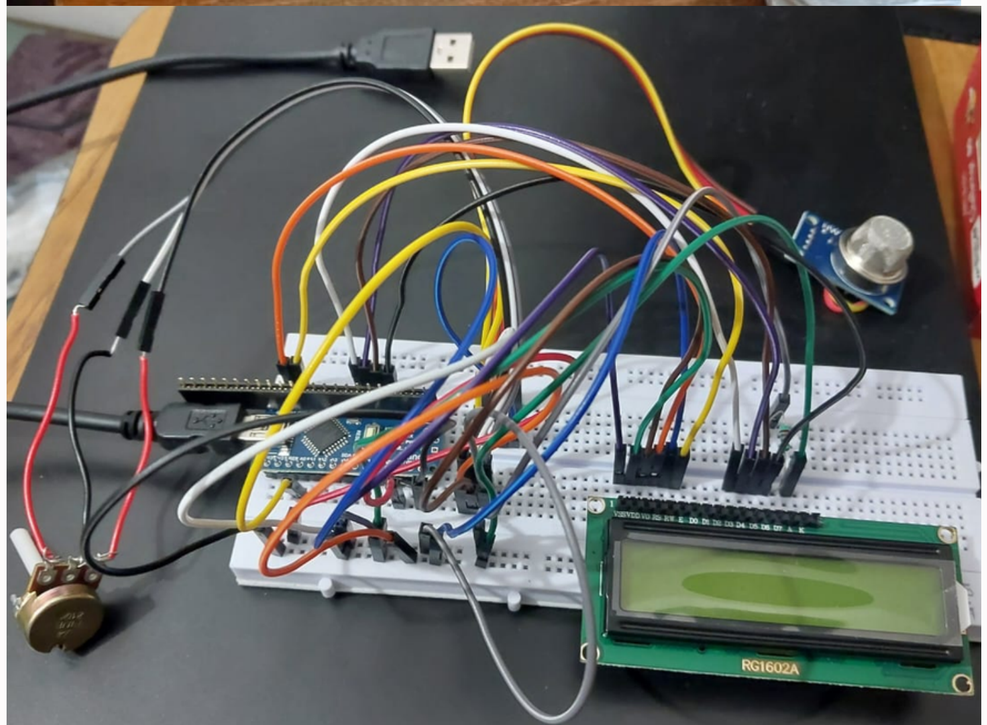
AVISHKAR 2024

# ALGAL AIR PURIFIER WITH CO2 SENSOR



# OBJECTIVE

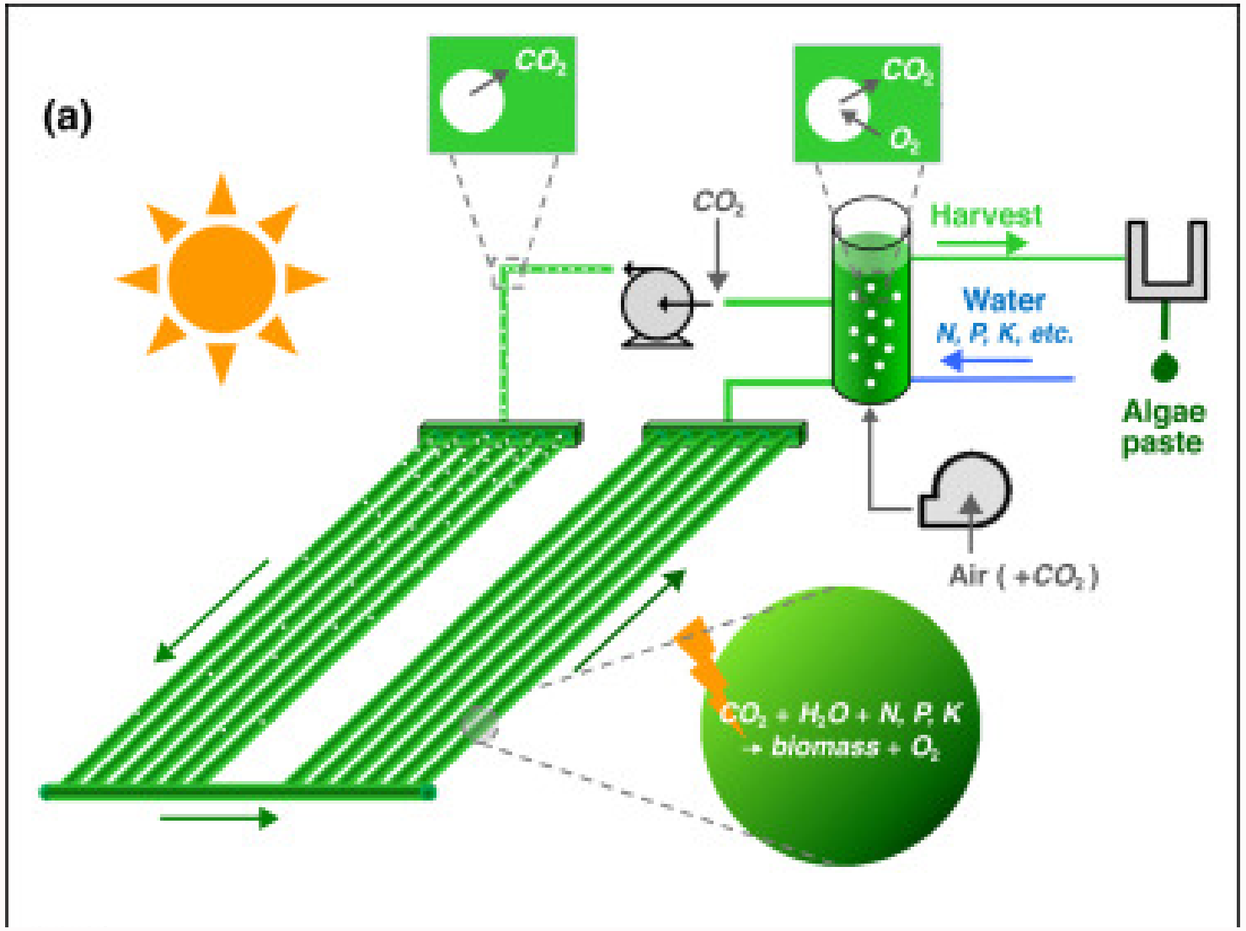
sequestration of co2 using algae

## Principle

Algae-based carbon sequestration holds immense potential for mitigating CO2 emissions by utilizing photosynthesis to capture and convert atmospheric carbon into biomass, offering a sustainable and scalable solution for combating climate change

# REACTION

The absorbed CO2 is utilized as a source inorganic carbon for microalgae cultivation instead of being stored, converting the inorganic carbon to organic carbon-based compounds(biomass) such as lipids, proteins, carbohydrates, pigments, and phenols via photosynthesis.



# MAIN EFFECT OF CO2 SEQUESTRATION?

Alongside carbon capture , Microalgae continuously produces biomass which can be converted to various biofuels such as bioethanol, biodiesel, biocrude oil, biomethane, biohydrogen etc. Utilization of wet microalgal biomass for biofuel production,
could improve the environmental sustainability and achieve carbon neutrality. Microalgae have a unique ability to convert both inorganic and organic carbon to biomass and it is rich in proteins, lipids,
and carbohydrates. Chlorella could accumulate high amounts of carbohydrate, lipids, and protein making them ideal feedstocks for biofuel production.
Microalgal Biofuels
