

Energy Supply Project Analysis (ESPA)

CSC 315/ACC 311-02 Group 1

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Inception: “Executive Summary”

- **Need:** The college needs to understand when it is most economical for The College of New Jersey to produce its own power and when it is best for the environment for The College of New Jersey to produce its own power.
- **Approach:** To answer this question the group had utilized GitHub to create a database of all the historical data for The College of New Jersey's energy usage. It provided the ability to create queries within the database to understand trends within the data.
- **Benefits:** When compared to other databases, this is a cost effective solution as GitHub is free to college students providing a cheap way to understand this data and gain understanding. The interface is clean, user friendly, and provides clear insights into the data.
- **Cost:** The goal of this project is to create a new way for The College of New Jersey to synthesize the energy that The College of New Jersey is producing and provide insights into that data. Moving forward, the cost would be maintaining the database, conducting PAR (periodic access review) to verify all users / editors of the database. This is within reason for the organization to maintain moving forward. Another cost to be considered for the application is the data needed to run the program. Because of the implementation of the fifteen minute intervals, the data needs to be formatted in a certain way. Some scripts were developed for this process, but the script does not fully work for the part of the data that handles the fifteen minute intervals. The initial setup of this application would need to take this into account which means it should be preformatted to have a meter consumption id be broken down into the corresponding fifteen minute intervals.

Elaboration: Project Proposal and Specifications

• Problem statement.

As of recently, TCNJ is attempting to determine if their current sustainability and economical efforts are sufficient. The college has information regarding each of their buildings such as the type of meters used and the cost, but it is not maintained using a database or a user-friendly application or system. Moreover, the majority of the information is not easily understandable at first glance, and it is difficult to search for specific details such as the cost of energy or the amount of energy usage. Overall, the issue is determining which energy source contributes the most towards a possible economic or pollution problem.

• Objective of the module.

The objective of the project is to create and supply an easy to use application and database that is meant to highlight the general categories of energy supply as well as amount of energy cost with its respectable types of energy, which include fuel oil and natural gas and electric-grid. Furthermore, the project plans to address a way for users to see the relationship between the costs for sustainability and the environmental impact the sources have.

Our module will address the following questions:

- How can the two energy sources, electric-grid and elements from the power plant, differ in terms of their energy supply efficiency?
- How can each energy source vary in energy supply depending on the dates and seasonal aspects?

The end goal is to provide the college with a product that will allow them to discern the best routes of action to become more efficient and cost-effective.

• Description of the desired end product, and the part you will develop for this class.

The desired end product that will be developed includes a finalized database and application where the user is able to retrieve their respective piece of information. For instance, the product will utilize a table that will allow the user to compare the energy supply for each energy source using the same unit of measurement and cost per unit. It will feature another table that shows the costs per year for each energy source. All of this information will be categorized by year. Check boxes will be added to allow the user to select which energy source they would like to look at, and text boxes will be used to have the user input what years they would like to see. Another checkbox will be inserted if the user would like to see the meter cost for each individual energy source.

REVISION: The user interface sample has been revised to insert radio buttons that offer a year, month, or 15 minute option. Additionally, an ‘other’ option using a checkbox has been added to the ‘Select an energy source’ area.

Question 1 - UI Sample

TCNJEnergySupplyAnalysis.com

Home Energy Efficiency Energy Reliability Admin Login

Energy Supply Analysis

How can the two energy sources, electric-grid and elements from the power plant, differ in terms of its energy supply efficiency?

Select either:

Select an energy source:

- Electric-Grid
- Natural Gas
- Fuel Oil
- Other

Please enter a starting year from (ex. 2009 - 2020):

Please enter an ending year from (ex. 2009 - 2020):

Show meter cost?

Submit

Database Interaction
(Use Case)

Using the input, we would take the type of energy sources selected and the starting/ending year, and we would search and display that data on a table. In this sample case, the user is looking for the cost of all the energy from the years ranging from 2009 to 2012. We would also convert each energy source's unit to kBtu and show the cost per year. Moreover, we would create an average that reflects kBtu/cost for each year. We will be using the SELECT and PROJECT operations to grab specific years along with the specific energy sources chosen by the user. Additionally, we will have a separate table that shows the separate meter costs per year for each energy source. Filters would be used to isolate the years and energy sources in the table. Furthermore, the JOIN operation will be used to have data from the selected energy sources into one table based on the years chosen.

Result:

Standard kBtu / Cost				Meter Costs					
Year of Start Date	Cost (\$)	Standard kBtu	[Standard kBtu]/[Cost (\$)]	Year of Start Date	Electric - Grid	Fuel Oil (No. 2)	Natural Gas	Other:	Meter Type1
2009	1,767,096	295,958,925,234	2,317,644	2009	112,548		1,654,548		1,767,096
2010	4,344,435	611,383,416,938	6,183,328	2010	381,284		3,963,151		4,344,435
2011	3,995,550	608,920,998,752	6,524,884	2011	341,038		3,654,512		3,995,550
2012	3,403,877	647,272,152,811	8,121,119						

In addition, the product will feature a table that allows users to view the supply for each energy source based on individual months and seasons depending on a range of years. Check boxes will be utilized so the user can select which energy source they would like to look at, and radio buttons will be added so the user can select if they would like to look at the energy supply by months or by seasons. Text boxes will be used to have the user input what years they would like to see, and a drop-down menu will be utilized so the user can select what starting month they would like to see.

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Home Energy Efficiency Energy Reliability Admin Login

Energy Supply Analysis

How can each energy source vary in energy supply depending on the dates and seasonal aspects?

Select an energy source:

- Electric-Grid
- Natural Gas
- Fuel Oil
- Other

Please enter a starting year from (ex. 2009 - 2020):

Please enter an ending year from (ex. 2009 - 2020):

Please select a specific month:

Please select a specific season:

Database Interaction
(Use Case)

Using the input, we would take the type of energy sources selected, selecting the option by year and then further specifying whether it would be a season or specific month basis. There is also another option for the user to see only the picked month for each year that is specified by the user. The algorithm for this operation would perform the SELECT operation on the relevant tuples according to the time frame selected according to the energy sources, in conjunction with PROJECT to form a table that is readable to the user with the relevant columns. The RENAME operation would have to be used when converting the energy units of each source measured, as the algorithm necessitates that kbtu is the universal unit of measurement for this data analysis. Filters would be used to isolate the year, month chosen by the user or to isolate certain months depending on the season. Additionally, the JOIN operation will be used to have data from the selected energy sources into one table based on the years chosen or the seasons selected.

TCNJEnergySupplyAnalysis.com

Home Energy Efficiency Energy reliability Admin Login

Standard kBtu / Cost Chart (5)

Month of Start ...	Electric - Grid	Fuel Oil (No. 2)	Natural Gas	Other:	Meter Type1	Grand Total
January 2017	12,493,644		34,714,986,135			34,727,479,779
January 2018	1,131,520	8,926,198,348	63,399,252,956			72,326,582,824
January 2019	963,229	7,358,649,636	59,819,459,732	0		67,179,072,597
Grand Total	14,588,393	16,284,847,984	157,933,698,823	0		174,233,135,200

To be able to adjust information, certain users, most likely someone with admin privileges, will be able to insert or delete data on an additional page once they select an energy source and a specific year. The other users will be able to see the cost and emission breakdowns per building, but will be able to do the other actions aforementioned.

- Description of the importance and need for the module, and how it addresses the problem.**

The database and application is essential to the project since TCNJ's current method of maintaining data also lacks easily accessible and readable information regarding energy usage. It will search for areas to reduce costs, and reduce pollution. It will present a way to be greener since users can look to see how they can be more economical and produce less environmental pollution by using their own power. The way the module will do this is by organizing all of the data presented in the excel spreadsheet and presenting it in a fashion that is easy to read. Seeing a breakdown of the costs and emissions by building will also help those who are interested in knowing this information determine which areas to start with first if there happens to be any buildings in particular that are creating a lot of pollution or consuming large amounts of money. The end results of the product will map TCNJ's goal to promote environmental sustainability and incorporate sustainability within its recreational and residential operations. The product will also assist in the college's energy plan to commit to renewable energy.

