University of
Strathclyde
Glasgow

Developing District Heating Systems

Robert Kilpatrick

Assistant Director Development & Operations, University of Strathclyde

Why District Heating?

- One of the key strategies that can deliver a step change in carbon reduction
- Aligns with the Scottish Governments strategy towards decarbonising the heat network
- Puts heating pipework infrastructure into the ground that can last for 50+ years having flexibility to produce the heat through a range of current and potentially still to be developed heat generation technologies
- Provides an opportunity to tackle fuel poverty through connecting social housing
- The opportunity to link to other district heating to improve resilience and take advantage of differing heat load profiles

The Scottish Governments Climate Change Delivery Plan

- The Climate Change (Scotland) Act 2009 sets targets to reduce Scotland's emissions of the basket of six Kyoto Protocol greenhouse gases by 42% by 2020 and 80% by 2050, compared to the 1990/1995 baseline

- The Scottish Government's Climate Change Plan, Third Report on Proposals and Policies 2018-2032 (RPP3) published February 2018 sets out how Scotland can deliver its target of 66% emissions reductions, relative to the baseline, for the period 2018–2032.

- The focus is on energy efficiency, in early years, with a greater uptake of low carbon heating sources (heat pumps and district heating) and energy efficiency measures from 2025.

The HE Sector Perspective

To acknowledge and highlight each University's commitment to sustainable development, both University of Glasgow and University of Strathclyde joined other leading universities around the world in becoming signatories to the Talloires Declaration and the Copernicus Charter.

ULSF is the Secretariat for signatories of the Talloires (pronounced Tal-Whar) Declaration.

What is the Talloires Declaration?

Composed in 1990 at an international conference in Talloires, France, this is the first official statement made by university administrators of a commitment to environmental sustainability in higher education. The Talloires Declaration (TD) is a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations and outreach at colleges and universities. It has been signed by over 350 university presidents and chancellors in over 40 countries.

Copernicus - The University Charter for Sustainable Development

Geneva, May 1994

Principles of action

- Institutional commitment
- Environmental ethics
- Education of university employees
- Programmes in environmental education
- Interdisciplinarity
- Dissemination of knowledge
- Networking
- Partnerships
- Continuing education programmes
- Technology transfer

The HE Sector Drivers

- Carbon Reduction normally features in the University Strategic Plan and is often one of its Key Performance Indicators
- As a organisation part funded by the Government through the Scottish Funding Council, there is a requirement to demonstrate commitment to carbon reduction
- Saves money by offsetting the cost of carbon - Carbon Reduction Commitment and/or EU-ETS schemes

Key Performance Indicators	Current Performance	Targets
How will we measure progress?	What is our baseline?	What are our ambitions?
14. Athena SWAN Silver award	Bronze Institutional Award renewed 2014	Submit for Silver Institutional Award by 31 July 2020
15. Operating surplus as a % of turnover	2.5%	Achieve a surplus annually of between 2 - 4%
16. Carbon emissions	30,000 tCO2e	Reduce by 25% by 2020

University of Strathclyde Glasgow

Case Study 1
University of Glasgow

Drivers for Change

- Existing steam district heating had come to the end of it useful life
  - Steam main over 55 years old and starting to fail
  - Original boilers
    - **2 x 6.5 MW approaching 30 years**
    - **1 x 4.4 MW over 40 years old**
    - **1 x 1.9 MW over 40 years old**
- Served or partially served 10 buildings but had over the years had been used less as steam d/h had fallen out of favour versus relatively inexpensive localised LTHW gas boilers

STEAM vs LTHW

- More expensive to install, operate and maintain
- Less efficient
- Less flexible
- More complex to operate and difficult to control
- More dangerous and poses a higher risk
- Inherently noisier in operation

University of Glasgow

Other Opportunities

- Replace life expired high voltage cabling
- Install new IT duct network system whilst installing DH mains and HV cabling
- Reconcile plant room space and make plant more accessible
- Create a demonstration/teaching/research/visitor space within the energy centre
- Design to allow future connection to other heat networks and possibly supply heat to third parties
- Social/Economic Benefits: Opportunities for full time, part time roles with the contractor and secondment of staff through delivery of community benefits requirements

University of Glasgow

University of Glasgow

University of Glasgow

Network and Energy Centre Details

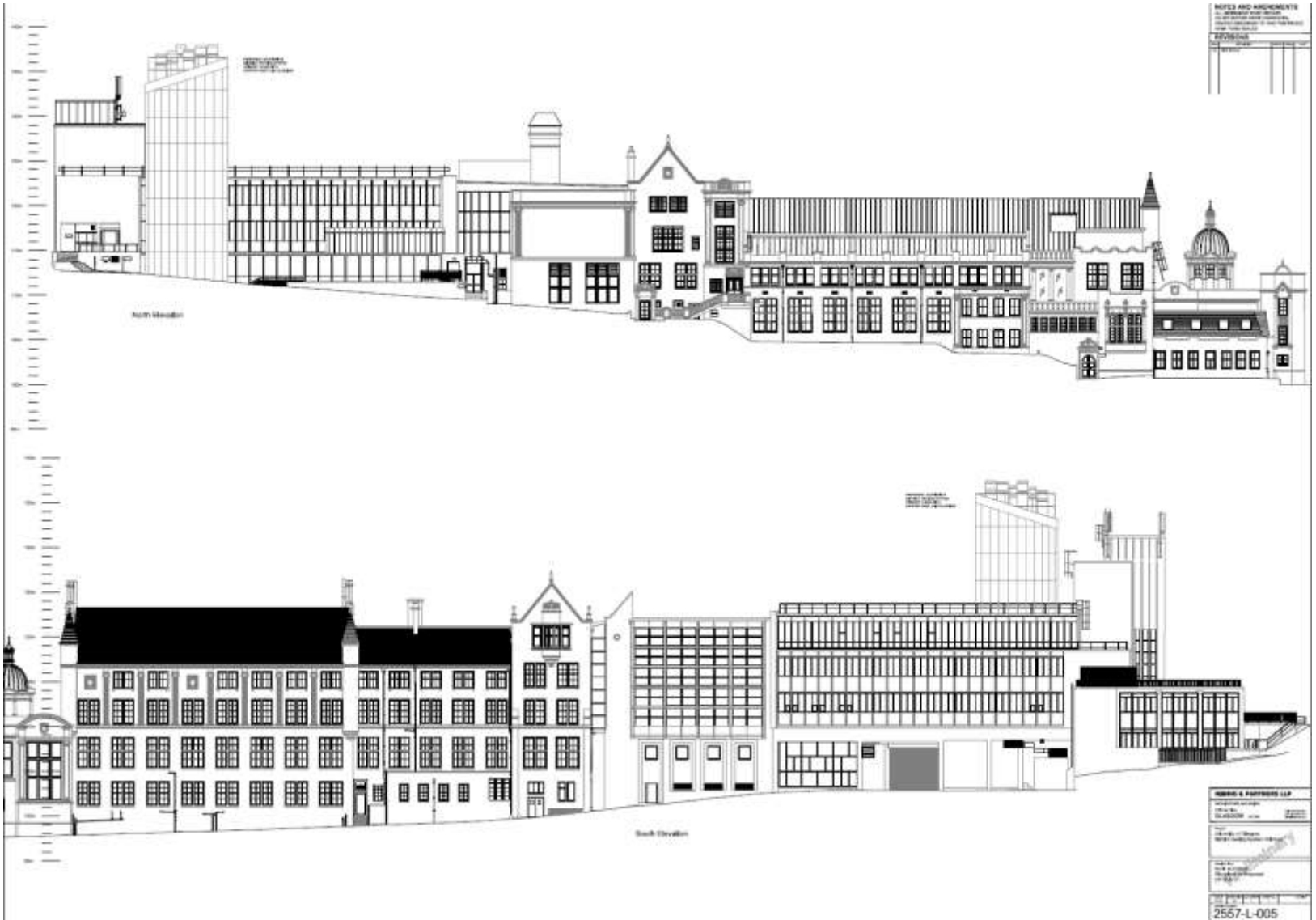
- Connected to 34 of the largest buildings within the Gilmorehill Campus on both sides of University Avenue
- Construction of a new energy centre located within the original main boilerhouse
- 45 MW of gas boiler plant and a 3.4 MW(e) CHP engine
- Future-proofed providing heat for additional 60,000m² GIA of new build.
- Provision of oversized mains to allow future connection to a possible city wide D/H scheme

