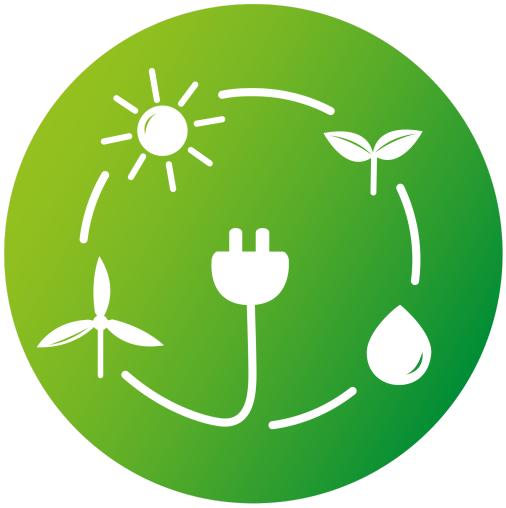
Mid Semester Project Report

Energy Experts

Group 6

Zane Mrazek, Thomas Camilli, Julianna Iannini, Melissa Duff, Michael Wertz, Tj Cilvick, Matthew Volpe



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Problem Statement

Identify trends in energy demand from a versatile database for TCNJ campus buildings regarding energy costs, building square footage, energy usage types, building types, building age, and occupancy for TCNJ campus buildings. There needs to be a more efficient way to view this data and draw conclusions from patterns in the database.

Objective of the Module

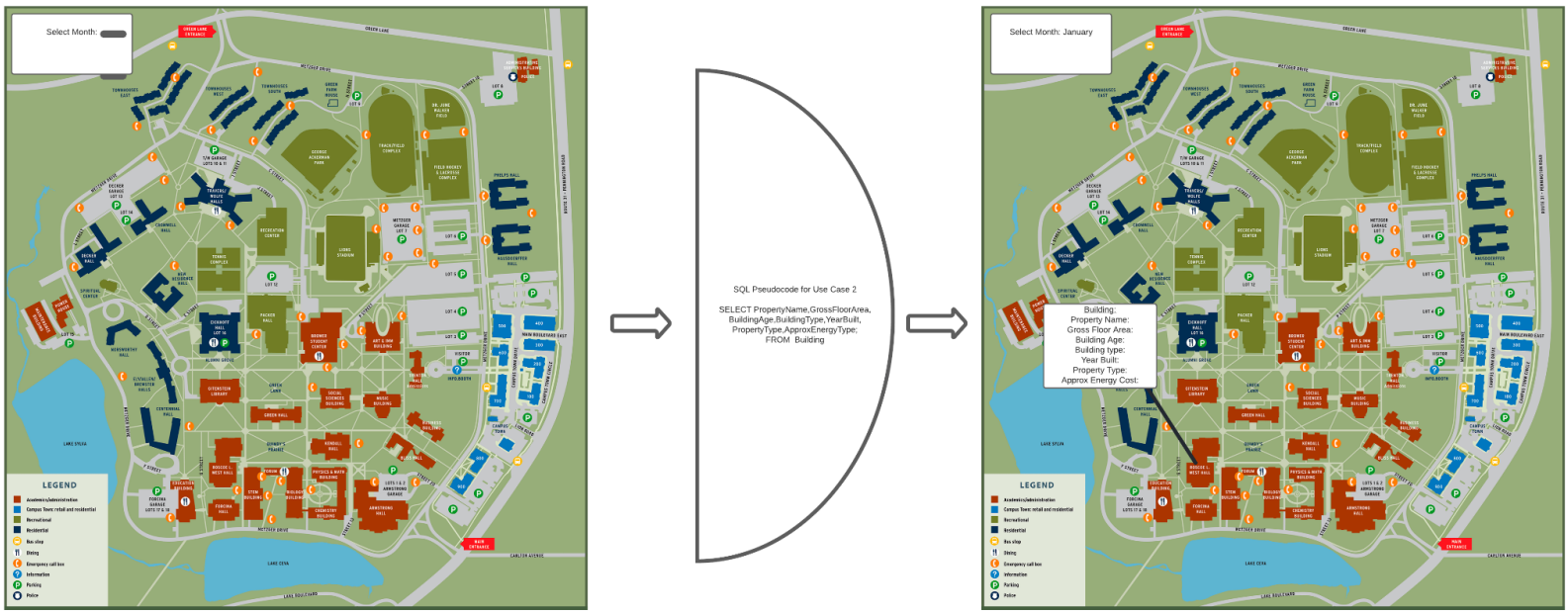
- What is the energy consumption of campus buildings on a Gross Square Footage basis?
- What is the carbon equivalent emissions of campus buildings on a Gross Square Footage basis, on both a site and source basis?
- What are the best indicators of cost of energy demand based on the available indicators such as energy costs, square footage, usage types, building types, building age, and occupancy for TCNJ campus buildings?
- What patterns or trends exist in the stated indicators that relate to the associated cost with energy demand?

