



Clean Fuels – Technology & Regulatory perspective

Dr. Sukrut Thipse

Senior Deputy Director

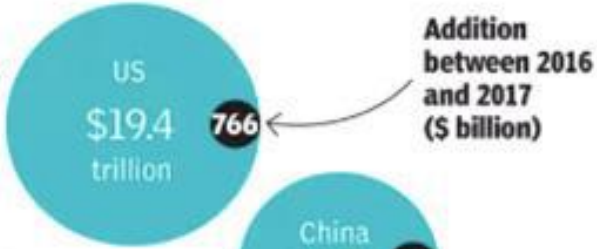
Automotive Research Association of India (ARAI)



India's Vibrant Economy

INDIAN ECONOMY TO DOUBLE TO \$5 TRILLION BY 2025

10 largest economies in 2017



If India keeps adding just this much to its GDP every year, it will be a \$5-trillion economy by 2025

337 ● 2.6 India

262 ● 2.1 Brazil

206 ● 3.7 Germany

117 ● 2.6 France

117 ● 1.7 Canada

78 ● 1.9 Italy

-36 ● 2.6 UK

-77 ● 4.9 Japan

\$337 billion is more than the GDPs of 158 countries, including Pakistan, Bangladesh and Malaysia

Atmanirbhar Bharat The Road Ahead

5 Pillars of Self-Reliant India

- Economy**: Quantum jumps, not incremental changes
- Infrastructure**: One that represents modern India
- System**: Technology driven
- Demography**: Vibrant demography of the largest democracy
- Demand**: Full utilisation of power of demand and supply



Sustainable Mobility is the need of the hour

1



Energy Security

In FY22, **\$120 Bn** oil imports which accounts for **>85%** import dependency

2



Global Commitment

Reduction of **45%** carbon intensity & **1 bn** tonne of CO₂ by 2030

3



Pollution Mitigation

22/30 most polluted cities in the world are in India

Indian Automotive Industry is aligned with the Government of India's vision & priorities towards sustainability



India's Emission Profile

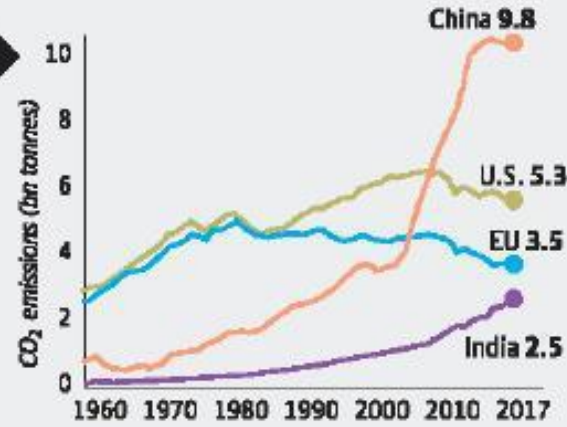
Country	CO ₂ Emissions per year (billion tons)	%age Share in Global Annual Emissions	CO ₂ Emissions per capita (tons/person)
World	34.5	100%	4.9
China	9.86	28.6%	7.1
United States	5.19	15.1%	16.4
European Union	3.74	10.9%	7.4
India	1.97	5.7%	1.6
Russia	1.77	5.1%	12.4
Japan	1.32	3.8%	10.4

Local Air Pollution is a Concern

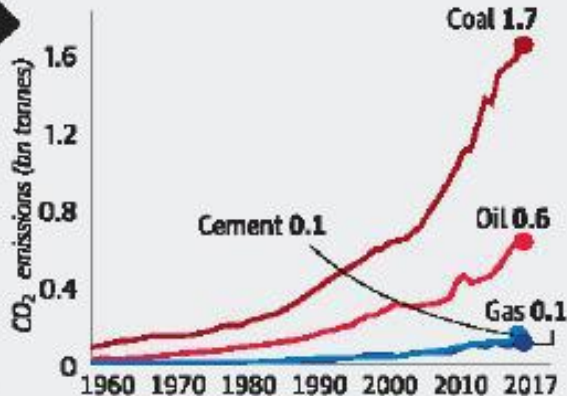
A breath of foul air

Global CO₂ emissions have risen steadily over the decades. China's emissions accounted for 27% of the global total. India was the third-highest contributor

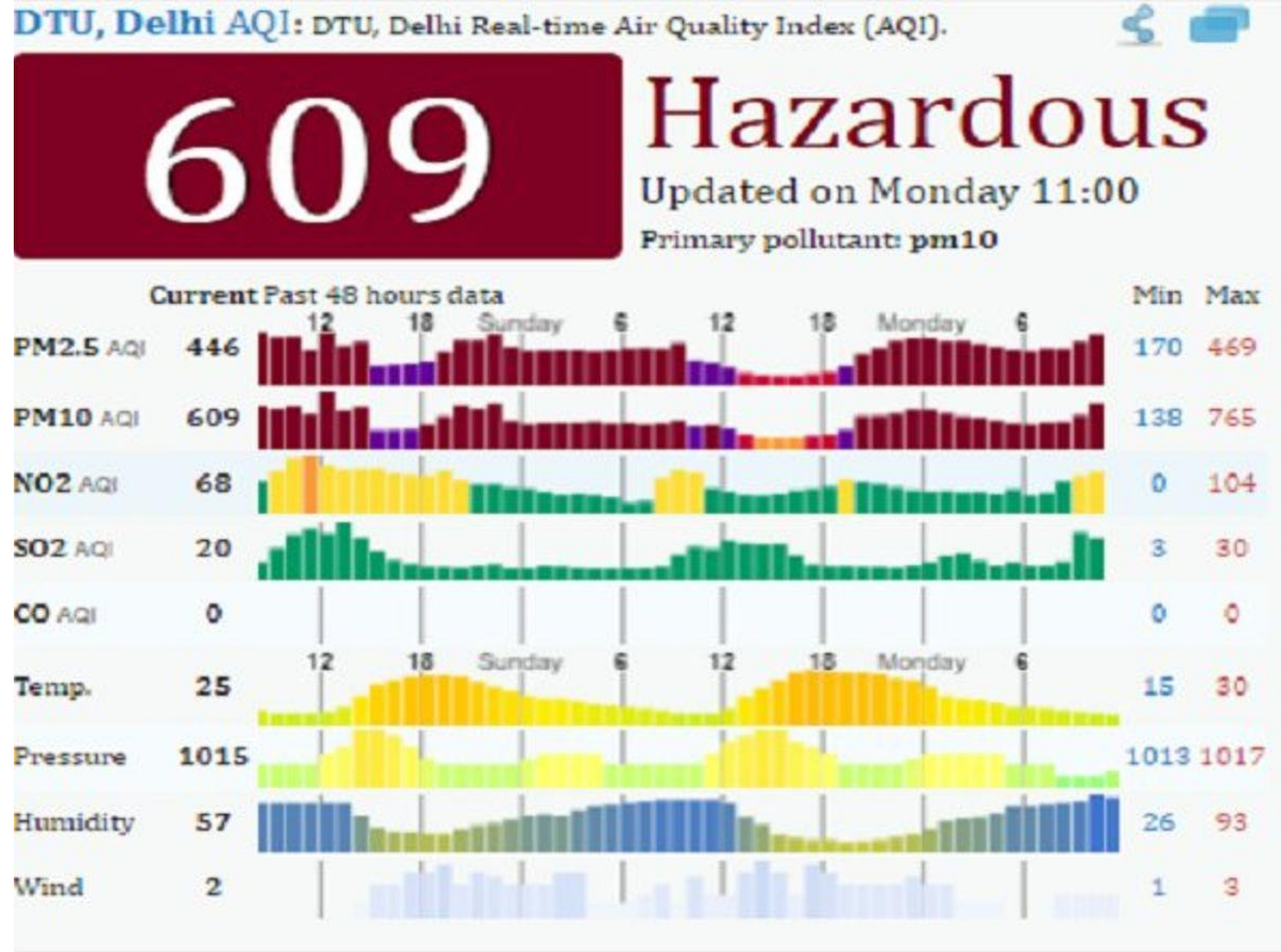
India's projected carbon emission of 2.6 billion tonnes in 2018 would account for 7% of the global CO₂ levels, which are set to hit an all-time high this year



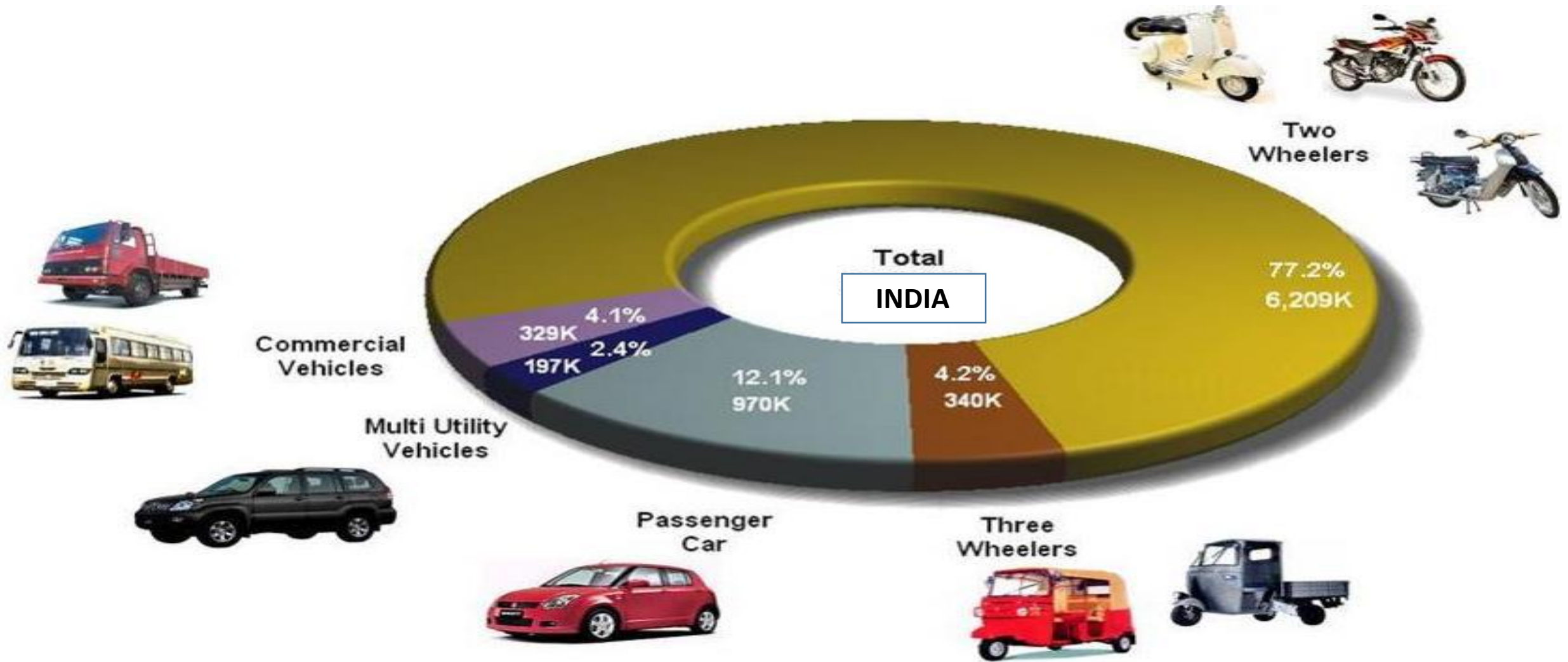
Although India is rapidly going in for solar and wind power, coal usage continues to grow strongly. Coal is responsible for 65% of India's CO₂ emissions



Air Quality Index (AQI) – Concern in Cities

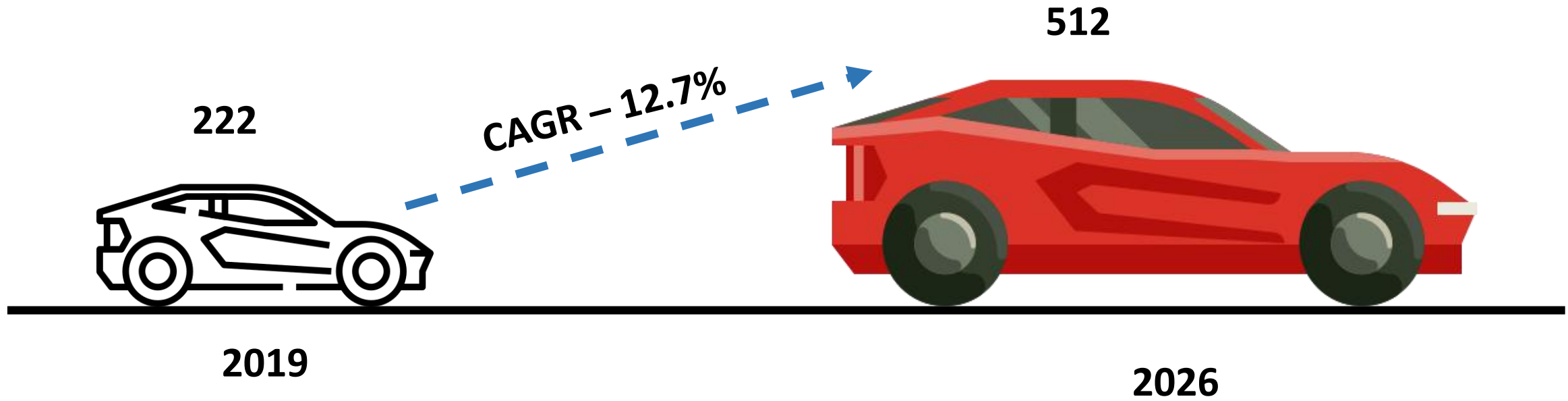


Vehicle Distribution Profile in India

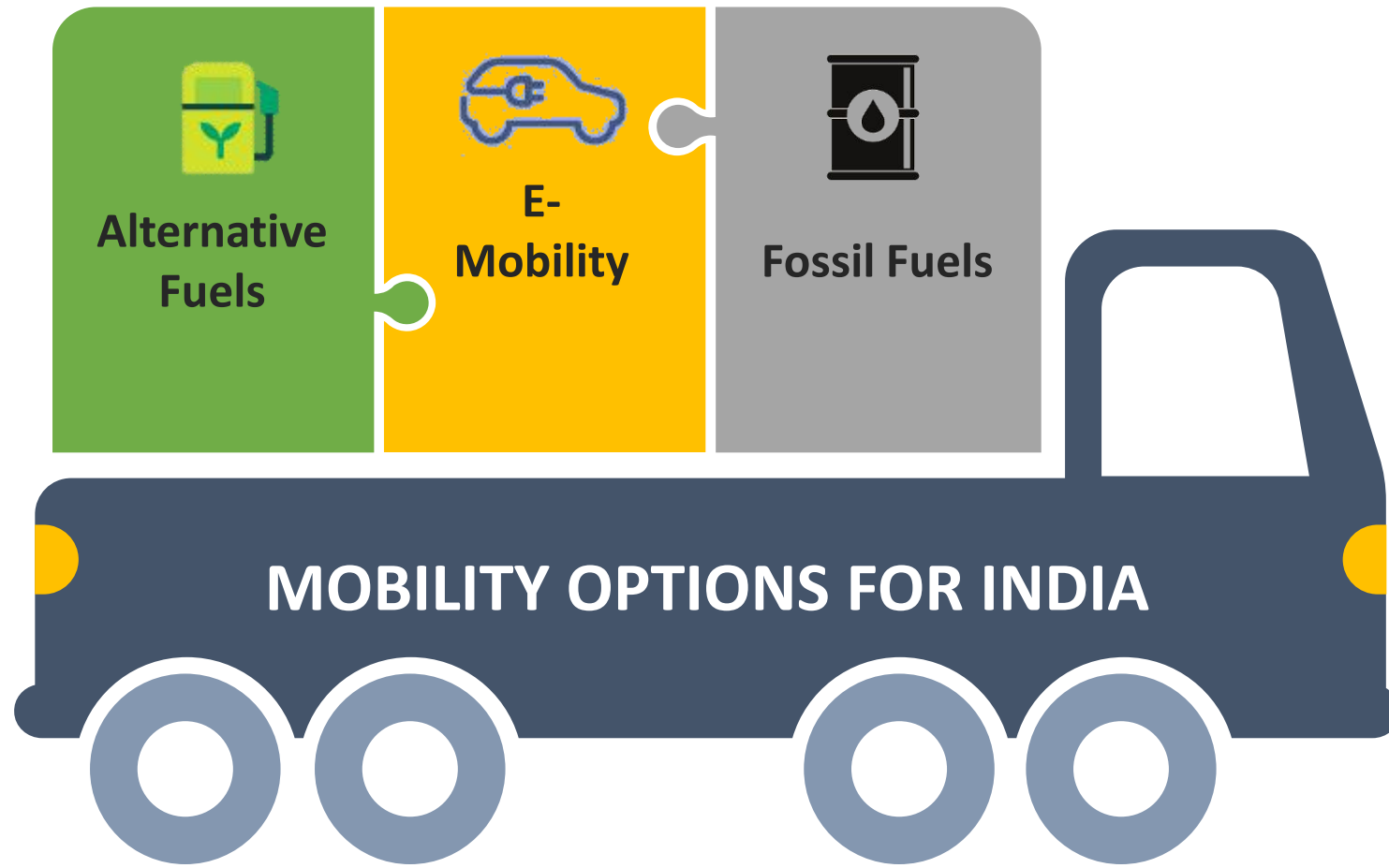


AUTOMOBILE MARKET IN INDIA

(includes new, used vehicles and associated services (In USD billion))



