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MAINS Impact- 2025 – 06/02/2025

ETHANOL BLENDING

SYLLABUS:

GS 3 > Economic Development > Indian Economy and issues > Renewable energy

REFERENCE NEWS:

- Recently, Union Minister Nitin Gadkari said that India will achieve its target of **20% ethanol blending of petrol in the next two months**, several months ahead of the originally planned 2025 deadline. This would entail the production of nearly 1,100 crore litres of fuel ethanol in one year.
- The 1,100 crore litres of fuel ethanol will come from sugar and high grade molasses, Food Corporation of India (FCI) rice, broken rice, and maize. India's ethanol distillery capacity has ramped up to **1,600 crore litres**, driven by a range of government incentives and the promise of a stable, lucrative market.
- The Centre has also targeted **5 per cent blending of biodiesel with diesel by 2030**.

WHAT IS ETHANOL BLENDING?

- An ethanol blend is defined as a **blended motor fuel containing ethyl alcohol that is at least 99% pure**, derived from agricultural products, and blended exclusively with petrol (gasoline).

ETHANOL:

- Ethanol, a **volatile, colorless liquid**, is a key biofuel produced naturally by **fermenting sugars or via petrochemical methods**.
- In India, ethanol is **primarily produced using sugarcane molasses**.
- Ethanol also produced from starches in potatoes, corn, wheat, and other plants.
- Since ethanol is produced from plants that harness the power of the sun, **ethanol is also considered as renewable fuel**.

BENEFITS OF ETHANOL BLENDING:

- **Energy security:**
 - Higher usage of ethanol as an automobile fuel **will help save import costs**, as India's dependence on crude oil imports has been increasing over the years.
 - In the period from April to August 2023, this **dependence rose to 87.8%, compared to 86.5%** in the same period a year earlier, according to the Ministry of Petroleum and Natural Gas.
 - It is estimated that the **E20 (80% petrol and 20% Ethanol) program can save USD 4 billion** (Rs 30,000 crore) per annum for India (source: Press Information Bureau (PIB)).

- **Cleaner Environment:**
 - One crore liter of E10 (90% petrol and 10% Ethanol) saves around 20,000 ton of CO2 emissions.
 - As the **ethanol molecule contains oxygen**, it allows the engine to more completely combust the fuel, resulting in fewer emissions and thereby reducing the occurrence of environmental pollution. Also, by **reducing crop burning a conversion of agricultural residues/wastes to biofuels** there will be further reduction in Green House Gas emissions.
- **Additional Income to Farmers:**
 - **By adopting 2G technologies**, agricultural **residues/waste can be converted to ethanol** and can fetch a price for Indian farmers. Also, **conversion of surplus grains and agricultural biomass** can help in price stabilization.

Categories of biofuels

Biofuel can be categorized into different categories depending on the materials used for its production.

- **First Generation Biofuel:** Conventional biofuels, derived from **food sources** such as starch, sugar, and vegetable oil, like ethanol from sugarcane or sugar beets.
- **Second Generation Biofuel:** Also known as "**olive green**" or "**cellulosic-ethanol**," produced from sustainable non-food materials, including waste vegetable oil and forest residues.
- **Third Generation Biofuels:** Referred to as "**algae fuel**" or "**oilage**," sourced from algae, generating a high yield of biofuels like biodiesel, gasoline, and ethanol.
- **Fourth Generation Biofuels:** Involves the use of **advanced biotechnology**, featuring bio-engineered trees and algae, known for carbon capture and storage capabilities, representing a significant advancement in biofuel technology.

- **Cheaper alternative:**
 - While **petrol is subject to excise duty**, **GST is levied on ethanol**. Hence, the usage of ethanol blended fuel will enable consumers to save Rs 30-35 per liter.
- **Investment in Rural Areas:**
 - Oil Marketing Companies are in the process of setting up 2G bio refineries across the Country. This will **spur infrastructural investment in the rural areas**.
 - For example, **Indian Oil's 2G bio-refinery in Panipat**, Haryana, uses local rice straw to produce ethanol, boosting the rural economy by creating jobs and repurposing agricultural waste.
- **Employment Generation:**
 - Ethanol production and bio refinery can contribute to jobs in Plant Operations, Village Level Entrepreneurs and Supply Chain Management.
- **Other benefits of ethanol being used as engine fuel:**
 - With a **113 octane rating**, **ethanol is the highest performance fuel** on the market and keeps today's high-compression engines running smoothly.

