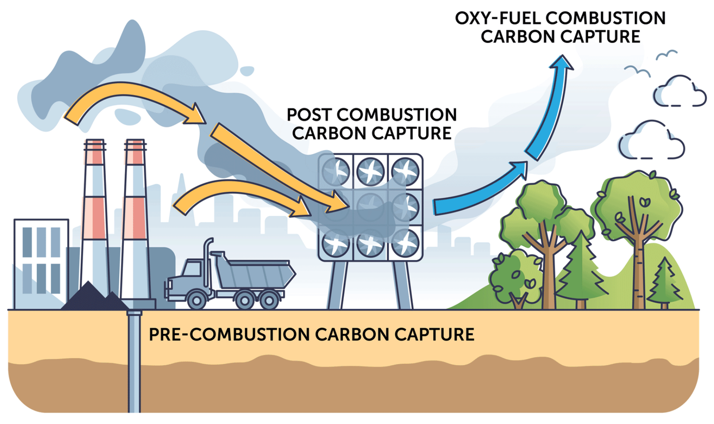
Boiler Room System

Team Members: Alex Kieu, Jordy Gutierrez, Jesus Noriega, Tianle Tan, Victor Ramirez
Faculty Advisor: John L Williams
SoCalGas

Departments of Electrical Engineering and Mechanical Engineering
College of Engineering, Computer Science, and Technology
California State University, Los Angeles

Project Background

Carbon dioxide (CO_2) is a major greenhouse gas and a key contributor to global warming. Although the adoption of renewable energy continues to grow, heavy industries such as cement production, steel manufacturing, and fossil fuel-based power generation still emit significant amounts of CO_2. Integrating carbon capture technologies at these emission points provides an effective strategy to reduce atmospheric carbon levels, mitigate climate change, and support a more sustainable industrial future.



Objective

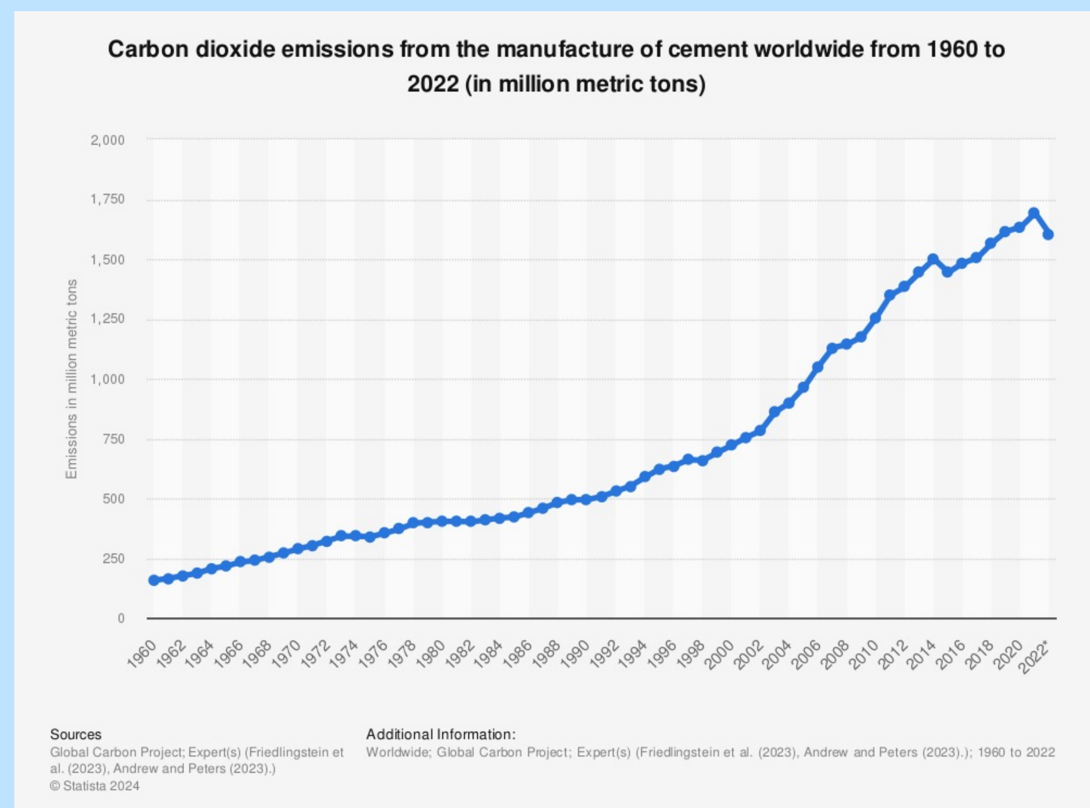
The primary objective of this project is to upgrade the existing facility at California State University, Los Angeles, to improve its environmental efficiency and sustainability. Additionally, the project aims to develop a scalable model that can be implemented at other campuses and schools across California. The focus is on adapting existing carbon capture technologies to reduce emissions from the campus boiler, thereby contributing to the reduction of overall carbon emissions in the state. Simultaneously, the project will explore solutions for the storage and long-term management of the captured carbon.

