Smart Power Grids: The Future of Our Community

Circuit Weavers

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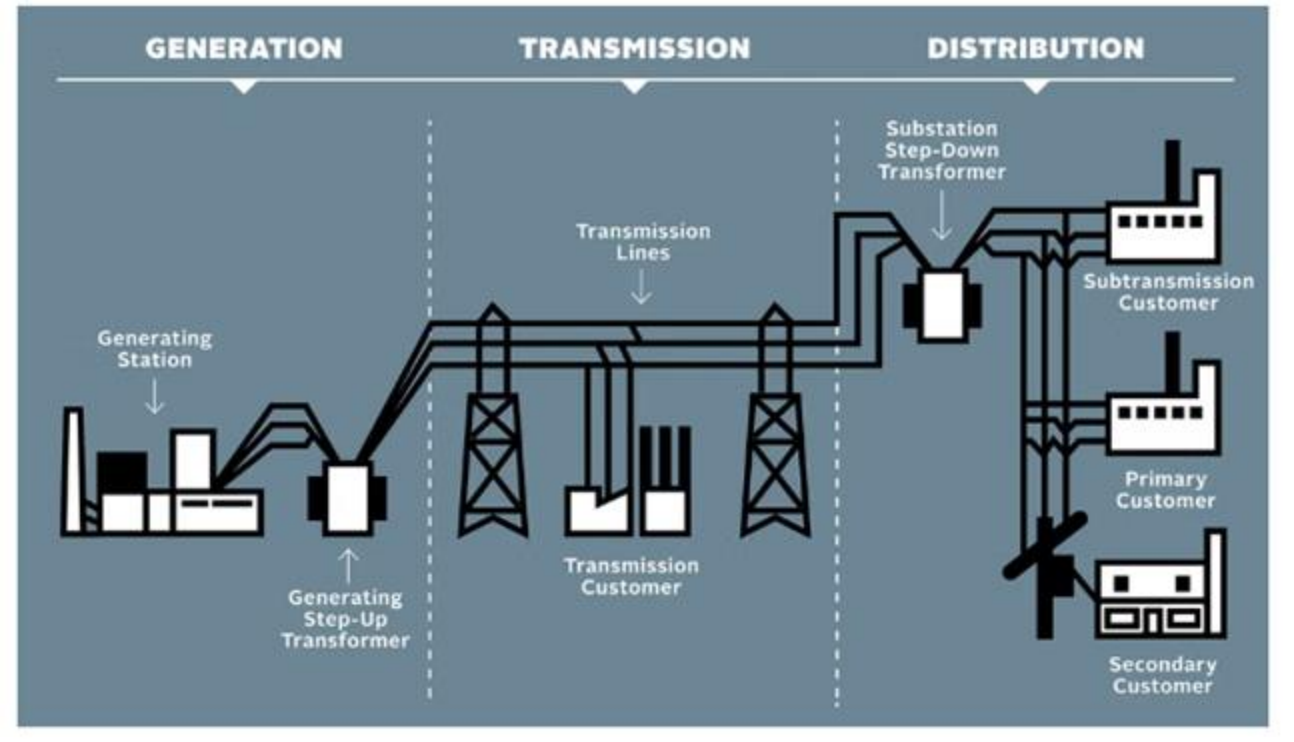
Introduction

Our society relies heavily on electricity for important things, like cleaning our water, powering our schools, and saving lives.

Smart grids are the future of our community, in helping people have access to something so critical during times when it's limited

There are certain steps in how power reaches us, which is demonstrated in our visual. The problem with this. . .



Popular Mechanics- popularmechanics.com/science/energy/a44067133/how-does-the-power-grid-work/

Due to various reasons, between

10 & 15 million

People lose power in Florida each year

Why?

