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Government of India

ROADMAP FOR ETHANOL BLENDING IN INDIA 2020-25

Report of the Expert Committee

NITI Aayog | Ministry of Petroleum and Natural Gas





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Publishing Agency: NITI Aayog

Year of Publication: June 2021

Language: English

ISBN : 978-81-949510-9-4

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Foreword

India's net import of petroleum was 185 Mt at a cost of US $ 55[1] billion in 2020-21. Most of the petroleum products are used in transportation. Hence, a successful E20 program can save the country US $4 billion per annum, i.e. Rs. 30,000 cr. Besides, ethanol is a less polluting fuel, and offers equivalent efficiency at lower cost than petrol. Availability of large arable land, rising production of foodgrains and sugarcane leading to surpluses, availability of technology to produce ethanol from plant based sources, and feasibility of making vehicles compliant to ethanol blended petrol make E20 not only a national imperative, but also an important strategic requirement. Different agencies of the government have made rapid moves to put in place a favourable regulatory and retail ecosystem for safe, and effective use of ethanol blended petrol. With the recently approved interest subvention incentives for grain based distilleries, the target of 20% blending of petrol in the country by 2025 thus appears feasible and within reach. Oil Marketing Companies have prepared their plans for phased rollout, and vehicle manufacturers have assured of making a similar plan once the intention of the government with timelines is publicly declared. What is left is smoothing of some regulatory stipulations to provide single window service for setting of new ethanol distilleries and to ease interstate movement of denatured ethanol. A consumer awareness campaign of the benefits of ethanol blending for the nation will help generate active participation of the vehicle owners, and smoothen the rollout.

Given the multiplicity of agencies involved, an efficient and timely rollout calls for effective coordination between actors, and close monitoring. This report suggests an annual road-map for production, and supply of ethanol till 2025-26, and systems for its countrywide marketing. The suggested roadmap is eminently achievable, provided there is effective oversight of the progress.

The report was possible in a short span of 75 days with active cooperation from all the members, and dedicated support from our colleagues, namely Sh. Rajnath Ram, Adviser, NITI Aayog, Sh. Peeyush Agrawal, Deputy General Manager- Bio-Refinery Cell, MoP&NG, Dr. Sakthivel P, Sr Research Manager, IOCL, Dr. Sweety Pandey, Young Professional, NITI Aayog and Mr. Kowtham

1 *Source:* PPAC: https://www.ppac.gov.in/content/212_1_ImportExport.aspx

Raj VS, Young Professional, NITI Aayog. I would like to thank CSTEP for modeling the ethanol demand scenarios using Sustainable Alternative Futures for India (SAFARI). I appreciate Mr. Sunil Kumar, JS, MoP&NG for ably coordinating the work of this committee, and liberally devoting his time and genius to this national endeavour.

I also acknowledge the very useful comments from, Dr. Rajiv Kumar, Vice Chairman, NITI Aayog, Sh Amitabh Kant, CEO, NITI Aayog, Dr. V. K. Saraswat, Member, NITI Aayog, Mr. Tarun Kapoor, Secretary, MoP&NG on our drafts.

After its presentation to MoPNG in March 2021, this report was updated based on developments till 2nd June, and suggestions from concerned ministries.

Date: 02.06.2021

Dr. Rakesh Sarwal
Additional Secretary
NITI Aayog



List of Abbreviations

APM	:	Administered Price Mechanism
ARAI	:	Automotive Research Association of India
AIS	:	Automotive Industry Standard
BIS	:	Bureau of India Standards
BS VI/ BS6	:	Bharat Stage VI
CoS	:	Committee of Secretaries
Cr.	:	Crores
CCEA	:	Cabinet Committee of Economic Affairs
CTO	:	Consent to Operate
CTE	:	Consent to Establish
DFPD	:	Department of Food and Public Distribution
DFS	:	Department of Financial Services
DHI	:	Department of Heavy Industries
DPIIT	:	Department for Promotion of Industry & Internal Trade
E5	:	Five percent ethanol blended petrol
E10	:	Ten percent ethanol blended petrol
E20	:	Twenty percent ethanol blended petrol
E85	:	Eighty Five percent ethanol blended petrol
ED95	:	Fuel with 95% ethanol & 5% ignition improver for modified diesel engines
EBP	:	Ethanol Blended Petrol Program
EoI	:	Expression of Interest
ESY	:	Ethanol Supply Year (December to November of following year)
EC	:	Environmental Clearance
EAC	:	Expert Appraisal Committee
EMP	:	Environmental Management Plan

EIA	:	Environmental Impact Assessment
EV	:	Electric Vehicle
FCI	:	Food Corporation of India
FRP	:	Fair & Remunerative Price
FFVs	:	Flex Fuel Vehicles
GDP	:	Gross Domestic Product
GSR	:	General Statutory Rules
GST	:	Goods and Services Tax
IDR Act	:	Industries (Development and Regulation) Act
IOCL	:	Indian Oil Corporation Limited
KLD / KLPD	:	Kilolitres per day
LMT	:	Lakh Metric Tonne
MoEF&CC	:	Ministry of Environment, Forest & Climate Change
MoP&NG	:	Ministry of Petroleum & Natural Gas
MoRT&H	:	Ministry of Road Transport & Highways
MT	:	Metric Tonnes
MMT	:	Million Metric Tonnes
MSP	:	Minimum Support Price
NBCC	:	National Biofuel Coordination Committee
NPB	:	National Policy on Biofuels
OM	:	Office Memorandum
OMCs	:	Oil Marketing Companies
PESO	:	Petroleum & Explosives Safety Organization
PP	:	Project Proponent
PPE	:	Personal Protective Equipment
PM-JIVAN	:	Pradhan Mantri Jaiv Indhan Vatavaran Anukool Awashesh Nivaran
R&D	:	Research and Development
SIAM	:	Society of Indian Automobile Manufacturers
SPCB	:	State Pollution Control Board
SEIAA	:	State Environment Impact Assessment Authority
SO	:	Statutory Order
RON	:	Research Octane number
TOR	:	Terms of Reference
UTs	:	Union Territories
ZLD	:	Zero Liquid Discharge



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Executive Summary

Achieving energy security and the transitioning to a thriving low carbon economy is critical for a growing nation like India. Blending locally produced ethanol with petrol will help India strengthen its energy security, enable local enterprises and farmers to participate in the energy economy and reduce vehicular emissions. The Government of India notified the National Policy on Biofuels – 2018 (NPB–2018) on 4.06.2018 wherein, under the Ethanol Blended Petrol (EBP) Program, an indicative target of 20% blending of ethanol in petrol by 2030 was laid out.

Cabinet Secretary, Government of India, while chairing a meeting of the Committee of Secretaries (CoS) dated 28.11.2020, on the subject ***'Manufacturing, Sales, Utilization and blending of ethanol'*** inter-alia directed that, ***"****MoP&NG may institute an Expert Group to finalize a clear roadmap not only to achieve year-wise blending targets for the next 10 years but also the various policy implications of such a plan. Issues such as pricing of ethanol, matching pace of the automobile industry to manufacture vehicles with new engines with the supply of ethanol, pricing of such vehicles, fuel efficiency of different engines etc. may be studied.****"***

Accordingly, an inter-ministerial committee under the Chairmanship of Additional Secretary, NITI Aayog was formed comprising representatives from MoP&NG, DHI, MoRT&H, DFPD, IOCL, and ARAI (Annexure A). Subsequently, the target year for achieving 20% ethanol blending in petrol was advanced to 2025 by CCEA in the meeting held on 21.12.2020.

The committee noted that a very strong foundation for the ethanol blending program had been laid out by the following initiatives:

1. Interest subvention scheme for molasses and grain-based distilleries (DFPD).
2. Setting of standards for E5 (Ethanol 5%, Petrol 95%), E10 and E20 blends of Ethanol blended petrol (Bureau of India Standards, BIS).
3. MoRT&H has notified GSR 156(E) on 8th March 2021 for adoption of E20 fuel as automotive fuel and issued mass emission standards for it. MoRT&H has also notified Safety standards for ethanol blended fuels vide GSR 343(E) dated 25th May, 2021 on the basis of Automotive Industry Standard (AIS 171). It lays down safety requirements for type approval of pure ethanol, flex-fuel & ethanol-gasoline blended vehicles in India.
4. BS-VI Emission norms in effect since 1st April 2020 are applicable for E-20 Vehicles.

After soliciting inputs of relevant ministries and associations, analyzing progressive demand-supply projections, challenges in the manufacture of E20 vehicles and infrastructure of Oil Marketing Companies (OMCs), the committee suggests a gradual rollout of E20 ethanol in the country to achieve the target by 2025. In the meantime, the rollout plan suggests pan-India availability of E10 from April, 2022 for use as a protection fuel to meet the demands of existing vehicles till April 2025.

In this report, the committee has estimated an ethanol demand of 1016 cr. litres based on expected growth in vehicle population. Modelling exercise on expected penetration of electric vehicles estimates the ethanol demand for petrol blending in the range of 722-921 crore litres in 2025. The committee has, however, framed its recommendations on an optimistic demand for ethanol (1016 cr. litres) to ensure that the objectives of E20 are met by 2025.

The current ethanol production capacity in India of 426 crore litres derived from molasses-based distilleries, and 258 cr. litres from grain based distilleries is proposed to be expanded to 760 cr. litres and 740 cr. litres respectively. This would be sufficient to produce 1016 cr. litres of ethanol required for EBP and 334 cr litres for other uses. This will require 60 lakh MT of sugar and 165 lakh MT of grains per annum in ESY 2025 to be used for producing ethanol, which the country can support. The committees' generous demand estimates, and consequent supply projections give us confidence that our suggested plan for E20 roll-out is robust.

To get the ball rolling, MoP&NG should proclaim and lay out the target for 10% ethanol blending of gasoline fuel all over the country by April, 2022. MoP&NG should further initiate phased roll-out of 20% ethanol blending from April, 2023 onwards to enable action by all stakeholders, namely Oil Marketing Companies, vehicle manufacturers, service stations, distilleries, and entrepreneurs as per a detailed roll-out plan suggested (Figure 9.1). This should be supported by a simpler and quicker regulatory regime, preferably single window clearance by the States, MoEF&CC, PESO, DFPD and MoP&NG and the launch of educational campaigns for the consumers.

When using E20, there is an estimated loss of 6-7% fuel efficiency for 4 wheelers which are originally designed for E0 and calibrated for E10, 3-4% for 2 wheelers designed for E0 and calibrated for E10 and 1-2% for 4 wheelers designed for E10 and calibrated for E20. SIAM has informed that with modifications in engines (hardware and tuning), the loss in efficiency due to blended fuel can be reduced. To compensate the consumers for a drop in efficiency from ethanol blended fuels, tax incentives on E10 and E20 fuel may be considered.

SIAM has assured the committee that once the roadmap for availability of ethanol blended fuel in the country is issued by MoP&NG, they would gear up to supply compatible vehicles in line with the roadmap. E20 material compliant and E10 engine tuned vehicles may be rolled out all across the country from April 2023. These vehicles can tolerate 10% to 20% of ethanol blended gasoline and also give optimal performance with E10 fuel. Vehicles with E20 tuned engines can be rolled out all across the country from April 2025. These vehicles would run on E20 only and will provide high performance.

In recommendations (Chapter-9), the report lays out specific responsibilities of union ministries, state governments and vehicle manufacturers, which is summarised in Figure 9.1 as the suggested E20 rollout plan for 2025. To accelerate the adoption and transition to ethanol blended fuels, price incentives through tax relief at the retail level on ethanol blended fuel and tax incentives for vehicles compatible with E20 are suggested. The government may also encourage use of lower water consuming foodgrain crops like maize, and 2G feedstock for production of ethanol.



Committee Members

S. No.	Name of the Member	Position	Signature
(i)	**Dr. Rakesh Sarwal,** Additional Secretary, Niti Aayog	Chairman	
(ii)	**Shri Sunil Kumar,** Joint Secretary (R), Ministry of Petroleum & Natural Gas	Member Secretary	
(iii)	**Shri Amit Mehta,** Joint Secretary, Department of Heavy Industries	Member	
(iv)	**Shri Amit Varadan,** Joint Secretary, Ministry of Road Transport & Highways	Member	
(v)	**Shri Subodh Kumar Singh,** Joint Secretary (Sugar), Department of Food & Public Distribution	Member	
(vi)	**Dr. S.S.V Ramakumar,** Director (R&D), Indian Oil Corporation Limited	Member	
(vii)	**Dr. Reji Mathai, Director,** Automotive Research Association of India (ARAI)	Member	





Introduction

1.1 The energy demand in our country is rising due to an expanding economy, growing population, increasing urbanization, evolving lifestyles and rising spending power. About 98% of the fuel requirement in the road transportation sector is currently met by fossil fuels and the remaining 2% by biofuels. Today, India imports 85%[2] of its oil requirement. The Indian economy is expected to grow steadily despite temporary setbacks due to the COVID pandemic. This would result in a further increase of vehicular population which in turn will increase the demand for transportation fuels. Domestic biofuels provide a strategic opportunity to the country, as they reduce the nation's dependence on imported fossil fuels. In addition, when utilized with appropriate care, biofuels can be environmentally friendly, sustainable energy sources. They can also help generate employment, promote Make in India, Swachh Bharat, doubling of farmers' incomes and promote Waste to Wealth generation.

1.2 Ethanol is one of the principal biofuels, which is naturally produced by the fermentation of sugars by yeasts or via petrochemical processes such as ethylene hydration. It has medical applications as an antiseptic and disinfectant. It is used as a chemical solvent and in the synthesis of organic compounds, apart from being an alternative fuel source.

1.3 The National Policy on Biofuels – 2018, provides an indicative target of 20% ethanol blending under the Ethanol Blended Petrol (EBP) Programme by 2030. Currently petrol with 10% ethanol blend (E10) is being retailed by various Oil Marketing Companies (OMCs) in India, wherever it is available. However, as sufficient quantity of ethanol is not available, therefore, only around 50% of petrol sold is E10 blended, while remaining is unblended petrol (E0). The current level of average ethanol blending in the country is 5% (Ethanol Supply Year 2019-20). Due to several interventions in the supply side of ethanol, the Ministry of Petroleum aims to achieve 10% ethanol blending levels in the Ethanol Supply Year (ESY) – 2021-22 i.e. April, 2022. This step along with achieving E20 targets will require emission norms for nationwide standardization and adoption. The MoRT&H has notified BS-

2 PPAC's Snapshot Of India's Oil And Gas Data, January, 2021 Accessed From https://www.ppac.gov.in/WriteReadData/Reports/202102190444572101992SnapshotofIndia'sOilGasdata,January2021.pdf

VI emission norms in Central Motor Vehicle Rules 1989 which are applicable to all vehicles post 1st April 2020. Newer vehicles on E-20 will have to meet BS-VI norms. MoRT&H has notified GSR 156(E) on 8th March 2021 for adoption of E20 fuel as automotive fuel and issued mass emission standards for it. MoRT&H has also notified Safety standards for ethanol blended fuels vide GSR 343(E) dated 25th May, 2021 on the basis of Automotive Industry Standard[3] (AIS 171). It lays down safety requirements for type approval of pure ethanol, flex-fuel & ethanol-gasoline blended vehicles in India.

