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Energy efficiency in freight transport by road

Introduction

Energy efficiency is a concept that has been firmly inserted into the public agenda in recent years. The main factors motivating this process have been the rising cost of fossil fuels, climate change and problems with the energy supply.

If there is a sector in which this new energy and environmental situation represents an opportunity, that sector is transport. The impact of this sector on countries' energy consumption patterns and its weight in terms of greenhouse gas emissions and pollutants, place it at the heart of enormous transformations driven by this new reality. According to the report entitled "Transport, Energy and CO₂ – Moving Toward Sustainability (IEA/OECD 2009)," transport represents about 19% of global energy consumption and 23% of energy-related carbon dioxide emissions (CO₂), and it is estimated that if immediate action is not taken, energy consumption and transport-related CO₂ emissions should increase approximately 50% by 2030 and over 80% by 2050. In the particular case of road transport in developing countries, an increase of 2.8% per year is expected between now and 2030.

In Latin America, Freight Transport by Road (FTR, for the purposes of this Bulletin) is on the verge of an "energy and environmental awakening," with enormous potential to set off the greatest transformation this industry has ever seen. This transformation will, in essence, require a major push to professionalize and formalize the sector's industrial and entrepreneurial structure.

This issue of the FAL Bulletin addresses energy efficiency and its challenges in terms of freight transport by road.

To this end, different national plans for energy efficiency in transport were reviewed, for both developed countries and for Latin America.

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Introduction



I. Freight Transport by Road (FTR) transformations



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UNITED NATIONS

ECLAC

In this context, the transport sector is being called to take center stage in this dynamic of transformation, in light of its weight in the energy consumption pattern, between 30% and 35% of the energy consumed nationally. In the particular case of transport, practically all consumption is derived from oil. For this reason, analysing energy efficiency in this sector, and specifically in FTR, requires studying every angle of the situation: modal split, industrial structure, regulatory framework, management competencies, levels of technological penetration, etc.

Furthermore, in the case of FTR, if energy efficiency is approached in a proper, professional manner, the results will be directly and solidly reflected in increased economic profitability, which alone justifies adopting more efficient practices.

Therefore the challenge is to strengthen the management structures of FTR companies in order to rapidly and systematically construct a culture of energy efficiency in accordance with the tools that are currently available for this purpose. For the FTR industry, conserving energy should not be viewed as an imposition or sacrifice, but rather as a real opportunity to improve the productivity and competitiveness of companies.

This document takes a comprehensive look at the Energy Efficiency (EE) challenge as it relates to freight transport by road (FTR) operations. To this end, it first puts into context the major transformations that have placed transport at the center of national and regional competitive strategies. The second part is a review of different international experiences related to national EE plans and their actions for FTR. The final section presents the central aspects that should be included in EE programmes within FTR companies.

I. Freight Transport by Road (FTR) transformations

The impact of transport on the supply chain has increased in recent decades due to the dynamics of competition and current consumption, the relocation of production

and the paradigm of stock reduction in the supply chain, substituting transport for storage. In this context, the transport and distribution industry has evolved as it has seen the services required by its clients become increasingly more complex. Today it is no longer enough to fulfill the basic premise of transport: managing the physical flow of merchandise, transporting the load within the agreed upon time frame without damaging it. There are at least three additional flows that must now be managed and that are understood to be an integral part of any modern transport and distribution service, namely the information, documentation and value flows, thus adding new dimensions to the services the transport industry provides and making it the central component of comprehensive logistics management.

Adjusting to these changes requires addressing a series of conditions that are limiting the sector's development, such as an industrial structure characterized by a significant number of micro-operators, the older average age of fleet vehicles, relatively easy access to the activity, minimal requirements related to security, emissions control, etc., which, in short, mean that a significant segment of the industry is operating outside the formal sector. This is exacerbated by the lack of incentives for vehicle owners or independent hauling contractors to either join or merge with networks or professional transport service companies or leave the sector, which, combined with the aforementioned conditions, produces the instability that characterizes this industry and that is known as "subsistence transport." It would be a mistake to assume that the subsistence rates often found in countries with excess supply, fragmentation and informality can be considered a competitive advantage, given that low rates represent relatively lower logistics costs for the companies that use these services. In fact, it is actually an enormous risk factor for the sustainability of the transport industry and for the haulers themselves, and an obstacle to professionalization. The true challenge is to secure these rates by developing the sector, which will ensure that its rate level is actually a sign of greater productivity and efficiency, and sustainable over time.

