MAYOR OF LONDON

Zero Carbon London by 2050

Decentralised Energy Enabling Project

Matt Thomas (matthew.thomas@london.gov.uk)

24/07/2018

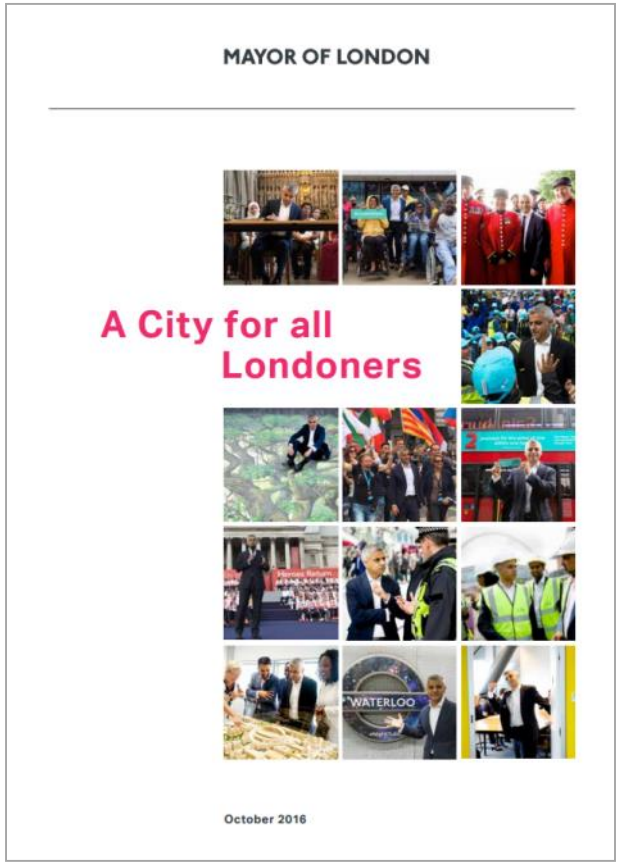
OVERVIEW

- Introduction to the London Environment Strategy
- Modelling, pathways and targets
- Role of decentralised energy
- Challenges
- Programmes

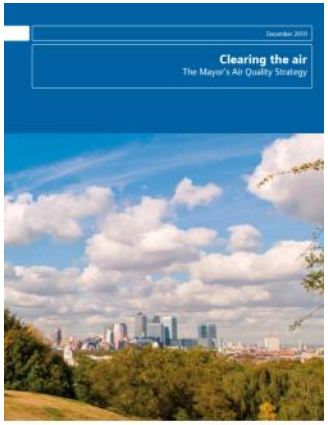
A CITY FOR ALL LONDONERS

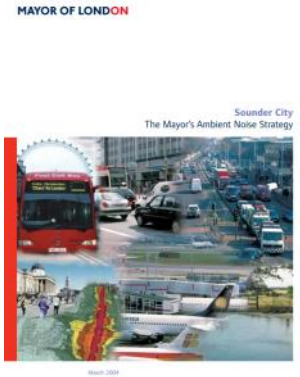
Vision: ”for London to be the greenest of all global cities”

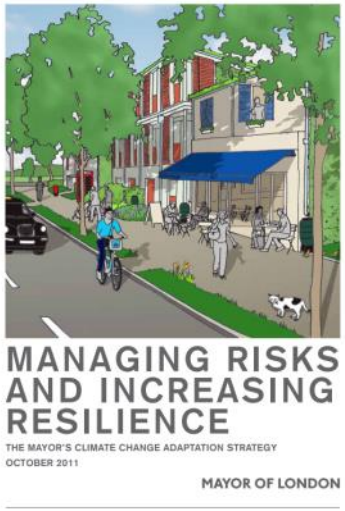
Objectives: “My environmental objectives can be broken down into two key areas – making the city healthy, resilient and fair, and making it resource efficient, low carbon and green.”

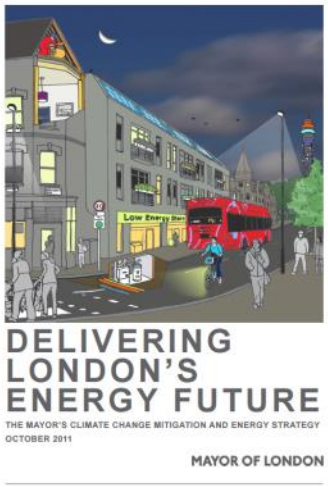


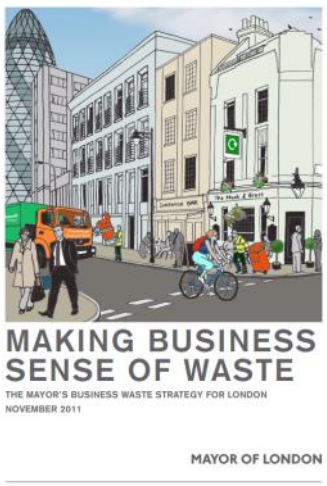
LONDON ENVIRONMENT STRATEGY











LONDON ENVIRONMENT STRATEGY

- London's first integrated environment strategy
- Ambition includes:
  - Zero carbon city
  - Zero waste city
  - World Health Organisation $PM_{2.5}$ targets for air quality
  - Increase green cover to 50%
  - Action plans for fuel poverty and solar
  - New funding to catalyse action
  - New businesses cases for energy efficiency and green infrastructure

