



Building Life Cycle Cost Analysis

Team

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Project Description

Project: Building Life Cycle Cost Analysis for Prince George's County Parks & Recreation across six facilities.

Primary **business objective** of this project is to understand the relationship between:

- initial capital investment
- changes in building codes
- long term operational costs

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Project Description

This will enable Prince George's County Parks & Recreations to make better informed decisions about the construction of new facilities and how to minimize long term operational costs.

Requirements:

- Comparative cost analysis of utility costs
- Animated visualizations that tell a story
- Data Cleaning Procedures
- Centralized walkthrough level process



Gathering Data

- Look at what types of variables we were dealing with and gather measurements needed to create an analysis
- We were given architectural documents for building surface area and volume to calculate Energy Use Index

Project Phases



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Data Cleaning

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Data Analysis and Visualization

- We began creating visualizations using Python and using one of the datasets as a model that can be analyzed in order to understand quantitative trends

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Reporting and Documentation

- We began creating a final report that explains a walk through of what we produced towards our goal and data management recommendations for future to ensure accurate analysis.



Buildings

Publick Playhouse

- Area: 14,190 sq ft
- Opened on June 1st 1946
- Estimate of project: About \$1.2 Million
- Large brick theater venue for:
 - music and modern dance
 - musical theater
 - historical drama
 - educational programs
 - monthly events for seniors





Laurel-Beltsville Senior Center

- Area: 16,925 sq ft
- Opened on January 1st 2012
- Estimate of project: Unknown
- One-story building featuring:
 - Lobby
 - Fireplace lounge
 - Fitness and exercise room
 - Ceramics room
 - Arts and crafts room, a hobby woodcraft room
 - Billiards room
 - Computer lab
 - Conference room
 - Great room which has a stage and a catering kitchen.



Southern Region Tech & Recreation Center

- Area: 37,048 sq ft
- Opened on June 1st 2013
- Estimate of project: \$15 Million
- LEED Certified Silver
- Features:
 - suspended indoor track
 - climbing wall
 - workout facilities
 - group exercise areas
 - large multipurpose room
 - professional recording studio
 - Kitchen
 - Classrooms.
 - Expansive green roof



Palmer Park

- Area: 21,921 sq ft
- Opened on April 1st 2017
- Estimate of project: Unknown
- Renovated and is an addition to an existing center built in 1960s
- Features:
 - Classrooms and offices
 - Fitness center
 - Dance studio
 - Collegiate-size gymnasium
 - Building is surrounded by glass to use natural light



Southern Area Aquatics & Recreation Complex

- Area: 75,984 sq ft
- Opened on February 29th 2020
- Estimate of project: >\$36 Million
- First multi generational recreation complex
- Achieved LEED Silver status
- Features:
 - Fitness center
 - Indoor track
 - Gym
 - Natatorium
 - Hospitality spaces
 - Cafe



Westphalia

- Area: 16,233 sq ft
- Opened in US in 2016
- Estimate of project: \$2.5 to \$4 Million
- LEED Silver-equivalent and promotes daylighting, uses recycled materials, and has zero-irrigation landscaping.
- Features:
 - Outdoor basketball court
 - Baseball field
 - Playground
 - Weight and fitness room
 - Two multipurpose rooms for dance classes and other services

Discarded: Data Quality Issues





Data



Data Overview

- Utilities data received in flat file with all locations
- Problems include:
 - Inconsistent facility names
 - 2 names for Publick Playhouse & Palmer Park
 - Duplicate billing periods
 - Missing billing periods
 - Billing periods with 0 cost
 - Billing periods with 0 utility use
 - Billing periods with missing entries for utility use
 - Billing periods with utility usage but no cost



Data Cleaning (Python)

- Steps taken:
 - Standardized location names in dataset
 - Removed all rows where Cost is 0
 - Aggregated duplicate billing periods
 - Reported dates of missing billing periods
 - All graph descriptions
 - Removed all rows where Utility Use is 0 or missing
 - EUI graph only



Result

Python Output

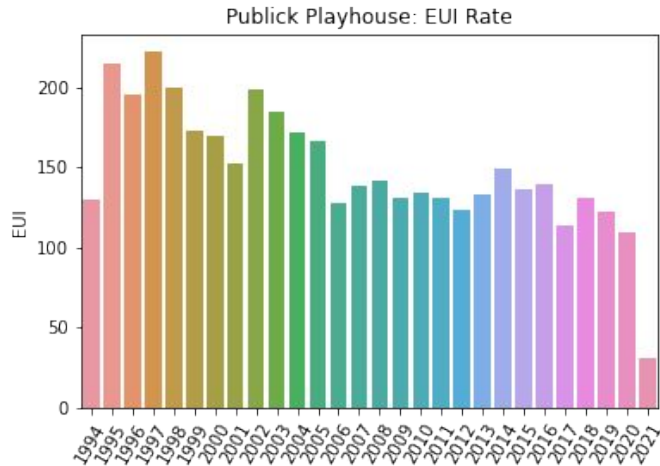
- Report with folders for each facility
 - Visualizations
 - Descriptions



Python Output

- Energy Usage Intensity (EUI)

