Bio-Fuels: Opportunities & Challenges from Indian Perspective

Session : Future Fuel & Fuel blends

ECMA 15th International conference – "Clean Air Today, Everyday"

Mr. Harmeet Singh

Deputy General Manager, Powertrain System Development

MARUTI SUZUKI

Oct 22nd, 2024

©2024Maruti Suzuki India Limited

Contents

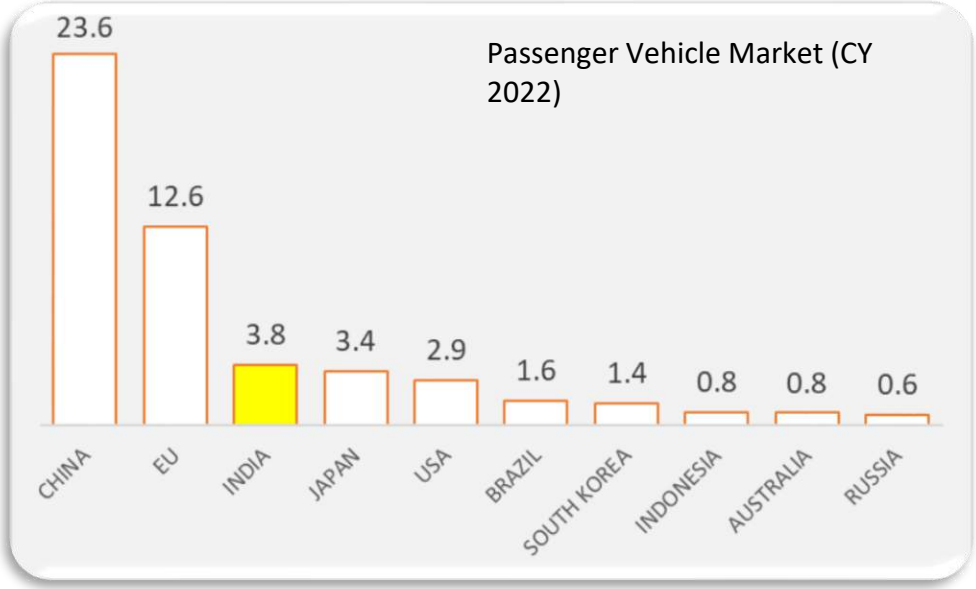
MARUTI SUZUKI

India today is shifting gears to become a major economy

- India: **5th largest Economy** & **3rd Largest PV** Market in World
- **Mobility required to support** the Economic progress to be become a Developed nation
- **This growth story must be scripted with responsibility towards Environment**

Economic Standing

Mobility



OICA Report

Sustainable Development

But there are challenges for Sustainable Development

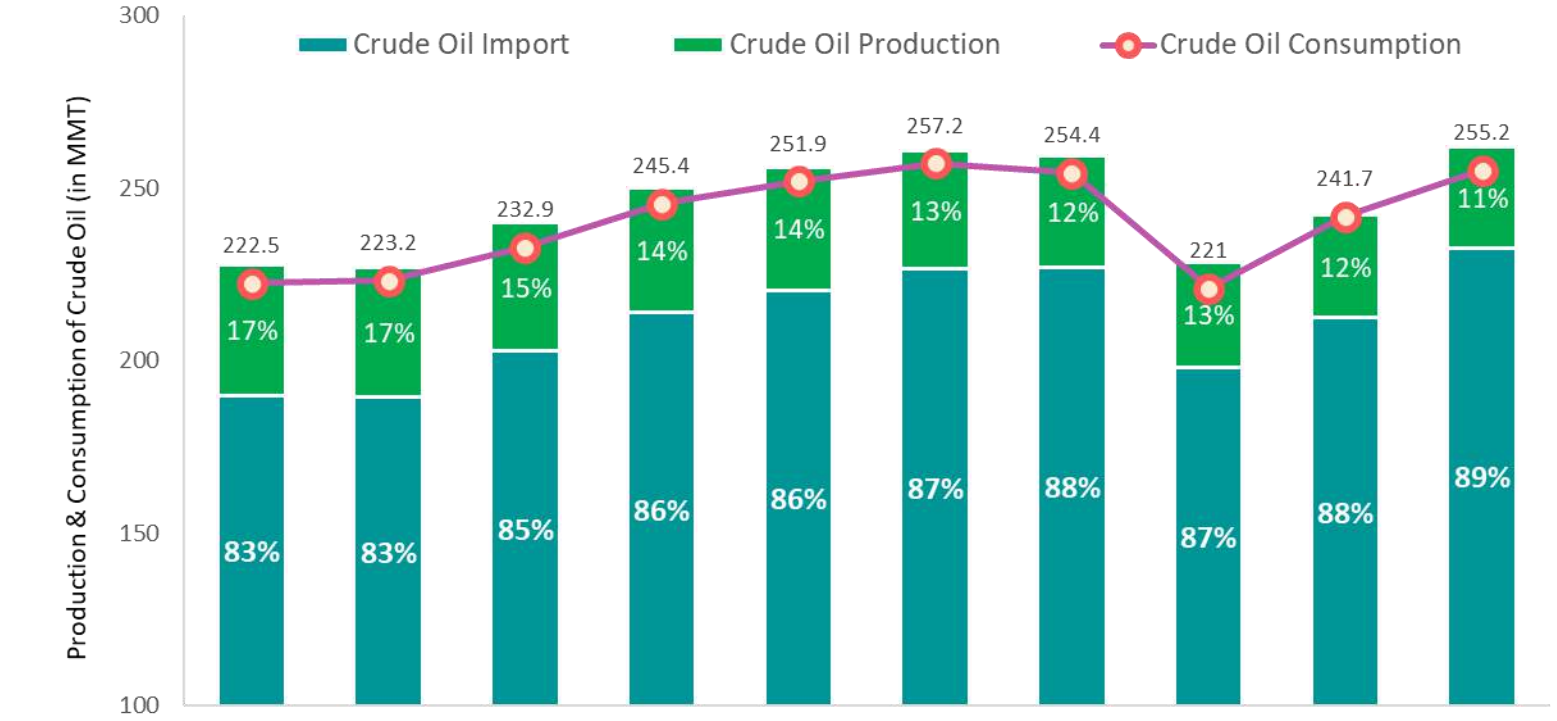
©2024Maruti Suzuki India Limited

1. Challenge of Energy Security & growing need for mobility

MARUTI SUZUKI

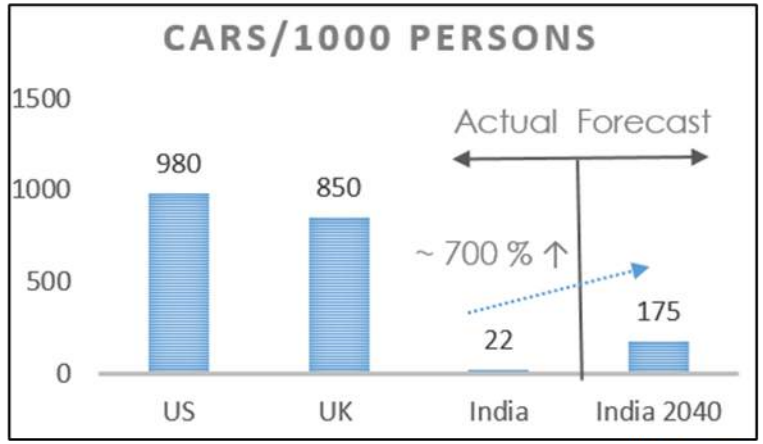
- With **158 Bn $ import bill**, **~89%** of crude **oil is imported**.
- **Transport sector** accounts for **~37% of crude** consumption. **PVs** contribute **~4.3%** of total crude
- Demand for fuel can potentially increase, impacting further the **Energy security concern**.

