Hands-On Solar Energy Projects to Enhance Learning in Electric Circuits

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Introduction:

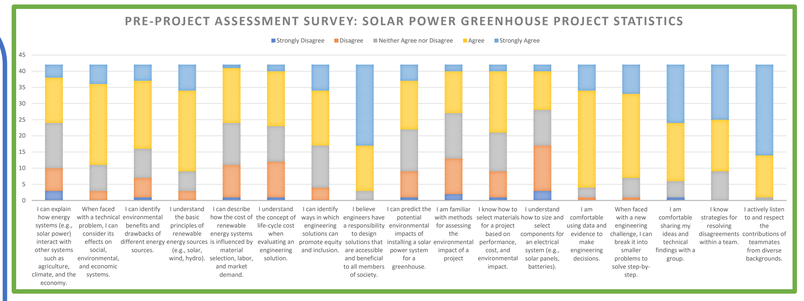
- Engineering students often struggle to connect abstract circuit concepts with real-world applications.
- Sustainability and renewable energy provide a meaningful context for applied learning.
- This project introduced hands-on, team-based solar energy activities into ENGR 2305 Electric Circuits I and ENGR 2105 Electric Circuits I Lab.
- The goal was to enhance student engagement, technical competency, and collaboration while aligning with sustainability-focused education.

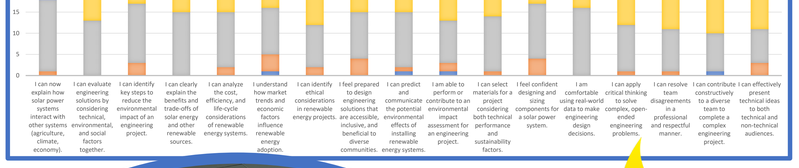
Project Overview:

- ***Courses involved:***
  - ENGR 2305 Electric Circuits I
  - ENGR 2105 Electric Circuits I Lab
- ***Participants:*** 42 undergraduate students pursuing Electrical, Computer, or Mechanical Engineering
- ***Central project:***
  - Design of a solar backup power system for the greenhouse at the HCC Katy campus.
  - Students worked in teams to solve an authentic engineering problem with real constraints.

Evaluation & Assessment:

- Measured learning outcomes included:
  - Pre- and post-project surveys indicating improvements in student confidence and applied understanding.
  - Individual progress reports
  - Presentation of proposed design in front of a Judging Panel from HCC, UT Tyler and McGraw Hill.
- Student reflections highlighted increased motivation and relevance of course content.



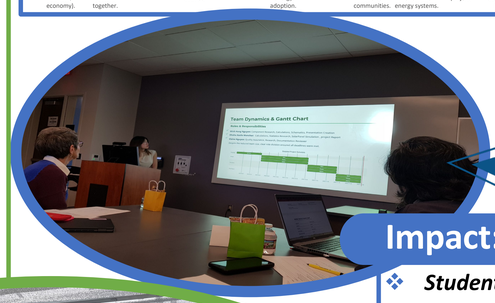


Procedure & Methods:

- New project module added to ENGR 2305 focusing on applied circuit analysis using solar energy systems.
- Two new lab experiments added to ENGR 2105: *Characterization of a photovoltaic solar panel, Series and parallel circuit analysis of solar panels*
- Students analyzed in teams voltage, current, and power requirements of the Greenhouse under varying sun-hours, and proposed a backup solar system design.
- Team-based problem solving emphasized communication, conflict resolution, and collaboration.
- Assessment tools included pre- and post-project surveys, lab reports, and project evaluations.

Progress & Plan for Scaling Up:

- The pilot implementation successfully integrated sustainability-focused projects into core circuits courses.
- ***Lessons learned:***
  - Real-world projects increase engagement and ownership of learning.
  - Structured teamwork guidance improves collaboration outcomes.
  - Clear project milestones improve technical depth and time management.
- ***Future Plans:***
  - Expanding the project to include data acquisition and performance monitoring of the solar energy system, combined with irrigation and environmental controls to support autonomous greenhouse operation and systems level analysis.



Impact:

- ***Student Impact:*** Improved engagement, stronger technical skills, and enhanced teamwork experience.
- ***Institutional Impact:*** Supports sustainability initiatives and experiential learning goals at HCC.
- ***Societal Impact:*** Prepares future engineers to address renewable energy and sustainability challenges.

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