Description of Desired End Product

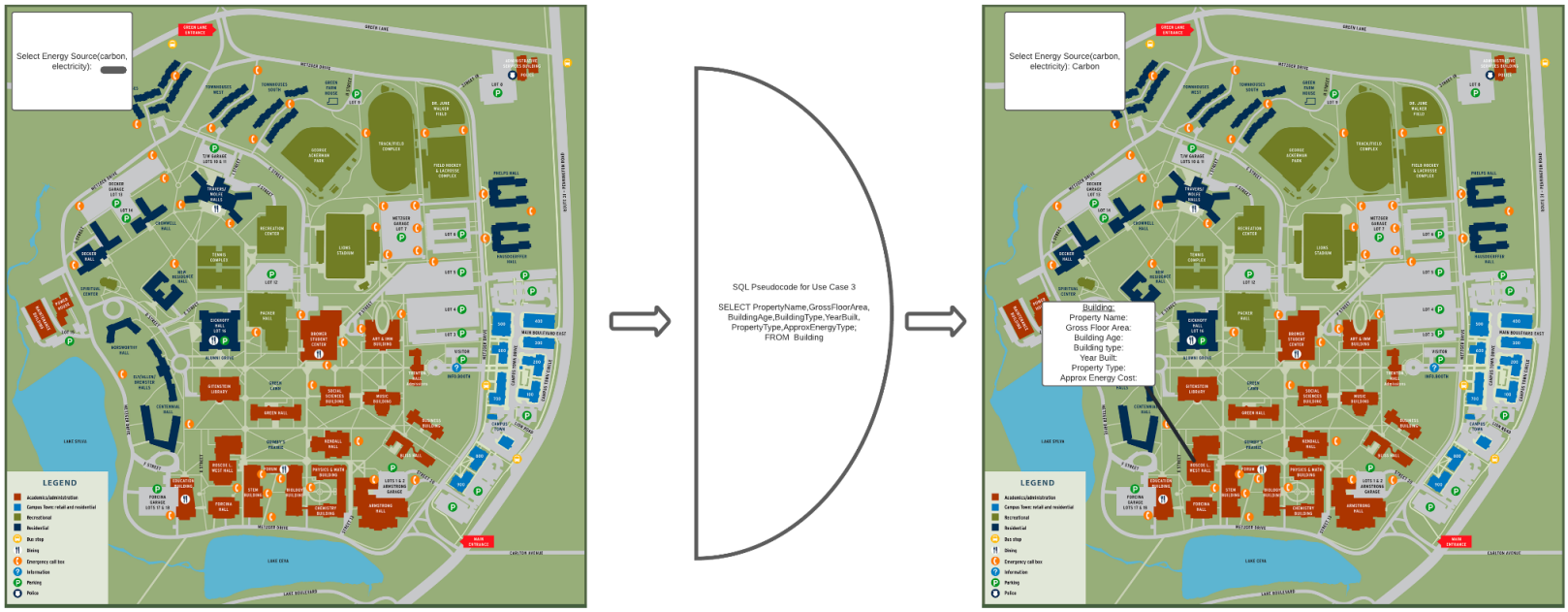
A database back-end and web-based UI/website that has multiple types of users.

