The Turing Group

Representing Cypress Creek Group 3
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Guided by: Michael Roberts

Background Information

- Traditional grids are designed to deliver energy to consumers through a few wires.
- This design is vulnerable since one failure may result in a failure to many consumers, failing to be fault tolerant and produce outages more often.

The solution? Smart Grids

- Smart grids are a more efficient design by introducing artificial intelligence to detect and reroute power depending on the situation.
  - Perform continuous self-monitoring
  - Perform self-healing operations through self-reconfiguration
  - Communicate with neighboring grids
  - Automatically alert humans for manual assistance
- Using Artificial Intelligence can help us manage grids in a smart way.

Design Process

Choosing Our User Types

- Choosing user types allows prioritizing energy consumers in the community.
- Prioritization on emergency necessity and heavy reliance facilities.
    - Public services
    - Extreme common usage
- Other facilities are not immediately required and can be supplied energy later.

The User Types

School	Grocery Store
Fire Station	Hospitals/ER
Bank	Senior Living Center
Gas Station	Police Station
Water Systems	Penitentiary

Public Services

- Hospitals
- Fire Stations
- Police Stations
- Penitentiaries
- Water Systems

Heavy Reliance

- Gas Stations
- Senior Living Center
- Banks
- Grocery Stores
- School

Conflicts

- Some user types do not exist within a 2.5m radius
- Some user types exist seldomly
- No clear categorization of ordered prioritization
- Some locations are just regular houses

The NEW! User Types

Schools (6)	Grocery Stores (2)
Fire Stations (1)	**Restaurants (12)**
Banks (1)	**Residential Zones (15)**
Gas Stations (7)	**Auto Dealerships (0)**
Water Systems (1)	**Outpatients (4)**

Restaurants

- More present and uses a moderate amount of energy
- 24/7 usage; quick service restaurants

Residential Zones

- Many, many homes in the area

Auto Dealerships

- More present and use a massive amount of energy

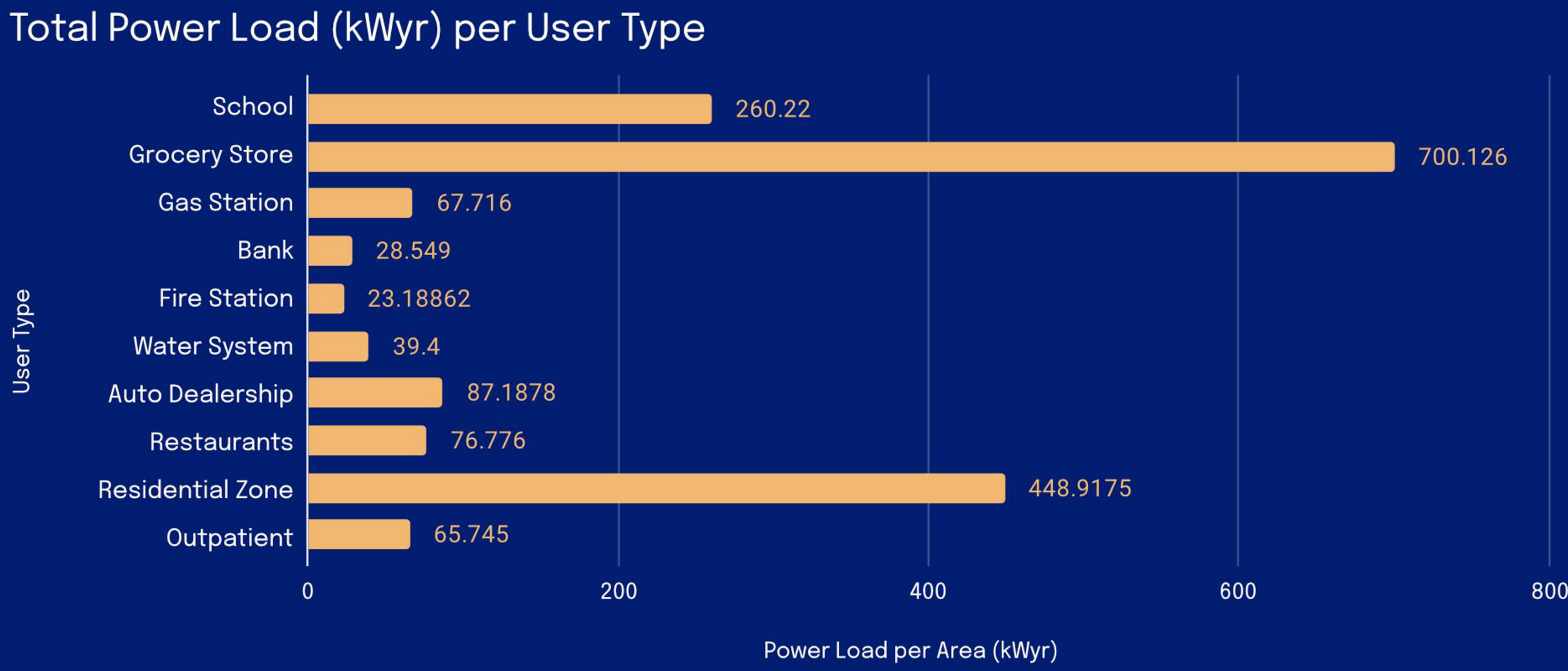
Outpatients (pharmacies and clinics)