Whole microalgal biomass can be converted to biofuels such as bioethanol, biodiesel, biocrude oil, biomethane, Bioethanol.

# MAIN EFFECT OF CO2 SEQUESTRATION?

**Bioethanol**

**-Bioethanol is produced by alcoholic fermentation, which uses algal biomass containing sugars, starch, or cellulose. In this process, the biomass is broken down, and the starch is turned into sugars (saccharification), which are then degraded by yeast cells to produce ethanol in anaerobic conditions**

**-Bioethanol production from various microalgae biomass ranges from 0.07 to 0.5 g g−1 and the production yield depends on the carbohydrate content in the microalgae biomass(Chlorella could reach up to a 69.7% carbohydrate content)**

**Biodiesel**

**-Biodiesel, known as fatty acid methyl esters(FAME) ,is synthesized by esterification process from edible or non-edible vegetable oils. It is converted at temperature of about 60 °C in the presence of an alkali catalyst fatty acid methyl esters produced had**

**an unsaturated content of >90%.**

# MAIN EFFECT OF CO2 SEQUESTRATION?

**Biocrude Oil**

**-Hydrothermal liquefaction has emerged as a promising thermochemical technique for converting different types of biomass to biocrude oil .Microalgae biomass as a feedstock has several advantages, such as higher biocrude yield and better quality and requires temperatures ranging from 300 to 350 °C in the presence of organic and alkali catalyst.**