- **Plan for how you will research the problem domain and obtain the data needed.**

In order to fully understand the problem domain, our group plans on performing an analysis on the historical data to understand the trends within TCNJ energy usage. We will also look into the college's current method of power and determine areas that would be a possible alternative depending on the sustainability and cost of the energy source. To obtain additional data, we will reach out to the CSC315/ACC311 professors and Paul Romano if there is other data we will need.

- **Other similar systems / approaches that exist, and how your module is different or will add to the existing system.**

Other systems that function similarly to our planned product include the *Energy Star Portfolio Manager*, AASHE's *Sustainability Tracking Assessment and Ratings System*, and the *Environmental, Social, and Governance Investing* system. Our planned product is different in that the end user will be able to make an informed decision as to where environmental and economic factors may need to be improved in certain areas. Furthermore, our system is able to differentiate the cost and usage for each energy source, and it utilizes an easy-to-understand map that will show the trends of TCNJ's energy consumption as well as other information. Additionally, our system will be created with the needs of what TCNJ requires to determine the status of their sustainability and economic efforts in mind.

- **Possible other applications of the system (how it could be modified and reused.)**

Based on historical data, we could create an expected budgeted amount of money and energy needed, and then if current actual data is provided, add a window within our dashboard to show the budgeted vs. actual. This method of analyzing data could be repurposed for other colleges or different aspects of the college like vehicle supply, food supply, water supply, etc.. The data can also be purposed for examining economic and environmental impact with differing times of year. Additionally, the database will be able to be modified to include new years, thus allowing a possibility that new trends can be introduced as the college operates throughout different periods.

Some of the assumptions we're making is that we'll have access to the data Romano possesses in regards to the energy usage from the power plant as well as the energy TCNJ uses with the grid. We also expect this data to be very close to what the energy supply distribution is like at TCNJ, which is how we're so confident that the data we present will be accurate to the user.

- **Performance – specify how and to what extent you will address this.**

We would like the database to run smoothly without any lag or crashes. One thing that would help with this is by not using any NULL attributes when establishing our data, which would use less performance overhead. Additionally, we will try to keep the amount of complex attributes to near zero since that would also limit performance due to the large amount of nesting

needed to implement. Furthermore, we will attempt to implement solely binary relationships and avoid n-ary relationships.

- **Security – specify how and to what extent you will provide security features.**

We will not have a lot of security features to start. Github will probably be useful because of its own security features, such as the personal access token and general authentication. We'll also make sure to make our code private where it can be made private. Privileged users or administrators will be able to directly modify data per building, while the vast majority of the users will be treated as guests that will be able to see different levels of data in relation to the privilege levels that they have. As a result of this security, this will ensure that the more sensitive aspects of the financial information regarding operating costs with the college will not be leaked to the public.

Once our project departs Github and is delivered to TCNJ facilities, we will still reinforce security in other ways. One way to do this is with our multi-level user access. We'll set up the data in a way where the confidential data the client does not want to be seen by general users within the application will be forbidden whereas users such as admins will be able to view this data and modify it as well.

- **Backup and recovery – specify how and to what extent you will implement this.**

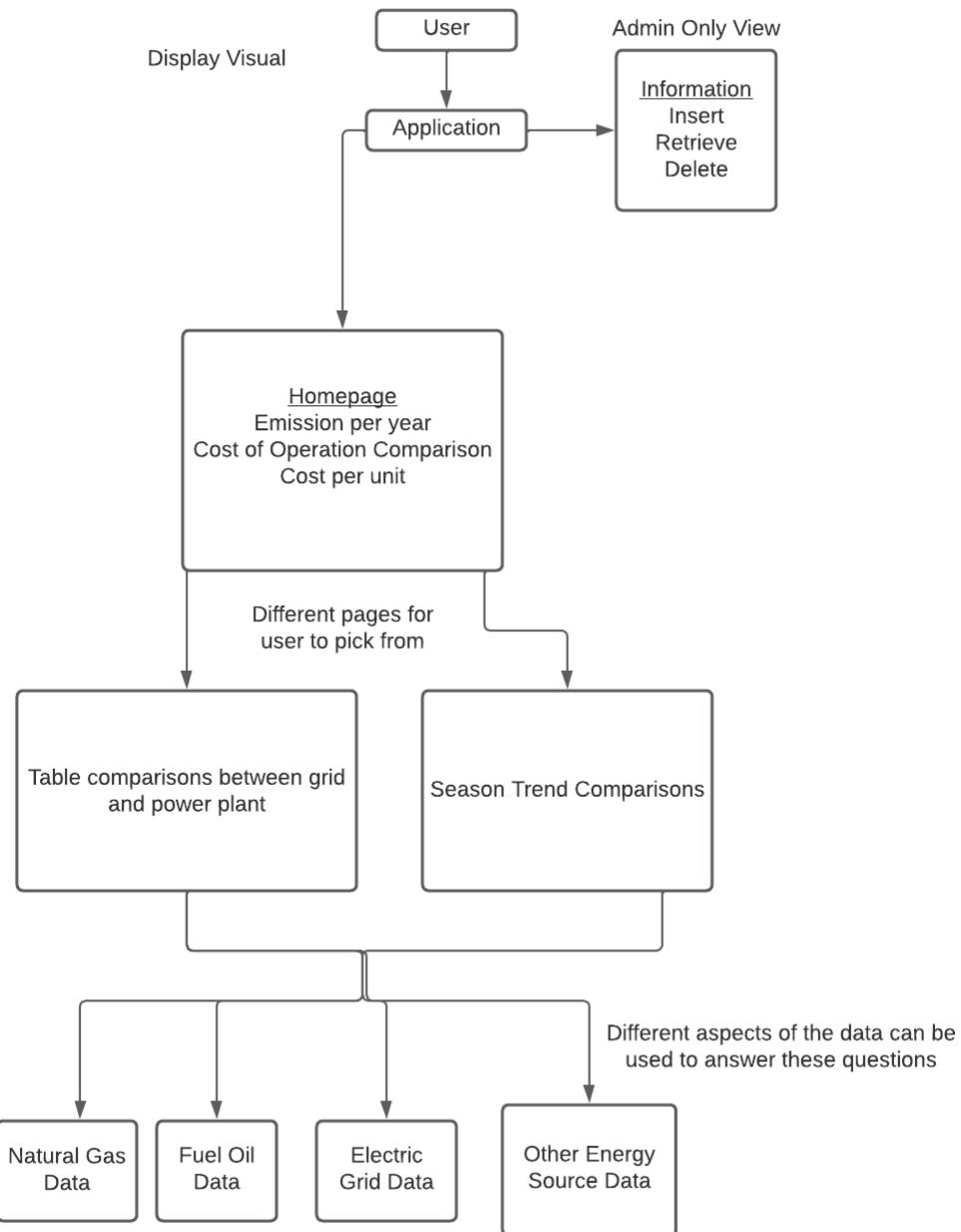
We will probably not need to use a backup and recovery system because Github most likely has redundancies and copies of the code. We most likely will not need anything else for backup.

Once the project departs Github and is delivered to TCNJ facilities, we will do a bi-weekly or monthly export of our data to ensure that the database ever goes down. This will allow us to have some data to restore the database back to in the worst case scenario. In terms of recovery, we will be sure to keep documentation of setting up the database initially so that we will be able to do it much faster should anything ever happen to the backend of our application.

- **Technologies and database concepts the group will need to learn, and a plan for learning these.**

Some technologies and database concepts that the group will need to learn include Python, Flask, and PostgreSQL. In order to learn more about these languages, we will be utilizing LinkedIn Learning on our own time. We plan to use these languages in order to create our interactive application. For the mathematical calculations and to organize any essential data, we will utilize tools from Microsoft Excel.