II. The importance of EE and sustainability for FTR

Energy efficiency in FTR refers to the amount of energy required for companies to access products, raw materials, markets and clients, and for people to access the goods they need. In general terms, EE improvements in freight transport operations are related to:

- **Modal shift:**
Encouraging the use of more efficient and less polluting modes of transport by effectively combining rail, river or sea transport with FTR.
- **Using efficient vehicles:**
It is estimated that advances in enhanced motors, the development of lightweight equipment, aerodynamic improvements, better tyres, etc., may mean that equipment will be 30-40% more efficient by 2030. Whether these technologies are incorporated is largely determined by the income level of the countries, and the results obtained depend on the ability of operators to properly manage technologies.
- **Improvements in fleet management:**
Using technological systems for transport management and logistical programming techniques will ensure better vehicle use, avoiding unnecessary trips and improving occupation factors and efficiency in handling and routing the load. It is expected that dead time will be reduced, unnecessary trips will be eliminated, and there will be a subsequent reduction in fuel consumption and its associated pollution.

The dynamic for sustainable transport is related to a cycle characterized by integrated logistical processes, based on efficient, integrated transport services. Among other things, this involves internalizing the environmental, urban, social and economic impacts of this reality, which places new demands on transport services. The major challenge is that this dynamic, or cycle, could become a vicious circle that increases and complicates the negative impacts, making them more costly and, ultimately, becoming an obstacle to sustainable development, or, on the contrary, it could become a virtuous circle in which each cycle improves economic, environmental and social standards, even becoming a national competitive advantage, improving and increasing access to markets.

III. FTR and national EE plans

As we have seen, there are valid reasons why governments are interested in prioritizing efforts aimed at increasing EE in the transport sector. We would point out that in all the national EE plans and their considerations pertaining to the FTR sector there are certain common themes that can be summarized by saying that efficient energy use is a strategic option in the energy policy of the countries and FTR in this context is a relevant sector with great potential for improvement.

The success of an EE plan is based on:

- Establishing a policy with a long-term focus that begins with a comprehensive evaluation of the reality of the transport and logistics structure and takes into account the real needs of the national economy.
- An institutional and conceptual framework that ensures the consistency and coordination of national and sectoral EE policies.
- The necessary collaboration on the part of government, business, freight haulers and operators of different transport modes, establishing clear goals that can be monitored and evaluated to ensure constant improvement.
- Prioritizing resource allocation in accordance with the effectiveness and impact of different instruments and approaches, based on a vision of what a sustainable transport system should be.

In general, the main obstacles that must be overcome for EE in FTR are related to three central themes: first, the capacity and speed with which FTR organizations discover, adapt and apply technologies and good energy practices; second, the economic barriers to accessing advanced technologies and credit in the context of an industrial structure characterized by excess supply, rates below total costs and informality; lastly, the cultural obstacle, when EE is not internalized in corporate priorities and daily habits, especially in the case of this industry's strategic human resource: the drivers. These obstacles feed on one another; therefore, a national EE plan must tackle them holistically, aiming at mainstreaming and professionalizing this sector.

A. National EE plans in Latin America and the Caribbean (LAC)

A recent study conducted by ECLAC and OLADE (Latin American Energy Organization) analysed the situation and perspectives on actions and instruments linked to energy efficiency in 26 Latin American and Caribbean countries.¹ The study showed that in the majority of countries the activities, projects and programmes for promoting and developing energy efficiency are –in the public sector– under the control of ministries, national commissions and/or energy secretariats or bureaus, with varying degrees of visibility and influence, depending on the country. After analyzing the different cases, it is evident that a large majority of the countries see transport as a major EE component. However, the difficulty of accessing the proposed activities and the results that have been obtained make it challenging to put together and distribute the regional lessons that have been learned. Below are some regional EE programmes that include specific activities related to freight transport by road.

