THE UNIVERSITY of EDINBURGH

Social Responsibility and Sustainability

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Prepared on October 2016 by Andrew Arnott for SRS Comms team, SLSG, Horsfall Labs, SBS, and General Circulation.

Horsfall Labs (SBS) Energy Monitoring

Findings from "small power" electricity monitoring June – October 2016

Description of the paper

This paper describes the findings of a project which monitored the "small power" (i.e. plug-in) electricity consumption of the Horsfall labs in Roger Land Building, rooms G38, G40 and G42. During this time a staged campaign to raise awareness of environmental and energy savings was conducted, and the impact monitored.

It should be noted that unfortunately there have been significant interruptions to the automated data collection since 24th August and as such some conclusions are speculative.

Methodology

The aim of the project was to ascertain the impact of the engagement methods used by the Department for Social Responsibility and Sustainability (SRS) when engaging with laboratories. A laboratory(ies) was required which had previously had little interaction with SRS. The School of Biological Sciences (SBS) was identified as having potential locations which suited this requirement, and as such Sandra Lawrie (Technical Services and Estates Manager) distributed an email around SBS asking for volunteers. Louise Horsfall volunteered her labs in the Roger Land Building. Due to maternity leave the project was taken over by Michael Capeness.

Clamp on electricity current meters which involve placing a magnetic field around an electric wire were connected to the electrical circuits at the distribution board by University of Edinburgh electricians, organised via George McMillan SBS Buildings and Technical Manager. These meters were connected to smart phones which then transmitted the data via wifi to a website called Pilio, which is run by University of Oxford (who requested we trial their software). The data can then be retrieved and downloaded onto a computer via any internet connection.

Monitoring Circuit(s)	ROOM	Equipment
7L3, 8L3 (Phone 2)	G40	7L3: PCR machine, class II cabinet, 2x vaccum pumps and 2 benchtop centrifuges, a water bath 8L3: 2x microcentrifuges and a small spectrophotometer
12L1, 13L1, 14L1 (Phone 3)	G38	All small power equipment in G38
6L3 (Phone 4)	G40	6L3 Power supplies x 2, gel documentation system (inc PC) a UV/vis spectrophotometer
7L1 (Phone 5)	G42	7L1 - Fume hood, 2x shaking incubator, vacuum pump/freeze dryer, ice machine

Table 1: Monitoring circuits

Baseline data was monitored and gathered for one month without telling the lab users they were being monitored. After one month stickers and posters describing and encouraging good environmental and energy efficient behaviours were sent to Michael Capeness who distributed them around the labs and surrounding corridors, offices, break out areas and bathrooms. After 2 months a face to face presentation was given, further emphasising the desired behaviours and answering questions related to this topic to try to motivate change. (During this presentation interim energy data was presented to the group). Monitoring continued for another month to ascertain the impact of the face to face presentation (however during this time there were numerous interruptions to the energy data).

Discussion

Methodological problems

1. The volunteering labs were potentially already following good practice.

Those laboratories volunteering to take part in a study looking into lab sustainability may potentially have a more environmentally aware population to start with, and thus may be undertaking better practices, and thus there may be less opportunity for improvement.

2. Lack of awareness of the maximum size of an Excel Spreadsheet/.csv file in 32bit format.

Data loss from c.24th August until 9th September (although continuing sporadically throughout September) affected 3 of the 4 circuits. The circuit which was unaffected had a phone which was programmed to reset itself every 24hours, thus the size of any one data file from that phone was limited to 24 hours. The other 3 phones were not programmed in this way, and as such built up large data files from capturing data points every 5 seconds. Eventually the number of data points exceeded the maximum capacity of the .csv files to which the data was being transferred. This occurred on 24th August. This was not something the team at SRS were aware was a possibility, and as such this was not noticed until 9th September, at which point the 3 affected phones were re-set. Thus 3 circuits lost data from 24th August to 9th September.

This was unfortunate timing as the face-to-face presentation took place on 6th September and as such this period covers the lead-up to and immediate time period following the presentation – reducing our ability to understand the impact of the presentation.

For reasons currently unknown all of the 3 phones affected by the above issue, which had reliably been gathering data for 2 months from 24th June to 24th August, became intermittent in their data gathering after having been re-set on 9th September. So for those 3 circuits the energy data post-presentation is poor and compromised.

3. Not calibrating the meters prior to installing them (thus data is generic figures, not watts/kW)

The figures displayed by the monitoring system are not calibrated. Thus a figure of 100 on the monitoring system does not equate to 100Watts or 100kW etc. Calibration was intended and was theoretically an option for these monitoring systems but the conversion factor supplied by Pilio and University of Oxford were found not to be correct for all of the clamp-meter/phone combinations when a ‘sense check’ was undertaken. As such each meter/phone combination would need to have been tested in controlled laboratory conditions in order to ascertain the correct conversion factor to allow conversion of the data from

the monitoring system into energy data. This is something we would hope to be able to complete prior to any future projects.

