

## CEREB - A joint activity

- Partners -City and Kingston Universities
- Funders:
  - HEFCE (£2M)
  - London Development Agency (£880 K)
  - M&E Sustainability (£20 K x 3)

HEFCE HIGHER EDUCATION FUNDING COUNCIL FOR ENGLAND

LONDON DEVELOPMENT AGENCY

m&e sustainability

CITY UNIVERSITY LONDON LONDON SOUTH BANK UNIVERSITY Kingston University London

## The new K2 building



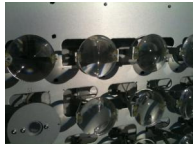
- LSBU's new teaching facility
  - 4 lecture theatres
  - 10 classrooms
  - 12 simulated hospital environments
  - Staff office space
- Roof top energy centre

## Sustainability in K2

- Building design CO<sub>2</sub> emissions 55% below 2006 Building Regulations
- Passive design and energy recovery
- Displacement ventilation
- 11% savings for renewables (meeting the London Plan targets)
  - Ground Source Heat Pumps
  - Solar thermal hot water
- CEREB provides additional features

## Roof top energy centre

- A showcase for efficient and renewable energy technologies in an urban setting
- To bring renewables into the mainstream
- Research into building, system and component performance
- Teaching
  - Builds on over 60 years of building services education at London South Bank University



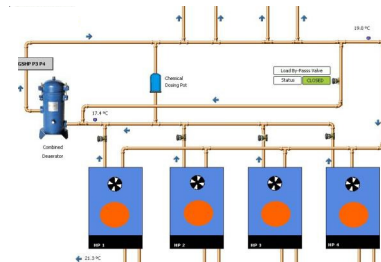
## Showcase of technology

Base build systems - Ground source heat pumps  
 Solar thermal hot water

CEREB systems – Photovoltaics  
 Solar fibre optics  
 Absorption cooling  
 Heat recovery  
 Phase change  
 Urban wind

## Ground Source Heat Pumps

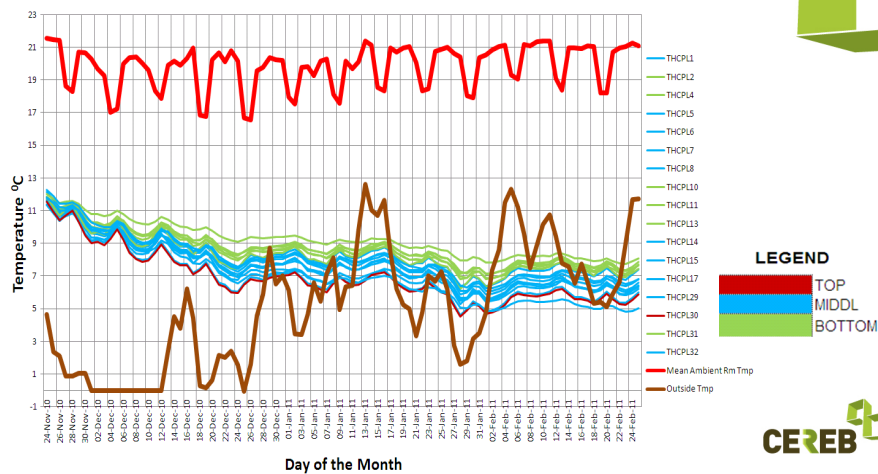
- LSBU K2 500 kW reverse cycle for heating and cooling
- Ground source in the structural piles
- 22–25 m deep to avoid ground water
- 173 piles to provide required thermal mass



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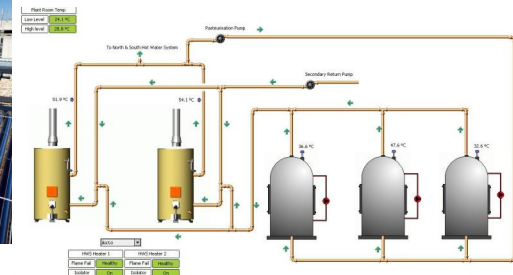
## K2 ground temperatures

