Fuel Efficiency Norms for Heavy Duty Vehicles

Presented By: Sumant Kumar

Agenda

- ***Impact of Growing Economy in India***
- ***Why FE Norms for Heavy Duty Vehicles***
- ***Development of Fuel Economy norms for heavy duty vehicles.***
- ***Formation of Steering Committee***
- ***BEE Notification***

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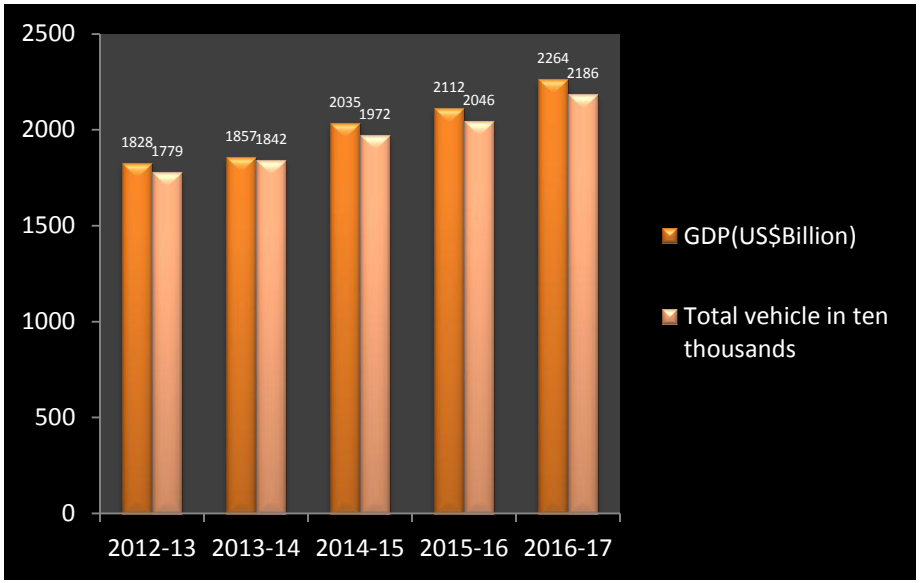
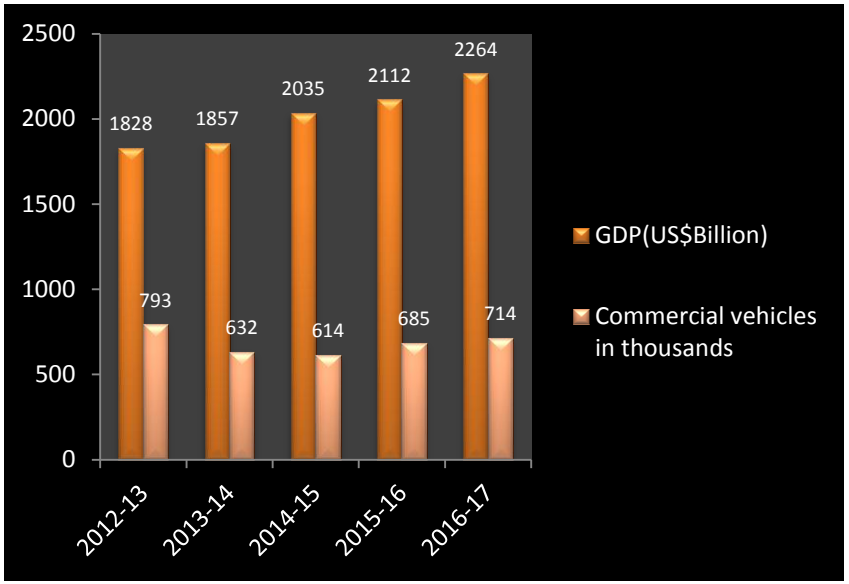
Automobile Domestic Sales Trend