4. Possible influence of neighbouring circuits on the data recorded

The profiles of phones 4 and 5 are almost identical, yet they should be monitoring quite different circuits. This may be from some form of interference between the circuits meaning that electricity consumed in one circuit is monitored by both meters. This may be due to positioning of the clamp on meters, although, as noted in the methodology, these were fitted by University of Edinburgh electricians.

Data analysis

Analysis of the data which we did manage to gather (although see notes above about data integrity) does not show a significant change in energy consumption overall as a result of the engagement undertaken. This is best illustrated when we look at a graph of the daily total energy consumption figures, once outliers have been removed (see notes above about data integrity). See figure 1 below.

High energy consumption is shown during early August, likely due to operating higher energy experiments.

Figure 2 below shows that the majority of the increase in energy consumption in early August came from phones 4 and 5:

Phone 4 circuit 6L3 Room G40	**Power supplies x 2, gel documentation system (inc PC) a UV/vis spectrophotometer**
Phone 5 circuit 7L1 Room G42	**Fume hood, 2x shaking incubator, vacuum pump/freeze dryer, ice machine**

Discussion with Mike Capeness indicates that the freeze dryer and pump were being operated substantially during that time in G42. See note above about concern of the independence of the energy data from these two circuits.

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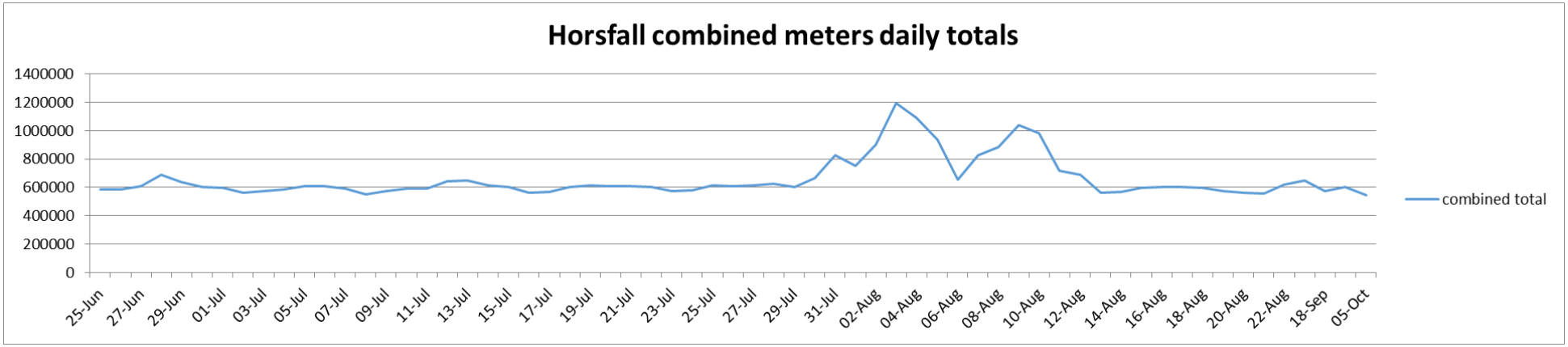

Figure 1: combined energy meters daily totals (outliers removed)

