

Fuel Economy Improvement – in Perspective of India

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Abstract:- Secure energy resource is one of the prime factor to drive growth of any country, and it becomes more critical for developing country where in growth rate is much higher and demands energy exponentially.

Though, fossil fuels will still retain the major share of energy supply in the India and developing countries in Aisa, these countries are facing the challenges of preventing environmental degradation as a result of the hydrocarbon combustion and long-term challenges of energy availability and sustainability due to various uncertainties in the forms of a possible global economic crisis, political uncertainties in the oil exporting countries as well as more frequent natural disasters. Even with advances in vehicle technology, both conservation and methods for reducing the fuel consumption of existing vehicles are needed to decrease the petroleum consumption and greenhouse gas emissions.

INTRODUCTION :

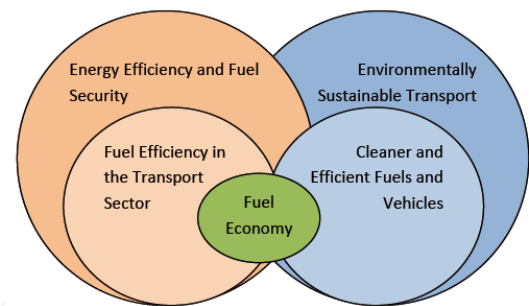
Road transport is a key element in the mobility of goods and people. It is also a significant consumer of liquid fossil fuels worldwide and thus a major contributor to the increasing global greenhouse gas (GHG) emissions, especially CO₂, and air pollution. While most developed countries have put in place vehicle fuel economy standards, China is the only developing country in Asia with such standards.

Fuel consumption by transport is expected to increase by more than 5% per year until 2030 because of rapid urbanization and economic growth resulting in greater demand for mobility. ASEAN countries increasingly rely on fuel imports, fuel prices are very volatile, and several countries heavily subsidize fuel putting pressure on national budgets. CO₂ emissions are expected to rise equally as fuel use increases. Air pollution, although depending on the quality of fuel and emission control devices, will also increase. Of these, particulate emissions are of concern because of their health impacts as well as their contribution to global warming because they contain black carbon or "soot".

Fuel economy policies and measures are therefore important for fuel security and costs, climate change and air pollution control. Such policies and measures could lead to up to 16% reductions in fuel and CO₂ emissions if applied to light duty vehicles (LDVs) and up to 26% if applied to both LDVs and high duty vehicles (HDVs).

The development of framework for fuel economy policies should be linked to or placed into context of other policies; efforts of which can help in energy efficiency and fuel

efficiency in transport sector, climate change and air pollution control, as shown in the figure.



Fuel Economy in the context of Energy Efficiency and Sustainable Transport

SCOPE OF FUEL ECONOMY IMPROVEMENT:

Fuel economy improvement is very crucial in today's world where energy resources are depleting rapidly and fuel prices are increasing exponentially. This led to really look into details on, what are ways to improve fuel economy? How can one reduce loss of fuel in various location?

In my opinion, for India prospective, following ways can help in improving fuel economy.

1. Mobility Infrastructure development
2. Enforcement of Fuel Quality throughout country.
3. Utilization of high grade Lubricating Oil
4. Educating customer on utilization & maintenance of vehicles.
5. Role of Policies in Fuel Economy Improvements
6. Technology Selection and it's effective implementation.

Brief discussion on above said topics is covered in this paper.

1. Mobility Infrastructure Development:

In developing country like India, few major cities are connected by highways and possesses limited infrastructure. Recently efforts had been taken to upgrade existing old, narrow roads to world class standards. But still there is huge scope for infrastructure development. Thousands of kilometers of road, still need road surfacing, widening roads to adequate width, minimization of check posts etc. Improving all these can help in running vehicles continuously for longer distance, thus reducing braking of huge number of

vehicles over long distances. Hence avoiding power losses, resulting fuel savings.

Link roads and bypasses right from towns until cities and metros; improved intersections and junctions will be helpful for multi axle vehicles and tractor trailers to move goods outside city, and avoiding city traffic and hence saving lot of fuel.

