in the fleet of vehicles.

Organization of transport flows Focus – Form N° 3

Optimizing vehicle loading coefficients

SUMMARY FORM

Action description

Optimizing the loading of vehicles allows more load on a single vehicle.
Several solutions emerge, working on the load factor and on the routes operated empty ratio.

Domain of relevance

These solutions are adapted to all vehicles and all sorts of transport activities.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Optimizing the Volume / Weight ratio of shipments Rationalizing the volume use and the payload of each vehicle				LCV RS RL SE MI
Resource sharing transport between several customers Resource sharing offer a vehicle for transporting merchandise with multiple pick-up or deliveries				LCV RS RL SE MI
Using a double floor loading system Using a trailer equipped with a double floor capacity load system				SE MI
Using a software enhancing the load coefficient Using a specific software optimizing the load coefficient				LCV RS RL SE MI
Trailer chassis equipped with a mobile road container unit Using mobile road container units				SE MI
Counter flow transport Implementing a transport organization that allows to load one customer one way and another customer for return				LCV RS RL SE MI
Replacing a standard refrigerated vehicle with a multi temperature one According to the nature of goods transported, using a dual or multi temperature vehicle will save travels made by several standard				LCV RL SE MI

Nota Bene: the introduction section of the document provides all details on chosen hypothesis

Organization of transport flows Focus – Form N° 3

Optimizing vehicle loading coefficients

DETAILED FORM

Context and regulatory measures

Optimal use of the road transport of merchandise depends on several factors: number of kilometres, load factor of the vehicles, return empty ratio. Optimizing the number of kilometres can be achieved through the use of planning tools (ACTION FORM OF TRANSPORT FLOWS N° 2 “Data processing tools optimizing routes”). The present form offers solutions for truck loading optimization, either by increasing the load factor (solutions 1 through 5) or by reducing kilometres operated without load (non-revenue kilometres) (solutions 5 and 6).

In the case of heavy-duty trucks, a study by the European Environment Agency has shown that in those countries where data are available, the load coefficient has slightly diminished since the year 2000, with the average European figure being less than 50% (in weight). The load coefficient is subject to strong variations, according to the type of activity of the transport operator.

Mode	MGW (Tons) Vehicle Type	Average Tonnage per Vehicle
Road	< 7,6	1,2
	7,6 TO 12	2,3
	12,1 TO 14	2,2
	14,1 TO 20	5,5
	20,1 TO 26	9,5
	26,1 TO 28	8,9
	28,1 to 32	12,2
	> 32	14,5
	Semitrailer	16,8

Average tonnage by road transport vehicles (in tonnes), Source: SOeS, Survey TRM 2005

Increasing the average load coefficient (in weight and volume) will reduce non-revenue kilometres and the number of trips made, reducing energy consumption and thus the CO₂ emissions of the vehicles involved. The reduction of the number of vehicles operated with no load also reduces fuel consumption. In France, in 2008, the no-load kilometres ratio was 21.9% – or more than one kilometre without load every five kilometres (see chart on the following page).

en million de véhicules-kilomètres

Trajets	Genres		
	Camions	Tracteurs routiers	Total
Total	3 540	12 212	15 752
dont en charge	2 709	9 601	12 310
dont à vide	831	2 611	3 442
% à vide	23,5%	21,4%	21,9%

Source : SOeS, enquête TRM 2008

Number of vehicle-kilometres travelled – operations carried out loaded or without load – Survey TRM 2008

Optimizing loading solutions will make it compulsory to follow in a first step the load coefficient, as well as the ratio of empty vehicle return trips on each route served.

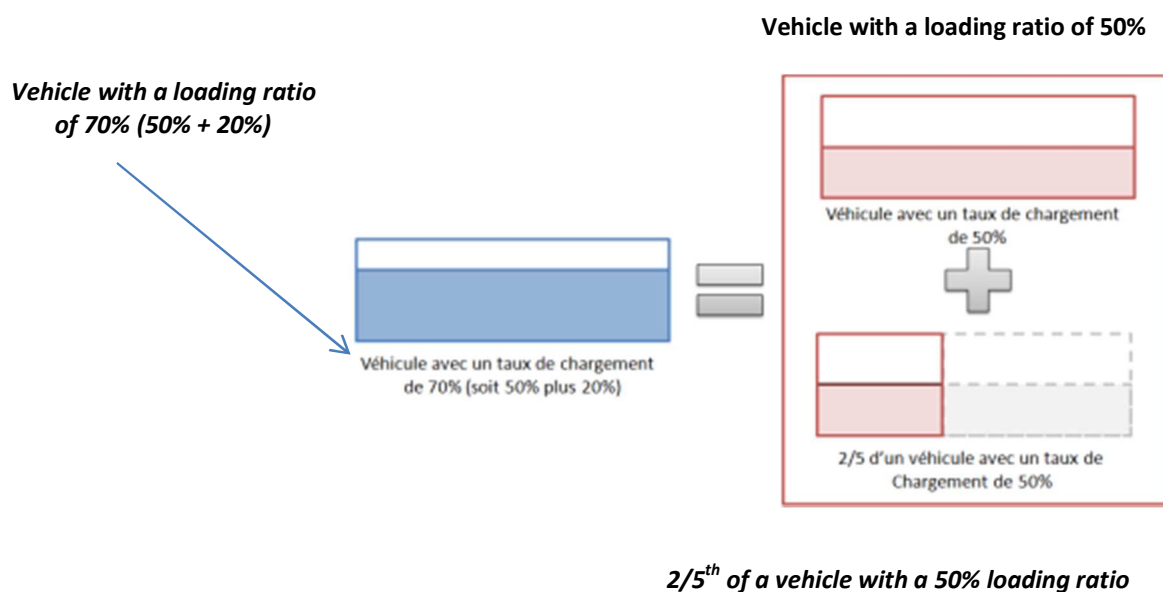
Savings associated with increase of load coefficient

Increasing the load factor of vehicles will have the direct effect of increasing the load transported, thus increasing fuel consumption, fuel consumption being in proportion to the total mass transported. But given the fact that the empty vehicle mass is not zero, a 10% increase of the load factor will not generate an identical increase on the total mass. Due to this, the consumption per tonne transported will be reduced, while the load coefficient increases.

Estimating that the load supplement had been shipped by road on similar vehicles, and an average load coefficient, savings are potentially important since an increase of 1% in the coefficient load factor allows a fuel reduction of between 0.5% and 0.9% (average 0.7%) for the same quantity of merchandise transported.⁷⁰

These figures were obtained through a vehicle calculation model with a load coefficient of $X + 10\%$ (or 20% or 30%) and comparing the emissions associated with this vehicle (per t.km) with those associated transporting same load, but considering two vehicles of which one is a fully laden vehicle with an $X\%$ coefficient and $1/5$ (respectively $2/5$ and $3/5$) of another vehicle with a load coefficient of vehicle loaded to 50% of its capacity.

The principle shown below is a theoretical one, and savings associated with the increase of the load coefficient will greatly vary, according to the way the transport operator is organized.



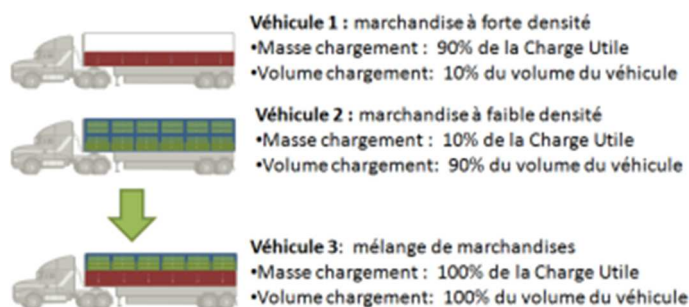
Source: ADEME calculation – data from Bilan Carbone®

⁷⁰ Calculations made from Bilan Carbone® input data.

Solution 1: Optimizing the volume to weight ratio of shipments

How does it work?

When transporting voluminous products, the vehicle maximum payload can rarely be reached. Fuel consumption per t.km and CO₂ emissions are thus more important. In order to optimize the transport of such products, it is advisable to diversify the types of products transported in order to maximize the volume and the payload offered.



In the theoretical example given here, vehicles 1 and 2 are under-utilized due to the nature of merchandise, while vehicle 3 is used to its maximum loading and volume capacities.

LCVs axial guidance trailer (source: equipment manufacturer)

In the case of light commercial vehicles (LCVs) it is possible to connect a trailer to 3.5-tonne maximum types.⁷¹ Total trailer connection time is less than 5 minutes, as with a standard trailer.

The “new” combined vehicle then offers a 1.5 t to 2-tonne payload for a volume between 20 m³ and 25 m³ and the MCW (Combined Gross Weight) is 7 tonnes.⁷² This combination increases the payload, but the speed is restricted to a maximum 90 km/h and an “EB” type driving licence is therefore necessary (instead of the “B” driving licence in the case of an LCV driven without trailer).

Experience with furniture delivery has shown that three times more furniture can be loaded compared to a standard van, and 10 deliveries can be performed instead of the usual three. The relevant use of the trailer will also prove to be very useful when transporting building materials to construction sites.



A fuel consumption comparison has to be made before purchase, due to the extra weight being towed, which will have a negative impact and reduce the savings made elsewhere.

⁷¹ We have excluded the option of a conventional trailer drawn by a light utility vehicle. This solution, while advantageous on occasion, is very problematic in daily use. It is rarely used by professionals, due to the overall volume, difficult manoeuvring and instability on the road.

⁷² GCAW (Gross Combined Authorized Weight) is the addition of the **MGW** of the vehicle and the trailer weight.

Impact on fuel consumption and CO₂ emissions

Putting into place this solution could increase the loading coefficient (in weight and volume) by 50%. However, to reach this figure the transport operator will have to dispose of products of different densities and manage a situation where expedition and destination points are close to each other. Taking into account these constraints, it is considered that this solution will on average increase the load coefficient of the vehicles by 5% to 10%, which represents a 3% to 7% fuel reduction (applying the average conversion factor of 0.7 mentioned in the detailed form). In the case of LCVs of the COC type (cabin-over-frame), savings of up to 20% can be reached.