The Faults of Our Current Grids

- **Lack of Real Time Monitoring and Control**
  - **Traditional grid:** Operators rely on periodic checks and outdated data
  - **Smart grid:** Use of sensors, smart meters, and and communication networks

- **Limited Fault Tolerance and Self Healing**
  - **Traditional grid:** Little fault tolerance, relies on human evaluation and repair
  - **Smart grid:** Reports outages automatically, works to deliver power to users through different routes

- **Issues in Power Distribution and Integration**
  - **Traditional grid:** One way power flow, cannot integrate renewable energy, inefficient transmission
  - **Smart grid:** Distribute power as needed, two way power flow, integration of renewable energy

Exploring Our Community

Being in a hurricane-ridden area, some challenges facing the community are the amount of energy it takes for some places to start or maintain running for a lasting amount of time. Especially during storms, when the cutting off of power lines keeps certain users from gaining power. During or after a natural disaster it may take a long time to find out about any problems and the cause of them, let alone fixing the problems and get things back to normal.

User types:

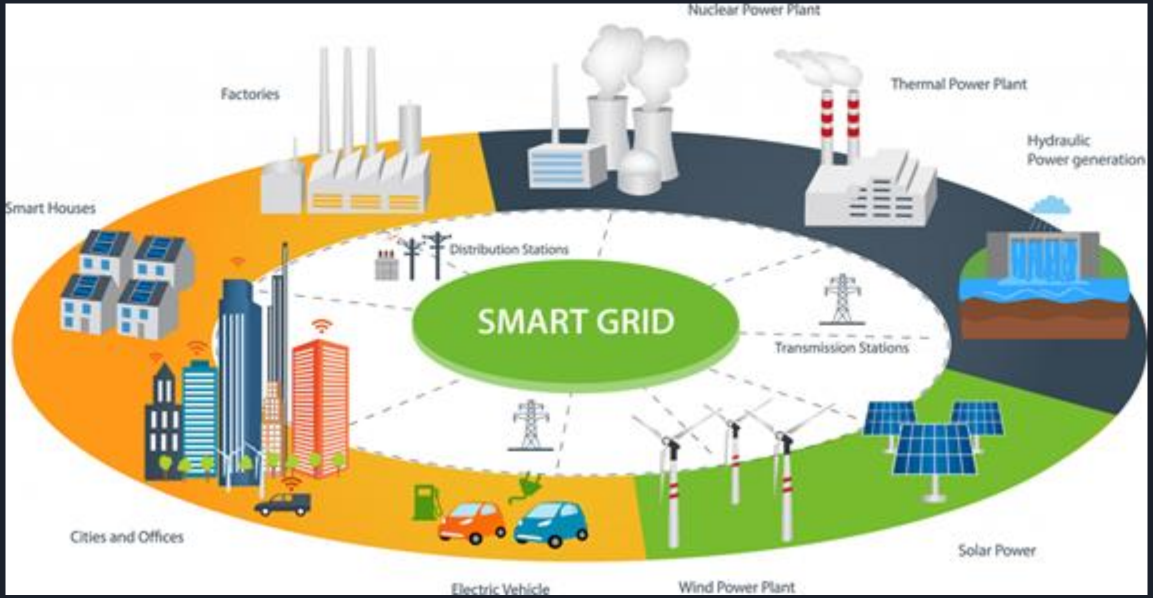
1. Hospitals/ER
2. Schools
3. Homeless Shelters/Evacuation Shelters
4. Gas Stations
5. Water and Sewage Treatment plants
6. Power Plants
7. Grocery Stores/Pharmacies
8. Communication Services
9. Emergency Services
10. Neighborhoods

Exploring Our Community

The user types we choose we believed were important for during or after a natural disaster.

❖ The Hospitals/Er would be an important factor for as during or after a natural disaster people could have been very injured and need medical attention immediately, plus the hospital is also a good place for shelter if there is enough space.

❖ We chose water and Sewage Treatment plants because when a natural disaster just finishes and we are in the aftermath stages the sewers become filled, and it allows for bacteria to build up and keeps people from having clean water for a decent time because the water is backed up with how much is filled in the sewers.



