Roadmap for S&L programme for tyres in India

Final report

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pwc

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List of abbreviations

ABS	:	Antilock Braking System
AIS	:	Automotive Industry Standard
AISC	:	Automotive Industry Standard Committee
ARAI	:	Automotive Research Association of India
BEE	:	Bureau of Energy Efficiency
BIS	:	Bureau of Indian Standards
CAFE	:	Corporate Average Fuel Economy
CIRT	:	Central Institute for Road Transport
CMVR	:	Central Motor Vehicle Rules, 1988
CMVR–TSC	:	Central Motor Vehicle Rules Technical Standing Committee
COP	:	Conformity of production
dB	:	Decibels
EC	:	European Commission
EC Act	:	Energy Conservation Act, 2001
ET	:	Extra tread
EU	:	European Union
FY	:	Fiscal year
G	:	Wet grip index
HDV	:	Heavy duty vehicles
ICAT	:	International Centre for Automotive Technology
IEC	:	International Electro technical Commission
IRMRA	:	Indian Rubber Manufacturers Research Association
ISO	:	International Organization for Standardization
LCV	:	Light Commercial Vehicle
MoRTH	:	Ministry of Road Transport and Highways
ML	:	Mining and logging
MPT	:	Multipurpose track
MV Act	:	Motor Vehicle Act, 1988
NHTSA	:	National Highway Traffic Safety Administration
OEM	:	Original Equipment Manufacturer

PCRA	:	Petroleum Conservation Research Association
POR	:	Professional off-road
R-117	:	UN Regulation ECE R-117
RR	:	Rolling resistance
RRC	:	Rolling resistance coefficient
S&L	:	Standards & Labelling
SSEF	:	Shakti Sustainable Energy Foundation
TED	:	Transport Engineering Division
TED 7	:	Transport Engineering Division committee 7
TEDC	:	Transport Engineering Division Council
TERI	:	The Energy and Resources Institute
UN ECE	:	United Nations Economic Commission for Europe
WSSN	:	World Standard Service Network
WP	:	Working Party of the United Nations Economic Committee for Europe

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1. Introduction

1.1. Project background

The transport sector in India forms the backbone of its economy. The sector is responsible for transportation of goods and people across the country. It is a key factor in driving economic growth, and improving access and general prosperity of people in the country.

Transport and energy are closely interlinked. The transport sector forms a major component of the energy demand. In 2005, India's transport sector comprised 11% of the total primary energy demand and 16.9% of the commercial energy supply.[1] The break-up of the energy consumption from the transport sector is shown in Figure 1.

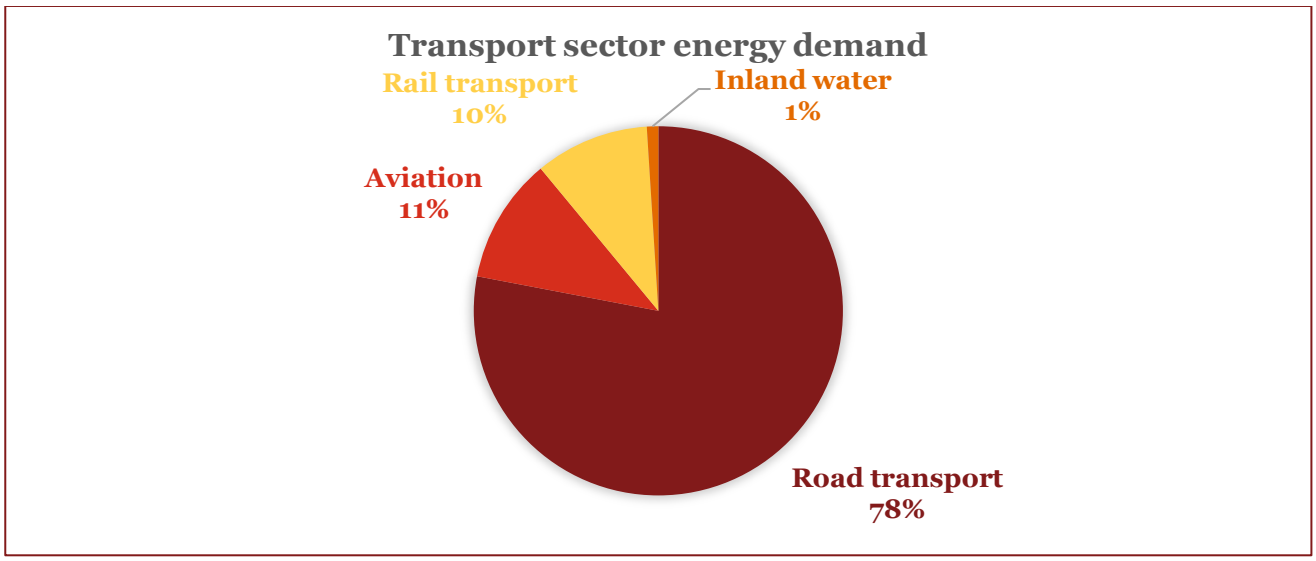


Figure 1: Break-up of the energy demand from the transport sector (2005)

Rise in population, increasing spending capacity of the people and economic prosperity in general are the key drivers of energy consumption in the transport sector. Also, the rising spending capacity of people leads to rise in the demand for motor vehicles. India's population is projected to reach approximately 150 crore by 2030.[2] India's GDP is projected to grow by 7.9% over the next seven years.[3] On this basis, India's transport sector is expected to grow at over 6% on the backdrop of economic activity and surge in vehicle stock.[1] Also, the Transport sector's share in total energy demand is expected to double to about 20% by 2030.

It is expected that the fuel demand of the transport sector will be largely met through fossil fuels, especially coal and crude oil. The supply chain often suffers from uncertainty in availability of crude oil and unpredictability in its price. With import of crude oil already comprising a major portion of fiscal deficit in India, the government has started focussing on introducing energy efficiency (fuel efficiency) in the sector.

Implementing fuel efficiency measures in the transport sector will not only reduce the consumption of fuel but also help in reducing the intensity of CO_2 emissions from the sector.

[1] Singh, K. P. (2009). Energy scenario in transport sector in India, Rites Journal
[2] http://www.euromonitor.com/india-in-2030-the-future-demographic/report (accessed on 28 July 2016)
[3] http://indianexpress.com/article/india/india-others/india-to-achieve-highest-gdp-growth-over-next-8-years-study/ (accessed on 28 July 2016)

1.2. Fuel efficiency mandate in India

The vehicle fuel efficiency mandate in India began in October 2011, when the MoP, in collaboration with MoRTH, released a consultation paper on 'Passenger car fuel economy' under the provisions of the EC Act, 2001. The paper was uploaded on BEE's website and advertisements inviting comments were released in leading newspapers across India. A public consultation on the paper was also held later on 1 November 2011.

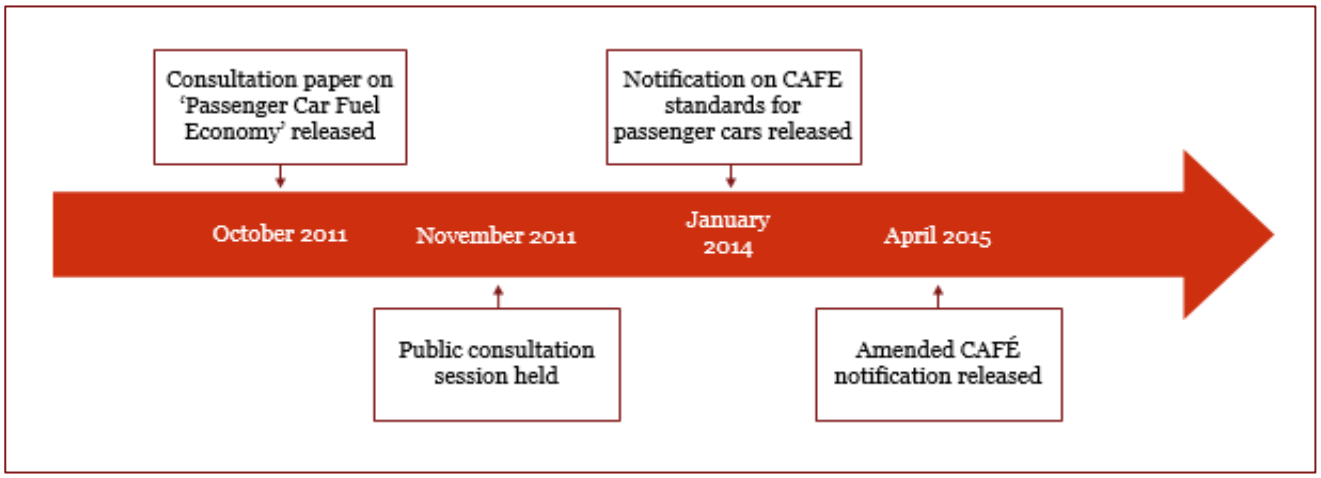


Figure 2: Passenger car fuel efficiency mandate in India

The consultation paper discussed a two-pronged approach for accelerating a reduction in the average fuel consumption in new cars introduced in the Indian market. The approach involved two schemes: CAFE standards and labelling of passenger cars.

- **CAFE standards**: Development of fuel consumption standards for passenger cars for the medium and long term. This would provide manufacturers with a regulatory signal to continuously reduce fuel consumption of new passenger cars sold by them.
- **Passenger car labelling**: Introduction of a programme of mandatory labelling of all new passenger cars sold in the market. The labels would provide consumers with information on the actual fuel consumption of the car and the fuel consumption relative to other models in the same weight category. This would help consumers make informed choices while purchasing vehicles.

The next breakthrough in the passenger car fuel economy mandate came in January 2014, when the Central Government of India released the CAFE notification under the provisions of the EC Act. The standards define the fuel consumption norms that have to be met by passenger car manufacturers by FY 2017–2018. The notification was further amended in April 2015 to include electric vehicles in the scope of the CAFE norms.

The government has also taken the initiative to introduce fuel economy norms for HDVs in India. In 2015, the PCRA[4] under the guidance of Ministry of Petroleum & Natural Gas (MoP&NG), Government of India started the initiative for those HDVs having GVW of more than or equal to 12 Tonnes.

Since the government has undertaken several initiatives to introduce fuel efficiency policies in vehicle space in India, automobile manufacturers will need to take measures to improve the fuel efficiency of vehicles sold by them.

The fuel efficiency improvement potential in a motor vehicle is subject to various vehicle technology options available to manufacturers. It is expected that advances in engine and transmission technologies as well as in other components of vehicles would contribute the most towards reducing fuel consumption in the coming

decade. The improvement potential is present in the engine and transmission design, vehicle aerodynamics, auxiliary systems and tyres.

1.3. Potential for achieving fuel efficiency through tyres

Tyres, mainly because of their RR, account for 20–30% of the fuel consumption of vehicles.[5] A reduction of the RR of tyres may therefore contribute significantly to the energy efficiency of road transport and thus to the reduction of emissions.

The EU has already put in place policy initiatives to introduce fuel efficiency in the European tyre market. Tyres sold in the EU region are required to show a mandatory label indicating the fuel efficiency rating, wet grip rating and noise value in dBs.

Introducing fuel efficiency requirements for tyres sold in India would add significantly to the energy efficiency mandate in the transportation sector. Such a programme would also help automobile manufacturers meet their fuel efficiency requirements as set by the government.

S&L programmes have previously proved effective to drive markets towards energy efficient products. S&L programmes are globally accepted to be a cost-effective solution to increase consumer awareness and facilitate uptake of higher efficient products. Such a programme for tyres could prove effective to introduce energy efficiency in the tyre space in India.

In this context, SSEF has initiated this study to ***assess the feasibility of rolling out an S&L programme for tyres in India***. This study has been entrusted to PwC India.

1.4. Scope of work

The following activities are included in the scope of work for this study:

1) Analyse the existing standards (RR and noise) and labelling mechanism accepted internationally (UN ECE R117)
2) Analyse the tyre standards issued by BIS and AIS
3) Identify the technology and implementation impediments in upgrading the Indian standards to internationally accepted standards for various vehicle types
4) Understand the feasibility of developing a standards and labelling framework for Indian conditions

[5] https://ec.europa.eu/energy/sites/ener/files/documents/FIN%20User%20guide%20-%20tyres.pdf (Accessed on 28 July 2016)

2. Approach

2.1. Broad outline for assessing feasibility of rolling out the S&L programme for tyres in India

The project team has taken the following approach to gain a holistic view of the existing situation of the Indian tyre market, understand the regulatory structure of tyres in India, existing requirements of tyres sold in India and internationally to analyse the feasibility of rolling out an S&L programme in the country.

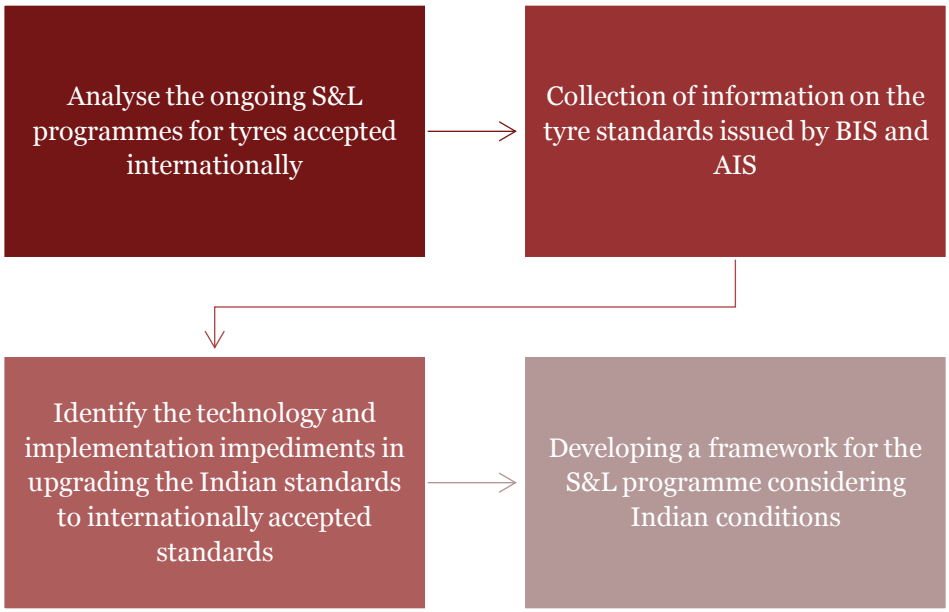


Figure 3: Overview of the approach for conducting the feasibility study

We have followed a four-pronged approach to conduct this study. In each step, all major stakeholders, including regulatory bodies, tyre manufacturers, industry experts and test agencies have been consulted.

- We first analysed the Indian tyre market to understand the current situation of the industry, key drivers, major players and current trends.
- We analysed the existing regulatory mechanisms, requirements, etc., applicable for tyres sold in the country.
- We reviewed existing international regulations and programmes for tyres to understand the key requirements and thoughts in developing the programme in India.
- We consulted all major stakeholders to understand their views towards the programme and pinpoint the major barriers faced in development of the standards in the country

Our findings from the above-mentioned activities and assessment of feasibility for development of the programme have been presented in this report.

The steps mentioned in Figure 3 represent the major components of this study. The sub-activities and overall approach related to conducting this study are explained in the following section.

2.2. Approach for assessing feasibility of rolling out an S&L programme for tyres in India

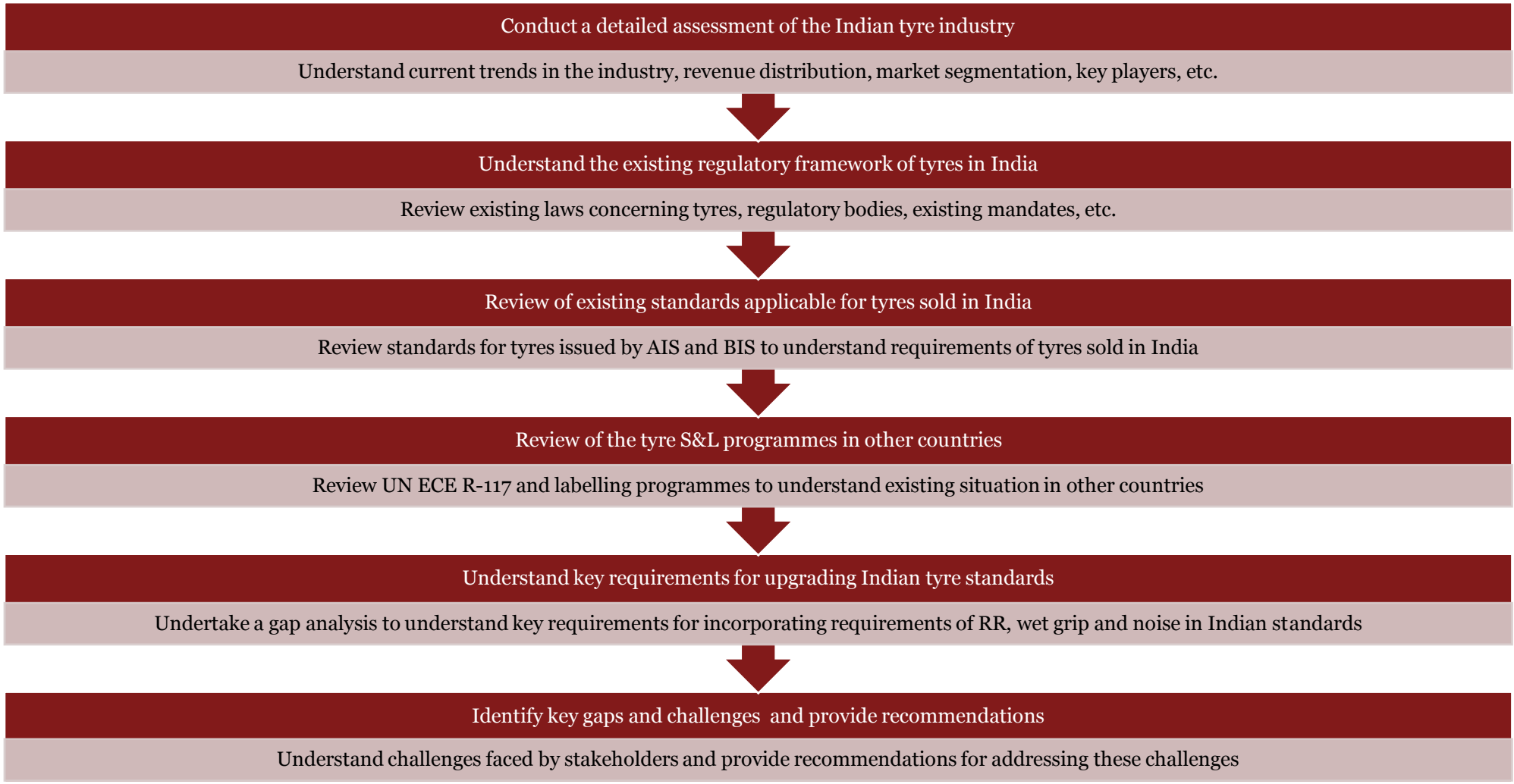


Figure 4: Approach for assessing feasibility to develop an S&L programme for tyres in India

3. Assessment of the tyre market and regulatory structure in India

Tyres are the only components of a vehicle that are in contact with the ground. They from one of the most important components in an automobile. Naturally, the tyre industry derives its demand from the automobile industry.

The tyre industry has seen tremendous growth in recent years on the backdrop of the high growth seen in the automobile industry. The industry accounted for about 5% of the global tyre market in FY 2010– 11. The industry generated a revenue of about 50,000 crore INR during FY 2014–15. Exports during the year reached 10,500 crore INR.