- A diagrammatic representation of the system boundary that specifies what data you will model and which queries you will implement.



REVISION: The diagrammatic representation has been revised to have an ‘other energy source data’ option in the data area.

- 1-page quad chart:

 <p style="text-align: center;">Energy Supply Database</p> <p>Peter Kelly, Sterly Deracy, Amy Vargas, Joseph Oczkowski, Grant Bushoven, Matthew Seitz, Daniel Melamed</p>	
<u>Need</u>	<u>Approach</u>
<ul style="list-style-type: none"> Efficient and easy to understand database and application regarding energy consumption and pollution Cost effective analysis to decide where and when to use power from campus or sustainable energy Determine which energy source is causing the most pollution 	<ul style="list-style-type: none"> To separate the four types of meters and analyze historical trends (cost and usage) Find a common measurement to compare usage rate to cost Analyze the results to come up with efficient and environmental friendly solution.
<u>Benefit</u>	<u>Competition</u>
<ul style="list-style-type: none"> High performance and secure database access to energy use on campus Clear analysis on which energy sources should be used to save the most money and reduce pollution Comfort knowing that TCNJ will have the greenest and economically efficient solution for powering campus 	<ul style="list-style-type: none"> Includes ability to differentiate cost and usage between the four types of meters. Utilizes a visually appealing and easy to understand tables illustrating trends of TCNJ's energy usage. Tailored to the needs of what TCNJ requires to determine the status of their sustainability and economical efforts.

02/06/22

Proposal Pitch Slides

Problem Statement

- TCNJ is determining if their current sustainability and economical efforts are sufficient.
- Data is currently not placed using a database or a user-friendly application.
 - Difficult to understand and search for information
- Main issue is to determine which energy source contributes the most towards a possible economic or pollution problem.

Objective

- To resolve this issue, our group will plan on creating:
 - An efficient database that highlights general categories including cost and energy usage
 - Focus on C.T.O and emissions of Tri-Gen/Boilers/Chiller
 - Emissions at Site/Source
 - Separate subcategories that differentiate by energy type
 - Visualization of the environmental impact and cost relationship present for further analysis

Desired End Product Description

- Easily understandable map with information breakdown by building
- Include a map that displays:
 - Costs of each energy source
 - Total emissions of each energy source
 - Total emissions at a site/source basis
- User will be able to retrieve pertinent information, filter data to an extent

Why Model is Important

- TCNJ currently lacks an easily accessible/readable information application regarding energy use
- Find optimal areas to reduce energy costs and pollution via visual
- Users can see biggest contributors to cost and pollution
- End result will map to TCNJ's goal for environmental sustainability
- Also offer insight to plan for renewable energy

Method of Research

In order to fully understand the problem domain, our group plans on:

- Performing analysis on historical data to understand trends within TCNJ energy usage
- Look into the college's current strategy for energy supply
- Determine areas that would be a possible alternative depending on:
 - Sustainability
 - Energy cost
 - Energy consumption

Similar Approaches

- Energy Star Manager
- AASHE's STAR
- Scoring Analytic
 - Rating of energy source's cost and pollution

Possible Alternate Applications

- Create expected budgets based on available funds and energy needed
- Examine economic and environmental impact by season
- Re-use application to examine trends:
 - That may arise as time goes on
 - Different areas of college:
 - Vehicle supply
 - Food supply
 - Water supply

Elaboration: Design

Energy Supply Database Project Pitch

• Problem statement.

As of recently, TCNJ is attempting to determine if their current sustainability and economical efforts are sufficient. The college has information regarding each of their buildings such as the type of meters used and the cost, but it is not maintained using a database or a user-friendly application or system. Moreover, the majority of the information is not easily understandable at first glance, and it is difficult to search for specific details such as the cost of energy or the amount of energy usage. Overall, the issue is determining which energy source contributes the most towards a possible economic or pollution problem.

• Objective of the module.

The objective of the project is to create and supply an easy to use application and database that is meant to highlight the general categories of energy supply as well as amount of energy cost with its respectable types of energy, which include fuel oil and natural gas and electric-grid. Furthermore, the project plans to address a way for users to see the relationship between the costs for sustainability and the environmental impact the sources have.

Our module will address the following questions:

- How can the two energy sources, electric-grid and elements from the power plant, differ in terms of their energy supply efficiency?
- How can each energy source vary in energy supply depending on the dates and seasonal aspects?

The end goal is to provide the college with a product that will allow them to discern the best routes of action to become more efficient and cost-effective.

• Description of the desired end product, and the part you will develop for this class.

The desired end product that will be developed includes a finalized database and application where the user is able to retrieve their respective piece of information. For instance, the product will utilize a table that will allow the user to compare the energy supply for each energy source using the same unit of measurement and cost per unit. It will feature another table that shows the costs per year for each energy source. All of this information will be categorized by year. Check boxes will be added to allow the user to select which energy source they would like to look at, and text boxes will be used to have the user input what years they would like to see. Another checkbox will be inserted if the user would like to see the meter cost for each individual energy source.

Question 1 - UI Sample

The screenshot shows a web-based application for energy supply analysis. At the top, there is a header bar with the URL "TCNJEnergySupplyAnalysis.com" and navigation links for "Home", "Energy Efficiency", "Energy reliability", and "Admin Login". Below the header, the main title "Energy Supply Analysis" is displayed in a large, bold font. A descriptive subtitle follows: "How can the two energy sources, electric-grid and elements from the power plant, differ in terms of its energy supply efficiency?" Underneath the subtitle, there are two sections for selecting time intervals. The first section, titled "Select either:", contains three radio buttons: "Year" (selected), "Month", "Hourly", and "15 minutes". To the right of this section, there is a placeholder text "Please enter a starting year from (ex. 2009 - 2020):" followed by an input field containing the value "2009". The second section, also titled "Select either:", contains three radio buttons: "Year", "Month", "Hourly", and "15 minutes". To the right of this section, there is a placeholder text "Please enter an ending year from (ex. 2009 - 2020):" followed by an input field containing the value "2012". Below these sections is a checkbox labeled "Show meter cost?" which is checked. At the bottom of the form is a "Submit" button.

Database Interaction
(Use Case)

Using the input, we would take the type of energy sources selected and the starting/ending year, and we would search and display that data on a table. In this sample case, the user is looking for the cost of all the energy from the years ranging from 2009 to 2012. We would also convert each energy source's unit to kBtu and show the cost per year. Moreover, we would create an average that reflects kBtu/cost for each year. We will be using the SELECT and PROJECT operations to grab specific years along with the specific energy sources chosen by the user. Additionally, we will have a separate table that shows the separate meter costs per year for each energy source. Filters would be used to isolate the years and energy sources in the table. Furthermore, the JOIN operation will be used to have data from the selected energy sources into one table based on the years chosen.

Result:

Standard kBtu / Cost				Meter Costs					
Year of Start Date	Cost (\$)	Standard kBtu	[Standard kBtu]/[Cost (\$)]	Year of Start Date	Electric - Grid	Fuel Oil (No. 2)	Natural Gas	Other	Meter Type
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TCNJEnergySupplyAnalysis.com

[Home](#) [Energy Efficiency](#) [Energy reliability](#) [Admin Login](#)

Energy Supply Analysis

How can each energy source vary in energy supply depending on the dates and seasonal aspects?

Select an energy source:

Please enter a starting year from (ex. 2009 - 2020):

Electric-Grid
 Natural Gas
 Fuel Oil

Please enter an ending year from (ex. 2009 - 2020):

Select either:

By month
 By season

Please select a specific month:

Please select a specific season:

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Using the input, we would take the type of energy sources selected, selecting the option by year and then further specifying whether it would be a season or specific month basis. There is also another option for the user to see only the picked month for each year that is specified by the user. The algorithm for this operation would perform the SELECT operation on the relevant tuples according to the time frame selected according to the energy sources, in conjunction with PROJECT to form a table that is readable to the user with the relevant columns. The RENAME operation would have to be used when converting the energy units of each source measured, as the algorithm necessitates that kbtu is the universal unit of measurement for this data analysis. Filters would be used to isolate the year, month chosen by the user or to isolate certain months depending on the season. Additionally, the JOIN operation will be used to have data from the selected energy sources into one table based on the years chosen or the seasons selected.

