1. Introduction:

- As we are living in the 21st century the human being has developed a lot in terms of Physical, Mental, Technical & Socially and still progressing towards the future with dedication and hardships. Looking behind we invented a lot of things which had given a certain direction to humanity. Invention of 'Electricity' is one of the biggest inventions which invented before, and now became a very important and necessary part of our community. But "the great the invention is, the worst is its side effect", and the side effect of mass electricity production is 'Air pollution'. And it is necessary to take it in the consideration while generating electricity so we can balance with our environment, or the outcomes will be severe.
- So, to minimize the air pollution we need to take proper measures like Tree plantation, Reduce the deforestation which still won't be enough in reduction of air pollution in atmosphere. So, another thing we have to do is to extract the CO_2 from air artificially with the help of DAC (Direct Air Capture) method. The DAC method extracts the CO_2 from the atmosphere and separates it in form of fresh air and pure CO_2.
- Direct Air Capture (DAC) technology is a process that involves capturing carbon dioxide (CO_2) directly from the air using specialized equipment. It has the potential to play a significant role in reducing emissions from hard-to decarbonize sectors, such as transportation and industry. DAC typically involves several steps, including air filtration, absorption of CO_2, Separation of CO_2 and Storage or utilization. The captured CO_2 can then be stored or used in various applications, such as enhanced oil recovery, synthetic fuel production, and industrial processes.

2. Objective:

- The primary objective of Direct Air Capture (DAC) technology is to capture carbon dioxide (CO_2) directly from the atmosphere and utilize it.
- The technology is a form of carbon capture, utilization, and storage (CCUS), which aims to reduce greenhouse gas emissions and mitigate climate change.
- Additionally, DAC can be used to remove CO_2 that has already been emitted into the atmosphere, thus helping to reduce atmospheric CO_2 concentrations.

3. Scope:

- Addressing hard-to-decarbonize sectors: DAC technology could be used to capture CO_2 emissions from hard-to-decarbonize sectors.
- Carbon removal: DAC technology has the potential to remove CO_2 that has already been emitted into the atmosphere, which could help to reduce atmospheric concentrations of greenhouse gases and limit the impacts of global warming.
- Economic opportunities: The development and deployment of DAC technology could create new economic opportunities in various sectors.

3. Relevance:

- This project is directly related to the stability of the environment. The current state of the environment is at critical point where the use of fossil fuels for electricity generation is massive, Transportation producing toxic gases, Deforestation, Forest fires and so on which is leading towards the air pollution at its peak, Global warming, Acid rains, Deficiency in Oxygen levels which has direct impact on the human life.

- The project is counter to the constantly increasing Air pollution levels and global warming the main objectives of project are stated which are to capture the ambient air, separate CO_2 from the ambient air and release the CO_2 free air and storing or using the captured CO_2 for various purposes.

- This project can be installed in places such as industrial areas, roads, tunnels, cities having large scale of pollution zones.

- The successful completion of this project will develop a small prototype of the large-scale DAC project which is simple in structure, easy installation, less space requirement, cheap in cost, and good production ability. The process of the CO_2 filtration will be less as compared to the large-scale DAC project. But smaller scale projects can be installed in large quantities.

4. Present Theory and Practices:

a. Literature review

Sr. No	Author Name	Year of Publication	Description paper	Parameters considered	Results
1	Wurzbacher J. A.	2019	The article provides a detailed description of the system and its components, as well as the results of a preliminary economic analysis. The authors suggest that the system could be economically viable with the potential to capture CO_2 at a cost of around \$100-\$200 per ton.	Scale of the system, deployment of the system, cost required for the system, components required.	Overall, the article provides an interesting perspective on direct air capture of CO_2 and proposes a novel system for large-scale implementation.
2	Lackner, K. S., & Granger, R.	2016	The article discusses the technical and economic feasibility of direct air capture (DAC) of carbon dioxide (CO_2) from the atmosphere as a means of reducing greenhouse gas emissions. The authors explore the potential of DAC technology to capture CO_2 from ambient air and concentrate it for use or storage.	Challenges associated with DAC, including the energy requirements for capturing and concentrating CO_2, the costs of the technology, and the scalability of the process, different DAC technologies that have been proposed.	DAC technology is still in its early stages of development, it has the potential to play a significant role in mitigating climate change by providing a means of capturing CO_2 from the atmosphere.

