



**IIT
Ropar**

HS202 PROJECT

GROUP:- 16

Name of project :-

**Green Retrofit :
Ethanolizing
Older Engines**

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In extending our sincere appreciation to our Professor Kamal Kumar Choudhary and TA mam, Aditi Das, we are profoundly grateful for their consistent support, encouragement, and insightful guidance. Their mentorship has been instrumental in our individual growth, fostering within us a deeper understanding of our roles in shaping a positive impact within our society. Their unwavering commitment to our development has not only empowered us as individuals but has also instilled in us a collective sense of responsibility towards effecting meaningful change.

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1. Abstract

Energy researchers are currently facing a significant challenge in transitioning to sustainable fuel sources, particularly with regards to ethanol blending. Ethanol, derived from sugarcane residues, presents a promising solution to mitigate pollution and reduce dependence on fossil fuels. However, the adoption of ethanol blending faces hurdles, particularly in retrofitting older vehicle engines to accommodate this new fuel blend. This necessitates addressing issues such as engine performance, corrosion, fuel system damage, cold start problems, and material compatibility. By leveraging technological advancements and government collaboration, older vehicles can be upgraded to run on ethanol blends, promoting environmental sustainability and energy independence. The implementation of ethanol blending initiatives, alongside incentives for engine retrofitting, aims to encourage widespread adoption and reduce reliance on traditional fossil fuels, thus benefiting both the environment and consumers.

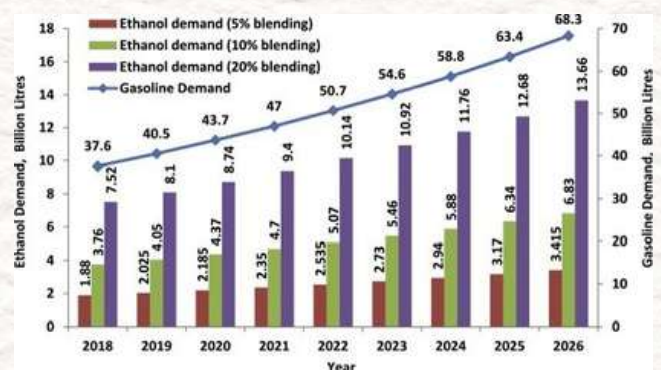
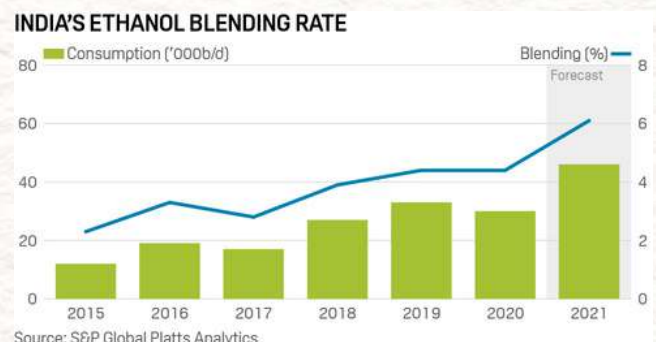
2. Definition of The Problem

2.1 Problem Statement:

In contemporary society, the utilization of oil and petroleum as primary fuels poses significant challenges due to environmental concerns, resource depletion, and geopolitical instability. Despite ongoing research into ethanol as a more sustainable alternative, the transition faces hurdles in terms of adoption and implementation. Existing car models are predominantly designed for petrol use, requiring mechanical modifications to accommodate ethanol or finding alternative fuels with comparable advantages. Streamlining this process is critical to fostering widespread acceptance and realizing the potential of ethanol as a cleaner, more efficient fuel source, ultimately reducing reliance on traditional oil-based fuels and mitigating environmental impact.

