



WARWICK

Metering and Data at University of Warwick

How we use it...

Environmental Sustainability Team, Estates Office

Mark Jarvis, Sustainability Engineer, Metering Infrastructure Owner

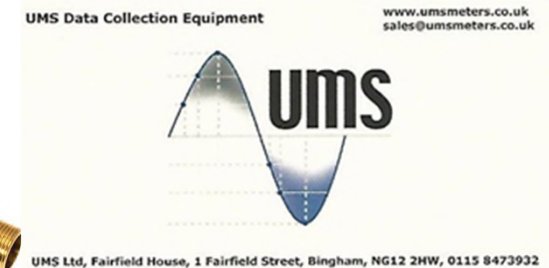
16Apr18



WARWICK

Campus Utility Meters

- ~250 Buildings, ~40 HV Substations
- 2,080 AMR Elec meters
- 313 AMR Gas Meters
- 293 AMR Thermal Meters
- 451 AMR Water Meters





WARWICK

Remote Metering System

- Mostly Sub-Metering below main building meters
- Remotely connected meters are read every half an hour
- Real-time acquisition has been demonstrated
- Some data goes back to 2008
- All data held on University servers
- Includes data for individual houses, residential buildings, academic/commercial buildings, Energy Centers, plant, split lighting/power, equipment, entire campus usage, Fiscal supplies etc.



WARWICK

How Much Data?

- 3,179 meter remotely read, and growing
- 12,502 individual parameters captured every half an hour
- 167,000 Half-Hours worth of data – 9.5 Years
- 702 Million data points, 600K readings a day
- ~89Gb of meter readings



Great... so what does it look like?

11Apr18





Meanwhile, back at Mark's Desk...

WARWICK



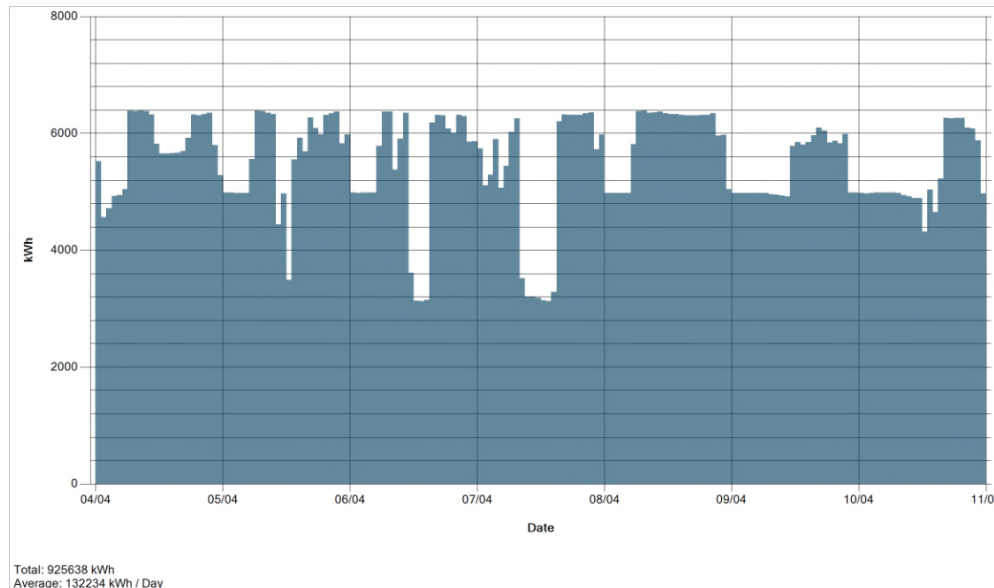


WARWICK

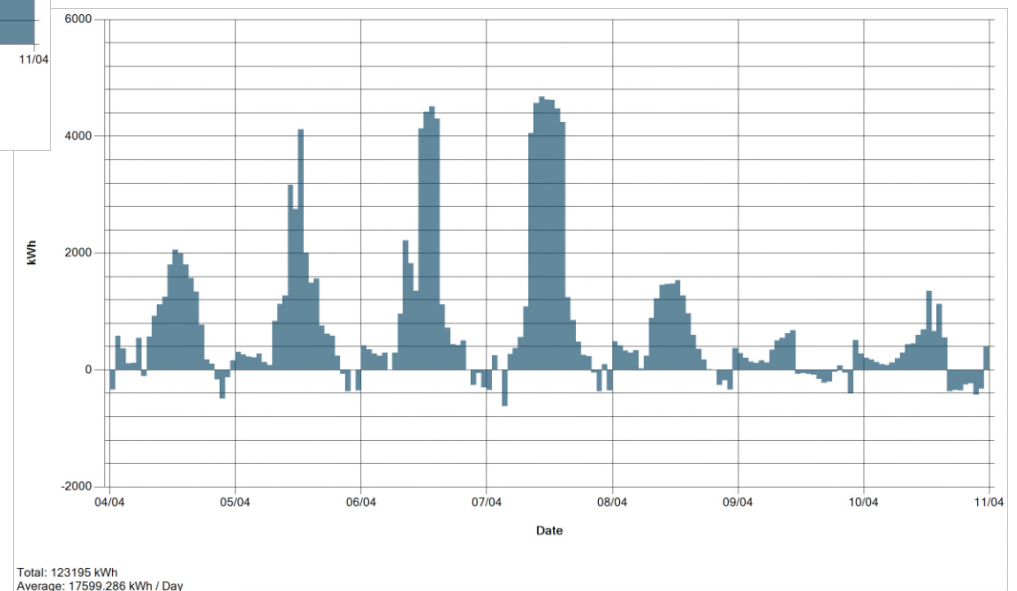
Software

- Coherent Research Data Collection Server and Data Logging Equipment
 - Data acquisition primarily, and configuration of AMR
 - Display and access of data
 - Basic Exception reports - threshold reports
 - More dynamic reports – “Historic Average Report”
 - Excel Template report – Just dumps data into a spreadsheet which then has your own analysis built in
 - API's ready for other software to suck data out into other software