b. Conclusion of Literature review

- From all the reviews considered and studied we can conclude that the project has a lot of complex parameters such as High cost, large infrastructures, High energy requirements and it is necessary to overcome for efficient and smooth operations of these projects.

5. Proposed Work:

Direct air capture (DAC) technology has gained attention in recent years as a potential tool for mitigating climate change. It involves removing carbon dioxide (CO_2) from the air and storing it or using it in various applications. Small-scale DAC technology can be an effective way to reduce greenhouse gas emissions in communities where traditional mitigation methods are not feasible or too costly.

Here are some steps to consider when proposing a small-scale DAC project:

- Assess the feasibility: Conduct a feasibility study to determine if a small-scale DAC project is viable for our location. Consider factors such as the availability of funding, energy requirements, local regulations, and the potential market for captured CO_2.
- Determine the technology: There are various types of DAC technologies, each with its strengths and limitations. Research and compare the different options to determine which technology is best suited for our needs and budget.
- Site selection: Select a location for the DAC plant that is suitable for the technology, has access to a reliable energy source, and is close to the source of the captured CO_2.
- Construct and commission the plant: Construct the DAC prototype and commission it.
- Operate and maintain the system: Once the system is commissioned, it will require regular maintenance and operation to ensure it runs smoothly and efficiently.
- Monitor and report the results: Continuously monitor the performance of the DAC plant and report the results to stakeholders and regulatory authorities.

In summary, a small-scale DAC project involves assessing feasibility, selecting the appropriate technology, securing funding, selecting a site, obtaining permits and approvals, constructing and commissioning the plant, operating and maintaining the plant, marketing the captured CO_2, and monitoring and reporting the results. With proper planning and execution, small-scale DAC technology can be an effective tool for reducing greenhouse gas emissions and mitigating climate change.

6. Methodology/Planning of work:

The project is divided in three parts for the easy and fast completion of project considering deadlines and other academics.

- Filtration – Here we are building the prototype such as it will suck the ambient air from the atmosphere and passing the dust free air to the filter

- Separation – Here we are building the next part of the prototype which will process on the filtrated air and separates the CO_2 from the air and releases the CO_2 free air and forwards the extracted CO_2 to next part

- Storage – Here we are building the storage unit which will hold the CO_2 in container.

Planning of Work

Sr. No	Activity	Time Duration	Target Date
1	Title Selection	Week 1	08/08/2023
2	Title Finalization & Presentation (10% project)	Week 2	09/08/2023
3	Discussion about Project progress with guide	Week 3	22/08/2023
4	Altering with guidelines provided by guide	Week 3	12/09/2023
5	Synopsis presentation to guide (25% project)	Week 4	20/09/2023
6	Synopsis presentation to evaluation committee (25% project)	Week 5	10/10/2023
7	Hardware Discussion with guide	Week 6- Week 7	17/10/2023
8	Simulation of project	Week 7- Week 9	27/10/2023
9	Hardware Implementation (50%)	Week 9- Week 10	20/12/2023
10	Synopsis presentation to evaluation committee (50% project)	Week 11- week 12	27/10/2023

7. Work Done till Date:

Our project aims to extract CO2 directly from the air on a small scale. We began by conducting research on the topic and gathering information related to the project. We sought guidance from guide and take what we need to do for our project. We have given a presentation to the project evaluation committee about our project related work and objective of project.

With the help of our guide and the gathered information we were able to identify the most suitable components required to complete the project. Here we are willing to build a small scale direct air capture which is able to collect the carbon dioxide direct from the air.

