LoT-NET

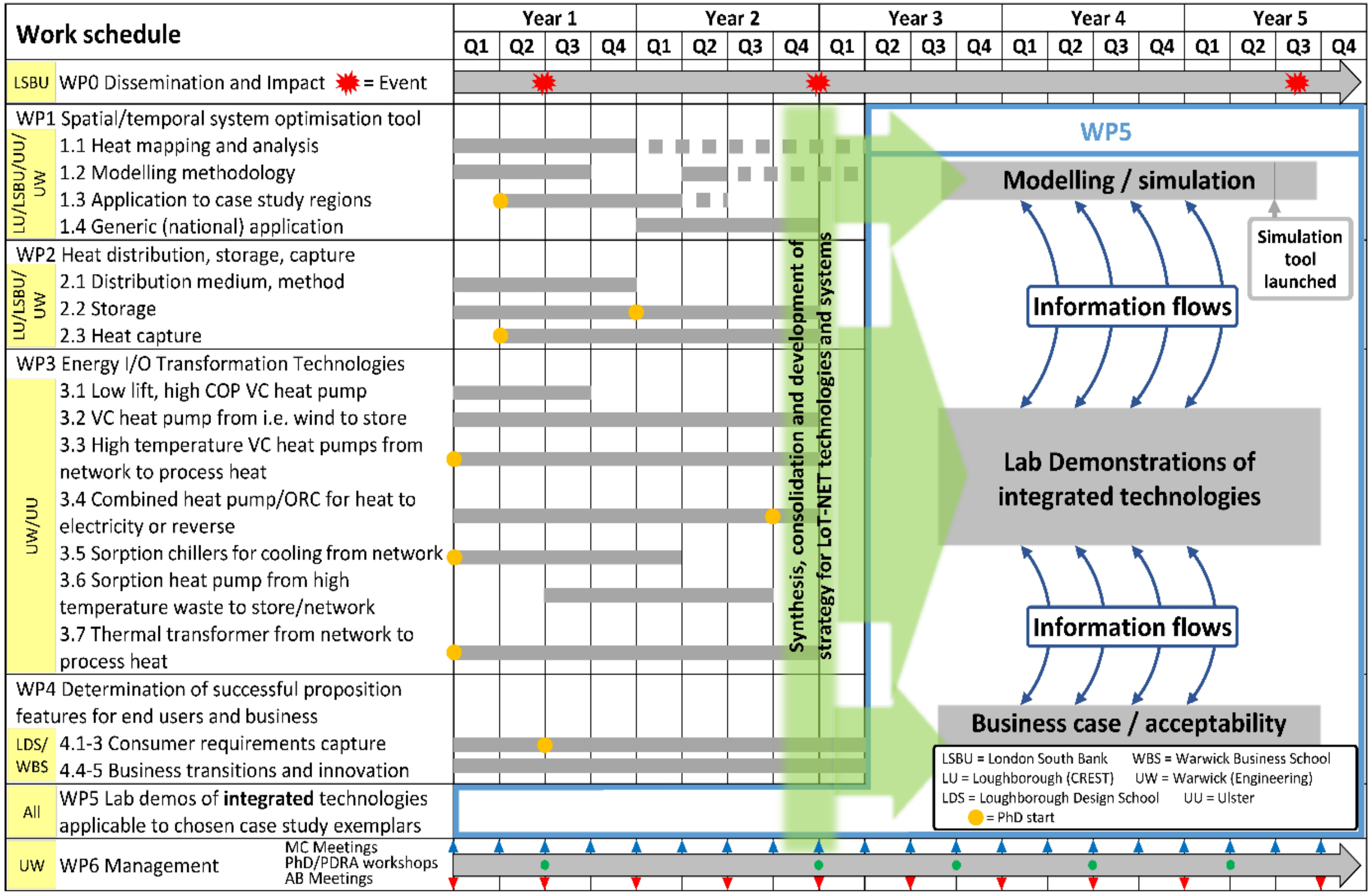
Advisory Board Meeting 10th March 2022
Revised Mid-term Report: Part 2

Low Temperature Heat Recovery and Distribution Network Technologies

Part 2: Agenda – Ambitions for the Case Studies

- Larger scale, real world smart local energy system case studies
- 4th/5th Generation Energy Networks – including “LoT-NETs”
- What questions should the Case Studies answer?
- Case Study: Islington
- Case Study: Loughborough
- Case Study: Warwick
- Discussion & Summary

Original Work Packages



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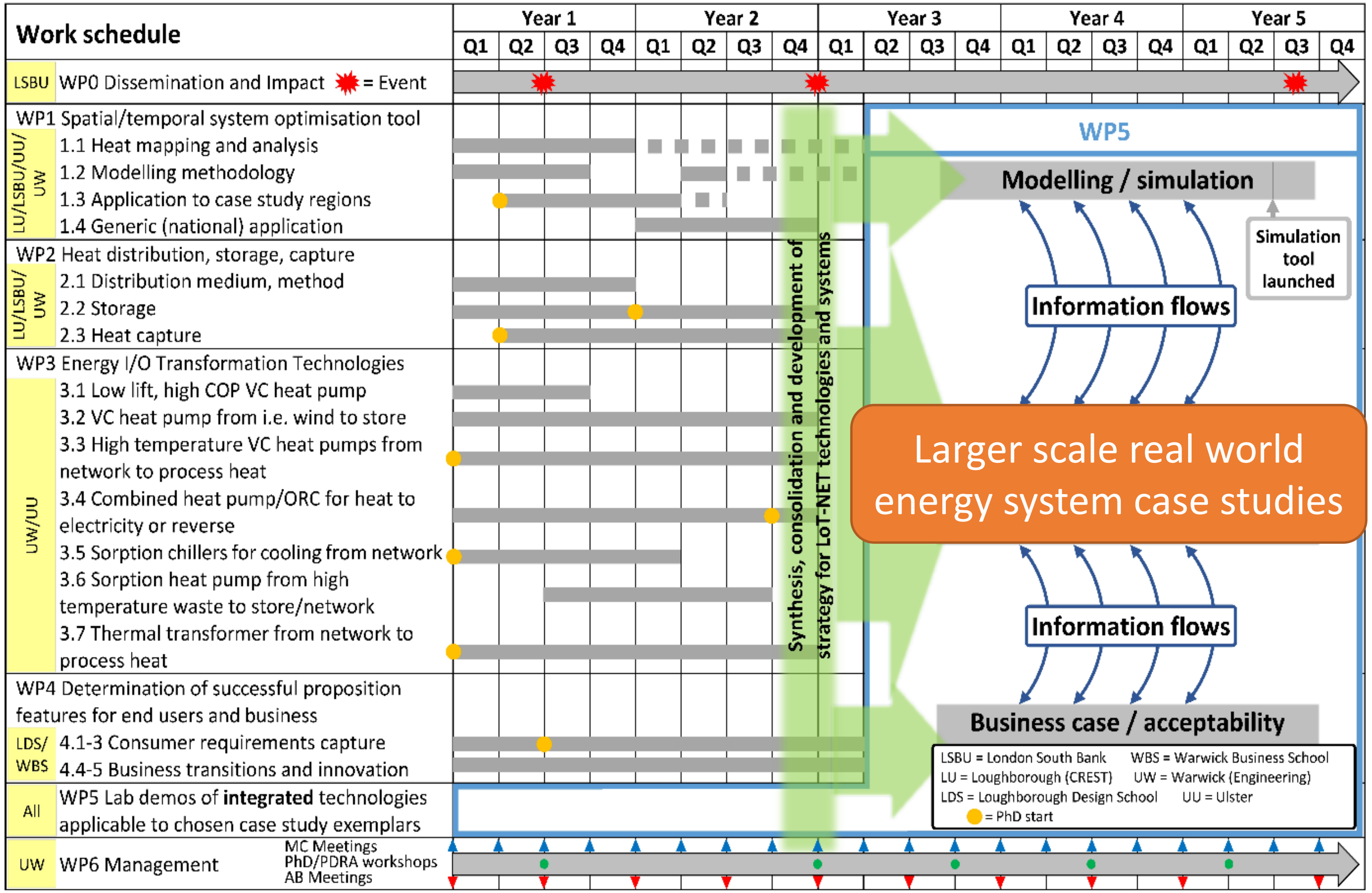
Phase 2: Including larger scale real world energy systems



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Case Studies – How can they demonstrate LoT-NET's ongoing work and how do they accelerate LoT-NET's impact?

- **Islington: GreenSCIES** is a case study investigating an integrated, Smart, Local Energy System (SLES) for a large community in the London Borough of Islington. The system is based around a 5th generation ambient-temperature heat network loop with distributed energy assets such as heat pumps, solar photovoltaic and the flexible integration of electric vehicles.
- **Loughborough town.** The model is currently being used to assess different network options that can deliver a net zero heating solution for the domestic dwellings in the town of Loughborough. It will be refined to assess a range of network typologies include other non-domestic heat demands in the Loughborough area and integrate waste heat sources.
- **The University of Warwick** campus is a multi-vectoral energy system with an electricity network, heating network, cooling network and rising transport demand from EVs. The challenge is to decarbonise energy use to achieve net zero for scope 1&2 emissions by 2030 and add scope 3 by 2050.

Case Studies: Questions for discussion – How LoT-NET can inform…..

- What will the CCC's 20% of heating from heat networks actually be?
- How can LoT-NET help PFER projects be integrated, multi-vectoral systems, not just an assembly of activities?
- How can LoT-NET make local energy systems smarter and more flexible?

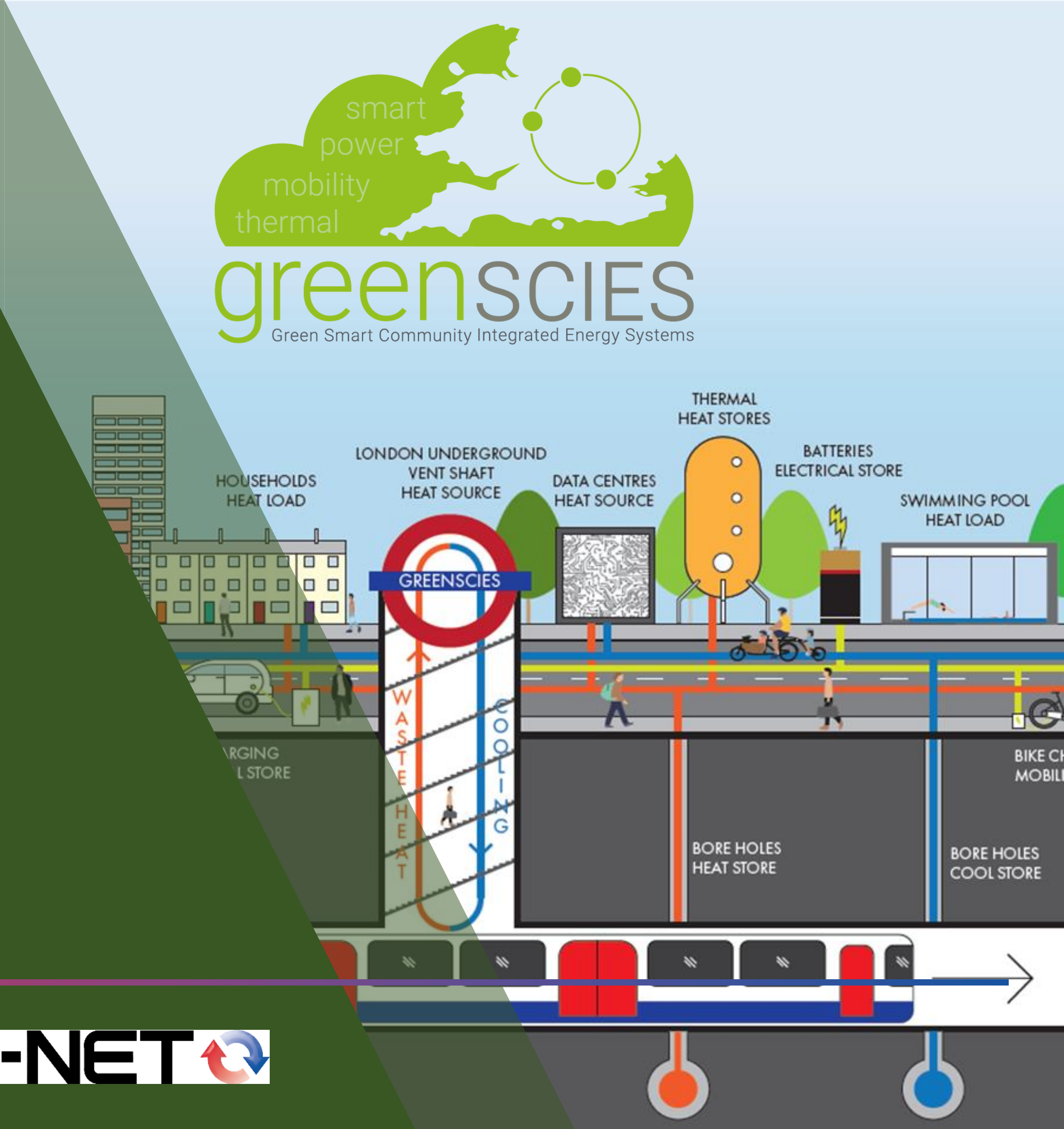
- Other questions LoT-NET's cases can help answer?

Islington Case Study

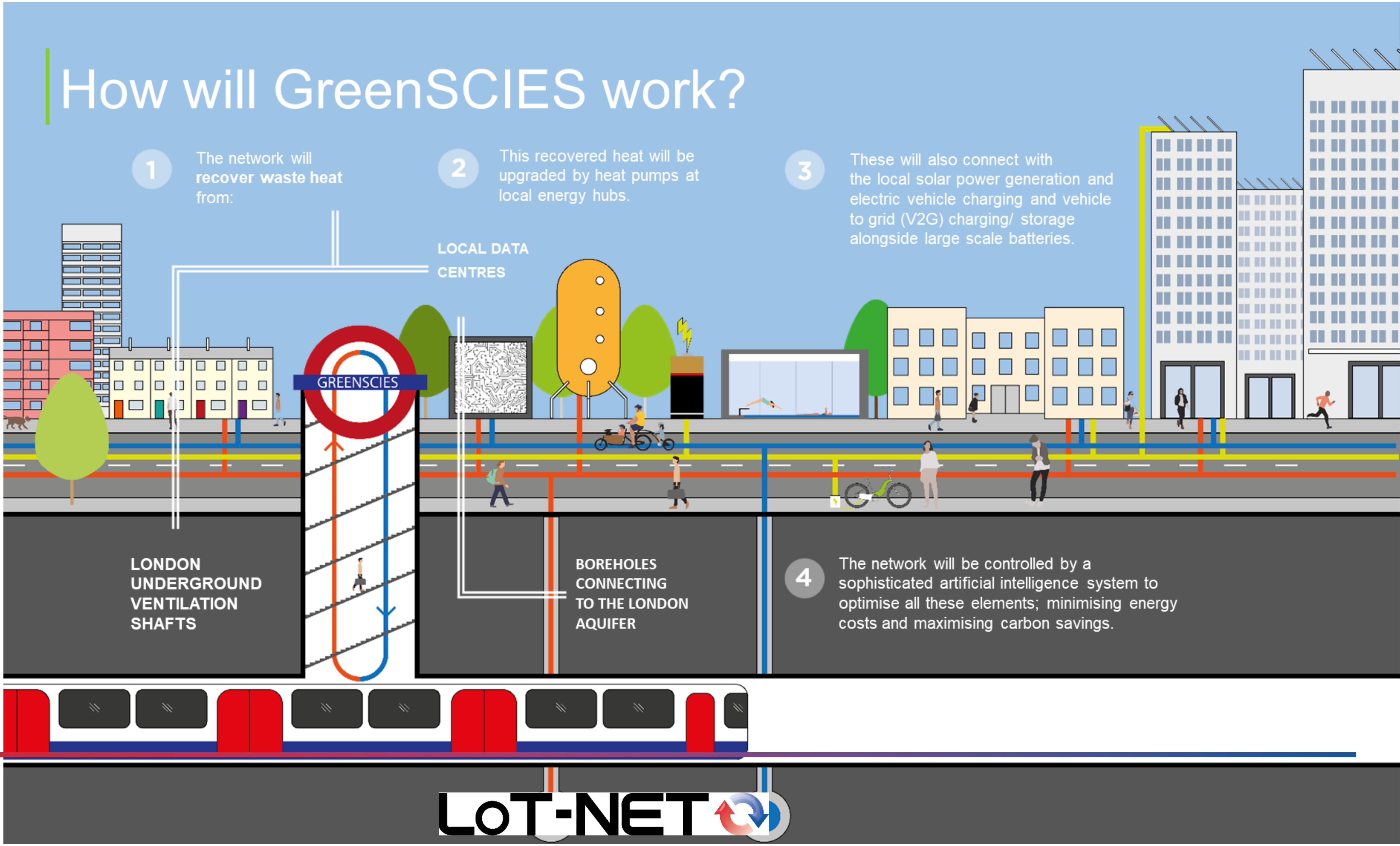
GreenSCIES

The Urban Case

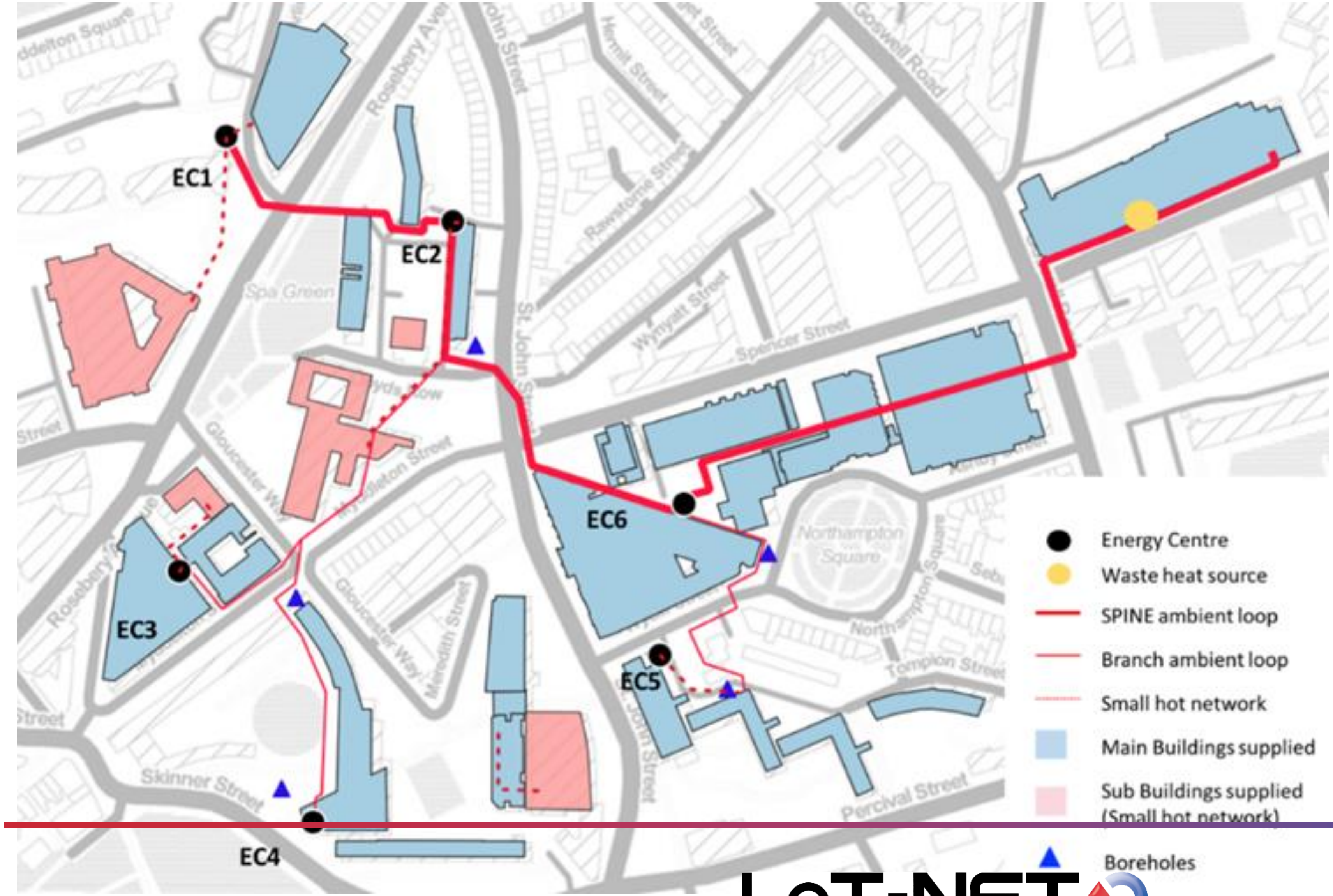
Graeme Maidment and Akos Revesz
London South Bank University



