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# Fuels of the Future

## *Sustainable fuels for carbon neutral growth*

**January 2023**

ICRA

THE ASSOCIATED CHAMBERS OF COMMERCE AND INDUSTRY OF INDIA

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# Foreword

Climate change concerns and energy security have driven the demand for future fuels. The concern over the rapid depletion of fossil fuels has prompted the search for alternative fuels with efficiencies like those found in conventional fuels. Several alternative fuel options have been considered and developed, including biomass-based diesel, hydrogen & synthetic fuels, but the increasing energy demand is still rising.

India's revolutionary steps towards achieving a gas-based economy like Sustainable Alternative Towards Affordable Transportation (SATAT) in which clean and green fuel like Compressed Biogas (CBG) will be generated by using organic waste. The government had implemented the Ethanol Blended Petrol (EBP) Programme throughout the country, launched the Green Hydrogen Policy, and the new Electric Vehicle Policy, positioning India as a leading destination in alternate fuels. These projects will help in saving foreign currencies spent on purchase of crude oil, generate employment, and promote Make in India.

ASSOCHAM recommends the government focus on some of the concerns such as demand scenario, feedstock availability, technology infusion, lack of skilled labour & awareness. Future consumption is based on alternative fuel resources and distribution infrastructure. We are sure addressing the above concerns will undoubtedly lead to the sustainable growth of these new-age fuels.

I hope our Conference on 'Fuels of the Future' will provide an opportunity for all stakeholders to come together and deliberate the evolution of these new-age fuels that can play a vital role in advancing the country's net zero growth agenda.

**Deepak Sood**
Secretary General
ASSOCHAM

# Foreword

The global and Indian automobile industry are witnessing major technological transitions, especially with respect to emissions and safety. Petrol remains a fuel of choice in the domestic passenger vehicle market, as stricter emission norms and narrowing price gap between petrol and diesel have reduced the viability of diesel vehicles. CNG vehicles have also gained prominence in the recent years, aided by favourable running cost, improving penetration of CNG dispensing stations across the country and enhanced product offerings by original equipment manufacturers (OEMs). Lower emissions in CNG vehicles would also help OEMs in complying with the impending Corporate Average Fuel Economy (CAFÉ) norms. Demand for Electric Vehicles has increased exponentially in the last two years with the Government's push, increasing awareness and new launches. However, share of EVs in the overall PV industry remains low, at 1% currently. ICRA expects the proportion of CNG, EVs and hybrid vehicles to increase to 20-30% of new vehicles sales in the next 5 years. However, petrol-based vehicles are likely to account for a significant portion of new PV sales over the medium term. This makes it important to reduce emissions from petrol-based vehicles to meet the CAFÉ norms and start the trajectory towards achieving carbon neutrality over the medium-to-long-term besides promotion through adoption of alternative powertrains, including EVs and hybrids.

Ethanol blending would reduce vehicular emissions, strengthen energy security, help reduce oil imports and conserve forex reserves. Besides, other benefits include controlling excess sugar supply in the country as ~65% of total ethanol production comes from molasses-based distilleries. Ethanol blending in petrol has been gradually increasing in the last several years, and India achieved 10% ethanol blending in 2022. Further, the Government of India has advanced its target for E20 implementation to 2025 from 2030 earlier.

ICRA believes that the readiness of the auto industry and the OEMs to meet E20 blending norms is unlikely to be a major challenge. No major design changes are required from a vehicle standpoint except material recalibration, and the impact on the vehicle cost is expected to be less than 1% in case of passenger vehicles and about 2-3% in case of two-wheelers. While no major capex is envisaged, changes in engine designs and after treatment system apart from material selection will be key to meet the norms. Loss of fuel efficiency is expected as vehicles transition from the E10 to E20 compliant design and this would increase the total cost of ownership (TCO). However,

OEMs are looking at technological improvements like light-weighting to offset the impact. Operating E10-compliant vehicles with E20 fuel would result in corrosion of certain engine components, and there would be requirements to replace the corroded parts during the vehicle lifecycle.

Making adequate ethanol available pan India and addressing portability challenges would be imperative, given that ethanol production is currently concentrated in select states such as Uttar Pradesh, Karnataka and Maharashtra owing to feedstock availability. The GoI has been providing relatively faster environmental clearances and financial assistance in the form of interest subvention to facilitate capacity addition and ensure adequate ethanol availability for seamless transition. Some states have also announced state-level incentives to encourage investments. Tripartite agreements are being signed between OMCs, project proponents and banks to ensure that payments from OMCs are utilised for timely debt servicing. Overall, in ICRA's view, cohesive approach from all stakeholders will facilitate the E20 transition within the targeted timelines.

**Mr. Shamsher Dewan**
Senior Vice President & Group Head - Corporate Ratings
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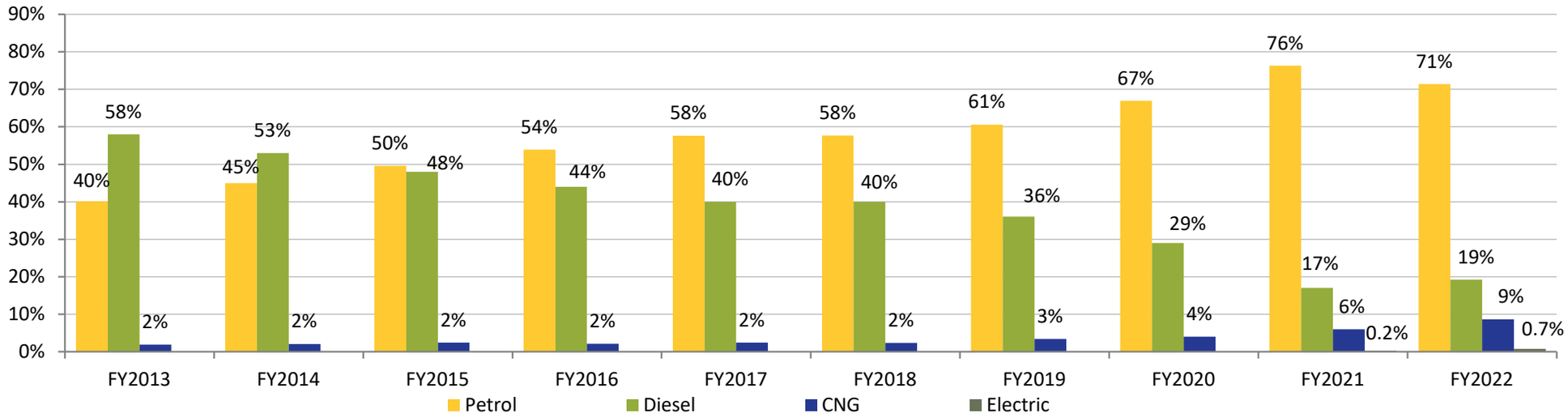
# Powertrain Mix in Passenger Vehicles in India

***Petrol to remain dominant over the medium term although adoption of alternate powertrains will rise***

# Petrol has emerged as a fuel of choice in the Indian Passenger Vehicle market

***Exhibit: Trend in powertrain mix for domestic passenger vehicles***




Petrol vehicles have gained share as stricter emission norms and narrowing price gap between petrol and diesel has reduced viability of diesel vehicles.

CNG has also gained prominence over the past couple of years aided by - a) favourable running cost, b) improving penetration of CNG dispensing stations across the country and c) enhanced product offerings by OEMs.