EUI.PNG



EUI.TXT

Publick Playhouse (EUI)

MISSING DATA in ELECTRIC:

	From	To	Days
0	1995-11-13	1995-12-12	29 days
1	2017-10-17	2017-11-16	30 days

MISSING DATA in NATURALGAS:

	From	To	Days
0	1995-10-07	1995-11-06	30 days
1	1996-04-10	1996-11-06	210 days
2	1997-09-09	1997-10-08	29 days
3	2014-09-04	2014-10-03	29 days
4	2018-08-09	2018-10-10	62 days

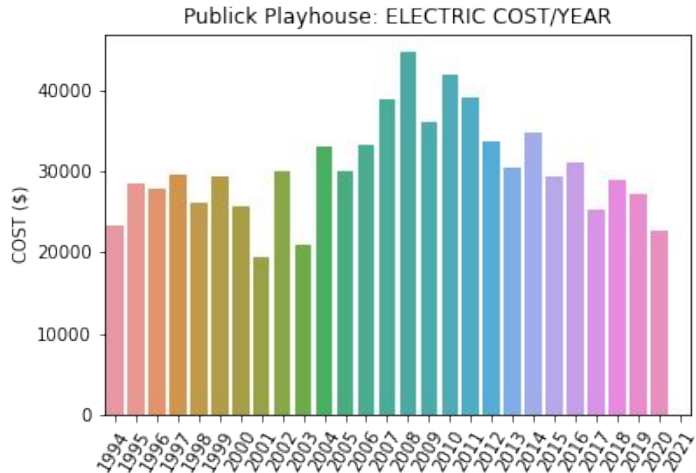
Start Date	EUI
1994	129.976136

- Report Results
 - Publick Playhouse
 - YEARLY ELECTRIC.png
 - YEARLY ELECTRIC.txt
 - YEARLY WATER.png
 - YEARLY WATER.txt
 - YEARLY NATURALGAS.png
 - YEARLY NATURALGAS.txt
 - YEARLY TELEPHONE.png
 - YEARLY TELEPHONE.txt
 - EUI.png
 - EUI.txt
 - Palmer Park Community Center
 - Southern Area Aquatics and Recreation Complex
 - Laurel Beltsville Senior Activity Center
 - Southern Tech&Rec Complex

Python Output

- Yearly cost with description for each utility

YEARLY WATER.PNG



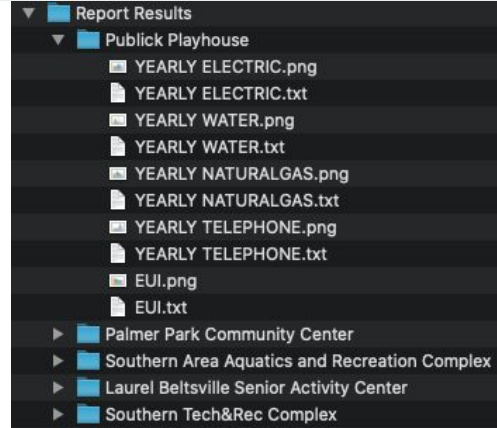
YEARLY WATER.TXT

Publick Playhouse (YEARLY ELECTRIC)

MISSING DATA:

	From	To	Days
0	1995-11-13	1995-12-12	29 days
1	2017-10-17	2017-11-16	30 days

Start Date	Cost
1994	23235.13
1995	28523.01
1996	27744.58
1997	29520.40



Usability

- Jupyter Notebook
 - Included documentation explaining how to use
 - When run, saves all graphs and information to a folder