2.2 Origin of the Problem:

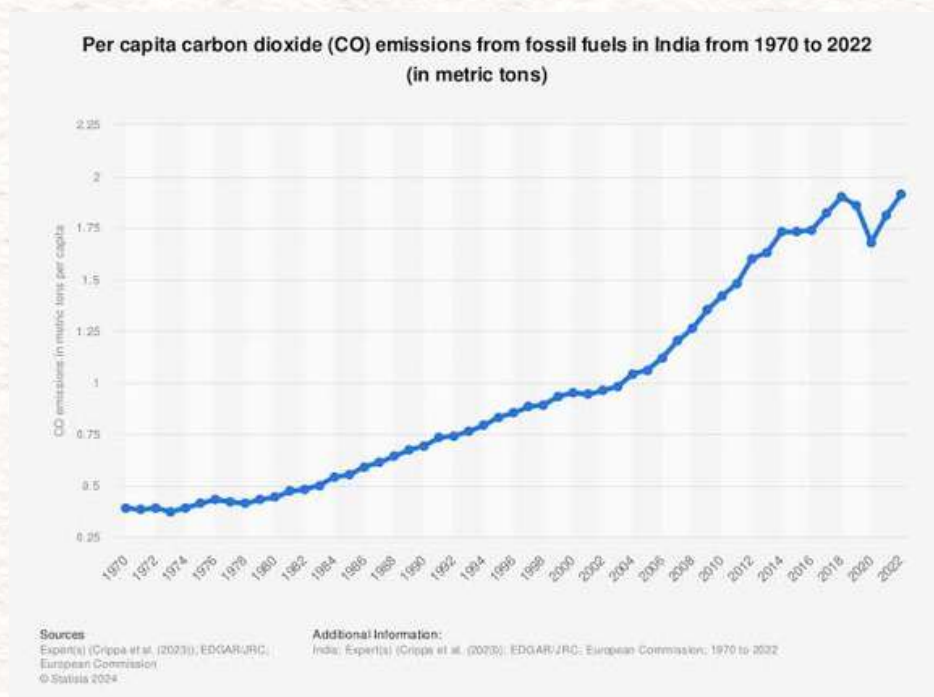
In 2014, one of our group members purchased a car, unaware of the impending shift in fuel regulations. Fast forward to 2022, the Indian government mandated the use of E-20 fuel in metro cities, catching us off guard. Soon after, his car began experiencing engine knocking issues, a consequence of the ethanol blend. As the government plans to enforce E-50 fuel by 2027, we realized the pressing need to address this challenge. While newer car engines are designed to be ethanol compatible, the crux of the issue lies in retrofitting existing vehicle engines. This realization sparked our project focus: to develop technology that makes older vehicle engines ethanol compatible. Overcoming hurdles like engine performance, corrosion, fuel system damage, cold start issues, and material compatibility is paramount in this endeavor.



2.3 A Detailed Description of The Problem:

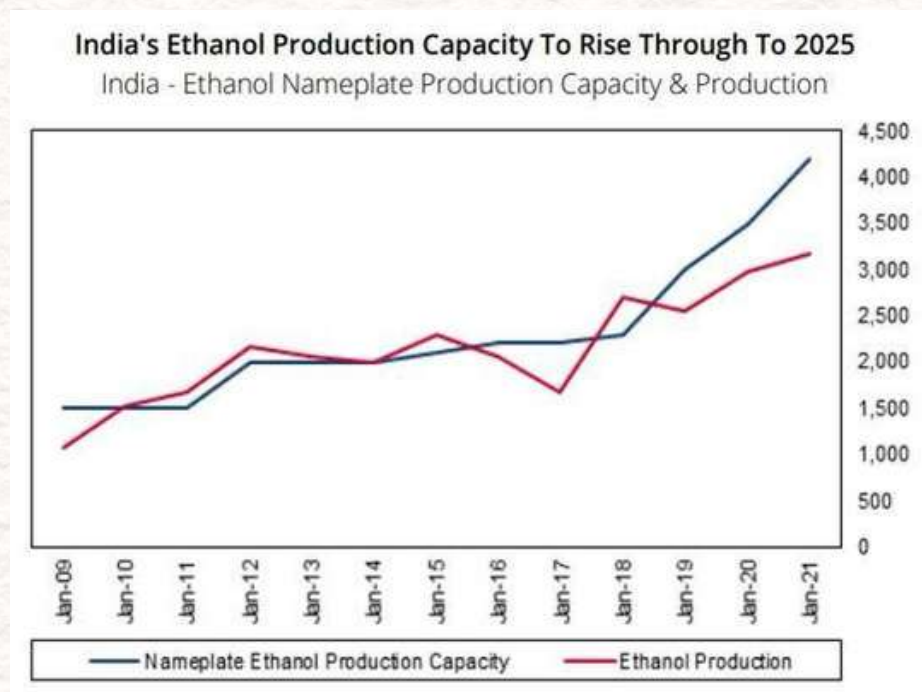
In response to India's pressing issues surrounding petrol and oil, particularly concerning pollution, price fluctuations, and geopolitical dependencies, the proposal of ethanol blending emerges as a multifaceted solution. Derived from sugarcane residues, ethanol serves as a greener alternative to traditional fossil fuels, mitigating pollution and supporting local farmers through agricultural waste utilization.