EST 1892 LSBU



GreenSCIES in Islington



newriver
Green Smart Community Integrated Energy Systems

Investible

Constructible

- Blueprint
- Construction ready design
- Lessons learnt

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New River Value Streams Overview

CHAMP (Cooling, Heating, and Mobility and Power) Integration

- Cooling produced as a bi-product of Heating
- Mobility – shared capex but also V2G
- Power – PV earns higher value or EV/HPs receive lower cost electricity but also with Flexibility by:
  - Picking the cheapest price periods reduces elec cost for HPs/Evs
  - Benefits include carbon savings
  - Additional flex services: Capacity Market, Balancing Mechanism, FFR
  - Heat/coolth/power storage important to maximise this

Control system will optimise CHAMP integration

The New River Dashboard

greenSCIES
Green Smart Community Integrated Energy Systems

2,208 households/
8,832 people
connected locally

£16m investment

44,026 MWh/yr
Low carbon
energy supply

10 businesses and
other organisations
connected

Fuel poverty mitigation
for 242 households

5,709 Direct CO2
reduction t/yr

5489 MWh/yr
Total Energy Use
Reduction

440-1,342 kW EV
Charging capacity
enabled by GreenSCIES

Direct Economic
Impact £2m

50 Jobs

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Construction in Islington

newriver

Green Smart Community Integrated Energy Systems

Department for Business, Energy & Industrial Strategy

Green Heat Network Fund

Transition Scheme Overview

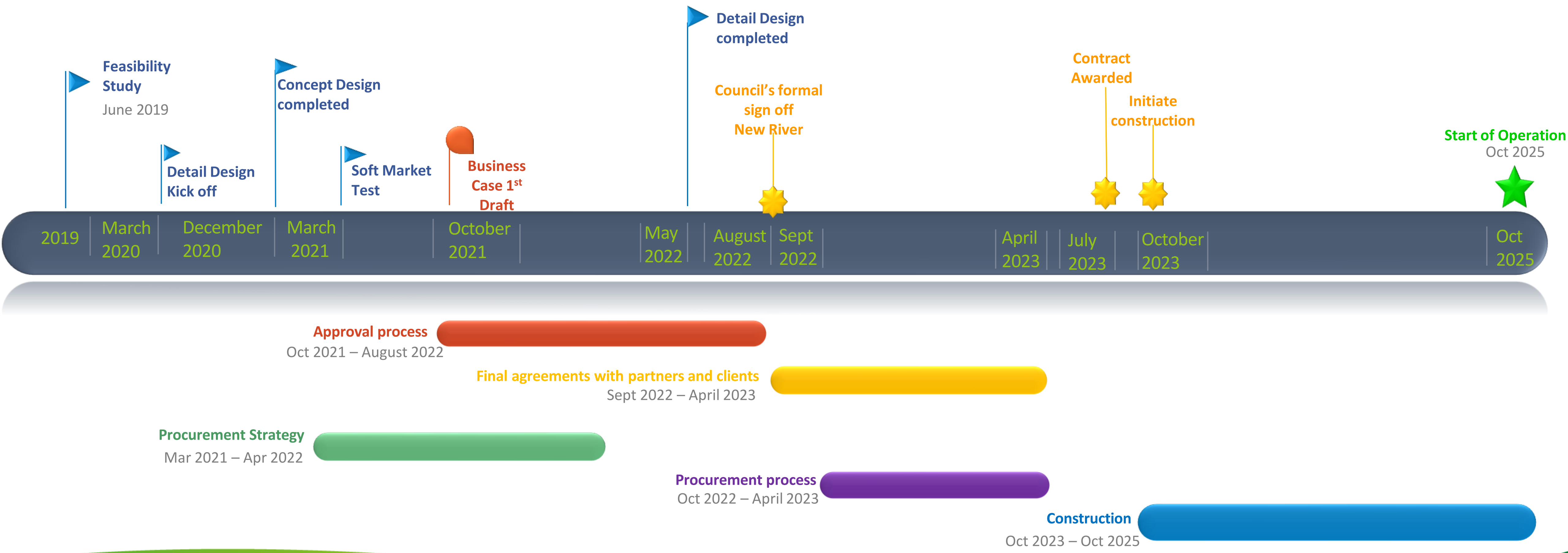
Supporting the commercialisation of low carbon heat network projects

Version 1.2

New River Scheme **Timescales**

Together we can make Islington net zero carbon by 2030

ISLINGTON



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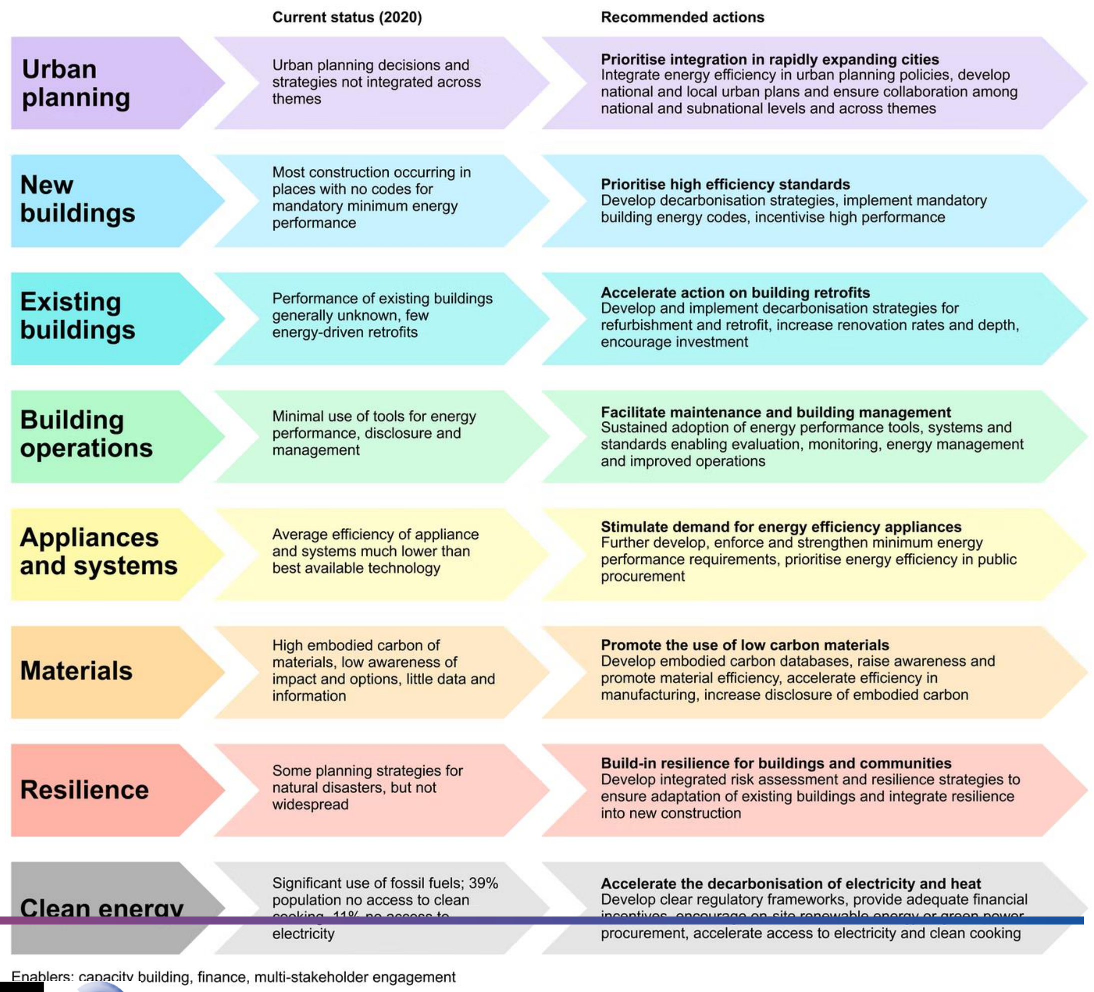
Netzero roadmap for Islington

- Overarching strategy
- Learning from NR/ GS2
- Using the toolkit to explore different scenarios. Ie
  - Break down Islington into some different types… ie %
  - With Architype A building and Demographic type Y, things that could be done are X,Y,Z
- Output - report



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REPLICATING GREENSCIES

smart
power
mobility
thermal

replicating
greenscies
Green Smart Community Intregrated Systems

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Opportunity for wider replication

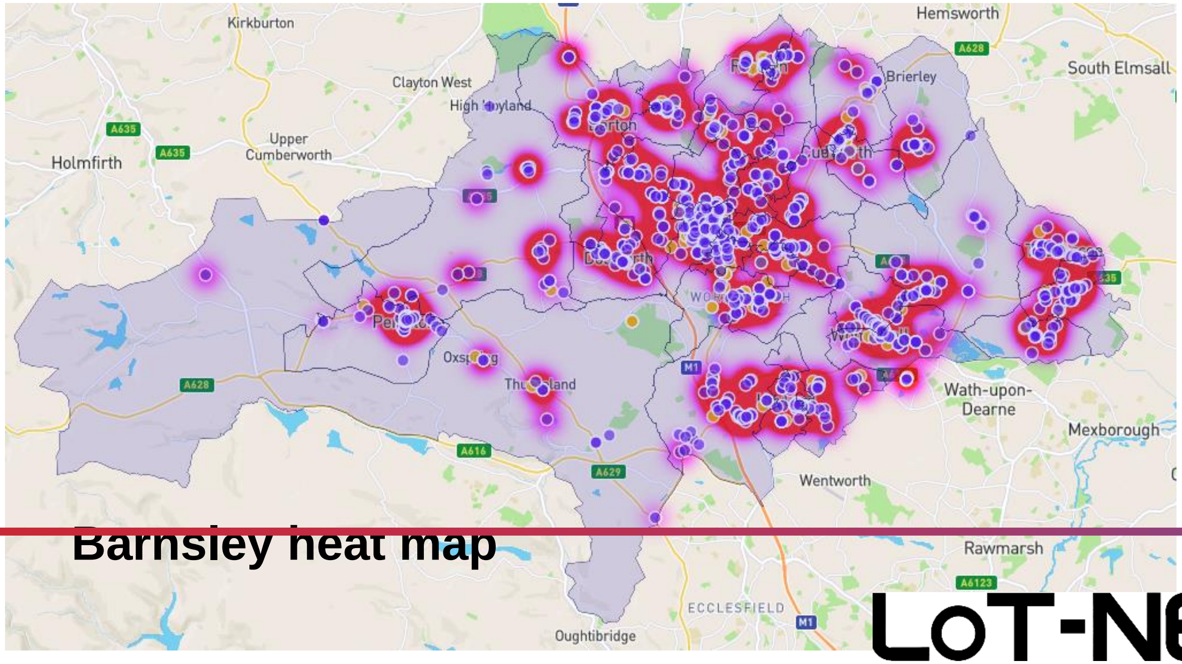
- In 2019, the UK government set a legally binding-target to achieve net-zero greenhouse gas emissions from across the UK economy by 2050.
- Since then 3/4 of all local councils across the UK have formally declared a climate emergency.
- More than half of them have set a goal of reaching net-zero carbon emissions locally by 2030 or sooner.
- LSBU and GreenSCIES partners have set up a Centre of Excellence (CoE) in Smart Local Energy Systems to support organisations meeting carbon targets.

2030

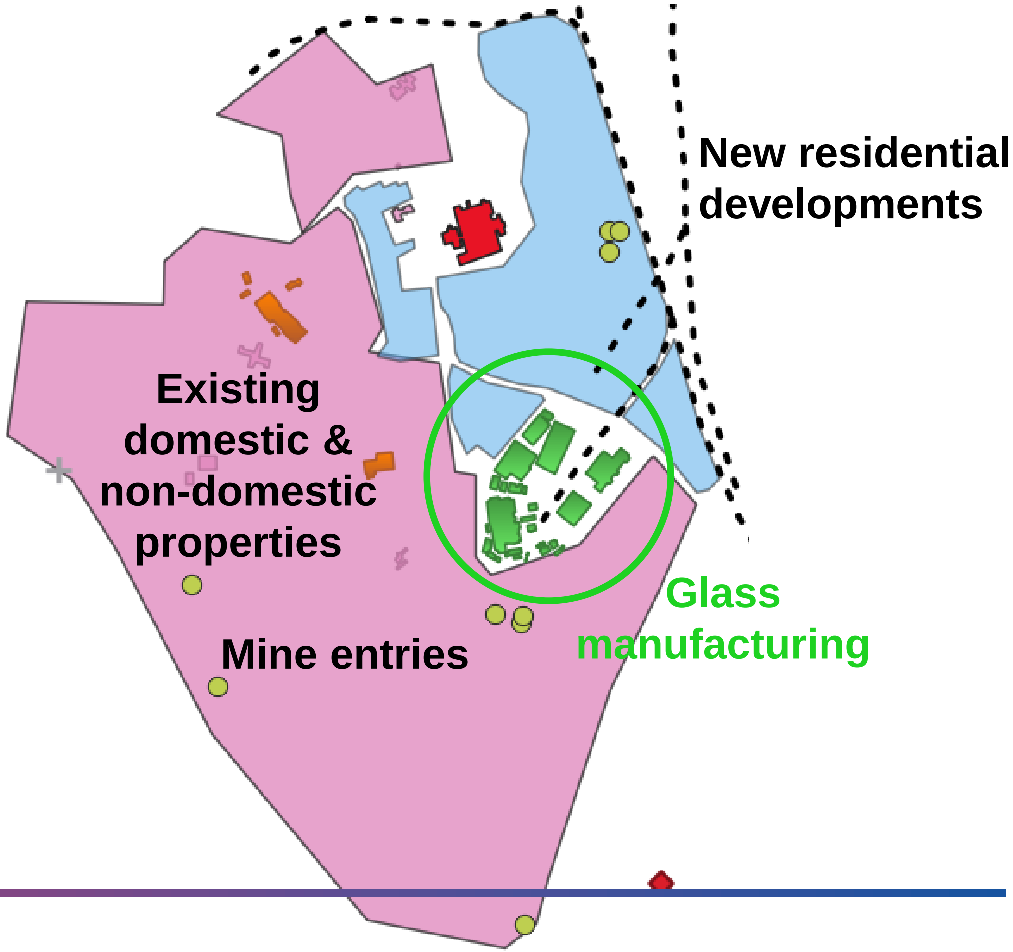
SHEFFIELD

Proposed SLES network in **Barnsley, Sheffield City Region**:

- Connecting new residential developments & existing domestic and non-domestic buildings
- Heat recovery from glass manufacturing
- Energy storage in mine water



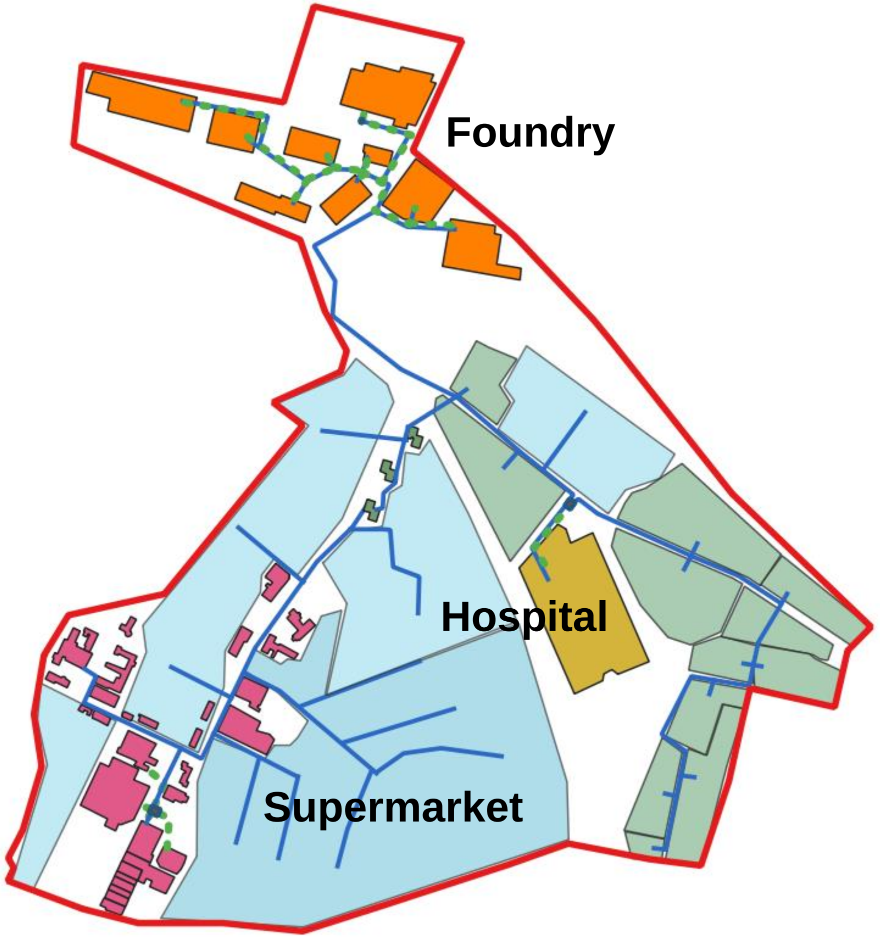
Barnsley heat map



West Midlands

Proposed heat network in **Sandwell, West Midlands**:

- Connecting new residential developments & existing domestic and non-domestic buildings
- Heat recovery from a foundry, hospital and supermarket
- Energy storage in the aquifer



3,168 households/
12,672 people
connected locally

£64m
investment

56,923 MWh
Low carbon energy
supply

25,643 Direct tCO2
reduction after 10-yr

A pathway to Net Zero carbon emissions by 2041
(West Midlands Combined Authority target)

Case study selection template

Latest updates!