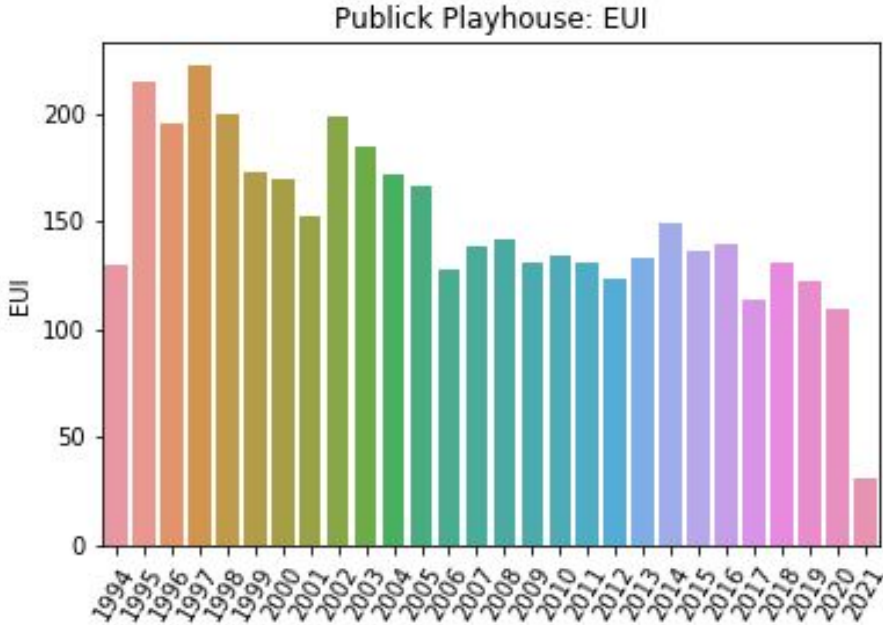


Analysis

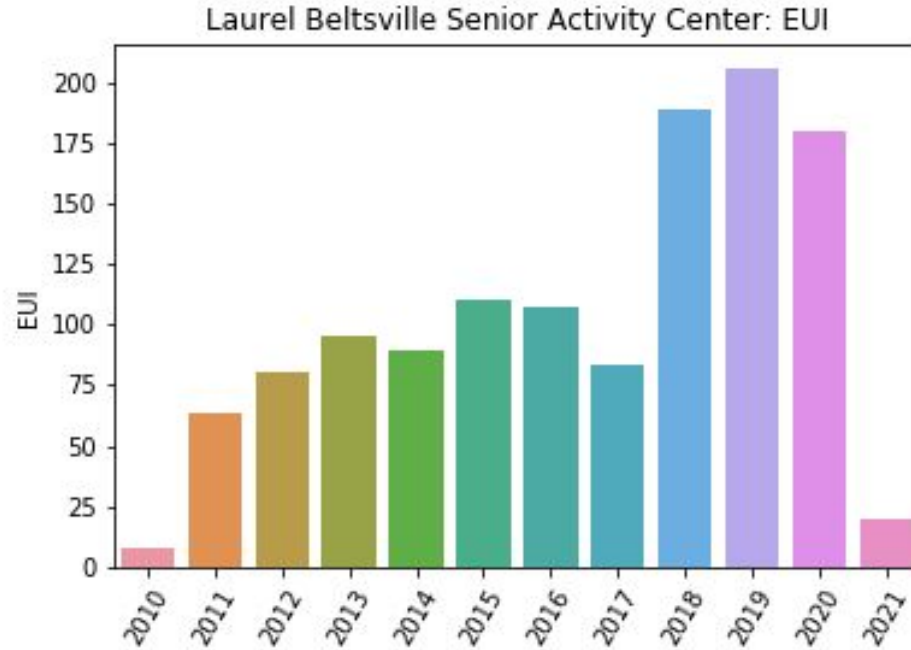
EUI Reference from Energy Star

Entertainment/Public Assembly	Convention Center		109.6	56.1	CBECS - Social/Meeting	
	Movie Theater		112.0	56.2	CBECS - Public Assembly	
	Museum					
	Performing Arts					
	Recreation	Bowling Alley		112.0	50.8	CBECS - Recreation
		Fitness Center/Health Club/Gym				
		Ice/Curling Rink				
		Roller Rink				
Swimming Pool						
Other - Recreation						
Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting		