However, while the benefits of ethanol blending are clear, the challenge lies in retrofitting older car engines to accommodate this new fuel blend. The process involves intricate mechanical adjustments to ensure compatibility and performance while addressing potential drawbacks such as corrosion, fuel system damage, cold start issues, and material compatibility.



To achieve this, a comprehensive approach is necessary, involving collaboration between automotive engineers, fuel specialists, and regulatory bodies. Research and development efforts must focus on understanding the unique requirements of ethanol-blended fuels and devising effective retrofitting solutions that maintain vehicle integrity and performance

Overcoming this obstacle would not only extend the lifespan of existing vehicles but also facilitate the widespread adoption of ethanol blending, thus reducing reliance on fossil fuels, enhancing energy security, and promoting environmental sustainability. By fostering collaboration among stakeholders and investing in research and development efforts, India can pave the way for a greener and more sustainable transportation sector.



2.4 Current Developments in The Domain:

Hydrogen fuel vehicles present a promising solution with zero emissions and high energy efficiency, offering reduced air pollution and greenhouse gas emissions. Their quick refueling capability adds convenience, and their versatile production methods allow for renewable hydrogen sourcing, enhancing environmental sustainability. However, challenges arise from the carbon footprint of hydrogen production and its energy-intensive nature, which may offset some environmental benefits.

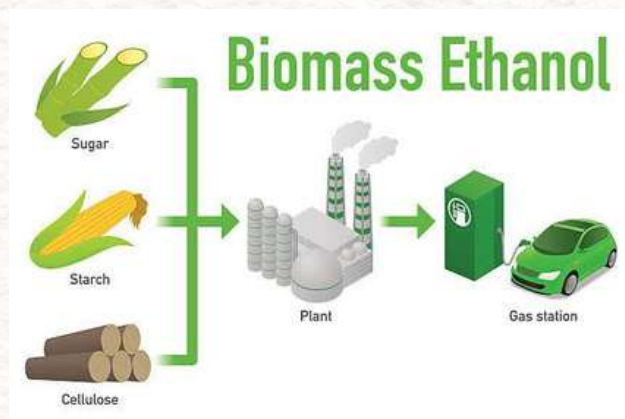
Electric vehicles offer similar advantages, producing zero emissions, boasting higher energy efficiency, and requiring lower operating costs compared to conventional vehicles. Reduced noise pollution and decreased reliance on fossil fuels further contribute to their environmental appeal. Nonetheless, concerns persist regarding the environmental impact of battery production and the sources of electricity generation, which may still involve fossil fuels, albeit mitigated by renewable energy adoption.

Despite the environmental advantages of hydrogen fuel and electric vehicles, challenges remain, including the carbon footprint of hydrogen production and the environmental impact of battery production. Ethanol fuel-based vehicles emerge as a promising alternative, derived from renewable biomass sources and boasting lower emissions during production. By promoting ethanol fuel-based vehicles, significant reductions in reliance on fossil fuels and mitigation of environmental impacts can be achieved across the transportation sector.

2.5 The Need for Resolving the Problem:

The imperative for resolving the issues related to ethanol-compatible engines in older cars stems from the need to address multiple pressing concerns facing India's transportation sector. Firstly, with escalating pollution levels and environmental degradation attributed to fossil fuel consumption, transitioning to greener alternatives like ethanol is essential for mitigating these adverse effects and promoting sustainable development.