System Requirements

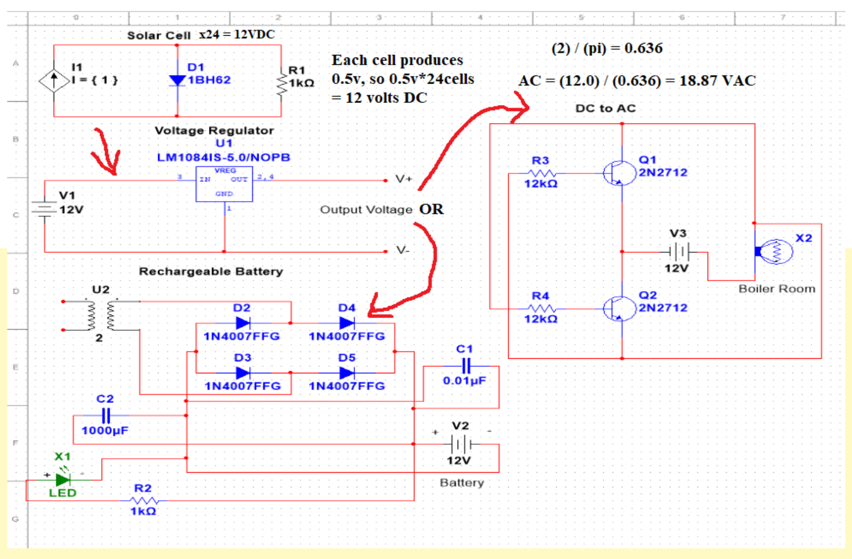
Design Description Requirements
- Cost: Cost > $30,000
- Space: 4m x 6m
- Material: Stainless Steel
- Time for one cycle: t > or = 3 hours
- Pump(Large Size): ~ 30 L/min
- Water Cooling: > or = 6kW
- Plate Exchange (Largest Size): Heat Transfer are > or = to 37.7 sq ft
- Amount of CO2 Captured: 30%

Reasons for Requirements
- lower the cost
- be able to push the fluid for the system
- cooling the temperature from 120 C to 20 C
- be able to cool within 2hrs

Our design cost came to around $28,640 without accounting for any labor or electricity. Since our team can't perform on a real-life boiler system, we are just assuming we are in a perfect world. In terms of selling, we were able to determine that each cycle will produce 32 kgs of CO2 and by doing so we would place that CO2 into containers and be able to sell each container for about $7 per kg. This would only be possible if the purity of the CO2 is approximately 90% or better.