	Potential case studies										
	ASDA supermarket	**Barnsley**	**Blaenau Gwent**	**Cambridge Uni**	**Croydon Council/Westfield**	**Dorset Council**	**Queen Mary University/VOLTA**	**OPDC**	**Regional Distribution Centre (Cold store)**	**H2**	**Warwick**
Client category	Retail	Council	Manufacture	Academic Institution	Council	Council	Academic Institution	Housing development	Retail	Industrial	Academic Institution
Connection initiated through (sponsor)	LSBU	Helen/Cat	Raj	Kristina	LSBU	Akos	GS	GS/Phil	LSBU	Akos, Chris	LSBU, Cullinan, Russell
CoE Consultancy sub-category	Potential feasibility case study for RGS/IUK	Potential feasibility case study for RGS/IUK	One for the CoE	Potential feasibility case study for RGS/IUK	Potential feasibility case study for RGS/IUK	Potential feasibility case study for RGS/IUK	One for the CoE	Scoping study first - then Potential feasibility case study for RGS/IUK	Potential feasibility case study for RGS/IUK	Potential feasibility case study for RGS/IUK	Potential feasibility case study for RGS/IUK
Conclusions, Comments, Questions during the workshop (January 2022)	Double check data availability. What's their attitude to be part of the community? Arrange a mtg to test their keenness. Which ASDA? All ASDA? Could it be more generic? Looking at the overall potential rather than a specific store. Maybe categorise them based on heat rejection, locality, etc. Then dive into more detailed for a few. Check with ASDA about cold stores.	Industrial cluster, new heat sources innovate mine water store. They are planning a big PV farm. Intending the scheme could be very interesting - but maybe its worth exploring or finding a different industrial cluster e.g. cement works, etc. Keen to construct. An output could be a large Barnsley wide Masterplan.	CoE project, potential industrial cluster. This could be a duplication of Barnsley (glass factory). No knowledge of keenness. There is an existing heat network in the vicinity - potentially the heat could be recovered into that. We can say that we have experience already working with glass.	Cullinan had a good meeting with the Uni. They seemed keen to be involved. Specifically sharing of heating and cooling between campus buildings. Mixed on new and old buildings.(Eddington included with new CHP) Follow up re social housing, local council, etc. i.e. clarify who are the beneficiaries! Timeframe should be double checked with them. Capital expenditure for construction should not be an issue for the Uni. Mobility aspects have not been discussed. Need to follow up.	LSBU had a good meeting the Council. They were keen to be involved. Net-zero commitment by 2030, MPH and community all critical for Croydon. They are keen for us to looking at their social housing. Westfield has several disused buildings in the area which they'd be keen for us to include in the study. At the moment its unclear what waste heat sources we could utilise. Needs exploring. Maybe sewer heat. Chris said that there is a Data Centre which we could potentially look at. Akos to explore other options.	Waste heat from a Crematorium. Phil suggested that its probably too small the heat output. There might be an opportunity to generate electricity as well. Follow up on the past LSBU project to confirm heat availability. Unfortunately the Council haven't been engaging thus far so they don't seem too keen to be involved at this point.	CoE to provide feedback on their works. Too close to locality. Too similar to New River.	Old Oak and Park Royal Development Corporation (OPDC). Large project. 7 big data centres. 3 old and 4 new. AECOM is already appointed for a DH study. OPDC is keen for us to explore SLES opportunities. Scoping study for a much bigger study (SLES focused) - by the end of April EV opportunities needs exploring. There is a Royal Mail depot in the area. Client is keen for us to explore avoided costs through demand side response, flexibility etc.	Link this with ASDA LSBU has lots of data on cold stores inlc. location, size, etc. Currently they are not delivering heat over the fence. We'd need to explore and confirm social benefits.	Discussed that it would interesting o include some industrial H2 sites. It would help diversifying our case studies. Waste heat capture from electrolyser.	Russell is involved in V2G project with the University. They are keen to explore DHC opportunities. RESO (another PFER project) - follow up with David E Chris modelled Warwick already in detail - perhaps less innovative. Uni plus other campus organisations. Again, who are the beneficiaries? What's the impact on the Community? Social value?
Updates on progress since workshop (09/02/2022)	Graeme and Akos started liaising with ASDA - a meeting is scheduled for the 3rd of March. .	Ongoing liaison as part of GS2	Not progressed	Phil initiated a contact with Jeff L who suggested can help us to get in touch with Cambridge City Council (CCC). A meeting with the Uni and CCC is scheduled for the 11th of March.	Meeting is scheduled with Croydon Council for the 18th of March. Waste heat sources in the area: Three large food stores, Large supermarket, a few large electrical substation transformers.	Annual estimated waste heat availability from the specific crematorium is: 480573 kWh Engagement not progressed with Dorset Council so this option remains a low priority one.	No further engagement with QMUL at thus point.	The Replicating GreenSCIES proposal to develop a scoping study that would inform a larger OPDC LAEP study has been developed by Phil and submitted to OPDC. The proposal received a positive feedback. It is very likely that OPDC will be our first case study for RGS.	To be discuss with ASDA during the upcoming meeting.	Chris suggested to get in touch with Protium regarding about a new big electrolysers. Akos reached out and a meeting is to be scheduled. Date TBC.	Akos and Graeme had a meeting with Warwick. They are interested in participating within the study. However, this would be a limited study with no impact on local communities. Also there has been lot's of work done on this campuses and thus limited original contribution for the RGS team.

Asda – A demonstration

- ASDA committed to Net-Zero by 2040
- Most stores are big gas burners!
- Huge potential for decarbonisation.
- They are keen to be involved in Replicating GreenScies
- Lots of available data for all supermarkets across the country.
- Heating and Cooling
- Lot's of disused car parks
- PV & EV opportunties to be explored as currently not in major focus within the organisation.
- Scope & timescales TBC

+

- Funding for a demo
- Part of an EU project

Centre of Excellence in Smart Local Energy Systems

To accelerate the development and roll-out of Net-Zero Integrated Smart Local Energy Systems

Two Service Strands

1. Consultancy
2. Training & Education

Five Subject Pillars

1. Heating and Cooling

- Heat networks
- Heat pumps
- Ambient loops
- Thermal Energy Storage
- Techno Economic
- Etc.

2. Power

- Solar PV
- Batteries
- Flexibility
- DSR
- Smart control
- Etc.

3. Mobility

- Electric Vehicles
- V2G
- Charging infrastructure
- EV Modelling
- Etc.

4. Engagement

- Stakeholder engagement
- Community engagement
- Consumer interactions
- Awareness campaigns
- Collaborative working
- Community consultations

5. Investment

- Investment options
- Ownership options
- Funding opportunities
- Value streams
- Business case
- Tender development
- Soft Market Tests, Surveys

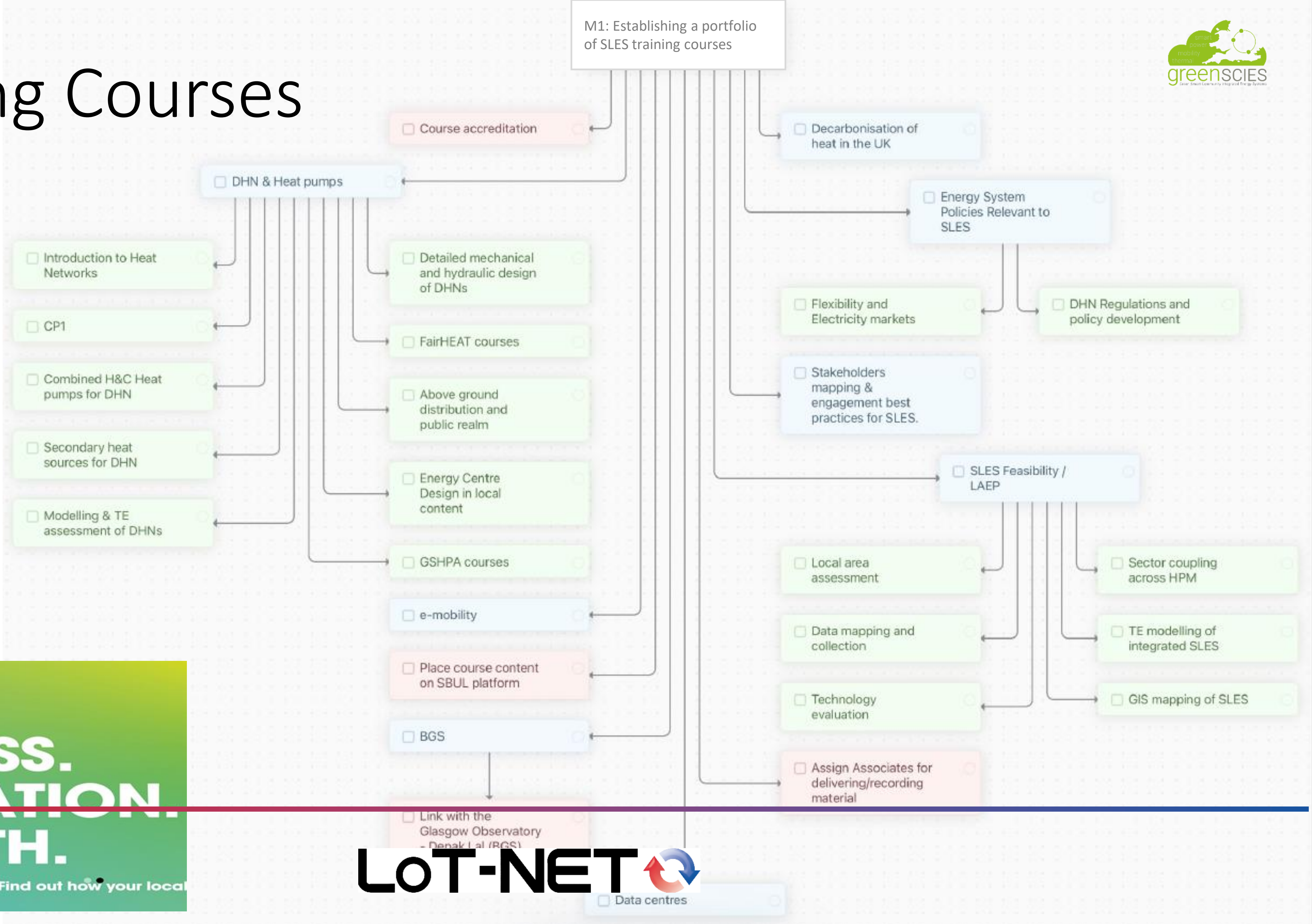
Training Courses

Main subject areas

Short course title

Action

- Owned Courses
- Badged Courses



Case Study: Loughborough – The Town Case

- Loughborough- market town in the east midlands
  - 23,478 dwellings, mix of different building types
  - Approximately 67,000 population in 2018
- 1186 towns in England and Wales with populations between 5,000 and 225,000
  - 91 population > 75,000
  - 347 population > 20,000 and <75,000
  - 748 population > 5,000 and < 20,000
  - Total population represented about 32.6 million people
- Loughborough can be treated either as a single unit or broken down in to sub units providing scope for modelling and optimising district heat networks at different scales

Case Study: Loughborough – Further model development

- The Loughborough case initially acts as the case to develop and expand our model development
  - Modelling will be refined to provide greater temporal and spatial resolution
  - This allows different operational strategies to be assessed
- Areas to expand:
  - Building thermal mass and influence on heat demand profiles.
  - Network operating temperatures. Constant or variable. (High in Summer –for seasonal store charging, Lower in Winter – for seasonal store discharging while still meeting heat demands.)
  - Assessment of waste heat availability and potential for harvesting and upgrading.
  - Incorporate models for new heat generation technologies and approaches, size, distribution, efficiency
  - Storage: number, size, temperature, duration, type, location on the network
  - Network of networks, efficiency, cost, robustness implications
- Expansion of model boundary to include domestic electrical loads and their impact on renewable generation requirements (electrification of transport)

Case Study: Loughborough – Developing the modelling capabilities to….

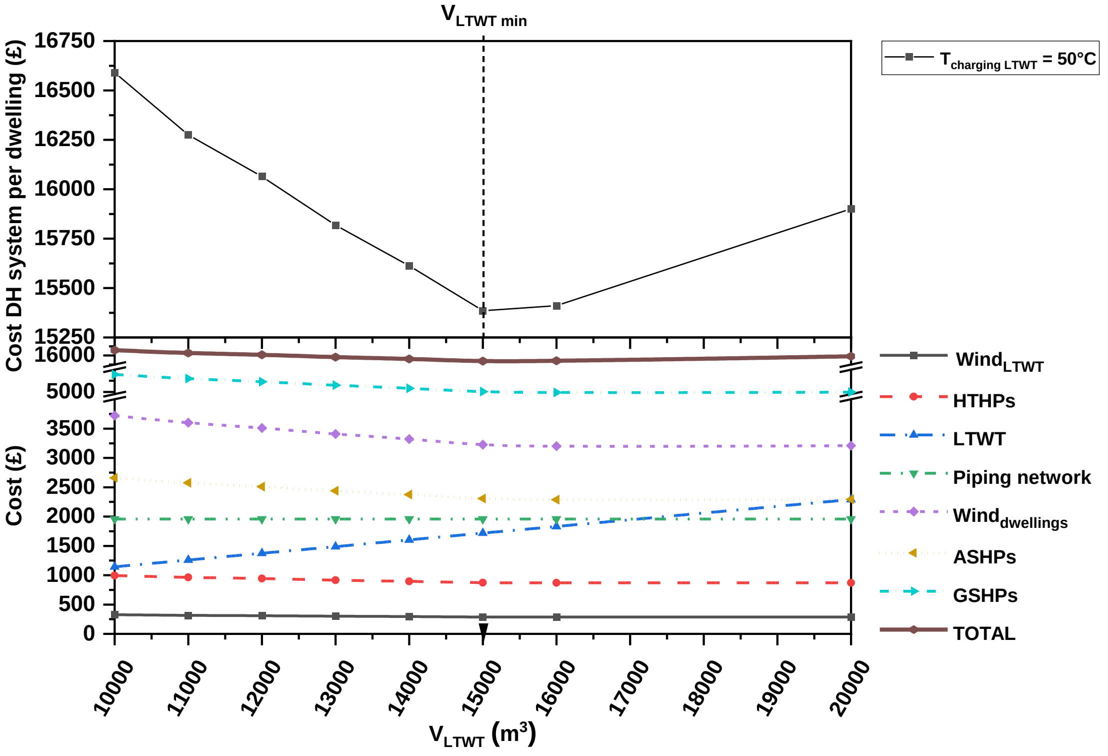
- A range of system options to provide net zero heating
- System cost optimisation to provide indicative cost per dwelling assuming different levels of user uptake
- Influence of network topology and operational strategy on cost and performance
- Cost sensitivity analysis, (flexing costs of each network component) to determine robustness of any proposed solutions
- Sensitivity to building thermal performance and the impact of different levels of building retrofit
- Longer term simulations to confirm solution robustness. (40-60 years of weather data may be required to capture changes in weather other than those due to global warming)
- Assessment of likely future loads (including cooling) and system performance using UKCIP weather data
- Do heat loads need to be met completely 100% of the time? What impacts on cost does flexibility in this area deliver?

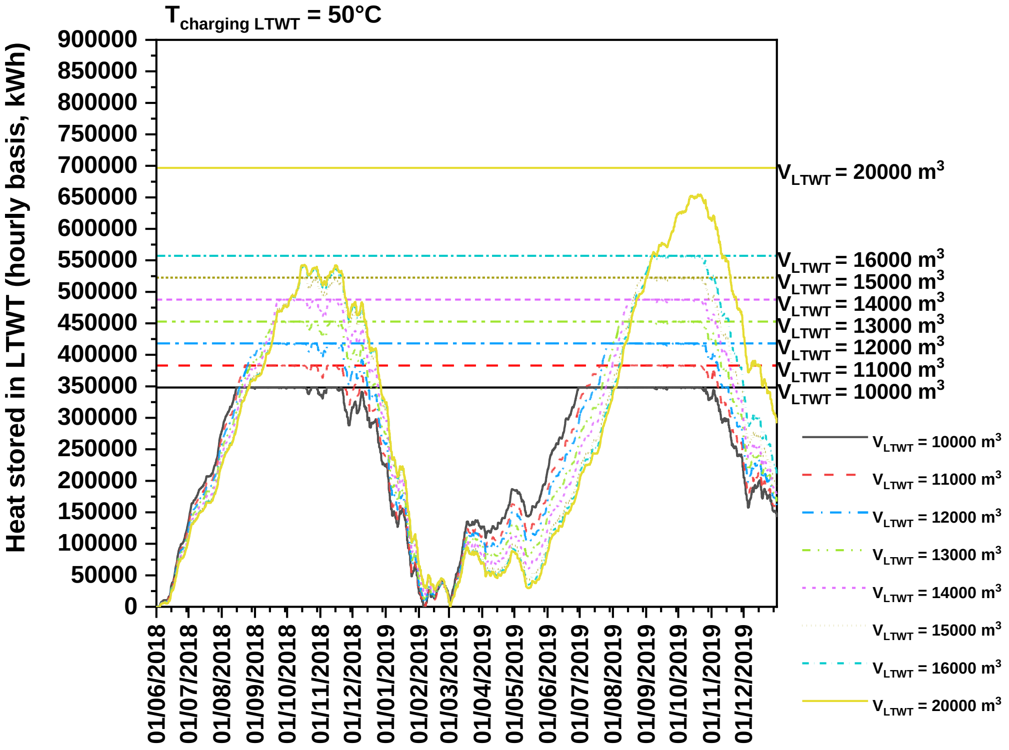
Case Study: Loughborough – Building from the 3 initial case studies

- From analysis and comparison of the 3 case studies a set of key system component options, network topologies and operational requirements will be derived that allow net zero heat delivery to be achieved at minimal cost
- A set of minimal constraints with weightings will be established
    - For example: linear heat density, existing infrastructure, available sites for storage, waste heat sources, available local renewable energy sources, other loads to be met, etc.
- This will allow areas to be assessed and allotted to four different categories:
    - Ideal candidate area, (score >95%)
    - Good candidate area, (score >80%)
    - Possible candidate area, (score > 60%) and
    - Limited potential
- Following an initial sift of areas the model will be applied to areas for which data is available in each of the categories to refine and assess the robustness of the constraints and weightings

Work Package 1.3 – Application to case study

Increasing the volume of the LTWT reduces the cost per dwelling up until a critical volume by reducing the installed capacity of RHS to fully meet heat demands. Further increases result in an oversized store, never fully charged and no further reduction in installed RHS capacity.





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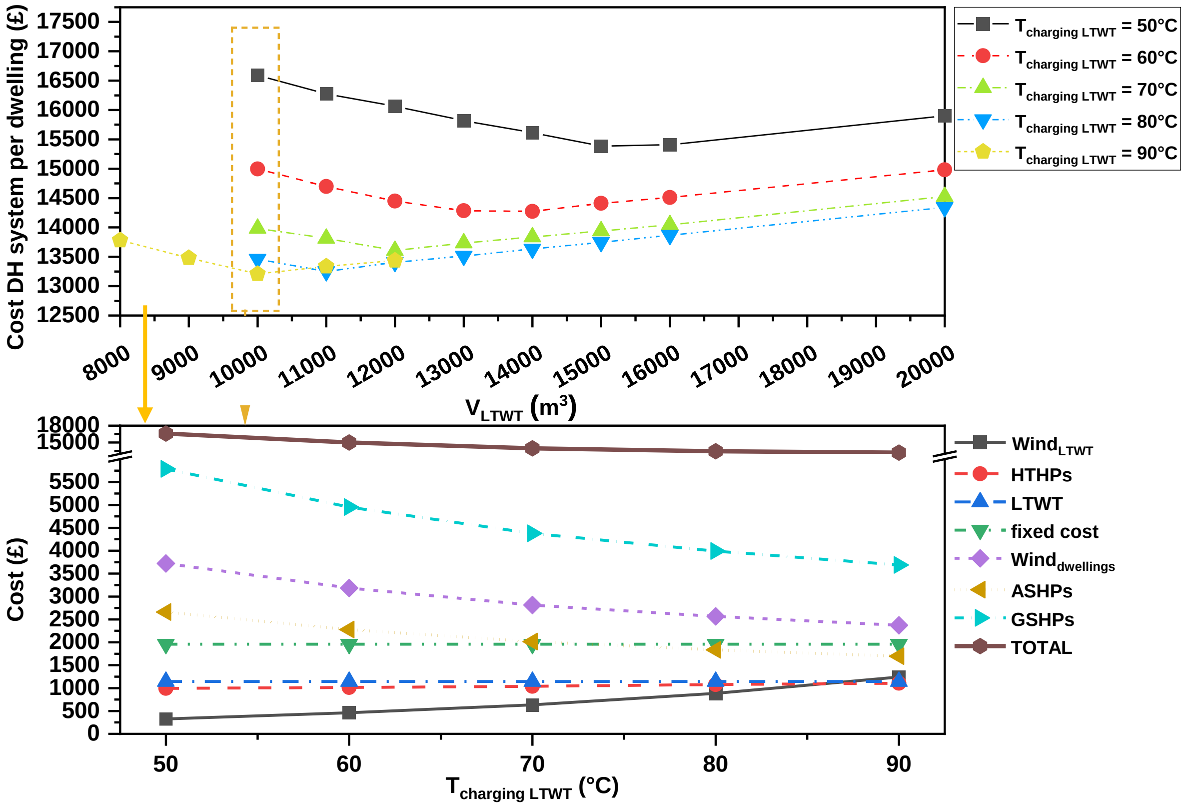
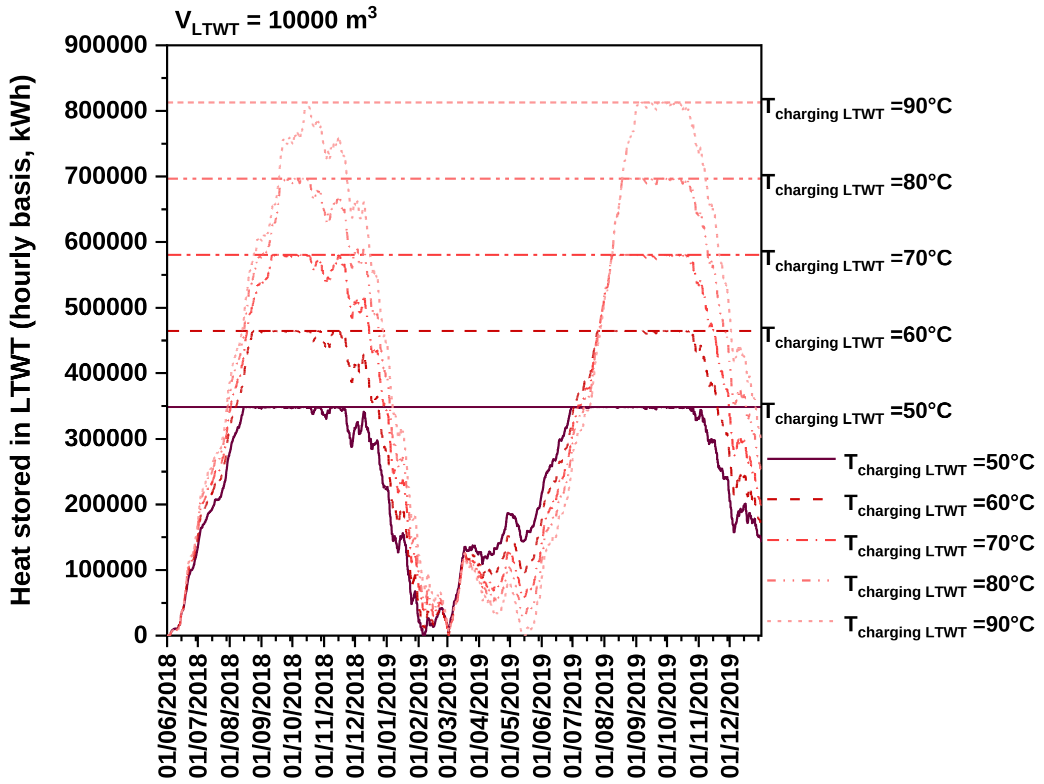
Work Package 1.3 – Application to case study

