METHODS AND RESULTS OF TRAINING ECONOMICALLY TECHNICAL DRIVING IN MEXICO

F.J. Garcia-Osorio[1], A. Maldonado-Susano[1], N. Dominguez-Vergara[2]

[1]Comisión Nacional para el Uso Eficiente de la Energía (MEXICO)
[2]Universidad Autónoma Metropolitana (MEXICO)

Abstract

In this paper a methodology in teaching the techniques of the economically efficient conduction of heavy duty vehicles to operators of those vehicles and to other workers of large, medium and small businesses is explained. The participating businesses are dedicated to the transportation of goods and passengers in Mexico. Most of the logistic companies in Mexico are very small. The methodology was adapted from the international literature to the Mexican situation by officials of the Comisión Nacional para Uso Eficiente de la Energía (CONUEE) [1] since the year of 2003. Since then the CONUEE has taught it in many companies. Some of the topics of the courses are theoretical while others are plainly practical. The courses are taught in the premises of the interested companies. The theoretical part consists in the explanation of the parts of a heavy duty vehicle, the concept of energy and that of energy efficiency. Another theoretical part concerns the identification of many old and top of the line technologies to reduce the fuel consumption of the vehicles. The power train of a motorized vehicle is explained in detail as well as the power, torque and specific consumption curves of the engine. On the practical part there is an emphasis on teaching the optimal operation of the vehicle to achieve a minimum consumption of the fuel with respect to the revolutions per minute of the engine. Some practical recommendations are taught regarding maintenance of the vehicles which impact fuel consumption. One of the final parts of the courses is a field practice with the heavy vehicles on the road to verify the techniques learned in the classrooms. A few concepts of business administration are also taught to help in better management of fuel consumption of the companies. Finally, the course is evaluated and there is a follow up of the fuel savings of the participating companies. The results of these courses which are provided by the Mexican Federal Government show that the participating companies manage to save about 30% of the fuel in transporting goods and passengers and reduce their carbon dioxide emissions. Therefore, the methodology has proved to be very effective. This is very important because the fuel consumption is 20% to 40% of the operation cost of the transportation companies. Besides that, Mexico imports more than 70% of the diesel and gasoline that are consumed in the country. In this paper, the methodology, topics and results of the courses are reported.

Keywords: Training, energy efficiency, environment, heavy vehicles.

1 INTRODUCTION

The Efficient Truck Drivers Program (Transportista Eficiente) started in the year of 2003 in the National Commission for Energy Efficiency (CONUEE) [1] to show workers and directives of transportation companies how to reduce their fuel consumption through teaching the key factors which affect the consumption, the operation of the heavy duty vehicles and training them in operation techniques of the vehicles on streets, roads and highways. Among the main objectives of this program has been to demonstrate to the owners and managers of transportation companies the feasibility of reducing the fuel consumption by training their operators of their heavy duty vehicles.

The freight companies which transport people and goods in Mexico spend around 30% of their operation costs in fuel. Which is why it is important to reduce their fuel consumption. The most of the heavy duty vehicles on the streets and highways in Mexico use diesel as fuel. It is very important to reduce the fuel consumption for the freight companies because the liter of diesel has increased from $10.18 pesos per liter in the year of 2012 up to $21.78 pesos per liter on April 30, 2019. For the Government of Mexico it is very important to reduce the consumption of diesel as Mexico imports more than 70% of the diesel it consumes because the Mexican refineries operate at 40% of its refining capacity. Furthermore, the Mexican petroleum production diminished from 3.4 million barrels daily in the year of 2004 to 1.6 million barrels daily in February of 2019. Oil is the raw material for refineries. If

the fuel consumption by heavy duty vehicles is reduced the importation of diesel could be reduced and the energy security and sovereignty of Mexico could increase.

In Mexico there are very few large freight companies. There are many medium size but the majority are so small that are called man-vehicle (hombre-camión). Some of the big companies have economic resources to renovate their vehicle fleets every 3 years or to rent yearly new trucks and trailers they use [2]. However, that is not the case for medium and small companies. Because of that the Mexican heavy duty vehicle fleet is 17 years old in average. So, the small companies are the ones which have the oldest heavy duty vehicles and therefore it is very important for them to diminish their fuel consumption without having to buy new vehicles. In Mexico many of the medium and small freight companies survive by overloading their vehicles, in this way the cost per ton per kilometer diminish. Also, those companies pay low salaries to their operators in order to reduce their operation costs.