Total Vehicles



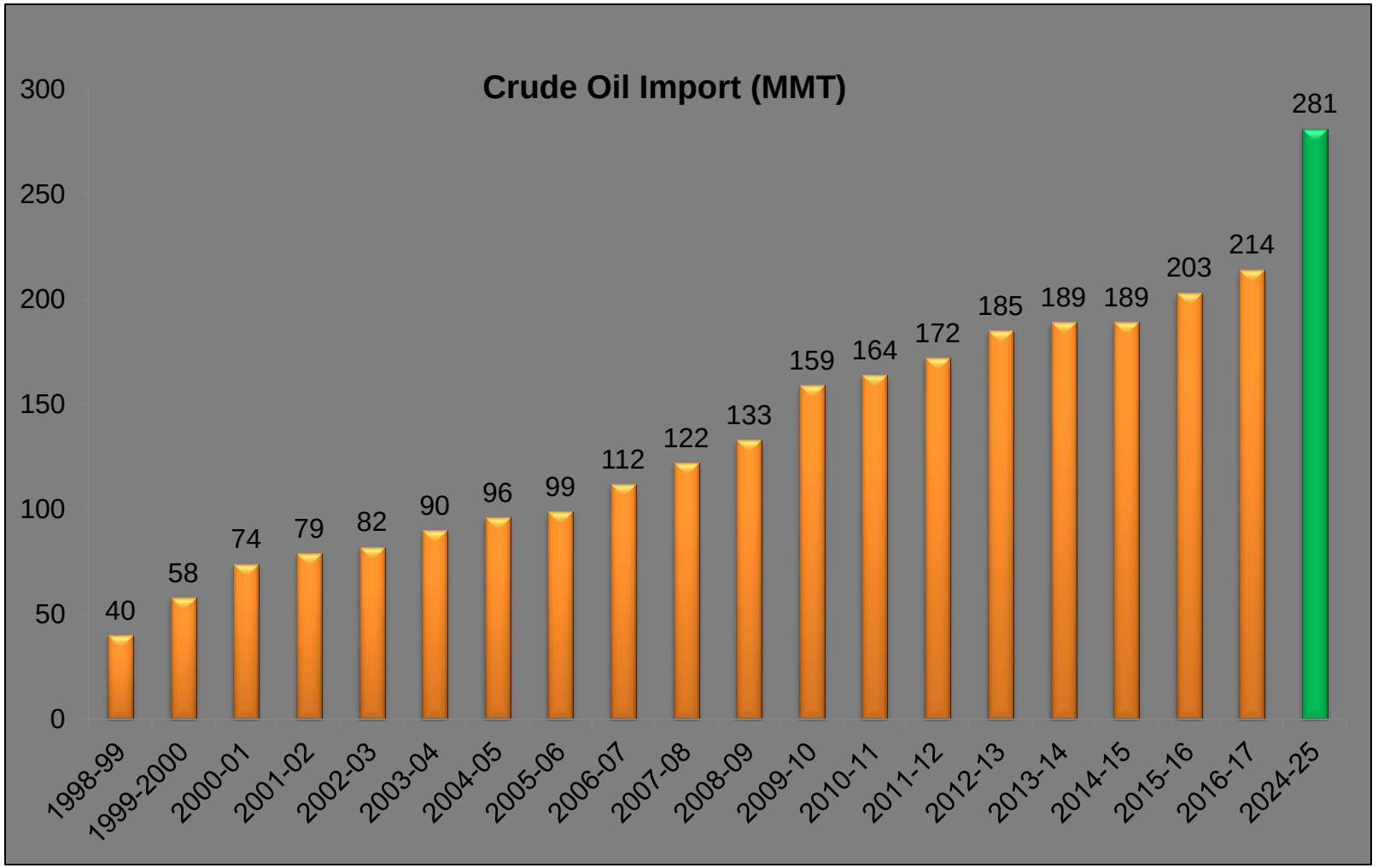
Commercial Vehicles



Year	GDP(US$Billion)	Total vehicle in ten thousands	Commercial vehicles in thousands
2012-13	1828	1779	793
2013-14	1857	1842	632
2014-15	2035	1972	614
2015-16	2112	2046	685
2016-17	2264	2186	714