3.1. Tyre market structure

3.1.1. Classification of tyres

Tyres can be classified on the basis of the following parameters:

- **Based on application**: Passenger car tyres, LCV tyres, HDV tyres, two-wheeler tyres, three-wheeler tyres, tractor tyres, etc.
- **Based on type of construction**: Bias ply construction or radial construction
- **Based on carcass material**
- **Based on pattern design**

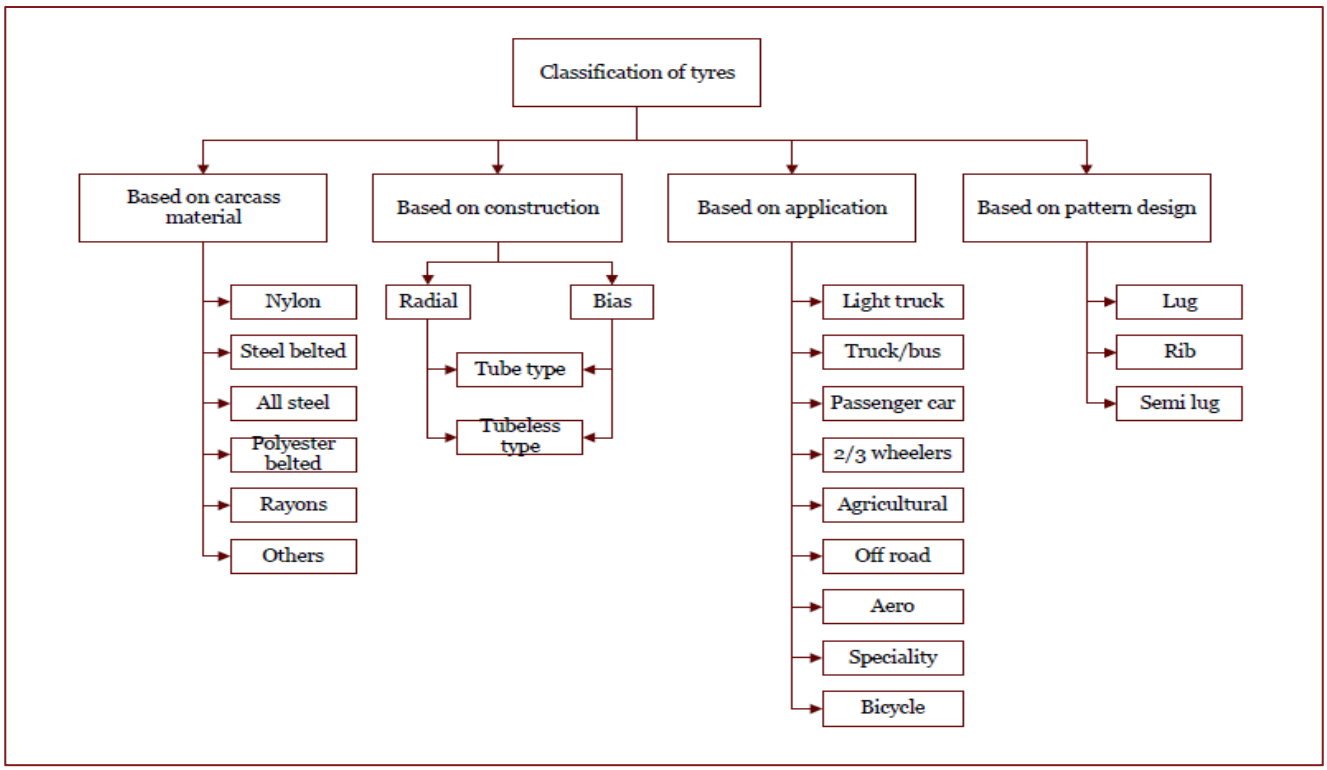


Figure 5: Classification of tyres (Know your tyre, 2016)

3.1.1.1. Classification based on application

Tyres are most commonly classified on the basis of the type of vehicles for which they are designed. In this classification, tyres are divided into passenger car tyres, LCV tyres, HDV tyres, two-/three-wheeler tyres, tractor tyres and OTR tyres.

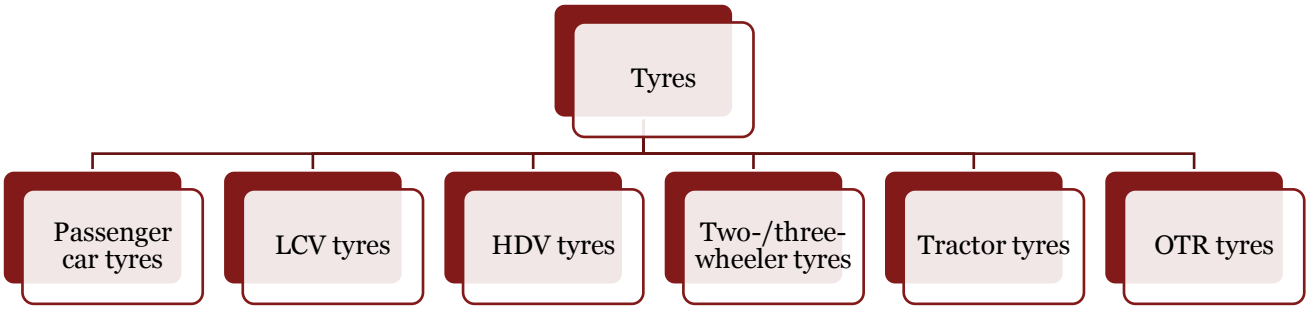


Figure 6: Classification of tyres based on application

All the above-mentioned vehicle categories are defined on the basis of the methodology mentioned in AIS-053: automotive tyre–types-terminology.

3.1.1.2. Classification based on type of construction

Tyres can be classified on the type of construction, i.e. bias tyres and radial tyres. These tyres are further segregated into tube and tubeless types.

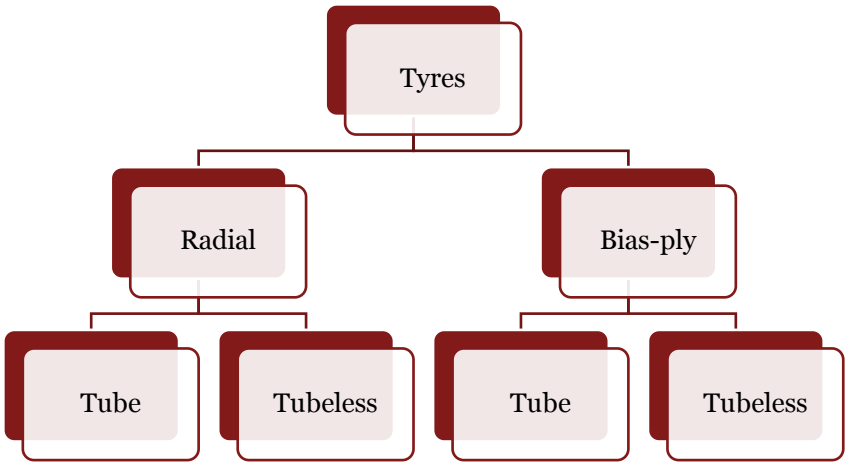


Figure 7: Classification of tyres based on type of construction

Bias-ply tyres

Bias-ply (or cross-ply) tyre construction utilises body ply cords that extend diagonally from bead to bead, usually at angles in the range of 30 to 40 degrees, with successive plies laid at opposing angles forming a crisscross pattern to which the tread is applied. The design allows the entire tire body to flex easily, providing the main advantage of this construction, a smooth ride on rough surfaces.[6] The design is such that the tyre is more stable at higher

[6] http://cocomponents.com/dealer/powersports-industry/bias-ply-radial-explained/

loads than radial tyres. However, bias tyres have the following disadvantages: **increased RR**, **less control and traction at higher speeds**.

Traditionally, the Indian market has been dominated by bias-ply tyres because of its lower initial cost and its load-bearing capacity.

Radial tyres

Radial tire construction utilises body ply cords extending from the beads and across the tread so that the cords are laid at approximately right angles to the centreline of the tread, and parallel to each other, as well as stabiliser belts directly beneath the tread. The belts may be cord or steel. The advantages of this construction include longer tread life, better steering control, and lower RR. Disadvantages of the radial tire include a harder ride at low speeds on rough roads and in the context of off-roading, decreased 'self-cleaning' ability and lower grip ability at low speeds.[7]

The uptake of radial tyres in India has been slow, especially in the HDV and LCV segments. This could be attributed to several factors: **tendency of consumers to overload vehicles**, **poor condition of Indian roads**, non-compatibility of radial tyres with older vehicles, unwillingness of consumers to switch to radial tyres, etc.

However, the passenger car segment has been completely radialised since 2015.[8] Table 1[9] shows the radialisation level in various vehicle segments in India.

Table 1: Market penetration of radial tyres

Vehicle segments	2001–02	2007–08	2015–16
Passenger cars	70%	97%	100%
LCVs	10%	15%	20%
HDVs	2%	9%	60%

3.1.2. Tyre market size

3.1.2.1. Tyre production

Tyre production has been growing at a consistent pace for the past few years. Tyre production reached a total of 1461.5 lakh units for FY 2014–15. Figure 8 shows the annual production of different categories of tyres over the years.

Figure 9 displays the annual production of different categories of tyres for FY 2014–15.

[7] http://cocomponents.com/dealer/powersports-industry/bias-ply-radial-explained/
[8] Based on interactions with stakeholders
[9] Based on interactions with stakeholders

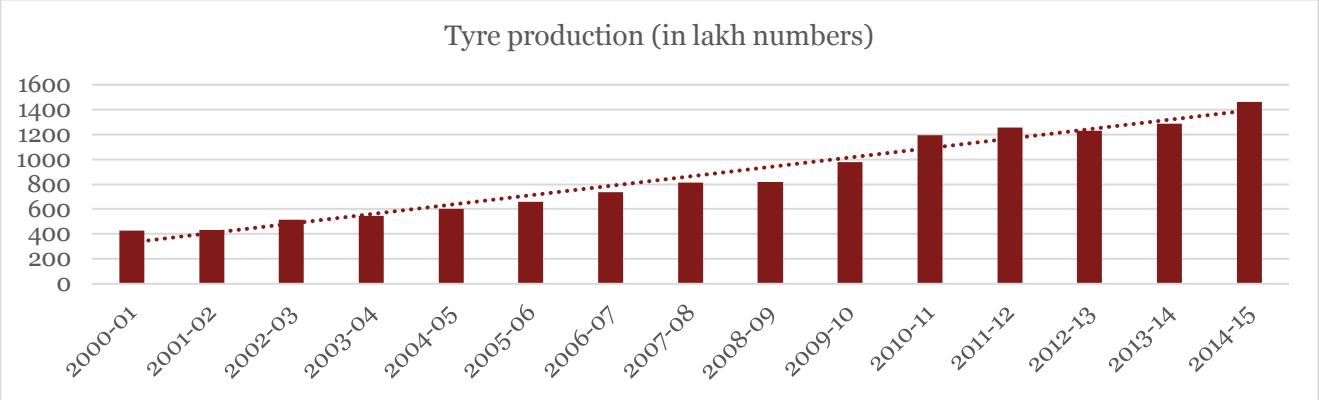


Figure 8: Tyre production in India (ATMA India, 2016)

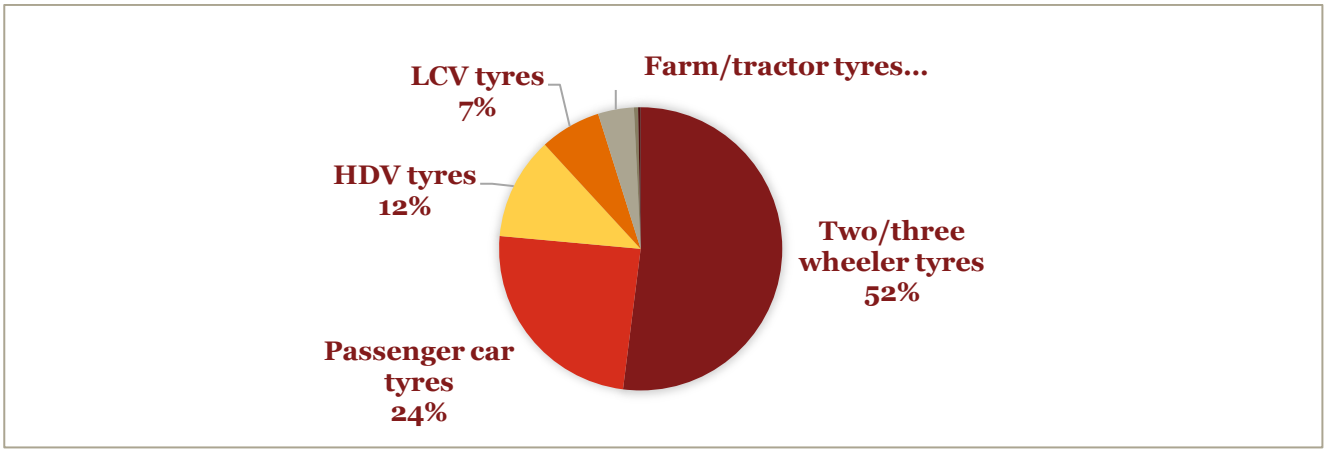


Figure 9: Segmental break-up of tyre production for FY 2014–15 (ATMA India, 2016)

From these figures, it can be concluded that in terms of numbers the share of tyres for two-wheelers is highest followed by tyres for passenger vehicles and then HDVs.

3.1.2.2. Tyre exports

Exports comprise a significant share of about 16% of revenue of the Indian tyre industry. As seen in Figure 10, exports have risen over the years, but the growth rate has been volatile. Figure 11 shows the segmental break-up of tyre exports for FY 2014–15.

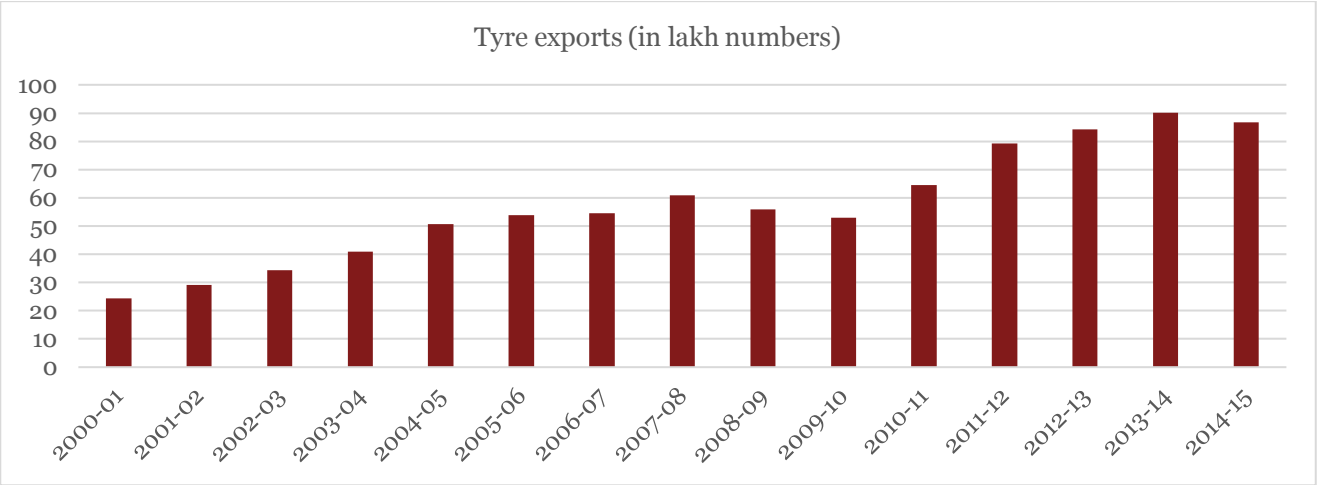


Figure 10: Tyre exports in India (ATMA India, 2016)

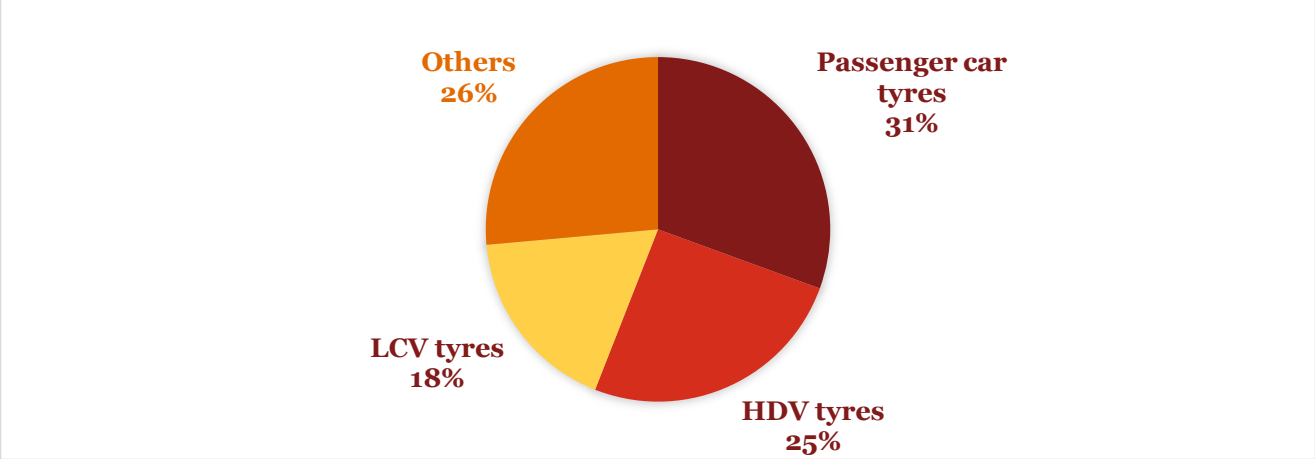


Figure 11: Segmental break-up of tyres exported for FY 2014–-15 (ATMA India, 2016)

The passenger car tyre segment and the HDV tyre segment together comprise the majority of exports from India. It can be noted that although the two-/three-wheeler tyre production is very high, exports are nearly non-existent for these tyres.

3.1.3. Tyre market end users

The tyre market can be categorised into three segments—OEMs, replacement and exports.

- **OEMs**: Automobile manufacturers make up the OEM segment. OEMs purchase tyres from tyre manufacturers in bulk quantities for their vehicles. Because of high competition and procurement in large volume by OEMs, tyre manufacturers have the lowest profit margins from this segment.
- **Replacement market**: These are the end customers who replace old tyres of their vehicles. The replacement market is generally operated through a dealer network and company-owned outlets. Since tyres are not procured in large quantities, the profit margins for tyre manufacturers are higher from this segment.
- **Export market**: Tyres of all types can be exported freely from India. The export segment generally operates at profit margins in between the OEM and replacement segments.

The segmental ***break-up of revenue*** in FY 2010–11 is given in the figure below.

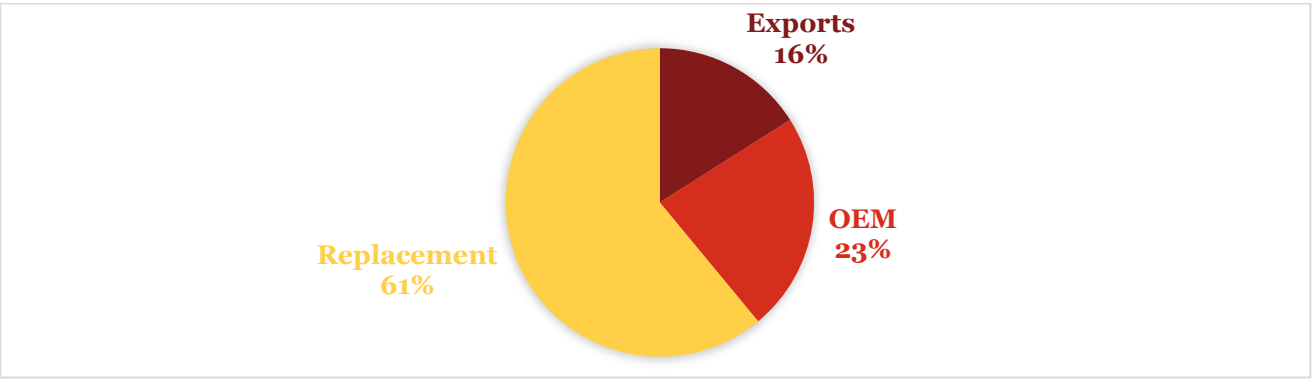


Figure 12: Segmental break-up of turnover for FY 2011 (Sushil Finance, 2012)

It is observed that if fuel efficient tyres are introduced, they can enter the tyre market through two separate market entry options—OEMs and replacement.

- **Market entry through OEMs**: With this option, **new** automobiles sold will come fitted with low RR tyres instead of the ones available in the market.
- **Market entry though replacement**: With this option, tyres in existing automobiles will be replaced with low RR tyres.

3.1.4. Key players

The tyre industry in India is highly competitive with over 40 manufacturers. However, it is dominated by a few major players as the top 10 manufacturers accounting for over 90% of total production in tyres. The key players in this industry include the following: MRF tyres, Apollo Tyres, JK Tyres and Ceat Ltd. Together, they command over 70% of the market share. The other major companies include Bridgestone and Michelin.

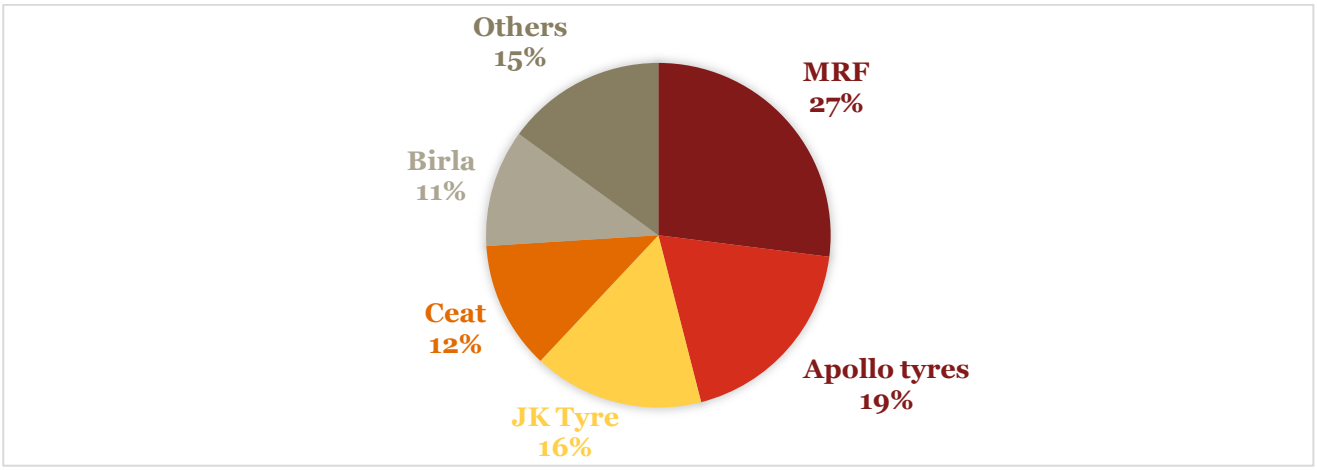


Figure 13: The tyre industry market share (FY11) (Sushil Finance, 2012)

Because the tyre market is entirely organised and dominated by only a few players, development and implementation of an S&L programme for tyres would be relatively easy.

