close the door
against energy waste

gFT glass & façade technology research group

UNIVERSITY OF CAMBRIDGE

Energy Appraisal of Retail Units

Assessing the effect of open doors on energy consumption and thermal comfort during the heating season

Research Student: Murat Basarir
Supervisor: Dr. Mauro Overend

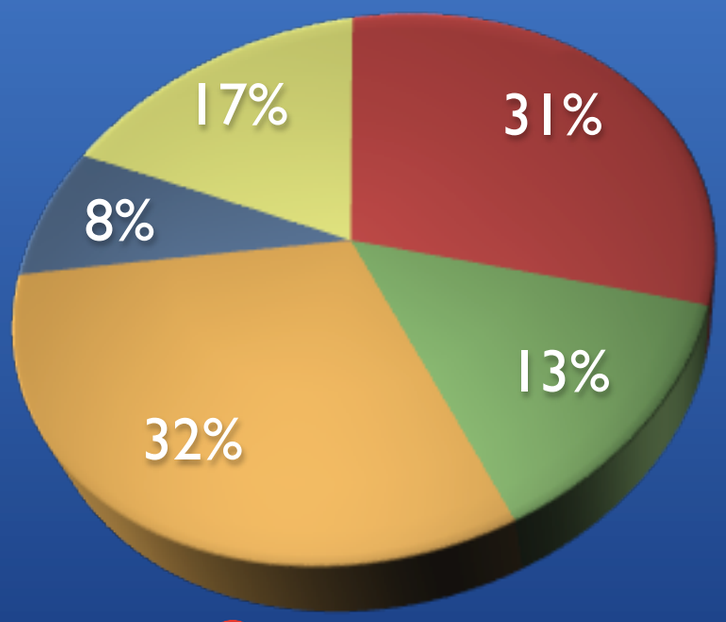
Overview of Presentation

- Project Motivation
- Objectives
- Methodology
- Analysis of Initial Results
- Summary
- Conclusion

Project Motivation

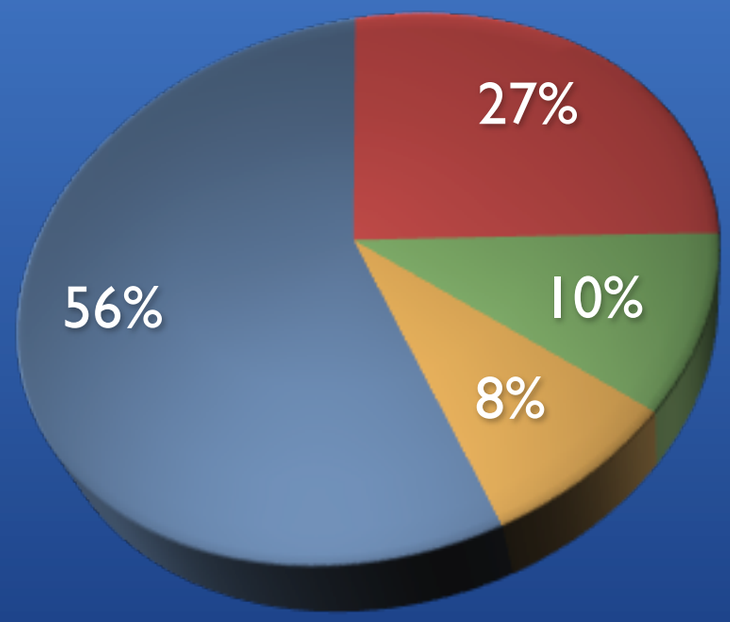
- UK Government has set carbon emission targets to 34 % below 1990 levels by 2020
- The service sector accounts for 19% UK's energy consumption
- Within the service sector the retail sector accounts for 20 % of the energy consumption

Energy use in the Average Retail Environment



DECC (2010) Energy Consumption in the UK Service Data Tables

Winter Door and Air Curtain Usage



Brown, N., Wright, A.J, Caeiro , J.A.J, Altan, H., Summerfield, A.J, "Large Scale Energy Surveys in the UK Retail Sector", RICS Annual Conference Cobra 2006

Project Objectives

1. Investigate energy consumption and thermal comfort under different modes of operation:
   i. winter (heating)
   ii. summer (cooling)

2. Deploy a wide range of wireless sensors to monitor all the factors that effect energy consumption in a store

3. Assess the benefits of implementing power meters in retail outlets

4. Quantify any differences to customer footfall

Methodology

1. Identify typologically different stores to participate in the field studies

2. Assemble and deploy a toolkit consisting of wireless sensors to monitor important parameters (energy consumption, temperature, door operation)

Methodology

3. Two key cases were investigated:

Open Door Day

- The heating was turned on at the start of business hours and was turned off once the set point temperature was reached

- The fan heaters above the doors (air curtains) remained turned **on** throughout the whole day

Closed Door Day

- The fan heaters above the doors (air curtains) remained **off** throughout the whole day

