

EAUC Energy Seminar -  
Navigating barriers to  
energy cost control and  
storage

January 28th 2016

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UNIVERSITY OF  
LIVERPOOL

# Introduction

- The Campus – brief description of University Campus
- Background to the energy problem.
- Electrical and District heating infrastructure
- SALIX funding of projects
- SALIX funding of CHP2 Project and refurbishment of Victorian Boilerhouse.

# Facts and Figures

- Main City Centre campus - 90 Acre site
- Member of The Russell Group of Universities
- 30,000 Students
- 5,000 Staff
- Mix of building stock old and new
- Abercromby Square built in 1835
- Victorian Waterhouse design buildings
- 1960's saw prolific development of campus
- New buildings currently under construction or planned in the next 5 years

# Victoria Building

The original “redbrick” university building



# Chatham Building



# Harold Cohen Library





# Sydney Jones Library



# Foundation Building





# Sports Centre



# Bio Sciences



# School of Management Building





# Small Animal Practice



# Newest Campus Buildings

- Vine Court Halls of Residence - an 850 bed student hall opened in 2012
- Crown Place Halls of Residence a 1239 bed student hall opened in Sept 2014
- Savings to offset this additional energy use will have to be made if the University is to keep in line with it's Carbon Reduction Commitments
- Other new buildings are:
  - Ronald Ross Building –adjacent to Bio- Sciences building and is a new medical research facility.
- Central Teaching Laboratories (CTL) linked on to the Lecture Block on the green by Chemistry Department
- All 4 will be relatively large users of energy



# Ronald Ross - Medical Science Facility



# Central Teaching Labs - (CTL)



# Vine Court – ECO Halls of Residences Opened in September 2012





# Crown Place Halls of Residence Opened in September 2014



# Energy Consumption Facts

**The University is a very LARGE USER of ALL utilities:**

## **Electricity Gas and Water**

In a typical year we consume:

64 Million kilowatt hours of electricity costing £5.4 Million Pounds

(55 Million kWh on the main campus alone!)

180 Million kilowatt hours of Gas costing £2.8 Million Pounds

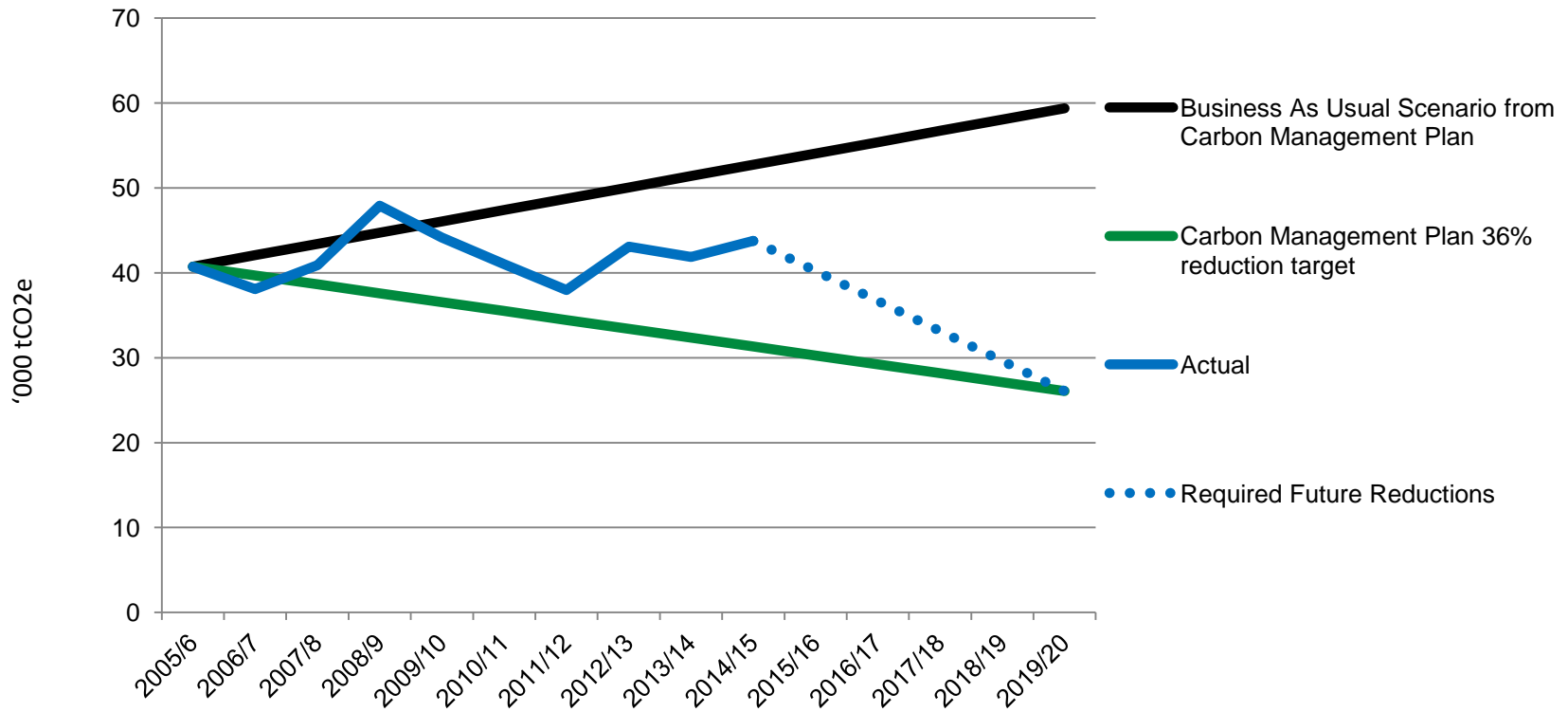
250 Million litres of water costing £1 Million

Giving a total annual energy bill of around £9.5 MILLION

Our base load electricity consumption is around 5MW - that means that our electricity load on site NEVER DROPS below 5.5 MW – not in the evening/middle of the night/even Christmas and New Year nights! it NEVER DROPS below 5.5MW