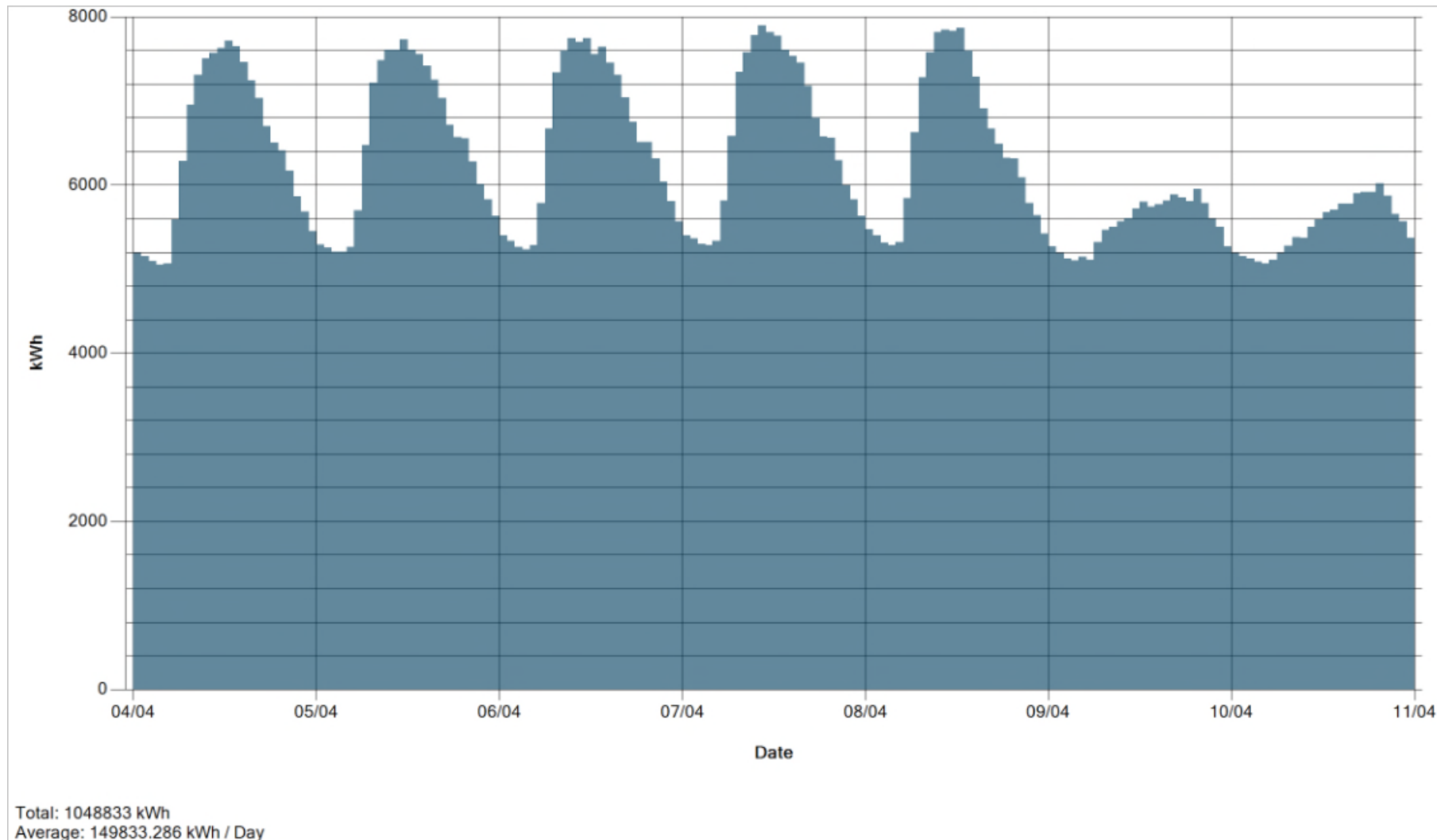
University Energy Centre Generation



...and Grid Usage

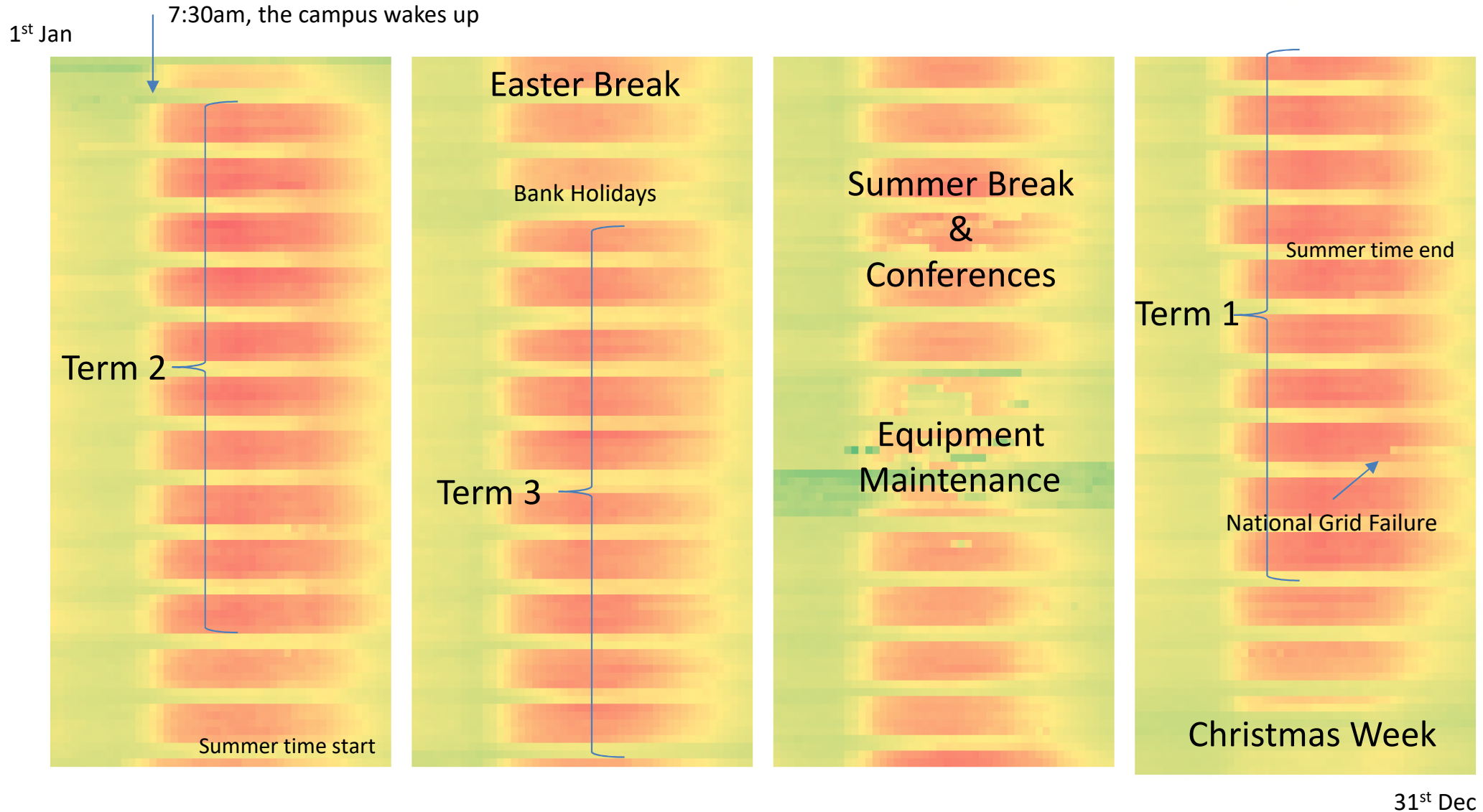


Total Central Campus Elec Usage



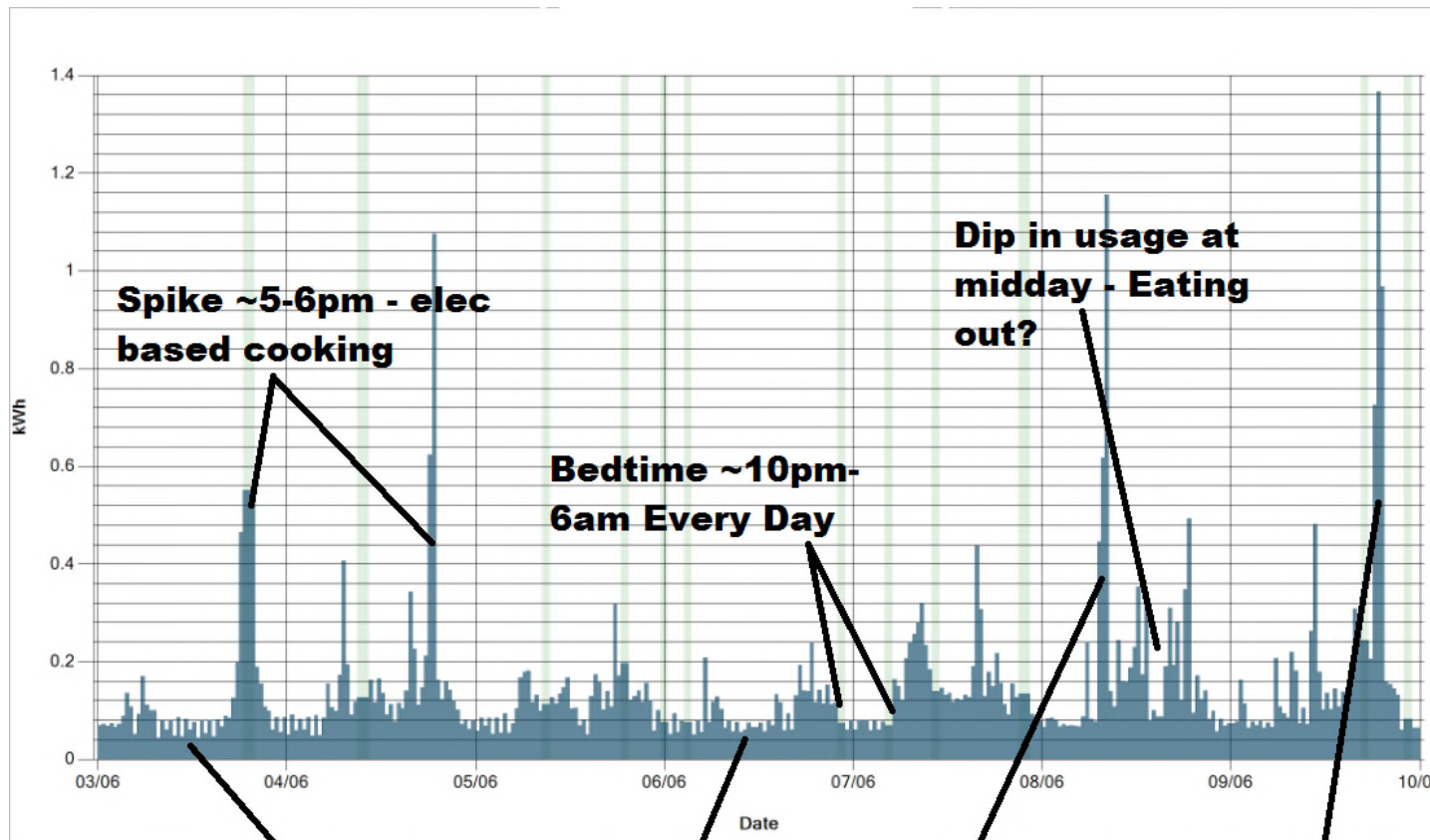
A Year as a heat map (Midnight to Midnight)