1.4 Currently the gasoline vehicles (2 wheelers & 4 wheelers) in the country are designed for running on pure gasoline and can be tuned to suit ethanol blended fuels ranging from E0 to E5 depending on the vehicle type. On the material compatibility front, the rubber and plastic components are compatible with E10. However, with the proposed target of E20, the vehicles are now required to become both material compatible and tuned for use of E20 fuel.

1.5 By taking into consideration the limitation of ethanol production from traditional C-Heavy molasses route and its competitive usage in potable and chemical sectors, the Central Government has allowed other sugarcane and food grain-based raw materials for ethanol production in line with the National Policy on Biofuels, 2018[4]. However, the existing combined alcohol/ethanol distillation capacity of 684 crore litres will have to be augmented for which this report attempts to provide a roadmap.

1.6 The task force on sugarcane and sugar industry[5] constituted under the Chairmanship of Professor Ramesh Chand, Member (Agriculture), NITI Aayog estimated that sugarcane and paddy combined are using 70% of the country's irrigation water, depleting water availability for other crops. Hence there is a need for change in crop pattern, to reduce dependence on one particular crop and to move to more environmentally sustainable crops for ethanol production. Cereals, particularly maize, and Second Generation (2G) biofuels with suitable technological innovations offer promise of a more environmentally benign alternative feedstock for production of ethanol.

1.7 Besides, the entire supply chain and logistics of OMCs needs to be augmented to store, handle and dispense E20 blends.

1.8 As per the decision of the CCEA in its meeting of 21.12.2020, the Government aims to advance adoption of 20% blending in gasoline in the country by 2025. Accordingly, MoP&NG, DFPD, DHI and MoRT&H have worked out a plan to achieve this target, which this report synthesizes.

3 Safety And Procedural Requirements For Type Approval Of Pure Ethanol, Flex-Fuel & Ethanol-Gasoline Blend Vehicles Accessed From https://morth.nic.in/sites/default/files/ASI/Draft_AIS_Ethanol%20Standard.pdf

4 Gazette Notification Dated 4th June 2018 Accessed From http://mopng.gov.in/files/uploads/NATIONAL_POLICY_ON_BIOFUELS-2018.pdf

5 Final Report of the Task Force on Sugarcane and Sugar Industry accessed from http://niti.gov.in/sites/default/files/2020-08/SugarReport.pdf

International Practices on Ethanol Blending in Petrol



2.1 Global transportation sector is facing three major challenges, namely depletion of fossil fuels, volatility in crude oil prices and stringent environmental regulations. Alternative fuels specific to geographies can address these issues. Ethanol is considered to be one of most suitable alternative blending, transportation fuel due to its better fuel quality (ethanol has a higher octane number) and environmental benefits.

The global production of fuel ethanol touched 110 billion litres in 2019 showing an average growth of 4% year per year during the last decade. The United States of America (USA) and Brazil contribute for 92 billion litres (84% of global share) followed by European Union (EU), China, India, Canada and Thailand. In order to increase the availability of ethanol for transport use, many initiatives have been taken by various countries across the world (Table 2.1). Brazil legislated that the ethanol content in gasoline sold in the country should be in the range of 18% to 27.5%, which is currently at 27%. Concurrently, the use of 100% hydrous ethanol by flex-fuel vehicles in Brazil has increased the average share of ethanol in transportation, to 46% in 2019 .

Table 2.1: Roadmap / Mandate for ethanol blending in various countries

Country	Roadmap / Mandate for ethanol blends	Program	Implementation by	Vehicle Type
Brazil [2]	National policy of Brazil continues the mandate for blending of 18-27.5% of ethanol in gasoline which originally started from 2015. This is currently at 27%.	National biofuels policy (Dec 2017)	Ministry of mines and energy (MME)	Mainly flex. Motorbikes and other two wheeler engines use E27
United States [3]	The clean air Act requires EPA to set the Renewable Fuel Standards (RFS) volume requirements annually. EPA updates volume requirements each year based on fuel availability.	Renewable fuel standard (RFS) program	Environmental protection agency (EPA)	Primarily normal; Flex for E30 or E85 only.
European Union (EU) [4]	EU aims to have 10% of the transport fuel of every EU country come from renewable sources, such as bio-fuels by 2020	Renewable energy directive	European commission	Flex and normal

China [5]	In September 2017, the Chinese government announced legislation proposing the use of ethanol in fuel for all of China with the target of 10% ethanol blending.	Fuel quality standards	National energy administration	Primarily normal
Thailand [6]	Alternative Energy Development Plan (ADEP) targets the share of renewable and alternative energy from biofuel to increase from 7% of total fuel energy use in 2015 to 25% in 2036	ADEP	Ministry of Energy	Primarily normal

2.2 CURRENT FUEL ETHANOL PRICE COMPARISON WITH OTHER COUNTRIES

The Table-2.2 below provides the country wise prices of ethanol.

Table 2.2: Ethanol price comparison

COUNTRY	Price in USD per litre (as on 22.02.2021)*
USA	0.613
Brazil	0.606
Thailand	0.684
India	Sugarcane juice / Syrup–0.865 (INR 62.65) B-molasses- 0.795 (INR 57.61) C-molasses- 0.630 (INR 45.69) Damaged food grains- 0.712 (INR 51.55) Surplus Rice with FCI – 0.785 (INR 56.87)

**Source: GlobalPetrolPrices.com accessed on 22.02.2021; 1 USD = 72.44 INR*

The prices of ethanol produced in India are higher in comparison to global players, since the cost of raw materials viz. sugarcane and food grains are fixed by the government to support the farming community.

Globally, the three major factors drive the production of ethanol and its usage in the transportation sector, namely :

1. **Demand Enrichment**: Governments' mandate for blending a minimum percentage (%) of ethanol with gasoline fuel & production of ethanol compatible vehicles.
2. **Supply Enrichment**: Schemes for ethanol production from different feedstocks and encouragement to augment bio-refineries and their capacities.
3. **Incentives**: Promoting the use of higher ethanol blends through price incentives (tax relief at the retail level) and tax incentives for vehicles compatible with E20 and E85.



Vehicle Technology

Ethanol blending offers significant advantages such as increase in Research Octane Number (RON) of the blend, fuel embedded oxygen and higher flame speed. These properties of ethanol help in complete combustion and reduce vehicular emissions such as hydrocarbon, carbon monoxide and particulate matter. The calorific value of ethanol is around 2/3rd of gasoline. This indicates that the increase in ethanol content will decrease the heating value of the ethanol-gasoline blend. Hence, more fuel is required to achieve the same engine power output. However, ethanol has a higher octane number and thus the engine can be operated with a high compression ratio without knocking. This increases the efficiency of the engine considerably. This combined with optimal spark timing negates the fuel economy debit due to low calorific value of ethanol [7]. Hence, ethanol is considered as an efficient fuel provided suitable modifications are made in the vehicle.

3.1 STUDIES ON E20 IN INDIA

A project to study the suitability of 20% ethanol-gasoline blend (E20) with in-use vehicles was undertaken by Automotive Research Association of India (ARAI), Indian Institute of Petroleum (IIP) and Indian Oil Corporation (R&D) during 2014-15, with a funding from Department of Heavy Industry (DHI) [8]. Material compatibility tests revealed that the metals and metal coatings had no issue with E20. Elastomers (NBR/PVC blend and Epichlorohydrin) had inferior performance with E20 compared to neat gasoline. Plastic PA66 had a drop in tensile strength after use with E20. In the vehicle level studies, fuel economy decreased up to 6% (depending on the vehicle type) on an average basis. The test vehicles passed startability and drivability tests at hot and cold conditions with E0 and E20 test fuels. In all the cases, there was no severe malfunction or stall observed at any stage of vehicle operation. No abnormal wear of engine components or deposits or deterioration of engine oils were observed after the on-road mileage accumulation trials.

3.2 MATCHING HIGHER ETHANOL BLENDS AND COMPLIANT VEHICLES

In order to use higher ethanol blends, the vehicles are supposed to be designed holistically to take care of material compatibility, engine tuning (spark timing) and optimization (compression

ratio) to garner the advantage of higher octane ethanol blends. However, high compression ratio engines may face catastrophic failure due to engine knocking when operated with low or nil ethanol content (i.e. low octane fuel). Similarly, the vehicles which are designed for low or nil content of ethanol in gasoline will result in lower fuel economy if used with higher ethanol blends.

3.3 RESEARCH PROJECTS UNDERTAKEN IN OTHER COUNTRIES

Joint studies reported by Massachusetts Institute of Technology and Honda R&D indicate that the improvement in relative efficiency upto 20% can be achieved with E20 compared to normal gasoline, when the engine is properly tuned. [9]. Trials undertaken by Ford Motor Company concluded that the engine optimized for E20 fuel showed comparable volumetric fuel economy (mileage) and range (kilometers travelled in single fill) of normal gasoline with a CO_2 reduction of 5% [10].

3.4 FLEX FUEL VEHICLES (FFVS)

Flex Fuel Engine technology (FFE) is a well-accepted concept in Brazil, representing over 80% of the total number of new vehicles sold in the country (2019). The Flex fuel vehicles used in Brazil operate with E27 or E100 Hydrous ethanol or any blend between these two. The vehicle technologies for ethanol are already proven along with the compatible fuel systems globally. So, the selection and optimization of technology for the engine has to be undertaken considering the availability of fuel ethanol. The cost of flex fuel vehicles (four-wheelers) would be higher in the range of Rs 17000 to Rs 25000. The two-wheeled flex fuel vehicles would be costlier in the range of Rs 5000 to Rs 12000 compared to normal petrol vehicles (SIAM).

3.5 REGULATORY STATUS OF ETHANOL AS A FUEL

The regulatory status and implementation details are as follows:

1. E5 [blending 5% Ethanol with 95% gasoline] was notified in 2015 by MoRT&H[6]. The rubber and plastic components used in gasoline vehicles produced since 2008 are compatible with E10 fuel.
2. E10 [blending 10% Ethanol with 90% gasoline] was notified in 2019 by MoRT&H[7]. The rubber and plastic components used in gasoline vehicles are currently compatible with E10 fuel.
3. The use of E-85 fuel (85% ethanol by volume) was notified in 2016 for 4 wheeled vehicles, 3 wheelers and 2 wheelers[8]. E100 [pure ethanol] for use in gasoline vehicles and ED95 [95% ethanol and 5% additives (co-solvent, corrosion inhibitors and ignition

6 GSR 412(E) dated 19.05.2015 Accessed from https://morth.nic.in/sites/default/files/notifications_document/Notification_No_G_S_R_412E_dated_19_05_2015_regarding_Flex_fuel_ethanol_vehicles_0.pdf

7 GSR 881(E) dated 26.11.2019 Accessed from https://morth.nic.in/sites/default/files/notifications_document/G.S.R.%20881%28E%29%2026th%20November%202019%20BS%20VI.pdf

8 GSR 682(E) dated 12.07.2016 Accessed from https://morth.nic.in/sites/default/files/notifications_document/Notification_no_G_S_R_682_E_dated_12_07_2016_regarding_Mass_emission_standards_for_Flex_Fuel_0.pdf

improvers)] for diesel vehicles have also been included in the same notification. The emission standards of E 85 and E 100 fuels have also been notified.

4. The specifications of E20 as a commercial fuel have been indicated in IS: 17021: 2018 by BIS.
5. The Ministry has notified GSR 156(E) on 8th March 2021 for adoption of mass emission standards for E20 fuel. The compatibility of a vehicle with the level of ethanol blend of E20 or E85 or E100 or ED95 is required to be defined by the vehicle manufacturer, and the same is required to be displayed on the vehicle by putting a clearly visible sticker.
6. The Safety Standard (AIS 171) for various blends of ethanol with gasoline has been notified vide G S R 343 (E) dated 25th May 2021[9]. The standard recommends material which is compatible with ethanol, viz., rubber, plastics etc. Ethanol blends increase electrical conductivity compared to gasoline, which causes corrosion of metal junctions. Therefore, the need to specify addition of corrosion inhibitors is also included. It also discusses (a) the toxic and carcinogenic nature of pure ethanol, (b) the necessity of personal protective equipment (PPE) for persons exposed to ethanol at the storage point (c) the need to have provisions for venting, flame arrestors and foam-based fire extinguishers for fighting ethanol flames. The standard also specifies labels for ethanol blends to be used in vehicles.

3.6 PRODUCTION OF ETHANOL BLENDED PETROL COMPATIBLE VEHICLES

Currently produced two-wheeler and passenger vehicles in the country are designed optimally for E5, with rubber and plastic components compatible with E10 fuel; their engine can be calibrated for E10 for better performance. As the EBP rolls out in the country, vehicles need to be produced with rubberized parts, plastic components and elastomers compatible with E20 and engines optimally designed for use of E20 fuel. SIAM has assured the committee that once a road-map for making E10 and E20 available in the country is notified by MoPNG, they would gear up to supply compatible vehicles in line with the roadmap. It is possible to roll out E20 material compliant vehicles by April 2022 and E20 Engine compatible vehicles by April 2023. However, considering the supply of Ethanol Blended Fuel, it is recommended that E20 material compliant and E10 engine tuned vehicles may be rolled out all across the country from April 2023. These vehicles can tolerate 10% to 20% of ethanol blended gasoline and also give optimal performance with E10 fuel. Vehicles with E20 tuned engines can be rolled out all across the country from April 2025. These vehicles would run on E20 only and will provide high performance.

3.7 PRICING OF E20 VEHICLES

The cost of E20 compatible vehicles is expected to be higher in the range of Rs 3000 to Rs 5000 for four-wheelers and Rs 1000 to Rs 2000 for two-wheelers, over and above the cost of ordinary vehicles tailored to run on 100% gasoline.

9 https://www.compfie.com/wp-content/uploads/2021/05/26052021_EHS_02.pdf

3.8 IMPACT ASSESSMENT OF USAGE OF E20 FUEL

An ambitious and calibrated transition towards an E20 regime will expectedly impact multiple stakeholders in the ecosystem in myriad ways. The Impact Assessment shows-

3.8.1 Impact on Environment

Vehicular emissions such as Carbon Monoxide (CO), Hydrocarbons (HC) and Oxides of Nitrogen ($NO_{x)}$ are currently under regulation in India. Use of ethanol blended gasoline decreases these emissions. A summary of emission benefits with E10 and E20 fuels compared to neat gasoline are presented in Table 3.1.