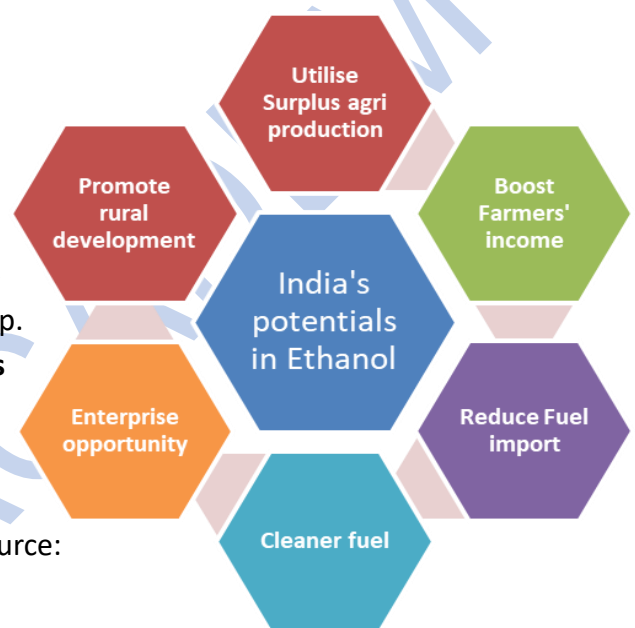
- Ethanol-blended fuel keeps the fuel system clean for optimal performance because it does not leave gummy deposits. Ethanol helps **prevent wintertime problems by acting as a gas-line antifreeze.**

FLEX FUEL VEHICLES:

- An FFV is a **modified version of vehicles that could run both on conventional petrol and doped petrol** with different levels of ethanol blends.
- These vehicles **are a logical extension of the Ethanol Blended Petrol (EBP)** programme launched by the Union Ministry of Petroleum and Natural Gas in 2003.
- These are **currently being used successfully in Brazil**, giving people the option to switch fuel (Petrol and ethanol) depending on price and convenience.

CHALLENGES:

- **Availability of Blended fuel:**
 - Ethanol production in India is **heavily dependent on the production of sugar and sugarcane**, which fluctuates due to the cyclic nature of the crop. Hence **sufficient quantity of ethanol is not available for blending.**
 - For instance, only around 50% of petrol sold in India is E10 blended, while remaining is unblended petrol (E0) (source: PIB).
- **Delays in getting clearance:**
 - 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.**
- **Lower efficiency:**
 - The calorific value of ethanol is low and this leads to reduction in performance.
 - Ethanol also **acts as a solvent and could affect the lubrication system in engines**, thereby increasing wear and tear.
- **Higher cost of vehicles:**
 - According to **the Society of Indian Automobile Manufacturers (SIAM)**, the cost of FFVs (four-wheelers) would be higher by Rs 17,000 to Rs 25,000 and Rs 5,000 to Rs 12,000 for two-wheelers compared to conventional petrol vehicles.
- **Customer acceptance:**
 - Flex fuel vehicles (FFV) would be more expensive than regular vehicles due to the upgradation of materials, engine parts and fuel system. Hence, customer acceptance will be a major challenge.
- **Concerns of Industry:**



- FFVs would require **additional investment in production lines and technology transfer**. For auto industry, this will **pose another challenge** that they are already facing with the **introduction of BS VI fuel, disruptions due to pandemic and competition from electric vehicles**.
- **Changes in existing fleet of vehicles:**
 - Currently produced vehicles in India are designed optimally for E5, with rubber and plastic components compatible with E10 fuel.
 - As **E20 rolls out, vehicles need to be produced with components and elastomers compatible with E20** and engines optimally designed for use of E20 fuel.
- **Ethical concerns:**
 - Despite being an agrarian powerhouse, India has a **high incidence of poverty and malnutrition**. In this situation, **diverting food grains for ethanol production** rather than addressing issues in food distribution raises ethical concerns.
- **Water Resource Concerns:**
 - **The Energy and Resources Institute** highlighted that producing 50% of the ethanol target from sugarcane would require an additional **400 billion litres of water**, potentially compromising water availability for food grain cultivation and threatening agricultural sustainability.

GOVERNMENT INITIATIVES:

- **National Biofuel Policy, 2018**
 - The Policy **categorizes biofuels as basic and advanced** to enable extension of appropriate financial and fiscal incentives under each category.
 - **Basic Biofuels:** First Generation (1G) bioethanol and biodiesel.
 - **Advanced Biofuels:** Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3G) biofuels, bio-CNG etc.
 - The Policy broadens ethanol production sources to include sugarcane juice, sugar-rich materials like **sugar beet and sweet sorghum, starch-based corn and cassava, and damaged grains unfit for consumption**.
 - It permits using **surplus food grains for ethanol** production with the **National Biofuel Coordination Committee's approval**. The Policy also supports advanced biofuels with a Rs. 5000 crore viability gap funding for 2G ethanol bio-refineries.
- **Pradhan Mantri JI-VAN Yojana:**
 - The scheme aims to provide **financial support to integrated bioethanol projects** using **lignocellulosic biomass and other renewable feedstock**.
- **Modified scheme to produce 1G ethanol:**
 - It aims for **extending financial assistance for producing 1st generation (1G) ethanol** from feed stocks such as cereals (rice, wheat, barley, corn and sorghum), sugarcane and sugar beet.
- **Ethanol Blended Petrol (EBP) programme:**
 - The Ethanol Blending Programme (EBP), **launched in January 2003**, aims to mix ethanol with motor spirit to **reduce pollution, conserve foreign exchange, and support the sugar industry**. Initially limited to sugarcane-derived ethanol, the program expanded **in 2018 to include ethanol from food grains, fruits, vegetables, and other waste**.

