R&D Scoping Study and Infrastructure Self-Assessment of Fossil Energy and Carbon Management Based Research Capabilities for California State University, Los Angeles

Presenter: Matthew Tang

PI: Dr. Yangyang Liu, Associate Professor

Co-PI: Dr. David Blekhman, Professor

California State University, Los Angeles

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2023 FECM / NETL Spring R&D Project Review Meeting

April 18, 2023

Acknowledgment

- DOE Funding: Award # DE-FE0032202
- Omer R. Bakshi (Program Manager, NETL, DOE)
- Prof. Arturo Pacheco-Vega, Director for NSF-CREST Center
- Dean René Vellanoweth, College of Natural of Social Sciences
- Dean Nancy Warter-Perez, College of Engineering, Computer and Technology

Project Overview

- Funding: $200,000 (DOE)
- Project Duration: 12 months (12/31/22-12/30/23)
- Project Participant: California State University, Los Angeles (Cal State LA)

  College of Natural and Social Sciences (Dr. Yangyang Liu, PI)

  College of Engineering, Computer Science and Technology (Dr. David Blekhman, co-PI)

- Overall Project Objectives
  - To evaluate how Cal State LA's current **research capability** and **educational activities** can be expanded to align with the DOE/FECM objectives. Cal State LA will also **identify gaps** in research and education capability and **develop strategies** to enable Cal State LA to be **competitive** for future solicitations focused on FECM-supported technologies.

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Project Objectives

1. Identify existing university **research thrust areas** that are synergistic with FECM mission goals and assess the **current capabilities and resources**, including personnel, expertise, awards, and facilities/equipment, in the identified areas.
2. Determine the **resource needs (gaps)** to enable competitive standing in future FECM research opportunities.
3. Describe Cal State LA's current **student education and training activities**, including current academic courses, programs, and curriculum, that aligns with FECM goals (decarbonization).
4. Discuss additional needs to **enhance the education and training of minority students** from underrepresented and structurally marginalized communities.
5. Assess the potential for **national and international collaborations** on research and education in decarbonization.

Team Members

Dr. Yangyang Liu (PI)

Dr. David Blekhman (co-PI)

Matthew Tang (GRA)

Jesus Corona (GRA)

Doroteo Manriquez (UGRA)

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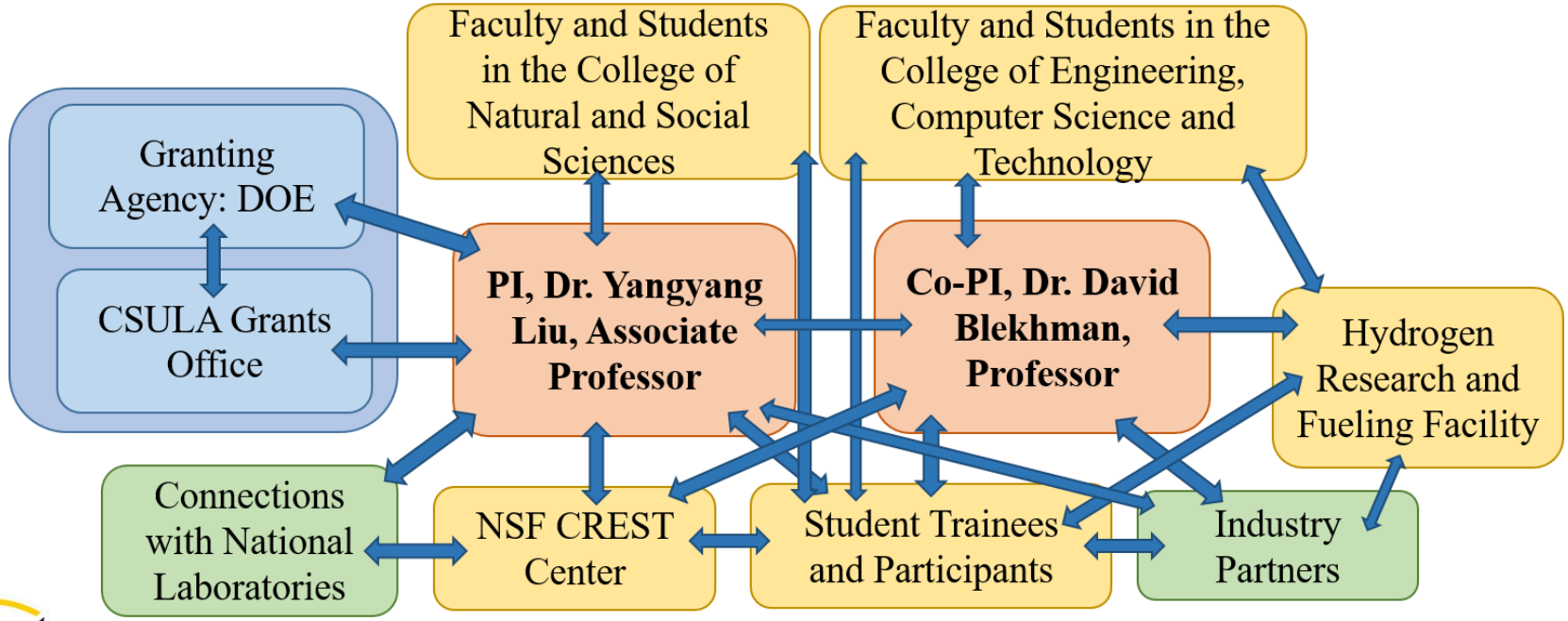
Project Organizational Chart



