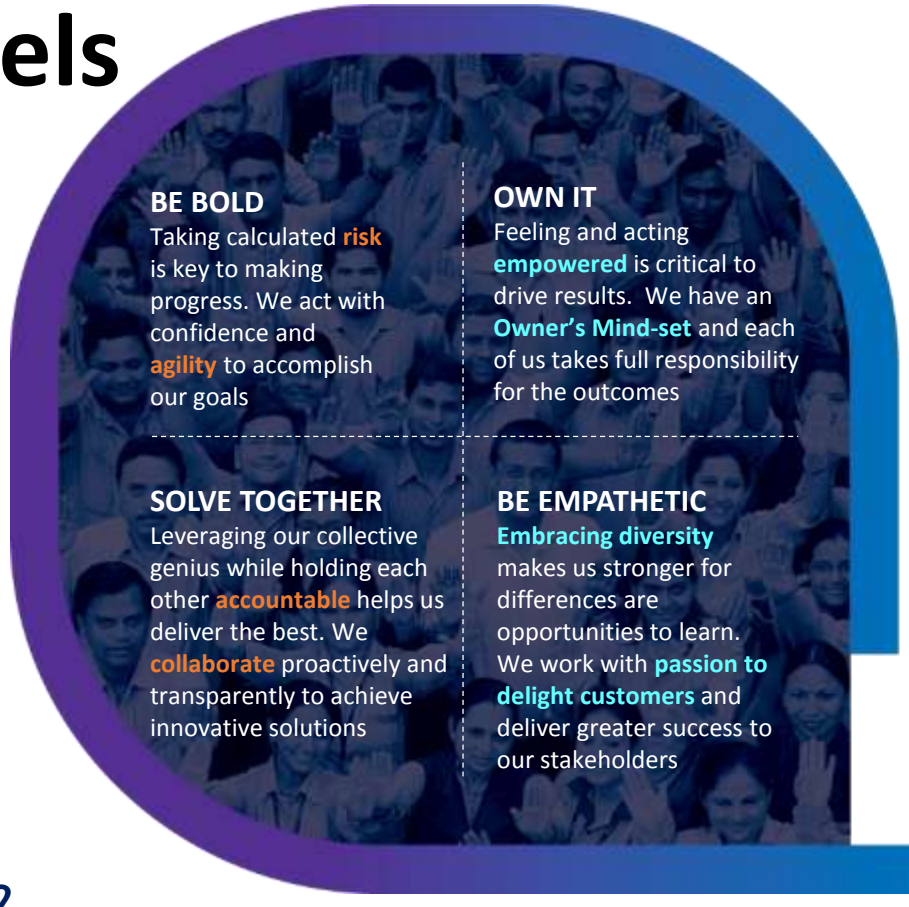
TATA MOTORS
Connecting Aspirations

OUR CULTURE CREDO

AT TATA MOTORS
We are connecting aspirations by being bold in thought and action, owning every opportunity and challenge, Solving together as one team and engaging all our stakeholders with empathy.
We are **MORE WHEN ONE!**



Future Regulations and Fuels

P S Gowrishankar

GM & Head – Regulations

Tata Motors Limited

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ECT 2022, New Delhi, 10th November 2022

Contents

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India's Climate Mitigation Action Plan

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- India released a National Action Plan for Climate Change in 2008.
- There are 8 missions associated with this plan

NAPCC (National Action Plan for Climate Change)

- National Solar Mission → Focus on Renewable Energy
- National Mission for Enhanced Energy Efficiency → **CAFÉ/HDFE/LMDFE Regulations are inline with this initiative**
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Eco-system
- National Mission for a Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

NAPCC Principles

- Protecting the poor through an inclusive and sustainable development strategy, sensitive to climate change
- Achieving national growth and poverty alleviation objectives while ensuring ecological sustainability
- Efficient and cost-effective strategies for end-use demand-side management
- Extensive and accelerated deployment of appropriate technologies for adaptation and mitigation
- New and innovative market, regulatory, and voluntary mechanisms for sustainable development
- Effective implementation through unique linkages – with civil society, LGUs, and public-private partnerships

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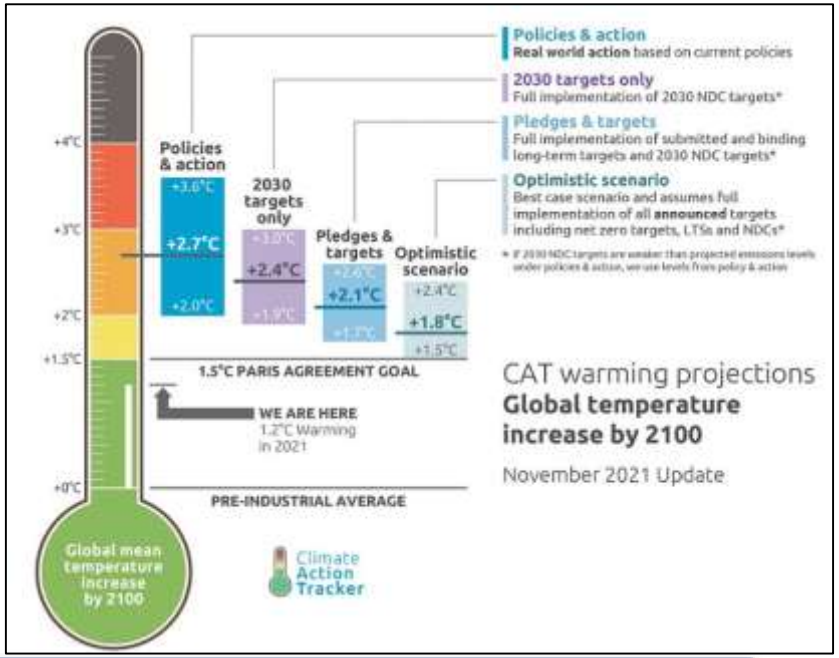
India's Commitments at COP

Focus on GHG Reduction while taking care of Growth Priorities for India

- Since 2009, India has made commitments to reduce Carbon Emissions of its GDP from 2005 baseline levels
- Focusing on Renewable Energy and Creation of Carbon Sinks.