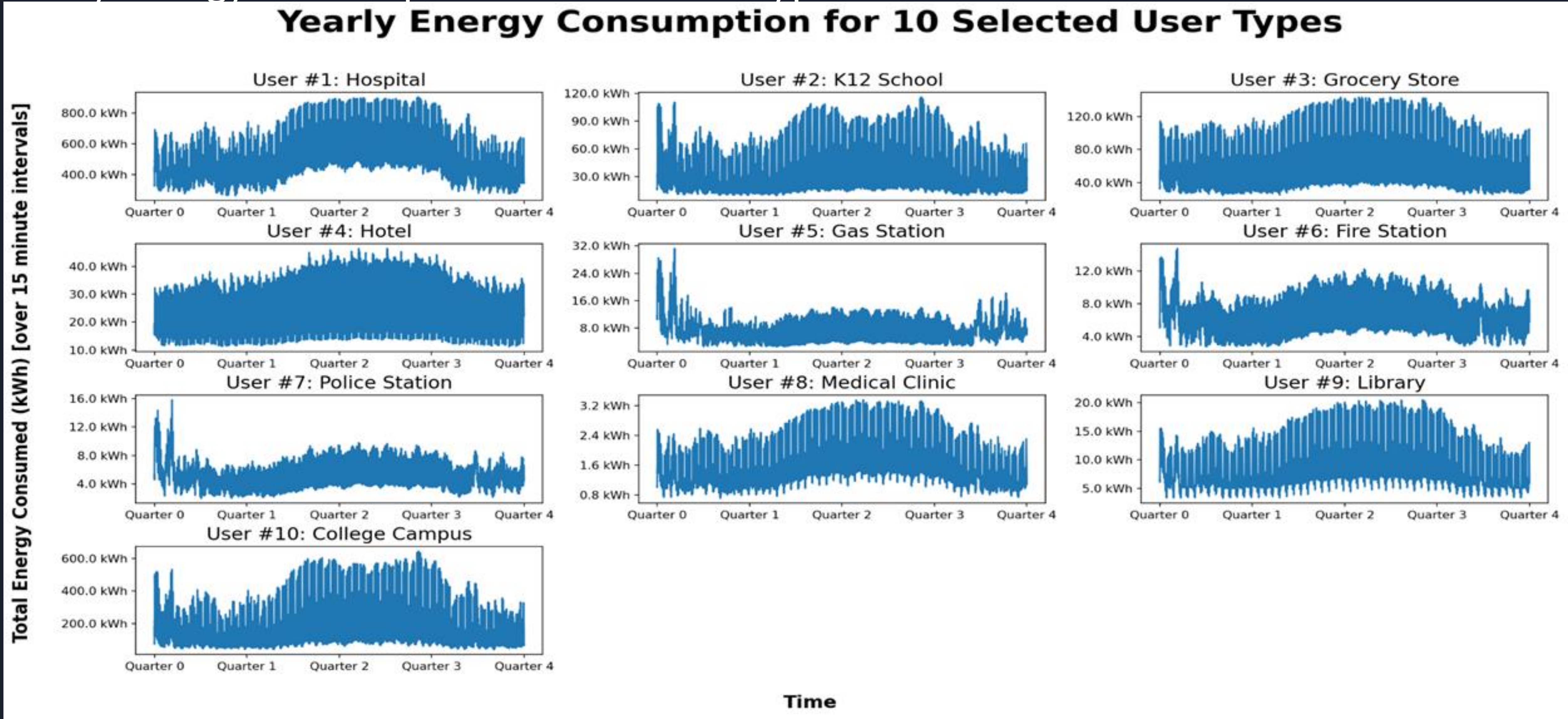
Exploring Our Community

- Homeless Shelters/Evacuation Shelters allows for people to be in a secure and safe place during or after a natural disaster.

- Our priorities were put in the way they are due to which places we felt would have the most impact during or after a natural disaster. Some important aspects that we took into consideration are distance, and how close these user types are to each other, plus how many of them there are.