Import Bill – Energy Security



PPAC's Snapshot of India's Oil & Gas data, PIB

Mobility needs



Niti Aayog

- India is heavily under-motorized

- India needs higher mobility for
  > Country's Economic development
  > Improve quality of life

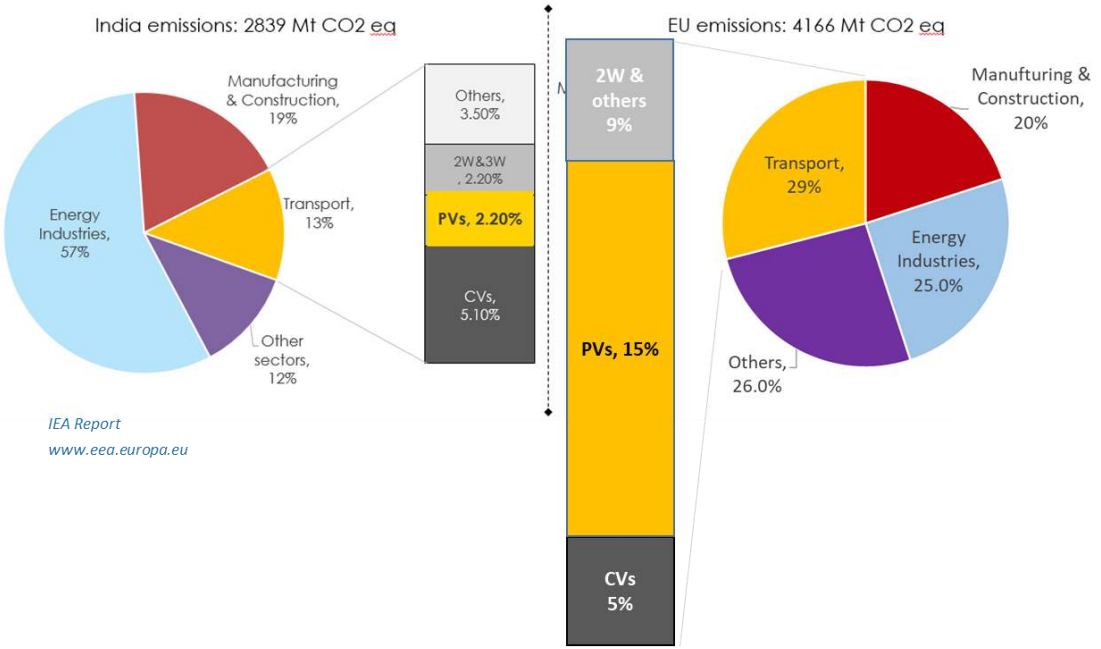
Locally produced Biofuels can support

©2024Maruti Suzuki India Limited

2. GHG & Local Emissions

- India is the **3rd largest GHG** emitter (behind CHINA & US) but Sectoral contributions are way different
- **Passenger Vehicles** in India **contribute 2.2%,** while **15% in EU** towards overall country level GHG emission
- North and Gangetic plains also facing a **Local pollution issue** (weather & farm fire aggravate it)
- **India must work for present challenges & sustainable paths for ambitious future growth plans**

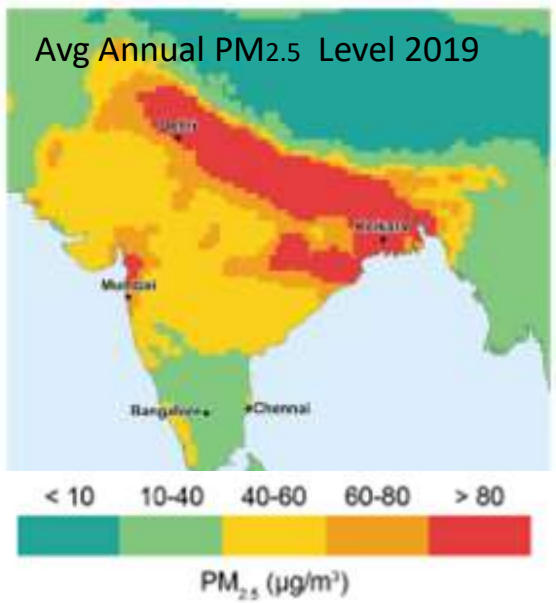
GHG Emissions



IEA Report

www.eea.europa.eu

Localized emissions , PM issue



Biofuels can provide solution for both the above challenges also

©2024Maruti Suzuki India Limited

Benefits of Biofuels

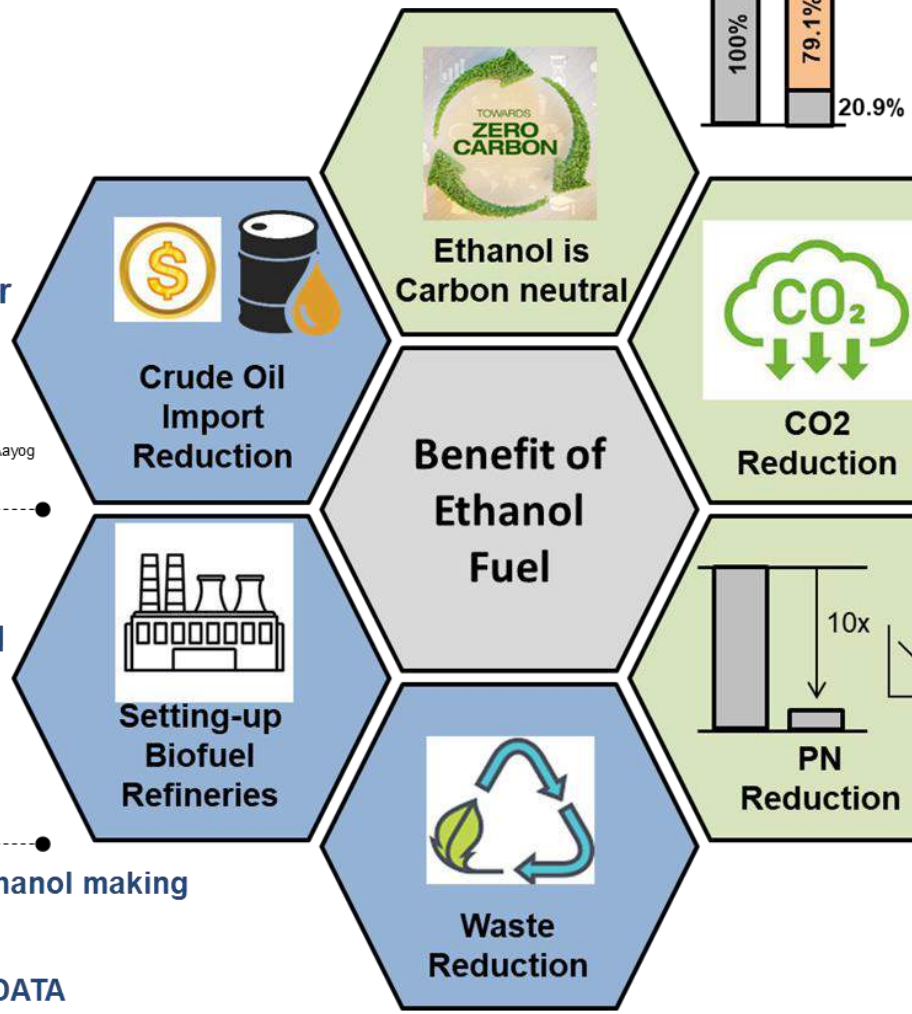
MARUTI SUZUKI

- FX saved in last 8 Years: INR 50,000 Cr
- From 2025, every year (estimated FX savings) approx. INR35,000 Cr

Source :Expert Committee Report → Niti Aayog

Local production of ethanol
→ Substitute to expensive crude oil import.

- Stubble used for ethanol making
→ No crop burning
- ANNDATA → URJADATA
→ Crops to oil companies for ethanol.



With E85 Fuel:
79.1% CO_2 is biogenic from E85.