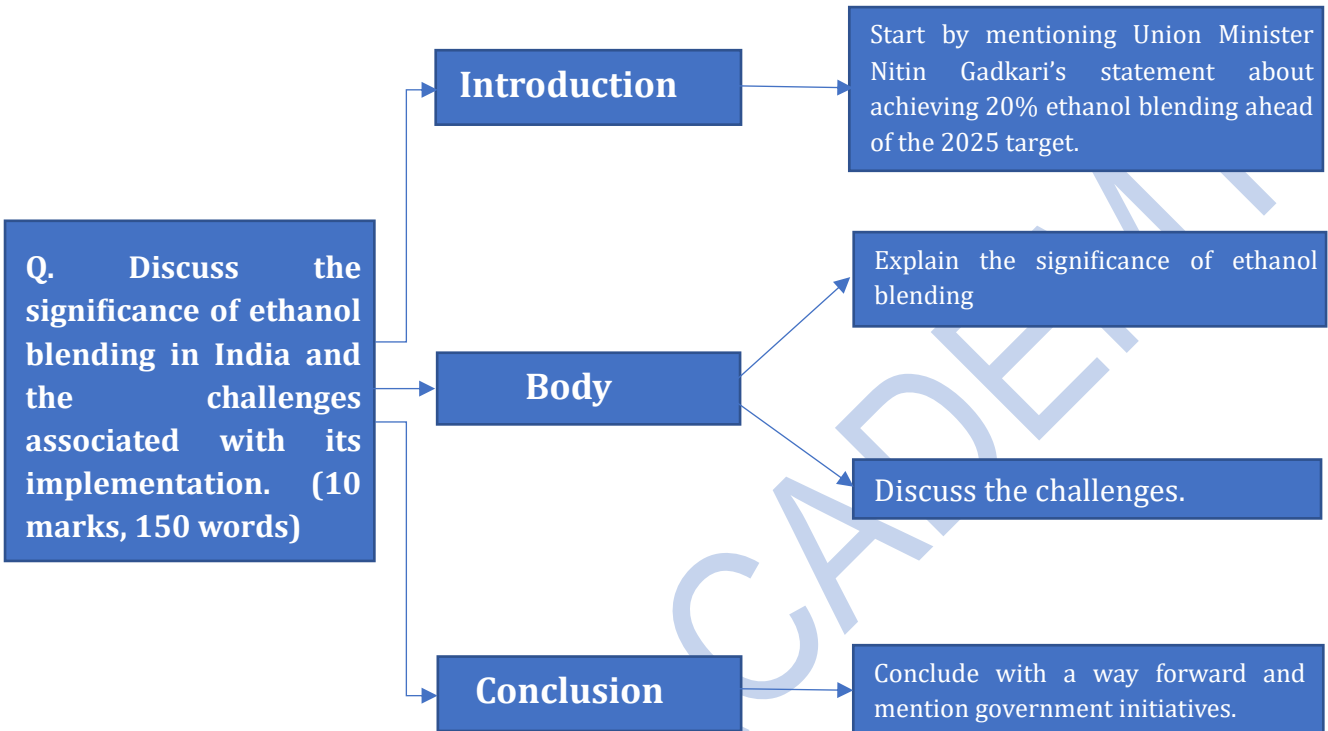
- **Roadmap for Ethanol Blending in India by 2025:**
 - The central government has recently released an expert committee report on the Roadmap for Ethanol Blending in India by 2025.
- **GOBAR DHAN Scheme:**
 - Launched in 2018, GOBAR (Galvanizing Organic Bio-Agro Resources) Dhan scheme aims to positively **impact village cleanliness and generate wealth and energy from cattle and organic waste**. It also aims at creating new **rural livelihood opportunities** and **enhancing income for farmers** and other rural people.
- **Repurpose Used Cooking Oil (RUCO):**
 - The **Food Safety and Standards Authority of India (FSSAI)** has launched this initiative that will **enable collection and conversion of used cooking oil** to biodiesel.

