

Computer Science Senior Design Project Description Template 2022-23

The goal of a Senior Design project is to challenge undergraduate students as they transition to industry and advance development within your organization. The project description should be written in language appropriate to undergraduate students with limited experience in your field of specialization.

Please indicate therein if your project requires US citizens only or has other restrictions.

The project description should:

- Include design, test, and build phases
- Require a maximum of 15 hours per student per week, 6 students per team
- Be approximately equivalent to a 9-month project for an entry-level engineer

Please return this form package to Amy.L.Richards@colorado.edu with a cc to nicholas.vita@colorado.edu

Project Description Template

EnergyHub
Brooklyn, NY
<https://www.energyhub.com/>

Project Title: Minimizing Energy Costs and Carbon Emissions through Load Flexibility

Industry Description and Company Products: Provide students with some information on your industry and products.

EnergyHub is a growing enterprise software company that works with the most forward-thinking companies in smart energy. Our platform lets consumers turn their smart thermostats, electric cars, water heaters, and other products into virtual power plants that keep the grid stable and enable it to operate reliably with increasing amounts of solar and wind power. We work on technology that already provides energy and cost savings to millions of people through partnerships with the leading companies in the Internet of Things.

EnergyHub is an independent subsidiary of Alarm.com (Nasdaq: ALRM). Alarm.com is the leading cloud-based platform for the smart home. Millions of home and business owners depend on Alarm.com technology every day to make their properties safer, smarter, and more efficient.

EnergyHub's primary customers are electric utilities, who purchase our "Distributed Energy Resource Management System" (DERMS) software platform. Our Mercury DERMS platform coordinates the behavior of more than 700,000 DERs, which are enrolled through more than 60 utility programs. One of the core features of the Mercury DERMS is that it gives utilities the ability to call "demand response" events in which the connected devices reduce their energy consumption during periods of peak electricity demand. This allows utilities to reduce energy costs, carbon emissions and reduces the need to build new power plants.

Contact Information: Designated technical contact (mentor) for the student team

Software engineering contact

Name, Title: Justin McCammon, Director of Data Engineering

Email: justin.mccammon@energyhub.net

Phone: 970-371-8818

Data Science contact

Name, Title: Paul Hines, VP, Power Systems (and data science)

Email: paul.hines@energyhub.net

Phone: 802-999-4537

Why students should choose this project: Students are presented with a selection of projects from our industry partners so they can select the one that best matches their interests and skill set. Consider adding information in this section as to why you feel your project would be an appealing senior design experience.

This project will give students the opportunity to directly contribute to one of the most important climate problems of our time: reducing greenhouse gas emissions in the electricity industry. This project will give students the opportunity to develop skills in data engineering, data science, web app design and front end development. And you will learn about the rapidly changing energy IoT (Internet of Things) sector. We do not expect that this will be an easy project, but it will be one that will challenge you to develop new skills that will provide a wide range of future career opportunities in the growing climate-tech sector.

Project Background and Objective: Brief explanation of the company, project, and desired objective(s).

As mentioned previously, the EnergyHub DERMS allows utilities to call demand response (DR) events to reduce peak loads. The goal of this project is to identify new strategies for calling DR events based on carbon reduction and energy cost reduction. The project will use publicly available data from electricity markets, along with third-party data for electricity-sector carbon emissions, to measure the impact of particular DR events. Once this impact measurement system is ready, you will next develop and test strategies for automatically calling DR events based on streaming price and carbon data for particular locations, given specified constraints such as the number of events that can be called per season. The resulting system will be usable through a web-app that provides users with deep insight into the impact associated with various strategies.

Project Requirements: The project requirements and constraints should be stated in broad and simple terms. The specific requirements will be established between the client and the team.