3.1.5. Retreading of worn-out tyres

Due to high initial cost of tyres, consumers generally prefer to retread worn-out/damaged tyres instead of purchasing new ones. This is especially true for the LCV and HDV segments. The cost of retreading a tyre is about 20–30% of the cost of a new tyre.

In the retreading process, the worn-out tread in the tyre is removed and the body of the tyre is replaced with a new tread called casing. Retreading of a tyre extends its life by 60% of the overall life of a new tyre. The tyre can be retreaded about two to three times during its life cycle. Therefore, on an average, a LCV and HDV tyre lasts for about 100,000 km instead of the designated 50,000 km.

The retreading sector is far more fragmented than the original market since there is a lot of involvement of the unorganised sector. Overall, there are about three major players in the re-treading market. The number of unorganised players are estimated to be over 10,000.

3.2. Regulatory structure

3.2.1. BIS

The BIS is established under the Bureau of Indian Standards Act,[10] 1986, as the national standards body of India under the aegis of the Ministry of Consumer Affairs, Food and Public Distribution. It represents India at the ISO, IEC and WSSN.

One of the major functions of BIS is the formulation, recognition and promotion of the Indian standards to regulate the industry and maintain quality of products, including tyres. The **TED 7 committee in BIS is responsible for drafting the standards for automotive tyres, tubes and rims.** The members of the committee are mentioned in **Appendix A.1.**

3.2.2. AIS

Automotive regulations in India are governed by MoRTH as per the MV Act, 1988, and CMVR, 1989. The CMVR-TSC advises MoRTH on various technical aspects related to CMVR. CMVR-TSC is assisted by the AISC in drafting the technical standards related to safety. The members of AISC are mentioned in Appendix A.

AISC submits the draft safety standards in the form of recommendations to CMVR-TSC for final approval. After approval, CMVR-TSC submits its final proposal to MoRTH. MoRTH then takes the final decision for incorporation of these recommendations in CMVR.

The AIS are published by the ARAI on behalf of the AISC. These AIS standards are generally based on UN ECE norms and modified to suit Indian conditions.

3.2.3. Test agencies for tyres

Test agencies have the mandate to provide certification and type approval to manufacturers against the tyre standards issued by BIS and AIS in India. They are also responsible for conducting COP testing of type approved tyres from time to time to ensure that these tyres are conforming to the specifications as per the type approval.

At present, four organisations are equipped with the facility for testing tyres as per existing Indian standard requirements:

- ICAT, Manesar
- CIRT, Pune
- ARAI, Pune
- IRMRA, Thane

3.2.4. BEE

As per the Energy Conservation Act, 2001, the central government, in consultation with BEE can, by notification, **specify the norms for** processes and **energy consumption standards for** any **equipment**, appliances which consumes, generates, **transmits** or supplies energy. Therefore, BEE has a key role in specifying fuel efficiency standards and preparing a labelling programme for tyres.

[10] The Government of India has tabled the new Bureau of Indian Standards Bill (2015), which received assent from both houses of Parliament in March 2016.

This report will provide an initial framework and roadmap to BEE for developing an S&L programme for tyres in near future.

3.3. Standards applicable for automotive tyres in India

In 2010, a notification was released that required all pneumatic tyres (radial and bias ply) manufactured and sold in India to comply with the specifications mentioned in the standards mentioned in Table 2 and must be type approved by testing laboratories.

Table 2: Applicable tyre standards in India

Standard	Description	Tyre segment
IS 15627: 2005	Automotive vehicles: Pneumatic tyres for two and three wheeled motor vehicles—specification	Two-/three-wheelers
IS 15633: 2005	Automotive vehicles: Pneumatic tyres for passenger car vehicles—diagonal and radial ply—specification	Passenger cars
IS 15636: 2012	Automotive vehicles: Pneumatic tyres for commercial vehicles—diagonal and radial ply—specification	LCV and HDV

We have conducted a detailed analysis of 15633 pertaining to passenger car tyres. The findings are discussed in the following section.

3.4. Key takeaways

There are two major components of the domestic market for tyres in India—**OEM**s and **replacement**. The market mainly comprises of the passenger car segment, HDV segment and two-wheeler segment.

Data from the above sections suggests that **both the passenger car and HDV segments hold considerable shares in the OEM and replacement segments.** Although the two-wheeler segment commands the majority share in the OEM segment, its share in the replacement segment is not that high. Also, the two-wheeler segment is more unorganised than the passenger car and HDV segments.

From the viewpoint of fuel efficiency, tyres are generally given higher importance due to the fact that fuel savings can be achieved merely by regular tyre pressure monitoring. The design improvements in tyres such as tyres with low RR can further provide significant savings. Considering the rising market for tyres in India and availability of robust regulatory structure, introduction of fuel efficiency policy measures in all segments of tyres would be beneficial in terms of fuel savings and eventually GHG emission reduction. However, the measures need to be undertaken in a phased manner.

To start with, it would be most appropriate to assess the feasibility of fuel efficiency policy measures for tyres of passenger car and HDV segments, since the regulatory bodies have already initiated the fuel efficiency policy measures for these vehicle types, and therefore any policy related with tyres of these two vehicle segments will facilitate OEMs in meeting the fuel saving targets. This will eventually help in accelerating the uptake of fuel efficient tyres programme as there will be demand pull from OEMs.

This report has focussed on development of S&L programme for the passenger car and HDV segments only.

4. Analysis of existing standards for tyres in India[11]

4.1. Overview of IS 15633: 2005

4.1.1. Scope

The standard IS 15633: 2005 specifies the general, dimensional and performance requirements of new diagonal and radial-ply pneumatic tyres designed primarily for vehicles in categories M1, T1 & T2.[12] However, it does not apply to tyres designed for the following:

a) Equipment of vintage cars

b) Competitions

4.1.2. Structure distinguished in particular

The following structures are distinguished in particular:

Diagonal or bias-ply: Structure in which the ply cords extend to the beads and are laid at alternate angles of substantially less than 90° to the center line of the tread.

Bias-belted: Structure of diagonal (bias-ply) type in which the carcass is restricted by a belt comprising two or more layers of substantially inextensible cord material laid at alternate angles close to those of the carcass

Radial-ply: Structure in which the ply cords extend to the beads and are laid substantially at 90° to the center line of the tread, the carcass being stabilized by an essentially inextensible circumferential belt

Reinforced or extra load: Tyre structure in which the carcass is more resistant than that of the corresponding standard tyre.

4.1.3. Test requirements

In order to adhere to this standard, tests have been prescribed for the following parameters:

- Tyre dimensions (sectional width and tyre outer diameter)
- Load/speed performance test
- Endurance test

[11] Disclaimer: The description provided in this chapter for Indian Standards for Automobile Tyres has been mentioned by taking reference from authorized copy of Standards. The Standards were procured by the project team.
[12] The categories M1, T1 and T2 are as defined in AIS:053.
M1: A vehicle used for carriage of passengers, comprising not more than eight seats in addition to the driver's seat.
T1: A Trailer having a maximum weight not exceeding 0.75 tonne
T2: A trailer having a maximum weight exceeding 0.75 ton but not exceeding 3.5 tonne.

- Bead unseating resistance test for tubeless tyre
- Tread wear indicators
- Tyre strength test

4.1.4. Type approval procedure

Application for type approval to be submitted by the manufacturer.

The application for type approval shall contain at least the technical information as specified in Annex K. For type approval of tyre belonging to one family of tyre, brand of the tyre to be selected for type approval shall be left to certifying authority. Worst case selection shall be made at the discretion of the certifying authority based on the family of tyres specified in 6.2.5.2 of the standard.

4.1.5. Conformity of production

Periodic testing and approval of each type of tyre as per the approved family of tyres in 6.2.5.2 shall be carried out. The approval marking shall be made only on the tyres of that approved family and the same shall not get extended to other families of tyres, unless tyres from out of that undergone the same testing and type approval for that family of tyre.

The authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. For each production facility, the normal frequency of these verifications shall be at least once every two years.

4.1.6. Markings

Tyres must be permanently and legibly marked on both sides of their sidewalls in the case of symmetrical tyre and at least on the outer sidewall in the case of asymmetrical tyre with the following markings:

- Make or name on one side of the wall
- Tyre size designation
- An indication of structure as given in the standard
- Speed category symbols
- The inscription 'M+S' or 'M.S' or 'M&S' in the case of snow tyre
- The load-capacity indices given in Annex A or maximum load carrying capacity and ply rating
- Maximum permissible tyre pressure in kPa or bar or kg/cm2 or any combination of this units
- The word 'tubeless' if the tyre is designed for use without an inner tube
- Manufacturer's code
- Week and year code or month and year code of manufacture

- For tyres that can be re-grooved, symbol 'U' at least 20 mm in diameter, or the word 're-groovable', must be molded on the sidewall

4.1.7. BIS certification markings

The product/tyres may also be marked with the standard mark. The use of the standard mark is governed by the provisions of the Bureau of Indian Standards Act, 1986, and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of the standard mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

4.2. Parameters not included in the standard

The standards mentioned above specify requirements related to safety, durability and dimensions for tyres in India. However, these standards do not specify requirements for performance parameters such as rolling resistance, external noise, internal noise, braking performance, etc. These factors are described below.

4.2.1. RR[13]

RR is a measure of the energy dissipated as heat because of rolling of the tyre. The rolling loss in a tyre is made up of mainly three components: *frictional force* between the tyre tread and the surface, *windage loss* and *hysteresis loss*. During normal operation of a tyre, hysteresis loss is the dominant factor influencing fuel efficiency as it is the main component of rolling loss.

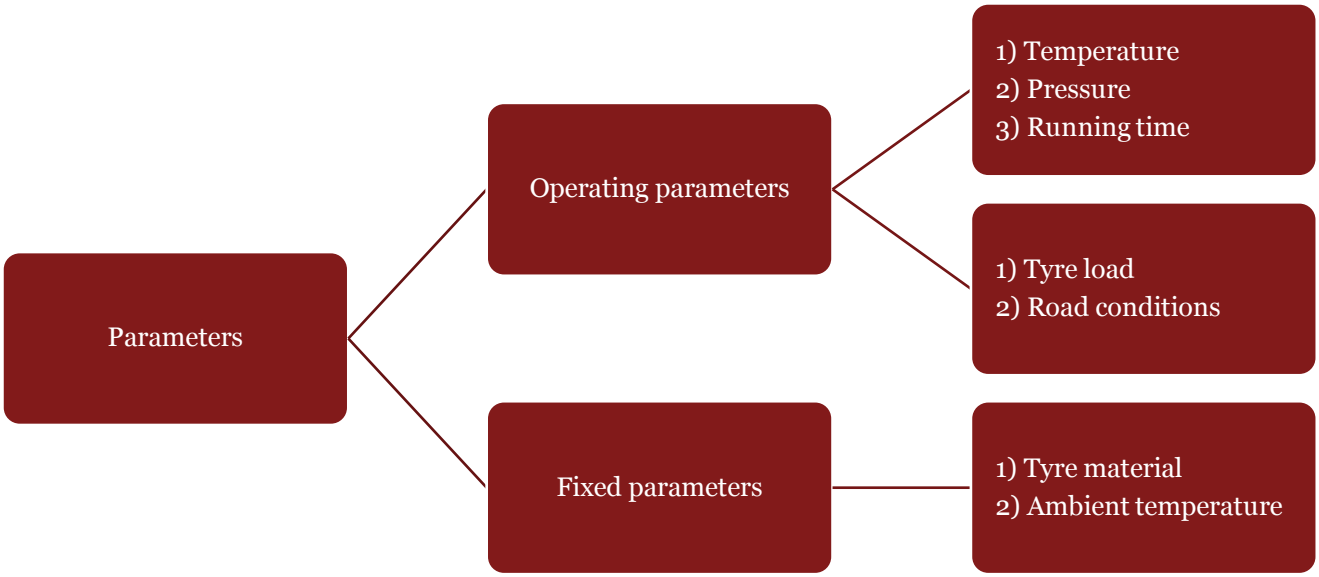


Figure 14: Factors affecting RR loss in tyres

[13] Clark and Dodge

The rolling loss is dependent on multiple factors as shown in the figure:

- **Temperature of the tyre**: As the temperature of the tyre increases, the rolling loss decreases. As the tyres roll, their temperature increases and hence rolling loss decreases. In general, the rolling loss can decrease by up to a third of its initial value.
- **Tyre pressure**: As the tyre pressure increases, the rolling loss decreases. As the tyres roll, their temperatures increase and causes the air inside the tyres to heat up. This in turn increases the tyre pressure and reduces the rolling loss.
- **Tyre load**: The rolling loss is dependent on the loading of the tyre. Increased load on the tyre increases the rolling loss.
- **Ambient temperature**: The equilibrium temperature of the tyre and therefore the rolling loss directly depends on the ambient temperature.
- **Tyre material**: This is one of the most important factors for determining the rolling loss in a tyre.
- **Running time:** As running time increases, the rolling loss of the tyre decreases.
- **Road conditions**: Road conditions directly affect the frictional force between the tyre and the surface. A smooth surface is better for driving and has a lower rolling loss.

Among the parameters presented above, only tyre material and tyre load remain constant during operation. Tyre speed, temperature and pressure are dynamic parameters and vary continuously during operation.

4.2.2. Wet grip

Wet grip refers to the safety performance of tyres. It defines the ability of a tyre to brake on a wet road. The wet grip of a tyre is judged by calculating its wet grip index (G). During measurement, the wet grip braking performance of the candidate tyre is compared to the wet grip braking performance of the reference tyre on a vehicle travelling straight ahead on a wet, paved surface.

Wet grip is measured with one of the following methods:

- **Instrumented passenger car method**: The testing method covers a procedure for measuring the deceleration performance of passenger car tyres during braking, using an instrumented passenger car equipped with an ABS. Starting with a defined initial speed, the brakes are applied hard enough on four wheels at the same time to activate the ABS. The average deceleration is calculated between two pre-defined speeds.
- **Trailer method**: The measurements are conducted on test tyres mounted on a trailer towed by a vehicle or on a tyre test vehicle. The brake in the test position is applied firmly until sufficient braking torque is generated to produce the maximum braking force that will occur prior to wheel lockup at a test speed of 65 km/h.

The wet grip index also depends on many factors such as material of the tyre, frictional force between the tyre and the surface, road conditions, tyre pressure, load, etc. It should be noted that lowering the value of RRC has a negative impact on wet grip and can therefore impact safety. Therefore, it must be ensured that manufacturers do not compromise with wet grip to reduce RR in tyres.

4.2.3. Noise[14]

The main source of road noise in the EU is the tyre-to-road surface interaction. It is an important indicator of driving comfort experienced by the driver.

Tyre noise is caused by multiple factors. One is the sound of the tread contacting the road. Another is the sound of air being compressed inside the tread grooves. Different tread styles and tread compounds cause different levels of noise, and as the tread wears down, the level and type of noise change.

Treads designed for heavier loads or off-road grip often are louder than treads designed for smooth rides. Grand touring tyres and others with asymmetric treads are usually the quietest, while high-performance directional treads are generally louder.

[14] http://tyres.about.com/od/understanding_tyres/a/Tyre-Noise.htm

5. Overview of international S&L programmes for tyres

5.1. Background

The World Forum for Harmonization of Vehicle Regulations (WP.29) is a working party of the UN ECE and is responsible for development of harmonised standards—UN Regulations—for vehicles to facilitate road safety and international trade. These regulations need to be ratified by individual member countries in their respective territories.

The UN ECE Regulation No. 117 (R117), originally published in 2005, introduced requirements on the maximum rolling sound emissions of tyres. In 2006, the 01 series amendments to UN ECE R117 added requirements on the minimum wet grip performance of passenger car tyres (C1 tyres). In 2011, the 02 series amendments to UN ECE R117 added requirements on the maximum RR of tyres and increased the stringency of the maximum rolling sound emissions requirements.[15]

The 02 series amendments to UN ECE R117 introduced the following changes:

- New test procedures and requirements for tyre RR
- Lower limit values for rolling sound emissions
- Revised definitions of special category tyres

The test procedures for determining RR of tyres are based on ISO 28580. The maximum RR limits are introduced in a two-stage process with separate limit values specified for class C1 tyres (passenger car tyres), class C2 tyres (light commercial vehicle tyres) and class C3 tyres (truck and bus tyres).

Timelines for compliance with limits for rolling resistance are shown in Table 3.

Table 3: Deadlines for compliance with rolling resistance limits[16]

Tyre class	Stage 1		Stage 2	
	Type approval	Implementation	Type approval	Implementation
C1	1 November 2012	1 November 2014	1 November 2016	1 November 2018
C2	1 November 2012	1 November 2014	1 November 2016	1 November 2018
C3	1 November 2012	1 November 2016	1 November 2016	1 November 2020

However, from the project team's discussion with the BIS (see Appendix B.3), it was understood that these limits have not been mandated as of date.

On the basis of limits set in R-117, many countries have put in place mandatory tyre labelling programmes. For example, the EU has passed Regulation 1222/2009 making it mandatory for tyres to be accompanied with

[15] http://www.interregs.com/articles/spotlight/new-ece-requirements-on-tyre-noise-and-rolling-resistance-published-000110 (Accessed on 28 July 2016)
[16] http://www.etrma.org/tyres/type-approval-requirements/requirements-detailed (accessed on 31 July 2016)

appropriate labels as specified in the regulation. The South Korea and Japan have set in place labelling programmes for tyres. The label design is still under consideration in the US.

5.2. Overview of UN ECE R-117

UN ECE R-117: Uniform provisions concerning the approval of tyres with regard to rolling sound emissions and to adhesion on wet surfaces and/or to rolling resistance.

5.2.1. Scope

The UN ECE R-117 applies to new pneumatic tyres of classes C1, C2 and C3 with regard to tyre rolling sound emissions, RR and adhesion performance on wet surfaces (only for C1 class tyres). However, the following types of tyres are exempted from this Regulation:

- Temporary use tyres
- Tyres having a nominal rim diameter code <10 or ≥25
- Tyres designed for competitions
- Tyres intended to be fitted to road vehicles of categories other than M, N and O
- Tyres fitted with additional devices to improve traction properties
- Tyres with a speed rating less than 80 km/hr (speed symbol F)
- Tyres designed only to be fitted to vehicles registered for the first time before 1 October 1990
- Professional off-road tyres (for requirements of RR and sound)

5.2.2. Specifications

The **regulation has set minimum standards for rolling resistance, wet grip and noise that must be met** by all tyres that come under the scope of the Regulation (see sub-section 5.2.1). The test methods for measuring the three parameters have been specified in the annexures of the Regulation.

Table 4 shows the limit values of RRC that tyres must maintain in Stage 1 and Stage 2[17] of the regulation.

Table 4: RRC limits (in N/kN)

Tyre category	RRC limit for Stage 1	RRC limit for Stage 2
C1	12.0	10.5
C2	10.5	9.0
C3	8.0	6.5

[17] Stage 2 of UN ECE R117 will begin from November 2016.

Table 5 shows the minimum value of G that ***tyres of category C1*** must maintain as per the regulation.

Table 5: Minimum value of G

Tyre category	G
Snow tyre with speed symbol indicating permissible speed ≤ 160 km/hr	0.9
Snow tyre with speed symbol indicating a maximum permissible speed > 160 km/hr	1.0
Normal (regular use) tyre	1.1

Table 6 and Table 7 show the maximum permissible rolling sound emission value for tyres of category C1 and categories C2 and C3 respectively.

Table 6: Maximum permissible rolling sound emission values for tyres of category C1

Stage 1		Stage 2	
Nominal sectional width	Limit dB	Nominal sectional width	Limit dB
145 and lower	72	185 and lower	70
Over 145 up to 165	73	Over 185 up to 245	71
Over 165 up to 185	74	Over 245 up to 275	72
Over 185 up to 215	75	Over 275	74
Over 215	76		

Table 7: Maximum permissible rolling sound emission value for tyres of categories C2 and C3

Tyre use	Limit dB for category C2		Limit dB for category C3	
	Stage 1	**Stage 2**	**Stage 1**	**Stage 2**
Normal	75	72	76	73
Snow	77	73	78	74
Special	78	74	79	75

5.2.3. Markings

The Regulation requires all tyres to bear the following markings:

- Manufacturer's name or trademark
- Brand name if it doesn't coincide with trademark
- The tyre size designation
- The inscription 'reinforced' or 'extra load' if the tyre is classified as reinforced

- The inscription 'traction' if the tyre is classified as traction
- The inscription 'M+S' or 'M.S' or 'M&S' if the tyre is designed to ensure better performance than a normal tyre in mud and snow conditions
- The 'Alpine' symbol if the tyre is classified in the category of use 'snow'
- The inscription 'MPT' (or 'ML' or 'ET') and/or 'POR' if the tyre is classified in the category use 'special'
- Tyres must provide adequate space for the approval mark
- The approval mark must be moulded into or onto the sidewall of the tyre and located in the lower area of the tyre on at least one of the sidewalls
- In case tyres identified by the tyre to rim fitment configuration symbol 'A', the marking may be located anywhere on the outside sidewall of the tyre

5.2.4. Procedure for approval

Tyre manufacturers must submit to the concerned authority an application for approval that specifies all the details as mentioned in the regulation. Test report and/or samples of tyres must also be submitted at the request of the Type Approval Authority.

If the tyre specifications meet the requirements as specified in the regulation, approval of that ***type of tyre*** will be granted. An approval number will be assigned to each type of tyre approved. Notice of approval or extension of approval or refusal of approval of a type of tyre would be communicated to parties to the agreement.