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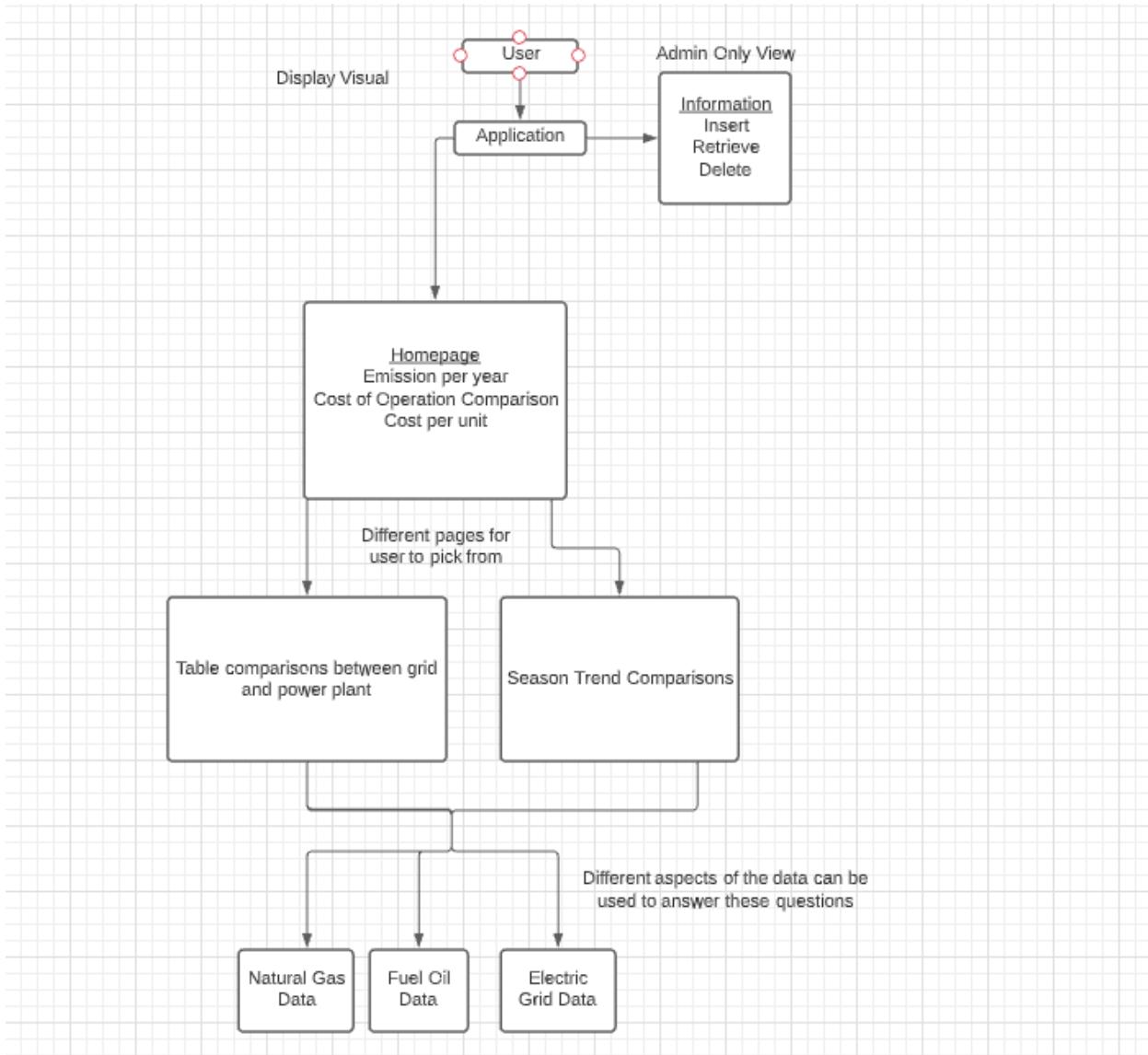
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- A diagrammatic representation of the system boundary that specifies what data you will model and which queries you will implement.



- 1-page quad chart:

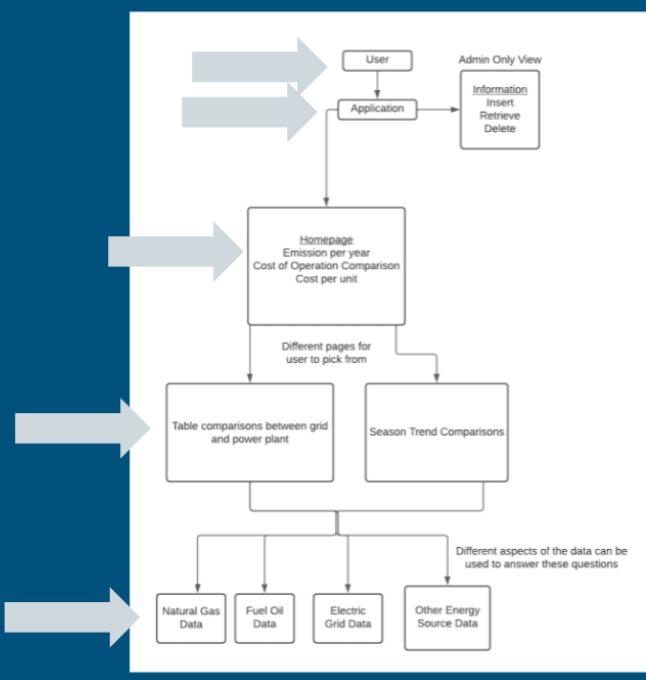
 <p style="text-align: center;">Energy Supply Database</p> <p>Peter Kelly, Sterly Deracy, Amy Vargas, Joseph Oczkowski, Grant Bushoven, Matthew Seitz, Daniel Melamed</p>	
<u>Need</u>	<u>Approach</u>
<ul style="list-style-type: none"> Efficient and easy to understand database and application regarding energy consumption and pollution Cost effective analysis to decide where and when to use power from campus or sustainable energy Determine which energy source is causing the most pollution 	<ul style="list-style-type: none"> To separate the four types of meters and analyze historical trends (cost and usage) Find a common measurement to compare usage rate to cost Analyze the results to come up with efficient and environmental friendly solution.
<u>Benefit</u>	<u>Competition</u>
<ul style="list-style-type: none"> High performance and secure database access to energy use on campus Clear analysis on which energy sources should be used to save the most money and reduce pollution Comfort knowing that TCNJ will have the greenest and economically efficient solution for powering campus 	<ul style="list-style-type: none"> Includes ability to differentiate cost and usage between the four types of meters. Utilizes a visually appealing and easy to understand tables illustrating trends of TCNJ's energy usage. Tailored to the needs of what TCNJ requires to determine the status of their sustainability and economical efforts.