The following chart shows fuel consumption savings that can be associated to this solution, linked to the reduction of the number of vehicle.km travelled.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to the solution (in % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	20% (light bodywork)
Rigid Small	Urban	3.6-12 t	3-7%
Rigid Large	Regional	>12 t	3-7%
Semitrailer	Long Distance	40 t	3-7%

Source: *transporters*.

Domain of relevance

This solution is appropriate for all types of vehicles and transport activities. However it will be more easily put in place when merchandise is of various densities.

Implementation

The different steps of implementation of this solution are the following:

- Identification of merchandise with high and low density: merchandise will have to be categorized. A simple solution is to note each pallet or partial weight.
- Identification of the route types that can integrate both types of merchandise: following the merchandise categorization process, it will be necessary to identify when it will be possible to group merchandise of low and high density in the same vehicles.
- Organizing mixed-density types of routes.

In order to identify the volume and weights of the pallets transported, scanning solution techniques exist which can give the weight and three dimensions of the pallet in fewer than 10 seconds. With the help of such devices, the parameters which define the vehicle load coefficient (mass and volume) can be recorded and utilized to optimize the loading process.

Apart from these systems, that can help implementing this action but which are not strictly necessary, the solution does not necessitate direct investment at all. In the case of a 5% to 10% increase of the load coefficient, the ROI time to be considered will be short (< 1 year).



However this solution demands a suitable type of market (large number of trips between cities or numerous customer bases with partial lots to transport).

The implementation opportunity will therefore have to be studied for each particular case. In the case of LCV transport, the trailer is sold bare to body work professionals, together with the specific equipment which has to be fitted on the frame. The base price is estimated at €20 000 ex VAT. With the options (paint, anti-skid coatings), global cost is estimated at €24 000. The expected ROI time is five years.

Follow-up of the solution

Follow-up indicators:

- Mass load coefficient of the vehicles (tonnes loaded/total payload).
- Volume load coefficient of the vehicles (volume load/volume offered).

Practical data collection process:

- Follow-up of the load coefficient of transport services commercialized.

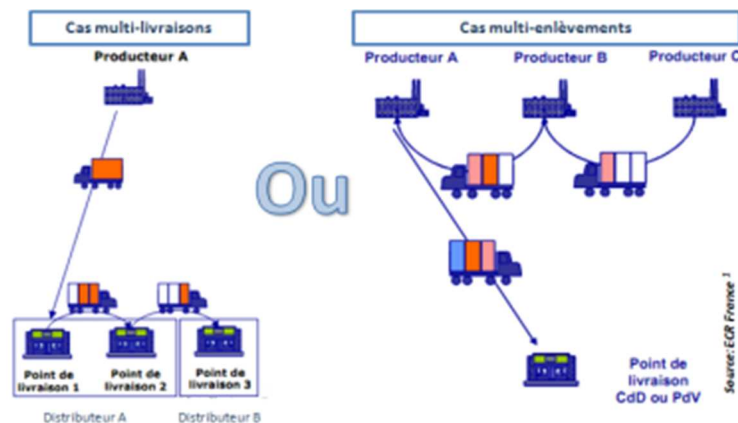
Solution 2: Transport resource sharing involving several customers

How does it work?

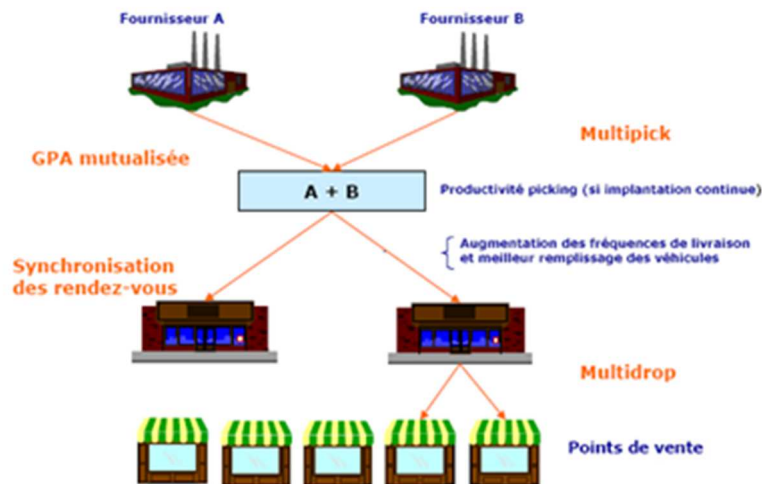
As shown in the diagram below, pooling can be carried out using two different concepts:⁷³

- Different producers use the same vehicle to deliver same consignee/customer (“multi-pickup”).
- A vehicle loaded by one supplier makes a delivery route delivering to different final customers (“multi-dropoff”).

In both diagrams below, this leads to a massification of the shipments forwarded, thus an increase of the load coefficient. Mutualization can even be pushed to its limit using platforms (regrouping/expediting).



Transport resource sharing can even be pushed to its limit using platforms (regrouping/expediting).



Resource sharing of transport flows indeed requires from the transporter a commercial initiative, globally, which means optimization of vehicles and infrastructure (delivery areas, groupage and despatch logistics platforms), together with an organization of the transport flows.

⁷³ Source: ECR France, http://www.ecr-france.org/web/conference2003/interventions/optimalisation_logistique.pdf

Cross-trading web platforms

As the load coefficient found in urban cycle delivery is often very low, mutualization will achieve significant CO₂ emission reductions.⁷⁴ To this effect, web-based cross-trading platforms aim to create a community of operators requesting and offering transport capacities, tracking from origin to the destination and all forwarding operations of the merchandise.

Optimizing vehicle size

Today, 7.5-tonne to 19-tonne vehicles are used for urban delivery routes or point to point, from the bulking centres situated in the peripheral areas of major cities, forwarded to final points of sale such as medium-sized supermarkets and superettes downtown. To ensure the cost effectiveness of this process, the average delivered tonnage of parcels delivered at each point will have to be high.

In urban distribution, the resource sharing of transport flows may push the transport operator to think about optimizing the size of its vehicles. In effect, it is admitted that several small vehicles will emit more CO₂ than the larger vehicle that would replace all of them.⁷⁵

As an example:

Unit delivery cost of a pallet is reduced by 40% when 21 pallets can be loaded onto just one vehicle (allowed by the regulation threshold allowing 29 m² loading surface) instead of only seven pallets (average number taken on a 17-m³ vehicle). CO₂ emissions per kg of transported merchandise are divided by 4 when a 2.5 m³ and 610-kg payload van is replaced by a 19-tonne vehicle, fully loaded.

This strategy is only relevant if the truck replacing all vans has a satisfactory load coefficient. The choice of the optimum size will be different according to the logistics used and the types of products transported. It would be wise to make a study of each case.⁷⁶

Impact on fuel consumption and CO₂ emissions

Organizing resource sharing of transport flows will have a variable effect on the global load coefficient, according to the distances covered between pickup and delivery point.

The main objective of this solution is to get as close as possible to a 100% load coefficient on the main travel segment, while having pickup points that are not situated geographically too distant from each other, as well as the delivery points. It can be estimated that on the whole route, the load coefficient will be increased by 10% to 15% (source: ECR France), with fuel consumption savings of 7% to 10% (if the average conversion factor of 0.7 is applied, as explained earlier in the action form).

⁷⁴ Source: Livre_blanc_logistique_urbain_AFILOG_janvier2012.pdf. In the AFILOG Survey in 2010, 40% of the panel stated that their load coefficient is over 90%, 50% between 70% and 90% of load coefficient. It has to be noted that all the respondents are distribution professionals, having already optimized their transport. It is therefore reasonable to think that real savings can be achieved through resource sharing for nonprofessional transport activities operated internally by retail distributors.

⁷⁵ Source: Livre_blanc_logistique_urbain_AFILOG_janvier2012.pdf.

⁷⁶ Source: CAS, Actes séminaire logistique urbaine

The following chart shows the savings range on fuel consumption generally made, associated with this solution.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings associated to the solution (in % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	7% to 10%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: calculation data from the ECR France document

Domain of relevance

This solution is adapted to all types of vehicles. It will prove to be all the more relevant if the main travel segment is important compared to the pickup and delivery segments of the rest of the trip. When maximizing transport flow mutualization, the transport operator still has to make sure that the customers' agreed delivery deadlines are all compatible.

Implementation

Implementation of this solution can be achieved in a three-step sequence:

- Identification of the long-haul segments where load coefficient is lower than 70%;
- Identification of the associated pickup and delivery points ;
- Identification of the resource sharing possibilities on the routes identified, using freight transport capacities research on the Internet, local operator clubs or through additional customers.

Apart from the possible prospection costs linked to the search of new markets, and subscribing to Internet freight cross-trading services, local or national operator groups, no other direct investment is necessary to implement this solution. With an average 10% to 15% increase of the load coefficient, and relatively low associated costs, it can be considered that the ROI time will be short (< 1 year).

This action requires access to an appropriate market (high forwarding demand between the same cities or districts, numerous customers in partial transport shipments). Feasibility of the solution must be considered for each particular case.

Follow-up of the solution

Follow-up indicator:

- Mass load coefficient of the vehicles (tonnes loaded/payload offered).

Practical data collection process:

- Follow-up of the load coefficient of the vehicles, for each shipment.

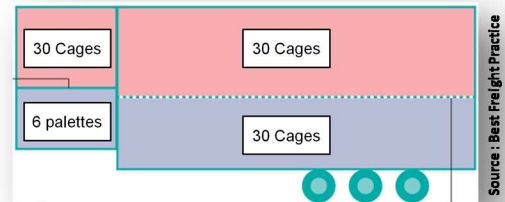
Solution 3: Using a double loading platform

How does it work?