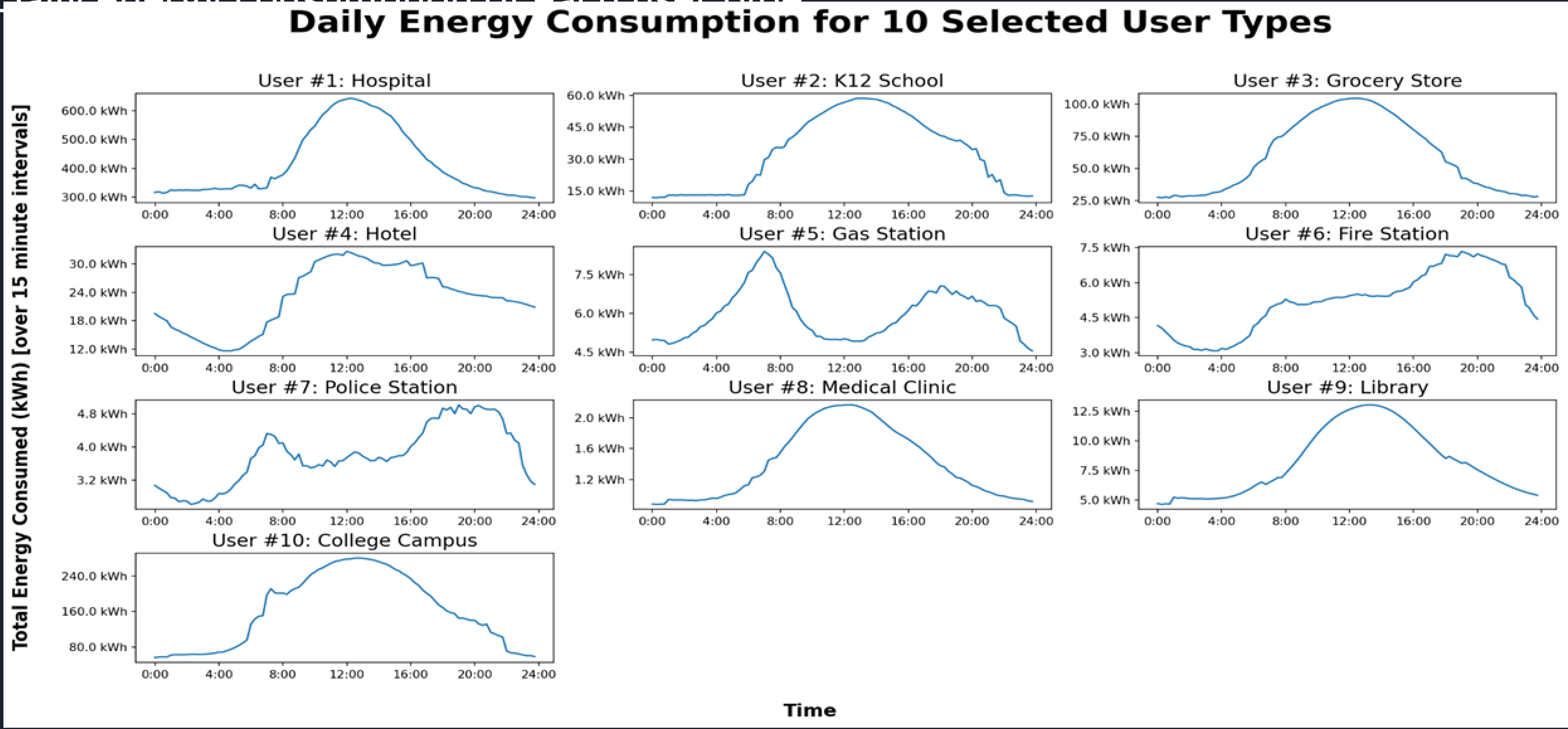
Power Needs In Our Community

Yearly energy consumption of each user type:



Power Needs In Our Community

Daily energy consumption of each user type:



Power Needs In Our Community

Considered Trends:

- ❖ Energy Consumption
- ❖ How to distribute energy efficiently.
- ❖ Does the User type have a generator.

Like all reliable AI models, ours is trained on data that is relevant to purpose. Trends in power use vary depending on certain factors, and having a knowledge of these will assist the AI model in providing prioritized user types an adequate amount of power.

Power Distribution through AI

We wanted our AI to distribute power to user based on different parameters. Parameters contribute to the amount of power each user gets.