Electrical Evolution



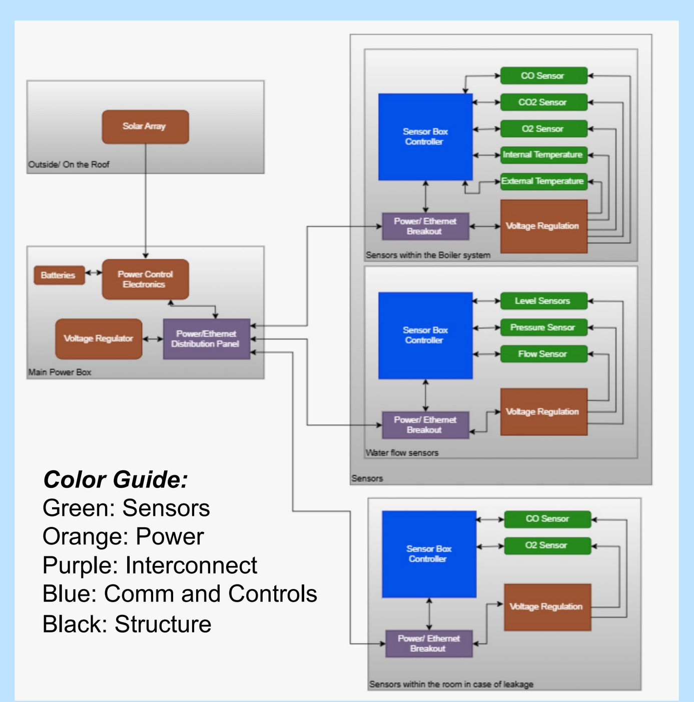
Values may change depending on power consumption needed: *24 total volts used in our case*

Solar Panel (PV Cell):
- Converts sunlight into DC electricity
- Represented as the source of current

Blocking Diode:
- Prevents reverse current flow from the load or battery to the panel during the night

Capacitor:
- Acts as a filter to smooth out the voltage ripples

Load:
- Represents the device consuming electricity, such as a DC motor, LED, or battery for charging

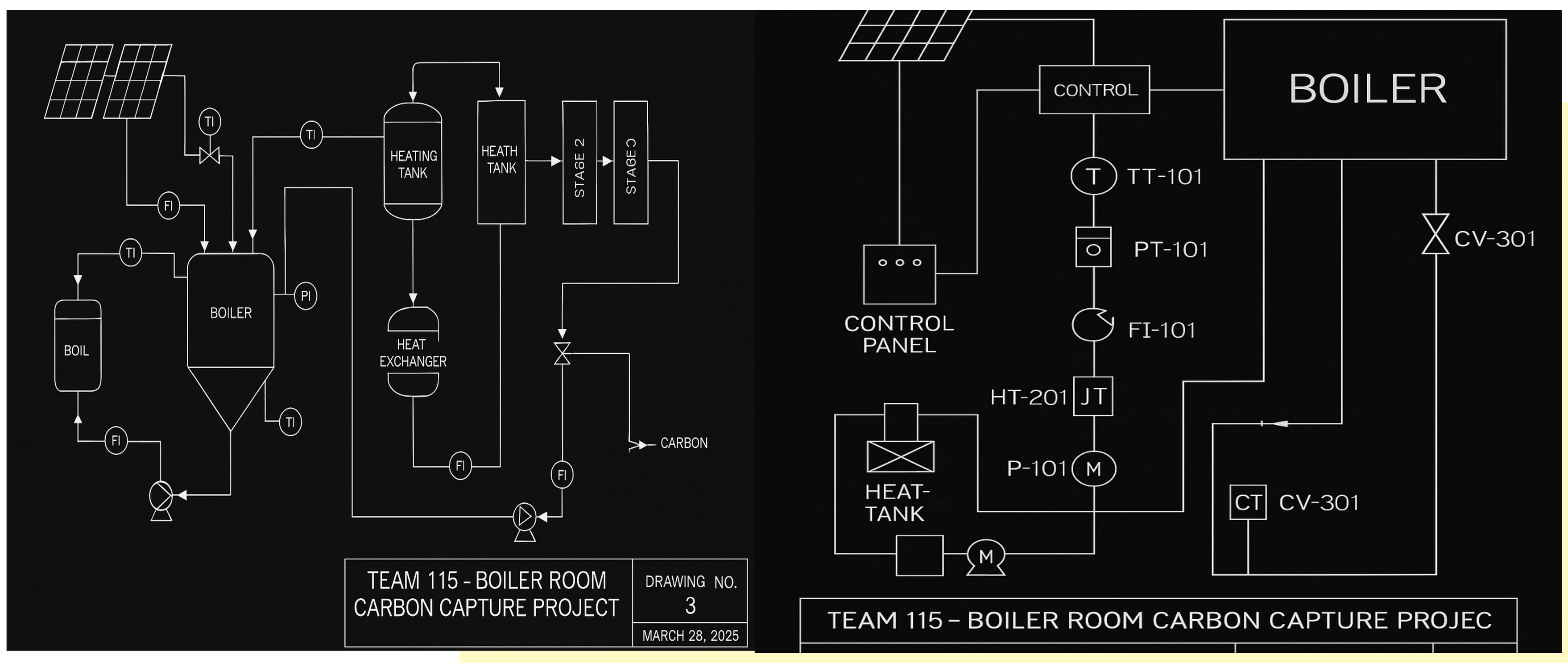


System block diagram for sensors within the boiler system

Connections:
- Positive (+) and negative (-) terminal are marked for proper orientation