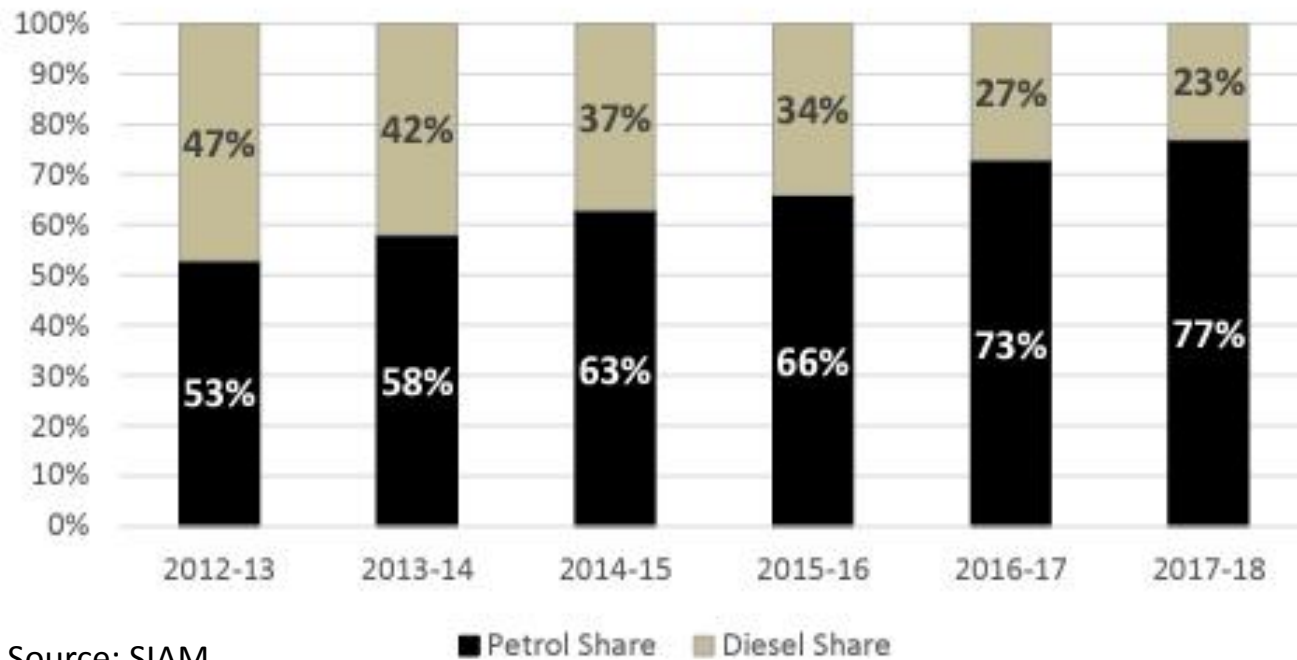
MOBILITY OPTIONS FOR INDIA



AUTOMOBILE MARKET IN INDIA

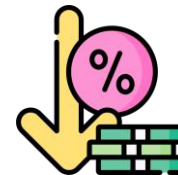
Changing customer preferences – From Diesel to Gasoline and greener technologies

Decreasing diesel vehicle share



Source: SIAM

Change in preferences partly attributed to –



Falling difference between gasoline and diesel retail prices



Introduction of greener technologies such as Hydrogen, CNG, LNG, hybrids, EVs, etc.



Regulatory moves by Govt. such as Ethanol blending program, PLI schemes, FAME II, green taxes, etc.

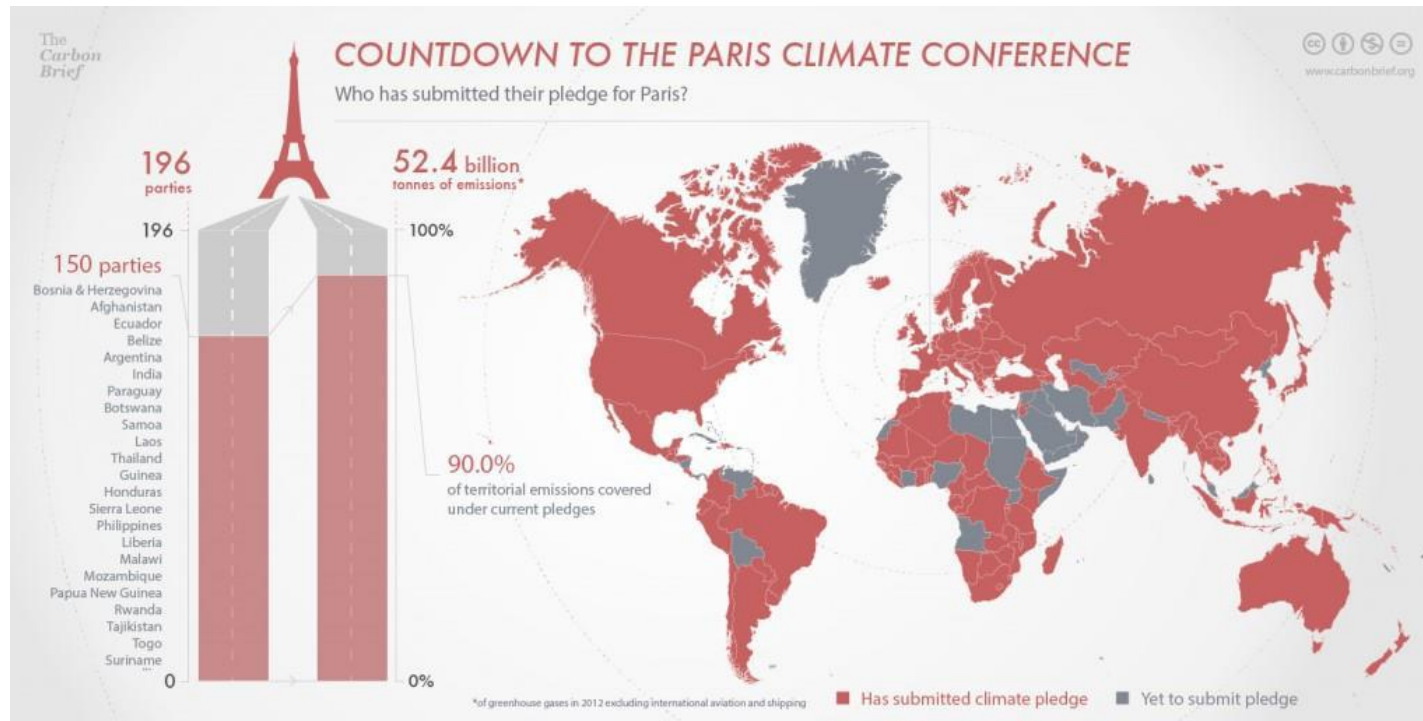


GOVERNMENT STRATEGIES



Nationally Determined Contribution (NDC)

NDC, or Nationally Determined Contribution, is a climate action plan to cut emissions and adapt to climate impacts. Each Party to the [Paris Agreement](#) is required to establish an NDC and update it every five years.





सत्यमेव जयते

Government of India
Ministry of Environment, Forest and Climate
Change

NDC for India

Indian Cabinet approved India's Updated Nationally Determined Contribution to be communicated to the United Nations Framework Convention on Climate Change

Approval translates Prime Minister 'Panchamrit' announced at COP 26 into enhanced climate targets

A step towards achieving India's long term goal of reaching net-zero by 2070

India now stands committed to reduce Emissions Intensity of its GDP by 45 percent by 2030

Prime Minister's concept of mass movement for 'LIFE'– 'Lifestyle for Environment' as a key to combating climate change"

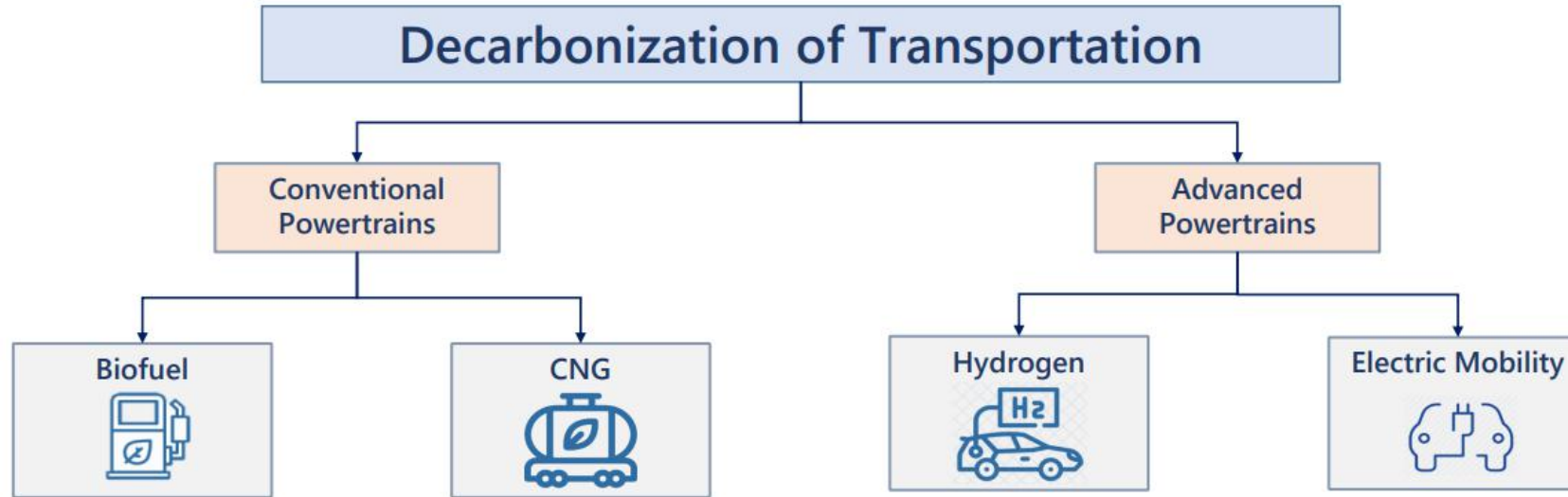


Panchamrit (Five Climate Goals)



- India will get its non-fossil energy capacity to 500 gigawatt by 2030
- India will meet 50 per cent of its energy requirements till 2030 with renewable energy
- India will reduce its projected carbon emission by one billion tonnes by 2030
- India will reduce the carbon intensity of its economy by 45 per cent by 2030
- India will achieve net zero by 2070

Decarbonization in Transportation



Under SIAM Sustainable Advocacy



Electric Mobility Initiatives

Government has approved Phase-II of FAME Scheme

Incentives on offer under phase II of FAME

- ▶ **₹10,000 per kW**
Planned incentive on the basis of battery size
- ▶ **₹20,000 per kW**
Planned incentive for electric buses
- ▶ **₹8,596 crore**
Total incentive sanctioned
- ▶ **₹1,000 crore**
Incentive for setting up charging stations



Source: Heavy industries ministry

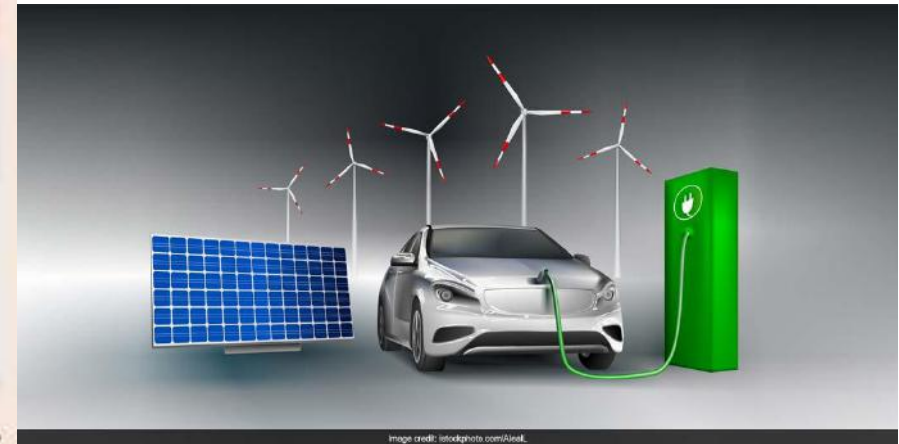


Image credit: istockphoto.com/Anil

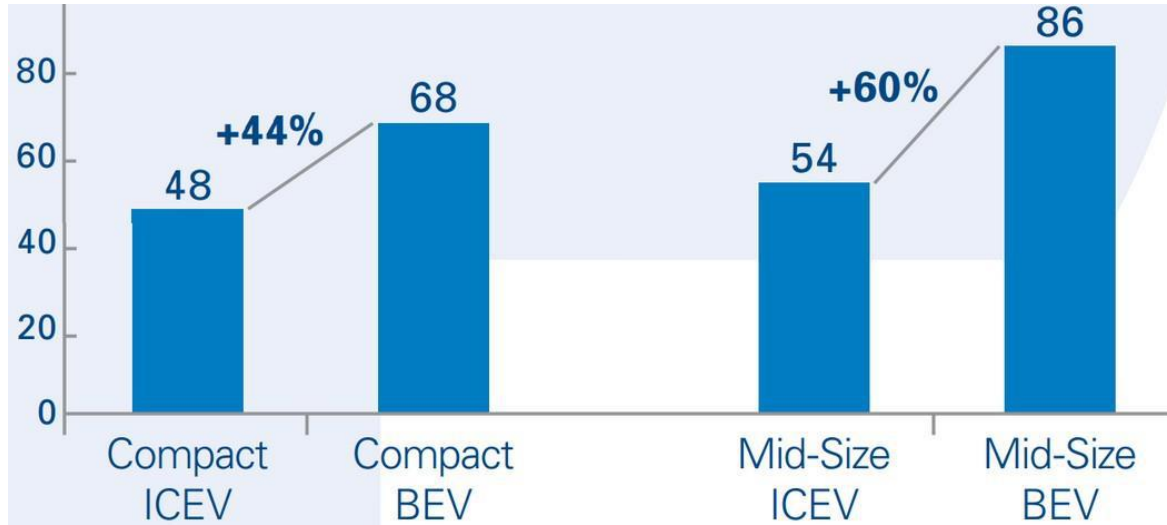
EV Charging Infra structure by Fuel Companies



10000 Charging Stations to be built

The Combustion Engine Refuses to Die

Internal combustion is surviving by adapting.