(i) Brazil. We identified two important projects with a transport focus, administered by CONPET (National Programme for the Rational Use of Oil Derivatives), which is under the Ministry of Mines and Energy. The TransportAR² Project includes specialized technical support for the fleets of fuel transport trucks that supply Petrobras (the project has financial and technical support from the company), reviewing environmental aspects, fuel-saving measures and fuel transport safety. The second is the EconomizAR³ Project, which also includes technical support for the road transport sector (freight and passengers) for the purpose of economizing fuel consumption and promoting improved air quality, and it is a joint initiative among CONPET, the Ministry of Transport and the National Transport Confederation.

(ii) Cuba. State plans have brought about the retrofitting of high-consumption equipment, along with a new freight transport code for the country, and planning based on physical consumption indices in each sector of the economy. As a result of these measures, savings in transport fuel for the State sector in 2006 and 2007 reached 662,000 tons of oil equivalent.

(iii) Chile. Country of Energy Efficiency Programme – (PPEE, in Spanish), under the Ministry of Energy, has developed pilot initiatives to train drivers and designed a system to provide technical assistance to small business owners in the transport sector in efficient fleet management. It has also developed a programme for replacing and retiring freight transport vehicles, which will not only lead to a significant reduction in fuel consumption –estimated at 23.6 million liters of diesel per year– but will also help to improve environmental and safety conditions. The PPEE is working on a National EE Plan 2010-2020, which includes an important chapter focused on transport, and which should be approved in March, 2010.

(iv) Colombia. National Programme for the Rational and Efficient Use of Energy and other forms of non-Conventional Energy (PROURE, in Spanish) – Ministry of Mines and Energy. Although this programme is still in the planning stages, the document entitled “Consultancy for Gathering Information and Defining Guidelines and Priorities in order to Support the Formulation of PROURE, February, 2009” identifies some sectoral programmes for transport.

(v) Mexico. Clean Transport Programme – National Commission for Energy Saving (CONAE, in Spanish) / Secretariat of the Environment and Natural Resources (SEMARNAT, in Spanish), Secretariat of Communications and Transport (SCT) and Transport companies. It is a national voluntary programme to reduce fuel consumption and the emissions of air pollutants and greenhouse gases. Its focus is on the use of vehicle technology, better logistical practices for FTR and improvements in the competencies of drivers, business owners and transport professionals. Companies undergo a voluntary environmental and energy evaluation, establishing target goals that are reported annually, which entitles them to use the “Clean Transport” logo (the program is supported by the United States Environmental Protection Agency – US EPA).

(vi) Nicaragua. The Ministry of Energy and Mines (MEM), through the Department of Energy Efficiency, has carried out different activities in all sectors of national energy consumption, including the Definition of a Fuel Savings Programme for the Transport Sector, with the collaboration

¹ *Situation and Perspectives on Energy Efficiency in Latin America and The Caribbean, Natural Resources and Infrastructure Division, ECLAC 2009.* <http://www.cep.al.org/publicaciones/xml/1/37451/lcw280e.pdf>.

² http://www.conpet.gov.br/esp/proy_transportar.php.

³ http://www.conpet.gov.br/esp/proy_economizar.php.

of institutions involved in the sector (Ministry of Transport and Infrastructure, the Mayor's Office in Managua, the National Police, Ministry of the Interior, etc.), which includes different actions to promote fuel economy designed to reduce national fuel consumption (gasoline and diesel) by 7.5%, which equals a savings of 16 million gallons, representing US\$ 80 million annually.

(vii) Uruguay. Energy Efficiency Project – Ministry of Industry, Energy and Mining / National Bureau of Energy and Nuclear Technology, is considering a programme of national scope aimed at improving energy use on the part of end-users in all economic sectors, promoting the efficient use of all types of energy, including electricity and fuels. It includes a focus on transport through measures designed to improve how people choose, drive and maintain their vehicles.