COP 26 has marked a serious commitment for GHG reduction and to move towards Net Zero by 2070



2009 Copenhagen COP 15

Targets for 2020

20~25% ↓ of Carbon Intensity of Economy by 2020 from 2005 levels

2015 Paris COP 21

Targets for 2030

- 33~35% ↓ of Carbon Intensity of Economy from 2005 levels.
- 40% Electricity Installed Capacity by Renewables
- Carbon Sink creation of 2.5 to 3.5 Billion Tonnes of CO2 equivalent by Forestation

2021 Glasgow COP 26

Targets

- Net zero emissions by 2070.
- 45% ↓ of Carbon Intensity of Economy from 2005 levels.
- Reach 500 GW Non-fossil energy capacity by 2030.
- 50% energy requirements from renewable energy by 2030.
- CO2 ↓ by one billion tonnes (1 Billion Tonnes) from now to 2030.

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FUEL ECONOMY

M1 CAFÉ & EU CO2 Emission Targets Roadmap

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Fuel Economy Norms	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036

M1

CAFÉ Corporate Average Fuel Economy

- **April 2017** CAFÉ Phase 1 130 g/km @ 1037 kg
- **April 2022** CAFÉ Phase 2 113 g/km @ 1145 kg
- **April 2022** Revised CAFÉ Phase 2 113 g/km @ 1082 kg
- **CAFÉ Penalty**
- **April 2027** CAFÉ Phase 3 ?
- *Stringent CAFÉ Norms + High Penalty for Non-Compliance*
- **April 2032** CAFÉ Phase 4 ?

EU Fleet Wise CO2 Emission Targets

- **EU CO2 targets @ 2015** ~ 130 g/km @ 1392.4 kg
- **EU CO2 targets @ 2020/2021** 95 g/km @ 1392.4 kg
- **EU CO2 15% reduction target from 2021 @ 2025**
- **EU 2019/631 CO2 Penalty** (Excess emissions × € 95) × number of newly registered vehicles
- **EU CO2 37.5% reduction target from 2021 @ 2030**
- **EU CO2 Target 55% reduction @ 2030**
- **EU CO2 Target 100% reduction @ 2035 CO2 Emissions = 0 gm/km ICE Ban**
- ***Fit for 55 Under Discussion***

CAFE Non-Compliance Penalty

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- Standard Penalty of Rs. 10 Lakhs plus Rs. 10, 000/per day penalty at company level for non-compliance to fuel consumption standard.
- In Addition, If the manufacturer of a vehicle fails to comply with the fuel consumption norms, they shall also be liable to pay an additional penalty per unit of vehicles sold in the corresponding year, as follows, namely:

(i) Rs. 25,000/ Vehicle for non-compliance of norms up to 0.2 litres per 100 kms (i.e., upto 4.74 g/km CO2 beyond the CAFÉ 2 Limit of 113g/km for M1 vehicles)

(ii) fifty thousand rupees per vehicle for non-compliance of norms above 0.2 litres per 100 kms (i.e., above 4.74 g/km CO2 beyond the CAFÉ 2 Limit of 113g/km for M1 vehicles)

EC Act is already passed by Lok Sabha and would be referred to Rajya Sabha in Winter Session

CAFÉ Non-Compliance Penalty

Energy Conservation Amendment Bill 2022
Ministry of Power

Motor Vehicle Act 1988
MoRTH

Non-Compliance under CMVR shall be punishable with imprisonment for a term which may extend to One Year or with fine which may extend to One Hundred Crore rupees (Rs. 100 crores) or with both.

Consider FY 21-22 Sales volume: 100,000

Penalty consider based on EC Amendment Bill

- Penalty for non-compliance of norms up to 0.2 litres per 100 km: Rs. 25,000 x 100,000 = Rs. 250 crores
- Penalty for non-compliance of norms above 0.2 litres per 100 km: Rs. 50,000 x 100,000 = Rs. 500 crores
- This penalty has to be considered with in addition to the standard Penalty of Rs. 10 Lakhs plus Rs. 10, 000/per day penalty (Rs. 0.465 crore) at company level for non-compliance to fuel consumption standard.

India Light, Medium & Heavy DVs & EU VECTO CO2 Emission Targets Roadmap

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Fuel Economy Norms		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
M & N > 3.5 T	L,M&HDV Fuel Economy							April 2023 HDFE & LMDFE Phase 1 Constant Specific Fuel Consumption (CSFC) Methodology				Unknown ??? HDFE & LMDFE Phase 2 ? Vehicle Energy Consumption Calculation Tool (VECTO) Methodology												
	EU Fleet Wise HDV CO2 Emission Targets		Vehicle Energy Consumption Calculation Tool (VECTO) @ May 2017 Introduction		EU 2019/1242 The first-ever EU-wide CO2 Emission Standards for Heavy-duty Vehicles						EU CO2 15% reduction target from 2019 @ 2025				EU CO2 30% reduction target from 2019 @ 2030							

Fit for 55 Under Discussion

- ✓ The 2030 target will be assessed in End 2022 as part of the review of the Regulation.
- ✓ The Final decision will be discussed in the European Parliament after the EC Proposal in November 2022, and adoption is expected to take six months to a year.