Table 3.1. Emission reduction potential of ethanol-gasoline blends [8]

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

* E10 project was carried out in 2009-10, E20 project in 2014-15. Hence, the test vehicles were not the same. However, the emission trend is similar.

Higher reductions in Carbon Monoxide emissions were observed with E20 fuel – 50% lower in two-wheelers and 30% lower in four-wheelers. Hydrocarbon emissions reduced by 20% with ethanol blends compared to normal gasoline. Nitrous Oxide emissions did not show a significant trend as it depended on the vehicle/engine type and engine operating conditions. The unregulated carbonyl emissions, such as acetaldehyde emission were, however, higher with E10 and E20 compared to normal gasoline, due to the presence of hydroxyl groups in ethanol. However, these emissions were relatively minor (in few micrograms) compared to regulated emissions (which were in grams). Evaporative emission test results with E20 fuel were similar to E0. Overall, ethanol blending can help decrease emissions from both two-wheelers and four-wheelers.

3.8.2 Impact on the consumer

1. **Fuel Efficiency**: While using E20 fuel, there will be a drop in fuel efficiency by nearly (a) **6-7% for 4 wheelers** designed for E0 and calibrated for E10, (b) **3-4% for 2 wheelers** designed for E0 and calibrated for E10 (c) **1-2% for 4 wheelers** designed for E10 and calibrated for E20 [8]. However, with the modifications in engines (hardware and tuning), the loss in efficiency due to blended fuel can be reduced.
2. **Startability**: In the E20 project [8], the results indicated that the test vehicles passed startability and drivability tests at hot and cold conditions with E0 and E20 test fuel. In all the cases, there was no severe malfunction or stall observed at any stage of vehicle operation.

3.8.3 Impact on the vehicle manufacturer

The following changes in the production line will be necessary to produce compatible vehicles.

1. Engines and components will need to be tested and calibrated with E20 as fuel.
2. Vendors need to be developed for the procurement of additional components compatible with E20. All the components required can be made available in the country.
3. No significant change in the assembly line is expected.

3.8.4 Impact on the component manufacturer

1. There will be no major structural change in the components in migrating from E10 to E20.
2. There will be changes in material of piston rings, piston heads, O-rings, seals, fuel pumps etc., all of which can be produced in the country.

3.9 VIEWS OF AUTOMOBILE INDUSTRY

The committee has also considered various inputs given by Society of Indian Automobile Manufacturers (SIAM), details of which are at Annexure-D. A gist of the same is given below.

1. Vehicles made in India since 2008 are material compatible with E10 and fuel-efficient compliant with E5. At the next stage when E10 is made available across the country, new vehicles can be made fuel efficient compliant by engine modification with E10.
2. Shift to E20 fuel is a logical, direct progression from E10 rather than going through intermediate steps of E12 and E15. However, following concerns are to be taken care:
   - E20 should be made available on a pan India basis.
   - E10 should be made available on a pan India basis as protection grade fuel for existing pool of vehicles
3. E100/Flex Fuel Vehicles: The cost of E100/ Flex fuel vehicles will be higher in comparison to E0/E10 vehicles which may result in an increase in total cost of ownership (TCO) for the customer. SIAM has suggested that only when E100 can be sold at 30% lower cost as compared to gasoline and if E100 fuel is available across the country can the flex fuel vehicles be a possible solution. Hence, SIAM has not recommended pursuing an E100 implementation / flex fuel approach for the time being. However, once fuel is available on a pan-India basis, a decision on promoting E100 vehicles can be taken.
4. Retro-fitment on existing Vehicles: The existing vehicles on road are material compatible to E10 but their engine/vehicles are not tuned to E10 for optimum performance efficiency. Developing parts with upgraded material for a large number of vintage variants with a wide range of fuel system component designs and then getting the customers to get their vehicles upgraded is a mammoth task. Keeping this complexity in view, a recommendation to continue dispensing E10 as a protection grade fuel all over the country has been made.
5. Alignment of changes with emission regulations: Adopting engines with higher ethanol blend means changes in engine hardware and also engine calibration (tuning). Auto

Industry is already working on the engine upgradation work for the next level of regulations (BS 6.2). Being a huge, unmodifiable task which cannot be course corrected, it is important that fuel changes are also aligned with these regulations to derive complete benefit from all the perspectives.

6. One Nation One Fuel specification: In the past, OMCs and OEMs (Oil and Auto industry) moved together for implementation of BS6 emission regulations and specification of a single fuel across the country. This needs to continue in future also to ensure portability of vehicles by customer, especially for vehicles designed for higher blends of ethanol keeping in mind the customer's acceptance and requirements.

Technical Specifications for Reference Fuel [BIS (Bureau of Indian Standards)]

E0/E5/E10	:	IS: 2796: 2017
E100	:	IS: 15464: 2004
E20	:	IS: 17021: 2018
ED95	:	Hydrous Ethanol IS 16629:2017 plus additives.
E85	:	IS: 16634:2017



Ethanol Blending Programme in India

4.1 With a view to give a boost to the agriculture sector and to reduce environmental pollution, the government of India had launched pilot projects in 2001 wherein, 5% ethanol blended petrol was supplied to retail outlets. Apart from field trials, R&D studies were also simultaneously conducted. The success of these field trials and studies paved the way for EBP in India. The Government of India vide its resolution dated 3rd September, 2002 decided to launch Ethanol Blended Petrol (EBP) Programme in January, 2003 for sale of 5% ethanol blended Petrol in nine States and four UTs.

4.2 Based on these promising experiences, the MoP&NG vide its notification dated 20th September, 2006 extended the 5% Ethanol Blended Petrol to twenty States and four UTs of the country with effect from 1st November, 2006. Public Sector Oil Marketing Companies (OMCs) were asked to sell 5% ethanol blended petrol subject to commercial viability as per Bureau of Indian Standards (BIS) specifications in the notified states and UTs.

In the upcoming years, the Programme showed mixed results with average blending ranging from 0.1% to 1.5% till 2013-14. However, the underlying potential of the programme was never disputed and the interventions by the government since 2014 are tabulated below (Figure 4.1).

DEC 2014

Govt. Re-introduced administered price mechanism for ethanol to be procured under the EBP Programme.

JAN 2015

Opened alternate route for ethanol production (2nd Generation including Petrochemical). Government has since directed Oil Public Sector Enterprises to set up bio-refineries

ESY 2014-15

Eased tender conditions – Multiple EOIs being floated, transportation slabs and rates

MAY 2016

IDR Act Amendment on 14th May, 2016 to clarify on the roles of Central and State Government for uninterrupted supply of ethanol to be blended with petrol under the EBP Programme.

ESY 2016-17

Regular Interaction with States and all other stake holders to address issues pertaining to EBP Programme. This is a continuous exercise.

JUN 2018

Notified forward looking and updated National Policy on Biofuels – 2018 involving all stakeholders.

JUL 2018

Interest Subvention Scheme for enhancement and augmentation of ethanol production capacity in the Country

ESY 2018-19

Allowed conversion of B heavy molasses, sugarcane juice and damaged food grains to ethanol. Fixed differentiated ex-mill ethanol price and procurement priority based on raw material utilized for ethanol production. Marked beginning of an era of differentiated ethanol pricing, based on raw material utilized for ethanol production.

MAR 2019

Opened a fresh window for inviting applications under interest subvention scheme for ethanol projects based on cane and molasses.

APR 2019

Extension of EBP Programme to whole of India except Island UTs of Andaman Nicobar and Lakshadweep islands

SEP 2019

New sources sugar & sugar syrup introduced for ethanol production and fixed remunerative price.

OCT 2019

Published "Ethanol Procurement Policy on a long-term basis under EBP Programme"

JUN 2020

OMCs have enhanced their ethanol storage capacity from 5.39 crore litres in November, 2017 to 17.8 crore litres in December 2020. With the current capacity, about 430 crore litres of ethanol can be handled annually considering 15 days of coverage period.

AUG 2020

One time registration of ethanol suppliers for long term, including giving them visibility of ethanol demand for 5 years

SEP 2020

OMCs started to provide Off-take guarantee letter and consent to sign tripartite agreement with ethanol suppliers and bankers to support the ethanol capacity expansion projects

SEP 2020

Opened fresh window for inviting applications under interest subvention scheme for ethanol projects based on cane and molasses.

OCT 2020

Further ease of tender conditions by OMCs like one time document submission, quarterly bank guarantees, multiple transportation rate slabs and transportation rates being linked to retail selling price (RSP) of diesel, reduction in security deposit and applicable penalty on non-supplied quantity etc.

OCT 2020

Approval of National Biofuel Coordination Committee (NBCC) to utilize surplus stock of rice lying with Food Corporation of India (FCI) to be released to the distillers for ethanol production.

NOV 2020

Approval of NBCC10 to utilize maize for ethanol production

JAN 2021

Interest subvention scheme for enhancement and augmentation of ethanol production capacity extended to grain based distilleries & distilleries producing ethanol from other feed stocks like sorghum, sugar beet etc apart from molasses-based distilleries.

Figure 4.1: *Progress in EBP program*

4.3 NODAL AGENCY FOR ETHANOL PRODUCTION

Department of Food and Public Distribution (DFPD) is the nodal department for promotion of fuel grade ethanol producing distilleries in the country. Government has allowed ethanol production/ procurement from sugarcane-based raw materials viz. C & B heavy molasses, sugarcane juice / sugar / sugar syrup, surplus rice with Food Corporation of India (FCI).[10] and Maize. The raw material wise conversion efficiency is tabulated in Table 4.1 below:

Table 4.1: Feedstock cost and ethanol yield

Feedstock	Cost / MT of the feedstock (Rs.)	Quantity of ethanol per MT of feedstock	Ex-mill Ethanol Price (Rs./litre)
Sugarcane juice / Sugar / Sugar syrup	2850 (Price of sugarcane at 10% sugar recovery)	70 litre per ton of sugarcane	62.65
B Molasses	13,500	300 litre	57.61
C Molasses	7123	225 litre	45.69
Damaged Food Grains (Broken Rice#)	16,000	400 litre	51.55
Rice available with FCI	20,000	450 litre	56.87
Maize#	15,000	380 litre	51.55

#The rates vary from region to region and also in accordance with demand/supply or quality.

Supply of ethanol under the EBP Programme has increased from 38 crore litres during ESY 2013-14 to 173 crore litres during ESY 2019-20 resulting in increase in blend percentage from 1.53% to 5.00% respectively. Further, the allocation for the ongoing ESY (2020-21) has surged to **332** crore litres, which is 91% more in comparison to the ethanol supplies received during preceding ESY (2019-20).

Table 4.2: Quantity Supplied (Ethanol) and %Blending Trends

Ethanol Supply Year	Qty Supplied (crore Lit)	Blending %age PSU OMCs
2013-14	38.0	1.53%
2014-15	67.4	2.33%
2015-16	111.4	3.51%
2016-17	66.5	2.07%
2017-18	150.5	4.22%
2018-19	188.6	5.00%
2019-20	173.0	5.00%
2020-21	332	8.50%

10 Ministry of Petroleum & Natural Gas Office Memorandum Dated 13th January 2021 Accessed From http://mopng.gov.in/files/article/articlefiles/OM-on-NBCC-decision-13012021.pdf

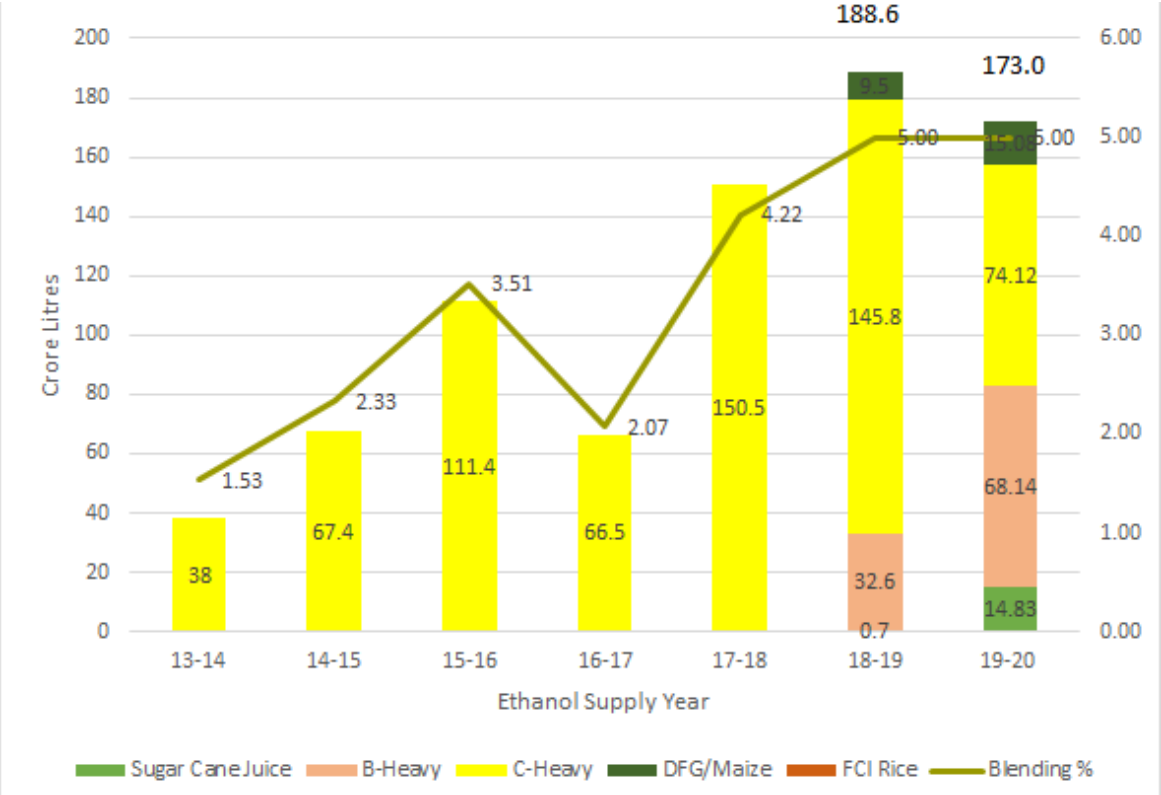


Figure 4.2: *EBP Programme Performance*

Source: OMCs

4.4 REGULATORY REGIME FOR GRANT OF ENVIRONMENT CLEARANCES TO DISTILLERIES

4.4.1 Procedure for obtaining Environmental Clearance (EC)

Environmental Clearance (EC) is issued by The Ministry of Environment, Forest and Climate Change (*MoEFCC*) / State Environment Impact Assessment Authority (*SEIAA*) as per the Environment Impact Assessment Notification 2006 under the Environment (Protection) Act 1986. The project proponents are also required to obtain Consent to Establish (CTE) and Consent to Operate (CTO) under the Air (Prevention and Control of Pollution) Act- 1981 and Water (Prevention and Control of Pollution) Act, 1974 from State Pollution Control Boards (SPCB) of States/UTs.