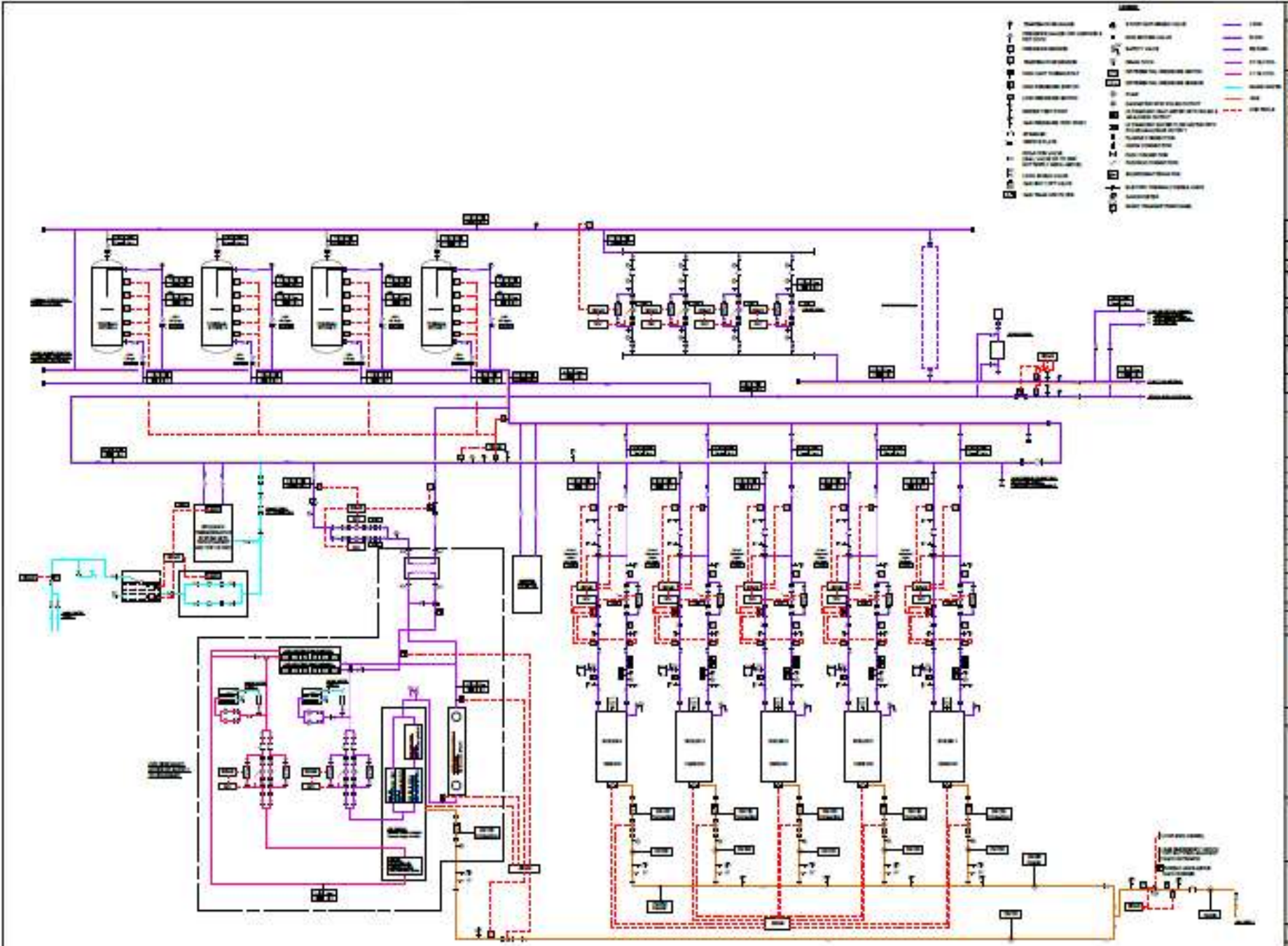
University of Glasgow

Engineering Challenges

- The installation of a new circa 30m high chimney adjacent to the Davidson (Biochemistry) Building
- Installation of a new medium pressure gas main from Partick Cross
- Upgrade of the dual owned Scottish Power and UoG Bower Building electrical substation.
- Requirement for temporary mobile steam boilers to allow original boilers to be removed to make way for new plant
- Replacing secondary vacuum steam heating systems in a live environment