Various parameters will have an influence on the quantity of goods that can be transported by a vehicle: gross maximum weight, vehicle volume, and the loading surface area available in the vehicle. In the most frequent case found, where the surface area is what limits the loading capacity, an optimized solution consists in using double deck floors. Trailers are now offered on the market by various manufacturers.

In the example shown, the number of containers available, has more than doubled due to the double deck added.

Referring to pallets, 66 can be loaded instead of the usual 33.



However, this solution means the combined use of two decks of pallets, which is not always possible due to the individual height of the pallet. Sometimes, customers will have to be approached, and asked to modify the height of an individual pallet format (please see the solution "Optimizing truck loading by modification of the palletization" – Action Form N° 4, Organization Of Transport Flows Focus).

Several double-floor systems exist, including modular ones working with rails and a hydraulic double floor. In the first case certain sections are used as modules according to transport needs.

For example, the bottom section can be divided in two, to accommodate two pallets topped up while the front of the section is left in standard format and accommodates one pallet height.

The second section is made of one part, the entire body is thus either divided in two or equivalent to a single floor.

Impact on fuel consumption and CO₂ emissions

Using a double-floor structure increases the floor surface and a greater quantity of merchandise can be loaded. In some instances using a second floor will generate 100% more payload.⁷⁷

In this case one vehicle will replace the use of two standard vehicles (the vehicle will take the same capacity as two single-floor vehicles). This is however a rather theoretical savings calculation. In actual fact, certain constraints will limit optimal floor utilization. For example, in the case of high-density products, the maximum allowed weight can be reached easily, making use of a double floor less attractive.

Given these constraints, it can be estimated that this solution will increase the load coefficient by 20% to 30%, on average, which in turn gives a 14% to 21% fuel consumption reduction (if we use the usual conversion factor of 0.7 explained above).

The following chart shows the range of fuel consumption reduction associated with this solution, linked with fewer vehicle.km needed.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to the solution (in % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	14-21%

Source: Calculated from transporter data and the Freight Best Practices programme.

Domain of relevance

This solution will be appropriate to articulated trucks/semitrailers. Implementing this solution is relevant when transport services are to be performed that do not attain the maximum regulatory authorized payload, which will be the case for low-density merchandise with a packaging profile that does not allow any stacking.

Implementation

Implementation of this solution will be done in several steps.

1/ It is important to carry out a thorough analysis for the activity concerned. For that reason, routes with low loading coefficients must be identified and then among these trips, the ones where one vehicle could replace two, and lastly validate two-pallet height possibility or else study options with the customer involved.

See Action Form N° 4 ORGANIZATION OF THE TRANSPORT FLOWS FOCUS, “Optimizing truck loading, altering palletization”).

2/ Double-deck loading systems have very different costs, and choosing the most appropriate system will prove very important:

- A module system will be more adapted to very diverse merchandise, due to the fact that only one section of the loading area can be utilized. Associated extra cost is between €3 000 and €6 000. With an increase of the load coefficient of between 20% to 30%, the ROI will be rapid (< 1 year).

⁷⁷ In the case of nonstackable pallets containing light-density goods and the height of which does not exceed 1.25 -1.4 m, it will be possible to switch from 33 to 66 pallets.

It is preferable to purchase a structure already pre-equipped with a double floor. This is due to the fact that although it could be performed afterwards, there are some constraints attached. The rail width (2 to 3 cm) could make difficult the loading and offloading of certain pallets (available width in the structure will be reduced by the presence of the rail mountings), if it was not engineered in the first place.

- The hydraulic double deck system will be more relevant for homogeneous loads. In effect, it will not be possible with this solution to load in the same vehicle pallets or containers of 1.60 m and two pallets of 1.30 m. In order for it to be used to its maximum capacities, this solution will have to be used for homogeneous transport of pallets/containers under 1.40 m high.
- The cost of this type of trailer is between €90 000 and €140 000, the ROI time will be long (> 3 years) and it will be advisable to check that contracts for upstream markets have been signed for the long term.

Moreover, the “new” overall height of the vehicle (which might create operating difficulties in some circumstances) must be taken into consideration and the constraint of the horizontal maximum dimension of the turn plate, which must be situated less than 1 meter from the ground, vertically measured.

The energy use resource of the hydraulic system can be batteries or the truck engine power. In that case, fuel consumption must be taken into consideration when calculating the ROI time.

Follow-up of the solution

Follow-up indicator:

- Mass load coefficient of the vehicles with or without double-floor equipment (tonnes loaded/payload).

Practical data collection process:

- Follow-up of the load coefficients of the trips made.

Solution 4: Using software to enhance load coefficient

How does it work?

In the case of routes with several offloading/loading sequences, the load coefficient can be variable all along the run, leading to an average coefficient that is low. To find a solution to this situation, an efficient way consists of organizing transport planning taking the load coefficient into account at each stage of the trip.

Some of the software now found on the market can offer these optional functions, optimizing transport planning as a function of the load coefficient of the vehicles.

Contrary to standard software optimization planning in terms of kilometres, software that integrates load parameters will optimize both the kilometres as well as the load coefficient optimization.

The available software will optimize the loading order of parcels or pallets, reducing time lost when delivering. This will not generate direct savings in terms of fuel consumption reduction.

Impact on fuel consumption and CO₂ emissions

The use of such software make solutions 1 and 2 presented above automatic, and even solution 3 if the operator has double-floor equipment in his fleet. It can be considered that savings will be greater than under solutions 1 or 2. With such a base, this solution will allow in average an increase of 10% to 20%, which represents between 7% and 14% fuel consumption reduction (with the 0.7 conversion factor explained above).

The following chart presents the range in which the savings associated to this solution can be found, linked to transport tasks performed while reducing kilometres.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to the solution (in % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	7% to 14%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Domain of relevance

This solution is adapted to all types of vehicles and transport activity. It is all the more relevant on medium and long-distance runs.

Implementation

Two approaches are possible: either software to optimize transport planning already has a function optimizing the load coefficient, or this function is an add-on to the existing tool (delivery management, travel optimization).



In order to facilitate the optimization, it will be necessary to enter the following data:

- For merchandise; weight, overall dimensions and volume taken, fragile or not, stacking possible or not, etc.
- For vehicles: maximum payload, volume offered, loading dimensions, etc.
- This data is often already available in the existing tool. It is therefore easier to add the load coefficient module to the existing tool, if it is not already available.
- This solution will prove to be a rather easy one to implement, once the operations of the added modules are understood. Solutions 1 to 3 will therefore be made simpler, and their implementation will become systematic.

Follow-up of the solution

Follow-up indicator:

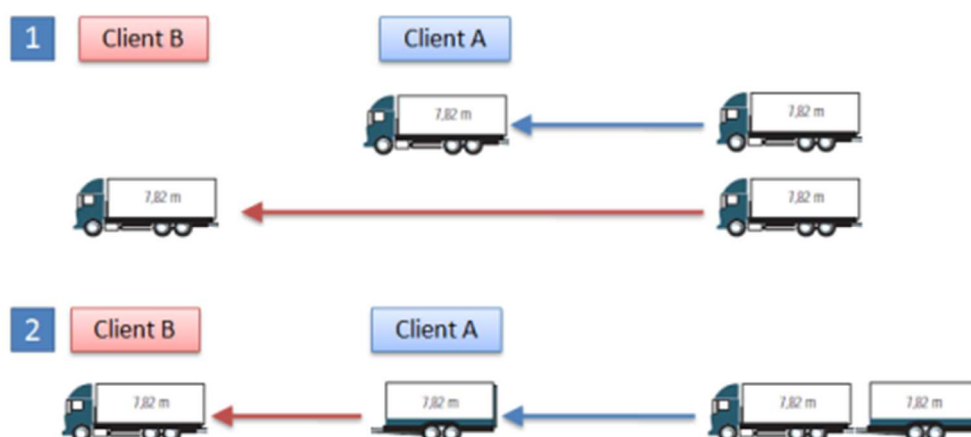
- Vehicle load coefficient;
- Market share of the travel associated with the use of this software.

Solution 5: Using a mobile road container or an additional trailer

How does it work?

The principle of this solution is to use Mobile Road Containers (MRC) (photo) giving the ability to leave a MRC at the first delivery point (with or without frame), eventually for an exchange with another one (loaded or not), and carry on the travel with the second one for service to the last point of delivery.

This organization allows the reduction of kilometres operated without load, while making it possible to increase the load coefficient. By going from situation 1 to situation 2 (illustrated below), it is possible to reduce unnecessary travel, one way or return. The other advantage is optimization of loading and offloading operations.



Impact on fuel consumption and CO₂ emissions

Savings associated with this action will be highly variable in terms of fuel consumption and CO₂ emissions. For example, the above illustration reduces the number of kilometres travelled. However the number of saved kilometres will depend on the distances between the different operators (distance between the loading point and customer A, distance between customer A and customer B).

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings associated to solution
LCV Light Commercial Vehicle	Urban	≤3.5 t	-
Rigid Small	Urban	3.6-12 t	-
Rigid Large	Regional	>12 t	-
Semitrailer	Long Distance	40 t	Very variable

Domain of relevance

Such a solution is relevant for semitrailers, especially in between logistics platforms for small parcel activities, removal, but also for partial shipments. In effect, it is necessary to dispose of two different delivery places for this action to be relevant.

Implementation

Implementing this solution will have an impact on transport organization. It will be advisable to take into account all consequences:

- Mobile road containers will have to be filled up separating goods for each different consignee;
- Pickup organization of the mobile container left aside (empty or full) and integration in a logistics route planning system that optimizes the use of the tractor and of the frame;

Concerning the investment to be made, this action will mean buying or renting the mobile containers.