One of the benefits of a higher fuel efficiency is less greenhouse gas emissions, mainly of carbon dioxide and in Mexico as in many parts of the world heavy duty vehicles contribute with a high percentage of these emissions.

The CONUEE started in the year of 2003 a very successful program to improve energy efficiency in the operation of the heavy duty vehicles in Mexico teaming with the Cámara Nacional del Autotransporte de Carga (CANACAR) [3]. In this paper we described the topics of the courses they provided and mainly the first results of that effort. So far, the program has been very successful.

The CONUEE continues providing this training but the Secretariat of Environment and Natural Resources (SEMARNAT) started another program, the Clean Transportation Program, whose content is basically the same as CONUEE's [4].

This paper starts with the definition of economically efficient driving, then the theoretical and practical topics of the course are listed, the techniques trained in the field are explained, some results are presented and finally the conclusions are given.

2 TRAINING AND MANAGEMENT OF ECONOMICALLY EFFICIENT DRIVING

The economically efficient driving consists in a better operation of the heavy duty vehicle as well as in improving the aptitudes and attitude of the operators [5][6][7][8]. This methodology allows to:

- Reduce fuel consumption to a minimum.
- Improve the performance of the engine.
- Increase safety for the operators.
- Reduce the deterioration of tires and other vehicle parts.
- Diminish the contaminant emissions.
- Reduce the number of accidents.

The key points of the methodology are knowledge on:

- Green zone. To identify the minimum specific fuel consumption and maximum torque.
- Fire triangle. To learn the elements of the combustion: air, heat and fuel.
- Root. To learn the recommended position of the foot on the gas pedal to maintain the best performance of the motor.
- To understand the conservation of linear momentum.

The basic objectives of this methodology are:

- To show proven techniques in other countries to save fuel.
- To raise awareness to the operator of the benefits in safety of this technique.
- To incentivize an attitude change in the operators while conducting a vehicle.
- To re-asses the attitude of the operator during operation.

The advantages of this methodology in Mexico are:

- It has been proven in the country.

- Its results are immediate.
- It is easy to implement.

The additional benefits of the methodology are:

- Fuel savings.
- Reduction of the maintenance, including those for parts and tires.
- Improving the vehicles availability.
- Higher business competitiveness through improving fuel efficiency.
- Better use of equipment.
- Improving safety.
- Reducing stress during driving.

The rules of economically conduction are:

- To carry out the shortest shifts in gears.
- To operate in the highest gears of the transmission.
- To not maintain a gear of the transmission for too long.
- To accelerate progressively.
- In making gear changes, to not press hard on the accelerator.
- To try maintaining a constant speed.
- While climbing a steep slope, to choose the best gear of the transmission and accelerate progressively.
- To keep your distance to the vehicle driving in front of you.
- To stop accelerating when reducing speed.
- To make use of the vehicle inertia.
- To try to maintain a constant velocity.
- To operate in the optimum range of revolutions of the engine.

3 TOPICS OF THE EFFICIENT OPERATOR'S PROGRAM

Among the main problems detected at the starting of the seminars was that the owners and directives of the corporations considered the training of their operators as a cost and that the operators once trained would leave their companies. On the other hand, the operators rejected training because many of them have learned empirically and considered that "it was not necessary to keep their technical skills updated".

Therefore, it was necessary to change the perceptions of both; that of the directives as well as the operators'. The focus of the Efficient Truck Drivers Seminar for the directives was on detecting areas of opportunity to reduce fuel consumption and therefore operation costs, and for the operators through the theoretical-practical technical-economic courses on how to reduce hands-on the fuel consumption of their vehicles in their usual routes.

The main topics of the Efficient Truck Drivers Seminar of the CONUEE have been based on the following topics.

Energy Diagnostics. It consists of 7 short steps to evaluate the company´s situation with respect to the fuel consumption. This is usually carried on with a software developed by CONUEE to conduct an energy self-diagnostics of the freight companies.

Economically-technical driving. This part consists in teaching the basic principles of the economically technical operation of the vehicles, starting with the knowledge of the vehicle technology.