University of Glasgow





Grontmij

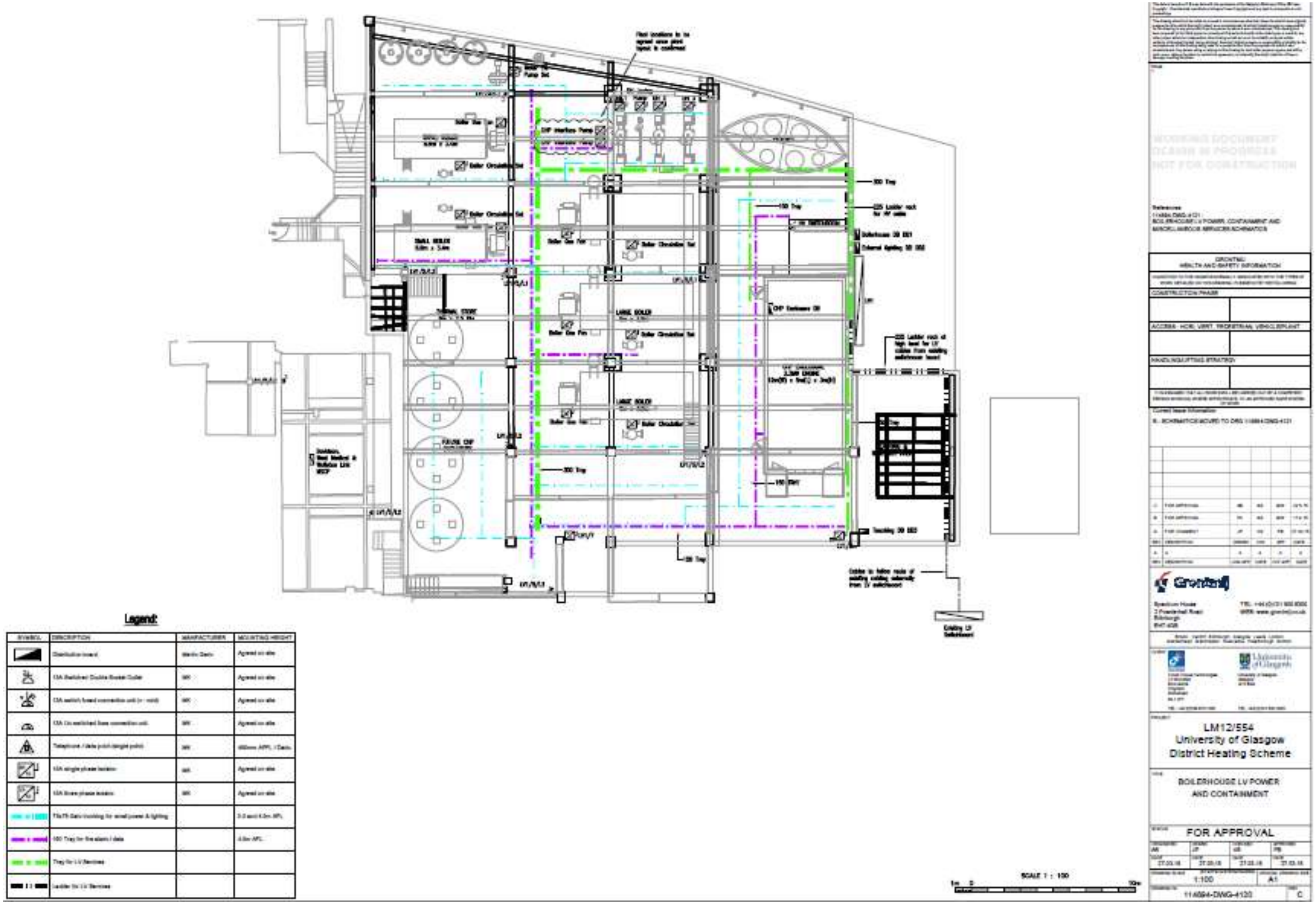
University of Glasgow
CHP / District Energy

MAIN ENERGY CENTRE
PROPOSED HEATING
SCHEMATIC

FOR APPROVAL

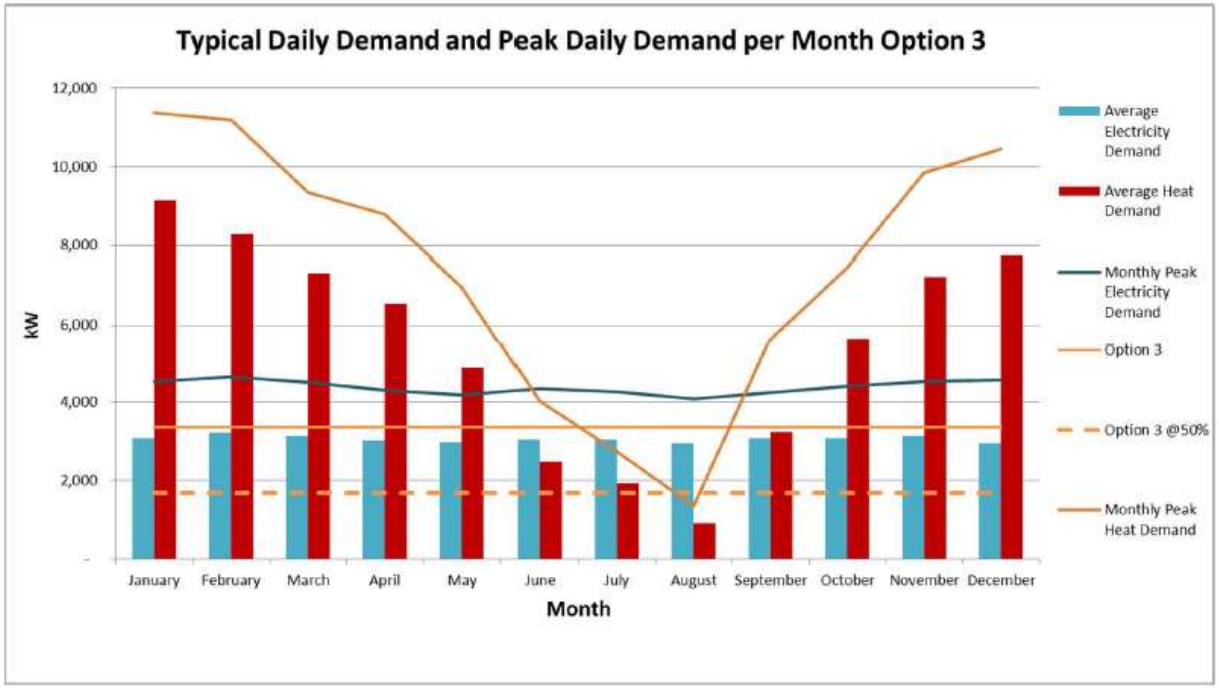
NTS

A1


Legend:
SCALE 1 : 100
LM12/554
University of Glasgow
District Heating Scheme
BOILERHOUSE LV POWER
AND CONTAINMENT
FOR APPROVAL
1:100
A1
114094-DWG-4120
C

University of Glasgow

Option	Total Annual Carbon Savings *(Tonnes CO2e)*
Option 1 – 1.5 MWe CHP Engine	2,500
Option 2 – 2.7 MWe CHP Engine	4,500
Option 3 – 3.4 MWe CHP Engine	5,000



University of Glasgow







University of Glasgow DEN/CHP Project

OJEU tender restricted procedure	
PQQ issued	24th December 2013
PQQ Return	3rd February 2014
ITT issued	4th April 2014
ITT Return	7th July 2014
Award of contract	28th October 2014
Contract Duration	65 Weeks

CASE STUDY 2
UNIVERSITY OF STRATHCLYDE

University of Strathclyde DEN/CHP Project

- Awarded £8M grant (conditional on matched funding)in March 2013 (one of three successful HEI's)
- Prepare business case to obtain funding approval for matched funding £8.2M
- Funding Approval October 2013
- Tender for a design team (traditional model) OJEU Restricted Procedure
- Appointment of Nifes consultancy (February 2014)
  - Review of feasibility study and thermal modelling etc.
  - Options appraisal re Energy Centre Location
  - Survey of plant rooms
  - Develop 'concept' design
- January 2015 Updated business case based on revised design presented for approval (2 x 2 MW, 15 buildings)
- Approval given to procure CHP engines in advance of the main works
- Peer review of concept design May 2015 till September 2015
- Develop tender for supply of CHP engines
- Tender issued July 2015 Return August 2015
- Tender evaluated September 2015 (but not awarded till December)

University of Strathclyde DEN/CHP Project

- Decision taken to resort to a D&B contract.
- ER's and tender documentation, including contract, prepared

OJEU tender restricted procedure	
PQQ (now ESPD) issued	11th November 2015
PQQ Return	11th December 2015
ITT issued	11th March 2016
ITT Return	6th June 2016
Award of contract	11th November 2016

CHP District Energy Scheme – Description

- Gas fired CHP and district energy scheme serving the John Anderson Campus generating and distributing hot water and electricity to 16 buildings in Phase 1
- 1 x 3.3MWe CHP and 24MW boiler plant plus ancillary equipment in a refurbished Energy Centre in the existing John Street Boilerhouse
- Over 4km of district heating pipe, electric cable and ducting to be installed
- 100m3 Thermal Store
- £20M project supported by £8M capital grant from Scottish Funding Council
- £2.6M annual savings
- Catalyst for wider city network

