RTEM - Real Time Energy Management Program

Background

- RTEM systems collect and monitor your building systems' performance data in real time. By connecting to a new or existing building and energy monitoring system, RTEM platforms pull data from a network consisting of meters, sensors, and controls, delivering the data to one central location.
- This data is then analyzed in the cloud, identifying optimization opportunities for your building that can significantly reduce energy expenditure

Application

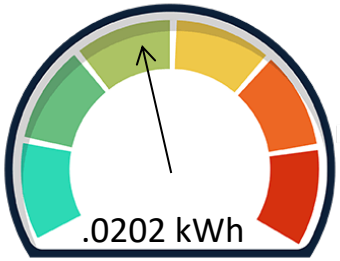
- The following is an overview of the dashboard design for RTEM buildings.

- https://www.nyserda.ny.gov/All-Programs/Programs/Real-Time-Energy-Management?gclid=Cj0KCQiAmL-ABhDFARIsAKywVafAKVA9NC1o8eZyTvrtTvyuX-UpXk2iR5HlreSjZl40e4iRpUQmIsAaAqMUEALw_wcB

No alerts

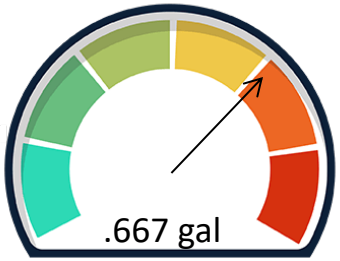
General Mockup

Power



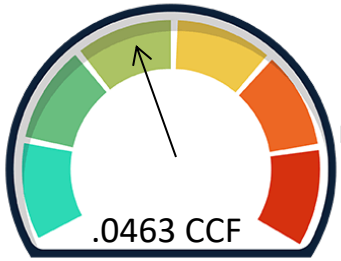
Good

Water



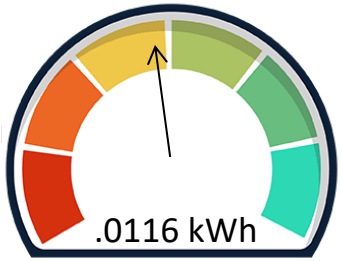
High

Gas



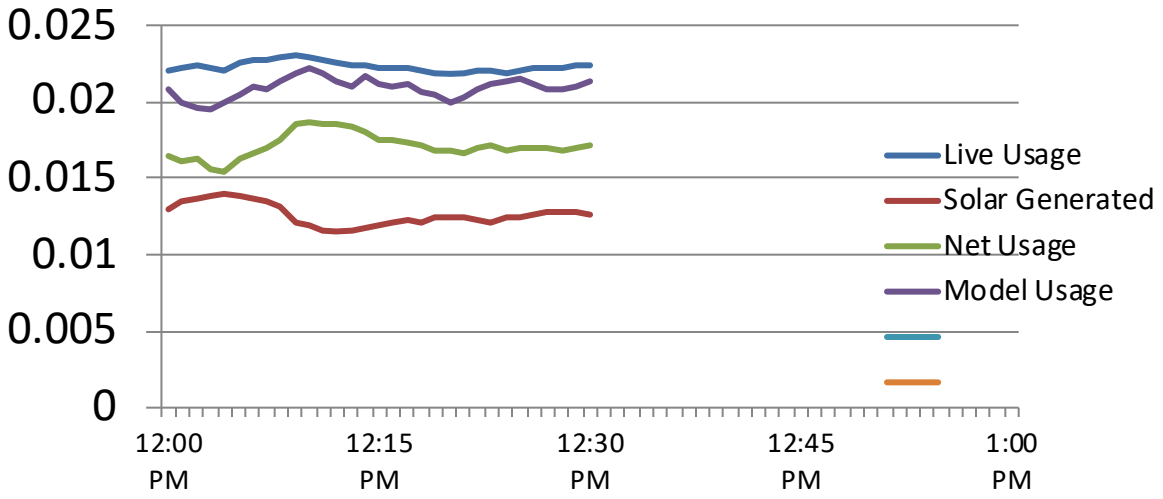
Good

Renewables



Okay

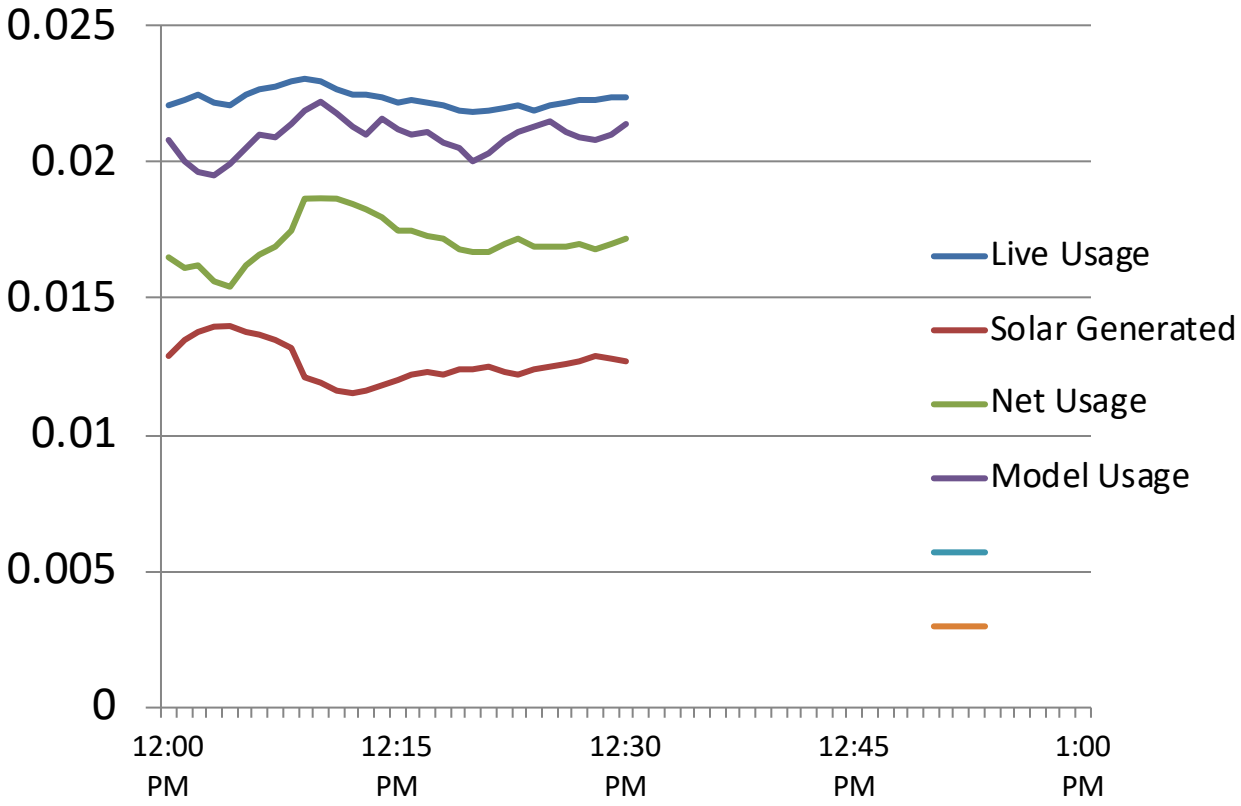
Live Feed & Analytics



So Far...
8.436 kWh used today
4.279 kWh generated today
93.279 kWh used this week
40.443 kWh generated this week
52.836 kWh net usage this week

Predicting	
1.764 kWh used this hour	42.336 kWh used today
.7488 kWh generating this hour	17.9712 kWh generating today
1.0152 kWh net usage this hour	24.3648 kWh net usage today