**Biomethane**

**-Biomethane is produced by anaerobic digestion where organic-rich waste streams are anaerobically digested by**
**methanogenic bacteria. The product of is commonly known as biogas, which comprises CH4 (55–75%) and CO2 (20–40%). A trivial amount of H2, H2S, N2, and water vapor is observed in biogas impurities .**
**The methane yield varies in the range of 200–400 L kg−1 algal biomass volatile solids.**

# Model Material Requirement

| QUANTITY | DESCRIPTION | COST |
|---|---|---|
| 2.5meter | small diameter pipe | 62 |
| 1.5Meter | big diameter pipe | 45 |
| 1 | water pump | 65 |
| 1 | air compressor | 40 |
| 3 | t-joint | 80 |
| 1 | nozzle | 10 |
| | Algal sample | extracted from ganga |
| 1 | Arduino nano | 245 |
| 1 | MQ-135 sensor | 130 |
| 1 | bread board | 80 |
| 1 | 16*2 lcd display | 150 |
| 1 | 10kohm potentiometer | 15 |
| 1 | 220ohm resistor | 1 |

Model cost-342

Sensors cost-685

# FACTORS AFFECTING CO2 SEQUESTRATIOIN

1. CO2 Concentration
   - High levels of CO2 positively influence carbon metabolism and biomass accumulation in microalgae, such as Chlamydomonas reinhardtii, which exhibited higher biomass and fatty acid accumulation.