(viii) Regional Sustainable Transport Programme: Global Environment Facility (GEF). This programme consists of projects in three countries (11 cities in Argentina, Brazil and Mexico) and a regional integration project, providing support to the cities to develop sustainable transport projects (basically urban passenger transport), emphasizing energy efficiency. The objectives are, in the broad sense, to reduce the rate of growth of greenhouse gas emissions generated by transport in Latin America; on a national level, the aim is to reduce the growth of greenhouse gases by using transport that consumes less energy; and regionally, the goal is to develop general guidelines for establishing common policies.

B. International experiences

(i) European Community. Independently of the programmes or national plans developed by the community countries, the Parliament and the Council of the European Union passed Directive 2006/32/EC, on “Energy End-Use Efficiency and Energy Services,” which lays out a framework for joint effort to achieve a savings of 9% by 2016. The community countries have structured their national EE action plans within the context of this directive, and they all include an important chapter on transport, with specific FTR measures.

(ii) Japan. Energy Conservation Law / “Top Runner”⁴ Programme for the transport sector, which establishes protocols for measuring and monitoring, as well as EE goals related to the manufacturing of heavy hauling vehicles by 2015. This law requires that freight transport companies incorporate into their business models medium- and long-term plans to reduce energy consumption and requires them to periodically send information on their energy consumption to the Ministry of Economy, Trade and Industry, which has the authority to monitor and apply sanctions.

(iii) Canada. FleetSmart⁵ Programme developed by the Canadian Government’s Clean Energy Agenda, for the purpose of promoting good EE practices that will lead to reductions in fuel consumption and emissions from commercial and institutional fleets. To this end, the programme includes training and education activities, information on technology, awareness campaigns and industry partnerships.

(iv) The United States. Environmental Protection Agency, (US EPA) has at its disposal a complete set of tools, studies and resources focused on Environmental Management, Climate Change and EE in FTR.⁶ Of note, the SmartWay Transport Partnership is a collaborative, voluntary program for both freight transport operators as well as for those generating freight, which uses a model for characterizing energy consumption and pollution standards, making it possible to evaluate strategies for improving those standards (“Freight Logistics Environmental and Energy Tracking – FLEET, Performance Models”).

(v) Other Programmes. The International Road Union (IRU), an organization that draws together the principal transport company associations, has brought attention to a series of national programmes developed and implemented by associations of FTR companies that contain measures and good industry practices aimed at –in addition to other goals– improving energy performance in transport operations.

⁴ http://www.eccj.or.jp/top_runner/index.html.

⁵ <http://www.nrcan-rncan.gc.ca/com/subsuj/tratra-eng.php>.

⁶ http://www.epa.gov/climatechange/wywd/tools_transportation.html.

C. Establishing an EE program in FTR companies

For transport companies, energy efficiency is much more than a social responsibility issue. Considering that fuel is the main cost item in this service (approximately 25% to 30% of the total cost structure, depending on the price of diesel), an energy efficiency programme implemented in transport companies has a direct and favourable impact on financial performance.

An EE programme in FTR companies is basically an operational excellence project requiring management based on processes, information, monitoring and constant improvement, using concrete indicators that can be monitored and evaluated over time. Another critical factor is related to developing human competencies and keeping them up-to-date, in order to give drivers and company employees in the sector the tools and skills necessary to adjust to this new scenario.

Generally speaking, the goal of efficient management in any FTR operation is to comply with the conditions of service as defined by the client, operating an adequate fleet, traveling a minimum number of kilometers, transporting the maximum load per kilometer, and achieving the best fuel-economy standards. Therefore, when we speak of an EE project in FTR companies, in addition to reducing the negative externalities generated by the sector, operating costs go down as a result of fuel savings and the life of the vehicle is extended by rational driving, using cleaner fuels and performing effective maintenance.

The steps toward “energy efficient” management of fleets are linked to, first, using timely and reliable information to characterize the energy consumption standards of the fleets and the current operations (to determine the baseline), in order to then, using specialized knowledge, develop practical projects and programmes with concrete actions designed to reduce consumption. This is perfectly valid for basic fleet management, as well as for managing large operations.