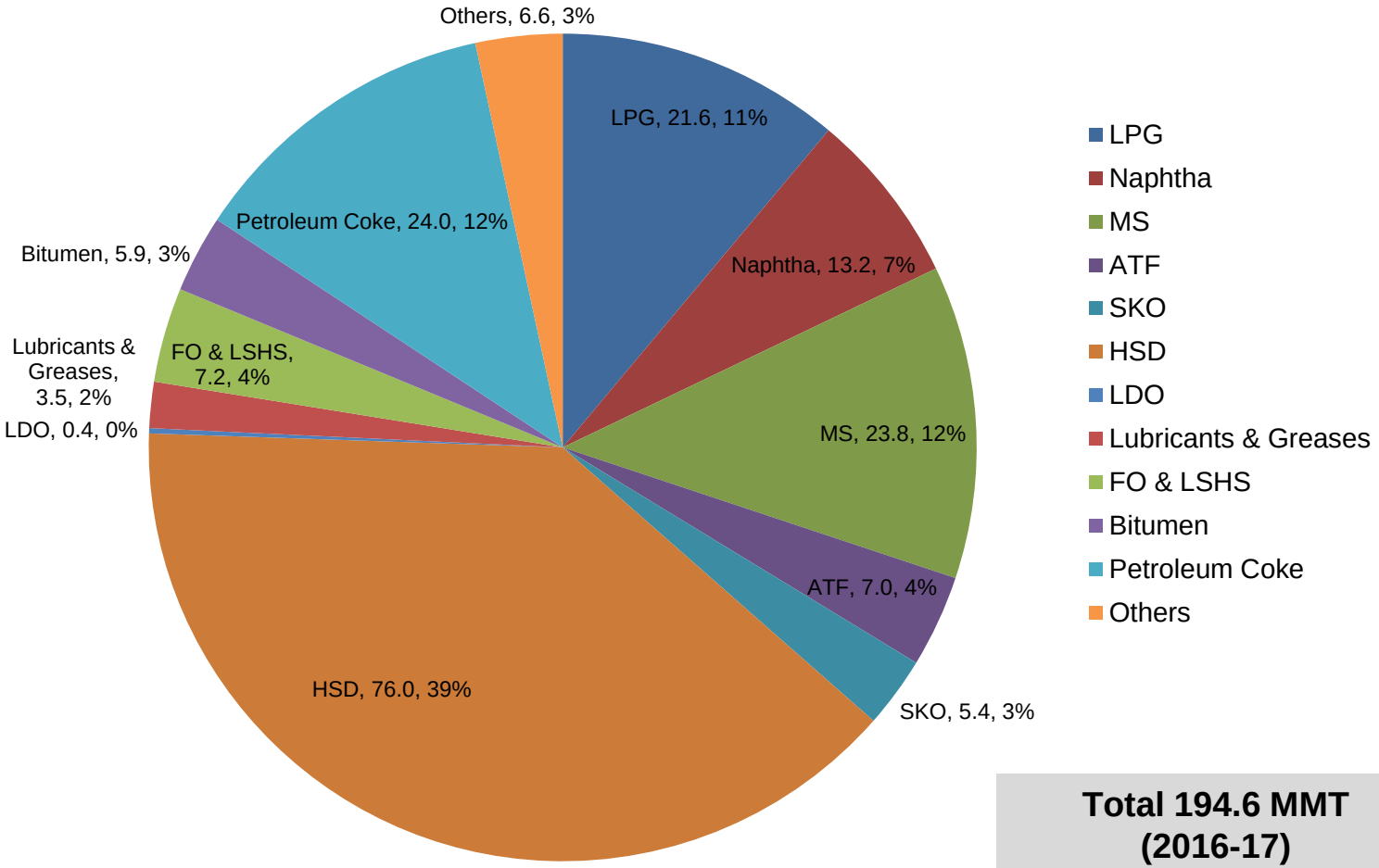
***** Source SIAM & World Bank***

Crude Oil Import (MMT)