- CO_2 saved in last 8 Years: 27 Lakhs MT
- From 2025, every year (estimated CO2 savings) approx. 25 Lakhs MT

Source :Expert Committee Report → Niti Aayog

- 10x less Particulate Number (PN) w.r.t. Gasoline
→ Less pollution

Reduce fuel imports, Curb GHG & PN Emissions & Benefit agrarian economy

©2024Maruti Suzuki India Limited

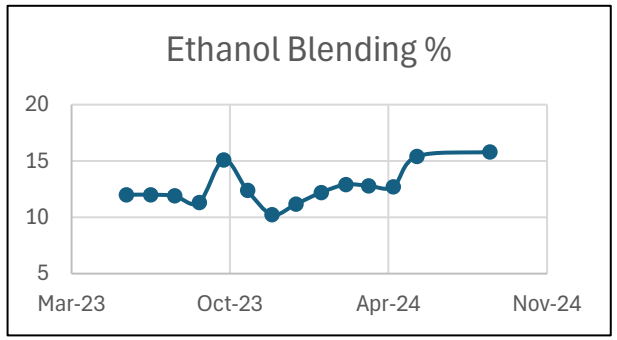
Initiatives by GOI

Govt is taking measures to adopt Alternate fuels to meet national GHG targets & Energy security

- Automotive industry is developing and adopting vehicles with the policy of GOI
- Energy producers are also shifting to renewable fuel/energy availability

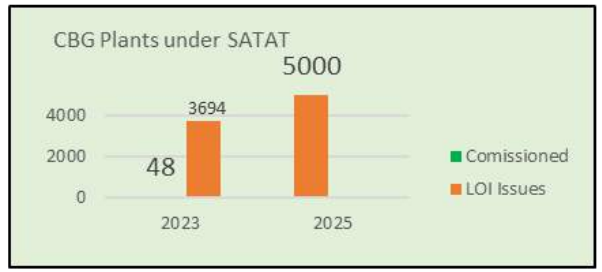
Ethanol / Flex Fuel

Source : Roadmap for Ethanol Blending in India

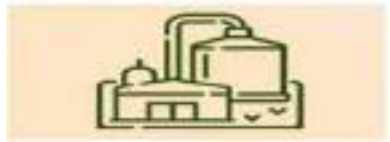


Average blending Nov 2023 to Aug 2024 touched 13.6 %

CBG



Source : https://satat.co.in/satat/#



5000 CBG Plants Targeted by 2024-25

3826 LoI issued for plants

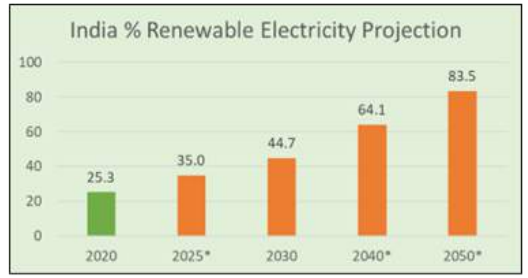
68 plants commissioned

15MMT of CBG production

22097 Tonnes CBG sold (FY 2023-24)

100 outlets currently dispensing CBG

EV



* Projection based on 2020 & 2030 data of CEA

- Initiatives are going on to meet the targets for renewable electricity production

Multi-path approach of GOI is promoting Biofuels and Electrification together

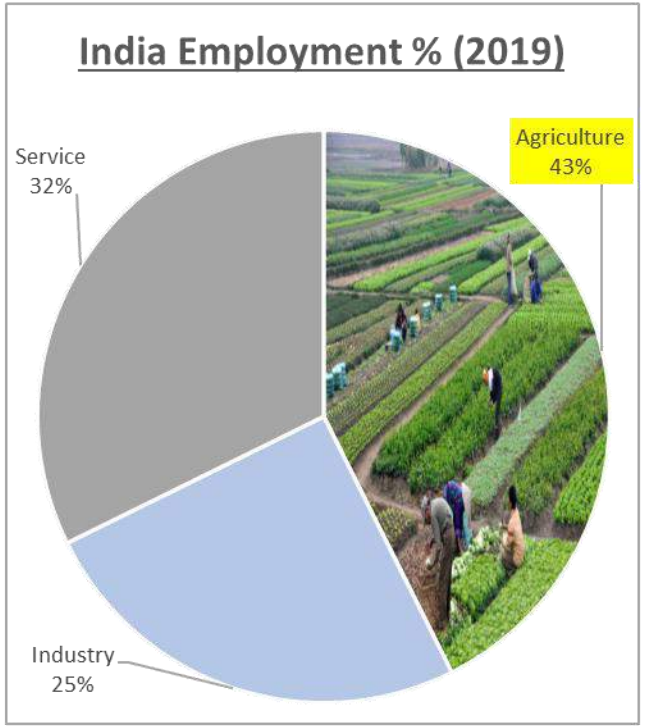
©2024Maruti Suzuki India Limited

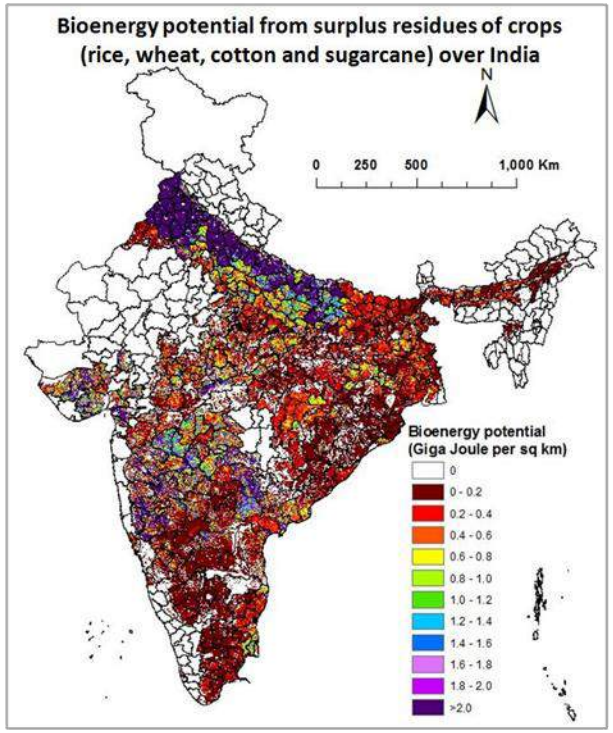
Contents

- ❑ Why India needs Bio-Fuels?
- ❑ Bio-Fuel: Opportunities
- ❑ Bio-Fuel: Challenges
- ❑ Way forward
  - Expectations from Emissions Control System
  - Enablers for Bio-fuels

1. India's Agriculture based Economy

Agriculture based Economy





- Huge potential for bio based low carbon energy sources Residue
- Opportunity to build agro based economy

Agriculture products & waste has huge potential

Bio-Ethanol Production Potential

Capacity Augmentation (in Cr. Lt)			
Year	Capacity Requirement		
	Grain	Molasses	Total
2019-20	258	426	684
2020-21	260	450	710
2021-22	300	519	819
2022-23	350	625	975
2023-24	450	725	1175
2024-25	700	730	1430
2025-26	740	760	1500

Department of Food and Public Distribution(DFPD) estimates

1 tonne = 380ltr Ethanol, PIB 24 MAR 2021

Bio-CNG Production Potential

Source	Annual Waste (in Mn Metric Tonnes)	Bio-CNG generation per ton	Total Bio-CNG Generation Potential
Agricultural Waste	600	0.1	60
MSW	66	0.05	3.3
Sum Total Bio-CNG Potential (MMT)			**63.3**