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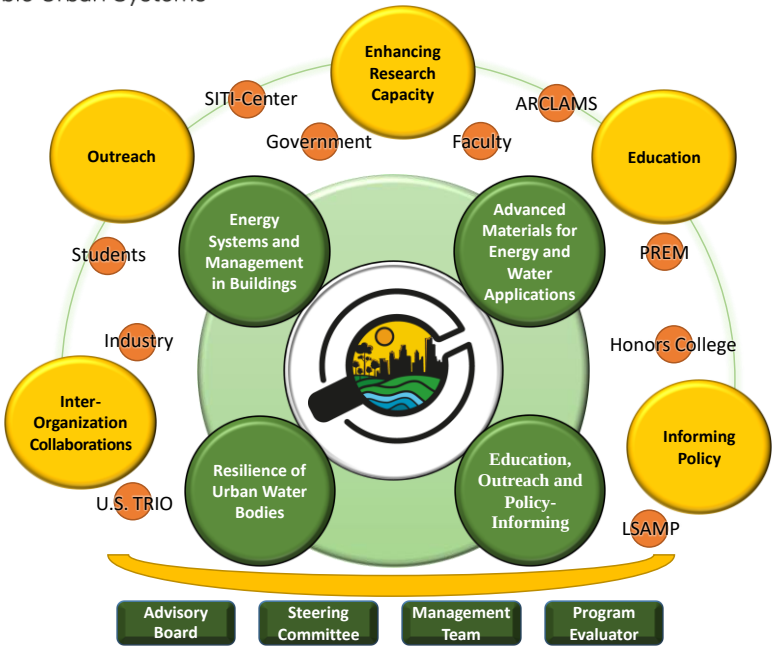
NSF CREST, National Laboratories and Industry Partners

NSF CREST
CATSUS
Center for Advancement toward Sustainable Urban Systems



Lawrence Livermore National Laboratory

Sandia National Laboratories

SoCalGas
A Sempra Energy utility®

azolla HYDROGEN

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Institution Background

Hispanic-serving and Asian American Native American Pacific Islander serving institution