In Thousands of Dollars at Present Value

Impact Area	ADL
Total Cost of Ownership	BEV is 44% more expensive than ICEV
Global Warming Potential	BEV has 23% less GWP impact than ICEV
Secondary Environmental Impacts	BEV has 3 times greater Human Toxicity Potential

Arthur Little Study on BEV Vs ICEV

Even the average engine may soon approach its electric rival in terms of grams of carbon dioxide output of 97 grams per kilometer. In the 2040 time frame, the value will reduce to 30 grams, which makes internal combustion engines competitive with electric vehicles

CAFÉ CHALLENGE FOR INDIA

CAFE regulations in India came into force from April 1, 2017



AIM

Lowering fuel consumption by lowering CO₂ emissions, serving the twin purposes of reducing dependence on oil and controlling pollution



Corporate Average

Refers to sales-volume weighted average for every auto manufacturer



Requirement

Average corporate CO₂ emission must be less than 130 gm per km till 2022 and below 113 gm per km thereafter



Trade-off

The reduced carbon footprint leads to increased fuel economy.



Contemplation

Economic penalties for OEMs who don't meet corporate average targets and envisage a system where credits under the scheme can be banked and traded.



PRESENT NEED FOR ALTERNATIVE FUELS

VISION – ATMANIRBHAR BHARAT

Use of home grown alternate fuels can reduce the fossil fuel import and can save import duty, this envisaging the 'Atmanirbhar Bharat' vision

GHG MITIGATION

Effects of Green House Gases can be mitigated by active usage of alternate fuels



PARIS COP AGREEMENT

The Paris Agreement's long-term temperature goal is to keep the increase in global average temperature to well below 2 °C (3.6 °F) above pre-industrial levels

LOCAL ENVIRONMENTAL POLLUTION

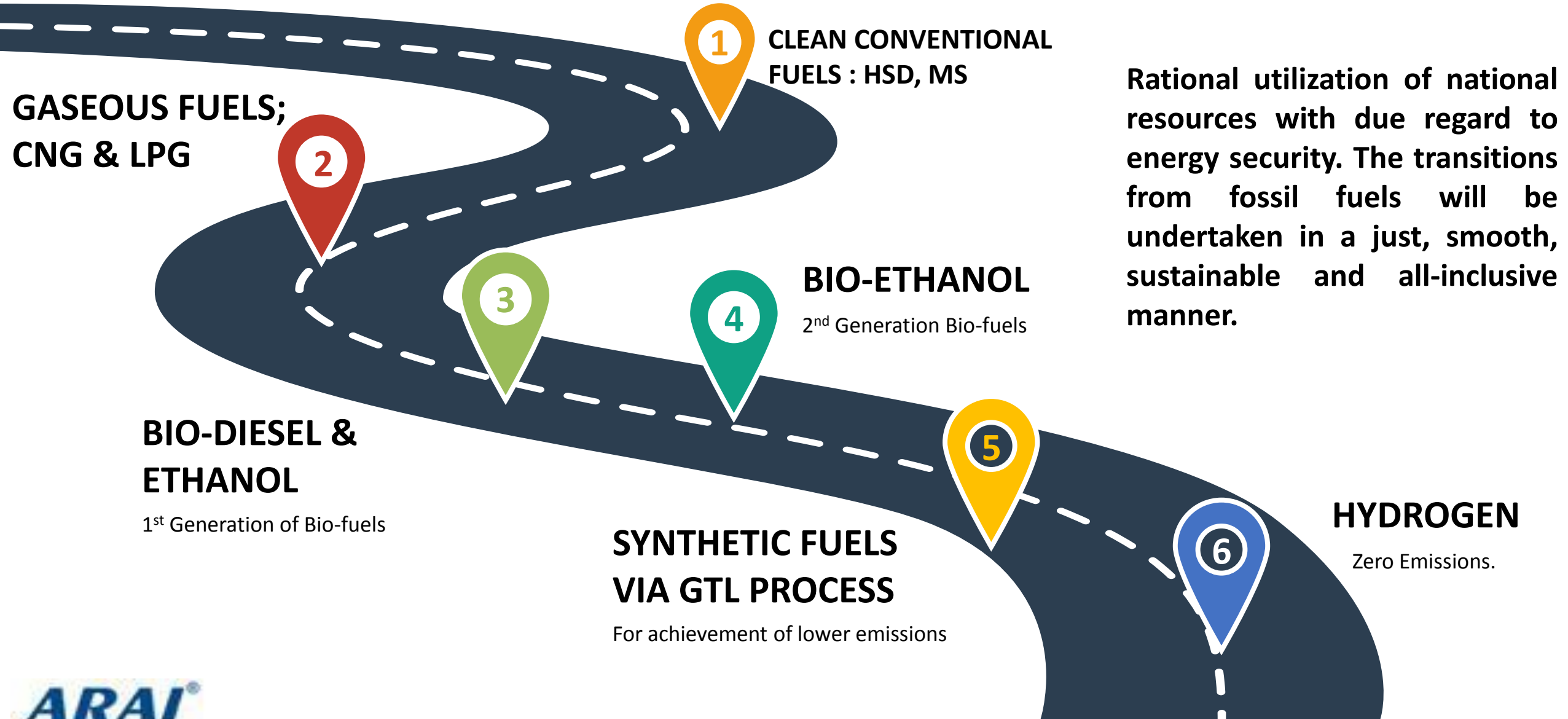
Use of Alternative Fuels will help to reduce the local Environmental Pollution problem and increase the amount of clean air.

BOOST INDIAN ECONOMY

Use of Alternative Fuels can boost Local Indian Economy



Fuel Roadmap In India



Rational utilization of national resources with due regard to energy security. The transitions from fossil fuels will be undertaken in a just, smooth, sustainable and all-inclusive manner.

ALTERNATIVE FUELS – NOTIFICATIONS

Bio-CNG /
Bio-
Methane

GSR 498 (E)
dated 16th
June 2015

Biodiesel
(B-20 and
B-100)

GSR 412 (E)
dated 11th
April 2016

Compressed
Natural Gas
(CNG)

GSR 889 (E)
Notified for
BS VI

Di-Methyl
Ether
(DME)

GSR 37 (E)
dated 17th
January 2020

Dual fuel –
Diesel/CNG/
Bio-CNG/LNG

GSR 1151 (E)
dated 29th
November 2018

Ethanol
(E-20)

GSR 156 (E)
dated 8th
March 2021

Ethanol
(E-85, ED-
95, E-100)

GSR 682 (E) dated
19th May 2015

Hydrogen

GSR 889 (E)
Notified for
BS VI

Hydrogen –
CNG
(HCNG)

GSR 585 (E)
dated 25th
Sept 2020

Liquefied
Petroleum
Gas
(Auto LPG)

GSR 889 (E)
Notified for
BS VI

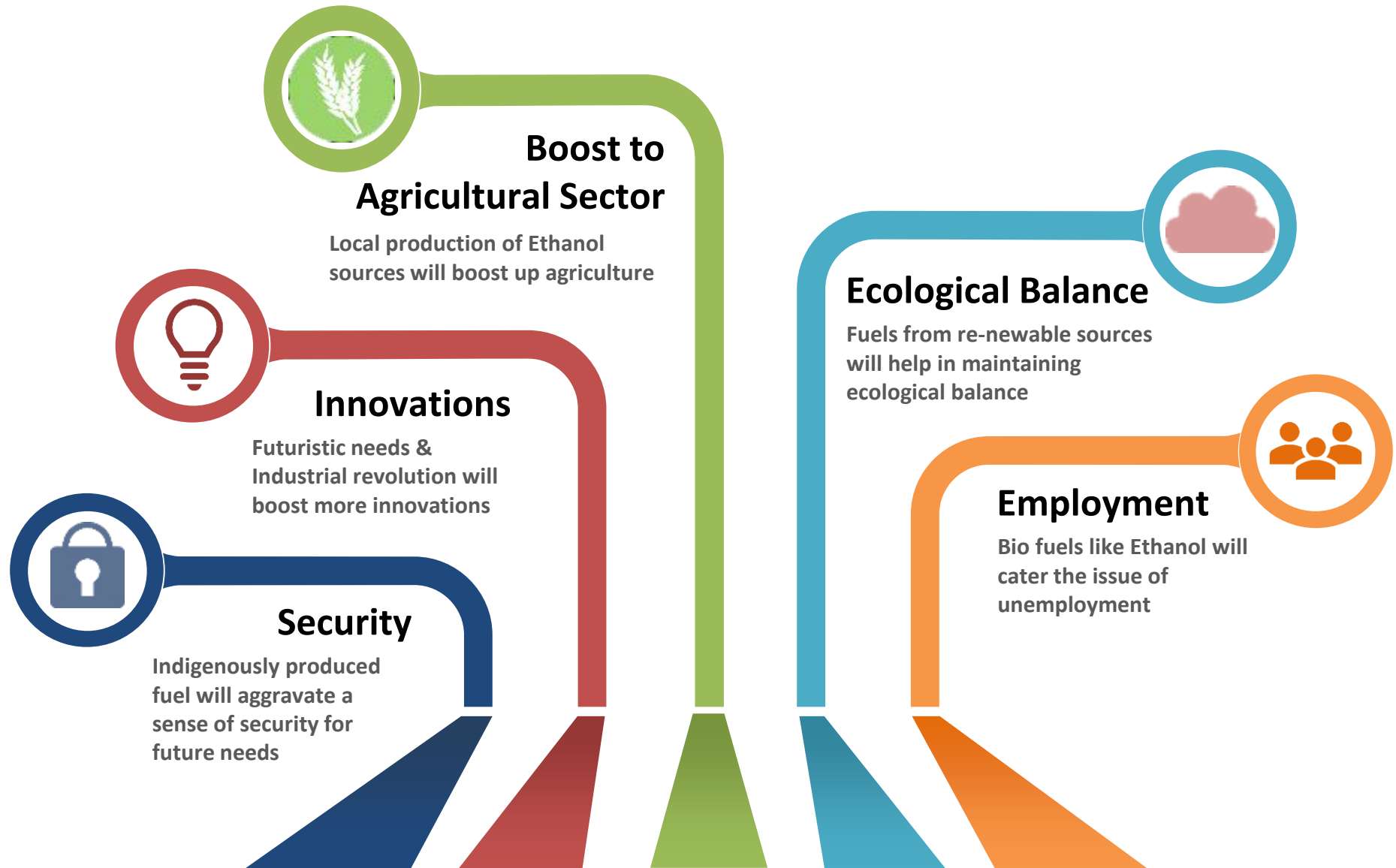
Liquefied
Natural Gas
(LNG)

GSR 643 (E)
dated 27th
June 2017

Methanol
M-15/ M100
& Methanol
MD95

GSR 490 (E)
dated 24th
May 2018

SOCIO-ECOLOGICAL IMPACTS OF ALT FUELS



ALTERNATIVE FUEL CATEGORIES



Natural Gas Based Fuels

These include CNG, LPG, LNG, Bio-CNG, etc.

Bio-Fuels

These include Ethanol, Methanol, Bio-Diesel, etc.

Hydrogen

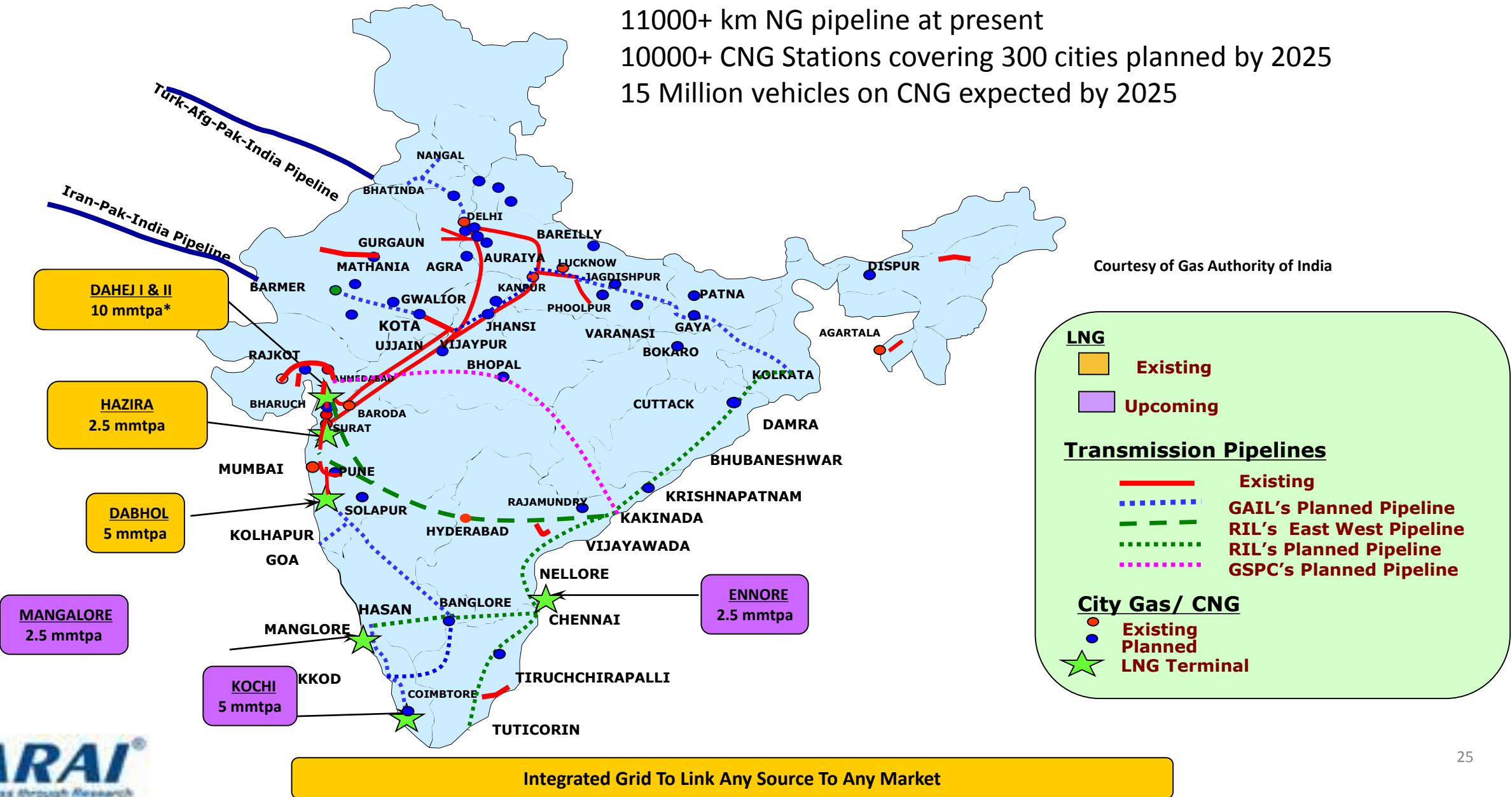
Hydrogen is a zero carbon fuel and can be used directly or with fuel cells

Synthetic Fuels

These include Dimethyl Ether (DME), GTL, Fischer Tropsch etc.