Increasing temperature in the LTWT reduced costs per dwelling, greater heat storage capacity reduces RHS required to fully meet load.0





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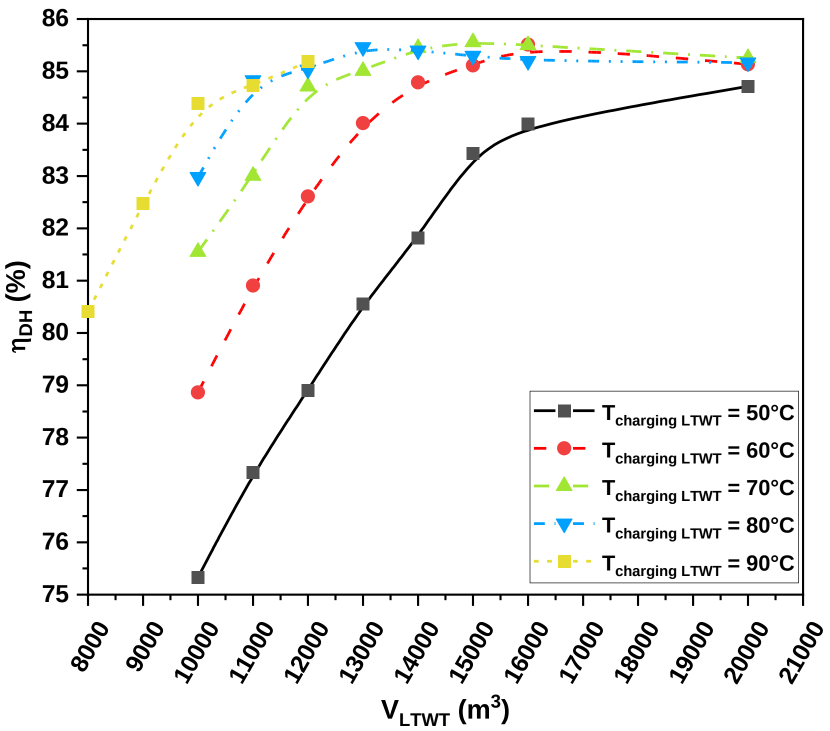
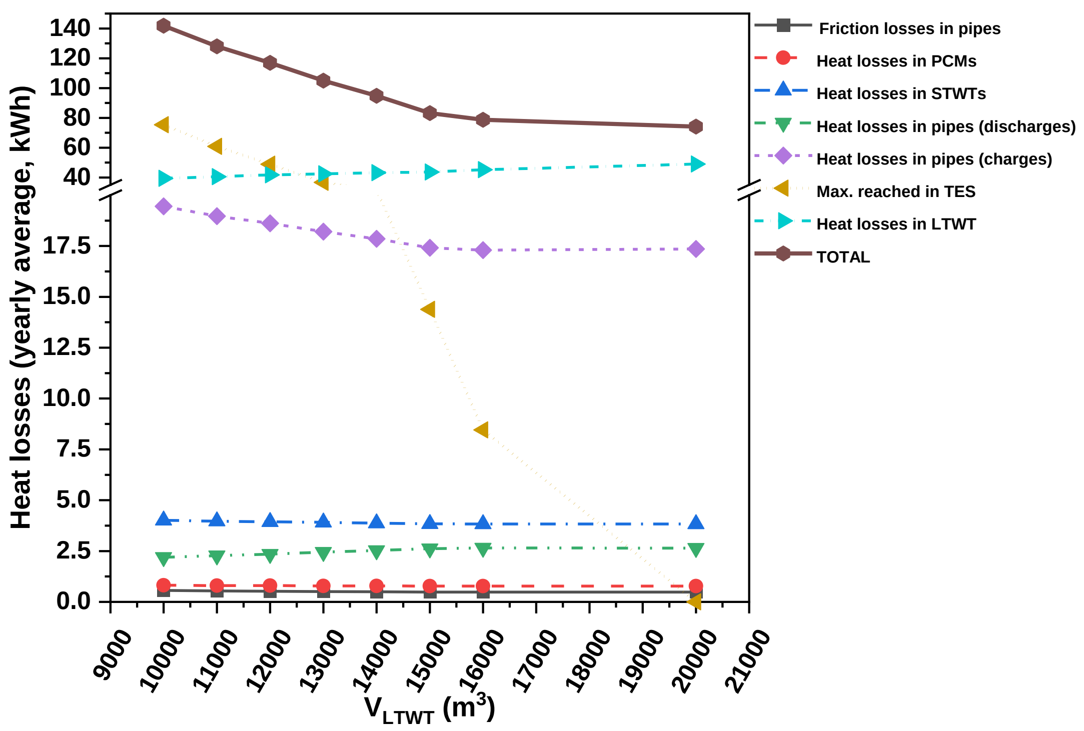
Work Package 1.3 – Application to case study

Increase in LTWT volume initially leads to a rapid increase in efficiency, (heat delivered/heat generated)
After the maximum efficiency is achieved increasing the store volume's impact on efficiency is low.
The major contribution to the change in efficiency results from an increase in renewable heat being stored and a reduction in generated renewable heat being shed.





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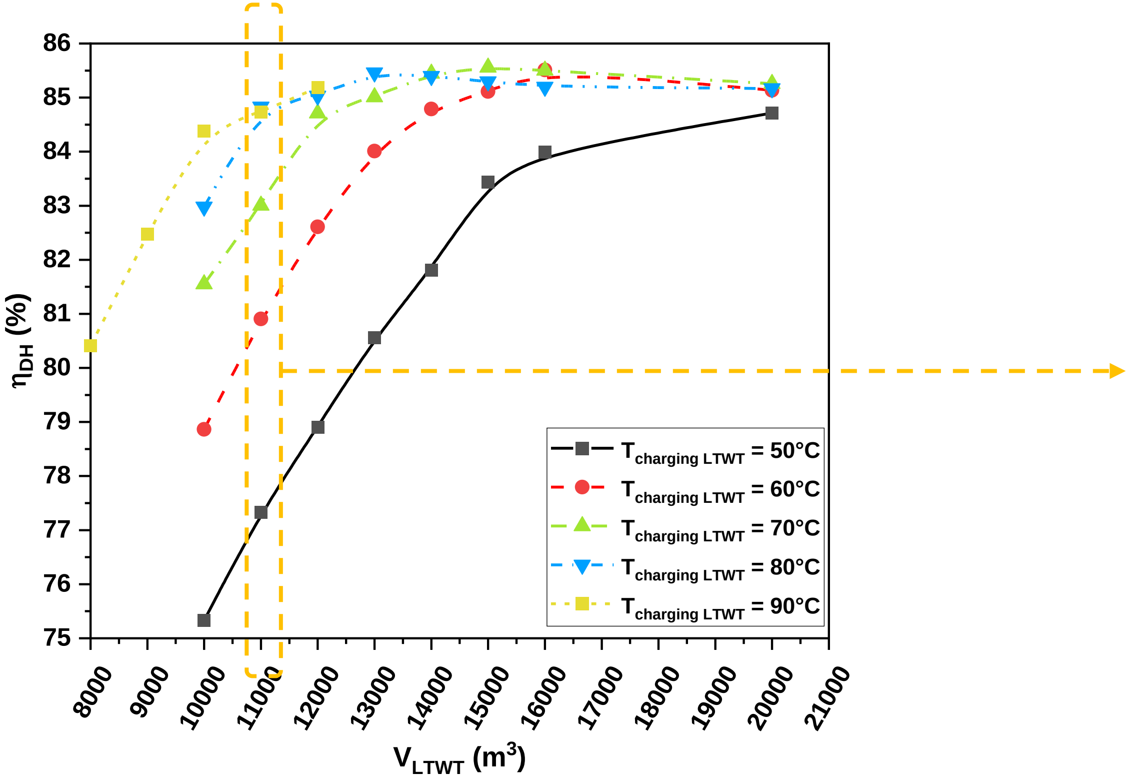
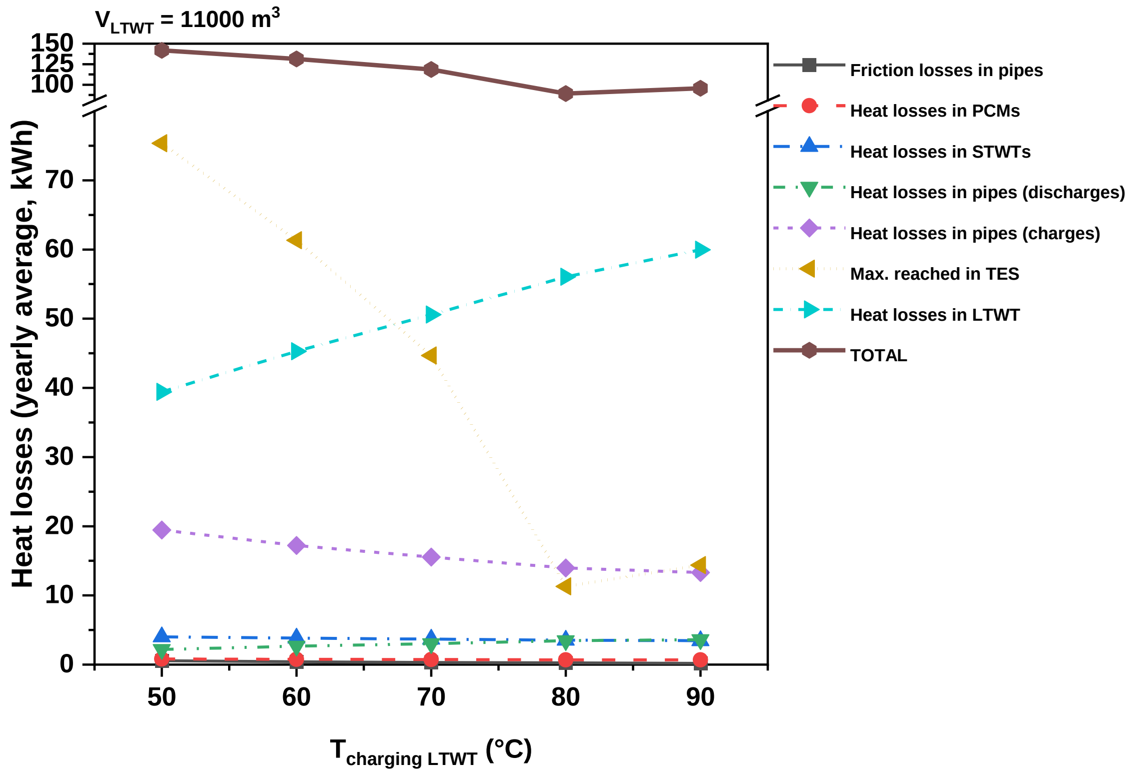
Work Package 1.3 – Application to case study

Higher LTWT storage temperatures increase system efficiency for a given store volume by increasing the energy storage capacity, reducing the shedding of renewable generated heat at times of low demand.





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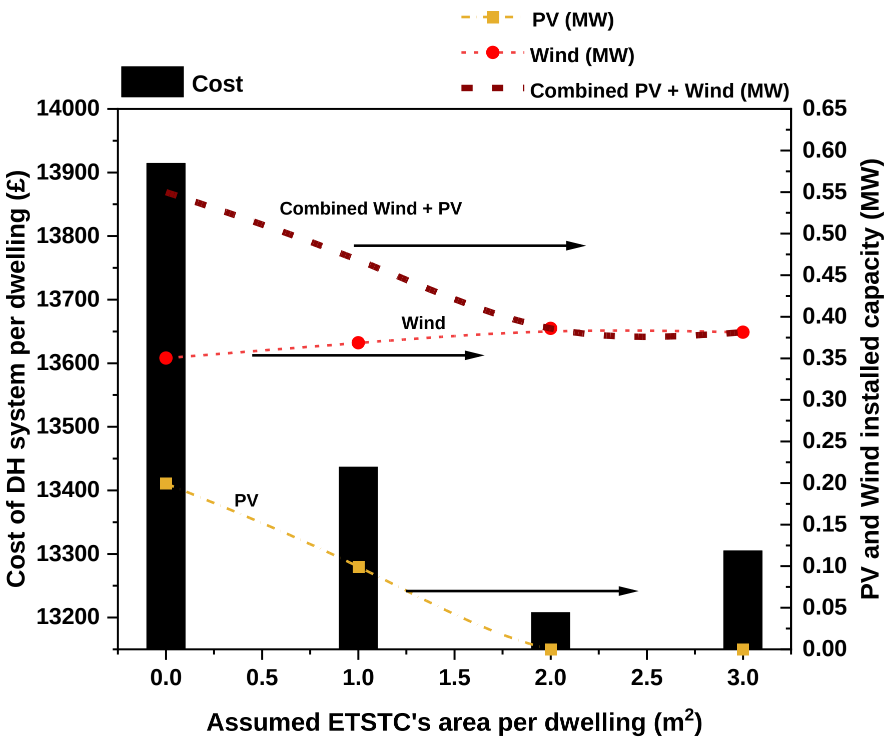
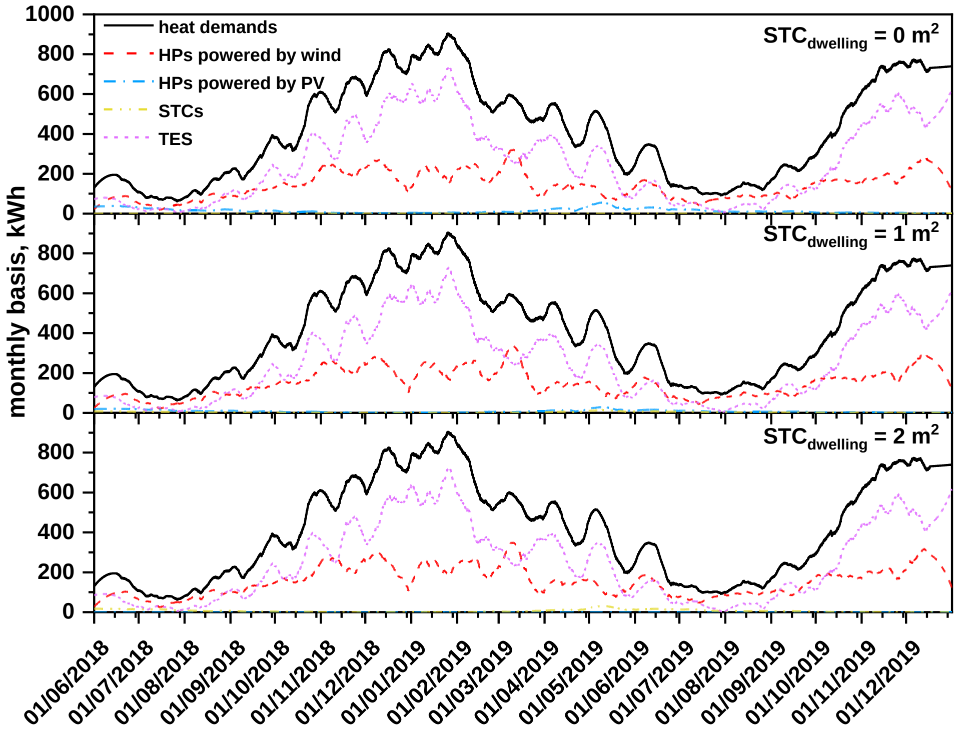
Work Package 1.3 – Application to case study

Average areas of ETSTC of less than 2m2 lead to an apparent decrease in the DH system cost due to a reduction in installed capacity of PV and wind. This appears to be due to the initial operation of the system in summer, no energy in storage , low capacity factor of wind in this period and high efficiency of solar thermal ETSTC.