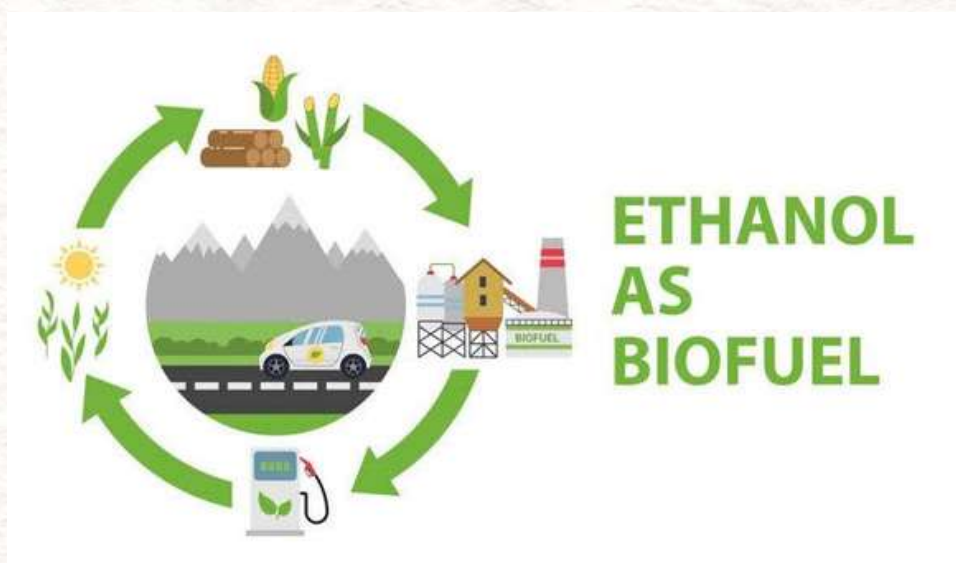
Secondly, the volatility of oil prices and the nation's heavy dependence on imports pose significant economic challenges. By promoting ethanol blending and enabling older vehicles to utilize this alternative fuel, India can reduce its reliance on foreign oil, thereby enhancing energy security and insulating itself from geopolitical uncertainties.



Additionally, empowering older vehicles to run on ethanol-blended fuels not only extends their lifespan but also promotes inclusivity, ensuring that all segments of the population can participate in the transition to cleaner energy solutions. This approach aligns with India's commitment to achieving its climate goals and advancing towards a more sustainable future.

Moreover, by investing in retrofitting technologies and infrastructure to support ethanol compatibility, India can stimulate innovation, create new job opportunities, and bolster its automotive industry.

In essence, addressing the issues surrounding ethanol-compatible engines in older cars is not merely a technical challenge but a strategic imperative that aligns with India's broader goals of environmental sustainability, economic resilience, and energy independence.