Follow-up of the solution

Follow-up indicator:

- % of travel optimized;
- % of kilometres reduction by optimizing travel;
- Mass load coefficient of the vehicles (tonnes loaded/total payload).
-

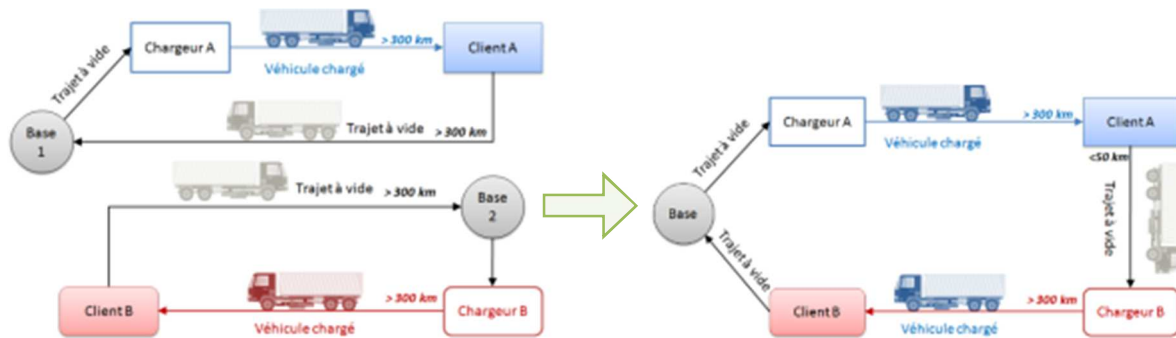
Practical data collection process:

- Follow-up of the load coefficient of the transportation service and of the kilometres travelled.

Solution 6: Reverse flow transport system

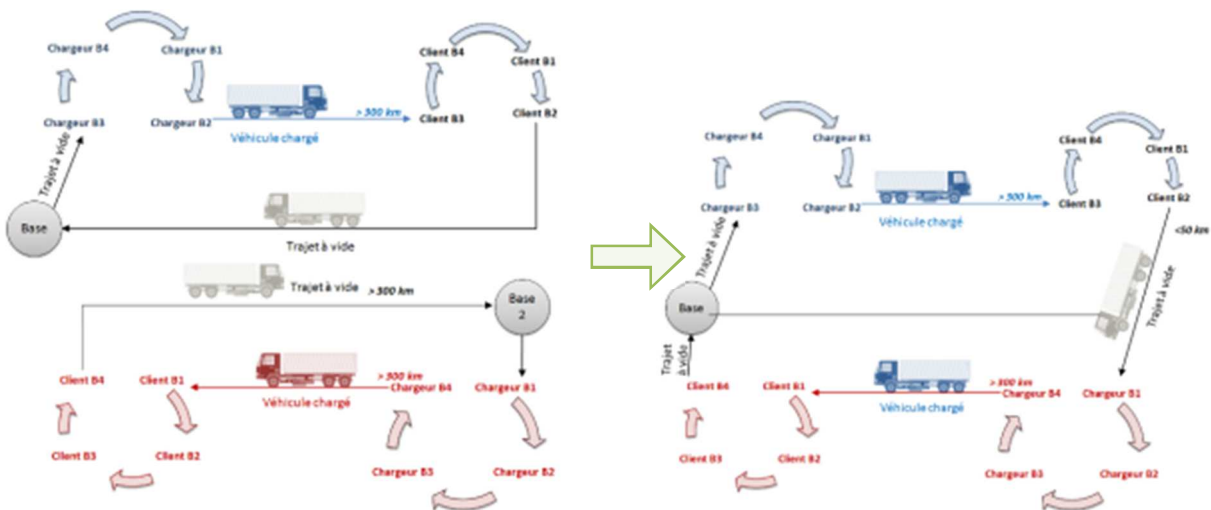
How does it work?

Reverse flow transport is the result of a system whereby the transport one way will take care of customer A's merchandise and the return travel will take care of customer B's merchandise.



As shown in the illustration above this solution will make it possible to use only one vehicle instead of two, on the condition that the merchandise of the second customer can be transported in the same conditions as the first customer (e.g.: tilter, Tautliner trailer, standard articulated truck, etc.).

The principle is similar in case of small parcel or partial shipments, with more customers and shippers at each stage of the transport. In the case of small parcel transport, it is also possible to work out mixed pickup and delivery cycles on the same trip.



In the case of small parcel transport, it is also possible to work out mixed pickup and delivery cycles on the same trip.

Impact on fuel consumption and CO₂ emissions

Reducing the empty load coefficient on return travels allows fuel savings. Instead of two vehicles transporting the same merchandise, only one is used. Given a national average of 21.9% empty runs on return trip for heavy-duty trucks (source TRM survey 2008), it can be considered that such an action will reduce from 22% to 15% the return empty ratio, on the basis of the theoretical data in the diagram above.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to this solution
LCV Light Commercial Vehicle	Urban	≤3.5 t	Variable
Rigid Small	Urban	3.6-12 t	Variable
Rigid Large	Regional	>12 t	Variable
Semitrailer	Long Distance	40 t	Variable

Domain of relevance

This solution will be all the more relevant, for the fuel consumption of a vehicle returning partly empty and on a long-distance run. In the case of small rigid trucks and of LCVs used in urban deliveries, taking back empty packaging and faulty products on return runs is routine practice.

Implementation

This solution requires finding a customer on a very precise itinerary or several customers on a more adaptable itinerary. It will be necessary:

- Either to find a customer that needs a return trip;
- Or find customers accepting the return run in several stages.

Numerous solutions exist for finding these customers, such as websites for cross-trading freight exchange, national or local enterprise groups which help put into relation customers with shipments and transport operators.

Follow-up of the solution

Follow-up indicator:

- Percentage of travels operated empty.

Practical data collection process:

- Follow-up of trips and kilometres operated empty.

Solution 7: Swapping a standard refrigerated vehicle for a multi-temperature refrigerated vehicle

How does it work?

All products transported need not be conditioned at the same temperature and in some cases, transport can be carried out by a single vehicle. In order to answer the needs of transporting temperature-controlled products at different temperature levels, transport operators may choose between mono-, bi- or multi-temperature options (with a volume kept at outside temperature) according to their type of organization (simultaneous or separated distribution delivering deep-frozen products with frozen products).

Temperature-controlled vehicles can maintain each product at a certain required temperature, according to their preservation specifications, in a range of temperatures between – 25 °C and + 5° C.

Using a multi-temperature vehicle, the operator will not have to use several refrigerated vehicles, transporting products at temperature below the strictly required one. Compartmented vehicles will help optimize both the distance and the accepted payload. This type of organization will also contribute to close monitoring of fuel consumption in a standard refrigerated vehicle, when using the vehicle for several products which do not have the same temperature control requirements.

A vehicle equipped with triple temperature control, will be capable of transporting at the same time deep-frozen, frozen, fresh and dry products.

Reorganizing the compartment sections inside the vehicle (length and width) while the delivery cycle is in progress, according to the volume occupied by merchandise in each compartment, will also contribute to a production of cold air that is fully adapted to real needs.

Impact on fuel consumption and CO₂ emissions

Use of a vehicle with double or triple temperature control will save using two to three different vehicles which would have to operate a specific route each. Estimated savings are linked to the transport operator's specific circumstances, and he has the responsibility to carry out an opportunity study on the operation of multi-temperature vehicles. For the transport operator, it is a matter of re-thinking the logistics chain.

Example: For a 500-km delivery route, carried out in the first case by two rigid trucks and in the second case by an articulate refrigerated semitrailer with dual temperature control, savings in terms of CO₂ emissions and fuel consumption is estimated at 30% linked to the reduction of the transport distances.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to this solution (% of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	20% to 30%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	



Domain of relevance

This solution can be applied to all refrigerated transport dealing with multiple levels of preservation-temperature requirements, all transported in the same vehicle.

Implementation

The extra cost generated by the purchase of a multi-temperature vehicle or trailer as compared to a standard one is between 15% and 20%. The ROI will depend on the appropriate use that is made of the vehicle.

Multi-temperature vehicles are available on the market. However this solution will mean reorganizing the transport logistics chain for products under temperature control. For this reason, the feasibility of this solution is to be considered intermediate.

Follow-up of the solution

Follow-up indicator:

- % of the travels operated by a multi-temperature vehicle or trailer.

Practical data collection process:

- Follow-up of the type of routes per vehicle type used;
- Follow-up of the number of trips performed per type of vehicle used.

Organization of transport flows Focus – Form N° 4

Working with customers and shippers to optimize transport organization

SUMMARY FORM

Action description

This action aims at organizing communication exchange and negotiations with customers and shippers integrating the notion of CO₂ emissions reduction, through the optimization of transport.

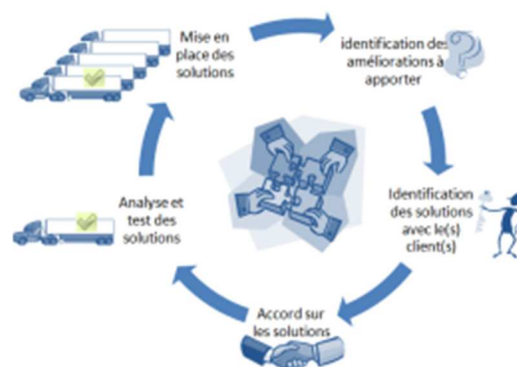
Domain of relevance

This action is appropriate to all transport activities.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Information on the CO₂ emissions levels of transport services performed Supplying to customers the information on CO ₂ emissions associated with his transport	0% 10% Indirect	> 3 years <1 year Indirect	Difficult Easy	LCV RS RL SE MI
Transport Plan definition involving customers Create an optimized Transport Plan involving customers	0% 10% Variable	> 3 years <1 year Variable	Difficult Easy	LCV RS RL SE MI
Optimizing loading of vehicles making changes to palletization process Proposing customers reconfiguring of pallet loading process	0% 10% 3% to 7%	> 3 years <1 year Variable	Difficult Easy	LCV RS RL SE MI
Implementing delivery and pick up appointments Planning deadlines for loading and offloading sequences	0% 10% Variable	> 3 years <1 year Variable	Difficult Easy	LCV RS RL SE MI

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Organization of transport flows Focus – Form N° 4
Working with customers and shippers
to optimize transport organization
DETAILED FORM

Context and regulatory measures

From the shippers and client's point of view, the major parameters that define quality transport service are price, dependability, transit times, condition in which parcels are received at destination, social and environmental impact. Each customer will give a relative importance to one or more of these parameters, according to his needs.