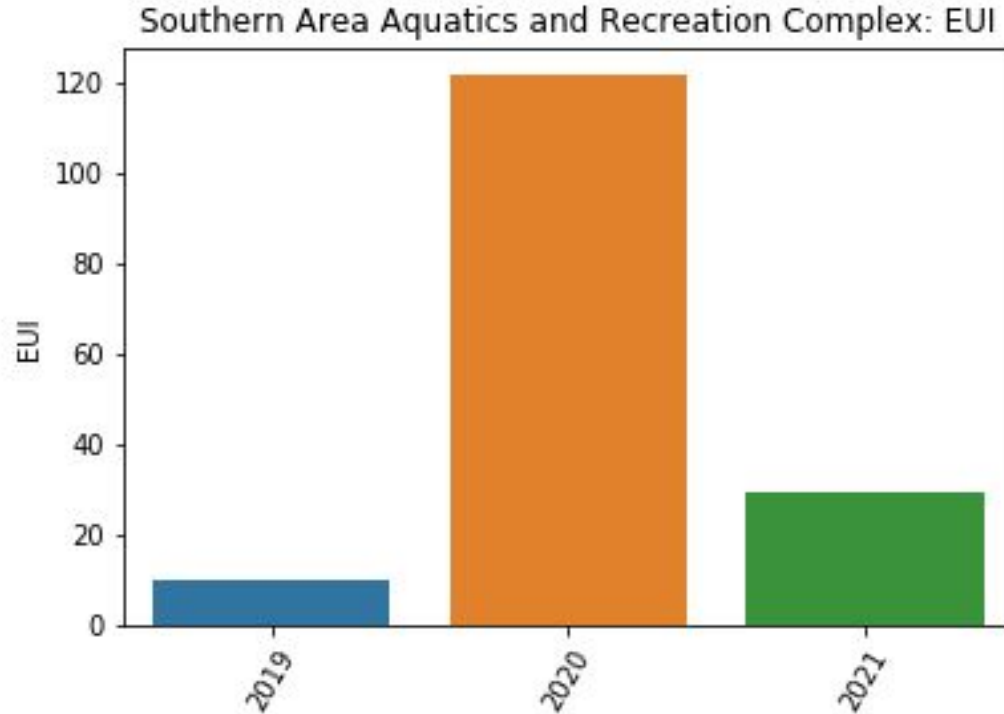
Publick Playhouse



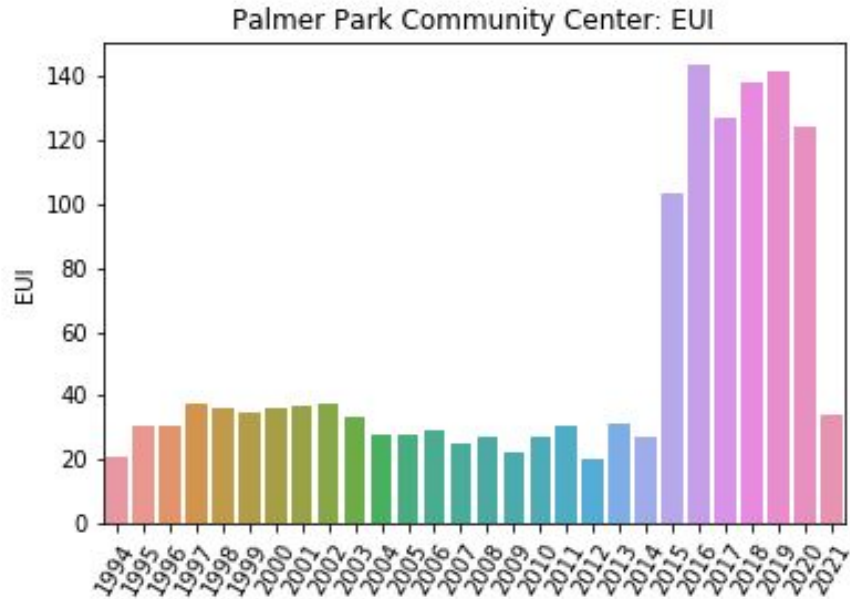
Laurel-Beltsville Senior Center



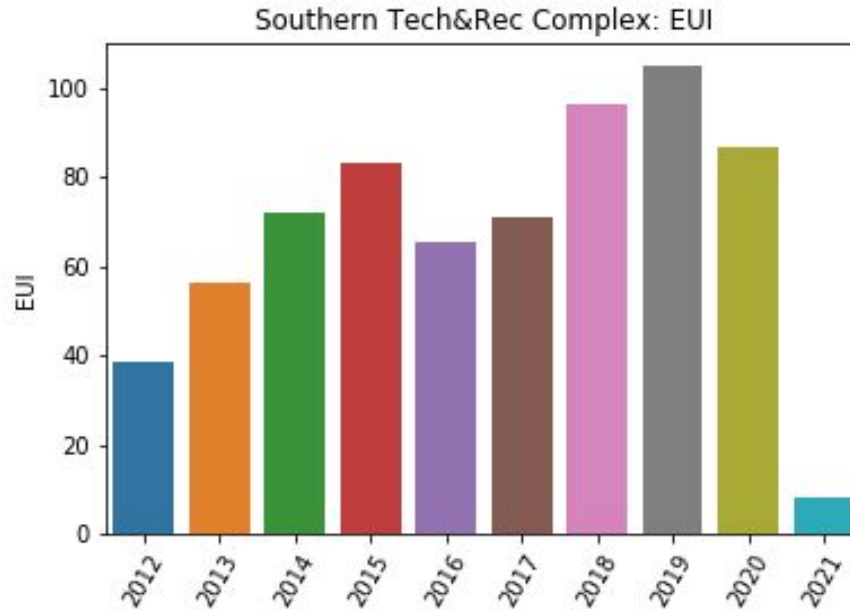
Southern Area Aquatics & Recreation Complex



Palmer Park

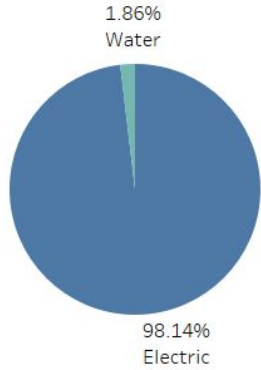


Southern Region Tech and Recreation Complex



Laurel

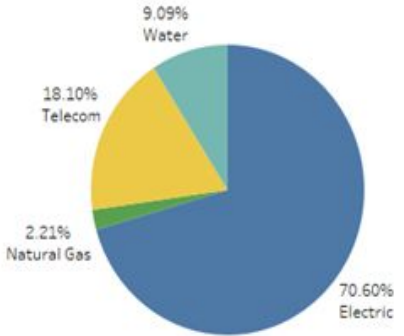
Pie Chart of Commodity Usage	Percentage Cost of All Utilities	Average Yearly Electric Usage	Average Yearly Electric Cost	Average Yearly Water Usage	Average Yearly Water Cost	Average Yearly Gas Cost	Average Yearly Telecom Cost	Total Yearly Usage All Utilities
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**Laurel- Pie Chart
of Commodity
Usage**