Science Complex
Urban sustainability initiative

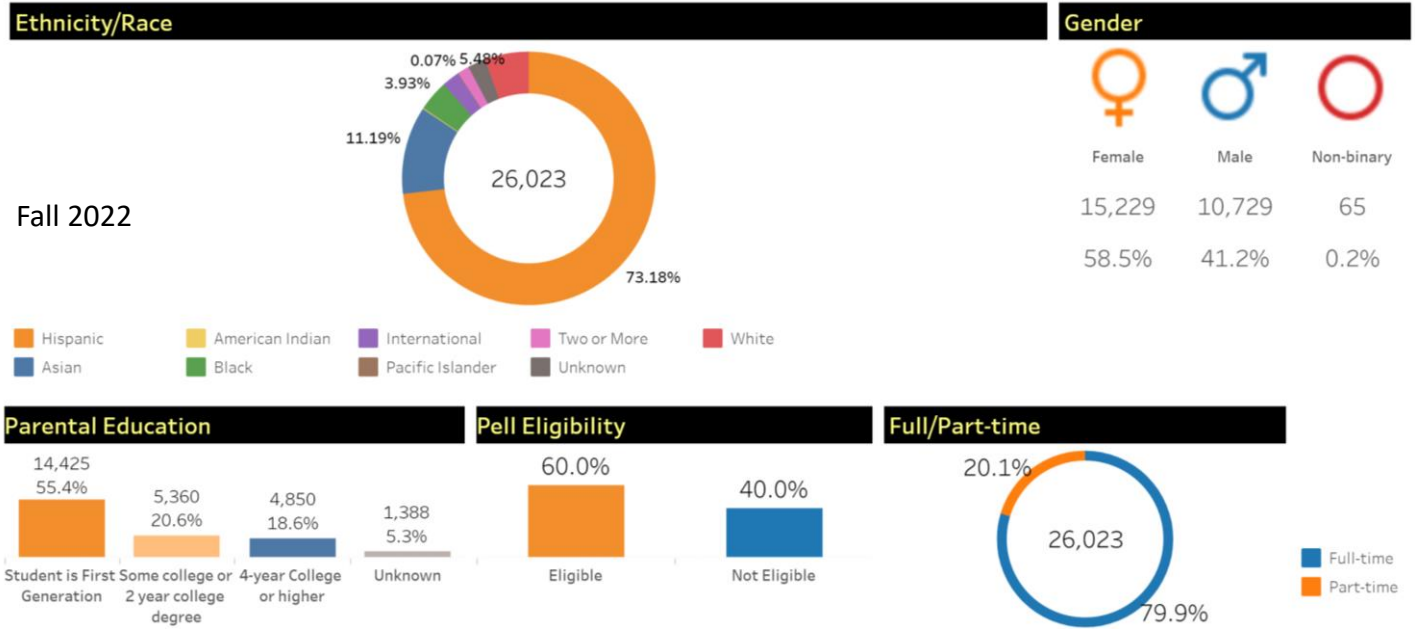
East of Downtown LA

Hydrogen Research and Fueling Facility

Ecocar

More About Cal State LA

- Ranked #1 for upward mobility for our students
- Having one of the most diverse student populations in the nation.
- Ranked #4 for most diverse faculty in nation



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Tasks

- **Task 1.0** - Project Management and Planning
  - Subtask 1.1 – Project Management Plan
- **Task 2.0** - Identify Existing University Research Thrust Areas that are Synergistic to FECM Mission Goals and Assess the Current Capabilities and Resources (to address Objective 1).
- **Task 3.0** - Determine the Resource Needs (Gaps) to Enable Competitive Standing in Future FECM Research Opportunities (to address Objective 2).
- **Task 4.0** - Describe CSULA's Current Student Education and Training Activities that Aligns with FECM Goals (to address Objective 3).
- **Task 5.0** - Discuss Additional Needs to Enhance the Education and Training of Minority Students from Underrepresented and Structurally Marginalized Communities (to address Objective 4)
- **Task 6.0** – Assess the Potential for National and International Collaborations on Research and Education in Decarbonization (to address Objective 5)
  - Subtask 6.1 – Assessment of Potential Research and Education Partnership with National Laboratories and Local Industry
  - Subtask 6.2 - Assess Local Political and Legislative Processes related to Carbon Management.