The following are high-level requirements for this project:

- All code should be written in Python, Java and/or JavaScript.
- Data should be stored in a relational database with a well-documented schema and SQL for ETL.
- The project should use only publically available data and data provided by EnergyHub
- All open-source software used should have well-documented license terms that are compatible with commercial use
- The resulting software should have a well-documented API that can be called by other software modules, and also a web-app front end.

Deliverables: The client is asked to indicate the desired deliverables in the project. The final deliverables will be established through negotiation between the team and the client as a stage of the project.

The key deliverables that will result from this project are the following:

- A web-app that can be used to view and evaluate results from a particular strategy
- Code deposited to a github repository
- A relational database with all source data loaded
- Documentation sufficient for future users to improve on the results

Skill Requirements: The client is asked to suggest the skill areas the students may need in order to complete the project.

- Experience with data manipulation in Python/Pandas
- Experience with databases and SQL
- Experience developing web-based data visualizations
- An understanding of the core principles of power and energy

Images: Please include relevant images for this project. For example, these can be existing designs on which you would like the students to improve or photos of an existing apparatus with which they may work.

Figure 1 below shows the power consumption (per device) for a group of electric vehicles, thermostats and batteries. Each of these devices responds to the DR event in a different way.

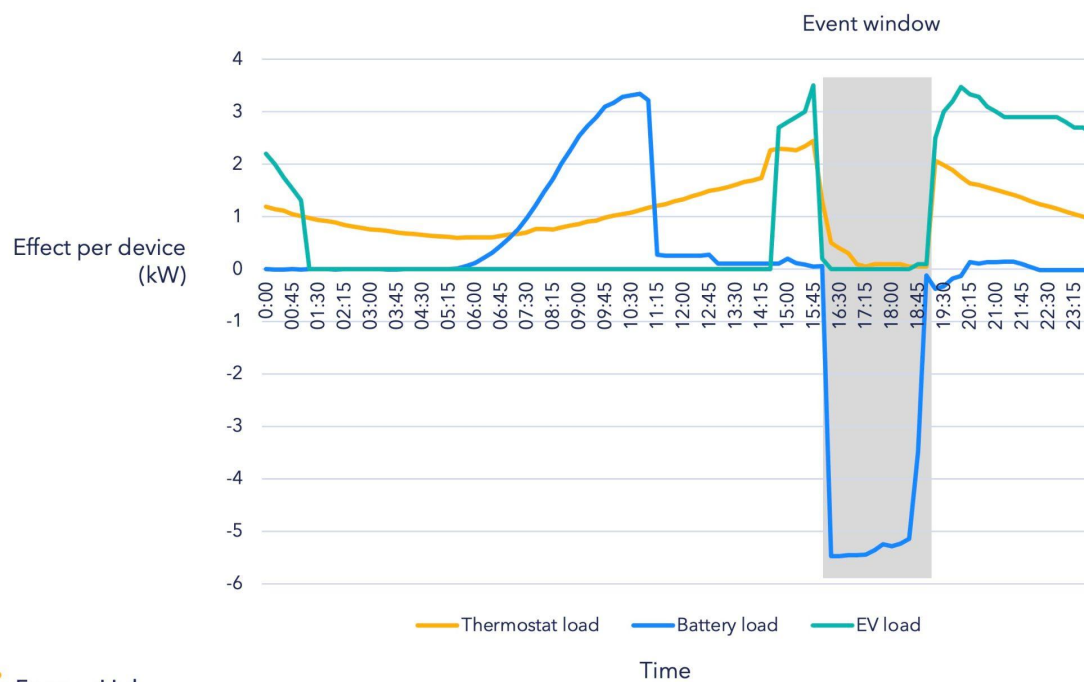


Figure 1. Timeseries of power consumption for a group of thermostats, batteries, and electric vehicles. The data are normalized to show the average load (power) per device. The DR event window is shown in gray.