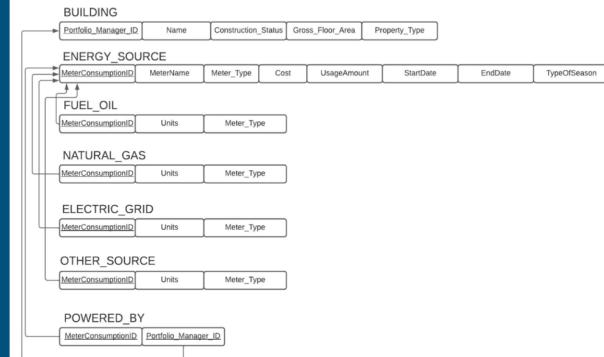
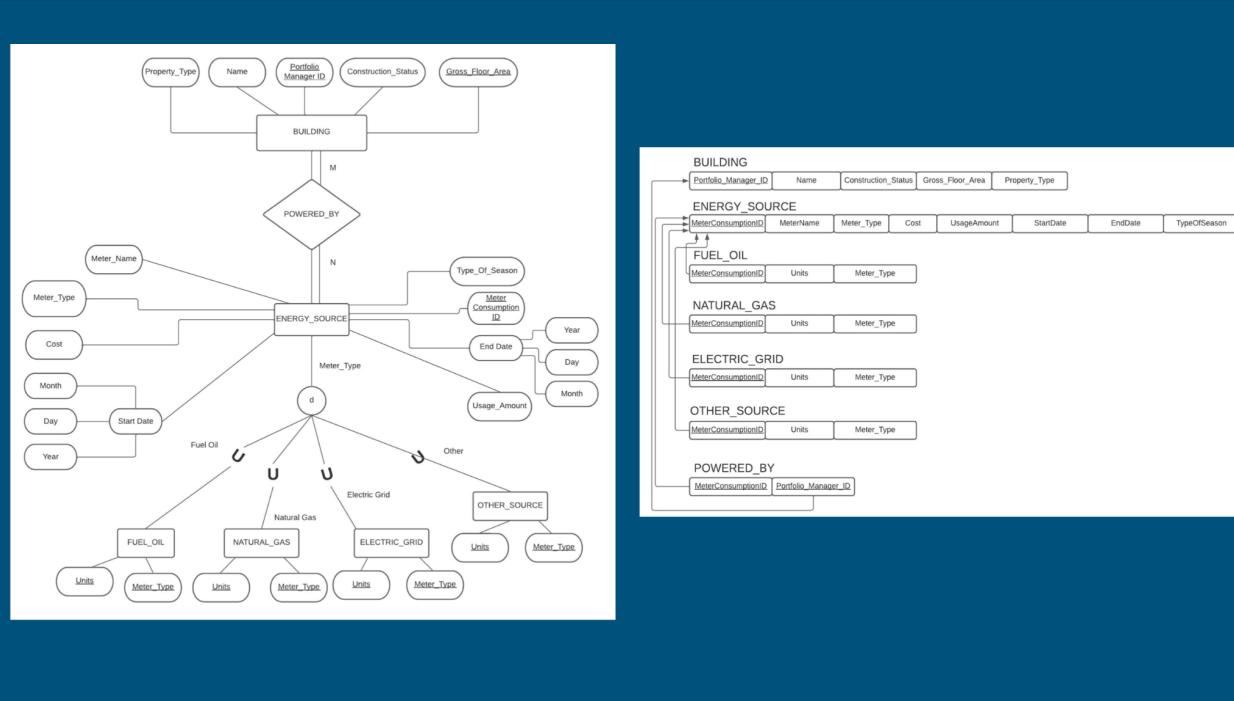
02/06/22

Mid-Semester Project Presentation

Information about Database

- 1430 rows of records within data set
 - Est. 4.1 million rows of records to display 15 minute fluctuations
- Type of searches
 - Select an energy source
 - Enter starting / ending year
 - Show meter costs
 - Select year, month, daily
 - Select by seasons
- Average number of searches
 - 2-4 per user





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Home | Energy Efficiency | Energy Reliability | Admin Login

Energy Supply Analysis

How can the two energy sources, electric-grid and elements from the power plant, differ in terms of its energy supply efficiency?

Select an energy source:

- Electric-Grid
- Natural Gas
- Fuel Oil
- Other

Select either:

Please enter a starting year from (ex. 2009 - 2020):

Please enter an ending year from (ex. 2009 - 2020):

Show meter cost?

TCNJEnergySupplyAnalysis.com																																																								
Home		Energy Efficiency		Energy Reliability		Admin Login																																																		
Result:																																																								
Standard kBtu / Cost <table border="1"> <thead> <tr> <th>Year of Start Date</th> <th>Cost (\$)</th> <th>Standard kBtu</th> <th>[Standard kBtu]/[Cost (\$)]</th> </tr> </thead> <tbody> <tr> <td>2009</td> <td>1,767,096</td> <td>295,958,925,234</td> <td>2,317,644</td> </tr> <tr> <td>2010</td> <td>4,344,435</td> <td>611,383,416,938</td> <td>6,183,328</td> </tr> <tr> <td>2011</td> <td>3,995,550</td> <td>608,920,998,752</td> <td>6,524,084</td> </tr> <tr> <td>2012</td> <td>3,403,877</td> <td>647,272,152,811</td> <td>8,121,119</td> </tr> </tbody> </table>				Year of Start Date	Cost (\$)	Standard kBtu	[Standard kBtu]/[Cost (\$)]	2009	1,767,096	295,958,925,234	2,317,644	2010	4,344,435	611,383,416,938	6,183,328	2011	3,995,550	608,920,998,752	6,524,084	2012	3,403,877	647,272,152,811	8,121,119	Meter Costs <table border="1"> <thead> <tr> <th colspan="5">Meter Type 1</th> </tr> <tr> <th>Year of Start Date</th> <th>Electric - Grid</th> <th>Fuel Oil (No. 2)</th> <th>Natural Gas</th> <th>Other:</th> <th>Grand Total</th> </tr> </thead> <tbody> <tr> <td>2009</td> <td>112,548</td> <td>1,654,548</td> <td>3,963,151</td> <td>4,347,435</td> <td>3,995,550</td> </tr> <tr> <td>2010</td> <td>381,284</td> <td>341,038</td> <td>3,654,512</td> <td></td> <td></td> </tr> <tr> <td>2011</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Meter Type 1					Year of Start Date	Electric - Grid	Fuel Oil (No. 2)	Natural Gas	Other:	Grand Total	2009	112,548	1,654,548	3,963,151	4,347,435	3,995,550	2010	381,284	341,038	3,654,512			2011					
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Home Energy Efficiency Energy Reliability Admin Login

Energy Supply Analysis

How can each energy source vary in energy supply depending on the dates and seasonal aspects?

Select an energy source:

- Electric-Grid
- Natural Gas
- Fuel Oil
- Other

Please enter a starting year from (ex. 2009 - 2020):

Please enter an ending year from (ex. 2009 - 2020):

Please select a specific month:

Please select a specific season:

By month
 By season

Select either:

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Standard kBtu / Cost Chart (5)

Month of Start ..	Electric - Grid	Fuel Oil (No. 2)	Natural Gas	Other:	Grand Total
January 2017	12,493,644		34,714,986,135		34,727,479,779
January 2018	1,131,520	8,926,198,348	63,399,252,956		72,326,582,824
January 2019	963,229	7,358,649,636	59,819,459,732	0	67,179,072,597
Grand Total	14,588,393	16,284,847,984	157,933,698,823	0	174,233,135,200