Project Timeline

Task Name	Assigned Resources	Year 1			
		Q1	Q2	Q3	Q4
1.1 - Project Management and Planning	PI				
2.0 - Identify Existing Research Thrust Areas that are Synergistic to FECM Mission Goals and Assess the Current Capabilities and Resources	Team				
Milestone A: research areas identified and assessed	Team				
3.0 – Identify Resources Needed to Enable Competitive Standing in Future FECM Research Opportunities	Team				
Milestone B: Identified Resources Needed to Enable Competition	Team				
4.0 – Describe CSULA's Current Student Education and Training Activities	Team				
Milestone C: Current Student Education and Training Activities Summarized	Team				
5.0 - Identify Additional Needs to Improve the Education and Training of Minority Students from Underrepresented and Structurally Marginalized Communities	Team				
Milestone D: Identified Needs to Improve the Education and Training of Minority Students	Team				
6.1 - Assessment of Potential Research and Education Partnership with National Laboratories and Local Industry	Co-PI and students				
Milestone E: Potential Research and Education Partnership Assessed	Co-PI				
6.2 - Assessment of Local Political and Legislative Processes related to Carbon Management.	PI and Co-PI				
Milestone F: Local Political and Legislative Processes related to Carbon Management Assessed	PI and Co-PI				
Final Report	PI and Co-PI				

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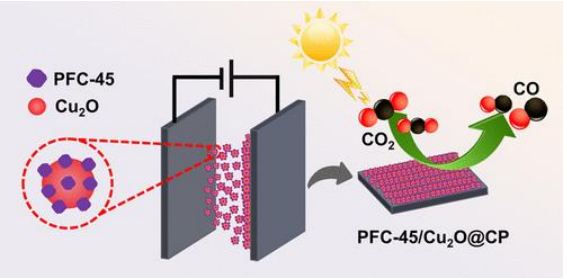
Task 2.0 - Identify Existing University Research Thrust Areas that are Synergistic to FECM Mission Goals and Assess the Current Capabilities and Resources (to address Objective 1)

- Identify research thrust areas synergistic to FECM mission goals
- Current personnel and their relevant expertise and experience
- Current awards received from DOE/NETL and other funding agencies in relevant research areas
- Existing facilities and equipment for the relevant research areas
- **Methods**: Web search, emails, interviews, and questionnaires/surveys

Task 2.0 - Identify Existing University Research Thrust Areas that are Synergistic to FECM Mission Goals and Assess the Current Capabilities and Resources (to address Objective 1)

Identified Research Thrust Areas:

1. Hydrogen with Carbon Management
2. CO_2 Removal and Conversion
3. Point-Source Carbon Capture

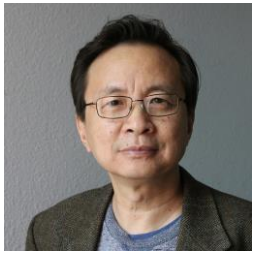


Current Personnel and Expertise/Experience

Faculty Members/Research Staff:

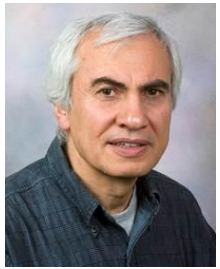
Dr. Yangyang Liu
Associate Professor
(Chemistry)

Dr. Matthias Selke
Professor
(Chemistry)



Dr. Yong Ba
Professor
(Chemistry)

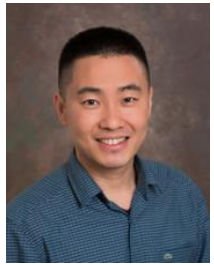
Dr. Dianlu Jiang
Senior Research Scientist
(Chemistry)



Dr. Radi Jishi
Professor
(Physics)

Dr. David Blekhman
Professor
(Technology)

Dr. Arezoo Khodayari
Associate Professor
(Civil and Environmental Engineering)



Dr. Travis Hu
Associate Professor
(Mechanical Engineering)