A Graph of Ground Temperature Distribution Across 3 Levels



Source: Metkel Yebiyo, LSBU

## Solar Thermal for Hot Water



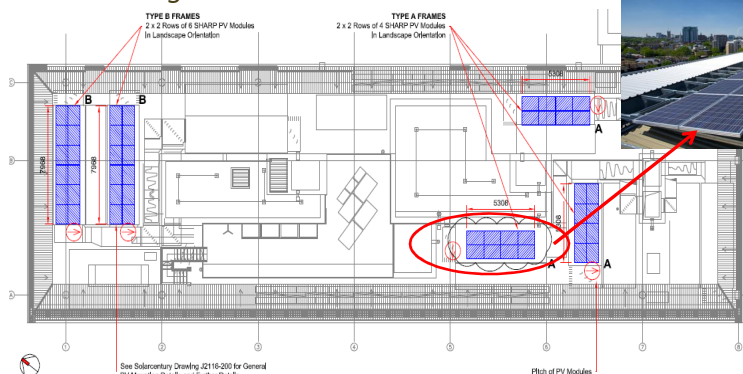
- 19 high efficiency evacuated tube collectors
- Serves DHW for K2 with gas fired top-up
- Fully heat metered



Manufacturer: Riomay

## Photovoltaic Farm

- 63 m<sup>2</sup> of PV farm producing 9 kW
- *Existing 10 kW PV installation at LSBU*

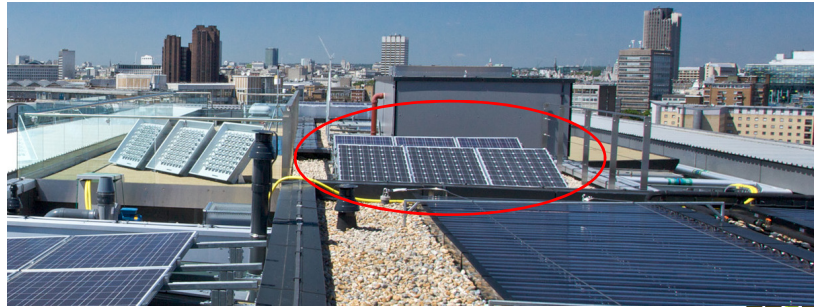


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Manufacturer: Sharp Electronics (UK) Ltd

## PV test bed

- 2 No plug and play station
- Completed MSc project on polycrystalline and monocrystalline performance



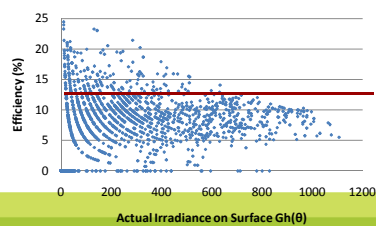
Manufacturer: Sharp Electronics (UK) Ltd

## PV Performance Analysis

Comparison of two PV arrays at CEREB

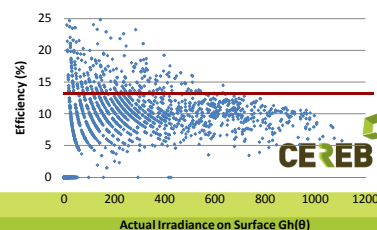
### Demo1 – Polycrystalline (175W)

- 3 Panels of 525W total peak output
- Declared Module efficiency of 13.3%
- Actual average efficiency 10.35%
- Energy produced 158.4kWh at an average of 1.3kWh per day



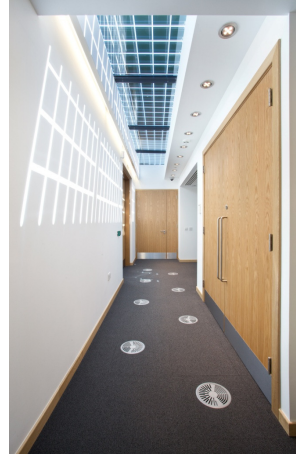
### Demo2 – Monocrystalline (180W)

- 3 Panels of 540W total peak output
- Declared Module efficiency of 13.7%
- Actual average efficiency 10.96%
- Energy produced 186.7kWh at an average of 1.5kWh per day