CNG Infrastructure in India

11000+ km NG pipeline at present
 10000+ CNG Stations covering 300 cities planned by 2025
 15 Million vehicles on CNG expected by 2025



INCREASING NGV PENETRATION IN INDIA

NGV Sales Penetration by 2030

50%



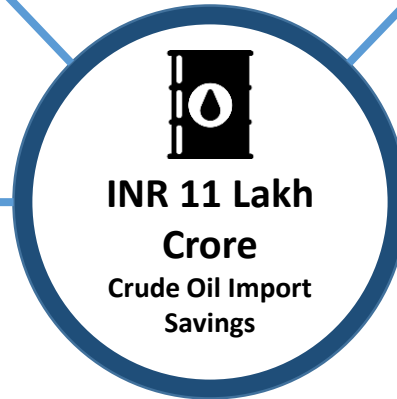
CNG Stations

10,000 Stations in the next 10 years



Target Segments for CNG

Cars, 3W, LCVs and Buses



Target Segments for LNG

Trucks



Crude Oil Import
Savings
10%
Of the Central Budget
Expenditure on Welfare
Schemes



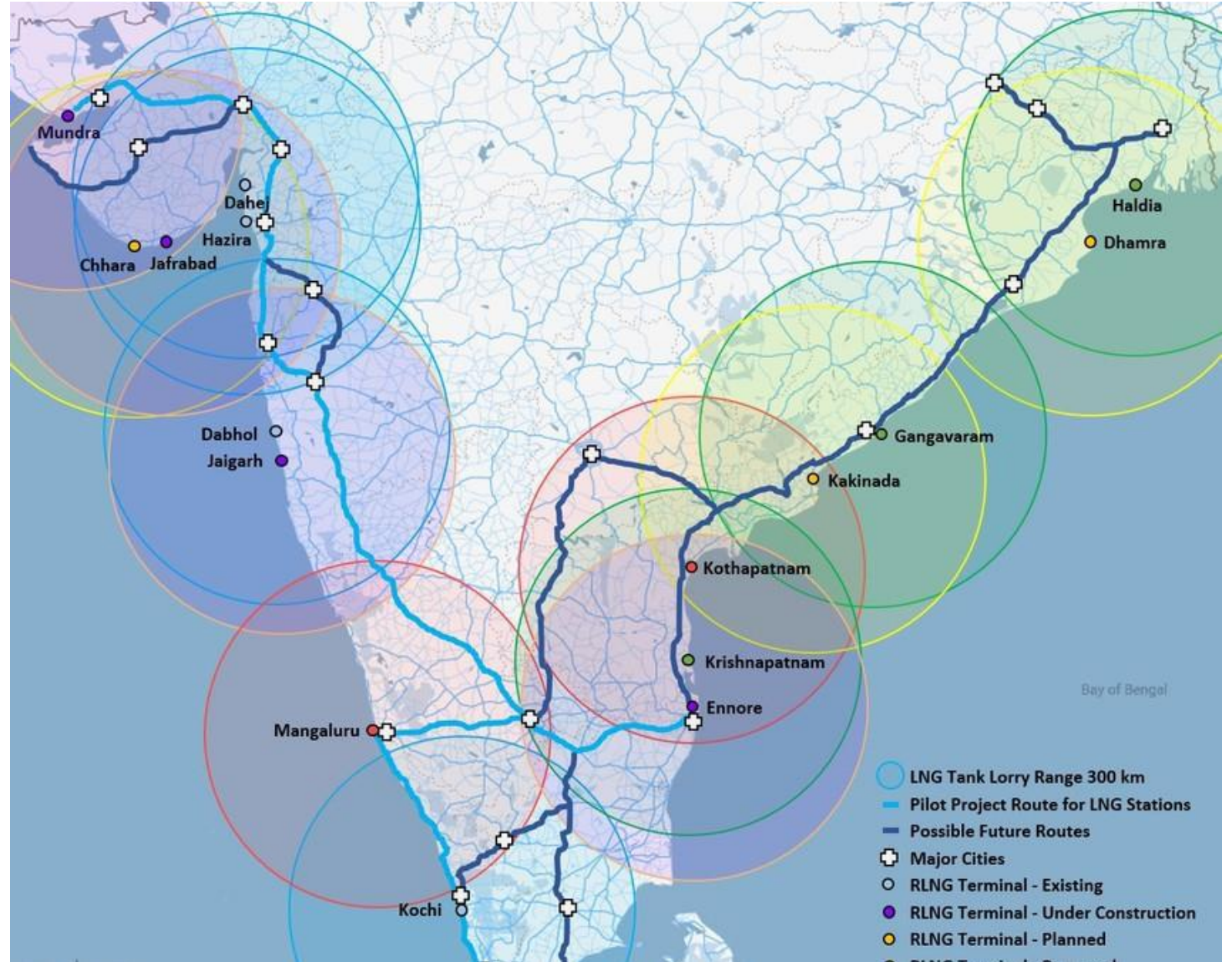
Growth in the income
of 3W and LCV drivers
Up to INR
5000 to 8000 per month



Employment
Generation
4 Lakh new jobs

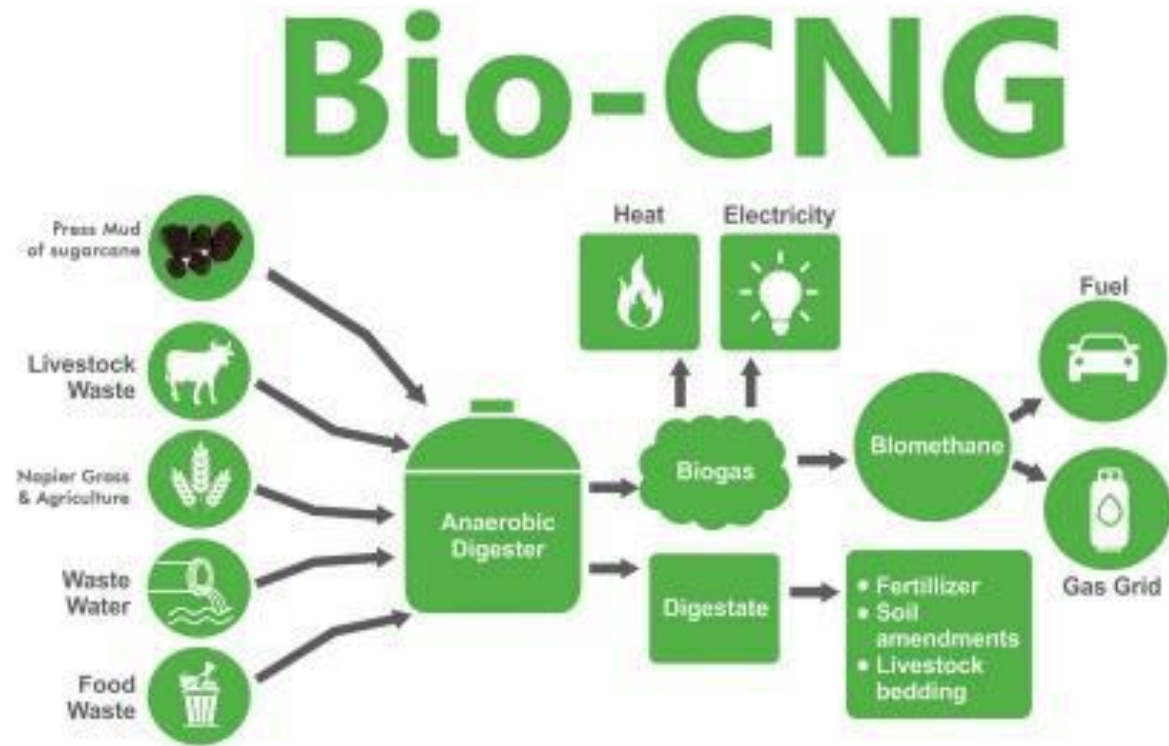


Liquified Natural Gas (LNG) Plans for India



Bio-CNG

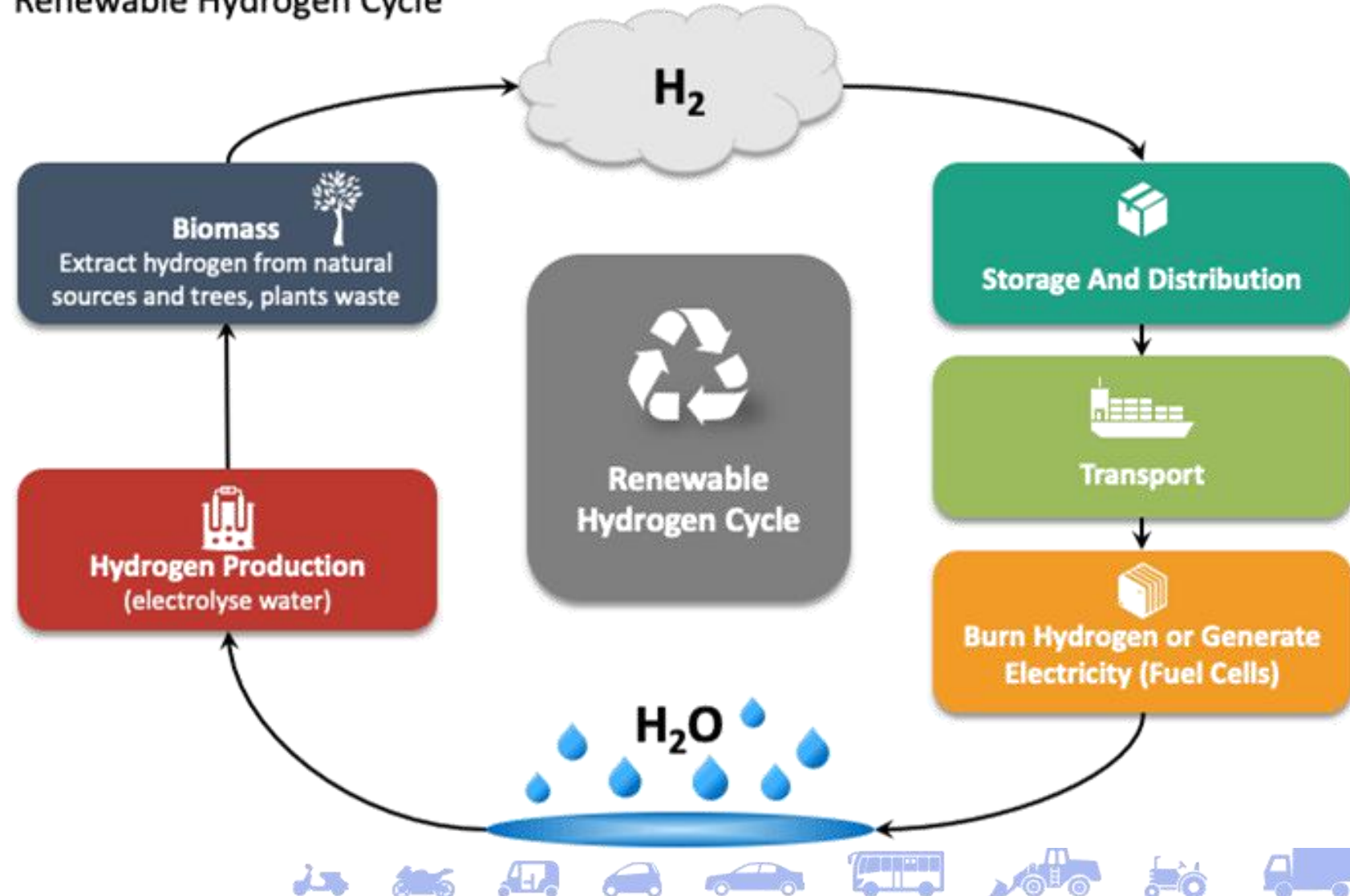
Bio-CNG is being recognized as an automotive fuel and also for rural use in tractors, pump set engines and for rural electrification i.e. gensets



HYDROGEN FUEL

Hydrogen is notified under CMVR vide GSR 889(E)

Renewable Hydrogen Cycle



Energy Carrier



Zero Carbon




Highly Efficient



HYDROGEN TYPES FOR INDIA


GREY HYDROGEN

Split Natural Gas into Hydrogen and CO2

 CO2 emitted in the atmosphere


BLUE HYDROGEN

Split Natural Gas into Hydrogen and CO2

 CO2 stored or reused

GREEN HYDROGEN

Split water into Hydrogen by electrolysis powered by water or wind

 No CO2 emitted



National Green Hydrogen Mission

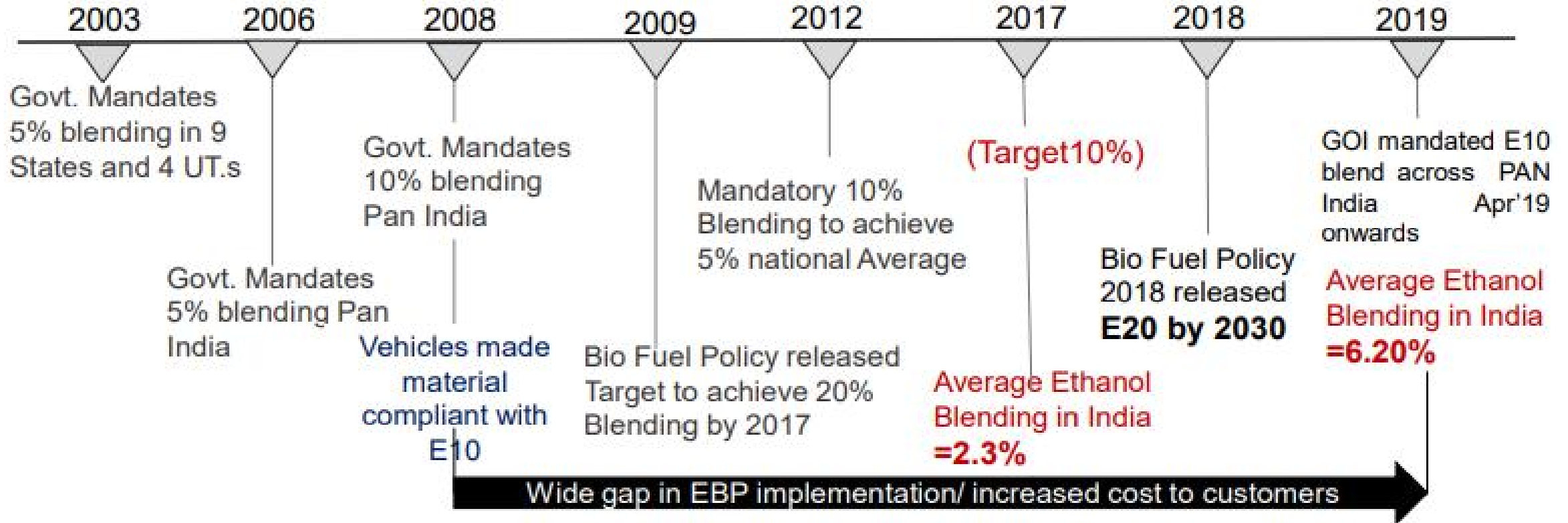
The National Hydrogen Mission launched in 2021 aims to make India a green hydrogen hub. The rapid expansion of green hydrogen production, increasing electrolyser manufacturing capacity in the country are envisaged alongside overall development of the power sector.



National Hydrogen Mission Major Activities envisaged

- Creating volumes and infrastructure
- Demonstrations in niche applications (including for transport, industry)
- Goal-oriented Research & Development; facilitative policy support
- Putting in place a robust framework for standards and regulations for hydrogen technologies
- Envisages generation of hydrogen from green power sources
- Aims to develop India into a global hub for manufacturing of hydrogen and fuel cells technologies
- The Government of India will facilitate demand creation in identified segments. Possible areas include suitable mandates for use of green hydrogen in industry such as fertilizer, steel, petrochemicals etc

HISTORY OF ETHANOL BLENDING IN INDIA

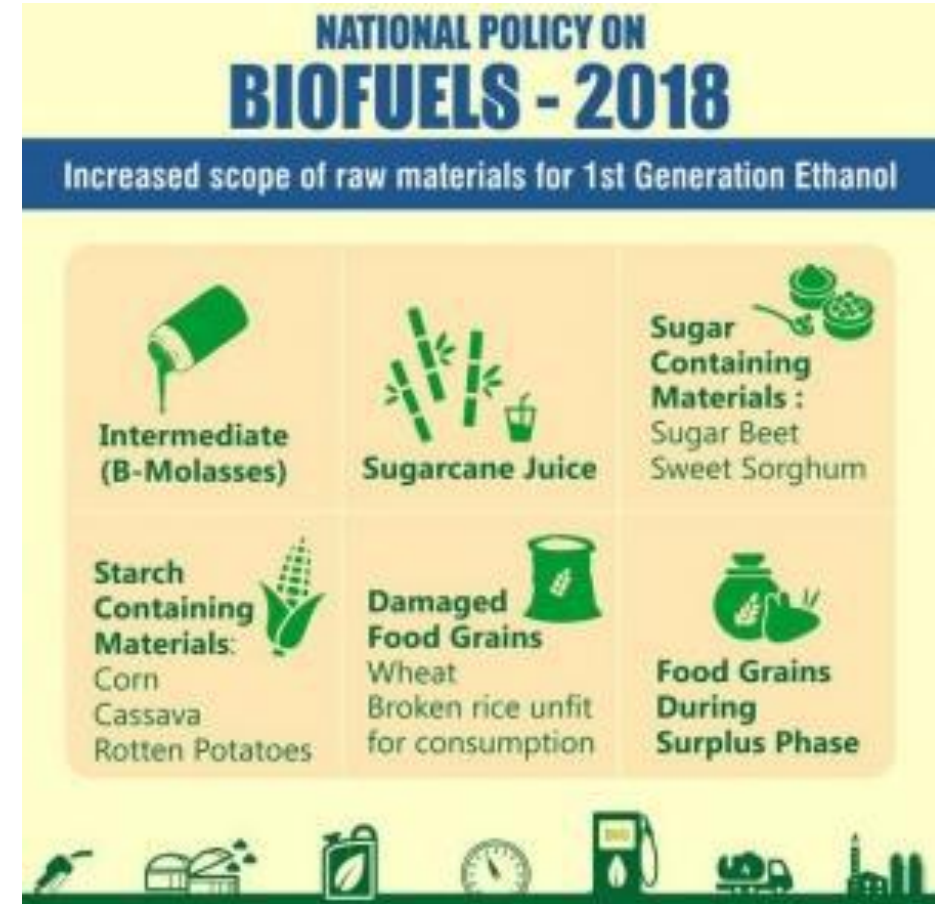


- Strong Government push & supporting policy is leading to increase in ethanol blending trend. However consistent year round supply of E10 across PAN India including NE India needs to be considered.
- GOI has allowed preparation of Ethanol from Sugar, which earlier was through molasses only. This should help in increasing the national average of Ethanol blending.
- As of now only Material compatibility ensured. Vehicle Performance and Fuel efficiency (4%) deteriorated with E10. This is due to uncertain fuel blend. Vehicles (2W and 4W) tuned for worst case E0 fuel.



