Using data analyses to create an optimal energy consumption policy

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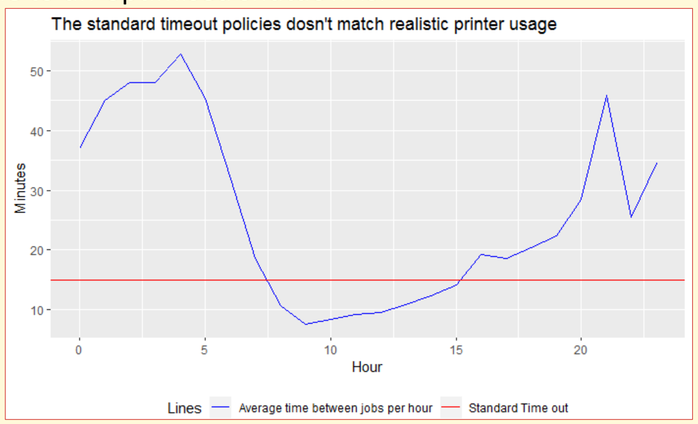
Aim

Investigate how the use of data analyses can be used to create an optimal energy consumption policy that balances energy-performance trade-off.

The Problem

On average, standby power makes up to 22% of a device's total energy consumption[1]. Most devices now days use energy policies to “turn off” a device after a set idle period. However this time-out is normally static and may be causing frequently used devices to be wasting more energy due to un-optimised shutdowns.



Motivation

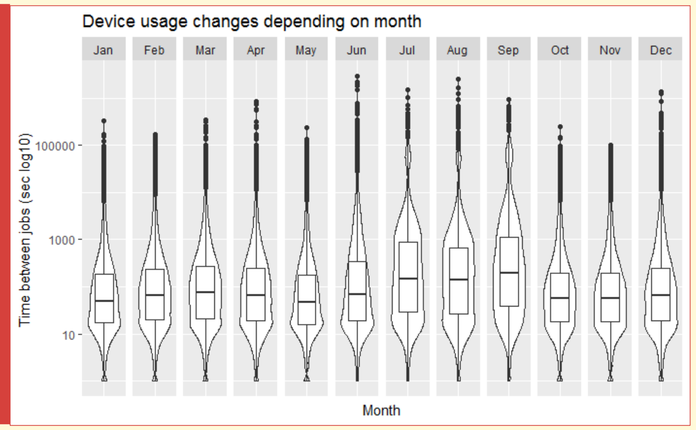
Using device usage data, analysis could be used to find patterns and trends that could be converted to an energy policy to help reduces overall energy wastage but also reduce un-optimised shutdowns. This would lead to

- a reduction in money wasted, beneficial as around $1 billion is spent on standby waste energy by the uk household sector each year [2]
- higher user satisfaction, as there will be less delays caused by shutdown devices needing be to turned on.
- Reduce in CO_2 emissions as an estimated 1 percent of global CO_2 emissions are casued by standby power [1]

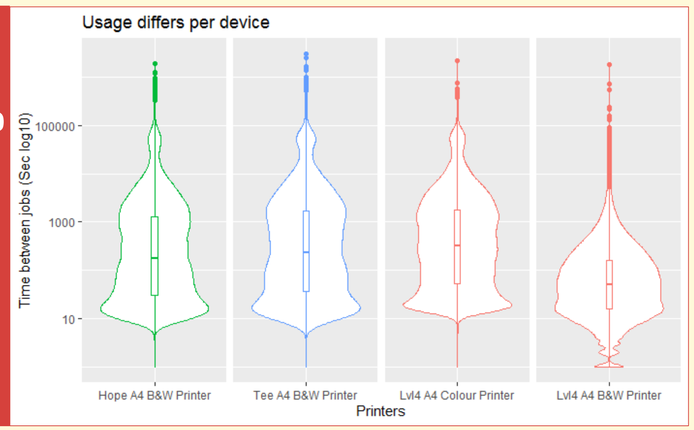
Analyses

Using a data set of printer jobs and user login sessions, analyses was done to find information in the following areas:

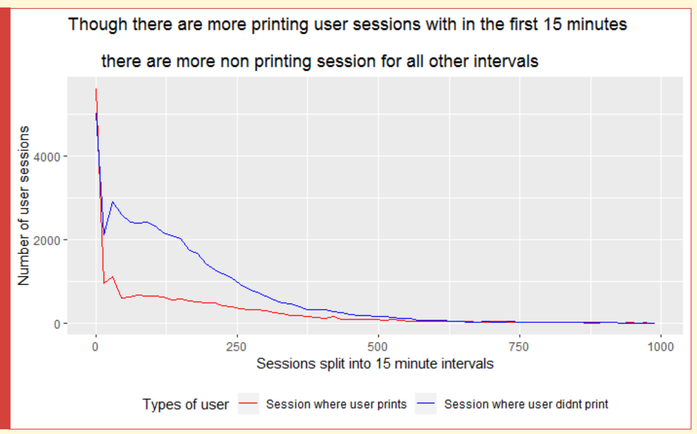
Time



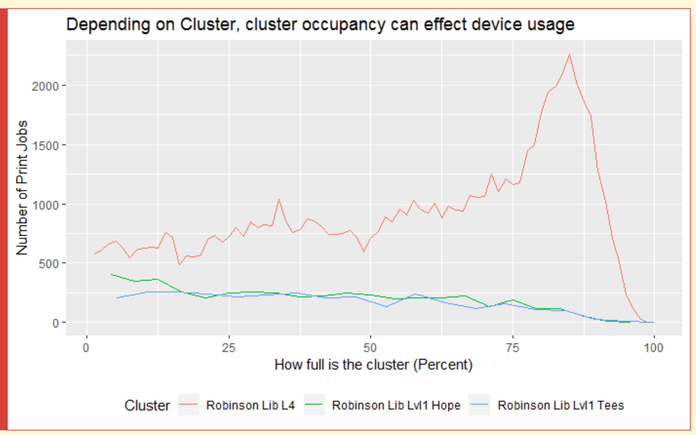
Device Usage



User Trends



Cluster Rooms



Technologies Used

RStudio, tidyverse, ggplot2, Java™, HTC simulator, Excel, Power BI

Simulation

Information collected was used to help create energy policies. These policies where then tested using a High Throughput Computing simulation [3]. The simulation allows us to see how efficient the custom polices are when ran against a simulation of realistic printer usage.

[1] Francis, J. (2014). Understanding And Performing Standby Power Measurements. Power Electronics. https://www.powerelectronics.com/technologies/power-electronics-systems/article/21861639/understanding-and-performing-standby-power-measurements

[2] Palmer, J. Terry, N, (2014). Powering the nation 2 : Electricity use in homes, and how to reduce it. Department of Energy & Climate Change pp 16

[3] Forshaw, M., McGough, A. and Thomas, N. (2015). HTC-Sim: a trace driven simulation framework for energy consumption in high-throughput computing systems. CONCURRENCY AND COMPUTATION: PRACTICE AND EXPERIENCE, pp 1-32