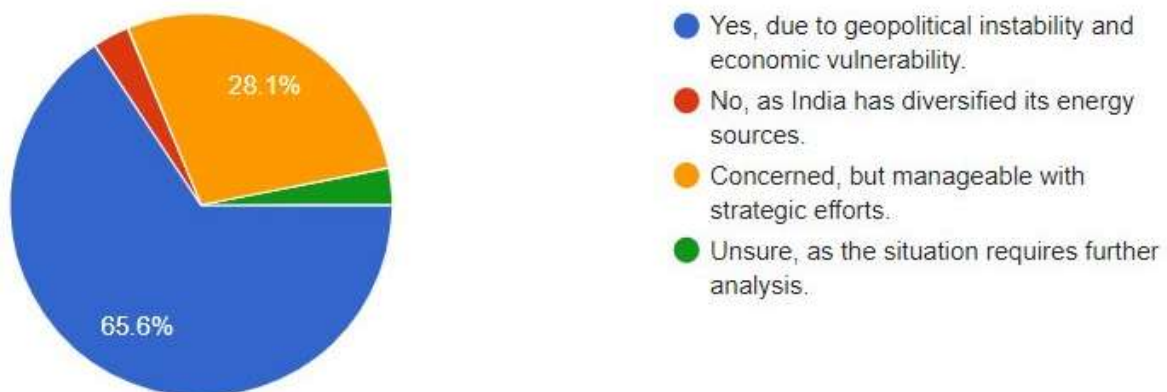


Ethanol: A Green Fuel

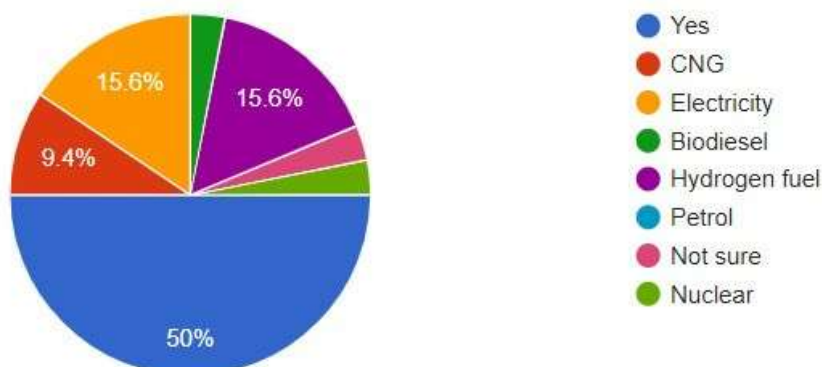
3. Survey Conducted

The following represents our survey findings conducted for our records:-

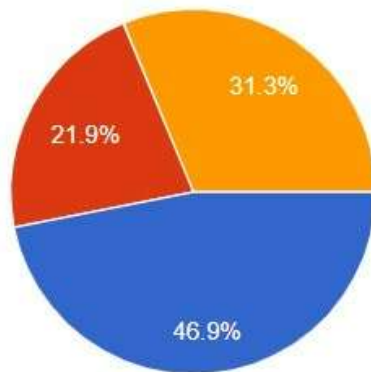
- Do you believe that India's dependence on Gulf countries for energy supply is a matter of concern?



- Do you think ethanol blending is the best fuel for vehicles in India ? If no then which is the best fuel according to you , if any other specify

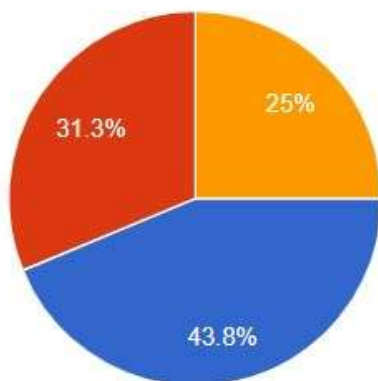


- How important do you think it is for India to reduce its reliance on imported oil?



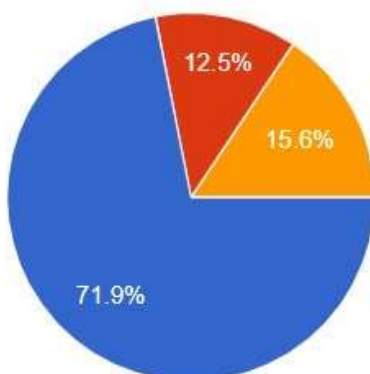
- Very important: Mitigates risks of price volatility and geopolitical tensions.
- Somewhat important: Requires gradual diversification amidst infrastructure constraints.
- Moderately important: Enhances energy security through diverse sources and partnerships.
- Not very important: Maintains flexibility amidst stable global markets and gro...

- Are you aware of the environmental benefits associated with using ethanol blended fuels?



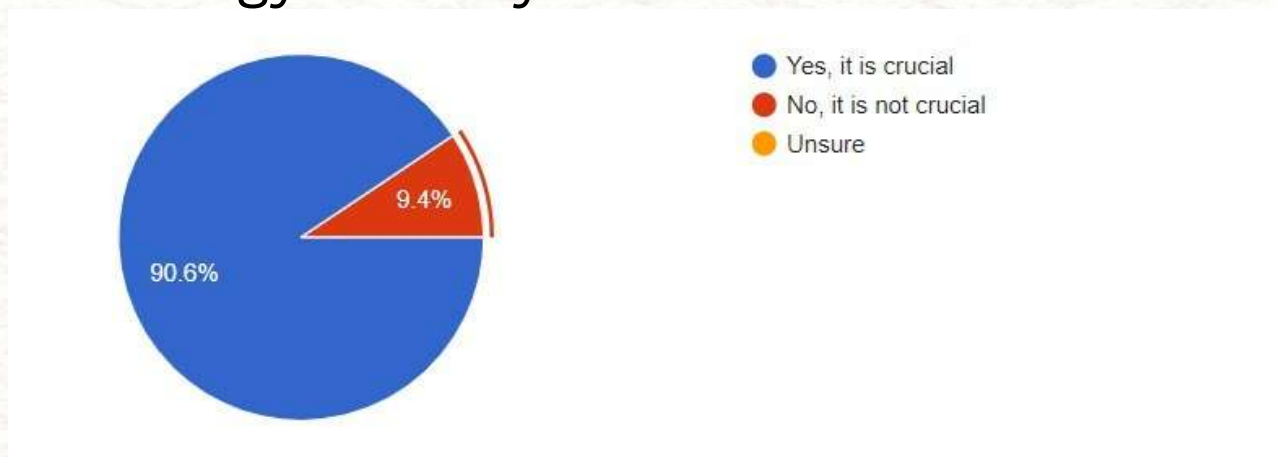
- Yes, I am aware
- No, I am not aware
- Somewhat aware
- Unsure

- Do you think is it necessary to think of an alternative fuel for Petrol ?