Equipment

POWER METER

SMARTPLUG

Equipment

TEMPERATURE SENSORS

1.17 cm

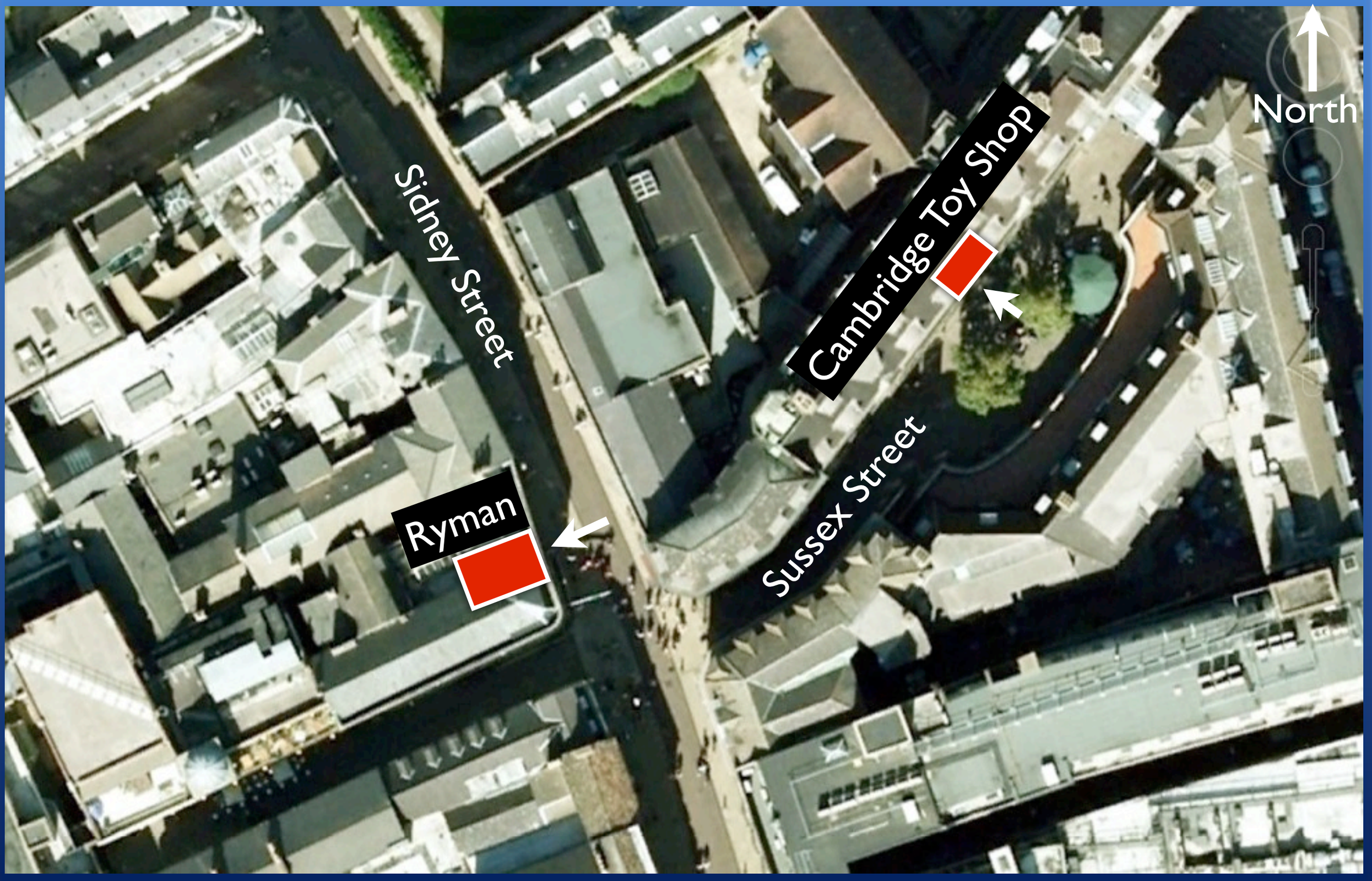
Temperature and Humidity Sensor

WEATHER STATION

75 cm

Outdoor Unit

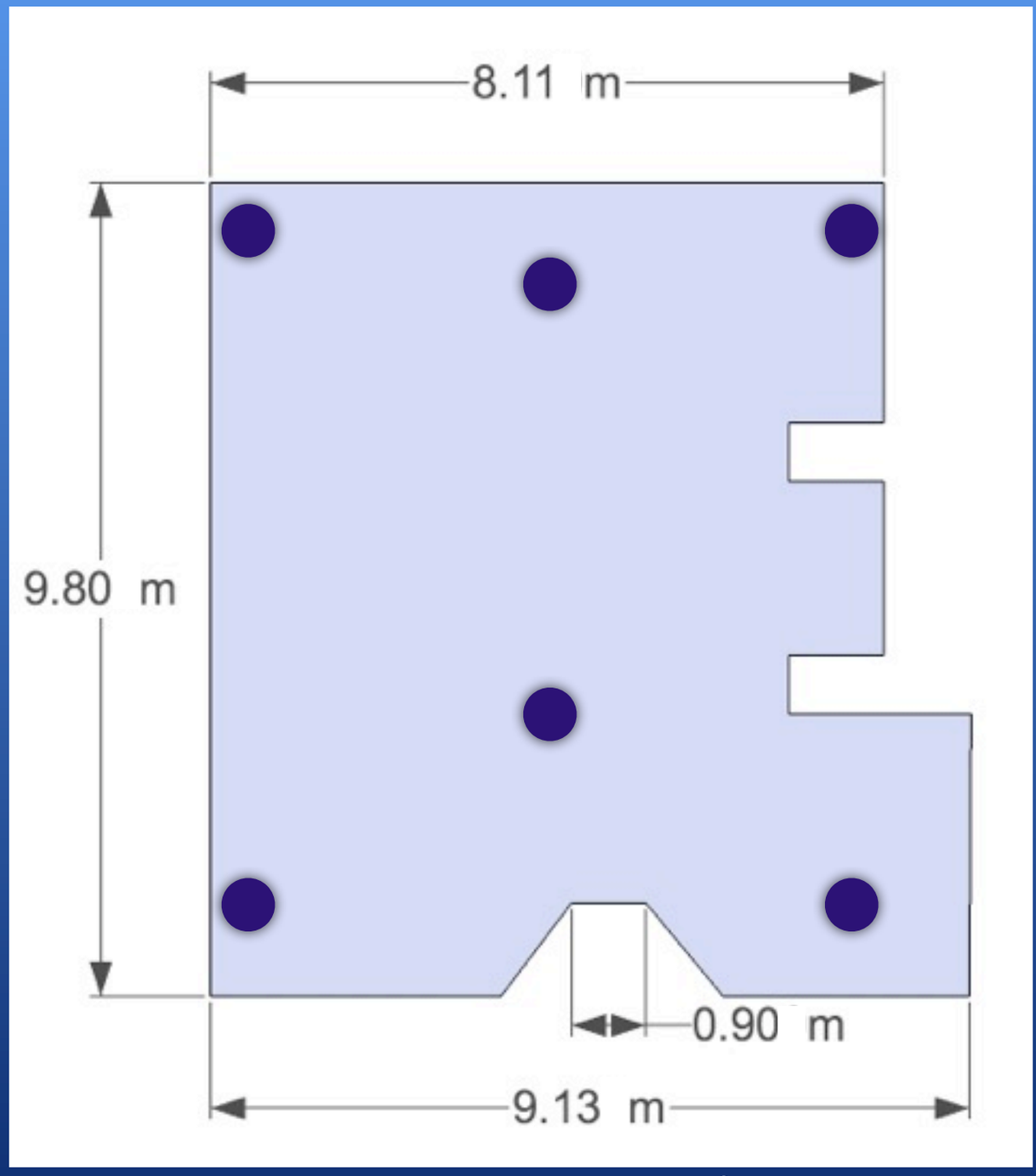
Indoor Unit


Sidney Street
Cambridge Toy Shop
North
Ryman
Sussex Street

Cambridge Toy Shop

Cambridge Toy Shop

Floor Plan of Cambridge Toy Shop



Floor Area: 158 m^2