Technical selection of the vehicles. This part is focused on teaching how to properly choose a vehicle, considering the needs and characteristics of the operation of the company. The concepts of startability (capacity of starting the vehicles) and of gradeability (the capacity of driving uphill) are explained as

well as how to calculate, for a few cases, the resistant forces that a vehicle encounters when moving. The software is used to make the proper selection. In this part of the course, other important factors in the selection of the vehicles are explained such as financial, economic and technical. In the technical part specific examples are given of how to calculate the requirements of power for the units to overcome the resistance when moving: from the air (aerodynamics), from the pavement (in rolling) and from the weight of the vehicles (inertia).

Maintenance. This part covers the types and principles of vehicle maintenance for a fleet, the indicators to monitor it and the basic tasks that a workshop manager should carry out.

Fuel management. To identify the variables which are useful to perform a good fuel management in the freight company and the factors which influence the over consumption.

Logistics. To optimize the route's design and the use of the fleet, to know the profitability of the services that provide and to make more efficient the different logistic operations to reduce the cost of the operations of the vehicles (fuel) and therefore to improve competitiveness.

Quality. To understand and comprehend the definitions of Quality and the requirements of the ISO 9001 standard, the advantages of knowing and complying with some of them are pointed out in this part of the course.

Management of the company. To strategically plan the businesses of the company, identifying the main characteristics of a family-owned company, its profits, and the main issues that menace its survival and growth.

The topics of energy diagnostics, economically technical driving, vehicle selection, maintenance, guidelines for energy efficiency and the group dynamics, take approximately an 80% of the time of the seminar.

4 METHODOLOGY OF TRAINING

4.1 Methodology of the hands-on training

Usually, the training courses to train trainers of economically technical driving have lasted 32 hours, including the hands-on part. The courses for operators last 24 hours. The number of hours has been optimized to obtain the maximum benefit in learning the methodology, which includes a deep understanding of the technical concepts and basic knowledge which are essential to foster a major awareness of the concepts and practice of the economically technical driving techniques.

An important result of the training is that the operator applies the techniques learned in the course, measures the fuel consumption and he/she confirms the amount of fuel which has been saved on routes that he/she uses driving typical vehicles of the company in real driving conditions.

It is also relevant, to explain to the operators participants in the courses, that the efficient driving is a new driving style, based on understanding the top of the line technologies that are built in the vehicles which complement and help their proper style of conduction. That is, adapting their personal styles to the use of the modern technologies.

4.2 Selection of the route and fuel consumption control procedures

The theoretical parts of the course, should take place in suitable training rooms. The training should be in training spaces which each company has –if that is the case-, but that have minimal noise and interferences from external factors.

The practical parts of these courses take place on typical routes of transportation of people and goods and using characteristic vehicles of the company. The routes should have: intersections, traffic circles, traffic lights, slopes, downhills, highways (including parts with entrances and exits), roads, etcetera.

A transparent procedure for measuring and controlling the fuel consumption should be created and followed during the driving practice. There are several methods to construct it.

On-board computer: if the vehicle is equipped with an on-board computer, its registers can be used to obtain the average and instant fuel consumption, as well as the average speeds in each trip. It is very useful in the practical training of the instructor to see at any time the instant fuel consumption during

the trip by the operator (zero fuel consumption in decelerations in which the vehicle moves by inertia; high fuel consumption in stop and go situations, etcetera).

Electronic devices in the marked. To install a fuel consumption device during the trip is essential in teaching the techniques. There are devices sold by suppliers which have simple instruments which can be attached to any vehicle that show the average and instant fuel consumptions, as well as the travelled distances and average speeds during the trips, besides of other useful parameters during the driving. Furthermore, these instruments allow to store registers of fuel consumptions and speeds for different drivers.

Filling the tank (filled to filled). If a vehicle does not have an on-board computer or it is not possible to install a specific electronic device to measure the fuel consumption, the following method can be used to measure the fuel consumption.

a) The tank is filled up to its nozzle, allowing the fluid to rest as it is being filled and filling it again, to leave the liquid level right at some mark.
b) To drive in the planned route.
c) To fill the tank again in the same way described in incise a) with the same pump and registering the liters supplied, which is the fuel consumed.

4.3 Development of the course

The courses are taught to groups of a maximum of 12 persons. The theory sessions are taught using the traditional methods in a classroom or the like. The instructor advises each of the participant in the solution of the proposed problems. Also, some practical exercises in communication are carried on in order to show the importance for the instructor or trainer to master or to improve his/her skills on it. During the practical part of the course specific instructions are given on the economically technical driving to each operator during the trips and an evaluation is done.