- Yes, to reduce environmental impact and dependence on finite resources.
- No, as current technology and infrastructure support petrol use efficiently.
- Maybe, considering long-term sustainability and technological advancements.
- Unsure, pending further assessment of economic, environmental, and societal...

- Do you believe that investing in research and development of alternative fuels, such as ethanol, is crucial for India's energy security?



Our survey indicates that most individuals understand the impacts of fossil fuels and the significance of ethanol. However, they lack awareness regarding the technical hurdles associated with ethanol blending in existing car engines. Nonetheless, they hope for a resolution to make older vehicle engines compatible with ethanol.

4. Goals pertaining to minimize the problem

Our main objective is to promote the widespread adoption of ethanol-blended fuel as a sustainable alternative to traditional oil and petroleum fuels, aiming to address environmental concerns and reduce dependency on fossil fuels in the automotive sector. Through strategic initiatives and innovative solutions, we aim to achieve the following goals:

1. Develop and implement engineering solutions to enable existing vehicle models to seamlessly integrate with ethanol-blended fuel, enhancing consumer choice and facilitating the transition towards more sustainable transportation options.
2. Collaborate with automotive manufacturers, fuel distributors, and regulatory bodies to establish standards and regulations for the production, distribution, and usage of ethanol-blended fuel, ensuring safety, quality, and compliance with environmental regulations.
3. Conduct comprehensive research and development activities to optimize ethanol production processes, improve fuel efficiency, and minimize environmental impact throughout the entire fuel lifecycle, from production to consumption.
4. Educate and raise awareness among consumers, stakeholders, and policymakers about the environmental and economic benefits of ethanol-blended fuel, highlighting its potential to reduce greenhouse gas emissions, enhance energy security, and stimulate economic growth in the renewable energy sector.
5. Foster partnerships and collaboration with government agencies, research institutions, and industry stakeholders to accelerate the adoption of ethanol-blended fuel through policy incentives, investment incentives, and infrastructure development initiatives.

By pursuing these goals, we aim to contribute to a more sustainable and environmentally conscious future, where ethanol-blended fuel plays a pivotal role in mitigating climate change, reducing air pollution, and promoting sustainable development in the transportation sector.

5. Tools and techniques perceived to be effective for resolving the problem

1. Engine Modification: Modifying the engine to handle ethanol-blended fuels can include upgrading components such as fuel lines, seals, and gaskets to materials that are resistant to ethanol's corrosive properties. Additionally, adjusting the engine's compression ratio and ignition timing can optimize performance with ethanol fuels.



2. Flex-Fuel Conversion: Converting the engine to a flex-fuel system allows it to run on ethanol blends of various concentrations. This provides flexibility in fuel choice and can reduce the risk of engine knocking and damage.

3. Ethanol Sensor Installation: Installing an ethanol sensor can help the engine adjust its parameters based on the ethanol content in the fuel. This can improve engine performance and efficiency while reducing the risk of engine damage.



4. Cold Start System: Adding a cold start system that preheats the fuel or the air entering the combustion chamber can improve cold start performance with ethanol-blended fuels. This can help prevent engine knocking and damage during startup.

5. Collaboration to make it effective: Yes, collaboration with government agencies, local vendors, and online payment companies would indeed be crucial for the success of this project. Government agencies can provide support in terms of waste management policies, regulations, and infrastructure. They can also help in promoting the project to a wider audience through their networks and outreach programs. Local vendors can be incentivized to participate in the project by offering them rewards for collecting and depositing waste at the vending machines. Online payment companies can provide a secure and convenient payment mechanism for the rewards earned by the users. To convince these entities, it would be necessary to demonstrate the benefits of the project in terms of waste reduction, increased recycling, and improved waste management. The project's potential to create a cleaner environment, reduce littering, and generate a positive impact on public health should also be highlighted. Additionally, the project's potential to create new business opportunities and boost the local economy can be highlighted to convince local vendors to participate. Overall, it would be important to engage with these entities early on in the project and involve them in the planning and implementation process to ensure their buy-in and support.