Demand for EVs has increased exponentially with government's push, increasing awareness, and new launches. EV share remains low at 1% currently.

*Source: SIAM, ICRA Research*

# Share of alternate powertrains including EVs to rise over the years…

## CNG

- Despite narrowing price differential led by hikes in CNG prices, operating economics of CNG remains favourable. Improving CNG fueling infrastructure coupled with new model launches will continue to aid consumer acceptability for CNG and drive penetration. It also helps OEMs in complying with impending CAFÉ norms.

## Diesel

- Despite narrowing price differential led by hikes in CNG prices, operating economics of CNG remains favourable. Improving CNG fueling infrastructure coupled with new model launches will continue to aid consumer acceptability for CNG and drive penetration. It also helps OEMs in complying with impending CAFÉ norms.

## Electric + Hybrid

- EV ecosystem (ex. public-charging infrastructure) still needs to be developed in India, leading to range anxiety issues. Battery prices are also on an increasing trend due to increase in raw material prices, thereby delaying the timeline for pricing parity for EVs. Mass adoption of EVs is likely to only happen over the medium to long term. ICRA expects EV penetration in PVs to be 4-6% of new vehicle sales, by FY2025.
- Hybrids may see enhanced adoption over the next 3-4 years. Hybrid vehicles can switch between electric and normal driving modes, and thus help resolve range anxiety issues. Further, hybrids are estimated to deliver a 30-35% higher fuel efficiency compared to a pure gasoline vehicle, which is likely to help mitigate the upfront price differential. Hybrids, though costlier than gasoline vehicles, remain priced at a discount to electric vehicles.

# CNG vehicles will continue to gain traction


**Favourable Operating economics, despite spurt in CNG prices**


**Improving fueling infrastructure**

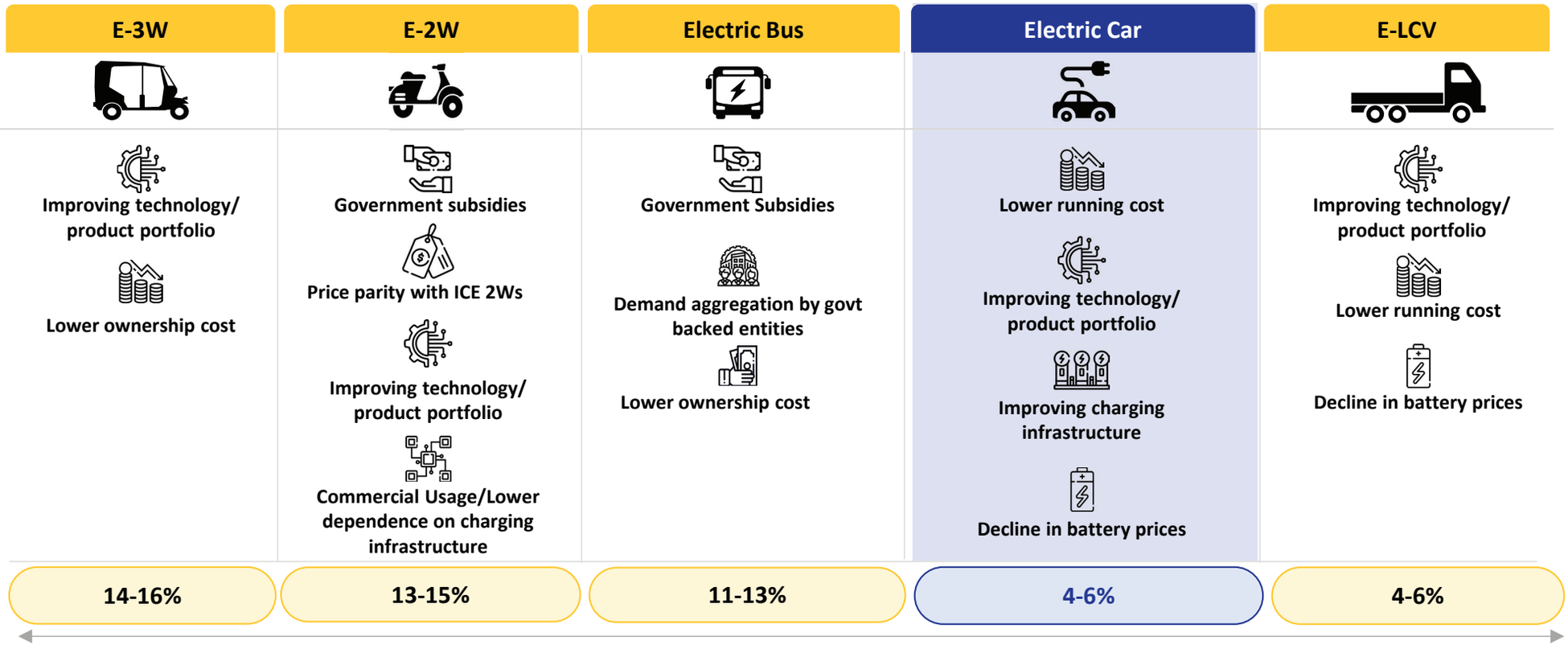

**New model launches by OEMs**


**Reduced emission which will help in meeting CAFÉ norms**

Despite narrowing price differential led by hikes in CNG prices, favourable TCOs, improving CNG fueling infrastructure coupled, new model launches by OEMs will continue to aid consumer acceptability for CNG and drive penetration. Further, CNG-based vehicles also help in reducing emissions vis-à-vis petrol vehicles and help in meeting CAFÉ norms.

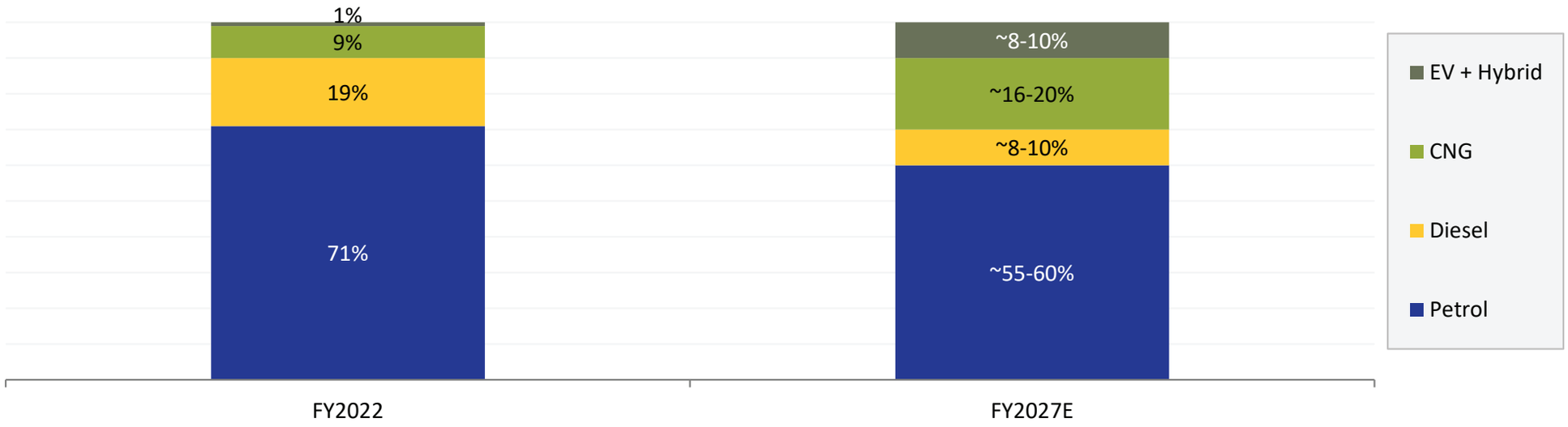
# Confluence of factors to support EV adoption over medium term