# Projected Carbon Emissions Graph



# Distributing the energy around the campus

High Voltage electricity distribution network –

- 4 off 11kV distribution rings serving 34 substations around the campus
- HV/LV interconnector circuits

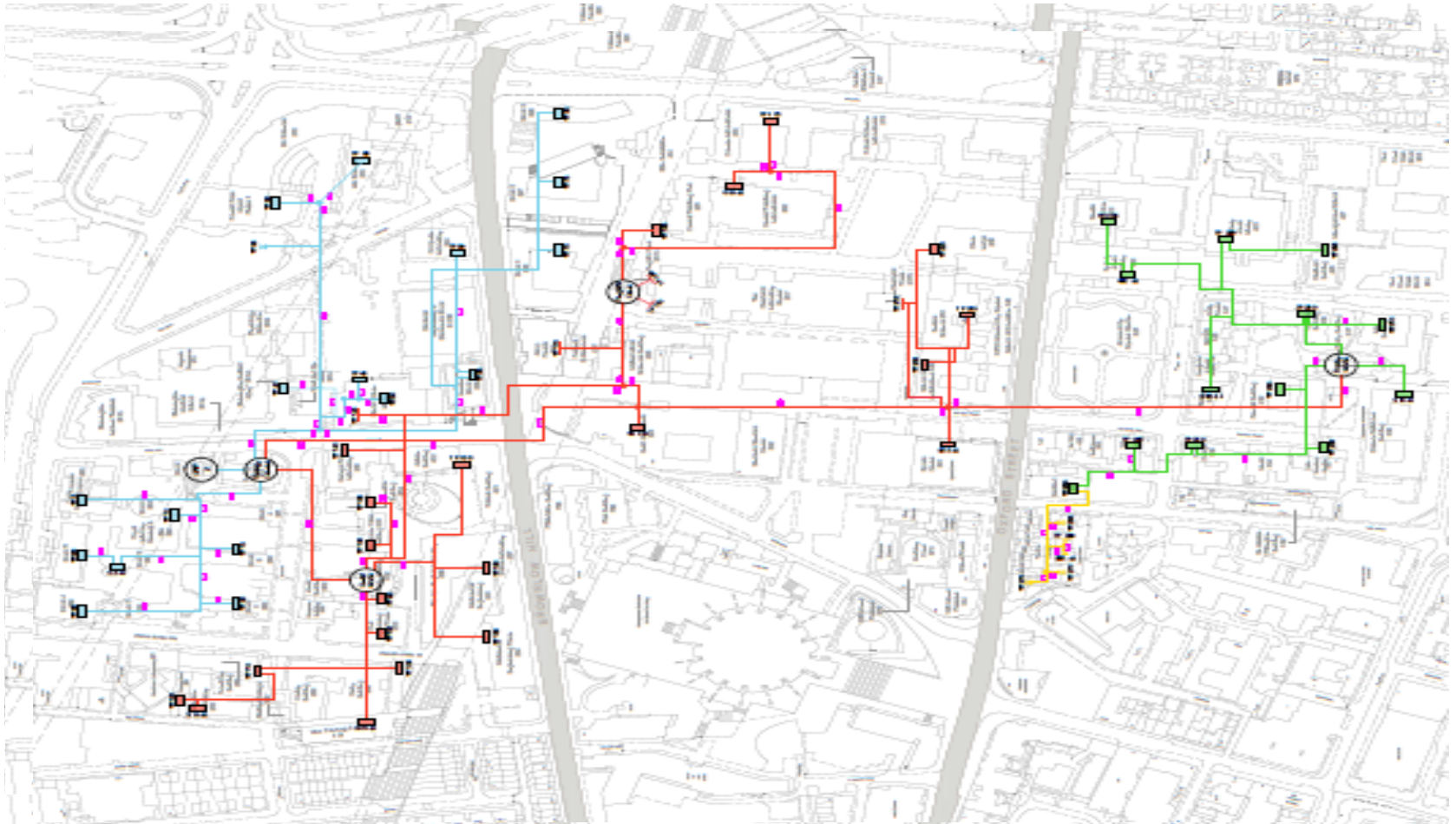
High Temperature Hot Water (HTHW) District Heating system-

- consisting of buried insulated pressurised mains distributing HTHW to plate heat exchangers in plant rooms 5k of buried mains
- Leak detection system and cathodic protection built into pipework

# District Heating Network

- Heat from the energy centre is distributed to building plant rooms via large buried High Temperature Hot Water (HTHW) and Low Temperature Hot Water (LTHW) mains distribution pipework around campus.
- Various zones serve different parts of the campus.
- Each building served from the district heating mains has a plant room with a plate heat exchanger for distribution within that particular building.
- The buried mains are pre-insulated mains and have leak detection monitoring built in