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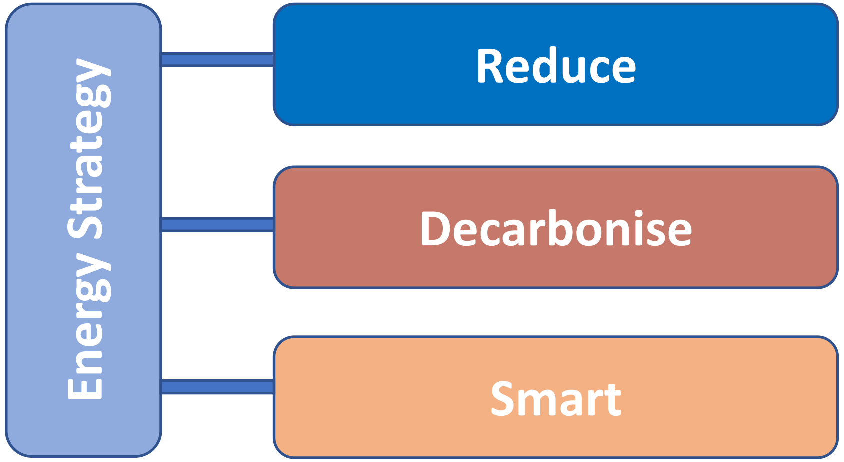
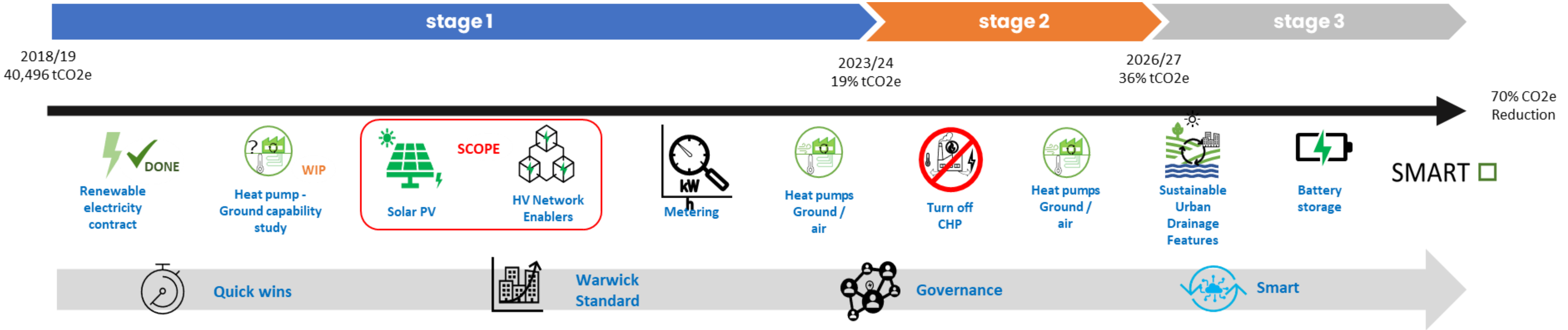
Case Study Warwick – The Integrated Campus Case



- University of Warwick Campus
  - ~£10pa spend, community of 34,000
  - Net Zero for Scope 1&2 by 2030
  - Net Zero for Scope 3 by 2050
- Energy & Infrastructure Strategy
- Projects
  - Energy 2020 – campus level solutions that decarbonise supply
  - Smart Square – smart, integrated system using a LoT-NET
  - The Warwick Standard – better buildings; new and retrofit
  - Management of Energy Networks – becoming a local DSO offering flexibility
- Now encompasses **Work Package 4.5** – Low temperature heat networks in Smart Local Energy Systems

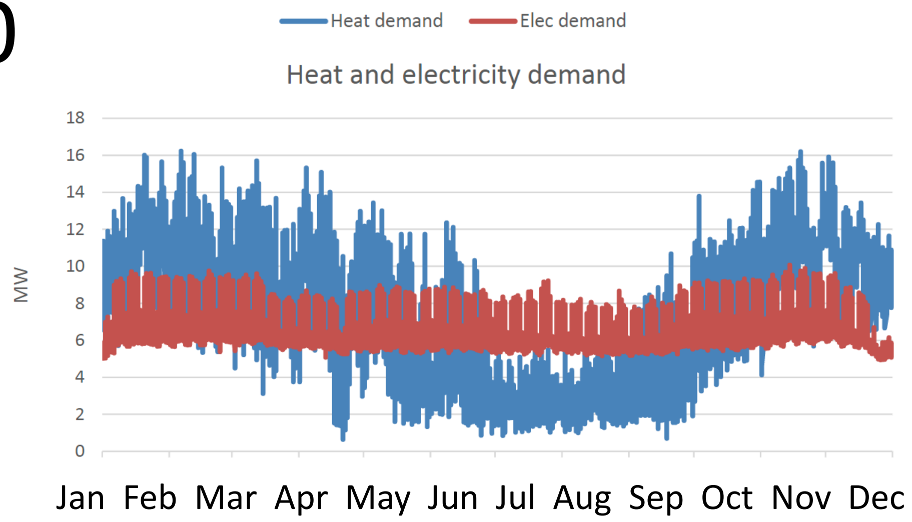
The role of heat and a LoT-NET in the Warwick Case Study



- Energy 2020
  - BEIS HNDU study: central vs local to achieve low/zero carbon heating across campus, including storage
- Smart Square
  - BEIS LoT-NET Study
  - Smart Square LoT-NET HP study: “commercial” vs “industrial”
  - Honeywell/Schneider Smarter Buildings study
  - Smart & Flexible: empirical analysis of actual building performance to identify key energy assets
- The Warwick Standard
  - Reducing heat demand in operation through better building standards; reducing Scope 3 emissions through heating design

Case Study: **Warwick** – Energy 2020

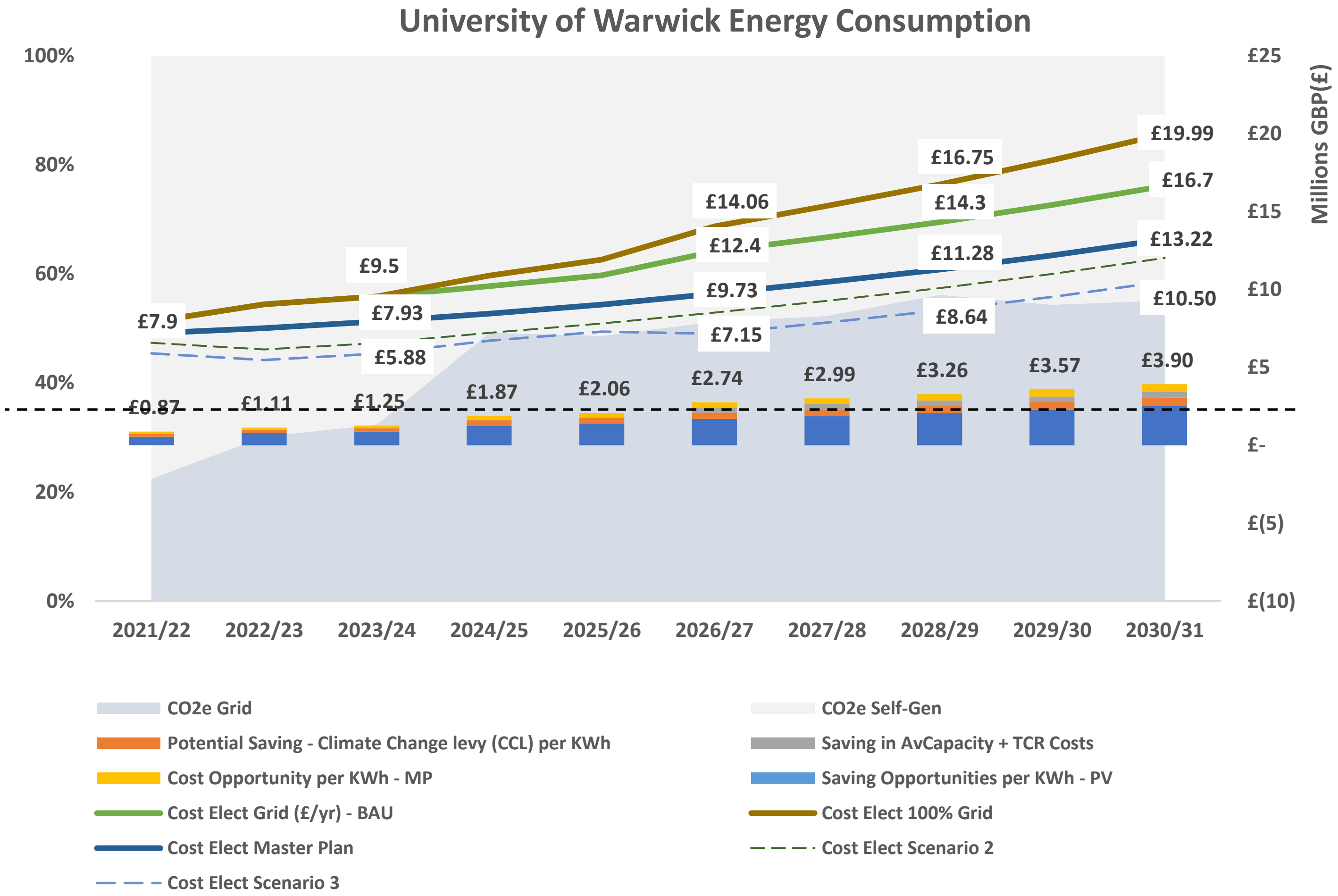
- Energy 2020 projects – campus level
  - Onsite PV generation (6-12MW) with battery storage (1MW) and electrical network improvements
  - Heat: BEIS HNDU project to determine what scale of HPs, where across campus
  - Near term goal: halve central CHP use and shifts the heat network from central supply to more distributed sources & storage
- Developing the “business case” for investments
  - From Carbon Savings to Investment Decisions!



Energy 2020 Business Cases: Understand Financial Performance

- **Approach and Analysis**

1) Three Scenarios were proposer to evaluate potential advantages and risks from different investment options
2) LCOE drove analysis to compare each scenario
3) LCOE allowed to compare different technologies and approaches again commercial alternatives like PPA or DNS
4) £37m tax savings may be achieve
5) Project economics helped to identify minimum instal capacity required for project to payback



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Business Case: Use of LCOE allowed easy evaluation of options

Option	Scenario	Levelized Cost of Energy (LCOE - p/KWh)	Net Present Value (NPV - £)	Payback Period (PbP – yrs.)	Return on Investment (ROI - %)	Internal Rate of Return (IRR - %)
-	**Business as a Usual**	12.77	N/A	N/A	N/A	N/A
-	**Grid Electricity**	19.12	N/A	N/A	N/A	N/A
1	**6 MW inc. relocation and reinforcement** NZCP	11.63	-£ 3,554,901	16.7	84%	2.52%
2	**6 MW inc. NO relocation with reinforcement** Graph. 05-02 appendix	10.12	£ 2,482,170	12.6	159%	8.73%
3	**6 MW inc. NO relocation NO reinforcement** Graph. 06-02 appendix	8.41	£ 4,495,306	10.4	177%	10.70%
-	**20 yrs. PPA contract Est**	14.48	N/A	N/A	N/A	N/A

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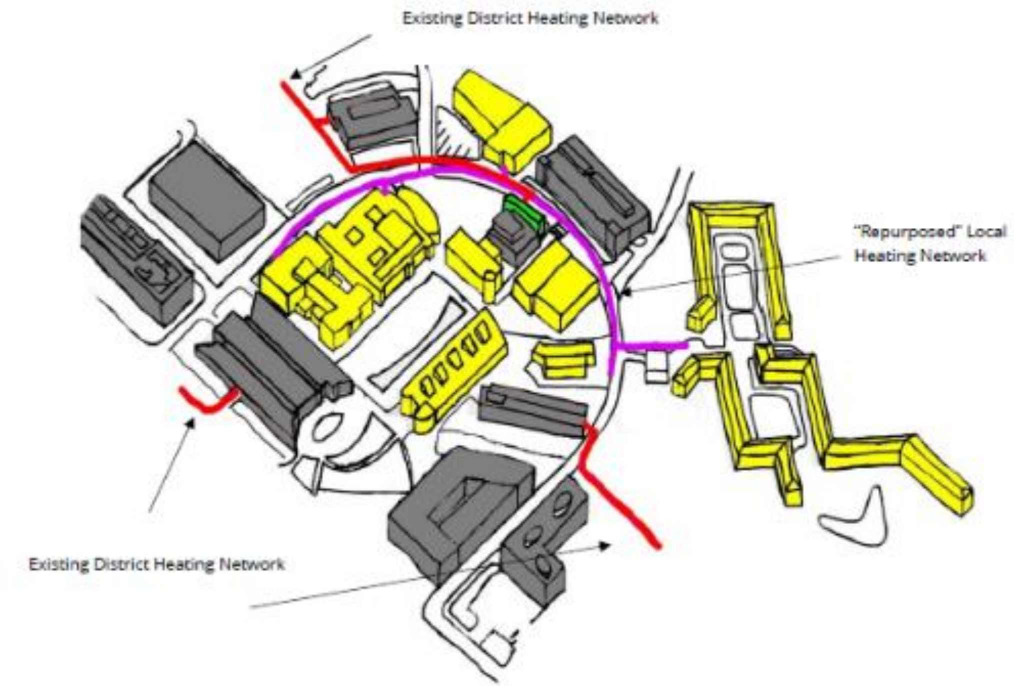
Applying this Business Case framework to UoW's heating network

- **Framing the scenarios**
  - Both legacy and future parts of the system interact in more complex & interdependent ways than for electricity/PV
  - Levels of comfort cause wider variations in heat consumption
- **Proposing Investment Choice Scenarios**
  - CHP/boiler/electricity via heat network (BAU)
  - All CHP via heat network
  - All central boilers/electricity via heat network
  - Mixtures of central and decentralised HPs with varying levels of heat network use
- **Required Data and Assumptions**
  - Agreement needed for a significant set of assumptions
- **Presenting the no regret, incremental investment choices.**
  - Work in progress



Case Study: Warwick – HNDU project

Techno-Economic Feasibility analysis will build on current District Heating network to investigate possible solutions to transition away from gas-fired CHP to low-/zero-carbon heat source.

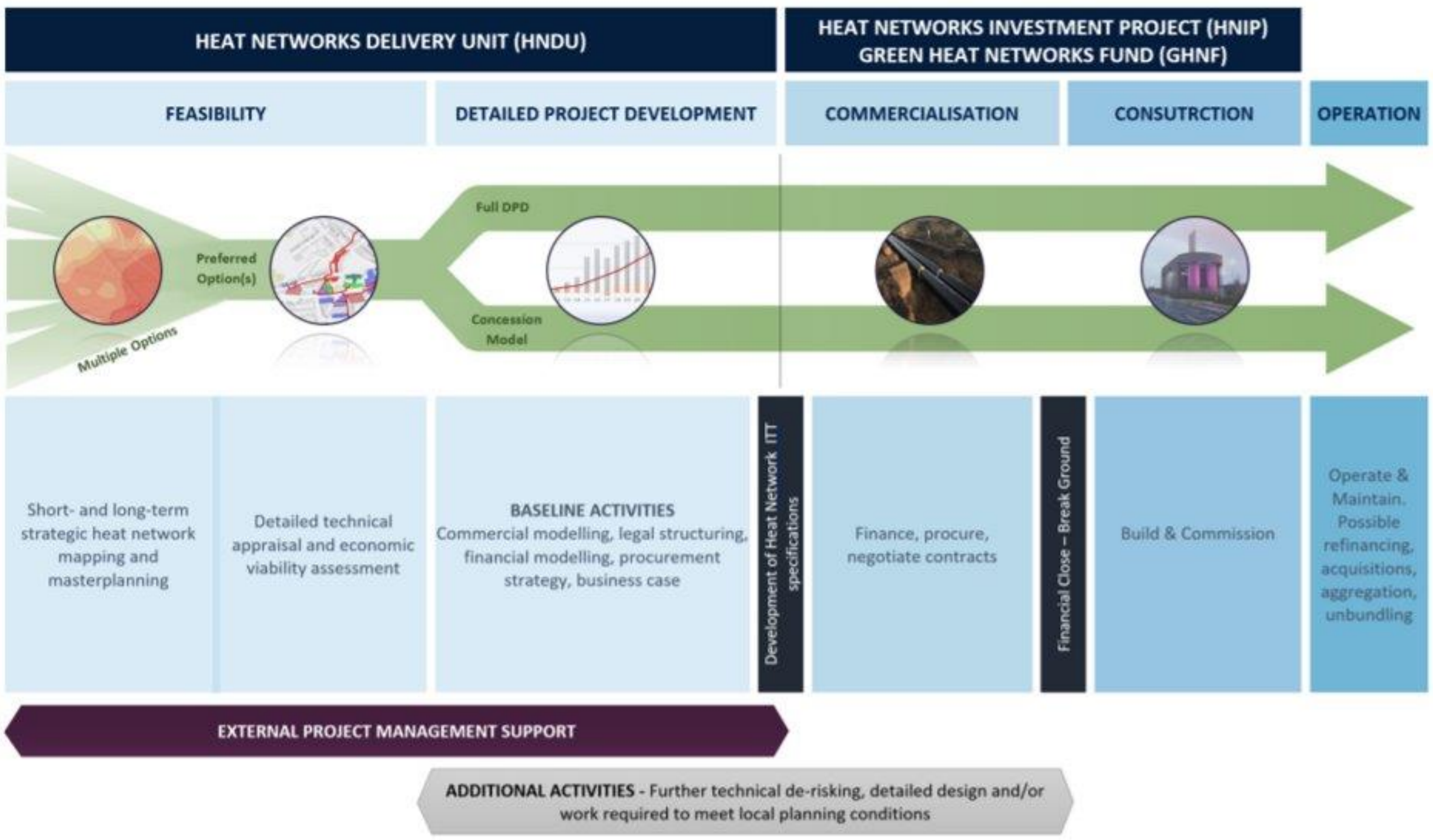
- Current network length **23 km** expanded from initial 16 km (2001)
- **150+ buildings connected**
- Main sources of heat: **Cryfield and Main Energy Centre gas fired CHP plants**
- **37 GWh of electricity** and **52 GWh of heat** are generated per year
- Number of **thermal stores** at major connection points
- Current renewable energy sources include **249 kW solar PV** (soon to be 344kW) and solar thermal panels
- Recent **network expansion** to connect further buildings and planned expansion to connect **new buildings developments**

Case Study: Warwick – HNDU project

Updated scope aims for a traditional feasibility study with the flexibility to incorporate various areas of interest given the available budget.

1. **Centralised heat pump (GSHP / ASHP) to replace centralised CHP**
   - Abide by the University of Warwick’s 2030 aims for net zero
   - Investigate 3rd/4th/5thgeneration heat networks
2. **Introducing small distributed low-carbon generation**
   - At building level, determine whether a site is better with its own low-carbon heating or connected to the heat network
3. **Heat network zoning**
   - Determine the feasibility of splitting/joining different heat network zones (i.e. Gibbet Hill Campus)
4. **Building optimisation**
   - Incorporate potential energy savings affecting annual and peak heat demands from previous studies, carried out by University faculty members and third parties, into network design
5. **Expansion/contraction analysis**
   - Consider the feasibility of including confirmed and likely campus expansions into the heat network

Figure 1: Heat Network Development Stages



HNDU project

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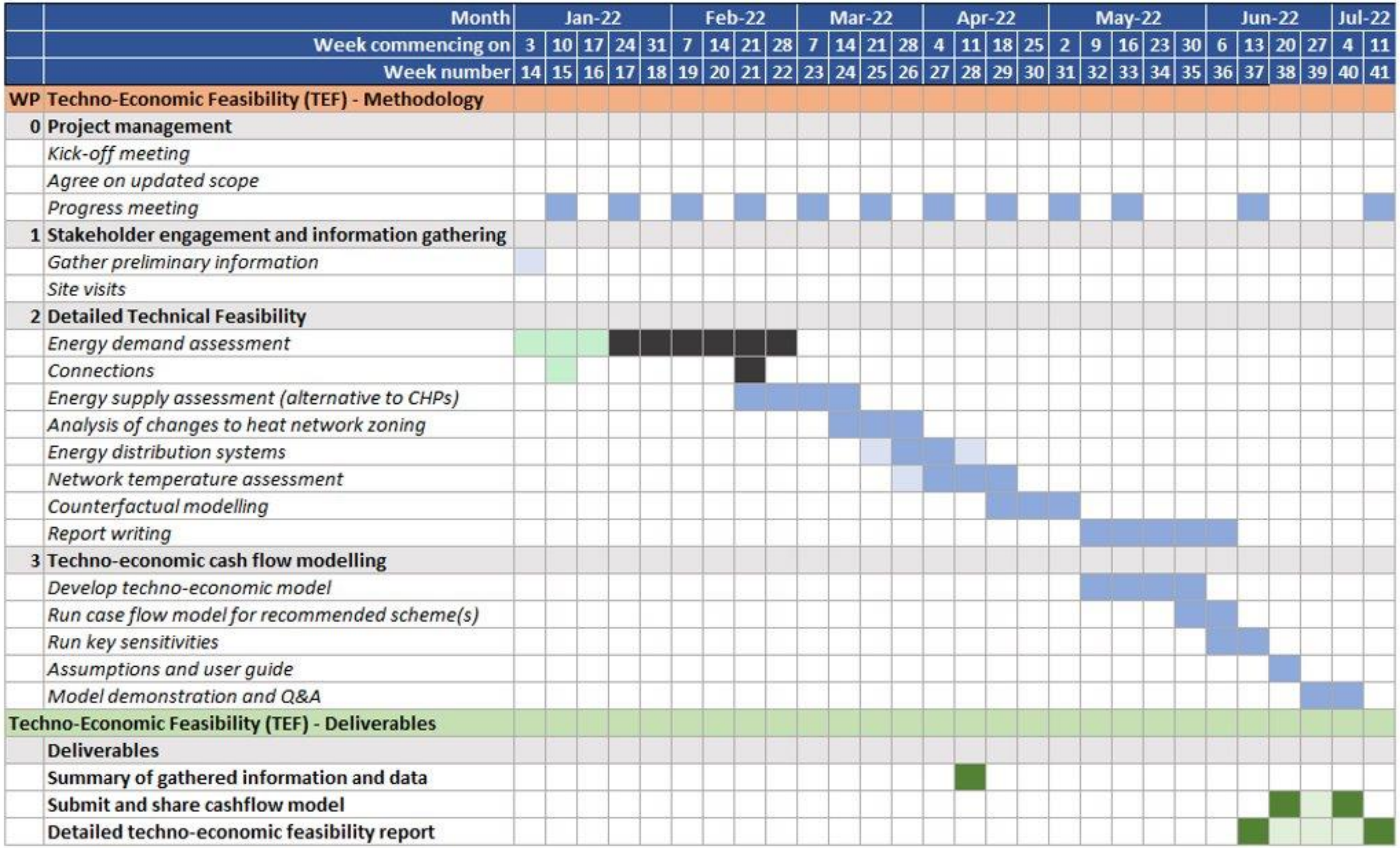