4.4 Resources

To teach the theoretical concepts it is necessary to use computer power point slides, flipcharts, traditional blackboards and also some videos.

It is also necessary to analyze the technical cards of the representative vehicles of the company.

For making the itineraries in free or economically technical driving old and new vehicles can be used, depending on the possibilities of the company.

It is very useful to use the vehicles on-board computers which can store registers of the fuel consumption, kilometers travelled, average speed, and the engine revolutions per minute (rpm). Otherwise, the measurements of those variables can be obtained with traditional equipment and instruments.

Although in most of the sessions participates the whole group, it is also necessary to coach individually during the theoretical and mainly during the practical part, giving detailed explanations of the topics being taught. Sometimes the initial structure of the courses changes because of the group dynamics.

There will be some differences in the initially proposed structure of the courses, because the activities of the groups will demand it.

Next, a development of a typical course is explained considering that the duration is of 4 days. The activities are listed and explained.

4.5 Activities of the theoretical practical course

4.5.1 Theoretical class (first day)

The courses can be inaugurated with the presence of the top management of the company. In the ceremony, the importance of this type of training is pointed out, noting concepts like efficiency, modernization as well as professional and ecologic driving. Afterwards, all the attendances are asked to introduce themselves briefly which is very useful to know their names, job positions in the company (workshop manager, heavy-duty mechanics, etcetera) as well as their activities. In the case of the operators it is known their years of experience in driving and the company vehicles they drive.

Later, the formal course begins with the explanation of the elementary concepts of force, torque and power and the physics involved with day to day examples and their application. The units and equivalences of the physical quantities are taught. Some characteristics curves of torque-power versus revolutions per minute are reviewed of some typical engines.

During the theoretical part, some new technological advances for the diesel engines and its accessories to improve the power levels of the engines (turbocharges, new cooling systems, electronic controls, etcetera) are described. It is explained the transmission of energy and motion since the crankshaft to the wheels of the vehicles and it is described how to calculate the speed of the vehicle with respect to the engine speed. To conclude this part, there is an exercise to illustrate that the knowledge must be transferred clearly and precisely, as an example of possible "wrong communication" among trainers and the people being trained.

4.5.2 Practical demonstration (first itinerary to travel) (second day)

During this section a route is selected and each participant drives (for a short time) without any comment or observation; this is called free driving. Each participant is evaluated and the fuel consumption and the number of times that he/she touches the braking and clutch is registered.

4.5.3 Theoretical class (third day)

During this session, the basic concepts of economically technical driving are taught, starting with the explanation of the characteristics curves of the engine, the specific fuel consumption and its relation to the power and torque of the engines.

Several examples of the characteristics curves of old and new engines are explained, showing the difference they present and the form in which they should be used in an efficient way.

4.5.4 Practical demonstration (second day of driving) (fourth day)

During this session the same itinerary of the second day of the course is travelled again but applying the economically technical driving.

During the trip the instructor registers again the necessary data to perform the evaluation and do the comparison between the free and the economically technical conduction of each of the participants. The instructors during the trips continuously explain to each of the participants the economically efficient driving techniques.

4.5.5 Analysis of the results

After finishing the trip and during the session in the classroom, several comments are given on their lived experience in the free and in the economically technical driving.

A comparison is done of the fuel consumption in both trips as well as the number of times the brake and clutch were touched and of the travelled times. The number of times that the braking is touched is related to the brake, clutch and tires wear. With the recollected data it is also possible to calculate the percentage increase in the fuel efficiency (in km/liter).

4.5.6 Practical guidelines to save fuel and improve road safety

1. When starting the vehicle do not accelerate to warm it, this besides wasting fuel, causes a larger engine wear and larger contamination. For gasoline vehicles one minute is more than enough, while for one on diesel it should take the same amount of time as that to fill out the air tanks of the braking system.
2. For starting up the vehicle begin with the first gear, this will easy the departure and it will take less effort to the engine to start moving, besides that it will protect the clutch.
3. In making gear changes, do not press hard on the fuel pedal to facilitate the change, this is not necessary because current transmissions have synchronizers.
4. Avoid abrupt acceleration, this will reduce the fuel consumption, will increase the lifetime of the tires and will make the driving safer and with less stress.
5. Do not exceed the speed limits, it has to be remembered that the heavy duty vehicle transports a weighted load and it will require a larger distance to stop it. The 4 seconds rule has to be applied, that is: choose an advertising spot or shrubs along the road as a reference and when

the vehicle ahead of you passes (by the reference) start counting 1001, 1002, 1003 and 1004, if your vehicle passes by the reference before you ended counting you are dangerously close. In case of rain apply the 6 seconds rule.