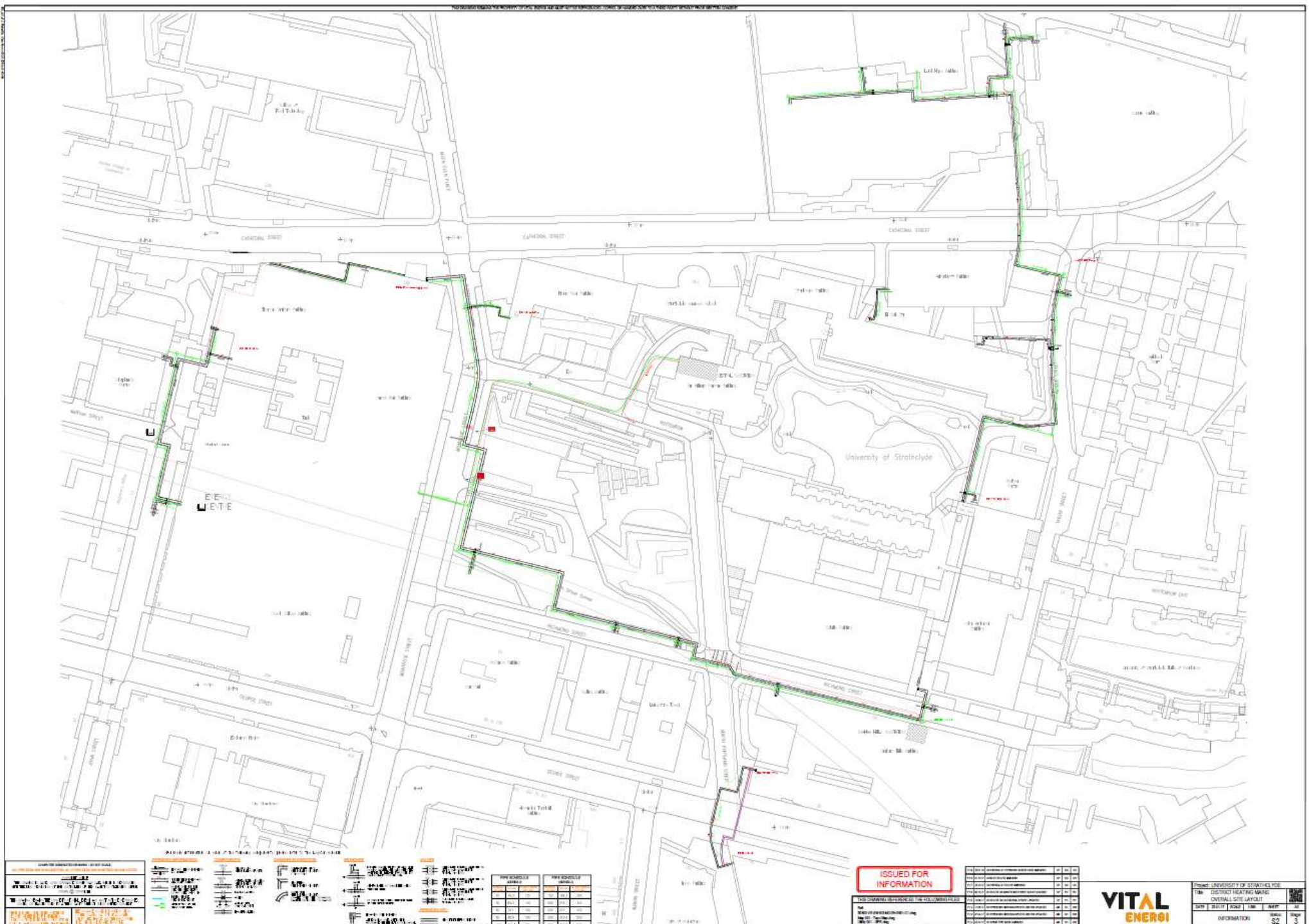
4,300 tonnes reduction of current emissions

Engineering Challenges

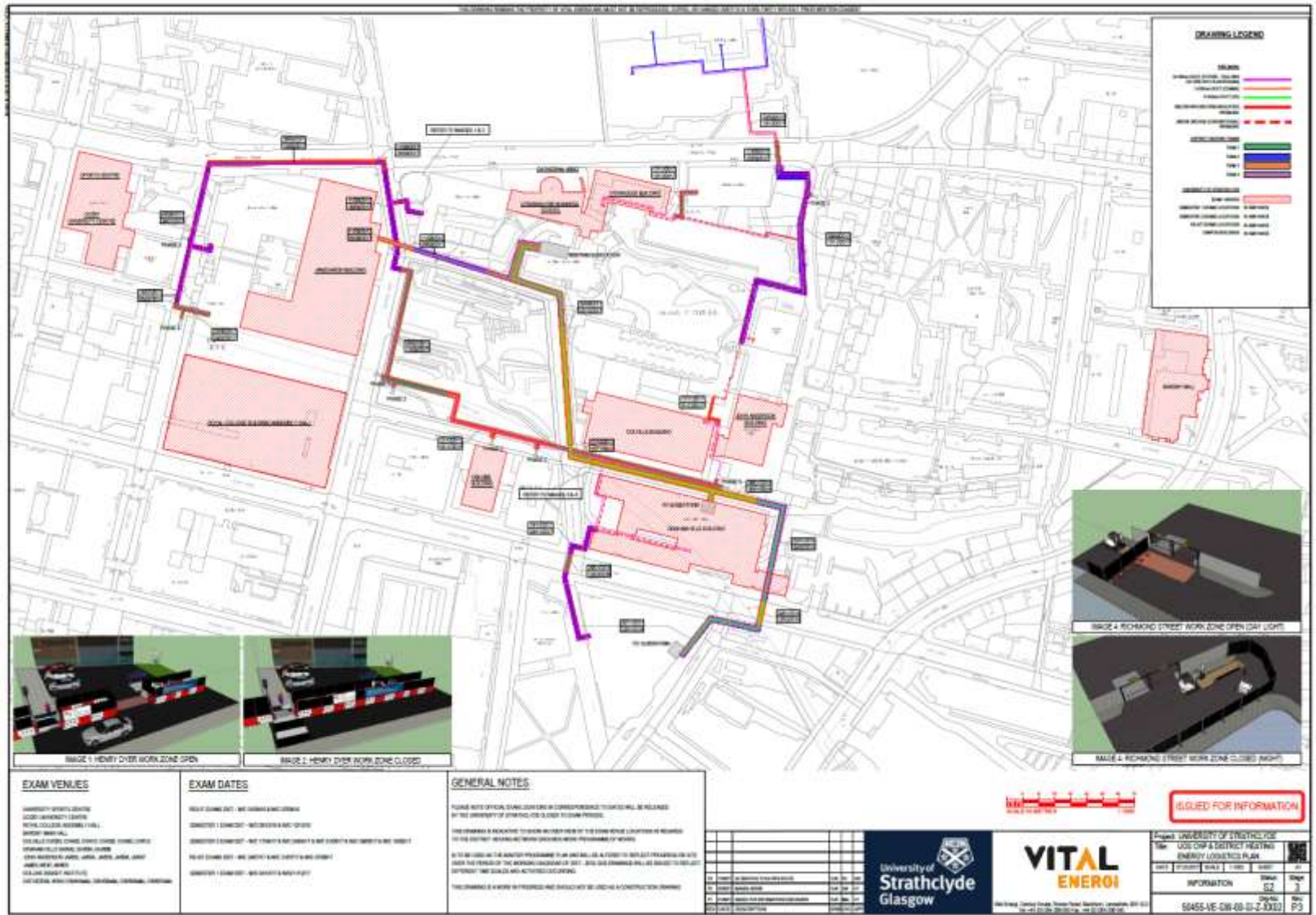
- Decision to retain existing steam boiler plant whilst stripping out the remainder of the boilerhouse to avoid the need for temporary boilers
- Topology of the site at Strathclyde
- Working in a very busy live campus environment with very little lay down space
- Inner city location with most of the excavations being on public roads
- Finding a route ! The density of existing services under public roads when trying to install very large diameter pipework
- Inaccuracies of as fitted drawings and GPRS surveys
- New CSHW relying on a heat connection from DEN but the timing not in alignment

