1.1 Problem Statement

What problem is your project trying to solve? Use non-technical jargon as much as possible.

The company we would be working with is named Polar Night Energy. Their product is a thermal battery that stores energy as heat in an insulated box of 500 to 600 degrees C sand. This sand can be heated up when renewables are plentiful, then the heat can be released to heat the university via the existing district heating system.This heat can be stored for months on end, allowing the system to be charged up throughout the year, then discharged during the winter.

As a team we would create a complete cost analysis and feasibility assessment of a Polar Night Energy system at ISU. The end goal would be to submit an installation proposal to the university, if the Polar Night Energy system proves to be suitable for the university's application.

1.2 Requirements & Constraints

List all requirements for your project. This includes functional requirements (specification), resource requirements, qualitative aesthetics requirements, economic/market requirements, environmental requirements, UI requirements, and any others relevant to your project. When a requirement is also a quantitative constraint, either separate it into a list of constraints, or annotate at the end of requirement as **"(constraint)**". Other requirements can be a single list or can be broken out into multiple lists based on the category.

- Qualitative aesthetics requirements: We want our system to link into current university heating, and possibly be situated in the current power plant.
- Functional requirements: Current goal is to use Polar Night Energy to meet 100% university demand for heating for at least a day at a time. Use energy from the grid to heat sand. The heat stored in the sand will then be used to make steam and heat the university on demand.
- Resource requirements: Create design and construction documents by the end of 492. Access to information from the ISU utilities and Polar Night Energy
- Environmental requirements: The system's overall CO2 emissions are significantly lower than the current system's emission.
- Economic requirements: Purchase energy from renewable generation plants and from MISO to offset the costs of natural gas. Installation and maintenance of the heating system.

Goal-Setting, Planning, and Execution (From Team Contract)

Team goals for this semester:

- Writing up a report about power consumption information from the University.
- Making cost analysis reports for varying sizes of the system.
- Tour the university power plant.

Team goals for the year:

- Submit a fully fleshed out implementation plan to the university. Include full costs and benefits.
- Grow support from other students and faculty members who agree that the university should instal this system.

1.3 Engineering Standards

What Engineering standards are likely to apply to your project? Some standards might be built into your requirements (Use 802.11 ac wifi standard) and many others might fall out of design. For each standard listed, also provide a brief justification.

Our project relies on our ability to obtain renewable energy, store it within the facility, and distribute it throughout the campus. If our request is approved and the system is implemented some of the standards we would need are as follows:

- Electrical Code Power Storage
- NFPA 70, 72, 101 (Electrical, Fire Alarm and Signaling, Life Safety)
    - NFPA 70 is the National Electrical Code which is the standard for safe installation of electrical equipment. NFPA 72 describes the installation standard for fire alarm systems which will be required if our storage is indoors. NFPA 101 defines standards for life safety based on construction, protection, and occupancy.
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- IEEC (Iowa Electrical Examining Board)
    - Needed for required permits/licenses.

There are a variety of other standards that would relate to the implementation and construction of our proposal, however, these are beyond the scope of our project which is to submit a cost analysis and feasibility report for the thermal battery to the university, not the implementation of the thermal battery itself.

1.4 Intended Users and Uses

Who benefits from the results of your project? Who cares that it exists? How will they use it? Enumerating as many “use cases” as possible also helps you make sure that your requirements are complete (each use case may give rise to its own set of requirements).

The primary user of our project will be Iowa State University. The thermal battery will be used to reduce Iowa State’s dependence on fossil fuels by using renewable energy to store heat for later use. In other words, the battery will be “charged” with heat in the summer when the heating demand is low and it will be released in winter when demand is high.