# District Heating Network



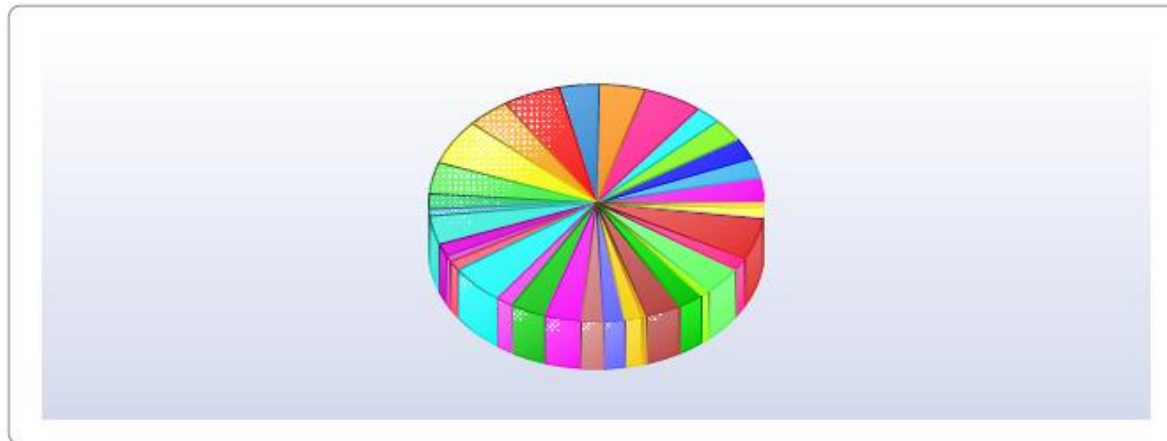
# UNIVERSITY OF LIVERPOOL

subdaykW

eSight®

From 24/04/2012 00:00

To 24/04/2012 23:59

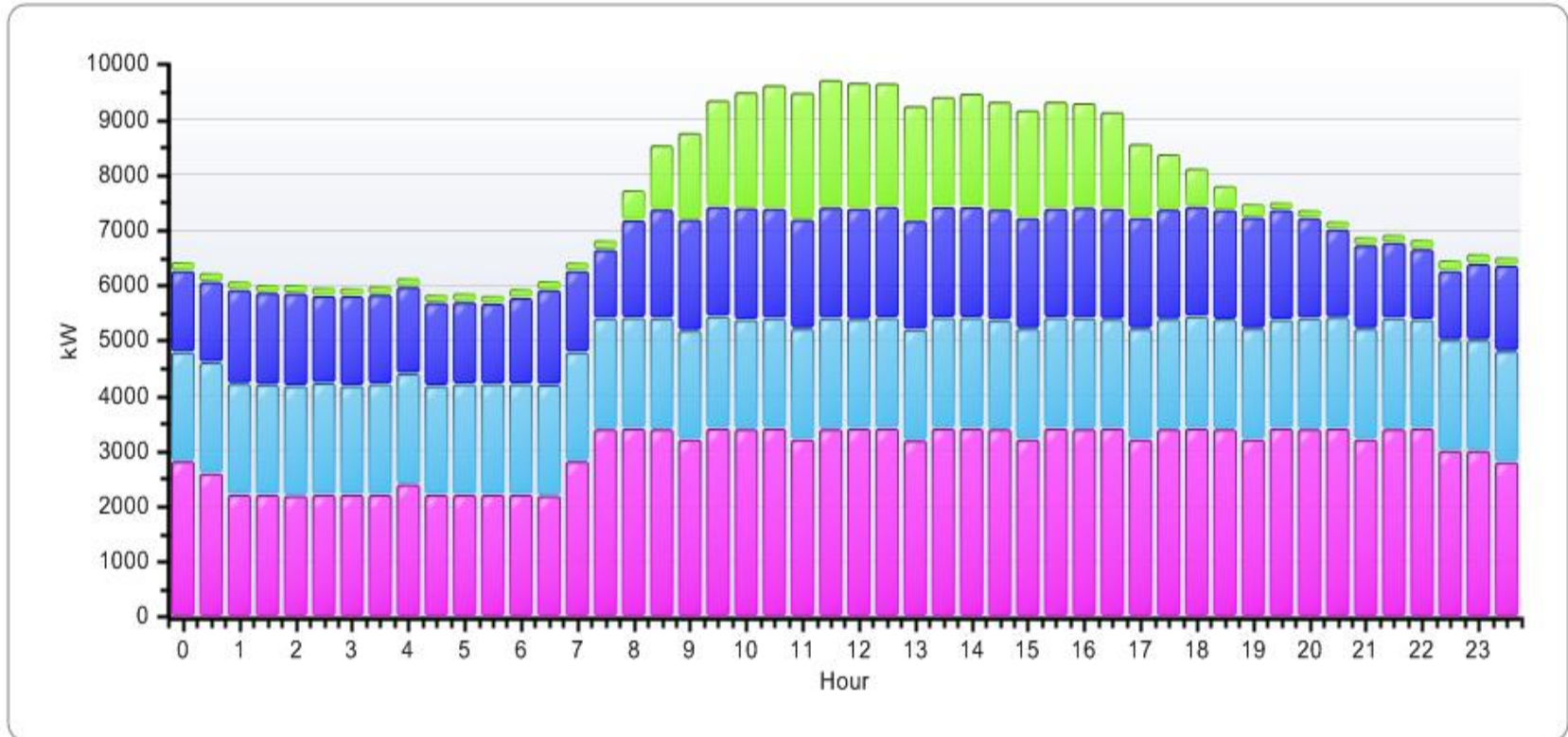


- |  |  |  |
|--|--|--|
| Energy Centre Main Meter (kWh)         | Substations APEX Main (kWh)            | Substations Architecture Sub (kWh)     |
| Substations Art Sub (kWh)              | Substations B Block (kWh)              | Substations Bio Science Sub 1 (kWh)    |
| Substations Bio Science Sub 2 (kWh)    | Substations Chadwick Sub (kWh)         | Substations Chemistry Sub 1 (kWh)      |
| Substations Chemistry Sub 2 (kWh)      | Substations Chemistry Sub 3 (kWh)      | Substations Computer Sub (kWh)         |
| Substations Derby Sub 1 (kWh)          | Substations Derby Sub 2 (kWh)          | Substations Eleanor Rathbone Sub (kWh) |
| Substations Electrical Eng Sub 1 (kWh) | Substations Electrical Eng Sub 2 (kWh) | Substations F Block (kWh)              |
| Substations George Holt (kWh)          | Substations Herdman Sub (kWh)          | Substations Melville Sub 1 (kWh)       |
| Substations Melville Sub 2 (kWh)       | Substations Mulberry Sub (kWh)         | Substations Nuffield Sub (kWh)         |
| Substations Oliver Lodge Sub 1 (kWh)   | Substations Oliver Lodge Sub 2 (kWh)   | Substations Pilkington (kWh)           |
| Substations Sherrington Sub (kWh)      | Substations Students Union Sub (kWh)   | Substations Syd Jones Aber Wing (kWh)  |
| Substations Syd Jones Grove wing (kWh) | Substations Tower Mech Eng (kWh)       | Substations Walker Eng (kWh)           |
| Waterhouse Block D.D Block (kWh)       | Waterhouse Block H Block H (kWh)       | Waterhouse Block J.J Block (kWh)       |