Height of Ground Shop Floor: 3.25 m Height of Sensors : 1.5 m

Temperature and Humidity Sensors

Energy Consumption for Cambridge Toy Shop

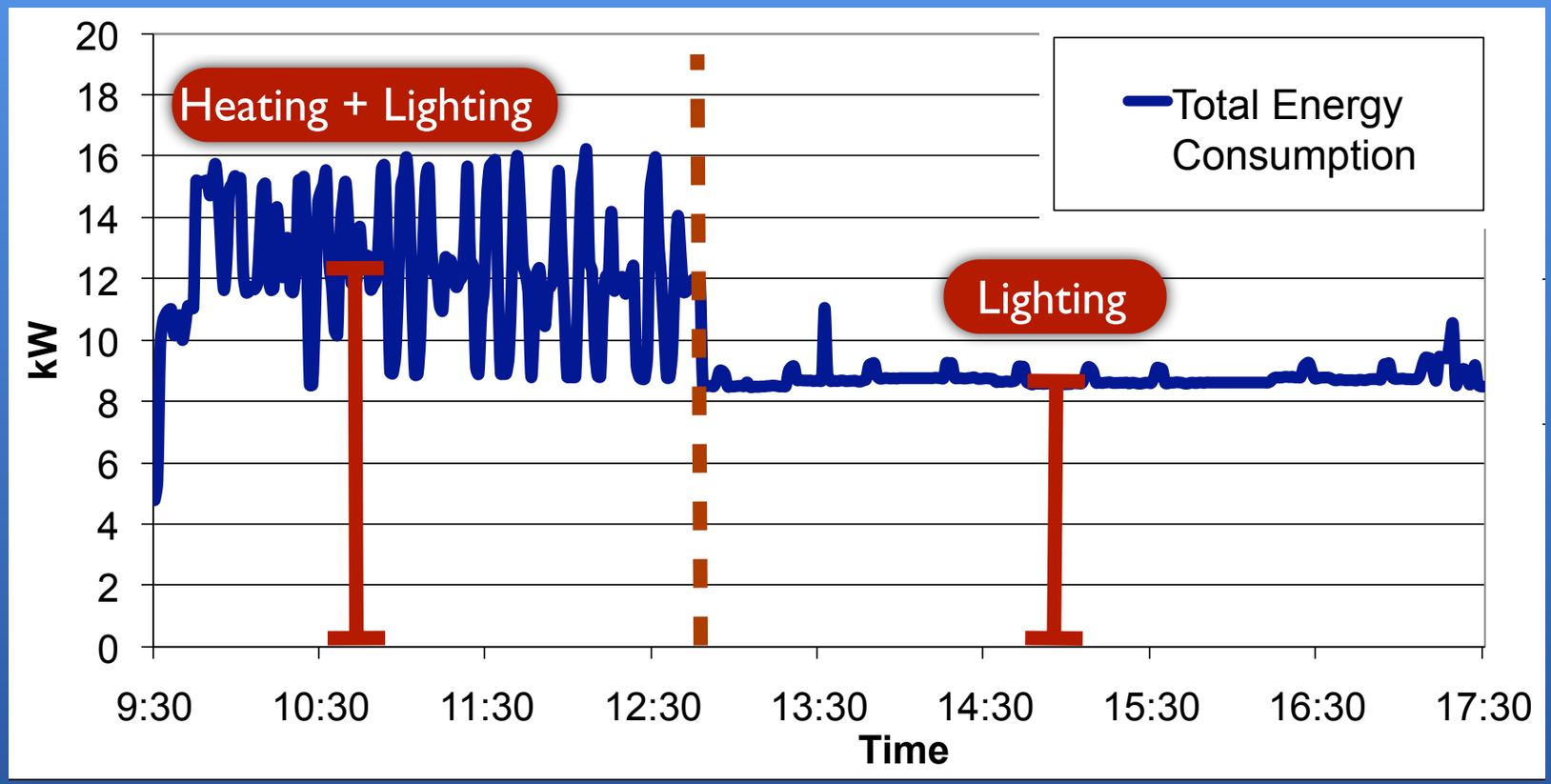
Closed Door Case

Date: March 8, 2010

Average Outside Temperature: 6.4 C
Min: 1.8 Max: 10.5

Average Wind Speed: 0.1 m/s

Total Daily Energy Consumption: 82 kWh



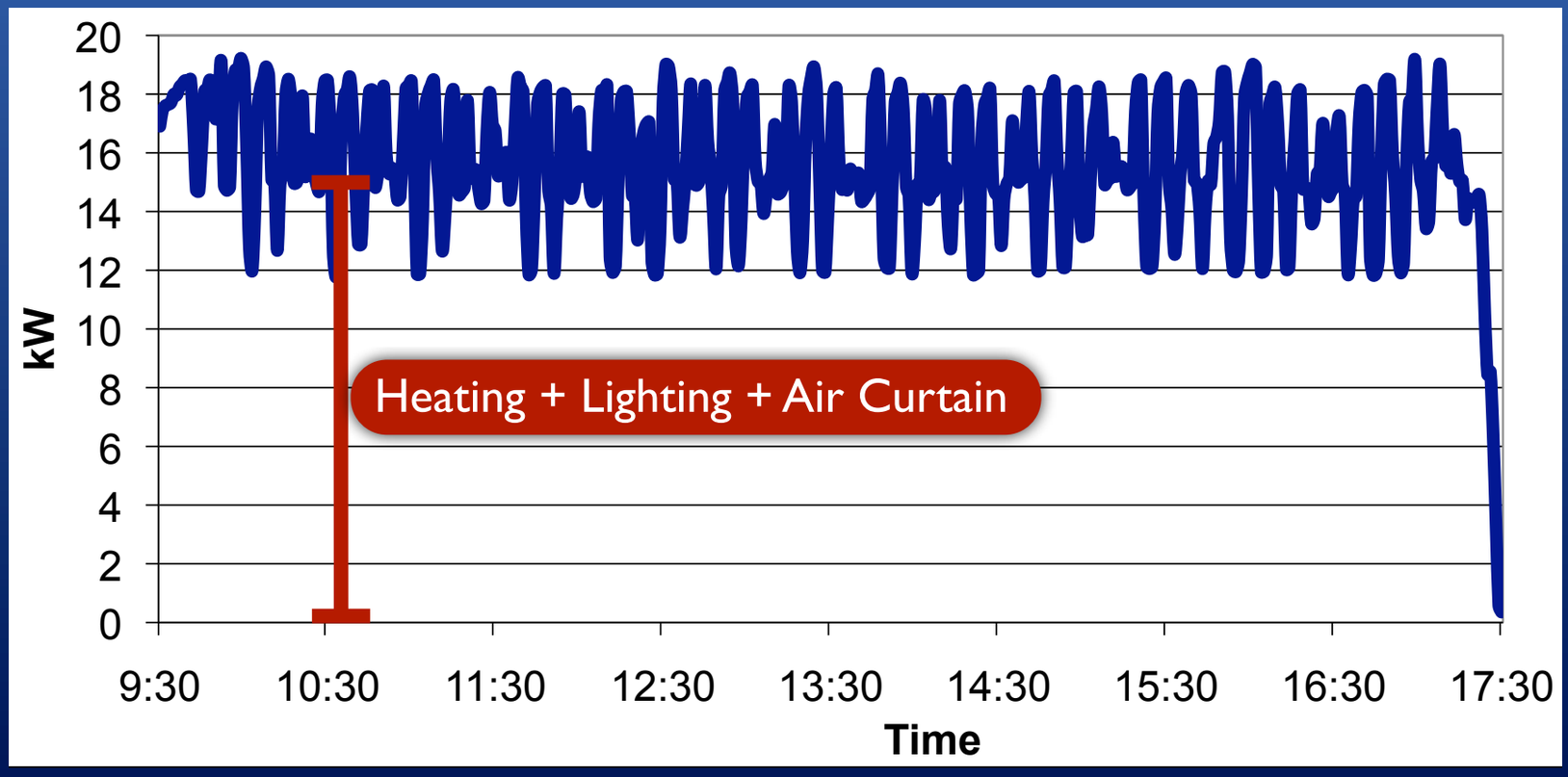
Open Door Case

Date: March 11, 2010