HNDU – Gantt chart

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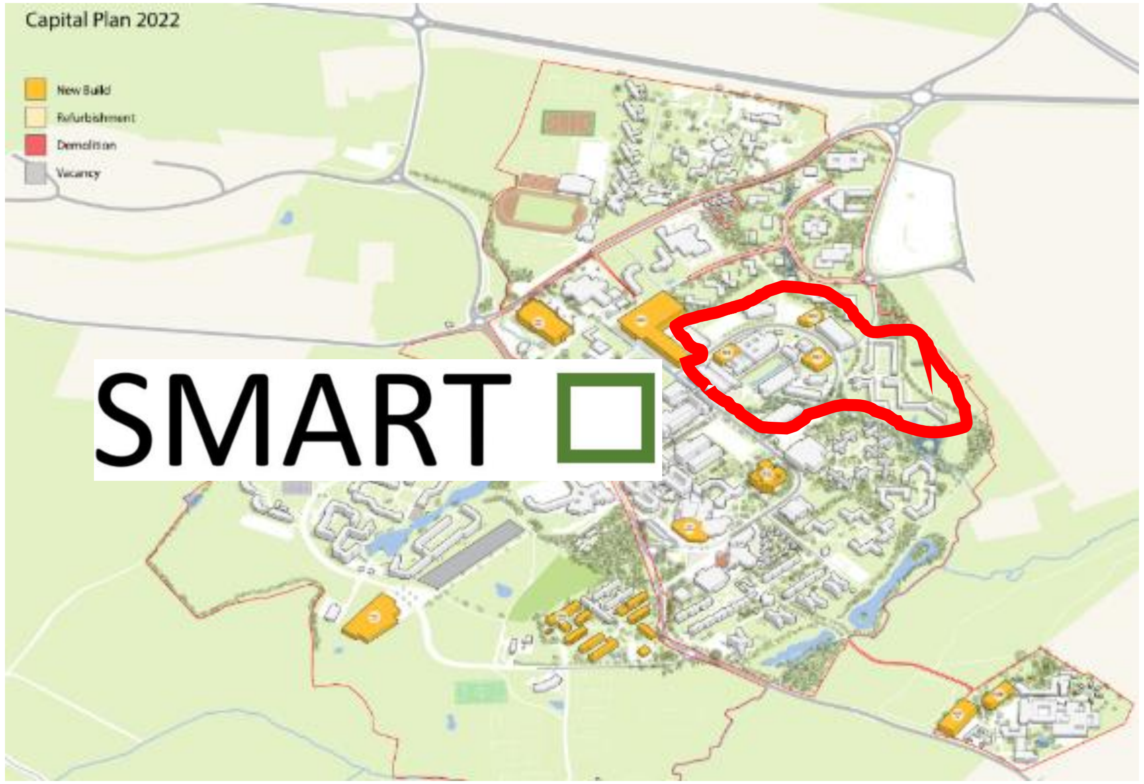
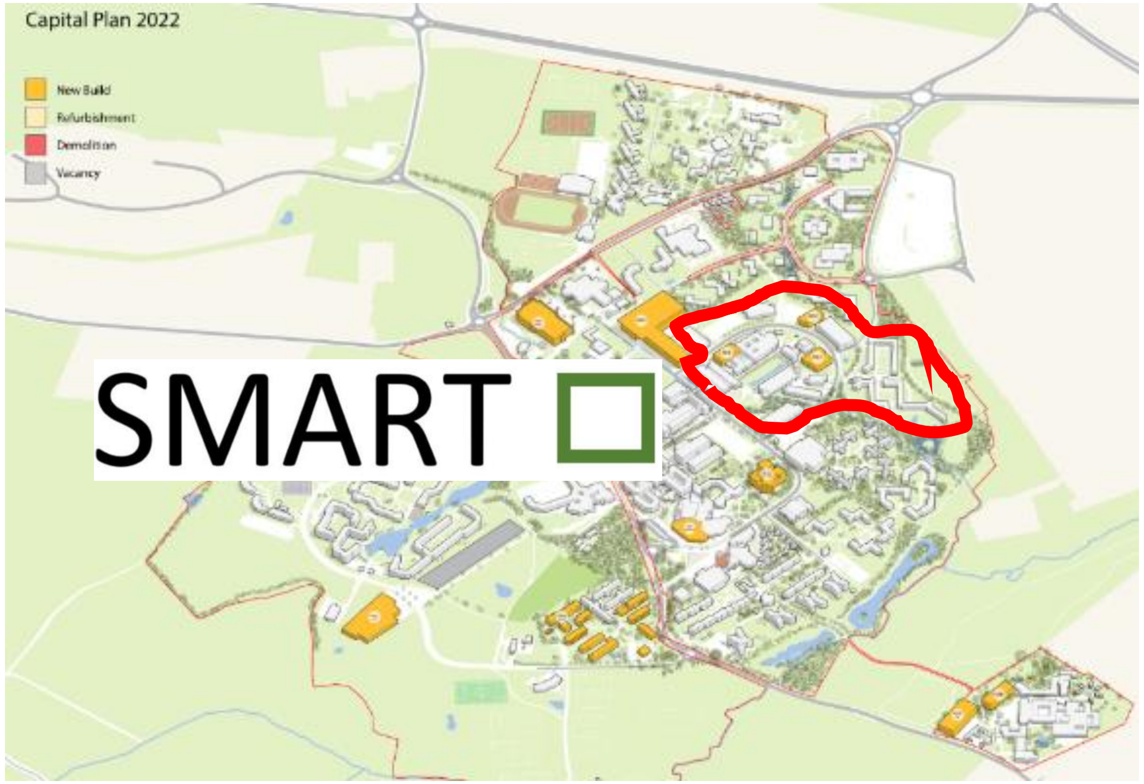
Case Study: Warwick – Smart Square

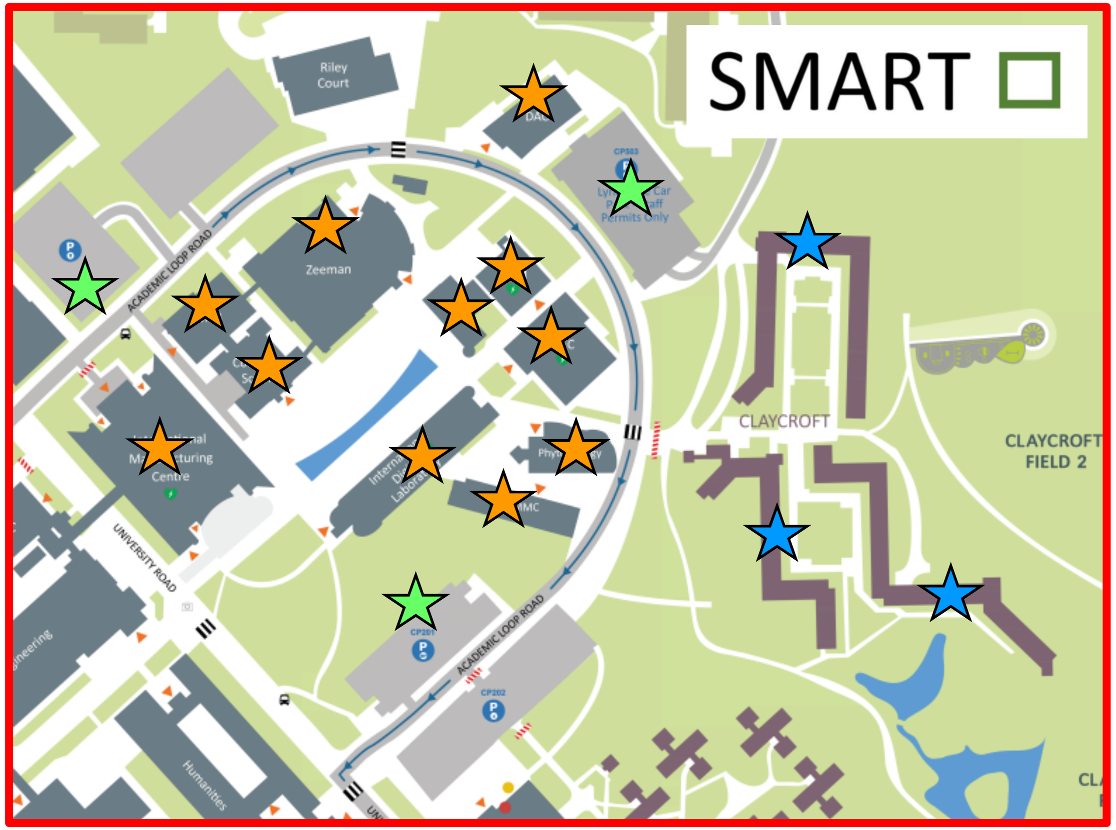
- Upgrades 10% of campus:
  - Lower temperature heat network
  - Integrated management across power, heating, cooling and transport
  - Smart building demonstrators
  - Opportunities for a transactive energy platform.
  - Significant levels of monitoring and control in place that provides actual building and network performance.
- Achieving a smart, flexible, local energy system
  - Cost and carbon
  - To be rolled out across Warwick, and beyond…



Case Study: Warwick – Smart Square Activities

- Smart Square LoT-NET analysis
  - Technical analysis for Smart Square transition
- Smart & Flexible Buildings
  - Empirical analysis of building performance
  - RA has been on parental leave since last AB
- Smart Square HP Evaluation
  - HP options to decarbonise Smart Square
- Smarter Buildings Study
  - Phased actions to make Smart Square buildings and their control systems smarter

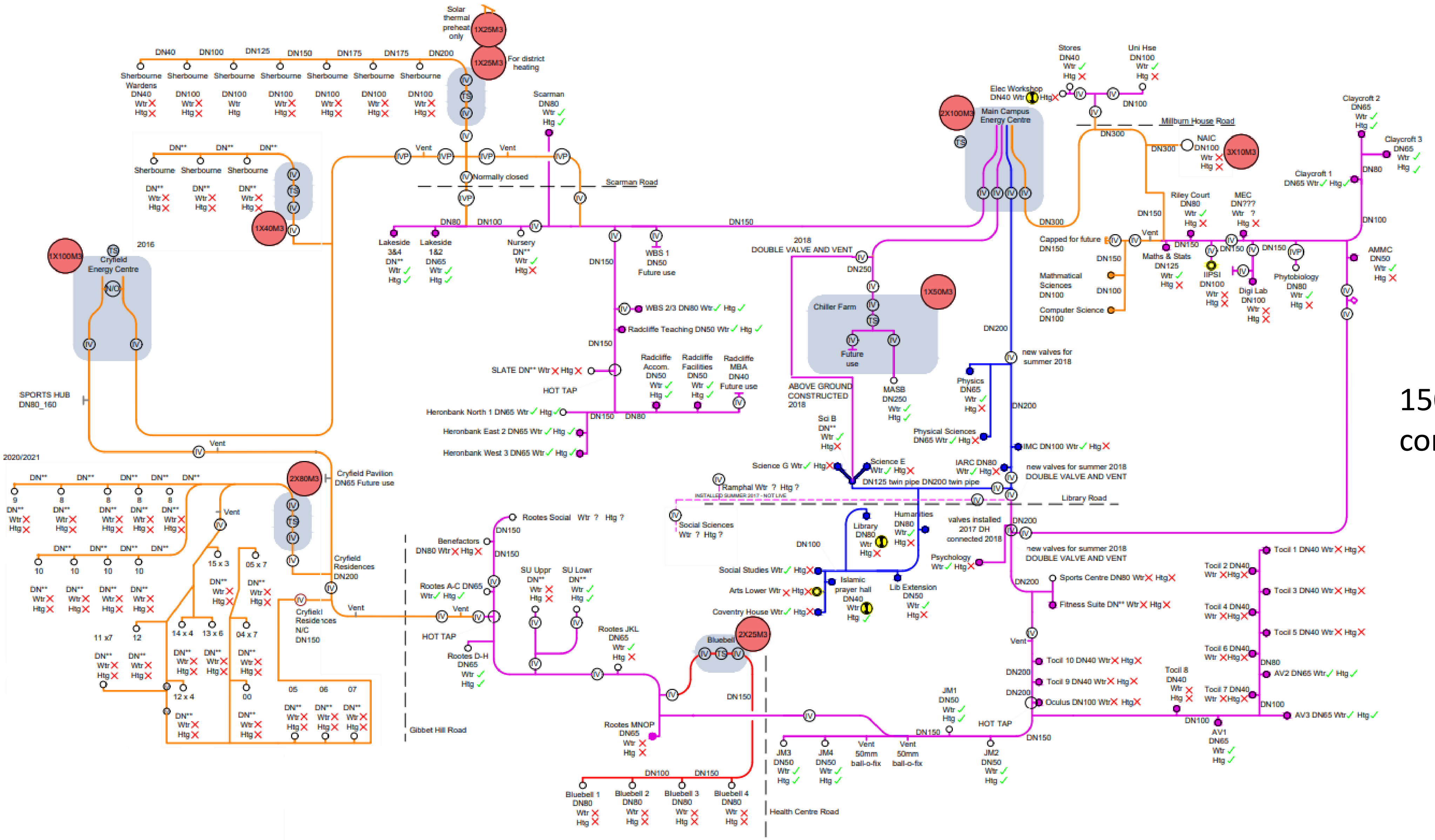




SmSq in the University of Warwick Campus:

- 17 buildings - mixed use (built 1992-2019)
- ≈ 50:50 heat and power use
- Seasonal profiles: heating, cooling, power, PV & E

Residential / Non residential / Car Park



150+ building connections

District Heating system

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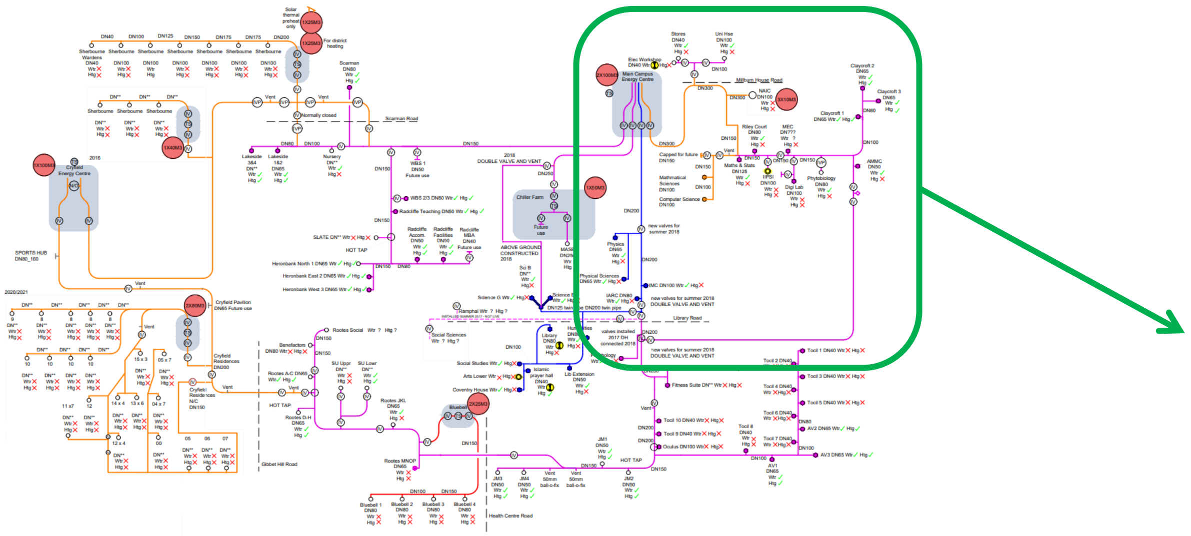
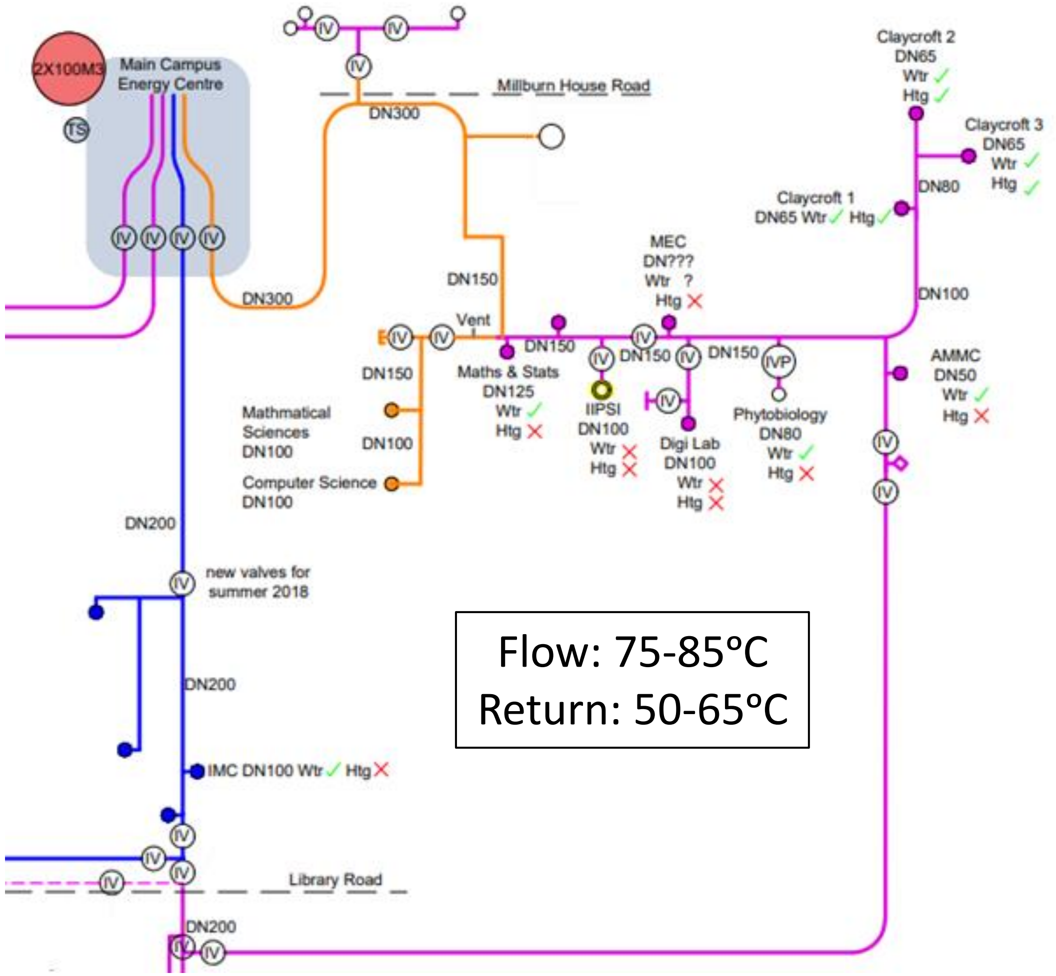
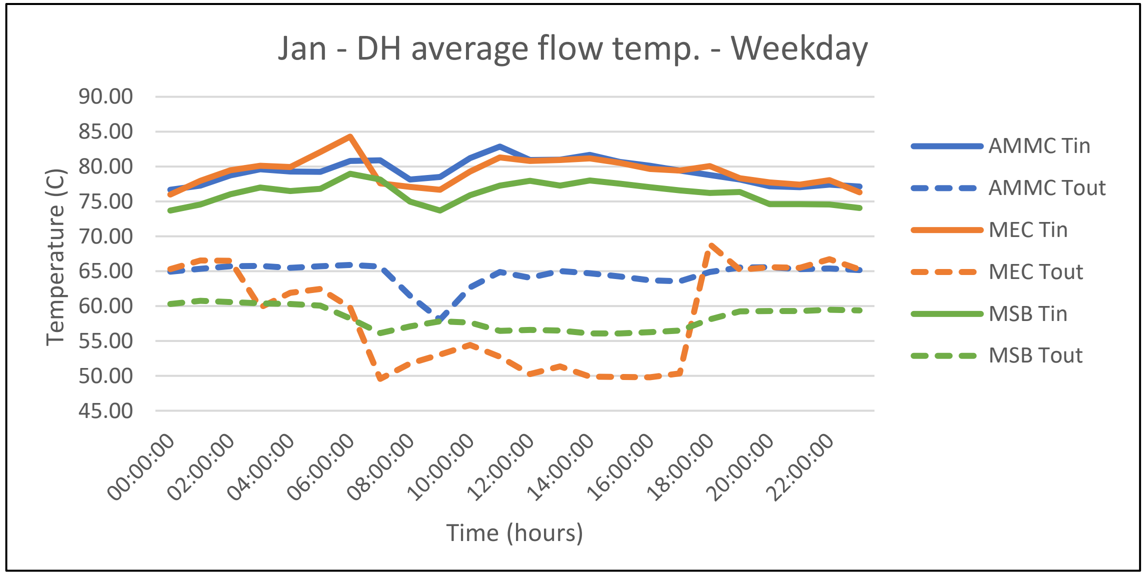
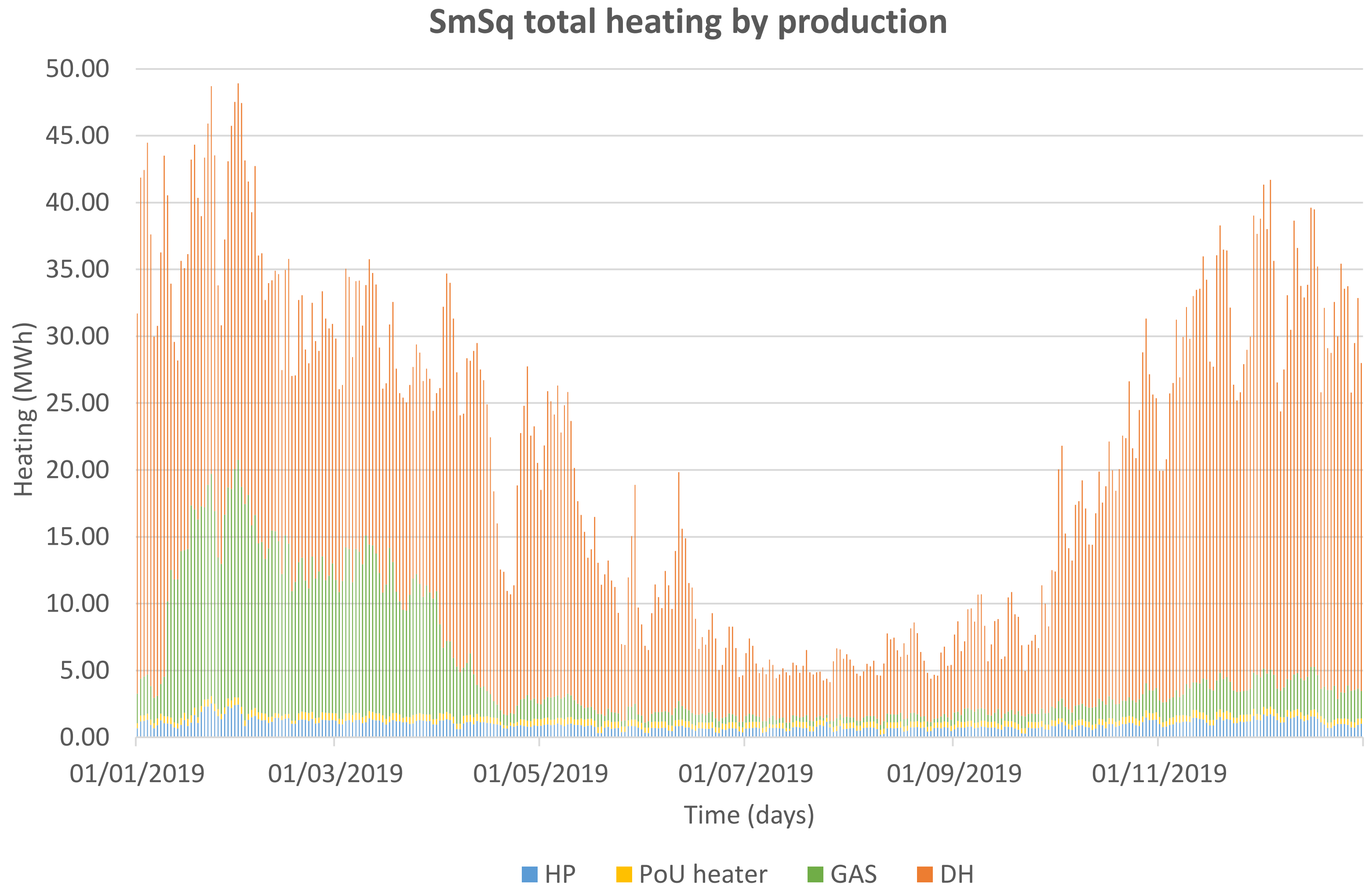