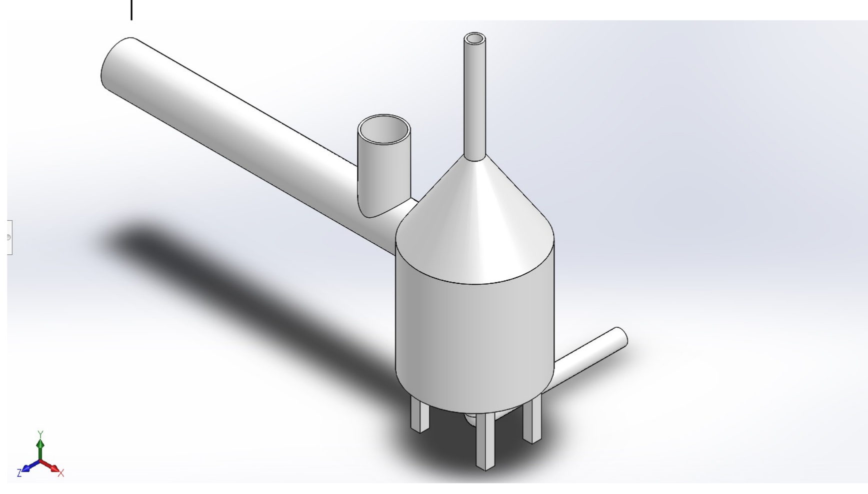
Battery (optional):
- Stores excess energy generated by the solar panel for later use, use as at night or when needed

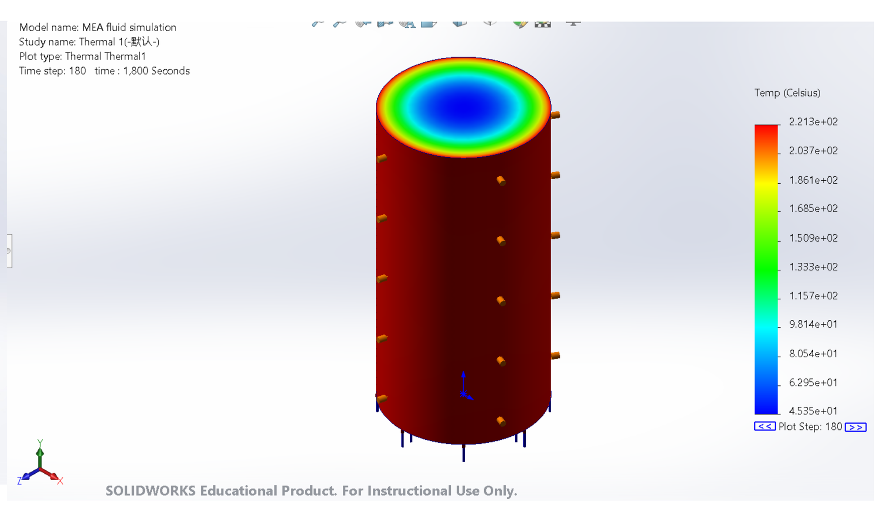
Simulated Design Using AutoCAD



- Electric Schematic Design (right)
- Piping and instrumentation design (left)
- P&ID and electrical schematics are essential for project construction and valuable for developing core skills in electrical engineering.