6 Drive in the rpm optimum range of your engine, which is marked in the tachograph or in the green zone of the tachograph, or consult the operator's manual of the owner of the vehicle. If you do not have it, try to drive within the speed limits in the city as well as on the road.

7 Try to drive in the last gears of the transmission; for example: if your unit has 10 gears try to drive in the 10th and in the optimum range of operation if the road and the load allow it.

8 On a steep slope perform a regressive change (if driving in the 10th gear change to the 9th), this will increase you capacity to climb and later accelerate progressively to maintain the operation in the optimum range of the engine.

9 When approaching a traffic light, stop accelerating, this will reduce the speed of the vehicle and will make the driving safer.

10 Do not keep the engine running without justified cause, a running engine in a stationary vehicle produces a lot of fuel wasted and suffers greater wear, besides that it can generate the carbonization of the combustion chamber.

11 The economically technical driving does not only saves fuel, but also money and reduces the maintenance operations, as well as accident risks and the emissions of contaminants. Be alert. Do not rely solely on your experience, you must be always prepared for any unexpected event, remember that not everybody on the street or road has your experience.

5 EXPERIENCE OF THE EFFICIENT TRUCKS DRIVERS PROGRAM IN 2003

The Efficient Truck Drivers Program was created in 2003 and consisted of courses about how to increase the energy efficiency in the Mexican auto-transport. The courses were taught under the joint organization of the National Commission for Energy Savings (CONAE) and the National Chamber of Trucking (CANACAR) [3]. In the courses participated 500 directives and representatives of the CANACAR trucking industry from different regional headquarters of Mexico. Half of the trucking industry participants to the seminars considered that it is possible to achieve reductions of fuel between 6% and 10%, applying some of the activities recommended in the events.

The technical assistant was provided to the companies affiliated to CANACAR which operate more than 400,000 units to transport federal loads. The CANACAR had 55 regional offices in all the country. It was intended that directives participate in the courses.

There were 13 Efficient Truck Drivers seminars organized in the year of 2003 in regional headquarters of the CANACAR across the country since the 16 of May until the 28 of November of 2003. About 50% of the 500 participants were company directives including some owners of the companies, while the rest were operative personnel of those companies. The largest number of participants were in the City of Tlalnepantla in the State of Mexico and in the cities of Mexico and Monterrey.

6 MAIN BARRIERS TO IMPLEMENT ENERGY EFFICIENT MEASURES IN TRANSPORTATION

The main barriers to implement energy efficient measures identified by the truck companies are discussed during the courses.

Economically technical driving. Lack of knowledge of the driving techniques. Little awareness and unfavorable attitude of the operator to this technique. There is not training for the administrators to support the technique in the companies. Sometimes, because of the operation conditions, the drivers are asked to drive over the speed limits legally established.

Improving maintenance. Lack of qualified personnel. Lack of following up the maintenance programs. Effective availability of spare parts in time and quality.

Vehicle selection. Lack of technical knowledge to select the vehicles. Diversified loads and routes. High costs of the heavy duty vehicles.

If the companies do not have trained drivers, these will be unwilling to drive the vehicles with a favorable attitude to properly maintain the equipment and therefore, their profitability will be drastically

reduced. Furthermore, without the cooperation of the other workers of the company (administrative), it will be very difficult to reach the fuel consumption goals which satisfy the levels of competitiveness based on improving the fuel efficiency.

In the case of maintenance, there has been a quick change and even an evolution of the vehicles technology but the people who repair and carry out the maintenance of the top of the line vehicles are not up today with the knowledge of the new technology and how to perform the maintenance. There is also the need to create the infrastructure to effectively distribute the spare parts of those new vehicles.

Also, it is noticeable that the owners or directives do not give too much importance to maintenance and that can result in higher costs to the company in the long term. One should remember that the maintenance is related to the efficiency of the vehicles and how quick the companies can response to changes in new opportunities of services in the transportation businesses.

Vehicle selection: for small and medium size companies, there is very little financial capacity to buy new vehicles with the best technological capabilities, aligned with the load needed to be transported, the different clients and the best use of the routes.