Laurel

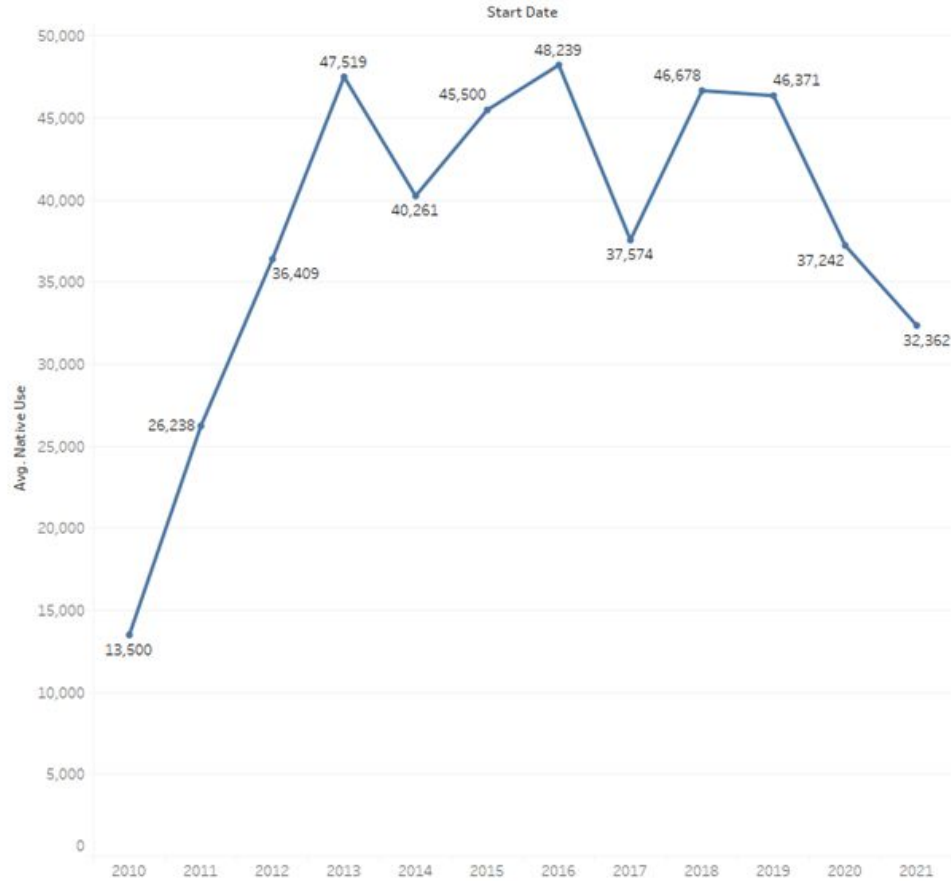
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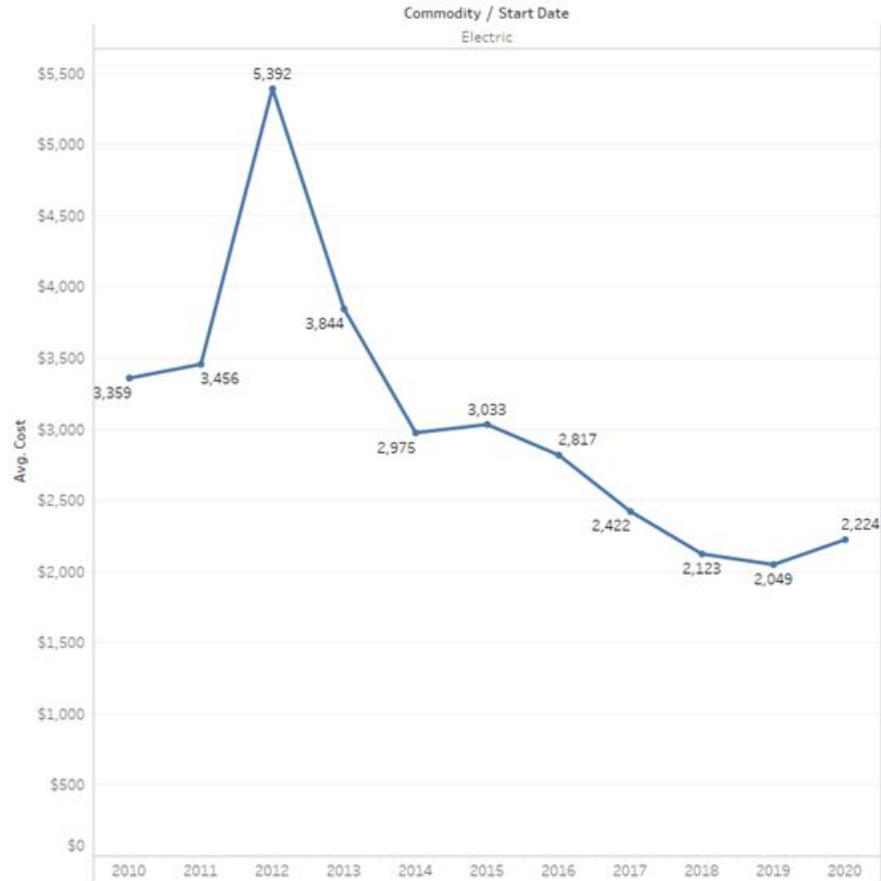
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**Laurel-
Average Yearly
Electric Usage**