*Exhibit: Key growth drivers for electrification across all segments*



# …however, petrol will remain dominant powertrain over the medium-term

***Exhibit: ICRA's Estimate of powertrain mix in Passenger Vehicles in India***



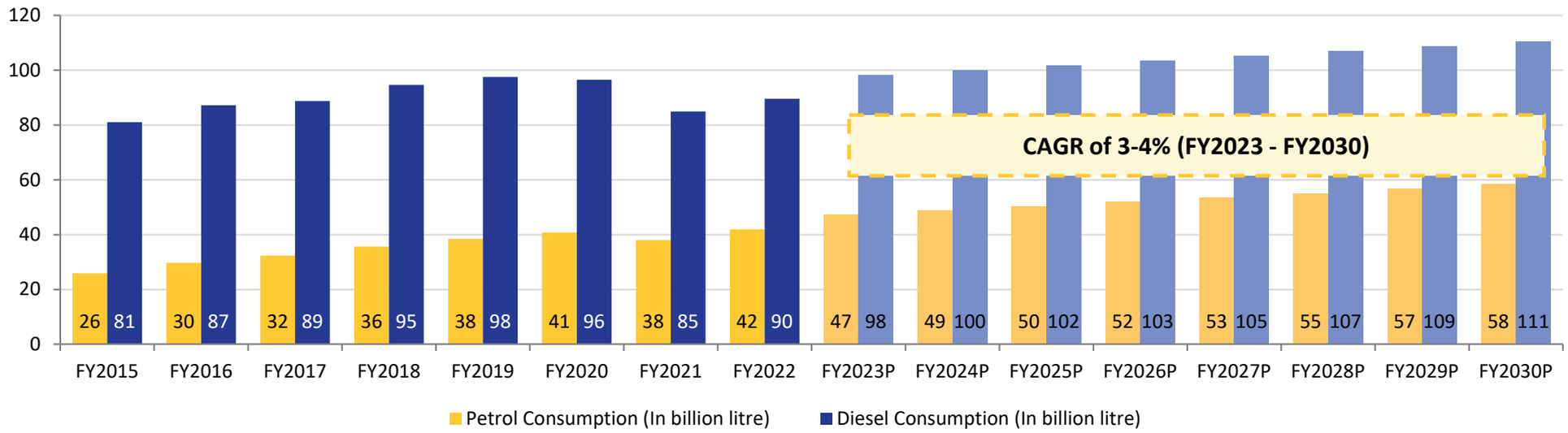

- The proportion of CNG, EVs and hybrid is likely to increase to 20-30% as proportion of new vehicles sales in the next 5 years.
- However, petrol-based vehicles are likely to remain a significant portion of new PV sales over the medium term.
- This makes it critical to reduce emissions from petrol-based vehicles to meet CAFÉ norms and start the trajectory towards achieving carbon neutrality over the medium-to-long-term besides promotion through adoption of alternate powertrains including EVs and hybrids.

# Overview of Ethanol Blending Norms in India

***Increase in ethanol blending to facilitate achievement of India's net zero goals***

# Consumption of conventional fuels to increase with growth in automobile volumes

***Exhibit: Trend in domestic petrol and diesel consumption over the years (in billion litre)***




- The medium-term outlook for the PV industry remains healthy aided by growing income levels, improving urbanisation, relatively weak public transport and under-penetration of PVs (about 30 cars per 1000 people). Accordingly, ICRA expects the PV industry to grow at a CAGR of around 6-9% over the medium-term.
- The increase in vehicle penetration is likely to drive demand for petrol over the medium term. ICRA expects a CAGR of 3-4% in petrol consumption over the period FY2023 to FY2030.

*Source: PPAC, ICRA Research*

# Ethanol blending with petrol offers multiple benefits

***Exhibit: Key advantages of ethanol blending***

Strengthens energy security and helps to reduce oil imports and conserve forex reserves.

Eonomical compared to petrol from a fuel cost perspective

Reduces vehicular emissions; implementation of E20 will accelerate net zero goals

Currently, the ethanol production is entirely from 1G source. It aids in controlling excess sugar supply in the country as ~65% of total ethanol production comes from molasses-based distilleries. Going forward, as 2G ethanol production increases, there would be incremental benefits including end use of agri crop waste and lower water requirements.

| Cost savings in E100 fuel over E10 petrol (As on December 29, 2022) | Unit | Cost of E10 petrol | Cost of E100 fuel | | |
|---|---|---|---|---|---|
| | | | Sugarcane Juice | B heavy molasses | C heavy molasses |
| **Price to Dealers (excluding Excise duty and VAT)** | Rs/Lt | 57.4 | 65.6 | 60.7 | 49.4 |
| **Excise Duty** | Rs/Lt | 19.9 | 0.0 | 0.0 | 0.0 |
| **Dealer Commission** | Rs/Lt | 3.8 | 3.8 | 3.8 | 3.8 |
| **VAT (Including VAT on dealers' commission)** | Rs/Lt | 15.7 | 18.7 | 17.4 | 14.4 |
| **Retail Selling Price in New Delhi** | **Rs/Lt** | **96.7** | **88.1** | **81.9** | **67.5** |

