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E20 Petrol and India's Ethanol Blending Programme: Transition Towards Higher Ethanol Blends

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Recent Developments:

- **India** completed the nationwide transition to **E20 Petrol** (**20% Ethanol + 80% Petrol**) in the **2025–26 ethanol supply year**, achieving the target nearly **five years ahead** of the original **2030** timeline.
- In **June 2026**, **Union Minister for Petroleum and Natural Gas Hardeep Singh Puri** launched **E85 Fuel** (**85% Ethanol + 15% Petrol**) for **Flex-Fuel Vehicles (FFVs)**, marking the next phase of India's biofuel transition.
- The rollout has triggered public debate regarding **fuel efficiency**, **vehicle compatibility**, **consumer choice**, and the readiness for future blends such as **E25** and **E85**.

Ethanol Blending Programme (EBP):

Meaning and Objective:

- **Ethanol Blending Programme (EBP)** aims to mix **ethanol**, a renewable biofuel, with petrol to reduce dependence on imported crude oil and promote cleaner transportation.
- **E20 Petrol** contains **20% ethanol** and **80% petrol**, while **E85** contains **85% ethanol** and is suitable only for **Flex-Fuel Vehicles**.
- The programme seeks to improve **energy security**, reduce **greenhouse gas emissions**, conserve **foreign exchange**, and provide an additional market for agricultural produce.

Evolution of the Programme:

- The **National Policy on Biofuels (2009)** initially proposed achieving **20% ethanol blending** by **2017**, but implementation progressed slowly because of supply and policy constraints.
- The **National Policy on Biofuels, 2018** accelerated the programme by expanding eligible feedstocks and advancing the **E20** target to **2025–26**.
- India rapidly increased ethanol blending from **E10** to **E20** within about **three years**, significantly faster than originally envisaged.

Chemistry of Ethanol Blending:

Scientific Basis:

- **Ethanol (C?H?OH)** possesses a shorter carbon chain than petrol hydrocarbons, resulting in comparatively lower carbon dioxide emissions during combustion.
- **Ethanol** has a **Research Octane Number (RON)** of around **108**, considerably higher than conventional petrol, improving resistance to **engine knocking**.
- **Higher octane fuel** allows cleaner combustion and offers the potential for designing future engines with **higher compression ratios** and improved efficiency.

- **Ethanol** has a lower **calorific value** than petrol, meaning it contains less energy per litre, which directly affects fuel economy.

Advantages of Higher Ethanol Blending:

Economic Benefits:

- Reduces **crude oil imports**, thereby strengthening **energy security** and lowering the import bill.
- Saves valuable **foreign exchange** by substituting imported petroleum with domestically produced biofuel.
- Creates an assured market for **sugarcane**, **maize**, surplus grains, and other approved feedstocks, supporting farmers and the sugar industry.

Environmental Benefits:

- Reduces lifecycle **greenhouse gas emissions** compared to conventional petrol.
- Improves combustion efficiency, thereby reducing emissions of **carbon monoxide** and **unburnt hydrocarbons**.
- Promotes the transition towards **renewable transport fuels** in line with India's climate commitments.

Technological Benefits:

- High octane value improves combustion characteristics.
- Better resistance to knocking supports the development of more efficient engines in future vehicle designs.

Challenges Associated with Higher Ethanol Blends:

Reduced Fuel Economy:

- Ethanol's lower energy content leads to a measurable decline in **fuel efficiency**, particularly in vehicles originally designed for lower ethanol blends.
- Mileage reduction becomes more pronounced as ethanol concentration increases.

Vehicle Compatibility Issues:

- Older vehicles designed for **E10** may experience deterioration of **rubber components**, fuel lines, and certain engine parts because ethanol readily absorbs moisture.
- Higher combustion temperatures may make cold starting relatively more difficult under low-temperature conditions.
- Higher ethanol blends beyond **E20** may require redesign of engine calibration, corrosion-resistant materials, and fuel delivery systems.

Consumer Concerns:

- Indian consumers currently have limited fuel choice because **E20** has become the standard retail petrol.
- Unlike some countries, consumers generally do not receive a significant price incentive despite potential mileage reduction.

Flex-Fuel Vehicles (FFVs):

Meaning:

- **Flex-Fuel Vehicles (FFVs)** are specially designed automobiles capable of operating on varying ethanol-petrol blends ranging from **E20** to **E100**.
- The engine automatically adjusts the air-fuel mixture according to the ethanol concentration.

Importance:

- Enable greater utilisation of domestically produced ethanol.
- Provide flexibility to consumers where multiple fuel options are available.
- Form the technological foundation for future adoption of **E85** and higher ethanol blends.

Road Ahead: E25 and E85:

Future Transition:

- India intends to gradually move towards **E25** while expanding the availability of **E85** for compatible vehicles.
- Future implementation requires improvements in **engine calibration**, **fuel-system durability**, **material compatibility**, and fresh **homologation** before commercial adoption.
- The transition must balance **consumer interests**, **vehicle safety**, and **environmental objectives**.

Brazil's Ethanol Model:

Key Features:

- Brazil initiated its ethanol programme during the **1970s** in response to global oil shocks.
- Petrol sold in Brazil typically contains **27–35% ethanol**, while **E100** is widely available.
- Consumers can choose among multiple fuel options according to prevailing prices.
- Strong government support and favourable pricing made **Flex-Fuel Vehicles** the dominant vehicle category.
- The Brazilian model demonstrates that **consumer choice**, **pricing incentives**, and **vehicle readiness** are critical for successful adoption of high ethanol blends.

Value Addition for UPSC:

Important Facts:

- **E10: 10% Ethanol + 90% Petrol**
- **E20: 20% Ethanol + 80% Petrol**
- **E85: 85% Ethanol + 15% Petrol**, suitable only for **Flex-Fuel Vehicles**
- **E100:** Nearly pure hydrous ethanol used in specially designed vehicles.
- **1G Ethanol** is produced from **sugarcane**, **molasses**, **maize**, and food grains, whereas **2G Ethanol** is produced from **agricultural residues** such as paddy straw and other lignocellulosic biomass.
- **Research Octane Number (RON)** measures a fuel's resistance to engine knocking; a higher **RON** indicates better knock resistance and supports higher engine compression ratios