5.2.5. Conformity of production

In order to verify conformity of tyres to the characteristics approved under the type approval application, a random sample of tyres bearing the approval mark is taken from the series production. The normal frequency of verification of conformity of production will be at least once every two years.

In case a particular tyre fails the verification of conformity of production, the approval granted with respect to the Regulation can be withdrawn.

5.3. International tyre labelling programmes

Several countries have set tyre labelling programmes in place to raise consumer awareness and promote fuel efficiency in the tyre industry. These countries include the EU member countries, South Korea and Japan. The programme in the US is yet to be finalised. All these programmes are aligned with the limits specified in the limits specified in UN ECE R-117.

Details of these programmes are discussed in the following subsections.

5.3.1. Tyre labelling program in the EU

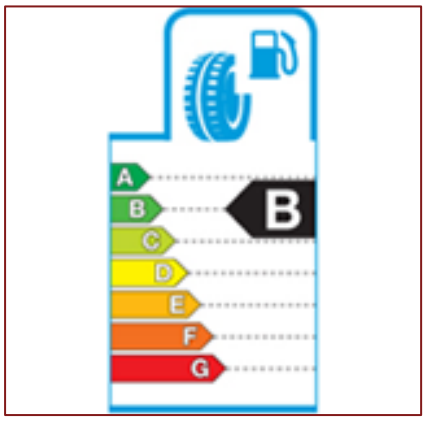
The EC passed the Regulation 1222/2009 with a goal to improve the safety, the economic and environmental efficiency of road transport by promoting fuel-efficient and safe tyres with low noise levels. The label specifications are aligned with the standards specified in UN ECE R-117.

The scope of the regulation is the same as that of UN ECE R-117. The rules apply to all tyres produced on 1 July 1 2012 or later.

The fuel efficiency is indicated using grades between A to G—A indicating the best performance and G worst. Table 8 shows the grading criteria. Tyres with grade G[18] would fail to comply with UN ECE R-117.

Table 8: The EU fuel efficiency grading using RRC (N/kN)

Class	PCR (C1)	LTR (C2)	TBR (C3)
A	RRC ≤ 6.5	RRC ≤ 5.5	RRC ≤ 4.0
B	6.6 ≤ RRC ≤ 7.7	5.6 ≤ RRC ≤ 6.7	4.1 ≤ RRC ≤ 5.0
C	7.8 ≤ RRC ≤ 9.0	6.8 ≤ RRC ≤ 8.0	5.1 ≤ RRC ≤ 6.0
D			6.1 ≤ RRC ≤ 7.0
E	9.1 ≤ RRC ≤ 10.5	8.1 ≤ RRC ≤ 9.2	7.1 ≤ RRC ≤ 8.0
F	10.6 ≤ RRC ≤ 12.0	9.3 ≤ RRC ≤ 10.5	8.1 ≤ RRC
G	12.1 ≤ RRC	10.6 ≤ RRC	



Just as with fuel efficiency, wet grip of a tyre is indicated with the help of grades from A to F, A indicating the best performance and F the worst. Tyres with grade G would fail to comply with UN ECE R-117.

Alignment procedure for rolling resistance machines

The value of RRC obtained from the test procedure mentioned in UN ECE R117.02 is only valid for type approval. However, for the EU labelling programme, the values obtained from the test procedure must be corrected using the alignment procedure mentioned in EU Commission Reg 1235/2011.

This has been done because there is a lot of deviation in RRC values obtained in different machines ***for the same tyre***. To avoid this situation and standardise the value of RRC obtained, candidate machines are required to undergo an alignment procedure as mentioned in the standard.

Alignment procedure[19]

The machine alignment procedure requires two predetermined alignment tyres used by the candidate laboratory operating the machine. These tyres will be used to align machines in candidate laboratories by comparing RRC results obtained on a reference machine (present in a reference laboratory). An alignment formula is then established and shall be used to translate the results obtained on the candidate machine into aligned results.

[18] For C1 and C2 tyres
[19] Reference: The information is based on consultative discussions with test agencies and secondary research

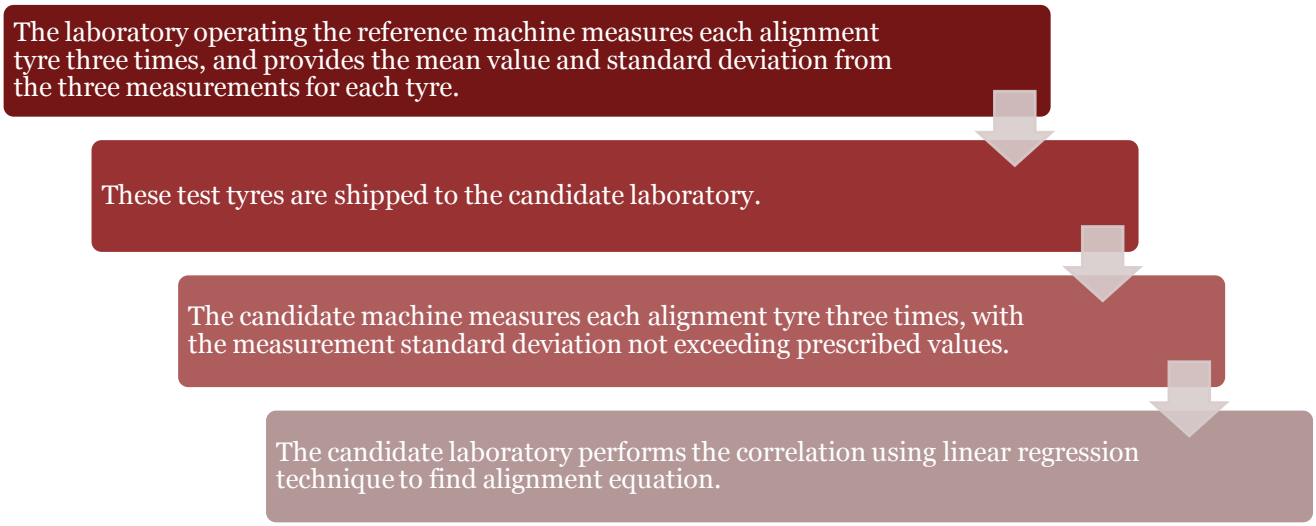
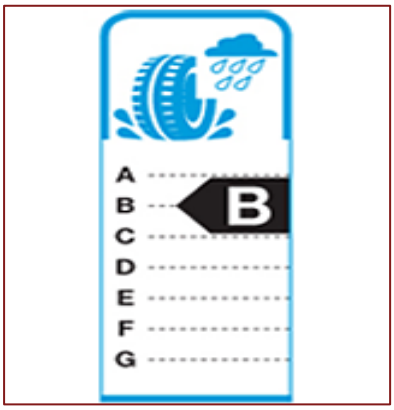


Figure 15: Alignment procedure for tyre reference laboratory

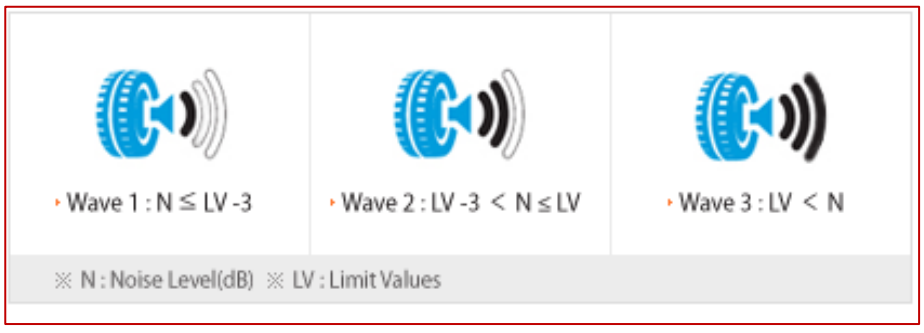
The alignment procedure mentioned above must be repeated every two years by the candidate laboratory. The EU Commission Regulation 1235/2011 has set up ***a network of reference laboratories*** for this purpose.

Table 9: The EU wet grip grading using wet grip index (G)

Class	PCR (C1)	LTR (C2)	TBR (C3)
A	1.55 ≤ G	1.40 ≤ G	1.25 ≤ G
B	1.40 ≤ G ≤ 1.54	1.25 ≤ G ≤ 1.39	1.10 ≤ G ≤ 1.24
C	1.25 ≤ G ≤ 1.39	1.10 ≤ G ≤ 1.24	0.95 ≤ G ≤ 1.09
D			0.80 ≤ G ≤ 0.94
E	1.10 ≤ G ≤ 1.24	0.95 ≤ G ≤ 1.09	0.65 ≤ G ≤ 0.79
F	G ≤ 1.09	G ≤ 0.94	G ≤ 0.64



The exterior noise levels are measured in dBs and are indicated using three figures. The noise dB level is also mentioned in the label. More black bars mean that the tyres create more road noise.



The testing methods for RRC, wet grip index and external noise levels are the same as those used for UN ECE R-117.

Relevant stakeholders

1. **National authorities**

    - Member states of the EU must apply the market surveillance provisions included in Annexure IV of the regulation.
    - They are obliged to survey the market, which includes compliance checks of the various provisions of the tyre labelling regulation.
    - National authorities also have to check the conformity of the declared classes on the label and of the measured values.
    - The controls must be performed exclusively by the national authorities and not by independent institutions.[20]

2. **Tyre suppliers**

    They have to give this information in the following way:

    - For passenger car, light truck and truck tyres, the information must be available in technical promotional literature (leaflets, brochures, etc.), including the manufacturer's website
    - For passenger and light truck tyres, the manufacturers or importers have the choice of either putting a sticker on the tyre tread or a label accompanying each delivery of batch of tyres to the dealer and to the end consumer

3. **Retailers (at point of sale)**

    - Must ensure tyres, which are visible to consumers at the point of sale, carry a sticker or have a label in their close proximity which is shown to the end user before the sale
    - Must give the information during the purchase process when the tyres offered for sale are not visible to the end user
    - Must give the information on or with the bill

4. **Vehicle suppliers and distributors**

    - Must declare the tyre wet grip and fuel efficiency class and external rolling noise measured value of the tyre type(s) that are offered in option, when different from those fitted normally on the basic vehicle.
    - As soon as the customer is given a choice either in the size/type of tyres fitted on the basic rim or a choice of rim and tyre size, the labelling information must be provided before sale
    - There might be no obligation to provide information only in those cases where there is a choice of rim with tyres types and sizes that are strictly identical to those which are sold automatically with the new vehicle.

[20] https://ec.europa.eu/energy/sites/ener/files/documents/20121031_tyres_labelling_questions_answers_en.pdf

5.3.2. Tyre labelling programme in Japan

In January 2010, Japanese manufacturers began to implement a voluntary passenger vehicle summer tyre efficiency and safety labelling programme.[21]

Tyres must have at most 0.012 dimensionless RRC (expressed as 12.0 N/kN) and meet minimum wet grip requirements to qualify for the labelling programme described.

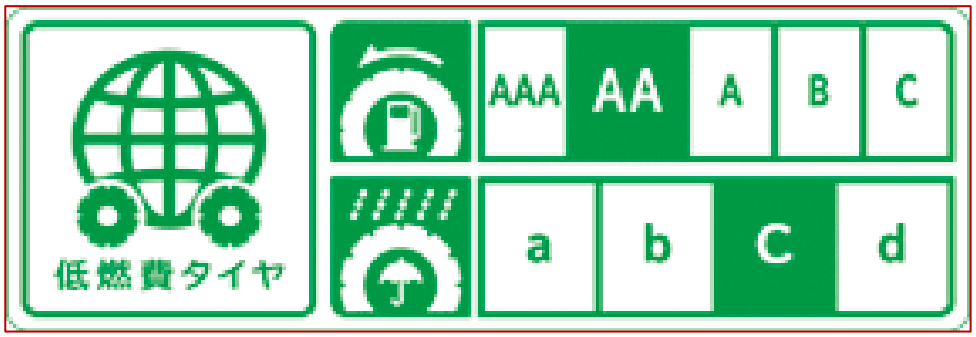
Tyres with at least 0.009 RRC (expressed as 9.0 N/kN) also qualify for the low-energy tyre logo. Durability and winter tyre requirements have not been included.[22]

Table 10: Different RR grades in Japan

RRC (N/N)	GRADE	Equivalent EU grade
RRC ≤ 0.0065	AAA	A
0.0066 < RRC < 0.0077	AA	B
0.0078 < RRC < 0.0090	A	C
0.0091 < RRC < 0.0105	B	E
0.0106 < RRC < 0.0120	C	F

Table 11: Different wet grip grades in Japan

Wet grip index (G)	GRADE	Equivalent EU grade
155 ≤ G	a	A
140 ≤ G ≤ 154	b	B
125 ≤ G ≤ 139	c	C
110 ≤ G ≤ 124	d	E



It should be noted that those tyres graded 'C' in fuel efficiency do not pass the specifications of UN ECE R-117.

[21] Tyre Express, 2010
[22] http://www.theicct.org/sites/default/files/publications/ICCT_tyreefficiency_jun2011.pdf

5.3.3. Tyre labelling programme in South Korea

The tyre-labelling programme is one of the eco-friendly efforts made in South Korea. A voluntary tyre-labelling programme for passenger cars was enacted on November 2011. In November 2012, the programme was made compulsory.

The label has a grading system for two parameters—RRC and wet grip. A sample label[23] is shown below:

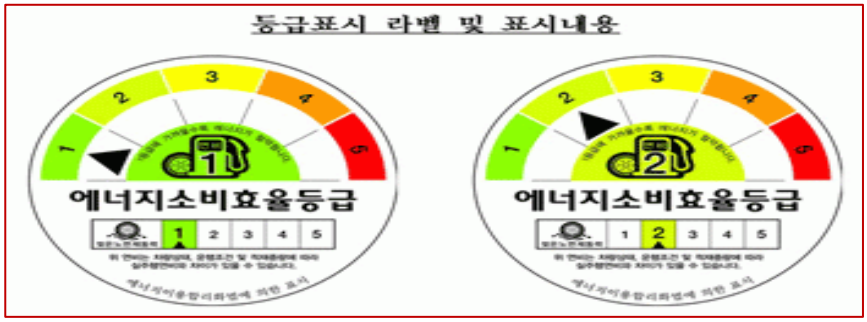


Table 12: Different RR grades in South Korea

Grade	RRC (N/kN)	Notes
1	RRC ≤ 6.5	
2	6.6 ≤ RRC ≤ 7.7	
3	7.8 ≤ RRC ≤ 9.0	
4	9.1 ≤ RRC ≤ 10.5	
5	10.6 ≤ RRC	The value of RRC must be 12.0 or less.

Table 13: Different Wet Grip grades in South Korea

Grade	Wet grip (G)	Notes
1	1.55 ≤ G	
2	1.40 ≤ G ≤ 1.54	
3	1.25 ≤ G ≤ 1.39	
4	1.10 ≤ G ≤ 1.24	
5	G ≤ 1.09	The value of G must be 1.10 or higher

The current tyre efficiency rating system targets only Passenger Cars because they are currently the largest in number, however, as the STs, vans and large trucks are expected to grow in the future, it would be necessary to fully expand the current system.[6]

5.3.4. Tyre labelling programme in the US

The Energy Independence and Security Act, 2007, requires that the NHTSA finalise a national tyre fuel efficiency consumer information programme to educate consumers about automotive replacement tyres' effects on fuel consumption, safety and durability. In this context, NHTSA finalised a rule on 23 March 2010 that adopts ISO 28580:2009(E) as the RR testing procedure (U.S. NHTSA, 2010, p. 13). However, NHTSA did not finalise a

[23] http://images.rezulteo-tyres.co.uk/news/tyre_label_korea_uk_vl.gif

proposed rating, labelling, and consumer education programme for efficiency, safety and durability. As of now, there is no system in place for labelling of tyres in the US.

It is expected that the labels will contain information on the following parameters:

- Fuel efficiency (measured using RRC)
- Safety (measured by wet traction)
- Durability

On 9 July 2015, a bill calling for the introduction of minimum tyre performance standards and compulsory tyre registration has been introduced into the US Senate. As of now, it has been read twice and referred to the Committee on Commerce, Science and Transportation.[24] The bill is called the Tyre Efficiency, Safety and Registration Act S.1741.

[24] https://www.congress.gov/bill/114th-congress/senate-bill/1741/text - as on 6 December 2015

5.3.5. Summary

All the labelling programmes discussed have been aligned with UN ECE R-117. The overview on various international tyre labelling programmes highlights various approaches considered for tyre labelling in terms of the scope, labelling criteria etc. as per the details provided in Table 14.

Table 14: Summary of international labelling programmes for tyres

Country	EU	Japan	South Korea	US
Regulation	EU Tyre Labelling Regulation 1222/2009	-	-	NHTSA released the rules for regulation in 2010. However, it has not been implemented yet.
Label details	1. Rolling resistance 2. Wet grip 3. External noise level	1. RR 2. Wet grip	1. RR 2. Wet grip	-
Applicability	Applies only to tyres of passenger cars, LCVs and HCVs	Applies only to PCR tyres	Applies to passenger cars	-
Voluntary/ mandatory	Mandatory for tyres produced on or after 1 July 2012	Voluntary since January 2010	Mandatory	-

Several countries as mentioned above have rolled out tyre labelling programmes that have been aligned with UN ECE R117. A similar approach can be adopted in India, where a labelling programme can be rolled out that would complement the minimum performance standards for RR and wet grip which would be developed by BIS.

6. Progress in development of standards for RR and wet grip in India

As per the provisions of the BIS Act, 1986, BIS is given the mandate to establish Indian standards in relation to any article and/or process through a process of consultation involving consumers, manufacturers, government and regulatory bodies, technologists, scientists and testing laboratories through duly constituted committees.

The **TED 7 committee** of TEDC in BIS is responsible for composition of standards of automotive tyres, tubes and rims. The committee began discussing on drafting standards for RR and wet grip for tyres in India in 2014.

Despite relentless efforts of the committee members and various stakeholders, presence of several important issues, including test data for tyres for Indian conditions and aligned test facilities has slowed down the progress of development of standards in India.

6.1. Key stakeholders

The key stakeholders for the development of standards can be categorised into regulatory bodies, test agencies and industry. Roles of these stakeholders are defined below.

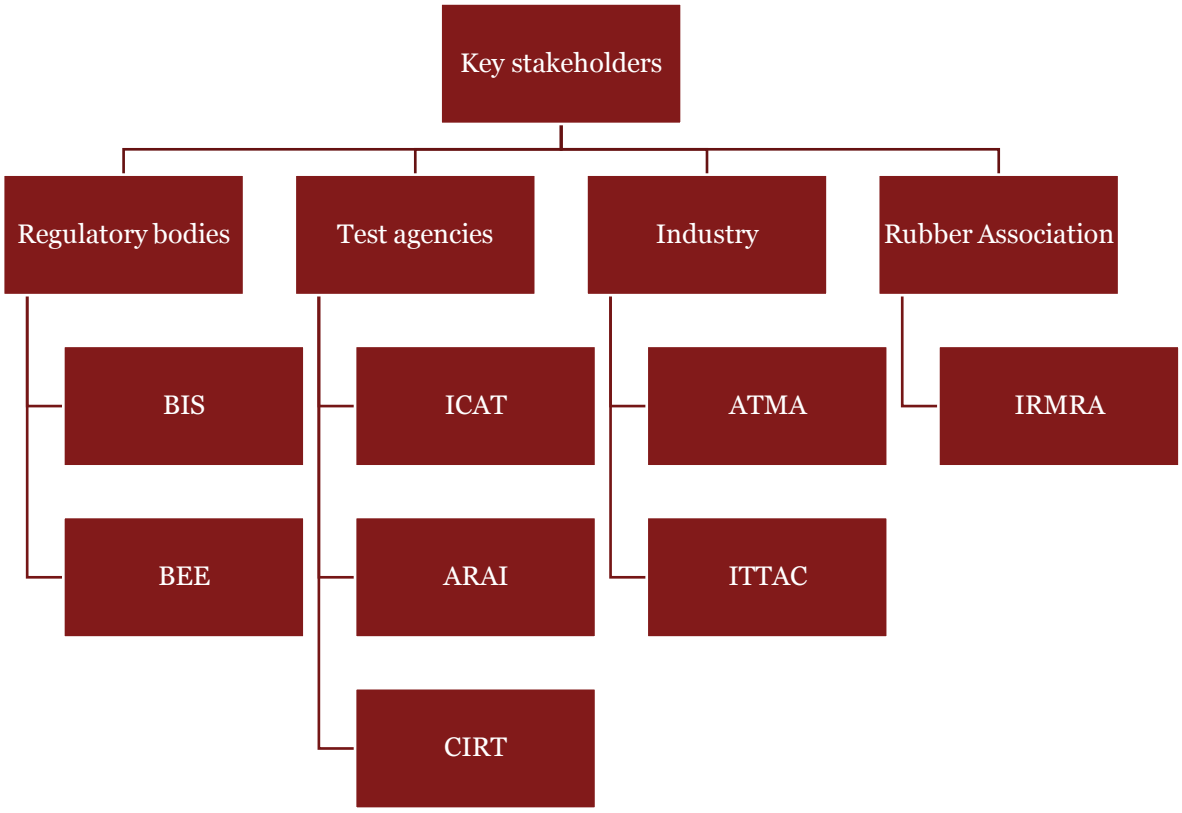


Figure 16: Key stakeholders

6.1.1. Role of regulatory bodies

Regulatory bodies have the legal mandate to prescribe and define standards in India. The BIS and BEE are the key regulatory bodies pertaining to designing an S&L programme for tyres in India.