In order to get Environment Clearance for new projects, the Project Proponent (PP) has to submit an application at Parivesh portal for Terms of Reference (TOR) which is generally issued in a month's time. Thereafter, normally one season (4 months) time is spent in Environment Impact Assessment Study and this duration should be continuous and excluding the rainy season.

After preparation of a draft EIA report based on the ToR, it is submitted to SPCB for Public hearing/ Public Consultation. SPCB writes to the District Collector for conducting Public Hearing. Since one month notice period is required for conducting public hearing, so practically, it takes 2 to 4 months time in conducting public hearing. Thereafter, application for environmental clearance (EC) is submitted to MoEF&CC/SEIAA which is deliberated in the Expert Appraisal Committee (EAC) and after recommendations of EAC, Environment Clearance is granted by the MoEF&CC/SEIAA and this activity takes 2-4 months time. The whole procedure in getting EC takes at least 10 months.

4.4.2 Measures taken by MoEF&CC to optimize the required time in obtaining Terms of Reference (ToR) and for data collection for preparation of Environment Impact Assessment

1. After receipt of application for a new project, standard Terms of Reference (ToR) are issued within a maximum of one week, while data collection is required only for new projects.
2. **Standard ToR:** In order to expedite the process of clearance, the Ministry has issued Standard ToR which allows Project Proponent (PP) to begin the EIA / EMP preparation even before applying for ToR. Validity of ToR has also been extended from 3 to 4 years.
3. **Flexibility in Collection of Data:** Baseline data can be collected before hand, without waiting for grant of ToR, for preparation of EIA, provided the data collected is not more than three years old at the time of submission of the proposal for EC. (Ministry's O.M dated 29.08.2017).
4. The MoEF&CC has provided for issuance of instant ToRs for the projects or activities in respect of all expansion proposals and new proposals located in notified industrial areas.

4.4.3 Measures taken by Ministry to optimize the time taken in approval of EC

1. Earlier, EC was required even when Zero Liquid Discharge (ZLD) units like incineration boilers, bio-composting methods etc. were included in the distillery as these systems increased the annual production capacity. However, MoEF&CC vide OM dated 25th March,2019 has clarified that in case of projects/distilleries involving installation of incineration boilers or bio-composting operations to achieve ZLD there shall be no requirement for amendment in existing EC to increase the number of working days .
2. The Ministry vide Notification dated 13th June, 2019 has amended the EIA Notification, for decentralizing and expediting the EC for distilleries, and has delegated powers to State Environment Impact Assessment Authorities (SEIAA) for molasses-based distilleries upto 100 KLD and for non-molasses-based distilleries with a capacity of upto 200 KLPD from earlier provisions of SEIAA having powers only for non-molasses-based distilleries with a capacity of less than 60 KLD.
3. The Ministry vide the same Notification dated 13th June, 2019 has amended the EIA Notification, 2006 exempting the requirement of EC for 'Isolated storage' projects, which has facilitated building Ethanol storage capacity by OMCs.
4. When sugar rich feed stocks viz. B-Heavy molasses, sugarcane juice/ sugar syrup/ sugar are used for production of ethanol, and the production increases beyond the licensed capacity without any expansion of the existing plant & machinery or technology, the Ministry has exempted such increase in production by upto 50%, due to change of raw materials, from the requirement of prior environment clearance subject to furnishing of "No increase in pollution load certificate" from the concerned State / Union Territory Pollution Control

Board (Notification dated 16th January, 2020). The said notification states that *"Any change in raw material-mix or product-mix, change in quantities within products or number of products in the same category for which prior environmental clearance has been granted, shall be exempted from the requirement of prior environmental clearance provided there is no increase in pollution load and the resultant increase in production is not more than 50 percent of the production capacity permitted in the earlier environmental clearance and the project proponent shall follow the procedure for obtaining 'No Increase in Pollution Load' certificate from the concerned State Pollution Control Board or Union Territory Pollution Control Committee."*

5. Earlier, meetings of Expert Appraisal Committee to consider & recommend proposals for grant of EC were held once in a month, but now MoEF&CC is holding a minimum of two EAC meetings a month for further expediting the decision on EC proposals.

6. MoEF&CC has exempted expansion projects from Public Hearing subject to furnishing a certificate from MoPNG stating that the proposal is for the purpose of Ethanol Blending Programme (vide notification no. SO345 (E) dated 17.01.2019). Now, MoEF&CC vide its OM dated 28th January 2021 has relaxed the requirement for certificate from MoPNG for the specific purpose of a proposal being for Ethanol Blending Programme. As per the said OM, certificate from any competent authority stating that the end use of bio-ethanol is for the purpose of blending with petrol, shall be sufficient.

7. The Ministry vide its notification of 2nd March, 2021 has now exempted ethanol producing units proposing expansion of capacity with no increase in pollution, from obtaining EC. Vide this notification, all expansion projects will continue to be considered as B2 projects which are exempt from Public Hearing. Now, the applicant has to submit the application to MoEF&CC directly, which would be considered in Expert Appraisal Committee (which is meeting twice in a month) and on its recommendations, EC would be granted by MoEF&CC in a months time.



Procurement of Ethanol and its Pricing

5.1 From the inception of the EBP Programme, various pricing models have been adopted by the government which were based on the prevailing macro-economic situation of the sugar industry and the oil sector. The ethanol procurement gained momentum after the introduction of Administered Pricing Mechanism for Ethanol from ESY 2014-15. Prices of ethanol produced from sugarcane sources is approved by the Cabinet Committee on Economic Affairs (CCEA), while that from foodgrains is decided by OMCs. Since ESY 2018-19, Government has introduced a differential pricing policy wherein higher rates were offered to sugar mills for production of ethanol from B-heavy molasses and sugarcane juice. Further In ESY 2019-20, even higher prices were offered for conversion of sugar/sugarcane juice to ethanol. The ex-mill price of ethanol being paid to ethanol suppliers for ESY 2020-21 produced from various variants of sugarcane and food grains is given in Table 5.1 below.

Table 5.1: Administered Price of Ethanol by Source

Raw material Source	Ex-mill Ethanol Price (Rs./litre)
B-Heavy	57.61
C-Heavy molasses	45.69
Sugar/Sugar Syrup	62.65
Damaged Food Grains/ Maize	51.55
Surplus Rice (FCI)	56.87

5.2 PRICING MECHANISM OF ETHANOL FROM SUGAR SECTOR

1. **Sugar/Sugarcane Juice/Sugar Syrup:** The pricing model is based on Fair and Remunerative Price (FRP) of Sugar Cane on which cost of conversion, depreciation and cost of capital is added to compute the ex-mill price of ethanol (Rs. 62.65/litre).
2. **B Heavy:** The pricing model followed for B Heavy is linked to the normative cost of sugar on which cost of capital is added to compute the ex-mill price of ethanol (Rs. 57.61 per litre).

3. **C Heavy:** The pricing model followed is based on prices of molasses and ex-mill price of sugar. For ESY 2020-21, an estimated all India average recovery rate of 11.2% has been considered per metric ton of sugarcane and C heavy rate of Rs. 45.69 per litre has been computed.

5.3 IMPACT OF EXISTING ETHANOL PRICING MECHANISM

1. **Central Government:** While petrol is subject to excise duty, GST is levied on ethanol. While GST would be in the range of Rs. 2.28/litre to Rs. 3.13 per litre of ethanol based on an ex-mill price in the range of Rs. 45.69/litre to Rs. 62.65/litre, excise duty on petrol is Rs. 32.98/litre. Considering total national ethanol blending volumes of 332 crore litre, revenue loss to the central government due to replacement of petrol by ethanol amounts to Rs. 10,950 crore per annum.

2. **Oil PSUs:** OMCs pass on to the consumers any change in the price of fuel due to blending of ethanol and are therefore not impacted by the pricing of ethanol. At present, excise duty on landed cost of petrol at oil depots is higher than GST on the landed cost of ethanol and the benefit is being passed on to the retail consumers. However, in the future, should the price of ethanol increase beyond that of petrol, consumers may have to pay more for ethanol blended fuel. In such a scenario, tax (GST) breaks on Ethanol may become necessary.

3. **Environmental Cost:** Sugarcane is a water intensive crop. On an average, one tonne of sugarcane can produce 100 kg of sugar, and 70 litres of ethanol. Cultivation of each kg of sugar requires 1600 to 2000 litres of water. Hence, one litre of ethanol from sugar requires about 2860 litres of water[11]. It is estimated that sugarcane and paddy combined use 70% of irrigation water of the country[12]. Keeping in view the need for water conservation, it is advisable to shift some of the area under sugarcane to less water intensive crops by providing suitable incentives to farmers. The Task Force on sugarcane and sugar Industry constituted under the Chairmanship of Professor Ramesh Chand, Member (Agriculture), NITI Aayog has suggested ways to minimize water consumption through various means to encourage farm diversification.

4. **Ethanol production from non-sugar sources:** Share of production of ethanol from non-sugar sources like damaged food grains and FCI rice is relatively small. The net returns from sugarcane are much higher than those from food crops; for example, in Karnataka it was about Rs. 1,13,590 per hectare as compared to Rs. 33,877 per hectare from paddy and 22,931 per hectare from maize during FY 2018-19[13]. The situation is similar in other states also. A high price of sugarcane leads to a higher price of sugar and its by-products like molasses, ethanol.

11 The water footprint of sugar and sugar-based ethanol, University of Twente, 2009 https://www.utwente.nl/en/et/wem/education/msc-thesis/2009/scholten.pdf

12 Report of the Task Force on sugarcane and sugar Industry dated 3rd June 2020, constituted under the Chairmanship of Professor Ramesh Chand, Member (Agriculture), NITI Aayog accessed frm http://niti.gov.in/sites/default/files/2020-08/SugarReport.pdf

13 Report of the Task Force on sugarcane and sugar Industry dated 3rd June 2020, constituted under the Chairmanship of Professor Ramesh Chand, Member (Agriculture), NITI Aayog accessed frm http://niti.gov.in/sites/default/files/2020-08/SugarReport.pdf

5. **Environmental impact of choice of feedstock:** In the interest of environmental sustainability, making ethanol available on a pan-India basis and sharing the benefits of EBP widely, measures to promote production from non-sugarcane sources, food grains, especially maize[14] and second generation sources may be promoted through suitable pricing mechanisms.

14 Cost of Production of Rice and Maize in World Trade Organization Era of Karnataka accessed from http://14.139.155.167/test5/index.php/kjas/article/viewFile/1206/1198





Fuel Ethanol Demand in India

Ethanol (also called ethyl alcohol, or alcohol) is an organic chemical compound with chemical formula C_2H_5OH. Besides the EBP Programme, ethanol finds competitive usage in the portable sector and the chemical & pharmaceutical industry. Demand for ethanol as a fuel is primarily driven by blending mandates, widespread availability of fuel, and compatible vehicles and fulfilment of other infrastructural requirements.

6.1 GROWTH IN VEHICLE POPULATION

The vehicle population in the country is around 22 crore two and three wheelers and around 3.6 crore four-wheelers (SIAM). The 2 wheelers account for 74% and passenger cars around 12% of the total vehicle population on the road. The two-three wheelers consume 2/3rd of the gasoline by volume, while 4 wheelers consume balance 1/3rd by volume. The growth rate of vehicles in this segment is pegged at around 8-10% per annum. An estimate of year-wise addition of gasoline-based vehicles in the country is given in Table-6.1 below:

Table 6.1: Projected addition of gasoline vehicles (in Lakhs)

Units in (lakhs)	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
Two-wheeler gasoline	174	139	167	181	195	211	227	246	265	287	309
Passenger Vehicle (gasoline)	20	20	22	24	26	28	30	33	35	38	41

*The estimate is based on the following assumptions:

V-shape recovery in sales in FY22, followed by growth at CAGR of 8% in all segments.

Share of petrol vehicles will be 83% of the total passenger vehicle sale

Source: SIAM

6.2 DEMAND PROJECTIONS OF GASOLINE

Based on expected vehicle population, the demand projections of gasoline in India are given in Table-6.2.

Table 6.2: Gasoline demand projections

Projections as per the 'Report of the Working Group on Enhancing Refining Capacity by FY 2040										
Product / Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Motor Gasoline (MMTPA)*	27.7	31	32	33	35	36	37	39	40	41
Motor Gasoline (Cr. Ltr.)	3908	4374	4515	4656	4939	5080	5221	5503	5644	5785

* Interim figures from PPAC considering growth @ 3-4% YoY (Source: MoP&NG)

* Projection interval is for 5 years and the data has been linearly extrapolated.

The effect of COVID pandemic and introduction of EVs are considered.

6.3 DEMAND PROJECTION OF FUEL ETHANOL

The projected requirement of ethanol based on petrol (gasoline) consumption and estimated average ethanol blending targets for the period ESY 2020-21 to ESY 2025-26 are calculated below:

Table 6.3: Ethanol demand projection

Ethanol Supply Year	Projected Petrol Sale (MMT)	Projected Petrol Sale (Cr. litres)	Blending (in %)	Requirement of ethanol for blending in Petrol (Cr. litres)**
A	B	B1=B X 141.1	C	D=B1*C %
2019-20	24.1 (Actual)	3413 (Actual)	5	173
2020-21	27.7	3908	8.5	332
2021-22	31	4374	10	437
2022-23	32	4515	12	542
2023-24	33	4656	15	698
2024-25*	35	4939	20	988
2025-26*	36	5080	20	1016

* The petrol projections may undergo revision due various factors like penetration of EVs, etc.

** The figures are optimistic, as the E20 fuel will be consumed by new vehicles from April 2023 only. The demand for ethanol will, however, increase due to penetration of E100 two wheelers, which are now being manufactured in the country.

6.3.1 Additional Modeling of Ethanol Demand Scenarios

In addition, an Ethanol Demand modelling exercise was done by CSTEP (Center for Study of Science, Technology & Policy) using their long-term simulation model called **Sustainable Alternative Futures for India (SAFARI).** The SAFARI model estimates India's energy demand and emissions up to 2050 under various scenarios. It is driven by socioeconomic parameters like population and

GDP, as well as development goals like food, housing, healthcare and education infrastructure, transport, and power for all. Given the inherent uncertainties in projections for the future and with electric vehicle revolution on the horizon, different scenarios have been considered. To estimate the demand for petrol and consequently ethanol, three scenarios for **electric mobility uptake** have been considered:

1. **Conservative (low EVs)** – negligible uptake of electric mobility up to 2030.
2. **Business-As-Usual (BAU, medium EVs)** – medium uptake of electric mobility; around 15% of car passenger-kilometres (pkms) and 30% of two-wheeler and three-wheeler pkms are assumed to be electric by 2030.
3. **Low Carbon (high EV uptake)** – 30% of car pkms and 80% of two-wheeler and three-wheeler pkms are assumed to be electric by 2030.