Construction: Tables, Queries, and User Interface

- Tables:

```
CREATE TABLE DATE_INTERVAL (Meter_Consumption_ID varchar(20) UNIQUE  
PRIMARY KEY, StartDate date, TypeOfSeason varchar(7) , StartTimestamp time);  
  
CREATE TABLE BUILDING (Name varchar(50) UNIQUE, Portfolio_Manager_ID varchar(30)  
UNIQUE, Construction_Status varchar(50), Gross_Floor_Area int, PRIMARY KEY  
(Portfolio_Manager_ID, Name));  
  
CREATE TABLE ENERGY_SOURCE (Portfolio_Manager_Meter_ID varchar(30) UNIQUE,  
MeterName varchar(30) UNIQUE, Meter_Type varchar(30), PRIMARY KEY  
(Portfolio_Manager_Meter_ID, MeterName));  
  
CREATE TABLE BUILDING_TYPE (Name varchar(50) PRIMARY KEY references  
BUILDING(Name), Property_Type varchar(30));  
  
CREATE TABLE ENERGY_SOURCE_COST (Portfolio_Manager_Meter_ID varchar(30)  
REFERENCES ENERGY_SOURCE(Portfolio_Manager_Meter_ID) PRIMARY KEY, cost  
float, Usage_Amount float);  
  
CREATE TABLE FUEL_OIL (Portfolio_Manager_Meter_ID varchar(30) REFERENCES  
ENERGY_SOURCE(Portfolio_Manager_Meter_ID), MeterType varchar(30), Units  
varchar(26));  
  
CREATE TABLE NATURAL_GAS (Portfolio_Manager_Meter_ID varchar(30) REFERENCES  
ENERGY_SOURCE(Portfolio_Manager_Meter_ID), MeterType varchar(30), Units  
varchar(26));  
  
CREATE TABLE ELECTRIC_GRID (Portfolio_Manager_Meter_ID varchar(30)  
REFERENCES ENERGY_SOURCE(Portfolio_Manager_Meter_ID), MeterType varchar(30),  
Units varchar(26));  
  
CREATE TABLE OTHER_SOURCE (Portfolio_Manager_Meter_ID varchar(30)  
REFERENCES ENERGY_SOURCE(Portfolio_Manager_Meter_ID), MeterType varchar(30),  
Units varchar(26));  
  
CREATE TABLE MAPS_TO (Portfolio_Manager_Meter_ID varchar(30) REFERENCES  
ENERGY_SOURCE(Portfolio_Manager_Meter_ID), Meter_Consumption_ID varchar(20))
```

```
REFERENCES DATE_INTERVAL(Meter_Consumption_ID), PRIMARY KEY  
(Portfolio_Manager_ID, Meter_Consumption_ID));
```

```
CREATE TABLE POWERED_BY (Portfolio_Manager_ID varchar(30) REFERENCES  
BUILDING(Portfolio_Manager_ID), Portfolio_Manager_Meter_ID varchar(30) REFERENCES  
ENERGY_SOURCE(Portfolio_Manager_Meter_ID), PRIMARY KEY (Portfolio_Manager_ID,  
Portfolio_Manager_Meter_ID));
```

```
CREATE VIEW YEAR_ENERGY_SOURCE_KBTU_COST AS  
SELECT cast(EXTRACT(YEAR FROM StartDate) as int) AS Year, Cost, Usage_Amount,  
Usage_Amount/cast(SUM(Cost) as float) AS kbtuPerCost, Meter_Type  
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY Year, Cost, Usage_Amount, Meter_Type;
```

```
CREATE VIEW YEAR_SOURCE AS  
SELECT Year, SUM(Cost) AS Cost, SUM(Usage_Amount) AS  
Usage_Amount, (SUM(Usage_Amount)/cast(SUM(Cost) as float)) AS kbtuPerCost  
FROM YEAR_ENERGY_SOURCE_KBTU_COST  
GROUP BY Year;
```

```
CREATE VIEW MONTH_ENERGY_SOURCE_KBTU_COST AS  
SELECT cast(EXTRACT(YEAR FROM StartDate) as int) AS Year, cast(EXTRACT(MONTH  
FROM StartDate) as int) AS Month, Cost, Usage_Amount, Usage_Amount/cast(SUM(Cost) as  
float) AS kbtuPerCost, Meter_Type  
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY Year, Month, Cost, Usage_Amount, Meter_Type;
```

```
CREATE VIEW MONTH_SOURCE AS  
SELECT Year, Month, SUM(Cost) AS Cost, SUM(Usage_Amount) AS Usage_Amount,  
(SUM(Usage_Amount)/cast(SUM(Cost) as float)) AS kbtuPerCost  
FROM MONTH_ENERGY_SOURCE_KBTU_COST  
GROUP BY Year, Month;
```

```
CREATE VIEW MINUTE_ENERGY_SOURCE_KBTU_COST AS  
SELECT StartDate, StartTimestamp, cast(Cost as float)/(30 * 24 * 4) AS cost,  
cast(Usage_Amount as float)/ (30*24*4) AS Usage_Amt, (Usage_Amount/(cast(Cost as float)) /  
(30 * 24 * 4)) AS kbtuPerCost, Meter_Type
```

```
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY StartDate, StartTimestamp, Usage_Amount, Cost, Meter_Type  
ORDER BY StartDate ASC;
```

```
CREATE VIEW MINUTE_SOURCE AS  
SELECT StartDate, StartTimestamp, SUM(cost) AS Cost, SUM(Usage_Amt) AS Usage_Amt,  
(SUM(Usage_Amt)/cast(SUM(Cost) as float)) AS kbtuPerCost  
FROM MINUTE_ENERGY_SOURCE_KBTU_COST  
GROUP BY StartDate, StartTimestamp;
```

```
CREATE VIEW YEAR_METER_COST AS  
SELECT cast(EXTRACT(YEAR FROM StartDate) as int) AS Year, Meter_Type, Cost  
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY Year, Meter_Type, Cost;
```

```
CREATE VIEW YEAR_METER_COST_SOURCE AS  
SELECT YEAR, Meter_Type, SUM(Cost) AS Cost  
FROM YEAR_METER_COST  
GROUP BY YEAR, Meter_Type;
```

```
CREATE VIEW MONTH_METER_COST AS  
SELECT cast(EXTRACT(YEAR FROM StartDate) as int) AS Year, cast(EXTRACT(MONTH  
FROM StartDate) as int) AS Month, Meter_Type, Cost  
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY Year, Month, Meter_Type, Cost;
```

```
CREATE VIEW MINUTE_METER_COST AS  
SELECT StartDate, StartTimestamp, Meter_Type, cast(Cost as float)/ (30*24*4) AS Cost  
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY StartDate, StartTimestamp, Meter_Type, Cost  
ORDER BY StartDate ASC;
```

```
CREATE VIEW MONTH_USAGE AS  
SELECT cast(EXTRACT(YEAR FROM StartDate) as int) AS Year, cast(EXTRACT(MONTH  
FROM StartDate) as int) AS Month, Meter_Type, Usage_Amount
```

```
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY Year, Month, Usage_Amount, Meter_Type;
```

```
CREATE VIEW MONTH_USAGE_SOURCE AS  
SELECT Year, Month, SUM(Usage_Amount) AS Usage, Meter_Type  
FROM MONTH_USAGE  
GROUP BY Year, Month, Meter_Type  
ORDER BY Year, Month;
```

```
CREATE VIEW SEASON_USAGE AS  
SELECT cast(EXTRACT(YEAR FROM StartDate) as int) AS Year, cast(EXTRACT(MONTH  
FROM StartDate) as int) AS Month, TypeOfSeason, Usage_Amount, Meter_Type  
FROM DATE_INTERVAL NATURAL JOIN MAPS_TO NATURAL JOIN  
ENERGY_SOURCE_COST NATURAL JOIN ENERGY_SOURCE  
GROUP BY Year, Month, TypeOfSeason, Usage_Amount, Meter_Type;
```

```
CREATE VIEW SEASON_USAGE_SOURCE AS  
SELECT Year, SUM(Usage_Amount) AS Usage, TypeOfSeason, Meter_Type  
FROM SEASON_USAGE  
GROUP BY Year, TypeOfSeason, Meter_Type  
ORDER BY Year;
```

- Queries:

Selecting Year Option:

```
SELECT year, cost, usage_amount, kbtupercost  
FROM YEAR_SOURCE WHERE CAST(year AS int) BETWEEN <yearSel_startyear> AND  
<yearSel_endyear>  
ORDER BY year;
```

Selecting Show Meter Cost for Year:

```
SELECT year, meter_type, cost  
FROM YEAR_METER_COST_SOURCE  
WHERE meter_type IN {List of Meter Types} AND CAST(year AS int) BETWEEN  
<yearSel_startyear> AND <yearSel_endyear>  
ORDER BY year;
```

Selecting Month Option:

```
SELECT year, month, cost, usage_amount, kbtupercost  
FROM MONTH_SOURCE
```

```
WHERE CAST(year AS int) = <monthSel_year> AND CAST(month AS int) BETWEEN
<monthSel_startmonth> AND <monthSel_endmonth>
ORDER BY year, month ASC;
```