*Source: PPAC, NITI Aayog, ICRA Research*

# Gradual increase in ethanol blending over the last several years

***Exhibit: Ethanol blending roadmap in India***


**2003 & 2006** — Government mandated 5% blending in 9 states and 4 union territories in 2003 and pan-India in 2006

**2008** — Government mandated 10% blending pan India & vehicles made compliant with E10

**2009** — National Policy on Biofuels released – Target to achieve 20% blending of ethanol by 2017

**2012** — Mandatory 10% blending to achieve national average of 5%

**2017** — Average ethanol blending in India was 2.3%; target to achieve 10%

**2018** — Biofuel Policy 2018 released; E20 target by 2030

**2022** — Average pan-India ethanol blending of 10% achieved in June 2022

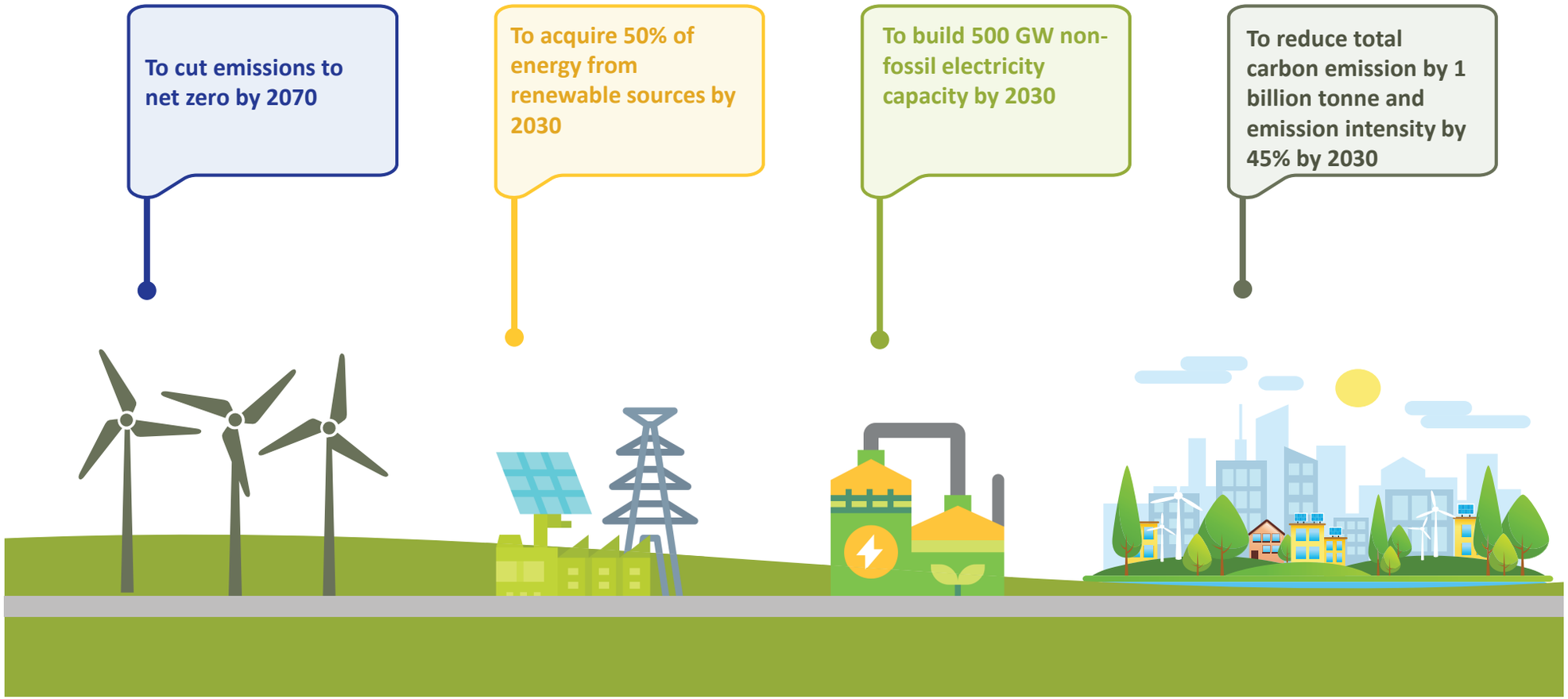
**2025P** — Target to achieve 20% ethanol blending by 2025

**2030P** — Increase in ethanol blending rates & availability of flex fuel vehicles

*Source: White Paper on Alternative Fuels for Vehicles by SIAM, Press Information Bureau – Government of India, ICRA Research*

# India's pledge at COP26 expected to accelerate ethanol blending further

***Exhibit: India's announcement at the COP26 summit***

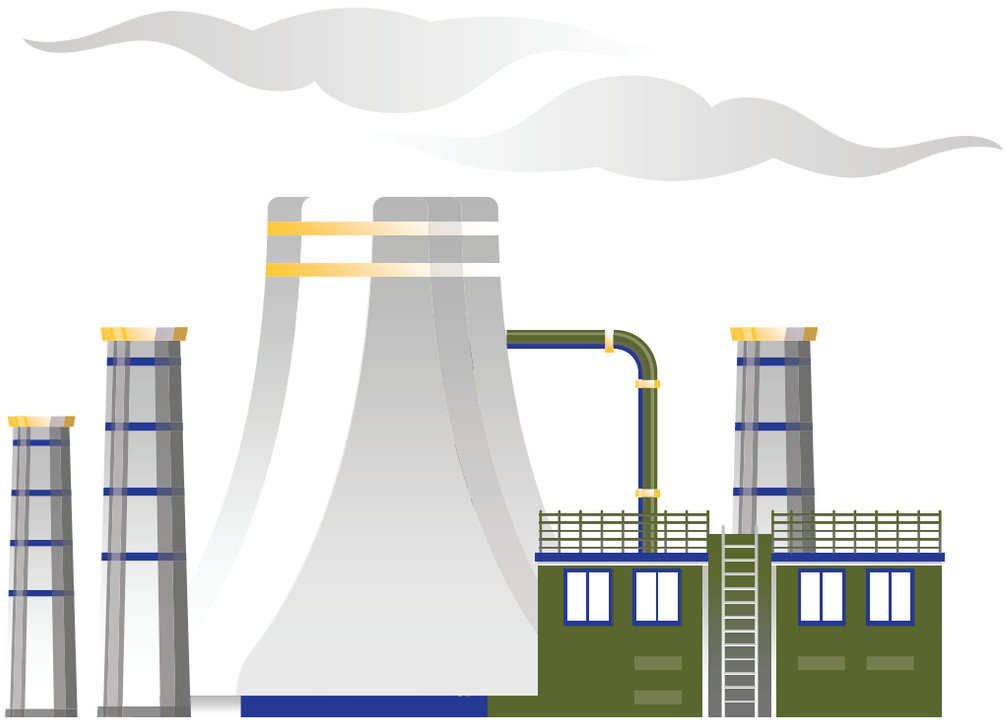


# E20 Implementation from Auto OEM Perspective

***Minimal capex and material changes required; OEMs unlikely to face major challenges to meet targeted timelines***

# Addressing multiple issues critical for seamless E20 implementation

***Exhibit: Key issues to be addressed during the E20 transition***



OEM readiness - OEMs expected to be ready from the material, vehicle calibration and vendor development perspective for E20 implementation

About 6% loss of fuel efficiency is expected as vehicles transition from E10 to E20 compliant design and this would increase the total cost of ownership (TCO)

Compatibility of E20 fuel for older vehicles - Addressing compatibility issues of existing vehicle parc (designed for E10) with E20 fuel is critical. Not addressing will result in accelerated corrosion of engine components parts like fuel hoses and further loss of fuel efficiency

From a supply-side perspective, making ethanol available in adequate quantities across the country and addressing portability challenges would be imperative

*Source: ICRA Research*

# OEM readiness not a challenge to meet implementation timelines; no major capex envisaged

## Material and design compatibility

- Only some engine components such as fuel hoses, rubber parts, seals and O-rings needs to be recalibrated with advanced materials.
- This would need alternate sourcing and imports in the interim, till such time local vendors are developed.
- OEMs are expected to be ready on the materials front in the near-term.
- Subsequently, engines would be redesigned with the advanced materials. Given the minimal changes required, elongated testing periods may not be required. OEMs are unlikely to have any challenge in meeting the 2025 deadline.

## Cost implications

- No major design changes are required from a vehicle standpoint except material recalibration. Impact on cost to be less than 1% per passenger vehicle and about 2-3% in the case of 2Ws.


## Capex

- No significant change in the assembly line is expected. Only marginal changes (For instance, tooling) are required. Hence no major capex is envisaged for the E20 implementation. However, ancillaries will have to incur some investments.