The BIS has the mandate to define and prescribe standards for testing and performance for tyres in India. Once these standards have been notified, tyres would need to gain type approval to be sold in India.

As per the Energy Conservation Act, 2001, the central government, by consultation with BEE can, by notification, **specify the norms for** processes and **energy consumption standards for** any **equipment**, appliances which consumes, generates, **transmits** or supplies energy. Therefore, BEE has the mandate to develop an S&L programme for tyres.

6.1.2. Role of test agencies

Test agencies such as ARAI, CIRT and ICAT play a key role in the design and implementation of an S&L programme for tyres.

Test agencies would be responsible for issuing type approvals and perform Conformity of Production (COP) testing once the programme has been developed.

6.1.3. Role of industry

The tyre industry is the most important stakeholder in the design and implementation of the programme. Tyre manufacturers would be directly affected by the programme and have a key role in improving the fuel efficiency scenario of the sector.

Therefore, holding consultations with the industry is imperative for designing any programme for tyres.

6.2. Overview of tyre testing infrastructure available in India

The project team held discussions with all major tyre test agencies in India to understand the availability of test infrastructure for RR and wet grip in the country. Table 15 indicates the availability of RR testing facility at IRMRA and wet grip facility at ICAT.

Table 15: Situation on availability of infrastructure for testing of tyres

Test agency	Rolling resistance	Wet grip
IRMRA	**Available.** However, the machine has not been aligned as per the procedure defined in ISO 28580.	Not available.
ICAT	Not available. ICAT has ordered the machine and it will be ready by December 2016.	**Available.** The test agency has the capability to test the passenger car tyres with both methods 1 & 2 mentioned in UNECE R117. For HDV tyres, facility can test with vehicle method only. However, in both

		cases the feasibility for fulfilling the test conditions as per as per UN ECE R117 needs to be evaluated.
CIRT	Not available. Proposal submitted to the Government. Should be completed within 2 years.	The testing as per test method 1 of UNECE R117 (vehicle method) can only be performed. However, the agency is not performing wet grip testing as of now.
ARAI	Not available. Should be available within 2 years.	The testing as per test method 1 of UNECE R117 (vehicle method) can only be performed. However, the agency is not performing wet grip testing as of now. The equipment for test method 2 is not available as of now.

6.3. Summary of stakeholders' perspective towards the programme

Several discussions were held with almost all important stakeholders of the programme to identify their views towards the programme and understand the existing issues holding up the progress. A summary of the views of key stakeholders is presented below. Detailed minutes of these discussions have been attached in **Appendix B. -**

6.3.1. BIS' perspective

The initiative for developing standards for RR and wet grip was taken in 2014 by the TED 7 committee. The committee has decided that focus will be kept on setting standards for rolling resistance and wet grip at present.

However, despite their relentless efforts, presence of few impediments have halted the progress of this initiative. These impediments are outlined below:

- **Lack of data on Indian tyre market**: The most important barrier is the lack of data on existing condition of the Indian tyre market with reference to RR and wet grip. Without this data, benchmarking is not possible and hence standards for RR and wet grip cannot be set.

6.3.2. Test agencies' perspective

The test agencies confirmed that there is limited infrastructure for testing RR and wet grip in the country. However, it is estimated that all testing agencies in India will develop this capacity within a span of two years. ICAT, Manesar already has the equipment required for testing wet grip and is expected to develop capacity to test for RR within six months.

Once all the test agencies have the infrastructure for testing for rolling resistance, all the machines should be calibrated with a reference machine as per ISO 28580 to avoid variation in value of RR.

In their opinion, once testing capacity has been developed and data on existing market scenario has been generated, development of standards for tyres will be expedited.

6.3.3. Industry's perspective

The tyre industry is enthusiastic for development of fuel efficiency norms for tyres in India. However, they have some concerns about the programme. They are discussed below:

- **Poor conditions of roads in India:** Since the poor road conditions in India may hamper the fuel savings incurred as a result of the programme, the government should first focus on improving road conditions in India first.
- **Prescribing minimum standards for RR may lead to rise in cost of a tyre**.
- **Low levels of radialisation in LCV and HDV segments**: There is very low penetration of radial tyres in LCV and HDV segments. Since achieving 100% radialisation in these segments will lead to a lot of fuel savings, the industry thinks that the government should first focus on this task. Hence, the discussion to bring fuel efficiency in HDV tyres have not progressed much.

6.3.4. IRMRA's perspective

IRMRA appreciated the effort to bring the fuel efficiency criteria for tyres and/or for development of an S&L programme for tyres in India. It is the only organisation in India that has the infrastructure to test for RR at present. IRMRA conducts tests for RR for tyres to be exported to European markets.

IRMRA has conducted a preliminary study by selecting 20 random samples of passenger car tyres from the Indian market and testing them for RR. It has found that most of these tyres belonged to the 'E' category of the European fuel efficiency label.

6.4. Key takeaways

Although the stakeholders have a shared a few concerns, however, all key stakeholders have expressed their in-principle agreement for development of fuel efficiency criteria for tyres in the form of S&L programme. The main impediment in development of the programme is lack of RR and wet grip test data for a representative sample of tyres in India.

The project team has assessed the barriers and has proposed few options to be followed to expedite the development of S&L programme in India.

This has been discussed in the following chapter.

7. Framework for assessing the feasibility of rolling out an S&L programme for tyres in India

7.1. Assessment of feasibility of S&L programme for tyres

Based on the assessment of the existing scenario of the tyre industry in India and inputs from various stakeholders, a framework for evaluating the feasibility of rolling out an S&L programme has been developed. The parameters against which this is done are shown below:

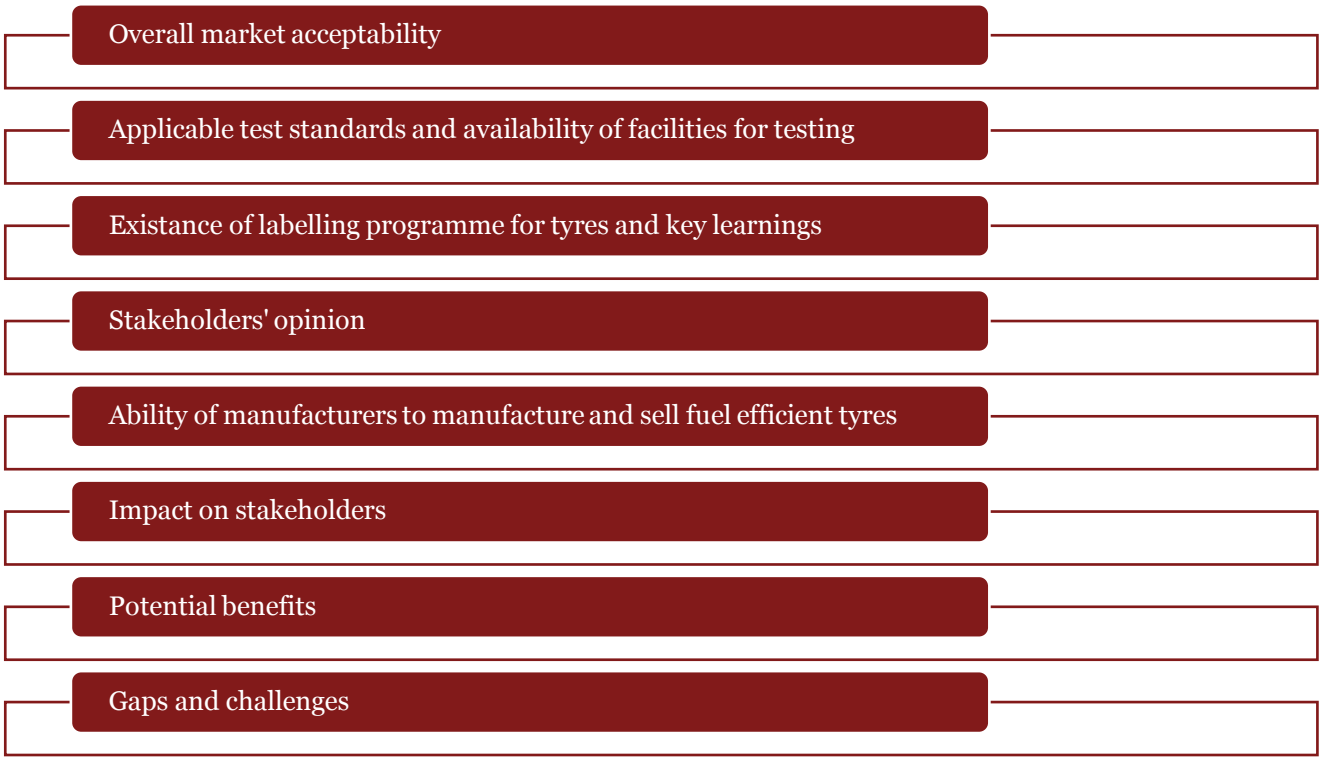


Figure 17: Factors considered for assessment of feasibility

7.1.1. Market acceptability of S&L programme

The S&L programme was first launched in India in 2006 for four appliances on a voluntary basis. The programme has evolved tremendously ever since. The S&L programme has now been extended to 21 appliances with the programme mandatory for five products.

The labelling programme has proved to be a great success in the last decade. It has successfully led to transformation of the appliance market towards energy efficient products. The air conditioning market is a major example in this context. The labelling programme has led to air conditioners becoming 25% more efficient in the last decade.

On the backdrop of success of the labelling programme, BEE is considering to release a notification, introducing a labelling programme for passenger cars in India. The star rating will be based on the fuel economy of the passenger car, as calculated using the value of CO_2 emissions.

On the demand side, reports from various agencies including SIAM have suggested that fuel economy value is one of the most important factors for Indian consumers. Viewing this fact in conjunction with the success of the S&L programme, a **high market acceptability** of the programme can be anticipated.

7.1.2. Test standards and facility for testing

Tyre standards issued by BIS and AIS specify requirements for parameters such as safety, durability, marking, etc. They do not require tyres to be tested for performance parameters such as RR and wet grip. However, UN ECE R117 has specified minimum standards and test protocols for RR, wet grip and noise.

The TED 7 committee in BIS has been working on developing test standards for RR and wet grip for tyres in India. However, the most important barrier is the lack of data on the existing condition of the Indian tyre market with reference to RR and wet grip. Without this data, benchmarking is not possible and hence standards for RR and wet grip cannot be set. Also, the test facilities would need to calibrate their setup as per the conditions of reference lab (as per ISO 28580).

A working test facility for RR is available with IRMRA and that for wet grip is available with ICAT. The testing agencies at their discretion can undertake the calibration process which is very well defined in UN ECE and ISO Standards. The testing for wet grip can be performed by other testing agencies as per the vehicle method mentioned in UN ECE R117. The tracks available at VRDE Pune and tracks in Chennai where testing of wet braking is done can be used for wet grip testing. Further, testing agencies are developing facilities for RR testing and will be ready with complete set-up in next 2 years. Regarding the need of generating requisite data for developing standards at present, the existing facility of IRMRA and wet grip testing can be used for testing of sample tyres.

7.1.3. Existing labelling programmes and key learnings

At present, tyres are not subject to any labelling requirements for fuel efficiency in India. IS 15633: 2005 requires tyres to contain specific markings for identification of the tyre type, its structure, size, load index, etc.

However, several other countries have developed and implemented labelling programmes for tyres. The EU passed Regulation 1222/2009 that put in place a mandatory labelling programme for tyres sold in member states. The labelling programme has been lined with UN ECE R117 in such a way that tyres falling in the last grade (G) in the label fails to meet the standards set by UN ECE R117.

As per the studies published on their official website, the labelling programme has been successful in increasing the fuel efficiency levels of tyres in recent years.

The most important learning from the EU tyre labelling programme is the requirement of setting up a network of reference machines for testing of RR. RR machines in other laboratories are aligned with any one of the laboratories in the network as per the procedure prescribed by ISO 28580 and Regulation 1222/2009.

For rolling out a programme in India, a similar framework must be set up to ensure reliability in values for RR obtained by different test agencies for the same tyre.

7.1.4. Manufacturer's ability to manufacture and sell fuel efficient tyres

Interactions held with tyre manufacturers and ATMA suggest that manufacturers in India have the capability to manufacture fuel efficient tyres in India. However, they had raised concerns that the price of these tyres would be higher than that of a normal tyre.

On the demand front, it is anticipated that there will be a very high acceptance rate for fuel efficient tyres by OEMs. OEMs have a mandate to reduce the fuel consumption of their vehicles, and introduction of fuel efficient tyres would be an effective way to achieving that mandate.

Since fuel efficiency is one of the major decision factors for an Indian consumer, it is anticipated that the fuel efficient tyres would do well in the replacement market as well.

The S&L programme would have a key role in increasing awareness levels of consumers and OEMs towards fuel efficient tyres.

7.1.5. Potential benefits

Global experience has suggested that S&L programmes for appliances and equipment have proved to be one of the most cost-effective methods of improving the energy efficiency penetration in the market. The programme has proved quite successful in India over the last decade.

As mentioned in the previous sub-section, the market acceptability of low RR tyres is anticipated to be high. Therefore, penetration of fuel efficient tyres in the Indian is expected to be high once the S&L programme is rolled out.

The potential fuel savings are calculated in Chapter 8.

8. Estimated fuel savings

This section attempts to estimate the potential fuel savings that would occur till the end of FY 2023–24 if fuel efficient tyres (hereinafter referred to as **low RR tyres**) are introduced in the market at the end of FY 2018–19. In this section, the approach used for assessment of potential savings is first described, listing out the assumptions that have been considered while carrying out the analysis.

8.1. Approach followed to calculate potential savings

The assessment of fuel saving potential has been done in terms of **actual fuel savings**, **monetary savings** and **emissions savings** that would occur up to FY 2023–24 in this analysis. The period between FY 2018–19 and FY 2023–24 is referred to as the target period in this chapter. The major steps involved in this estimation are shown below.

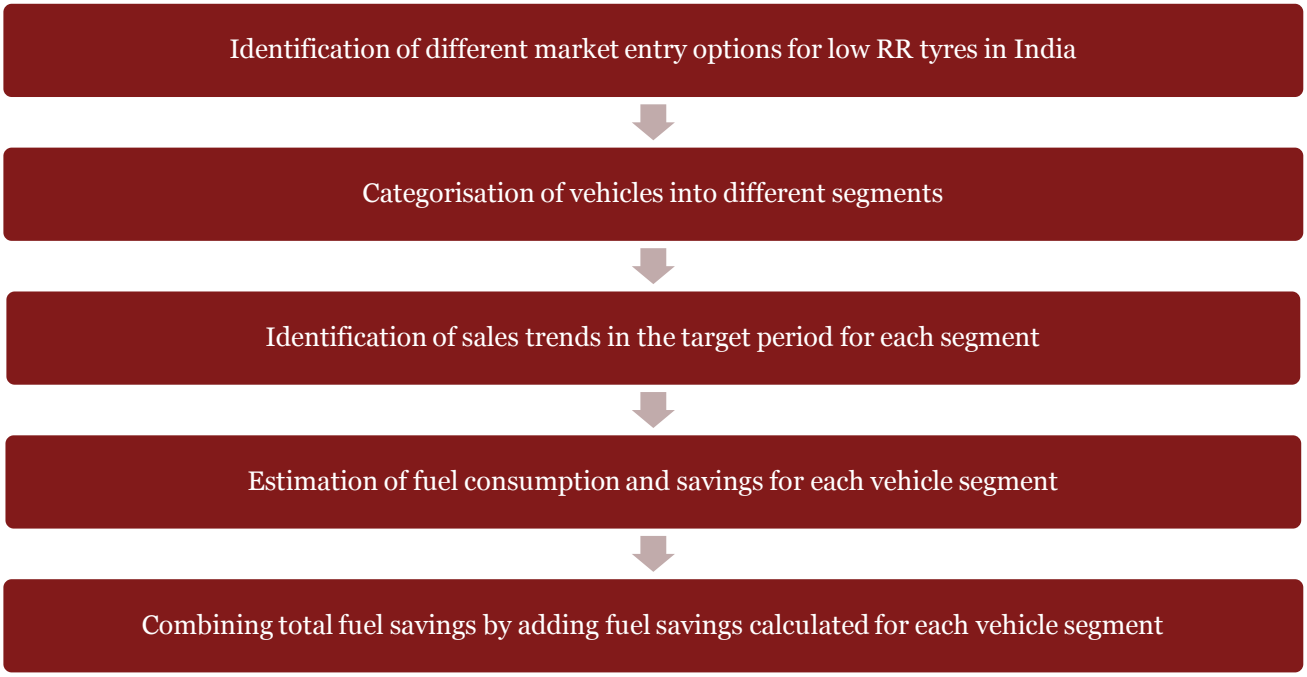


Figure 18: Approach followed for calculating potential savings

8.2. Identification of market entry options for low RR tyres in India

It has been assumed that low RR tyres will be available in the market by the end of FY 2018–19 as a result of launching the S&L programme. There are mainly two options for low RR tyres to enter the tyre market. They are as follows:

1. **Through OEMs**: With this option, **new** automobiles sold from start of FY 2019–20 will come fitted with low RR tyres instead of the ones available in the market. Therefore, potential fuel savings up to FY 2023–24 attributable to this option depends on the number of vehicles sold in financial years from **FY 2019–20** to **FY 2023–24**.

2. **Replacement:** With this option, tyres in **existing** automobiles (that are not fitted with low RR tyres) are replaced with low RR tyres. With this option, only those vehicles sold before FY 2019–20 are to be considered because vehicles sold after FY 2019–20 will be fitted with low RR tyres. Therefore, potential fuel savings attributable to this option depends on the vehicles plying on the roads till the end of FY 2018–19 and market penetration[25] of low RR tyres.

Ideally, the replacement market will also include those tyres which are replaced in vehicles sold after FY 2019–20. However, this segment is not considered in this analysis because of the following reasons:

- Tyres of very few vehicles sold after FY 2018–19 will be replaced by FY 2023–24.
- Vehicle users accustomed to using low RR tyres **should** prefer replacing their tyres with low RR tyres. Therefore, no **additional** fuel saving would occur from this segment.

The two market entry options discussed above cater to mutually exclusive and exhaustive market segments. Therefore, the potential fuel savings for one segment is independent of the other and will be calculated separately.

8.3. Segmentation of vehicle market in India

Since each segment has a different level of radialisation and frequency of replacement, the entire automobile market has been segmented to facilitate calculation of fuel savings. Fuel saving for each segment through market entry options will be assessed and calculated separately.

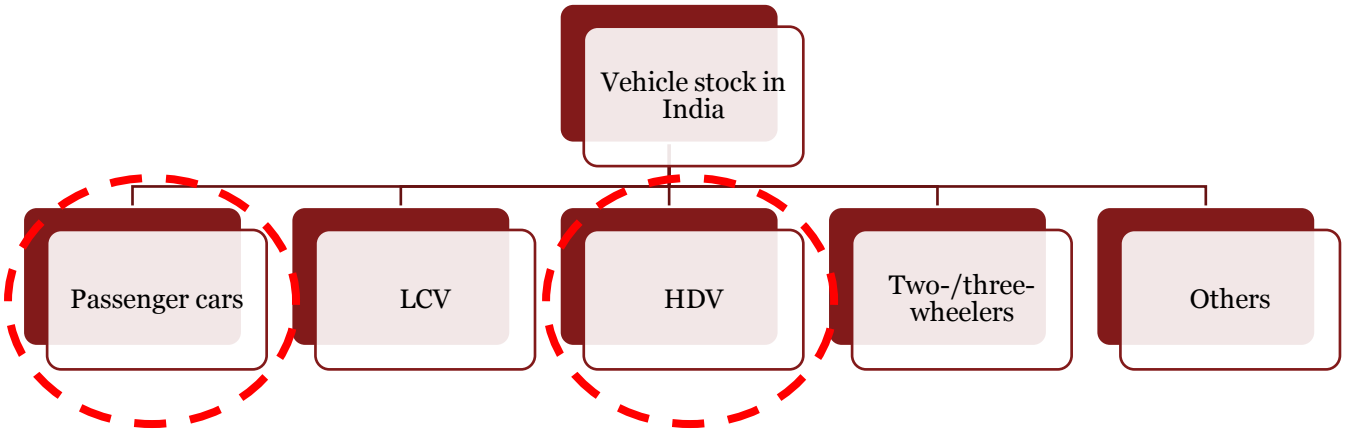


Figure 19: Segmentation of vehicle market in India

As described in Chapter 3, the main focus of this report is towards the passenger car and HDV segments and therefore, potential fuel savings have been calculated for these two segments only.

8.4. Data on vehicle sales during the target period

In this chapter, values of sales estimated for all financial years are based on vehicle sales data obtained for FY 2014–15. Sales data for passenger vehicles, two-wheelers and three-wheelers have been obtained from SIAM's website, and that for LCVs and HDVs have been obtained from ICRA's quarterly reports.

[25] We have defined market penetration as the percentage share of low RR tyres in the entire tyre replacement market for each vehicle segment for a particular year.

The year-on-year sales growth rate for all vehicles has been assumed to be 2.5% for passenger cars and 5% for HDVs. Forecast of vehicle sales for FY 2015–16 to FY 2023–24 has been done on the basis of this assumption.

The table below indicated the value of sales for each segment of vehicles. All vehicle sales values taken further in this analysis have been referenced to the below table.

