

# 1. Introduction

## 1.1. PROBLEM STATEMENT

The Iowa State University campus requires a modernized microgrid to meet growing energy demands, enhance resilience, and support sustainability goals. Currently, the Iowa State Microgrid has functional limitations and needs future planning upgrades to ensure long-term energy reliability. These upgrades include connecting the entire campus to the microgrid, planning for future load growth, adding protection coordination to prevent large-scale outages, and replacing outdated, non-functional equipment. Incorporating renewable energy sources such as solar panels and small-scale wind turbines is also crucial, though the landlocked nature of the campus poses challenges for grid integration. Our project involves designing and modeling an upgraded electric distribution microgrid for Iowa State's campus, along with developing a plan for a substation that will effectively manage the new microgrid.

The problem we're addressing stems from the clear need for upgrades, highlighted by the August 2023 overload in power demand that resulted in a fire at the campus power plant. This incident led to power outages, canceled classes, and disruptions in dormitory power supply, underscoring the urgency for a more resilient grid. As new buildings and increasing technology demands continue to drive power usage upward, future planning for load growth is essential. Factors such as electric vehicle charging stations, air conditioning in every dorm, and expanding classroom technologies will contribute to rising power demands. Our project will not only project future load growth to ensure continued power supply but also focus on improving protection coordination by introducing devices like reclosers, which will prevent large-scale faults and mitigate the risk of similar incidents occurring again.

## 1.2. INTENDED USERS

The microgrid and substation design and upgrade plans have three primary users: Iowa State Utilities, Landowners in the area, and Power Consumers on campus.

### 1.2.1 Iowa State Utilities

Iowa State Utilities could be considered the primary user of our product. This group includes all the employees working in the utilities and facilities department at Iowa State University, focusing on those who deal with power generation and power distribution for the campus. All workers who deal with the power distribution and generation facilities on the university microgrid will be considered the users of our design.

The primary need for the campus utility group will be the ability to understand and interpret our designs and upgrade plans. The models, data, and cost estimates that we present to the utility department need to be able to be interpreted by different people and departments within ISU Utilities. As part of our deliverables we will be providing a list of potential reliability upgrades,

possible locations and designs to install renewable energy, and a list of other upgrades we plan to make to plan for future load growth within the campus microgrid.

One of the largest parts of our deliverables is to provide approximate cost estimates to ISU utilities for all of our proposed designs and ideas. These estimates, as well as our designs, will help our primary user, ISU Utilities and the university as a whole determine if these upgrades to the system are projects they would like to go through with. The University will have to value our proposals as part of the process to determine the value they will receive from our proposed upgrades to the university microgrid and the ISU substation.

### 1.2.2 Local Landowners

Local Landowners are the people who own land around Ames. Specifically people who own empty lots that may be bought for energy production.

The local landowners need their land to be used in a way that benefits them. There needs to be a balance between the benefits of us using the land and the negative impacts. Wind turbines, for example, may create too much noise if the land is near populated areas. The landowners will not allow us to use their land if our project does not benefit them.

Our project will benefit local landowners as it may become a source of income for them. We may have to rent the land or outright buy it. This would provide income for the landowner. The landowner may also benefit from the moral satisfaction of renewable energy being used on their land.

### 1.2.3 On-Campus Power Consumers

The On-Campus Power Consumer user is a more broad group than the other more specifically defined users. This group includes Iowa State University students, staff, faculty members, and other groups that may not be on campus with as high of a frequency like visiting prospective students, companies giving presentations or participating in club-sponsored activities, and academic conferences that are held on campus.

The main need for the power consumer user will be the need for consistent access to power. That is because their uses for power will include heating and cooling, lighting, and the ability to charge and use technology. These functional needs are currently met, but there have been incidents in the past due to external factors (like weather or power plant fires) where these services have not been readily available. In those cases, the users lose access to electricity and are unable to have their needs met in buildings on the microgrid.

This user group, unlike the other two, is not concerned with the design specifications of the proposed design like the cost value of upgrades or more effective grounding studies. They will, however, derive value from a more consistent source of power. Less power outages and shorter periods when power is lost or shut off for maintenance will mean more productive time available to the consumer on campus, which will lead to higher satisfaction levels. The more environmentally conscious consumers will also benefit from proposed sources of renewable

energy, since these sources would reduce the carbon footprint of the Iowa State microgrid and align with their values of protecting the environment.

## [APPENDIX](#)

[Empathy Map](#)

[Utilities Power Plant Data](#)

[OpenDSSModelNotes](#)

[ISU Energy Data](#)

[User Needs and Requirements](#)

[Lightning Talk 2: Users and Needs](#)

[Transmission Project Scope](#)