However, it has to be noted that environmental criteria are gradually gaining in importance in the calls for tender and transport specifications received from customers. Their obligations to disclose environmental aspects of their trade in their annual financial report, and the incoming carbon assessment report obligations will lead to a more demanding attitude regarding environmental impacts, in particular CO₂ emissions.

Government regulations for the mandatory publication of CO₂ emissions that were agreed at the Grenelle environmental conference were published in the *Journal Officiel* on October 25th 2011, in application of Art. 228 of the Grenelle II legislation that makes it compulsory for transport operators (removal transport included) to display their CO₂ emissions on transport invoices before the end of 2013.⁷⁸

This instruction stipulates that "Anyone who commercializes or organizes a transportation service of passengers, merchandise, or removal of belongings must provide to the beneficiary of the service, information on the quantity of carbon dioxide emitted by the transport modes used to deliver the transportation service."

A government instruction of April 10th 2012 specifies that on October 1st 2013, display of the CO₂ emissions linked with each mode of transport, will become mandatory and must be displayed on each invoice.⁷⁹

A second instruction dated April 10th 2012 indicates the figures of reference to be used in these calculations.⁸⁰ Article N° 1 is relative to the emission factors of the energy sources used by different transport modes (electricity, road diesel fuel or non-road diesel fuel, liquefied petroleum gas (LPG) and natural gas).

A chart that is published in annex specifies the value of the Level 1 (government publication) for public transportation according to vehicle type (22 categories, from 3.5 tonnes to 40 tonnes), the type of transport made and the load unit numbers transported in the vehicle.

⁷⁸ Decree n° 2011-1336 of 24 October 2011, "relatif à l'information sur la quantité de dioxyde de carbone émise à l'occasion d'une prestation de transport".

⁷⁹ Instruction of 10 April 2012 "pris pour l'application de l'article 14 du décret n° 2011-1336 du 24 octobre 2011 relatif à l'information sur la quantité de dioxyde de carbone émise à l'occasion d'une prestation de transport" (JORF n° 0092 of 18 April 2012, page 7010).

⁸⁰ Instruction of 10 April 2012 "pris pour l'application des articles 5, 6 et 8 du décret n° 2011-1336 du 24 octobre 2011 relatif à l'information sur la quantité de dioxyde de carbone émise à l'occasion d'une prestation de transport" (JORF n° 0095 of 21 April 2012, page 7180).

From the chart, a “energy source consumption ratio” per kilometre can be identified. Information which has to be provided to the customers must include not only the transport operation itself but also repositioning operations, kilometres operated empty and emissions generated by engine idling when the vehicle is stationary which are linked to the primary transport operation.

Some of the solutions which have been identified for fuel consumption and CO₂ emissions reduction purposes might make it worthwhile to work with customers, for cooperative brainstorming.

The transport of merchandise system includes transport operators (offer) as well as customers (demand) or the end customer (final demand). Involving all the actors will allow the whole transport system to be redefined. Thanks to this global brainstorming, all the key parameters in merchandise transport can be treated, achieving an optimal solution that the transporter could not have reached by himself.

Solution 1: Information on CO₂ emissions related to transport services

How does it work?

The objective of this solution is primarily to address the future regulatory information display of CO₂ emissions in the transport service provided (See Context and regulatory section above).

Impact on fuel consumption and CO₂ emissions

This solution does not engender direct CO₂ emissions or fuel consumption reductions. However, it can help in the long-term optimization process and is often a first step towards other solutions.

Moreover, this analysis often has an indirect effect which is both positive and important: information recorded on CO₂ emissions of transport services ordered by customers will allow them to make a precise emissions diagnosis; this will constitute a first step to establishing a reduction action plan, in cooperation with transport operators. Implementing this action means taking a closer look and follow-up action on all operator activity consumption.

It is also an opportunity given to refine each and every chart tracking the operator's activities, and enhance internal management, which will in turn contribute to emission reductions.

Domain of relevance

This action is appropriate to all transport activities.

Implementation

The April 10th 2012 government instruction stipulates that, as of October 1st 2013, all transport services provided must be accompanied by a display on transport invoices of the CO₂ emissions generated for each transport service provided.⁸¹

Follow-up of the solution

Follow-up of solution indicators:

- % of customers who have been made aware of the CO₂ emissions of their transport services;
- Number of customers informed of the CO₂ emissions of transport services;
- % of total turnover representing the customers informed.

Practical data collection process:

- Follow-up of the turnover covered by the evaluations.

⁸¹ Instruction of 10 April 2012 "pris pour l'application de l'article 14 du décret n° 2011-1336 du 24 octobre 2011 relatif à l'information sur la quantité de dioxyde de carbone émise à l'occasion d'une prestation de transport" (JORF n° 0092 of 18 April 2012, page 7010).

Solution 2: Designing a transport plan involving customers

How does it work?

The major constraints when working out a transport plan are the following:

- Delivery deadlines;
- Types of merchandise transported;
- Loading and offloading capacities.

Involving the customers in the transport plan will help redefine a plan that takes into account not only the customer's constraints, but also the organization scheme that will integrate environmental aspects at stake which have been agreed upon during teamwork.

It will then be possible to renegotiate some of the present objectives (delivery deadlines, frequency and quantity delivered, delivery time span, etc.) and to check their relevance against the customer's actual needs.

In the case of LCVs operating on urban routes, the delivery deadline is usually a very tight constraint. However in some cases, the transport operator will have the opportunity to negotiate with some of his customers ("if you get your delivery a quarter of an hour later, I can offer a price reduction of X%, which will in turn translate into Y% of CO₂ emissions corresponding to your delivery").

Potential savings will be important if the transport operator manages to group several customers geographically close to one another in the same time frame.

Impact on fuel consumption and CO₂ emissions

Benefits in terms of fuel reduction and CO₂ emissions will be highly variable according to customers, constraints and modifications foreseen.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to this solution (% of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	variable
Rigid Small	Urban	3.6-12 t	variable
Rigid Large	Regional	>12 t	variable
Semitrailer	Long Distance	40 t	variable

Domain of relevance

This solution is applicable to all transport activities.

Implementation

The transport operator has to be proactive regarding his customers and stick to a certain logical attitude:

- Creation of a first transport plan draft taking into consideration customers' constraints and specific demands;
- Identification of the points that will not make optimization possible, environmentally speaking;
- Taking into account the imperative constraints that the shipper may have due to his own customers' specifications and requirements;



- Brainstorming to find internal solutions to tackle these problems. If certain solutions have an impact on customers:
 - Identify customers associated with these solutions;
 - Meet with customers to present the solutions and their advantages in terms of CO₂ emissions;
 - With each customer, evaluate the degree of priority of the identified needs, in order to validate the solutions proposed or carry on working on them;
- Set up test routes to validate the identified actions and the benefits obtained in terms of CO₂ reduction;
- Alterations made to the transport plan, taking into account negotiations carried out upstream.

When working out the transport plan in conjunction with each customer, it is necessary to determine several solutions and find the points that will eventually stop the process working, in order to go directly to the solution points that have been identified as the most important.

Solutions foreseen to better global transport environmental reporting could require some investment. The ROI time will have to be analysed for each case.

An agreement satisfying all concerned parties will have to be reached and if needed the “business as usual organization” will have to be modified. As a matter of fact, the implementation of this solution will vastly depend upon the relationship between the transport operator and its customers..

Moreover, a partnership and cooperation approach leads to a win-win kind of agreement, usually benefiting both customer and transporter, since it goes well beyond the standard “supplier-customer” relationship as we know it.

In the case of the LCVs used on urgent urban delivery routes, the transporter usually waits until the last minute in case another customer also asks for pickup. However this has its limits, and the new constraint must not bring service problems to the customer’s organization.

Follow-up of the solution

Follow-up indicator:

- Follow-up of fuel consumption per 100 km before and after reworking the transport plan.

Practical data collection process:

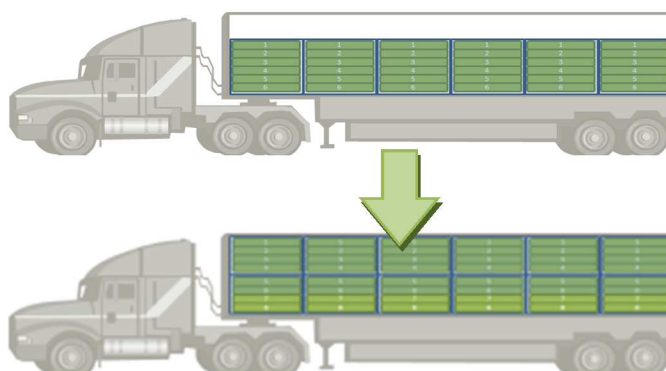
- Analysing fuel consumption per vehicle and per customer.

Solution 3: Optimizing the loading coefficient of vehicles through pallet disposition reshuffle

How does it work?

This solution consists in finding, in cooperation with customers, the best possible solution in terms of load coefficient, modifying the specifications of the transported shipments. In some cases it can be observed that the number of products transported can be limited by volume or by the nature of the shipments: making it impossible to use double-floor solutions, pallets being too tall to allow pallet stacking, or else too short, generating a poor load coefficient.

Ex.: Switching from packaging that allows 6 products on each pallet without a stacking option, to packaging of 4 on each pallet that allows stacking, it becomes possible to transport 33% more product in the same vehicle.



This solution also allows increasing of the load factor of the vehicles. This is close to solutions 1 through 5 proposed in the Action Form N° 3 of the ORGANIZATION OF THE TRANSPORT FLOWS FOCUS –“Optimizing vehicle loading”. This solution, requiring the cooperation of the customer, will go further than individual transport operator action. If the pallet height is not adapted to the use of a double floor, the transport operator alone will not be able to optimize the load factor of his vehicles.