Laurel

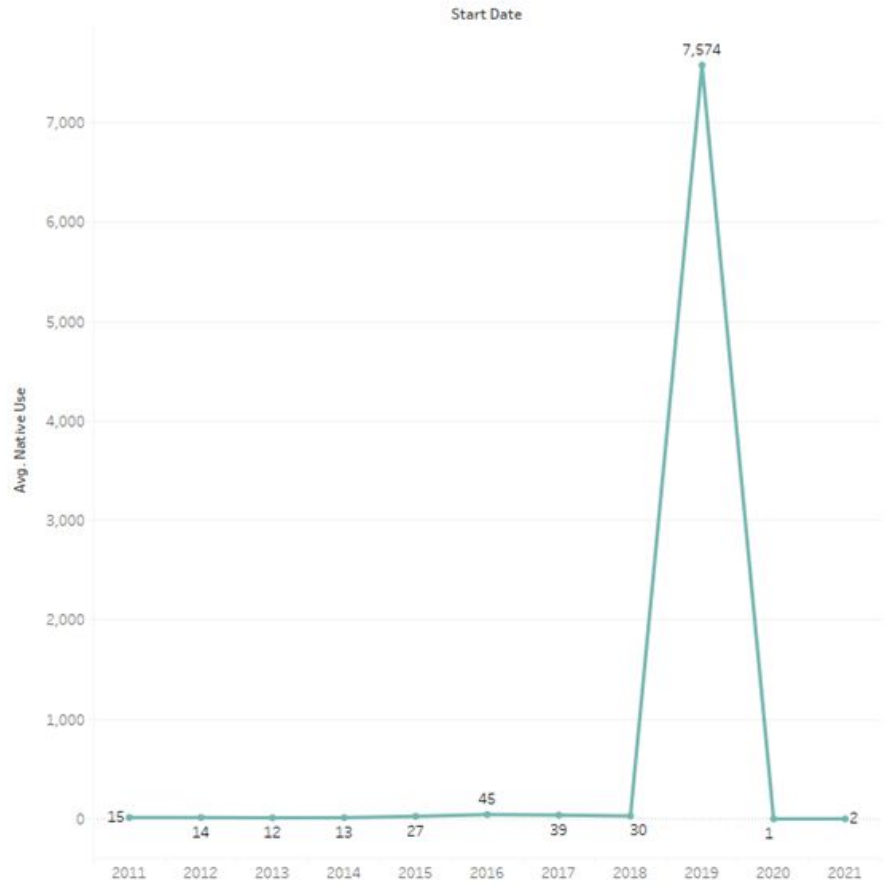
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**Laurel-
Average Yearly
Electric Cost**

Laurel

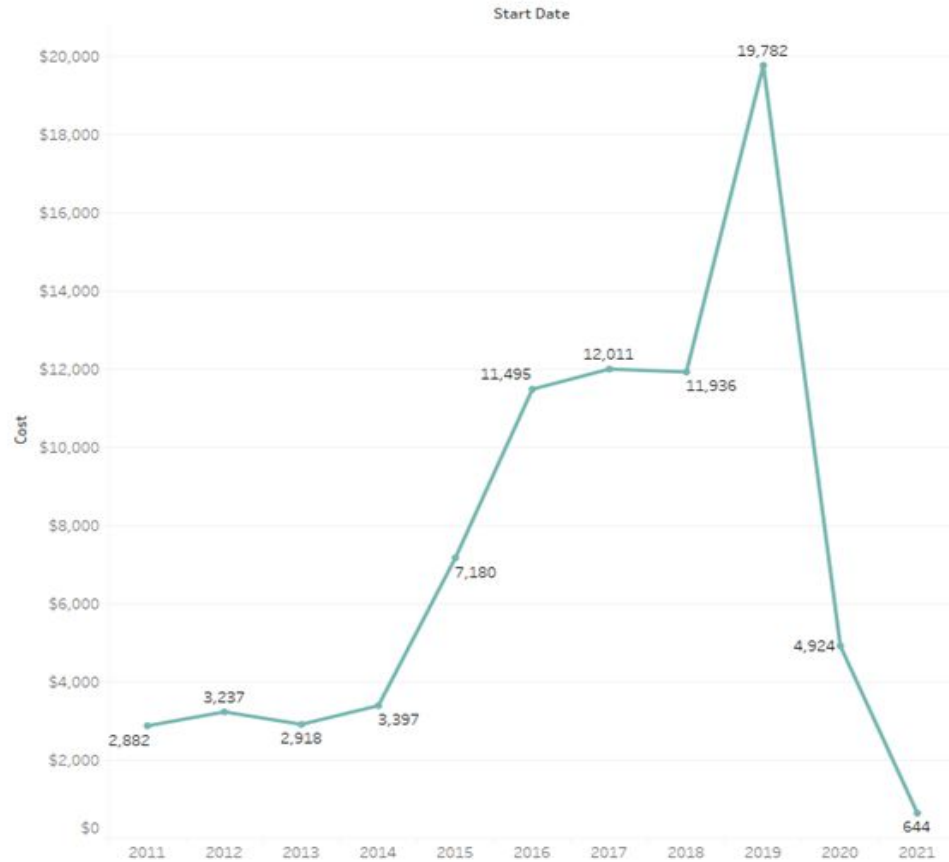
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**Laurel-
Average Yearly
Water Usage**