# Main Campus electricity profile Jan 2015



■ Elec Generated.Generation CHP 1 (kW)  
■ Elec Generated.Generation CHP 3 (kW)

■ Elec Generated.Generation CHP 2 (kW)  
■ Fiscal Electricity Imports HH Non Res.MainCampus (kW)

# Local Collaboration on Energy Issues

- The University is part of several local energy collaboration initiatives such as:
- The “Knowledge Quarter” encompassing Liverpool University and Liverpool John Moores University and the Royal Liverpool University Teaching Hospital along with Liverpool Enterprise Partnership (LEP) with a view to sharing energy networks and experiences and expertise
- Smart City/Campus exploring initiatives with Liverpool City Council and our own academics looking at several areas such as combining energy awareness with mobile technology and social networks
- Part of local Universities “support group” meeting with peers from other North WEST Universities to share practices information experiences etc...

# How SALIX Funding has helped The University of Liverpool

2008 - £800k SALIX Revolving Green Fund – Institutional Small Projects

Voltage Optimisers

LED Lighting

Draught sealing

Pipe lagging

Variable speed drives

Lighting in Growth Rooms

2010 – £2.9m SEELS

Voltage Optimisers

Lighting & Heating Controls

2013 - £6.2m SEELS

Combined Heat & Power Plant

# How SALIX funding has helped The University of Liverpool

2013 - £6.2m SEELS

Combined Heat & Power Plant (CHP2) a major contribution to the refurbishment of the former coal fired Victorian boilerhouse which now houses the 2 new 2MWe Edina CHP engines generating approx: 24M/kWh/year with a simple payback of around 5 years.

2014- RGF4 Funding application - £432k under small scale energy efficiency projects application we have successfully applied for funding to install LED external lighting across the campus. This project is underway and will be completed by March 2016.

RGF4 – under the exemplar application scheme we have applied for funding for overcladding of a tower block

# New Sports Hall LED Lighting funded by RGF3 SALIX Funding

- Scheme to replace old inefficient poor lighting in Sports Hall with new LED lighting giving lighting standards up to Sport England minimum requirements
- Scheme was a great success showing instant improvements to the delight of sports centre management staff and sports centre users.
- Lighting levels were raised from a poor average of around 150 lux to a minimum of 500 lux with no glare problems.
- The scheme cost around £26k with a payback of 3.5 years
- Further LED lighting improvements totalling some £75k are planned for the rest of the sports centre facilities including the spinning room, fitness studios, squash courts and the main sports hall itself.