Power Mockup



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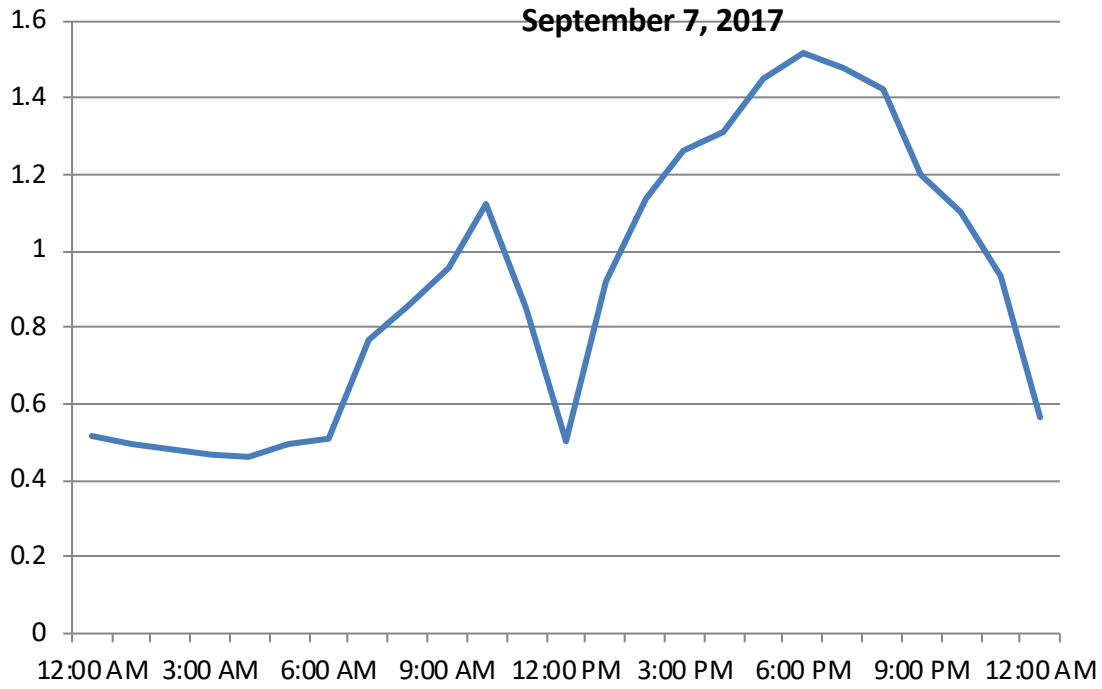
Power Mockup

- Daily View
  - Displays data per day, by hour/minute/second



Hour ↓

Calendar

12	1	2	3	4	5	6	7	8	9	10	11
.515	.497	.484	.468	.462	.493	.512	.769	.856	.956	1.12	.853

