INDIA'S FUEL ECONOMY BENCHMARKS

How to make them work for an energy-efficient and climate-secure world

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Why this study?

Fuel efficiency standards for vehicles directly influence mileage and carbon emissions per litre of fuel burnt and are one of the most difficult and least understood policy instruments in India. We need to develop a better understanding of them if we are to achieve multiple objectives of reducing oil demand and emissions of heat-trapping gases, protecting consumers from rising oil prices, strengthening energy security, driving technological innovation, and catalyzing electrification of the vehicle fleet.

Even though India has taken steps to substantially improve its mass emissions standards for vehicles to Bharat Stage VI (BS-VI) in 2020 (that regulates emissions of toxic pollutants), regulatory mandate and standards for reducing energy and carbon footprints of vehicles has remained weak. This is a matter of serious concern as vehicle numbers and freight transport are growing rapidly, leading to an exponential rise in fuel consumption.

As per the International Energy Agency's (IEA) India Energy Outlook 2021, the energy demand for road transport is projected to more than double over the next two decades, based on today's policy settings and assuming that COVID-19 spread will be controlled in 2021.[1] India is set for a huge expansion in transportation infrastructure—from highways, railways and metro lines to airports and ports.[2]

The IEA report also states that a total of 300 million vehicles of all types will be added to India's fleet between now and 2040. Oil demand is expected to increase by almost four million barrels per day (mbd) to reach 8.7 mbd in 2040—the largest increase for any country. Over half of the growth will be fuelled by diesel-based freight transport. An additional 25 million trucks are expected to be on India's roads by 2040 as road freight activity triples. If a combined strategy of fuel efficiency, electrification of vehicle fleet, and fuel switching is implemented, the growth in oil demand can be limited to less than 1 mbd.[3] Fuel efficiency improvement is central to this priority package to tame energy guzzling.

Fuel efficiency regulation is, therefore, a crucial measure for India to meet its Nationally Determined Contribution (NDC) commitment to reduce energy emissions intensity by 33–35 per cent by 2030. The regulation is also needed to cut down the burgeoning oil import bill. Government of India has a roadmap to reduce import of crude oil by 10 per cent by 2021–22.

India cannot keep the oil splurge in the vehicle sector untamed. Between 2005–06 and 2019–20, petrol and diesel consumption has increased by three times and two times

respectively. Over 80 per cent of crude oil is imported. Linked to the consumption, import dependency of crude has increased to 85 per cent in 2019–20.

Yet fuel efficiency regulations for vehicles—the key regulatory instrument to control energy guzzling in vehicles—have remained mostly nebulous. So far, India has implemented fuel efficiency standards only for passenger cars. These standards have not been implemented for other segments like heavy duty vehicles, two-wheelers and other commercial vehicles. It is not yet clear how soon the standards for passenger cars will be tightened for the subsequent stages and the standards for other vehicle segments implemented.

In India, these standards are crafted by the Bureau of Energy Efficiency (BEE) under the Energy Conservation Act, 2001 that is administered by the Ministry of Power (MoP). The standards are also notified under Central Motor Vehicles Act, 1988 and its Rules by the Ministry of Road Transport and Highways (MoRTH) for implementation. The process of setting and implementing these standards in India is relatively new.

There are concerns that the economic slowdown due to the COVID-19 pandemic is stoking resistance in the automobile industry against ambitious targets and timely implementation of these standards. This can hurt not only the low-carbon growth path but also the interest of the industry itself. More so, when the global vehicle technology trajectory is evolving rapidly, driven by net-zero pathways. The major vehicle markets of Europe, the US and China, among others, are adopting green recovery approaches to recover from the pandemic-linked economic dislocation to drive low-carbon and zero emissions pathways. They are co-joining strategies to set more stringent targets for fuel and carbon savings from internal combustion engines (ICE) while accelerating electrification of their vehicle fleets. Nearly 20 countries have committed to phase out ICE vehicles completely in the time horizon of 2040–50.

India cannot ignore these sweeping changes in the global markets. It makes neither economic nor environmental sense to remain static. Therefore, it has become necessary to understand the key lessons from the experience with these regulations in India to chart a future pathway for rapid change.

At the outset, and for the sake of simplicity, it is necessary to explain that fuel efficiency regulations are interpreted and presented differently in different countries. Broadly, the term "fuel efficiency" is used generically and is understood as "kilometer per litre" by most consumers to gauge the mileage of a car. But several countries regulate fuel efficiency as a "fuel economy standard" or in litres per 100 km basis. This is commonly used to compare standards between regions with different units for fuel consumption and distance travelled. The other approach is to set the standard as gram of CO_2 emissions per kilometer (CO_2 g/km). CO_2 emissions are linked to the carbon content of the fuel and the amount of fuel burnt.

This is a direct measure. Moreover, vehicles are tested for CO_2 emissions that are converted to fuel economy or mileage numbers. In India, these standards are called Corporate Average Fuel Consumption Standards (CAFCS) that are mentioned in both fuel economy terms (litres per 100 km) and also in terms of CO_2 emissions (CO_2 g/km). Therefore, to simplify things for the reader, this paper will broadly refer to these regulations as fuel efficiency standards, but provide specific target numbers in CO_2 g/km unless fuel economy numbers need to be mentioned separately.

This assessment of India's preparedness for fuel-saving regulations in the vehicle sector has become necessary to inform future pathways, maximize fuel savings from ICE vehicles and accelerate electrification of the vehicle fleet. This policy paper has reviewed the current status of implementation of the Stage 1 fuel efficiency standards for passenger cars in India to understand the effectiveness of the standards and gaps in the implementation strategy to draw lessons for the next stage. This analysis has also highlighted the current status of implementation of these standards vis-à-vis heavy duty vehicles (HDVs) that are major guzzlers of fuel, and the prospect of crafting these regulations for two-wheelers, the largest guzzlers of petrol.

This analysis has also underscored the importance of a consumer information system on fuel efficiency and emissions performance of vehicle models to help consumers make informed choices and purchase decision to build demand and push the market towards cleaner and more fuel-efficient vehicles. This bottom-up pressure is critical to catalyze the market and technological innovation.

Summary of the review

Passenger cars

The first-ever fuel efficiency standards for passenger cars in India, termed CAFCS were implemented in 2017–18. Stage 2 standards are scheduled for implementation in 2022–23. A gazette notification (of 23 April 2015) outlines these standards. BEE estimates that these standards can lead to a reduction of 22.97 million tonnes in fuel consumption by 2025.

To compute the actual fuel consumption of every vehicle model that runs on petrol, diesel and Compressed Natural Gas (CNG), CO_2 emissions in g/km are affirmed through tests during type approval certification of vehicles. The actual fuel consumption of electric models is also measured in terms of kWh per 100 km. Thereafter, the respective "petrol equivalent fuel consumption values" of a particular vehicle model are calculated for diesel, Liquefied Petroleum Gas (LPG), CNG and electric vehicles based on the conversion factors notified in the regulations. Thus, actual fuel consumption of vehicles is derived from CO_2 emissions (g/km) tested at the time of vehicle certification.[4]

India is approaching the deadline for Stage 2 standards in 2022–23, But there is a strong pushback from the automobile industry for its deferment on the grounds that big investments have been made to upgrade to BS-VI emissions standards in 2020 and COVID-19 pandemic has slowed down the economy. Reportedly, the government has not yet officially approved any delay.

Public and policy conversation on crafting these regulations has remained challenging as the technicality of this standard setting process and its implementation and compliance methods are complex and not very well understood. The design and implementation of these standards are very different from the BS-VI mass emissions standards for toxic emissions which have been implemented as a 'per vehicle standard', meaning that they require all models of vehicles to pass the certification test to meet the assigned values for pollutants to be sold in the market. Certification based on this testing by a vehicle testing agency like the Automotive Research of India (ARAI) is the basis of compliance and sale in the market.

It is not so straightforward in the case of CAFCS for cars. Technically, this standard is set in terms of petrol-equivalent litres per 100 km, based on the weight of the vehicle model. Weight influences fuel consumption of vehicles—small cars use lesser amount of fuel compared to bigger cars and SUVs. However, compliance with the standard is worked out differently. Compliance is not based on per vehicle measurement at the time of certification. Compliance is monitored at the corporate fleet-level. This means for each manufacturer, the average fuel consumption (in terms of petrol equivalent litre per 100 km) is computed and weighted against the sales of each make and model during the fiscal year. The compliance is assessed annually for each carmaker based on the sale of each and every make and model and certified CO_2 emissions value provided by a vehicle certification agency like ARAI and the average emissions levels are weighted against sales. Then weighted average of the sales of all manufacturers are taken together to compute industry-wide compliance. At the end of each year, the status of industry-wide compliance is established and reported. It is calculated based on a formula given in the notification that requires specific parameters like CO_2 per fuel efficiency-level and kerb weight of the vehicle (weight of the vehicle that takes into account the weight of all the standard equipment fitted on the vehicle and consumable items while measuring the weight of the vehicle).

This compliance mechanism is based on self-reported data on certified emissions levels and sales data of each model and make of vehicles for the fiscal year that is submitted by all manufacturers every year to MoRTH. Therefore, transparency and accountability in the reporting systems is critical for effective implementation. This will have to be ensured in future.

Different manufacturers produce widely different cars—a mix of small and big, petrol, diesel, CNG and electric cars—and individual fleet-wide targets vary accordingly (that is

represented in a mathematical slope that has been notified as a regulation). But irrespective of this variation, the industry-wide collective average has to stay within the regulatory limit.

An assessment of Stage 1 standards shows that all car companies have not just met but exceeded the 2017–18 requirement of fuel efficiency. According to an independent evaluation by IEA, the average fuel consumption of new light-duty vehicles sold in 2018 was roughly 9 per cent above the target for that year. Thus, the industry has comfortably achieved its target. Moreover, as the estimates of International Council of Clean Transportation (ICCT) shows, the fleet is only 7 per cent away from meeting the next target in 2023.[5] This implies that targets are not very ambitious in the first place.

Moreover, at the current level of fleet-wide fuel efficiency or CO_2 emissions intensity, only a small improvement is needed to meet the Stage 2 standard in 2022–23, especially after the weigh adjustment. As mentioned, CAFC standards are intimately linked to the average weight of cars. For instance, the Stage 1 standard of 5.49 litre per 100 km or 129.8 CO_2 g/km was linked with the average car weight of 1,037 kg. Stage 2 standard limit, applicable from 2022, is 4.77 litre per 100 km, linked with an average vehicle weight of 1,145 kg or 113 CO_2 g/km.[6&7]

However, it may be noted that the average weight keeps changing annually, depending on the product portfolio of the industry. The targeted fuel efficiency value is adjusted accordingly. In fact, over the last few years, the average weight of Indian car fleet has been reduced, largely because of a reduction in the number of diesel cars (that are normally heavier). Therefore, BEE has adjusted the average car weight for the 2022–23 standards to 1,087 kg from the originally proposed 1,145 kg. Lowering of the weight to this extent does not change the norm value by much but makes it somewhat easier for the industry to meet the standard. After this adjustment, the original target of 113 CO_2 g/km or 4.77 litre per 100 km remains unchanged. Thus, the industry has no additional ground to delay implementation of the 2022–23 CAFC standards.

Yet another approach of CAFC standards is the practice of allowing extra credit points to compute compliance with the standards. This is consistent with global practices to encourage innovation to go beyond the minimum requirements of the standards. These extra points incentivize the industry to adopt improved technologies and zero emissions electric cars to go beyond the common minimum standards and push the innovation trajectory. This approach has been adopted because there are several parameters of vehicles like weight and aerodynamics, and other innovative technological approaches that cannot be considered while testing emissions from the vehicles but these influence fuel efficiency and their adoption vary across the industry. To encourage eco-innovation, the CAFC regulations allow extra credit points to be earned by the car manufacturers for their

annual calculation of compliance. Currently, the CAFC standard has provided for super-credits for predefined technologies that include battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and strong hybrid electric vehicles (HEVs), as well as for regenerative braking, start–stop systems, tire pressure monitoring systems, and six-speed or more transmissions. If these credits are linked with high-end solutions, technology can improve faster, but if they are linked with small incremental technology approaches, it can be a wasted effort.

India has not only set unambitious targets that the industry can meet easily, but it has further weakened the targets by giving away super-credits or extra points for ineffectual technological approaches like six-speed transmission that normally all big and luxury cars use or tyre pressure monitoring that depends on a driver's behaviour. The biggest give away initially was the mild-diesel hybrids that resulted in only nominal improvement; this was removed subsequently from the eligibility list. But weaker targets and super-credits for ineffectual technological approaches have impeded movement towards more substantial technology transformation like electrification.

This is a missed opportunity as global experience has shown that a well-designed super-credit system combined with stringent fuel efficiency norms can help speed up technology transformation and electrification of the fleet. This is the experience in Europe. Despite having heavier vehicles, compared to low-powered smaller cars of India—Europe has set CO_2 standards at 95 CO_2 g/km in 2020–21, as opposed to 113 CO_2 g/km in India. The average weight of the car fleet in Europe is about 1,400kg—higher than in India. Even with heavier cars, Europe has set a target that is 20 per cent tighter than that of India. This has accelerated electrification of the fleet—an important decarbonization strategy—in Europe, despite the pandemic-led economic downturn. Europe is now aiming to meet 60 CO_2 g/km for cars in 2030, that is equivalent to what most two-wheelers in India meet.

India's current standards cannot drive electrification of the fleet. These standards can be met with the normal incremental effort of the industry to improve ICE vehicles. On the other hand, even the electrification of a small percentage of the fleet can help meet the standards, removing the incentive for any improvements in ICE fuel efficiency. This has been borne out by a study of ICCT that has estimated that with only 1–2 per cent electrification of the fleet, major carmakers like Maruti and Tata can meet Stage 2 targets without any significant changes in the ICE technology. But tighter targets would have required higher levels of electrification.

While staying on track to meet the Stage 2 standards, the process of tightening the next targets for 2026 and 2030 should be put in place and decided this year for notification to give a longer term space to the industry. The targets need to be ambitious and a strategy to

leverage them for electrification needs to be in place. Super-credits should be phased out after 2023, testing methods for certification should be improved to reduce the gap between lab-based emissions and on-road emissions and related fuel efficiency performance to ensure real world performance. The industry is also hoping to work out a carbon credit scheme but its design and valuation is critical for it to be effective.

Another lesson to be considered is that while tightening the norms, the testing method for vehicle certification in the laboratory will also have to be made more stringent for delivery of real world fuel efficiency performance. One of the most critical parameters is the driving cycle (that simulates on-road driving conditions through a cycle of acceleration, deceleration and idling) that is used for measuring emissions in the laboratory. The current cycle used in India is not as exacting. As the global good practice indicates, India needs to adopt the Worldwide Harmonized Light Vehicle Test Procedure (WLTP) based on the new driving cycles (Worldwide Harmonized Light-duty Vehicles Test Cycles or WLTC) as the standard laboratory test to measure fuel consumption and CO_2 emissions intensity of passenger cars. While this proposal is already on the anvil, it needs to be adopted not later than April 2023 when more reforms are expected to be rolled out on fuel economy as well as BS-VI standards.

Only a more rigorous test cycle for certification can help lower the gap between certified level of emissions and real world performance. As India moves towards tighter fuel efficiency norms and electrification and labelling of cars, consumer demand for bridging this gap will become much stronger. Consumers will become more sensitive to on-road emissions and fuel efficiency performance of internal combustion engines as well as the range of driving per electricity charge for electric vehicles. It may be recalled that recently, Delhi government had to delist and debar a popular e-car model Nexon from getting incentives under the electric vehicle programme because consumers had complained that they were not getting the range promised by the manufacturer (based on certified data). Both fuel efficiency regulations and electric vehicles programme need to mandate use of the WLTC cycle to address this concern over real world performance.

Heavy-duty vehicles

India took the initiative to craft fuel consumption standards for heavy-duty vehicles in 2016–17. But implementation was kept on hold. These norms were further modified after the implementation of BS-VI emissions standards in 2020 and were notified for implementation in April 2023.

The reason for this deferment is industry opposition to the design of the standards. In contrast to the CAFC standards for passenger cars, the standards for heavy-duty vehicles were designed as 'per-vehicle standard' in which each vehicle model is tested for certification

12 and does not follow a corporate average level annually. The chassis and engines for heavy-duty vehicles are used for diverse application with a wide variety of body designs. These are often not tested as fully built vehicles.

The vehicle industry opposed this, stating that it does not leave the system flexibility to account for fleet-wide changes possible across the industry with a range of other innovations that also allow for a more diverse product portfolio. The industry wants to adopt more simulation-based models for reporting compliance, that draw upon test results from the certification process.

While it is possible to move towards corporate average standards, Stage 1 standards (that have already been crafted) need to be implemented fully. The new format and test procedures can be adopted for the next round of revision. But in the interest of energy security and decreasing the carbon impacts, implementation of these standards must not be delayed any further as heavy-duty vehicles are the biggest guzzlers.

Reportedly, the industry expects that the original proposal that was designed in light of the BS-IV vehicles should be amended in light of the advent of BS-VI vehicles. The industry also expects that new fuel consumption norms for these segments should align with the implementation of Phase 2 real world driving emissions regulations that are expected to come into force in 2023. However, these regulations require urgent attention.

Two-wheelers

Two-wheelers with small engines have the smallest energy and carbon footprints among all motorized vehicles. But they are also in need of fuel efficiency standards. Two-wheelers dominate the vehicle fleet and are so numerous that they use up nearly 60 per cent of all the petrol consumed in the country. This cannot be ignored. Traditionally, the two-wheeler fleet was dominated by small, low-powered engines, but the trend is towards bigger engine capacity with more power and torque, due to change in consumer choices.

BEE has started the discussion on fuel efficiency standards for two-wheelers. The process needs to be expedited and made to adhere to a specific timeline.

Next steps

Based on this review of the current status of fuel efficiency standards and consumer information systems, key steps have been identified for each vehicle segment for priority action and also for improving the consumer information system. BEE has estimated and compared the impact of all the energy efficiency schemes and programmes in India in terms of total energy saved and reduction in the amount of CO_2 emissions in 2018–19.

The estimate shows that even at the current level of regulation, CAFC has led to a higher energy saving then the FAME-I incentive scheme for electric vehicles. CAFC has reduced 0.848 million tonnes of oil equivalent (MTOE) as compared to the FAME-1 scheme reduction of 0.038 MTOE. This corresponds to emissions reduction due to CAFC by 2.650 million tonne carbon dioxide ($MtCO_2$), as opposed to 0.070 $MtCO_2$ by FAME-1.[8] If CAFC norms can be further tightened, they have the potential to induce faster fleet-wide changes.

Passenger cars

Do not delay the timeline for 2022–23 standards and set targets for 2026 and 2030: Government of India has to ensure that Stage 2 norms are implemented on time in 2022–23 and are not delayed in the face of industry pressure. Already, by adjusting and lowering the average weight of cars, meeting the Stage 2 standards has become comparatively easier. The original notification had pegged the standard to average kerb weight of 1,145 kg for Stage 2 target of 2022–23, and it was stated that the next stage can adopt either this or lower weight as per the market trend at the time of adoption. With a reduction in the share of diesel vehicles in the fleet, the overall average weight of vehicles in India has decreased below 1,100 kg. Accordingly, BEE has proposed to change the weight for Stage 2 standards to 1,087 kg. The industry has no reason to delay the implementation of the new standards.