# New LED Sports Hall lighting



# Energy Centre



# Energy Centre

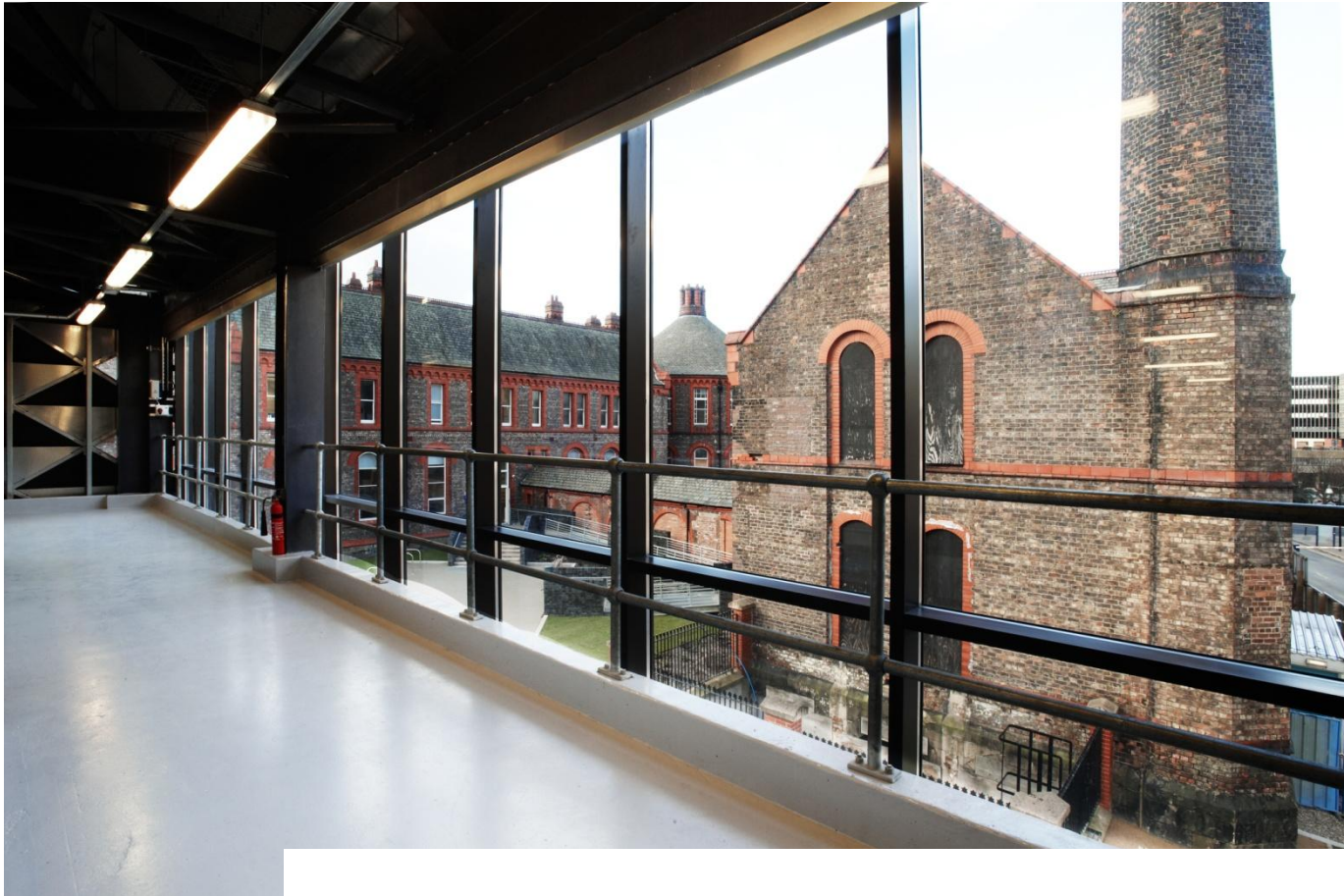




# CHP Jenbacher CHP Engine



# UNIVERSITY OF LIVERPOOL



# Benefits of building NEC

The University will own and operate a state of the art environmentally friendly energy centre capable of supplying the energy requirements of the University for the next 25 years

The NEC will go a long way to helping the University meet its challenging carbon reduction commitments

The NEC will help the University keep energy costs under control in an ever changing utilities market

Students will have direct access to live energy centre data for a variety of academic projects in collaboration with Mechanical Engineering Department

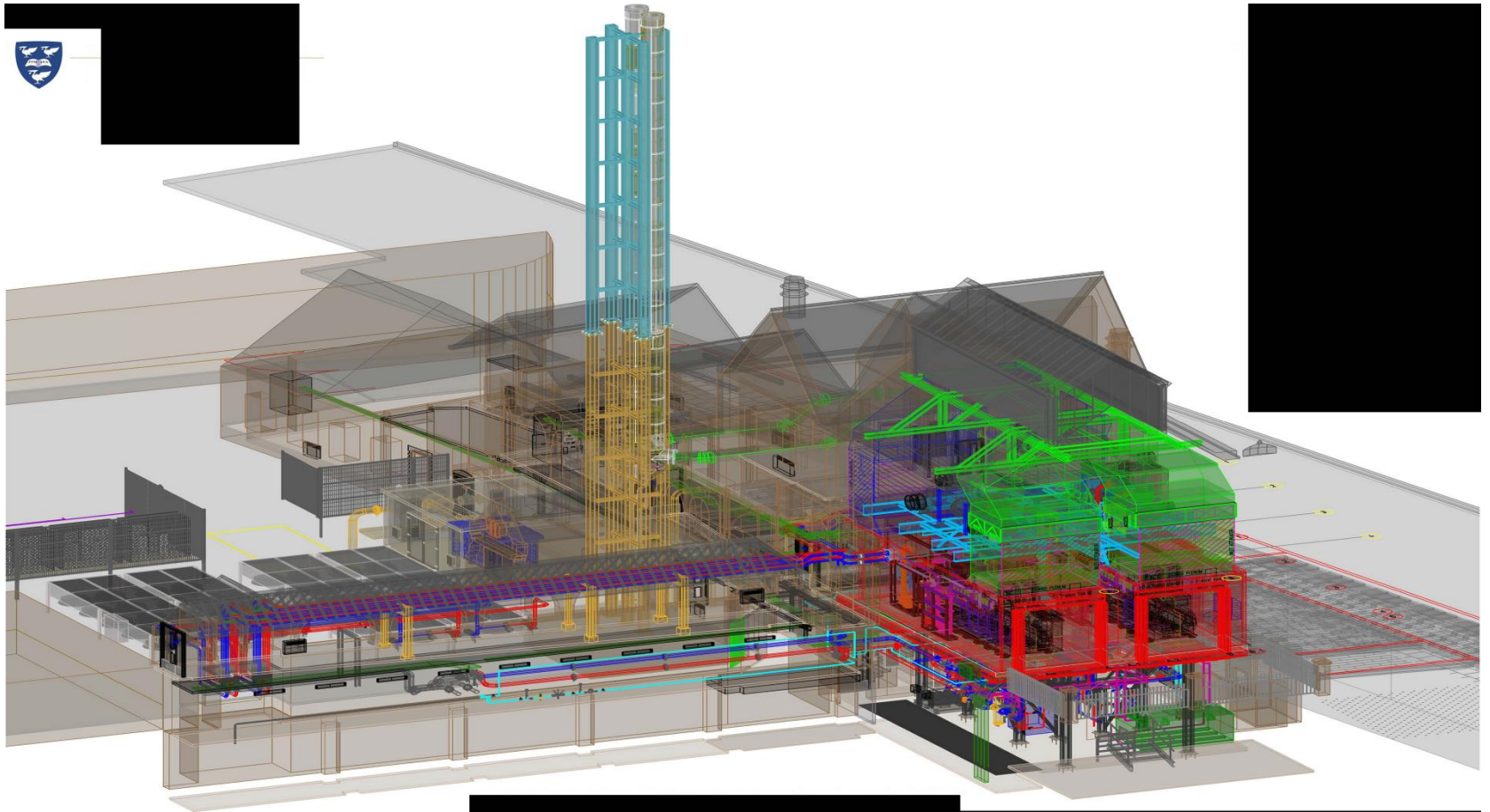
# CHP 2 – Renovated Victorian Boilerhouse funded with SALIX loan

- SALIX loan of £6.2Million (of an £8.5Million scheme)
- CHP installation adjacent to new energy centre (in old Royal Infirmary Victorian former coal fired boilerhouse)
- 2 x 2.0 MWe CHP EDINA engines to run 5000 hours per year and generate an additional 20 + Million kWh of electricity and another 4MW of heating capability.
- Electrical export facility built in
- Helping to further reduce carbon emissions in line with Carbon Management Plan