This Day…

Average kWh per hour: .945

Peak Hour: 7 PM

Low Hour: 4 AM

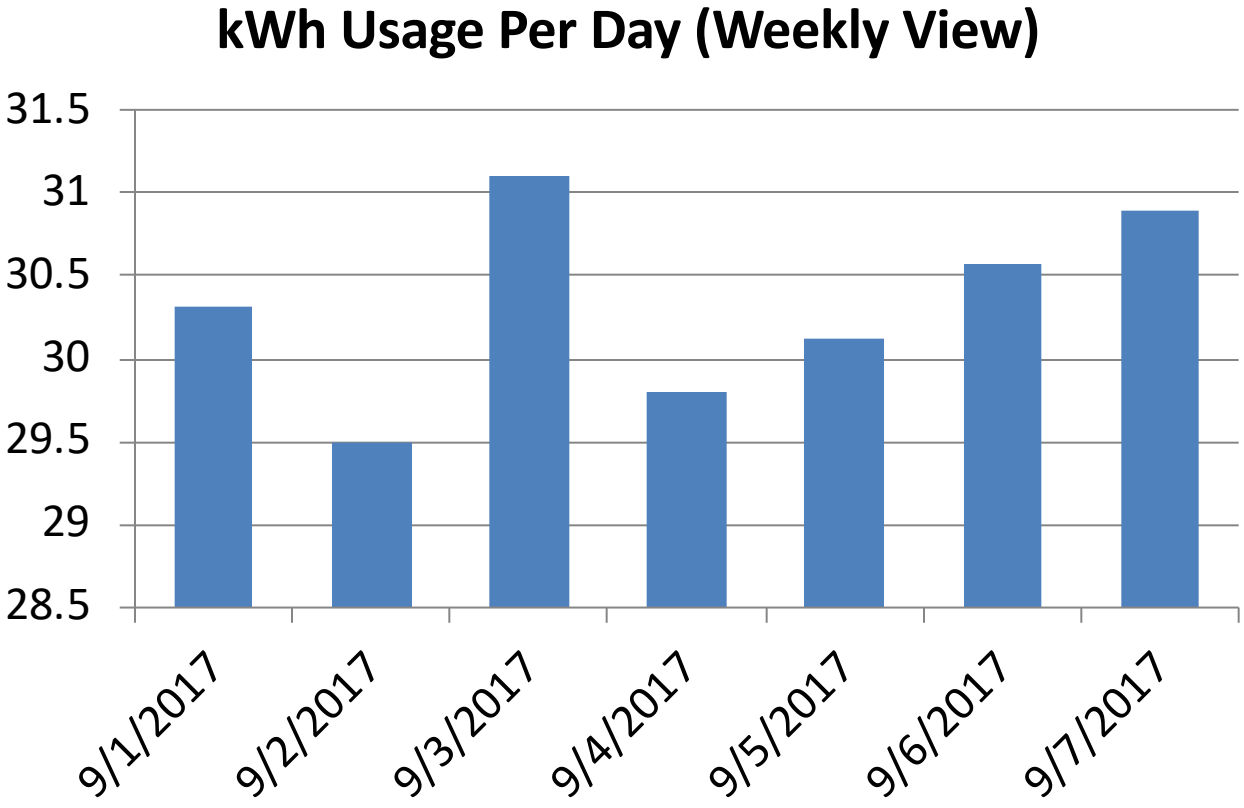
This Week…

Average kWh per hour: 1.104

Peak Hour: 7 PM (Sept 4) @ 1.763

Low Hour: 5 AM (Sept 2) @ 3.98

Power Mockup



9/1	9/2	9/3	9/4	9/5	9/6	9/7
30.318	29.486	31.125	29.792	30.125	30.569	30.892

This Week…

Average Daily Usage: 30.327 kWh

High: 31.109 (9/3/2017)

Low: 29.486 (9/2/2017)

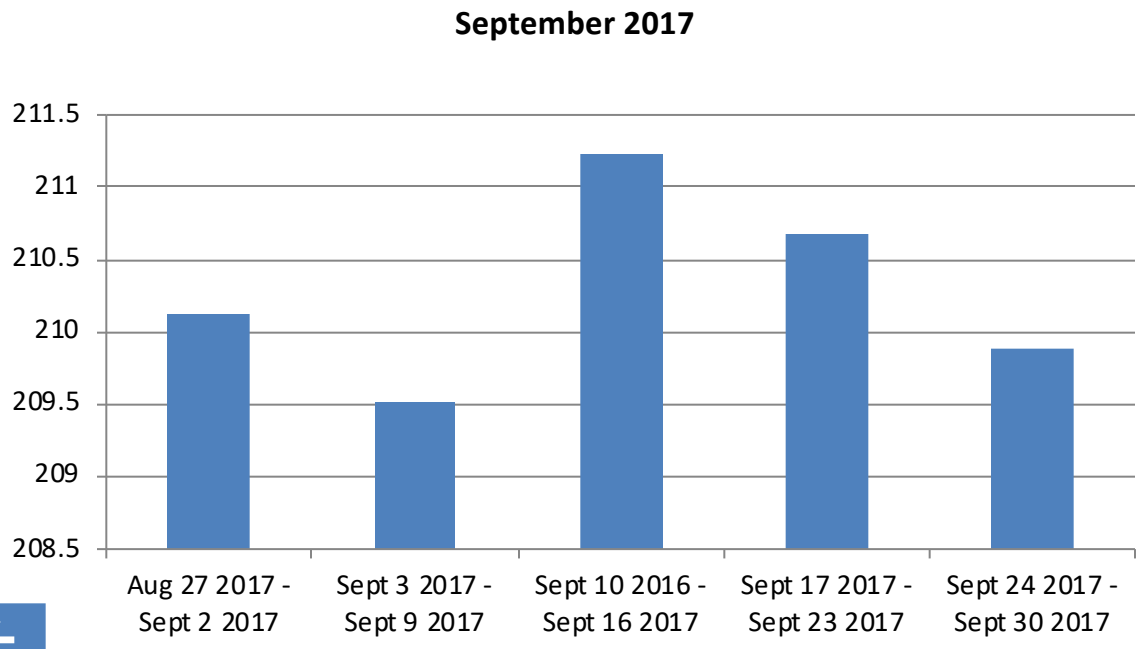
This Month…

Average Daily Usage: 30.327 kWh

High: 31.109 (9/3/2017)