CO2 Reduction Policies for Motor Vehicles – M & N Categories

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Clean Vehicles in Public Transportation

FAME India Scheme

- FAME I – Apr 15 to Mar 19
- FAME II – Apr 19 to Mar 24
- Maximum demand incentives @ Rs. 20,000 per kWh for Buses
- EV Policies by States

Incentives for Vehicles, Infrastructure and Users (20 States have announced)

Low Carbon Fuels

Alternate Fuels

- CNG / LNG
- Bio Diesel
- Methanol Economy (Plans drafted by NITI Aayog)
- H_2 for ICE and Fuel Cell Vehicles

Vehicle Performance Improvements

- BS VI Phase II –In-Use Performance Ratio, OBD II and In-service Conformity Factor
- HDFE
- LMDFE

Scrappage Policy

Effective from 25th Sept 2021

Phase out Unfit and Polluting vehicles

RRR and HMR are under discussion

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Light & Medium Duty Vehicle CSFC Norms (3.5T To 12T GVW)

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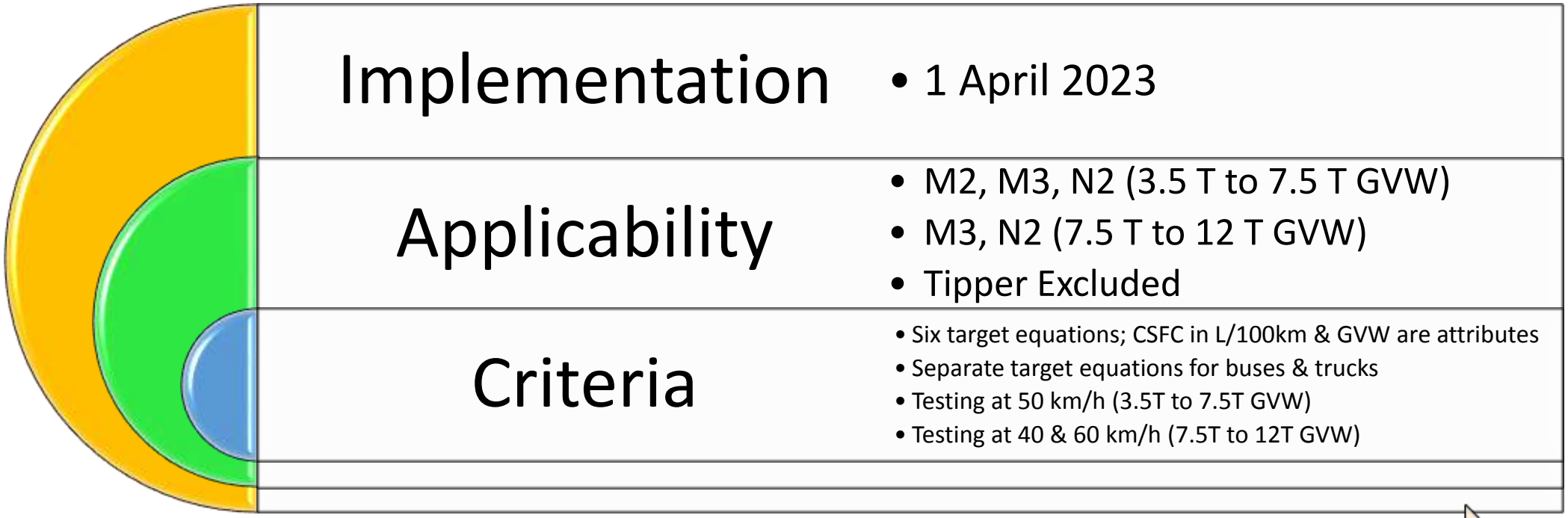
MoRTH issued Draft notification G.S.R. 503 (E) dated 01st July 2022 on Fuel Consumption Norms applicable for Light & Medium duty vehicles (GVW - 3.5T to 12T).



April 2023

- **For BSVI Light & Medium Duty Vehicles (3.5T to 12T GVW) excluding Tippers, Constant Speed Fuel Consumption (CSFC) Norms would be applicable from 1st April 2023. The draft MoRTH notification cross refers previously issued Ministry of Power (MoP) Notifications for mandatory compliance to CSFC Targets**
- **Correction factor of 1.05 to be applied on vehicle CSFC targets having GVW 3.5T to 7.5T**
- **Correction factor of 1.00 to be applied on vehicle CSFC targets having GVW 7.5T to 12T**

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Heavy Duty Vehicle CSFC Norms (> 12T GVW)

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MoRTH has issued Draft notification G.S.R. 503 (E) dated 01st July 2022 on CSFC Norms applicable for Heavy duty vehicles (GVW greater than or equal to 12T).