** Source PPAC

India's Consumption Pattern of Petroleum Products

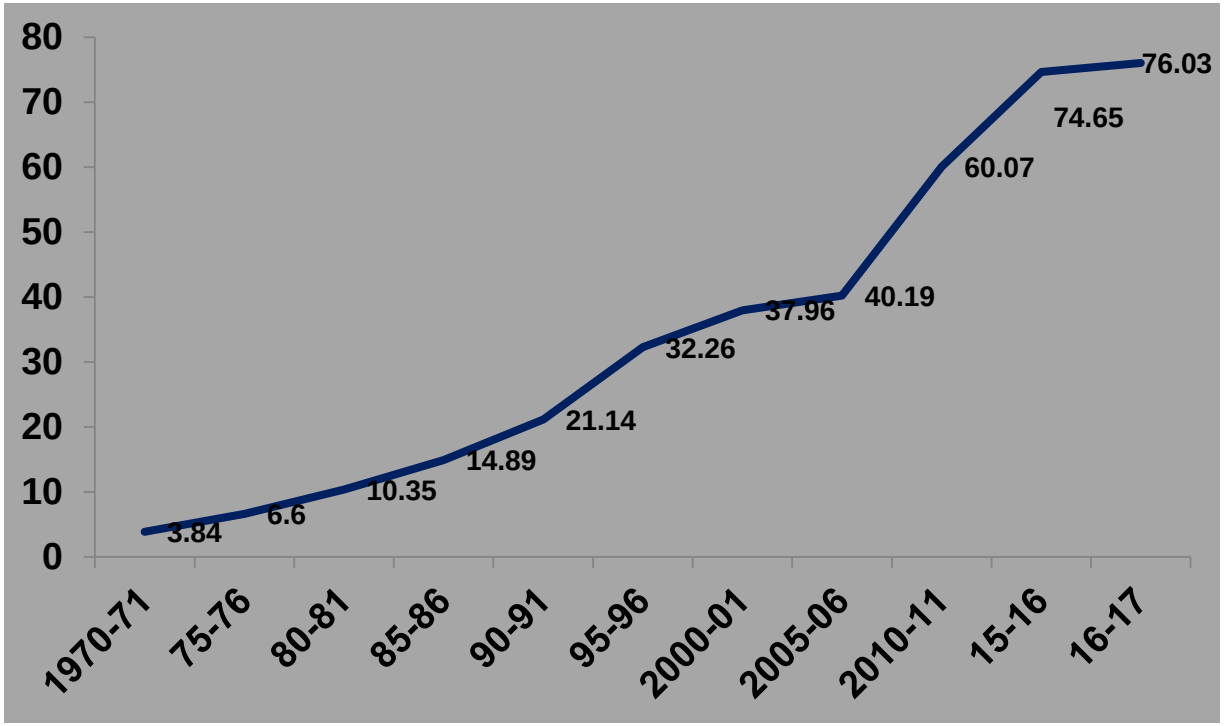


Total 194.6 MMT (2016-17)

No in Million Metric Tons

***** Source PPAC***

Trends in consumption of diesel in India (Million Tonnes)