Impact on fuel consumption and CO₂ emissions

Savings associated with this solution will greatly depend upon the initial status of the volume taken by packaging. Increasing the number of transported products will, in certain conditions, double the initial shipment size. Savings associated with this increase will depend however on the consumption curves of the vehicle taking into account the load factor and the % of empty return trips made.

On average, optimizing packaging volume will increase the load factor by 5 to 10% which means 3% to 7% fuel consumption savings (given the 0.7 conversion factor explained page 3 of the Action Form N° 3 of the ORGANIZATION OF TRANSPORT FLOWS FOCUS).

The following chart gives the fuel reduction range associated with this solution and linked to the reduction of kilometres saved.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to this solution (in % of consumption)
LCV Light Commercial Vehicle	Urban	≤3.5 t	3% to 7%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: Transporters



Domain of relevance

This action is mainly applicable to pallet transport or any other transport that needs groupage of the merchandise.

Implementation

The different steps to follow for implementation of this solution:

- Identification of the merchandise which has overall dimensions not allowing any load optimization.
- Exchange with the customer in order to brainstorm for solutions: using smaller pallets, or pallets with lower gross weight, choice of more resistant compartment cardboard, etc.
- Solutions being very diversified, it will be important to take all parameters into consideration: quantities transported, volumes, order frequency and quantity of each order. Lastly, the brainstorm solutions will have to take into consideration the impacts on the customer output, modifications on production lines or modifications to storage equipment.;
- Identification of the solutions presenting the best “cost of modification/savings of space carried out” ratio.

In general this solution does not necessitate specific investment for the operator.

However, the solutions which will alter pallet volumes will eventually alter the existing organization on customer premises and could take some investment resources. This solution needs consensus among all parties involved. The ROI time will have to be analysed for each particular case.

Follow-up of the solution

Follow-up indicator:

- Follow-up of the load factor before and after alteration.

Practical data collection process:

- Setting up a follow-up of the load coefficient (in mass and/or in volume) observed for the transport service.

Solution 4: Organizing delivery or pickup appointments with customers

How does it work?

Agreed appointments between the transport operator and the customer will optimize the waiting time sequences either while loading or unloading. Reducing waiting time will enable more deliveries with same vehicle, performed in a day's work. This solution will have an impact on the load factor of the vehicle (possibility to deliver to more customers by loading the vehicle in an optimal way), and on engine idling time (during offloading and/or loading sequences).

Human resources and materials can be used in an optimal way respecting the initial transport plan.

Impact on fuel consumption and CO₂ emissions

Planning for appointments will optimize the loading and offloading sequences, cutting waiting time on delivery and pickups, increasing vehicle productivity. The load factor increase and cumulative engine idling time reduction can be very significant. These will of course be variable according to context.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Savings linked to this solution (% of CO ₂ emissions)
LCV Light Commercial Vehicle	Urban	≤3.5 t	variable
Rigid Small	Urban	3.6-12 t	variable
Rigid Large	Regional	>12 t	variable
Semitrailer	Long Distance	40 t	variable

Domain of relevance

This solution is appropriate for all types of transport, the more loading and offloading sequences, the greater the efficiency gains. On urban delivery routes, or "on-call" urgent transport, with either rigid trucks or LCVs, planning for appointments will reduce unnecessary kilometres (in a Business-to-Customer relation, it is estimated that between 5% and 30% of attempted deliveries are missed due to the consignee's absence).

Distributors have taken the initiative of a setting up in city centres, a delivery system for the customer's benefit, selecting a 2-hours time span taken out of a total service span from 7:00 am to 22:00 pm. Appointments also offer e-distributors some opportunities for cooperation, and offering resource-sharing services.

Implementation

Implementation itself will be simple but it has to be integrated into the overall transport organization. In effect, appointments mean defining first with the customer, or the end customer, dates and delivery or pickup deadlines.

This information will have to be considered when transport planning is reworked. Once appointment cycles are in place, waiting time is reduced and conflict will generally disappear between employees of the different operators of the global logistics chain.



Follow-up of the solution

Follow-up indicator:

- Follow-up of the load factor before and after the appointment cycle is in effect;
- Follow-up of engine idling times;
- % of transport services organized with appointments cycle in effect.

Practical data collection process:

- Follow-up of the load factor (either in mass or volume ratio) of the transport services;
- -follow-up of the total cumulated engine idling time records (via telematics devices).

Organization of transport flows Focus – Form N° 5

Communicating practices to transport subcontractors

SUMMARY FORM

Action description

The objective of this action is a double one:

- provide transport subcontractors with the data, tools and methods which will help them reduce their fuel consumption and CO₂ emissions.
- reduce all global CO₂ emissions of subcontracted transport, in order to enhance global environmental performance in order to communicate to customers (especially in view of the soon-to-be mandatory CO₂ display on invoices of all transport services rendered).

Domain of relevance

This action is particularly appropriate to contracted transport subcontractors.

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
Informing subcontractors on Good Practice implementation Making relevant data available to subcontractors, enabling them to reduce fuel consumptions and CO ₂ emissions	0% 10% 1% to 2%	> 3 years < 1 year Non applicable	Difficult Easy	LCV RS RL SE MI
Proposing the use of Key Performance Indicators (KPI) for fuel consumption Proposing tools and methods to subcontractors, allowing them to follow up consumption, with the purpose of reducing them	0% 10% Non applicable	> 3 years < 1 year Non applicable	Difficult Easy	LCV RS RL SE MI
Proposing subcontractors to join Charter CO₂ Objective Program Making all relevant data, for subcontractors to join the Charter program	0% 10% 5%	> 3 years < 1 year Non applicable	Difficult Easy	LCV RS RL SE MI

Nota Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Organization of transport flows Focus – Form N° 5
Communicating practices to transport subcontractors
DETAILED FORM

Context and regulatory measures

The global activity of a transport operator includes activity performed by his own fleet and transport made by subcontractors. Objective CO₂ Charter enables the integration of all subcontracted road transportation, analysis and abatement calculations. The bigger the transport activity share in the global turnover, the more important it is to communicate to subcontractors what is at stake, environmentally.

In the road transport sector, two types of subcontracting relationship exist:

- Permanent subcontracting where all is written down in a contract;
- Spot subcontracting which is informal and occasional.

Due to its long-term implementation, this action is more appropriate for the first type of subcontracting (permanent). The reason for this is the proposed solution requires dialogue and exchange that will enable and convince the subcontractor of the necessity to reduce his “own” CO₂ emissions, as well as fuel consumption.

Implementing this action calls for caution in order to prevent the transporter/subcontractor relationship from being recast as an employment contract.

In order to prevent this from happening, the following points must be respected:

- Signature of the CO₂ Charter must not contribute to creating a subordination type of relation, in legal terms, between the contractor and the subcontractor, i.e. the contractor must not intervene in everyday management and the work organization of the subcontractor.
- The subcontractor must remain in total control of his management, both technically and commercially. As such, the contractor cannot interfere with the subcontractor’s choice of the suppliers of goods and services that are needed to produce the transport service required.
- The subcontractor must have total freedom of choice in the actions taken to achieve the objective of reducing CO₂ emissions.
- It is advisable to define all the obligations of the subcontractor either in the original service contract or by riders to the original contract.

Solution 1: Informing transport subcontractors of good practices

How does it work?

The first step for obtaining subcontractors' commitment is to provide the relevant information necessary for them to put into action the good practices concerning fuel reduction and GHG emissions. Information provided must concern all four optimization Focuses (Vehicle Focus, Fuel Focus, Driver Focus, and Organization of transport flows Focus).

Impact on fuel consumption and CO₂ emissions

According to the feedback from transport operators who committed themselves to the Charter programme during the 2009–2012 period, savings gains from the Charter are on the order of 5%, although information on good practices for fuel savings will not be sufficient alone to achieve these savings which are linked to a true management commitment on the part of the transport operator.

However this information constitutes a first step in raising awareness as to what is at stake and the operating management levers concerned. Given this framework, and although all quantitative evaluation is difficult, it is considered that this communication action will have positive impacts on both fuel consumption and abatement of CO₂ emissions, but duration will however be limited.

Messages linked with good practices will have a tendency to fade away and lose their initial efficacy. Between 1% and 2% savings during the first year of this communication effort are expected (and nothing else for the following years).

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Inform subcontractors of good practices to be adopted (% CO ₂ gains per subcontractor informed)
LCV Light Commercial Vehicle	Urban	≤3.5 t	1 to 2%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Source: ADEME

Domain of relevance

This action is appropriate for all transport operators who operate using road subcontractors.

Subcontracting has been a growing trend in the past few years, both for long-distance express transport and urban deliveries.

In the case of downtown routes, subcontracting usually takes the form of a vehicle rented with driver service, when the activity does not allow carrying out the transport service by the contractor himself (it will not be profitable to employ a dedicated driver on peri-urban routes with only a few delivery points).



Implementation

Several solutions can be implemented to provide subcontractors with good practice information:

- Give subcontractors the Action Forms of the CO₂ Charter pertinent to their specific activity: delivery, distribution, or long-distance transport;
- Invite subcontractors to meetings on this subject.

Implementing this solution will contribute to reducing CO₂ emissions within the global perimeter, but will not directly reduce fuel consumption: therefore a ROI time cannot be calculated.

Implementing this solution will be easier if the number of permanent subcontractors is limited and subcontractors are open to change and to proposals for optimization.

Follow-up of the solution

Follow-up indicators:

- % of the activity being subcontracted and where subcontractors are involved in solutions;
- vehicles and drivers concerned.

Practical data collection process:

- Follow-up of the information provided to subcontractors.

Solution 2: Proposing use of key performance indicators for fuel consumption

How does it work?