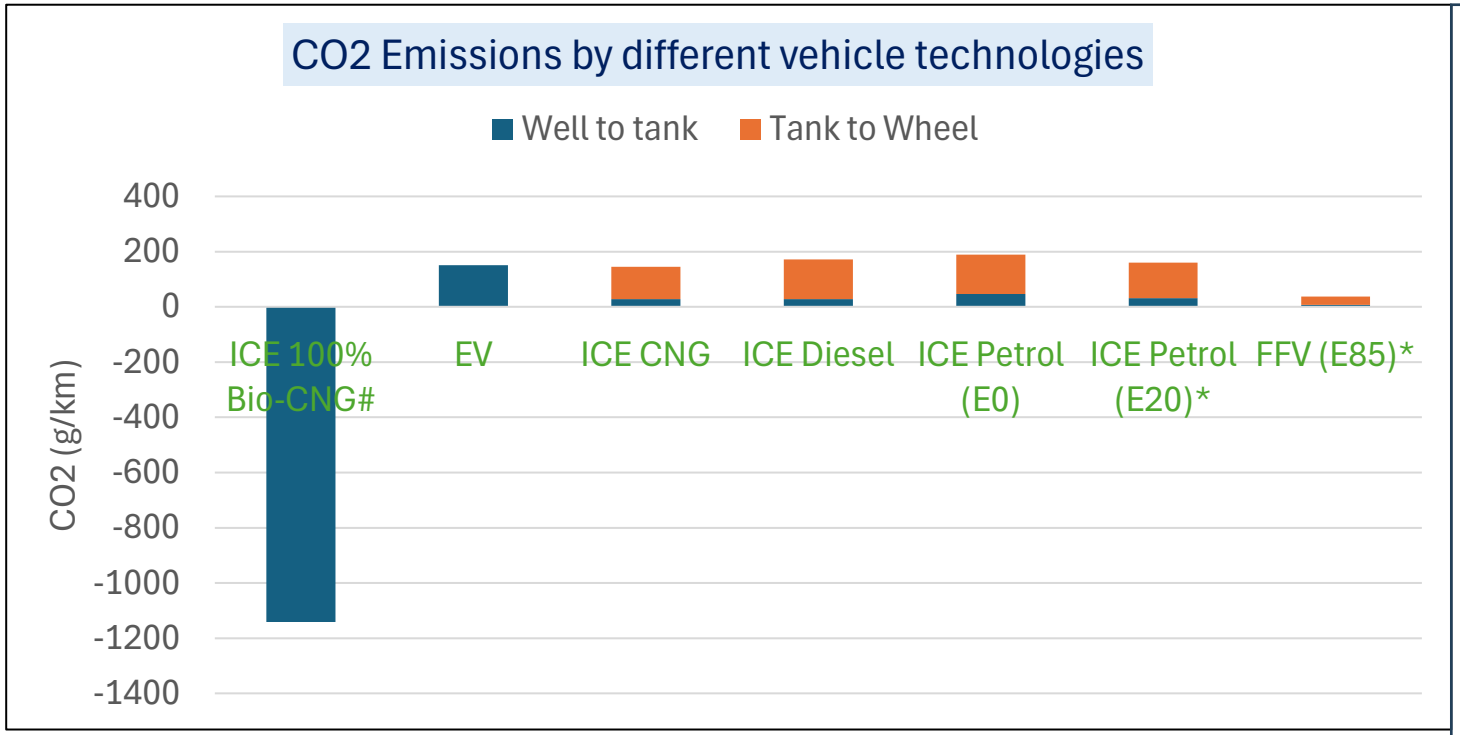
Nomura

India has specific advantage to utilize Bio-Fuels while also ensuring sustainable growth of Economy

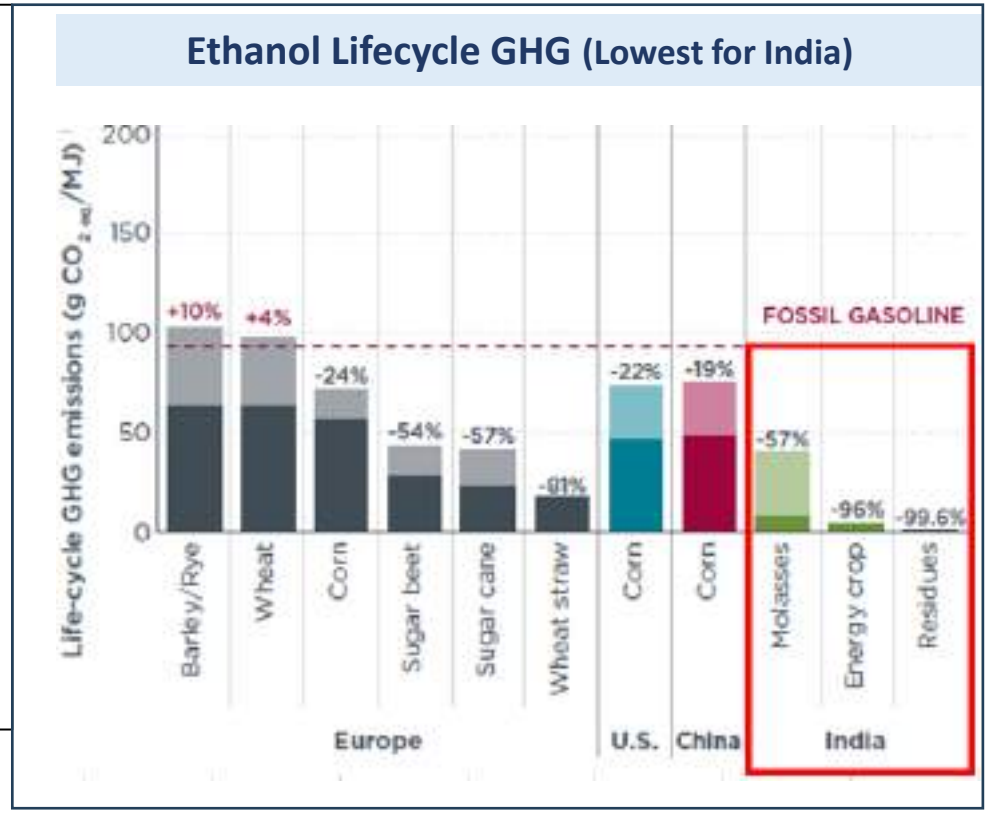
©2024Maruti Suzuki India Limited

2. Carbon Intensity of Bio-Fuels

- Comparative CO_2 Impact based on carbon intensity of fuels reveals considerable potential by shifting to Bio-Fuels (Ethanol and Bio CNG)
- Based on Well to Tank emission intensity, India has advantage to utilize while also ensuring sustainable growth



Source: www.teriin.org



Notes:
*ICE Petrol (E20), ICE HEV (E20), FFV (E85) WTW derived from TERI report considering Biogenic CO2 for Ethanol
Tailpipe CO2 is sees as 117g/km, but as per IPCC principle & TERI report, biogenic emissions for CBG = 0

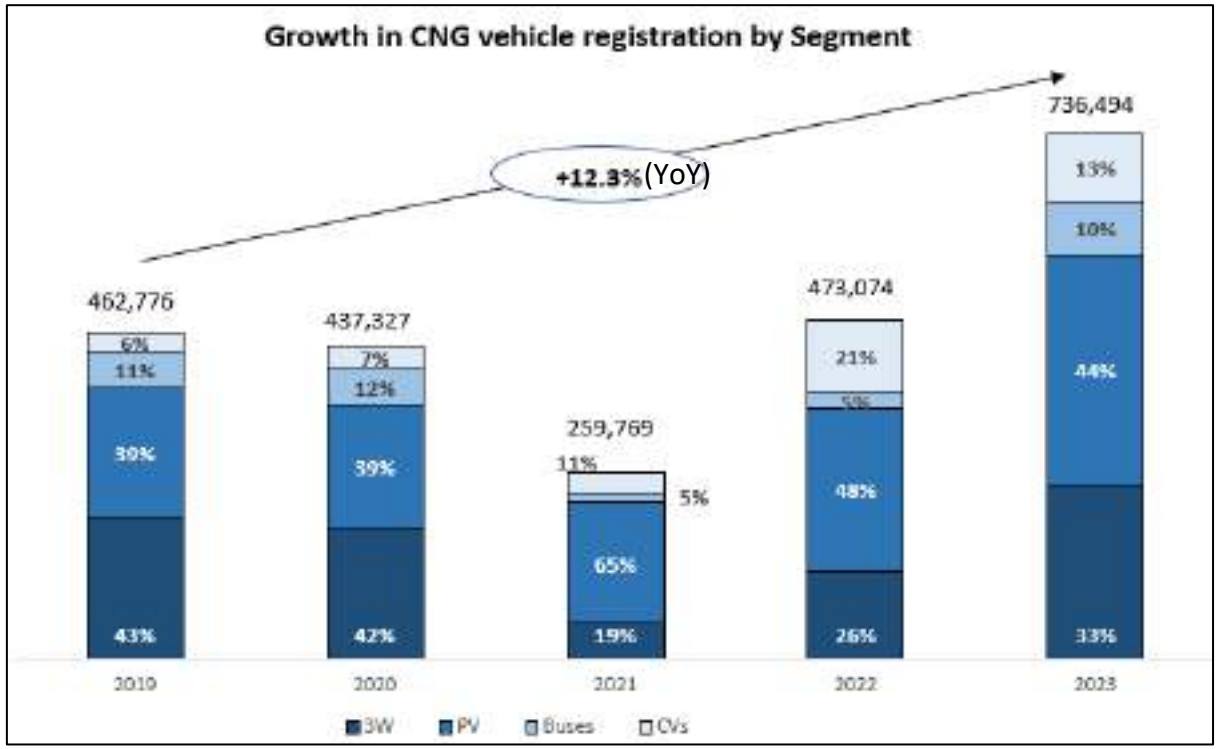
India has advantage in terms of lifecycle GHG Emissions for Bio-Fuels