Instead, the process to tightening the standards for the 2026 and 2030 timeframes should be begun immediately to give a clear direction and time to the industry to improve. Also, while tightening the standards, attention must be paid to the design of super-credits to ensure real world fuel savings and electrification. Future changes in average kerb weight also need to be anticipated by the new standards. It is quite likely that the average vehicle fleet weight will increase in future as consumer preference is shifting towards SUVs and sedans, especially compact SUVs.

Tighten the testing parameters for vehicle certification: It is not only the norm value that matters, but also the testing parameters that have a direct bearing on the stringency of the norms and delivery of real world performance. India needs to quickly replace its current driving cycle that is used for testing and measuring emissions from vehicles in the lab for certification. Currently Modified Indian Driving Cycle (MIDC) which is a modified version of the European NEDC test cycle is used for testing cars in India. It is necessary that India adopt the WLTP—based on the new WLTC—as a laboratory test to measure fuel consumption and CO_2 emissions from passenger cars, and other pollutant emissions in April 2023. Only a more rigorous test cycle for certification can help lower the gap between certified levels of emissions and real world performance. As India moves towards tighter fuel efficiency norms and electrification and labelling of cars, consumer demand for bridging this gap will become stronger. Consumers will become more sensitive to on-road performance of IC engines as well as the driving range of electric vehicles.

Super-credits and flexibility mechanisms should be modified to make the industry more innovative: While tightening the requirements of super-credits to incentivize some technologies and electrification, there should also be a plan to phase out inconsequential technical approaches post 2023. Currently, as per assessments carried out by the ICCT, manufacturers selling luxury or high-end vehicles including BMW, Volvo, Mercedes and Jaguar, benefit more from the flexibility mechanisms.

ICCT points out that 25.5 per cent of the 2019–20 passenger cars sold in India were equipped with six-speed or more transmissions.[9] It is important that CO_2 credits for this technology are not allowed any more. Giving such credits stymies innovation and new technology adoption. Super-credits should rather be oriented toward electrification.

Mandate public disclosure of super-credit flexibility mechanisms: While the industry has begun using super-credits to establish compliance with the standards, annual reports published by the MoRTH on compliance of the industry do not provide detailed information on how technological approaches have been adopted by different manufactures to earn super-credits. The official report needs to put this out for deeper understanding of the trends in technology adoption and innovation.

Penalty: At this moment, there is no clarity about punitive action in case manufacturers fail to meet the standards. The draft regulations mention that if a manufacturer does not meet fuel-consumption standards for the reporting period, the designated agency shall report such non-compliance to MoRTH and MoP/BEE for suitable action.[10] But there is no clarity on the measures the regulatory agencies can take.[11] This clarity is needed in the new rules. There seems to be hesitation on part of the government to impose penalties. But regulations of this kind require penal action to prevent leakages and deviation.

Carbon trading as an instrument for compliance: As part of the next round of regulations, BEE is exploring the possibility of developing a carbon credit system for the compliance mechanism. This means those who overachieve their target can trade their CO_2 credits with the laggards to help them meet the target. Even the National Automotive Policy, 2018 has recommended banking and trading of CO_2 credits by vehicle manufacturers.

It was stated that CO_2 credits awarded to a manufacturer for exceeding the compliance requirements should be valid for two to three years. This will offer flexibility to manufacturers and avoid penalties for non-compliance. It was also stated that a public information system will be created to provide manufacturers model-level information on emissions and fuel consumption. Additionally, CO_2 credits or debits per manufacturer will be available to facilitate trade of credits between manufacturers.[12]

These measures can work as instruments of compliance if they are designed effectively. Moreover, trading should only be allowed after the standards have been tightened. The mathematics of the trading is important. First of all, actual trading should happen between companies based on real financial transaction and should not be moderated by a nodal agency for industry-wide compliance. The trading needs to happen between individual manufacturers. Market valuation of credit is most critical and the amount of credit purchased and pricing should be transparent. At this stage, the oil equivalent energy that has been adopted under the Perform, Achieve, Trade (PAT) scheme of MoP should be taken as the benchmark and the value should not be below this.

Moreover, the trading should happen only in terms of absolute tonnes of oil equivalent or tonnes of CO_2 emissions and not in terms of g/km of CO_2 emissions. As the trading happens based on lifetime emissions of cars, the km of vehicle models can be hugely variable. For instance, diesel models will travel longer than petrol vehicles. Therefore, the quantum of emissions to be traded by different manufacturers will depend on the fuel mix of their portfolio. This has to be comparable.

Additionally, future trading must not be allowed. Trading should happen for one fiscal year and the credits should be carried over or banked for multiple years. For instance, the credit for the period 2017–22 should not be made available for compliance in the year 2021–22. If manufacturers begin to trade for compliance based on past credits, the system will be weakened. Proper rules will have to be fleshed out for credit transfer.

Data disclosure: For compliance reporting, application of super-credits and trading of credits robust data in the public domain is a necessary requirement. Corporate fuel average system cannot work if it is not known how credits are being decided and given; and details of make and models sold, and their emissions status are unavailable. The data has to be transparent.

To achieve transparency, complete disclosure of data to enable a proper assessment is needed. At present, MoRTH publishes the basic summary of corporate average performance and targets along with credits accrued in the form of a simple table mentioning names of the corporate manufacturers. This data matrix also requires a thorough technology assessment of change in the fleet, sales data and technological information of all carmakers needed for assessing compliance. Both annual fuel consumption reports and manufacturers' report with details on eco-innovation and super-credits need to be put out. Doing so will improve transparency and accountability in the system and will also help independent evaluation of compliance. India must follow global best practices in this regard.

Heavy-duty vehicles

Implement the standards: At the time of writing this report there was little clarity about the status of implementation of the standards for heavy-duty vehicles. It is evident that the 'per vehicle standards' that were originally developed were further modified after the introduction of BS-VI emissions standards and were notified for implementation in April 2021. The heavy-duty segment consumes a major share of diesel, and contributes significantly to the transport sector's CO_2 emissions. India has to fast track implementation of the standards. While implementing the 'per vehicle' standard now, the option of corporate average standards can be assessed for the next level of revision. Fuel economy measurement and rating approaches should be enforced at the earliest.

Assess and finalize alternative method of testing: BEE claims that with present test procedure for heavy vehicles is costly and consumes time and energy. So they are proposing to develop a tool which can assess the fuel efficiency of a vehicle without the need for a physical test. Government of India has created a technical committee that has initiated the development of a computer-based simulation tool (like VECTO in EU) as per Indian conditions.

It is claimed that the tool can help reduce the cost and time of forecasting of performance of vehicles. But the tool will have to be reviewed and assessed for efficacy. Industry demand for simulation model needs to be evaluated carefully as it is a very complex system and has limited application globally.This segment is complex, as the engine and chassis of heavy-duty vehicles are adapted for diverse applications and vehicle body types. It will be beneficial if the focus remains on improving engine efficiency and testing parameters that represent different operating points of driving conditions.

Two-wheelers

Frame and implement fuel efficiency standards: Immediate steps need to be taken to set fuel efficiency standards for this segment. A system and process for setting of standards will have to be put in place for time-bound implementation. Even though these vehicles have the smallest carbon and energy footprints, given their sheer numbers and gradual migration to bigger and more powerful engines, the benefit of lower-powered vehicles on Indian roads may be soon eroded.

Consumer information

While framing and strengthening fuel efficiency regulations, it is equally important to create a well-structured consumer information system on fuel efficiency and emissions level of vehicles to stimulate consumer demand. Only this can catalyze the market for quicker uptake of vehicles with better performance and create bottom-up pressure on the industry

to adopt technologies that will accelerate change. This will save fuel and also out-of-pocket expenses for the consumer while setting new benchmarks for technology development for the industry. Mileage—average km per litre of fuel burnt—is the most important criterion for the price-sensitive consumer while buying a vehicle.

So far, there has not been much of a regulatory effort to inform consumers about the choices based on fuel-efficiency performance that is verified and graded. The current voluntary system that the vehicle industry follows in this regard is weak. A strong analysis of global good practices to understand how to improve consumer access to information to make informed choices and push the market towards stronger efficiency benchmark is needed. The role of regulations in taming operational fuel use is not well understood and needs attention now.

Therefore, this study has reviewed the current system of public communication systems for the consumers to inform and influence choices and purchase decisions. This is currently the weakest link in the Indian regulations. Several car manufacturers have made public mileages in km per litre for their car models. But there is no scientifically established labelling system to provide more structured information to consumers who can then understand the ranking of the models in terms of performance or compare them with peer models to make an informed decision. Consumers largely depend on informal and anecdotal data available from different sources.

Introduce fuel-efficiency labelling programme for vehicles: India needs to introduce a detailed and robust labelling programme for vehicles within a year and mandate that only the sale of cars and two-wheeler models with labels will be allowed. Any vehicular labeling programme is bound to fail if it is not backed by a rigid framework for enforcement. Regulators must ensure credibility of labels, monitor whether manufacturers are complying with the labelling system for all their cars, and carry out extensive outreach programmes to enable consumers make green choices. The system should be dynamic.

Introduce a transparent system of consumer information for fuel efficiency: A fuel economy guide could be released in English and other Indian languages. Consumers should get detailed information about emissions, fuel and monetary savings, comparison with peer brands and front runners, etc. This requires common portals to enable consumers to calculate potential cost savings on buying a particular vehicle based on the usage and mileage. This would be in addition to the regular fuel efficiency values. The information must have clarity about the gap between certification values and real-world values to prevent confusion. Fuel consumption and emissions data must be integrated and highlighted in all promotional and advertising material of a vehicle model. The consumer must be able to verify the claims of auto-makers.

Build consumer trust: Vehicular labelling systems, once implemented, must be allowed sufficient time to seep into behavioural patterns of the consumers. For this, trust must be built for the consumer and this is possible only if consumers are familiar with labels and understand the information that a label provides. A familiar example from India is the ISI mark for household appliances.

Set up a grievance cell for consumers

This report is divided into two parts. Part 1 reviews and identifies the gaps in the current approaches and gaps in fuel efficiency regulations for passenger cars, and outlines the challenges for the heavy-duty segment and two-wheelers to lay out priority measures for policy.

Part 2 outlines the challenges with regard to the current status of consumer information system and what more needs to be done.

PART 1

1. Fuels, emissions and passenger cars

India's effort to control fuel guzzling and heat-trapping CO_2 emissions from passenger cars is not very old. The implementation of the first-ever standards related to fuel consumption in cars started in 2017–18. Stage 2 standards are scheduled for implementation in 2022–23. It has, therefore, become necessary to assess the experience so far and draw lessons for informing the trajectory of this regulation. It must be noted that passenger cars are defined as M1 category vehicles with gross vehicle weight not exceeding 3,500 kg under the Central Motor Vehicle Rule (CMVR).

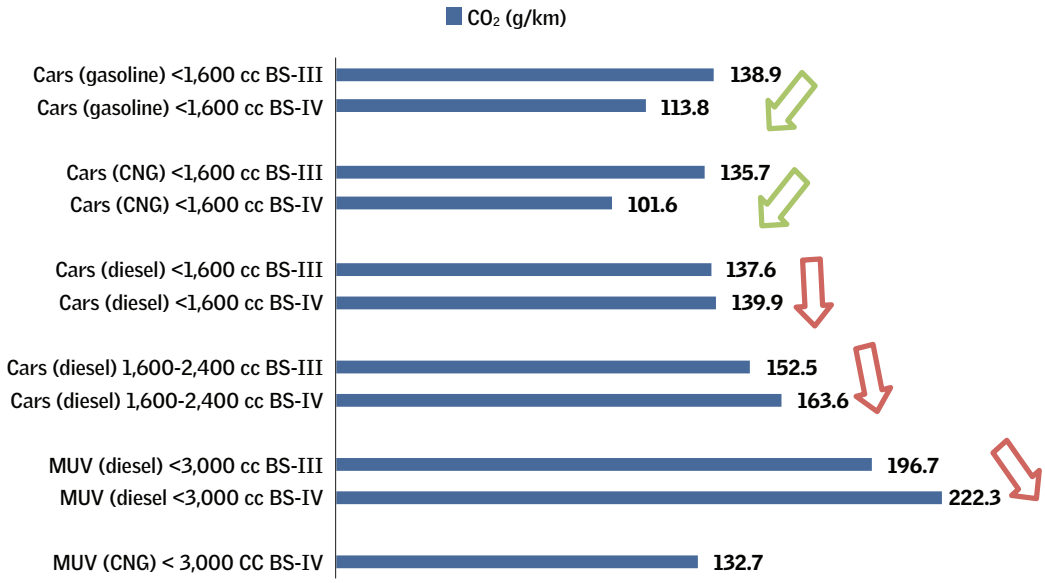
CO_2 emissions trends in cars

India measures CO_2 emissions as part of its vehicle certification process that is reflective of fuel efficiency and is the proxy for fuel consumption. CO_2 emissions profile of India's car fleet is expected to have changed over time with improvement in vehicle technology through the successive stages for Bharat Stage mass emissions standards—from Stage I to Stage VI. Even though mass emissions standards are about regulating toxic pollutants, technology improvements like replacing carburetor-based fuelling to precise fuelling through electronic fuel injections in petrol vehicles, or moving from mechanical injection to advanced indirect injection in diesel vehicles, using low-carbon fuels can improve fuel efficiency as well. But such improvements can be negated if emissions control systems and overall kerb weight of vehicles increase, and the aerodynamic features of the vehicles change.

Long-term changes in CO_2 profile of different vintage of technologies can be gauged from the CO_2 emissions factors developed for different generation of emissions standards. Emission factors developed by ARAI for BS-III and BS-IV vehicles shows that while CO_2 emissions from petrol and CNG cars have reduced over time, emissions from diesel cars and MUVs have increased. This could be due to increased weight of diesel cars, but it can be assessed better (see *Graph 1: Trend in CO_2 emission factors through successive stages of Bharat Stage emissions standards*). Emission factor of CO_2 for BS-VI cars are not available from ARAI yet.

More granular analysis is needed of varying set of parameters including test data, information on technology improvement, changes in weight and aerodynamic features of vehicles and hybridization to understand the annual trend in fleet-wise CO_2 profile or fuel economy profile.

Graph 1: Trend in CO_2 emission factors through successive stages of Bharat Stage emissions standards



Source: Prepared based on the data from ARAI 2018 report; Emission Factors for Indian In-use Post-2005 Vehicles

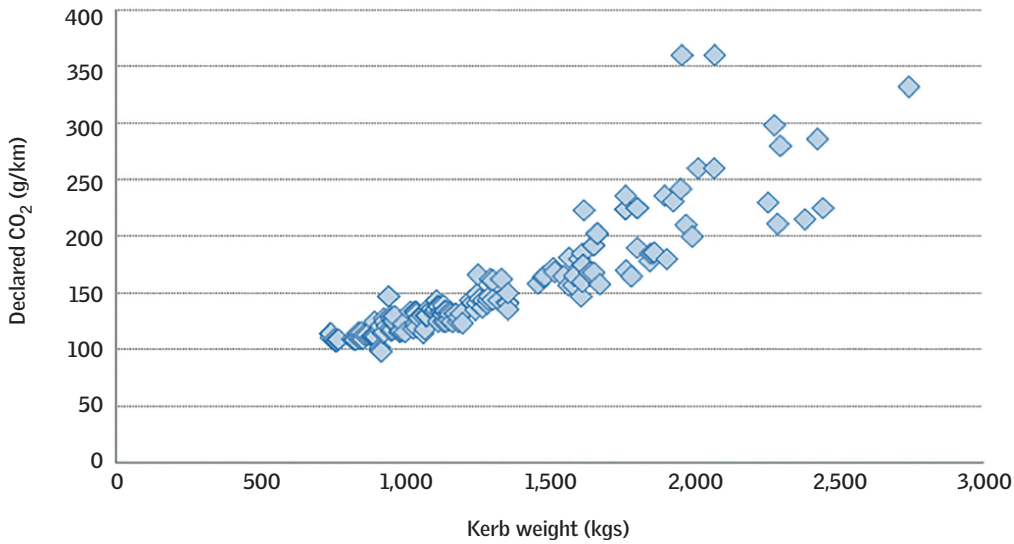
More recent profiling of CO_2 emissions from cars by fuel types is possible based on data available from the Society for Indian Automobile Manufacturers (SIAM) that was released for BS-VI vehicles in April 2020. It includes data on fuel economy level of makes, models and variants. It reflects the current baseline of the new models.

Petrol cars

The SIAM database shows that there are 188 petrol models and variants. Their CO_2 emissions range from 98 g/km to 360 g/km, depending on the weight category. Heavier vehicles use up more fuel. Smaller engines dominate the petrol car fleet. Almost 70 per cent of petrol models have kerb weights of less than 1,500 kg, with CO_2 emissions ranging from 98 to 166 g/km. Further, sub-categorization indicates that about 30 per cent of petrol models have kerb weights of less than 1,000 kg; 40 per cent of models are in 1,000 to 1,500 kg category; and 30 per cent of the models are in the weight category of 1,500 kg to 2,000 plus kg.

This indicates that if the percentage of bigger vehicles with higher CO_2 emissions increases in the fleet, fleet-wide emissions will rise as well. If sale of small weight cars remains robust, overall average CO_2 emissions from petrol cars can remain lower as well. With more power and bigger engine capacity,CO_2 emissions will consistently increase unless hybridization kicks in for big cars (see *Graph 2: CO_2 emissions from BS-VI petrol passenger cars*).

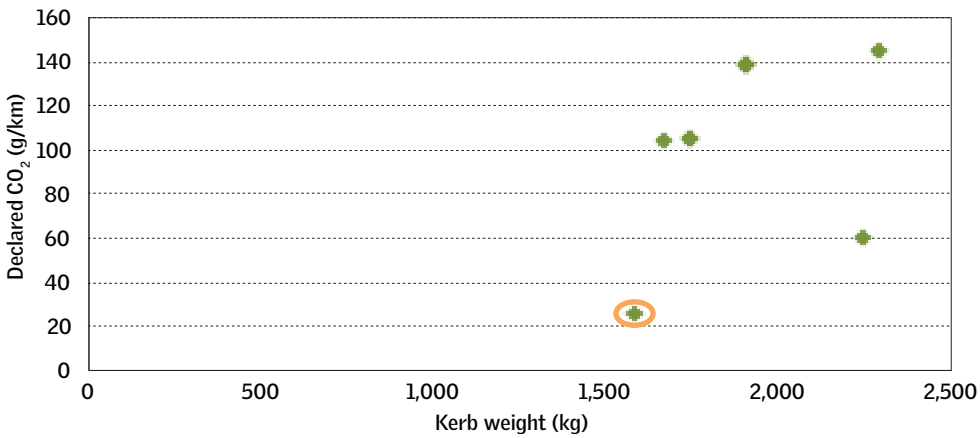
Graph 2: CO_2 emissions from BS-VI petrol passenger cars



Source: Based on SIAM BS-VI FE data

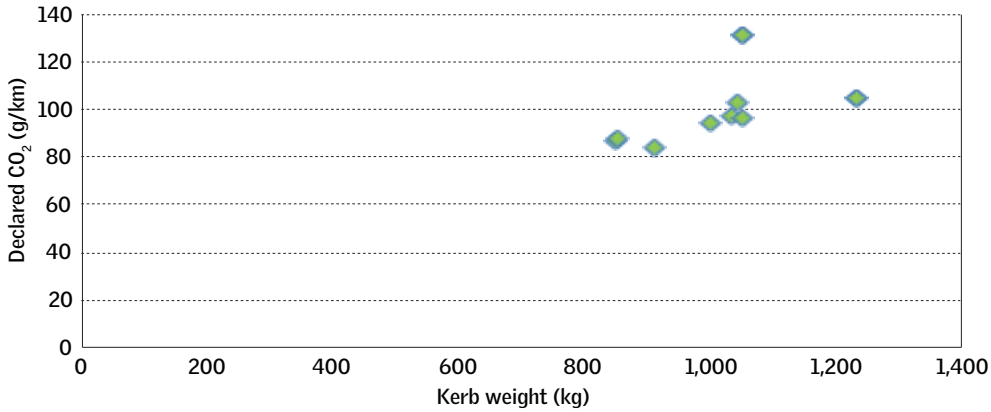
The SIAM dataset also indicates that petrol-hybrid cars have the potential to make the petrol segment more fuel-efficient, especially in the bigger vehicle segment. As per the data, kerb weight of petrol-hybrid passenger vehicles varies from 1,665 kg to 2,290 kg, and CO_2 emissions range between 60 g/km to 145 g/km. In the same weight range, petrol vehicles have higher CO_2 footprints (i.e., ranging from 158 g/km to 360 g/km). Therefore, hybridization can improve performance of bigger vehicles and bring them closer to the mid-segment and small cars (see *Graph 3: CO_2 emissions from petrol-hybrid and electric four-wheelers*).