PARAMETERS:

- User priority- The ranking that each user get based on their impact on the community
- Available power- The amount the power the city receives to distribute.
- Power consumption- How much power the users consume.
- Time of day- How much power the users use based on the time of the day.

User Name	Normal Max Power 12A-12A (kW)	Normal Power Distribution (%)
User 1: Hospital	2574.9	27.9
User 2: K12 School	469.9	5.1
User 3: Grocery Store	3343.5	36.2
User 4: Hotel	914.5	9.9
User 5: Gas Station	503.4	5.4
User 6: Fire Station	29.4	0.3
User 7: Police Station	40.1	0.4
User 8: Medical Clinic	34.7	0.4
User 9: Library	208.4	2.3
User 10: College Campus	1124.1	12.2
Total (kW)	**9242.8**	**100.0**

What we had to consider

We had to consider:

- ❖ The amount of power we can distribute
- ❖ The amount of power our user consume

If we couldn't meet these requirements user wound be without power and if we exceeded the requirement we would be wasting power.

Trade offs during a outage(60% of max):

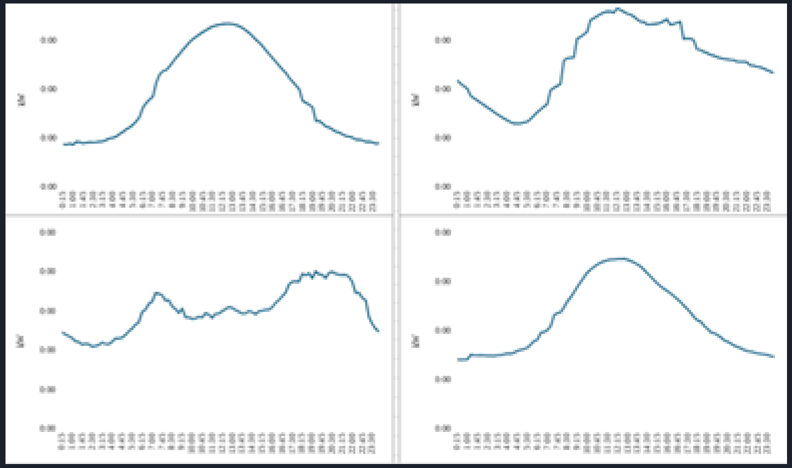
- ❖ Less Available power
- ❖ User priority

During a outage we would have to give power to users with a higher priority. We also considered users that would have generators such as hospitals and grocery stores.

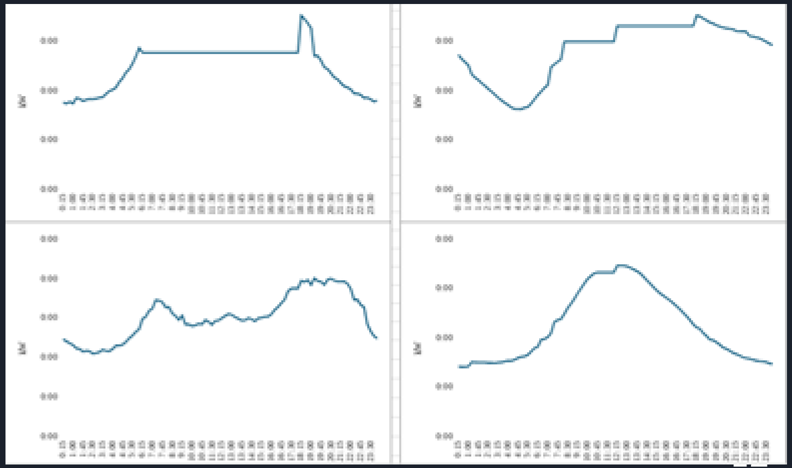
Training in the future:

We would train the AI with different scenarios. so if something new happens in can understand what to do based on what it learned.