The “Toolkit for Clean Fleet Strategy Development”⁷ created in 2006 by the United Nations Environment Programme (UNEP) and the company TNT is an excellent example and exercise to structure and guide the configuration of

a “clean fleet.” A complete, comprehensive set of tools assist in characterizing the fleet in operation as well as possible strategies to use for the purpose of configuring and managing clean fleets.

For an EE Programme to be successful, it is essential to structure the programme’s activities within a consistent general framework that undertakes the task of configuring and operating the fleet, as shown in the following table.

Configuration (strategic scope)	Fleet Management (operations scope)
<i>Deals with configuring the fleet and operations. It includes designing and optimizing the system and the infrastructure being managed, as well as major improvement projects or the technology upgrades necessary for sustainability.</i>	<i>Deals directly with fleet operation, resolving optimization problems that arise on a daily basis while performing the service.</i>

It is important to note that an EE programme in FTR companies requires strict coordination and consistency between the two scopes mentioned above and demands a clear understanding of the client’s requirements and of the competitive strategies of the supply chains in which one participates. Both dimensions are relevant in terms of the duties of the transport manager or fleet manager, but their relevance has distinct focal points and therefore requires different competencies in order to achieve superior performance.

1. Strategy / Configuration

The strategic dimension of an EE programme in FTR companies involves managing the following aspects:

Logistics optimization: Attention must be given to the ability of transport to participate, according to efficiency criteria, in the operational definitions of the service cycle, grounded in the real knowledge gained by operating these processes. The aim is to collaborate with optimization and efficiency from a comprehensive logistics perspective.

⁷ <http://www.unep.org/tnt-uneptoolkit/>

This has to do with the determining factors related to operations as defined by the client: pick-up and delivery points, the management of scheduling windows and the streamlining of customs and intermodal processes. This dimension is strategic because once the operation cycles have been defined, the entire operation depends on them for a considerable period of time, and they must be strictly adhered to, with little room for flexibility on the part of the FTR operator.

Fleet configuration: The goal is to operate the ideal fleet in terms of capacity, performance and investment. During its life cycle, which, depending on the nature of the operation, can last from four to ten years, the choice of equipment will largely determine –structurally– the performance and emissions standards of transport operations. Therefore, improving the quality of the purchase decision and how the decision is made is a central imperative of any EE strategy and to a large degree becomes a process of continual upgrades with respect to new vehicle technologies existing on the market.

Investing in auxiliary equipment and aerodynamic technologies can be an important source of fuel savings, up to 8%. It is crucial to fully understand the nature of the transport operations and to know the existing equipment, and how it performs in the particular operations to be carried out by the fleet, because, depending on the cycle and geographical space, the equipment could either reduce or increase fuel consumption.

Other options, such as electronic engine controls for long-distance fleets, which are already standard in developed industries, despite the greater initial cost, provide better performance, better efficiency and cause less polluting emissions, by allowing en-route driving information to be better managed, as well as allowing the programming of efficient-driving “templates.”

Information systems: Systematizing a history of information on the energy performance of the diverse equipment that is available, working under real operating conditions, is fundamental for the configuration of a fleet that will generate value for FTR companies, and will also make it possible to truly understand the energy performance of an operation. This information will be very useful both for daily fleet management, as well as for making better decisions about configuring new services or operating cycles, choosing technologies or evaluating equipment with a view to efficiency.

2. Operations / Fleet management

For FTR, fleet management is at the heart of the central processes of the service. Management responsibility lies with the Traffic Department, and its activities include vehicle and route selection, and the management of loads, consumption and drivers. Under the operational excellence goal, an EE programme in FTR companies must cover the following areas of improvement:

Management of Drivers: Well-trained and motivated drivers are involved in fewer accidents, use less fuel, represent lower maintenance costs, collaborate in the care of the vehicle, extending its life, and can be trusted in terms of their attitude toward service and clients. In general, in Latin American and The Caribbean (LAC), the regulations and laws demand only that basic requirements be met to obtain a commercial driver’s license, and do not require competencies in “rational and economical driving,” “efficient driving” or “ecodriving.” Training in efficient driving is a central aspect of any EE program, and must be approached by fleet managers in a systematic and consistent manner. A difference in performance of between 30% and 35% has been detected between drivers with the highest standard and those with the lowest standard.