University of Strathclyde Existing Energy Centre

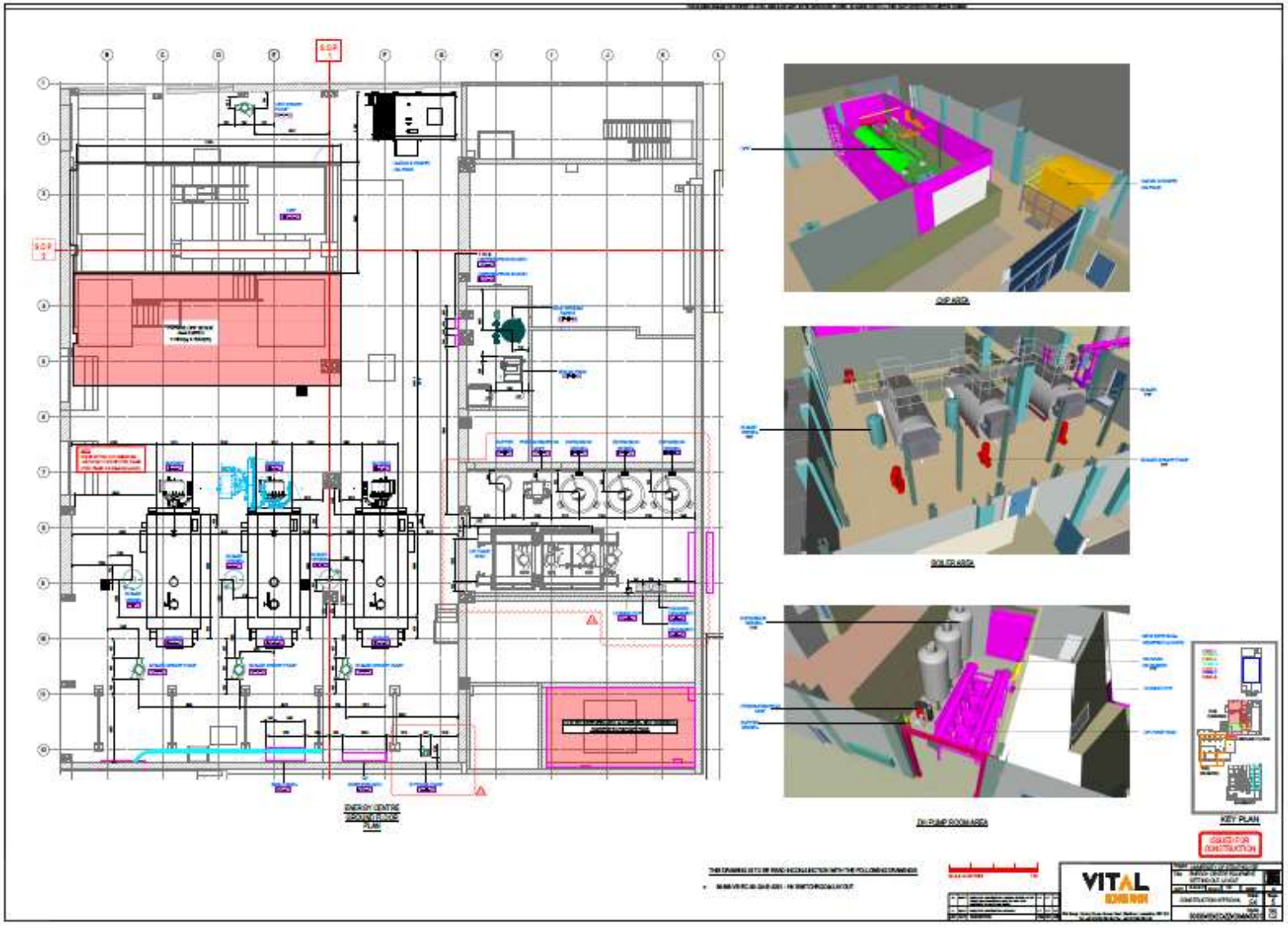
- Existing steam boilers The 2No LP Steam Boilers located in John St Boilerhouse provide steam for heating and hot water to the Island Site, i.e. Royal College Building, James Weir Building, and a portion of the Thomas Graham Building now over 45 years old and at the end of their useful life


ISSUED FOR INFORMATION
VITAL ENERGI

DH Route Logistics



Energy Centre












The current overall achieved progress is 79.8% against the planned target of 81.6%

Vital Energi programmes titles & revision:	Contract Programme 14th Dec 2017 (Rev C)
Contract award date:	11th November 2016
Contract completion date:	26th October 2018
Forecast completion date:	26th October 2018
Reporting date:	8th March 2018
Contract week number:	Week 68
Overall ahead (+) / behind (-) prog	Contract Programme: -6.5 days

Developing Stakeholder Relationships

- Early engagement with University’s Corporate Commination's
- Take the opportunity to tell people what you are doing and why
  - Meet with various building occupants
  - Present at Faculty Meetings
  - Regular Communications Meetings
- Consider impact on business as usual. Lots to consider!
  - Deliveries to site such as bottled gases
  - Collections such as refuge and chemical and hazardous waste
  - Parking loss of spaces, disruption

Community Engagement
"The Strathclyde Commitment"

University of Strathclyde Glasgow

No.	Commitment	Recommendations	Progress/ Target Date
1	Employ local staff	• Current local staff level at 65%. Utilisation of local Sub-Contractors and staff.	Presentation and layout to be confirmed.
2	Employ 4 direct apprentices and 10 sub-contractor apprentices	• VE have allocated 3 craft apprentices within the offsite fabrication team and 2 on-site. • Currently we have 5 subcontractor apprentices on site	May-July 17
3	Offer 4 paid work placements for a minimum of 12 weeks	• Presentation for potential work placements took place 25th Oct 17 and was well attended event. Uo5 to provide CV's Feb 2018	October 17
4	Offer 4 undergraduate/ graduate internships	• 7 undergraduate/ graduate utilised on the project Zoe, Reece, Martin, Steven, Craig, Cian & Chris	Completed
5	Engage with local primary school	• Tree Planting event arranged for 30th Nov 2017 with 46 kids from St Mungos primary school • UoS have contacted the Lord provost to attend event	30th Nov 2017
6	Hold Open Days/ participate in fundraising	• VE sponsoring Climate Change Adaptation event on 21st Sept 2017	Sept 17
7	Utilise SME for local businesses	• Project team already utilising SME for work packages	Presentation and layout to be confirmed.
8	Facilitate an analysis of local supply chain impact for the project so that a socio-economic assessment can be made	• Ongoing dialogue with VE/UoS/	Presentation and layout to be confirmed.
9	65% target for local spend on project	• Local spend currently at 68% with final forecast of 71%	Ongoing