Normal power distribution



Outage power distribution



Power Distribution at different times:

12:00 AM - 5:59 AM - Adjustment				
User	Disaster Power Distribution (% Max)	Distributed Power (kW	Normal Max Power Demand (kW) from 12A-6A	Power Allocation Difference (kW) from 12A-6A
User 1	**27.0**	1497.3	1364.6	132.7
User 2	**4.0**	221.8	105.6	116.2
User 3	**28.0**	1552.8	1434.7	118.1
User 4	**12.0**	665.5	546.0	119.5
User 5	**10.0**	554.6	431.5	123.1
User 6	**3.0**	166.4	16.6	149.8
User 7	**2.0**	110.9	27.2	83.8
User 8	**2.0**	110.9	17.9	93.0
User 9	**4.0**	221.8	94.9	126.9
User 10	**8.0**	443.7	382.9	60.7
	100.00	5545.67		

6:00 AM - 11:59 AM - Adjustment				
User	Disaster Power Distribution (% Max)	Distributed Power (kW	Normal Max Power Demand from 12A-6A	Power Allocation Difference (kW) from 12A-6A
User 1	**41.0**	2273.7	2551.6	-277.9
User 2	**8.2**	454.7	449.8	4.9
User 3	**25.0**	1386.4	3322.6	-1936.1
User 4	**10.8**	598.9	897.8	-298.9
User 5	**9.0**	499.1	503.4	-4.3
User 6	**0.4**	22.2	21.5	0.6
User 7	**0.8**	44.4	34.6	9.8
User 8	**0.6**	33.3	34.5	-1.3
User 9	**0.5**	27.7	199.9	-172.1
User 10	**3.7**	205.2	1108.3	-903.1
	100.00	5545.67		

12:00 PM - 5:59 PM - Adjustment				
User	Disaster Power Distribution (% Max)	Distributed Power (kW	Normal Max Power Demand from 12A-6A	Power Allocation Difference (kW) from 12A-6A
User 1	**41.0**	2273.7	2574.9	-301.2
User 2	**8.5**	471.4	469.9	1.5
User 3	**25.0**	1386.4	3343.5	-1957.1
User 4	**12.0**	662.7	914.5	-251.8
User 5	**7.5**	415.9	411.1	4.9
User 6	**0.5**	27.7	27.3	0.4
User 7	**0.7**	38.8	37.6	1.2
User 8	**0.7**	36.0	34.7	1.4
User 9	**0.5**	27.7	208.4	-180.6
User 10	**3.7**	205.2	1124.1	-918.9
	100.00	5545.67		

6:00 PM - 11:59 PM - Adjustment				
User	Disaster Power Distribution (% Max)	Distributed Power (kW	Normal Max Power Demand from 12A-6A	Power Allocation Difference (kW) from 12A-6A
User 1	**30.0**	1663.7	1548.2	115.5
User 2	**4.0**	221.8	328.7	-106.9
User 3	**31.8**	1763.5	1763.2	0.4
User 4	**12.8**	709.8	705.2	4.6
User 5	**7.7**	427.0	423.4	3.6
User 6	**0.6**	33.3	29.4	3.9
User 7	**0.8**	44.4	40.1	4.2
User 8	**0.4**	22.2	22.1	0.1
User 9	**0.1**	5.5	139.0	-133.4
User 10	**11.8**	654.4	676.2	-21.8
	100.00	5545.67		

- Patterns in types of users
  - Ex, predominantly neighborhoods, or predominantly businesses?

- Density of users
  - Are prioritized users clumped together, or more sparse?