Graph 3: CO_2 emissions from petrol-hybrid and electric four-wheelers



Note: The encircled value is of an electric car
Source: Based on SIAM BS-VI FE data

Graph 4: CO_2 emissions from CNG four-wheelers



Source: Based on SIAM BS-VI FE data

CNG cars

There is an advantage in using low-carbon fuels like CNG. Their use can lower carbon emissions vis-à-vis other categories of vehicles. This is evident from the data. The emission levels of cars using CNG are largely in the range of 80–120 CO_2 g/km—a lot less than those of petrol models (see *Graph 4: CO_2 emissions from CNG four-wheelers*).

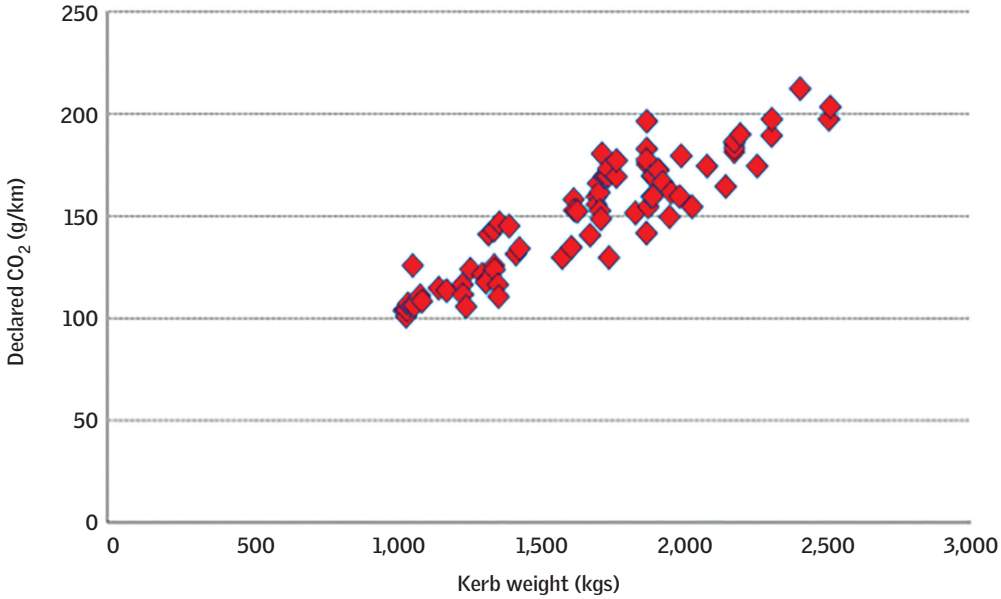
Diesel cars

SIAM database of BS-VI vehicles includes 95 models and variants. Diesel vehicles are largely in the bigger weight categories. Currently, there are no diesel models in the 1,000 kg or below weight class. With the introduction of BS-VI emissions standards, that has made emissions control systems for diesel vehicles more complex and expensive, several small car models have gone out of the market.

Moreover, narrowing down of diesel and petrol prices and tighter regulations for diesel cars in major markets like Delhi and NCR to cut toxic emissions have further disincentivized the diesel car market. According to market reports, sale of diesel variants in the small car and sedan segment has fallen to 1.8 per cent during April–July 2020, and in the SUV segment to 42 per cent.[13] More financial year-wise data is needed to establish the actual trend. This decline has also contributed towards lowering of average kerb weight of the vehicles.

In the weight category of 1,000 to 1,500 kg, CO_2 emissions from diesel vehicles are in the range of 101 to 147 g/km which is less than that of the upper value for petrol vehicles (ranging between 98 and 166 g/km). Petrol vehicles have shown higher increase in CO_2 emissions in the heavier weight categories (see *Graph 5: CO_2 emissions from diesel four-wheelers*).

Graph 5: CO_2 emissions from diesel four-wheelers



Source: Based on SIAM BS-VI FE data

Regulating fuel consumption

Fuel consumption standards for cars are framed by the BEE under the Energy Conservation Act and notified by MoRTH under the Central Motor Vehicle Act and Rule (CMVR) for enforcement. Stage 1 standards came into force in India in 2017–18, and Stage 2 standards are to be implemented from 2022–23 onwards. These standards are called Corporate Average Fuel Consumption (CAFC) and stated in litres per 100 km, linked to the Corporate Average Curb Weight of all cars sold by a manufacturer in a fiscal year. BEE expects that these standards would lead to a reduction of 22.97 million tonnes in fuel consumption by 2025.

According to Stage 1 standards, the average weight of all cars was expected to be 1,037 kg in 2016–17. Accordingly, CAFC standards fuel consumption limit is less than 5.49 litres per 100 km of fuel. This translates into 129.8 CO_2 g/km in 2017–18. Stage 2 standards will come into force in 2022–23, with an assumed average kerb weight of 1,145 kg. Accordingly, the average fuel consumption standards limit will 4.77 l/100 km or 113 CO_2 g/km.[14&15] But it was also stated that this limit can be adjusted as per the market trends. The proposal is to adopt 1,087 kg as the new kerb weight for the 2022–23 standard. Though this does not significantly alter the target value of 113 CO_2 g/km target in 2022–23, lowering the weight category makes it a little easier for the industry to meet the standards. This certainly does not leave any scope for the industry to negotiate a delay in meeting the Stage 2 standards as per the schedule.

The compliance mechanism for meeting these standards is novel as these are sales-weighted corporate average standards. In 2018, MoRTH released the methodology and mechanism to determine compliance of manufacturers with fuel-consumption standards.[16] CAFC, as BEE explains, is the average of the standard fuel consumption of all vehicles sold by the manufacturers in a fiscal year. The fuel consumption is derived from CO_2 emissions measured under standard conditions at the nationally accredited labs.

Currently, compliance is assessed annually for each carmaker based on the sale of each and every make and model and certified CO_2 emissions intensity from ARAI. The average emissions levels are weighted against the sales. This is calculated based on a formula given in the notification that require specific parameters like average fuel consumption (CO_2 emission) levels and kerb weight of the vehicle. While this sales-weighted CO_2 emissions level average varies across individual carmakers based on the type of vehicles they produce, the collective average has to stay within the industry-wide limit. Depending on the make, model and weight, each vehicle manufacturer will have its own unique average target for the year. But together they need to conform and stay within the specified limit for the industry as a whole. The factors for converting consumption of different fuel types into gasoline-equivalent fuel consumptions and for converting from gasoline-equivalent fuel consumption to CO_2 emissions are defined in the regulation.[17]

Enforcement is a complex process

The administrative and technical procedure for measuring and monitoring average fuel consumption in litre per 100 km of passenger cars have laid out the detailed processes for establishing compliance with fuel economy norms. As per the regulations, each manufacturer is required to submit an 'annual fuel consumption report' and 'manufacturer's fuel consumption passbook'. A designated agency needs to examine and verify the manufacturer's data. After verification, the designated agency issues a 'status of compliance' to the manufacturer and an annual fuel consumption compliance report is submitted to MoRTH and MoP (BEE).

The manufacturer's annual corporate average CO_2 performance with respect to the target is quantified in terms of CO_2 credits and debits in metric tonnes per km. These credits and debits are recorded in the manufacturer's fuel consumption passbook and can be used for any management purposes by the nodal agency. In case a manufacturer submits electric vehicle technology, they are incentivized by giving extra credit, which are called 'super-credits'.[18]

This mechanism demands robust data reporting by the industry, independent verification, and minimal incentives to avoid giving wrong incentives for inappropriate technologies.

Adequacy of norms

Fuel consumption standards for cars have missed an opportunity in India. The country could have aimed for a much tighter target to ensure higher fuel and carbon savings.

Legacy challenge

India could have taken early advantage to meet tighter standards when it had a bigger advantage due to domination of small cars in its fleet with average low weight. It is, therefore, important to understand the way the standards setting process has evolved from its earliest stages. The process was started around 2011–12 by BEE. Originally, the first consultation paper Passenger Car Fuel Economy Labelling and Standards, that was released by BEE for public comments around 2011–12, drew serious criticism for being too little, too late. It asked the car industry to meet 5.73 litre per 100 km fuel efficiency standard limit in 2015, and 5.14 litre per 100 km fuel efficiency standard limit by 2020.

But available information clearly demonstrates that most of the industry has already achieved a better rate of improvement than what was proposed. Between 2007 and 2010, the car industry had improved its average fuel economy from 6.53 litre per 100 km to 6 litre per 100 km—an improvement of 2.8 per cent per year. But the original target was asking the car industry to meet a target of only 0.8 per cent improvement between 2010 and 2015, and 2.2 per cent between 2015 and 2020. This was discussed in the public consultation.

India was, therefore, deciding its targets when its baseline was comparable with most other major vehicle producing countries. This is simply because of the domination of low-powered, low-weight small cars in its fleet and not because India had access to state-of-the-art technology and certainly not because of regulation. In fact, the average weight of the European car fleet in 2012 was 1,300 kg, as opposed to 1,050 kg of India's car fleet. In 2010, India's fleet-wide CO_2 emissions were estimated to be 141 g/km against 145 g/km in Europe. But Europe was already working towards a target of 95 g/km in 2020. India had the opportunity to be below 105 g/km in 2020.This could have been easily achieved with 2.5–3 per cent improvement a year.

The final CAFC norms that were announced for two-stage enforcement were only slightly tighter than the original proposal. As mentioned earlier, Stage 1 CAFC standards limits were less than 5.49 litres per 100 km in 2017–18 and less than 4.77 litre per 100 km at the average weight of 1,145 kg in 2022–23. This also translates into 129.8CO_2 g/km in 2017–18 and 113 CO_2 g/km by 2022–23.

Super-credits to meet the standards

Compliance with the standards is not dependent only on the tested fuel economy or CO_2 emissions standards. The regulations also define certain technical approaches and

electrification of models that manufacturers can adopt for which they get extra points or credits at the time of computation of compliance with the standards. This is the flexibility that is allowed to the industry to innovate and adopt certain technologies that can improve fuel efficiency and can be accounted for while assessing compliance with the corporate average sales-weighted norms.

Globally, such extra credit points are normally given to encourage quicker adoption of advanced technological approaches that have a bearing on fuel efficiency of vehicles. Manufacturers are allowed to score extra points for adopting more innovative technologies on the presumption that they will allow fuel savings that cannot be otherwise quantified during certification testing. Moreover, with several manufacturers taking such steps, more can be achieved at a fleet-wide level.

Under the current standards, vehicle manufacturers get super-credits for producing battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and strong hybrid electric vehicles (HEVs), as well as for regenerative braking, start–stop systems, tyre pressure monitoring systems, and six-speed or more transmissions. Derogation factors for CO_2-reducing technologies are applied in this calculation to reward innovative technologies that produce real-world CO_2 savings beyond what is measured over a standardized test cycle during vehicle type approval. The compliance provisions allow manufacturers to use derogation factors for four CO_2-reducing technologies in calculating the corporate average CO_2 performance.

Accordingly, for the purpose of calculating the corporate average CO_2 performance, a manufacturer uses a volume derogation factor of three for BEVs, 2.5 for PHEVs, and two for HEVs. This means that a BEV counts as three vehicles, a PHEV as 2.5 vehicles, and an HEV as two vehicles in calculating fleet average CO_2 emissions. The fuel consumption of the electricity-driven portion for BEVs and PHEVs is converted from electricity consumption based on an equation provided in the regulations. This improves the fleet-wide sales-weighted average of the manufacturer.

While super-credits can help, they can also weaken the effect of the standards if too many extra points are granted for inappropriate and ineffectual technologies for calculation of the average fuel economy level achieved by each manufacturer. This can seriously dilute and weaken the programme. Manufacturers can get away with making minimal effort to improve fuel efficiency.

Currently, there are concerns with regard to some of the super-credits or extra points that are granted. When the programme had started, extra points were allowed for mild diesel hybrid vehicles, and that was a big giveaway. In fact, mild diesel hybrid technology was

also included in the FAME I incentive programme for electric vehicles that was eventually taken off the list when FAME II came in. But the largesse of super-credits continued under the fuel consumption rules. Now it has been taken off the list.

Nonetheless, there are still a few other technical approaches that weaken the standards. These are six-speed transmission and tyre-pressure monitoring systems. These are commonplace and cannot be considered either eco-innovation or substantially effective. For instance, tyre-pressure monitoring systems depend on a driver's activation and are not automatic. They should not be incentivized under the fuel economy regulations. In any case, they are required to be installed by fitness and safety regulations, so they must be removed from fuel economy regulations. Solutions dependent on a driver's behaviour should not be considered. The other approach of regenerative braking helps to recover and save energy to some extent. This may still be considered for the time being. The credit system for eco-innovation should be more explicitly leveraged for incentivizing introduction of more fully battery-operated electric vehicles to pace up electrification.

Overall, it is evident that the current standards are weak and the industry has overachieved the limits set by them. According to BEE, the industry has exceeded the targets in 2017–18 and 2018–19 by 6.58 CO_2 g/km and 7.92 CO_2 g/km respectively. IEA, has also estimated that the average fuel consumption of new light-duty vehicles sold in 2018 was roughly 9 per cent better than the target for that year. Thus, the industry has comfortably achieved the target. Moreover, the fleet is only 7 per cent away from meeting the next target set for 2023.

Energy savings from any technology should be evidence-based. It should be real, quantifiable, and verifiable over the vehicle's lifecycle. Therefore, the next revision of standards will have to remove the credits for some of these ineffectual technological approaches and make more explicit linkages with electrification targets to maximize gain from this regulation.

Status of compliance

India now has three years of experience with implementation of Stage 1 standards. It is important to draw lessons from this phase to inform the next round of revision.

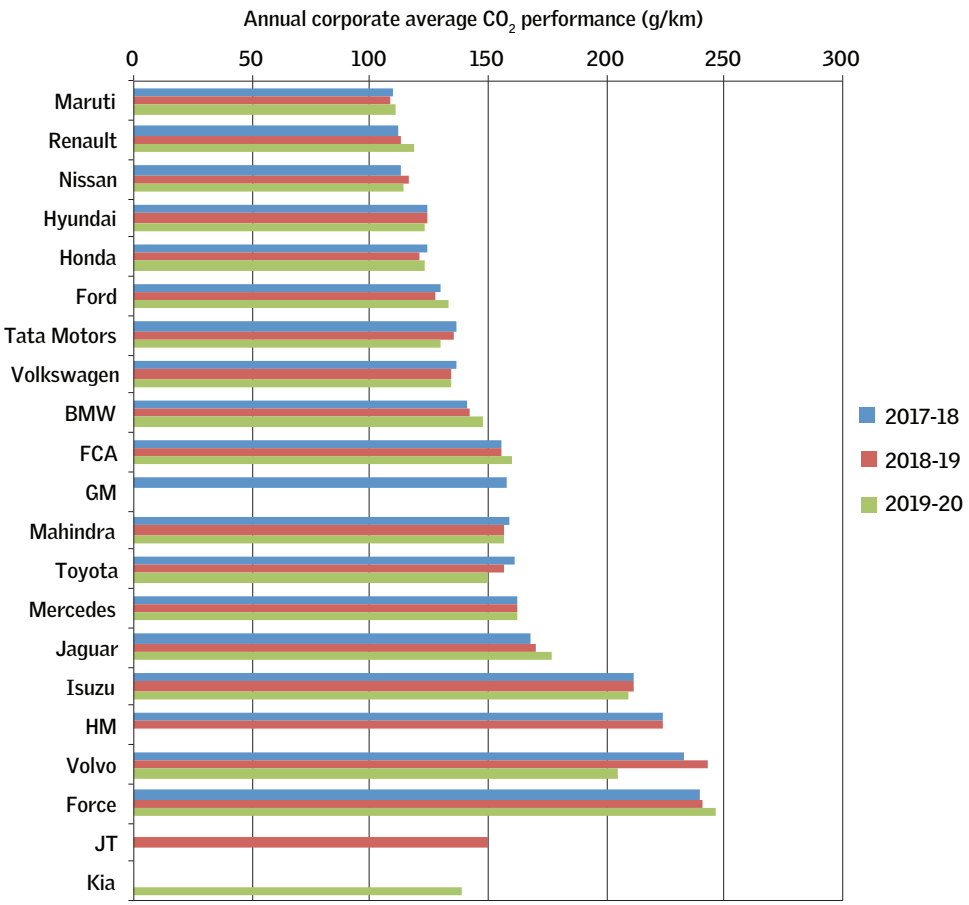
Annual compliance reports are published by MORTH on their website. Annually, data is collected from the vehicle manufacturers on sale of each model and make of vehicles, their certified CO_2 levels, and the information on technology approaches adopted that qualify for super-credits. Based on this, compliance is estimated by the government for each

manufacturer and also for the entire industry. Compliance is assessed by first estimating annual performance and is compared with the target.

The first compliance report published by the MoRTH shows that all car manufactures met the 2017–18 fuel consumption standards with various flexibility mechanisms taken into account.[19]

Subsequently, MoRTH published compliance reports for 2018–19 and 2019–20, which indicates that all manufacturers are in compliance [20&21] (see *Graph 6: MoRTH reporting of annual corporate average CO_2 performance*). Annual performance data of MoRTH of manufacturers for 2017–18, 2018–19 and 2019–20 indicates that among them Maruti

Graph 6: MoRTH reporting on annual compliance with corporate average CO_2 performance



Note: According to ICCT, based on sales volumes in 2019–20, Force Motors, Jaguar, Isuzu and Volvo should all be categorized as small manufacturers
Source: Prepared based on MoRTH annual fuel consumption compliance reports for 2017–18, 2018–19 and 2019–20

Suzuki has the lowest annual corporate average CO_2 performance value. However, the average CO_2 values increased marginally in 2019–20, compared to 2017–18 values. Manufacturers showing a decline include Hyundai, Honda, Tata Motors, Volkswagen, Mahindra, Toyota, Mercedes, Isuzu and Volvo. Renault, Nissan, Ford, BMW, FCA, Jaguar and Force indicate an increase in corporate average values of emissions intensity between 2017–18 and 2019–20.