Community Engagement
“The Strathclyde Commitment”

46 Children from St Mungo's School planting trees with Glasgow’s Lord Provost Eva Bolander

Engagement with Local Community Councils

- Townhead and Ladywell
- Merchant City and Trongate
- Dundasvale

Working With Local Authorities

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

Code of Practice
Third Edition (Scotland)
January 2015

New Roads and Street Works Act 1991

Specification for the
Reinstatement of
Openings in Roads

THE SCOTTISH
ROAD WORKS
COMMISSIONER

RAUC(S)

Glasgow
CITY COUNCIL

Roads (Scotland) Act 1984

CHAPTER 54

ARRANGEMENT OF SECTIONS

PART I

PUBLIC ROADS

General powers and duties of roads authorities

Section
1. Powers and duties of local roads authorities.
2. Powers and duties of Secretary of State as roads authority: management and maintenance.
3. Power of Secretary of State to make advances to local roads authorities etc.
4. Agreements between authorities.

Trunk roads

5. Trunk roads.
6. Local and private Act functions with respect to trunk roads.

Special roads

7. General provision as to special roads.
8. Further provision as regards classification of traffic for purposes of special roads.
9. Supplementary orders relating to special roads.
10. Certain special roads to be trunk roads.

Classification of roads

11. Classification of roads.

A

THE OFFICE OF THE
SCOTTISH ROAD WORKS COMMISSIONER

Working With Local Authorities

- Temporary Traffic Regulation Notice (TTRN) works up to 5 days duration
- Advertised Temporary Traffic Regulation Order (TTRO) works over 5 days Duration
- In advance of applying for a TTRN/TTRO early contact with the Councils Roads department is highly recommended!

Working with Local Authorities

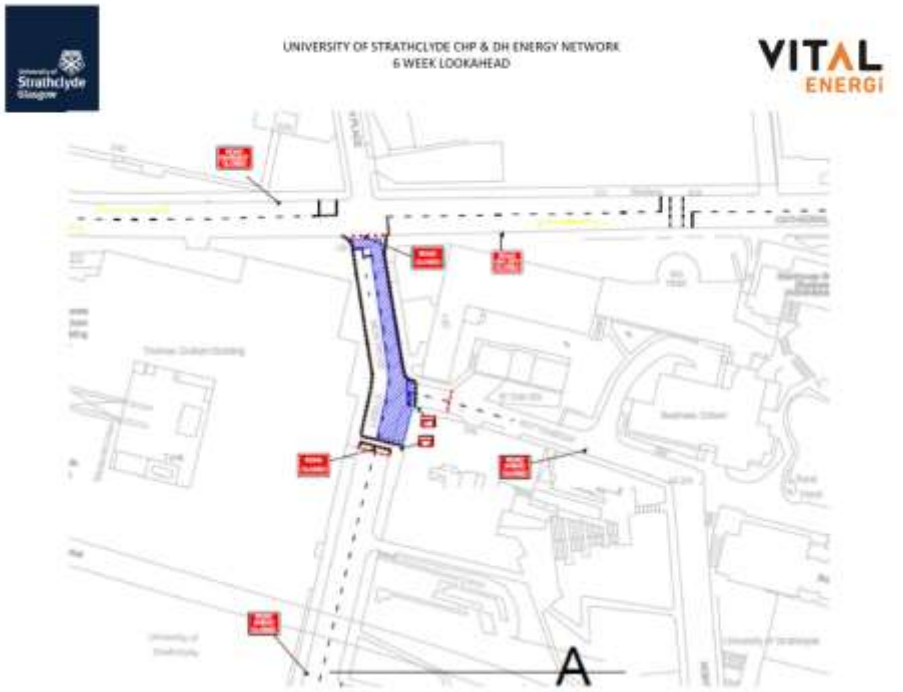
- Under Section 56 of the Roads (Scotland) Act 1984, any person carrying out any works on a public road, must obtain the consent of the Roads Authority before the works commence. The term 'road' encompasses carriageways, footways, verges and any remote public footpaths or cycleways
- Anyone (including Utility Infrastructure Providers (UIP's)) wishing to install new apparatus in the public road, must obtain the consent of the Roads Authority under Section 109 of the New Roads & Street Works Act 1991 (NRSWA).
- All types of works and activities on the public road or footway require traffic management in one form or another depending on the nature of the works and/or the nature of the road or footway.
- Glasgow City Council operate a works embargo period at Christmas time. Any permit applications that may impact the city traffic flow at this this time, will normally be rejected.

Authority to Excavate and Install Services Under the Roads

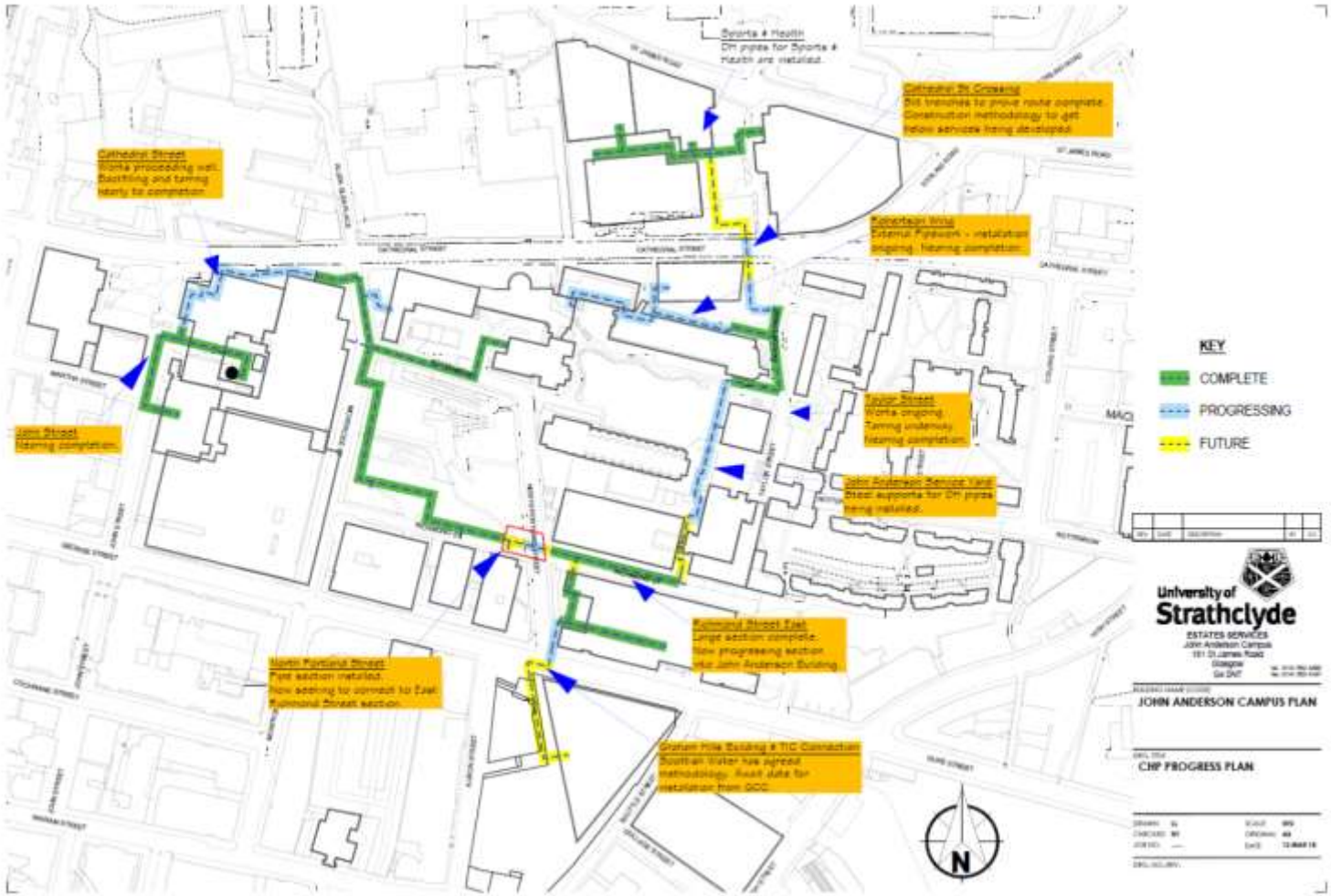
- The Council as the local Roads Authority, have a statutory duty to co-ordinate all works on the public road network. They must use best endeavours to ensure that works are carried out safely, with the minimum of inconvenience to road users, and that the structure of the road is protected.
- This duty is overseen by the Scottish Road Works Commissioner, who is appointed by the Scottish Government. The Commissioner is the Keeper of the Scottish Road Works Register, which lists all road works in Scotland. The road works are the programmed and emergency works undertaken by, or on behalf of utility companies, construction companies and the council.
- The council rarely excavate the road but do repair it or replace the surface.
- The utility companies such as gas, water or electricity are usually responsible for excavations in the road and have statutory powers to undertake works.