- Medical care and uses a moderate amount of energy

The Numbers

- Power load represent the average energy used by each user type.
- Supplied power represents the average energy of the user type multiplied by the amount of occurrences it has in the radius.
- We can use these measurements to calculate the total power that our grid will be required to produce and the total energy consumption within our circle.

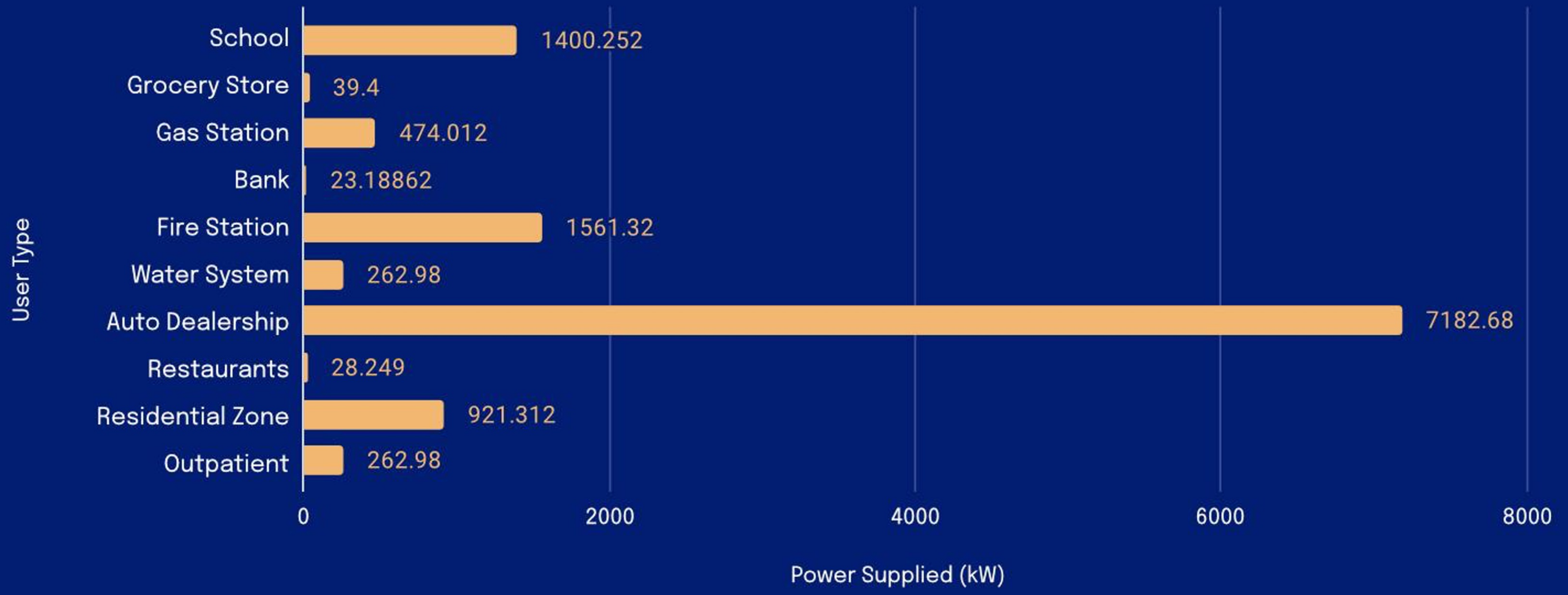
The Numbers



kWyr = Kilowatts per year

The Numbers

Supplied Power (kW) per User Type in the 1.5m radius



kW = Kilowatts

Total kW: 11,893.39362

The Rankings

- A ranking system will help us better understand how the power grid will be designed to deliver energy to specific users.
- Factors: Emergency necessity, energy consumption, reliance, and quantity.

- Highest priority: Requires immediate access.