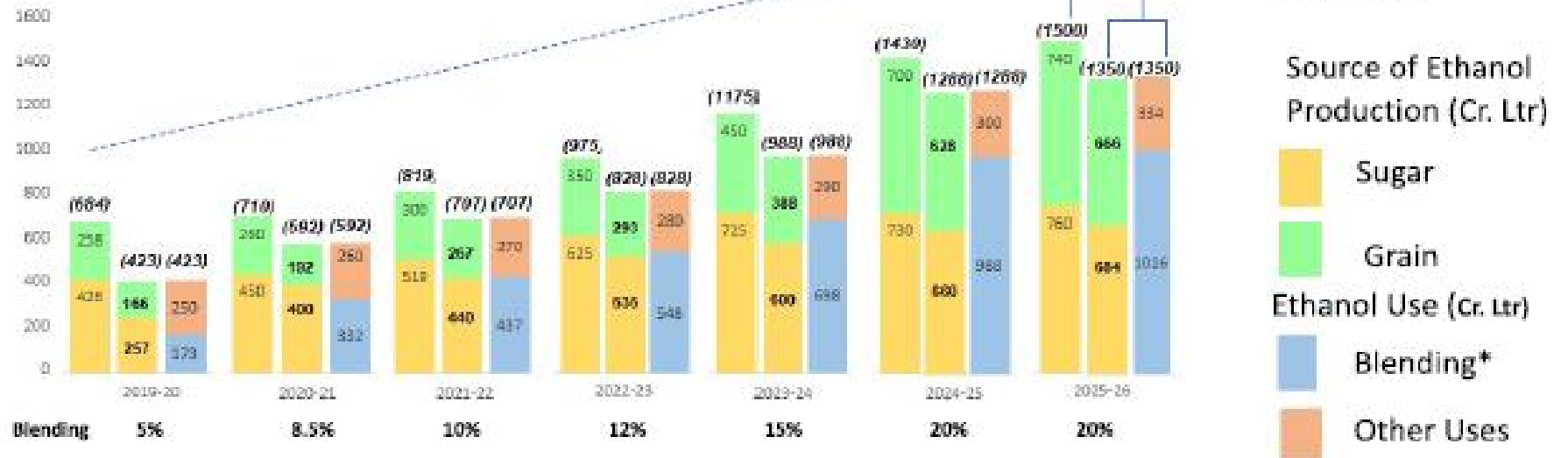
BIOFUEL POLICY

- The 2018 National Policy on Biofuels had a target of 20 per cent blending of ethanol in petrol and 5 per cent blending of biodiesel in diesel by 2030. **Recently amended to 2025**
- This is to be achieved by increasing production of ethanol using damaged food grains like wheat and broken rice as well as conversion of excess sugar.
- India expects to achieve blending up to E10 by 2022
- Plans to roll out E20 fuel by 2023 with E10 as protection grade
- Higher blends of Ethanol will be subsequently implemented
- Ethanol production is estimated as 1500 Cr Litres by 2025-26



Launch of Ethanol Blending Roadmap by Niti Aayog

EBP Production and Roll out Plan



Pan – India E10 Fuel Available

E20 Fuel Roll-out

Manufacture E10 ENGINE COMPATIBLE
E20 MATERIAL COMPATIBLE Vehicles

*To meet 20% Blending in Gasoline whose demand rises by 200% from 302 Cr. Lt. to 1016 Cr. Lt., due to increase in vehicles – by 47% (3484 Lakhs) for 2W and 36% for Passenger Vehicles (230 Lakhs) in this period

Nationwide availability of E20 from EY 2025

Rollout of Full E20 material and Engine compatible vehicles

Single Window Clearance by States, MoFPC, PESO, DFPD and MoPNG

ROADMAP FOR ETHANOL BLENDING IN INDIA 2020-25

Report of the Expert Committee

NITI Aayog | Ministry of Petroleum and Natural Gas

- MoPNG notifies E10, E20 Roadmap
- MoPNG drops the need for MoPNG Certificate, gives Environmental Clearance (<10 months)
- State Governments allow Interstate Movement of Ethanol, Issue Consent to Establish Expediently

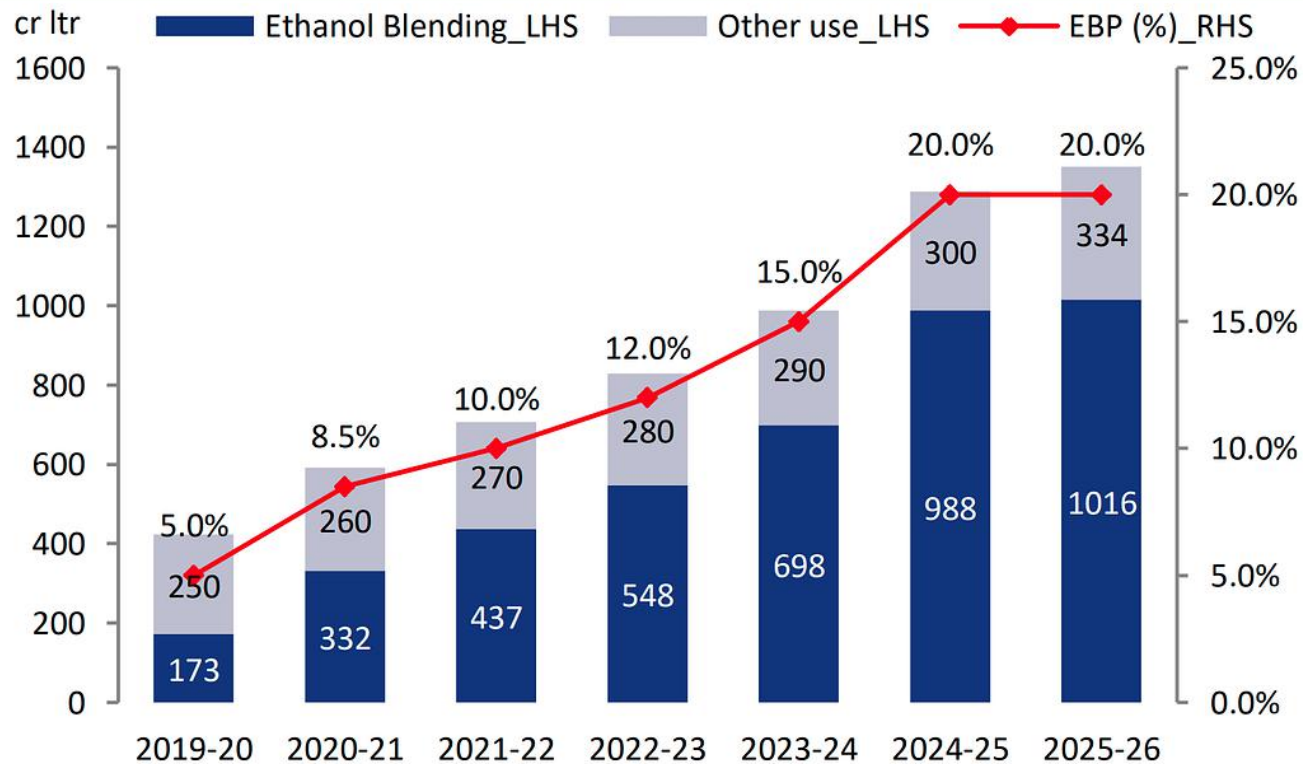
Single Window Clearance

Educational Campaign

Launch of E-20 Fuel



Ethanol End Use



Source: JM Financial, Roadmap for Ethanol Blending 2020-25 (June 2021)

Bloomberg | Quint



Flex Fuel Policy to be Announced Soon

**Flex-Fuel Engines in Vehicles
Govt to bring new policy soon**



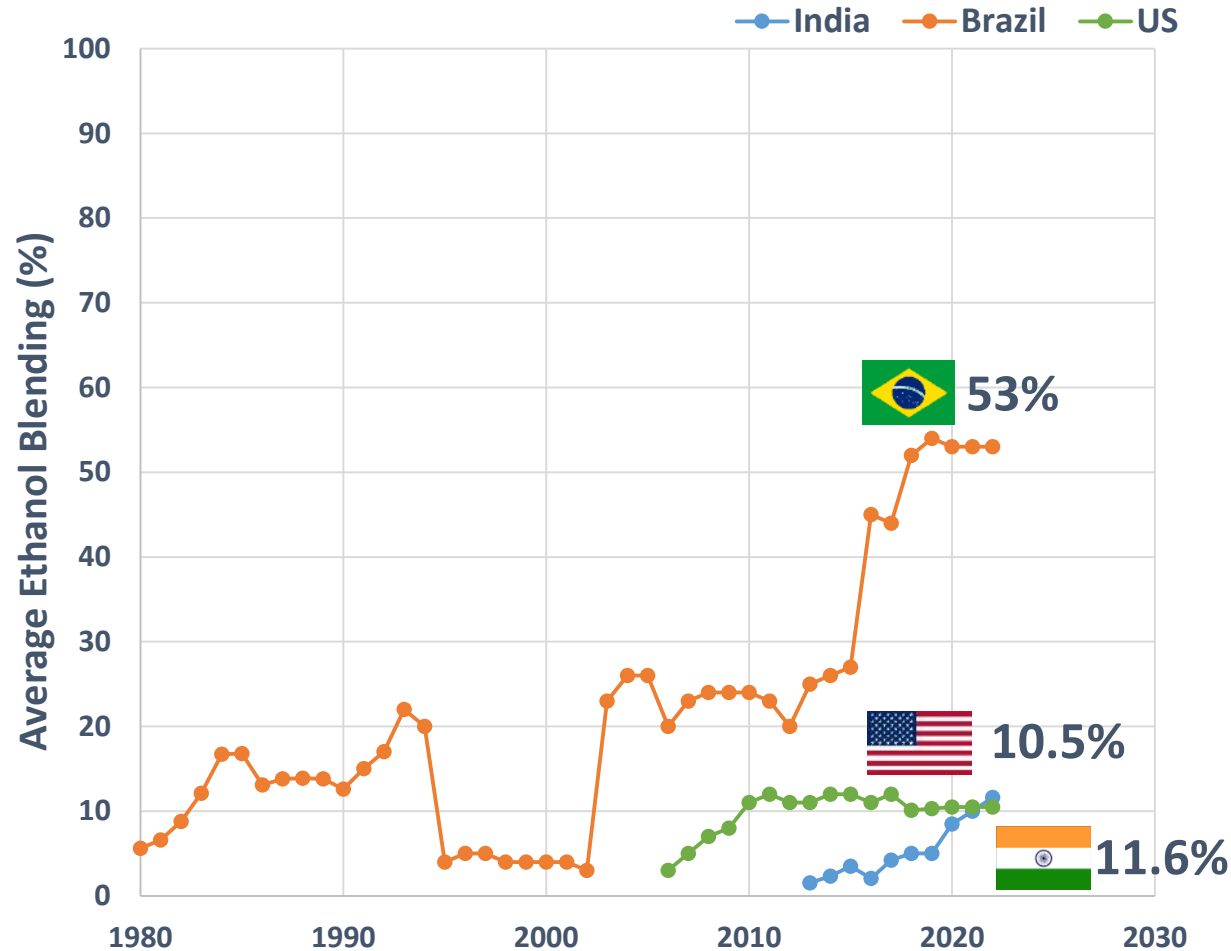
Mr. Nitin Gadkari, Hon. Minister Road Transport and Highways, Govt of India



Flex fuel bike tested by ARAI displayed to Hon. Secretary MHI.

Global Ethanol Blending Current Trend



National Average Ethanol Blend



53% National average blending : Brazil ensured Robust Ethanol Adoption Model

Learning from Brazil for Quick ethanol penetration

Difference b/w India & Brazil

	Brazil	India	
Area	 8.51 Million Km ²	 3.3 Million Km ²	Brazil area is 2.5x <ul style="list-style-type: none"> • More agriculture area for crops. • More ethanol production.
Population	21.5 Crore	140.8 Crore	India has 6.5x
Fuel Consumption	X	2X	India has 2x

India needs double ethanol production in lesser area

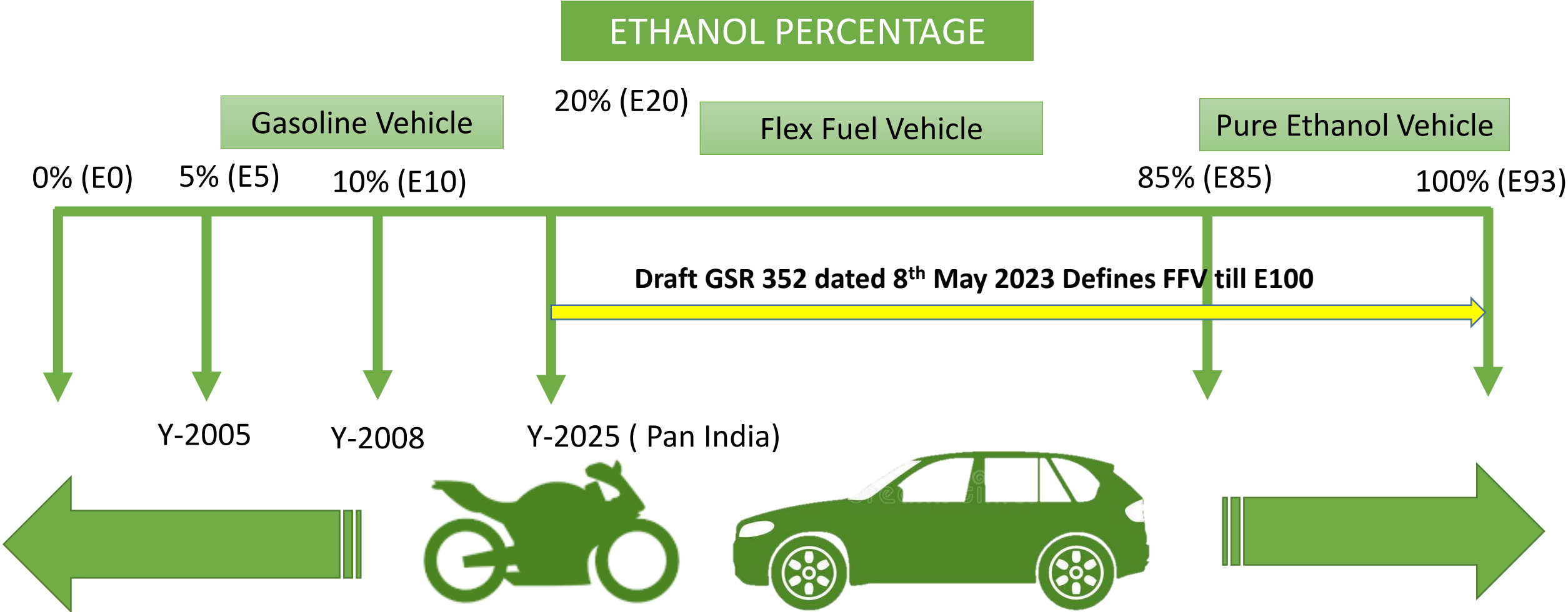
India to match Brazil level → Challenge is 5x