Efficient driving refers to a style of driving characterized by operating the vehicle within an optimal range of revolutions, in the engine’s so-called “sweet spot,” accelerating less, and anticipating traffic flow. The influence of demands made on the engine and on the driver, in terms of fuel-saving behavior, are very important. Training courses in efficient driving will have a bearing on fuel economy of between 5% and 20%. A 20% reduction is generally achieved right after the first course, for only a brief period. Over time, drivers tend to partially return to their previous style of driving, whereby the benefit is less. Therefore a central issue is the ability of transport organizations to develop an efficiency culture that consolidates and contains the modified driving habits. Even so, in the long term, it is feasible to obtain average savings of 8% to 10% by managing drivers.

In addition to designing training policies, daily management in terms of monitoring and controlling performance is fundamental if the organization is to build an EE culture that will improve the fuel-consumption standards associated with driving.



To this end, establishing an incentive system for drivers who consume less has been shown to contribute significantly to achieving this goal.

There are some driver activities and functions that are often not taken into account and that have an important impact on fuel consumption, such as aerodynamic loading and cabin-heating. For transport operations where the load is protected by a tarp, supervising both the loading and the tying and tension of the tarp can affect the level of aerodynamic drag, and consequently, the amount of fuel consumption per trip. For situations in which the driver has to remain in a parked vehicle, heating the cabin with the proper devices will result in ten times less fuel consumption than heating the cabin while the motor is idling.

For further information about the implications of and specific tools for efficient driving or ecodriving, visit www.ecodrive.org.

Maintenance management: Proper fleet maintenance is essential for optimal functioning, and it affects fuel consumption, equipment availability and safety. Improper or insufficient maintenance can have a direct impact on performance, increasing fuel consumption, causing mechanical problems that increase costs significantly and leading ultimately to a larger fleet size due to less equipment availability.

An inspection and maintenance programme that aims at operating a fleet with high energy efficiency and environmental standards consists of – depending on the type and age of the fleet – systematically ensuring that the engines are properly tuned, that filters and fuel injectors are clean and that tyres are correctly inflated and aligned.



Carrying out good inspections and making the respective repairs tends to improve fuel consumption between 3% and 7% and reduces the emissions of particulate matter, NO_x and VOCs between 10% and 20% (reductions depend on the initial state of the fleet).

Checking tyres: Low tyre pressure causes greater rolling resistance, worse performance on curves and an increase in the running temperature, which, in addition to increasing fuel consumption also increases the risk of accidents. The International Energy Agency (IEA) estimates that fuel consumption increases between 2.5% and 3% for each pound per square inch (psi) below optimal tyre pressure and reduces the life of the tyre by approximately 15%. There are two measures that have been shown to be most effective:

- Inflating tyres with dry nitrogen, which has been shown to suffer significantly less loss of pressure and offers greater stability in terms of the temperature inside the tyre, as well as reducing humidity, which makes the tyre casing last longer.
- Automatic tyre inflation when pressure levels vary.

Checking alignment: Improper wheel alignment causes greater rolling resistance and, consequently, more fuel consumption. Wheels that are out of alignment waste fuel and wear out quickly. Uneven wear on the tyre treads is a visual sign of improper alignment, although there is also technology that permits the mobile monitoring of wheel alignment.

Tune-ups and checking filters: Regular tune-ups to check the fuel injection and distributor systems (for engine systems with mechanical injection), and checking spark plugs and the condition of oil, air and fuel filters will have a significant effect on fuel consumption. A dirty oil filter, besides increasing the risk of severe damage to the motor, can increase the vehicle's consumption by 0.5%; a clogged air filter causes a drop in air flow pressure during the intake cycle, which increases consumption by up to 1.5%; and a malfunctioning fuel filter can increase consumption by up to 0.5%.

For further information on monitoring and maintenance, visit www.cleanairnet.org.