Vehicle segment	Domestic sales (FY 15)
Passenger car	2,601,236
LCV	337,390
HDV	277,571
Two-wheelers	15,975,561
Three-wheelers	532,626

8.5. Potential fuel savings from the passenger car segment

The passenger car segment has been divided further as shown below to facilitate calculation of potential fuel savings.

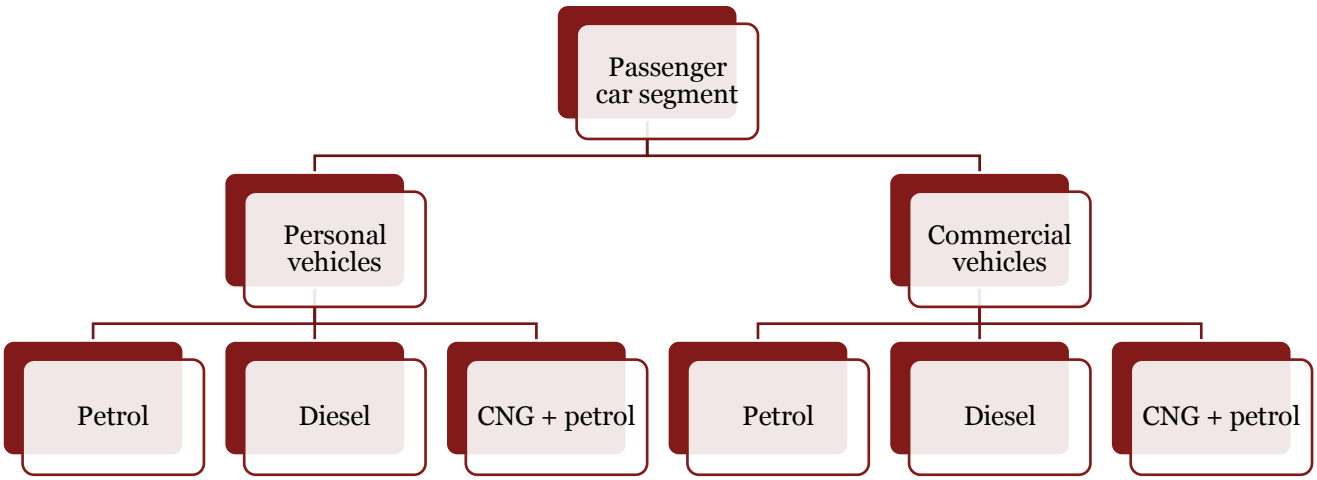


Figure 20: Vehicles covered under passenger car segment

Furthermore, the following assumptions have been made to calculate the potential fuel consumption in this segment:

1. The average mileage for passenger car vehicles is estimated to be 15 km/l for petrol vehicles, 18 km/l for diesel vehicles and 12 km/kg for CNG vehicles.[26]
2. The average distance travelled by a commercial passenger car is 120 km per day and that for a personal passenger car is 40 km per day.[27]

[26] These values are based on PwC analysis and previous research.
[27] These values are based on PwC analysis and previous research.

3. The proportion of petrol cars, diesel cars and CNG cars is assumed to be 30:20:1.[28]
4. The ratio of personal passenger cars to commercial passenger cars is assumed to be 40:60 for each financial year.

Based on the above assumptions, the fuel savings in this segment can be calculated using the following methodology.

- The fuel consumed by one passenger car in one day can be calculated using the following formula:

$$Fuel\ consumed = \frac{Distance\ travelled\ per\ day}{Average\ mileage}$$

- The fuel consumed per year is then calculated by multiplying the above value with the number of cars for the year and the number of years the cars run.
- The total fuel consumption is calculated by adding the fuel consumption values for each year.

To calculate the fuel savings in the passenger car segment, the following assumptions have been made:

1. The RR research study conducted by IRMRA has revealed that most passenger car tyres in India fall under the E category of the EU label. Therefore, for this calculation, the value of RR for low efficiency tyres, on average, will fall under E category.
2. We estimate that if the S&L programme is implemented in India, the low RR tyres introduced will have fuel efficiency rating of B as per the EU tyre label.
3. Research conducted by independent organisations suggest that switching between G & A tyres would reduce fuel consumption by 9%.[29] Therefore, the potential fuel saving has been estimated at 7% (conservative estimate).

Based on this, total fuel savings can be calculated using the following formula:

$$Fuel\ saved = Percentage\ fuel\ savings \times Total\ fuel\ consumption$$

8.5.1. Potential fuel savings from market entry through OEMs

Through this option, all new passenger cars, that would be fitted with high RR tyres otherwise, will be fitted with 'low RR' tyres starting from FY 2019–20. It is assumed that sale of all vehicles is distributed evenly throughout the year and therefore, for calculation purposes, it has been assumed that all vehicle sales occur at **middle of the year**.

The fuel savings accrued until the end of FY 2023–24 will depend on the number of years that a vehicle is being used. The following table provides the years of use for vehicles sold in each financial year.

Sale year	Years of use till FY 2023–24
FY 2019–20	4.5
FY 2020–21	3.5
FY 2021–22	2.5
FY 2022–23	1.5
FY 2023–24	0.5

[28] These values are based on PwC analysis and previous research.
[29] https://ec.europa.eu/energy/sites/ener/files/documents/FIN%20User%20guide%20-%20tyres.pdf (accessed on 27/07/2016)

Sale of passenger cars have been forecasted for financial years FY 2019–20 to FY 2023–24 taking the value of year-on-year growth rate as 2.5%. The results are shown below.

Passenger car type	Fuel type	FY 2019–20	FY 2020–21	FY 2021–22	FY 2022–23	FY 2023–24
Personal	Petrol	692,485	709,797	727,542	745,730	764,373
	Diesel	461,656	473,198	485,028	497,153	509,582
	CNG	23,083	23,660	24,251	24,858	25,479
Commercial	Petrol	1,038,727	1,064,695	1,091,313	1,118,595	1,146,560
	Diesel	692,485	709,797	727,542	745,730	764,373
	CNG	34,624	35,490	36,377	37,287	38,219

Based on the above information and methodology described in the previous subsection, the total fuel consumption (**in million l for petrol and diesel, and million kg for CNG**) for each year in the target period has been calculated as:

Fuel type	FY 2019–20	FY 2020–21	FY 2021–22	FY 2022–23	FY 2023–24
Petrol (million l)	16,682	13,299	9,737	5,988	2,046
Diesel (million l)	9,268	7,388	5,409	3,327	1,137
CNG (million kg)	695	554	406	250	85

The total fuel consumption and fuel savings attributable to the OEM market entry option is calculated as shown below. The rates of petrol, diesel and CNG are assumed to be 65/l INR, 50/l INR and 40/ kg INR.

Fuel type	Total fuel consumption (million l or kg)	Fuel saving potential (%)	Total fuel saved (million l or kg)	Rate of fuel (INR/l)	Total savings (crore INR)
Petrol	47,752	7	3,343	65	21,727
Diesel	26,529	7	1,857	50	9,285
CNG	1,990	7	139	40	557

8.5.2. Potential fuel savings from market entry through replacement

Calculation of fuel consumed (and subsequently fuel savings) through this option is trickier than in the previous case and requires taking few more assumptions. They are outlined below:

1. Passenger cars are scrapped after ten years of use.
2. Passenger car tyres are replaced every 50,000 km. Therefore, it is estimated that tyres of personal passenger cars need to be replaced every 4 years and those of commercial cars every 2 years.

The above two assumptions have been considered in order to obtain a conservative estimate. The contribution to fuel savings of any vehicle is dependent on the number of years that the low RR tyres would be used **instead of conventional tyres.** The years of use has been defined in such a way and is dependent on the lifecycle of the vehicle and the frequency of replacement of tyres.

For example, a commercial passenger car replaces its tyres in 2 years. Therefore, those commercial passenger cars that will be bought in FY 2018-19 will replace their tyres in FY 2020-21, thereby amounting to savings of 3.5 years till FY 2023-24. The values for others have been calculated in similar fashion and is shown in the table below. Also, only those cars are considered that are sold on or after FY 2014-15.

Sale year	Years of use till FY 2023–24	
	Personal passenger cars	Commercial passenger cars
FY 2014–15	1.5	3.5
FY 2015–16	4.5	4.5
FY 2016–17	3.5	3.5
FY 2017–18	2.5	4.5
FY 2018–19	1.5	3.5

Sale of passenger cars have been calculated for the financial years FY 2014–15 to FY 2018–19 taking the value of year-on-year growth rate as 5%. The results are shown below:

Passenger car type	Fuel type	FY 2014-15	FY 2015–16	FY 2016–17	FY 2017–18	FY 2018–19
Personal	Petrol	612,056	627,357	643,041	659,117	675,595
	Diesel	408,037	418,238	428,694	439,411	450,397
	CNG	20,402	20,912	21,435	21,971	22,520
Commercial	Petrol	918,083	941,035	964,561	988,675	1,013,392
	Diesel	612,056	627,357	643,041	659,117	675,595
	CNG	30,603	31,368	32,152	32,956	33,780

Based on the above information and methodology described in the previous sub-section, the total fuel consumption (**in million litres for petrol and diesel, and million kg for CNG**) for each year in the target period has been calculated as:

Fuel type	FY 2014 –15	FY 2015 –16	FY 2016 –17	FY 2017 –18	FY 2018 –19
Petrol	10,276	15,113	12,048	14,595	11,343
Diesel	5,709	8,396	6,694	8,108	6,302
CNG	428	630	502	608	473

The total fuel consumption and fuel savings attributable to the replacement market entry option is calculated as shown below. The rates of petrol, diesel and CNG are assumed to be 65 INR per litre, 50 INR per litre and 40 INR per kg. Also, **the market penetration rate is assumed to be 30%.**

Fuel type	Total fuel consumption (million litre or kg)	Fuel saving potential (%)	Market penetration rate (%)	Total fuel saved (million litre or kg)	Rate of fuel (INR per litre)	Total savings (in crore INR)
Petrol	63,376	7	30	1,331	65	8,651
Diesel	35,209	7	30	739	50	3,697
CNG	2,641	7	30	55	40	222

8.5.3. Total potential fuel savings from the passenger car segment

The total potential fuel saving can be calculated by adding the fuel savings obtained from individual market entry options. The results are shown below:

Fuel type	Total fuel saved through OEMs (million litre or kg)	Total fuel saved through replacement (million litre or kg)	Total fuel saved	Rate of fuel (INR per litre or INR per kg)	Total savings (in crore INR)
Petrol	3,343	1,331	4,674	65	30,381
Diesel	1,857	739	2,596	50	12,980
CNG	139	55	194	40	776

Therefore, the total money saved within the target period from **the passenger car segment** is estimated to be **44,137 crore INR**.

8.6. Potential fuel savings from the HDV segment

The passenger car segment has been further divided so as to facilitate calculation of potential fuel savings.

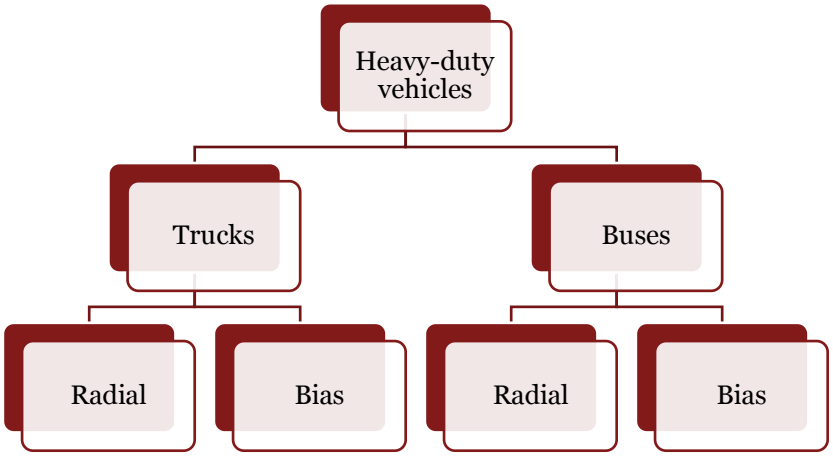


Figure 21: Segmentation of the heavy-duty vehicle market

Furthermore, the following assumptions have been made in order to calculate the potential fuel consumption within this segment:

- The radialisation level of the HDV segment is assumed to be 60%.
- The average mileage of a bus is assumed to be 4.5 km/l and that for a truck to be 5 km/l.[30]
- The average distance travelled by a bus in a day is assumed to be 205 km and that for a truck to be 220 km.[31]
- Sales of trucks during FY 2014–15 is 195,918 and that of buses is 81,653.[32]

Based on the above assumptions, fuel savings within this segment can be calculated using the following methodology.

- The fuel consumed by one vehicle in one day can be calculated by using the following formula:

$$Fuel\ consumed = \frac{Distance\ travelled\ per\ day}{Average\ mileage}$$

- The fuel consumed per year is then calculated by multiplying the above value with the number of vehicles for the year and the number of years the vehicles run.
- The total fuel consumption is calculated by adding the fuel consumption values for each year.

To calculate the fuel savings in the HDV segment, the following assumptions have been made:

- The value of RR for low-efficiency **radial** HDV tyres, on an average, will fall under the E category of the EU label.
- We estimate that if the S&L programme is implemented in India, the low RR tyres introduced will have a fuel efficiency rating of B as per the EU tyre label.

[30] Values based on research conducted by PwC
[31] Values based on PwC and PCRA analysis
[32] Values based on reports obtained from ICRA website

- Research conducted by independent organisations suggests that switching between G&A tyres will reduce fuel consumption by 9%.[33] On this basis, potential fuel saving has been estimated, conservatively, to be 7%.

Also, by replacing bias tyres, we have assumed that fuel efficiency is further improved to 12%. Based on this, total fuel savings can be calculated using the following formula:

$$Fuel\ saved = Percentage\ fuel\ savings \times Total\ fuel\ consumption$$

8.6.1. Potential fuel savings from market entry through OEMs

Through this option, all new HDVs, that will be fitted with high RR tyres otherwise, will be fitted with low RR tyres starting from FY 2019-20. It is assumed that the sale of all vehicles is distributed evenly throughout the year and therefore, for calculation purposes, it has been assumed that all vehicle sales occur during the **middle of the year**. Fuel savings accrued until the end of FY 2023–24 will depend on the number of years that a vehicle is being used. The following table provides the years of use for vehicles sold in each financial year.

Sale year	Years of use till FY 2023–24
FY 2019–20	4.5
FY 2020–21	3.5
FY 2021–22	2.5
FY 2022–23	1.5
FY 2023–24	0.5

Sales of HDVs have been forecasted for the financial years FY 2019-20 to FY 2023-24 taking the year-on-year growth rate as 5%. The results are shown below.

HDV type	Tyre type	FY 2019–20	FY 2020–21	FY 2021–22	FY 2022–23	FY 2023–24
Buses	Bias	41,685	43,769	45,958	48,255	50,668
	Radial	62,527	65,654	68,936	72,383	76,002
Trucks	Bias	100,019	105,020	110,271	115,784	121,573
	Radial	150,028	157,529	165,406	173,676	182,360

Based on the information and methodology described in the previous sub-section, the total fuel (**diesel**) consumption (**in million litres**) for each year during the target period has been calculated as shown below.

[33] Retrieved from: https://ec.europa.eu/energy/sites/ener/files/documents/FIN%20User%20guide%20-%20tyres.pdf

HDV type	Tyre type	FY 2019–20	FY 2020–21	FY 2021–22	FY 2022–23	FY 2023–24
Buses	Bias	3,119	2,547	1,910	1,204	421
	Radial	4,679	3,821	2,866	1,805	632
Trucks	Bias	7,228	5,903	4,427	2,789	976
	Radial	10,843	8,855	6,641	4,184	1,464

The total fuel consumption and fuel savings attributable to the OEM market entry option is calculated as shown below. The rate of diesel is assumed to be 50 INR/l.

HDV type	Tyre type	Total fuel consumption (million litre)	Fuel saving potential (%)	Total fuel saved (million litre)	Rate of fuel (INR/l)	Total savings (crore INR)
Buses	Bias	9,202	12	1,104	50	5,521
	Radial	13,802	7	966	50	4,831
Trucks	Bias	21,324	12	2,559	50	12,795
	Radial	31,986	7	2,239	50	11,195

8.6.2. Potential fuel savings from market entry through replacement

The following assumptions have been made to calculate the fuel saved through replacement option:

- HDV tyres are replaced every 250,000 km after factoring in the concept of retreading. Therefore, tyres of buses and trucks must be replaced every 4 years.
- HDVs are scrapped after 15 years of use.
- Research conducted by independent organisations suggests that switching between G&A tyres will reduce fuel consumption by 9%.[34] On this basis, potential fuel saving has been assumed to be 7%. Also, since the HDV segment consists of bias tyres as well, we have assumed that an additional saving of 5% will be incurred.

Based on the above assumptions, the number of years of usage are calculated and shown in the table below:

Year of sale	Years of usage till FY 2023 – 24
FY 2009–10	2.5
FY 2010–11	1.5
FY 2011–12	4.5

[34] Retrieved from: https://ec.europa.eu/energy/sites/ener/files/documents/FIN%20User%20guide%20-%20tyres.pdf

FY 2012–13	3.5
FY 2013–14	2.5
FY 2014-15	1.5
FY 2015-16	4.5
FY 2016-17	3.5
FY 2017-18	2.5
FY 2018-19	1.5

Sale of HDVs have been estimated for the financial years FY 2009–10 to FY 2018–19 by considering the year-on-year growth rate as 5%. The results are shown below.

HDV type	Tyre type	FY 2009–10	FY 2010–11	FY 2011–12	FY 2012–13	FY 2013–14
Buses	Bias	25,591	26,870	28,214	29,625	31,106
	Radial	38,386	40,306	42,321	44,437	46,659
Trucks	Bias	61,403	64,473	67,697	71,081	74,635
	Radial	92,104	96,709	101,545	106,622	111,953

HDV type	Tyre type	FY 2014–15	FY 2015–16	FY 2016–17	FY 2017–18	FY 2018–19
Buses	Bias	32,661	34,294	36,009	37,809	39,700
	Radial	48,992	51,441	54,013	56,714	59,550
Trucks	Bias	78,367	82,286	86,400	90,720	95,256
	Radial	117,551	123,428	129,600	136,080	142,884

Based on the information and methodology described in the previous sub-section, the total fuel consumption (**in million litres**) for each year within the target period has been calculated as:

HDV type	Tyre type	FY 2009–10	FY 2010–11	FY 2011–12	FY 2012–13	FY 2013–14
Buses	Bias	1,063.80	670.19	2,111.11	1,724.07	1,293.06
	Radial	1,595.70	1,005.29	3,166.67	2,586.11	1,939.58
Trucks	Bias	2,465.32	1,553.15	4,892.43	3,995.48	2,996.61
	Radial	3,697.98	2,329.73	7,338.64	5,993.22	4,494.92

HDV type	Tyre type	FY 2014–15	FY 2015–16	FY 2016–17	FY 2017–18	FY 2018–19
Buses	Bias	1,063.80	670.19	2,111.11	1,724.07	1,293.06
	Radial	1,595.70	1,005.29	3,166.67	2,586.11	1,939.58
Trucks	Bias	2,465.32	1,553.15	4,892.43	3,995.48	2,996.61
	Radial	3,697.98	2,329.73	7,338.64	5,993.22	4,494.92

The total fuel consumption and fuel savings attributable to the replacement market entry option is calculated as shown below. The rate of diesel is assumed to be 50 INR/l and the market penetration rate is assumed to be 30%.

HDV type	Tyre type	Total fuel consumption (million litre)	Fuel saving potential (%)	Market penetration (%)	Total fuel saved (million litre)	Rate of fuel (INR/l)	Total savings (in crore INR)
Buses	Bias	7,677	12	30%	276	50	1,382
	Radial	11,515	7	30%	242	50	1,209
Trucks	Bias	17,791	12	30%	640	50	3,202
	Radial	26,686	7	30%	560	50	2,802

8.6.3. Total potential fuel savings from the HDV segment

The total potential fuel saving can be calculated by adding the fuel savings obtained from the individual market entry options. The results are shown below:

Fuel type	Total fuel saved through OEMs (million litre)	Total fuel saved through replacement (million litre)	Total fuel saved (million litre)	Rate of fuel (INR/l)	Total savings (crore INR)
Diesel	6,868	1,719	8,587	50	42,935

Therefore, the total money saved within the target period from **the HDV segment** is estimated to be 42,935 **crore INR**.

9. Next actions and recommendations

9.1. Summary of gaps and challenges

The most important barrier impeding the development of a standards and labelling programme in India is non-availability of test data of rolling resistance and wet grip. Because of this, the existing situation of the Indian tyre market with respect to these two parameters have not been assessed. The industry has also raised concerns regarding variation in the results of RRC obtained from different machines.

Concerns raised by various stakeholders need to be addressed before the standards and labelling programme can be developed. The project team has identified the following as the key existing barriers or challenges in the roll-out of the programme in India.

- Limited infrastructure for testing of rolling resistance and wet grip in India
- Variation in RRC value obtained by different machines
- Unavailability of data on the Indian tyre market
- Low radialisation levels in LCV and HDV tyre segments

Some of the barriers mentioned above have been analysed and the possible options for overcoming these barriers are suggested below.

9.1.1. Key barrier: Unavailability of data on the Indian tyre market

The project team held multiple discussions with the Bureau of Indian Standards to understand TED 7 committee's progress in the development of standards for rolling resistance in tyres. Members of BIS shared that unavailability of data representing the current situation of the Indian market with respect to rolling resistance and wet grip is a major impediment halting the development process. The primary reason because of which data has not been generated has been the limited testing infrastructure for these parameters in Indian laboratories. BIS also mentioned that because sizes of tyres used in Europe as well as other countries do not match those in India, data on international tyres cannot be used.