Laurel

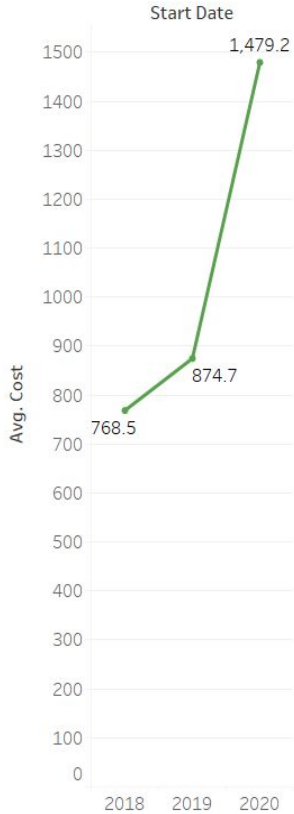
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Average Yearly
Water Usage**

Laurel

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- Commodity
- Null
 - Electric
 - Natural Gas
 - Telecom
 - Water

Commodity

Natural Gas

**Laurel-
Average Yearly
Gas Cost**

Laurel

Pie Chart of Commodity Usage	Percentage Cost of All Utilities	Average Yearly Electric Usage	Average Yearly Electric Cost	Average Yearly Water Usage	Average Yearly Water Cost	Average Yearly Gas Cost	Average Yearly Telecom Cost	Total Yearly Usage All Utilities	Total Yearly Cost All Utilities
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Commodity