Note District Heating contractors do not have the statutory powers that utility companies posses and so require to go through what can be a lengthy application process.

Managing Conflict



Managing Conflict



Managing Risk – Risk Register

UNIVERSITY OF STRATHCLYDE
CHP & DISTRICT ENERGY PROJECT

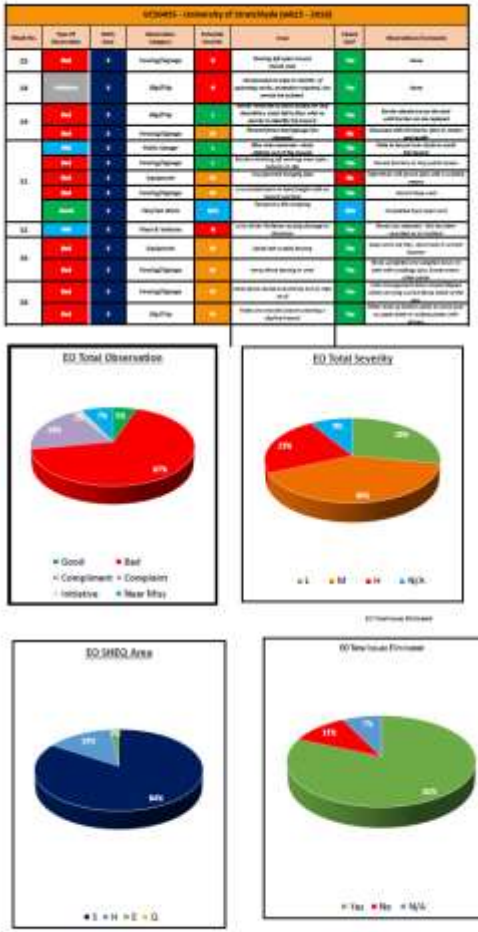
PROJECT RISK REGISTER

REVISION - 6

DATE - 23/8/17

No	Risk Category	Description of Risk, Issue or Opportunity	Impact	Type (Risk / Opportunity)	Probability (P)	Impact (I)	Risk Score (P x I)	Actions to Manage Risk (Potential or Achieved)	Owner	Further Action Required?	By	Current Action Status (RAG)
					(1-5)	(1-5)						
1	Approvals	Failure to receive statutory approvals inc. boilerhouse ventilation, flues and dispersion modelling	Contractor risk but may still result in delay and cost to completion	Risk	2	5	10	Discussions held with authorities prior to applications, and continuing. Most consents now received	VE			
2	Approvals	Failure to receive statutory approvals for underground / overground DH pipework	Contractor risk but may still result in delay and cost to completion	Risk	1	5	5	DH not deemed to require planning permission, but VE should continue regular communication with Planning	VE			
4	Approvals	Failure to receive G59 approval on time	Contractor risk but may still result in delay and cost to completion	Risk	2	5	10	Regular discussions held with SPEN but firm and regular pressure to be applied by both VE and UoS	VE/UoS	Firm and regular pressure to be applied by both VE and UoS	VE/ UoS	
5	Approvals	Failure to secure gas supply	Contractor risk but may still result in delay and cost to completion	Risk	1	3	3	Gas connection & Meter successfully installed	VE			
6	Approvals	Changes in statutory legislation	Delay and cost to completion	Risk	1	3	3	No action	N/A			
7	Finance	Inability to manage contingencies and additional costs / claims	Project overspend, delays and claims	Risk	2	4	8	Regular cost reviews and management	NIFES / Armour			
8	Third Parties / Stakeholders	Change to scope of works by Client or Stakeholder	Variation to cost and timescales	Risk / Opportunity	4	3	12	Manage control of change	UoS			
9	Third Parties / Stakeholders	Changes in land ownership	Delay, cost and rerouting of works	Risk	1	3	3	Landsearch complete by University Solicitor	UoS	Further review required in light of DH and gas route changes	UoS	
10	Third Parties / Stakeholders	Communication internal and public and dealing with complaints	Damage to reputation, impact on program	Risk	3	3	9	Identified in contract prelims, link with university marketing and comms team	UoS / VE			
11	Design	Inaccurate 'as existing' information	Delay in completing design	Risk	3	1	3	Contractor is required to verify existing information	VE			
12	Design	Failure to achieve design requirements	Failure to meet ER's	Risk	2	3	6	Design substantially completed but submission/approval process to continue	VE			
13	Construction	Failure to reach the required depth of excavation for the DH pipework on Cathedral Street	Failure to achieve requirements set out by roads department may result in the need to remove this pipework and reroute DH system.	Risk	2	5	10	Alternative solution to be found to satisfy the Roads Department	VE			
14	Construction	Unidentified obstructions / diversions	Contractor risk but could still result in delay in completing works	Risk	5	4	20	Risk transferred to contractor, Surveys and consultation completed as identified	VE	Pay particular attention to Scottish Water mains. Avoid or protect	VE	
15	Procurement	Delay in delivery of long leadtime or critical items	Delay in completion to works	Risk	1	3	3	Alternative manufacturers, phased works or re-sequencing	VE			
16	Construction	Difficulties in enabling/maintaining access for deliveries and construction and building operations	Inability to maintain operations in buildings; cost; programme delay	Risk	3	4	12	Look ahead programmes; consultations with operations and events identified etc in ITT; communications strategy developed	UoS / VE	VE Site Management plan is to be regularly updated with new information	VE	
17	Construction	Contactor failure to manage sequencing of works	Continuity of works; campus operations; impact on concurrent projects	Risk	2	4	8	Look ahead programmes; consultations with operations and events identified etc in ITT; communications strategy	VE			
18	Construction	Failure to keep up to date with decision required eg NEC3, reviews, proposals	Compensation events being raised; cost, quality and programme impact	Risk	3	4	12	Sufficient resources; action log; regular reviews;	All			
19	Construction	Failure of Contractors to meet project objectives eg. Quality, Cost, Time	Additional maintenance requirement; Carbon Reduction not achieved; output specifications not achieved	Risk	2	3	6	Technical approvals process; on site inspection; CoW	VE			
20	Construction	Failure of existing systems and interfaces eg. Isolations	Delay; additional costs; compensation events; impact on maintaining operations	Risk	5	3	15	Detailed site surveys; ongoing communications with Contractors; advance works assessment	UoS / VE			
21	Construction	Failure of existing services operation	Delay; additional costs; compensation events; impact on maintaining operations	Risk	1	2	2	VE programme and RAMS to anticipate issues	N/A			