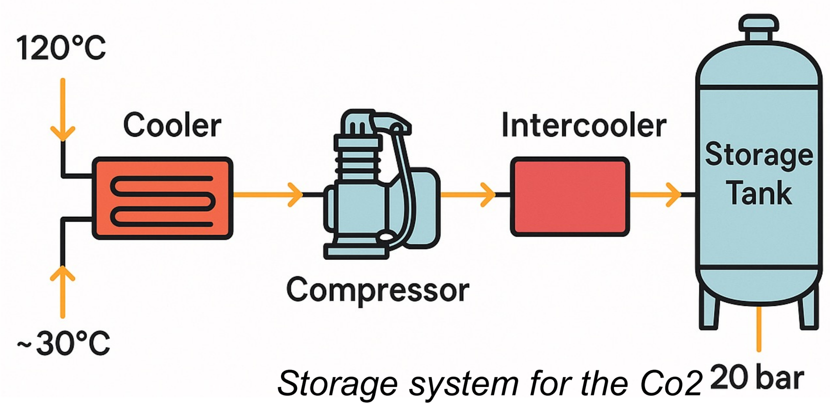
Mechanical Evolution



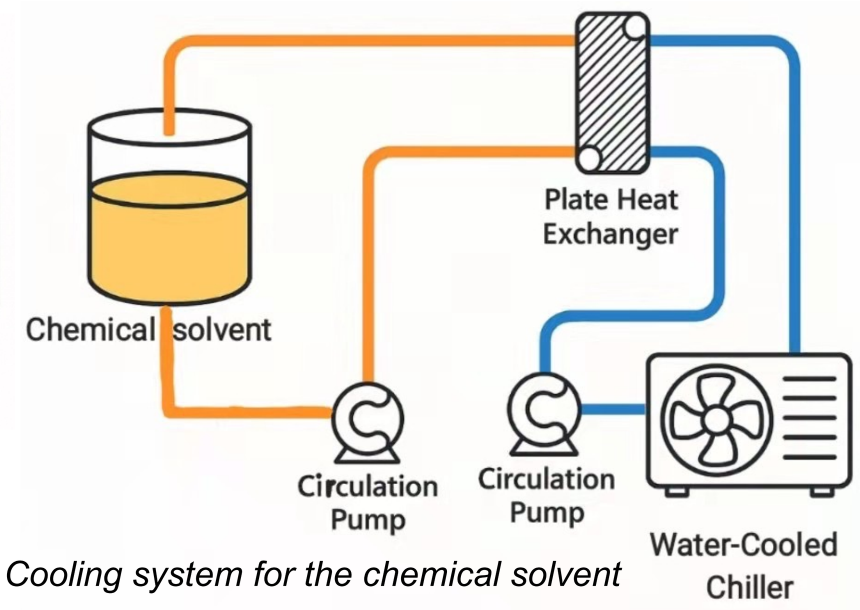


SolidWorks simulation for the heating process

SolidWorks Design:
- Gas flow it in on the left side
- First vertical tube led to the exhaust
- Second vertical tube led to the compressor process
- Cylinder tank for Heat up the Chemical solvent after it fully absorb
- Bottom tube led to cooling the chemical solvent for reuse propose



Storage system for the Co2

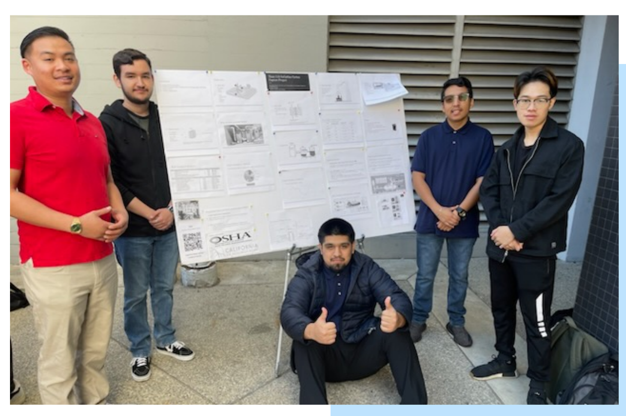


Cooling system for the chemical solvent

Conclusion

- We are expecting to reduce 30% of the Carbon that produce by the boiler on campus
- Looking forward to have a small scale of the system to verify the prediction
- Improve the efficiency of the system and the purity of the CO2

Project Team



Left to Right:
Alex Kieu- E.E.
Jesus Noriega-E.E.
Victor Ramirez-M.E.
Jordy Gutierrez- E.E.
Tianle Tan- M.E.