6. Detailed work plan

- **Prototype:-** Our initial step in the project is to develop a prototype of our flex fuel conversion kit for normal gasoline engines. While existing conversion kits focus on gasoline vehicles, our concept aims to cater to a broader range of engines, including those running on ethanol blends. Therefore, we need to design and build a prototype that can seamlessly integrate with various types of engines and fuel systems, ensuring compatibility and optimal performance. This prototype should be cost-effective, efficient, and user-friendly, providing drivers with an easy and reliable way to switch between gasoline and ethanol blends. We will test and refine the prototype iteratively, ensuring it meets our standards and requirements for functionality and usability.
- **Collaboration with Outside Entities:-** Government collaboration is crucial for making older vehicle engines compatible with ethanol blending due to its role in setting regulations, providing financial support, facilitating coordination among stakeholders, and creating public awareness. Regulatory frameworks can be established to support ethanol adoption and incentivize retrofitting. Financial support can fund R&D for technological solutions. Government coordination can align stakeholders' efforts, and public awareness campaigns can educate vehicle owners about the benefits and importance of retrofitting.



7. Innovation of the proposed solution

Our innovative approach focuses on optimising ethanol blending techniques to enhance fuel performance and reduce emissions in existing combustion engines. By fine-tuning the ethanol-to-petrol ratio and incorporating advanced engine calibration algorithms, we aim to maximize the efficiency and compatibility of ethanol-blended fuel with conventional vehicle models.

Additionally, our solution explores the integration of renewable energy sources, such as biomass-derived ethanol, to further minimize the carbon footprint of transportation. Through extensive research and collaboration with industry experts, our proposed solution offers a cost-effective and environmentally sustainable pathway towards reducing reliance on fossil fuels and fostering a greener automotive landscape.

8. Approaches required to implement the proposed solution

1) Prototype:- Our machine's design is intricate, incorporating a number of features that need for knowledge of both hardware and software to be implemented. We might start by looking into the research facilities that are accessible in the laboratories of our IIT and asking PhD students who are studying related subjects for assistance. If necessary, we can work with professionals outside our IIT to offer specialised support.

2) Collaboration with Outside Entities:- Government collaboration is essential for resolving the issue of making older vehicle engines compatible with ethanol blending for several reasons. Firstly, the government plays a crucial role in setting regulations and standards related to fuel usage and vehicle emissions. By collaborating with the government, stakeholders can ensure that regulatory frameworks are in place to support the adoption of ethanol blending and incentivise the retrofitting of older vehicle engines.

Secondly, government collaboration is necessary to provide financial support and incentives for research and development efforts aimed at finding technological solutions to make older vehicle engines ethanol compatible. This can include funding for pilot projects, grants for innovation in engine modification technologies, and tax incentives for companies investing in ethanol-compatible engine retrofits.

Additionally, government collaboration can help facilitate coordination among different stakeholders, including automotive manufacturers, fuel suppliers, research institutions, and regulatory agencies. By convening stakeholders and fostering dialogue, the government can ensure a unified approach to addressing the technical challenges associated with ethanol blending in older vehicles.

Furthermore, government collaboration is crucial for creating public awareness campaigns to educate vehicle owners about the benefits of ethanol blending and the importance of retrofitting older vehicle engines. By leveraging its communication channels and resources, the government can effectively reach a wide audience and encourage participation in the transition to ethanol-compatible engines.

Overall, government collaboration is necessary to provide regulatory support, financial incentives, coordination, and public awareness efforts to successfully resolve the issue of making older vehicle engines compatible with ethanol blending.

3) Supply Chain: Our approach to implementing techniques for enabling normal petrol engines to run on ethanol-blended fuels through the automotive supply chain would involve several key steps. We would start by conducting thorough research and development to understand how ethanol affects engine performance and durability, allowing us to develop or modify engine components accordingly. Collaborating closely with fuel and component suppliers would ensure that the necessary parts and fuels are available. We would then adjust manufacturing processes to incorporate these new components, with a strong emphasis on maintaining high standards through quality control measures. To promote awareness among consumers, we would launch targeted marketing campaigns and work with dealerships to highlight the benefits of using ethanol-blended fuels. Ensuring compliance with regulations and establishing feedback mechanisms for continuous improvement would also be essential parts of our implementation strategy.

9. Possible barriers to the proposed implementation

- Complexity of techniques to implement:- Implementing techniques such as engine modification, fuel system upgrades, ethanol sensor installation, flex-fuel conversion, cold start system installation, and fuel additive use can come with their own set of challenges and potential problems. While many of these techniques are intended to improve engine performance, improper implementation or compatibility issues can actually lead to decreased performance or efficiency. Some techniques, like ethanol sensor installation and cold start system installation, may require regular maintenance to ensure they continue to function properly. Some modifications, such as changing the engine's compression ratio or installing certain components, may need to comply with local regulations and emissions standards.
- Problem in Contacting with Government Authorities:- Contacting the appropriate government authorities which helps us to implement these techniques would be difficult at first. Approaching government authorities for approvals can be time-consuming.