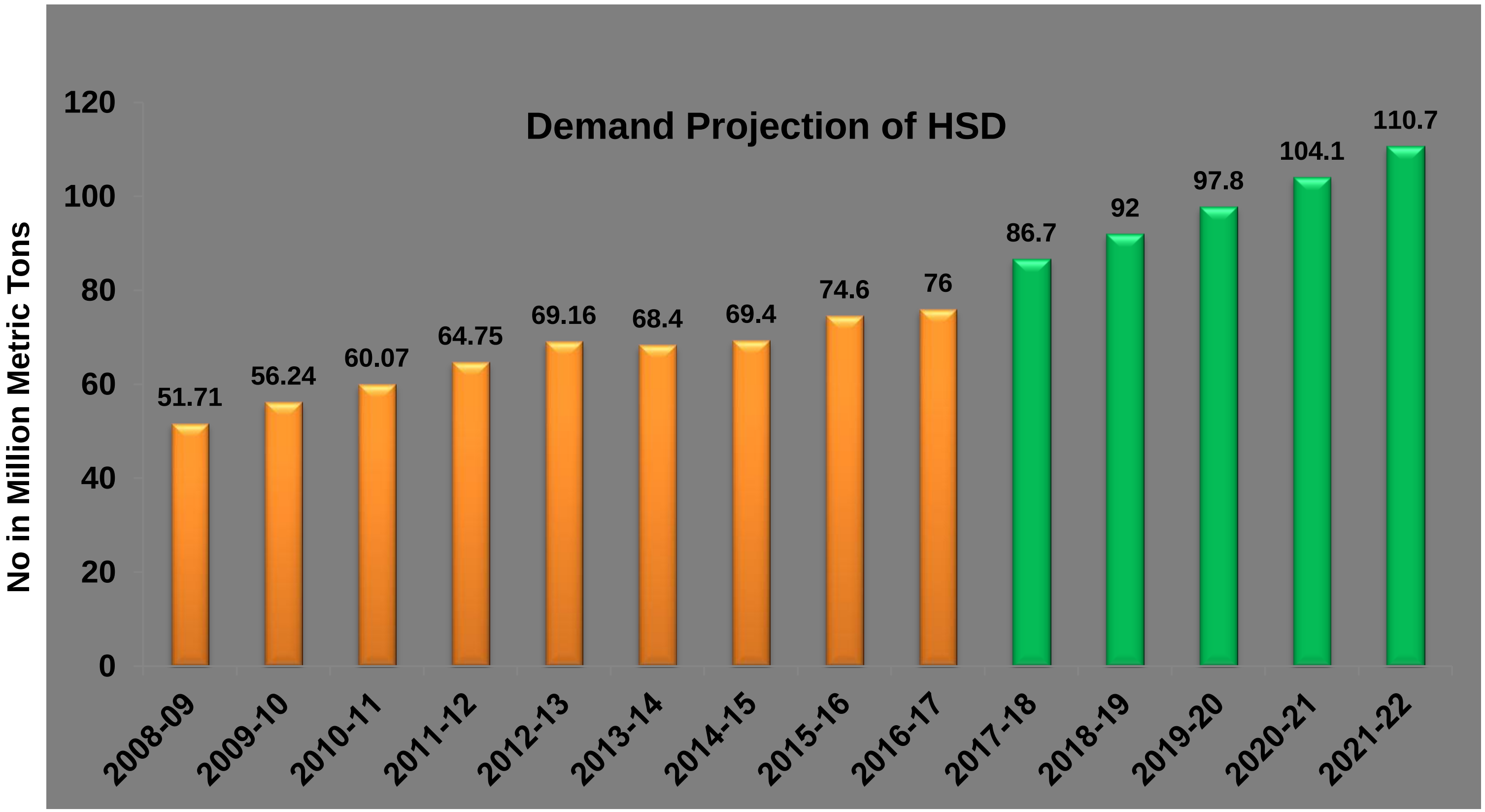


1970-71	3.84
1975-76	6.6
1980-81	10.35
1985-86	14.89
1990-91	21.14
1995-96	32.26
2000-01	37.96
2005-06	40.19
2010-11	60.07
2015-16	74.65
2016-17	76.03

CAGR 7%

*** Source PPAC*

Demand Projection of HSD in India



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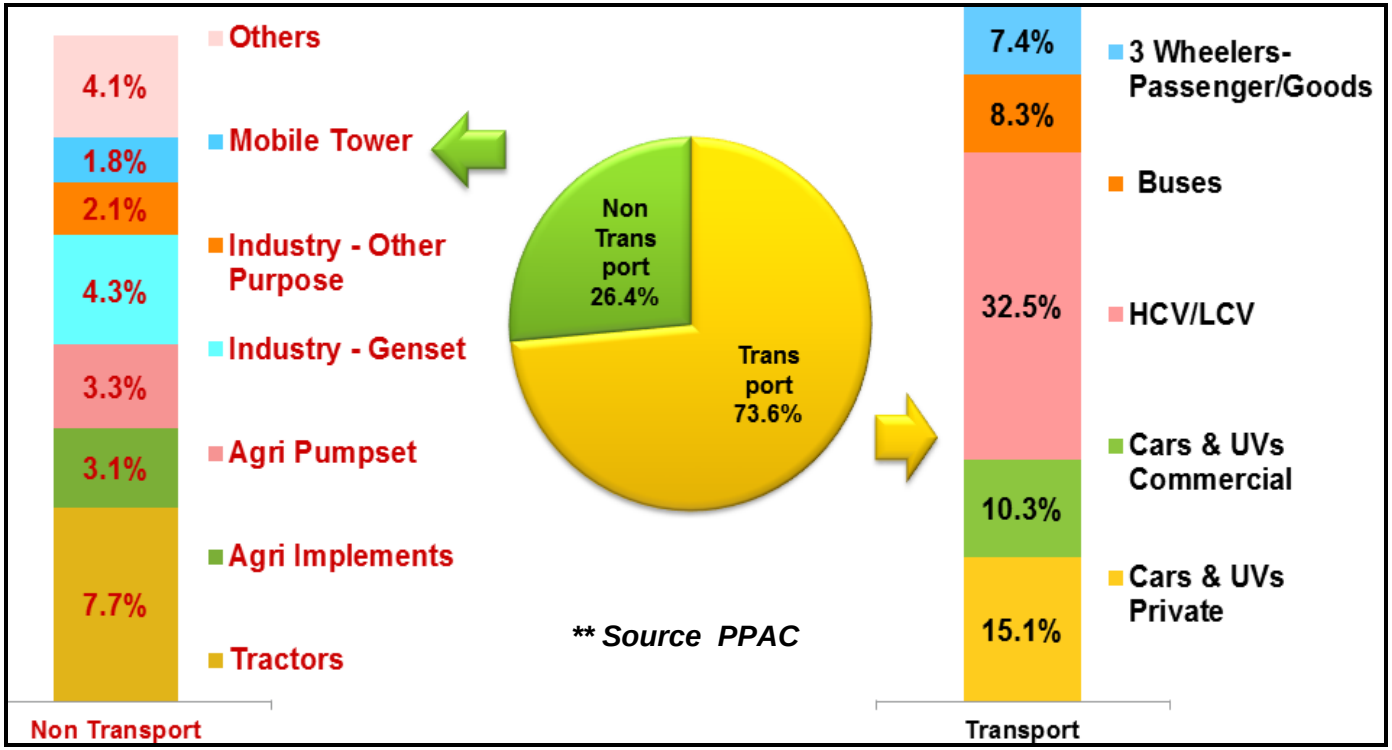
Pattern of HSD consumption in India