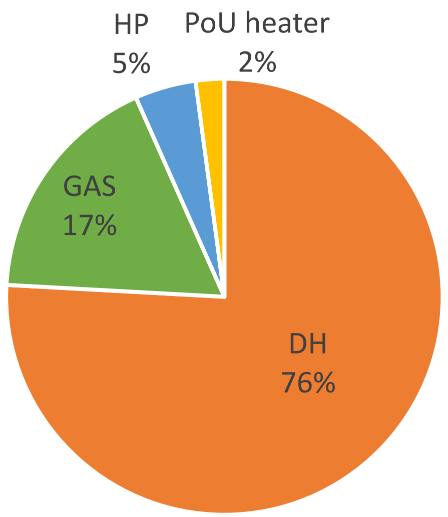


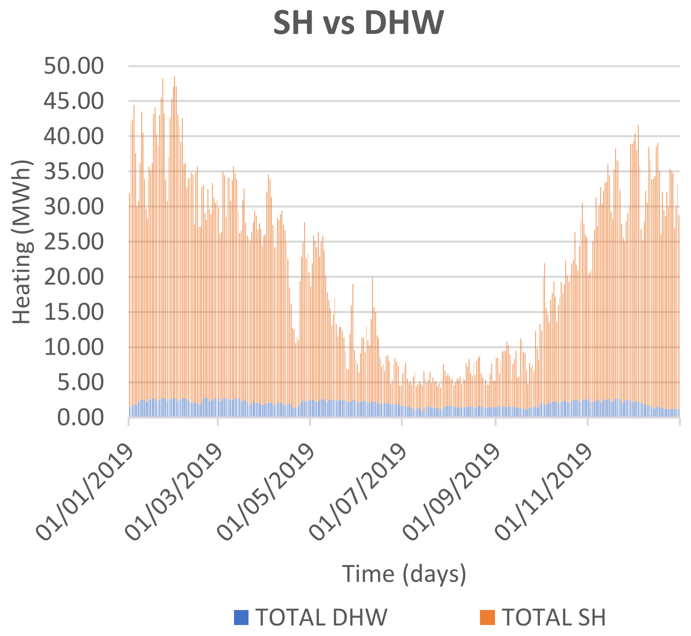
Wtr ✗ No hot water without district connection
Htg ✗ No heating without district connection
Wtr ✓ Hot water can be maintained without district connection
Htg ✓ Heating can be maintained without district connection



Total heating consumption in 2019 → 7765 MWh







Type of heat production

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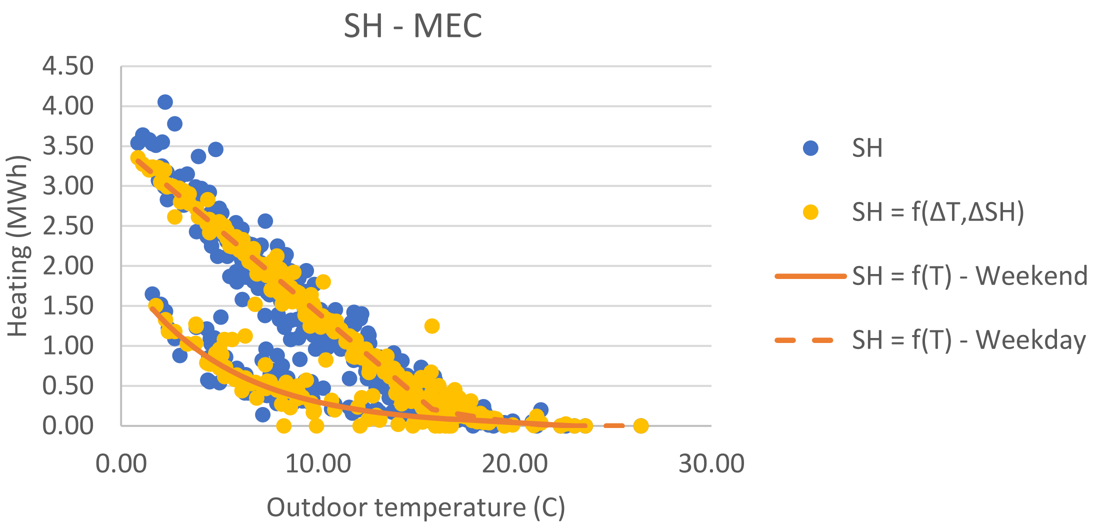

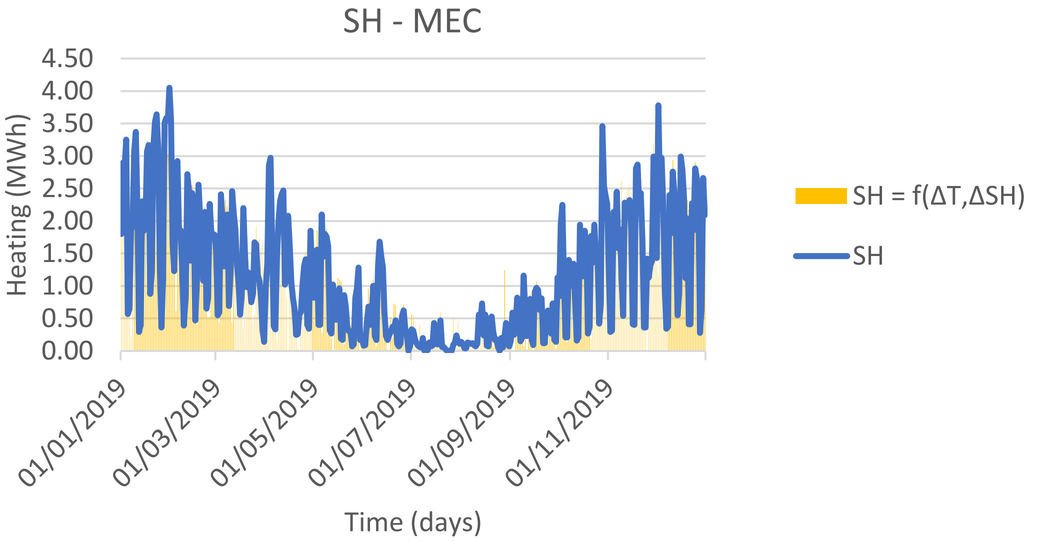

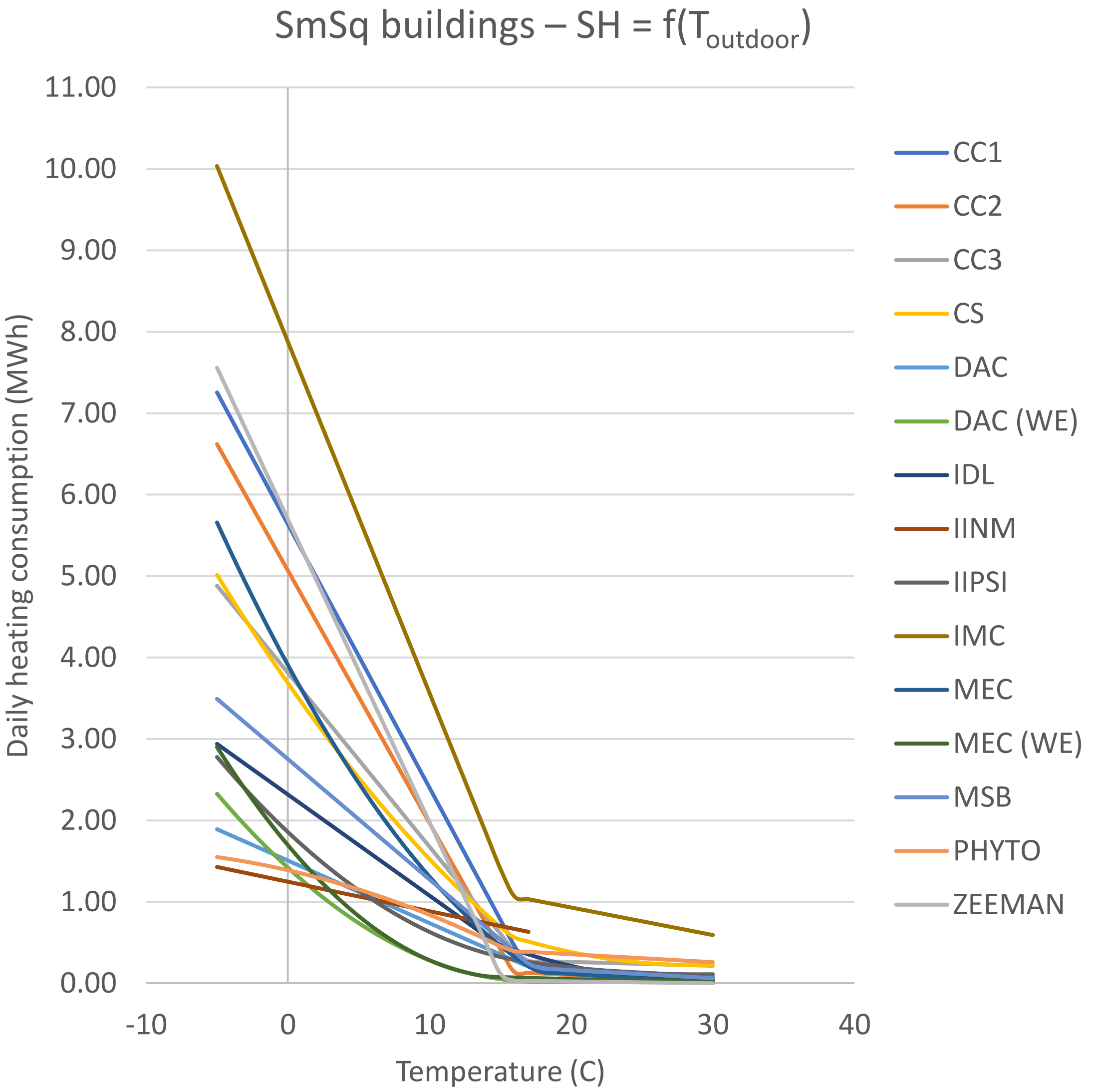

Daily consumption $f(T_{outdoor})$

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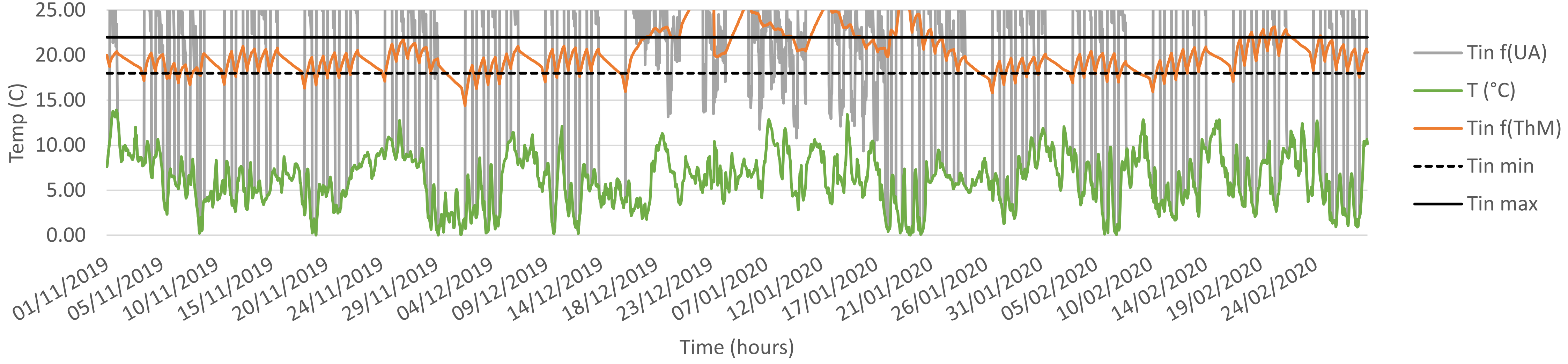
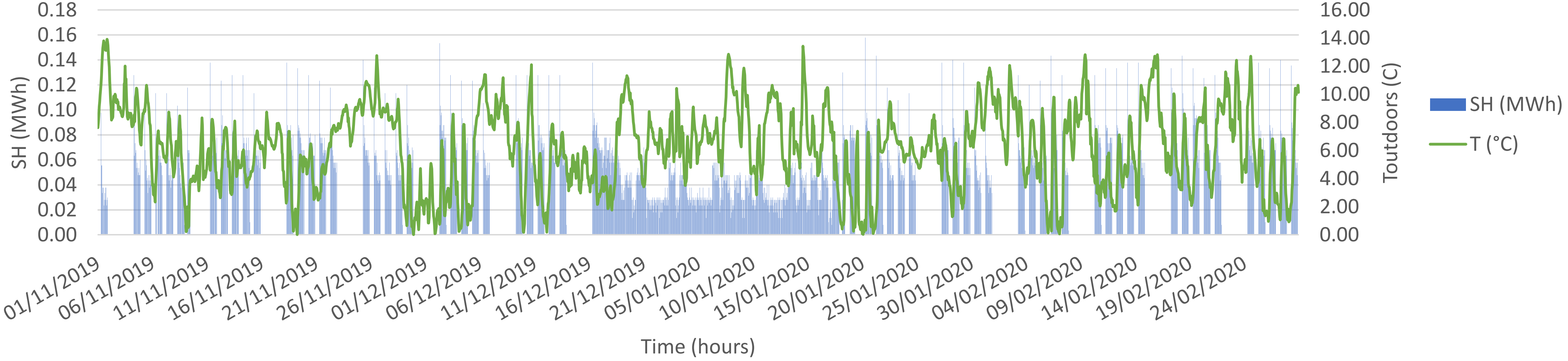
SH hourly profiles

Th Mass	Th Mass/m2	% within limits
570,000,000	211,460	70%





Thermal Mass of building

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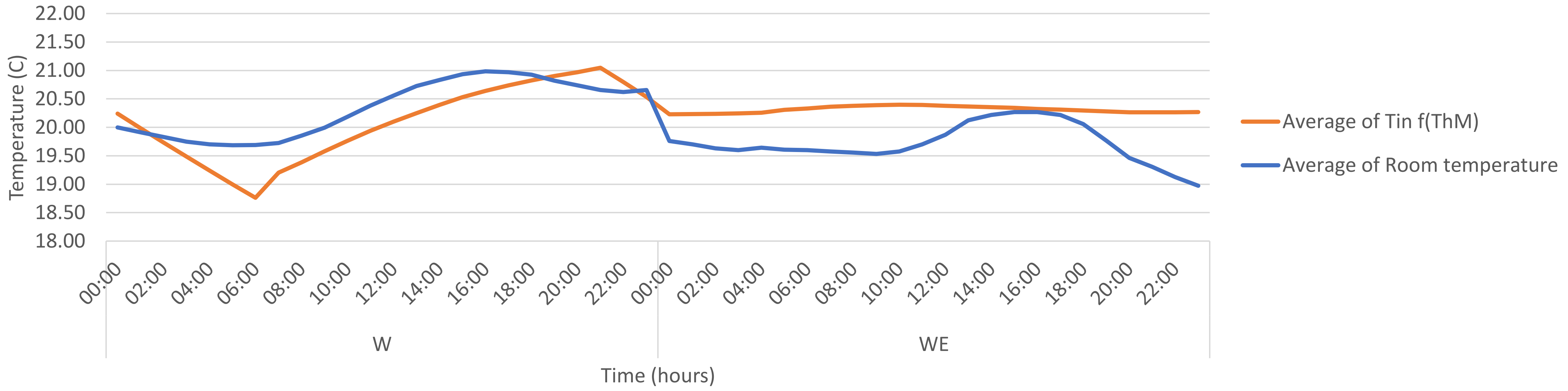