Low: 29.486 (9/2/2017)

Power Mockup

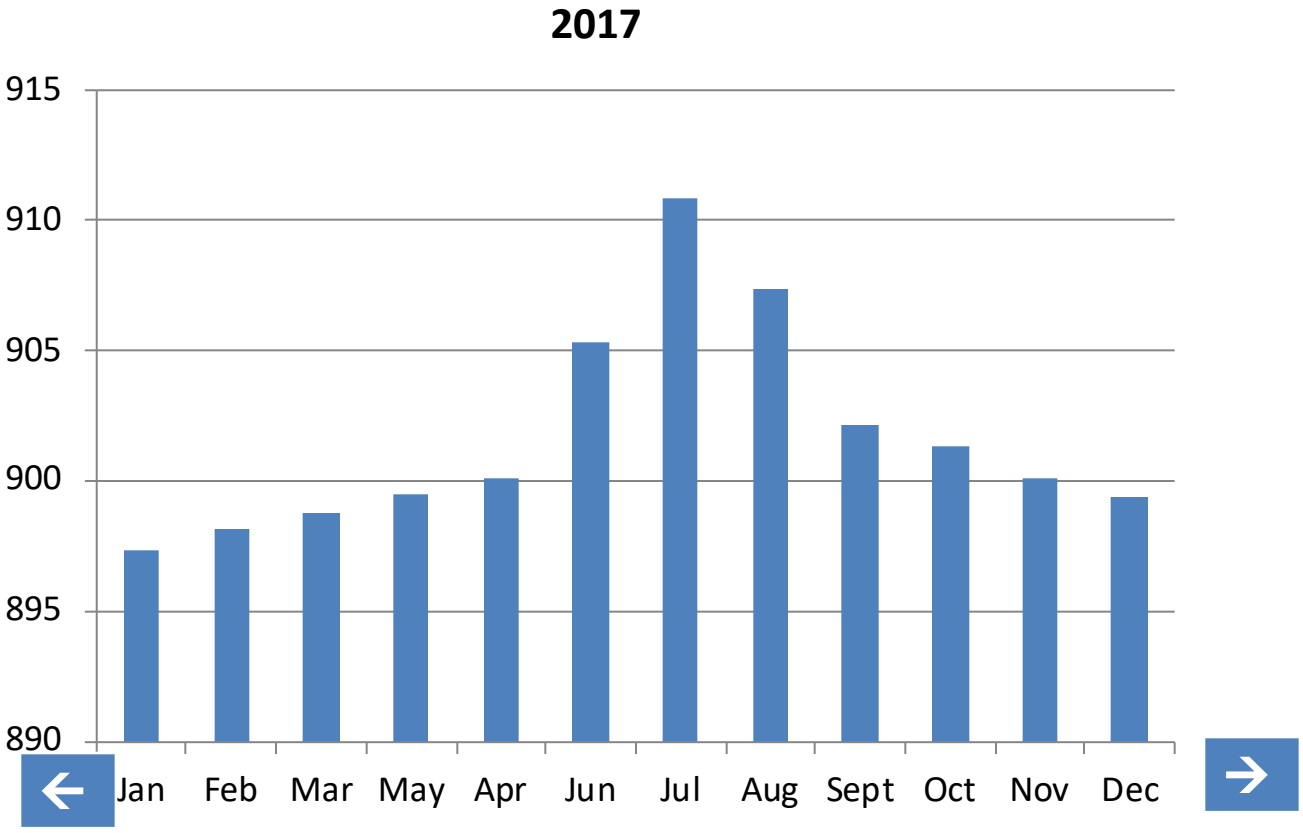


This Month…
Avg Weekly Usage: 210.288 kWh
High: 211.23 (Sept 10 – Sept 16)
Low: 209.52 (Sept 3 - Sept 9)