Background :

- ❖ India's requirement of HSD to increase from 76.03 MMT in 2016-17 to 110.7 MMT in 2021-22.
- ❖ Major Consumption is by Heavy Duty Vehicles (trucks and buses).



Factors causing energy loss in HDVs

Figure depicts Energy loss in vehicles caused due to various factors and potential energy savings.

No in Million Metric Tons

Types	Urban / Intercity (percent)	Potential of energy savings (percent)
Engine Losses	60	28
• Heat rejection	26	
• Exhaust heat	24	
• Gas exchange	4	
• Friction	1.5	
• Engine accessories	2.5	
Aerodynamic losses	4-10 / 21	11.5
Drivetrain losses	5-6 / 2	
Braking losses	15-20 / 0-2	
Auxiliary loads	7-8 / 4	
Rolling resistance	8-12 / 13	11

Engine losses account for maximum losses.

***** Source NRC***

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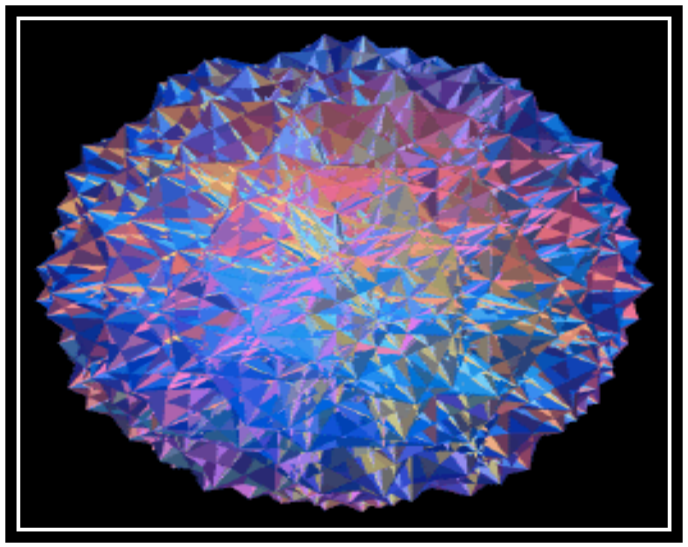
Fuel consumption standards typically includes

- ✓ **Approaches to the design of fuel consumption target values**
- ✓ **Stringency of the target**
- ✓ **Timing of Introduction**
- ✓ **Compliance roadmap**

Dimensions of Fuel consumption standards

- ❑ Fuel consumption standards based on
  - GVW or Kerb weight
  - Segments of buses and trucks
- ❑ Type of Fuel consumption standards
  - Engine standards
  - Vehicle standards
- ❑ Unit(s) of fuel consumption standards- km/L or L/km or L/ton-km or L/k Wh
- ❑ Testing procedure for fuel economy test
  - On road testing
  - Engine testing
  - Chassis + Engine testing
  - Computer simulation
- ❑ Test cycles for fuel consumption testing



HDV Global Regulatory Landscape

- **Only four countries in the world currently have HDV CO2/efficiency standards**

