

# Design and Scale-Up of Photobioreactor

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## Motivation

- The major challenge policy makers, government and scientists around the world currently tackle is the global warming.
- In the 21st century, the planet will become warmer with detrimental environmental effects on our lives, since the global average surface temperature has risen by 0.3 – 0.6 °C (0.5 – 1.1 °F) [1].
- For example, Indonesia will move its capital city as its current one is sinking, average wildlife populations have dropped by 60 percent in just over 40 years, and excessive heat exposure contributed to more than 8000 premature deaths in the United States from 1979 to 2003.
- Hence, to achieve a healthier and cleaner environment, the priority should be mitigating greenhouse gas (GHG), mainly CO<sub>2</sub>, and use renewable sources for fuel.

## Project Description

- Microalgae is considered as the most promising medium for renewable energy and GHG mitigation, mainly CO<sub>2</sub> [2].
- It can attain fast proliferation under several hours and it has over 3000 different strains. However, an efficient and cost-effective photobioreactor (PBR) for microalgae cultivation is required.
- Computer simulation, through its close interaction with experiments, has shown to be a useful tool in offering a fundamental knowledge of key aspects of many emerging technologies.
- Hence, our aim is to employ a customized approach to design an efficient and cost-effective photobioreactor.



# Our Primary Goal Is To Develop An Efficient And Cost-Effective Photobioreactor



## Context

- Design and scale-up are major issues in developing an efficient and cost-effective PBR.
- It is essential to conduct complete optimization study at laboratory scale prior to scale up [3]. Comprehensive optimization study has never been conducted.
- Our approach of combined numerical and experimental study provides various advantages, compared to other optimization methods, which are as follows: (i) reduced workload; (ii) low cost; and (iii) shorter design period.
- Hence, we believe we will achieve our goal.

## Project Deliverables

- Pitt Momentum Fund will be utilized to build an experimental setup required for our research.
- We will have the experimental setup constructed and preliminary experiments conducted by the end of the 1-year funding period.
- Once the preliminary results are obtained, we will apply for NSF funding to further pursue our primary goal.
- The mid-term check for success would be the procurement of the required equipment, whereas the final check would be the working experimental setup.

## Potential Impact

- The fund will help us launch towards our goal to develop an efficient and cost-effective PBR.
- If we achieve our primary goal, we will create a PBR, which provides a healthier and cleaner environment along with biomass as a by-product.

## References

- [1] EPA., U.S., *Report on the 2013 U.S. Environmental Protection Agency (EPA)*
- [2] Shuba, E.S., et al., *Sustainable Energy Reviews*. 2018. **81**: p. 743-755.
- [3] Rawat, I., et al., *Applied Energy*. 2013. **103**: p. 444-467.