This Year…
Avg Weekly Usage: 204.58 3kWh
High: 219.932 (July 9 – July 15)
Low: 190.424 (May 7 – May 13)

Aug 27 – Sept 2	Sept 3 – Sept 9	Sept 10–Sept 16	Sept 17–Sept 23	Sept 24-Sept 30
210.12 kWh	209.52 kWh	211.23 kWh	210.68 kWh	209.89 kWh

Power Mockup



Jan	Feb	Mar	May	Apr	Jun	Jul	Aug	Sept	Oct	Nov	Dec
897.32	898.13	898.76	899.46	900.12	905.38	910.83	907.37	902.19	901.34	900.12	899.43

This Year…

Average Monthly Usage: 901.704 kWh

High: 910.83 (July)

Low: 897.32 (January)

All Years…

Average Monthly Usage: 904.326

High: 914.23 (July 2016)

Low: 898.32 (W

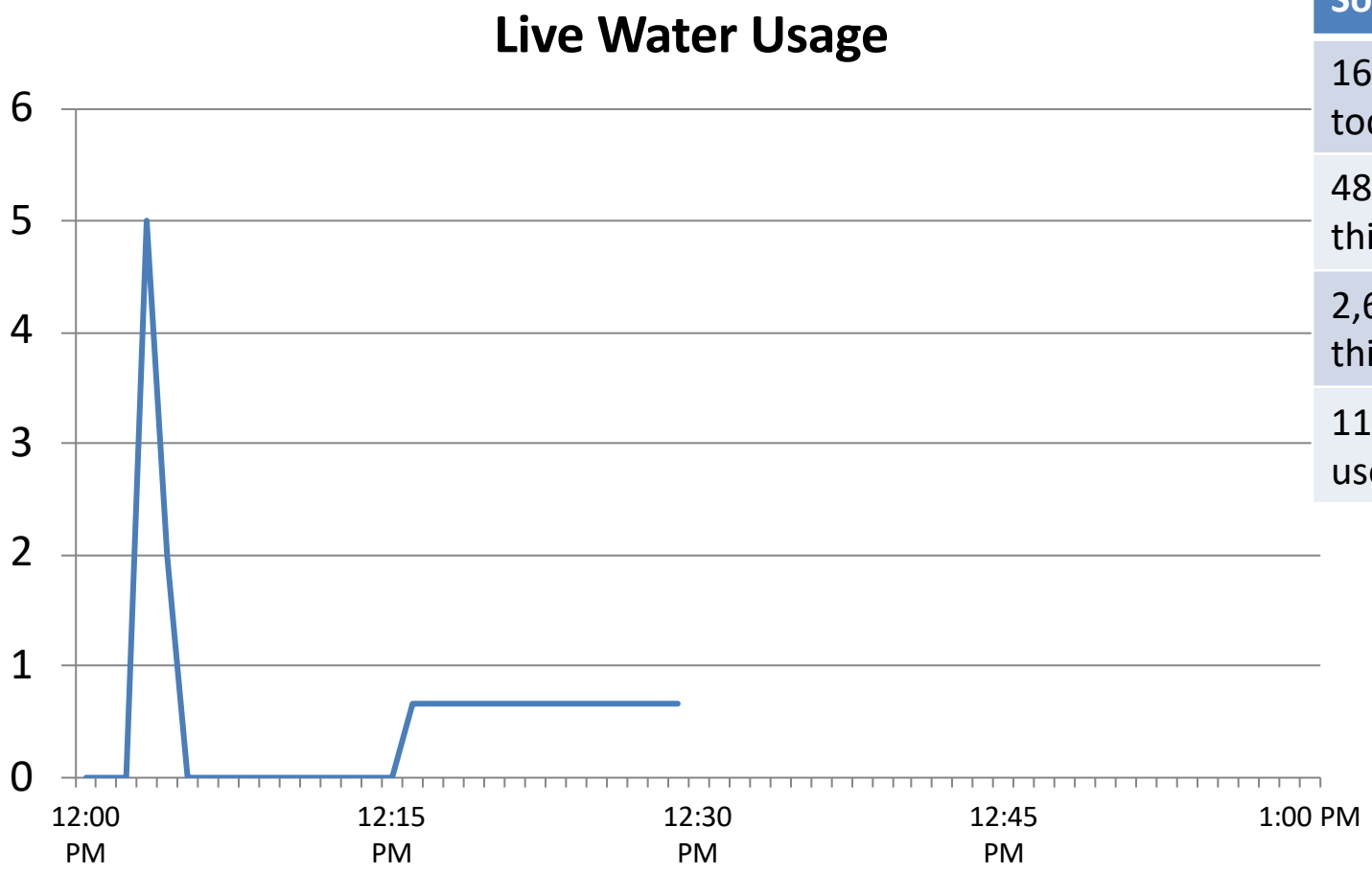
Gas

- Real-time gas monitoring (BTU/CCF)
- Day, week, month, year usage
- Peak usage per day/week/month/year

Water

- Real-time water monitoring (gallons)
- Day, week, month, year usage
- Peak usage per day/week/month/year

Water Mockup



So Far…
160.25 gallons used today
481.75 gallons used this week
2,606.73 gallons used this month
11,008.35 gallons used this year

Appendix

- Additional Research Information

Research on
Smart Devices for Analytics

- Energy and Renewables:
- emonPI: £155.04 (inc VAT) = $207.60
- 2 X Clip-on CT sensors *£9.60 (inc VAT)* ($12.66 ea)
- 2 x AC-AC voltage sensor adapter *£11.99 (inc VAT)* ($15.83)
- 1 x USB 5V DC PSU *£7.79* ($10.29)
- ~= $274.87 + s/h emonPI has local protocols to transmit data directly to our own server, such as MQTT or node-red.
- Water and Gas:
- Smappee: $129 + s/h (Water and Gas)
- No local data transmission, but has an API to obtain data. Sends data by radio, then uploads it to Smappee's databases. It uses two sensors that attach to the water/gas meters. If we use Smappee, we'll have to run a Python script to pull their data and add it to our own database. An issue with Smappee is that the water and heating meters have to be no more than 3 meters apart from each other, as the sensors are attached to the transmitter. As a side note, Smappee also has an energy monitor: $249 for just energy, $349 for both energy and solar.