The barriers vary depending on the region. For example, in the northeastern region of the country one of the main problems in the availability of heavy duty vehicles operators (notwithstanding the grade of qualification that they have), while in the south there is a great offer of them.

Half of the directives points out to the operators as the main obstacles to follow up the maintenance of the units. About one third of the surveyed directives considers that exists the difficulty to follow up maintenance actions, but the rest considers that there are no barriers and that it is only necessary to take the decision to carry them out.

7 RESULTS

The fuel savings depend on the type of vehicle, as it is shown in Table 1.

Almost 80% of the surveyed people consider that can save from 6% up to 20%. Only 22% considers that the savings are limited to a range of 1% to 5%.

The three more sensitive factors to obtain an improvement on energy efficiency are: a) the application of economically technical conduction, b) improve maintenance and c) suitable vehicle selection.

Estimates of the amount of liters of diesel saved of the participants in the Efficient Truck Drivers CONUEE-CANACAR Seminars are presented in Table 2.

In the Table 2, the estimates of the monthly and the annualized total fuel savings of the participant companies in the Efficient Truck Drivers Seminars during the year of 2003 are reported. The calculation of the fuel savings is based on monthly trips and real average fuel performance, applying the lower fuel efficiency estimates proposed by the operators of each company.

The high estimate could be 20% larger than the results shown in Table 2.

Table1. Achieved average fuel consumption.

Type of vehicle	*Percentage of fuel savings (%)*
Tractor	11
Foreign line buses	16
Minibus	16
Delivery vehicle	16
Regular urban passenger bus	17
1.5 ton pick up truck	22

Table 2. Saving estimates. Results of Efficient Truck Drivers CONUEE-CANACAR Seminars.

Place	Number of vehicles	Monthly consumption (liters)	Estimated savings (liters)
Tlalnepantla	645	5,342,500	106,850
Ahuazotepec	218	1,396,667	27,933
México, D.F.	800	5,365,595	107,312
Guadalajara	542	4,010,673	80,213
Tlalnepantla	278	1,773,611	165,350
Monterrey	1,387	8,808,539	450,013
Orizaba	296	1,266,389	67,739
México, D.F.	713	3,411,295	310,943
Aguascalientes	1,341	8,005,817	626,983
Reynosa	319	1,609,028	104,706
Uruapan	84	17,143	1,154
Coatzacoalcos	1,275	6,053,667	618,251
Cuernavaca	408	1,646,866	88,052
Total - Monthly	4,879	48,707,789	2,755,500
Total- Yearly		584,493,472	33,066,002

There are difficulties to suitable vehicle selection, the correct operation of the vehicles and the proper maintenance by the responsible people. The responsible people are, the person who purchase the vehicles (owner), the persons who drives them (operators) and the persons who repairs them (the body shop heads and the mechanics).

8 CONCLUSIONS

The Efficient Truck Drivers Seminars are cheap but with great results and benefits:

a) To obtain the information and suitable technologies to take advantage of the areas of opportunity identified in the company, mainly in training the operators, the decision for a more effective selection and in improving and following-up the maintenance programs.

b) To identify and exploit the potential fuel savings that the owners, directives and operators identify in their companies and that in average are at least 7.5%.

c) To obtain economic benefits, not only from the fuel savings, but also from the indirect savings, due to the longer conservation of the vehicles, less number of accidents in the routes, as well as in a higher availability of the vehicles.

d) To learn and use the methodologies in order that the entrepreneurs of freight companies obtain important savings in their businesses which will allow to carry out investments to improve the productivity and competitiveness of their companies.

e) To implement the methodology recommended in the Efficient Trucks Drivers Seminars nation-wide as it could bring very important fuel savings for the freight companies and the country.

The implementation of fuel savings based on the philosophy and techniques of the Efficient Truck Drivers Seminars could generate in a short period of time, savings of at least 4% in the costs of freight companies.

This CONUEE program has continued and has been very successful in reducing the fuel consumption of many private companies. Many other Mexican government offices (the Secretariat of Energy, SEMARNAT and the Secretariat of Communications and Transport) have participated in recent efforts [9]. Details of very recent achievements will be reported in a future paper. In this paper we have only reported how those programs started in Mexico and some of the accomplishments of a government office (CONUEE) teaming up with private companies.

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