Figure 6.1 shows the ethanol demand in 2025 under these scenarios. As per this projection, the ethanol demand will be in the range of 722-921 crore litres in 2025 to meet E20 targets**.** In this report, we have assumed an enhanced ethanol demand of 1016 crore litres based on expected growth in the vehicle population (Table-6.1). The SAFARI model gives us confidence that our projections would cover the most ambitious scenario of ethanol demand in the country, and thus gives a robustness to our roadmap for rollout of E20 by 2025.

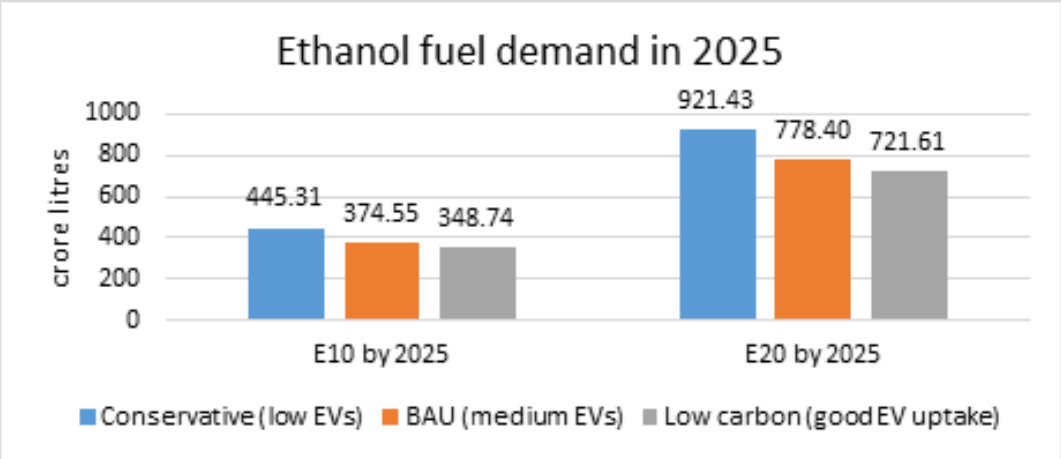


Figure 6.1: *Ethanol fuel demand in 2025 under various scenarios*





Ethanol Supply Projections

7.1 ETHANOL PRODUCTION CAPACITIES

In the year 2017-18, installed capacity of molasses-based distilleries was around 278 crore litres. With a view to enhance ethanol production capacity in the country, the government in July, 2018 & March, 2019 notified two interest subvention schemes for molasses-based distilleries. Under the aforesaid scheme of DFPD, interest subvention at the rate of 6% per annum or 50% of rate of interest charged, whichever is lower on the loan sanctioned was borne by the central government for a period of 5 years. DFPD approved 368 projects for setting up of new distilleries / expansion of existing distilleries.

Loans amounting to about Rs.3600 crore have been sanctioned by banks to 70 sugar mills so far; 31 projects have been completed creating a capacity of 102 crore litres as a result. The capacity of molasses-based distilleries has reached to 426 crore litres. 39 more projects with capacity of 93 crore litres are likely to be completed by March, 2022 which will bring cumulative capacities to about 519 crore litres.

With a view to achieve blending targets, DFPD is making concerted efforts to enhance the ethanol distillation capacity in the country. For this, the government had invited applications from the entrepreneurs under the ethanol interest subvention schemes in September, 2020 during a window of 30 days. Thus far, 238 projects for a capacity enhancement of 583 Cr litres with a loan amount of about Rs.16,000/- crore have been approved by DFPD. It is expected that at least 400 Cr litres capacity would be added from these projects by 2024.

7.2 MODIFIED INTEREST SCHEME TO ENHANCE PRODUCTION CAPACITY OF ETHANOL

Cabinet Committee on Economic Affairs (CCEA) in its meeting dated 30.12.2020 approved a note of DFPD for extending financial assistance for producing 1G ethanol from feedstocks such as cereals (rice, wheat, barley, corn & sorghum), sugarcane, sugar beet etc.[15] Thereafter, with the

15 The Department of Food & Public Distribution notified a modified scheme to enhance ethanol distillation capacity in the country for producing 1st Generation (1G) ethanol from feed stocks such as cereals (rice, wheat, barley, corn & sorghum), sugarcane, sugar beet etc. Accessed from https://pib.gov.in/PressReleasePage.aspx?PRID=1688616

approval of CCEA, DFPD has notified modified interest subvention scheme on 14.01.2021 for setting up new grain-based distilleries/ expansion of existing grain-based distilleries to produce ethanol & production of ethanol from other 1G feed stocks. About 418 applications received for capacity addition of 1670 Cr litres have been recommended for in-principle approval. It is expected that at least ethanol capacity of about 500 Cr litres (of molasses and grain-based) would be added from these upcoming projects. Further applications would be invited by DFPD as and when required.

Thus, it is expected that capacity of molasses-based distilleries would increase from current levels of 426 crore litres to 730 and 760 crore litres by 2024-25 and 2025-26 respectively. 75 crore litres capacity is being added by existing grain-based distilleries; further OMCs are planning to set up about 10-15 new grain-based distilleries thereby adding capacity by 100-150 crore litres. Hence, capacity of grain-based distilleries is expected to reach 350, 450, 700 and 740 crore litres during 2022-23, 2023-24, 2024-25 and 2025-26 respectively from current levels of 258 crore litres.

DFS has impressed upon banks to expedite sanctioning and disbursal of loans. Concept of Tripartite Agreement between mills/distilleries, banks and OMCs has been introduced which is facilitating mills/distilleries to avail loans for ethanol projects. State Bank of India has also issued Standard Operating Procedure (SOP) for sanction and disbursal of loans to molasses-based distilleries. Similar SOPs are also being issued in respect of grain-based distilleries; and by other banks. DFPD has developed a web portal viz. http://sugarethanol.nic.in to review the progress of upcoming ethanol projects on a real time basis. In the portal, project proponents can share the bottle-necks, if any, faced by them so that related Ministries like DFS, MoEF&CC, DFPD, MoP&NG and State Governments can sort out the problems by expediting requisite clearances and sanctioning and disbursal of loans. DFPD has held webinars with the State Governments, Industry Associations, MoP&NG, DFS, MoEF&CC, Banks, OMCs to motivate investors to set up the distilleries and expedite various approvals and clearances. DFPD plans to hold state specific webinars with State Governments, entrepreneurs, DFS, MoEF&CC, MoP&NG to assess the progress of projects and to ensure speedy clearances of projects.

To achieve an 8.5% blending target in ESY 2020-21 (December, 2020 to November, 2021), about 332 crore litres ethanol is required against which about 325 Cr litres have been allocated by OMCs (till 22.02.2021) to sugar mills/distilleries. Also, in the next ESY 2021-22, OMCs need to procure 437 crore litres of ethanol to achieve 10 % blending.

7.3 AVAILABILITY OF FEED-STOCKS FOR PRODUCTION OF ETHANOL

To produce 684 crore litres of ethanol by the sugar industry by 2025-26, sugarcane equivalent to 60 LMT of surplus sugar would be diverted to ethanol. In the current sugar season 2020-21 more than 20 LMT of sugar is estimated to be diverted. To produce 666 crore litres of ethanol/ alcohol from food grains by 2025-26, about 165 LMT of food grains would be utilized. At present damaged food grain availability is around 40 lakh ton in the country. In 2020-21 approximately 20 lakh ton maize is surplus; FCI Rice is also sufficient in stock (266 LMT) and it will continue to remain robust as procurement of paddy/rice at MSP continues at expected levels. The country is producing sufficient food grains and sugar to meet the requirement for ethanol (Table 7.1).

Molasses-based distilleries have also been offered interest subvention to convert them to dual feed, to convert both food-grains & molasses into ethanol. Thus, it is expected that there would be sufficient ethanol distillation capacity to achieve blending targets. DFPD is effectively monitoring the situation and encouraging states and investors to set up new industries and make sufficient availability of ethanol for blending.

Under PM-JIVAN scheme, 12 commercial plants and 10 demonstration plants of Second Generation (2G) Bio-Refineries (using ligno-cellulosic biomass as feedstock) are planned to be set up in areas having sufficient availability of biomass so that ethanol is available for blending throughout the country. Already Rs. 1969.50 Crores have been earmarked for this scheme. These plants can use feedstocks such as rice straw, wheat straw, corn cobs, corn stover, bagasse, bamboo and woody biomass, etc.

Table 7.1: Availability of feed-stock for Ethanol in the Country (In Lakh Ton)

Feed-stock	Annual production	Annual Consumption	Surplus
Sugar[16]	320	260	60
FCI rice*[17]	520 (Annual Procurement)	350 (Annual issue)	309[#18] (Stock in central pool)
Maize**[19]	285	165	103[##]

** FY 2019-20, **as per Market Begin year, # stock in central pool as on 31.03.2020, ##expected after export*

7.4 ESTIMATION OF SUPPLY AND CAPACITY AUGMENTATION

During the meeting of Committee of Secretaries on 13.11.2020, DFPD informed that the fuel 20% ethanol requirement by 2025 will be met from sugar as well as grains sectors. Table 7.1 provides the Year-wise and Sector-wise Ethanol Production Projections as per increasing Blending Percentages.

Table 7.2: Year wise & Sector wise Ethanol Production Projections

Ethanol Production Projections										
ESY	For Blending			Blending (in %)	For other uses			Total		
	Grain	Sugar	Total		Grain	Sugar	Total	Grain	Sugar	Total
2019-20	16	157	173	5	150	100	250	166	257	423
2020-21	42	290	332	8.5	150	110	260	192	400	592
2021-22	107	330	437	10	160	110	270	267	440	707
2022-23	123	425	542	12	170	110	280	293	535	828
2023-24	208	490	698	15	180	110	290	388	600	988
2024-25	438	550	988	20	190	110	300	628	660	1288
2025-26	466	550	1016	20	200	134	334	666	684	1350

16 https://www.pib.gov.in/PressReleasePage.aspx?PRID=1684626

17 https://dfpd.gov.in/writereaddata/Portal/Magazine/FoodgrainBulletinforJanuary2021Bilingual.pdf

18 https://fci.gov.in/stocks.php?view=46

19 https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=India%20-%20Grain%20and%20Feed%20Update%20-%20February%202021_New%20Delhi_India_02-02-2021

The following table (Table 7.3) details the Grains and Molasses based Ethanol Production Capacity necessary to meet the Production Projections above.

Table 7.3: Ethanol capacity requirement by Year and Raw Material

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

Note: Minor shortfall in capacity in any year can be compensated as sugar mills are also using sugar rich feed stocks like B heavy molasses / sugar syrup which produces 20% more ethanol of rated capacity. Now many mills have started using these feed stocks in place of C heavy molasses. The capacity utilization in these 5 years vary from 84 percent to 90 percent.

Table 7.4 below lays down the capacity augmentation plans for 2025-26, and its year wise breakup

Table 7.4: Ethanol Capacity augmentation (20% blending by 2025-26)

Ethanol Supply			
Ethanol Supply (in Cr. Lt.)	Fuel ethanol	Other uses	Total
(A) From sugar sector	550	134	684
(B) From grain/ maize etc.	466	200	666
Total Supply	**1016**	**334**	**1350**
Capacity Augmentation			
Ethanol Capacity (in Cr. Lt.)	Molasses based	Grain based	Total
Existing ethanol/alcohol capacity	426 (231 distilleries)	258 (113 distilleries)	684
Capacity addition from sanctioned projects	93 (will be added by March,2022)	0	93
New capacity to be added	241	482	723
Total Capacity required by Nov 2026 to reach 1350 Cr litres supply	760	740	1500

- Additional capacity (90 % of 1500 = 1350) has been taken to account operational efficiency, raw material availability in various parts of the country due to natural calamity etc., increase in demand in ethanol due to economic factors and anticipated demand of ethanol in flex-fuel vehicles.
- Molasses based distilleries can produce 20% additional ethanol if sugar rich feed stocks like B- heavy molasses are used as the same capacity can cater the higher demand of ethanol.

- Total planned capacity is 1500 crore litres per annum, distribution between grain and molasses may change depending on various factors.
- It is relevant to mention that earlier on the inputs obtained from MoP&NG, 900 cr ltrs ethanol was estimated to achieve 20% blending and 300 Cr ltrs was the requirement of other sectors, thus total requirement was assessed to be 1200 cr litres by 2024-25. However, as per the revised estimates of gasoline consumption obtained from MoP&NG, about 988 cr ltrs is required to achieve 20% blending by 2024-25 and total requirement of alcohol including other sectors would be 1288Cr litres. For 2025-26, ethanol requirements is 1016 cr ltrs to achieve 20% blending and total requirement of alcohol including other sectors would be 1350 Cr litres.





Challenges in Rollout of E20 Program

This section lists possible challenges to stakeholders, and suggested measures to pre-empt and counter these for a successful roll-out of EBP

8.1 CHALLENGES TO PRODUCERS

The following are the challenges that the producers need to overcome in order to facilitate higher production of ethanol:

1. Availability of sufficient feedstock on a sustainable basis viz., sugarcane, food grains: Current regulations in the country allow production of ethanol from sugarcane, sugar, molasses, maize and damaged foodgrains unfit for human consumption. Further, surplus rice with FCI is also allowed[20]. States like Chattisgarh have raised the issue of permitting rice procured by the state government to be allowed for production of ethanol. The list of feedstocks allowed for production of ethanol needs to be expanded.
2. Augmentation of ethanol production facilities as planned.
3. Inter-state movement of ethanol–There are some states which produce ethanol more than the requirement for blending within the State. This has to be transported to other states where the availability of ethanol is less. While amendment has been made to the IDR Act which legislates exclusive control of denatured ethanol by the central government for smooth movement of ethanol across the country, the same has not been implemented by states thereby restricting this movement of ethanol
4. Weather related issues – floods / drought thereby affecting the crop.
5. Prices of feed-stock and ethanol.

8.2 CHALLENGES TO OMCs

The following are the challenges that the OMCs need to overcome in order to facilitate higher use of ethanol in gasoline and also to ensure pan-India supply of the same.