## Solar Rooflight

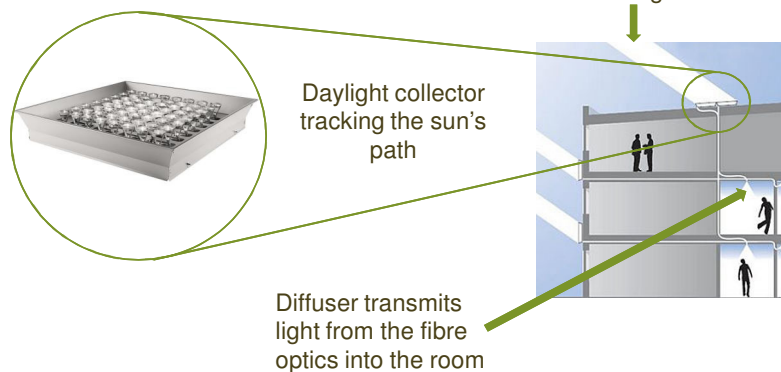
- 4 No of PV glass laminate
- Providing daylight and electricity



Manufacturer: Glazing Vision

## Solar Fibre Optics

- Enabling natural light to be transmitted into buildings



Images courtesy of [www.parans.com](http://www.parans.com)



## Solar Fibre Optics



- Provides daylight from direct sunlight only
- Measured lighting levels 150 Lux maximum on the working plane

## Absorption Chiller

- Uses heat source to provide cooling
- Ammonia/ water
- 12 kW system
- Flow 6-15°C variable, return 9-18 °C variable
- Potential tri – generation (from e.g. fuel cell)
  - Future project to link to the solar thermal system

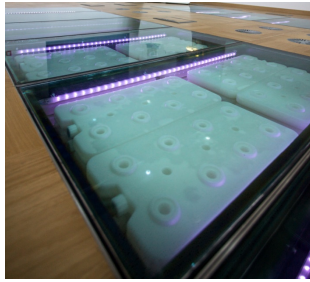


Manufacturer: Chillie



## Phase Change Material

- Provides thermal storage for night time cooling
- Monitored with temperature sensors



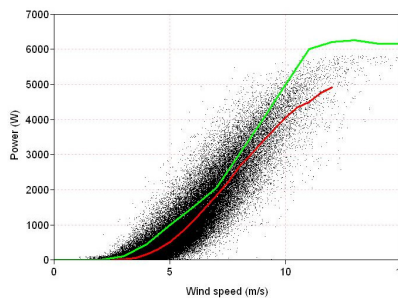
## Urban wind

- Urban wind turbine trial
  - Two 6 kW turbines - One horizontal and one vertical axis
  - High frequency monitoring over 3 years
  - Also measuring sound and vibration effects on the building
- Funding obtained to work with developer of Strata Tower at the Elephant and Castle to evaluate performance



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## Wind turbine monitoring (6 kW HAWT)

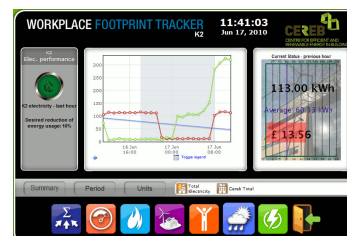
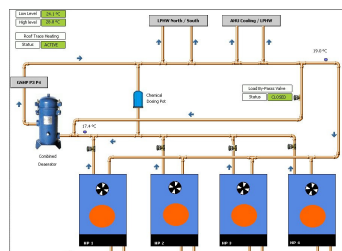


- **One minute average data**
- Black dots denote raw data
- Green curve denotes published power curve
- Red curve denotes mean power in 0.5m/s intervals
- Annual yield 4.2 MWh
- Around half of that predicted
- Vertical axis machine had a poorer performance in this location



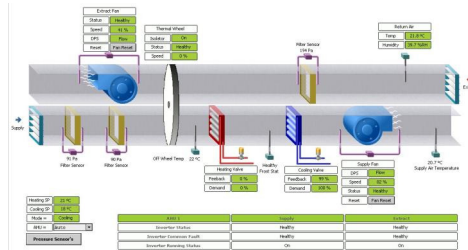
## Monitoring

- Making full use of the Building Management System (BMS)
- Working with an industry partner to develop novel information display and data reporting systems
- Data available through an interactive web portal