WORLDWIDE ETHANOL BLENDS

Country	Unleaded Petrol (Petrol + alcohol mixture)
Brazil	With 27± 1 % (E27) ethanol and E100
European Union	With 4.7 – 5.3 % ethanol (E5) – EURO V With 9.0 – 10% ethanol (E10)– EURO VI With 83 – 85 % ethanol (E85)– EURO V for FFV Ethanol (ED95)– Ethanol min 92.4% - EURO V/VI
United States - California	With 9.8 – 10.2% ethanol (E10)
United States - Federal	With 14.6 – 15% ethanol (E15) – Proposed With 83 – 85 % ethanol (E85) - for FFV
Japan	With 9– 10% ethanol (E10)



Ethanol Vehicle Nomenclature



ETHANOL – NOTIFICATIONS

**AIS 171
AISC Safety
Standard for
higher Ethanol
Blends**

**GSR 343 (E)
dated 25th May
2021**

**E-12 and E-15
Blends**

**GSR 728 (E)
dated 12th
October 2021**

**Flex Fuel and
Pure Ethanol
(E-85, ED-95,
E-100)**

**GSR 682 (E) dated
19th May 2017 and
GSR 352 (E) dated 9th
May 2023**

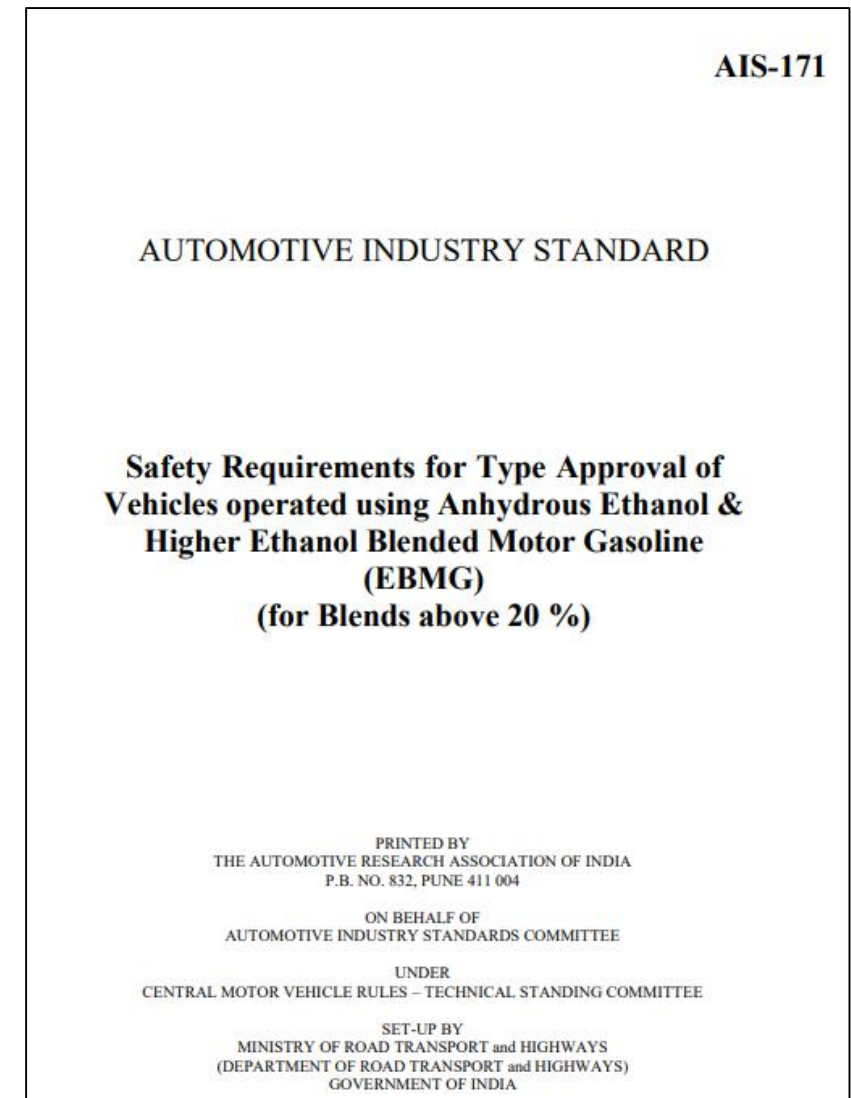
**Ethanol
(E-20)**

**GSR 156 (E)
dated 8th March
2021**



ETHANOL SAFETY STANDARD

- AIS-171 has been notified for Safety Requirements for Type Approval of Vehicles operated using Anhydrous Ethanol and Higher Ethanol blended motor Gasoline (EBMG) (for blends above 20%)
- The contents of this standard are:
 - a. Fuel Quality requirements including additives
 - b. Material compatibility considerations
 - c. General Health safety considerations
 - d. Fire Safety considerations
 - e. Electrical Conductivity considerations
 - f. Labelling of Ethanol fueled vehicles



BIS Standards for Ethanol Fuel and its Blends

E-10

IS 2796 :
2020

E-20

IS 17021:
2021

E-85

IS 16634 :
2017

E-100 (Old)

IS 15464 :
2004

E-100 (E93)

IS 17821:
2022

E-20
(Reference)

IS 17943:
2023



Ethanol Storage Regulations

- Ethanol is classified as a Type “A” fuel as per Petroleum Act 1934 as its flash point is below 23 deg C.
- Ethanol bulk storage above 30 liters, requires PESO approval
- License is issued under Form XI of the petroleum rules 2002 for bulk and on-board storage for Ethanol & its blends.
- Excise license is also required to store Ethanol

नाम - "विस्फोटक", नागपुर
Telegram: "EXPLOSIVES" Nagpur
Website: <http://peso.gov.in>
Email: explosives@peso.gov.in
दूरभाष: Telephone: 0712-2510248
फैक्स: FAX: 2510577
भारतगोपन विभाग के सभी पत्रादि "मुख्य विस्फोटक नियंत्रक" के पता पर भेजे जाएं, इसके अतिरिक्त नाम से नहीं।
All communications intended for this Office should be addressed to the Chief Controller of Explosives and NOT to him by name.


भारत सरकार
GOVERNMENT OF INDIA
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन
Petroleum and Explosives Safety Organisation
(पूर्व नाम - विस्फोटक विभाग)
(Formerly: Department of Explosives)
ए. ब्लॉक, पंचवा गल, केन्द्रीय कार्यालय परिसर,
"A" Block, 5th Floor, CGO Complex,
मंत्रिरी हिल्स, नागपुर - 440 006 (महाराष्ट्र)
Seminary Hills, Nagpur-440006

संख्या /No. R1(1)137/2017

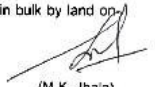
दिनांक /Nagpur, dated: 21st August, 2019

MEMO

Sub: License in Form XI for transportation of ethanol / ethyl alcohol in bulk –reg.

Ethanol / Ethyl Alcohol (Rectified Spirit / Denatured Spirit / Extra Neutral Alcohol / Absolute Alcohol) is covered under the Inflammable Substance Act, 1952 (20 of 1952). It may be noted that the flash point of ethanol / ethyl alcohol is below 23 °Celsius and therefore it is classified as petroleum Class A as per the Petroleum Act, 1934 (30 of 1934).

All the Heads of Circle and Sub Circle Offices of PESO may issue license in Form XI of the Petroleum Rules, 2002 for transportation of ethanol / ethyl alcohol in bulk by land on mechanically propelled vehicles.


(M.K. Jhaia)

Jt. Chief Controller of Explosives (H.O.D.)

To,
✓ All the Heads of Circle and Sub-Circle Offices of PESO: For Information and necessary action. (Through PESO's support site & website only)

Copy to:
Shri Praveen Kumar Sachan, Under Secretary, Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, Udyog Bhawan, New Delhi: 110 011 ;
For information only with reference to the letter No F.No. 17(57)/2019-Expl dated 14/08/2019 received from DPHT.

Jt. Chief Controller of Explosives (H.O.D.)



ETHANOL AS AUTOMOTIVE FUEL : ADVANTAGES

- Can be used as an oxygenate
- Higher CR can be used because of high knock resistance of the fuel
- Higher volumetric efficiency
- Higher flame velocity
- Wider flammability limits



ETHANOL AS AUTOMOTIVE FUEL : LIMITATIONS

- Highly corrosive in nature - it affects badly metallic and non-metallic parts
- Higher latent heat of vaporization causes cold and hot startability problems
- Higher Aldehyde emissions
- Requires large fuel tank capacity due to lower calorific value
- Higher evaporative emission due to higher RVP

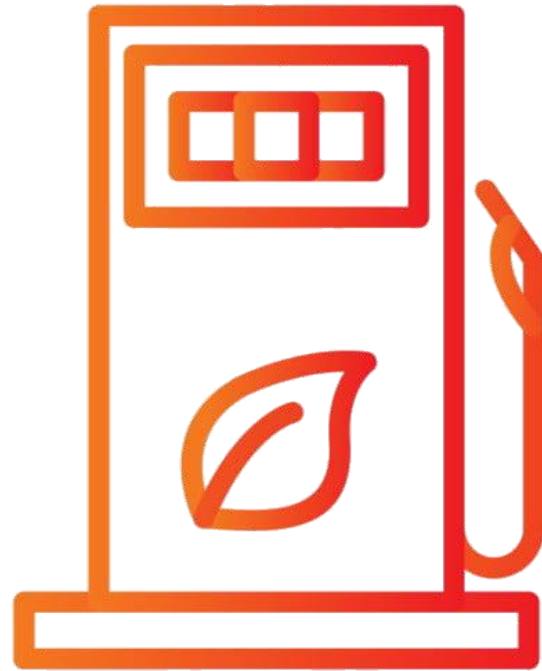


ENGINE MODIFICATIONS FOR ETHANOL BLENDS

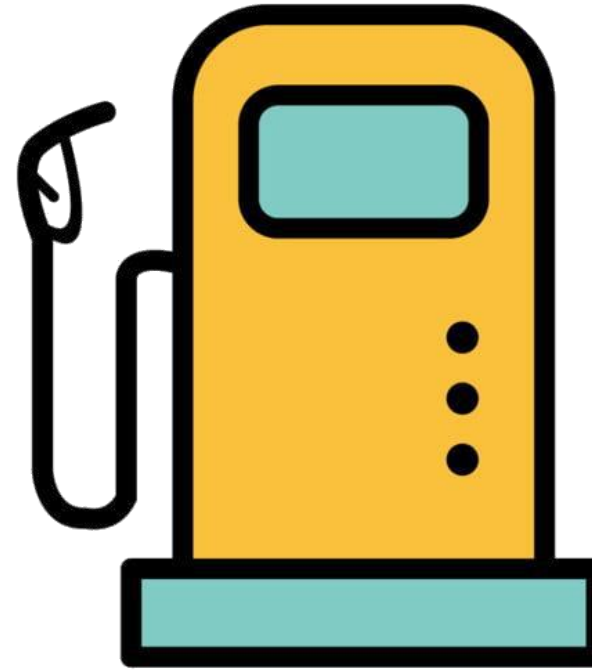
- Development of metal components for anti-corrosion properties
- Oil seals/rubber components should be made of compatible elastomers (e.g. Viton)
- Large fuel passages (jet/injector sizes) for equivalent energy
- Retarded ignition timing
- Higher compression ratios



E-20 ETHANOL FUEL BLEND



ETHANOL



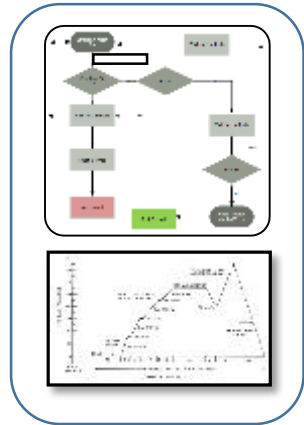
GASOLINE

E-20

- 20 % Blend of Ethanol with Gasoline
- Defined by BIS specification IS 17021
- Notified vide GSR 156 (E) dated 8th March 2021
- Vehicle Type approval as per Gasoline norms and as per BS-VI emissions
- Expected to be Introduced in India by 2024-2025, Parallel dispensing with E-10 which will continue as a protection grade
- Requires Compatible non-metallic materials and tuning of engine
- Not recommended for older generation of vehicles