- Moderate priority: Immediate supplementation not required.
- Lowest priority: Not immediately necessary at all; may be postponed.

The Rankings

Legend (active most…):

- ☀️ During the day
- ⏱️ 24/7

1 | Highest

- ☀️ Water Systems
- ⏱️ Fire Stations
- ⏱️ Gas Stations

2 | Moderate

- ☀️ Schools
- ⏱️ Outpatients
- ☀️ Grocery Stores
- ☀️ Residential Zones

3 | Lowest

- ☀️ Banks
- ☀️ Restaurants
- ☀️ Car dealerships

Powering The Community

Analysis of our Community

In order to implement redundancy, we created a system in which there are multiple nodes that connect every priority level.

- Creates fault tolerance within the smart grid.
- Allows for the same energy output throughout the grid even if one or more nodes fail.
- Backup battery for temporary power.

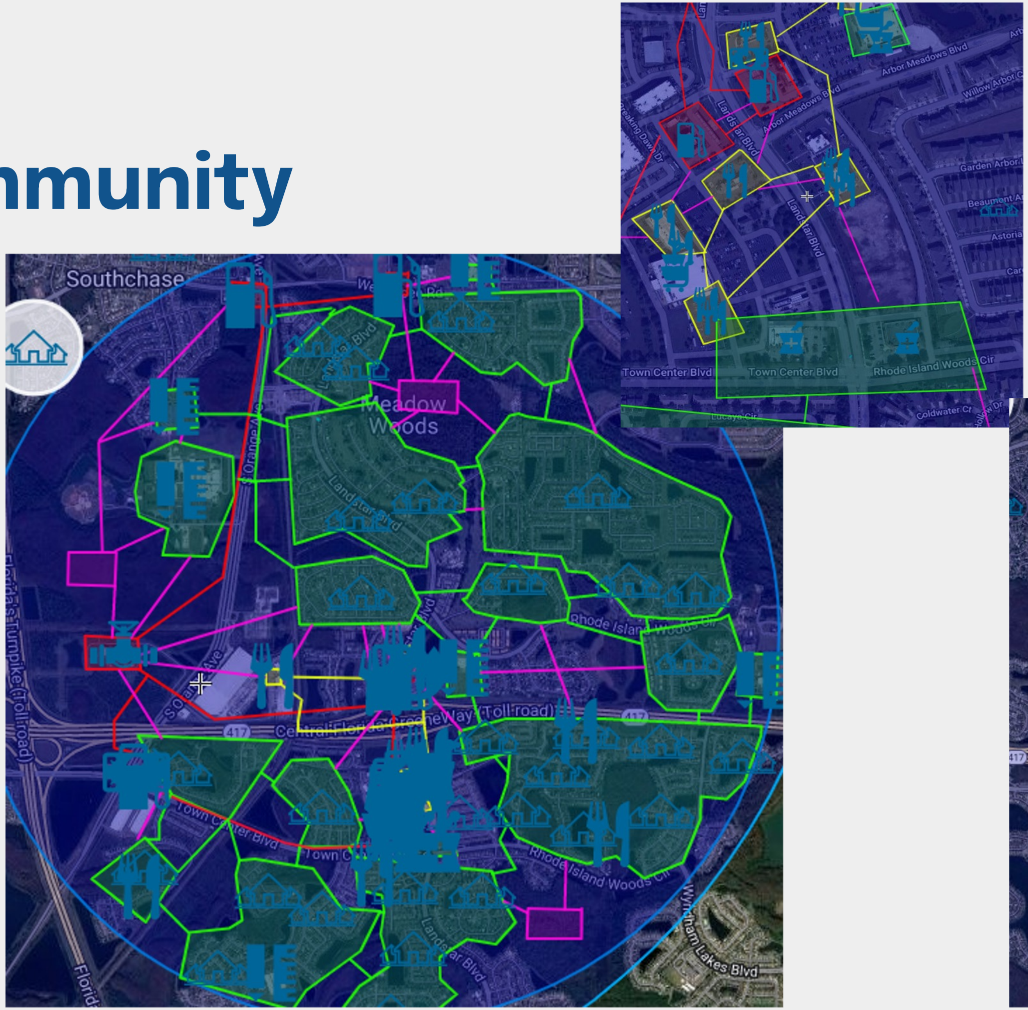
Legend:

Red: Highest

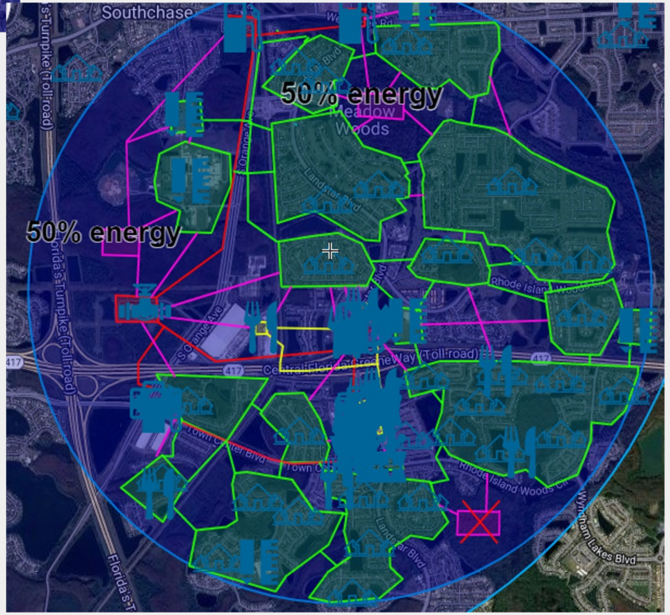
Yellow: Moderate

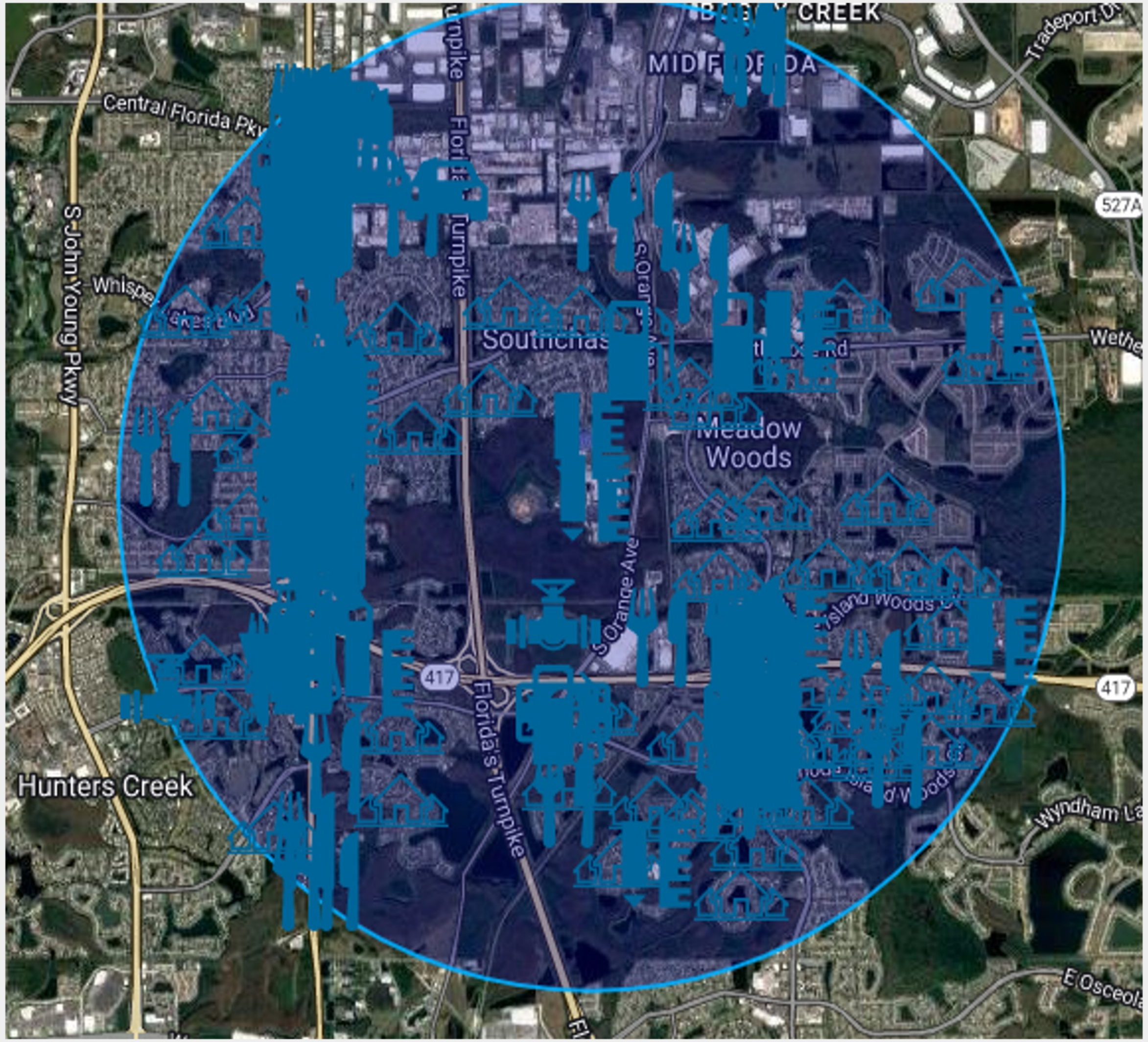
Green: Lowest

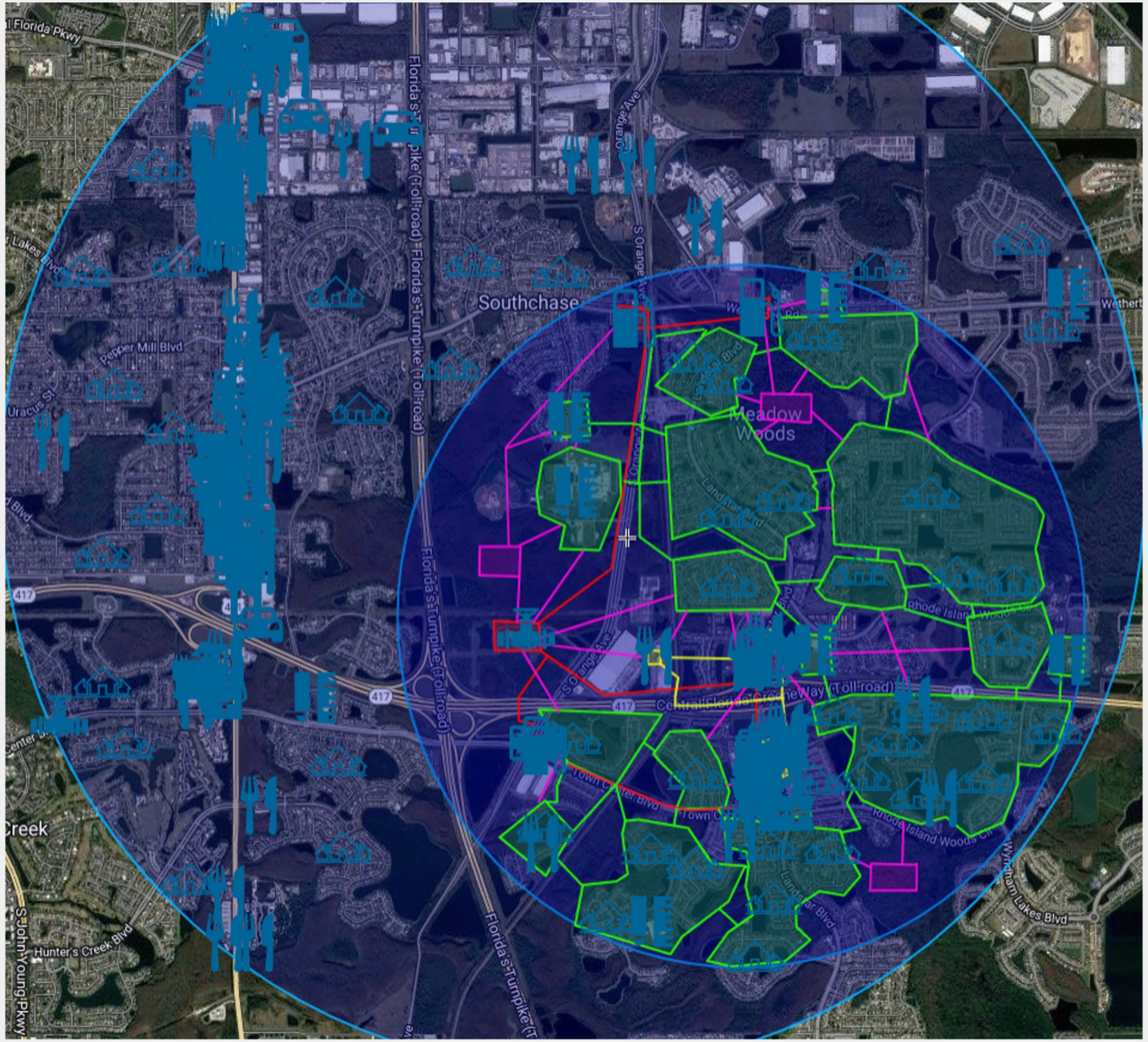
Pinkish Purple: Node Grid

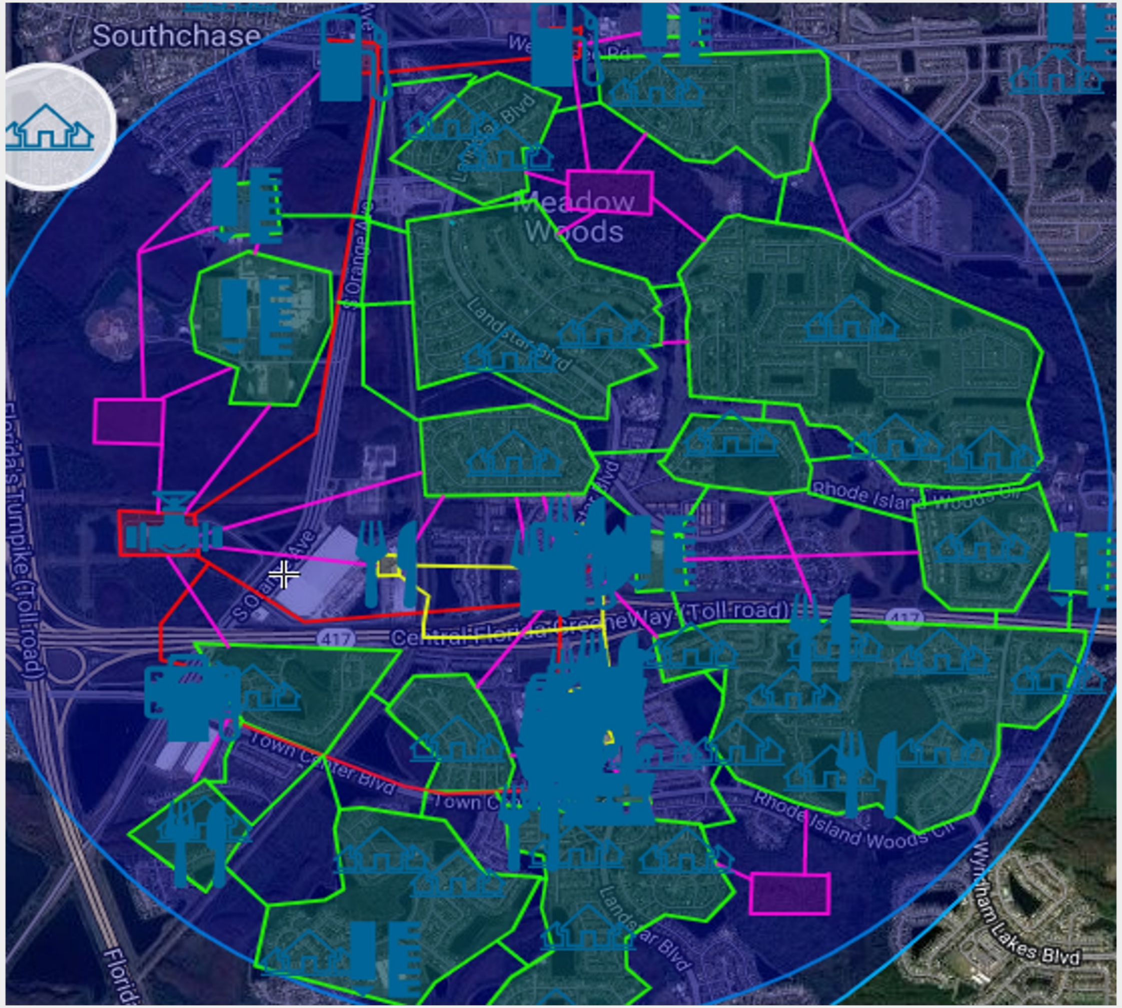


Example if a node fails:




Central Florida Pkwy
MID FLORIDA
Tradeport Dr
527A
S John Young Pkwy
Southchase
Meadow Woods
417
Florida's Turnpike
S Orange Ave
Hunters Creek
Wyndham La
E Osceola


Southchase
Meadow Woods
Pepper Mill Blvd
417
Florida's Turnpike (Toll road)
Rhode Island Woods Cir
Hunter's Creek Blvd
Creek
S John Young Pkwy
Wyndham Lakes Blvd



Southchase
Meadow Woods
Florida's Turnpike (Toll road)