20 Ministry of Petroleum & Natural Gas Office Memorandum Dated 13th January 2021 Accessed From http://mopng.gov.in/files/article/articlefiles/OM-on-NBCC-decision-13012021.pdf

8.2.1 Availability of ethanol across the country

1. Ethanol is not produced or available in some states for blending with gasoline
2. About 50% of total pump nozzles in India are supplying only E0
3. Restrictions on inter-state movement of ethanol due to non-implementation of the amended provisions of Industries (Development & Regulation) Act, 1951 by all the States. As on date only 14 states have implemented the amended provisions. The other states with a large consumption of petrol where implementation is pending includes Delhi, Uttar Pradesh, Rajasthan, West Bengal, Telangana, Odisha and Kerala.
4. Ethanol blending has not been taken up in North-East states due to non-availability of feedstock or industries
5. Transport of ethanol to different places for blending will increase the cost of logistics and transport related emissions

8.2.2 Changes in marketing infrastructure

1. Need for additional storage tanks for ethanol at marketing terminals / depots.
2. Need for ethanol compliant dispensing units.
3. Changes in nozzle calibration & legal metrology.
4. Need for an additional underground tank, pipes/hoses and dispensing units for ethanol blended gasoline supply at retail outlets. Dispensing infrastructure for E100 will be required for E100 two-wheelers introduced in the country. Due to this, there would be space constraint at various retail outlets for setting up of such extra infrastructural facilities.
5. Policy guidelines for differential pricing and labelling of various ethanol blended motor spirit.

8.3 CHALLENGES TO VEHICLE MANUFACTURERS

The following are the challenges that the vehicle manufacturers need to overcome in order to facilitate roll out of compatible vehicles for higher ethanol blended gasoline in the country.

1. Handhold vendors to develop ethanol compatible parts
2. Optimization of engine for higher ethanol blends
3. Conduct of durability studies on engines and field trials before introducing E20 compliant vehicles.



Recommendations

Based on the deliberations with all the stakeholders and analysis of various issues presented in the previous chapters, the following are the recommendations and suggested roll-out plan.

9.1 AUGMENTATION OF ETHANOL PRODUCTION CAPACITY

With liberalized feedstock policy, incentives and close monitoring as listed in Chapter-7, sufficient capacity for ethanol production is likely to be built in the country to meet demand till 2025. For this, both the sugarcane-based and grain-based ethanol production capacities shall have to be augmented by 78% and 187% to 760 and 740 crore litres respectively. To enable a pan-Indian roll-out, ethanol would need to be supplied from surplus to deficit states as per requirements so as to ensure **uniform availability of ethanol blends in the country.**

Over time, technology for production of ethanol from non-food feedstock, called "Advanced Biofuels" including second generation (2G) should be promoted so as to tap this abundantly available resource without causing any tradeoff with the food production system.

A close follow up is required of the planned steps for enhancing ethanol production capacity across the country to 1500 Cr. litres by ESY 2025-26 required for E20 blending. Special efforts are needed to attract investors to the North East of the county to avail the Interest Subvention Scheme of DFPD and build an adequate distillation capacity and to avoid long distance transport of ethanol.

9.2 ETHANOL BLENDING ROADMAP

1. MoP&NG should immediately notify the plan for pan-India availability of E10 fuel by April, 2022 and its continued availability thereafter until 2025 for older vehicles, and launch of E20 in the country in phases from April, 2023 onwards so as to make E20 available by April, 2025. MoPNG should notify that the blending program is applicable to all oil marketing companies,including the private companies. This will trigger action by all relevant stakeholders. The roll out of higher ethanol blends may be done in phases, starting with the states having surplus ethanol production.
2. In view of the switch of dispensing of EBP fuels between E10 and E20 (such as E12 or E15) as well in manufacturing compatible vehicles, the Expert Committee agrees

that intermediate blends will give flexibility to OMCs to manage supply and demand of ethanol in the country. For this purpose, BIS may formulate specifications for these intermediate E12 and E15 blends. Flex fuel vehicles should be encouraged and popularized for moving to higher blends.

3. A nation wide educational campaign should be launched jointly by MoP&NG through its OMCs, MoRT&H and DHI in partnership with the industry to educate the consumers of the benefits of EBP, and to select the correct fuel for their class of vehicles.

9.3 AUGMENTING INFRASTRUCTURE OF OIL MARKETING COMPANIES

OMCs will need to prepare for the projected requirement of ethanol storage, handling, blending and dispensing infrastructure. OMCs will need to augment their tankage capacity at supply locations, replace plastic equipment of dispensers, and build more dispensing stations for E20, and E10 petrol.

1. Dispensing mechanisms for retailing of E10 and E20 fuels may be provided in retail outlets. Dispensing infrastructure for E100 is also likely to come up for E100 two-wheeler vehicles introduced in the country. Due to this, there may be a space constraint at some retail outlets. Therefore, OMC's may explore the possibility of positioning infrastructure for E10 & E100 fuel from which E20 can be dispensed through mixing.

2. In view of clustering of ethanol distilleries in a few states, its transport all over the country involves additional costs. OMCs need to evolve suitable mechanisms to compensate the contracted suppliers in this regard.

The ethanol storage capacity (crore litres) as per the current tankage and additional tankage planned by OMCs is as under (Table-9.1).

Table 9.1: Current and planned storage capacities of OMCs

Company	Current Tankage (Cr Lit)	Work-in-progress /Additional Planned (Cr Lit)	Total capacity (Cr Lit)
IOC	6.50	12.50	18.60
BPC	4.50	7.40	11.90
HPC	6.80	6.94	13.74
OMC Total	17.80*	26.84	44.64**

* With the current capacity, about **430 crore litres** of ethanol can be handled annually considering 15 days of coverage period.

** Similarly, with a total tankage capacity of 44.64 crore litres by 2025, about **1060 crore litres** of ethanol can be handled annually considering 15 days of coverage period.

MoP&NG has informed that current blending facilities for E10 at depots locations are automated and will take care of E20 blending also; that OMCs will take up additional tankage jobs in a phased manner starting from high blending states to cover all locations by 2025. MoP&NG has further informed of the plan of OMCs to make E20 available by April 2023 at select cities of 11 States /UTs viz. Himachal Pradesh, Uttarakhand, UP, Haryana, Delhi, Goa, Daman Diu & Nagar Haveli, Karnataka, Bihar, Maharashtra & Punjab. Based on learning from these States, a roll-out

all over the country is planned by April 2025. Since India has a single automobile market, E10 and E20 will have to be made available all over the country, in the intervening period to reach national blending targets. If both cannot be dispensed from each retail outlet, some retail outlets can dispense E10 and some E20 so that both are available in close vicinity. Gradually, the share of E20 will increase by phasing out of E10.

9.4 EXPEDITING REGULATORY CLEARANCES FOR ETHANOL PRODUCING UNITS

9.4.1 Expediting Environmental Clearances

Currently, ethanol production plants/distilleries fall under the "**Red category**" and require environmental clearance under the Air and Water Acts for new and expansion projects. This often takes a long time leading to delays. While several steps have been taken to expedite Environment Clearances (EC) under the Environment Protection Act there are few areas of concern which if addressed, will facilitate early setting up of ethanol distillation capacities in the country.

1. For green field projects, the Department of Food and Public Distribution may follow up with applicants & MoEF&CC / State Governments so that Environmental Clearance (EC) is issued within a maximum 10 months from date of application.
2. State Governments should expedite issue of Consent to Establish (CTE) under the Air and Water Acts.
3. Now that technological advancements have made it possible for molasses-based distilleries with incineration boilers and grain-based distilleries to become Zero Liquid Discharge (ZLD) units and pollution is almost negligible, such projects (upto 100 KLD for molasses-based distilleries and 200 KLPD for non-molasses-based distilleries) with modern technologies can be categorised as B2 in place of B1 projects. This categorisation will save 6-8 months time of project proponents in getting EC as EIA study and public hearing are not required for B2 projects.
4. For smaller projects (say upto Rs 500 Crore) most of the features of CTE and CTO under Air and Water Acts are similar to those for EC. MoEF&CC may explore exempting such small projects with an investment limit of say Rs 500 Crore from EC, based on a self declaration of complying with the norms of Environment Protection Act. These projects will continue to require "Consent to Establish" and "Consent to Operate" under **Air** (Prevention and Control of Pollution) **Act**, 1981 and **Water** (Prevention and Control of Pollution) Act, 1974.
5. As per MoEF&CC notification dated 02.03.2021, expansion of sugar manufacturing units or distilleries would be appraised as category B2 projects subject to furnishing of a certificate by the competent authority that the ethanol produced by the units would be used for blending with petrol. It may be noted that DFPD is granting in-principle approval to ethanol projects which would be producing ethanol for supplying to OMCs under the EBP programme. It is suggested that a letter of grant of in-principle approval to ethanol projects may be treated as a certificate that the distillery unit would be producing ethanol for EBP programme & hence, such projects may be appraised as B2 projects.

9.4.2 Single Window Clearance

A system for single window clearances may be formulated by DPIIT to accord speedy clearances for new and expansion projects for ethanol production. This should include all clearances by Central and State agencies, including by PESO.

9.4.3 Unrestricted movement of denatured ethanol by State Governments

The Government of India amended the Industries (Development & Regulation) Act, 1951[21] vide notification No. 27 dated 14th May, 2016. As per the amendment, the State Governments can legislate, control and / or levy taxes and duties on liquor meant for human consumption; but **denatured ethanol**, which is not meant for human consumption, can be controlled only by the Central Government. Accordingly, ethanol meant for blending in petrol, being denatured, should be allowed unrestricted movement and should be free from the control of the states. However, only 14 states have implemented these amended provisions (some states have only partially implemented). All states need to allow unrestricted movement of denatured ethanol meant for EBP.

9.5 PRODUCTION OF HIGHER ETHANOL COMPATIBLE VEHICLES

1. MoRT&H has issued notification for Emission Norms and Safety Standard for E20 as an automotive fuel.
2. Since the E10 fuel is expected to be made available on a pan-India basis from ESY 2021-22, a decision on wider introduction of E100 fuel and promotion of flex vehicles may be taken.

Vehicle manufacturers may be asked to ensure that:

1. E20 material compliant and E10 engine tuned vehicles are rolled out all across the country from April 2023. These vehicles can tolerate gasoline blended with 10% to 20% of ethanol and also give optimal performance with E10 fuels.
2. Vehicles with E20 tuned engines are rolled out all across the country from April 2025. These vehicles would run on E20 only and deliver high performance.

9.6 INCENTIVES FOR ETHANOL BLENDED PETROL VEHICLES

Globally, vehicles compliant with higher ethanol blends are provided with tax benefits. A similar approach may be followed so that the cost increase due to E20 compatible design may be absorbed to a certain extent, as is being done in some states for promoting EVs.

9.7 PRICING OF ETHANOL BLENDED GASOLINE

1. For better acceptability of higher ethanol blends in the country, retail price of such fuels should be lower than normal petrol to compensate for the reduction in calorific value

21 Industries (Development and Regulation) Amendment Act, 2016 Accessed From https://dipp.gov.in/acts/industries-development-and-regulation-amendment-act-2016

and incentivize switching to the blended fuel. Tax breaks on ethanol as a fuel may be considered by the government.

2. In order to bring predictability and to encourage investment by entrepreneurs in expansion / new ethanol capacities, the government may devise and declare a **floor price of ethanol for five years** with an escalation clause for purchase by OMCs.

9.8 ENCOURAGING USE OF WATER SAVING CROPS TO PRODUCE ETHANOL

An in-house study (Annexure C) was conducted to understand potential for ethanol production from the lens of water consumption. It concluded that sugar continues to be the most lucrative food crop for ethanol even though it has the highest water consumption per acre. Amongst grains, maize is the least water-intensive crop that can be used for ethanol production, although the rate of conversion to ethanol is lower than for rice and broken rice. The production of ethanol from maize and such other low water consulting feedstock may be encouraged.

The Ethanol Roll-out plan has been summarized in figure 9.1

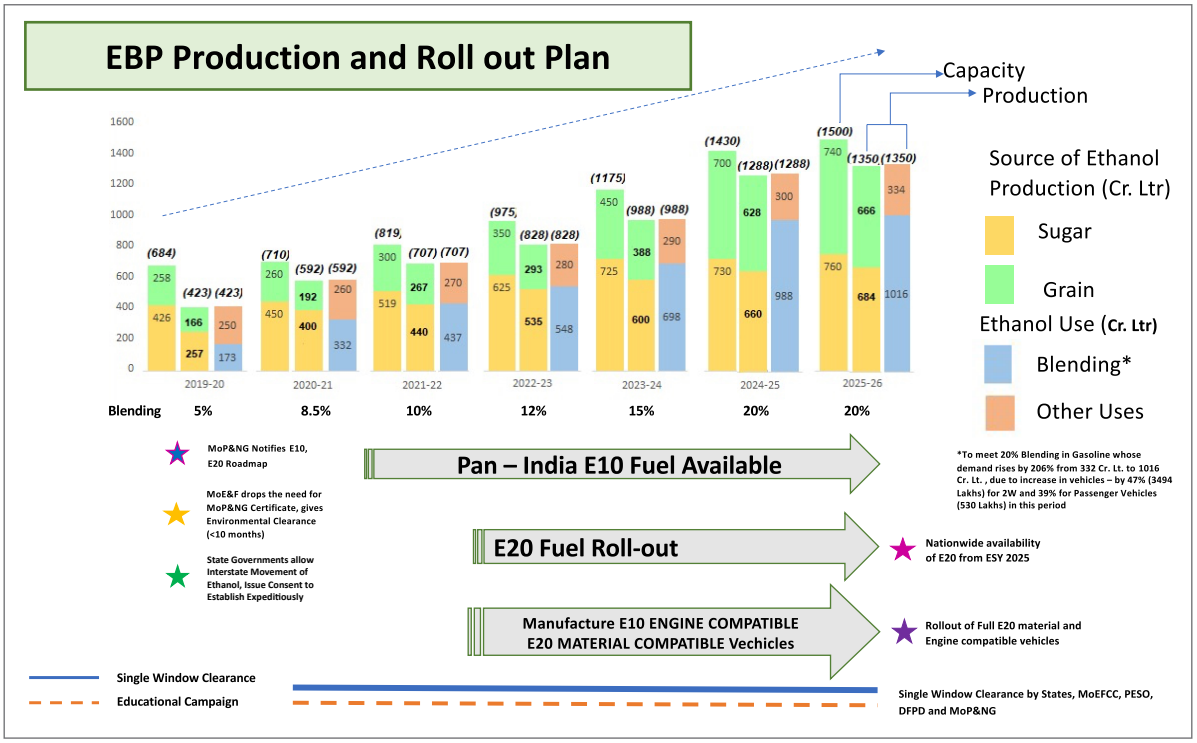


Figure 9.1: *EBP Production and Roll out Plan*



Annexure A



Constitution of the Committee of Experts

P-13032(17)/34/2017-CC (E-14219)
Government of India
Ministry of Petroleum and Natural Gas
(Biorefinery Cell)

Shastri Bhawan, New Delhi-1
Dated 26th December, 2020

OFFICE MEMORANDUM

Subject: Constitution of Committee of experts to finalize a clear roadmap of year-wise ethanol blending targets for the next 10 years and the various policy implications of the plan- reg.

1. The undersigned is directed to say that in the meeting of the Committee of Secretaries (CoS) held on 28.11.2020 under the Chairmanship of Cabinet Secretary on the subject 'Manufacturing, Sales, Utilization and blending of ethanol' it was *inter-alia* recommended that Ministry of Petroleum & Natural Gas (MoP&NG) may constitute an Expert Group to finalize a clear roadmap not only to achieve year-wise blending targets for the next 10 years but also the various policy implications of such a plan.