Average Outside Temperature: 6.1 C
Min: 3.5 C Max: 7.2

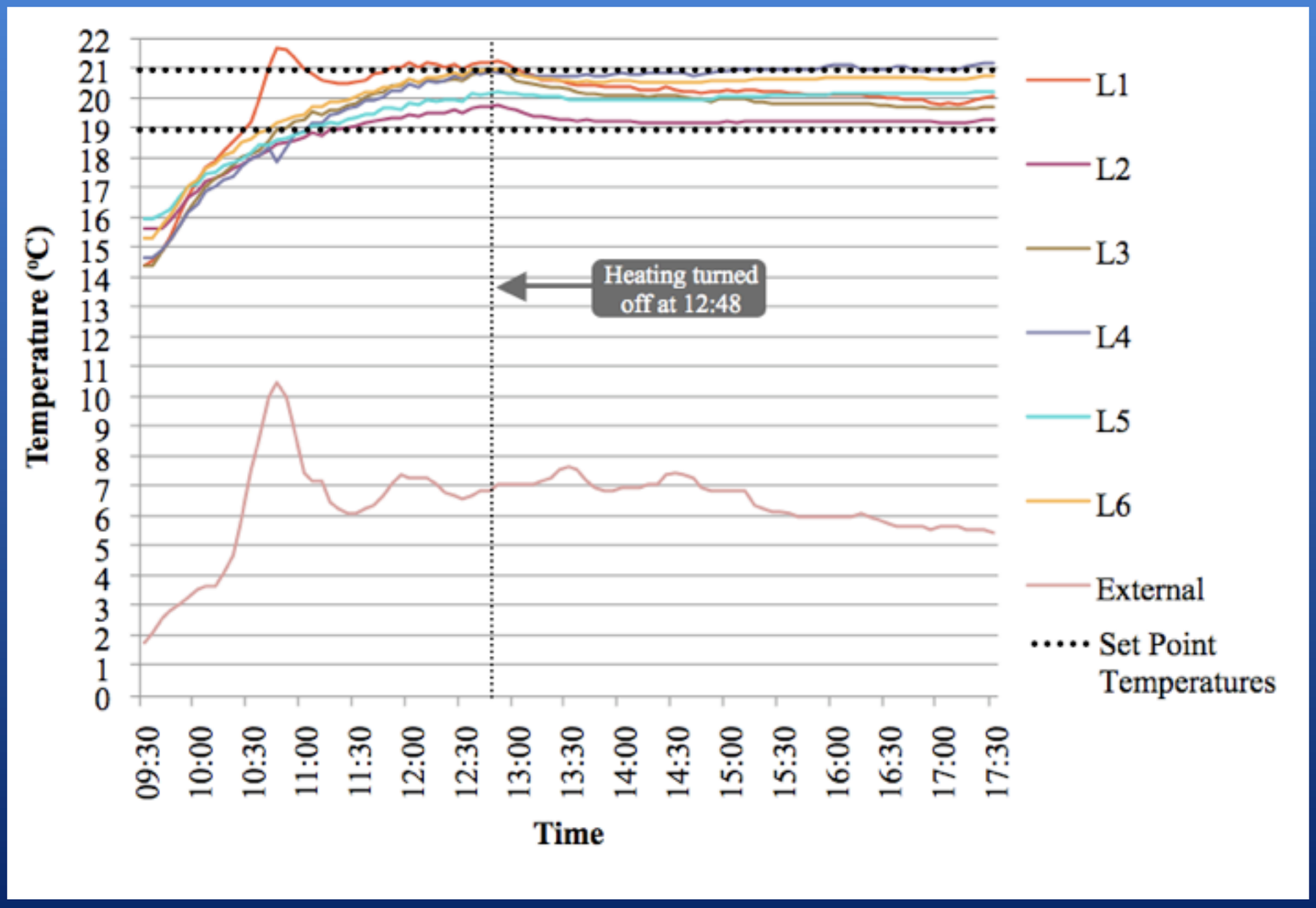
Average Wind Speed: 0 m/s

Total Daily Energy Consumption: 125 kWh



Temperature Distribution in Cambridge Toy Shop

March 8 - Closed Door Case



Temperature Distribution in Cambridge Toy Shop

Mar 11 - Open Door Case

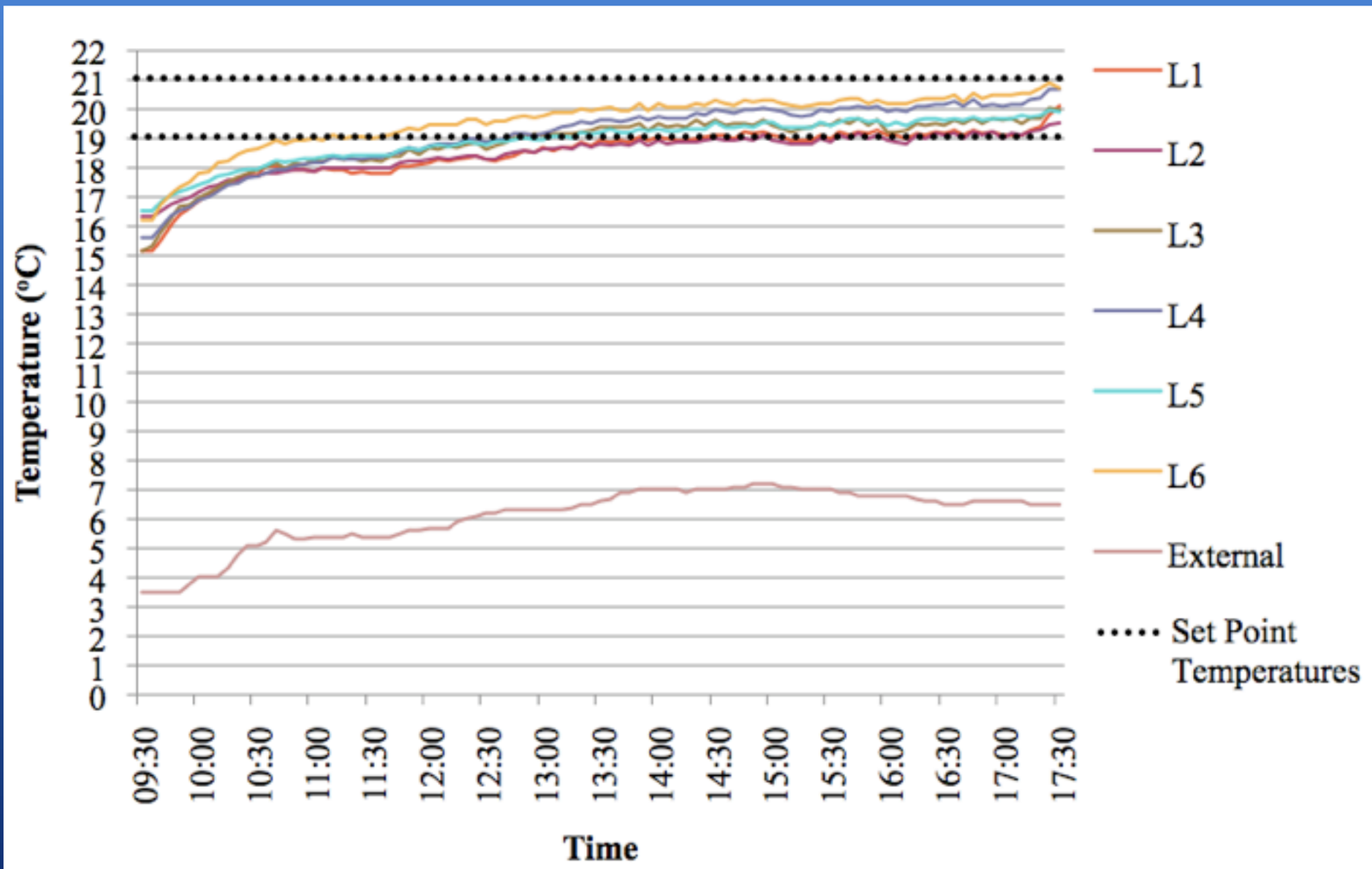
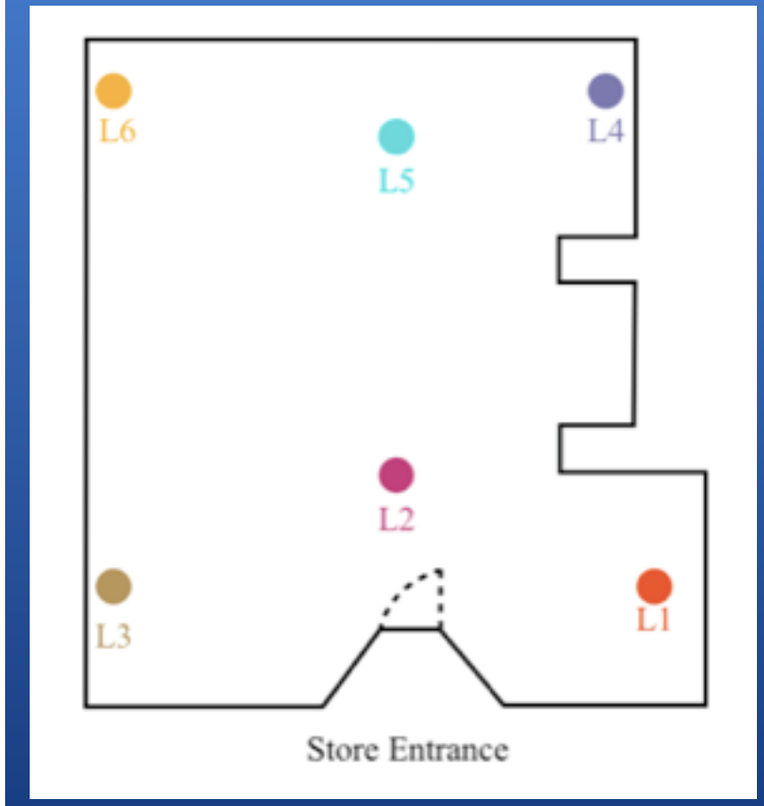