Country	HDV efficiency regulation in place	Regulations under consideration
U.S.	✓	✓
China	✓	✓
EU-27		✓
India		✓
Japan	✓	✓
Brazil		✓
Canada	✓	✓
Russia		✓
Mexico		✓
S.Korea		✓

**Source: ICCT

Fuel consumption norms for buses and trucks in other countries

Country/Region	Standard	Measure	Structure	Targeted Fleet	Test Cycle	Implementation
Fuel consumption standards						
United States	Fuel	mpg	Single standard for cars and size based standards for light trucks	New	U.S. Café	Mandatory
Japan	Fuel	km/l	Weight-based	New	JC08	Mandatory
China	Fuel	l/100-km	Weight-based	New	NEDC	Mandatory
Australia	Fuel	l/100-km	Single standard	New	NEDC	Mandatory
South Korea	Fuel	km/l	Engine size based	New	U.S.EPA City	Mandatory
Taiwan	Fuel	km/l	Engine size based	New	U.S. Café	Mandatory
Emission standards						
European Union	CO2	g/km	Single standard	New	NEDC	Voluntary
Canada	GHG (CO2,CH4, N2O, HFC5)	l/100-km	Vehicle class-based	In-use and new	U.S. Café	Mandatory
California	GHG (CO2,CH4, N2O, HFC5)	g/mile		New	U.S. Café	Mandatory

Major challenge in setting up fuel consumption standards

- One of the pre-requisites for development of fuel consumption standards is collection of **baseline data** for various models of buses and trucks under pre-defined test conditions.

- For establishing the baseline for fuel consumption standards, fuel consumption or **fuel economy data under standardised test conditions is required for each model of buses and trucks** for all manufacturers for the baselines year.

- One of the biggest **challenges** for developing fuel consumption standards for trucks and buses was **non-availability of any reported fuel economy data** of trucks and buses, either by manufacturers or government bodies.

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Process followed

- Formation of Steering committee by MoP&NG.
- Formation of sub-committes
- Formation of working groups
- Submission of reports to BEE by the steering committee
- Notification of Norms by BEE
- Implementation by MoRTH

FE Norms for Heavy Duty Vehicles

Project Approach

Stakeholder Consultation

- Interactions were performed with **Labs & Manufacturers Association** to assess the test capacity methods and market structure of HDV segment

Vehicle Classification

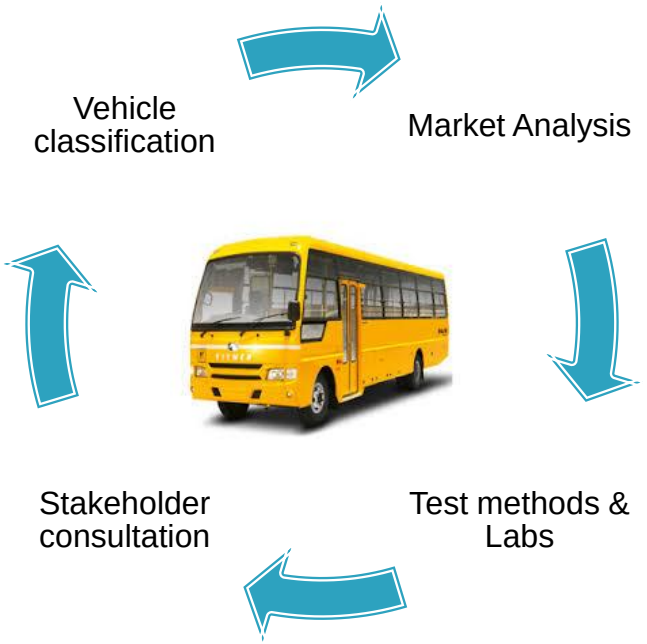
- Vehicle Classification was done to identify the category of **vehicles to be covered under the HDV FE norms** i.e. passenger carriers and good carriers.

Market Analysis

- Market Analysis was done to analyze the market size of **HDV M and N category.**

Test Methods & Labs

- **Analysis of test methods** national & international **and laboratory capacity** assessment was done to understand the facility in place in India to undertake the HDV testing.