Central Florida GreeneWay (Toll road)
Town Center Blvd
Rhode Island Woods Cir
Wyndham Lakes Blvd
Landstar Blvd
417

Arbor Meadows Blvd
Willow Arbor C
Landstar Blvd
Garden Arbor
Beaumont A
Astoria
Town Center Blvd
Rhode Island Woods Cir
Coldwater Ct
Lucaya Cir

Conclusion

Conclusion

- By collecting data on energy user types, we can create power grid designs oriented to the data to accurately and effectively supply power in a community.
- We can draw conclusions from the data to abstract and better our understanding of the community to make more informed decisions in designing.
- We can use this information to program artificial intelligence into power grids to continuously manage and resolve issues in an efficient manner.
- Finally, to ensure redundancy and fault tolerance, we can create a distributed system of interconnected power lines and nodes to better prevent outages.

Electricity Pylon Silhouette
pixabay.com/images/id-5004309
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Energy and user type metrics
energystar.gov

Avg. area of a gas station
statista.com/statistics/1016023/convenience-store-square-footage-us

Avg. area of a house
census.gov/construction/chars/highlights.html

Avg. number of residents in a neighborhood
eyeonhousing.org/2016/10/new-study-describes-characteristics-of-u-s-subdivisions

Avg. water plant size
eia.gov/consumption/commercial/reports/2012/water

Avg. area of an outpatient
matthews.com/whats-next-for-drugstores

Avg. area of an auto dealership
rsmeans.com/model-pages/car-dealership

Avg. area of a convenience store
statista.com/statistics/1016023/convenience-store-square-footage-us/

Avg. fire station size
rfpwizard.mrsi.erdc.dren.mil/MRSI/content/cos/hnc/fs/Library/Standard%20Designs/Standard_Design_Fire_Station__Mar2021_.pdf

Power Grids and Energy Distribution
ptc.mse.ufl.edu/design-contest-activities/background

Sources & References

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Thank you.
Any Questions?