WAY FORWARD:

- **Diversification of Feedstock:** While sugarcane has been the primary source for ethanol production, it's essential to diversify into other feedstocks such as maize, rice, and agricultural residues. This approach reduces the over-reliance on a single crop and mitigates risks associated with crop failures or market fluctuations.
- **Enhancing Production Capacity:** Investing in advanced distillation technologies and expanding existing facilities can increase ethanol output. The government aims to raise the country's ethanol production capacity from the current 700 crore liters to 1,500 crore liters by 2025.
- **Policy Support and Incentives:** **Financial Incentives:** Providing subsidies and tax benefits to ethanol producers can encourage investment in this sector. The government has been proactive in this regard, offering various incentives to boost ethanol production.
- **Addressing Economic Challenges:** Second-generation (2G) ethanol production, which utilizes non-food biomass, has faced economic viability issues due to high production costs. Addressing these challenges through technological innovations and economies of scale is crucial for the long-term success of the ethanol blending program.
- **Environmental and Ethical Considerations:** It's vital to balance ethanol production with food security and environmental sustainability. Utilizing agricultural waste and non-food crops can prevent potential conflicts between fuel and food needs.
- **Public Awareness and Acceptance:** Informing the public about the benefits of ethanol-blended fuels can enhance acceptance and demand. Highlighting advantages such as reduced emissions and support for the agricultural sector can foster positive public perception.

PRACTICE QUESTION:

Q. Discuss the significance of ethanol blending in India and the challenges associated with its implementation. (10 marks, 150 words)

APPROACH:**MODEL ANSWER:**

Recently, Union Minister Nitin Gadkari announced that India will achieve its target of 20% ethanol blending (E20) several months ahead of the 2025 deadline. This rapid progress is driven by increased ethanol production from sugarcane, maize, and other agricultural sources. Additionally, India has set a target of 5% biodiesel blending with diesel by 2030, highlighting the government's commitment to renewable energy.

Significance of Ethanol Blending**1. Energy Security**

- Reduces dependence on crude oil imports, which stood at 87.8% in April-August 2023.
- The E20 program is expected to save USD 4 billion (Rs 30,000 crore) annually.

2. Environmental Benefits

- Ethanol blending reduces CO₂ emissions, with one crore liters of E10 saving 20,000 tons of CO₂.
- Reduces crop burning by promoting the conversion of agricultural residues into biofuels.

3. Economic Benefits

- Provides an additional income stream for farmers by utilizing surplus grains and agricultural waste.
- Ethanol production boosts rural investments through bio-refineries and generates employment in supply chains and plant operations.

4. Performance and Cost Savings

- Ethanol has a high octane rating (113), ensuring efficient combustion in engines.
- Ethanol-blended fuel is cheaper, as petrol is subject to excise duty, while ethanol attracts GST.

Challenges Associated with Implementation

1. Availability of Blended Fuel

- Ethanol production is heavily dependent on sugarcane, which fluctuates due to its cyclic nature.
- Currently, only about 50% of petrol sold in India is E10 blended; the rest remains unblended.

2. Regulatory and Clearance Delays

- Ethanol plants require environmental clearance under the Air and Water Acts, causing delays.

3. Lower Efficiency and Engine Compatibility

- Ethanol has a lower calorific value, leading to reduced vehicle performance.
- It acts as a solvent, affecting the lubrication system and increasing engine wear and tear.

4. High Vehicle Costs and Consumer Acceptance

- Flex Fuel Vehicles (FFVs) cost Rs 17,000-25,000 more for four-wheelers and Rs 5,000-12,000 more for two-wheelers.
- Consumer reluctance due to increased vehicle costs and lack of awareness.

5. Industry Concerns

- Additional investment in FFV production lines and technology transfer required.
- Automobile manufacturers already face challenges from BS-VI norms and competition from EVs.

6. Ethical and Environmental Concerns

- Using food grains for ethanol may impact food security, given India's poverty and malnutrition levels.
- Producing ethanol from sugarcane demands high water consumption, posing sustainability concerns.

Way Forward

- **Diversification of Feedstock:** Expanding ethanol production to maize, rice, and agricultural residues will reduce reliance on sugarcane.
- **Enhancing Production Capacity:** Investing in advanced distillation technologies and expanding facilities can help meet future demand.
- **Policy Support and Incentives:** Financial subsidies and tax benefits can promote ethanol production and attract investment.
- **Public Awareness and Acceptance:** Educating consumers about ethanol's benefits can boost demand and adoption.

- **Addressing Economic Challenges:** Scaling up second-generation (2G) ethanol production can improve economic viability and sustainability.

The government has introduced several initiatives to support ethanol blending, including the **National Biofuel Policy, 2018**, **Pradhan Mantri JI-VAN Yojana**, and **Ethanol Blended Petrol (EBP) Programme**. The **GOBAR-DHAN Scheme** and **RUCO initiative** further promote biofuel production from waste. While challenges persist, sustained policy support, technological advancements, and public engagement will be key to successfully implementing ethanol blending in India.