1. Admins should be able to modify/add/delete data from the database and manage the list of users.
2. Ordinary users should be able to request data and identify patterns and trends in a visual format.

- Use Case 1. Determine the energy consumption of a campus building on a Gross Square Footage basis.
- Use Case 2. Determine the approximate cost of energy for a campus building in a chosen month.



- Use Case 3. Determine the approximate cost of energy for a campus building given a chosen energy source.



Importance and Need for the Module

The database should be able to have users query it and pull information from it. This format should make it easier for the stakeholders to understand the relationships between the factors impacting energy demand.

Research Plan

We will use the provided spreadsheets to obtain the necessary data for the database that we will be constructing. For any further research into energy demand, we will either reach out to Paul Romano (our stakeholder) or use the internet to bridge any gaps in our information. Variables used: Square footage, building age, building type, cost per month (to be chosen by the user), meter ID, meter name, energy source (carbon or electricity).

Other Existing Systems

The only other system that allows users to view this data would be the provided spreadsheets. This is a highly inefficient way to access the data, since it requires manually looking through thousands of lines of information and no easy way to identify trends/patterns.

Possible Other Applications

The format of this database could be applied/refactored to many other areas where the same data is available, allowing others to draw their own conclusions about trends in energy demand in their area. Such areas might be other universities or corporate campuses to help identify the economic and environmental factors of energy demand. It could also be used as an aid in things like real estate investment to help get an idea of the costs associated with the buildings being purchased.

Performance

We won't have to worry about this aspect of the project, since the data samples will be relatively small, so PostgreSQL won't have any performance issues retrieving or doing any other operations on the data.

Security

GitHub should be able to provide some limited security to our code, since there is developer privacy. We're also using a VM which will have authentication/authorization. Once the project leaves GitHub's protection and is delivered to TCNJ facilities, we will have a login system and users with the admin status to change user permissions or delete unnecessary accounts.