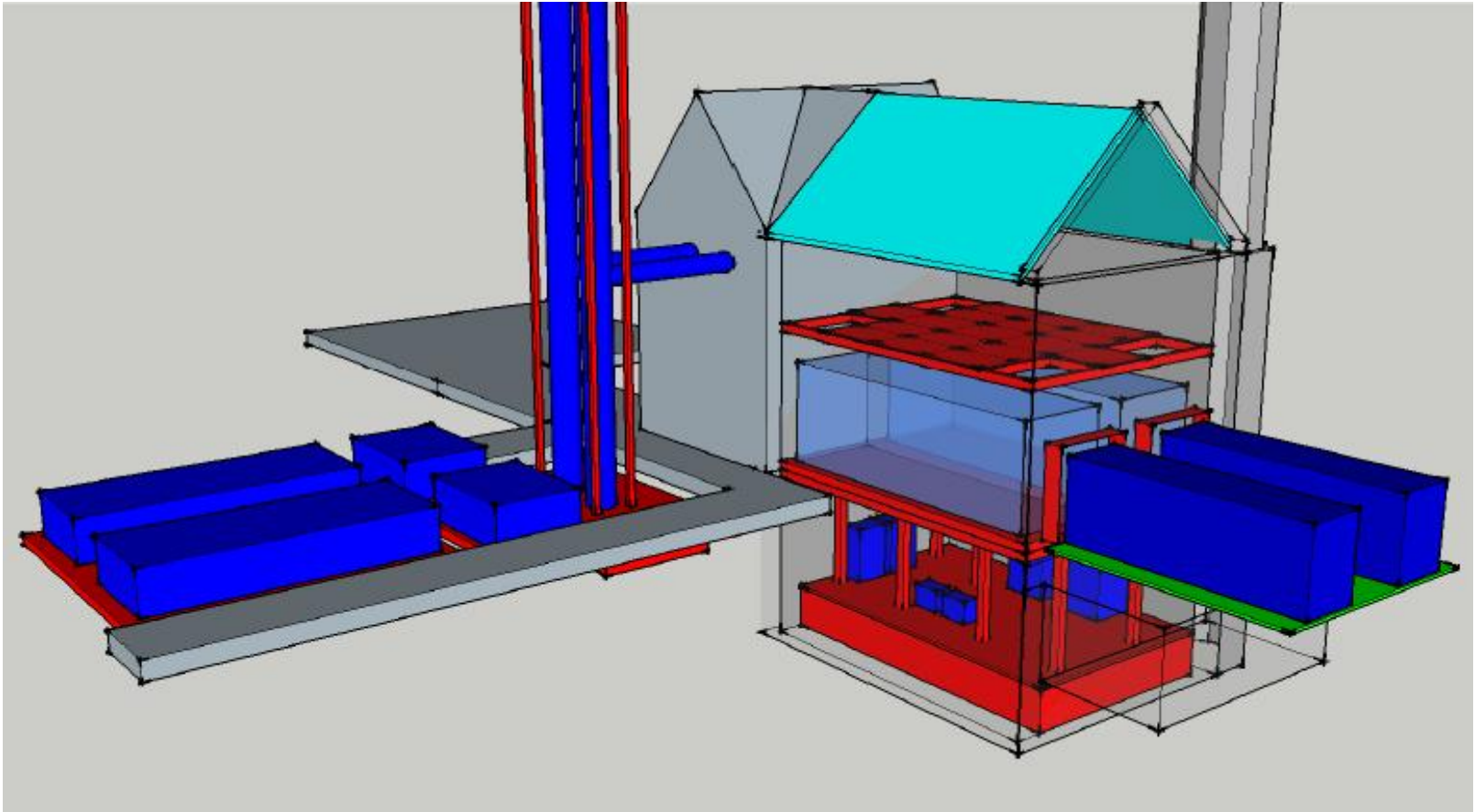


# CHP 2 – Project Issues - Condition





# CHP 2 – Project Issues – access for main plant





# Chimney re-enforcing



# New Roof Ventilation Chamber





# CHP Engine Cells - access





# CHP Engines being delivered into cell





# CHP 2 – Project Issues – access for main plant

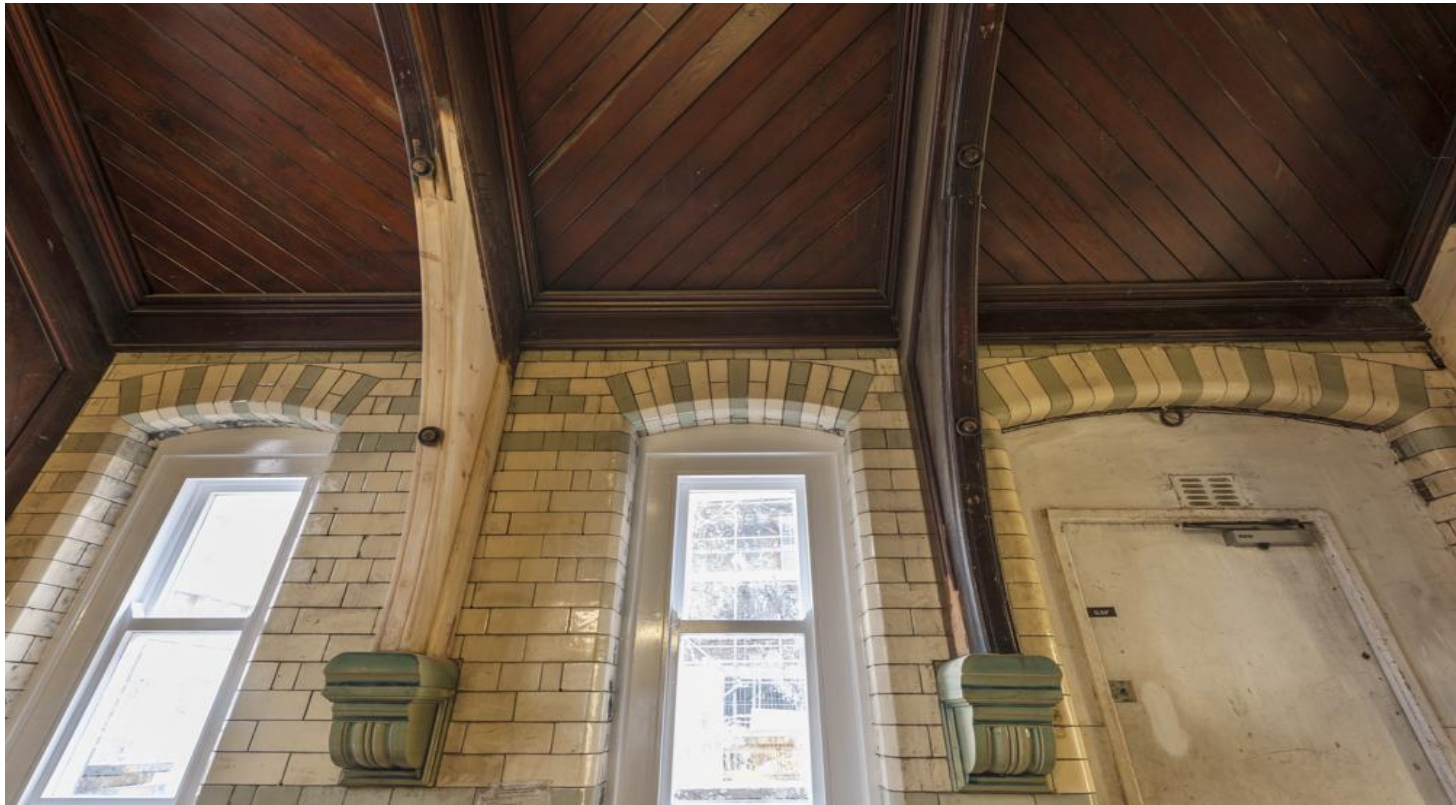


# Finished cells





# Restorative joinery work in former chapel



# Restorative joinery work in