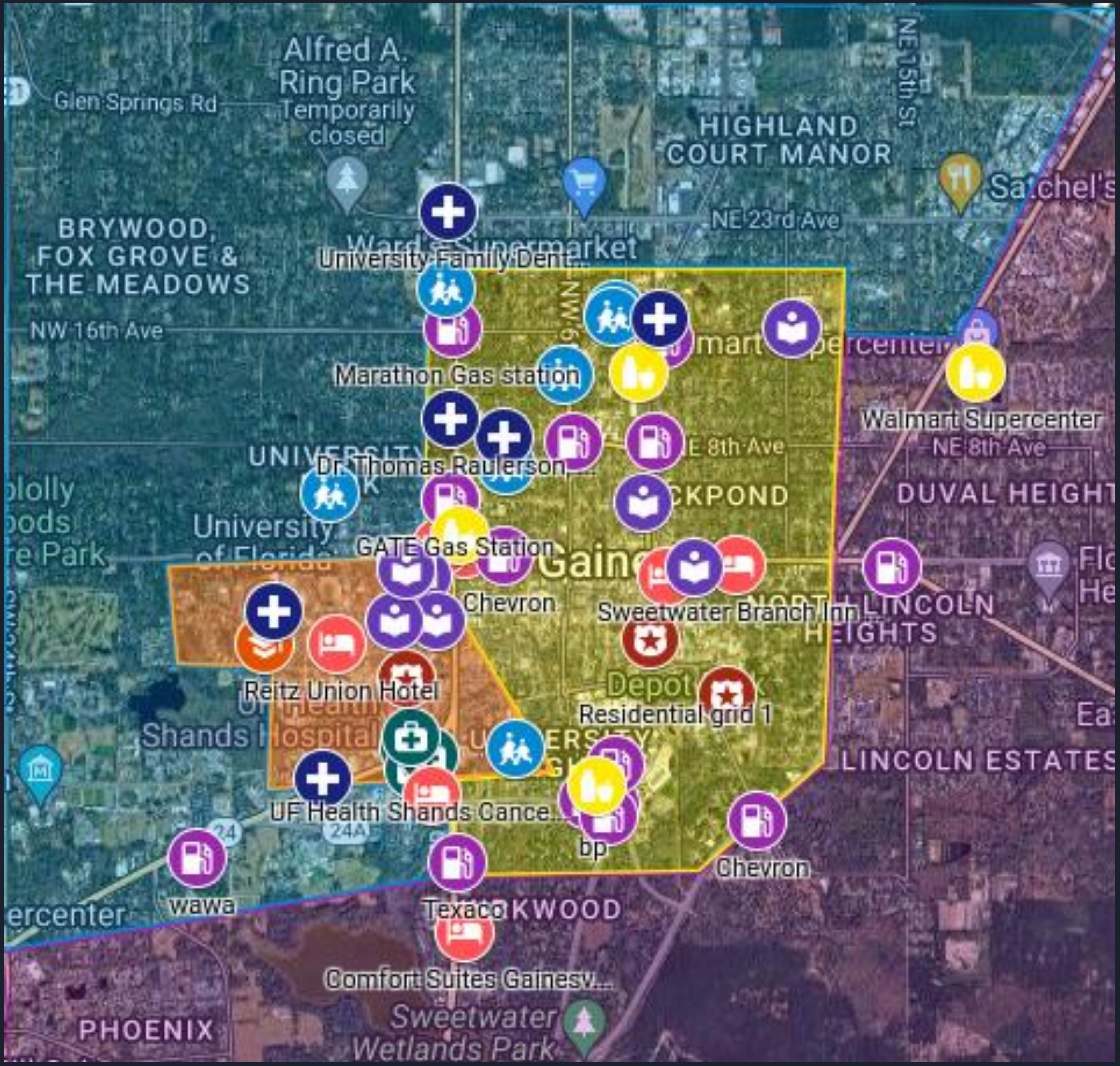
- Existing divisions
  - Are there parts of the community already on their own grid?