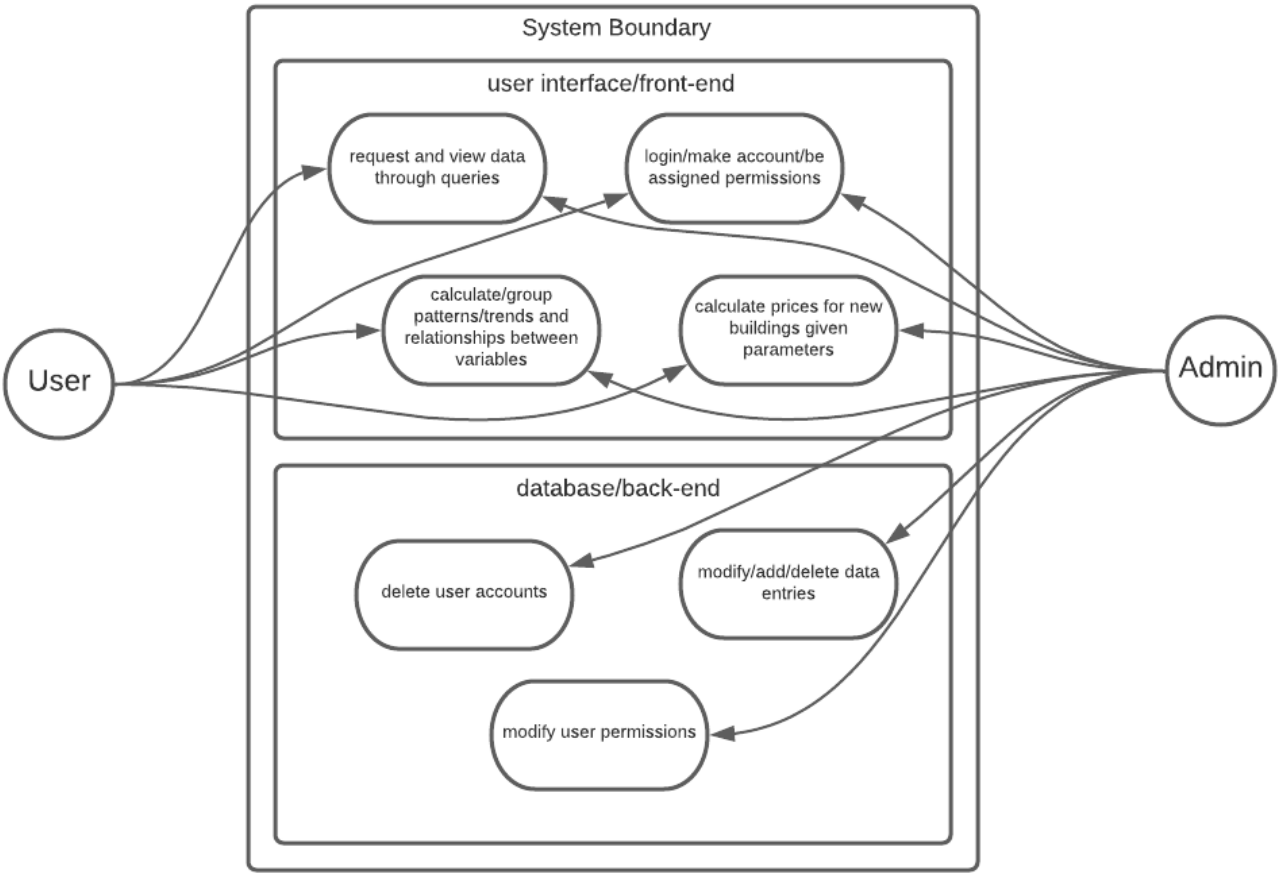
Backup and Recovery

In regard to version control, GitHub will allow us to backup previous versions of the code and make branches so in the event that we lose some portion of our code, we can always fall back upon older versions and recover them. Our group should plan to save their code to the repository often (and in separate branches) so it is organized and up to date, also preventing possible merge conflicts. Once the project leaves GitHub's protection and is delivered to TCNJ facilities, we hope to have a backed-up version of the application, possibly on the cloud/Oracle cloud/web-application portal. We could also potentially implement a decentralized/peer-to-peer connection so in case one server goes down, the application won't be deleted/lost.