KEY OBJECTIVES

- Objective 6.1 Reduce Emissions of London's Homes and Workplaces While Protecting the Most Disadvantaged by Tackling Fuel Poverty

- Objective 6.2 Develop Clean and Smart, Integrated Energy Systems Utilising Local and Renewable Energy Resources
  - Delivering more decentralised energy in London
  - Planning for London's new smart energy infrastructure

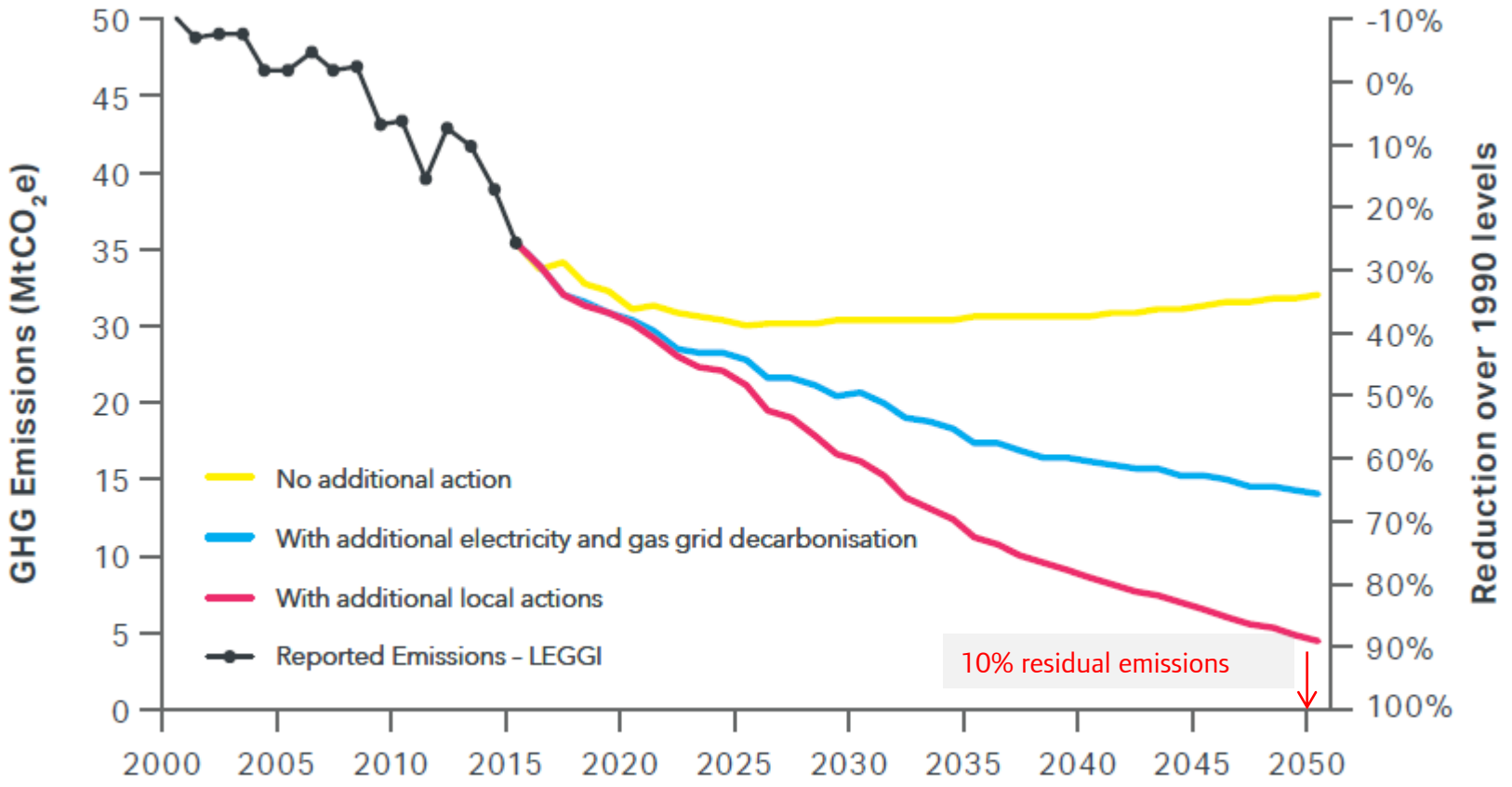
RELATIONSHIP WITH OTHER MAYORAL STRATEGIES