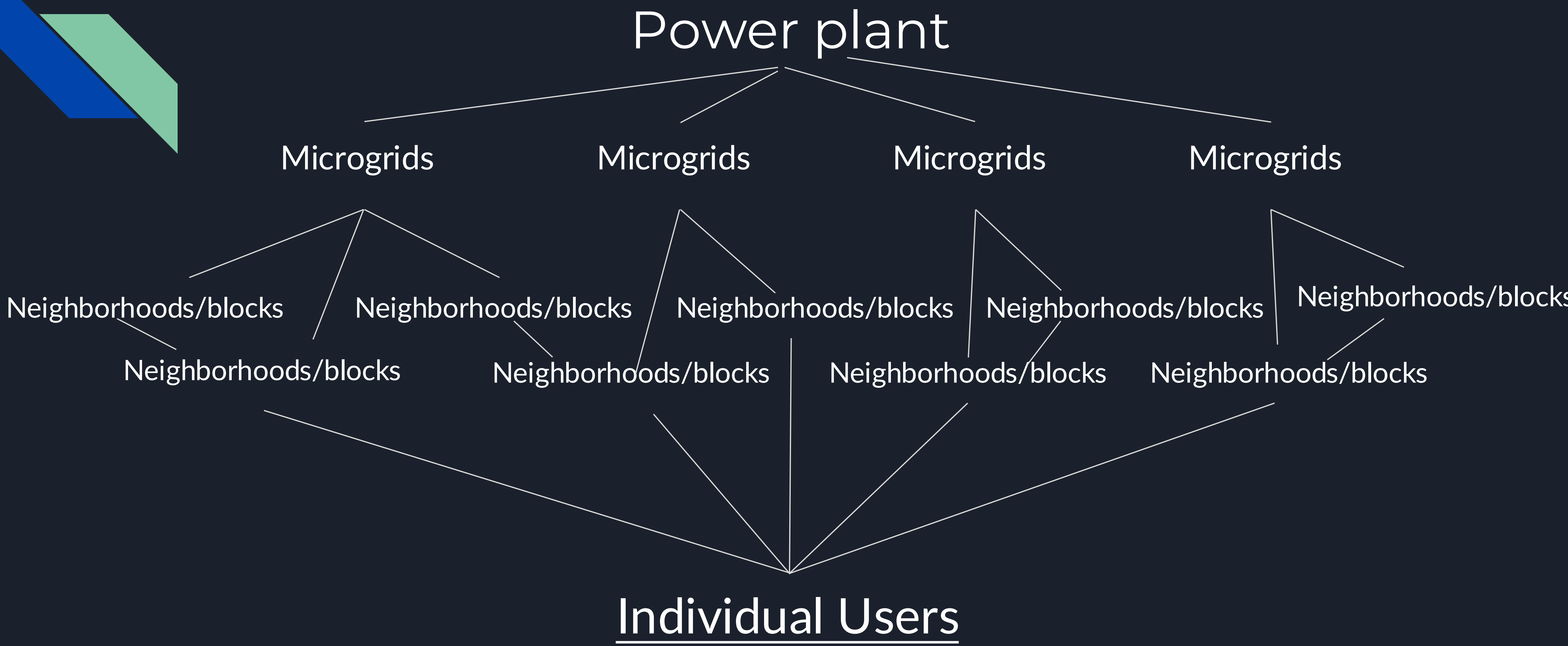
- Even distribution of power to each district
  - Do a larger and smaller district have similar power needs?

The factors considered in our microgrid division:

Our microgrid design:

- ❖ Orange - UF campus
- ❖ Yellow: Commercial district
- ❖ Blue: Residential district 1
- ❖ Purple: Residential district 2




Power plant
Micrografts

Individual user interfaces:

Found in each home, like a thermostat

- Map of power distribution in your district
- Details of power use in your home
  - What devices/outlets are using what percentage of power?
- How much power is allotted to you?
  - Accommodations, requests
- Give spare power?
  - If you are not using all of the power that is provided to you, feed it back into the grid and get a small discount on your power bill
- Control your power use
  - How much power is allocated to each device/outlet?
- Updates on when things will return to normal

Our Plans for a Smart Grid:

Overall, we went through a process that involves teaching ourselves, and our AI model, the power needs of our community, insomuch that our model would prove helpful in distributing power during shortages and emergencies in a way where users, especially those integral to our community's function, will have adequate supply to fulfill their needs.

AI models, by nature, learn and adapt, especially due to the nature of our microgrid divisions. With human assistance and augmentation, it could bring all of the pros of smart grid technology - and the cons, of course, can be mitigated. Through the implementation of self healing technologies into our grid, slowdown detection, sensors, cyber security measures, built in renewable energy stations, coupled with planning out our network's hardware in a way that has more fault tolerance than our current system, could revolutionize our community.

It would be difficult, yes, but what's stopping our community from being a community of firsts?

Let the Gators charge forward, and we can weave our future

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Thank you!

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Questions?