- **Supply Chain Challenges:-** Acquiring the necessary components and materials for implementing these techniques may pose challenges due to potential supply chain disruptions. Sourcing specialized parts or additives required for engine modifications or fuel system upgrades could be hindered by limited availability.
- **Technical Expertise and Training:-** Successfully implementing complex techniques such as engine modification and flex-fuel conversion requires specialized technical expertise and training. Ensuring that technicians and mechanics possess the necessary skills and knowledge to perform these tasks safely and effectively can be a significant challenge. Providing comprehensive training programs by the government and ongoing support to personnel involved in the implementation process is essential to minimize the risk of errors or malfunctions that could compromise vehicle performance or safety. Moreover, the availability of qualified personnel may be limited, particularly in regions with a shortage of automotive engineering expertise.

10. Expertise available with each member to contribute

- Harsh Kulkarni: Harsh provides direction to the team, excelling in data research and compilation, ensuring project success in a proactive work environment.
- Sahil Mhapsekar: Sahil excels in design, presentation, and teamwork, leveraging his technical skills to drive project efficiency.
- Rajesh Bhakre: Rajesh's expertise lies in mechanical tasks and cooperation, contributing significantly to project progress through his diligent efforts.
- Aman Tadavi: Aman is adept at communication and providing help and awareness, contributing positively to team dynamics and project success.

11. Expected outcomes

If these techniques were implemented in every vehicle worldwide, several positive outcomes could be expected. Firstly, the use of ethanol-blended fuels and flex-fuel systems could reduce dependence on fossil fuels and lower greenhouse gas emissions, contributing to a cleaner environment. Engine modifications and fuel system upgrades could lead to improved engine performance, fuel efficiency, and longevity, reducing overall vehicle maintenance costs. Additionally, the use of fuel additives and proper maintenance practices could help keep engines and fuel systems clean and functioning optimally. Overall, these techniques could result in a more sustainable and efficient global transportation system, benefiting both the environment and consumers.

12. Suggested plan of action for utilization of expected outcome

To effectively utilize the expected outcomes of implementing these techniques in every vehicle worldwide, a comprehensive plan of action could be developed. Some of them are:-

- **Education and Awareness:** Launching educational campaigns to inform the public about the benefits of using ethanol-blended fuels, flex-fuel systems, and proper vehicle maintenance. Encouraging consumers to make informed choices about their vehicle's fuel and maintenance practices.
- **Infrastructure Development:** Investing in the infrastructure needed to support ethanol-blended fuels, such as fueling stations and distribution networks. Ensuring that these fuels are readily available to consumers worldwide.
- **Technology Development:** Continuing to research and develop new technologies for improving engine performance, fuel efficiency, and emissions reduction. Supporting innovation in the automotive industry to further enhance these outcomes.

13. Conclusion

In conclusion, our project aims to implement a comprehensive set of techniques to ensure that every car worldwide is fueled with ethanol-blended fuel. By promoting the use of ethanol-blended fuels, flex-fuel systems, and proper vehicle maintenance practices, we can achieve several positive outcomes, including reduced dependence on fossil fuels, lower greenhouse gas emissions, improved engine performance and fuel efficiency, and lower maintenance costs. To successfully implement this project, we propose a plan of action that includes education and awareness campaigns, government policies and incentives, infrastructure development, technology development, collaboration and partnerships, and monitoring and evaluation. By working together on a global scale, we can create a more sustainable and efficient transportation system for the future.

14. Contribution from each member

- Harsh:- Harsh contributed with his great research skills, problem-solving attitude, and provided stability to the team. His dedication and meticulous approach significantly enhanced project outcomes.
- Sahil:- Sahil excelled in crafting unique designs, presentations, and data presentation, while also facilitating effective coordination within the team. His creativity and attention to detail ensured captivating project deliverables.
- Rajesh:- Rajesh contributed with mechanical solutions and technical clarity, demonstrating strong teamwork and research skills. His expertise in resolving technical challenges proved invaluable to project progress.
- Aman:- Aman's strengths lie in communication, effort, and awareness, consistently demonstrating presence of mind and active participation in project tasks. His proactive approach and willingness to assist greatly contributed to the team's success.

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