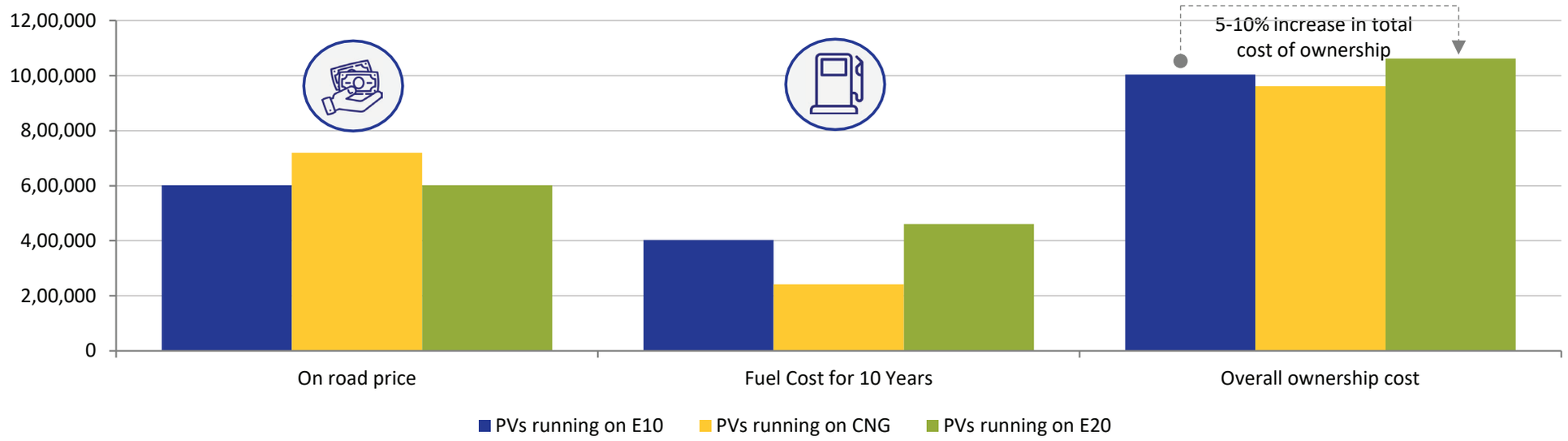
## Replacement demand potential for older vehicle parc

- Passenger vehicles which are currently running on the road are compliant with E10 fuel. Operating E10 compliant vehicles with E20 fuel would result in corrosion of certain engine components. Unless E10 and E20 fuels co-exist or retrofitment possibilities are discovered, there would requirements to replace the corroded parts during the vehicle lifecycle.

*Source: ICRA Research*

# Likely increase in TCO in E20 vehicles with lower fuel efficiency

***Exhibit: Total cost of ownership comparison between E10, CNG and E20 vehicles***




- E20 vehicles are expected to be 6% lower in terms of fuel efficiency compared to E10 vehicles. This will increase the TCO as E20 gets implemented.
- The older vehicle parc, designed for E10, when run on E20 fuel, will witness further fuel efficiency loss. Also, there shall be corrosion of some engine components, necessitating replacement of these parts during the vehicle lifecycle. These would increase the TCO further for older vehicles running on the road.
- However, discovery of retrofitment parts in E10 vehicles and technology advancements for improving fuel efficiency could mitigate these challenges over the medium term.

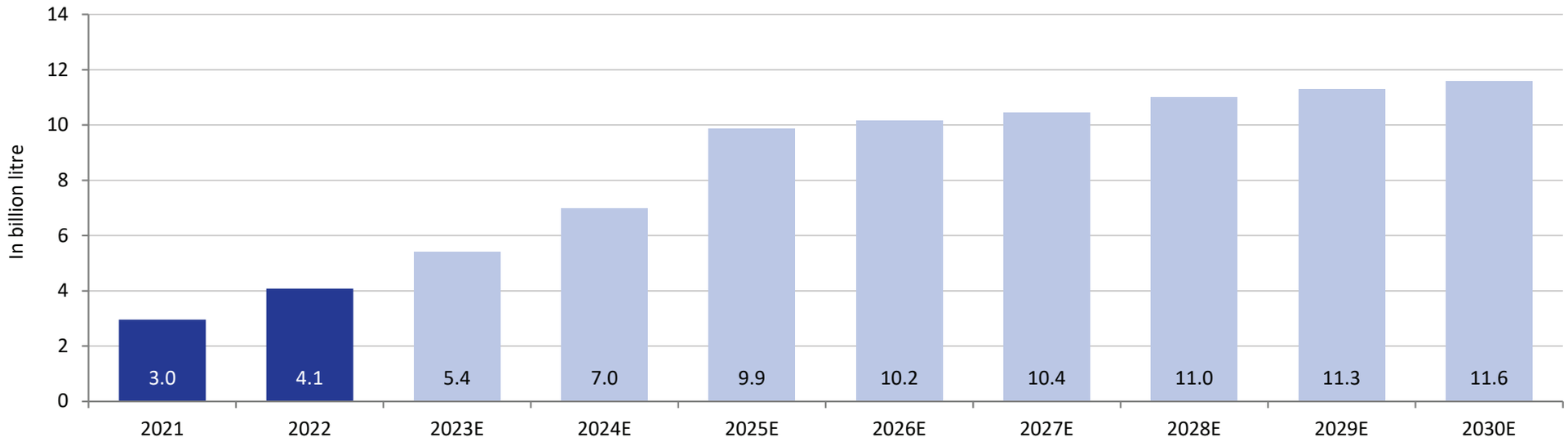
*Source: ICRA Research; Note: 1. Car and fuel prices are ex-Delhi, 2. Average annual running is assumed at 10,000 km and 3.TCO is calculated over a 10-year lifecycle*

# Ethanol Demand-Supply Dynamics

***Ramping up supply and pan-India E20 availability important***

# Demand for ethanol from automobiles to double by 2030

***Exhibit: Ethanol demand estimates (in billion litre) from the automobile industry***

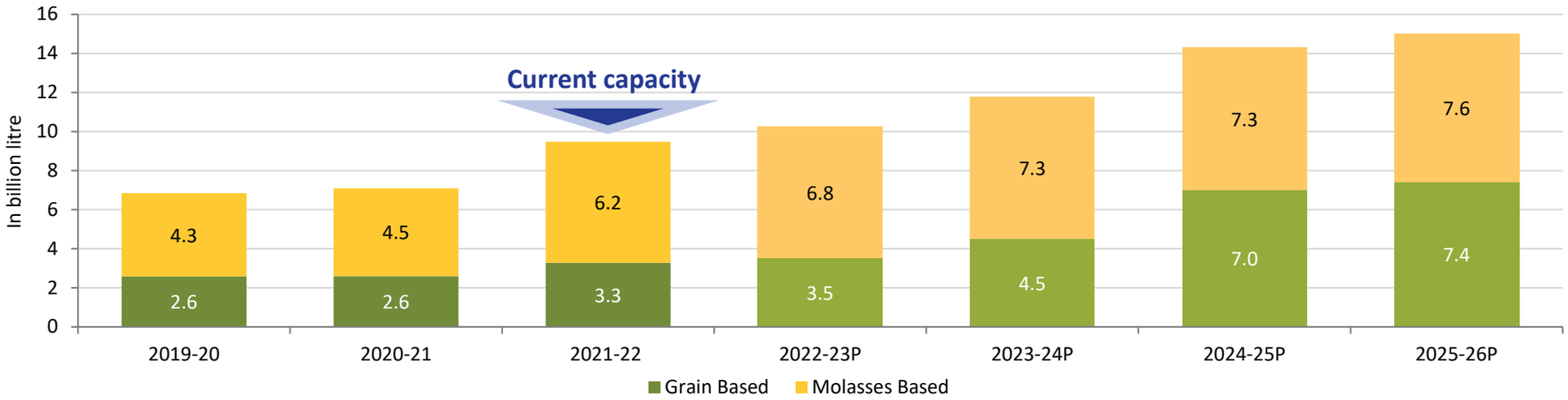



- The demand for ethanol from automobiles is expected to go up as vehicle parc and blending proportion increase. Demand from other applications such as alcobev, chemicals and cosmetics to name a few, would also increase the demand for ethanol further.
- While demand is entirely met from 1G ethanol currently, 1G and 2G ethanol would co-exist going forward.
- India is expected to be one of the larger global markets for ethanol, after the US and Brazil.