WARWICK



This was all done in Excel!

Zoom into an individual Flat...



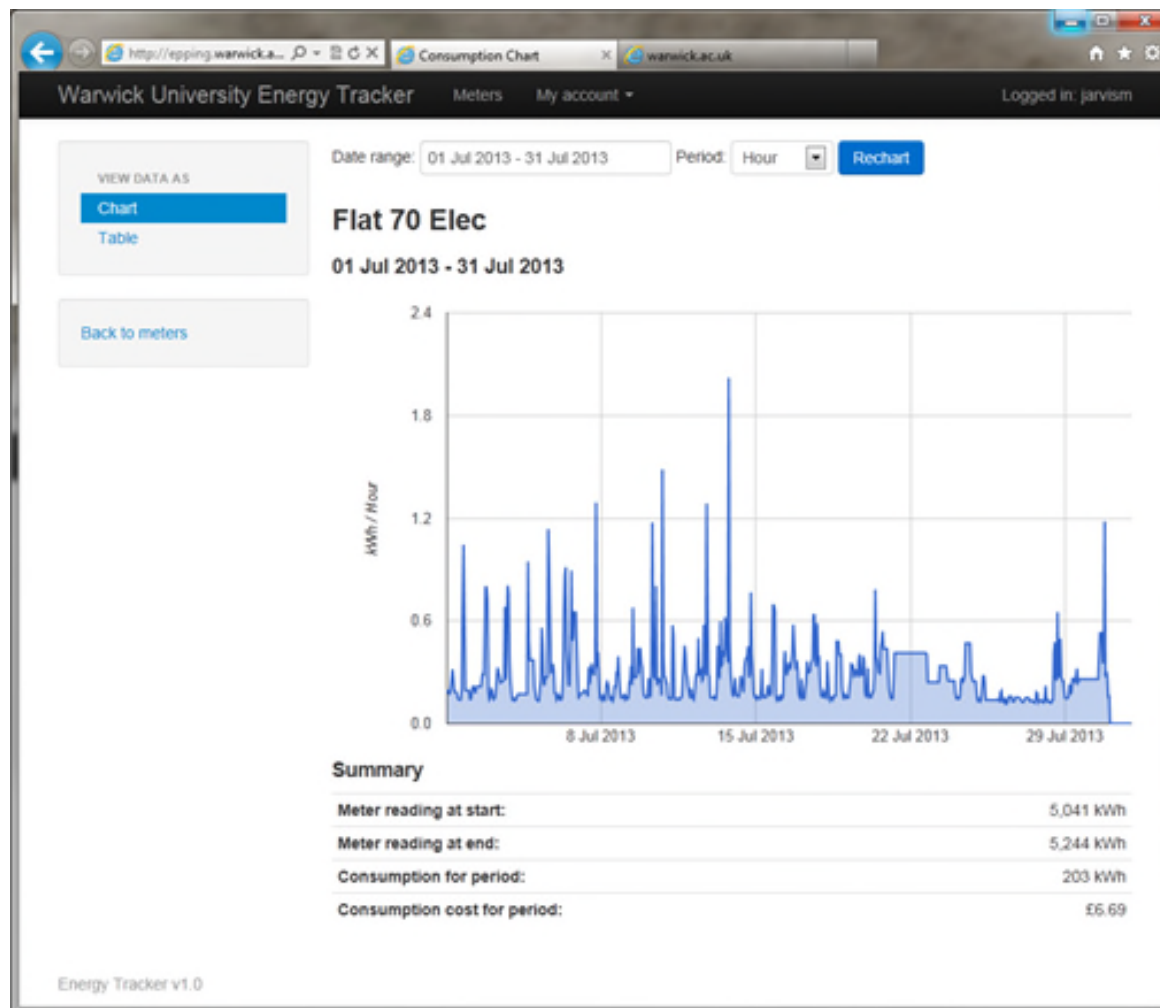
- Just Elec data here
- Matching Gas and water data may be available
- *Elec+Water = Washing Machine*
- *Gas+Water = Bath or Shower*
- Combination of all data will tell a detailed story on behaviour
- Occupants can learn how to economise
- **GDPR?!! This may be personal data!**

Unoccupied between 8am-5pm Mondays and Thursdays

Large Spike Sat Morning - Washing Machine?