Expertise/Experience Overview

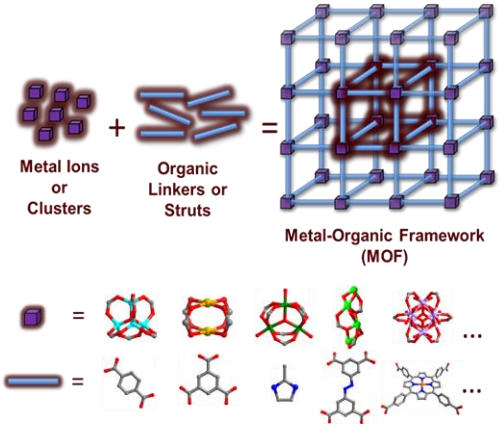
- **Dr. Yangyang Liu** – Functional porous materials for hydrogen storage, carbon capture, and conversion.
- **Dr. Matthias Selke** – The photochemistry and mechanisms of photocatalysts including those used for carbon dioxide conversion.
- **Dr. Yong Ba** – Structural characterizations of materials and the study of material-gas interactions using solid-state NMR techniques.
- **Dr. Dianlu Jiang** – Photocatalytic/semiconducting materials for hydrogen generation from water splitting.
- **Dr. Radi Jishi** – Molecular modeling of materials used for renewable energy applications
- **Dr. David Blekhman** – Hydrogen research and fueling facility, hydrogen generation with renewable energy, fuel cell, and electric vehicles.
- **Dr. Arezoo Khodayari** – Sustainable engineering solutions for air and water pollution prevention and control; post-combustion carbon capture.
- **Dr. Travis Hu** – Nanomaterials for hydrogen evolution; multiscale modeling and simulation.

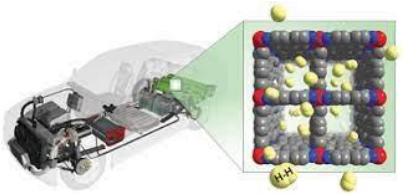
Expertise/Experience Highlights

Materials Chemistry

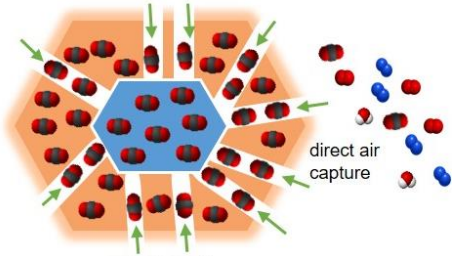
Metal-organic frameworks (MOFs)

- Hydrogen storage
- Carbon capture and storage
- Carbon dioxide conversion





Hydrogen Storage



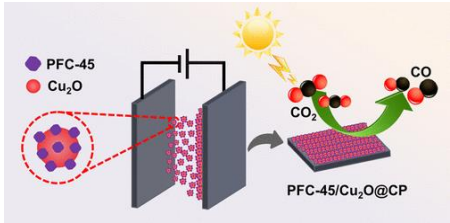
Carbon Capture

Dr. Yangyang Liu

Extremely high surface area:

1 g

> 5000 m^2



CO_2 Conversion

Expertise/Experience Highlights

Dr. David Blekhman

Hydrogen and Renewable Energy Technology

- Fulbright Distinguished Chair in Alternative Energy Technology, Chalmers University of Technology, Sweden (2019-2020)
- Technical Director, Hydrogen Research and Fueling Facility (2008-Present)
- Author-contributor to Forbes for Heavy Duty Hydrogen Transportation (2020-Present)
- Vice President, Research: Advanced Vehicle & Hydrogen Technology for Advanced Transportation Center of Southern California (2014-2017)
- Lead faculty, Shared Mobility “WaiveCar” with Hyundai Fuel Cell Vehicles (2018-2020)
- Lead faculty, Electric Vehicle Recharging Infrastructure on campus (2010-Present)
- Lead faculty, Photovoltaic Installation (2007-2010, 2015-2018)
- Lead advisor for competition teams: EcoCAR3 (2014-2018), EcoCAR2 (2011-2014), Supermileage (2008-2014), Shell Eco (2010-2011), Hydrogen Student Design Contest (2009-2018)

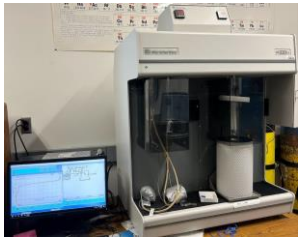
Current Awards (Highlights)