To identify possible solutions to this situation, the project team held detailed discussions with IRMRA, the only organization in India at present that is equipped with infrastructure to test for rolling resistance. Officials at IRMRA shared that the organisation had previously acquired few random passenger car tyre samples from the Indian market and tested them for rolling resistance. It was found that the rolling resistance value of most tyres came under the **F category of the EU label**.

IRMRA had presented these findings at the recently held TED 7 committee meeting. However, in the meeting, the industry raised concerns on the credibility of these results because the machine at IRMRA has not been calibrated with a reference laboratory. Another point raised during the meeting that the unavailability of wet-grip values of these samples prevented analysts from making inferences from the data.

The project team has found that generation of data will be easily completed once an adequate number of test agencies have developed facilities for testing of rolling resistance and wet grip. The tyre samples can then be tested for both rolling resistance as well as wet grip.

The issues raised during the meeting can be resolved if the rolling resistance machine is aligned with a reference machine. The same has been discussed with IRMRA and they have expressed their willingness for undertaking the alignment procedure.

9.1.2. Key barrier: Low radialisation levels in LCV and HDV tyre segments

Members of the tyre industry and ATMA have shared with the project team that only the passenger car segment has reached 100% radialisation. The radialisation levels of LCV and HDV segments stand at 20% and 60% at present. Industry members are of the opinion that the government needs to focus on achieving 100% radialisation within these segments before undertaking development of standards for rolling resistance of tyres.

Other members of the TED 7 committee have noted that the government has already taken several steps to increase the uptake of radial tyres in these segments. As a result, radialisation levels in the HDV segment have risen greatly from about 20% in 2008 to almost 60% in 2016. In their opinion, setting standards for rolling resistance will not stall this initiative and would lead to uptake of energy-efficient tyres in the country. Therefore, taking this into consideration, the programme needs to be launched first targeting passenger cars only and then be expanded to include other segments such as HDV, LCV segment and the two-wheeler segment.

9.2. Next steps for development of standards in India

Since IRMRA and ICAT already have facilities to test for rolling resistance and wet grip respectively, and other test agencies are poised to develop these capabilities within the next two years, major barriers towards development of the standards and labelling programme for tyres will be removed. Post this, the programme can be developed quickly.

The next major step towards development of standards for tyres is to generate data on the Indian tyre market. The most convenient way forward is to conduct tests for rolling resistance and wet grip for randomly selected samples from the passenger car segment through the test facilities available with agencies in India.

Once data is generated for the passenger car segment, the TED 7 committee can start working towards arriving at benchmark values for RRC and wet grip coefficients in the passenger car tyre market. Identifying existing benchmarks for these parameters will allow the TED 7 committee to develop minimum performance standards for tyres.

It is proposed that an ***energy-efficiency labelling programme*** needs to be simultaneously developed after the availability of data. Energy-efficiency labelling programmes have proved to be successful in creating awareness among consumers on fuel efficiency, and have effectively driven the market towards energy efficiency in India as well as other countries. A labelling programme for tyres could be developed on voluntary basis at first, and then be made mandatory once the programme implementation framework has been finalised.

In summary, the following steps need to be followed for development of standards and labelling programme for passenger car tyres in the country.

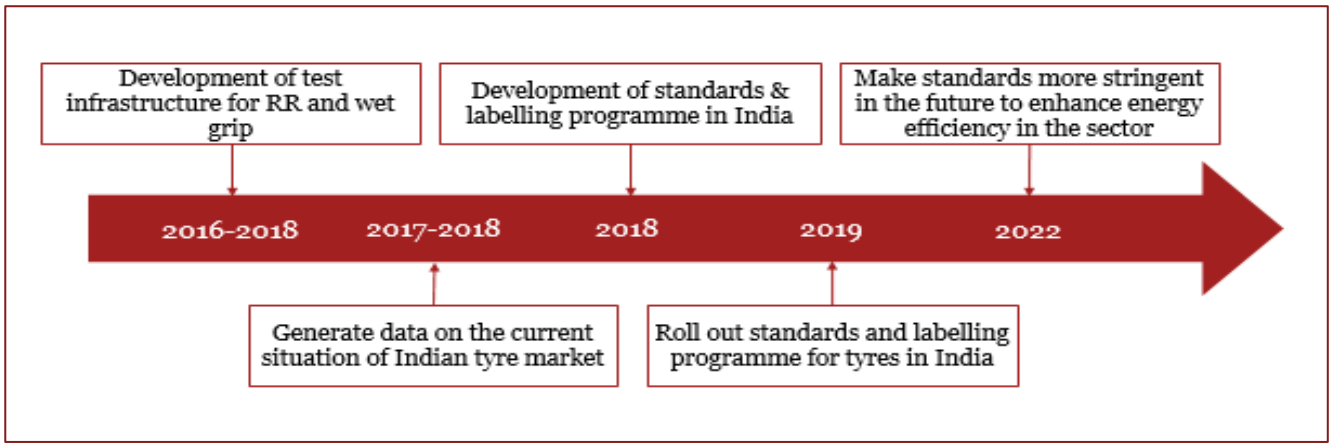


Figure 22: Steps for development of the S&L programme for tyres in India

9.2.1. Align RR testing machines with standard reference machines

Infrastructure for testing of rolling resistance will be available at all labs within two years. However, in order to maintain consistency in the results obtained for the same tyre in different machines, they must be calibrated with a reference machine. The alignment procedure has been provided in ISO 28580 and EU Regulation 1235/2011.

After the calibration procedure is complete, the sample machine develops a linear regression equation that aligns the RRC values obtained to that of the reference machine. After this, all values obtained in the sample machine are aligned or adjusted using the regression equation.

The testing agencies are ready for undertaking the calibration process. The options that can be followed and their feasibility are mentioned below.

Table 16: Options for calibration of machines in India

Option	Description	Feasibility
Option 1	In Europe, machines in all laboratories are calibrated with a reference machine every two years. The same test tyres can be used for calibration of all machines in India.	If the same tyres are used for all machines in India, the calibration process will be efficient.
Option 2	A single RR testing machine in India is developed as a reference machine. This machine will be calibrated with a reference machine in Europe every two years. All other machines in India are calibrated with this machine as per the procedure.	Feasible

Test agencies need to assess the most feasible option, taking guidance from the above-mentioned options, and arrive at a methodology for undergoing the alignment procedure.

9.2.2. Generating data on tyres in the Indian market

Generating data on the present situation of the Indian market with respect to rolling resistance and wet grip is the most important step in the development of a standards and labelling programme in India. This data will be analysed for setting the baseline level of rolling resistance and wet grip for tyres in the country.

As per the project team's discussion with various stakeholders, limited availability of testing infrastructure in the country as well as initiative for sample testing has been the primary reason impeding the generation of data on the Indian tyre market. However, the team noted that the facility for testing rolling resistance is available within IRMRA (albeit the machine is not aligned) and facility for testing wet grip is available with ICAT.

We recommend that the best way forward is to procure random samples of passenger car tyres and test them for rolling resistance at the facility in IRMRA. These tyres will be shipped to the facility in ICAT and tested for wet grip in the facility there. In this way, data on the Indian tyre market can be generated in an expedited manner.

After the rolling resistance testing machine in IRMRA is aligned with a reference machine as per the applicable procedure, ***the values obtained in the previous step would be adjusted*** as per the alignment equation.

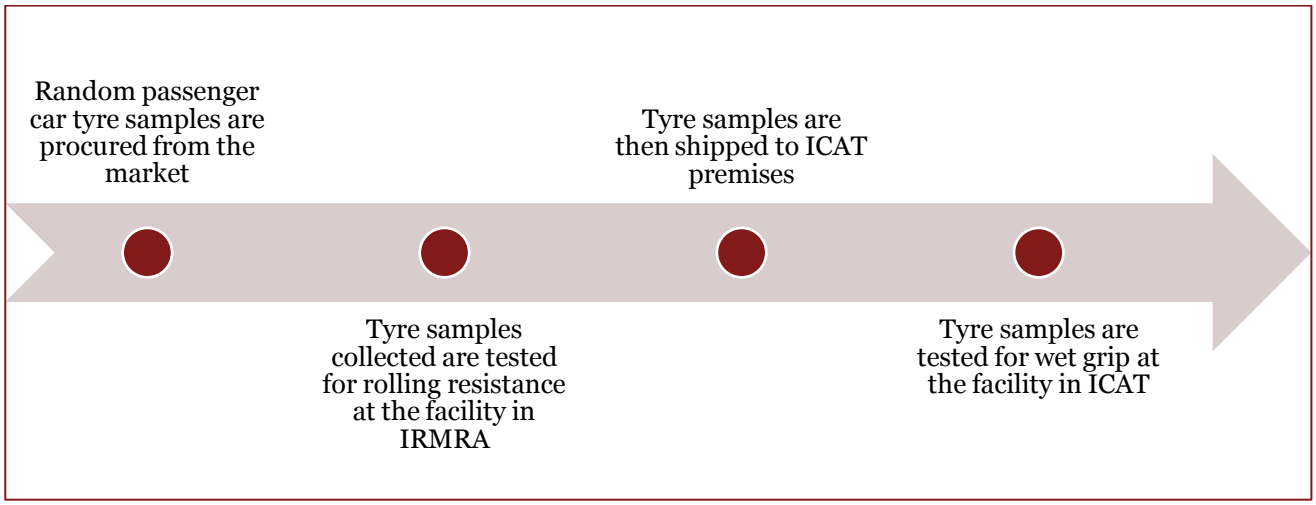


Figure 23: Steps for data generation

The project team held a detailed deliberation with IRMRA and requested IRMRA to provide a proposal for acquiring and testing tyre samples such that the results generated are representative of the existing situation of the tyre market in India.

To this end***, IRMRA shared with the project team a proposal*** which indicated that IRMRA will randomly select and acquire a total of 60 to 70 passenger car tyre samples from the market. These samples will be sufficiently distributed so that tyres of all sizes are represented within the samples. The indicative cost and the time required to generate the data was also mentioned within the proposal. The project team is held a discussion with ICAT for testing the samples picked up by IRMRA for wet grip. ICAT was willing to support the initiative.

IRMRA has estimated that testing of these tyres for rolling resistance will take approximately six months. ICAT has estimated that testing of these tyres for wet grip would take approximately two months.

The TED 7 committee, BIS and BEE should decide the most feasible option for generation of data on the Indian tyre market based on the assessment presented above.

9.2.3. Identifying benchmarks for tyres in India

Data generated from the previous step will allow members of the TED 7 committee to arrive at benchmark values for rolling resistance coefficient and wet grip for tyres in India. It is recommended that a committee needs to be formed that will decide on the next actions based on the conclusions obtained from the data.

Based on the values of these benchmarks, the committee would then be able to assess the potential for improvement of RR and wet grip values of tyres and set minimum performance standards.

A labelling programme needs to simultaneously be developed for tyres that would incentivise consumers to push the market towards energy-efficient tyres. Just as with the EU label, the RRC limits for each grade of the Indian label would be based on minimum standards prescribed above.

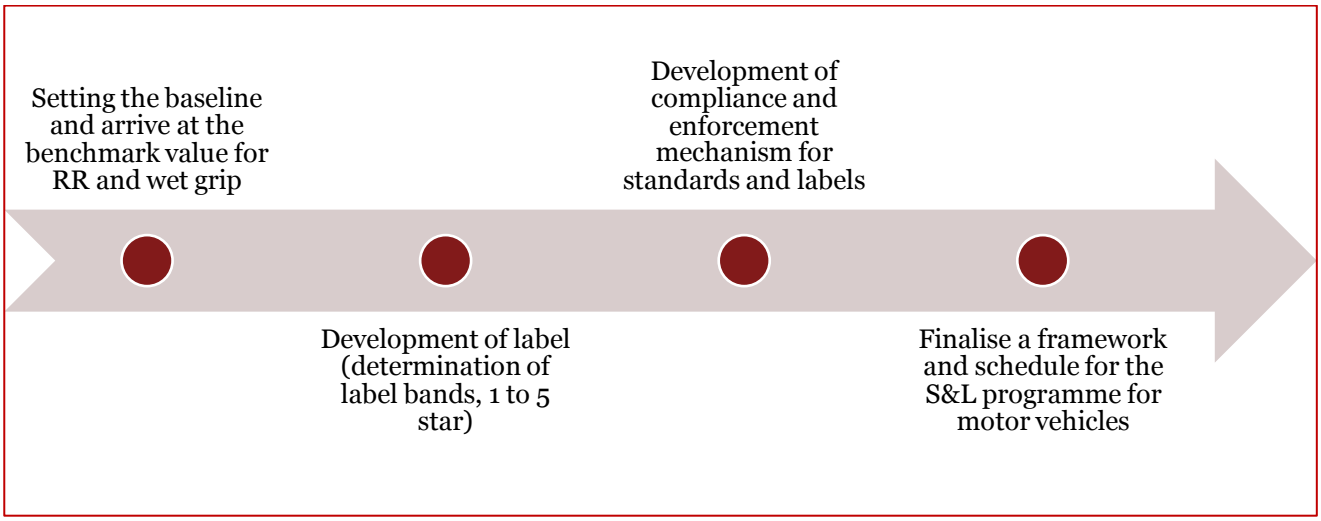


Figure 24: Steps for development of labelling programme for tyres

The standard and labelling programme should ideally be rolled out on a voluntary basis at first to provide time to stakeholders to prepare for the mandatory phase. Any major issues will be identified and corrected in the voluntary phase itself. The label bands will be updated from time to time on the basis of market penetration of energy-efficient tyres.

Arriving at a benchmark value for rolling resistance and wet grip would not take much time once sufficient data is available. It is estimated that benchmarking should be completed within the next 1.5 years.

9.2.4. Enforcement of mandatory standards for tyres

Once the labelling programme has been firmly established, energy-efficient tyres would have been introduced in the market. Enforcing the standards set in the previous step at this stage will help phase out and eliminate energy inefficient tyres from the market.

9.3. Projected roadmap for the S&L programme for tyres

Based on the requirements presented in the previous sections and indicative timelines for the development of infrastructure for testing rolling resistance and wet grip in India, we propose the following roadmap for development of standards and labelling programme in the country.

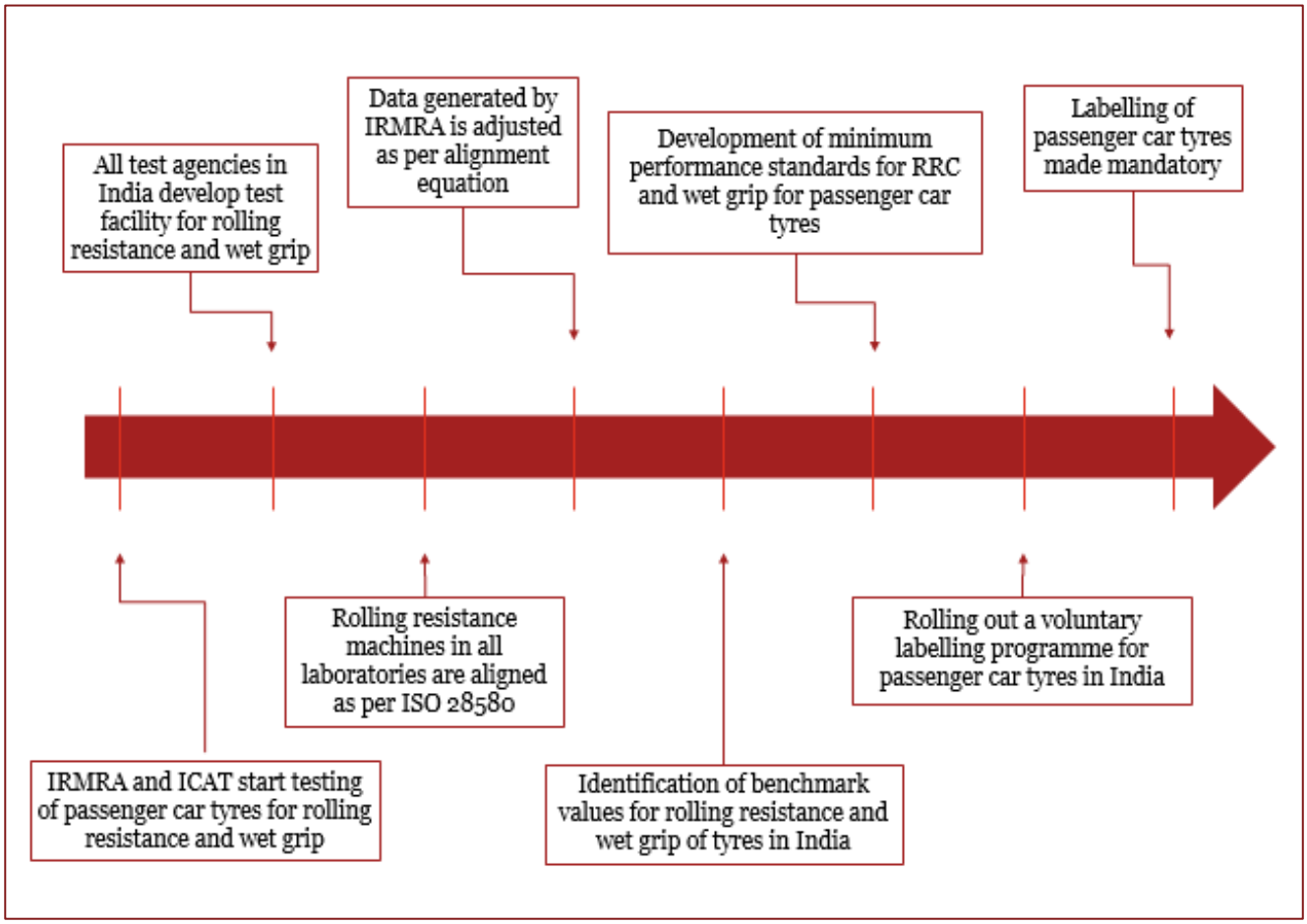


Figure 25: Roadmap for the development of S&L programme for tyres

Target market segments

As shown in the analysis of the Indian tyre industry (see Chapter 3), the passenger car tyre and the HDV tyre market segments are catered to by the organised market and therefore, are easier to regulate. The HDV tyre segment holds the majority share of the replacement market, followed by the passenger car tyre segment. This indicates that a labelling programme would be most effective if the programme targets consumers belonging to these two segments.

Therefore, it is **recommended that the standards and labelling programme should first begin with the passenger car segment and then be expanded to the HDV segment, LCV segment and the two-wheeler segment in the future.**

Appendix A. - Members of technical committees

A.1. BIS TED 7 committee

Sr. no.	Organizations represented
1.	Central Institute of Road Transport , Pune
2.	All India Motor Transport Congress , New Delhi
3.	All India Rubber Industries Association , Mumbai
4.	All India Tube Manufacturers Association, Jamnagar, Gujarat
5.	Ashok Leyland Ltd , Chennai
6.	Association of State Road Transport Undertaking , New Delhi
7.	Automotive Research Association of India , Pune
8.	Automotive Tyre Manufacturers' Association , New Delhi
9.	Bajaj Auto Ltd , Pune
10.	Central Institute of Road Transport , Pune
11.	Controllerate of Quality Assurance (Vehicles), Ahmednagar
12.	Department of Heavy Industry , New Delhi
13.	Directorate General of Supplies and Disposals , New Delhi
14.	Elastomer Technology Development Society , New Delhi
15.	Hero Moto Corp Limited , Dharuhera
16.	Indian Foundation of Transport Research and Training , New Delhi
17.	Indian Rubber Manufacturers Research Association , Thane
18.	Indian Tyre Technical Advisory Committee , New Delhi
19.	International Centre for Automotive Technology (ICAT) , Gurugram
20.	Kum Rajshree Parmar Memorial Foundation , Pune

Sr. no.	Organizations represented
21.	Mahindra & Mahindra Ltd , Nashik
22.	Maruti Suzuki India Ltd , Gurugram
23.	Ministry of Commerce and Industry , New Delhi
24.	Ministry of Road Transport and Highways , New Delhi
25.	NATRIP , New Delhi
26.	Society of Indian Automobile Manufactures , New Delhi
27.	Tata Motors Limited , Pune
28.	Toyota Kirloskar Motor Private Limited , Bengaluru
29.	Tractor Manufacturer`s Association , New Delhi
30.	Treadsdirect Limited , Coimbatore
31.	Triton Valves Ltd , Mysore
32.	Vehicles Research and Development Establishment , Ahmednagar
33.	Wheels India Ltd , Chennai

A.2. AISC committee for tyres

Sr. no.	Organizations represented
1.	Automotive Research Association of India, Pune
2.	Ministry of Road Transport & Highways, New Delhi
3.	Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, New Delhi
4.	Office of the Development Commissioner, Small Scale Industries, Ministry of Small Scale Industries, New Delhi
5.	Bureau of Indian Standards, New Delhi
6.	Central Institute of Road Transport, Pune
7.	Indian Institute of Petroleum, Dehradun
8.	Vehicles Research and Development Establishment, Ahmednagar
9.	Society of Indian Automobile Manufacturers
10.	Tractor Manufacturers Association, New Delhi
11.	Automotive Components Manufacturers Association

Appendix B. - Summary of discussions with stakeholders

B.1. Discussion with ATMA

The project team held a meeting with ATMA members on 12 January 2016. Representatives from all major tyre manufacturers in the country such as MRF, Apollo, JK, Bridgestone, Continental, Michelin, Yokohama, and Goodyear attended the meeting. The meeting was coordinated with the support from Mr Rahul Vachaspati, Deputy Director, ATMA. Along with the project team from PwC, Mr Ravi Gadepalli from Shakti Sustainable Energy Foundation also attended the meeting.