©2024Maruti Suzuki India Limited

3. Trends towards acceptability of alternate fuels

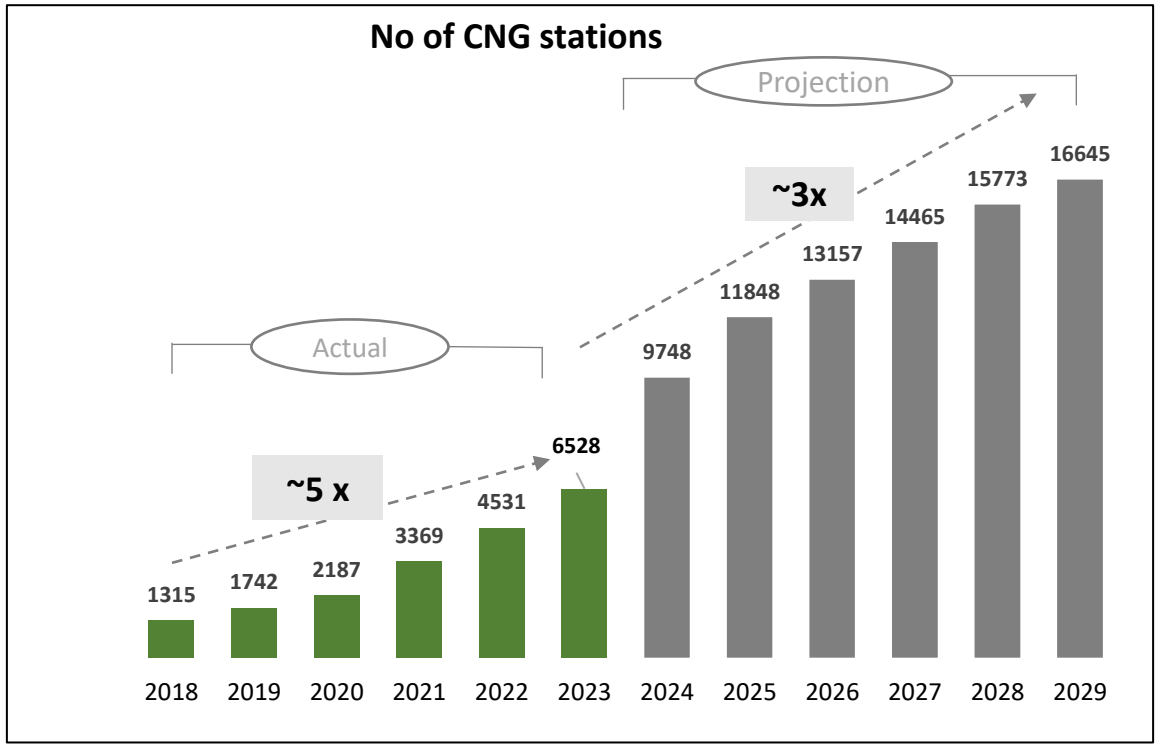
MARUTI SUZUKI

CNG vehicle share



Source: NRI

CNG station infrastructure (Actual and Projection)



Source: MoPNG Annual report 2022-23, NRI

- CNG vehicle sales have increased in all segments since covid and reached to record highest in FY 2023.
- PV segment has had significant share in overall numbers

- Increasing demand of natural gas in automotive sector is supported by continuously improving infrastructure by Govt

Widely increasing CNG station infrastructure & Customer acceptability for gaseous fuels point towards likely acceptance of CBG

©2024Maruti Suzuki India Limited

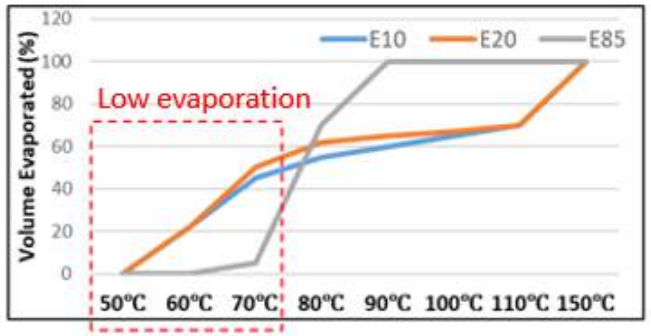
Contents

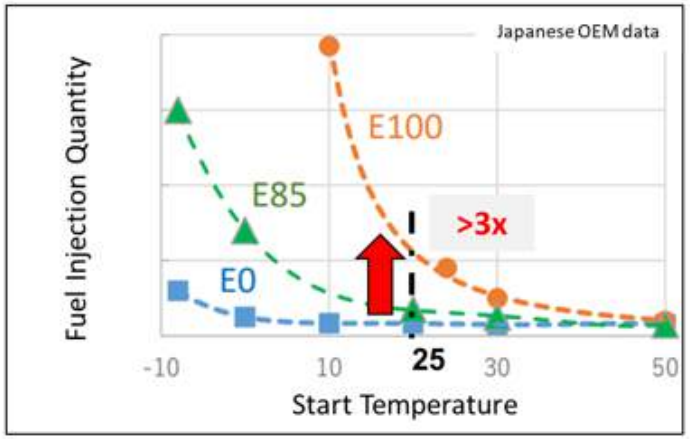
- ❑ Why India needs Bio-Fuels?
- ❑ Bio-Fuel: Opportunities
- ❑ Bio-Fuel: Challenges
- ❑ Way forward
  - Expectations from Emissions Control System
  - Enablers for Bio-fuels