Figure 3.9 March 11, 2010 (Open Door) Indoor and External Temperatures



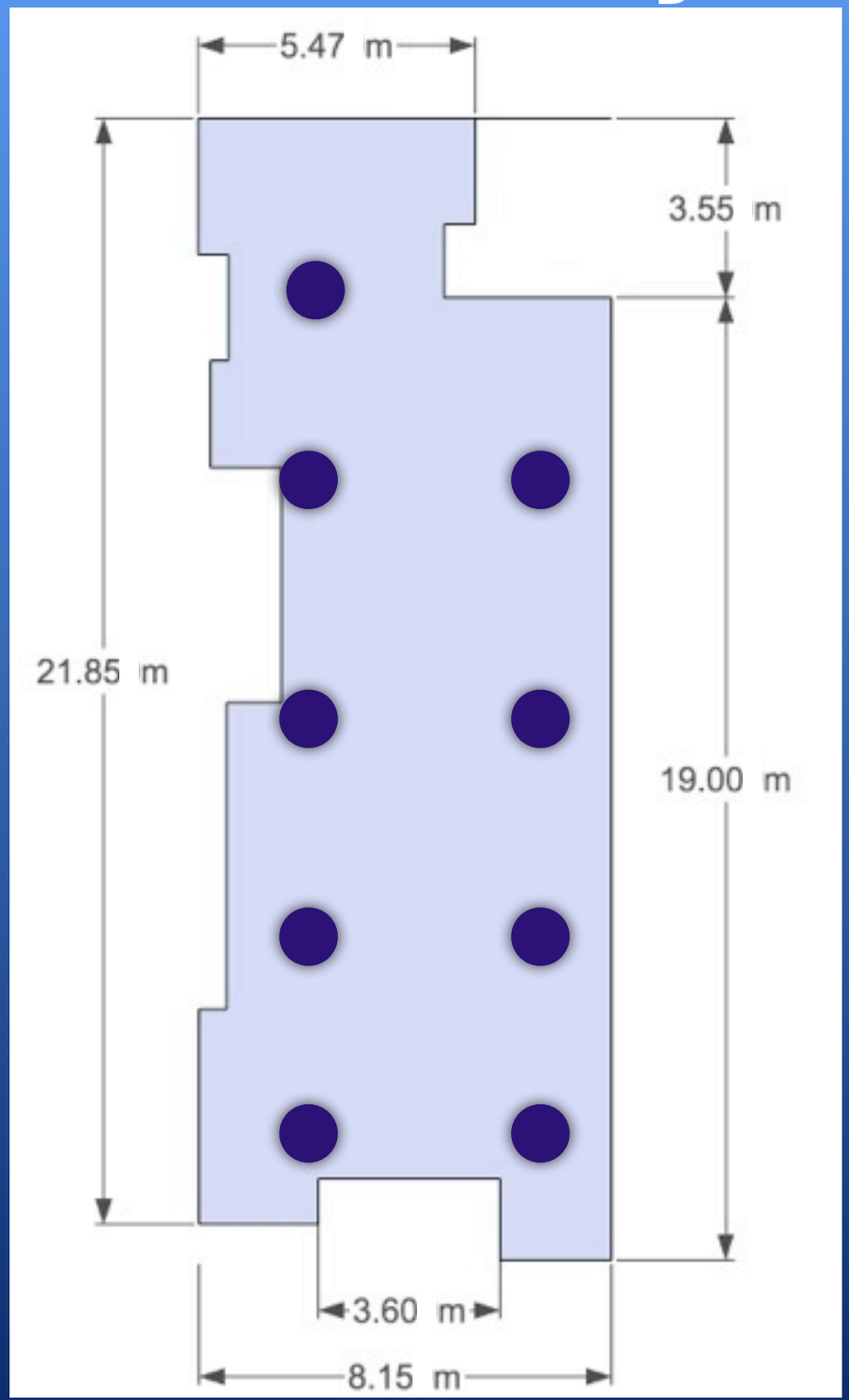
Ryman


Ryman
the stationer
LAKELAND
LAKELAND
SAVE
£30
3-2
CDs & DVDs
3-2

Ryman


Ryman
the stationer
SELECT FILING & NOTEBOOKS
BUY 1 GET 1 FREE
EPSON
Printer, Scanner
Copier & Fax Machine
SAVE £30
DURACELL BATTERIES
4+4 FREE
£3.79
NEW DESKTOP ACCESSORIES
Mix & Match
3 FOR 2
Pedestrian Zone
No loading Mon-Sat 10 am-4 pm