Implementation

- 1 April 2023
- Correction Factors for BS VI

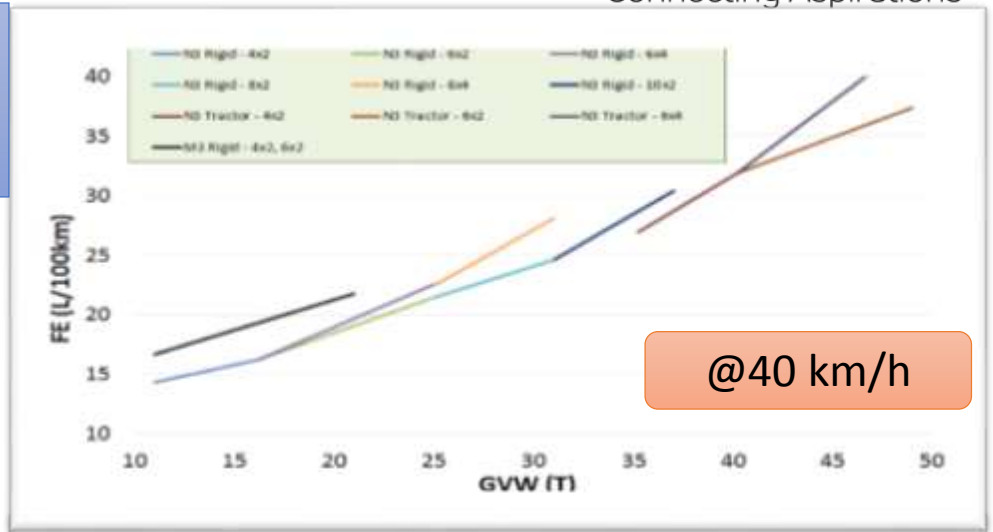
Applicability

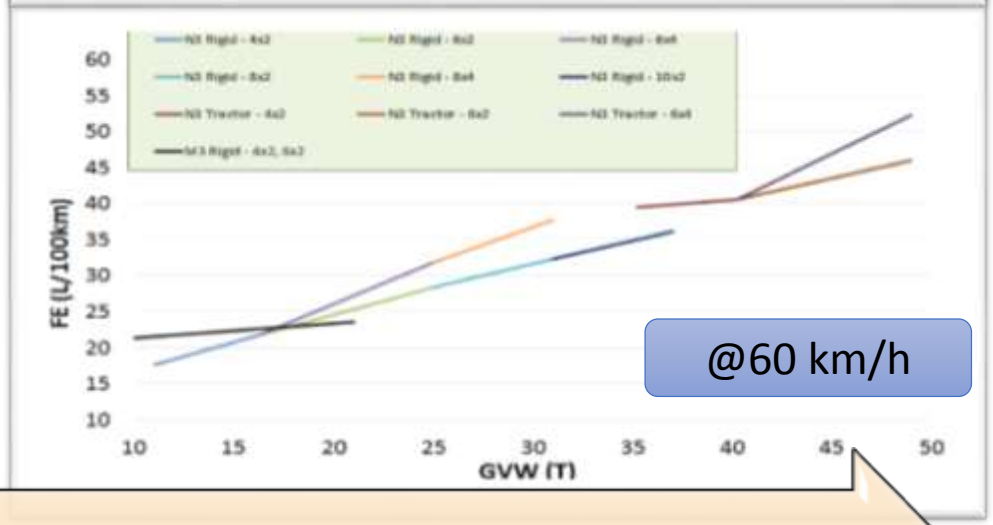
- M3 & N3 Category excluding Tippers
- GVW> 12 T

Criteria

- Targets in L/100km
- CSFC @ 40 & 60 km/h

April 2023





- For BSVI Heavy Duty Vehicles above 12T GVW excluding Tippers, Constant Speed Fuel Consumption (CSFC) Norms would be applicable from 1st April 2023. The draft MoRTH notification cross refers previously issued Ministry of Power (MoP) Notifications for mandatory compliance to CSFC Targets.
- Correction factor of 1.00 for BS-VI HDVs to be applied on already notified BS-IV HDVs FE norms equations for all sub-categories.

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Light, Medium & Heavy-Duty Vehicle CSFC Standard

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- MoRTH notified **FINAL Notification SO 4144 dated 2nd Sept 2022** pertaining to Constant Speed Fuel Consumption (CSFC) test for all M and N category vehicles excluding tippers, with gross vehicle weight more than 3.5 tonnes.
- **CSFC would be performed as per IS 11921:2020 version from 1st April 2023 (Currently IS 11921:1993 version is applicable).**
- The criteria to select the worst case vehicle for the test in a given family is defined in the standard (Criteria like Model with highest GVW, highest overall ratio, lower tyre rolling radius, highest frontal cross-sectional areas)

Conformity of production (CoP)

- Conformity of Production (CoP) requirements as per AIS 149 are notified by MoRTH vide draft notification GSR 503 (E) dated 1st July 2022.

FE & CO2 Regulation for HDVs in Europe (Simulation Approach)

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VECTO

SIAM
Society of Indian Automobile Manufacturers
Building the Nation, Responsibly

Vehicle Energy Consumption

VECTO
Vehicle Energy Consumption Calculation Tool

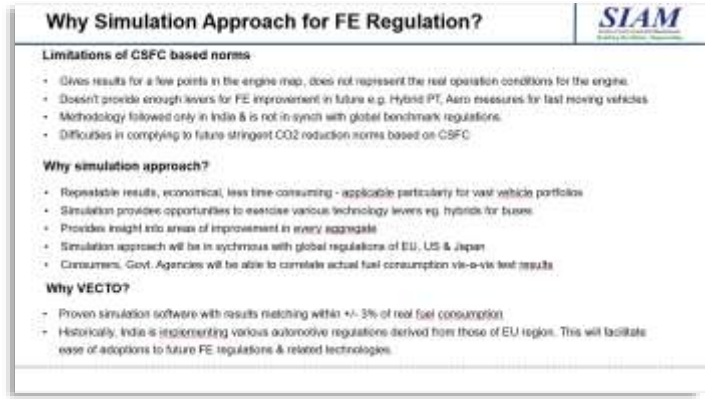
Simulation Tool for Heavy Duty vehicles (HDV)

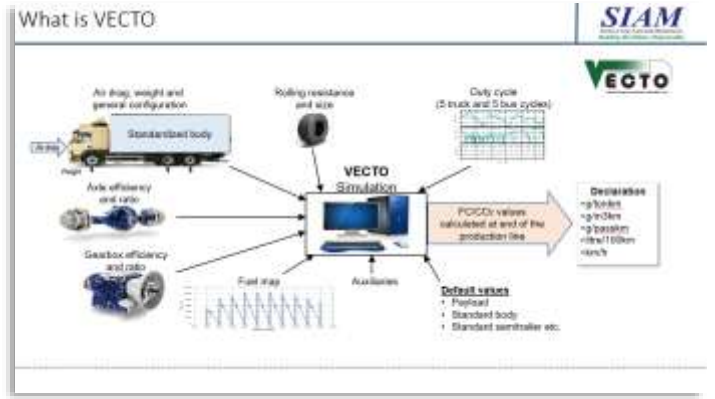
- **VECTO is the new simulation tool that has been developed by the European Commission and shall be used for determining CO_2 emissions and Fuel Consumption from Heavy Duty Vehicles (trucks, buses and coaches) with a Gross Vehicle Weight above 3500kg.**