former chapel





# Example of building interior before re-furb





# M&E work underway



# Link Corridor pipework

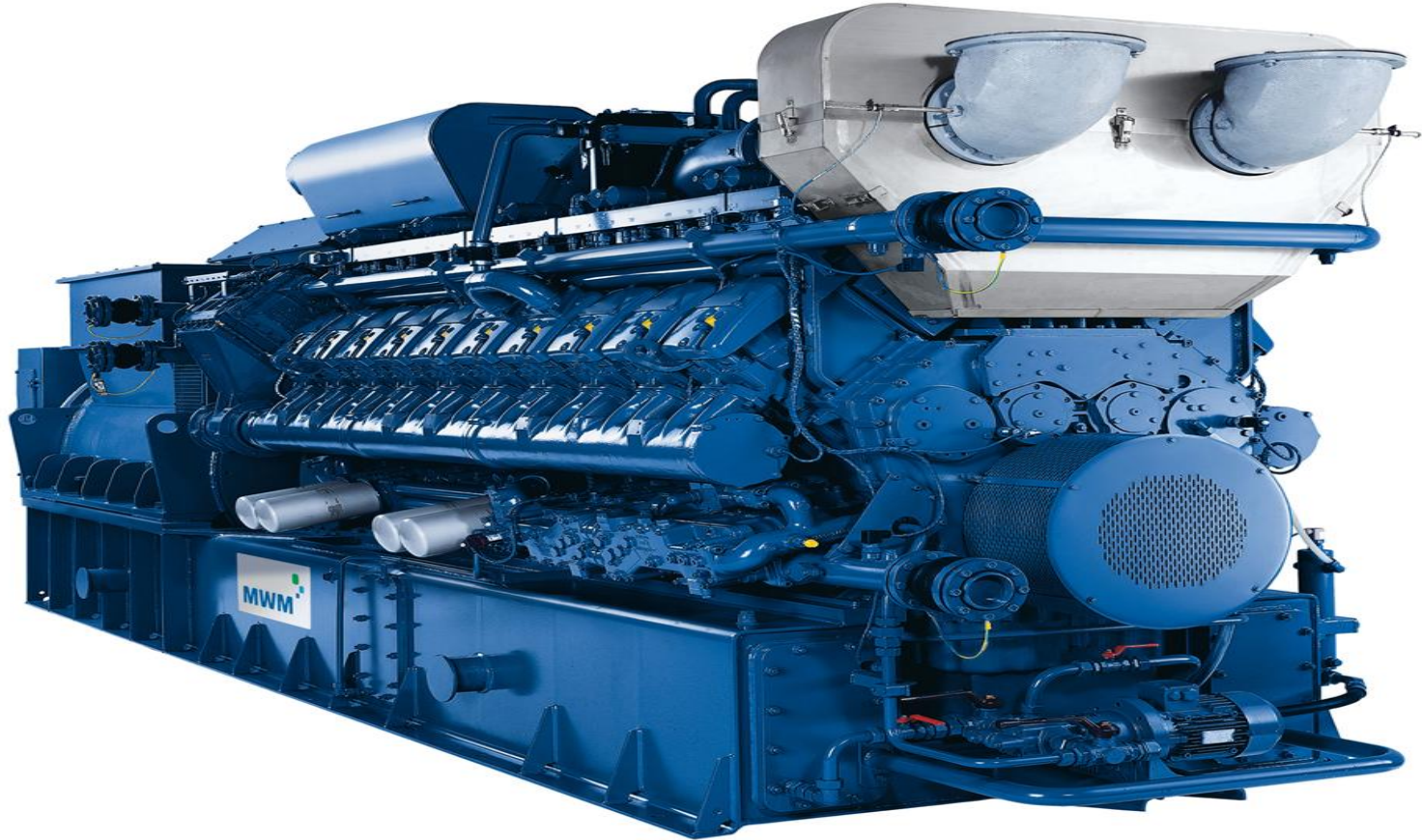


# HV Switchroom





# EDINA CHP ENGINE 2MWe



# Inside Edina Engine Cell





# Main Plantroom and distribution pipework



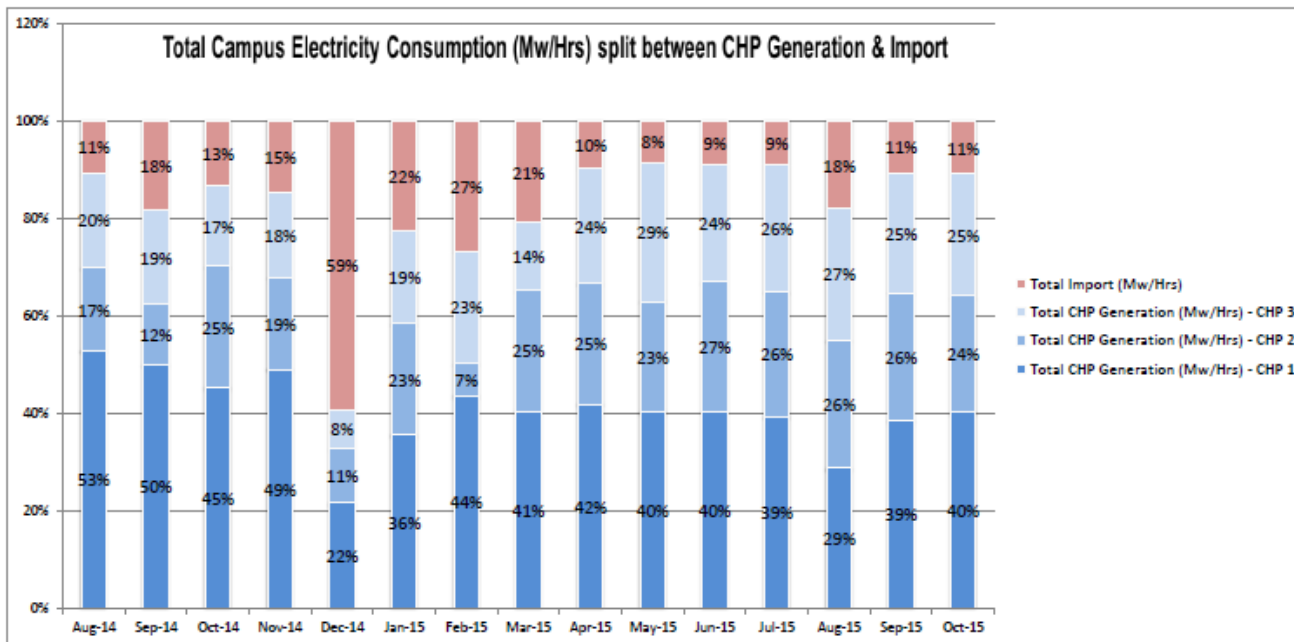
# Finished exterior



# Operational slide – how has the new CHP2 performed in the first year?