   - However, toxicity can occur with excessive CO2 concentrations due to acidity created.
   - Optimal CO2 concentrations vary among species; for example, Nannochloropsis sp. showed optimum sequestration at 10% CO2, while Nannochloropsis salina and Nannochloropsis oculata preferred concentrations of 2% - 6%. Similarly, Dunaliella species showed optimal growth at lower CO2 concentrations.

# FACTORS AFFECTING CO2 SEQUESTRATIOIN

2. pH
- Neutral pH conditions (6.5 to 8) are generally favorable, but acidic pH levels benefit acid-tolerant species like Scenedesmus sp. and Chlorella sorokiniana. Alkaline pH levels enhance CO2 solubility, benefiting high-CO2 and alkaline-tolerant species such as C. sorokiniana str. SLA-04 and Chlorella sp. AT1.

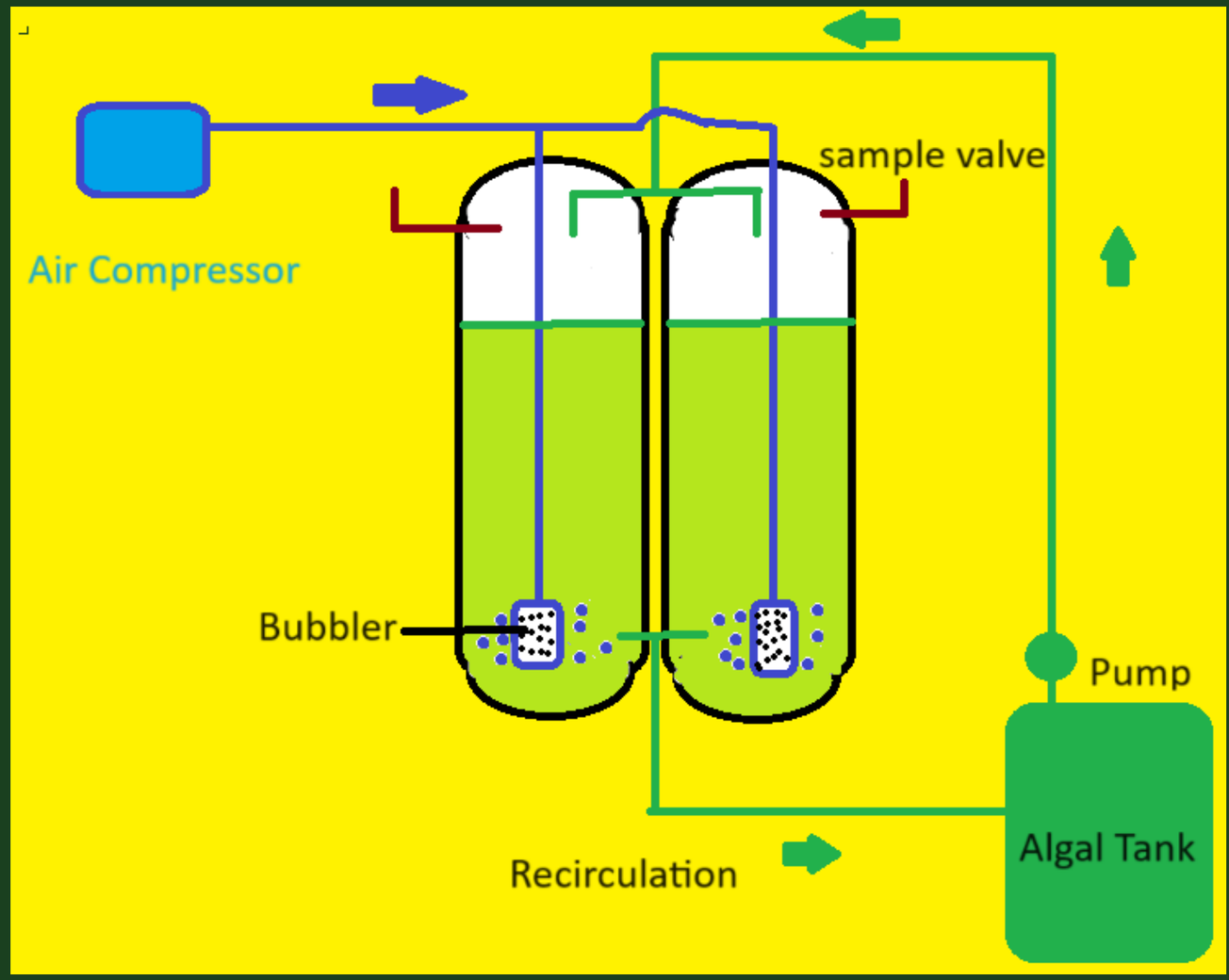
3. Illumination Period
- The duration of light exposure is essential for microalgae's photoautotrophic metabolisms, impacting ATP and NADPH production.
- Species like Chlorella vulgaris prefer longer light cycles for increased biomass production, whereas Nannochloropsis salina may experience light stress with longer cycles, leading to lower lipid production.