- I'm also looking into water flow sensors for Raspberry Pi. I think most are meant to be used with just one application (ie a garden hose or a faucet), but there are a few that we could try. From what I've read, not all of the sensors can detect trickles of water, and some might not be able to handle larger water flows. So if for example someone took a shower, using 5 gallons/minute, it might overwhelm the sensor. This can also be problematic if we were to try to use a flow sensor in a larger building/apartment complex; a large number of people all using water at the same time could easily overwhelm the sensor.

Research on
Smart Devices for Analytics

- Raspberry Pi: $30, Arduino: ~$40. Water flow sensors range from $5 - $10 for a household one, $30 or more for one meant for a larger building.

- Based on my research, there aren't many solutions available to measure gas usage. While there are a lot of water flow sensors available, the only gas sensors I could find, aside from Smappee, were ones meant to detect the presence of certain kinds of gas, as opposed to monitoring how much has flowed through. It might be possible to monitor the numbers on the meter instead, though that might not yield as accurate of a reading, and most likely wouldn't detect leaks. Smappee currently seems like the only viable way to monitor gas usage. If we can't use Smappee for water, we could look into alternatives and use Smappee only for gas.

- Server: Dell PowerEdge T20 Mini-tower Server System / Intel Pentium G3220 3.0GHz, 3M Cache, Dual Core (65W) / 4GB Memory / No Hard Drive / No Optical Drive / No Operating System

- Needs an operating system: use a Linux based OS

- How big of a hard drive do we need for it? (ex: 2TB = $64)

- Going by these figures (emonPI + Smappee + the server), the total cost to install the meters would be approximately $800, closer to $870 if we include the hard drive for the server.