This solution is a basic one when a voluntary fuel consumption action is undertaken. Reducing consumption means having good knowledge of vehicles' and drivers' individual fuel consumption. Being capable of measuring and tracking consumption also allows drawing up an initial assessment of the situation and setting realistic and documented quantitative objectives, as well as focused actions. This solution will give support to subcontractors in the acquisition of methods and tools which will give them a better understanding of their fuel consumption, monitoring and giving their drivers reachable objectives.

Within this frame, it is advisable to ask subcontractors to provide the consumption figures of the transport they carry out for their own account (Action Form N° 1, "Information on the CO₂ emissions of the transport service" of the Action Form N° 4, ORGANIZING TRANSPORT FLOWS FOCUS).

Impact on fuel consumption and CO₂ emissions

This solution has no direct impact on fuel consumption and CO₂ emissions. However, it is a prerequisite to any enhancement of subcontractor performance. To remain consistent with Action Form N° 3 of the FUEL FOCUS, "Enhancing the follow-up of fuel consumption", no savings have been associated with it.

Domain of relevance

This solution is appropriate to all transport operators using subcontractors' services.

Implementation

Several solutions exist helping subcontractors to implement a fuel management system, classified by increasing order of involvement of the operator:

- Provide the subcontractor with Action Form N° 3, FUEL FOCUS, "Enhancing the follow-up of fuel consumption";
- Present the subcontractor with examples of charts tracking consumption as well as with practical solutions which could be put in place by the subcontractor in order to determine the most suitable solution.

The greater the number of subcontractors, the more complex solution implementation will prove to be. It is advisable to implement the action beginning with the most important subcontractors.

Follow-up of the solution

Follow-up indicator:

- % of the subcontracted activity where transport operators are associated to the solution;
- corresponding number of vehicles and drivers

Practical data collection process:

- Follow-up of the information provided by transport subcontractors.

Solution 3: Proposing subcontractor's commitment to the principles of the CO₂ Charter

How does it work?

In order to reduce as much as possible the CO₂ emissions of subcontractors (which in turn impact the global emissions level of the transport operator), subcontractors may be invited to join the action in a voluntary manner.

By doing so, the transporter will be sure of implementation within subcontractors' structures of actions focused on the reduction of CO₂ emissions. The transport operator will be also in a position to share experience of the good practices he has implemented when signing the Charter with subcontractors and to inform them of about the programme.

In order to avoid legal requalification of the subcontractor relationship as an employment contract, it is imperative that all the precautions explained in the Context and regulatory measures section be taken. Adhesion to the CO₂ Charter principles must remain a proposal, in no way an obligation.

Impact on fuel consumption and CO₂ emissions

Savings related to this solution will depend on the reduction actions the subcontractor chooses to implement. Feedback on CO₂ Charter implementation shows a reduction of 5% for committed transport operators.

Vehicle Size	Main use considered	MGW (or MCW) In tonnes	Suggest signing on to the CO ₂ Objectives Charter (% gain per subcontracted market share for which the subcontractor signs the charter)
LCV Light Commercial Vehicle	Urban	≤3.5 t	5%
Rigid Small	Urban	3.6-12 t	
Rigid Large	Regional	>12 t	
Semitrailer	Long Distance	40 t	

Domain of relevance

This action is appropriate to all transport subcontractors.

Implementation

In the context of this action, it is possible to propose to subcontractors that they adhere to the CO₂ Charter, and to provide them with all documents related to its implementation.

Presenting them with transporters' feedback and experience can also motivate subcontractors to rally and commit themselves in turn. It is advisable to suggest the solution to the largest subcontractors first.

As a reminder, here are the major steps for implementing a CO₂ Objectives Charter programme:

Steps		Who	When	Tools and Documentation
N° 1	Prepare project – Auto evaluate	Company applying to voluntary involvement	Prior to getting involved in the programme	Tag N° 0 of the spreadsheet
N° 2	Perform CO ₂ audit	In-house or with the help of an external support	Prior to Charter signature	Specification required
N° 3	Diagnosis validation and Charter signature	ADEME/DREAL/Conseil régional (if applicable)	After carrying out CO ₂ audit	"Voluntary involvement" and the Application Manual
N° 4	Monitor programme for three years	Company	After Charter signature	"Voluntary involvement" and the Application Manual

Follow-up of the solution

Follow-up indicator:

- % of the activity subcontracted for which the transport operators commit to the Charter.

Practical data collection process:

- Follow-up of the information provided by road transport operators (commitment to the Charter, number of vehicles involved in the action).

Organization of transport flows Focus – Form N° 6

Optimization of merchandise delivery in urban transport operation

SUMMARY FORM

Action description	Domain of relevance
<p>Four solutions for the optimization of urban deliveries are described here:</p> <ul style="list-style-type: none">• Optimization of urban deliveries dedicated to retail shops and hypermarkets;• Optimization of the last-kilometre logistics for small parcel delivery;• Hub systems for downtown deliveries;• Cloak-room type delivery system.	<p>The last-kilometre transport of small parcels is most of the time carried out with light vehicles, sometimes bicycles or tripods.</p> <p>Dedicated deliveries for general store and supermarket supply with palletized goods are carried out by small or large rigid trucks.</p>

Solutions	CO ₂ Savings	Return On Investment	Feasibility	Domain of relevance
<p>Tractor and Cabin accessories</p> <p>Using cabin fixed accessories</p> <p>CEC TRA-EQ-15</p>	<p>0% 10%</p> <p>0,5% to 10%</p>	<p>> 3 years < 1 year</p>	<p>Difficult Easy</p>	<p>LCV RS RL SE MI</p>
<p>Trailer accessories</p> <p>Using trailer fixed accessories</p>	<p>0% 10%</p> <p>0,5% to 4%</p>	<p>> 3 years < 1 year</p>	<p>Difficult Easy</p>	<p>RS RL SE MI</p>

Note Bene: the introduction section of the document provides all details on chosen hypothesis

Illustrations



Organization of transport flows Focus – Form N° 6
Optimization of merchandise delivery in urban transport operation
DETAILED FORM

Context and regulatory measures

Optimizing urban transport of merchandise presents an important potential reduction of CO₂ emissions. The kilometres operated without load amount to a 25% average ratio on urban deliveries, and the average load factor is never above 67%.⁸²

Transport operators' desiderata are the following: reduced route lengths, optimizing average speeds (transport transit times therefore shorter), easier parking.

In order to reach these objectives, numerous solutions can be applied, and in particular:

- Developing Eco-Drive (Action Form 1, Driver Focus, solutions 1/2/3);
- Optimizing the last kilometre logistics;
- Using energy other than diesel fuel for vehicles;
- Using software optimizing routes (Action Form 2, Organization Focus, solutions 1 and 2);
- Resource-sharing platforms and distribution centres (Action Form 3, Organization Focus, Solution 2);
- Using concepts optimizing urban logistics, such as smart cloak-room arrangements;
- Developing cooperation workshops at the regional authorities' level.

Mandatory involvement of Communities

- Implementing some of the solutions described in the present Action Form suppose not only transport operators' initiatives, but also a deep involvement on the part of regional authorities and local communities. They have the power to set up a regulatory and incentive-oriented framework that will give birth to the appropriate logistics infrastructure and ease up traffic conditions for vehicles in town (especially the LCVs and the rigid types) by influencing in the following ways:⁸³
- Harmonize regulations on merchandise delivery (traffic, stops)
- Facilitate access to professionals in city centres (free access to clean vehicles, priority given to dedicated delivery zones and lanes)
- Dedicate delivery areas and restrict them to transport professionals only
- Broaden the use of the parking disk that speeds up vehicle turnover
- Experiment with time-share circulation (making more linear roads with management of the time and space per activity concerned) and initiate actions of communication focused on drivers and delivery personnel, with the objective that they will respect dedicated activities in special areas.
- Facilitate implementing urban logistics and distribution in city centres, participating in the identification and use of available property.⁸⁴

⁸² Source: "Pour un renouveau de la logistique urbaine" – Séminaire CAS – 3 April 2012 (conclusion_jp_ourliac.pdf)

⁸³ Livre_blanc_logistique_urbaine_AFILOG_janvier2012.pdf

⁸⁴ Urban logistics spaces and urban distribution centres are facilities designed to optimize, operationally and environmentally, goods delivery in cities, via implementation of load transfer points. The objective is to manage flows of goods entering or leaving towns and cities, by channelling them to sites where goods are grouped before or after the initial or final leg of travel. These facilities modify traditional goods delivery by including a new operator and a new transfer point in the chain, necessitating a revision of procedures. www.transports-marchandises-en-ville.org

Two aspects are the top priority in order to facilitate implementation of optimized solutions:

- Identification and conversion of land areas. Today this point is slowing down the implementation of solutions linked with last-kilometre optimization (urban logistics and distribution centres, charging stations for electric vehicles, bicycle lanes). Public and regional authorities have an important role to play in order to think out upstream the creation of logistic space in city centres, brainstorming for new district arrangements.⁸⁵
- Optimizing the flow of merchandise deliveries in town.

Close cooperation between all parties concerned (companies, local authorities, professional organizations) is therefore a must in order to push forward negotiation, especially for the use of underground parking in city centres, as well as harmonizing the needs for delivery points in terms of time span, and taking into account local traffic regulations put in place by the local authorities.⁸⁶

Charter of good practice delivery and transport of merchandise in central Paris

This charter established by the City of Paris in 2006 sets forth applicable regulations in Paris, 30 minutes maximum use of delivery spaces, and in general establishes an action plan to guide professionals and city authorities in a constructive relationship.

In particular it includes the following instructions:

- Transport professionals making deliveries in Paris have to comply with a regulatory code that takes the environment into account: clean vehicles are now the only ones that can deliver on a 24-hour basis.
- Concerning daytime deliveries, regulations state that the 17:00-22:00 period can be used by the following types of vehicles only: electric, gas, hybrid and all vehicles that comply with EURO Norms, according to the Charter of Good Practice of Transport and deliveries inside Paris.⁸⁷
- Night-time deliveries are those between 22:00 and 7:00.
- During that time span, only clean vehicles of a maximum floor area < 43 m² are accepted.
- More generally, delivery areas have been determined and delivery time span limited to 30 minutes, controlled through the help of a disk displaying start time.