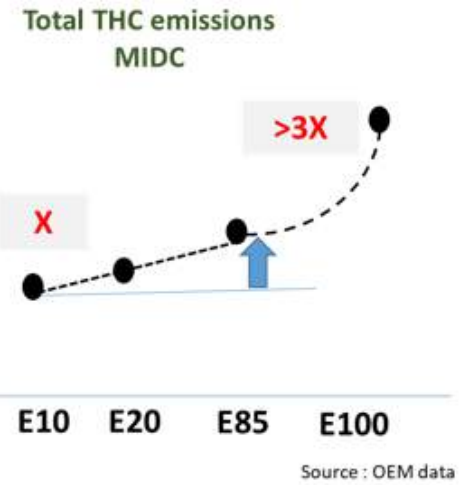
1. Emission challenge with Ethanol

MARUTI SUZUKI

A. Increase in fuel injection





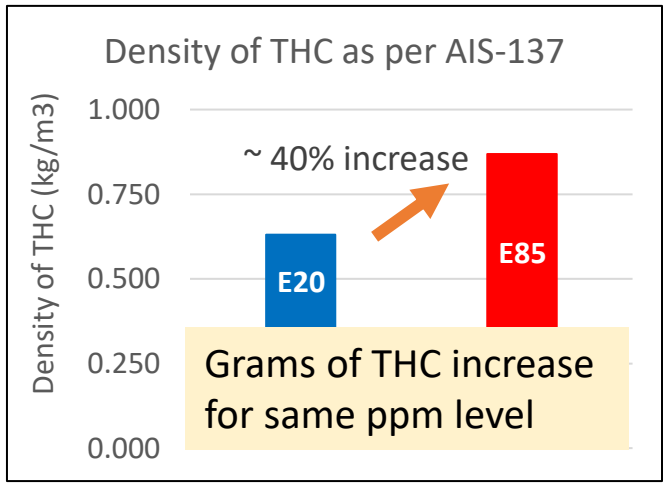


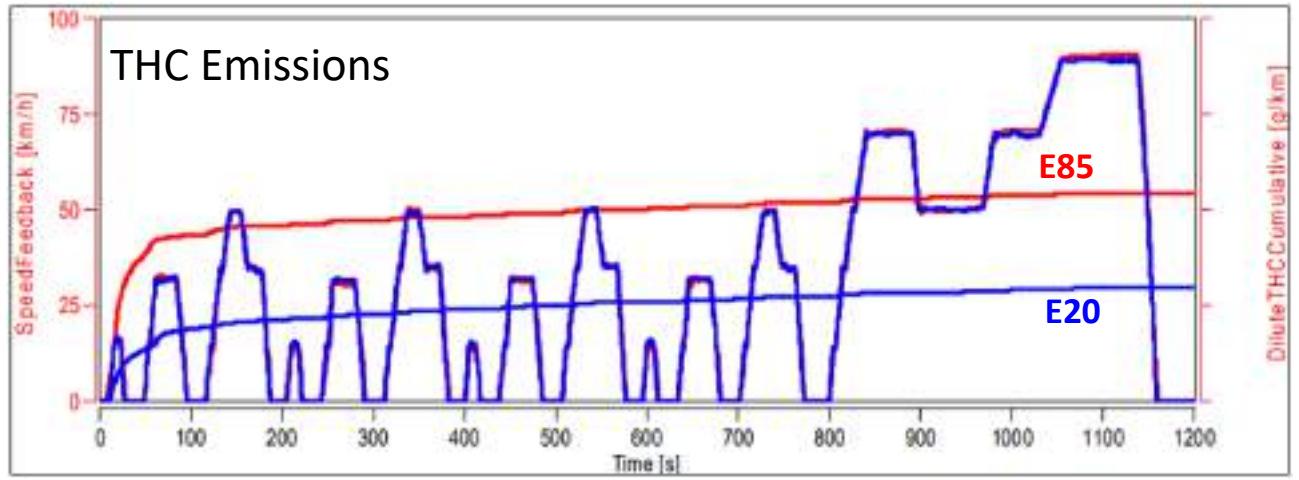
Low evaporation

Fuel Injection qty requirement at start increases

Bio-fuel properties result in unburnt Ethanol in tailpipe as THC

B. Increase in THC density





Need Solutions for reducing Cold Start Emissions

©2024Maruti Suzuki India Limited

2. Emission Challenge: MIDC -> WLTP-3P (2027 Onwards)

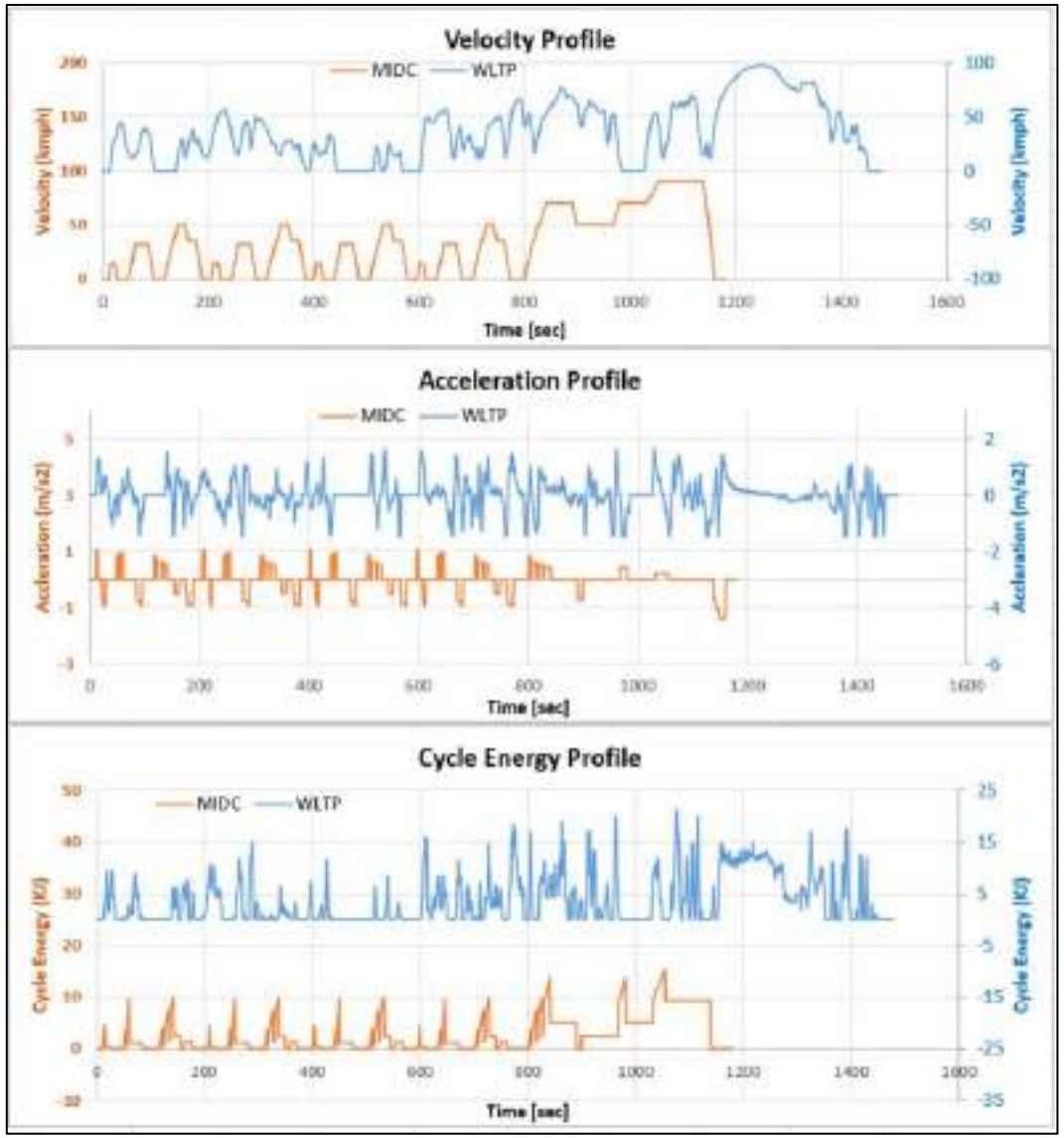
MARUTI SUZUKI

Emissions cycle impact MIDC → WLTP 3P (India)

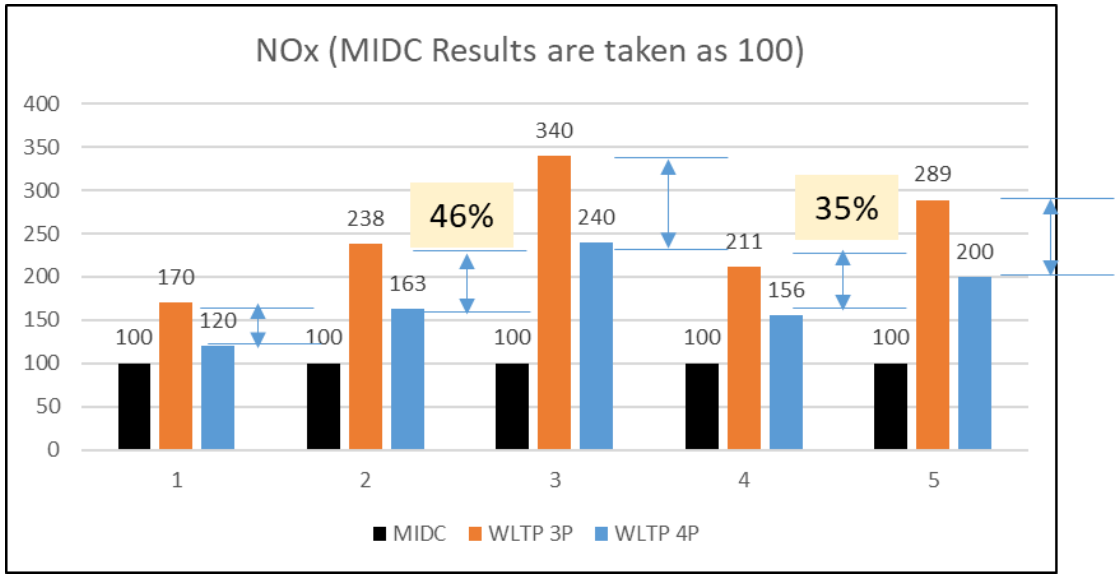
Dynamic Velocity Profile

Harsh Acceleration Profile

Higher Cycle Energy per Km



India's WLTP 3-Phase is stiffer than EU 4-Phase



- **WLTP is tougher than MIDC**
- **WLTP 3P (India) is tougher than WLTP 4P (EU)**
  (WLTP 4P is longer than WLTP 3P, Emissions are mainly at start)