We take a market serve for the components required for the project. Till now we have collected Potassium hydroxide for the filtration process, also suction fan we needed to suck the air into prototype. Air filter, Metal sheet, etc.

Also, we have discussed about the hardware with the guide and how much size it has about its capacity and its scale. We draw a structural diagram of our project. With all this information and guidance, we acquiring all the components and proceeding to set up the system for co2 extraction.

Overall, we work on the project involved conducting research, seeking guidance, collecting components, and setting up and testing the system for co2 extraction.

8. Facilities required for proposed work:

Direct Air Capture (DAC) technology requires certain facilities to operate effectively. Some of the key facilities required for DAC technology are:

- Air Intake System: DACs require a system to intake air from the environment. This system should be designed to capture air at a high rate and filter out any contaminants.

- Adsorbent Material: DACs use adsorbent materials to capture carbon dioxide from the air. The adsorbent material should have a high affinity for carbon dioxide and be able to capture it efficiently.

- Thermal Management System: DACs use heat to release the captured carbon dioxide from the adsorbent material. The thermal management system should be designed to control the temperature and pressure of the system to maximize the efficiency of the process.

- Carbon Dioxide Collection System: Once the carbon dioxide has been released from the adsorbent material, it needs to be collected and stored. The collection system should be designed to safely store the carbon dioxide and prevent any leaks.

- Energy Source: DACs require an energy source to power the system. The energy source can come from renewable sources such as solar or wind power, or from fossil fuels. The energy source should be reliable and cost-effective to ensure the economic viability of the technology.

9. Feasibility Study:

A feasibility study of Direct Air Capture (DAC) technology would involve assessing the technical, economic, and environmental aspects of implementing such a system. Here are some key factors that would need to be considered:

- Technical Feasibility: The technical feasibility of DAC technology involves assessing the performance and reliability of the technology. This includes evaluating the efficiency of the adsorbent material, the effectiveness of the thermal management system, and the reliability of the carbon dioxide collection system. It is also important to assess the scalability of the technology and the potential for integration with other carbon capture and storage technologies.
- Economic Feasibility: The economic feasibility of DAC technology involves assessing the cost of implementing and operating the system. This includes evaluating the cost of the adsorbent material, the cost of the thermal management system, and the cost of the carbon dioxide collection system. It is also important to consider the potential revenue streams, such as the sale of the captured carbon dioxide, and the potential for government incentives or subsidies.
- Environmental Feasibility: The environmental feasibility of DAC technology involves assessing the potential impact of the system on the environment. This includes evaluating the potential for air pollution from the intake system, the environmental impact of the adsorbent material, and the potential for leaks or accidents during the carbon dioxide storage and transport process.

Overall, a feasibility study of DAC technology would need to assess these and other factors to determine whether the technology is economically and technically viable and environmentally sustainable.

10. Conclusion:

Direct Air Capture (DAC) technology has the potential to play a significant role in mitigating the effects of climate change by capturing carbon dioxide directly from the atmosphere. However, there are several challenges that need to be addressed to make the technology feasible and effective.

On the technical side, improving the efficiency of the adsorbent material, developing more cost -effective and reliable thermal management systems, and improving carbon dioxide collection and storage techniques are key areas of research and development.

On the economic side, reducing the cost of implementing and operating the system is crucial to making the technology viable. This may require government incentives or subsidies, as well as exploring potential revenue streams such as the sale of the captured carbon dioxide. On the environmental side, minimizing the impact of the intake system, ensuring the sustainability of the adsorbent material, and preventing leaks or accidents during the carbon dioxide storage and transport process are important considerations.

Overall, direct air capture technology holds promise as a tool for mitigating climate change, but further research and development are needed to make the technology feasible and effective on a large scale. In conjunction with other carbon capture and storage technologies, direct air capture could be an important component of a comprehensive strategy to reduce greenhouse gas emissions and combat climate change.

11. References:

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These references provide a comprehensive overview of DAC technology, including its feasibility, cost-effectiveness, scalability, and potential applications.