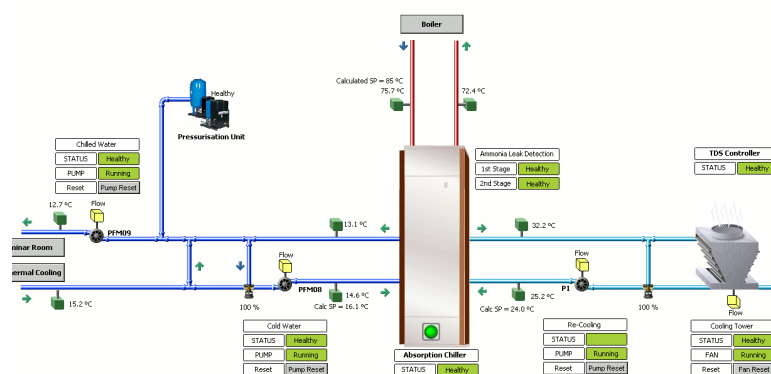
## Building Management System

- Use the BMS to show how systems are configured
- Use the data for student projects to reinforce taught theory
- Data can be stored for research projects



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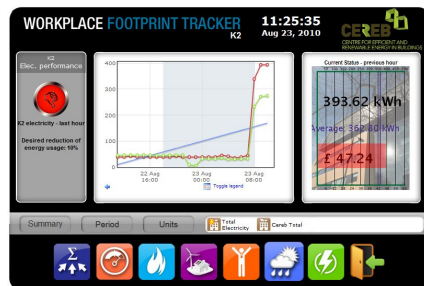
## Shows operating principles



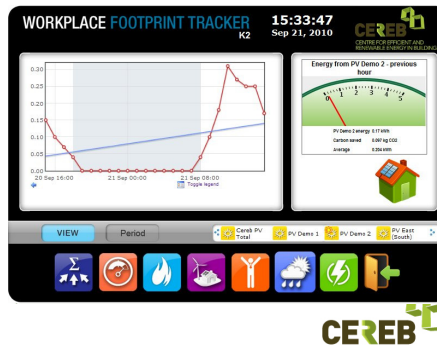
Absorption cooling system

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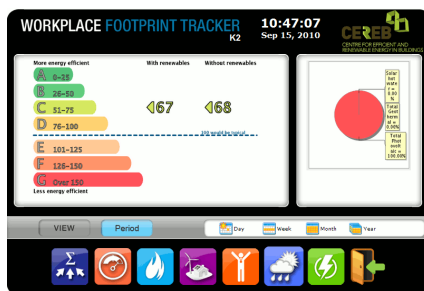
## Data visualisation



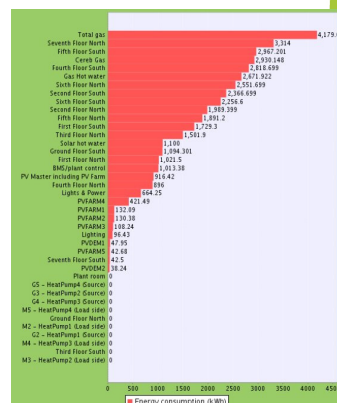
Work place footprint tracker – real time energy updates



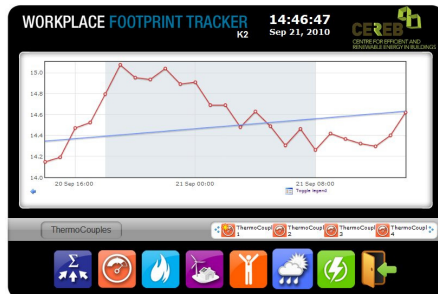
## Building performance



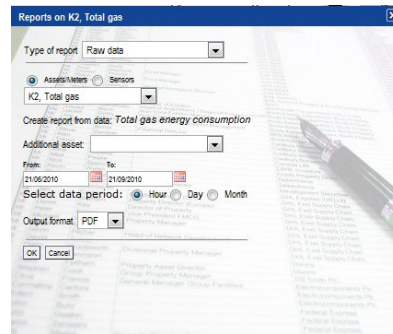
- Real time displays and reporting for different audiences



## Data retrieval



- Data from all sensors and meters stored for easy retrieval for research and teaching



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## Research

- Whole building evaluation
- In depth research of real system performance
- Inter-disciplinary research, e.g. occupant behaviour change in collaboration with psychologists
- Variety of levels of research and funding routes:
  - Under-graduate, Masters projects, PhD
    - Partner universities and other UK and international institutes
  - UK and EU funding sources
  - Strong focus on knowledge transfer with industry
- Data acquisition system makes international collaboration highly feasible

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## Teaching

- Enhanced learning for students
  - Lectures in CEREB
  - Access to plant facilities
  - Glass fronted air handling units
  - Exposed to more low carbon technologies



## Contact details

[www.cereb.org.uk](http://www.cereb.org.uk)