Analysis of data available from the compliance reports helps to understand the level of performance. It does not indicate the target values for each carmaker as that can vary across manufacturers depending on their product portfolio. Manufacturers producing smaller cars can have lower fleet averages, whereas those with bigger and heavier cars can have higher fleet averages. Their individual targets are calculated according to the formula given in the regulations. But collectively—irrespective of the individual level—industry-wide sales-weighted average has to meet the notified target.

Compliance reports trends of individual carmakers for three consecutive years are available. Some manufacturers, despite being within their respective limit, have recorded increase in CO_2 emissions over time. Some Original Equipment Manufacturers (OEMs), including Force Motors, Jaguar, Isuzu, and Volvo (small volume manufacturers in India) are at an advantage. Overall, the compliance report shows that the automobile industry has met the target and is compliant. Current reporting on compliance available in the public domain is very basic and does not provide extensive information on the reported data and super-credits for each manufacturer.

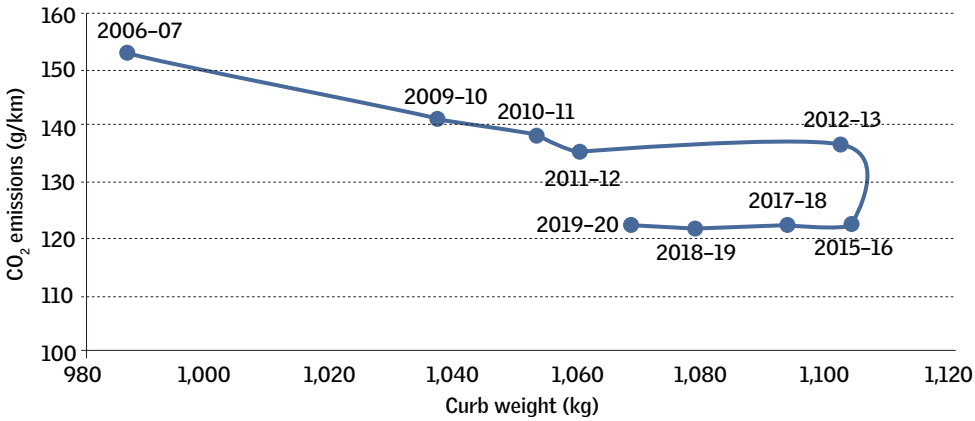
Raise the bar

BEE is now moving towards reforming and tightening the norms. Informing that process is critical. The current level of technology the industry has already helps it to easily meet the targets. Such relaxed benchmarks cannot drive technological improvements.

BEE has estimated the value of annual CO_2 emissions for the period 2017–18 to 2021–22 against the target of 129.3 g/km to compare the annual performance of the industry. For 2017–18 and 2018–19, the annual performance values were 122.71 g/km and 121.37 g/km respectively. This shows that the industry has exceeded the target by 6.58 CO_2 g/km and 7.92 CO_2 g/km respectively.[22]

According to an independent evaluation by IEA, average fuel consumption of new light-duty vehicles sold in 2018 was roughly 9 per cent better than the target for that year. Thus, the industry has comfortably achieved the target. Moreover, the fleet is only 7 per cent away from meeting the target set for 2023. Compared with 4–5 per cent annual CO_2 reductions

Graph 7: Historical fleet average CO_2 performance and curb weight



Source: Ashok Deo 2021, Fuel Consumption From New Passenger Cars in India: Fiscal Year 2019–20, ICCT working paper 2021–14

in other regions of world, India's CAFC target translates into only 1.5 per cent annual improvement, which is even lower than the 2.1 per cent annual reductions it achieved during 2006–17.[23] This implies that targets are very unambitious.

Moreover, the historical fleet average performance of CO_2 from 2006–07 to 2018–19, as available from ICCT, shows that there has been a consistent reduction in the average fleet CO_2 values, or improvement in fuel efficiency. During a ten year period (2009–10 to 2019–20), average CO_2 emissions have decreased by 1.4 per cent a year, while the average curb weight has increased by 0.5 per cent annually.

Significant reduction in CO_2 emissions took place between 2012–13 and 2015–16, averaging 3.4 per cent per year, along with the smallest increase in curb weight of 0.2 per cent per year. Curb weight decreased mainly in 2017–18 because of a significant decrease in the market share of diesel vehicles. In 2018–19 and 2019–20, both fleet average curb weight and CO_2 emissions remained relatively flat. The fleet average CO_2 emissions intensity in 2019–20 was 122.4 g/km.[24&25]

Additionally, ICCT has evaluated the performance of new vehicles sold in 2018–19 against the current and future standards, by taking into account the impact of flexibility mechanisms (application of super-credits and other CO_2 reducing technologies).[26] The evaluation shows that even without accounting for flexibility mechanisms, most corporate groups could meet the 2017–2018 standards at least two years early.[27]

ICCT's latest analysis of 2019–20 data has indicated that the fleet average of CO_2 emissions for 2019–20 is 122.4 g/km. ICCT expects and assumes that if the industry average fleet weight continues to fall, the compliance target for 2022–23 will translate into 109.4 CO_2

INSIGHTS INTO THE RACE

ICCT has carried out an independent assessment and estimated fuel efficiency of passenger cars of individual carmakers.[31] Targets and margin of compliance vary across car makers depending on the profile of their product portfolio.

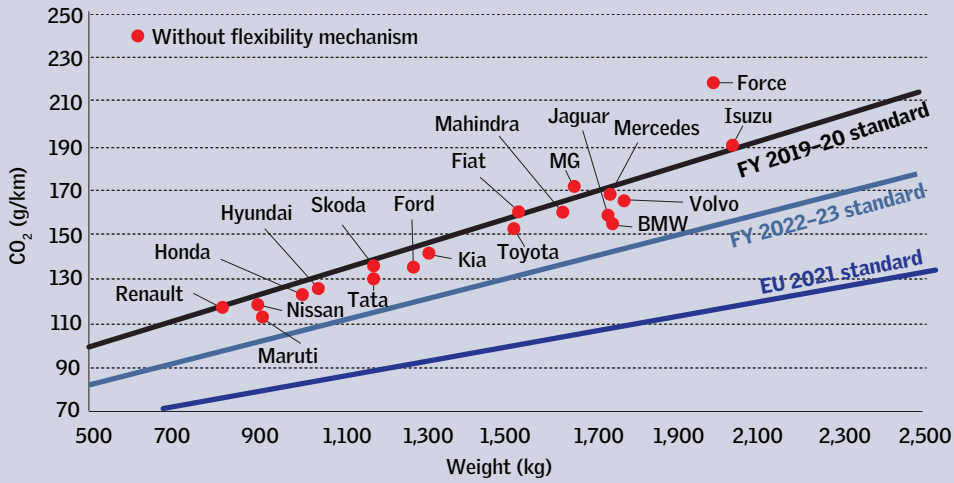
Most carmakers are able to meet the standards even without accounting for the flexibility mechanism. Several carmakers like Maruti, Nissan, Toyota are below the 2019–20 target without accounting for flexibility mechanism that gives supercredits for six-speed transmission, regenerative braking, start–stop, TPMS, electric vehicles and hybrid vehicles[32] (see Graph 8: CO_2 performance of corporate groups in 2019–20 with flexibility mechanisms).

Nearly all luxury car manufactures like Mercedes, BMW, Jaguar and Volvo have taken advantage of the flexibility mechanism by adopting the permissible technological approaches. They have adopted six-speed transmission for 100 per cent of their high-end models. A majority of their models have regenerative braking systems, tyre pressure monitoring and start–stop facilities.

Application of six-speed transmission and start–stop is increasing even in mass-market for passenger cars largely because these are allowed as a flexibility mechanism under the compliance standard.[33] About 48 per cent of Toyota models, 29 per cent of Tata models, 31 per cent of Mahindra models, 37 per cent of Hyundai models, and 39 per cent of Honda models have adopted this approach (see *Table 1: Adoption of technical approaches to qualify for flexibility mechanisms in 2019–20*).

ICCT has found that most mass market-manufacturers are not using flexibility mechanisms and super-credits in all of their vehicles. This leaves a lot of potential to reduce the gap with 2022–23 fleet average targets with more widespread adoption. Admissible features like six-speed transmission, start–stop, regenerative braking and tyre pressure monitoring under the flexibility mechanisms are cheaper compared with other sets of super-credits associated with electric vehicles, PHEVs, and strong hybrids.[34]

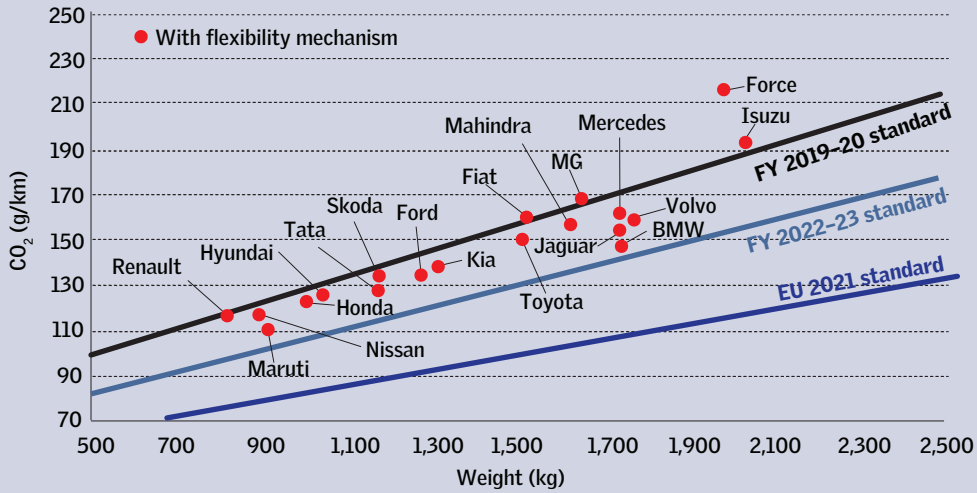
Graph 8: CO_2 performance of corporate groups in 2019–20 without flexibility mechanisms



Source: Ashok Deo 2021, Fuel consumption from new passenger cars in India: Manufacturers' performance in fiscal year 2019–20

With flexibility mechanism nearly everyone meets the standard. Only Force and Isuzu, that are listed as low-volume manufacturers in India—manufacture less than 5,000 units per year and are not required to meet the standards.

Graph 9: CO_2 performance of corporate group in 2019–20 with flexibility mechanisms



Source: Ashok Deo 2021, Fuel consumption from new passenger cars in India: Manufacturers' performance in fiscal year 2019–20

Table 1: Adoption of technical approaches to qualify for flexibility mechanisms in 2019–20

Manufacturer	Six-speed	Regenerative braking	TPMS	Start-stop	Six-speed transmission in 2018–19
	Per cent adoption				
Mercedes	100	27.9	98.9	98.9	100
BMW	100	97.7	97.7	97.6	100
Jaguar	100	26.8	74.6	74.6	100
Volvo	100	52.3	74.0	66.7	100
MG	100	16.3	56.4	12.7	—
Kia	100	0.0	55.0	0.0	—
FCA	98.7	0.0	0.1	0.3	100
Toyota	49.1	8.7	2.0	46.0	48.8
Tata	46.3	2.8	0.4	13.4	28.9
Mahindra	45.8	8.0	12.9	46.5	30.9
Hyundai	45.2	0.2	1.5	0.0	37.1
Honda	37.4	0.0	0.0	0.5	39.3
Škoda	28.5	2.6	5.6	2.6	25.0
Nissan	16.4	0.0	0.0	0.0	8.2
Ford	14.7	0.0	10.9	18.9	11.2
Maruti	5.5	9.3	0.0	9.3	0.0

Renault	4.9	0.0	0.0	0.0	8.7
Force	0.0	0.0	0.0	0.0	0.0
Isuzu	0.0	0.0	0.0	0.0	0.0

Source: Ashok Deo 2021, Fuel consumption from new passenger cars in India: Manufacturers' performance in fiscal year 2019–20

Ineffectiveness of the standards even with super-credits in pushing electric vehicle sales shows up in the miniscule share of electric vehicles in overall share of vehicle sales. While this is 1.2 per cent in the case of Morris Garages, for the rest (Tata, Mahindra, BMW, Volvo and Toyota), it varies between 0.1 per cent and 0.9 per cent (see Table 2: Share of electric, PHEV, and strong hybrids in the total sale volumes of manufacturers).

Table 2: Share of electric, PHEV, and strong hybrids in the total sale volumes of manufacturers

Manufacturer	Electric/PHEV/ strong-hybrid	Sales in 2019–20	Total sales volume in 2019–20	Share of EV/hybrid vehicles (%)
Tata	EV	1,250	1,33,697	0.9
Mahindra	EV	884	1,79,915	0.5
Hyundai	EV	377	4,86,063	0.1
MG	EV	274	22,502	1.2
BMW	PHEV	27	8,570	0.3
Volvo	PHEV	8	2,038	0.4
Toyota	Strong-hybrid	878	1,14,959	0.8

Source: Ashok Deo 2021, Fuel consumption from new passenger cars in India: Manufacturers' performance in fiscal year 2019–20

g/km against the notified target of 113 CO_2 g/km. Indian automobile industry needs to reduce fuel consumption by approximately 3.67 per cent over the next three years to meet the 2022–23 standards [28] (see *Box: Insights into the race*).

MoRTH data for top ten automakers (2017–18, 2018–19, and 2019–20) shows that except for Renault and Nissan, all manufacturers have improved their performance with from the previous year. Maruti and Ford are close to meeting the 2022–23 standard limit, but Mahindra, Tata and Volkswagen have a wider gap to bridge in the coming years.[29]
Moreover, most luxury car manufacturers have taken the advantage of the flexibility mechanism to improve compliance. But most carmakers have met the targets even without a flexibility mechanism, indicating laxity in standards. Super-credits are available for nominal technical approaches like six-speed transmission, tyre pressure monitoring and regenerative braking. But the standards are weak in pushing electrification of the fleet, even though super-credits are available for electric and hybrid vehicles.

As per ICCT's analysis, Maruti has the smallest gap to close with Stage 2 standards; it needs only 1 per cent electric vehicle penetration to meet its target without adding other

technologies to its fleet. Similarly, Tata, Ford and BMW can meet the target with at least 2 per cent electric vehicle penetration. With 3 per cent EV penetration, the top six manufacturers will be able to meet their targets without adding other technologies. Skoda, Morris Garages, and Fiat Chrysler Group will still have some gap left to cover after reaching a 3 per cent electric vehicle share in their fleet. ICCT has considered a 25 per cent fuel consumption benefit for strong hybrids as compared with conventional vehicles.[30] Stronger corporate average fuel efficiency standards that require more EV penetration can help set more ambitious target for electrification.

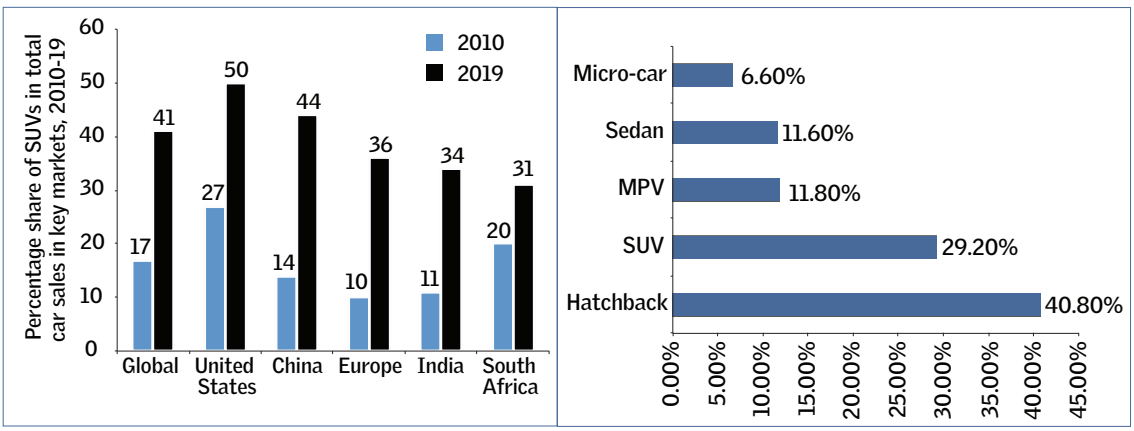
India will have to address this issue to prevent negation of the benefits from the rebound effect after the pandemic, not only from the rising number of vehicles but also from the growing preference for compact SUVs. Even though overall diesel car sales have dropped with the introduction of BS-VI emissions standards, a market survey shows that the consumer choice is shifting towards bigger vehicles, particularly SUVs. According to a study by YouGov, unveiled at the ET Auto EV Conclave 2020, around 46 per cent of Indian millennials are willing to buy an SUV in the next one year, including compact SUVs and the large ones. Sedan cars are also favoured[35] (see *Graph 10: Share of SUVs*). In India, utility vehicle (UV) sub-segment could hedge the economic slowdown, as it sales have remained almost flat, with a marginal increase of 0.48 per cent at a time when passenger car sales dropped from 23.57 per cent and vans by 39.23 per cent.[36]

This is consistent with the global trend reported by IEA. Globally, market share of SUVs has increased by 15 per cent between 2014 and 2019, and is 40 per cent of the global light-duty vehicle market. SUVs and pick-up trucks—which tend to be even larger—are also increasing in number. In Europe, 38 per cent of new vehicles are SUVs, compared

Graph 10: Share of SUVs in new sales

(a) Share of SUVs in total car sales in key markets, 2010–19

(b) Share of different category of passenger vehicles in calendar year 2020



Source: Market sources

with 10 per cent in 2010. The average fuel consumption of a small SUV or pick-up is more than 15 per cent higher than for an average medium-sized car.[37] India has begun to mirror this trend.

However, despite these changes, the average kerb weight of vehicles has not increased in India. In fact, it has declined from 1,145 kg noted in the regulations for estimating the norms, to a little less than 1,100kg in 2020. This is largely because of the elimination of several diesel car models due to the introduction of BS-VI emissions standards. But this may change in future.

Align with global trends

The message from the current phase is clear. Indian norms are weak. The industry has already achieved and exceeded the norm requirements by a margin and are also quite close to meeting the next target. In fact, several manufacturers could meet the norms even without earning extra points or credit. This leniency cannot drive technology improvement to the desired level or even help build ambition for electrification.

There is no case for delaying Stage 2 standards beyond 2022–23 as was originally scheduled. In fact, readjustment of the average weight factor further makes it easier to meet the standards. The industry should not ask for a two-years delay.

It is very clear from the global trend that such delays will only harm Indian automobile industry. It cannot remain insulated from the changes already occurring in the global market, where the push is towards stronger regulatory benchmarks. Globally, CO_2 emissions standards or fuel economy regulations for vehicles have been instrumental in optimizing fuel savings from the IC engines and also fast-tracking electrification of vehicle fleet.

Stringent decarbonization targets have led to quicker scaling up of hybrids and electric vehicles. In Europe, stringent 2020–21 standards of 95 CO_2 g/ km has provided that push. In fact, for the 2021–30 time frame, CO_2 emissions will have to be reduced by 15 per cent by 2025 and by 37.5 per cent by 2030, relative to the 2021 baseline, to reach 60 CO_2 g/ km. The regulation will be reviewed in 2023. Also, stringent targets have been set for light commercial vehicles and vans.[38]

Even though overall vehicle sales in Europe have suffered nearly 40 per cent in 2020 due to the economic downturn, the market share of EVs has more than doubled compared to 2019.[39] This has also led to a phenomenal increase in sales of EVs in EU—the share of EVs has increased from an average of 3 per cent of new sales in 2019 to 11 per cent in 2020.[40]

European fuel efficiency targets have also set the benchmark for zero- and low-emission vehicles (ZLEV). The 2020–30 regulation introduces 'benchmarks' for zero- and low-emission vehicles (ZLEV), defined as vehicles with CO_2 emissions intensities of up to 50 g/km.