2. In addition to the above, it was also recommended that issues such as pricing of ethanol, matching pace of the automobile industry to manufacture vehicles with new engines with the supply of ethanol, pricing of such vehicles, fuel efficiency of different engines etc. may be studied. All stakeholder Ministries/Departments/ entities and known experts in the area may be included therein. International experience may also be borne in mind while devising the roadmap.

3. Accordingly, with the approval of Competent Authority, it has been decided to constitute an Inter-Ministerial Committee under the Chairmanship of Additional Secretary, NITI Aayog with the following composition:

(i)	Dr. Rakesh Sarwal, Additional Secretary, Niti Aayog	Chairman
(ii)	Shri Sunil Kumar, Joint Secretary (R), Ministry of Petroleum & Natural Gas	Member Secretary
(iii)	Shri Amit Mehta, Joint Secretary, Department of Heavy Industries	Member
(iv)	Shri Amit Varadan, Joint Secretary, Ministry of Road Transport & Highways	Member
(v)	Shri Subodh Kumar Singh, Joint Secretary (Sugar), Department of Food & Public Distribution	Member
(vi)	Shri S.S.V Ramakumar, Director (R&D), Indian Oil Corporation Limited	Member
(vii)	Dr. Reji Mathai, Director, Automotive Research Association of India (ARAI)	Member

4. The Committee can invite representatives of other stakeholders like Society of Indian Automobile Manufacturers (SIAM) etc. as and when required.

5. The Committee shall examine all the recommendations of the Committee of Secretaries which also includes availability, feedstock and pricing mechanism of ethanol over the next 10 years, the time lines and modalities to commence E12, E15 & E20 blends in the country with emphasis on infrastructure availability, requirements and future development for higher ethanol blends, availability, pricing and efficiency of compatible engines / vehicles for these higher blends like flex-fuel vehicles etc.

6. The Committee will have a tenure of three months from the date of its constitution, or until further Government orders.

7. This issues with the approval of the Minister, Petroleum & Natural Gas.

Sd/-
(Santanu Dhar)
Under Secretary to the Govt. of India
Tel. 011-23074369

To,

1. Dr. Rakesh Sarwal,
   Additional Secretary, Niti Aayog
2. Shri Amit Mehta, Joint Secretary,
   Department of Heavy Industries
3. Shri Amit Varadan, Joint Secretary,
   Ministry of Road Transport & Highways
4. Shri Subodh Kumar Singh, Joint Secretary (Sugar),
   Department of Food & Public Distribution
5. Shri S.S.V Ramakumar, Director (R&D),
   Indian Oil Corporation Limited
6. Dr. Reji Mathai, Director,
   Automotive Research Association of India (ARAI)

Copy to:

Shri Niranjan Chandrashekhar Cheriyamane, Deputy Secretary, Cabinet Secretariat, Rashtrapati Bhavan, New Delhi (w.r.t Cabinet Secretariat Communication No. 102/2/1/2018-CA-IV dated 02.12.2020).

Copy also to:

1. PS to Minister, P&NG
2. PPS to Secretary, MoPNG
3. PS to JS (R), MoPNG
4. PS to DS (BR), MoPNG



Annexure B



Meetings & Consultations of the Expert Committee

Meeting dated 28.12.2020:

1. Dr. Rakesh Sarwal, Additional Secretary, Niti Aayog (In Chair)
2. Shri Sunil Kumar, Joint Secretary (Refinery), Ministry of Petroleum & Natural Gas
3. Shri Amit Mehta, Joint Secretary,Department of Heavy Industries
4. Shri Amit Varadan, Joint Secretary, Ministry of Road Transport & Highways
5. Shri Subodh Kumar Singh, Joint Secretary (Sugar), Department of Food & Public Distribution
6. Dr. S.S.V Ramakumar, Director (R&D), Indian Oil Corporation Limited
7. Dr. Reji Mathai, Director, Automotive Research Association of India
8. Shri Mukul Maheshwari, CGM, Indian Oil Corporation Limited
9. Dr. Sakthivel P., Sr. Research Manager, Indian Oil Corporation Limited
10. Shri Santanu Dhar, US(BR), Ministry of Petroleum & Natural Gas
11. Shri Peeyush Agrawal, DGM, Bio-refinery Cell, Ministry of Petroleum & Natural Gas

Meeting dated 05.01.2021:

1. Dr. Rakesh Sarwal, Additional Secretary, Niti Aayog (In Chair)
2. Shri Sunil Kumar, Joint Secretary (Refinery), Ministry of Petroleum & Natural Gas
3. Shri Amit Mehta, Joint Secretary, Department of Heavy Industries
4. Shri Amit Varadan, Joint Secretary, Ministry of Road Transport & Highways
5. Shri Subodh Kumar Singh, Joint Secretary (Sugar), Department of Food & Public Distribution
6. Dr.S.S.V Ramakumar, Director (R&D), Indian Oil Corporation Limited
7. Dr. Reji Mathai, Director, Automotive Research Association of India
8. Shri Prashant Banerjee, DG, SIAM & his team -Shri Harjeet, Shri Anoop Bhat & Shri C.V.Raman

9. Ms.Ramya Natrajan, Sr. Research Engineer, CSTEP
10. Shri R.K.Jaiswal, DHI
11. Shri Mukul Maheshwari, CGM, Indian Oil Corporation Limited
12. Dr Sakthivel P., Sr. Research Manager, Indian Oil Corporation Limited
13. Shri Santanu Dhar, US(BR), Ministry of Petroleum & Natural Gas
14. Shri Manish Sarda, DGM, Bio-refinery Cell, Ministry of Petroleum & Natural Gas
15. Shri Peeyush Agrawal, DGM, Bio-refinery Cell, Ministry of Petroleum & Natural Gas

Meeting dated 15.01.2021

1. Dr. Rakesh Sarwal, Additional Secretary, Niti Aayog (In Chair)
2. Shri Sunil Kumar, Joint Secretary (Refinery), Ministry of Petroleum & Natural Gas
3. Shri Amit Varadan, Joint Secretary, Ministry of Road Transport & Highways
4. Shri Subodh Kumar Singh, Joint Secretary (Sugar), Department of Food & Public Distribution
5. Shri Prashant Banerjee, DG, SIAM & his team members
6. Shri Kapil Verma, DS(BR), Ministry of Petroleum & Natural Gas
7. Shri Peeyush Agrawal, DGM, Bio-refinery Cell, Ministry of Petroleum & Natural Gas

Meeting dated 02.03.2021

1. Dr. Rakesh Sarwal, Additional Secretary, Niti Aayog (In Chair)
2. Shri Sunil Kumar, Joint Secretary (Refinery), Ministry of Petroleum & Natural Gas
3. Shri Subodh Kumar Singh, Joint Secretary (Sugar), Department of Food & Public Distribution
4. Shri Sujit Bajpayee, Joint Secretary, Ministry of Environment, Forest & Climate Change
5. Dr.S.S.V Ramakumar, Director (R&D), Indian Oil Corporation Limited
6. Dr. Reji Mathai, Director, Automotive Research Association of India
7. Shri Peeyush Agrawal, DGM, Bio-refinery Cell, Ministry of Petroleum & Natural Gas

Annexure C



Note on Water Intensity of Consumption for Ethanol Production

Objective: To meet the advanced target of achieving E20 Ethanol Blending in fuel by 2025, a study was conducted to understand ethanol production's potential sources from the lens of water consumption.

Results and Methodology: The following results are derived with a combination of inputs from DFPD, MoP&NG, public information on crop yields, water consumption per acre.

Sugarcane is a water intensive crop. On an average, one tonne of sugarcane can produce 100 kg of sugar, and 70 litres of ethanol. Cultivation of sugarcane for each kg of sugar requires 1600 to 2100 litres of water. Hence, one litre of ethanol from sugar requires 3000 litres of water. It is estimated that sugarcane and paddy combined use 70% of irrigation water of the country. Keeping in view the need for water conservation, it is advisable to shift some of the area under sugarcane to less water intensive crops by providing suitable incentives to farmers.

Our calculations are built on DFPD assumptions on the quantity of ethanol produced through differing feedstocks, as provided above and in Table 2. First, we analyzed the yield per acre for sugarcane and grains[1], followed by analyzing annual water consumption per acre[2]. The water footprint for ethanol production is arrived through secondary research[3] and DFPD Calculations.

Conclusion: From the above analysis, we conclude that sugar continues to be the most lucrative food crop for ethanol even though it has the highest water consumption per acre. Amongst grains, maize is the least water-intensive crop for ethanol production, although the litre of ethanol generated per acre is lower than rice and broken rice. We must continue to explore the feasibility of other grains which can supplement sugar in ethanol production to meet the 2025 targets.

Table 1

Food Crops	Yield per Acre (MT)	Annual Water Consumption per acre (m^3)	Ethanol Generated (Lt) /Acre	Direct Numbers for Water used per L of Ethanol (m^3) from Literature
Sugarcane (DFPD)	31.58	6631.8	2211	3
Rice (+Broken Rice)–Secondary Research				4.48[3]
Maize–Secondary Research				2.57[3]
Wheat–Secondary Research				4.90[3]

Table 2

Food Stock	Cost / MT of the feedstock (Rs.)	Quantity of Ethanol per MT of feedstock	Ex-mill Ethanol Price (Rs./litre)
Sugarcane juice / Sugar / Sugar syrup	2,850.00	70	62.65
Damaged Food Grains (Broken Rice#)	16000.00	400	51.55
Rice available with FCI	20000.00	450	56.87
Maize#	15000.00	380	51.55

Sources:

1. *Yields Per Acre–https://www.statista.com/statistics/764345/india-yield-of-sugarcane/, https://www.statista.com/statistics/764299/india-yield-of-rice/, https://www.indiaagronet.com/indiaagronet/crop%20info/maize.htm, https://www.statista.com/statistics/764310/india-yield-of-wheat/*
2. *Water Consumed per Acre–https://www.downtoearth.org.in/news/water-use-is-excessive-in-rice-cultivation-30352, https://www.sciencedirect.com/science/article/pii/S0048969719313026, https://claroenergy.in/5-most-water-intensive-crops/*
3. *Research on Water Footprint for Ethanol Production–The Water Footprint of Bioethanol Chung Chia Chiu, Wei-Jung Shiang, and Chiuhsiang Joe Lin, Journal of Clean Energy Technologies, Vol. 4, No. 1, January 2016*
4. *Ethanol Production from Maize–http://www.soybeansandcorn.com/news/May9_19-Corn-Based-Ethanol-now-4_6-of-Brazils-Ethanol-Production*
5. *Ethanol Production from Wheat–http://www.esru.strath.ac.uk/EandE/Web_sites/02-03/biofuels/quant_bioethanol.htm*

Annexure D



Inputs from the Automobile Industry

SIAM

Prashant K Banerjee
Executive Director

Society of Indian Automobile Manufacturers
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TD-02:396

28th December 2020

Mr. Sushil T Williams
Dy Secretary
Ministry of Petroleum and Natural Gas
Shastri Bhawan
New Delhi – 110 001

Sub: SIAM comments - Roadmap for Ethanol blending in Petrol

Dear Sir,

SIAM would like to thank MoPNG for sharing the National Ethanol blending road map proposal. The automobile industry strongly agrees that alternate fuel usage in transport sector is one of the means of achieving energy security and reducing the oil bill. Use of bio-fuels like Ethanol will additionally support GHG reduction in parallel. We have always ensured to support Government of India initiatives in the past in this regard. SIAM reiterates its commitment for future initiatives also in this aspect. We believe faster and sustainable realization of energy security and clean air goals require joint efforts of Government, Oil Marketing Companies (OMCs) and Auto Industry.

Additionally, SIAM firmly believes the success of these initiatives depend on "value addition" to the most important stakeholder; Customer or Vehicle user. A customer centric and simple deployment approach will automatically ensure these progressive initiatives to become a great success.
Based on careful analysis of the proposal shared by MoPNG and detailed deliberations within SIAM, we would like to submit our feedback and recommendations towards "Ethanol-Gasoline Blending Roadmap". Request you to kindly refer to Annexure 1 and 2 for more details in this regard.

1. ***Government's plan of ensuring E10 across nation by 2022 is a welcome step***. Once this step is accomplished, SIAM will make its vehicles fully E10 compliant by calibrating engines suitably and with optimum performance. This will bridge the gap of present untapped Fuel efficiency loss with current vehicles which are E10 Material compliant only. It should be critically noted ***E10 full compliant Vehicles (2W & 4W) cannot run on lower Ethanol blend as there will be knocking, which will damage the Engine.***

2. ***SIAM welcomes E20 implementation and dispensing plan from 2028.*** Moving from E10 to E20 gasoline is a logical progression. SIAM expects that all the Oil companies should ensure E20 availability and dispensing across the country on the committed time frame similar to BS VI fuel implementation. This is essential for OEM's (SIAM members) to develop the vehicles which are E20 compliant and without any loss in Fuel Efficiency (expected ~6% vs E10) or performance deterioration to the customer. Considering the lead time required for vehicle development, we request this E20 transition to be taken up by Government at least 4 years in advance and suggest aligning with the future Emission/Fuel efficiency regulation. Industry will require E20 fuel for development and testing purposes from 2024 itself. OMCs should also confirm E20 fuel availability to OEMs for such activities.

Society of Indian Automobile Manufacturers

3. ***Implementation of Intermediary Blends in multiple steps in Ethanol excess locations. (E10 → E12 → E15).***
   Auto Industry would prefer to limit the number of steps of changeover and move to E20 directly. Although Technology Development to comply with higher Ethanol blend (E12, E15) may not be a concern. However, engines and vehicle development time will be required. In case it is required to move in smaller steps, it is highly recommended to align these deployments with successive emission/fuel consumption regulation timelines.