Floor Plan of Ryman



Floor Area:153 m^2 Height of Store : 2.6 m

Height of Sensors : 1.5 m

Temperature and Humidity Sensors

Energy Consumption for Ryman

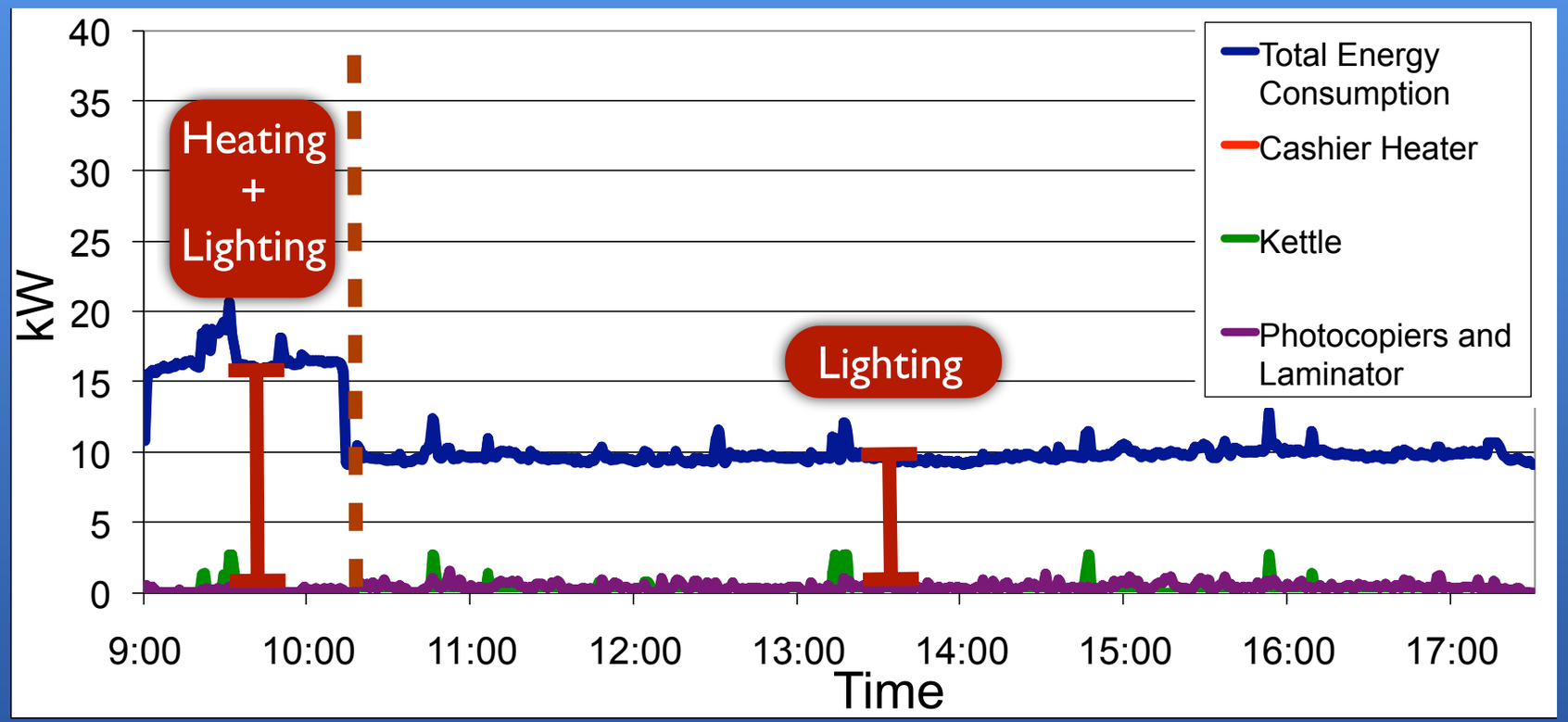
Closed Door Case

Date: March 3, 2010

Average Outside Temperature: 6.0 C
Min: 2.6 Max: 9.4

Average Wind Speed: 1.6 m/s

Total Daily Energy Consumption: 92 kWh



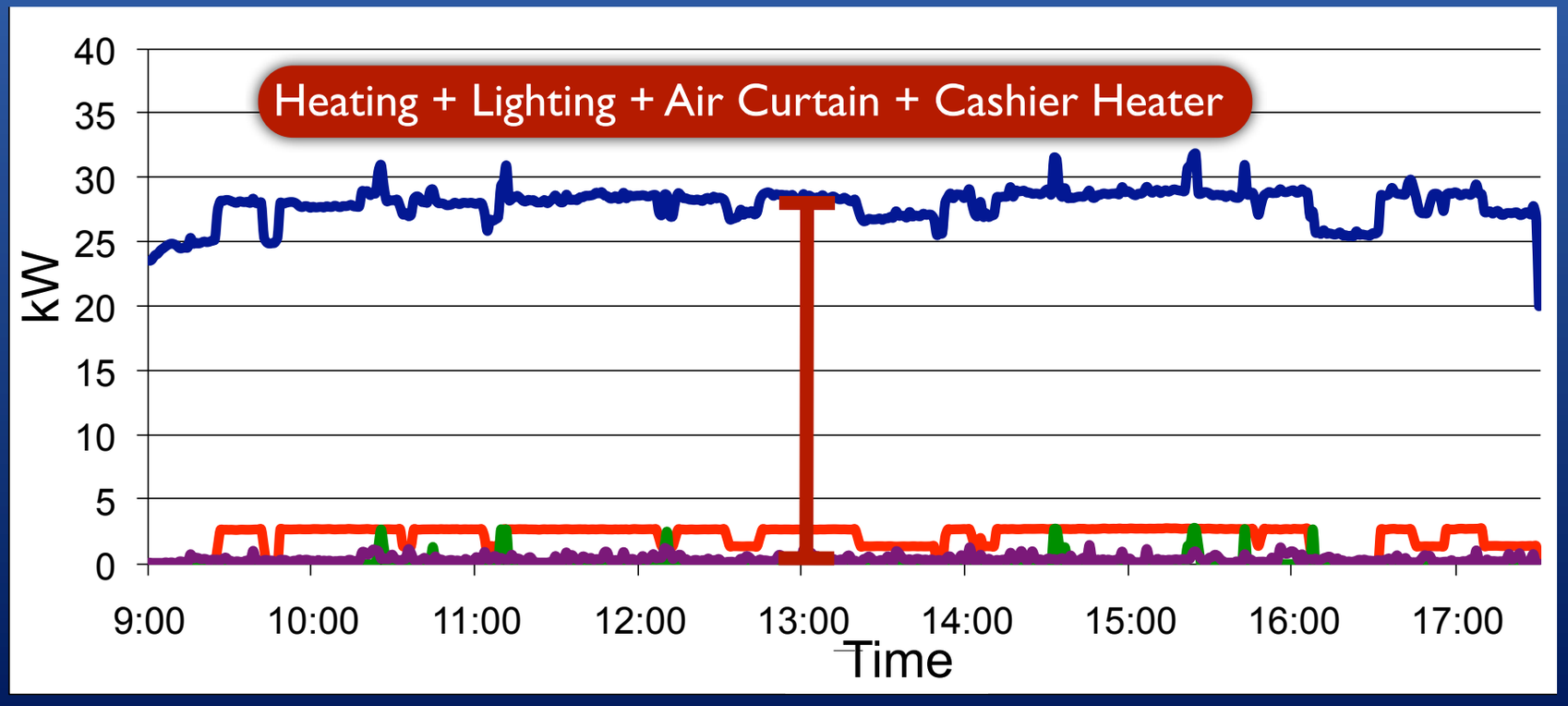
Open Door Case

Date: March 11, 2010

Average Outside Temperature: 5.2 C
Min: 1.4 C Max: 7.3

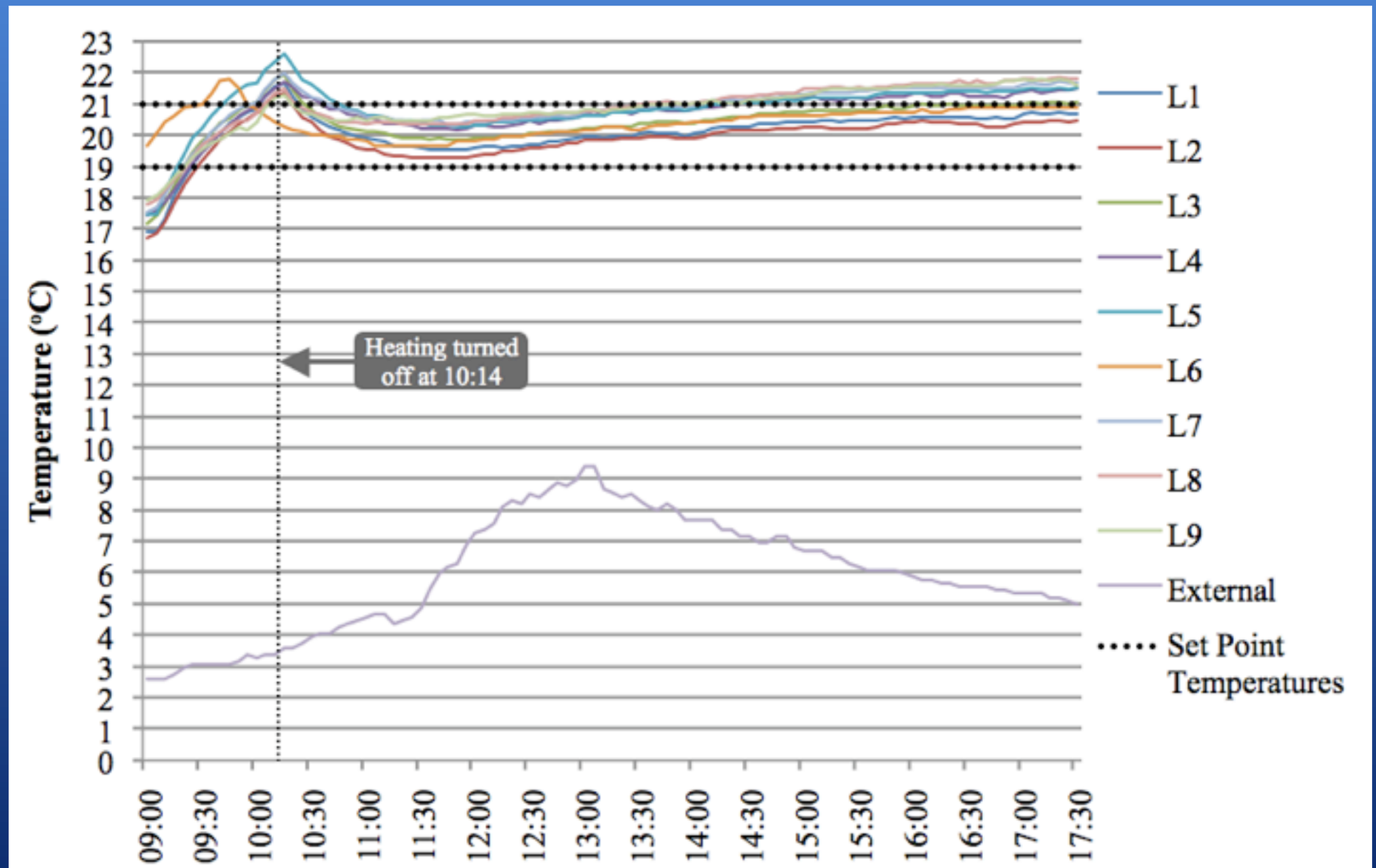
Average Wind Speed: 1.3 m/s