The ZLEV benchmarks are 15 per cent reduction in CO_2 emissions by all cars from 2025, 35 per cent reduction by only cars from 2030, and 30 per cent reduction by other LCVs from 2030.[41] This is not mandatory yet. But manufacturers with a higher share of ZLEV vehicles are rewarded with more relaxed CO_2 targets. ZLEV vehicles are expected to include battery electric vehicles (BEV) and plug-in hybrids (PHEV), as the 50 g/km threshold is considered too challenging for conventional ICE vehicles. To help manufacturers meet the targets, selling EVs provides them with extra credits that makes compliance easier by reducing the limit's stringency by up to 5 per cent.

India cannot ignore these two global efforts that are leveraging CO_2 standards or fuel economy regulations to accelerate electrification and also setting the timeline for completely phasing out ICE cars. The transformative impact of these moves will change the rules of the global market and competition.[43]

If the CO_2 emissions and fuel consumption values based on the regulatory targets of different countries are compared, the major markets of Europe, the US, China, Japan, Canada and South Korea have already set targets to move much beyond India even if we take the heavier weight category into account (see *Graph 11: India lags behind in the global race*).

Next steps

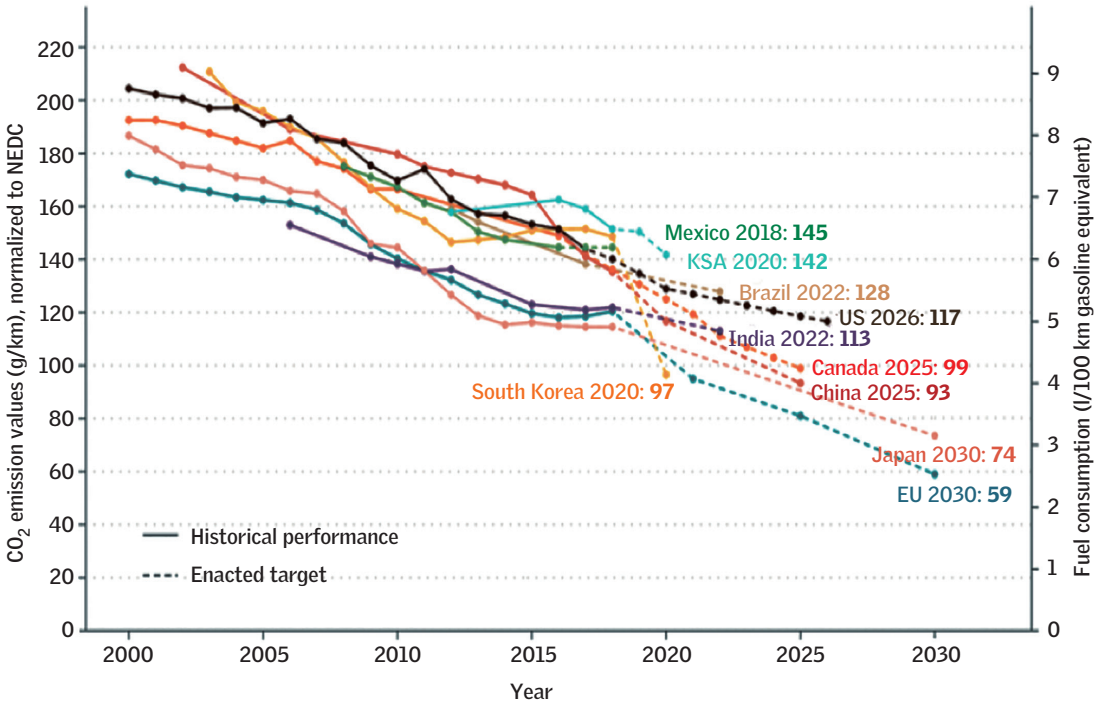
Clearly, India needs to maximize the decarbonization potential of its fuel efficiency regulations. BEE has estimated the total energy saving and reduction in CO_2 emissions in 2018–19. The estimates show that even under current regulations the CAFC has resulted in higher energy saving than the FAME-I incentive scheme for electrification. While CAFC has reduced 0.848 million tonnes of oil equivalent (MTOE), the FAME-1 scheme has reduced 0.038 MTOE. This corresponds to emissions reduction due to CAFC norms of 2.650 $MtCO_2$ as opposed to 0.070 $MtCO_2$ reduction due to FAME-1.[44] If CAFC norms can be further tightened they have the potential to effect faster fleet-wide change.

Therefore, it is necessary to ensure that the timeline for Stage 2 standards is not extended and they are implemented in 2022–23, while the targets for 2026 and 2030 are revised to give a clear direction of improvement to the industry.

The changes in average kerb weight of the fleet with time also need to be anticipated, because it has a bearing on fuel efficiency level of cars. In fact, the original notification had

Graph 11: India lags behind in the global race

Passenger car CO_2 emissions and fuel consumption values, normalized to NEDC test cycle



Source: ICCT 2020, Chart library: Passenger vehicle fuel economy

pegged the Stage 2 standards to average kerb weight of 1,145 kg. But it had further stated that for Stage 2 it can adopt either this or lower weight as reflected in market trends at the time of adoption. As of today, the overall average mass weight of vehicles in the Indian market has dropped to below 1,100 kg largely due to reduction in the number of diesel vehicles. Consequently, BEE has proposed to change the weight for the Stage 2 standards to 1,087 kg. With this change, the industry has no reason to delay the implementation of Stage 2 standards.

Moreover, while reforming the standards, India will also have to tighten some of the testing parameters. Replace the driving cycle that is currently used for testing and measuring emissions from vehicles in the lab for certification. This Modified Indian Driving Cycle (MIDC), or the modified version of the European NEDC test cycle that is currently used for testing cars in India, should be replaced with the more exacting WLTP based on the new driving cycles WLTC. This cycle for laboratory testing to measure fuel consumption and CO_2 emissions from passenger cars and other pollutant emissions needs to be implemented not later than April 2023. It can help to lower the gap between certified levels of emissions and real world performance that consumers demand.

Moreover, while tightening the requirements of supercredits to incentivize some technologies and electrification, it is necessary to phase out inconsequential technical approaches that enjoy supercredits. The ICCT's assessment shows that manufacturers that sell luxury or high-end vehicles including BMW, Volvo, Mercedes and Jaguar benefit more from the flexibility mechanisms. That 25.5 per cent of the 2019–20 passenger cars sold in India were equipped with six-speed or more transmissions.[45] This inhibits innovation and adoption of new technology. The supercredits should be oriented toward electrification.

Additionally, annual reports published by MoRTH on compliance of the industry need to provide detail information on technology approaches adopted by different manufactures to earn supercredits for compliance.

The rules also need to be clearer on penalty for non-compliance to prevent leakages and deviation.[46] According to the draft regulations, if a manufacturer does not meet the fuel-consumption standard for the reporting period, the designated agency shall report such noncompliance to MoRTH and the MoP/BEE for further suitable action.[47]

In the next round of reforms, BEE is expected to develop a carbon credit system for the compliance mechanism. Those who overachieve their target can trade the CO_2 credits with the laggards to help them meet their targets. Banking and trading of CO_2 credits by vehicle manufacturers has also been recommended by the National Automotive Policy 2018. It was stated that CO_2 credits awarded to a manufacturer for over-compliance should be valid for two–three years to offer flexibility to manufacturers and avoid penalties for non-compliance. Additionally, CO_2 credits or debits per manufacturer will be available to facilitate trade of credits between manufacturers.[48]

However, it is necessary to design this scheme for effectiveness. Trading should be allowed only after tightening of the standards. The actual trading should happen between individual companies based on real financial transaction and not moderated by a nodal agency for industry-wide compliance. Market valuation of credit is most critical and the amount of credit purchased and pricing should be transparent. At this stage, the oil equivalent energy that has been adopted under the Perform, Achieve, Trade (PAT) scheme of MoP should be taken as the benchmark and the value should not be below this.

Moreover, trading should happen only in terms of total grams and not grams per kilometer. As the trading happens based on lifetime emissions of cars, the kilometers of vehicle models can be hugely variable. For instance, diesel vehicles will travel longer than petrol vehicles. Therefore, quantum of emissions to be traded by different manufacturers will depend on the fuel mix of their portfolio. This has to be comparable.

The trading should happen for one fiscal year and the credit should not be carried over or banked for multiple years. Future trading must not be allowed. For instance, the credit for the period 2017–22 should not be made available for compliance in the year 2021–22.This will weaken the system if manufacturers begin to trade for compliance based on past credits. Rules will have to be written properly for transfer of credits.

Compliance reporting, application of supercredits and trading of credits require transparent datasets in the public domain to indicate the compliance and how credits are being decided. It is necessary to provide details of make and models sold and their emissions status. This requires disclosure of data. Currently, MoRTH publishes only the basic summary of corporate average performance and targets along with credits accrued in the form of a simple table mentioning names of corporate. This needs to be supported by a thorough technology assessment including change in fleet, sales data and technological information of all carmakers. Both annual fuel consumption reports and manufacturers' report with details on eco-innovation and super credits need to be put out.

2. Heavy-duty vehicle segment

IEA projections have indicated that heavy-duty vehicle (HDV) sector will be the key driver of oil demand in future. Regulations can help achieve substantial fuel savings in the sector.

Government of India has developed fuel economy standards for the HDV segment. The enforcement process is expected to have started after the notification for implementation from April 2021 onwards. No baseline compliance report is available in the public domain.

The HDV standards developed so far are unlike the CAFC standards developed for passenger cars, which require fleet-wide targets to be achieved based on sales-weighted average performance of each manufacturer in a given year. Rather, the HDV standards are like a per-vehicle standard resembling BS emissions standards under which each and every vehicle model is tested for compliance before the grant of a type-approval certification.

This per-vehicle approach of HDV standards has led to an aggressive push back from the automobile industry. The industry wants corporate-average standards that allow greater flexibility and different testing methods. This had initially created a logjam.

Genesis of the HDV standards

In 2014, the Ministry of Petroleum and Natural Gas formed a steering committee for monitoring the progress of fuel economy of heavy-duty vehicles in India. Commercial vehicles were responsible for the highest consumption of diesel (at 26.75 per cent), followed by buses (at 10.75 per cent). The transport sector is the major consumer of diesel and accounts for more than 70 per cent of total diesel sales in India. HDVs (trucks and buses) consume a lion's share of diesel in the transport sector.[49]

HDVs travelled more kilometres than vehicles in other transport categories. India's transport sector, with such a large fleet of HDVs, has significant potential of creating energy and fuel savings. Creating fuel efficiency norms for the heavy commercial segment was expected create space for these savings and complement India's INDC targets.[50]

The Ministry of Power, in consultation with BEE, notified fuel efficiency norms for HDVs with a gross vehicle weight (GVW) of 12 tonnes or more on 16 August 2017. This was as per provisions of Section 18 of the Energy Conservation Act, 2001. Phase 1 of the norms were applicable from 1 April 2018, under which HDVs had to comply with BS-IV norms. Phase 2 of the norms are scheduled for implementation from 1 April 2021.

Going by the notification of the Ministry of Power in August 2017, the standards, applicable to HDVs weighing over 12 tonnes, would have limited the maximum fuel consumption of goods vehicles (belonging to the N3 category) to 2.76–6.82 km per litre. The maximum fuel consumption of passenger vehicles with nine or more seats (under the M3 category) was to be limited to 4.22–5.82 km per litre. As per a report by the sub-committee set up by the petroleum ministry in 2014 to draft the standards, the measures would have saved 1.27 million tonnes of diesel between 2018 and 2023. This would have meant a reduction of Rs 7,564.82 crore in the fuel import bill over the five years. It would also mean prevention of 4.07 million tonnes of CO_2emissions during the period.[51]

The enforcement of the norms was the responsibility of MoRTH. According to this norm, every vehicles manufacturer was required to comply with the fuel consumption value (in liters/100 km) obtained by the equation corresponding to the vehicle GVW in the notification. If any model of any manufacturer consumed more fuel than the prescribed value, the manufacturer would not be permitted to manufacture, sell or import that model.[52] As per the provisions of the norms, MoRTH has to implement the conformity of production by the Constant Speed Fuel Consumption (CSFC) method to be conducted once every two years and at least one conformity of production for every vehicle has to be conducted by 1 April 2020.

Thereafter, the Prime Minister constituted a Group of Secretaries to recommend a transformational action plan for energy efficiency and conservation. The Group carried out detailed deliberations and consulted with a wide spectrum of stakeholders and experts, and presented its recommendations to the Prime Minister on 12 January 2016, which included various recommendations for all sectors, including the need of regulation for fuel efficiency of heavy-duty vehicles.

The report of the Group, published in the form of Energy Conservation and Efficiency Eleven Point Action Plan in 2015, emphasized the need for fuel efficiency norms for HDV vehicles.[53]

Uncertainty around the standards

It was reported in 2018 that the enforcement of HDV standards had been put on hold.[54] The vehicle industry pushed back as it did not want the standards in the current form (as per vehicle standards). It was also reported that the government was considering taking a fresh look into the standards after three long years of deliberations.[55]

The vehicle industry objected to the calculations based on which the standards have been drafted.[56] It wanted Corporate Average Fuel Economy (CAFE) standards. SIAM

also 43 opposed the use of CSFC test as a calculation method. According to SIAM, several external factors can impact vehicle performance and produce different results when a CSFC test is repeated on different occasions. SIAM wanted the EU's Vehicle Energy Consumption Calculation Tool (VECTO) method to be followed, in which all components of a vehicle that influence emissions, such as tyres, aerodynamics, engines, transmission and weight, are tested separately in the laboratory. The inputs are then fed into a software tool to calculate fuel consumption as well as emissions.[57]

The sub-committee had not accepted the suggestion then saying the test track is at par with those available internationally. Though the VECTO method of calculation can be adopted gradually, it would require a lot of investment on behalf of testing agencies. This is also a very complex system and is applied selectively even in European markets. It is evident that if the process had started in 2016, the first set of guidelines would have come only in 2022–23. But India cannot afford to wait that long. Besides, Europe is still working to finalize its VECTO norms, the report adds.[58]

A report by PWC states that countries across the world are using different methodologies for assessing fuel economy for HDVs.[59] As already mentioned, India is considering CSFC. A standardized approach is used in the CSFC method for obtaining the fuel economy. Other countries like China, Japan and US use computer simulations with data inputs from tests like Chassis Dynamometer and Engine Dynamometer. CSFC is a proven method of testing.

There is sufficient testing infrastructure available in the country to test HDVs as per the CSFC methodology. On the other hand, there is limited infrastructure presently available in the country to develop simulation methods as adopted on a limited scale globally, which will require huge infrastructural investments and a larger time-scale for implementation (five–ten years). Furthermore, all vehicle manufacturers are aware of the operational processes involved in CSFC testing. Thus, it would be prudent to move forward with current available test procedure using CSFC in the short-term as per the PWC report.[60]

Simulation-based vehicle certification system

Several countries around the world have embraced simulation modelling in developing fuel-efficiency and GHG standards for commercial trucks and buses. Experts opine that rather than developing a completely new simulation tool, countries can adapt EU's VECTO model after considering necessary changes of the country-specific vehicle types and operations.

The current regulation for HDVs greater than 12 tonnes requires a vehicle to be tested on track at a constant speed but government agencies are also evaluating the option of carrying fuel-efficiency evaluation based on simulation modelling. Government of India has created a technical committee to guide the development of a VECTO-based certification process.

NORMS FOR LIGHT-DUTY GOODS CARRIER VEHICLES

CSFC norms for light and medium commercial vehicles were notified on 16 July 2019.

How are the standards designed? The norms are applicable for the vehicle categories of M2, M3 and N2 as per the Central Motor Vehicle Act and Rules. These vehicles have GVWs ranging between 3.5–12 tonnes. These vehicles are to be tested at a constant speed of 50 kmph. And vehicles having GVW 7.5–12 tonnes will be tested on two speeds, i.e., 40 kmph and 60 kmph. The vehicles fuel consumption per 100 km should be lower than the value obtained from the target equation for the corresponding GVW. BEE states that manufacture of models of vehicles whose consumption was found higher than the target fuel consumption value will be stopped.[61]

The first phase of the norms was to be implemented from 1 April 2020. The fuel saving of 0.06 million metric tonnes (MMT) in a year and cumulative 0.25 MMT fuel saving in three years was anticipated from the implementation of these norms.[62] But declaration on compliance with Phase I norms and reporting has not been made public.

ICCT has conducted a study to establish a baseline of fuel consumption for new light commercial vehicles (LCVs) sold in India in 2018–19. Results show that the fleet-average CO_2 emissions level for LCVs in India is 143.1 g/km in 2018–19. While the fleet average CO_2 emissions of India's LCVs is 9.4 per cent lower than the EU's LCV fleet, India's vehicle fleet is also lighter. Based on fleet-average weight, Indian LCVs would have to further improve by 12 per cent to meet the EU targets for 2019.[63]

The objective is to develop an India-specific version of VECTO to determine the fuel consumption and CO_2 emissions levels that will be used for evaluating compliance with efficiency standards. But in such approaches verification of performance can be challenging.

Fuel efficiency of HDVs considerably varies because a single-engine model can be associated with diverse chassis types, duty cycles, payloads, etc., so component testing and vehicle simulation have emerged as a viable alternative for fuel efficiency testing. So using this method requires testing of a small number of components which act as input for the vehicle simulation software. Full vehicle testing, on the other hand, is resource-intensive.

Next steps

To prevent further delay and lock in of CO_2 emissions and energy guzzling, India can implement the 'per vehicle standards' that are already in place. For the second stage, corporate average standards can be framed. Fuel economy measurement and rating approaches should be enforced at the earliest.

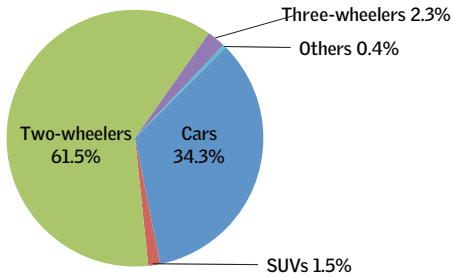
BEE has already proposed to develop a tool to assess the fuel efficiency of a vehicle without performing any physical test on it to reduce cost and time of testing and forecasting of vehicle performance. A technical committee and BEE has initiated the development of a computer-based simulation tool (like VECTO in EU) as per specific Indian conditions. But its implementation will require proper evaluation for efficacy. Heavy-duty vehicles are a complex segment, as the engine and chassis are adapted for diverse applications and vehicle body types. If the focus continues to remain on improving engine efficiency and testing parameters that represent different operating points of driving conditions, a lot can be achieved.

3. Two-wheelers

India is yet to develop and implemented fuel-efficiency standards for two wheelers. Among all motorized vehicles, two-wheelers have the smallest engines and energy footprints. But these vehicles are numerous and dominate India's on-road vehicle fleet. They use up the maximum share of petrol. According to a Petroleum Conservation Research Association (PCRA) survey in 2012–13, two-wheelers consumed 61.42 per cent of petrol in the vehicle sector. Recent trends show that the market is gradually shifting towards newer models that have larger engines, more capacity, and higher power and torque. Therefore, considerable energy saving is possible with fuel efficiency norms.