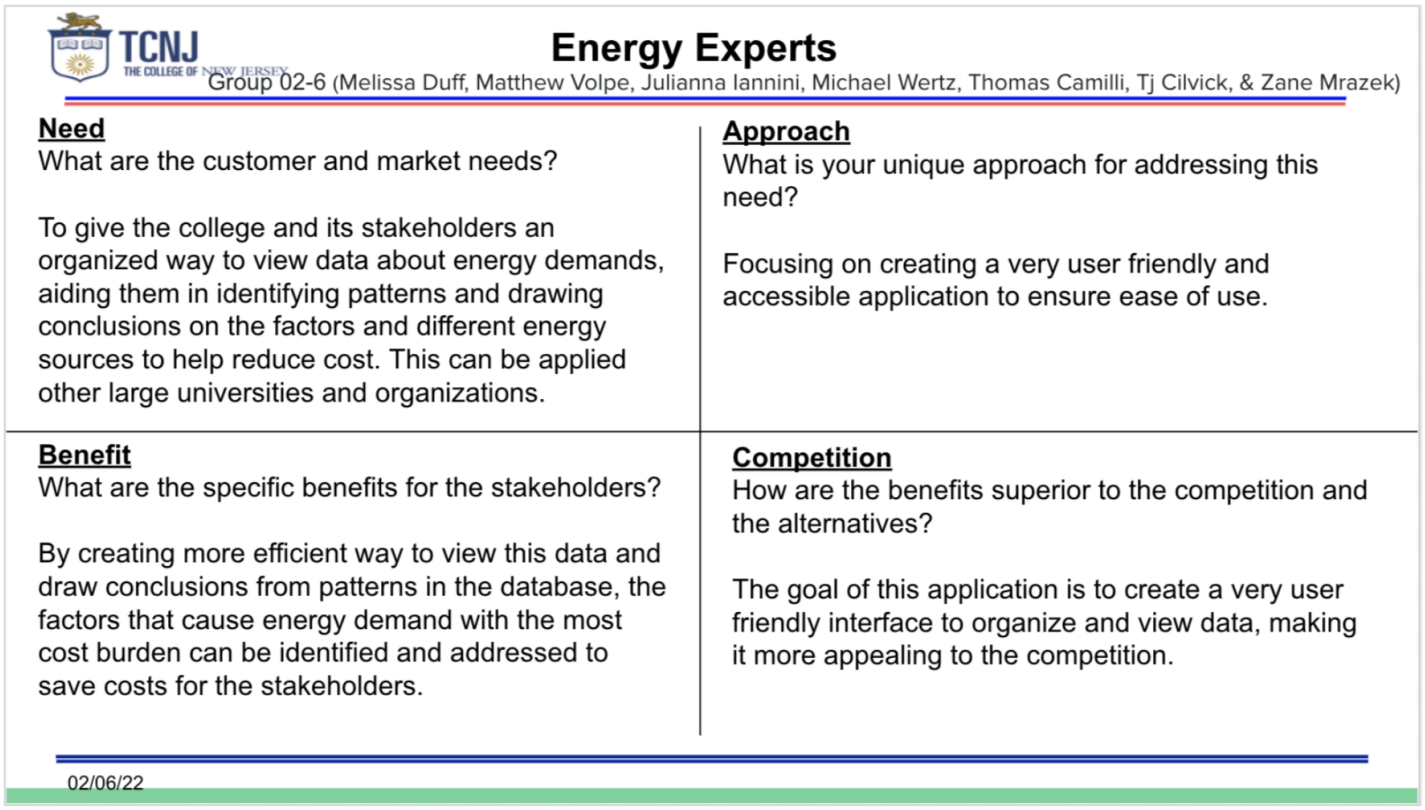
Technologies and Database Concepts to Learn

We will have a number of database concepts to learn for the completion of this project, such as PostgreSQL and how to write SQL schemas, which can be learned through reading the textbook and taking notes in class. We will also practice making ER diagrams and learn how to use querying in SQL, implementing certain operations such as delete, update/modify, and making transactions. We can also use the internet to learn how to make a proper UI for our database.

Diagrammatic Representation of System Boundary



Quad Chart



TCNJ THE COLLEGE OF NEW JERSEY

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Need
What are the customer and market needs?

To give the college and its stakeholders an organized way to view data about energy demands, aiding them in identifying patterns and drawing conclusions on the factors and different energy sources to help reduce cost. This can be applied other large universities and organizations.

Approach
What is your unique approach for addressing this need?

Focusing on creating a very user friendly and accessible application to ensure ease of use.

Benefit
What are the specific benefits for the stakeholders?

By creating more efficient way to view this data and draw conclusions from patterns in the database, the factors that cause energy demand with the most cost burden can be identified and addressed to save costs for the stakeholders.

Competition
How are the benefits superior to the competition and the alternatives?