   As an initiative from Auto Industry at the next stage of regulation change, OEMs will make their vehicles material compatible to higher blends of Ethanol as planned by MoPNG / GOI (Please see annexure 1 for details of roadmap)
   If E10 is declared and made available as base fuel from 2022 across India, OEMs would also consider optimizing the vehicles which will have lesser hurdle or issues to use E12 / E15 fuel, minimum compromise on performance and to have material compatibility for E20 also. In this case, ***SIAM will do a study with E12 and E15 fuel in their vehicle, evaluate and share the data in a span of 3 years from 2022.*** Performance compromise of running a E10 tuned vehicle with E12 or E15, if any, should be agreed by the Test / Regulation Agencies considering future CAFÉ and RDE requirements

4. ***E10 fuel availability for existing vehicles / customers is a MUST.*** Discontinuation of E10 fuel in Ethanol surplus areas while implementing E12/E15 or after E20 implementation, as proposed by MoPNG, is a critical concern. This will cause the entire population of vehicles available by 2028 un-usable as they may neither have material compatibility nor efficiency / performance optimized. This may cause material degradation, which could lead to fuel seepage/leakage and hence a safety issue, besides FE loss and poor drivability, especially for low powered 2W will not be acceptable to customer. *E10 fuel availability as Protection grade fuel for existing vehicles/customers is a Must and SIAM would strongly recommend continue dispensing of E10 fuel even after E20 deployment.*

5. ***E100 (E96 technically) implementation & dispensing in niche areas.*** *Considering the higher cost of Flex fuel vehicles and fuel efficiency loss of up to 30% in such vehicles running on E100, SIAM is not in favor of E100 deployment.* SIAM recommends deferment of E100 implementation till a thorough study on the customer value preposition is completed. Customer acceptance will be also a challenge due to high vehicle cost and additional disadvantage of substantial lower fuel efficiency.

6. ***Retrofitting the older vehicles with materials / components to comply with higher ethanol blend:*** MoPNG has suggested to prepare retro-fitment of critical components and materials in the existing vehicles to comply with E10 fuel and E10 compliant vehicles for higher ethanol blend usage in future. SIAM finds this is a practically impossible task considering larger population of existing vehicle variants, parts design and development issues, cost of retro-fitment and finally customer acceptance. SIAM request to consider the global practice of protecting base fuel grade for existing customers and moving for higher blends for future customers.

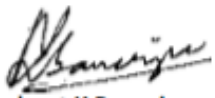
7. ***Focus only on Ethanol – Gasoline blend Implementation.*** Auto Industry is presently working on powertrain development to meet next stage of Emission and Fuel Efficiency norms. It may be noted that study of biofuels and related vehicle development will need focused work owing to the variation in fuel properties. Considering MoPNG priority, implementation of higher Ethanol blends for automotive industry in the next 10 years, all the stake holders (SIAM, OMCs and Test Agencies) will be prioritizing activities like development of Ethanol Fuel compliant vehicles, Ethanol blend availability plan and regulation compliances in that regard. It will make the plan complex and diluted if other fuels like Methanol also considered in the same time frame. Hence, SIAM request MoPNG and Government of India to keep Methanol fuel blend implementation for automotive in the least priority as mentioned earlier by NITI Aayog. However, SIAM members can support in experimentation work in that regard.

Society of Indian Automobile Manufacturers

With the above explanations and facts, SIAM sincerely hope MoPNG will find our request is in-line with the road map shared by you. You may also find it as a simplistic, customer centric approach without any compromise on national long-term goal. Request your acceptance, also seek support from other ministries of Government of India and respective regulators joining hands to achieve the prime target of "National Energy Self-reliance".

With kind regards,

Yours faithfully,



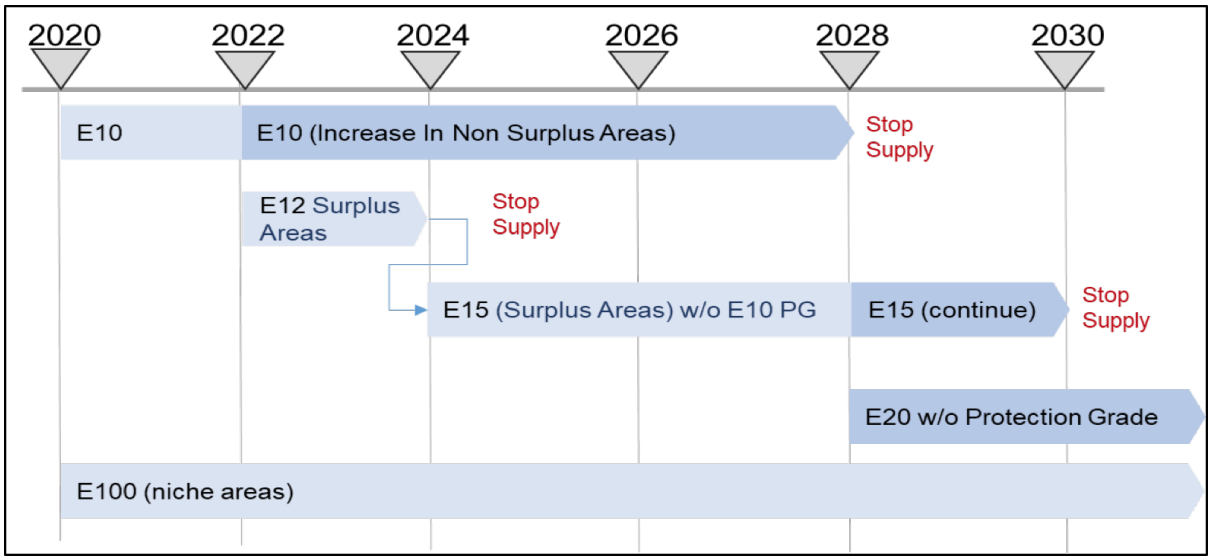
Prashant K Banerjee

Enclosure: Annexure 1 & 2

DETAILS OF SIAM RECOMMENDATIONS BASED ON STUDY OF "ETHANOL BLEND ROADMAP"

A. Understanding MoPNG Proposal

SIAM prepared the following graphical image based on the Ethanol roadmap document shared by MoPNG.



SIAM studied the document and details of its view on the proposal is briefly as below:

1. SIAM made its vehicle Material compatible with E10 from 2008 onwards but complete engine potential of higher octane number of blended fuel was not harnessed due to non-availability of fuel across nation. With E10, considering the lower calorific value of blend (around 4%), there is a fuel efficiency penalty of around 2~2.5%. If fuel is made available across the country and RON of E10 blend is upgraded to ~95RON, Manufacturers can plan to make modifications in engines (Hardware and tuning) to overcome the fuel efficiency penalty. With the help of above, complete potential of Government of India's vision of E10 across nation can be unlocked.

2. **Moving to E20** is a logical progression. But, drop in fuel efficiency of 6% is expected with E20 blend due to lower calorific value of the blended fuel. This drop is substantial and needs to be overcome. Industry will make requisite changes in the vehicles to meet material compatibility and also need to recover the loss of fuel consumption by change in engine hardware and engine re-calibration. However, following concerns are seen in the proposal from MoPNG.

   - MoPNG is considering E20 from 2028, however it is not clear whether it will be available across country as it is mentioned that E15 will coexist till 2030.
   - Additionally, non-availability of E10 fuel in parallel is a critical concern for existing pool of vehicles

3. **E12/E15 Transition:** SIAM would like to inform current vehicles being sold are Material compatible up to E10 fuel blend which are not be suitable for blends higher than E10 MoPNG has proposed to dispense E12 and E15 in surplus areas after E10 implementation country wide. Auto industry would recommend moving to E20 directly instead of smaller steps of E12 and E15 considering multiple developments in a short span of time. Following are the potential concerns:

- OEMs will not be able to calibrate the engines for E12 or E15 due to its limited availability only in surplus areas. Hence, loss of fuel efficiency, drop in performance of vehicles, especially for low powered two wheelers, will be very much felt by customers which will not be acceptable by them
- Engines, if calibrated for higher Ethanol blends like E12 or E15 (higher Octane) to recover fuel efficiency and driving feeling, cannot be driven with lower Ethanol blend (E10) as it can lead to knocking and engine failure.
- OEMs can make new vehicles material compliant with higher blends but not possible to update the existing vehicles.
- As an initiative, Auto Industry would make vehicles material compliant with higher blend of ethanol.
- Post E10 adoption across the country, Auto Industry will study the possibility of developing vehicles which can run with lesser compromise when run with E12 or E15. The study will be done in 3 years post 2022. However, any compromised performance will have to be factored in for various regulations like real drive emissions and OBD/In Service conformity.

4. **E100/Flex Fuel Vehicles:** From the customer perspective E100 compatible or Flex fuel vehicles do not seem to be feasible for India since the cost of ownership and running cost are going to be very high compared with regular vehicles.
   - It should be noted the flex fuel vehicles themselves could be more expensive than regular vehicles due to the upgradation of materials, engine parts and fuel system. Further, running cost (due to lower fuel efficiency) will be higher by more than 30% when run with E100 fuel. Unless the E100 fuel cost at retail outlets is made more than 30% cheaper, customer will not prefer the fuel / use for his vehicle. Customer acceptance will be the big challenge in this case.
   - Besides hardware changes, development effort of a Flex fuel vehicle is much higher than regular vehicles considering that the control systems have to be calibrated with multiple blends to derive optimum efficiency and meet emission regulations. Investing in development of such vehicles is not viable if the fuel is not available across the country.
   - Hence, SIAM recommends not to pursue E100 implementation / flex fuel approach till the E20 fuel availability and usage is established pan India basis and clear visibility of higher blends is foreseen.

B. SIAM believes success of the Ethanol blending program is to ensure customer acceptance

Main concerns from customer perspective could be:

a. Retaining Fuel Efficiency of Vehicles (Running cost)
b. Portability of vehicles: across the country without any challenge to higher blend availability
c. Supply assurance: Availability of compatible fuels till vehicle end of life.

From this perspective SIAM would propose a few basic requirements to be considered as below:

1. **Protection Grade fuel:** To ensure fuel availability for existing vehicles and assurance to customers, parallel dispensing of a protection grade **E10** fuel is a must. This is followed in other countries in the transition period. In Brazil transition to higher blends was spread over 30 or more years. Even today E0 fuel is available to customers as a choice in Brazil.

Retro-fitment on existing Vehicles is a mammoth task to change parts in older vehicles to make them compatible for higher blends. Developing parts, with upgraded material, for large volumes of vintage variants having numerous variations in fuel system component designs and then getting all the customers to get their vehicles upgraded is an unrealistic scenario. Safe operation of all the existing customers and vehicles can only be ensured through protection grade fuel dispensing and we consider this as our responsibility to service those vehicles by providing compatible fuel. Dispensing of protection grade fuel is an accepted practice in other countries which have moved to higher ethanol blends. SIAM strongly requests parallel dispensing of higher blends along with provision of protection grade E10 fuel.

2. **Alignment of Changes with Emission regulations:** Adopting engines with higher Ethanol blend means changes in Engine hardware and also engine calibration (tuning). Auto Industry is already working in the engine upgradation work for next level regulations (BS 6.2). Being a huge un-modifiable task, which cannot be course corrected, it is important fuel changes are also aligned with these regulations to derive the complete benefit from all the perspectives. This was followed in the past also whenever regulation change had been planned.

3. **One Nation One Fuel specification:** Both the OMCs and OEMs (Oil and Auto industry) moved together for BS6 emission regulation implementation and single fuel specification across the country respectively. This need to continue in future also to ensure portability of vehicles by customer, especially for vehicles designed for higher blends of Ethanol keeping in mind the customer acceptance and requirement.

C. Proposed Image of Fuel Change over to higher blends:

With well aligned mind on the national objectives, simplicity in implementation and customer acceptability, SIAM would like to share the below graphical road map for Ethanol blending:

Salient points about SIAM proposal Graph:

- Nationwide E10 conversion from 2022 supported by clear mandate for same. Specification of RON of this fuel with E10 should remain around 95.
- Nationwide adaption of E20 Fuel (Min. RON 97) from 2028 and or with next regulation change (Emission /Fuel consumption). This is going to be significant step in reducing oil imports and towards CO_2 reduction.
- Formal notification to confirm this fuel changeover at least 4 years in advance to provide a lead time for engine and vehicle development as well as compliance to emission regulation and vehicle homologation.
- Continue E10 as protection grade fuel for existing vehicles.
- Post E10 availability across the country, OEMs will make vehicles compliant from performance perspective also for E12/E15, hopefully to reduce the hurdle and loss of fuel consumption and drive concerns. OEMs will also make their new vehicles material compatible with E20 in the meantime.
- Defer the E100 implementation owing to the above stated reasons.

FLEX FUEL (ETHANOL BLENDS 85% OR MORE) SPECIFIC CHANGES AND CONCERNS

A. Technology Upgradation required to meet Flex Fuel configuration:

- As illustrated in the figure, as the ethanol blend percentage is increased, the changes required in the vehicle/engine increase.
- For Flex Fuel vehicles, apart from material compatibility, the engine has to be designed to be able to handle a totally different fuel (E100). E100 has very different chemical properties like very low (40%) Calorific value as compared to Gasoline, Very High Latent heat of vaporization causing cooling of charge/combustion etc. Ethanol also acts as a solvent and could wipe out the protective oil film inside the engine thereby could cause wear and tear.
- Due to these characteristics, Flex Fuel Engine needs to have different hardware like fuel heating systems for starting assist, fuel Injectors to be able to supply a higher quantity of fuel, fuel pump, spark plug etc. as in the chart above. Besides this the fuel injection control system is totally different to sense different fuel blends and change parameters of engine operation for trouble-free running for customer.
- These changes make such engines very specific to run in Flex fuel environment as well as lead to increase in cost of the engine and vehicle substantially, increasing the buying cost of customer.
- Additionally, Manufacturers will have to invest in a new compatible engine development.

B. Running Cost of Flex Fuel Vehicles:

Fuel efficiency of a Flex fuel vehicle running on Ethanol E100 will be more than 30% lower than a corresponding Gasoline Engine.

However as per current Ethanol fuel cost and taxation, ***cost of E100 at retail pumps will be 80% to 106% of Gasoline fuel*** (calculated for Delhi scenario) as shown in table below.

SIAM Table (Cost comparison of Gasoline fuel and E100 fuel)

Cost of 100% Petrol			Cost of E100 fuel		
Elements	Unit	1.11.2020	Sugarcane Based	B Heavy Molasses	C Heavy Molasses
Price to Dealers (excluding excise duty and VAT)	Rs/lit	25.77	62.65	57.61	45.69
Excise Duty	Rs/lit	32.98	0	0	0
Dealer Commission	Rs/lit	3.64	3.64	3.64	3.64
VAT (Including VAT on Dealer commission) in Delhi at 30%	Rs/lit	18.717	19.887	18.375	14.799
Retail Selling Price at Delhi	Rs/lit	**81.107**	**86.18**	**79.63**	**64.13**
Cost of E100 Fuel at Retail to equate running cost with Gasoline (30% lower)	Rs/lit			**56.8**	

With lower fuel efficiency and higher fuel cost, running cost of a flex fuel vehicle will be 10% to 36% higher than running on gasoline, making it unacceptable from a customer perspective.

Highlights

- Higher buying and running cost of Flex fuel vehicles make them unattractive for customers
- Availability of E100 in niche areas make it even more unattractive due to vehicle portability issues.
- E100 Availability in niche areas also makes it unviable for Manufacturers to invest in technology and Engine line up when customers are limited or even non-existent (considering cost of running).
- Only when E100 can be sold at 30% of lower cost as compared to Gasoline and if E100 fuel is available across the country can the flex fuel vehicles be a possible solution.



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