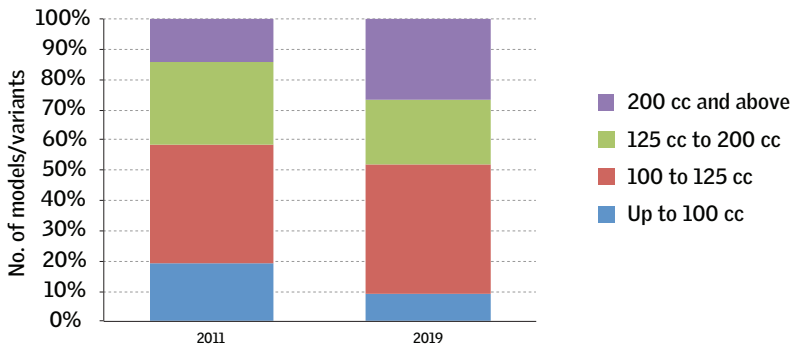
Most two-wheelers have engine capacities of less than 200 cc. However, there are models that have engines bigger than this. Consumer preference for higher capacity motorcycles

Graph 12: Vehicle segment-wise consumption of petrol



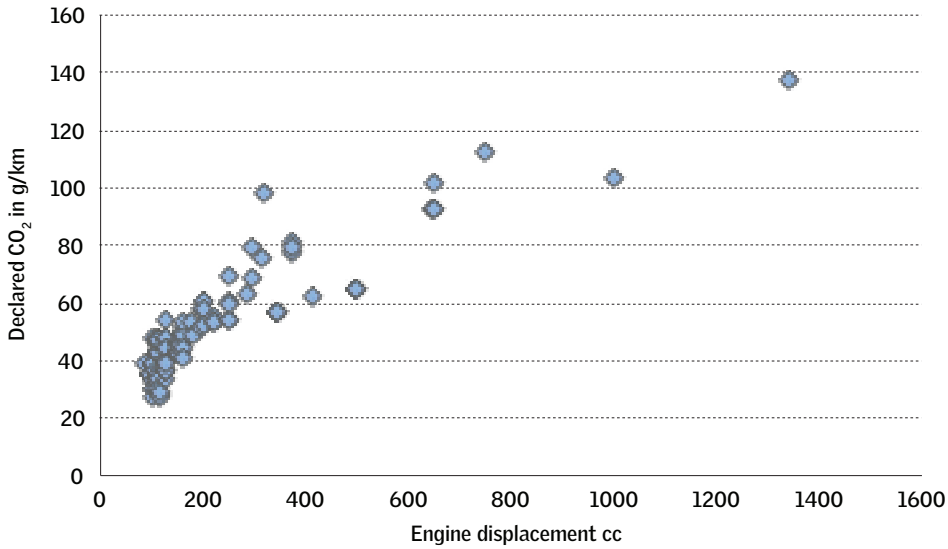
Source: Petroleum Planning and Analysis Cell, for 2012–13

Graph 13: Engine sizes and number of models available of two-wheelers
More models are available in the larger engine size segments



Source: Prepared based on SIAM 2W-FE-Data Declaration, January 2011

Graph 14: CO_2 emissions profile of two-wheelers as per engine size



Source: Based on SIAM 2W FE Declaration, 2018–19

(with higher CO_2 footprints) is growing. In 2011, only 14 per cent of the models were in the size class of more than 200 cc. But in 2019, this has gone up to 27 per cent. However, the smaller size class (100–125 cc) engines still dominate the market, with a 43 per cent share. In view of this, fuel efficiency norms should be expedited. The less than 100 cc segment has fewer models. More models are available in the 200cc and above segment.

CO_2 emissions data for make and model that SIAM has started to put out in the public domain shows that most smaller models are clustered in the range of 40–60 CO_2 g/km (see *Graph 14: CO_2 emissions profile of two-wheelers as per engine size*).

Next steps

India needs to initiate the technical process of developing the standards for two-wheelers immediately. Independent evaluation and mapping of the technology approaches in different two-wheeler segments that have been carried out can help to set the targets for the ICE models. This can also accelerate deployment of electric two-wheelers (see *Box: Fuel consumption reduction technologies for the two-wheeler fleet in India*). Globally, only China has mandated fuel consumption standards for both two- and three-wheeled vehicles. Stage I standards in China are currently in effect, and are managed by the National Development and Reform Commission. These standards are reported to have undergone revision in 2019 for all new vehicle sales and registrations.[64]

FUEL CONSUMPTION REDUCTION TECHNOLOGIES FOR THE TWO-WHEELER FLEET IN INDIA

There is hope that the technical process of setting up of fuel efficiency standards for two-wheelers will begin soon in India. Introduction of BS-VI emissions standards has finally eliminated the mechanical carburetor technology and fully established the fuel injection system in this segment. This opens up the opportunity for fuel efficiency improvements in the two-wheeler segment.

To assess and identify realistic fuel consumption targets for three different categories—small motorcycles, large motorcycles, and scooters—and also for the two-wheeler fleet overall, ICCT has mapped a variety of ICE technology packages with an increasing number of fuel efficiency technologies for each of the three segments. The objective has been to evaluate cost-effectiveness and payback periods of different ICE vehicle technologies. This has also considered electric two-wheelers (E2W) with a range of 100 kilometers (km) for a small motorcycle and 75 km for a scooter as one of the technology packages for each of those segments.[65] It shows that while transition to electric two-wheelers is inevitable, there are opportunities in the interim to gain better efficiency from ICE pathways.[66]

ICCT finds that even the most fuel-efficient segment of the two-wheeler fleet—small motorcycles—has the potential to further reduce fuel consumption by up to 42 per cent using ICE technologies alone.[67]

The analysis of manufacturer costs shows that a mandated CO_2 fleet average level of 25.3 g/km for the two-wheeler fleet can be expected to drive 32 per cent of electric two-wheeler penetration in the new total two-wheeler fleet by 2025. Setting a fleet average target of 20.5 g/km for 2030 could achieve fuel consumption reductions of 50 per cent in the two-wheeler fleet and a cost-effective penetration of 62 per cent electric two-wheelers. Adoption of stringent fuel consumption standards will give a clearer signal to vehicle manufacturers in terms of how much more efficiency gain from ICE pathway is possible while enabling rapid transition to electrification.[68]

PART 2

4. Transparency and fuel efficiency

Governments around the world have initiated complementary measures to raise awareness and influence consumer choice to enhance compliance with fuel economy standards. The key approaches include labelling of vehicles according to their energy efficiency performance and tax policies to promote better fuel economy. Once standards are set to benchmark improvements in vehicle technologies, these additional measures can help enhance market competition to favour fuel-efficient products. Europe, Japan and the US have elaborate systems in place in this regard.

India too needs to reinvent the entire approach to consumer information systems in the Phase-II of compliance with fuel efficiency norms. Helping consumers choose fuel-efficient models can also help accelerate innovation to achieve lower fleet-wide fuel economy averages.

The typical Indian consumer traditionally prefers mileage over engine power. In a report by the *Economic Times*,[69] a survey conducted by Ford suggested that six out of ten Indians wanted a fuel-efficient vehicle and fluctuating fuel prices were a major cause of concern for new car owners. Brand value, social prestige and after-sales service were some of the other major considerations during the purchase of a new vehicle.

A survey conducted by Nielson found that most urban consumers do make an effort to research vehicle attributes.[70] About 48 per cent consumers researched terms such as "technical specifications" and "expert reviews" online. Around 39 per cent visited about three dealers on an average, while 36 per cent consulted local car mechanics regarding vehicles specifications and value for money. However, while the urban consumer does look up the internet for information, word-of-mouth between family and friends about positive experiences regarding a vehicle model influences the decision to buy a vehicle more. A whopping 96 per cent consumers in the survey used opinions of friends and acquaintances as a source of information.

In spite of this, consumer awareness about fuel economy standards is remarkably low. Most car owners or potential buyers do not have enough information on the direct links between fuel economy standards and emissions control technologies in a vehicle and the long-term economic benefits that can accrue from more fuel efficient vehicles.

Whenever the information is available, consumers do compare models. In India, only mileage data, in the form of ARAI-certified fuel efficiency levels, is given in brochures of the vehicles (and that too not necessarily in all brochures).However, as the slew of lawsuits by consumers for being misled on mileages implies, the information declared by carmakers often falls short of consumers' expectations. SIAM provides fuel-efficiency data on its website but people have to analyze it for different segments in order to understand the relevance of the data in selecting a model. Fuel economy guides are not yet published in India and rating system for greener cars is non-existent.

Overall, most consumers still do not understand the intense technical jargon and implications of buying a fuel-inefficient vehicle. Additionally, standards and values, if at all existent and available for one car model, may not be available for others in the same price and size bracket. Only a few technology enthusiasts who follow car and bike trends have an edge in selecting vehicles with maximum fuel efficiency and minimum emissions. But this group is a minority, usually limited to larger metro cities.

Transparent consumer information systems and declaration of fuel efficiency need to be made available in an easily accessible, comprehensible and comparative format for consumers.

Compliance and certification rules

As noted earlier, every manufacturer or importer of M1 vehicles (with gross weight less than 3,500 kg), used as passenger vehicle, must comply with the AFCS.[71] In 2016, MoRTH notified the Fuel Efficiency Norms, wherein "Fuel Economy Star Label" was introduced.[72] As per this notification:

- Passenger vehicles not exceeding 3,500 kg manufactured after 1April 2016 must have the Fuel Economy Star Rating (FESR) label
- Labels must be displayed at the point of sale
- If vehicles are powered with more than one fuel, wherein one is CNG or LPG; the FESR label will be that of CNG or LPG, as applicable

The star rating is to be calculated on the basis of different fuel economy levels, as per a formula designated by the notification, with one star being the lowest and five stars being the highest. The notification also specifies the design and dimensions of the FESR label (see *Image 1: Proposed design of the FESR label*). The final notification is to be provided by BEE. At present, BEE is finalizing star labelling for agricultural tractors.[73] FESR labels are expected for all segments once finalized and notified by BEE. The International Centre for Automotive Technology (ICAT-Manesar) shall authorize the use of labels and numbers, based on a request by a manufacture. Therefore, at present, there is no regulatory compliance towards a vehicular labelling programme in India.

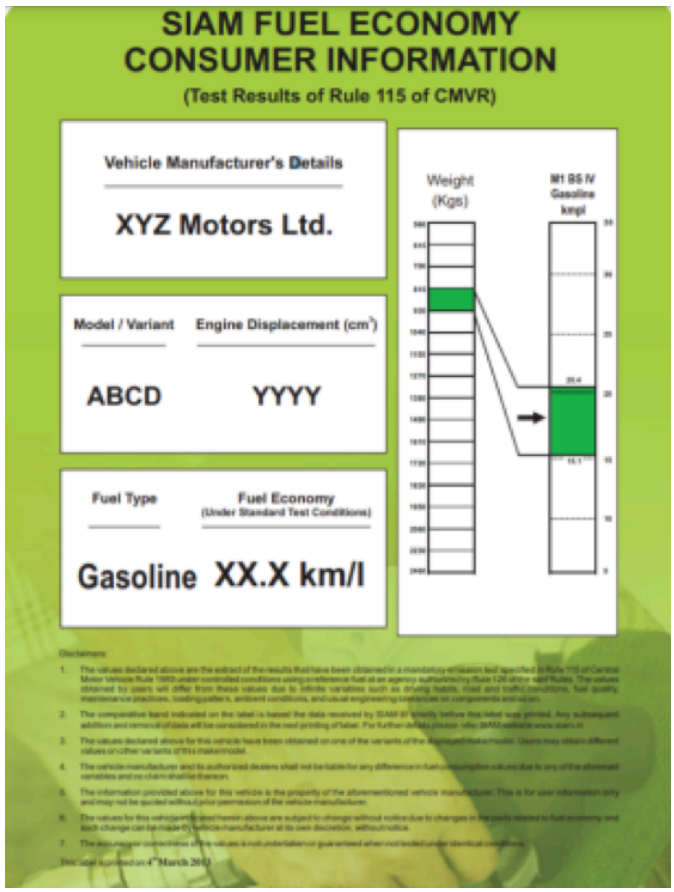
Image 1: Proposed design of the FESR label

Source: http://egazette.nic.in/WriteReadData/2016/167538.pdf

Voluntary labelling schemes

SIAM has been publishing the Fuel Economy Information Brochure from time to time,[74] to educate vehicle buyers on fuel economy. Apart from fuel economy, the brochure includes tips for improving fuel economy, information on bio-fuels and other fuel blends, importance of keeping fuel economy in consideration while purchasing a vehicle, and fuel economy labels. The brochure explicitly states that fuel economy estimates are from laboratory testing and ideally these brochures are available on SIAM's website or at the car dealer at the point of sale. SIAM also launched the first voluntary fuel efficiency labelling in 2008, and subsequent editions included information for the consumer in terms of comparative labelling. Voluntary comparative labels must be made available at the point of sale for the M1 category. There are no labels or ratings for electric, hybrid, dedicated gaseous fuel or bi-fuel operated vehicles.

Image 2: SIAM fuel economy label for M1 category of vehicles



Source: https://www.siamonline.in/FE-Decl-2013/4W/PDF-Ver/4WBSIVG-815-930-0312.pdf

The label (see *Image 2: SIAM fuel economy label for M1 category of vehicles*) includes such information as vehicle model and manufacturer's name, engine size, vehicle weight, fuel type and fuel economy to the nearest one decimal point. The units are km per litre for petrol and diesel. For vehicles running on LPG and CNG, the fuel economy is mentioned in km/kg. For electric vehicles, the economy is in km/kwh, wherein kwh is the battery power.

The labels also include a disclaimer about the values that are obtained as per mandatory emissions test specified in Rule 115 of the Central Motor Vehicle Rules of 1989 under controlled conditions using a reference fuel at an agency authorized by Rule 126 of the said Rules. These values would vary with driving habits, road and traffic conditions, fuel quality and maintenance practices, etc. Further, vehicle manufacturers and authorized dealers are not liable for any difference in fuel consumption and no legal claims thereof would be entertained. Overall, this is a completely voluntary declaration, issued in public interest, with no regulatory backing.

Sourcing information on fuel efficiency

Though, information is not available in a cohesive manner in any single source, at present, the consumer has the following options to look up for fuel economy and emissions of their vehicles. Overall, these sources are limited, and information published in these sources cannot be verified easily by the average consumer, who is not well-versed with the finer nuances of the auto-industry and regulatory bodies.

Reports on print, electronic and social media

Several informal sources that have the consumer's best interest in mind routinely publish reviews of new automobiles, news from the automobile industry, interviews with industry experts and notes on new government policies. These informal sources include automobile magazines, technology blogs and short videos on social media and television. Apart from these, some insurance companies have expert commentary on certain car models on their website. Most of these are free of heavy technical jargon and easily accessible. A few examples are:

- *Autocar India* (https://www.autocarindia.com/): Includes a print magazine and a website, as well as a "pro" website for advanced users.
- *Motoring World:* One of the most established and oldest automobile magazines of India. Access through retail purchase and a print subscription.
- *Top Gear Car:* Initially a BBC initiative started in 1993, the magazine began to be published in India in 2005. Can also be accessed as a website.
- https://www.overdrive.in/: A web portal for reviews and news with dedicated tracks for four-wheelers and two-wheelers

Culture of influencers

As social media has penetrated deeper into India, there has been a significant rise in self-proclaimed experts who market themselves through videos made during test drives. With time, these influencers gather substantial views and followers, and monetize their favorable reviews for cars and two-wheelers. The average consumer is unaware of this synergistic relationship between an influencer and an original equipment manager (OEM). On the positive side, influencers do manage to increase awareness on vehicular technologies among urban consumers.

Media communication

When any new vehicle model is released, positive details about the vehicle are released to the media, as part of the launch and publicity campaign. Fuel efficiency is highlighted, along with other superior performance features, with respect to the model's contemporaries. While these are widely reported by media outlets,[75] the values cannot be independently verified.

All these sources are informal, and not vetted by any regulatory agency. While some of them may be credible, many are not genuine. There is absolutely no mechanism to verify the claims made by these portals. The readership of the automobile magazines is often limited to bigger cities. Finally, almost all of these informal sources are in English, and there is dearth of information in vernacular languages.

Industry sources, company brochures and automobile dealers

In India, it is often the salesman at the dealers' who answer the most critical questions about a car. A potential customer can also chat with a representative of the company through a website. However, a quick survey around NCR has suggested that most potential buyers rely on information provided by the salesman and decisions are made on the test drive experience, along with recommendations from friends and finance schemes. In the survey, it was also found that SIAM's voluntary labelling system was not being used at all, and the only label was found for Seltos, by Kia Motors India Pvt Ltd, for eight of its variants (five for petrol and three for diesel).[76] The date of printing mentioned for all the labels was August 2019.

Additionally, customers are provided with a brochure. All car manufacturers publish detailed brochures for all their models in each segment. Brochures are also available on their website. There is no set pattern for car brochures, but typically, companies have attractive brochures that include details of car design, size specifics, special features, safety information and options for colour and choice of interiors. They also include detailed sections on technical specifications, including but not limited to engine type, power, dimensions and torque, brake and tyre specifications of the vehicle, and fuel tank capacity and economy.

Tracking ground evidence

For this report, CSE carried out a sample survey and collected brochures of 26 cars that are currently being sold in India. These brochures were collected and studied, and decoy conversations were held with dealers. It was found that information was easily available for only 11 models. In some cases, the brochure highlighted terms such as "improved fuel efficiency" and "lower fuel consumption" but did not explicitly provide data (see *Table 3: Fuel economy information in car brochures*).

Table 3: Fuel economy information in car brochures

S. no.	Model name	Fuel economy information in the brochure
1.	Tata Altroz	Not available
2.	Tata Tiago	Not available
3.	Tata Tigor	Not available
4.	Ford Ecosport	Yes (for both diesel and petrol variants, manual and automatic transmission modes)

S. no.	Model name	Fuel economy information in the brochure
5.	Ford Aspire	Yes (for both petrol and diesel variants)
6.	Hyundai i20	Not available
7.	Hyundai Aura	Not available
8.	Hyundai Creta	Not available
9.	Hyundai Elantra	Not available
10.	Hyundai Verna	Not available
11.	Hyundai Grand i10	Not available
12.	Nissan Kicks Turbo	No, mentions "improved" fuel economy; does not provide exact values
13.	Nissan Magnite	Yes, for all variants
14.	Maruti Suzuki Swift	Yes (mentions Rule 115 (G) of CMVR 1989)
15.	Maruti Suzuki Ertiga	Yes (for both petrol and CNG variants, manual and automatic transmission modes)
16.	Suzuki NexaBaleno	Yes (for both petrol and smart hybrid variants; mentions Rule 115 of CMVR 1989)[77]
17.	Toyota Camry	No, mentions "unmatched" fuel efficiency; does not provide exact values
18.	Toyota Glanza	Yes (for both manual and automatic transmission modes, and advanced Li ion battery)
19.	Renault Kwid	Not available in the brochure; mentioned briefly on the website[78]
20.	Skoda Octavia	Yes, as per WLT) for low, medium and high phases
21.	Chevrolet Sail	Yes (for both petrol and diesel variants)[79]
22.	Volkswagen Polo	Yes (mentions Rule 115 of CMVR 1989; also mentions tests done by agency, and that actual on-road efficiency might vary)
23.	Audi A6 Sedan	Yes (mentions ARAI certification)
24.	Mahindra XUV 300	Not available
25.	Mercedes Benz E-Class	No; mentions "low fuel consumption", does not provide exact values
26.	KIA Seltos	Not available

Source: CSE sample survey of randomly selected car models, based on brochures sourced from OEM websites and dealers

It is pertinent to note that even in cases where fuel efficiency is explicitly mentioned on the product brochure, it is not highlighted and usually includes a fine print. Overall, the design and style of the vehicles were found to be more prominent in the brochure. There was lack

of consistency between different models manufactured by the same parent company. For instance, both Nissan and Toyota have fuel economy information for some of their models, while it is conspicuously absent from others. Further, for Renault Kwid, the brochure did not carry any information about fuel efficiency, however it was briefly mentioned on their website, in fine print. For KIA Seltos, though SIAM's voluntary labelling information was available, the brochure for 2021, did not contain any information on fuel economy.[80]

Verbal communication with salesmen and automobile dealers resulted in vague answers and often the values provided were different for each individual. Additionally, in most cases neither the brochure nor the salesmen clarified if the said values would vary for real-world conditions, as these tests were done in a laboratory. Volkswagen Polo was the notable exception to this trend. Overall, it was found that automobile manufactures had indeed a long way to go towards publishing fuel efficiency values that would be useful to the average consumer.