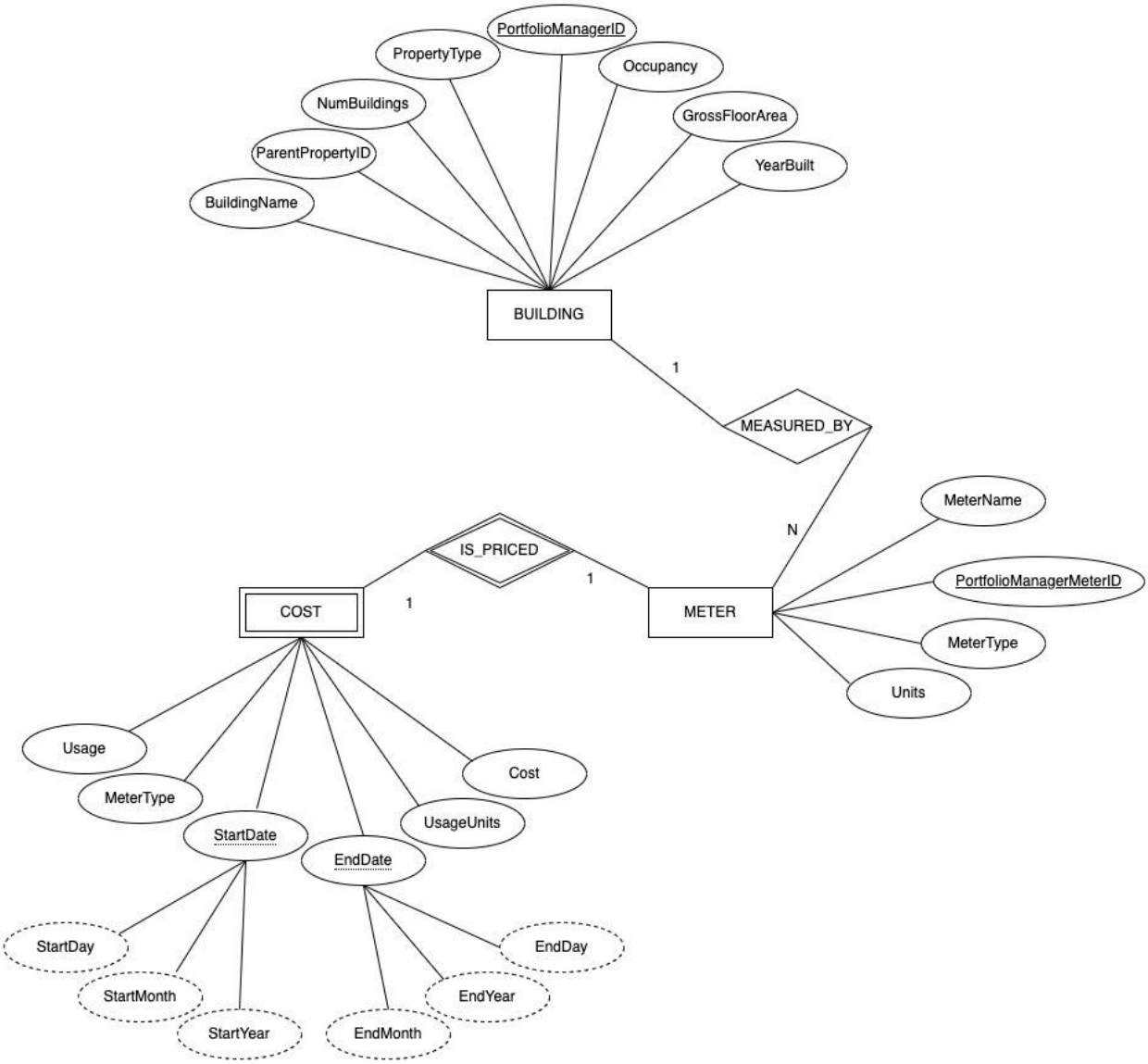
The goal of this application is to create a very user friendly interface to organize and view data, making it more appealing to the competition.