Roast Dinner being cooked on Sundays

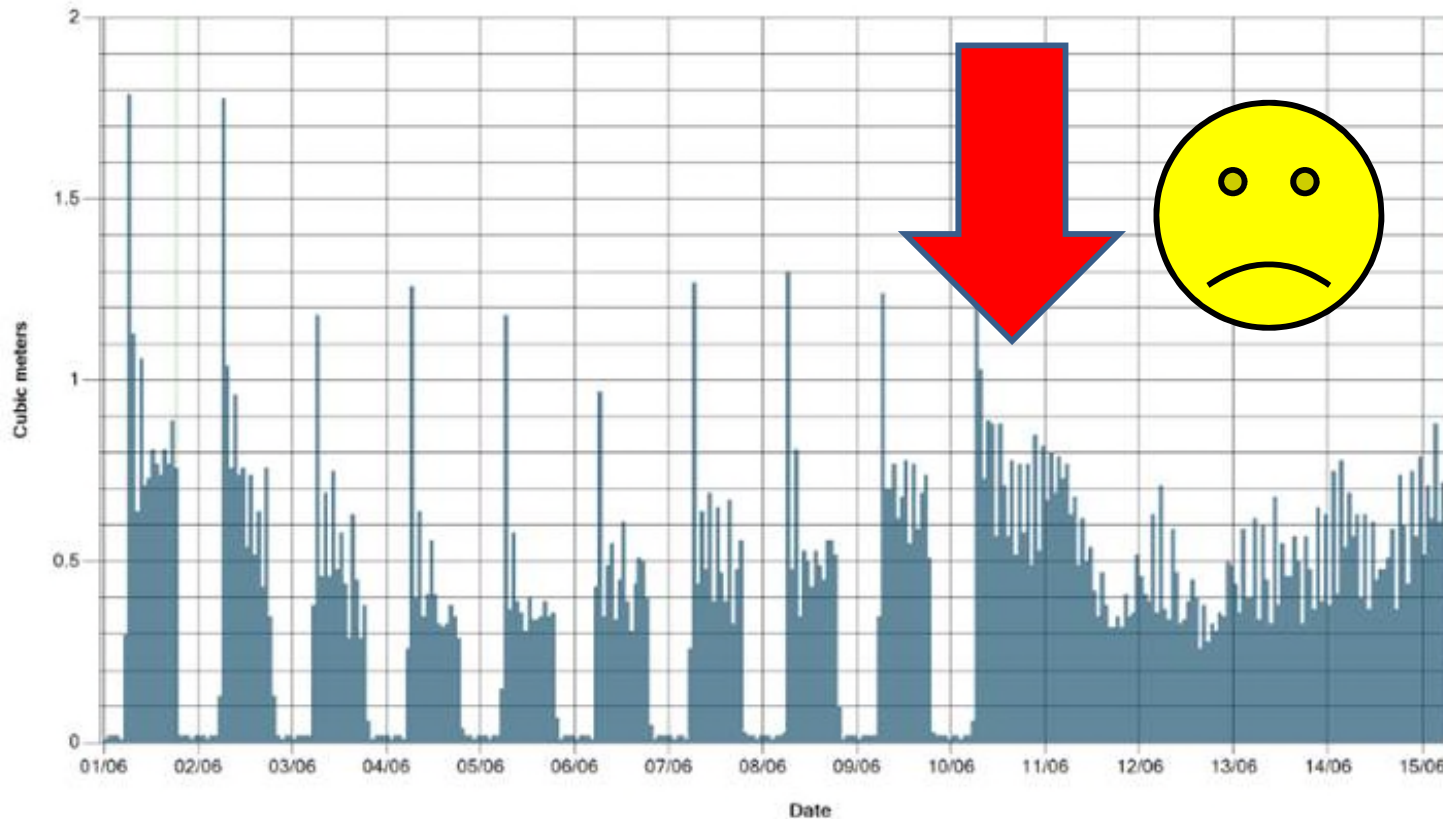
Simple interface for Tenants



- **“Energy Tracker”**
- Simplified interface to our main Data Collection Software
- Just shows hourly usage and a cost estimates
- Very Basic, yet quite empowering (if they engage and understand it!)

Spotting Failures as they happen

01/06/2015 - 15/06/2015 (by hour)



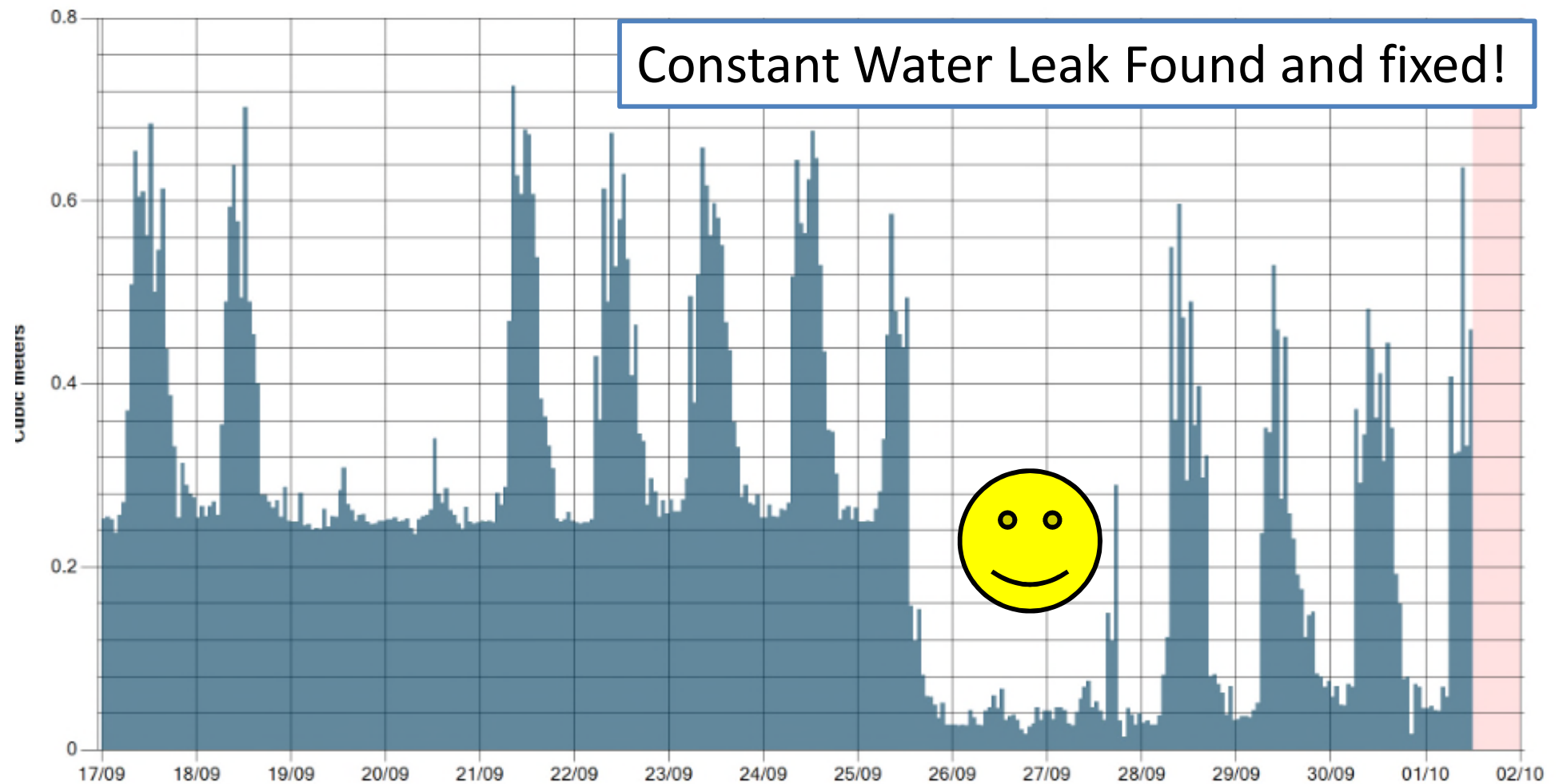
Total: 141.6 Cubic meters
Average: 9.44 Cubic meters / Day

- Gas Usage went 24/7
- Automatically reported to Energy Team
- Maintenance docket raised the same day
- After investigation, issue was a failed controller