Perspective of mixed transport solutions in town: the example of the tramway

In 2004 the city of Zurich in Switzerland took the initiative, called “tram-cargo”, of using tramway lines for transportation to pick up waste and bulky items.⁸⁸ Cars equipped with containers are proposed to the inhabitants of the city, according to a schedule that is published by the public transport operator. A second freight tram, called E-Tram, is dedicated to the pickup of electrical and electronic appliance waste, and started service in 2007. The cargo tram of Dresden in Germany, circulates in alternate mode in between passenger service trams.⁸⁹ The special feature of the Dresden tram is that it has a single customer and consignee, Volkswagen Group, which has taken charge of all the investment cost for the two connected terminals, taking 40 vehicles per day out of the road traffic.

To this day, no mixed transport of this kind has been developed in France, and the environmental regulations have not yet been drawn up.⁹⁰

⁸⁵ EPAD (Etablissement Public d'Aménagement de La Défense).

⁸⁶ Source: PIPAME 2009 study; as tried to develop a 'CDU' in the underground parking of the Mall of the 4 stroke, but the initiative failed because no agreement was possible with stores on delivery times and terms of delivery of the parcels.

⁸⁷ With under 23 m² floor area.

⁸⁸ Source: CAS seminar on urban logistics.

⁸⁹ PIPAME 2009 study.

⁹⁰ A project for deliveries in Paris using the T2 and T3 tramway lines, by means of a dedicated cargo vehicle, found no funding.

Solution 1: Optimized logistics schemes for urban deliveries

How does it work?

Optimizing urban deliveries to retail stores and supermarkets

Delivery routes to boutiques, superettes and supermarkets situated in town centres are the most important ones in terms of urban distribution volumes. Rigid trucks are used in order to expand flows to their maximum. In which case, the objective of the transport operator will be to optimize the load factor of his vehicles.

This objective will be reached by combining several solutions already described in the Organization of transport flows Focus, Action Form N° 3, "Optimizing vehicle loading":

- Optimizing the volume/weight ratio;
- Mutualizing transport between several customers;
- Using software to increase the load factor.

Action Form N° 4: "Cooperative teamwork with customers in view of optimization":

- Sharing transport planning with the customer;
- Organizing pickup and delivery appointments.

Urban logistics space for optimization of the "last kilometre" in small parcel delivery

In this scheme, merchandise is first conveyed to mass logistics platform outside of town. From these platforms, trips are made by rigid trucks as fully loaded as possible, directly to city centre platforms, as close as possible to consignees.

Working from these platforms it is therefore possible to organize for last-kilometre distribution of pallets and parcels, by means of vehicles well adapted in size and with an appropriate delivery perimeter.

Logistics spaces in town have two main advantages in terms of reducing fuel consumption: firstly, they optimize the number of delivered points per route, and secondly they allow delivery during unconventional hours. Moreover, certain logistics schemes aim at a transfer of goods switching from rigid truck thermal engine vehicles, to electric ones of smaller dimensions. In this case delivery time can be extended from 7:00 to 21:00.

Several types of vehicles can be used:

- Light electric vehicle van
- Three-wheel cycle with electric power assistance
- Electric cargo bicycle
- Electric trans pallets for the final delivery, on short distances.

Over one hundred experiments based on this scheme have been attempted worldwide, 20 of which are now implemented on the long term. In France, here are some examples:

- "Chrono-City" in the Paris Concorde district, which constitutes an operational urban logistics space.
- "Distripolis" scheme run by Géodis.⁹¹
- "Green Link" which offers downtown deliveries with the help of electric-assisted tricycles.
- "Elcidis" service from Proxiway in La Rochelle.
- The urban logistics space in the Lyon Cordeliers district which has been run by Lyon Parc Autos since January 2012.⁹² Merchandise is sorted onsite and distributed in central Lyon and suburbs 6 days a week between 6:00 and 13:00, on a 31 points of delivery route with two electric vehicles (each with a 2-tonne payload – 6 pallets).

⁹¹ Géodis – DISTRIPOIS®- La Logistique de la Ville de Demain.

⁹² Source: Supply Chain Magazine – Newsletter 1405 – 30 April 2012.

- The French Post Office *La Poste* has created a project named “PRELUD” (in the Greater Lyon metropolitan area) and has developed a last-kilometre urban distribution centre for deliveries by light electric vehicles.⁹³

Hub systems optimizing “on-call” express transport in city centres

This scheme constitutes an attractive kind of solution, although a very specific one, for flows that are concentrated in a restricted commercial district, for example, some large city centre districts or inner suburban districts. It allows reducing the kilometres made by the couriers. In the operational hub situated for a few years now in the Paris “Porte Maillot” district, incoming and outgoing flows are served by cycles (and also by light vehicles for the flows to and from the suburbs). The couriers use a large and flat 3-kg capacity backpack for mail type shipments and small parcels. Average distance of an urgent transport segment is between two and three kilometres. Average distance travelled daily by the couriers is an estimated 100 km, or 20 to 25 deliveries taking into account waiting time.

Intelligent cloak-room system for parcels

Several systems have been developed on this business model in France. The chart below summarises the main systems, either operational or in testing.

Name	Cloakroom Type	Customer targeted	Parcel Withdrawal System	Automated cloakroom – Number of operational points
Cityssimo (French Post Office La Poste)	Cloakrooms and space secured	Individuals	Privatized secured space, including RATP, commerce (Casino food retailer) and Colissimo customers.	21 sites in Ile-de-France (17 in Paris), 1 in Nantes, 1 in Lille, 1 in Lyon 24/24, 7/7.
Consignity (Independent-partnership with DHL)	Automated resource sharing cloakroom ⁹⁴ .	Professionals	Public space (parking lots, etc.)	7 sites in Paris 24/24, 7 /7.
E-box (Independent)	Automated intelligent logistics	Individuals Professionals	Privatized secured space. Situated in shops.	1 site à Paris (closed in 2007), 24/24, 7/7.
Bentobox (European project “City Log”)	Intelligent parcel cloakroom	Professionals	Allows delivering trolleys or mobile compartments apart from shop opening hours. Parcels available in a secured cloakroom.	Experiment in Lyon La Part Dieu shopping centre, during 6 weeks in 2012 ⁹⁵

Other countries, in particular Germany and some Anglo-Saxon countries, have deployed cloak-room systems on a much larger scale than in France; in Germany, the “Pack Station” system was launched by the Deutsch Post as early as 2000. Cloak-rooms (receiving, expediting and collecting points) are implemented on the main city roads, in railway stations, universities, as well as in some large corporations.

It is estimated that 1 000 Pack Stations are now operational in Germany, they are open 24 hours a day and 7 days, and the service is free, for individuals and companies alike.

⁹³ Source: CityFret, point et perspectives, Séminaire Urban Trucks, 6 December 2010 (CityFret Séminaire dec2010.ppt)

⁹⁴ The courier scans barcodes of the packages on the drive of the PLC, which induces a pre-reserved casing opening. At the closure of the subwoofer, the server alerts the consignee of the arrival of his package by text message, confirms the place of delivery and provides the secret code necessary to open the safe box. To retrieve the package, the customer must then scan his identification card and enter the secret code.

⁹⁵ Source: Supply Chain Magazine – Newsletter 1405 – 30 April 2012.



Impact on fuel consumption and CO₂ emissions

In the case of urban deliveries to retail and supermarket stores, with rigid trucks, it is possible to estimate the potential savings by comparison with solutions described in the ORGANIZATION OF TRANSPORT FLOWS FOCUS Action Form N° 3 , “Optimizing the loading of vehicles” and Action Form N° 4, “Cooperative teamwork with customers for optimizing”.

In the case of small parcel deliveries and distribution, solutions for optimization of the last kilometre logistics allow significant savings of CO₂ emissions, considering the electric vehicles assigned to the end of the transport chain. On the other hand, considering the whole transport chain in urban distribution, operators who have optimized the last-kilometre deliveries estimate their savings at multiples of 10% in the fuel saved due to their new logistics organization (without counting the savings made using the end transport electric vehicle). Lastly, in **the hub systems optimizing urban cycle for “on-call” deliveries**, and the **intelligent cloak-room system** for parcels, it will be necessary to observe for each case, the CO₂ emission savings made, because each initiative has a specific profile attached to it.

Domain of relevance

These solutions are appropriate for all city centre distribution deliveries.

Implementation

In the case of urban deliveries to retail and supermarket stores with rigid trucks, please see the ORGA 3 Form (“Optimizing the loading of vehicles”) and ORGA 4 (“Cooperative teamwork with customers for optimizing”).

Logistic urban spaces for last kilometre optimization.

Before launching a logistics system based on one or several platforms, optimizing the last kilometre, the operator will have to carry out a detailed economic analysis, in order to take into account in particular the impact of the extra transshipment effect that this system makes mandatory, as well as the availability and the cost of land use in city centres. Moreover, it appears that if small electric power vehicles are easy to use at a small scale integrating a fleet, their implementation is much more complex at a greater scale, for the following reasons:

- Electric mains and battery recharging stations are scarce (regulations has strong constraints which do not facilitate implementation in parking lots);
- High investment needed;
- If we have to compare the replacement of a diesel vehicle by an electric one, it will not be cost-efficient. The ROI can only be envisaged once a full in-depth logistical reorganization plan has been completed, reducing the number of vehicles (using urban logistics spaces), reducing the approach time of vehicles, resource sharing flows, broadening the delivery span time, and developing new delivery areas.

Follow-up of the solution

Follow-up indicator:

- Number of tonnes.km made using the optimized logistics scheme in urban distribution.

Practical data collection process:

- Recording all the yearly flows, per vehicle type.