Awards received from DOE/NETL and other funding agencies in relevant research areas

- In 2023, Dr. Yangyang Liu received funding from DOE EERE to develop porous materials for hydrogen storage.
- In 2023, Dr. David Blekhman received CSU Wang Family Excellence Award in Outstanding Scholarship for developing hydrogen research and fueling facilities.
  - ✓ 2023 – 2025 $152 K PI for subaward to Cal State LA from Symbio $10M award , “Symbio Fuel Cell Manufacturing”, funded by California Energy Commission
  - ✓ 2022 – 2023 $200K, Co-PI, “R&D Scoping Study and Infrastructure Self-Assessment of Fossil Energy and Carbon Management,” funded by the Department of Energy
  - ✓ 2022 – 2025 $500K, PI, “California ZEV Engineering Workforce Pilot by Cal State LA and Cerritos Community College,” funded by California Energy Commission
  - ✓ 2022 – 2023 $63K PI for subaward to Cal State LA from Rocketruck $206K “Mobile Fuel Cell Generator”, Department of Energy STTR Phase I
  - ✓ 2020 – Perpetual $625K, PI, SCAQMD endowed graduate research scholarship for graduate clean air research.
- In 2022, Dr. Arturo Pacheco-Vega along with 23 other faculty members received $5M from NSF for establishing a new NSF CREST Center for Advancement toward Sustainable Urban Systems (CATSUS).

Existing Facilities and Equipment (Highlights)

College of Natural of Social Sciences

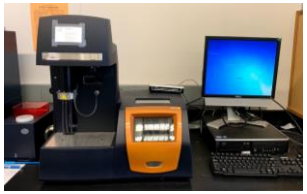


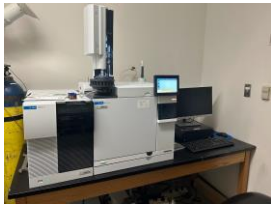
NMR Facilities

- Two Avance II 400 MHz NMR (Bruker)
- Avance 600 MHz NMR with solid-state capability (Bruker)

Equipment for Materials Chemistry

- Powder X-ray diffractometer (Bruker)
- Surface area analyzer (Micromeritics)
- Thermogravimetric Analyzer (Discovery TGA55)
- Gas chromatography (GC)-MS/MS (Agilent)





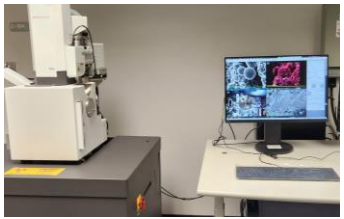
College of Engineering, Computer and Technology

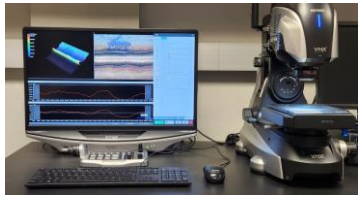
Hydrogen Research and Fueling Facilities

- Hydrogen GCMS
- Fueling station

Materials Characterization Laboratory

- Scanning electron microscopy (SEM)
- Atomic force microscopy (AFM)
- Optical microscopy
- Transmission electron microscopy (TEM)





Tasks to be performed

- **Task 1.0** - Project Management and Planning
  - Subtask 1.1 – Project Management Plan
- **Task 2.0** - Identify Existing University Research Thrust Areas that are Synergistic to FECM Mission Goals and Assess the Current Capabilities and Resources (to address Objective 1).

To do (next 3 quarters):