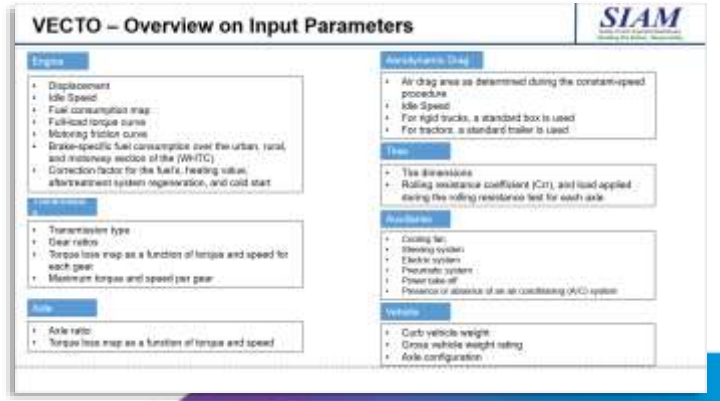
- From 1 January 2019 the tool will be mandatory for new trucks under certain vehicle categories in application to the certification legislation under type approval.
- As of 2019, the CO_2 emissions and fuel consumption data determined with VECTO, together with other related parameters, will be monitored and reported to the Commission and made publicly available for each of those new trucks.
- **Five different mission profiles for trucks and five different mission profiles for buses and coaches** have been developed and implemented in the tool to better reflect the current European fleet. VECTO is a downloadable executable file designed to operate on a single computer.
- The inputs for VECTO are characteristic parameters to determine the power consumption of every relevant vehicle component. Amongst others, **the parameters for rolling resistance, air drag, masses and inertias, gearbox friction, auxiliary power and engine performance** are input values to simulate fuel consumption and CO_2 emissions on standardised driving cycles.

Source: https://ec.europa.eu/clima/policies/transport/vehicles/vecto_en

The simulation approach provides unique data of CO2 & FC for each engineered and manufactured vehicle at lowest cost







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Important Considerations On Bharat VECTO

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- Common tool for Type approval & COP; should be available to OEMs on FOC basis for development
- Timeline for implementation based on development and learnings as well as transition time from European model.
- Classification of vehicle should be discussed and inclusion/non-inclusion of tippers.
- Support to ARAI by OEMs during development - Duty Cycles, Mission Profiles and Vehicle Identification.
- Relevance of VECTO in view of the various Alternate fuels and credits for them.
- Customization of tools for Indian applications (e.g. Cowl vehicle).
- Identification of the specialist for Tyre sub-group.
- Industry group to request BEE for external consultancy during execution of project by ARAI

EMISSION NORMS

Emissions Legislation

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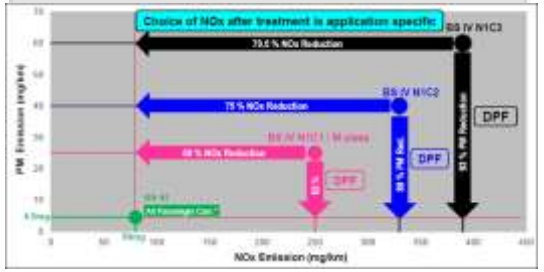
❖ *Emission standards are built on 4 main pillars:*

Legislation

Emission limits that define the maximum tailpipe emissions allowed.



Test cycle that defines how an engine or vehicle is operated for the emission test.

Test procedures that describe how to perform the tests and specifications for the test and measurement systems.

Equations describing how to calculate the final result.

- $(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}$

They are important for protection of the environment and the requirements for powertrain engineering.

They define the requirements for planning and operating a testbed and on field.

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Euro 6-7 & BS 6 Implementation Roadmap for Light Duty Vehicles

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Vehicle Class	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
M1, M2, N1, N2 < 3.5 T – EU	EU 2017/1151 (WLTP)				EU 2018/1832					WLTP Act 3						
M1, M2, N1, N2 < 3.5 T – IND	MoRTH / CMVR / TAP – 115/116				AIS 137 BS 6 Phase 1				AIS 137 BS 6 Phase 2				Draft AIS 175			

Switch from the NEDC to the WLTP test procedure without change of the EU6 emission limits.

EURO 6d - Temp

Sept 2017 WLTC + RDE (PN + NOx) (Temp. CF NOx 2.1 & Temp. CF PN 1.5)

EURO 6d-Temp-ISC — Jan 2019 WLTC+RDE+ISC

Sept 2019 WLTC+RDE+EVAP+ISC
EURO 6d-Temp-EVAP-ISC

Jan 2020
WLTC + RDE (PN + NOx)
EURO 6d-ISC-FCM
(Final CF NOx 1.43 & PN 1.5)-ISC-FCM

EURO 6e
Sept 2023
Euro 6d-ISC-FCM (Revised CF NOx 1.1 & PN 1.34)

EURO 6e-bis
Jan 2025
Euro 6e + Extension of RDE Ambient Condition, new UF concept factor for PHEV (based on available data)

Jan 2027
EURO 6e-bis-FCM
Euro 6e-bis + new UF concept factor for PHEV (based on data obtain directly from OBFCM)

Euro 7
Euro 6e-bis & Euro 6e-bis-FCM might get Integrated.
Applicable Date: TBD

April 2017 BS IV
MIDC
(ref. Euro 4)
(Nationwide)

April 2020 BS VI
MIDC + RDE Monitor + OBD 1 + ISC
(ref. Euro 6)
(Nationwide)

April 2023 BS VI
MIDC + RDE + OBD 2 + ISC + IUPR
(ref. Euro 6)
(Nationwide)

