Hydrogen Production Using Solar Electricity
Capstone 2.0 – Team 12

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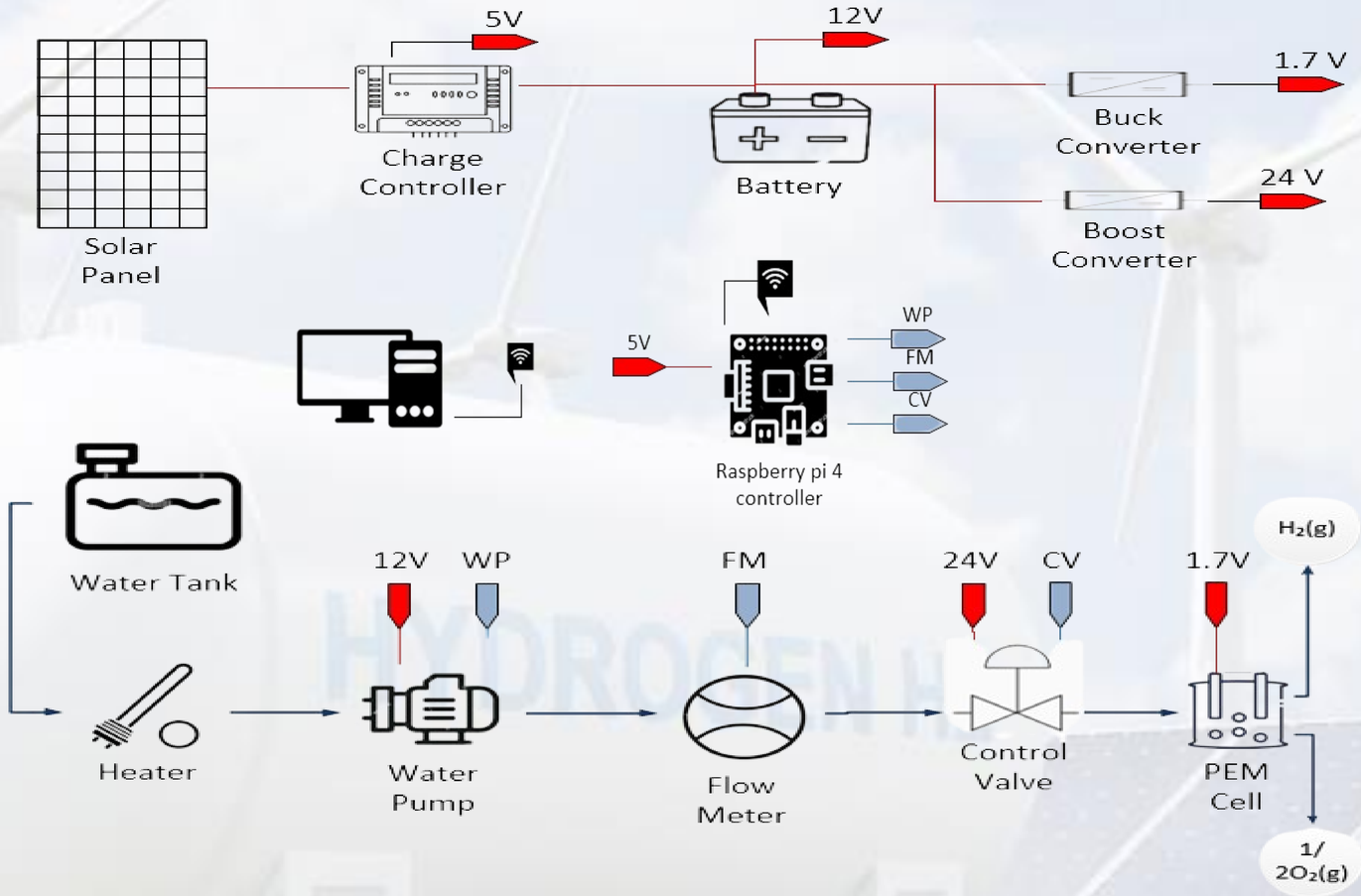
1. OBJECTIVES

The objective of this project is to develop an automated device that can reduce the carbon dioxide emissions in Saudi Arabia by splitting liquid water into green hydrogen and oxygen using solar electricity.

2. SPECIFICATIONS AND CONSTRANITS

- CONSTRANITS
  - Working in a safe area.
  - Operating pressure shouldn't exceed 10 bar.
  - Operating temperature shouldn't exceed 70 ℃.
  - Needed out doored space for testing the solar panel.
  - Some equipment requires relatively high voltage.
  - Water flowmeter cannot sense less than 1 L/min.
- SPECIFICATIONS
  - Hydrogen Production Rate 50 mL/min.
  - 99% Outcome purity of the outlet gases.
  - System efficiency should be around (50-80) %.
  - Clean source of electricity.
  - PEM cell voltage < 1.8V.
  - PEM cell current < 10A.
  - Power consumption < 48Wh.
  - Solar panel open circuit > 12V.

3. PROTOTYPE DESIGN



4. VERIFICATION & VALIDATION OF MEETING THE SPECIFICATIONS

- With PEM cell designed at 1.7V and current at 6.54A, the power consumption was estimated as 44.48Wh.
- Outlet gases were separated from each other.
- Normal operating conditions have been performed.
- The achieved system efficiency approximately equal 87%.

5. CONCLUSION AND FUTURE RECOMMENDATION

- The three main subsystems meet the specifications.
- The PEM Electrolyzer proved that it is a valid solution to produce green hydrogen and reduce carbon dioxide emissions in Saudi Arabia.
- The cost for installing this small-scale PEM Electrolyzer is relatively low compared to other solutions.
- For future recommendation, using more than 1 PEM cell to achieve a higher production rate than only 1 PEM cell.