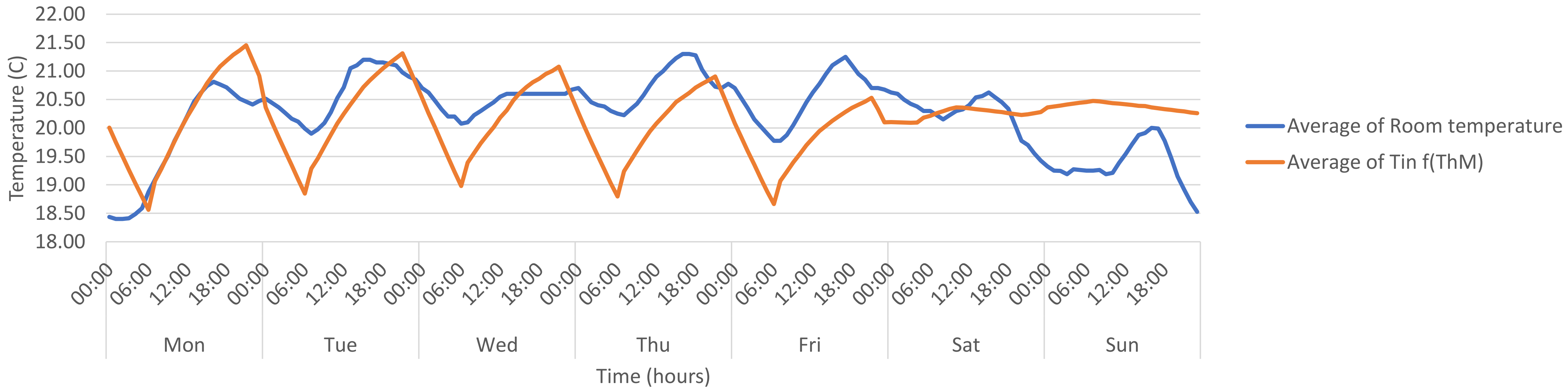

Thermal Mass calc - BMS

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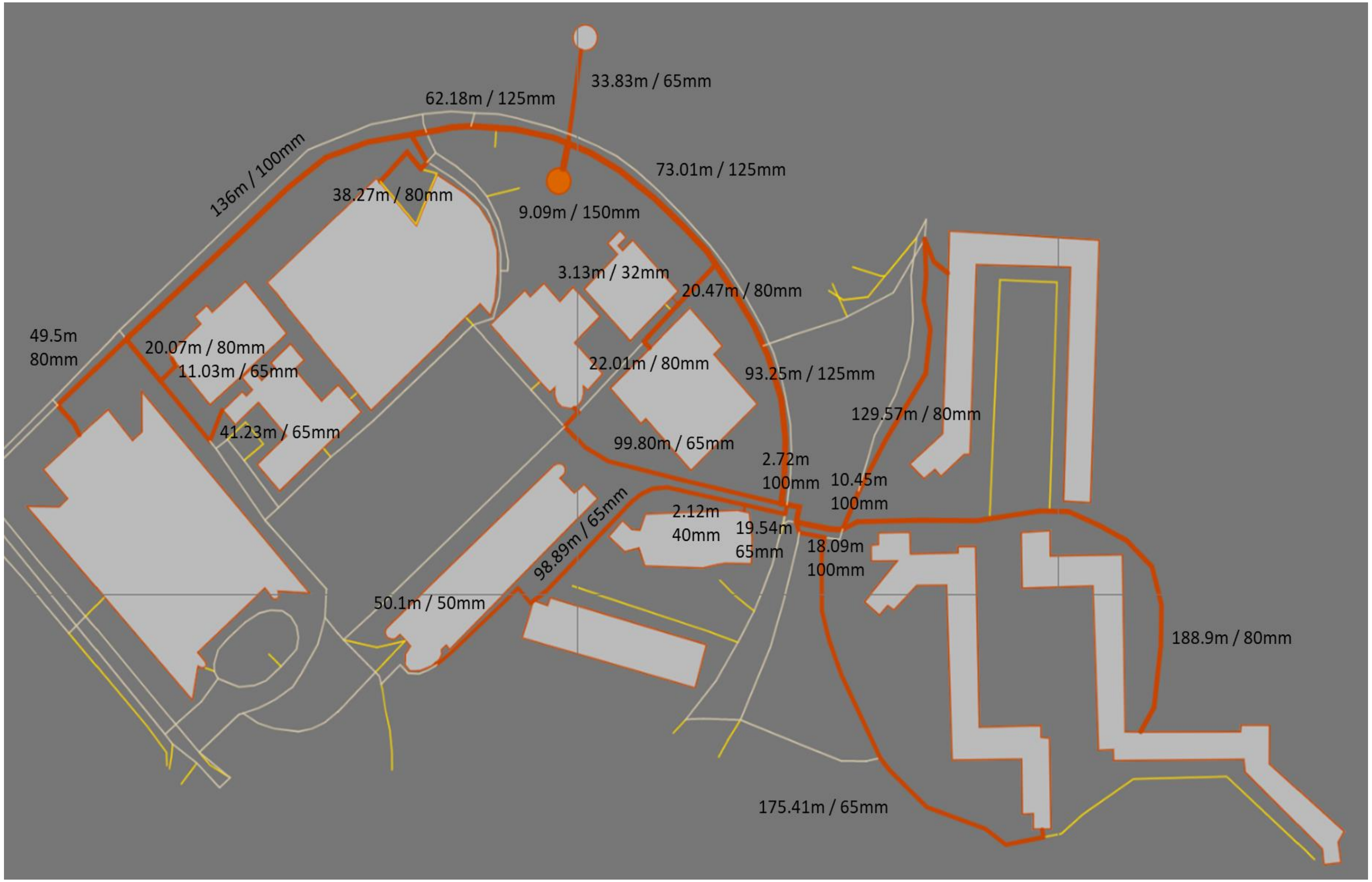

Length	Diameter (mm)	Capacity (kW)	Losses (kWh/yr)
49.50	80	509	11017
41.23	65	258	8149
11.03	65	200	2090
20.07	80	371	4248
136.00	100	725	31910
38.27	80	500	8490
62.18	125	1056	15470
9.09	150	2404	2525
33.83	65	211	6461
73.01	125	1333	18709
3.13	32	49	441
20.47	80	340	4282
22.02	80	340	4605
93.24	125	1093	23291
99.80	65	200	18906
19.54	65	236	3799
2.12	40	83	336
98.88	65	187	18552
50.10	50	150	8990
2.72	65	285	547
10.45	100	838	2506
18.09	100	674	4202
175.42	65	285	35341
188.90	80	382	40140
129.59	80	450	28237

DH network pipework

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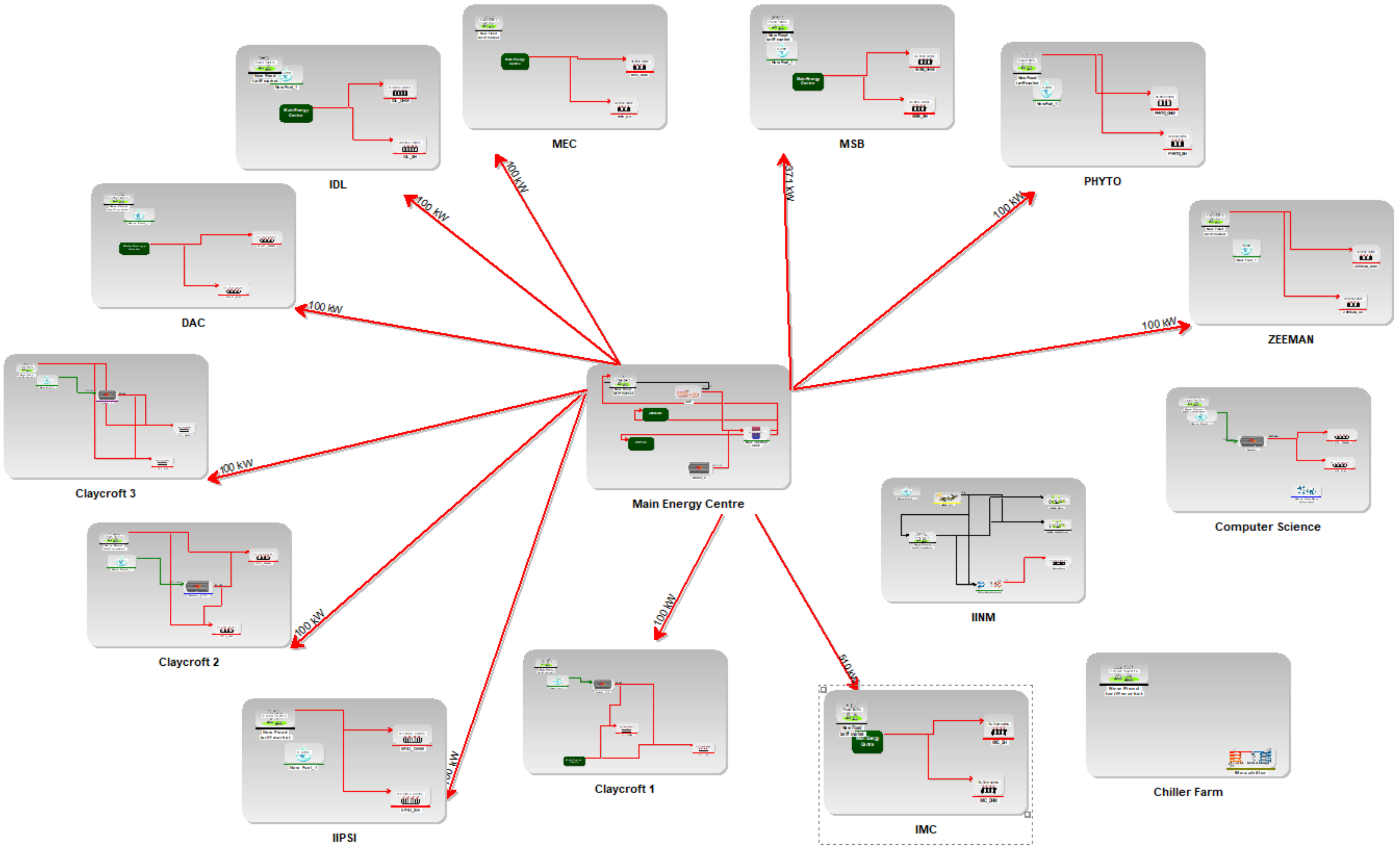
TEF analysis energyPRO



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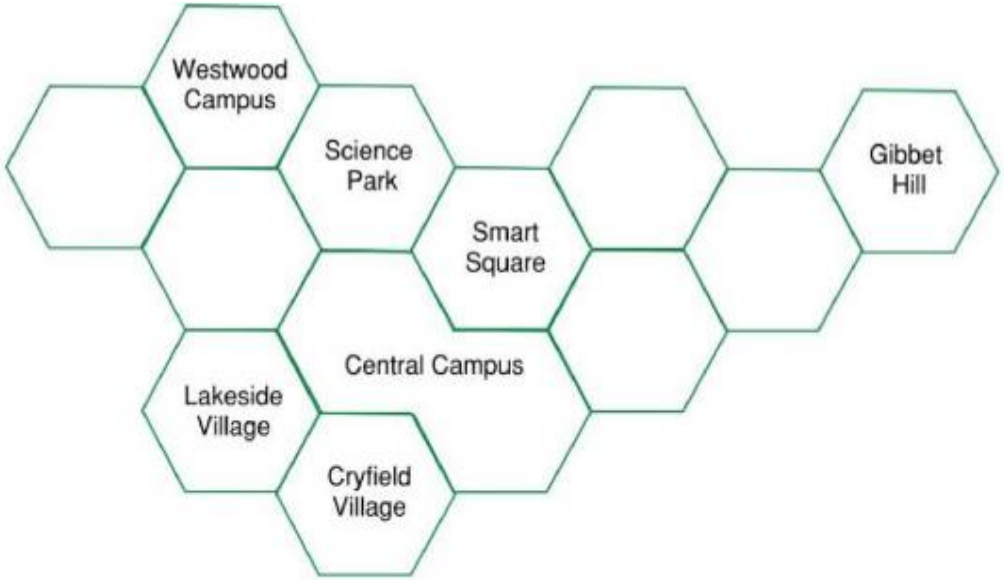
Case Study: Warwick – Smart Square HP Study

- Estates led study on options for HP use to decarbonise Smart Square
- Different Options based on
  - Option 1- Air source heat pumps (ASHP) and thermal energy storage
  - Option 2 – ASHP and ground source heat pumps (GSHP) with thermal energy storage
  - Option 3 – Deep Borehole ground source heat pumps (GSHP) and thermal energy storage

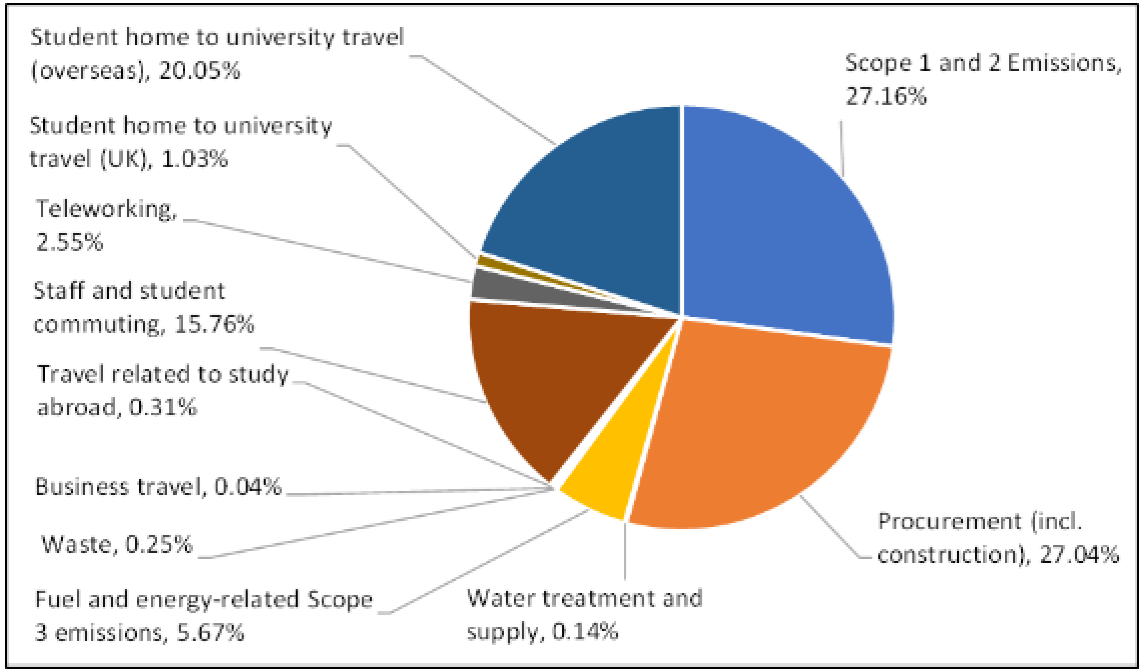


- With and without building fabric and control upgrades
- Comparisons based on operating costs only
- Insights on the sequencing and areas that could achieve 70% reduction in emissions by 2030….
- …. but not a “business case” evaluation that would allow investment decision-making

Case Study: Warwick – Warwick Standard

- New "Warwick Standard" close to publication
  - New builds need to be low temperature network ready
  - Retrofits must optimise their use of lower temperature heating
  - 5 building typologies

- New Scope 3 Emissions for 2020/21
  - UoW Scope 3 emissions *estimated* as 107,000 tCO2e in 2020/21 vs Scope 1+2 of 40,000



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ENERGY RESEARCH ACCELERATOR

At the forefront of energy transformation

Decarbonising University Campuses

3 March 2022

Delivered by MIDLANDS INNOVATION

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Warwick The University of Warwick
British Geological Survey Natural Environment Research Council

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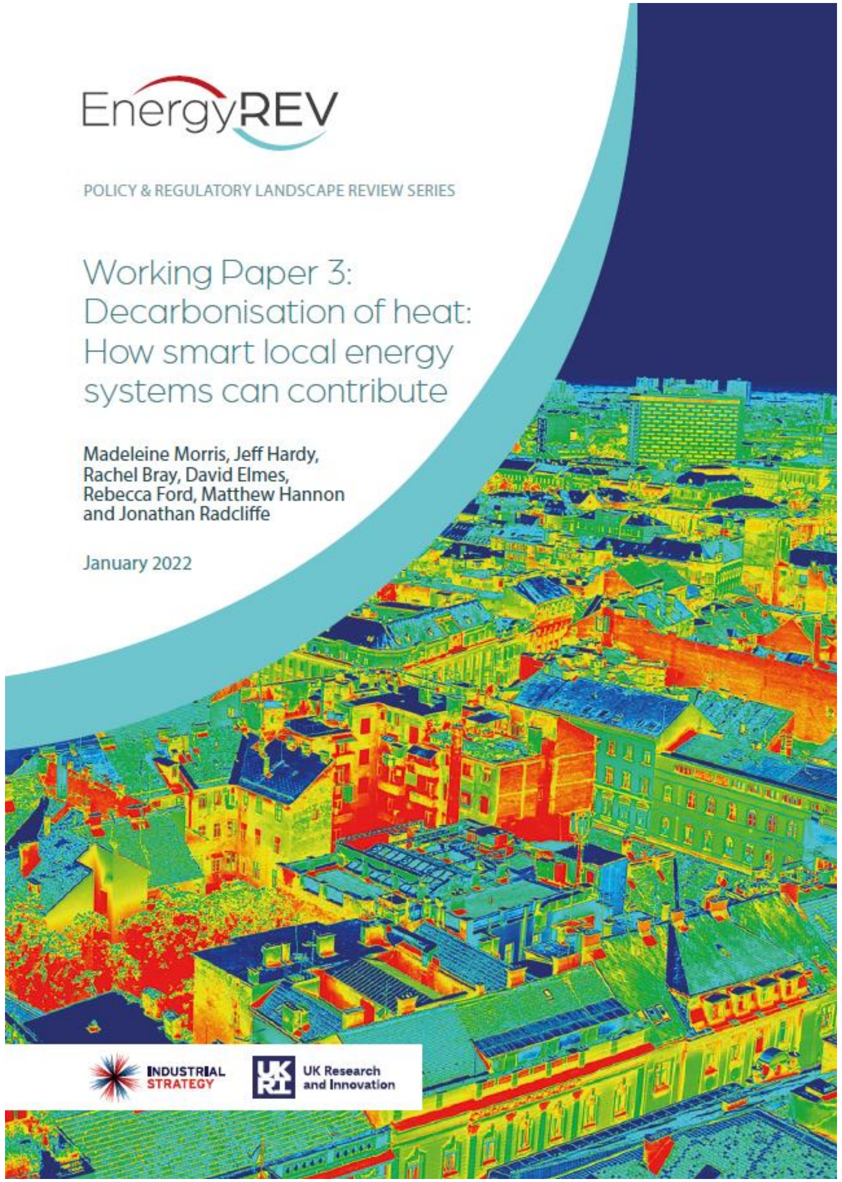
EnergyREV: SLES and Heat

- **Behaviours:** We are a decade behind electric power in our understanding of how to engage on behaviours that influence energy use in heat
- **Policies:** Stop-start policies and a top down focus have resulted in little progress on heat decarbonisation
- **Investment:** As there hasn't been a clear, long term strategy, the necessary investment decisions aren't being made
- **Supply Chain & Skills:** More capacity is needed to achieve the scale and pace required
- **Costs and Benefits:** There will be costs to decarbonise heat but also broad health and economic benefits too

- A Smart Local Energy System approach can offer a fresh approach to addressing these issues



Case Study: Warwick – Ambitions

- **Key Questions**

What is the future for a heat network like Warwick's?

  - The commercial path to a decarbonised heat network
  - The business cases to support incremental investments

What is the role for heat networks in Smart Local Energy systems?

  - Balancing local supply/storage/consumption with network/generation costs
  - Developing SLESs that offer flexibility to their surrounding networks

- **Ambitions**
  - Expand the business case approach to include heat network investment decisions
  - Develop the demand reduction pathway for buildings on a lower temperature heat network
  - Becoming smart and flexible to optimise energy and emissions within the Warwick SLES
  - Becoming smarter and more flexible to offer flexibility services to the surrounding network

Case Studies: Summary & Discussion

- Three cases:
  - Urban SLES (4,000-33,000): Integration around a LoT-NET, PFER DD
  - Campus SLES (34,000 community): Integration around a LoT-NET, PFER EnergyREV
  - Town (70,000): Modelling capability to deliver net zero heat at minimal cost

- Questions to help answer
  - What will the CCC's 20% of heating from heat networks actually be?
  - How can LoT-NETs help PFER projects be integrated, multi-vectoral systems?
  - How can LoT-NETs make local energy systems smarter and more flexible?

Phase 2: Including larger scale real world energy systems