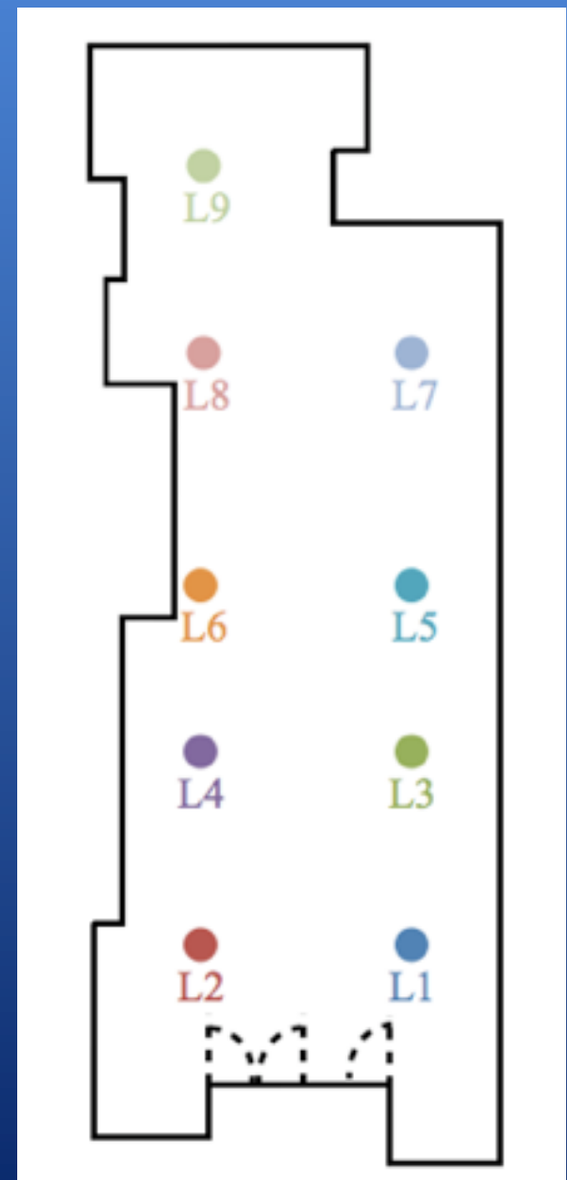
Total Daily Energy Consumption: 238 kWh



Temperature Distribution in Ryman

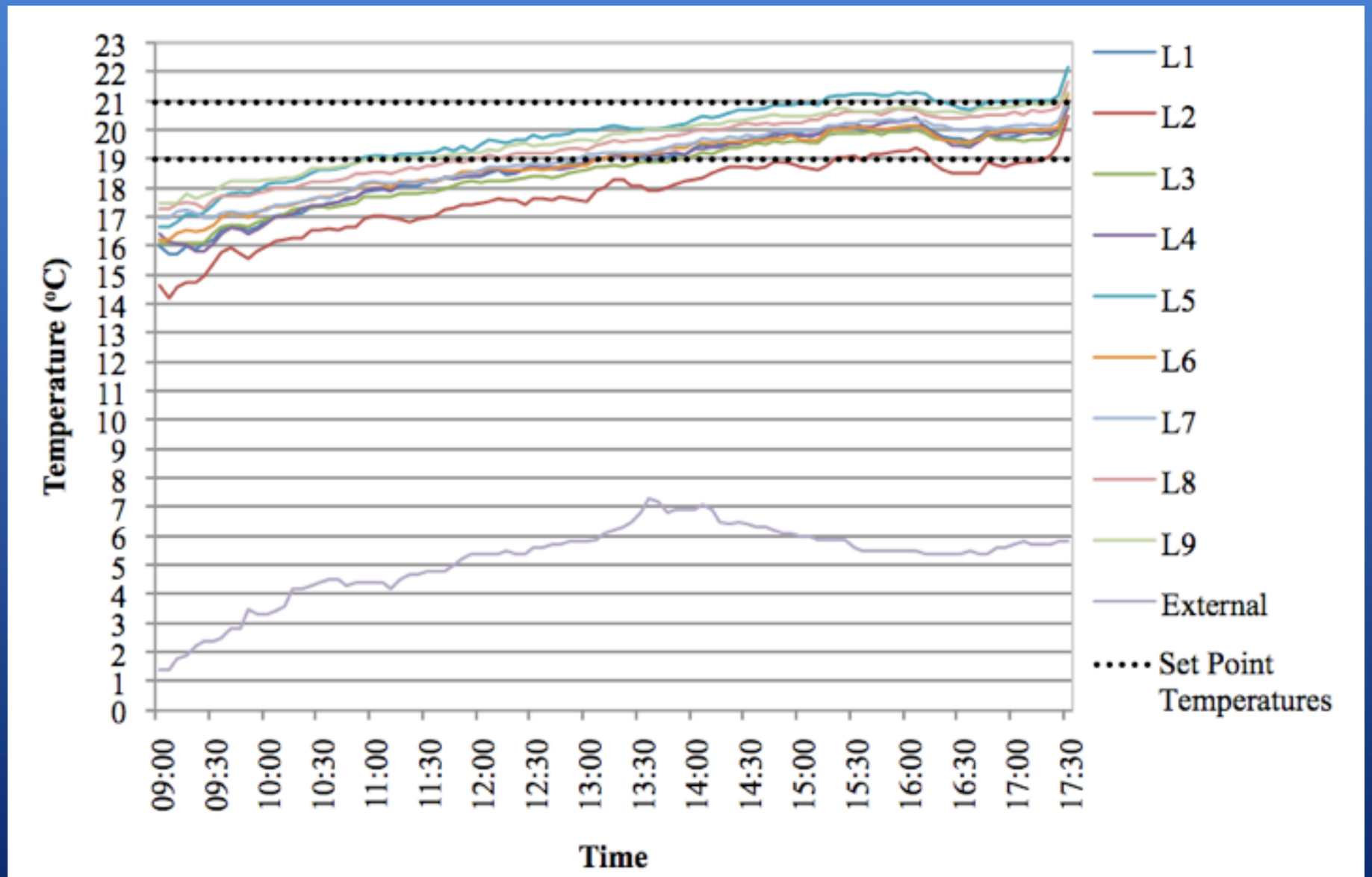
March 3 - Closed Door Case

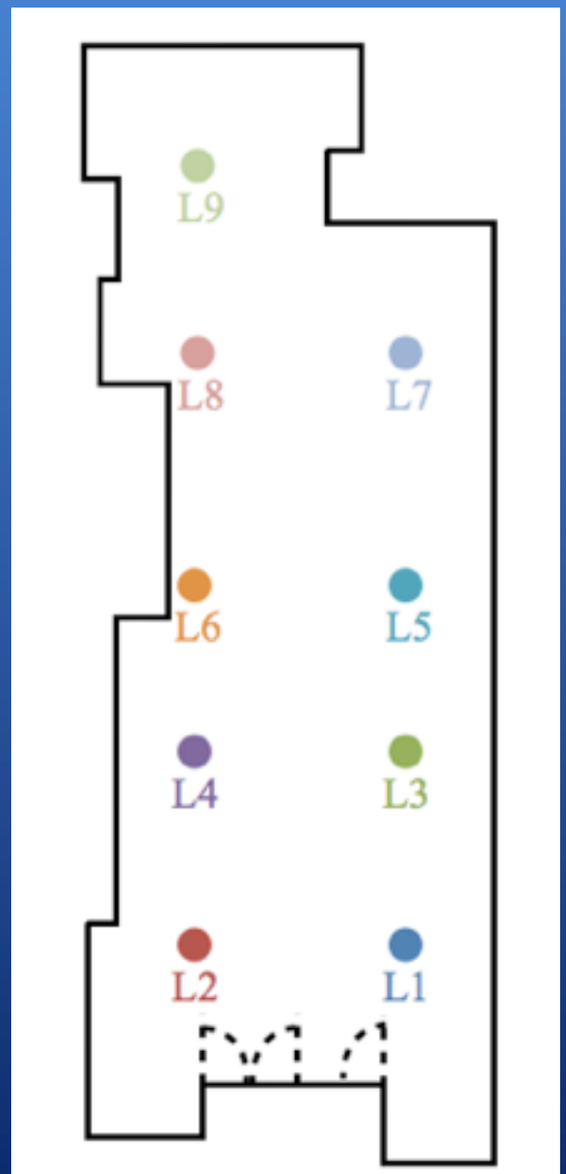




Temperature Distribution in Ryman

March 11 - Open Door Case





Summary for Winter

	Cambridge Toy Shop		Ryman	
	Energy	Emissions	Energy	Emissions
Mean Energy Consumption for Open Door Cases	114 kWh	62 kg CO_2e	198 kWh	108 kg CO_2e
Mean Energy Consumption for Closed Door Cases	80 kWh	44 kg CO_2e	91 kWh	50 kg CO_2e
Difference	34 kWh	18 kg CO_2e	107 kWh	58 kg CO_2e
Percentage Savings		30 %		54 %

*Based on weekdays and Saturdays

Conclusion

- A significant difference in energy consumption exists between different modes of door operation during the heating season

- The increase in energy consumption leads to a rise in CO_2 emissions

- Open doors can lead to areas of staff discomfort as they fail to meet CIBSE thermal comfort guidelines

- No evidence was found that footfall was affected by the closed door and any difference in transactions was not significant

Thank you