April 2027 WLTP - Under Discussion

Discussion for OBD III/FCM/Revised CF/BS 7 not initiated yet

India approaching for Emission Stage 6 WLTP procedure with stringent timeline

CF – Conformity Factor
PN – Particulate Number
NOx – Nitrogen Oxides
NEDC – New European Driving Cycle
WLTC/P – Worldwide Harmonized for Light Vehicle Test Cycle/Procedure
MIDC – Modified Indian Driving Cycle
ISC - Inservice Conformity procedure
EVAP- Evaporative Emissions
RDE – Real Driving Emission
OBD – On Board Diagnostics
FCM - Onboard Fuel and/or Electric Energy Consump. Monitoring

Euro 6-7 & BS 6 Implementation Roadmap for Heavy Duty Vehicles

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Vehicle Class		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
M & N > 3.5 T	EU	WHTC/WHSC																	
	IND	MoRTH / CMVR / TAP – 115/116								AIS 137 BS 6 Phase 1			AIS 137 BS 6 Phase 2				Standard Not Yet Initiated	

Jan 2013 – EURO 6: WHTC/WHSC + WNTE + PN Limits + OBD 1 + IUPR + RDE PEMS for CI

Sept 2014 – EURO 6b: Euro 6 + RDE PEMS for CI & PI (PEMS Power Threshold – 20% of Max Power)

Jan 2016 – EURO 6c: Euro 6b + OBD 2+ RDE PEMS CO,THC, NMHC, CH4, NOx CF 1.5

Sept 2018 – EURO 6d: Euro 6c + RDE (PEMS Power Threshold – 10% of Max Power)

Jan 2021 – EURO 6e: Euro 6d + RDE PEMS PN CF for CI + Addition of Cold Start Emissions in Data Evaluations of PEMS testing

Jan 2023 – EURO 6e: Euro 6d + RDE PEMS PN CF for CI & PI + Addition of Cold Start Emissions in Data Evaluations of PEMS testing

Euro 7 2025 ?
RDE - Discussion on PEMS testing of HEVs

April 2017 BS IV ESC/ETC (ref. Euro 4) (Nationwide)

April 2020 BS VI WHSC/WHTC + ISC PEMS Monitor (RDE for Gaseous Pollutants) + WNTE + OBD 1 (ref. Euro 6) (Nationwide)

April 2023 BS VI WHSC/WHTC + ISC PEMS CF (RDE for Gaseous Pollutants) + WNTE + OBD 2 + IUPR (ref. Euro 6) (Nationwide)

Discussion for OBDIII /FCM/Revised CF/ BS 7 not initiated yet

India approached for Emission Stage 6 procedure with stringent timeline

CF – Conformity Factor
CI – Compression Ignition
PI – Positive Ignition

ETC – Engine Transient Cycle
ESC – Engine Steady Cycle
WHTC – World Harmonised Transient Cycle
WHSC – World Harmonised Steady Cycle
WNTE – World Not-to-Exceed Limits
ISC - Inservice Conformity
PEMS – Portable Emission Measurement System
RDE – Real Driving Emission
OBD – On Board Diagnostics

FCM - Onboard Fuel and/or Electric Energy Consump. Monitoring

BS 6 Emissions for < 3.5t and > 3.5t Vehicles

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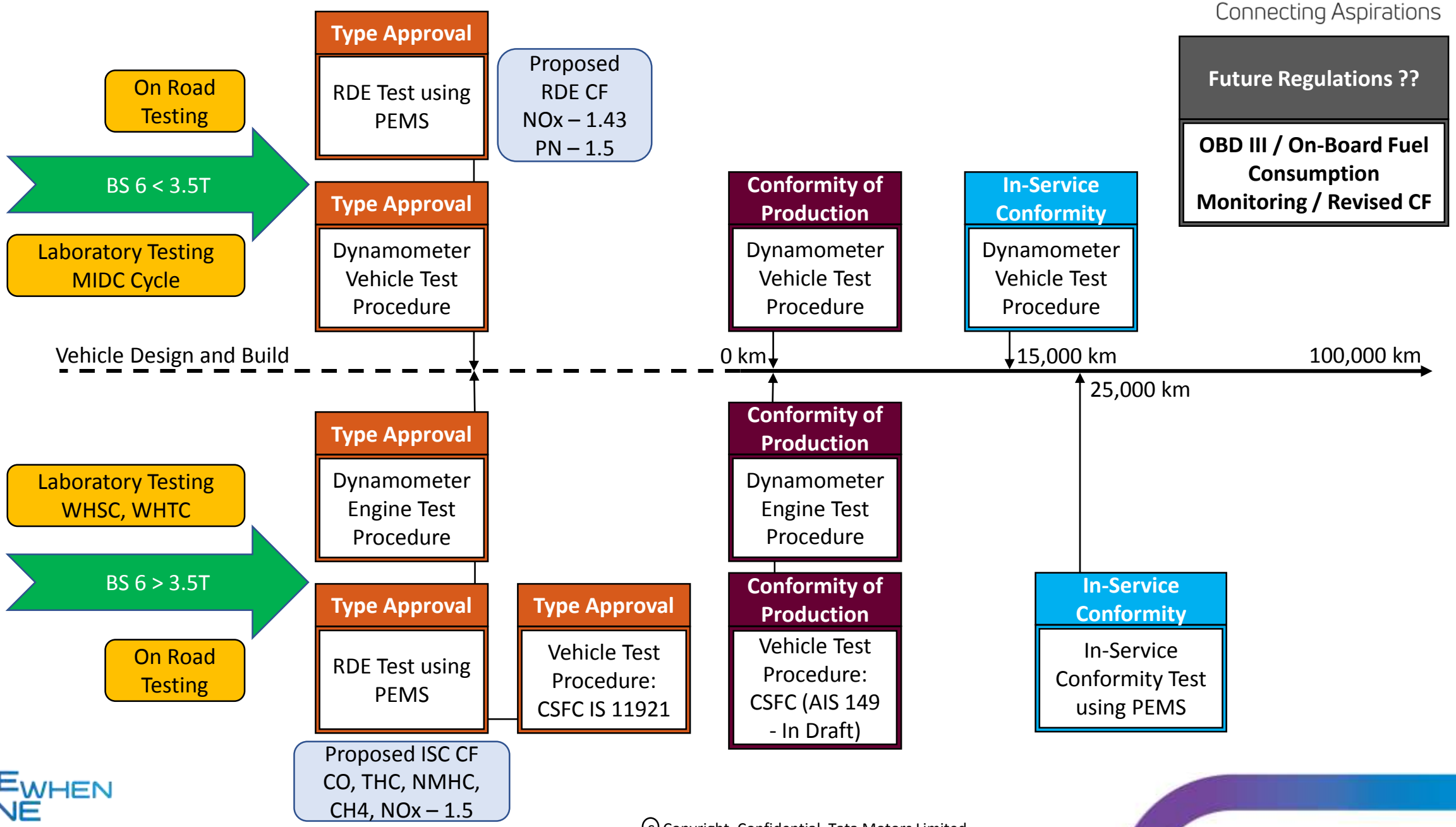