Data published by industry bodies and research organizations

SIAM publishes fuel economy data of passenger vehicles, both four-wheelers and two-wheelers, as declared by the manufacturer themselves. In 2020, it published data of 303 passenger cars, with separate values for petrol, diesel and CNG models.[81] The values for two-wheelers were last updated in 2019, covering 131 models.[82] SIAM's data includes details on engine power, declared fuel economy (in km per litre) and declared CO_2 emissions (in g/km). For four-wheelers, the data also includes kerb weight (kg) and emissions standards (BS-IV and BS-VI). This fuel economy declaration is different from the voluntary labelling scheme by SIAM.

ICCT also publishes research data on various subjects corresponding to the automotive industry. ICCT has published reports on performance of automobile companies controlling 99 per cent of the Indian market with respect to the 2022–23 emissions standards.[83] Similar analysis has been carried out for light commercial vehicles.[84] In the two-wheeler segment, ICCT has carried out analysis on the potential savings by consumers, when fuel-efficient technologies are incorporated.[85]

Data published independently by research institutions and industry bodies has limited reach. The core audience for these manuscripts are not necessarily everyday customers. Though rich in technical information, with detailed analysis by experts, these are not usually accessed by the average consumer. While all data is freely available on the internet, it is usually used by academics, policy makers and researchers, all well-versed with erudite scientific literature. However, they form only a tiny fraction of the consumer base. Efforts have to made to make this information available to all strata of society.

Difference between on-track testing and real-world efficiencies

As already mentioned, car manufacturing companies publish data on emissions and fuel consumption as part of their fleet brochure. This data is often derived from "track testing", wherein a vehicle is tested under laboratory conditions. This is different from Real Drive Emissions (RDE) wherein efficiencies are recorded from vehicle behaviour in real driving conditions, on highways and regular roads. Though often used interchangeably, the testing scenarios vary considerably. Key parameters such as driving cycles, torque, vehicle loading, driving resistances, trip length, start and stop conditions, ambient temperature levels, gear-shift behaviour and power demand will vary.[86]

In India, at present, testing is carried out by ARAI. The testing process includes simulating conditions as close to the Indian Driving Cycle (IDC), as per the Automotive Industry Standard-137 (AIS-137), as possible. A test usually lasts for about 19 minutes (1,140 seconds) for a distance of 10 km. The speeds rarely exceed 90 km/h and both deceleration and acceleration is tested gradually. These tests are conducted on new vehicles, and therefore, do not account for fuel efficiency after a few years of wear and tear and a few thousand kilometers. Additionally, fuel efficiency of a vehicle will decrease at higher elevations, in mountainous terrain, and is slightly higher in the plains. These finer nuances are not captured in the IDC.[87]

At present, there is no regulatory body in India that demarcates between ARAI-certified fuel efficiency and real-world mileage. Some web portals such as Zigwheels conduct surveys and report actual efficiencies as experienced by users.[88] In some cases, they also project monthly fuel costs for vehicles. However, all these are third party websites. There is no mechanism to verify their claims. The survey results do not include details about sample size or any other statistical information.

In its report, the ICCT has found that the gap between official values for vehicular fuel efficiency and actual reported values in everyday driving has increased. This gap was reported to be the highest in the EU and lowest in the US.[89] The report concluded that fuel economy standards, as marketed by car manufactures, should correspond to real-world measurements.[90]

EU has mandated that RDE test requirements in the form of WLTP.[91] WLTP provides more realistic emissions and fuel consumption results. In India, WLTP is expected to be introduced in 2023.[92] It will have to be backed by legislation to ensure proper compliance.

Factors defining consumer choice

The question one must ask is whether a consumer actually estimates fuel savings while purchasing a vehicle? Or whether they take into account the potential savings equivalent to the vehicle's slightly higher purchasing price? Studies in the US suggest that consumers do consider the fuel economy of the vehicles that they purchase, both in the new and used vehicle markets. It was found that increased fuel prices lead to much higher demand for more fuel-efficient vehicles and that higher gasoline prices lead people to buy more fuel-efficient vehicles and keep more fuel-efficient vehicles for long-term use.[93] However, in some cases, and in particular in the US, fuel economy still ranks below other vehicle attributes.

Vehicle type, reliability, price, features and safety are some of the features that find higher priority than fuel economy in the country. But this trend varies across vehicle segments. For instance, a chunk of the decline in the sales of larger SUVs in the country between 2002 to 2007 was attributed to the increase in the price of gasoline. Most consumers associate higher mileage with more compact vehicles, but also feel these vehicles should ideally be cheaper due to their smaller sizes, as consumers are not aware of the finer aspects of vehicle engineering and technology inputs for greater fuel economy.[94]

In the 2018 Automotive Fuel Economy Survey,[95] to assess the average American's attitudes towards vehicles' fuel economy, it was found that 38 per cent of American car owners chose fuel economy, while only 22 per cent chose purchase price and maintenance cost while selecting a vehicle. At 85 per cent, a majority of American car buyers feel that automobile manufacturers must continue to implement better fuel economy for all vehicle classes in the interest of better economic returns and a cleaner environment.

In India, price of the vehicle and brand values are the first things that consumers look for, followed by fuel economy, maintenance costs and after-sales service.[96] As per a survey by Nielson,[97] technical specifications such as engine performance and safety are important factors we well.

Global labels

Globally, countries have designed fuel economy labelling programmes for both passenger cars and commercial vehicles to influence and inform consumer choice for both ICE vehicles and EVs. The structure and the elements of the labels differ across countries (see *Annexure: Global labels*). But broadly and variably, they provide information on fuel economy (or fuel consumption) and CO_2 emissions to help consumers make informed choices.

USA was the first country to introduce a vehicle labelling programme. At present, there are different labels for gasoline, diesel and electric vehicles. Additionally, there are labels for vehicles running on a fuel mixture such as gasoline–ethanol. A unique feature that these labels provide the end consumer is the approximate amount of monetary savings associated with the fuel economy.

Global consumer awareness campaigns

Apart from labelling of vehicles, some countries have dedicated and successful consumer awareness campaigns to inform their citizens about fuel consumption, comparison between vehicle models and emissions rates in an attempt to inculcate behavioural changes

Mexico has a dedicated portal, accessible to all consumers, that includes fuel economy databases and labels, information for dealers and testing data for all car segments.

EU has issued a directive under which fuel consumption data for all new passenger vehicles is made freely available to consumers. While on display at a dealer's showroom, each car model must clearly have the fuel consumption and CO_2 emissions displayed in both the metric system (litres per 100 kilometers) and the imperial system (miles per gallon), with separate values for urban and extra-urban conditions. Finally, the directive mandates all manufacturers to include fuel consumption and CO_2 emissions data in all fleet brochures and print advertisements.

Image 3: A screen-grab of the US government website fueleconomy.gov

Source: https://www.fueleconomy.gov/.

In the US, copies of guides with gas mileages and fuel savings for car models have to be made available to consumers in showrooms. This is mandated by federal law. Further, this information is also publicly available on a government website (https://www.fueleconomy.gov/). The portal in intuitive, easy to use and includes features like fuel savings by consumers on each car models.

The portal also includes an annual "fuel economy guide", which is a one-stop shop document published every year with fuel economy estimates for all vehicle models released that year, including passenger cars, trucks and vans. It excludes some SUVs and vehicles with weight rating of 10,000 pounds or more. Like the website, the guide is intuitive, easy to follow, and also includes the latest news on federal tax credits, incentives and disincentives for the financial year and information on fuel blends. Lately, additional information on the nation's charging infrastructure and tips for managing electric vehicles have been included, keeping in mind the growing popularity of electric vehicles.[98]

US has also introduced a Green Vehicle Programme,[99] under which consumers are provided information on cleaner fuel blends, alternative fuels and electric vehicles. Additionally, financial calculations are provided to help consumers figure out potential savings when they shift to "greener vehicles". Detailed information on vehicle and fuel types, pricing etc. is made available for electric, hydrogen-run, CNG and biodiesel vehicles. This outreach campaign, run primarily by the United State Environment Protection Agency, helps American make greener choices in the purchase of vehicles.

Information about incentives for consumers

Most countries have mandated a labelling scheme for their vehicles. Labels on car windows provide information about the fuel efficiency range expressed in litres per 100 km or miles per gallon, and emission rates. Further, consumers have access to similar information for all car models to compare values. Some countries also publish annual fuel economy guides. However, to bring in behavioural change and enhance consumer acceptance; incentives have to be given to consumers and these incentives have to be widely notified. These incentives can be in the form of:

- Schemes for purchase and sale of fuel-efficient vehicles; rebate during registration
- Higher fuel taxes for less fuel-efficient vehicles
- "Fee-bates": Mix of fees and tax rebates
- A system of taxes based on CO_2 and NO_x emissions and fuel efficiency for consumers

Financial incentives have been explored for choosing the most fuel-efficient vehicles in some countries with varying degrees of success. For instance, certain countries have introduced

a system of financial incentives and disincentives in the form of a tax deduction based on fuel-efficient performance.

US and Canada have introduced a "fee-bate" for fuel-efficient and less-efficient cars respectively. The United States government provides tax credits for the purchase of energy-efficient vehicles on the basis of the vehicle's fuel economy and energy savings. Specifically, California developed a 'feebate' system (fee as penalty and rebate as reward). The purchase of older, less fuel-efficient vehicles was discouraged at the federal level in the United States through the Gas Guzzler Tax. This is levied under the 1978 Energy Tax Act. Another popular scheme is the Car Allowance Rebate System (CARS), also known as "Cash for Clunkers", which provides monetary benefit to car owners, when they trade their older polluting vehicles for new ones after a certain age limit.

In Canada, the eco-AUTO programme helps to lease out fuel-efficient cars and lighter trucks. A punitive green tax is levied as an excise duty towards those who purchase less efficient cars.

Several member states within the EU levy additional fuel taxes on less fuel-efficient cars.[100] In France, there is a higher rate of registration tax for vehicles with CO_2 emissions above 200 g/km. Austria has a one-time fuel consumption tax, at the time of registration of the car. Based on the type of vehicle, deductions are offered. There is a deduction of €350 for diesel vehicles, €450 for petrol vehicles and €600 for hybrid vehicles. Electric vehicles are completely exempt from this one-time tax. Both Germany and Sweden have annual circulation taxes, which consists of a base tax, and an additional CO_2 tax. In Germany, the CO_2 tax is only levied when the car emits above 95 g/km, and increases linearly by €2 for every 1 g/km increase. In Sweden, there is a base tax of Swedish Krona (SEK) 360 and an additional SEK20 for each gram increase of CO_2 above 117 g/km. This additional tax is to be further multiplied by a factor of 2.33 in case of diesel vehicles.[101]

UK has initiated a number of measures such as lower rate of vehicle excise duty on vehicles with engine smaller than 1,549 cc. Staggered excise duty for new passenger vehicles based on their CO_2 emissions has also been introduced. In 2006, a net zero rate of excise duty was introduced for vehicles with lowest carbon emissions.

Impact of labelling on consumer behavior

Though there have been very few studies on impact of vehicular labelling on vehicle sales, most of them suggest that labels focused on fuel economy and corresponding financial gains help sale of fuel-efficient cars. However, there needs to be a balance between the amount of

information that needs to be on the label and also keeping the label attractive with a high recall quotient.

Early lessons can be drawn from the household appliances segment. It has been found that some consumers are indeed willing to pay slightly more for devices that have lower long-term energy costs.[102] In the automobile segment, vehicle labels have been more effective when they come from regulatory bodies and academia, rather than from the industry. In India, at present, refrigerators and air conditioners are sold with the "Energy Star" labels. Appliances with higher stars tend to be more costly.[103] However, it has been found that consumers may prefer appliances with higher stars.

Therefore, any vehicular labelling programme has to be simple, easy to comprehend, with a high recall value, must explicitly inform consumers about monetary savings, and must be combined with overall tighter fuel economy standards.[104]

The way forward

For a country as large and diverse as India, a one-size-fits-all approach will not be appropriate while developing a consumer information system. Any mechanism for disbursal of information on fuel economy standards has to include a multi-pronged strategy, including print, digital and social media.

India needs to introduce a detailed labelling programme for vehicles within a year. Sale of car models without a label should be prohibited. A transparent system of consumer information for fuel efficiency must be introduced, incorporating best practices from across the globe. A fuel economy guide could be released in English and other Indian languages. Consumers should get detailed information about emissions, fuel and monetary savings, comparison with peer brands and front runners, etc.

This requires creating a common portal to enable consumers to calculate potential costs savings for buying a particular vehicle based on usage. This would be in addition to the regular fuel economy values.

The information must have clarity about the gap between certification values and real-world values to prevent confusion. This must include a grievance cell for consumers.Fuel consumption and emissions data must be integrated and highlighted in all promotional and advertising materials of a vehicle model.

Any vehicular labelling programme is bound to fail if it is not backed by a rigid framework for enforcement. Regulators must ensure credibility of labels, monitor OEMs to comply with labelling systems for all their cars, and carry out extensive outreach programmes to enable consumers to make green choices. The system should be dynamic.

Information should be easily accessible to all potential buyers and not just to the urban elite. Information must be comprehensible without layers of technical jargon and must be made available in multiple Indian languages. The consumer must be able to verify the claims of the automobile makers.

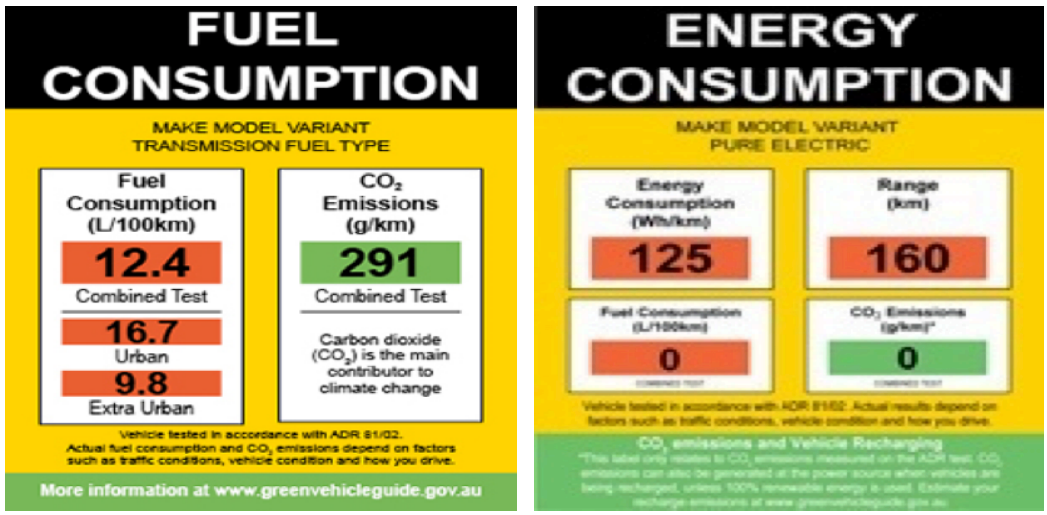
There must be an oversight by a single regulatory body that will liaise between OEMs, testing agency, MoRTH and the consumer. This must include a grievance cell for consumers.

Labels must be fixed on the windshield of every passenger car at the dealer's showroom. Staff at automobile showrooms must be well-versed with fuel economy of cars on display, and should be able to clearly explain the difference between laboratory and real-world values.

Vehicular labelling systems, once implemented, must be allowed sufficient time to seep into behavioral patterns of consumers. For this, consumer trust must be built, which will only happen when consumers are familiar with labels and understand the information that a label provides. A familiar example to emulate in India is the ISI mark for household appliances.

Annexure: Snapshots of the global labelling programme

Widely divergent labelling programmes have emerged globally that can be reviewed for development of a labelling programme in India. They vary in design, structure and level of information.