Selecting Show Meter Cost for Month:

```
SELECT year, month, meter_type, cost
FROM MONTH_METER_COST
WHERE meter_type IN {List of Meter Types} AND CAST(month AS int) BETWEEN
<monthSel_startmonth> AND <monthSel_endmonth> AND CAST(year as int) =
<monthSel_year>
ORDER BY year, month ASC;
```

Selecting 15 Minute Option

```
SELECT StartDate, StartTimestamp, cost, usage_amt, kbtupercost
FROM MINUTE_SOURCE
WHERE StartDate = <minSel_date> AND starttimestamp BETWEEN <minSel_starttime> AND
<minSel_endtime>
ORDER BY StartTimestamp;
```

Selecting Show Meter Cost for 15 Minute Option

```
SELECT StartDate, starttimestamp, meter_type, cost
FROM MINUTE_METER_COST
WHERE meter_type IN {List of Meter Types} AND starttimestamp BETWEEN <start_time>
AND <end_time> AND StartDate = <minSel_date>
ORDER BY StartTimestamp;
```

Selecting Specific Month Option

```
SELECT Year, Month, Meter_Type, Usage
FROM MONTH_USAGE_SOURCE
WHERE meter_type IN {List of Meter Types} AND Cast(Year AS int) BETWEEN <start_year>
AND <end_year> AND Cast(Month AS int) = <q2monthSel>;
```

Selecting Specific Season Option

```
SELECT Year, Meter_Type, Usage, TypeOfSeason
FROM SEASON_USAGE_SOURCE
WHERE meter_type IN {List of Meter Types} AND Cast(Year AS int) BETWEEN <start_year>
AND <end_year> AND TypeOfSeason = <q2seasonSel>;
```

- User Interface:

Home Page

The screenshot shows a Mozilla Firefox browser window displaying the 'Home Page' of the 'ESPA - Energy Supply Project Analysis' website. The address bar shows the URL as 127.0.0.1:5000. The page title is 'ESPA - Energy Supply Project Analysis — Mozilla Firefox'. The main content area has a blue header with the word 'ESPA' on the left and navigation links 'Home', 'Energy Efficiency', and 'Energy Reliability' on the right. Below the header, the page title 'Home' is centered. A welcome message reads: 'Welcome to our comprehensive database for the TCNJ energy supply! Here you are able to browse the data that was provided to us by Mr. Paul Romano (TCNJ's Director of Maintenance) concerning TCNJ's energy supply. The purpose of allowing you to view this data is to help answer two very important questions. These questions are: When is it economical for the campus to produce its own power as opposed to using that of the electric grid?, and when is it least polluting for the campus to produce its own power as opposed to using that of the electric grid, on both a site and source basis? The information provided can help to point out where the major costs are coming from when it comes to powering our campus, and how it can be used to serve the environment as a way of seeing where the energy usage can be cut in the buildings. The database provides detailed breakdowns for each question based on season or even as detailed as 15 minute intervals for a specified date. Our goal is that our users will be able to make the most of the data and functionality provided by this website, and that TCNJ can do its part to help the Earth. Happy searching!' At the bottom of the page, there is a copyright notice: '© ESPA 2022'. The taskbar at the bottom of the screen shows several open applications, including a terminal window titled 'Menu' and 'templates', and a file named 'DDL.sql'.

15 Minute Interval with Meter Cost Query

ESPA - Energy Supply Project Analysis — Mozilla Firefox

ESPA - Energy Supply Project +
127.0.0.1:5000/question1
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ESPA Home Energy Efficiency Energy Reliability

Energy Efficiency

How can energy from the electric-grid and energy from the power plant differ in terms of their supply efficiency?

Select an energy source:

Electric - Grid
 Natural Gas
 Fuel Oil
 Other

Select either:

Year
 Month
 15 Minute

Please enter a specific date:

07/03/2018

Please enter a starting time:

00:00 AM

Please enter an ending time:

05:00 AM

Show Meter Cost?

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Results — Mozilla Firefox

Results
127.0.0.1:5000/questionone_handler
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ESPA Home Energy Efficiency Energy Reliability

15 Minute Interval with Meter Cost Result

Date	Time	Total Cost	Usage Amount	Kbtu/Cost
2009-07-01	00:00:00	8.02234375	140.044097222222	17.456755978852467
2009-07-01	00:15:00	8.02234375	140.044097222222	17.456755978852467
2009-07-01	00:30:00	8.02234375	140.044097222222	17.456755978852467
2009-07-01	00:45:00	8.02234375	140.044097222222	17.456755978852467
2009-07-01	01:00:00	8.02234375	140.044097222222	17.456755978852467

Date	Time	Meter Type	Cost
2009-07-01	00:00:00	Electric Grid	1.2713090277777777
2009-07-01	00:15:00	Electric Grid	1.2713090277777777
2009-07-01	00:30:00	Electric Grid	1.2713090277777777
2009-07-01	00:45:00	Electric Grid	1.2713090277777777
2009-07-01	01:00:00	Electric Grid	1.2713090277777777

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15 Minute Interval without Meter Cost Query

The screenshot shows a web browser window with the URL `127.0.0.1:5000/question1`. The page title is "Energy Efficiency". The content includes a form with the following fields:

- Select either:**
 - Year
 - Month
 - 15 Minute
- Please enter a specific date:**
- Please enter a starting time:**
- Please enter an ending time:**
- Show Meter Cost?
- Submit** button

At the bottom of the page, there is a copyright notice: © ESPA 2022.

The screenshot shows a web browser window titled "Results — Mozilla Firefox" with the URL `127.0.0.1:5000/questionone_handler`. The page title is "Energy Efficiency". The content displays a table of data:

Date	Time	Total Cost	Usage Amount	Kbtu/Cost
2018-07-03	00:00:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	00:15:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	00:30:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	00:45:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	01:00:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	01:15:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	01:30:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	01:45:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	02:00:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	02:15:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	02:30:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	02:45:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	03:00:00	0.00807291666666667	0.101875	12.619354838709675
2018-07-03	03:15:00	0.00807291666666667	0.101875	12.619354838709675

Month with Meter Cost Query

The screenshot shows a web browser window titled "ESPA - Energy Supply Project Analysis — Mozilla Firefox". The address bar displays "127.0.0.1:5000/question1". The page content is titled "Question 1 Example 1". It contains three main sections: "Select an energy source:" with checkboxes for Electric Grid, Natural Gas, Fuel Oil, and Other (Natural Gas and Other are checked); "Select either:" with radio buttons for Year (selected), Month, and 15 Minute; and "Please enter a starting month:" with input fields containing "7", "Please enter an ending month:" with input field "12", and "Please enter a year:" with input field "2009". A checkbox "Show Meter Cost?" is checked, and a blue "Submit" button is visible.

Month with Meter Cost Result

The screenshot shows a web browser window titled "Results — Mozilla Firefox". The address bar displays "127.0.0.1:5000/questionone_handler". The page content is titled "ESPA". It displays two tables. The first table has columns: Year, Month, Total Cost, Usage Amount, and Kbtu/Cost. It shows two rows: one for 2009, Month 12, Total Cost 28616.48, Usage Amount 375620, and Kbtu/Cost 13.126002918597955; and another for 2009, Month 7, Total Cost 23104.35, Usage Amount 403327, and Kbtu/Cost 17.456755978852467. The second table has columns: Year, Month, Meter Type, and Cost. It shows two rows: one for 2009, Month 7, Meter Type Natural Gas, Cost 19442.98; and another for 2009, Month 12, Meter Type Other, Cost 4709.21. At the bottom, there is a copyright notice "© ESPA 2022".