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FUELS

MoPNG Roadmap for Ethanol 20 Migration across India

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Ethanol Supply Year (Dec to Nov)	E10	E20	Estimated Ethanol Requirement (Cr Lit.)
2020-21	85%	0	332
2021-22	100%	0	437
2022-23	85%	15%	542
2023-24	50%	50%	698
2024-25	15%	85%	988
2025-26	0%	100%	1016

E20 Fuel Implementation Plan of GoI - 2022

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State	Phase 1 Cities (Preparedness by Mar'23)	Phase 2 Cities (Tentative) (Preparedness by June'23)
Bihar	Patna	
Delhi	Delhi	
Daman Diu & Dadra & Nagar Haveli	Daman & Silvassa	
Haryana	Chandigarh	Faridabad, Gurgaon, Panipat
Karnataka	Bengaluru	
Maharashtra	Mumbai, Pune, Thane, Nagpur	Aurangabad
Punjab	Chandigarh	Ludhiana, Amritsar
Uttarakhand	Dehradun	
Uttar Pradesh	Lucknow, Kanpur, Noida (Incl. Greater Noida)	Ghaziabad, Varanasi

Vehicle Technological Upgrades for Ethanol Blends & FFVs

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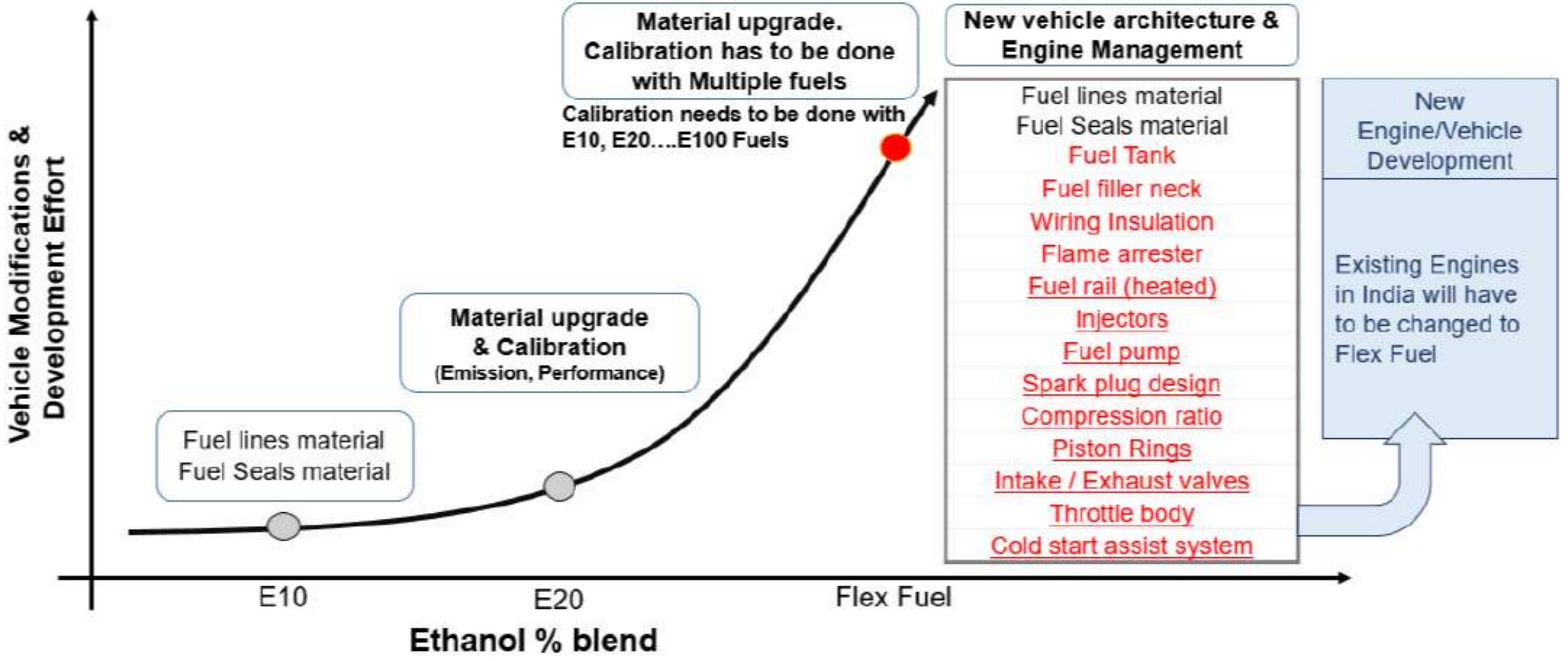