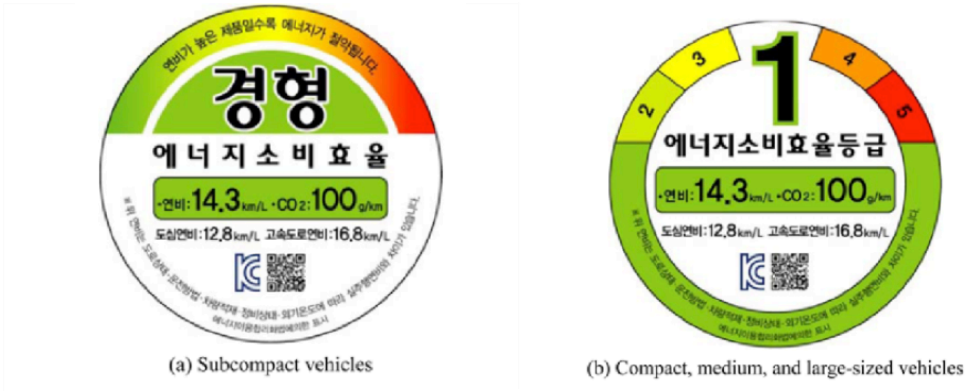


Source: https://www.greenvehicleguide.gov.au/pages/Information/FuelConsumptionLabel

New Zealand

Source: https://resources.fuelsaver.govt.nz/label-generator/

South Korea

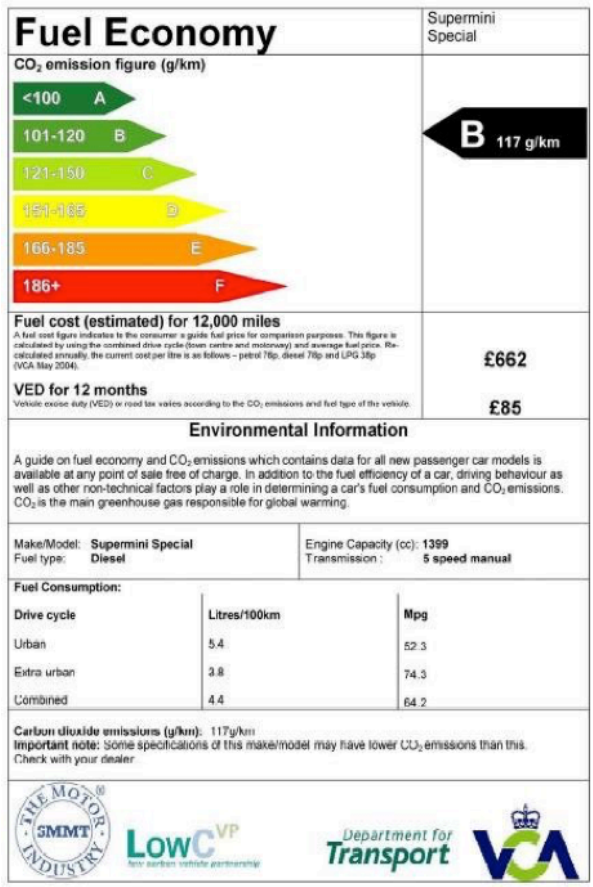


(a) Subcompact vehicles

(b) Compact, medium, and large-sized vehicles

Source: https://www.researchgate.net/figure/Fuel-economy-label-of-Korea_fig1_303716709

United Kingdom



Note: The new Fuel Economy label used in the UK gives a rating between A–F, with A being the highest rating. The rating is for both new and second-hand vehicles. Additionally, the UK Vehicle Certification Agency also provides fuel economy, CO_2 emissions and noise pollution data of all new cars, 4x4s vans and pickups trucks that are sold in the UK.
Source: (1) https://www.researchgate.net/figure/The-new-Fuel-Economy-label-used-in-the-UK-gives-clear-rating-from-A-F-for-CO_2-emissions_fig1_329944235; and, https://carfueldata.vehicle-certification-agency.gov.uk/

China

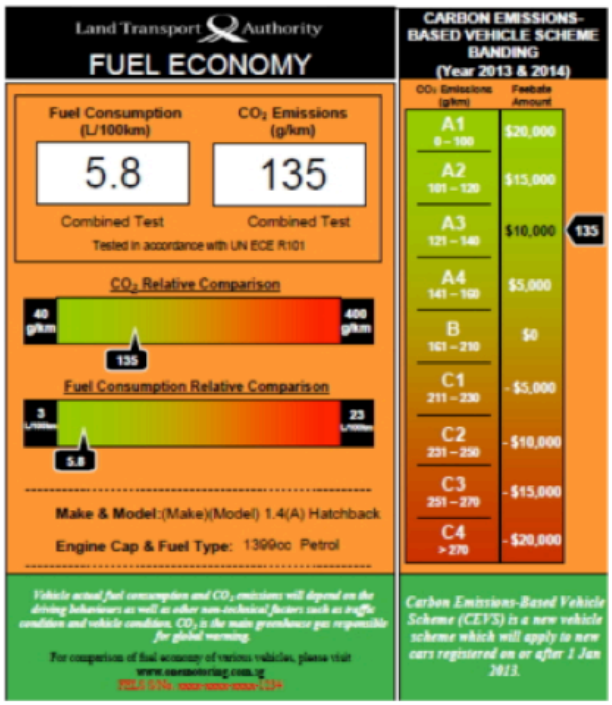
Source: https://carnewschina.com/2015/01/06/mg-gts-mg-gs-and-knock-it-off-now/

Chile

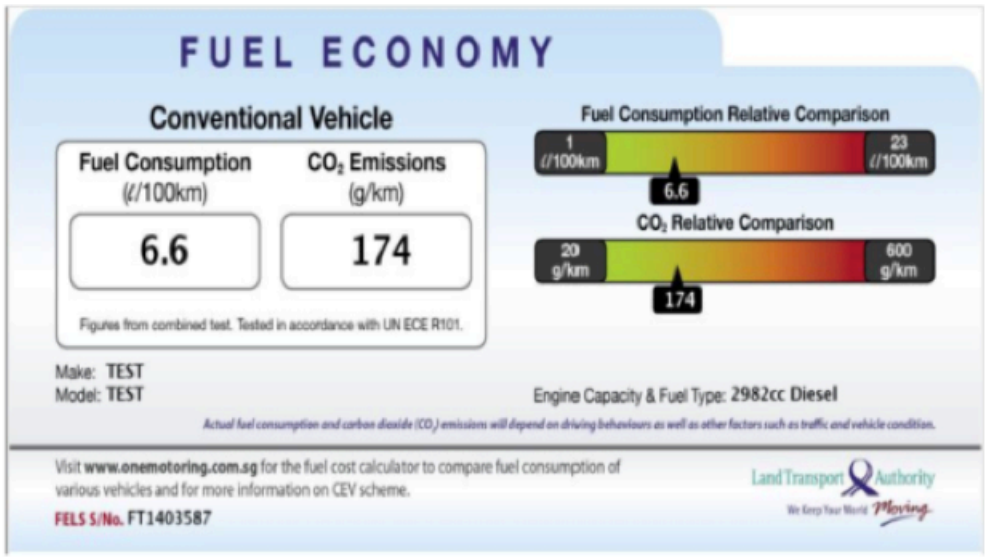
Source: https://www.fiafoundation.org/transport/gfei/autotool/case_studies/samerica/chile/cs_sa_chile.asp

Singapore

The country had mandated fuel economy labels for passenger cars since 2012.
Singapore new fuel economy label, mandated since 2012.

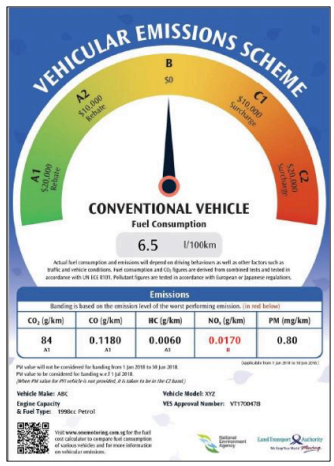


Note: These labels are mandatory even when a petrol or diesel vehicle is converted to a CNG vehicle.
Source: https://www.carsandstars.com.sg/new-car-emissions-for-vehicles-rebate-surchage/

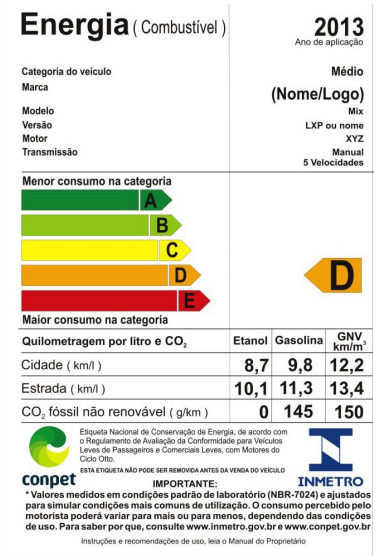


Source: https://onemotoring.lta.gov.sg/content/onemotoring/home/owning/ongoing-car-costs/fuel.html

Singapore also mandates declaration of emissions for passenger cars and light goods vehicles. The Vehicular Emissions Scheme (VES) label is affixed on the windscreen of the cars at the showroom. For passenger cars, the emissions for CO, HC, CO_2, NO_x and particulate matters are indicated on the label to help consumers make informed choices.



Source: https://onemotoring.lta.gov.sg/content/onemotoring/home/owning/ongoing-car-costs/fuel.html

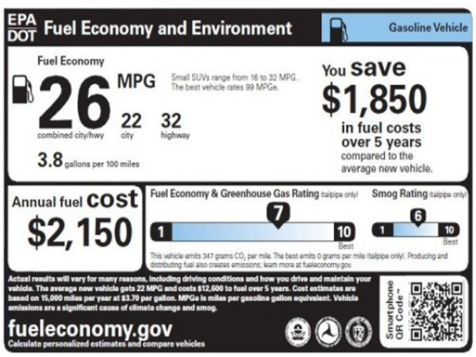


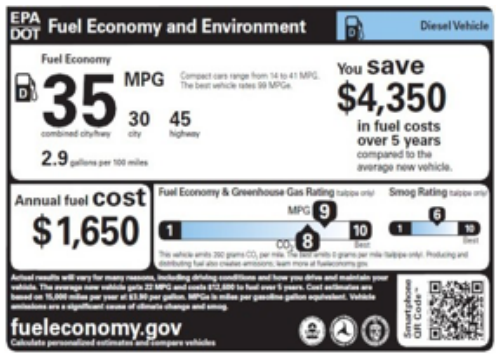
Brazil

The government has instituted the national programme for energy conservation and labels are generated for all consumer goods such as heaters, air conditioners, ovens and automobiles. The fuel type is specified in case of combustion engines, and energy efficiency for electric operated vehicles.

Source: https://thebrazilbusiness.com/article/energy-efficiency-labeling-in-brazil

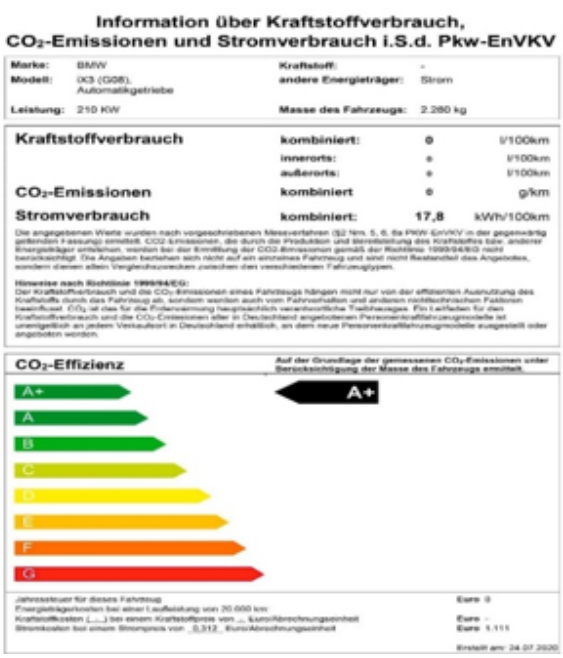
United States was the first country to introduce a vehicle labelling programme. At present, there are different labels for gasoline, diesel and electric vehicles. Additionally, there are labels for vehicles running on a fuel mixture such as gasoline–ethanol. A unique feature is that these labels provide the end consumer information regarding the approximate amount of monetary savings associated with the fuel economy.





Source: https://www.nhtsa.gov/corporate-average-fuel-economy/fuel-economy-and-environment-label

Germany

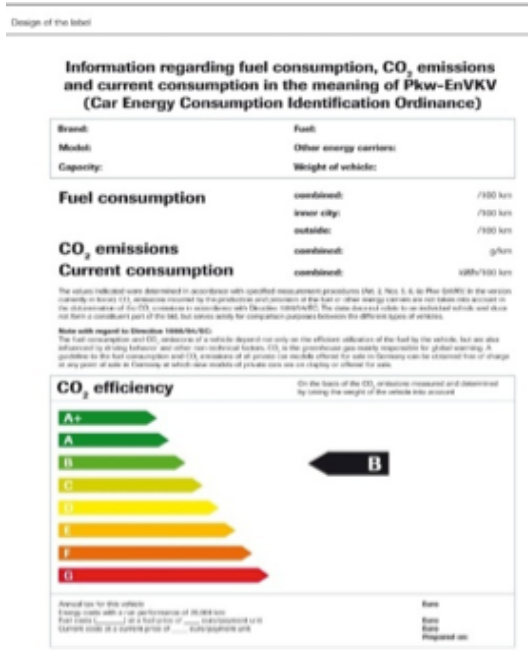

Information über Kraftstoffverbrauch, CO_2-Emissionen und Stromverbrauch i.S.d. Pkw-EnVKV

Marke: BMW
Modell: iX3 (G08), Automatikgetriebe
Leistung: 210 KW
Kraftstoff: -
andere Energieträger: Strom
Masse des Fahrzeugs: 2.280 kg

Kraftstoffverbrauch — kombiniert: 0 l/100km; innerorts: 0 l/100km; außerorts: 0 l/100km
CO_2-Emissionen — kombiniert 0 g/km
Stromverbrauch — kombiniert: 17,8 kWh/100km

CO_2-Effizienz — Auf der Grundlage der gemessenen CO_2-Emissionen unter Berücksichtigung der Masse des Fahrzeugs ermittelt.

A+
A
B
C
D
E
F
G


Design of the label

Information regarding fuel consumption, CO_2 emissions and current consumption in the meaning of Pkw-EnVKV (Car Energy Consumption Identification Ordinance)

Brand:
Model:
Capacity:
Fuel:
Other energy carriers:
Weight of vehicle:

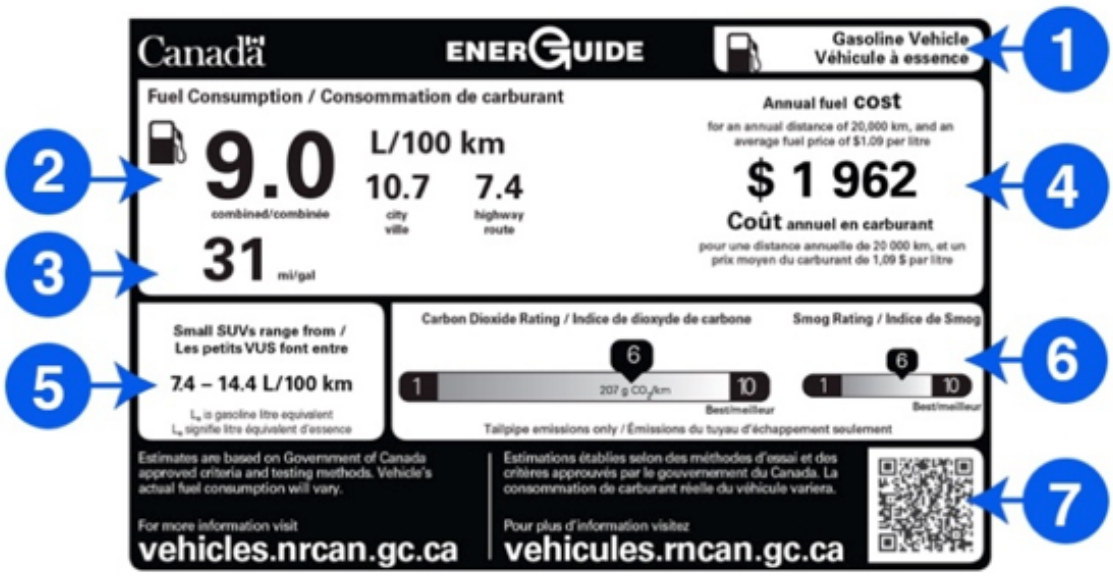
Fuel consumption — combined: /100 km; inner city: /100 km; outside: /100 km
CO_2 emissions — combined: g/km
Current consumption — combined: kWh/100 km

CO_2 efficiency

A+
A
B
C
D
E
F
G

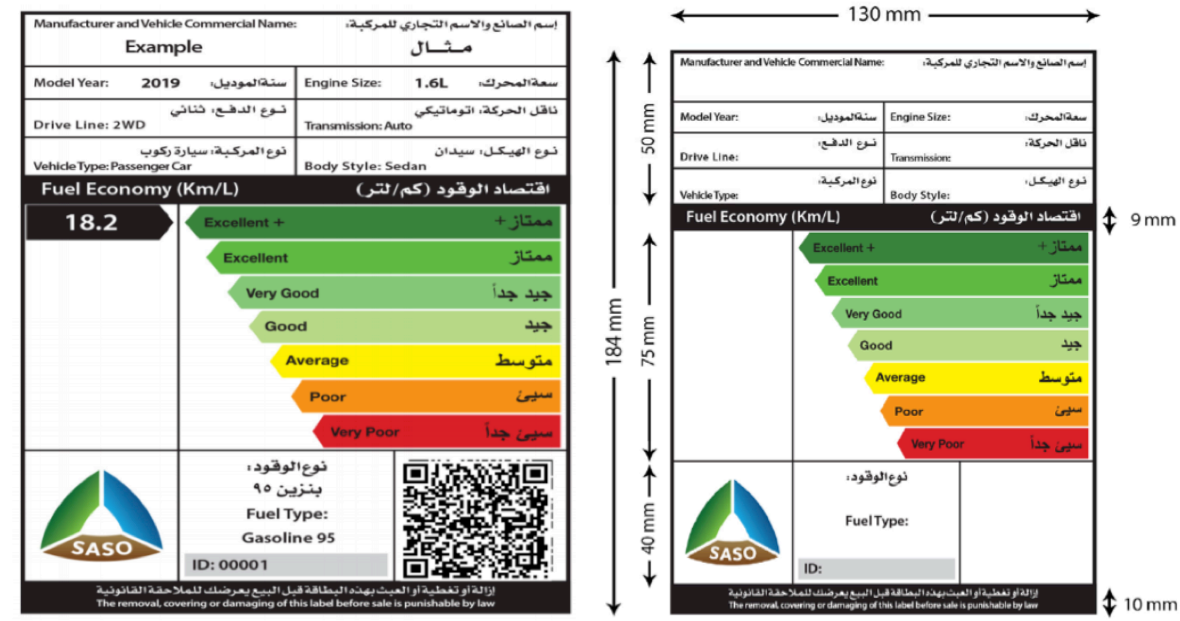
Canada:

Updated in 2016, the new labels include the following features in both English and French.



Note: (1) For vehicle type and fuel; (2) For fuel consumption in L/100 km and is based on a combination of 55 per cent intra-city and 45 per cent highway driving; (3) For fuel economy in miles per imperial gallon; (4) Annual fuel cost for driving 20,000 km; (5) for Vehicle class range; (6) includes the CO_2 and smog ratings for tail pipe emissions on a scale from 1 (worst) to 10 (best) and;(7) QR code – for all other information including the national data base for fuel consumptions ratings for vehicles.
Source: https://www.nrcan.gc.ca/energy-efficiency/energuide-canada/energuide-vehicles/21010

Saudi Arabia



Note: The Kingdom of Saudi Arabia, has the Saudi Arabia Corporate Average Fuel Economy Standard (Saudi CAFE) for all light duty vehicles from 2021 to 2023, including imported and locally produced vehicles that are expected to be sold in Saudi Arabia as a part of the integrated approach to improve energy efficiency across the transportation sector.[105] These standards were initially set in 2015 and 2018 for implementation between 2016-2020 and have again been set for 2021 to 2023. There are strict guidelines for label design and dimensions.[106] Additionally, tampering of the label before sale and registration of vehicle is a legally punishable offence.

Saudi Standards Metrology and Quality Organization (SASO) is the legal entity that is responsible for issuing and updating all standards and regulations and managing inspection and testing activities in the Kingdom of Saudi Arabia. The fuel economy values are compartmentalized into seven distinct brackets, each with upper and lower limits, with corresponding colors. For instance, a vehicle falls into the "Excellent +" bracket if its fuel efficient is greater than or equal to 17.8 km/L, and the label has a very dark green color. The next bracket is that of "Excellent" wherein fuel efficiency is greater than or equal to 14.7 km/L but less than 17.8 km/L, with corresponding dark green color, and so on and so forth.

The labels include information such as vehicle model name, manufacturer name, year, vehicle segment type, fuel type and a black pentagon pointing at the fuel economy bracket that corresponds to the vehicle's declared fuel economy to one decimal point. These labels are valid from 2019 onwards, until updated or renewed by the SASO.

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Fuel efficiency standards for vehicles directly influence mileage and carbon emissions per litre of fuel burnt and are one of the least understood policy instruments in India. This assessment of India's preparedness for fuel-saving regulations in the vehicle sector has become necessary to inform future pathways, maximize fuel savings and accelerate electrification of the vehicle fleet. This analysis also underscores the importance of a consumer information system on fuel efficiency and emissions performance of vehicle models to help consumers make informed choices while buying new vehicles.

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