Verifying that a fix worked

733 - Basement Water Meter: Cumulative Volume

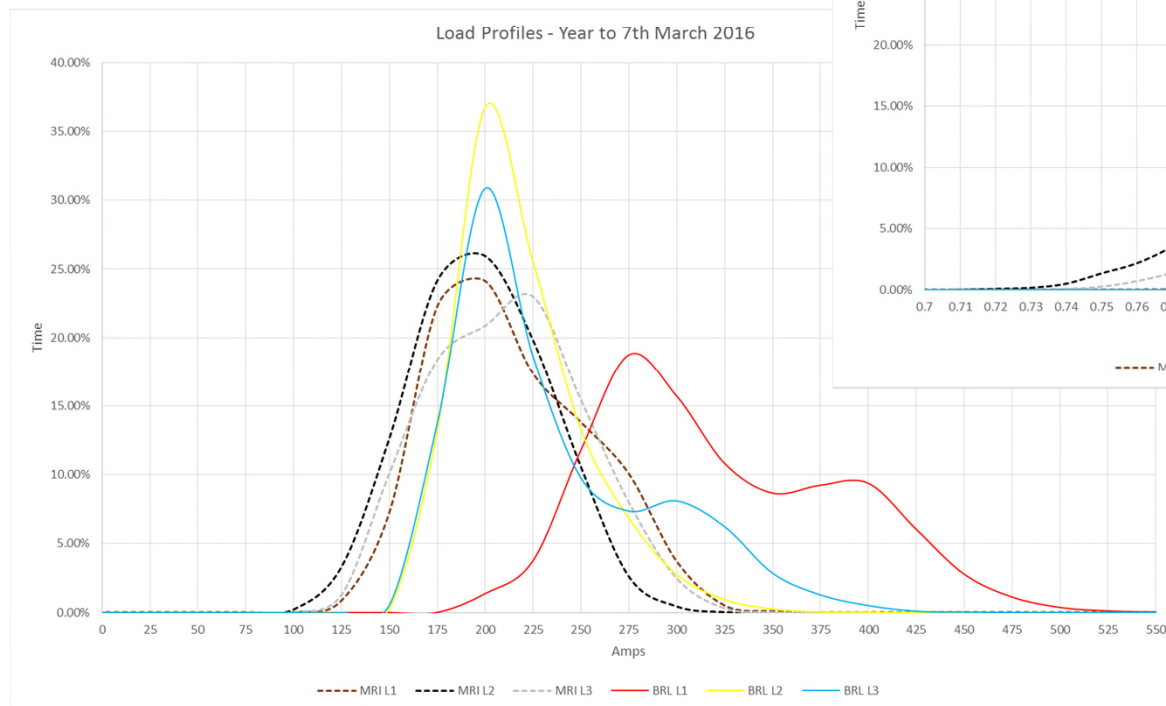
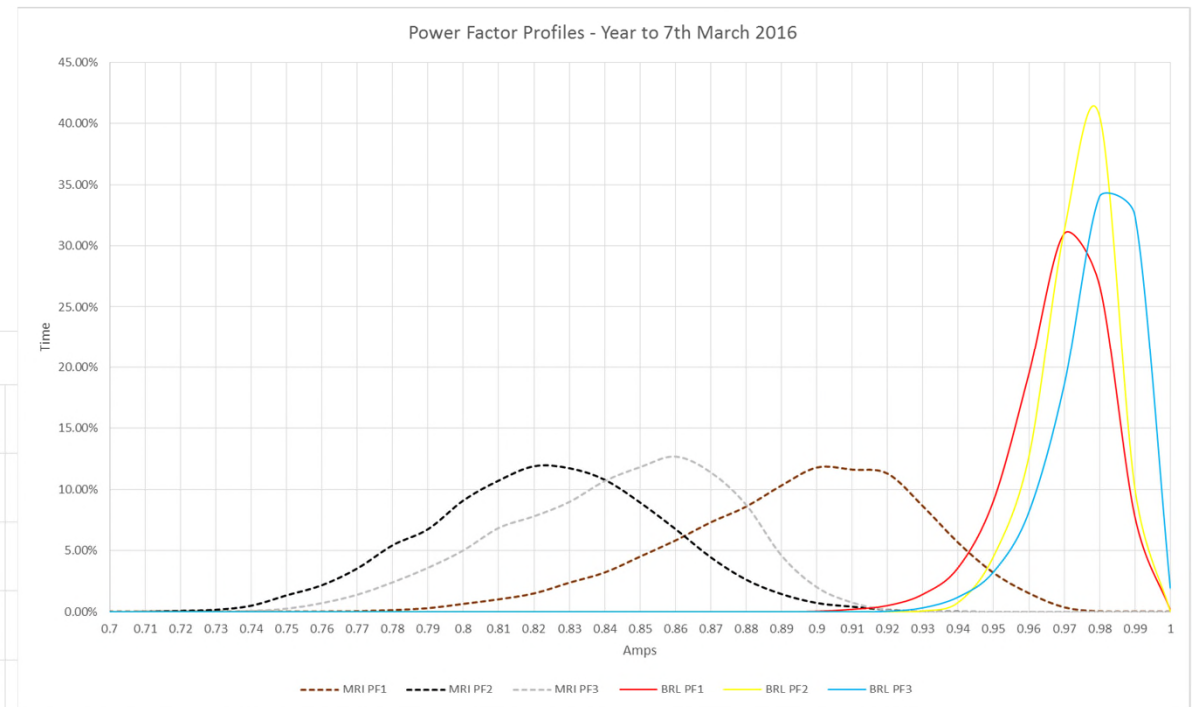
17/09/2015 - 01/10/2015 (by hour)



Infrastructure Analysis

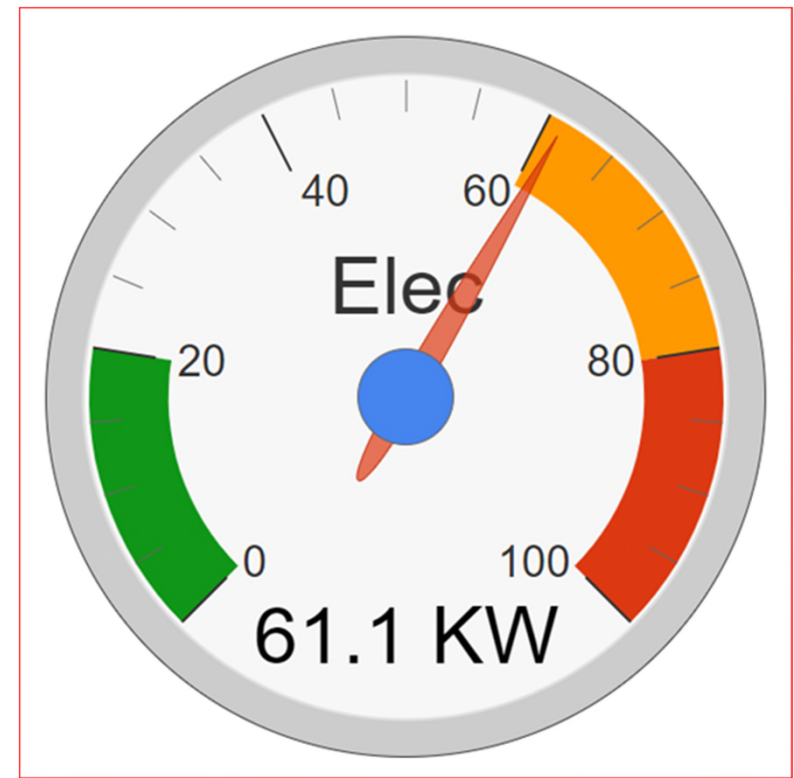
WARWICK

- Per phase loads on electrical supplies
- Per phase power factor
- Total Harmonic Distortion
- etc.

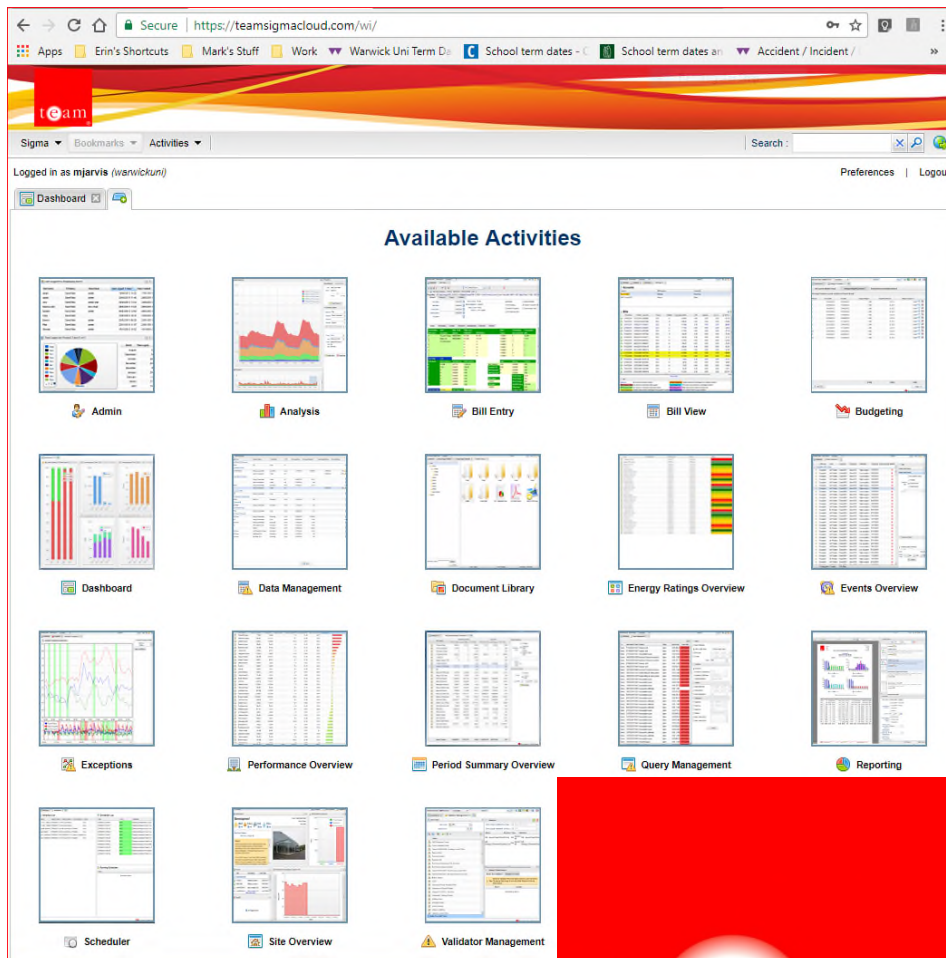


Live Meter data

- Live Data, along with other sensors are used to modulate our CHP Generators and other plant and equipment – BMS has direct hardware link
- Academic Researchers interrogate AMR equipment over the network for real-time electrical data
- In House software development has produced live feeds which can be used for Websites, Dashboards and Public displays