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National Hydrogen Mission

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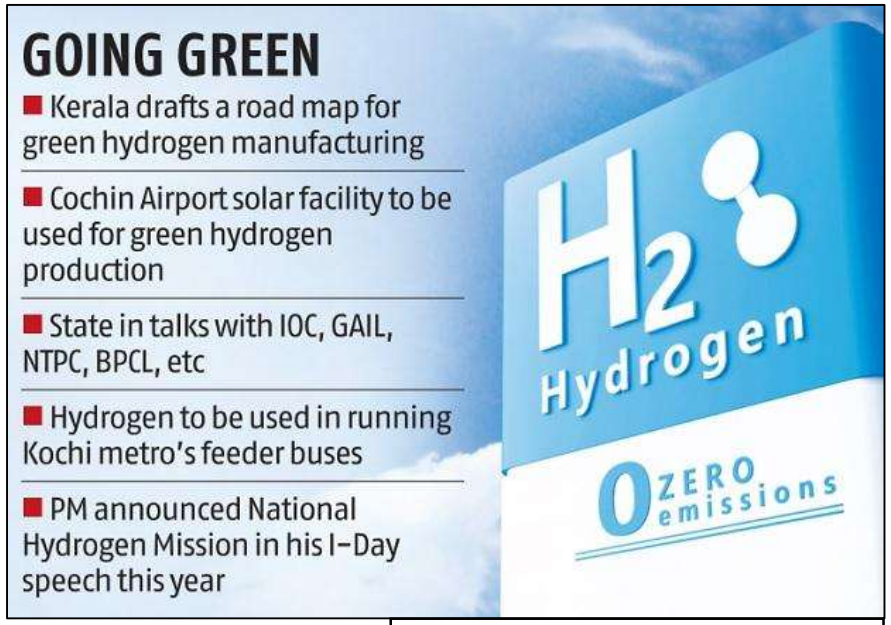
- Hon'ble Prime Minister launched the National Hydrogen Mission on India's 75th Independence Day (15th August 2021).

Aims to

- Harnessing the Hydrogen Energy to curb crude oil imports
- Develop India as a Global Hub for Hydrogen Technology
- Emerge as an Export Hub for Green Hydrogen and Green Ammonia.
- Robust Framework for Standards and Regulations
- Support to meet National Climate Targets and International commitments for clean energy.
- Production target of 5 million tonnes of Green hydrogen by 2030



*Business Standard 10th Sept 2021

H2 Regulations Scenario in India

Emissions	Safety	Under Formulation
• AIS 137 Part 3 (< 3.5t) • AIS 137 Part 4 (> 3.5t)	• AIS 157 – Fuel Cell Electric Vehicle **(Already notified in CMVR)**	• AIS 195 – H2ICE

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Way Forward

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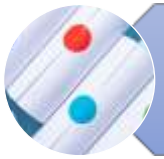
Stable & Credible Policy road map with sufficient lead time for emission, fuel availability & alternate energy - **Complemented by institutional mechanism for seamless implementation**

Need careful & balanced consideration while formulating fuel efficiency regulations – Based on **long term repercussion on sustainability**



The holistic approach requires not only for carbon neutral technologies & fleet electrification for Net Zero but also **enabling infrastructure, consumer education & through strict enforcement.**

Availability of E10 Protection Grade Fuel post 2025 shall be ensured - **Customer Centric Approach**

Vehicle purchase and Fleet renewal decisions will be driven more by value proposition than by price or brand name **– Technology, Market & Customer driven**

Challenge of striking a balance between cost of technology, value added services, safety interventions, infrastructure limitations/upgrades, retention of jobs & new job creations and purchasing capacity of our populace – **Collectivism & togetherness is required**

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Thank You

Outline of AIS 175 (WLTP Regulation) : Introduction

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Type 1 - Emissions of Gaseous Compounds, PM, PN & to Emissions of CO2 and FE and/or the measurement of Electric Energy Consumption and Electric Range	• UN GTR No. 15 Amendment 6 • UNR 154 Revision 1, 2 and 3
Type 2 - Idle and High Idle Emissions / Free Acceleration Smoke	• AIS 137 part 3 (Amendment 1,2,3,4)
Type 3 – Crankcase Emissions	• AIS 137 part 3 (Amendment 1,2,3,4)
Type 4 – Evaporative Emissions	• UN GTR No. 19 Amendment 3
Type 5 – Durability of Pollution Control Devices	• UN GTR No. 15 Amendment 6
OBD – On Board Diagnostic	• UN GTR No. 15 Amendment 6

Outline of AIS 175 (WLTP Regulation) : Introduction

TATA MOTORS
Connecting Aspirations

RDE (Real Time Driving Emission)	• WLTP RDE procedure based on draft UN GTR on global RDE procedure.
ISC - In-Service Conformity	• Commission Regulation (EU) 2017/1151 as amended by (EU) 2017/1154, (EU) 2017/1347 and (EU) 2018/1832.
Auxiliary Emission Strategy (AES) / Base Emission Strategy (BES)	• AIS-137 part 3 Amendment (1,2,3,4)
Pure Electric Vehicles / Hybrid Electric Vehicles	• UN GTR No. 15 Amendment 6
CoP – Conformity of Production	• UN GTR No. 15 Amendment 6 • AIS 137 part 6 – Administrative Procédure
CAFÉ – Corporate Average Fuel Economy	• AIS 137 part 3 (Amendment 1,2,3,4)
Coast Down - Road Load Determination	• UN GTR No. 15 Amendment 6 • UNR 154 Revision 1, 2 and 3

MOREWHEN ONE
BE BOLD | OWN IT | SOLVE TOGETHER | BE EMPATHETIC