E20 BLEND PROJECT CARRIED OUT IN ARAI



Startability
And Driveability



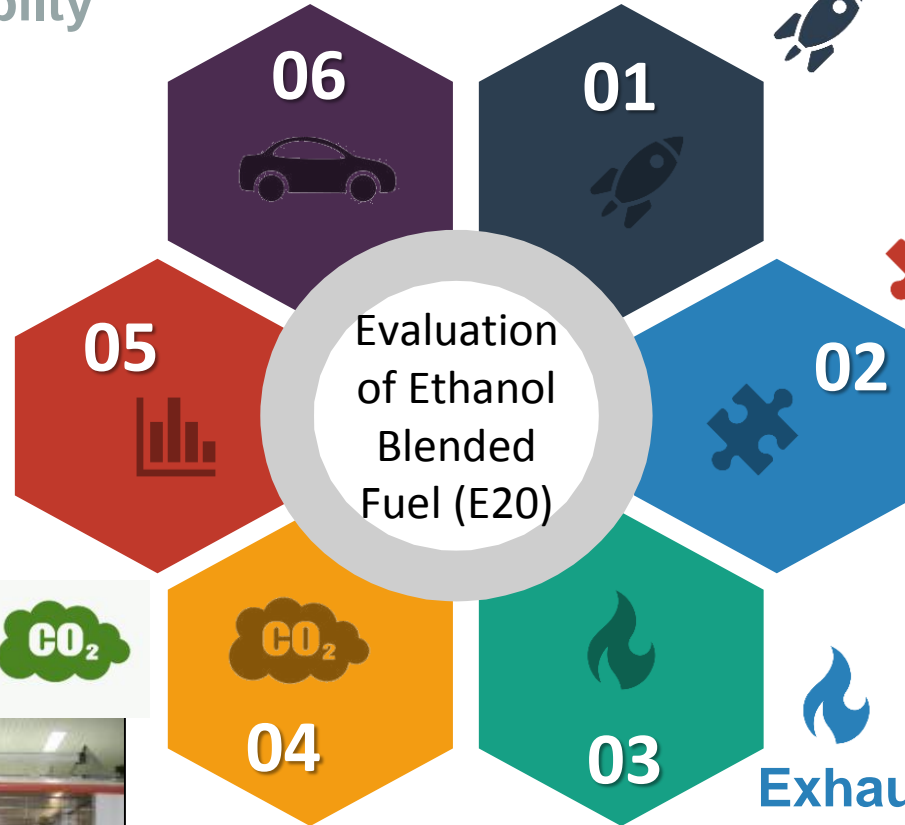
Laboratory
Experiments



Field Trials on
vehicles



Component Rating



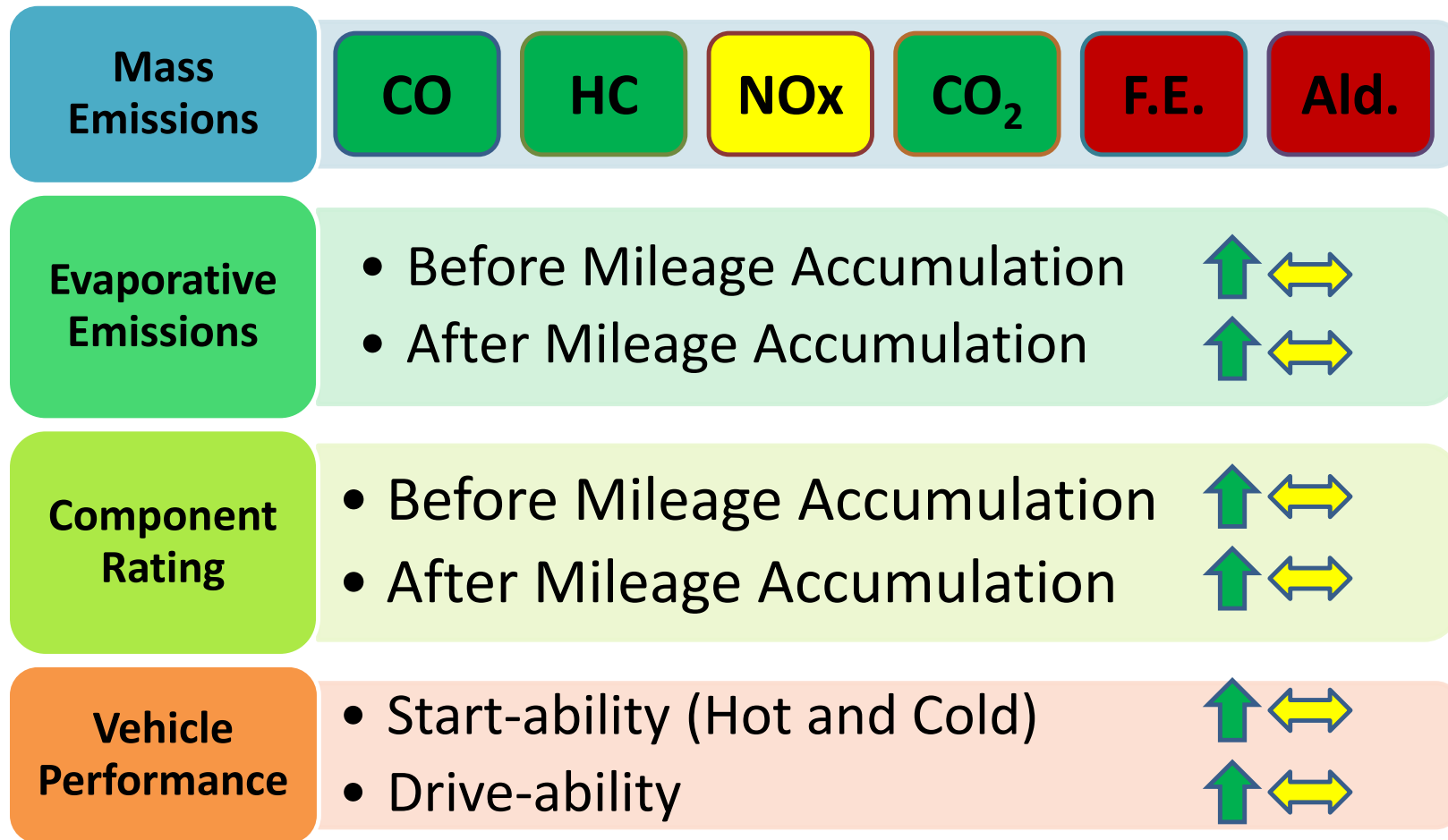
Evaporative
Emissions



Exhaust Emissions



E20 BLEND PROJECT RESULTS



Performance with E20	
↑	Better
↔	Similar
↓	Poor

Impact of fuels on a material to be considered in view of intended application of components in which the material is used.



E20 BLEND PROJECT RESULTS

Material Compatibility

Metals

- All metals



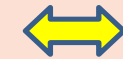
Elastomers

- SBR, HNBR and Polychloroprene
- Fluoroelastomer
- NBR/PVC and Epichlorohydrin



Plastics

- Acetal, PBT and PA12
- PA66



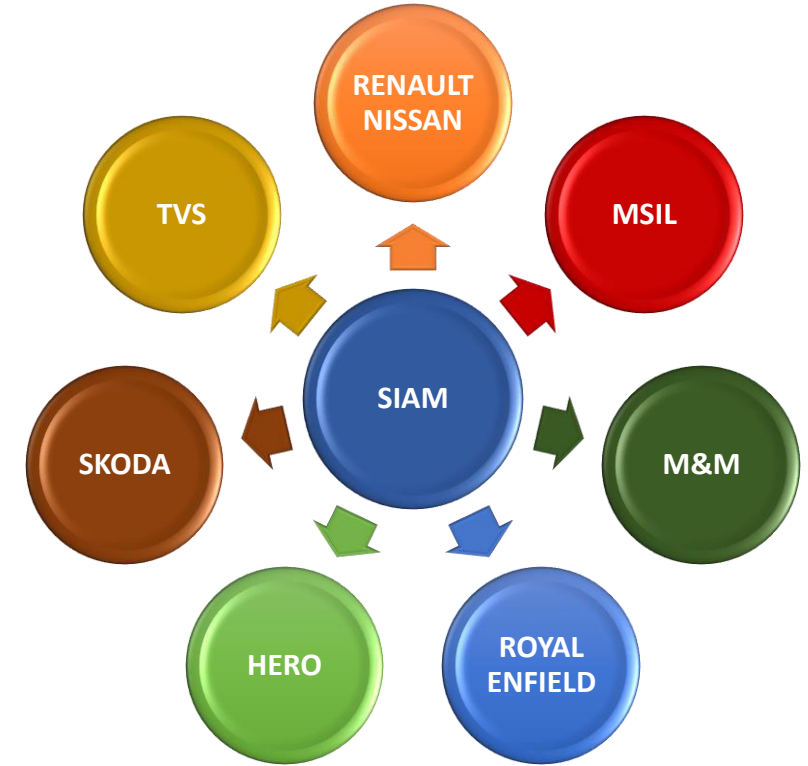
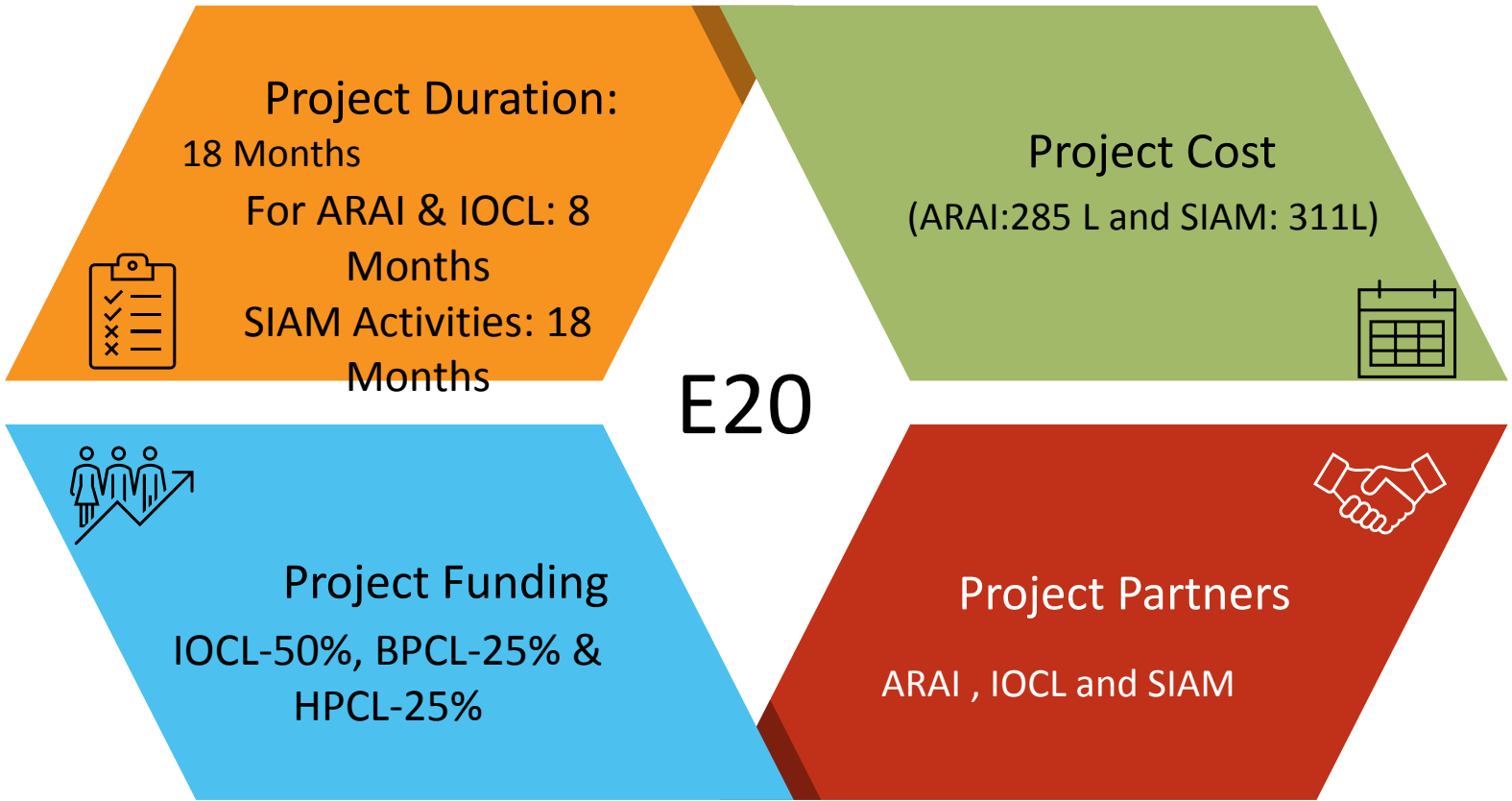
Performance with E20	
	Better
	Similar
	Poor

Impact of fuels on a material to be considered in view of intended application of components in which the material is used.



E-20 Project : BS VI Work

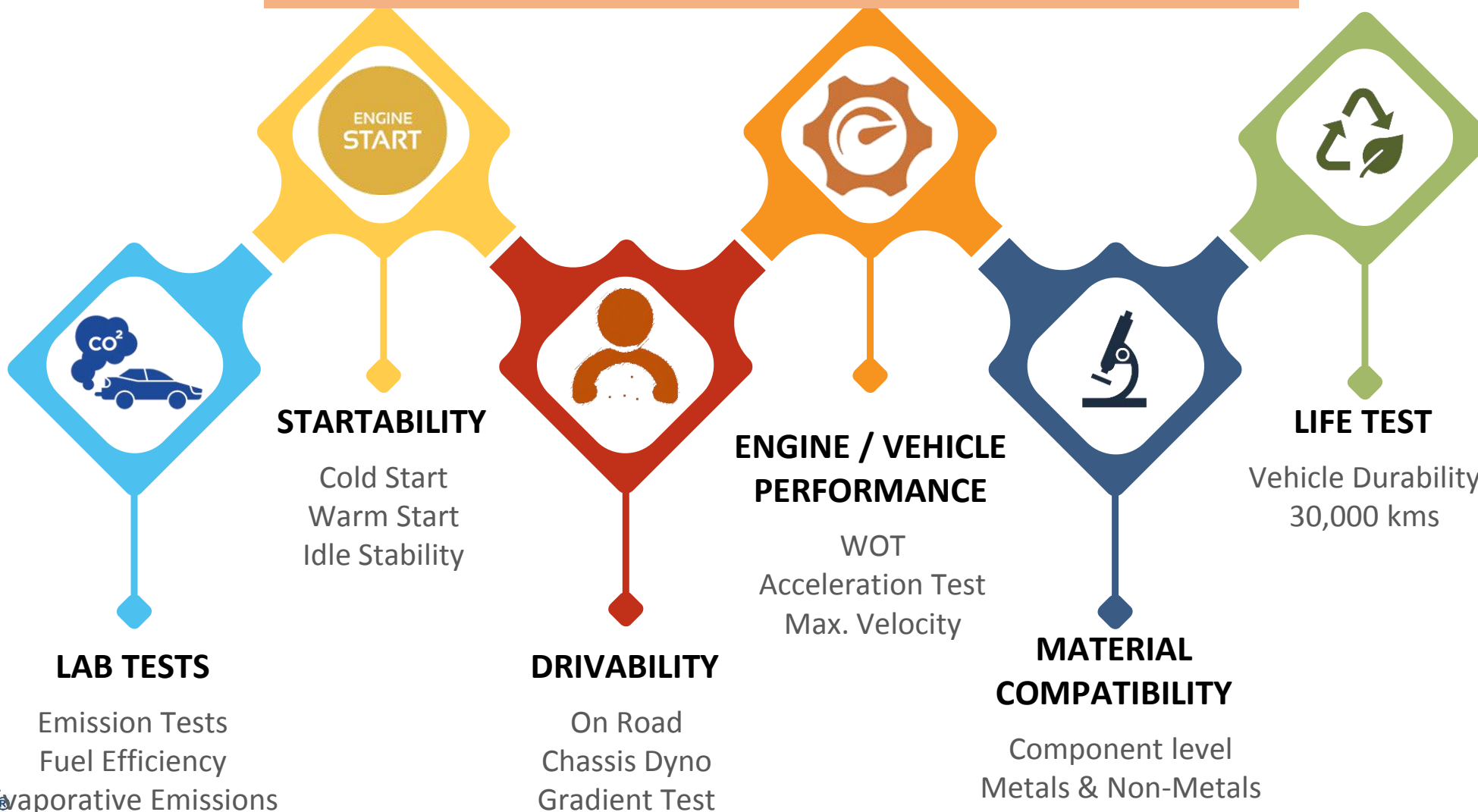
Objective : To study impact of E20 fuel on E10 compliant vehicles of different vintages



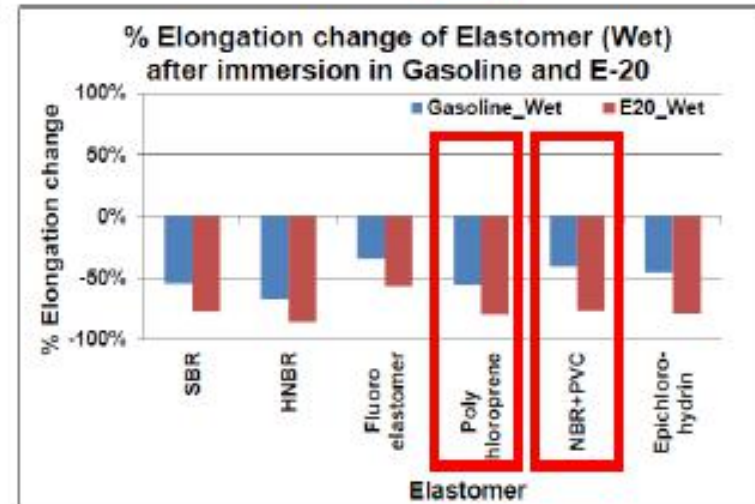
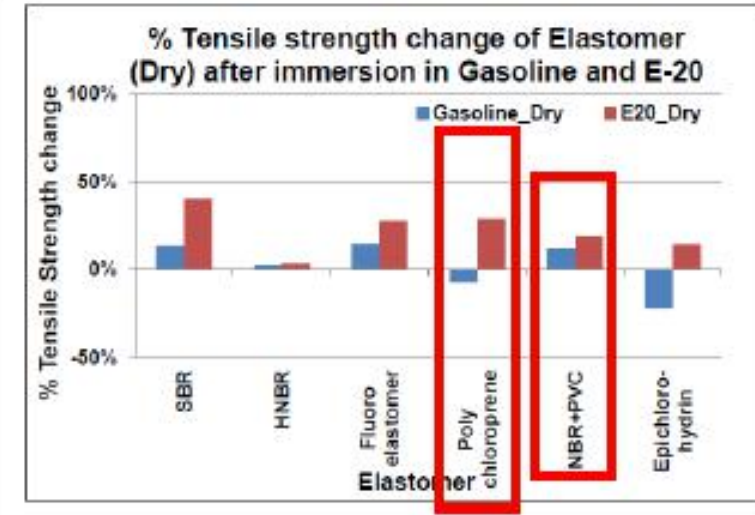
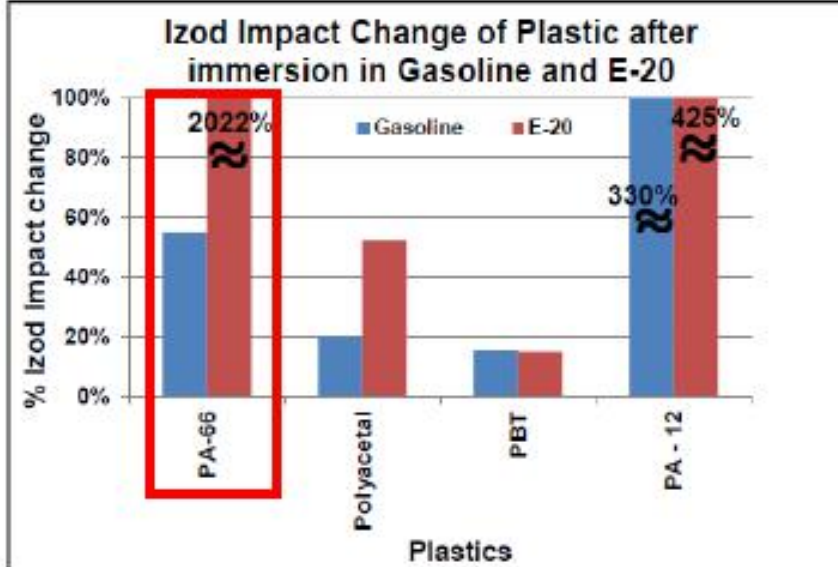
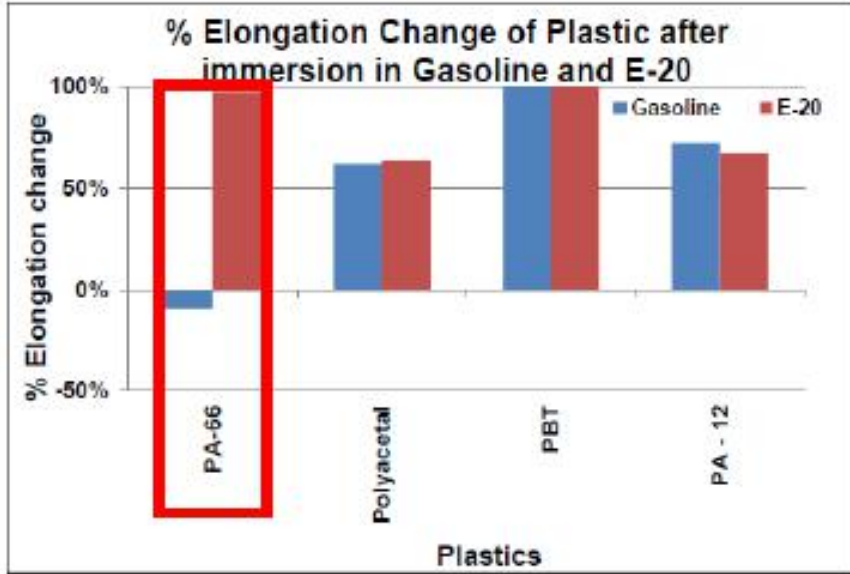
Project Commenced – March 2022