# FACTORS AFFECTING CO2 SEQUESTRATIOIN

4. Temperature
- Optimal temperature requirements vary among microalgae species and affect CO2 dissolution and enzyme activity. For instance, C. vulgaris prefers 30°C, N. oculata prefers 20°C, Scenedesmus sp. thrives at 25°C, and S. obliquus at 30°C.
- Low temperature gives changes to the amino structures while high temperature stretch and break the polypeptide chain.

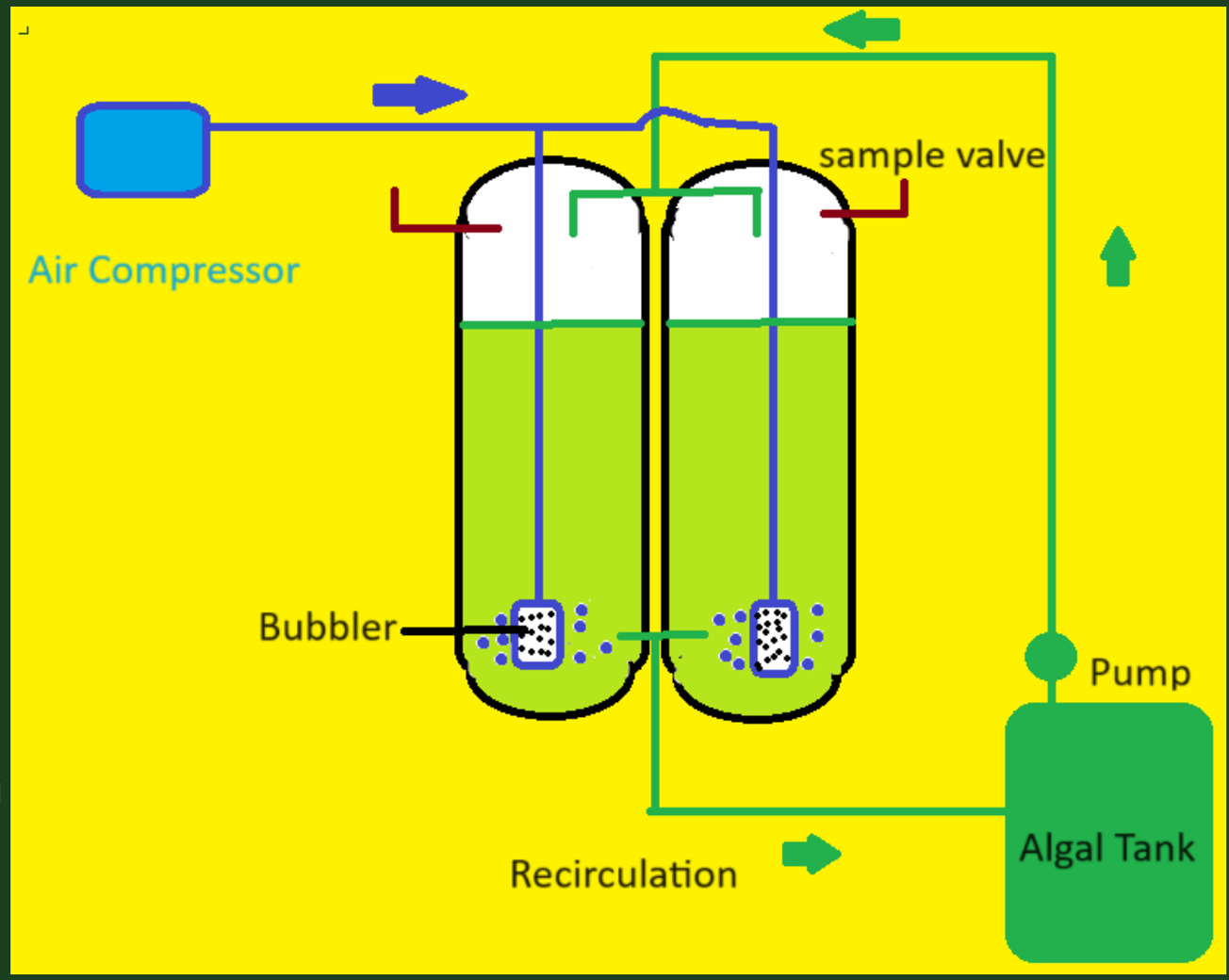
# PROCEDURE

- algae is pumped through a submersible pump into the reactor.
- after the filling of reactor air compressor and recirculation valve is turned on.
- air entered inside reactor is bubbled through bubbler inside the reactor.
- to inhance efficiency increase surface area,no.of reactors, microalgae.



# PROCEDURE

- Bubbler- used to reduce size of bubble entering in reactor. it helps in uniform mixing of gases and resist the encounter of large concentration of co2 with algae colony.
- Recirculation- it helps in proper mixing of co2 with every algal colony. it maintains the co2 concentration uniform in all over reactor,  also helps in maintaining long life cycle of algae.