*Source: Niti Aayog, ICRA Research; 20% ethanol blending rate assumed from 2025*

# Ability to ramp up capacities remains critical

***Exhibit: Ethanol capacity requirement (in billion litre)***




- In order to augment supply of ethanol, the Ministry of Environment, Forest and Climate change, GoI, has approved green clearance process for grain-based distillery projects until March 31, 2024. This has resulted in faster environmental clearances, with window of 2-3 months from the time of application (was 12-18 months earlier). Further, there is also financial assistance provided in the form of interest subventions of 6% p.a. or 50% of rate of interest charged by banks, whichever is lower, for the loans taken for ethanol projects. There are also tripartite agreements being signed between OMCs, project proponents and banks to ensure that payments from OMCs are utilised for timely debt servicing.
- The GoI has also permitted procurement of ethanol from other non-food feedstock, besides molasses. Investment of Rs. 10,000 crore is in pipeline to set up 12 biofuel refineries across the country by OMCs. The first of these was commissioned by IOCL in August 2022 at Panipat. This is expected to be followed suit by a 3G plant (by IOCL) and a 2G plant by HPCL in FY2023. Capex and opex requirements, are, however, higher in 2G/3G compared to 1G ethanol.

*Source: Niti Aayog, Press Information Bureau – Government of India, ICRA Research*

# Ability to ramp up capacities remains critical

## Ethanol Availability

Pan-India ethanol availability and transportation remain critical. Ethanol production is currently concentrated in the sugarcane producing states of Uttar Pradesh, Karnataka and Maharashtra.

## Feedstock Availability

Availability of key raw material (i.e. broken rice for grain-based distilleries), captive power, and water remains critical; raw material availability is also subject to agro climatic risks

## Demand - supply dynamics

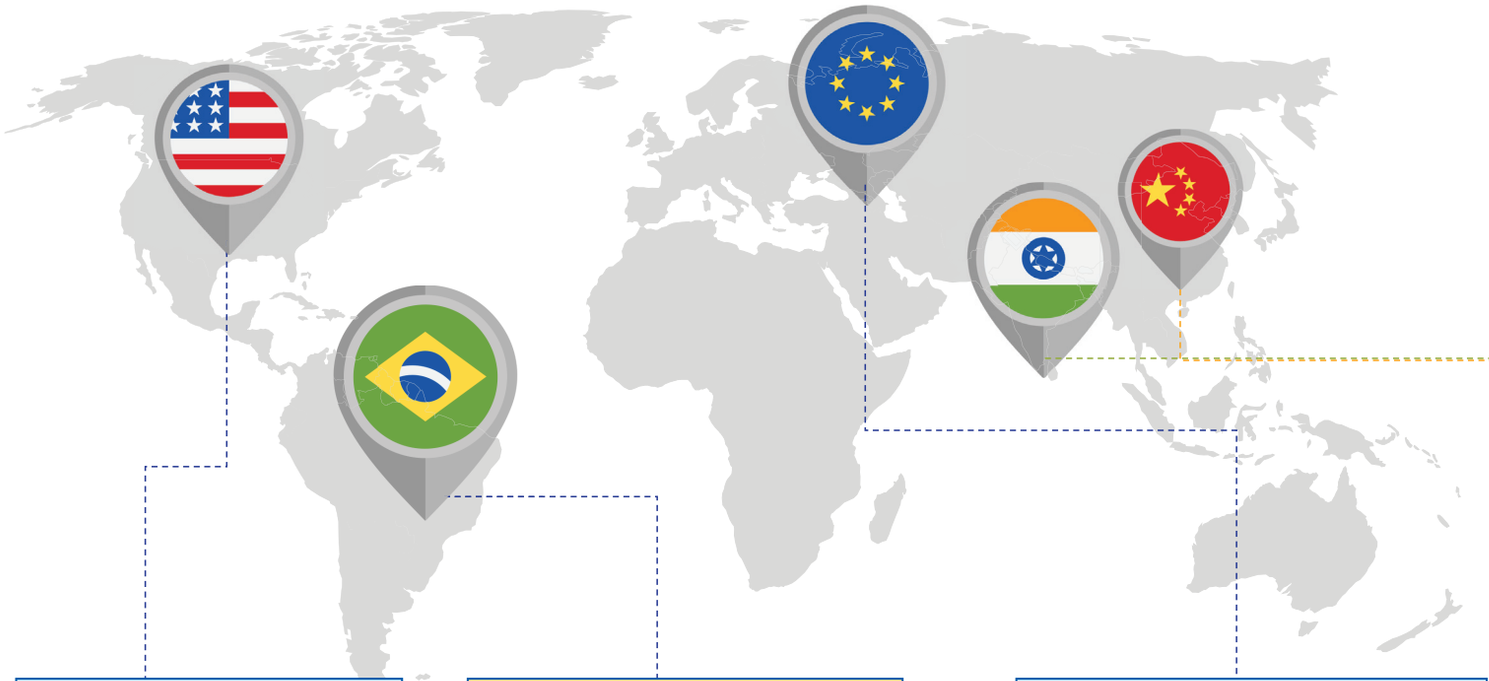
Demand-supply dynamics could influence ethanol prices. In addition, faster than expected adoption of EVs could weaken the demand for petrol and accordingly ethanol.

*Source: ICRA Research*

# Global Landscape

***Brazil has been an early mover in ethanol blending***

# Different strategies adopted by nations globally to reduce automobile emission



**United States of America**
Promotion of blended fuels and EVs by the Government to reduce emissions

**Brazil**
Brazil's focus is on ethanol blending and has multiple flex fuel models available, which account for almost 92% of PV industry sales.

**European Union**
Electric vehicles have gained popularity in EU because of incentives and availability of charging infrastructure. Plans to move to only electric new vehicles over the medium term.