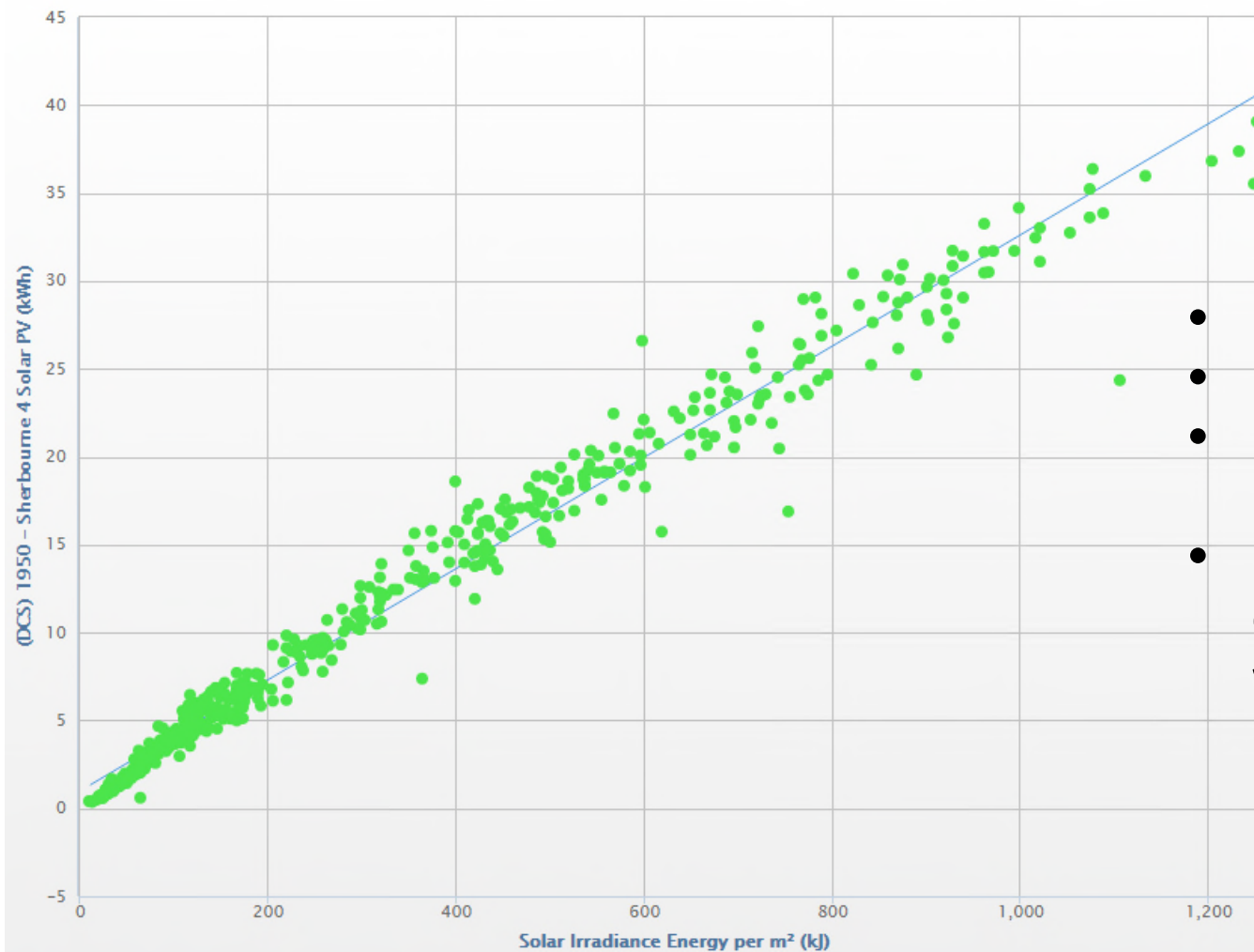
Energy Management & Analysis



- **TEAM Sigma Cloud**
- Bill Validation, record keeping & Queries
- Tenant Billing
- Basic Reporting
- Hopes...
- Forecasting, Accruals
- Normalised/Corrected data analysis (i.e. weather, occupancy)
- CUSUM, MVLR etc.
- League Tables, Rankings for reports
- Exception Reports on halfhourly AMR
- Sharing Data to departments

What we want to do more of...

Regressions against other data

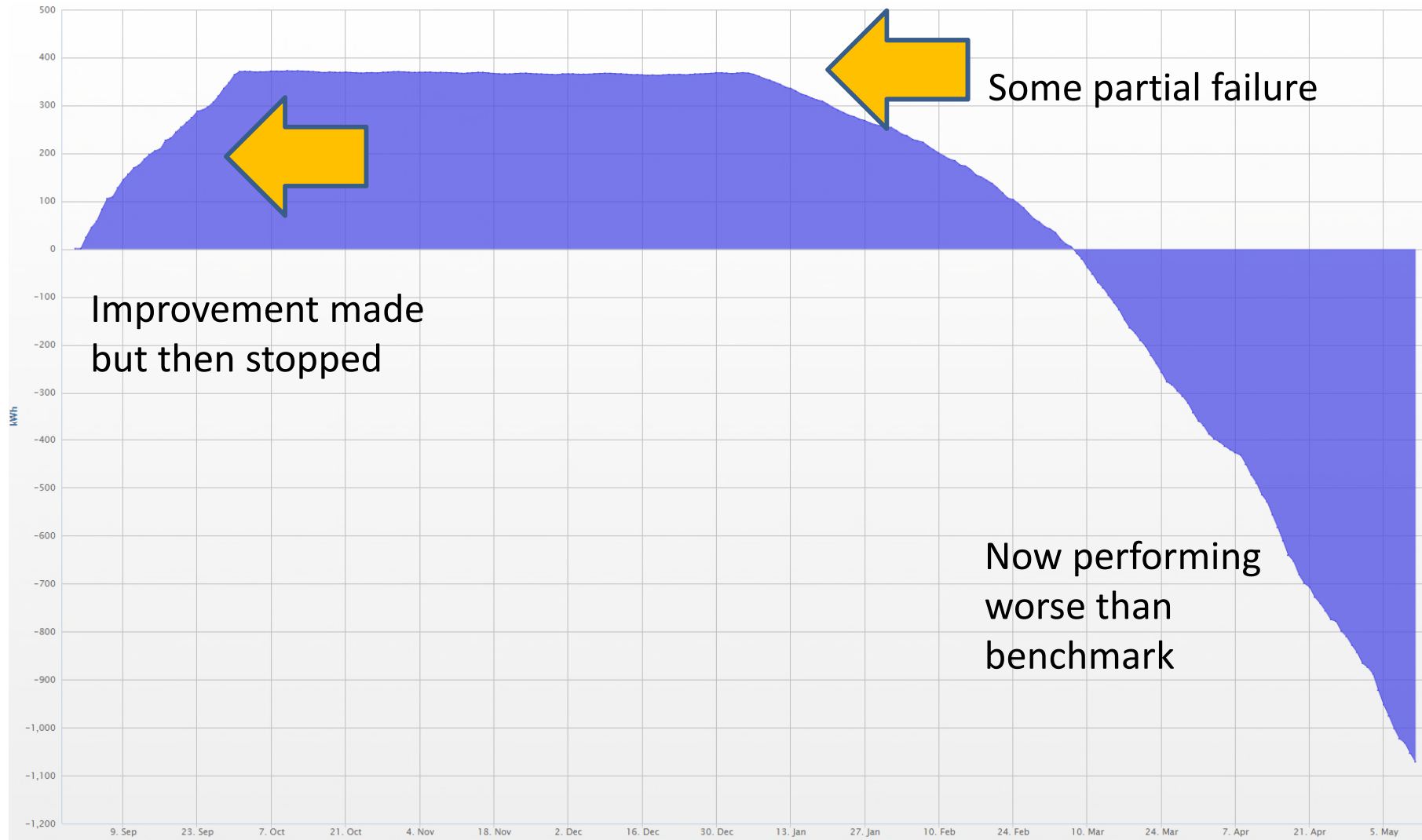


- PV Generation vs Insolation
- Heating Gas vs Temperature
- Electricity vs Occupancy/Wifi
- Multiple time bands depending on hours of use, weekday/end, term etc.