- **Task 3.0** - Determine the Resource Needs (Gaps) to Enable Competitive Standing in Future FECM Research Opportunities (to address Objective 2).
- **Task 4.0** - Describe CSULA's Current Student Education and Training Activities that Aligns with FECM Goals (to address Objective 3).
- **Task 5.0** - Discuss Additional Needs to Enhance the Education and Training of Minority Students from Underrepresented and Structurally Marginalized Communities (to address Objective 4)
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  - Subtask 6.1 – Assessment of Potential Research and Education Partnership with National Laboratories and Local Industry
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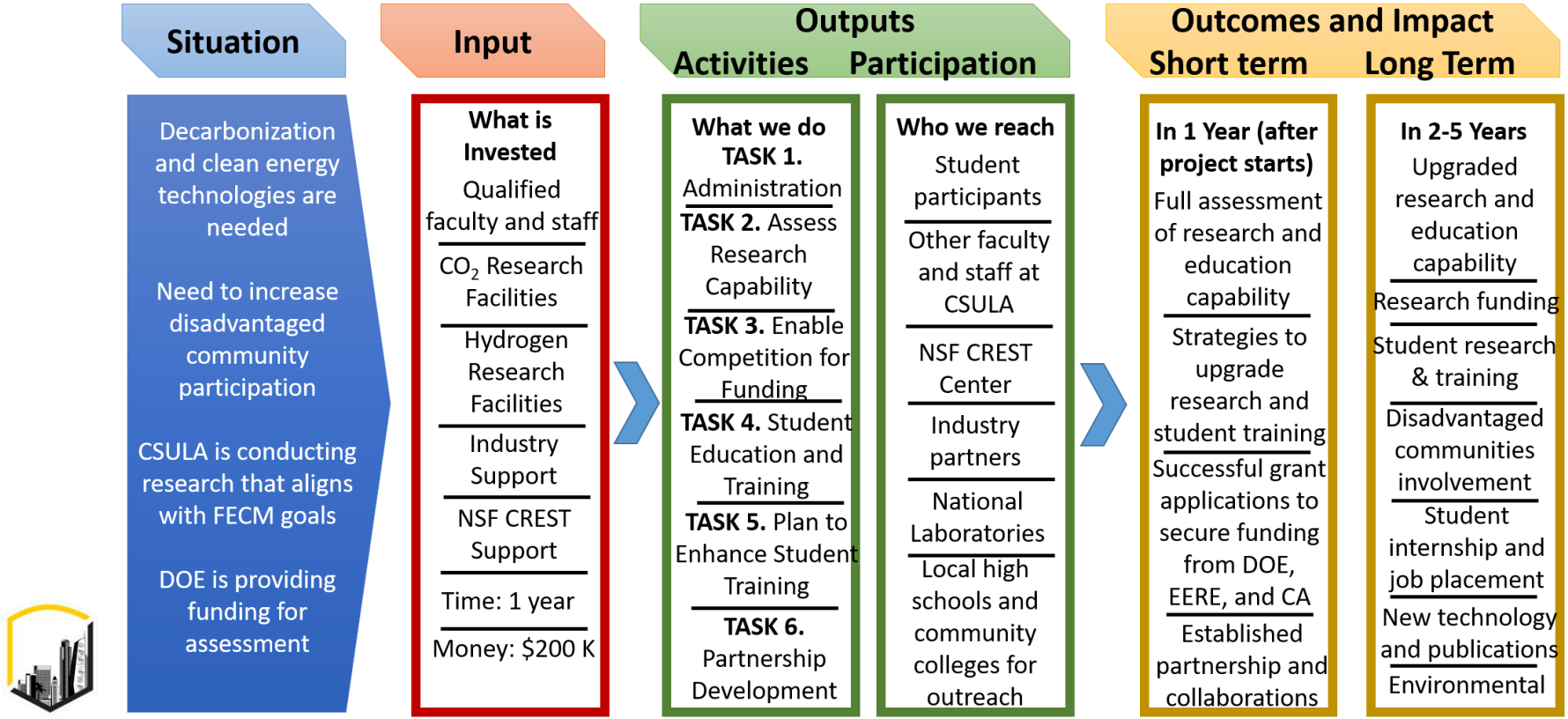
Logic Model



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Summary and Impact

- During the first quarter of this project, we have identified three research thrust areas that are synergistic to FECM mission goals.
- We also assessed the personnel, their expertise and experience in the related areas.
- A list of current awards as well as existing facilities and equipment in relevant areas were summarized.

- Strategies will be developed to enable Cal State LA to compete for future funding opportunities on FECM technologies.
- An increased number of minority students from disadvantaged communities will participate in decarbonization research and education.


THANK
YOU!