- Both engines have run in excess of 6000 hours each which exceeded our expectations/business case assumptions of 5000 hours
- Total generated electricity in first year of operation from CHP2 is 22.4MkWh
- Site has acted as an exemplar for Heritage restoration and hosted many visits of staff students and outside bodies and institutions

# Generation and Import % split

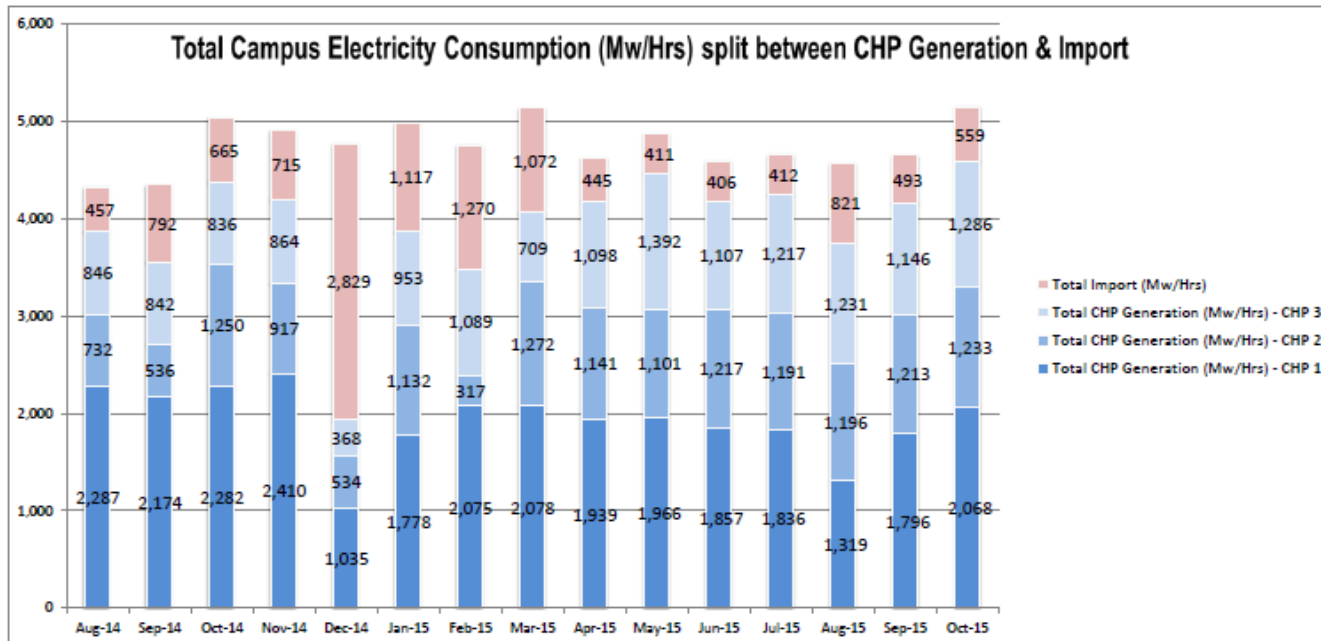




# Generation and Import in MWhrs

ULEC

15 months to 31 October 2015



THANKS FOR LISTENING  
ANY QUESTIONS?