What we want to do more of...

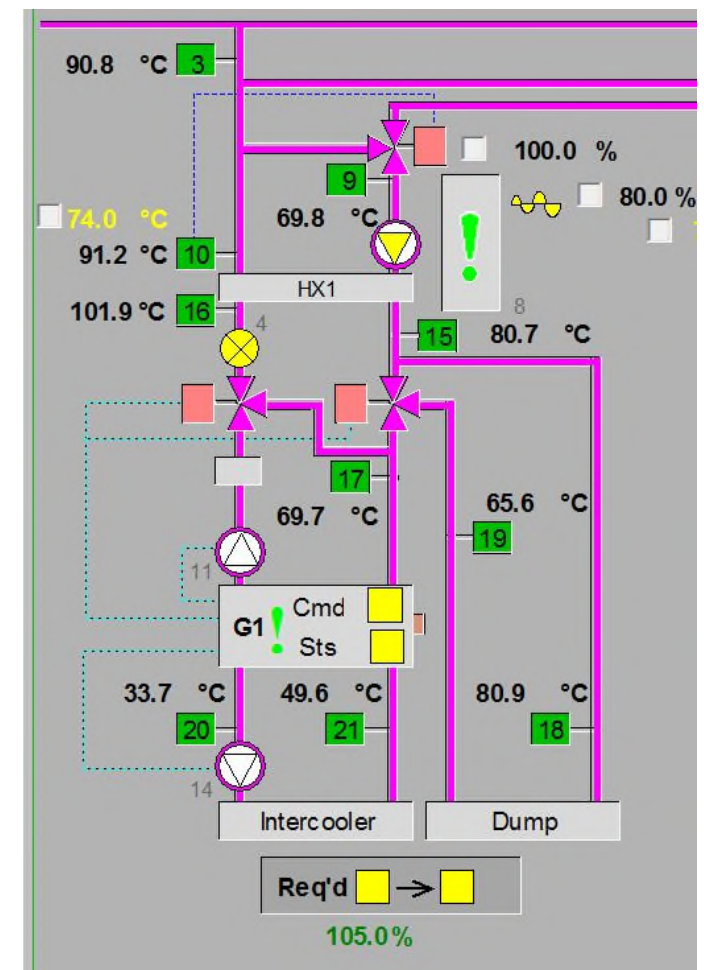
WARWICK

Regression Models create CUSUMs



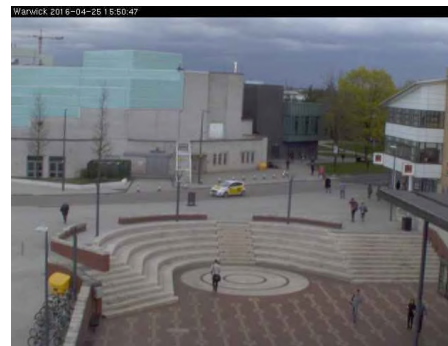
Other Sources of Data - BMS

- 44,310 points in use
- Temperatures: Internal air, external air, within Ventilation systems, heating pipework, air conditioning etc.
- Valve settings, Pump/Fan Motor Duty, boiler duty
- Calculated Set Points, Humidity, CO2 level
- Air pressure, static/differential water pressure
- Smoke/fire sensors, Alarm/PIR sensors
- All can potentially be logged every 6 seconds



Other Sources of Data – Occupancy

- 4,293 Doors “connected”
- Large number of student blocks (bedrooms), individual scan in (but not out)
- Card entry areas i.e. Academic areas, Life Sciences (tailgating, and no scanning out)
- Library Turnstiles – identify all individuals in and out
- ITS Wifi device tracking – identify all logged in wifi devices (smartphones, laptops) to represent occupancy (Now being logged!)
- CCTV




Awareness Raising / Behaviour Change

- Management Dashboards/Reports
- Staff/Department tracking tools
- Student Competitions – “Live” League Tables
- Public Display Screens
- Departmental Display Screens
- Websites
- Posters and other Feedback campaigns

Awareness Raising / Behaviour Change

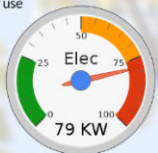
Welcome to Argent Court



WARWICK

14:25 Thu 24°C
Wednesday 01 July
Fri 28°C

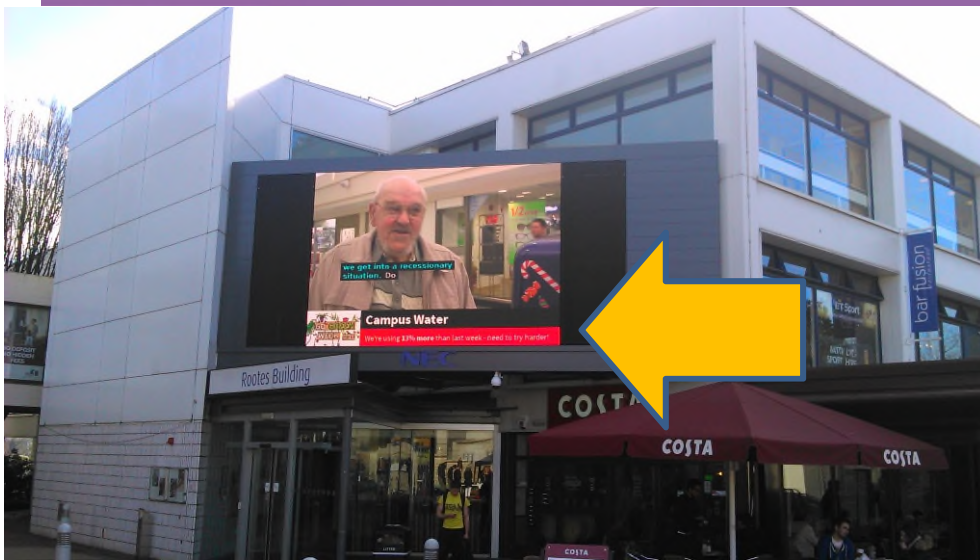
Argent Court's current energy use



This Friday at noon the University of Warwick will be observing the nationwide minute silence, in respect of all of the Tunisia attack victims.

🏆 Student Switch Off 2015/16 🏆
1st Oct 2015 — 2nd May 2016 (ends in 10 days)

1	Tocil	21/04/2016	8.4%
2	Redfern	21/04/2016	6.8%
3	Lakeside	21/04/2016	6.7%
	Bluebell	21/04/2016	4.9%
	Cryfield		




we get into a necessary situation... Do

Campus Water
We're using 20% more than last week... (used to be 7000l)