Planned and developed infrastructure can reduce larger number of small vehicles running in and around city and resulting in saving fuel.

Better infrastructure is a need and this can contribute in improving fuel economy on larger scale.

2. Enforcement of Fuel Quality:

The formulation and or content of fuel obviously has a major effect on combustion and the exhaust pollutants being emitted. The relative proportions of different substances in the fuel, whether they are natural constituents, impurities or deliberate additives, can have effect on vehicle performance accordingly. Hence fuel quality plays critical role in vehicle performance and thus impacts on fuel economy.

Enforcement of existing fuel quality regulations through, end user awareness, by conducting strict audits and by using high tech refineries can help to improve quality of fuel being used in country.

3. Utilization of New Generation / High Grade Lubricating Oil:

Lubricating oil in an engine serves several functions, including reducing friction, cooling engine, protecting against wear, removing injurious impurities. It is primarily its effect on friction that impacts fuel economy (FE). Friction is an important cause of energy loss within vehicle. Engine oil reduces friction in two ways, one is hydrodynamic lubrication and other is boundary lubrication.

New generation engine oils are designed to reduce friction losses by lubrication by tailoring the viscosity characteristics of base oil and by adding oil additives.

Lowest possible viscosity results in best FE but this needs to be defined in considerations with oil consumption and engine durability and oil change intervals.

Usages of oil additives (friction modifier additives) can be a better solution to improve FE while maintaining engine durability.

The use of fuel- efficient oils provides modest benefits to fuel economy at very low cost to consumer.

4. Educating Drivers for Fuel economy Improvement:

Every manufacturer are aware of best efficiencies zones for a particular vehicle from fuel economy point of view and it's normally displayed on dashboard through various kind of displays. Although, it's shown on dashboard, still insisting and guiding as a campaign for driving accordingly during various interactions with customer (owners and drivers) can help in resulting improvement in fuel economy .

Also, during use of vehicle, customer may go for modifications in vehicle systems like intake / exhaust / cooling etc., to make it fancy or for comfort which may lead in adverse effect on fuel economy. Necessary guidelines should be given to customer to avoid such changes.

Eco-driving programs in Europe have been effective in achieving real world fuel savings. In the U.S., promotion of more efficient driving has largely been limited to efforts by automotive companies and state governments.

To make most effective, driver education programs should include both driver training and public information campaigns. In addition to informing drivers about tips for more efficient driving, such education programs should focus on:

1. Directing tips toward mainstream drivers,
2. Addressing misconceptions about driving, and
3. Motivating more efficient driving styles.

First, the drivers of vehicles with moderate power-to-weight ratios, the most common vehicles, stand to save the most fuel through changes in driving style.

Vehicles with moderate power-to-weight ratios have the most aggressive driving patterns and are more sensitive to aggressiveness than higher performance vehicles. Lower performance vehicles are even more sensitive, but have lower potential for less aggressive driving.

Fuel consumption is lowest during steady-speed driving at a moderate speed and increases with both increasing and decreasing speeds. As speed drops, vehicle efficiency decreases much more than wheel work. As speed increases, wheel work increases, while efficiency remains relatively constant.

Tips for fuel economy improvement over driving styles are:

- Drivers with low aggressiveness should: focus on reducing accelerations and decelerations over reducing speeds during highway driving.
- Drivers with high aggressiveness should: focus on reducing speeds during highway driving over reducing accelerations and decelerations.
- For manual transmissions, use the highest gear possible
- Eliminate excessive idling.
- Combine trips to reduce overall distance traveled.
- Don't wait for the engine to warm-up before driving.
- Use cruise control, except for on hills.
- Keep tire pressure high.
- Don't use a roof rack or other parts that increase aerodynamic drag.
- Remove excess weight.
- Use air conditioning and other accessories only when necessary

5. Role of Policies in Fuel Economy Improvements:

In surveying measures being used by governments around the world to promote vehicles with low fuel consumption and low greenhouse emissions include:

- support for research and development into new vehicle technologies,
- support to manufacturers to develop vehicles which use alternative fuels,

- voluntary automotive industry agreements on fuel efficiency.
- mandatory vehicle fuel efficiency or CO₂ emission standards.
- Application of traffic management measures for enforcing regulations.
- Preferential application of traffic management measures for identified fuel efficient, environment friendly low emission vehicles, e.g. use of transit lanes, cheaper parking areas, reduced road tolls,
- Government fleet procurement policies,
- Differential government taxes and charges based on fuel efficiency or greenhouse gas emissions (or proxies such as engine size or vehicle weight), e.g. vehicle registration, stamp duty, import duties, and
- Subsidies for purchase or conversion of alternative fuelled vehicles.