FE Norms for Heavy Duty Vehicles

Vehicle Classification

Vehicle Category	Category Name	Category Details (GVW in Tons)
Buses (Carrying Passengers)		
Category – M_1	Car 	< 3.5T
Category – M_2	Bus 	< 5T
Category – M_3	Bus 	5T
Trucks (Carrying Goods)		
Category – N_1	LCV 	≤ 3.5T
Category – N_2	MCV 	3.5T ≤12 T
Category – N_3	HCV 	12 T

FE Norms for Heavy Duty Vehicles

Test Methods

S. No.	Type of Test	Simulation of	Countries considering fuel consumption norms for HDVs
1.	**On-road**	NA	India 
2.	**Chassis Dynamometer**	Road	China 
3.	**Engine Dynamometer**	Road and non-engine components	US, EU, Japan   
4.	**Computer Simulation**	All	US, EU, Japan, China    

FE Norms for Heavy Duty Vehicles

Lab Capacities in India

Parameters	ARAI	VRDE	ICAT	CIRT
Test Track	NA	Available	Development under process	NA
Facility for chassis Dynamometer	Yes	Yes	Yes	NA
Facility for Engine Dynamometer	Yes	Yes	Yes	Yes
FE – Test Equipment	Yes	Yes	Yes	Yes
Trained Manpower	Yes	Yes	Yes	Yes
NABL Accreditation	Yes	Yes	Yes	Yes

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CSFC standards for HDVs-1st phase(W.e.f 1.4.18)

N3 Rigid vehicles at 40 km/h		
Gross vehicle weight range	**Axle configuration**	**Equation for deriving target fuel consumption (1/100km)**
12.0-16.2	4x2	Y=0.362X+10.327
16.2-25.0	6x2	Y=0.603X+6.415
16.2-25.0	6x4	Y=0.723X+4.482
25.0-31.0	8x2	Y=0.527X+8.333
25.0-31.0	8x4	Y=0.928X-0.658
31.0-37.0	10x2	Y=0.960X-5.100

N3 Rigid vehicles at 60 km/h		
Gross vehicle weight range	**Axle configuration**	**Equation for deriving target fuel consumption (l/100km)**
12.0-16.2	4x2	Y=0.788X+9.003
16.2-25.0	6x2	Y=0.755X+9.546
16.2-25.0	6x4	Y=1.151X+3.122
25.0-31.0	8x2	Y=0.650X+12.160
25.0-31.0	8x4	Y=0.968X+7.692
31.0-37.0	10x2	Y=0.650X+12.160

X = Gross vehicle weight in tonnes
Y = Normalized value (fuel consumption) in litres/100kms

CSFC standards for HDVs-2nd phase(W.e.f 1.4.21)

N3 Rigid vehicles at 40 km/h		
Gross vehicle weight range	**Axle configuration**	**Equation for deriving target fuel consumption (l/100km)**
12.0-16.2	4x2	Y=0.329X+9.607
16.2-25.0	6x2	Y=0.523X+6.462
16.2-25.0	6x4	Y=0.673X+4.032
25.0-31.0	8x2	Y=0.430X+8.780
25.0-31.0	8x4	Y=0.732X+2.558
31.0-37.0	10x2	Y=0.963X-7.753

N3 Rigid vehicles at 60 km/h		
Gross vehicle weight range	**Axle configuration**	**Equation for deriving target fuel consumption (l/100km)**
12.0-16.2	4x2	Y=0.600X+9.890
16.2-25.0	6x2	Y=0.515X+11.271
16.2-25.0	6x4	Y=0.932X+4.515
25.0-31.0	8x2	Y=0.382X+14.598
25.0-31.0	8x4	Y=1.318X-5.148
31.0-37.0	10x2	Y=1.043X-5.913

X = Gross vehicle weight in tonnes
Y = Normalized value (fuel consumption) in litres/100kms

CSFC Standards for HDVs

Salient features- BEE Notification

- **Norms for HDCV of category M3 and N3**
- **GVW> 12 T in accordance with CMVR 1989**
- **1st phase of the norms are effective 1.4.18 & the 2nd phase from 1.4.21**
- **FC of each vehicle of a particular category shall be< FC value derived from the equation of that category**
- **Applicable to vehicles complying with BS IV emission norms**
- **For BS VI emission norms , a suitable correction factor would be used**
- **Testing method would be CSFC**
- **MoRTH to enforce the norms**
- **Conformity of production (COP), by MoRTH, to be once in 2 years**

Benefits

- Reduced dependency on import
- Reduced carbon emission
- Money saving
- Increase in energy sustainability
- Step forward to align with the world on environment protection

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