- Electric
- Natural Gas
- Telecom
- Water

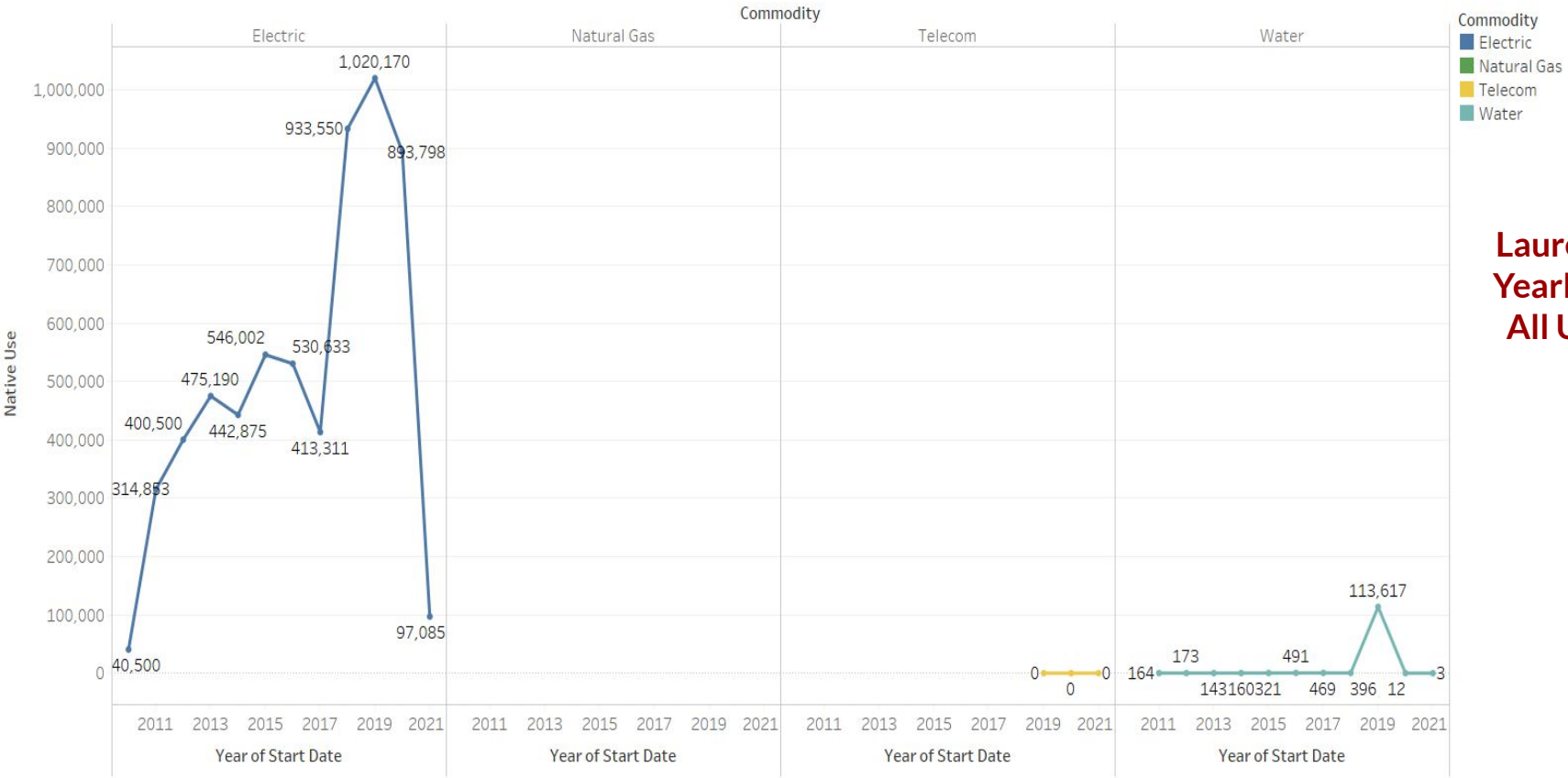
Commodity

- Telecom

**Laurel-
Average Yearly
Gas Cost**

Laurel

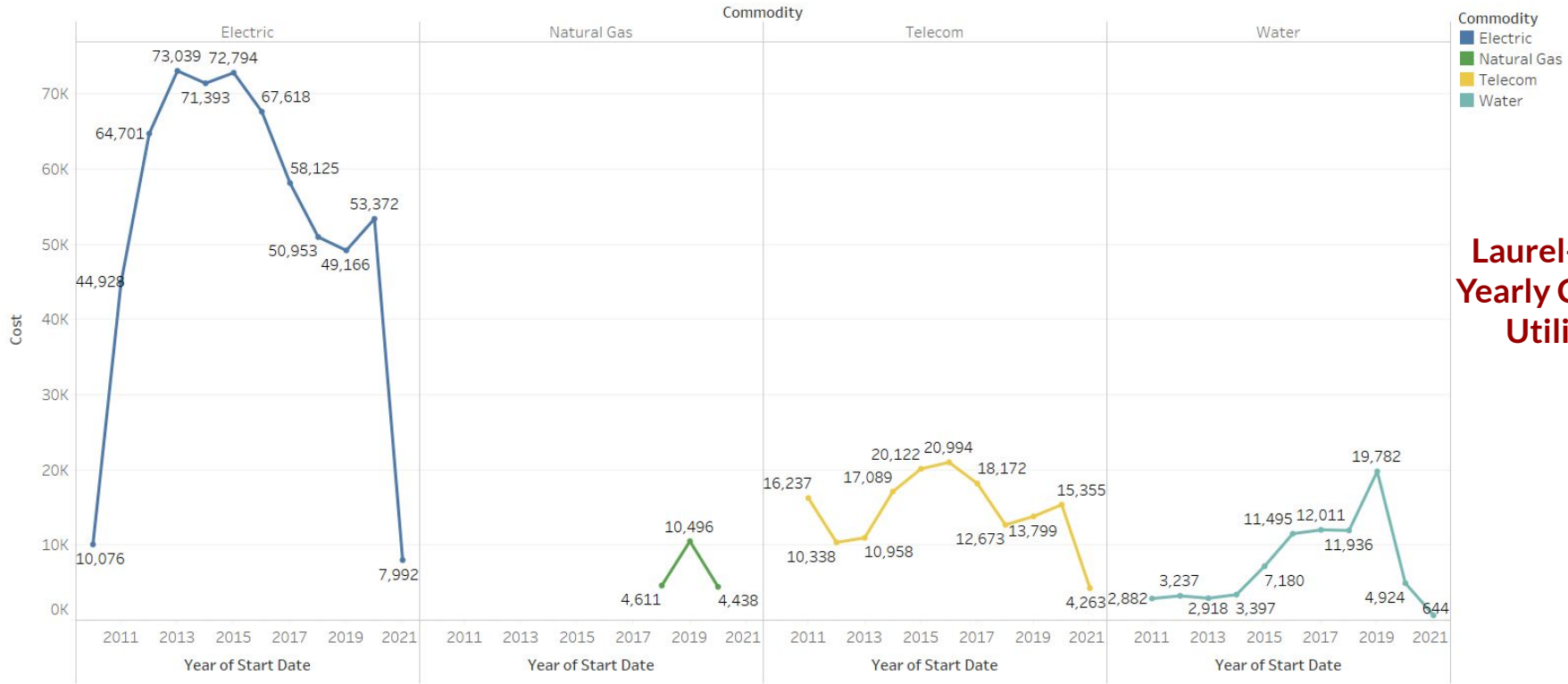
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Laurel- Total Yearly Usage All Utilities

Laurel

Pie Chart of Commodity Usage	Percentage Cost of All Utilities	Average Yearly Electric Usage	Average Yearly Electric Cost	Average Yearly Water Usage	Average Yearly Water Cost	Average Yearly Gas Cost	Average Yearly Telecom Cost	Total Yearly Usage All Utilities	Total Yearly Cost All Utilities
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Laurel- Total Yearly Cost All Utilities



Recommendations

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- ❑ Thermostat Data
 - ❑ Insights into how much money goes toward heating/ cooling
 - ❑ Is it too hot/ cold in the building?
 - ❑ Any inefficiencies in the system?
- ❑ Building Traffic
 - ❑ How many people enter and exit in a day?
 - ❑ Cost/ person to operate?
 - ❑ Can conduct surveys on building climate
 - ❑ Is it too hot, too cold, etc
 - ❑ How long does each person spend there?
- ❑ Mapping out which meters control which utilities
 - ❑ How much do lights cost?
 - ❑ How much does AC cost?
 - ❑ How much does heat cost?
- ❑ Initial cost of building
- ❑ Cost of required updates
- ❑ Cost of Maintenance
- ❑ Is building over or under staffed?



Thank You!

Questions?