Year	Month	Total Cost	Usage Amount	Kbtu/Cost
2009	12	28616.48	375620	13.126002918597955
2009	7	23104.35	403327	17.456755978852467

Year	Month	Meter Type	Cost
2009	7	Natural Gas	19442.98
2009	12	Other	4709.21

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Month without Meter Cost Query

ESPA - Energy Supply Project Analysis — Mozilla Firefox

ESPA - Energy Supply Project x +

127.0.0.1:5000/question1

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ESPA Home Energy Efficiency Energy Reliability

Energy Efficiency

How can energy from the electric-grid and energy from the power plant differ in terms of their supply efficiency?

Select either:

Year
 Month
 15 Minute

Please enter a starting month:
1

Please enter an ending month:
12

Please enter a year:
2020

Show Meter Cost?

Submit

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Month without Meter Cost Query Result

Results — Mozilla Firefox

Results x +

127.0.0.1:5000/questionone_handler

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ESPA Home Energy Efficiency Energy Reliability

Year	Month	Total Cost	Usage Amount	Kbtu/Cost
2020	7	133.98	2975.4	22.20779220779221
2020	10	15.93	419.0	26.30257376020088
2020	11	15.93	419.0	26.30257376020088

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Yearly with Meter Cost

ESPA - Energy Supply Project Analysis — Mozilla Firefox

ESPA - Energy Supply Project x +

127.0.0.1:5000/question1

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ESPA Home Energy Efficiency Energy Reliability

Energy Efficiency

How can energy from the electric-grid and energy from the power plant differ in terms of their supply efficiency?

Select an energy source:

Electric - Grid
 Natural Gas
 Fuel Oil
 Other

Select either:

Year
 Month
 15 Minute

Please enter a starting year:

2009

Please enter an ending year:

2020

Show Meter Cost?

Submit

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☰ Menu templates 127.0.0.1:5000/questionone_handler lion@spring2022... Wed May 4, 20:08

Yearly with Meter Cost Result

Results — Mozilla Firefox

Results x +

127.0.0.1:5000/questionone_handler

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ESPA Home Energy Efficiency Energy Reliability

Year	Total Cost	Usage Amount	Kbtu/Cost
2009	291973.82	48892231.39	167.4541621231657
2011	8588.98	1166861.0	135.85559635719258
2016	268098.19	48550902.0	181.09373285959148
2017	134.98	1045614.4	7746.4394725144475
2018	573.089999999999	10940436.6	19090.25912160394
2019	1703.57	11933245.299999999	7004.845882470341
2020	149.91	3394.4	22.642919084784204

Year	Meter Type	Cost
2009	Electric - Grid	23876.63
2009	Natural Gas	268097.19
2011	Natural Gas	8588.98
2016	Fuel Oil	1.0
2016	Natural Gas	268097.19

Year Without Meter Cost Query

127.0.0.1:5000/question1

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ESPA Home Energy Efficiency Energy Reliability

Energy Efficiency

How can energy from the electric-grid and energy from the power plant differ in terms of their supply efficiency?

Select either:

Year
 Month
 15 Minute

Please enter a starting year:
2009

Please enter an ending year:
2020

Show Meter Cost?

Submit

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Results — Mozilla Firefox

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ESPA Home Energy Efficiency Energy Reliability

Year Without Meter Cost Query Result:

Year	Total Cost	Usage Amount	Kbtu/Cost
2009	291973.82	48892231.39	167.4541621231657
2011	8588.98	1166861.0	135.85559635719258
2016	268098.19	48550902.0	181.09373285959148
2017	134.98	1045614.4	7746.4394725144475
2018	573.0899999999999	10940436.6	19090.25912160394
2019	1703.57	11933245.299999999	7004.845882470341
2020	149.91	3394.4	22.642919084784204

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Specific Season Query

ESPA - Energy Supply Project Analysis — Mozilla Firefox

ESPA - Energy Supply Project Analysis — Mozilla Firefox

127.0.0.1:5000/question2

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ESPA Home Energy Efficiency Energy Reliability

Question 2

Example 1

Select an energy source:

Electric-Grid
 Natural Gas
 Fuel Oil
 Other

Please enter a starting year
2009

Please entering an ending year
2010

Select either:

Month
 Season

Please select a season:
Cooling

Submit

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Specific Season Query Result

Results — Mozilla Firefox

cab-project-02-1/DBMOD x Results +

127.0.0.1:5000/questiontwo_handler

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ESPA Home Energy Efficiency Energy Reliability

Date	Meter Type	Usage Amount	Season
2009-07-01	Natural Gas	119.82430555555555	Cooling
2009-07-02	Natural Gas	119.82430555555555	Cooling
2009-07-03	Natural Gas	119.82430555555555	Cooling
2009-07-04	Natural Gas	119.82430555555555	Cooling
2009-07-05	Natural Gas	119.82430555555555	Cooling
2009-07-06	Natural Gas	119.82430555555555	Cooling

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Menu lion@spring2022:~/D... ACCESS TOKEN (~D.. Results — Mozilla Fire... Sun Apr 24, 20:04

Specific Month Query

ESPA - Energy Supply Project +

127.0.0.1:5000/question2

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ESPA Home Energy Efficiency Energy Reliability

Energy Reliability

How can each energy source vary in energy supply depending on the month or season?

Select an energy source:

Electric - Grid
 Natural Gas
 Fuel Oil
 Other

Please enter a starting year

2009

Please entering an ending year

2020

Select either:

Month
 Season

Please select a month:

July

Submit

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Specific Month Query Result

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ESPA Home Energy Efficiency Energy Reliability

Year	Month	Meter Type	Usage Amount
2009	7	Electric - Grid	1383968.39
2018	7	Electric - Grid	293.4
2020	7	Electric - Grid	2975.4

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Transition: Maintenance

Private Github Project URL:

- <https://github.com/TCNJ-degoodj/cab-project-02-1>

Final Project Demonstration

Slides:

ESPA: Energy Supply Project Analysis

Sterly Deracy, Peter Kelly, Amy Vargas, Joseph Oczkowski, Matthew Seitz, Grant Bushoven, Daniel Melamed

Stakeholder's Need and Our Approach

- Need : Efficient and easy to use database that allows the user (Paul Romano) to see information regarding energy supply usage at TCNJ
- Two main questions:
 - When is it economical for the campus to produce its own power as opposed to using that of the electric grid?
 - When is it least polluting for the campus to produce its own power as opposed to using that of the electric grid, on both a site and source basis?
- Our Approach: Database with two dedicated sets of queries
 - Energy Efficiency
 - Broken down into yearly, monthly, 15 minute intervals
 - Energy Reliability
 - Broken down by heating/cooling season in yearly/monthly intervals

ESPA's Impact

- Benefits
 - Specialized
 - Detailed 15 minute breakdowns
 - Robust room for expansion
 - Front end error checking
 - Straightforward and practical design
- Costs:
 - Data predefined in 15 minute intervals
 - Sizable memory space
 - Brand new website

User Interface Screenshot:

The screenshot shows a Mozilla Firefox browser window with the title "ESPA - Energy Supply Project Analysis — Mozilla Firefox". The address bar displays "127.0.0.1:5000/question1". The navigation bar includes links for "Getting Started", "Homepage", "Forum", "Wiki", "Manjaro Discover S...", "Mozilla News", "Home", "Energy Efficiency", and "Energy Reliability". The main content area has a blue header "Energy Efficiency". Below it, a question asks, "How can energy from the electric-grid and energy from the power plant differ in terms of their supply efficiency?". There are three form sections: "Select an energy source:" with checkboxes for Electric - Grid, Natural Gas, Fuel Oil, and Other; "Select either:" with radio buttons for Year, Month, or 15 Minute; and "Please enter a specific date:" with a text input field containing "07/03/2018". Below these are fields for starting and ending times (both set to "00:00 AM") and an ending time ("05:00 AM"). A checkbox "Show Meter Cost?" is checked. A large blue "Submit" button is at the bottom.

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Transition: Product Hand Over

Sterly's URL: <https://github.com/sderacy/csc315cab>

Amy's URL: <https://github.com/A-Vargas-GP/cab-project-02-1>

Peter's URL: <https://github.com/kellyp11/cab-project-02-1>