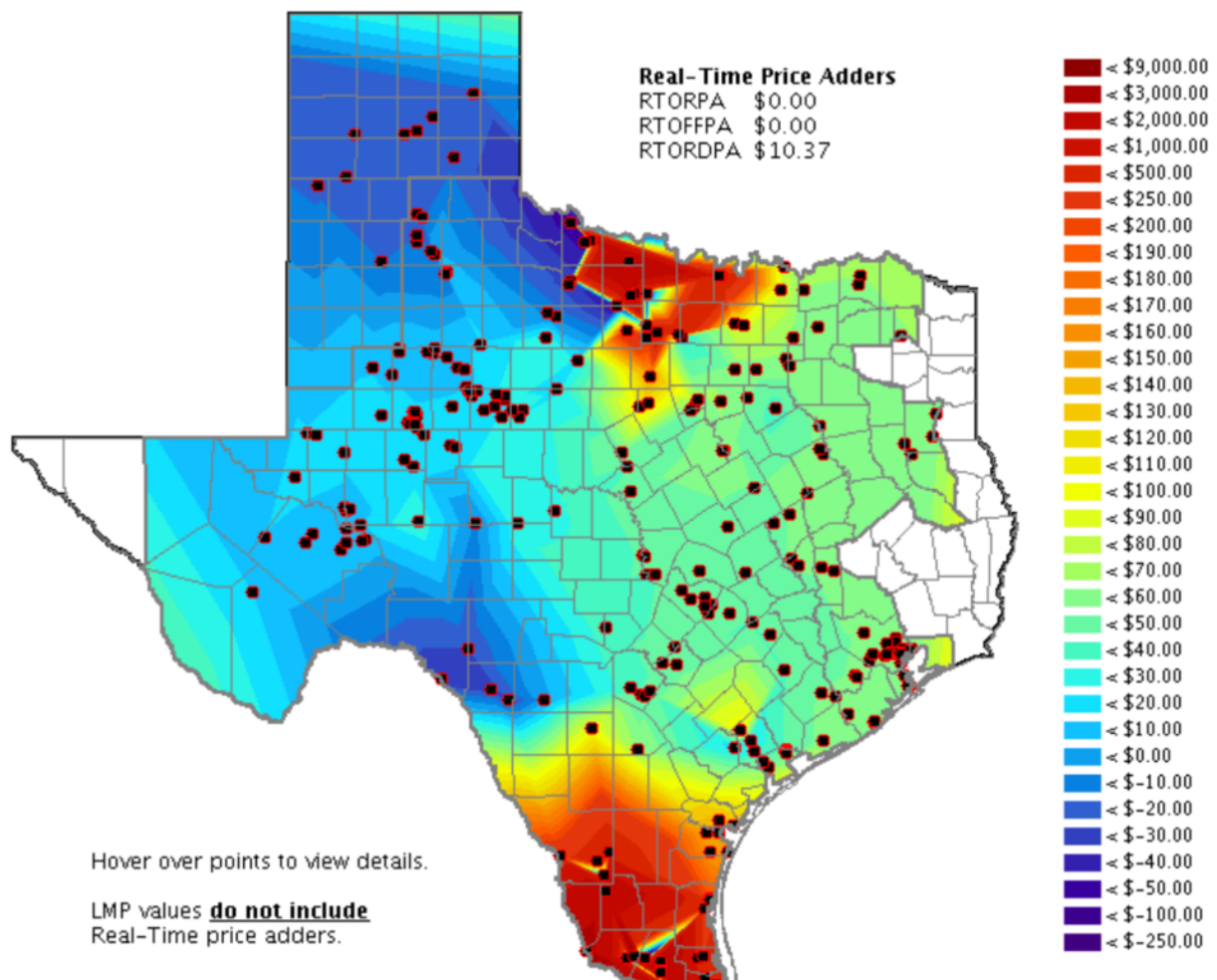


Figure 2. The price of electricity in Texas for a sample day. As shown some locations have much higher prices (and also carbon emissions) than others, suggesting that different strategies will be needed for different locations. (source: ERCOT)