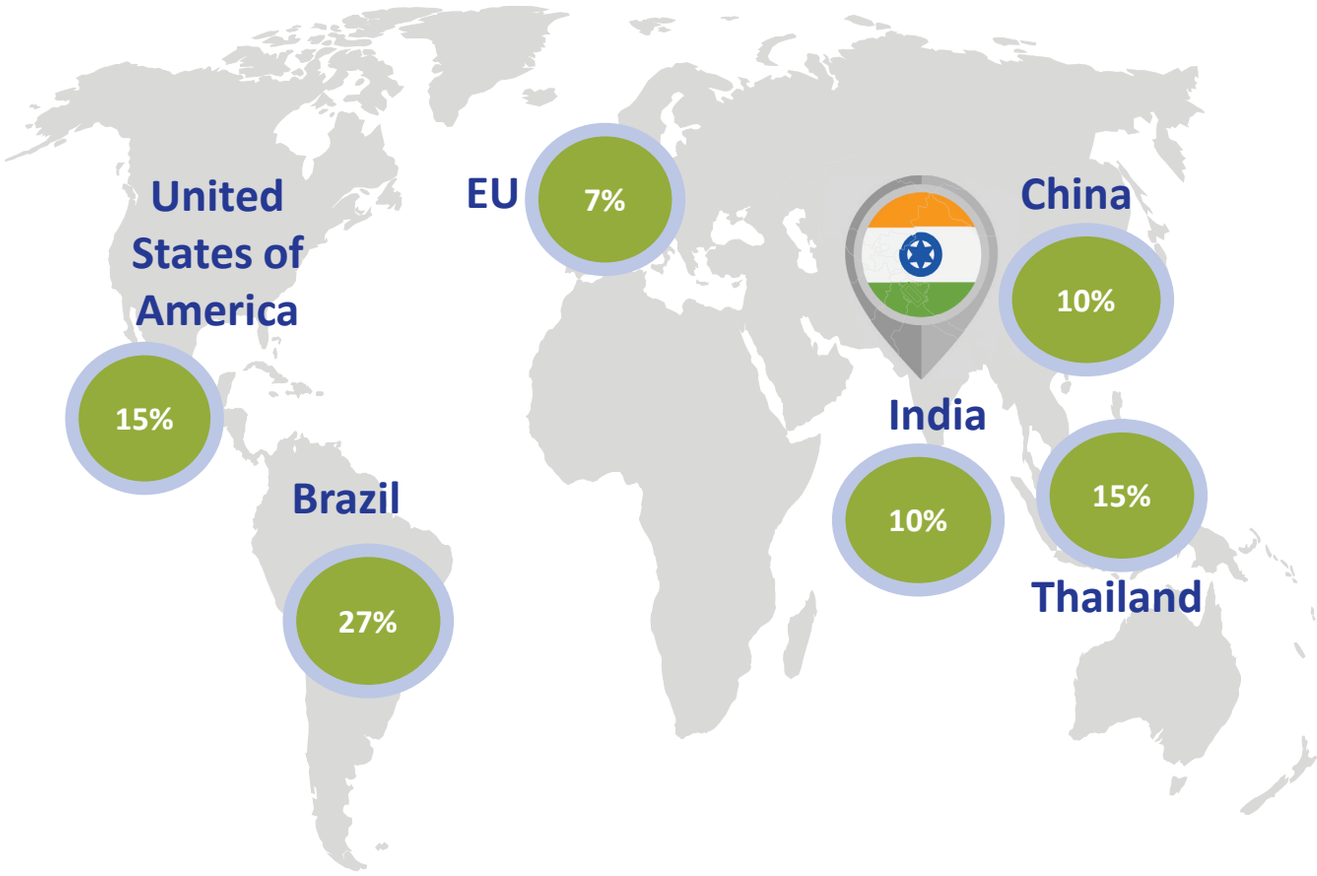
**China**
Chinese automobile market is largely focused on electric vehicles; availability of subsidies, adequate charging infra, local vendor ecosystem and periodic launches of new EV models vis-à-vis gasoline engines to promote EV usage further.

**India**
Indian market would have co-existence of EV, CNG vehicles and blended petrol. The policy environment is conducive for promoting both EVs and ethanol blending.

*Source: ICRA Research*

# Brazil remains one of the early movers in ethanol blending

***Exhibit: Mandates for ethanol blending in different geographies***




## Brazil's ethanol blending evolution

- **Initial Phase (1975 - 1979) –** Government subsidies include low interest rate loans for sugarcane plantation and new mills
- **Phase II (1979 - 1985) –** Oil price triples, oil deficit reaches peak. Government makes efforts to increase ethanol-based vehicles, resulting in demand for petrol and E100 vehicles
- **Phase III (1986 - 1995) –** Shortage of ethanol due to increase in E100 vehicles sales. Ethanol fuel-injected engine launched. Stops sale of pure petrol, only blended petrol sold
- **Phase IV (1995 - 2000) –** Increase in ethanol blending mandated in the range of 22-24%
- **Phase V (2000 - till date) –** Light vehicle sales rises. Flex fuel vehicles availability and ethanol capacities increase

*Source: ICRA Research*

# Four-pronged approach has made ethanol blending a success story in Brazil

***Exhibit: Measures undertaken in Brazil to promote ethanol blending***

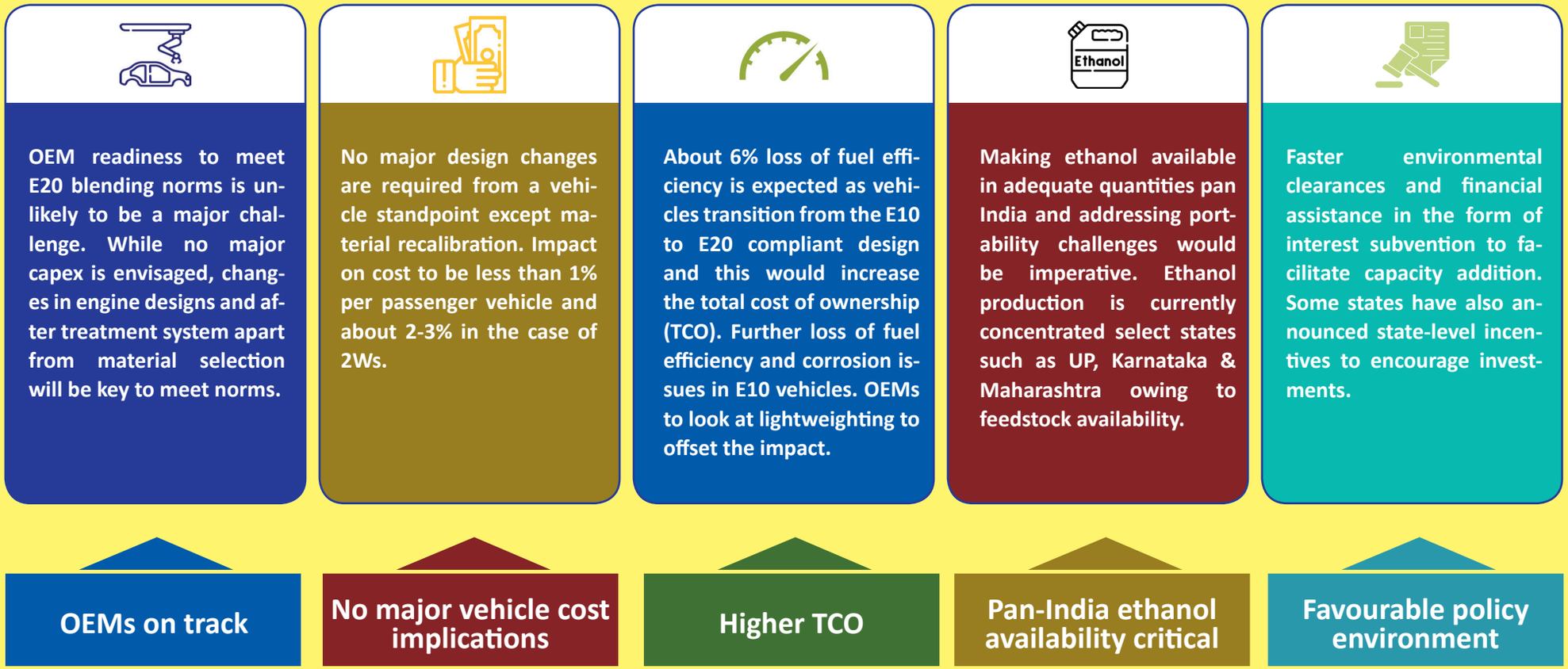

| | | | |
|---|---|---|---|
| Mass production of high yielding feedstock using modern agri-technologies has created a bio-economy in the country | Confidence on blended fuel availability without challenges | Advancement in vehicle technology – 92% of the light vehicles currently sold in the country are based on flex fuel. | Incentives/subsidies to promote adoption of flex fuel vehicles were given in the initial stages. |