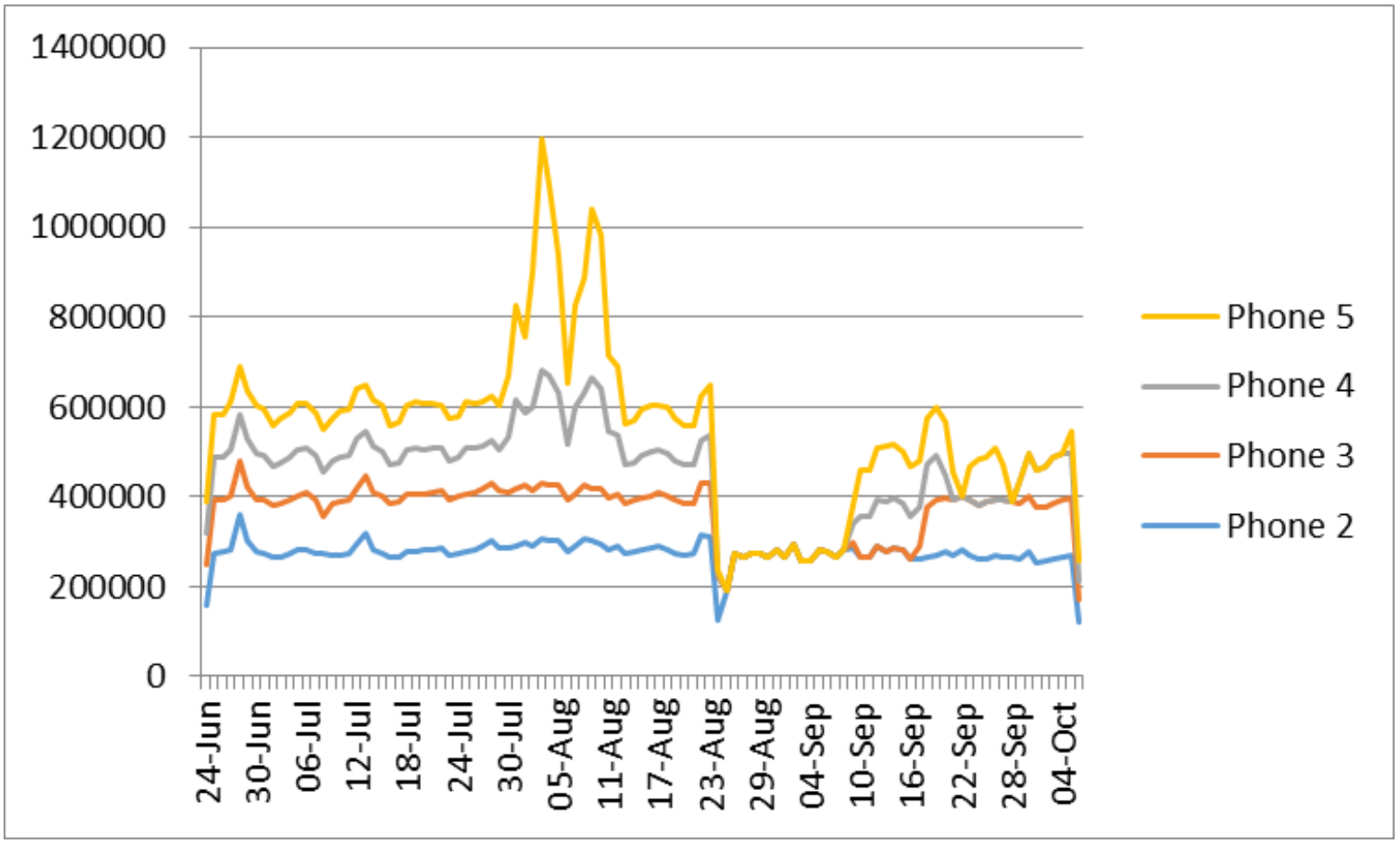

Figure 2: stacked graphs showing daily total energy consumption for all circuits monitored (outliers included)

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Feedback from the Horsfall Group members

During a workshop on 17th October 2016 members of the Horsfall Lab Group were shown graphic representations of the energy consumption of the labs over the monitoring period. Below are a series of comments about engagement with lab users to encourage sustainable behaviours:

- The presentation made me think in more detail about switching things off and the equipment to target.
- The wipe-clean cards are useful to tell people not to switch off things, e.g. waterbaths. Typically people switch off equipment quite a lot *(**this good practice may partly explain why no improvement was measured**)*
- People read the posters more when they were on the back of toilet doors, but they were told to remove them from this location and only pin them on the official noticeboards. However, noticeboards are in corridors where people are not stationary, but rather are moving swiftly through, so the posters etc get little attention on the official noticeboards
- Monitoring of lab level electricity, leading to good graphic representations of data is very engaging for a scientific audience.
- They would be keen to know what the energy consumption of individual items is. *(They were advised to use plug-in energy monitors for this purpose. It was pointed out that some of this info is already on the back of the wipe-clean cards.)*
- It was suggested SRS run a uni-wide Green Initiatives Week to promote sustainable labs and other initiatives.
- Representatives of the Horsfall labs would like to be included on the invite list for SLSG workshops
- It was suggested that an SRS representative could visit each department annually and provide a sustainability lecture/induction. *(The group were told about the materials available on the SRS website including the induction presentations. In addition, it was confirmed that SRS would be enthusiastic to support/attend any such events in future if invited.)*

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Conclusion

Excluding the events of early August which do not seem likely to be attributable to the activities of this project, the baseline energy consumption does not change significantly between the beginning of the monitoring project and the end, despite multiple forms of communication encouraging good energy saving behaviours.

This may be as a result of poor or ineffective communications techniques. Or it could be due to the pre-existing energy efficiency of lab practices monitored prior to any engagement.

Recommendations

It is recommended that further projects be undertaken to try to reduce the influence of one-off or localised events/circumstances and potentially obtain a better picture of the impact (or lack thereof) of our current energy engagement practices. It is vital that we act upon lessons learned from the methodological problems section of this report prior to commencing any further work.