The project team gave a brief presentation to all the members. During the presentation, the team explained the main objective of the meeting to all members. Some of the areas covered included: the project objective, brief overview on S&L programmes, understanding of tyre industry in India, and the support required from ATMA.

The following points were discussed during the meeting:

- Industry members shared that the initiative taken by Shakti Sustainable Energy Foundation and PwC towards accelerating fuel efficient tyres in India is in right direction. However, before understanding the feasibility of S&L there is a need to understand the basic constraints for introducing rolling resistance and wet grip standards in India. It was shared that the road and traffic conditions in India is very poor in comparison with the countries where the S&L programme for tyres have already started.
- It was further shared that manufacturing of tyres with specified rolling resistance and wet grip parameters can be considered by the industry, however unless the road and traffic conditions improve, the actual consumer will not be able to experience the fuel efficiency benefits. Rather there can be negative implications because the cost of tyres might increase.
- Members also suggested that it would be helpful if the project team can get some information on the outcomes of the international S&L programme for tyres.
- The project team shared that improvement in tyre technology shall not be dependent on surroundings such as roads and traffic. Improvement in roads and traffic depends on various factors which are beyond the control of any single entity. Such improvements goes slowly and simultaneously along with the economic growth of the country and society. The initiative to introduce fuel efficient tyres in India will complement the various ongoing energy and fuel efficiency measures in the interest of the country.
- The project team also shared that support from the forum of ATMA is crucial for the study and with the help of the inputs provided, the team will identify the key constraints for improvement in tyre standards in India
- ATMA and industry members appreciated the efforts of the project team, and agreed to support the project team in undertaking this study.

B.2. Discussion with ICAT, Manesar

The stakeholder consultation meeting with ICAT, Manesar was held on 25 February 2016 within ICAT premises.

The meeting was held to discuss the following:

- ✓ Understand test laboratories' perspective towards the S&L programme for tyres
- ✓ Identify key barriers to the implementation of such a programme
- ✓ Get a clear picture of the technical capacity of labs to perform tests for the required parameters

The following points were discussed during the meeting:

- It was discussed that the initiative for development of standards for rolling resistance was taken around three to four years back by the TED 7 committee. However, as of now, the committee has been unable to finalise the limits for rolling resistance within the Indian context. This is because consensus has not been reached on whether to directly adopt ECE R117 or to develop a separate set of standards for India. Also, there is considerable reluctance on part of the manufacturers to provide data because of confidentiality concerns.
- In ICAT's opinion, ECE R117 cannot be adopted in India because of non-compatibility of these standards within Indian conditions. The issues faced are different road conditions, inadequate capability of labs to test for the parameters, etc. Also, substantial investment is needed for implementing the programme.
- The present capacity of test agencies in India to test for rolling resistance, wet grip and noise was discussed. ICAT informed that the infrastructure required for testing rolling resistance should be commissioned in ICAT, Manesar by June 2016. The apparatus in CIRT, Pune has not been in working condition for some time. ARAI, Pune does not have adequate infrastructure to test for rolling resistance at present. No test agency in India is equipped with the requisite infrastructure to test for wet grip and noise at present.
- Interrelation between technical parameters was also discussed. It was shared that decreasing the value of rolling resistance will reduce wet grip performance of a tyre. Also, changing the value of rolling resistance has little effect on the life of a tyre. However, since material and other aspects need to be upgraded, the overall cost of the tyre increases.
- In ICAT's opinion, cost for setting up the apparatus to test for RRC would be at least 1.5 crore INR.

B.3. First discussion with BIS

The meeting with BIS was held at Manak Bhawan, 9, Bahadur Shah Zafar Marg, New Delhi on 2 March 2016. The meeting was held to discuss the following:

- ✓ Gain insight of the progress of the work done so far for the development of standards for RRC, wet grip and noise in India
- ✓ Understand the key challenges that stakeholders are facing during the development of the standards
- ✓ Identify the next steps for taking the standards and labelling programme further

The following points were discussed during the meeting:

- The head of the TED informed that currently, ECE R-117 has not been made mandatory in any country. This is because there are certain issues that exist in the implementation for these standards.
- It was emphasised by the head of the TED that RR on its own cannot judge the performance of a tyre. The value of RR must be accompanied by that of wet grip and noise for appropriate judgement of tyre performance.
- The capacity of test agencies to measure the value of RR, wet grip and noise was discussed. It was understood that inadequate infrastructure for testing these parameters is present in India. ICAT, Manesar is expected to install the infrastructure required to test for RR by June 2016. However, the infrastructure required for testing wet grip and noise is not available in India at present. In BIS' opinion, it would take at least one to two years for test agencies to develop this capacity. A huge investment is required in this regard.
- It was pointed out that IRMRA had conducted a preliminary research and some data on rolling resistance limits has been submitted to BIS. However, that data is preliminary in nature and could not be used to compose the standards.
- The head of the TED pointed out that tyre performance depends on many parameters—tread material, temperature, tyre pressure, road conditions, etc. Therefore, it is difficult to technically assess the performance of a tyre in the absence of detailed testing under various pre-decided conditions.
- To gain an insight into the introduction of efficient tyres in the Indian market, the head of the TED also suggested that the project team should hold a discussion with tyre manufacturers who have brought out tyres with low RR recently.
- ISO 28580 for the measurement of RRC requires each test apparatus to be assigned a correction factor. Authorised test agencies in India have not done so. However, a few manufacturers are supposed to have completed the alignment procedure.
- Standards in India have been aligned to Regulations 35, 54 and 75 of the 1958 WTO regulations. Review of these regulations could be beneficial to this study.
- It was shared that the next meeting of the TED 7 committee will be held on 28 March 2016. The project requested BIS to extend an invite to project team to attend the meeting as an observer to further expand the study.

B.4. Second discussion with BIS

The meeting with BIS was held at Manak Bhawan, 9, Bahadur Shah Zafar Marg, New Delhi on 10 March 2016.

The meeting was held to discuss the following:

- Understand the existing barriers to the implementation of standards for rolling resistance, wet grip and noise in India
- Propose next actions for implementing the S&L programme

The following points were discussed during the meeting:

- It was emphasised by the head of the TED that rolling resistance on its own cannot judge the performance of a tyre. The value of rolling resistance must be accompanied by that of wet grip and noise for appropriate judgement of tyre performance.
- It was also pointed out that the data on rolling resistance is not available because standards representing Indian conditions have not been developed. Since there is a lot of variation in temperature, road conditions, etc. across the country, defining test conditions is difficult.
- There was a discussion on the various options for generating data and defining the limits for rolling resistance in Indian context. The project team presented these options to the head of the TED. Deliberation indicated that the most preferred approach for defining the limits is to have actual test data in Indian conditions.
- The project team presented an overview of the international S&L programme for tyres. The head of the TED shared that a standards and labelling programme for tyres is workable only after incorporation of limits for rolling resistance, wet grip and noise in the Indian Standard. He shared that during the next meeting of TED 7, the issue of defining limits for these parameters will be deliberated amongst the stakeholders and a possible approach would be identified. Also, it will be important to define the measures for enforcement of standards prior to such policies.

B.5. Discussion with CIRT, Pune

The meeting with CIRT was held on 12 April at CIRT, Pune. The meeting was attended by Mr. N. R. Kachare, CIRT, Mr. Mohit Verma, PwC and Jwalant Mehta, PwC.

The meeting was held to understand CIRT's perspective and opinion of this study and the current capacity to test for RR, wet grip and noise. The project team also discussed the key requirements to take the S&L initiative further.

The following points were discussed during the meeting:

- The project team started the meeting by explaining the objectives of the assignment and the progress made so far. The team presented the findings and pointed out the key discussion points of the meeting.
- Mr Kachare shared that in the TED 7 meeting held on 28 March, a discussion was held on GTR 16 and how India should comply with its requirements. CIRT had submitted a paper in the meeting that proposed the way India should move ahead to comply with GTR requirements. Mr Kachare briefed the project team on the contents of the paper. However, the GTR document is not a legally binding document.
- The project team had a detailed discussion with Mr Kachare on radialisation in Indian tyre market. He informed that the truck and bus segment has achieved a radialisation of around 23%. Radialisation of LCV segment is still very low. He shared that because bias tyres have a thicker sidewall than radial tyres, bias tyres have better load carrying ability. With the widespread habit of overloading freight vehicles and poor road conditions in the country, radialisation in LCV and T&B segments have remained low. However, buses and other public transport vehicles have begun shifting towards radial tyres.
- On being asked about the progress of the development of capacity of labs for testing for RR, wet grip and noise, Mr Kachare informed that CIRT is making efforts to develop infrastructure for testing RR of tyres. He has recently submitted a proposal to the government to procure the required equipment for measuring RR. He also informed that ICAT is in the process of developing tracks for measuring wet grip. He shared that the government is currently not focussing on developing a standard for noise in India. In his opinion, labs needs to develop capacity within the next two years. Also, it should cost around 20 crore INR for a lab to develop infrastructure for testing RR, wet grip and noise.
- Mr Kachare suggested that once adequate testing capacity has been developed, a round robin testing needs to be conducted to generate reliable data on the Indian tyre market. Once this is done, the value of limits for RR and wet grip will be decided. He also suggested that Indian labs coordinate with established labs in other countries during the entire process. He also informed that IRMRA had conducted a rudimentary research on RR of few tyres in India. However, no definite conclusion could be reached based on that data. In his opinion, the round robin testing could begin within the next three years.
- The project team enquired about the feasibility of sending tyres to foreign laboratories to generate data on Indian tyre market. Mr Kachare shared that it is more feasible to develop testing facility in India and conduct tests indigenously.
- Mr Kachare shared that UN ECE R117 requirements for tyres will get more stringent from November 2016 onwards. He also suggested the project team to review the developments in Russia.
- The project team enquired about a possible methodology to further classify tyres of M1, M3 and N3 categories. Mr Kachare informed that it could be possible on the basis of the rim diameter. Majority of M1 category tyres have rim diameter within the range of 12–16 inches. However, he shared that doing so would be practical once proper data on the Indian tyre market with respect to. RR and wet grip is available.

B.6. Discussion with ARAI, Pune

The meeting with ARAI was held on 12 April 2016 at ARAI, Pune. The meeting was attended by Mr. A. Badusha, ARAI, Mr. Mohit Verma, PwC and Mr. Jwalant Mehta, PwC.

The following points were discussed in the meeting:

- The project team presented the scope of work and the progress made so far to Mr Badusha. The team then described the agenda and expectations from the meeting. Mr Badusha agreed that setting standards for tyres can lead to improvement in the overall fuel efficiency of vehicles.
- He further emphasised that there exists a compromise between fuel efficiency and wet grip. He said that there is a need to find an optimum balance between RR and wet grip to achieve maximum fuel efficiency without compromising safety.
- Mr Badusha was of the opinion that the tyre noise aspect is not relevant to the Indian context at the moment. However, there is a need to develop an Indian standard for RR. CMVR rules specify breaking standards for tyres which indirectly involves standards for wet grip. OEMs comply with this standard at the time of production. Data on compliance in the aftermarket is not available.
- Mr Badusha shared that special tracks for testing of tyres are being constructed in different parts of India. They are being developed through government funding and can be used to test wet grip of tyres. For testing RR, he estimates that ARAI will have adequate infrastructure within the next two years.
- He informed that there are few reference labs for testing RR. Machines in candidate laboratories need to be calibrated with these reference labs from time to time. He emphasised that the main barrier in uptake of S&L norms is unavailability of infrastructure for testing RR. Once these facilities have been developed, a round robin approach for testing of tyres should be followed to establish the current situation of the tyre industry.
- The project team had a discussion on radialisation trend in Indian tyre market. Mr Badusha shared that radialisation has reached almost 100% in the passenger car segment. However, the share of radial tyres in LCV and T&B segments is small because of widespread tendency of drivers to overload freight vehicles. In his opinion, initiatives to curtail overloading of freight vehicles can slowly shift the market towards radialisation. Setting standards for RR will be most effective once market has reached 100% radialisation.
- Mr Badusha shared that it was suggested in the TED 7 meeting held on 28 March that manufacturers declare the values of RR, wet grip and noise for tyres that are exported to the European market. He also shared that an initiative has been taken to develop an Indian standard parallel to UN ECE R117 specific to Indian conditions. Notifying the standard may expedite transformation of the tyre market towards fuel efficiency.

B.7. Discussion with IRMRA

The meeting on the subject matter was held on 12 May 2016 at 1100hrs at the facility of IRMRA, Thane Maharashtra. The list of participants who attended the meeting includes the following:

- Dr Kasilingam Rajkumar, Director IRMRA
- Mr. Niteesh K. Shukla, Assistant Director, IRMRA
- Mr Rajeev Ralhan, Director, PwC
- Mr Zia Mujawar, Consultant, PwC
- Mr Mohit Verma, Manager, PwC

The meeting began with a round of introduction by the members present. Mr Rajeev and Mr Mohit briefly shared the work done so far by them on the subject matter. It was shared that so far the team has held discussions with BEE, ATMA, ICAT, BIS, CIRT, ARAI and ICCT. The outcomes of earlier discussions with these stakeholders were briefly shared with IRMRA officials by Mr Mohit.

The PwC team made a presentation covering the following areas:

- Overview of the existing regulation for automotive tyres (passenger cars and HDVs application) in India
- Overview of international S&L programme for tyres
- Discussion points included the following:
    - ✓ Impact of RR and wet grip thresholds on vehicle FE
    - ✓ Tyre manufactures that already have products which comply with UN ECE R117
    - ✓ Effect of external factors such as road conditions, climate, temperature and traffic that are beyond the control of policymakers
    - ✓ Methodology for India to define RR and wet grip thresholds and policy steps

The following points discussed during the meeting included the following:

Mr Rajeev expressed that defining thresholds for accelerating adoption of fuel efficient tyres is important for the country. He shared that the Government of India is aggressively working for fuel efficiency in passenger cars and HDVs and in various discussion forums the OEMs have requested the government to introduce low rolling resistance limits for tyres so that it can complement to the overall vehicle efficiency. Also, internationally various countries are strongly focussing on this aspect. He also shared that the PwC team is working on assessing the feasibility for S&L programme for tyres and through this exercise they would present a realistic roadmap and next actions in consultation with key stakeholders.

Mr Mujawar shared that introduction of labelling programme for tyres in India will be useful in the long run. The programme will provide an opportunity to the consumer to select tyres with greater fuel efficiency. A push from the government and pull through demand from consumers will lead to a complete market transformation of tyres in India.

Dr Rajkumar acknowledged the need for incorporating fuel efficiency aspects within the existing tyre standards in India. He appreciated the concerns highlighted and the work done by PwC team in this regard and shared that IRMRA through its RRC testing facility and sector expertise is providing all support to the government in this regard. Mr Niteesh shared that during December 2014 the first meeting of BIS TED7 regarding the subject matter was held within the premises of IRMRA and since then several meetings have been held in this regard. He shared

that initially there were constraints in India with limited testing facility however now, since ICAT is about to commission the RRC and wet grip facility, (also other labs have initiated the work for such facility), it is possible for the government to address this aspect and define the thresholds for the country at the earliest.

The PwC team presented the possible approaches for the country to procced on defining the thresholds in India. Based on the discussion there was an agreement on the need for testing of tyres in India instead of just adopting the limits defined in UN ECE R117. Mr Niteesh explained that there is a significant difference between the Indian and European market for tyres. The passenger car tyre sizes in EU are mostly above 15 inches diameter however in India, around 60% of the market falls between 12 to 14 inches diameter. There is a need to address this aspect for defining thresholds in India and therefore actual testing of tyres and defining limits based on test results will be ideal. The approach for testing will be such that it will incorporate calibration of results through testing of samples in international reference laboratories as well so that there aren't any concerns over results. It was discussed that the most appropriate method for India is to perform sampling (categorisation) of tyres as representative of tyre types in the market rather than tyre volume (population) or market size. It would be impractical to select each and every tyre type for testing, also it would lead to excess use of resources and time which might not provide any value addition.

Regarding IRMRA's experience of rolling resistance results for existing tyres in India, Mr Niteesh shared that they have conducted testing of various tyres of different sizes in India. Based on the results, the rolling resistance coefficient (RRC) for tyres in India ranges between 11 to 13 N/kN. This means that RRC values mainly falls in the F Energy Efficiency Class as per the EC Regulation indicating more fuel consumption.

There was a discussion on various parameters that affect RRC and wet grip performance such as tread pattern, material, and external conditions. The opinion was to follow the EU's approach for defining the broad limits rather than evaluating the impact of each and every type of tyre tread or material. Further, regarding external conditions such as the road condition, traffic, temperature, etc. representatives from IRMRA shared that the performance of tyres is evaluated under controlled conditions and hence such factors should not be a concern in defining the limits. Also, defining the RRC and wet grip thresholds is going to improve the performance of the vehicle rather than providing any adverse effects. Mr Niteesh shared that EU is revising the thresholds in 2016 and making it more stringent and if we will limit the tyre industry progress in India on account of external conditions, then it will not be in the interest of country.

The PwC team requested IRMRA to share a proposal for undertaking testing of tyres in India in order to define the RRC and wet grip thresholds covering the approach, resources required, indicative timeline, key recommendations and possible outcomes for the government. Mr Rajeev shared that the proposal from IRMRA will be useful in order to put up a need of adequate resources and actions towards fuel efficiency in tyres. He also shared that the proposal will be a value addition and supporting document for all stakeholders, including BIS and BEE for understanding the availability of testing setup in India and broad action required. Dr Rajkumar acknowledged the need for putting up such a proposal and suggested that they would appreciate other testing agencies also to be part of it. However, to start with a proposal from IRMRA will be presented as a part of recommended actions and simultaneously discussions will be held with ICAT and ARAI to share their proposals. Dr. Rajkumar appreciated the thoughts of the PwC team in putting together IRMRA's proposal as a part of their recommendations and shared that the team will share the proposal in around two weeks' time. Mr Rajeev shared that PwC will present the proposal from IRMRA to BEE and other government stakeholder so that they can be apprised about the resources required for the proposed next actions. Mr Rajeev provided the vote of thanks to Dr Rajkumar and Mr Niteesh for their support in all discussions and their agreement on sharing a proposal for testing of tyres.

B.8. Joint discussion with ICAT and IRMRA

The project team held a joint discussion with officials from ICAT and IRMRA on 17 June 2016 at the ICAT premises. The discussion was attended by the following officials:-

- Mr. Niteesh K. Shukla, Assistant Director, IRMRA
- Mr Amit K Karwal, Senior Manager, ICAT
- Mr Rajeev Ralhan, Director, PwC
- Mr Mohit Verma, Manager, PwC
- Mr Jwalant Mehta, Consultant, PwC

The discussion was held as a follow-up to the project team's meeting with IRMRA. It was held to understand ICAT's views on the proposal submitted by IRMRA for testing 60 random passenger car tyre samples from the Indian market for rolling resistance. The following points were discussed during the meeting:

- Mr Mohit started the meeting by presenting the progress of the study undertaken by the project team. He shared with the members of the discussion that IRMRA had recently shared a proposal for generating data on rolling resistance of passenger car tyres in India. He then shared the key findings of the work done by the project team and next steps for rolling out a standards and labelling programme in India.
- Mr Rajeev pointed out that the rolling resistance testing machine in IRMRA must be aligned with a reference laboratory before data on the tyre market is generated. Mr Niteesh acknowledged this fact and shared that the alignment procedure as per ISO 28580 will be done once few other labs in India have acquired rolling resistance testing facilities. Mr Amit shared that ICAT will develop infrastructure to test for rolling resistance within 5 months.
- Mr Niteesh shared that two options pertaining to the alignment are being considered at present – either align all machines in India with a reference machine from the European network every two years, or align one machine in India with a reference machine from the European network and all other labs in India shall be aligned with that lab.
- Mr Rajeev also pointed out that tyre samples tested for rolling resistance must also be tested for wet grip. Mr Amit acknowledged this and shared that ICAT has facilities to conduct tests for wet grip at present. The project team held a discussion on possible options for generating data for both wet grip and rolling resistance. One option that was discussed included that tyre samples would first be tested at IMRA for rolling resistance, and then be shipped to ICAT, where they would be tested for wet grip. However, this facility is not as per requirements of UN ECE R117 and is undergoing calibration at present.
- The project team also discussed the tyre sampling plan for generating data on the Indian market. Mr Rajeev shared that the ideal number of tyres to be tested should be around 70, which was close to what was proposed by IRMRA in its proposal. Mr Amit acknowledged this and shared that a sampling plan is being discussed by ITTAC.
- When enquired about next actions for the development of the programme, Mr Amit and Mr Niteesh both suggested that the project team and BEE deliver a presentation on the findings of this study and recommendation for next actions in the next TED 7 committee meeting. This way, both BEE and BIS would have consensus on the approach to be followed.

Post this discussion, the project team had a brief meeting with Mr U K Bhat, General Manager and Head, VEL, ICAT on the wet grip testing facility in ICAT. He shared that ICAT has a facility to test for wet grip. He also shared that around 20 complete working days are required for testing 60 tyres samples for wet grip. Therefore, around two months would be required for this task.