Welcome to Argent Court

IN THE LAST 30 MINUTES

WE USED ENOUGH ELECTRICITY TO MEET




461 CUPS OF TEA IN THE OFFICE



WARWICK

14:25 Thu 24°C
Wednesday 01 July
Fri 28°C

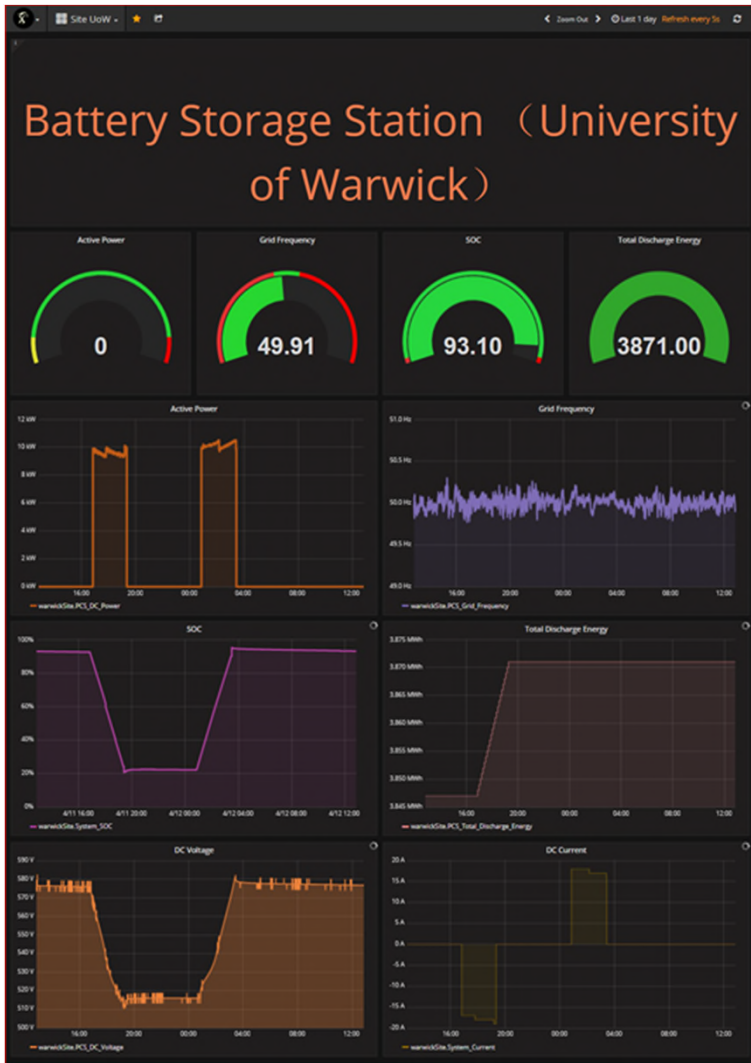
LAST 30 MINUTES



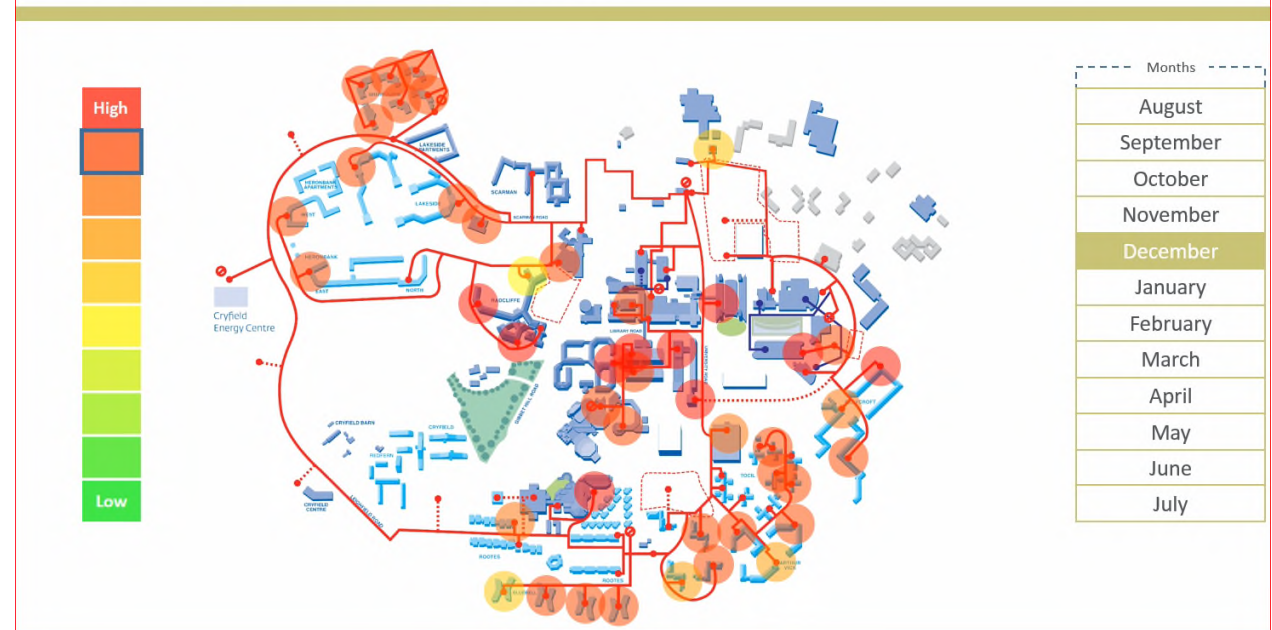
+2.5% ELECTRICITY USAGE VS. YESTERDAY

This Friday at noon the University of Warwick will be observing the nationwide minute silence, in respect of all of the Tunisia attack victims.

Work by others, academics & students WARWICK



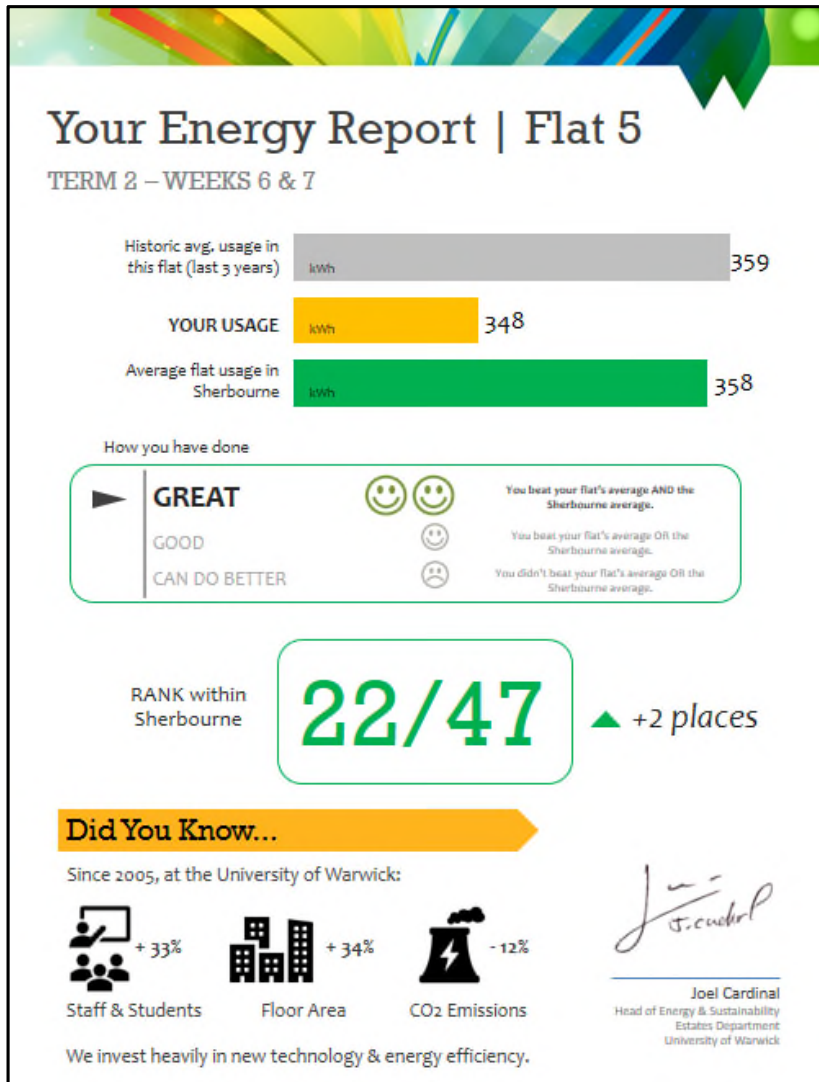
District Heat Map - December



Getting the data out there

WARWICK

Current works in progress...



- Paper Posters in kitchens every fortnight
- Social Feedback and “rankings” was very popular
- Students Engaged even without prizes/rewards
- Low energy savings, what can they influence?
- Great for awareness which is very valuable
- Hope to feedback with more automation