02/06/22

Proposal Pitch Presentation

ACC/CSC Stage 2

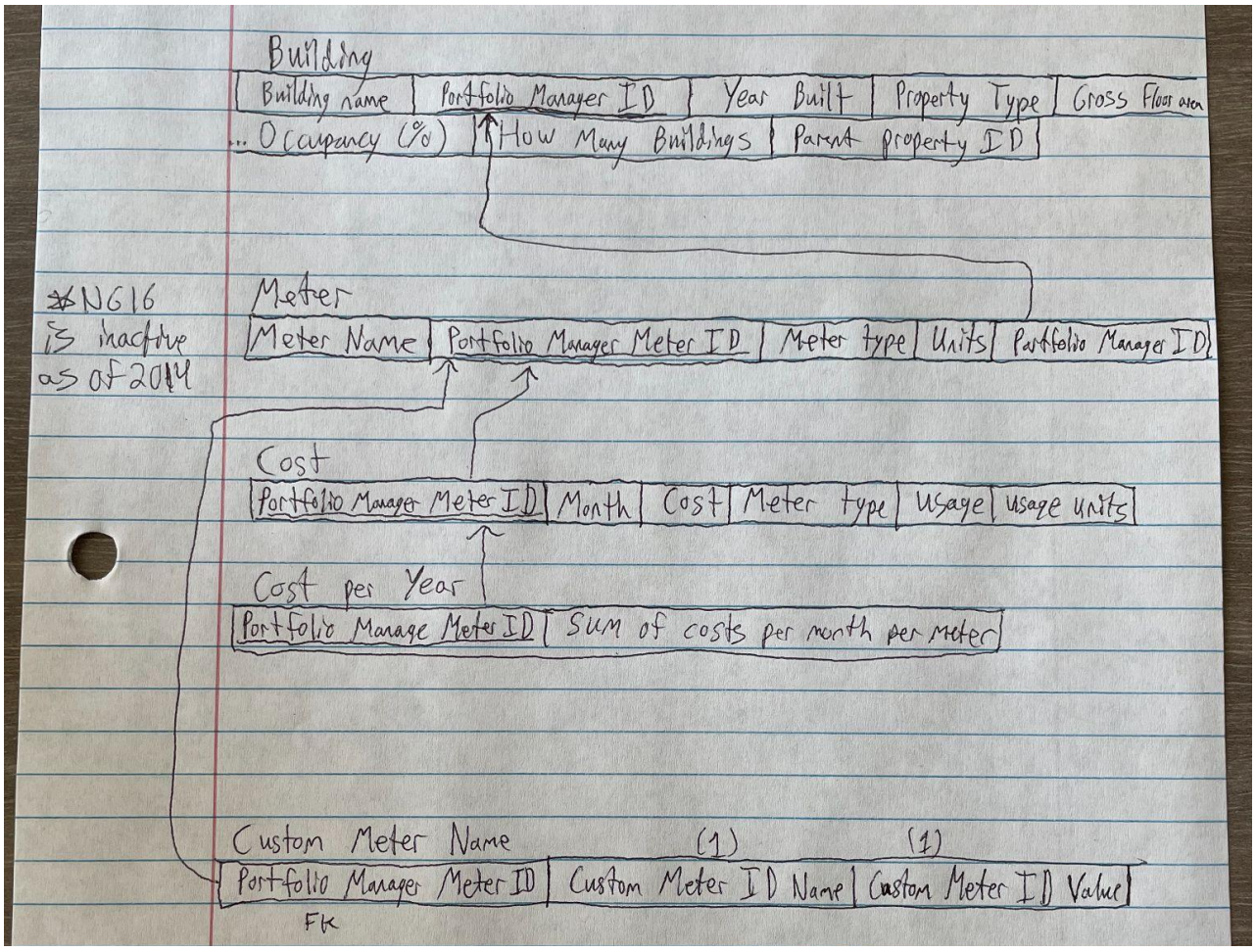
Entity-Relationship Diagram



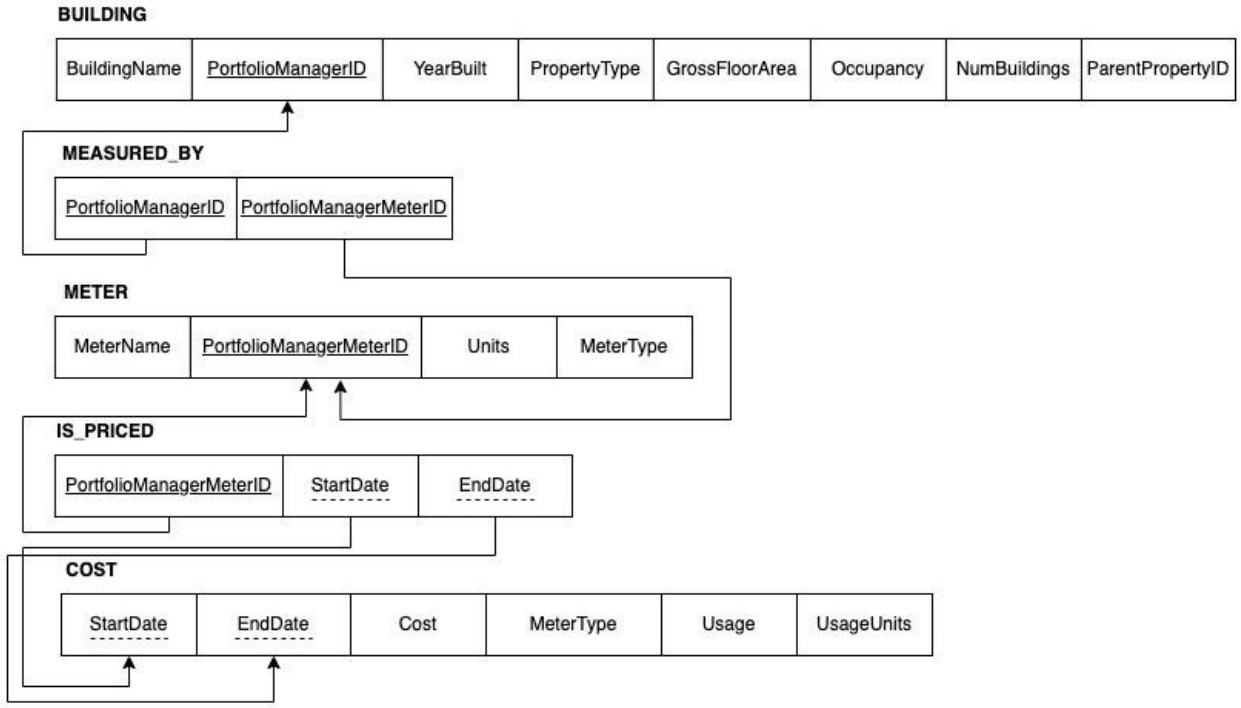
Relational Schema

The design for our relational schema went through multiple iterations, starting with more entities/tables before being condensed into a smaller number of entities (3 entities). Some of the older, revised entities from the first iteration (such as the “Cost Per Year” entity) were removed in favor of algebraic queries with aggregate functions.

Initial Schema



Revised Schema



Initial Database Statistics

Because natural gas meter NG16 has been inactive since 07/01/2014, we are going to store data past that point. There are 6 electric grid meters and 15 natural gas meters. Each meter reports the cost for a specific month. The most recent reported costs for each meter were reported in late January/early February of 2021. This means that each meter will have about 70 rows of cost data each. With 21 meters to collect cost data from we will have about 1470 rows for our cost table and 21 rows for our meter table. There are 47 buildings listed in the “ESPM Data CAB” so we will have one row per building in the database. Overall we can expect to have about 1538 rows.

For the types of searches a user can get

- General building specification data on each building type.
- Monthly cost data per building.
- Yearly cost per building (aggregate query)
- Cost for a building given an energy source.

We could in theory combine all types of searches into a single query executed by the user. Depending on the user, the average number of searches could be relatively small. If not every building is being compared there could be less than 50 searches made. We estimate that a user will compare similar buildings such as academic or residential buildings. This would mean the user would execute around 10 searches give or take.

Mid-Semester Project Presentation

Stage III CSC/ACC