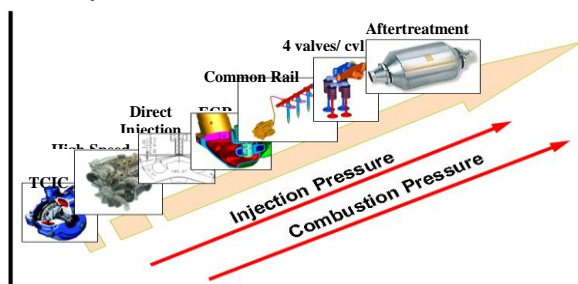
6. Technology Selection and its effective implementation :

Every vehicle manufacturer has own way of technology selection. In earlier days, technology selection strategy was having various inputs like product benchmarking, criteria of meeting emission norms, cost of ownership, appearance and durability and operating cost. But today's competitive world, one of parameter, which was considered earlier as a part of cost of ownership is become more dominant, is FUEL EFFICIENCY. This is due to higher fuel prices, globally. Thus, Priority parameters for technology selection are changed. Now days, most of vehicle manufacturer are having following parameters as prime inputs for technology selection:

- a) Capability to meet regulatory Compliance Requirement
- b) Scope in delivering competitive Fuel Efficiency
- c) Durability
- d) Cost of ownership
- e) Operating cost
- f) Serviceability
- g) Benchmarking of product segment.

TECHNOLOGY SELECTION ON FUEL ECONOMY:

Latest technologies having smart electronic controls are having precise control and better scope for optimization while compared with mechanical controls. Various technologies as shown in figure 1 below are used for delivering better fuel economy.



injection pressure and higher combustion pressure are being used as path to achieve better fuel efficiency.

EFFECTIVE IMPLEMENTATION OF SELECTED TECHNOLOGY:

After selecting technology for a particular product, what matters is effective implementation. While implementing a technology, one of compromised or ignored element is application engineering; which can actually decide effectiveness of selected technology and may affect considerably on fuel efficiency of vehicle.

An efficient transmission and an efficient engine if not matched properly with duty cycle of product, it may result into poor fuel efficiency product.

A well designed Vehicle intake system or exhaust systems may be modified by customers in field either for making fancy or for improving comfort can lead to increasing restriction in intake system or increasing back pressure in exhaust system, which an considerably impact on fuel efficiency of vehicle.

In few cases, modifications in vehicle front grill in front engine vehicles may lead to impact on vehicle cooling system efficiency and hence may deteriorate fuel economy.

Thus implementation of selected technology, awareness to customer on what to do and what not to do can help in maintaining technology advantage.

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REFERENCES:

1. Heywood JB "Internal Combustion Engine Fundamentals" McGraw Hill 1988,
2. 50BY50 Global Fuel Economy Initiative- Improving Fuel economy in the ASEAN- July 2010 paper
3. The Effects of Driving Style and Vehicle Performance on the Real-World Fuel Consumption of U.S. Light-Duty Vehicles by Irene Michelle Berry.
4. Owner Related Fuel Economy Improvements- Prepared by ENERGY and ENVIRONMENTAL ANALYSIS, INC., 1655 North Fort Myer Drive Suite 600, Arlington , VA 22209, Dec. 2001.
5. STONE Richard "Introduction to Internal Combustion Engines" SAE publication 1999
6. Potential measures to encourage the uptake of more fuel efficient, low carbon emission vehicles- Public discussion paper by Australian Transport Council (ATC) and Environment Protection and Heritage Council (EPHC) Vehicle Fuel Efficiency Working Group With support from The Australian Government, September 2008