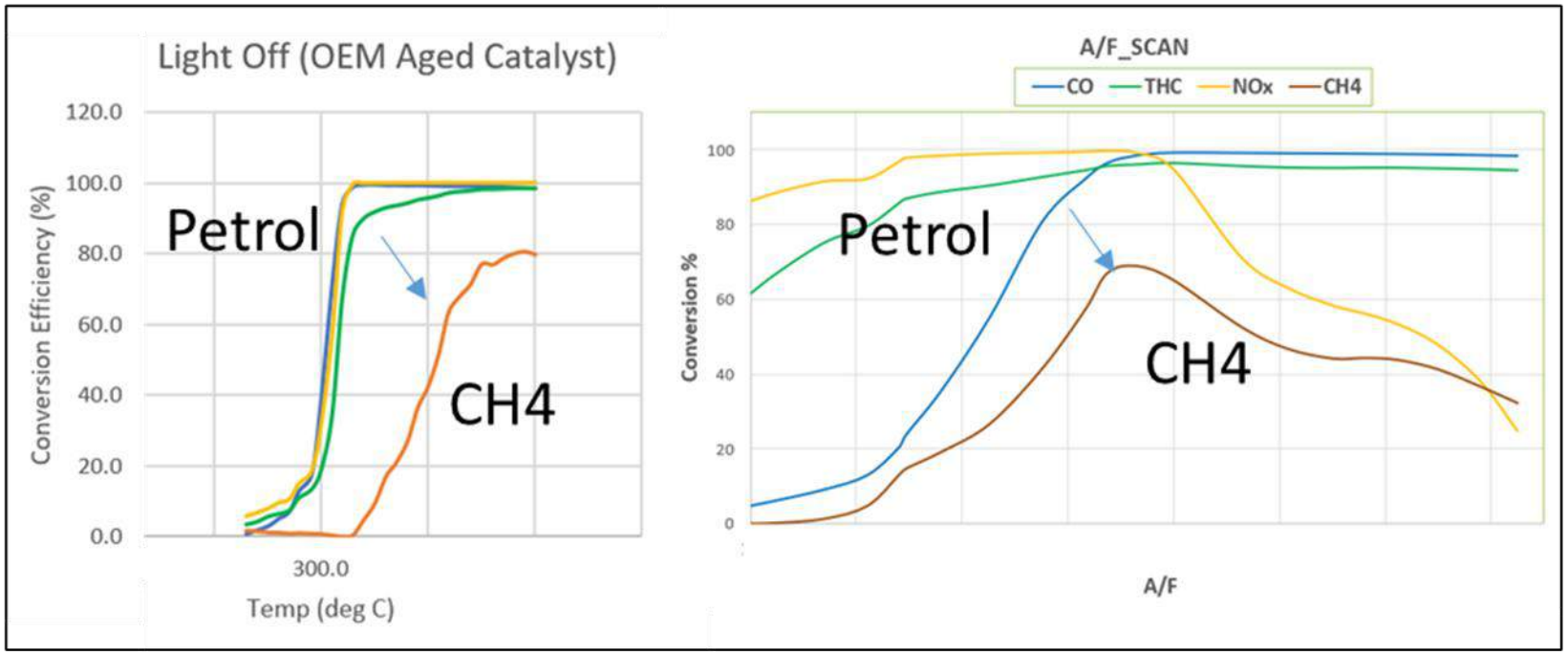
Development of High Performance Catalyst is required

©2024Maruti Suzuki India Limited

3. Emission challenge with Bio-CNG

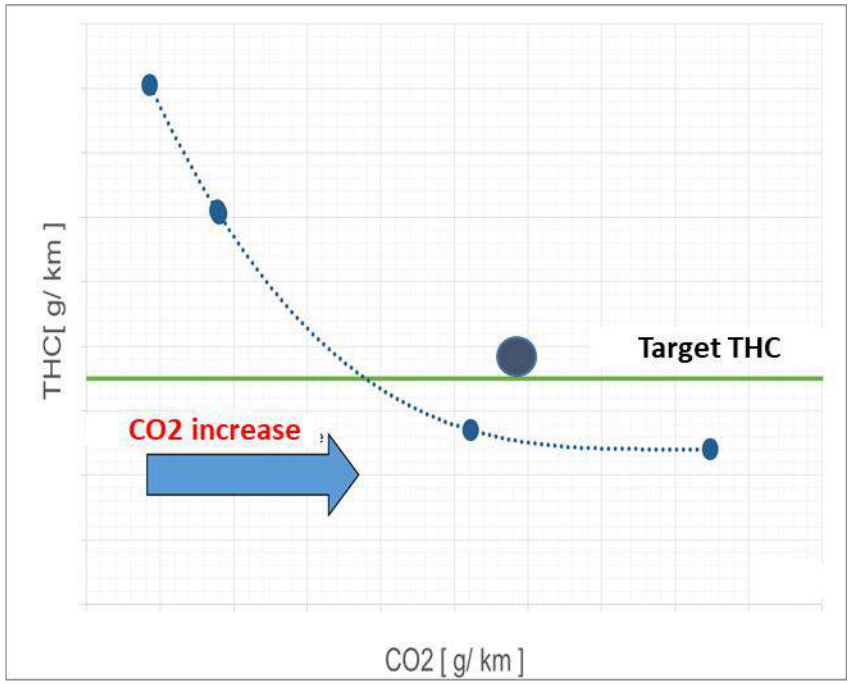
- **Methane is difficult to convert** and requires higher temperatures for conversion in TWC
- **Penalty of CO2** is there to meet THC emissions

Fuel properties (Bio-CNG / CNG)



Conversion performance with Methane is much lower to Gasoline

CO2 penalty



Extra fuel is used to reduce THC

Current approach increases overall GHG emissions performance of vehicle also

→ **Make regulatory provision for NMHC / NMOG rather than THC (like US, Japan, Brazil)**

©2024Maruti Suzuki India Limited

3. Emission challenge with Bio-CNG

MARUTI SUZUKI

Methane is not pollutant : International markets regulate NMHC /NMOG pollutants not THC

US FEDERAL

TIER 3 STANDARDS

TIER 3 FTP STANDARDS

Tier 3 Certification Bin Standards (FTP, 150,000 mi)				
Bin	NMOG+NOx (mg/mi)	PM[1] (mg/mi)	CO (g/mi)	HCHO (mg/mi)
Bin 160	160	3	4.2	4
Bin 125	125	3	2.1	4
Bin 70	70	3	1.7	4
Bin 50	50	3	1.7	4
Bin 30	30	3	1.0	4
Bin 20	20	3	1.0	4
Bin 0	0	0	0	0

CALIFORNIA

LEV III STANDARDS

Passenger Cars and Light Duty Trucks ≤ 8,500 lbs

Durability (mi)	Emission Category [1]	NMOG+ NOx (g/mi)	CO (g/mi)	Formalde-hyde (g/mi)	Particulates[2] (g/mi)
150,000 (optional)	LEV160	0.160	4.2	4	0.01
	ULEV125	0.125	2.1	4	0.01
	ULEV70	0.070	1.7	4	0.01
	ULEV50	0.050	1.7	4	0.01
	SULEV30	0.030	1.0	4	0.01
	SULEV20	0.020	1.0	4	0.01

Japan Emissions Regulation

EMISSIONS STANDARDS – GASOLINE AND LPG VEHICLES

			Test Mode	Unit	CO	NMHC	NOx	PM[1]
New Short Term	2000	Passenger Car	10-15 Mode	g/km	0.67	0.08	0.08	-
			11 Mode	g/test	19.0	2.20	1.40	
	2002	Mini Commercial Vehicle	10-15 Mode	g/km	3.30	0.13	0.13	
			11 Mode	g/test	38.0	3.50	2.20	
	2000	Light Commercial Vehicle (GVW ≤ 1.7 t)	10-15 Mode	g/km	0.67	0.08	0.08	
			11 Mode	g/test	19.0	2.20	1.40	
	2001	Medium Commercial Vehicle (1.7 t < GVW ≤ 3.5 t)	10-15 Mode	g/km	2.10	0.08	0.13	
			11 Mode	g/test	24.0	2.20	1.60	
New Long Term	2005	Passenger Car	JC08	g/km	1.15	0.05	0.05	
	2007	Mini Commercial Vehicle			4.02			
	2005	Light Commercial Vehicle (GVW ≤ 1.7 t)			1.15			
	2005	Medium Commercial Vehicle (1.7 t < GVW ≤ 3.5 t)			2.55		0.07	
Post New Long Term	2009	Passenger Car	JC08	g/km	1.15		0.05	0.005
		Mini Commercial Vehicle			4.02			
		Light Commercial Vehicle (GVW ≤ 1.7 t)			1.15			
		Medium Commercial Vehicle (1.7 t < GVW ≤ 3.5 t)			2.55		0.07	0.007
Future Regulations	2018	Passenger Car	WLTP	g/km	1.15	0.10	0.05	0.005
	2019	Mini Commercial Vehicle			4.02			
		Light Commercial Vehicle (GVW ≤ 1.7 t)			1.15			
		Medium Commercial Vehicle (1.7 t < GVW ≤ 3.5 t)			2.55	0.15	0.07	0.007

BRAZIL

"PROCONVE" STANDARDS FOR GASOLINE PC, LCV AND DIESEL LCV

Vehicle	Standard (g/km)	NMHC	CO	NOx[1]	HCHO	PM[2]
PC	L5	0.05	2.0	0.12 (0.25)	0.02	0.05
	L6		1.3	0.08	0.02	0.025
	L7[3]		1.3	0.03	0.01	0.005
LCV ≤ 1,700 kg	L5	0.05	2.0	0.12 (0.25)	0.02	0.05
	L6		1.3	0.08	0.02	0.03
	L7[3]		1.3	0.03	0.01	0.005
LCV > 1,700 kg	L5	0.06	2.7	0.25 (0.43)	0.04	0.06
	L6		2.0	0.25 (0.35)	0.03	0.04
	L7[3]	0.05	1.3	0.05	0.015	0.01