E20 PROJECT BY – ARAI, IOCL and SIAM

ASSESSMENT OF E20 FUEL ON E10 VEHICLES (2W & 4W)



MATERIAL COMPATIBILITY STUDIES FOR E20



- Materials like PA66, NBR/PVC etc are not compatible with E20 Blends
- Material used in Fuel Systems like hoses and gaskets.
- Vehicle Modifications required to meet the E20 requirements



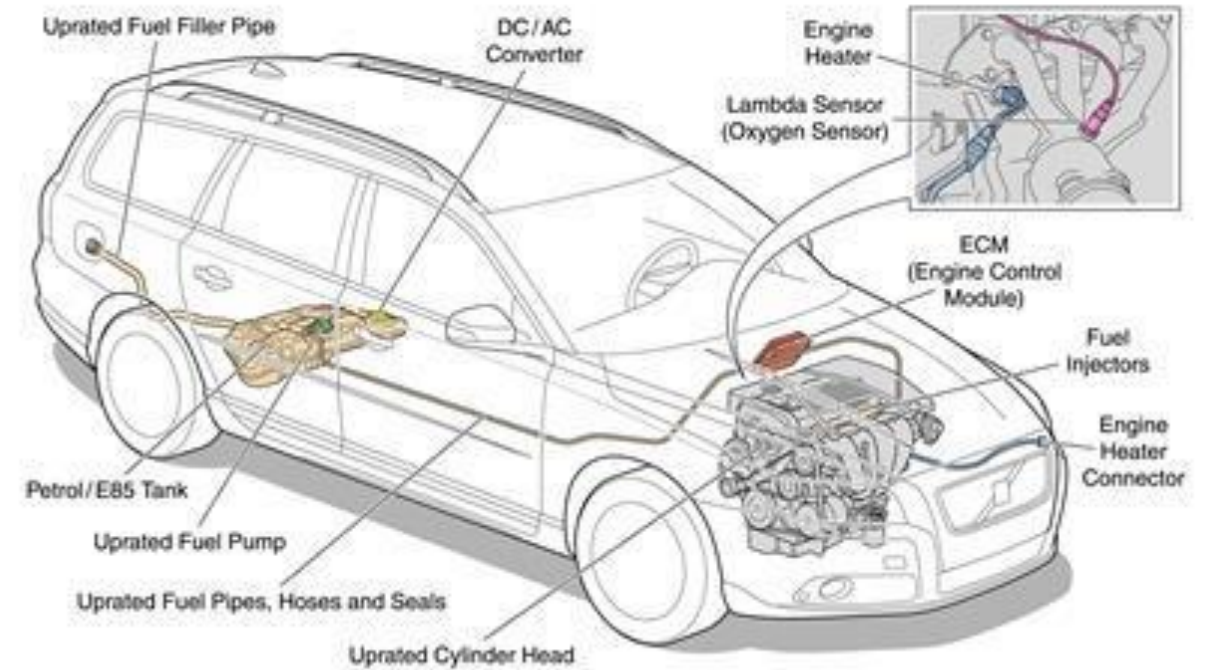
E-85 : Flex Fuel Technology



Flex Fuel (E-85)

- E85 (or flex fuel) is a term that refers to high-level ethanol-gasoline blends containing 70 % to 83% ethanol, depending on geography and season
- Sweden is, by percentage, one of the countries that uses more ethanol on their vehicles. That's why the Swedish marques have a broad range of models using flex-fuel powertrains.

Volvo Flexifuel System (E85 Bioethanol)



Volvo V70 2.0F

WORLDWIDE FFV ETHANOL BLENDS

Country	(Gasoline + Ethanol mixture)
Brazil	27± 1 % (E27) ethanol to E100
European Union	83 – 85 % ethanol (E85)– EURO V for FFV
United States - Federal	83 – 85 % ethanol (E85) - for FFV
India	Greater than 20% up to 85% ethanol for FFV 100% Ethanol – E93 (Pure Ethanol) – mono fuel



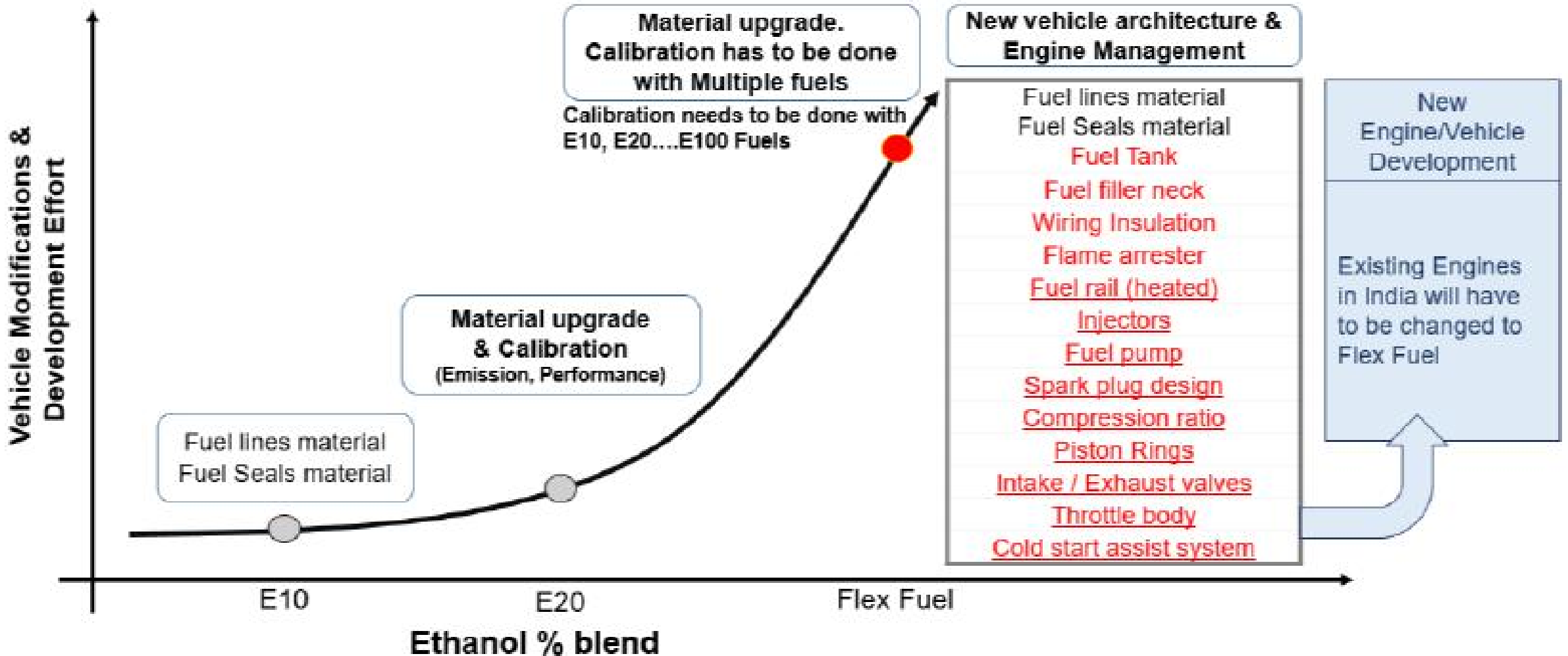
VEHICLE MODIFICATIONS FOR E85

Modifications for E85 include:

- Fuel hoses, valves and gaskets must be adapted to handle ethanol's more corrosive properties.
- The injection valves must be reinforced and designed for E85 as more fuel is injected into the engine—necessary since the energy content of E85 is lower than that of gasoline.
- The on-board software must be calibrated for E85. The engine management system automatically senses the current blend of fuel in the tank and optimizes the combustion process accordingly.



FLEX FUEL – SIAM VIEW (Vehicle Development Efforts)



Fuel Efficiency for E 85 Flex Fuel Vehicles

Fuel Efficiency Change

Source: SIAM Data

Blend \ CR	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5
E0	0.00	1.31	2.53	3.68	4.74	5.75	6.70	7.59	8.44	9.24	10.00
E5	-1.74	-0.45	0.75	1.88	2.93	3.91	4.84	5.72	6.56	7.35	8.10
E10	-3.48	-2.21	-1.03	0.07	1.10	2.07	2.99	3.85	4.67	5.44	6.18
E15	-5.21	-3.97	-2.81	-1.73	-0.71	0.24	1.14	1.98	2.79	3.55	4.27
E20	-6.95	-5.73	-4.59	-3.53	-2.54	-1.60	-0.72	0.11	0.90	1.65	2.36
E25	-8.69	-7.49	-6.38	-5.33	-4.36	-3.44	-2.58	-1.76	-0.99	-0.25	0.44
E30	-10.55	-9.37	-8.28	-7.26	-6.30	-5.40	-4.56	-3.76	-3.00	-2.28	-1.60
E35	-12.28	-11.13	-10.06	-9.06	-8.12	-7.24	-6.41	-5.63	-4.88	-4.18	-3.51
E40	-14.02	-12.90	-11.85	-10.86	-9.94	-9.08	-8.27	-7.50	-6.77	-6.08	-5.42
E45	-15.76	-14.66	-13.63	-12.67	-11.76	-10.92	-10.12	-9.37	-8.65	-7.98	-7.33
E50	-17.50	-16.42	-15.41	-14.47	-13.59	-12.76	-11.98	-11.24	-10.54	-9.88	-9.25
E55	-19.24	-18.18	-17.19	-16.27	-15.41	-14.60	-13.83	-13.11	-12.43	-11.78	-11.16
E60	-20.98	-19.94	-18.98	-18.08	-17.23	-16.44	-15.69	-14.98	-14.31	-13.68	-13.08
E65	-22.72	-21.71	-20.76	-19.88	-19.05	-18.28	-17.54	-16.85	-16.20	-15.58	-14.99
E70	-24.46	-23.47	-22.55	-21.68	-20.88	-20.12	-19.40	-18.73	-18.09	-17.48	-16.90
E75	-26.20	-25.23	-24.33	-23.49	-22.70	-21.96	-21.26	-20.60	-19.98	-19.38	-18.82
E80	-28.04	-27.09	-26.21	-25.39	-24.62	-23.90	-23.22	-22.57	-21.97	-21.39	-20.84
E85	-29.78	-28.86	-28.00	-27.20	-26.45	-25.74	-25.08	-24.45	-23.85	-23.29	-22.75
E90	-31.52	-30.62	-29.78	-29.00	-28.27	-27.58	-26.93	-26.32	-25.74	-25.19	-24.67
E95	-33.26	-32.38	-31.57	-30.81	-30.09	-29.42	-28.79	-28.19	-27.63	-27.09	-26.58

Fuel Efficiency drop and recovery by CR increase

- Flex Fuel Vehicles (4 Wheelers) are expected to cost higher than Regular Gasoline Vehicles around 20 %.
- Fuel Efficiency will be lower by around 25 to 30%
- To keep Running cost similar, Fuel cost at retail pump required to be lower than Gasoline by approx 30%

Feasibility of providing E85 at lower cost critical for customer acceptance of Flex Fuel Vehicles



Flex Fuel Vehicle Pavilion by SIAM



Honda will become the second 2-wheeler manufacturer after TVS to launch a flex-fuel engine powered motorcycle in India



SIAM organized a technology demonstration on flex fuel vehicles in India. It highlighted the readiness of OEMs for ethanol adoption through multiple segments of FFVs that will be launched in the next 2-3 years



After Treatment Challenges for Alt Fuels

- Presence of Oxy-hydrocarbon species like aldehydes and ketones in biofuel exhaust
- Presence of moisture in Hydrogen exhaust
- Presence of ammonia in CNG exhaust
- Requirement of GPF for controlling oil and fuel based PN
- Higher evaporative emission due to higher RVP in case of ethanol blends
- Durable, cost effective catalyst development for new synthetic fuels



RESEARCH & DEVELOPMENT IS THE KEY



ARAI Facilities for FFV Development & Certification



Emission system specification

- Exhaust gas sampling system : CVS-CFV
- CVS Flow: 4 to 30 m³/min with gasoline/diesel separation
- Venturi Sizes 4, 6, 8 & 12; Flow Rates from 4 to 30 m³/min in steps of 2 m³/min
- Heated Bag Double Cabinet for 12 Bags (35° C)
- CO, CO₂, THC, CH₄, NO₂ & NO, NO_x concentration
- Background Particulate measurement for GDI and diesel
- Particle number Counting
- PM measurement equipment
- Emission measurement equipment – Dilute bench
- GDi Tunnel

15 Test Cells, Chassis Dyno & Virtual Test Bed

Chassis Dynamometer Specifications

- Maximum Permissible axle load (kg) – 4500
- Roller diameter- 48 “(1219.2 mm)
- Maximum distance between the rollers (mm) -2744
- Minimum distance between the rollers (mm) -914
- Base Inertia (kg) – 1209
- Inertia Simulation Range (kg) - 454 - 5448
- Nominal minimum permanent motoring power (kW) - 150
- Speed range (km/hr) - 0-200

Fuel categories:

Compatible for diesel, gasoline, CNG, LPG, Methanol, Ethanol, DME, Bio fuels and other alternative fuels including Bi-fuel, dual fuel, HCNG etc.

Applications

- BSVI Emission Development & testing
- Vehicle development testing & OBD calibration
- Powertrain friction force measurement
- Driveline Oil Evaluation
- Vehicle testing using various national, international & custom made driving cycles
- Dynamic road gradient simulation
- Constant speeds fuel consumption tests

NABL accredited reference lab



Thank You