Managing Health & Safety -Dashboards



Managing Health & Safety Challenges

- Vehicle Movement
  - Excavators, dumpers, pipe delivery and unloading
  - Traffic management
- Pedestrian Control
  - Signage - do people look at them!
  - Temporary bridges over open trenches
- Under the ever watching eye of everyone!

Choice of Procurement Route

- Traditional 1 – Client engages a multi disciplined design team independent of the contractor
- Traditional 2 – Client engages a project (Engineer/Manager) lead consultant who brings the integrated design team together independent of the contractor
- D&B novated – Clients appointed design team are novated to the contractor at the end of RIBA stage 2(Concept Design),3(Developed Design) or 4(Technical Design).
- D&B (Turnkey) – Client goes to the market with a set of employers requirements to tender for a contractor responsible for designing, constructing, commissioning and testing the project including ensuring it performs as required to meet Good Quality CHP etc. The contractor will require to demonstrate the successful delivery of the business case outcomes such as energy and carbon savings to meet with NPV/payback modelled.

Pros and cons

Model	Pros	Cons
Traditional 1	• Fully designed scheme for a contractor to price • Scope of the scheme is determined to clients technical and budget requirements • Provides more cost certainty (less risk!) at an earlier stage to assist obtaining funding approval • Faster contractor delivery programme	• Stifles contractor innovation • Consultants may not have the same experience/expertise • Can result in elements of redesign that adds costs and can impact on programme • Can lead to overdesign • Client retains more of the design risk
Traditional 2	• As per traditional 1 • Single point of contact for the client in terms of design responsibility	• As per traditional 1
D&B Novated	• Client can select design team based on criteria set out within the tender documentation • Design can be developed to a fairly detailed level to allow works to be better costed prior to tender • Client can go to tender quicker • Allows for some contractor innovation	• Client loses direct control of the design team • Contractor may not agree/like the design leading to conflict • Contractor may not get on with novated DT • Can lead to additional costs if the design has not been sufficiently developed to avoid instructing changes to what has been priced
D&B Turnkey	• Single point of responsibility for project delivery • Opportunity for Contractor innovation • Allows client to go to the market earlier • Client transfers more risk to the contractor	• Contractor may include significant cost allowance to cover the risks that have not been fully identified • May result in additional cost if ER's are not detailed enough or prove to be inaccurate

Public Sector Procurement

- **Procurement Reform (Scotland) Act 2014** (Public Contracts Regulations 2015 – Rest of UK)
- **Official Journal of the European Union (OJEU)** Directive 2014/24/EU Of The European Parliament And Of The Council of 26 February 2014

  - **Open** - Using an Open procedure means that the Invitation to Tender must be sent to all suppliers that express an interest in response to the Contract Notice.
  - **Restricted** - The Restricted Procedure is a two-stage process which allows Institutions to draw up a short-list of interested parties by undertaking a pre-qualification stage, prior to the issue of invitation to tender documents. This is most appropriate when many suppliers exist within a market and it is not feasible to issue an Invitation to Tender to each.

OJEU Thresholds

The European public contracts directive (2014/24/EU) applies to public authorities including, amongst others, government departments, local authorities and NHS Authorities and Trusts.

The directives set out detailed procedures for the award of contracts whose value equals or exceeds specific thresholds. Details of the thresholds, applying from 1st January 2018 are given below. Thresholds are net of VAT.

THE EUROPEAN PUBLIC CONTRACTS DIRECTIVE (2014/24/EU)

	Supply, Services1 and Design Contracts	Works Contracts2	Social and other specific services3
Central Government4	£118,133 €144,000	£4,551,413 €5,548,000	£615,278 €750,000
Other contracting authorities	£181,302 €221,000	£4,551,413 €5,548,000	£615,278 €750,000
Small Lots	£65,630 €80,000	£820,370 €1,000,000	n/a

Therefore Notification Through OJEU Required

How to Start Off

- Engage a specialist to help undertake a feasibility study
- Collect and analyse energy data
- Determine which buildings are to be connected to the DEN
- Identify a location for an energy centre
- Consider a route for the DEN network and the likely issues associated with this
- Survey of existing plant rooms to provide high level info e.g. equipment inventory, layout and space availability
- Survey of existing infrastructure gas, electricity
- Consideration of any Planning, List Building, Way Leaves etc. requirements
- Identify other statutory/risk matters e.g. Asbestos survey information, underground risks, archaeological artefacts

University of Strathclyde Glasgow

Early Communication

University of Strathclyde Glasgow

- Engagement with local Planning, Historic Environment Scotland and Council Roads Department
- Engagement with Scottish Power Networks to discuss implications of G59 application
- Engagement with Scottish Gas Networks to discuss gas connection for energy centre and implications of consolidating site gas loads
- If intending to sell heat or heat and power to third parties then early development of an ESCO , SPV or Sub Co to orchestrate this

Employer’s Requirements

- Proposals prepared by design team members. The level of detail will depend on the stage at which the tender is issued to the contractor. The **Employer’s Requirements** may comprise a mixture of prescriptive elements and descriptive elements to allow the contractor a degree of flexibility in determining the **Contractor’s Proposals**.

What Information to Include Within Employers Requirements?

- Project Overview – size, scale, programme etc.
- Project Objectives – carbon reduction, energy savings, NPV payback
- Feasibility Study details
- Site Investigations
- Site drawings and schematics and other useful info
- Heat load profile, Power Load profile
- Specification for equipment

Other Things to Consider

- Form of Contract
  - NEC3 – various options
  - SBCC D&B
  - ICC
- CHP Engine Maintenance Contract (15 years?)

Alternatives to Gas-Fired CHP

- Alternative fuel for CHP engine
  - biofuel
  - biomass
- Heat Pump
  - Water Source
  - Ground Source
  - Air Source

Summary

- Undertake a detailed feasibility study
- Determine what the scope of the project is
- Ideally secure the funding required to deliver the full project scope
- Develop ER's that are detailed enough to allow bidders to price the works (Not too little detail but not too much either!)
- Recognise the advantages of awarding the contract to an experienced specialist DEN/CHP D&B Contractor
- Tender the works – Don't under estimate how long this will take!
- Appoint a contractor and get prepared for a roller coaster ride during the construction period

University of Strathclyde Glasgow

And Finally

QUESTIONS?

University of
Strathclyde
Glasgow