Reconsideration of CH4 as pollutant,
to be aligned as per international markets

©2024Maruti Suzuki India Limited

4. Non-Alignment of Regulations & Fiscal Policy with Biofuels

MARUTI SUZUKI

Country / Region	Multi Pathway approach for Carbon Neutral (Bio-fuel + Electrification)	Regulation Alignment for Biofuels		Fiscal Policy alignment for Biofuels	
		Emissions (THC → NMOG/ NMHC)	CAFÉ (Biogenic CO2 Correction)	Bio-fuel price parity for energy	Bio-fuel vehicle Tax incentive (FFV etc)
USA	O	O	O	O	O
Brazil	O	O	O	O	O
India	O	X	X	X	X
Europe	X	X	X	X	X

Present approach → EV only from 2035,
Not support Bio-fuels, E-fuels

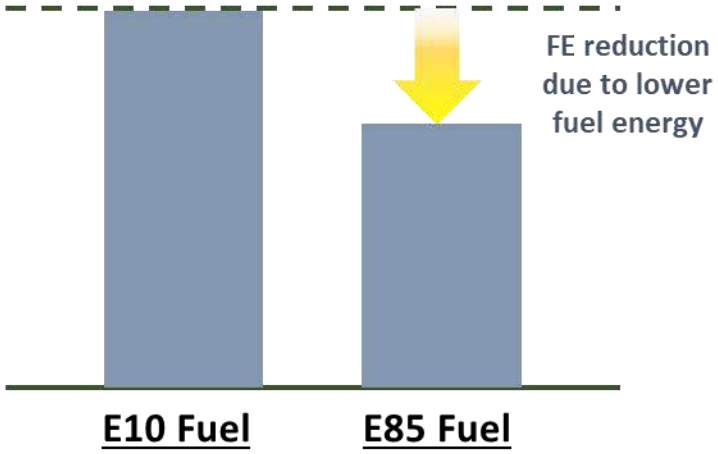
Enabling provisions are required for Bio-Fuel adoption

©2024Maruti Suzuki India Limited

5. Customer Acceptability

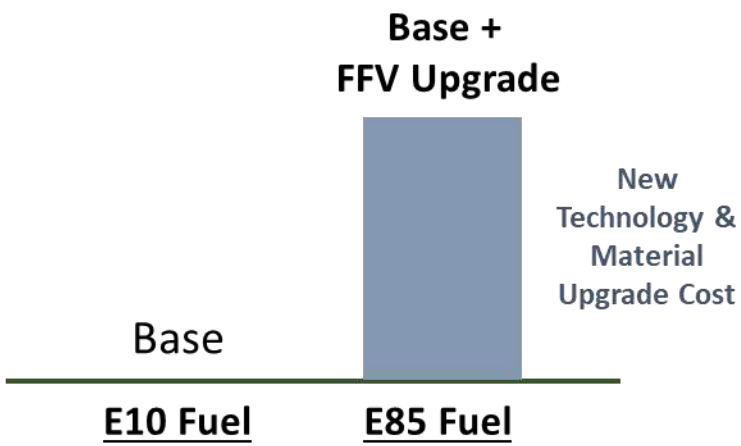
MARUTI SUZUKI

Fuel Economy



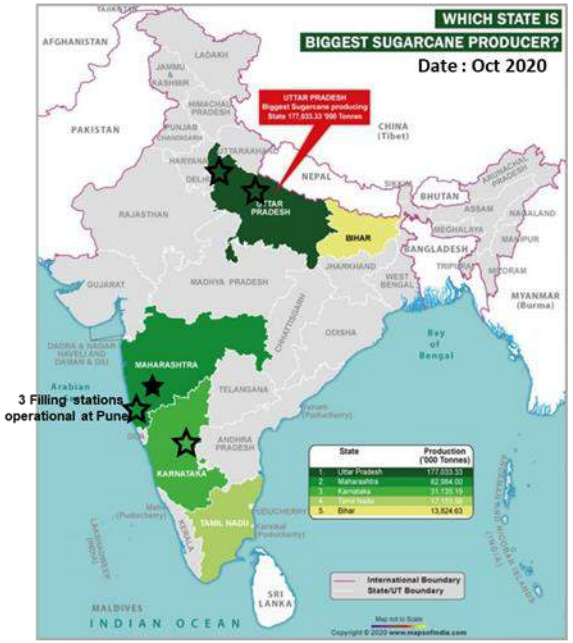
Price of E85 fuel to be at least 35% lower than E10 fuel

Vehicle Price



Appropriate tax incentives to promote FFVs

Fuel Availability



Consistent and quality fuel availability across nation

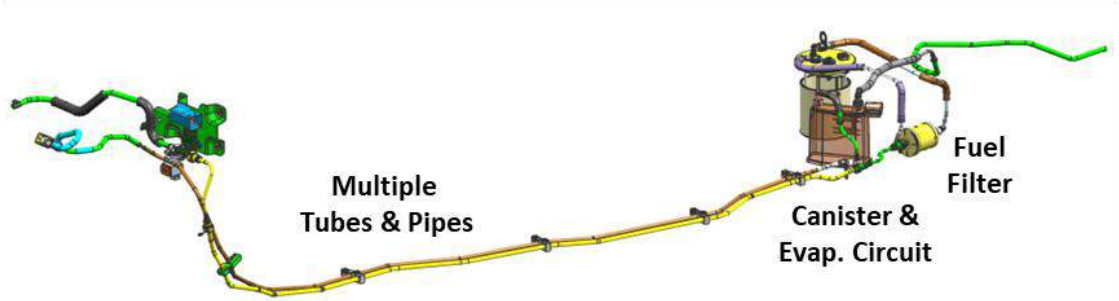
Fiscal Policy support & Fuel Availability Roadmap

©2024Maruti Suzuki India Limited

6. Technology development for FFV

MARUTI SUZUKI

1 Material Compatibility



2 Engine Start in Cold Weather Conditions & High Flow requirement


Fuel Rail with Heater


Rail Heater Control Unit


Relay & Harness


High Flow Injectors

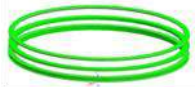

High Flow Fuel Pump

3 Design Upgrade for Core Engine Part Reliability with corrosive fuel


Cylinder head (Valve Seats)


Valve


Piston


Piston Ring


Spark Plug

4 Upgrade for Emission Regulation Compliance to meet BS6 Phase-2


Catalytic Convertor


Ethanol Sensor


Lambda Sensor

40+ New Logics
SW upgrade for intermediate blends
HW modification for additional Inputs


Engine Control Unit

Engine HW changes require extensive Development (E20 to E85)

- Extensive Reliability tests at Proto and Final tooled up stages.
- Vehicle Calibration / Validation with intermediate fuel blends.
- As good as new development

©2024Maruti Suzuki India Limited

Contents

- Why India needs Bio-Fuels?
- Bio-Fuel: Opportunities
- Bio-Fuel: Challenges
- Way forward
  - Expectations from Emissions Control System
  - Enablers for Bio-fuels

Bio-fuel adoption in India : OEM perspective on way forward

MARUTI SUZUKI

Policy Enablers for Biofuels

1. Regulatory support
   - CAFÉ : Biogenic CO2 accounting
   - Emissions : THC → NMHC / NMOG

2. Customer Acceptability
   - Price parity of Fuel as per energy
   - Price parity for Vehicle cost

3. Roadmap beyond 2025
   - Bio-fuel availability

Expectations from Emission Control System Partners

1. Higher performance Aftertreatment system
   - Ethanol /Pet light-off < 250˚C (OEM Aged)
   - CH4 light-off <350˚C (OEM Aged)
   - Wider conversion window for Bio-CNG / CNG
   - Low thermal mass substrate (>55% porosity)

2. HC Trap Catalyst with >30% emissions improvement

3. Alternate metal Catalyst to make it affordable

4. Focused Development for Biofuel's aftertreatment

Let's work together to achieve →Carbon Neutrality by Bio-fuels

©2024Maruti Suzuki India Limited

Thank You

Maruti Suzuki WagonR FFV proto

MARUTI SUZUKI

©2024Maruti Suzuki India Limited