*Source: ICRA Research*

# Key Takeaways

# Cohesive approach from all stakeholders to facilitate the E20 transition

***EXHIBIT : Key takeaways***




*Source: ICRA Research*

# Annexure


Sell
Buy
Instant Execution
Stop Loss
Take Profit
Deviation
50%
80%

# Ethanol blending will help in reducing vehicular emissions

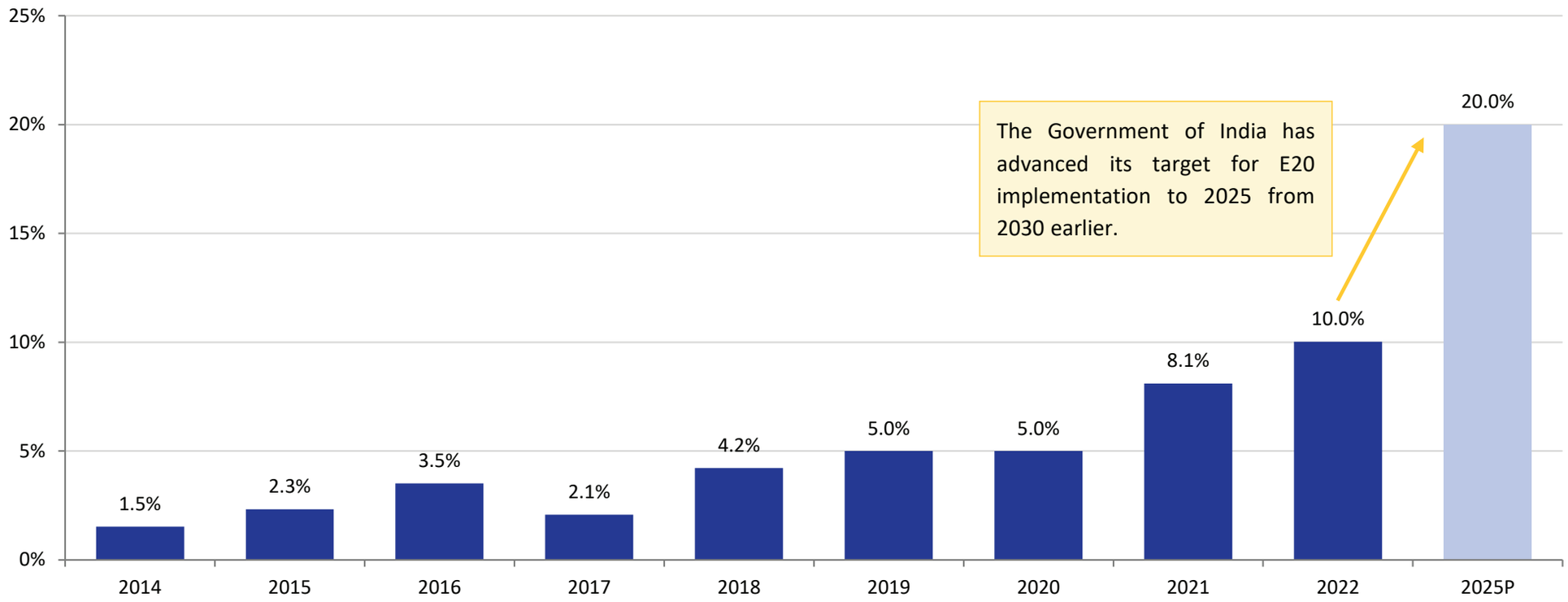
***Exhibit: Emission reduction potential of ethanol-gasoline blends***

| Emissions | Gasoline | Two-wheelers | | Four-wheelers | |
|---|---|---|---|---|---|
| | | E10* | E20* | E10* | E20* |
| **Carbon Monoxide** | Baseline | 20% lower | 50% lower | 20% lower | 30% lower |
| **Hydrocarbons** | Baseline | 20% lower | 20% lower | 20% lower | 20% lower |
| **Oxides of nitrogen** | Baseline | No significant trend | 10% higher | No significant trend | Same |

*Source: Niti Aayog, ICRA Research; * E10 project was carried out in FY2010 while E20 project was carried out in FY2015, with different test vehicles*

# Progressive rise in pan-India ethanol blending rates

***Exhibit: Trend in pan-India ethanol blending – Past & Projected***




*Source: Niti Aayog, ICRA Research*

# Meaningful adoption of flex fuel vehicles still some time away

***Exhibit: Challenges with adoption of flex fuel vehicles***

Significant technology and design changes will be required, resulting in higher investment and vehicle costs. Further, ethanol availability will have to ramp-up substantially, raising concerns on food security and feed-stock availability.

It is estimated that the running cost of flex fuel-based vehicles will be approximately higher by 30% compared to gasoline vehicles owing to lower fuel efficiency.

Limited flex fuel models are available at present. OEMs have started developing models at pilot scale. Flex fuel Wagon R has been showcased while Toyota has launched a project flex fuel-based hybrid EVs.

*Source: ICRA Research*

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# About ASSOCHAM

## The Knowledge Architect of Corporate India

The Associated Chambers of Commerce & Industry of India (ASSOCHAM) is the country's oldest apex chamber. It brings in actionable insights to strengthen the Indian ecosystem, leveraging its network of more than 4,50,000 members, of which MSMEs represent a large segment. With a strong presence in states, and key cities globally, ASSOCHAM also has more than 400 associations, federations, and regional chambers in its fold.

Aligned with the vision of creating a New India, ASSOCHAM works as a conduit between the industry and the Government. The Chamber is an agile and forward-looking institution, leading various initiatives to enhance the global competitiveness of the Indian industry, while strengthening the domestic ecosystem.

With more than 100 national and regional sector councils, ASSOCHAM is an impactful representative of the Indian industry. These Councils are led by well-known industry leaders, academicians, economists and independent professionals. The Chamber focuses on aligning critical needs and interests of the industry with the growth aspirations of the nation.

ASSOCHAM is driving four strategic priorities – Sustainability, Empowerment, Entrepreneurship and Digitisation. The Chamber believes that affirmative action in these areas would help drive an inclusive and sustainable socio-economic growth for the country.

ASSOCHAM is working hand in hand with the government, regulators, and national and international think tanks to contribute to the policy making process and share vital feedback on implementation of decisions of far-reaching consequences. In line with its focus on being future-ready, the Chamber is building a strong network of knowledge architects. Thus, ASSOCHAM is all set to redefine the dynamics of growth and development in the technology-driven 'Knowledge-Based Economy. The Chamber aims to empower stakeholders in the Indian economy by inculcating knowledge that will be the catalyst of growth in the dynamic global environment.

The Chamber also supports civil society through citizenship programmes, to drive inclusive development. ASSOCHAM's member network leads initiatives in various segments such as empowerment, healthcare, education and skilling, hygiene, affirmative action, road safety, livelihood, life skills, sustainability, to name a few.

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GAIL (India) Limited

# INDIA'S NATURAL GAS LEADER

## Energizing Possibilities

GAIL, transforming India's energy landscape
with presence across the entire gas value chain

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