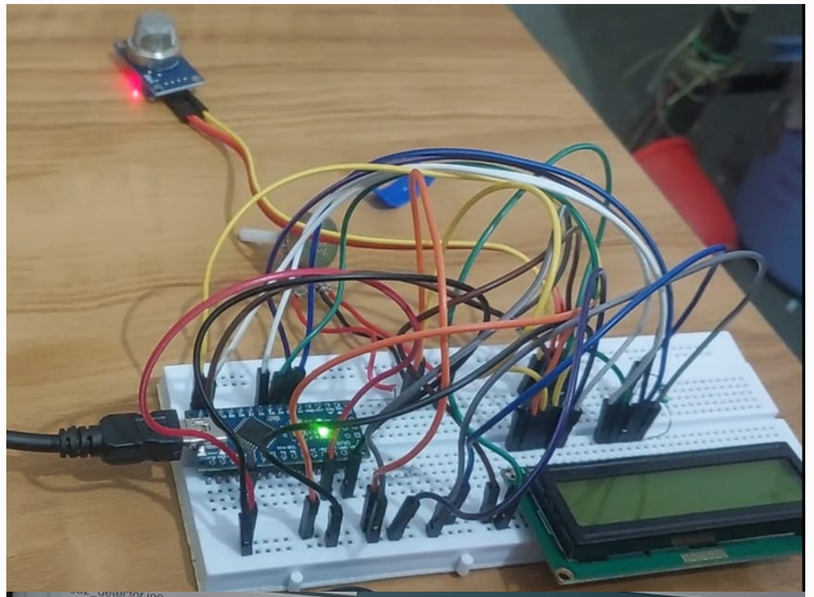
# Sensors construction

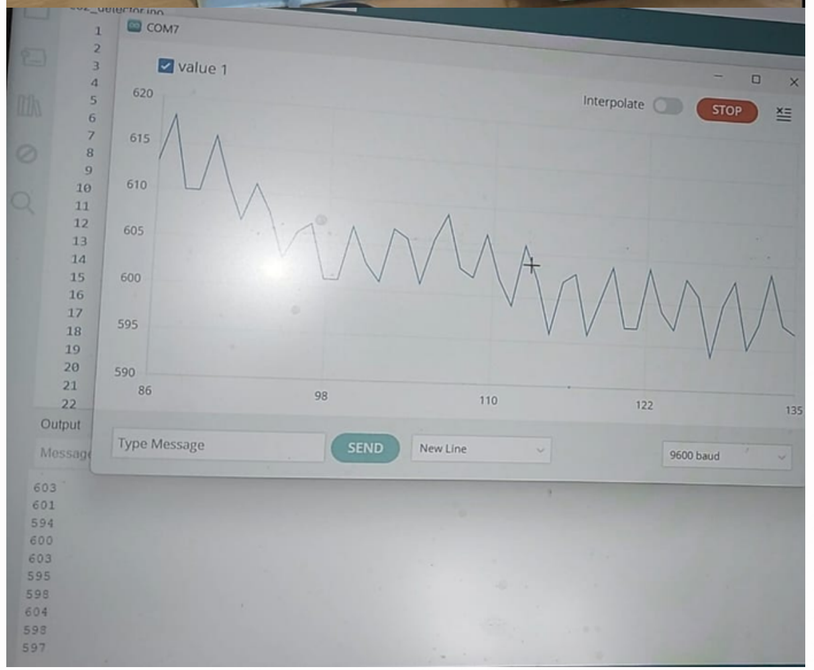
**Material required**

- Arduino nano
- MQ-135 sensor
- Display(16*2 lcd display,10kohm potentiometer, 220ohm resistor)

it is a relative co2 concentration measuring device which is standardised at ambient condition.it measures the relative difference of co2 concentration at a condition with respect to ambient condition.it is used to measure relative difference between initial and final condition.

**Arduino code:**
**https://drive.google.com/drive/folders/1_P67rFukAm2UEgA7voulVdRMLMLZK8BA?usp=drive_link**





# Future Scope

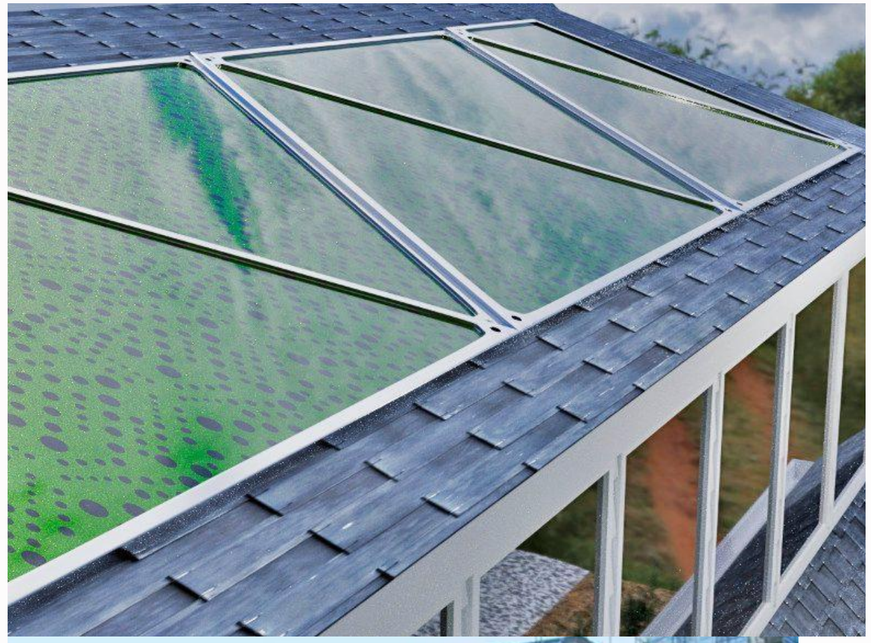
Promising future by harnessing photosynthesis to remove pollutants from the air efficiently and in generating renewable energy.

## ROOF TOP

Can be installed as a solar pannel on top of bulidings.

## WINDOWS

Can be installed in windows with two glasses hollow structure filled with algae and these windows will act as reactors.



# Thank you

2nd year(QUADRUPLE)
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