The Mayor aims for London to be a zero carbon city by 2050 and will:

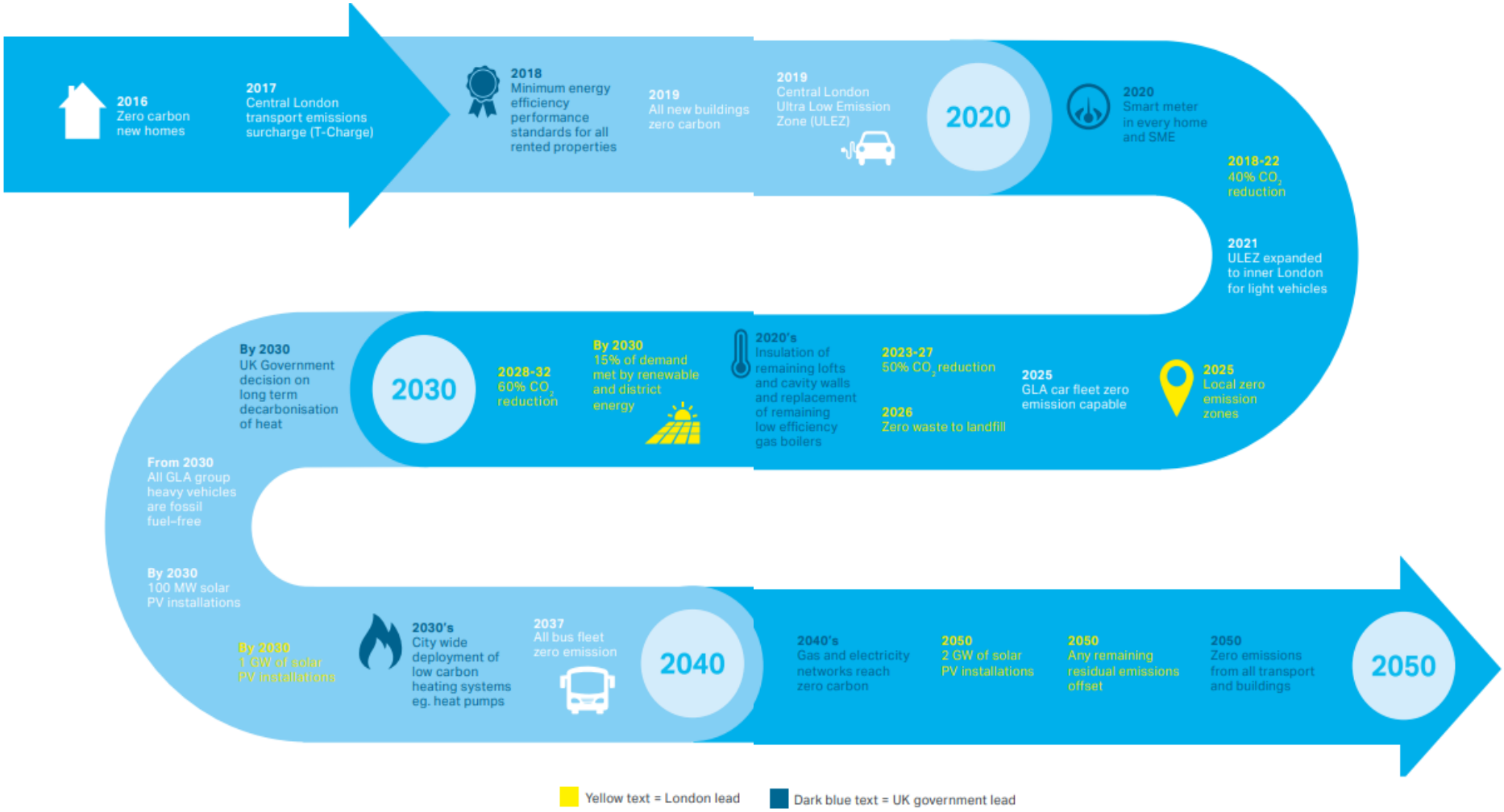
- help Londoners cut their energy use by supporting efforts to improve the energy efficiency of homes and public buildings and helping to roll out smart meters
- cut fuel poverty by targeting energy efficiency to low income homes and working with boroughs to enforce regulations for private landlords to improve the energy performance of their properties
- **provide technical assistance to help increase the number of homes and businesses connected to communal heat networks that use local energy sources, including energy created from waste**
- **increase clean energy generation with at least 100 megawatts more solar installed by 2030, through grants to community groups, pilot projects promoting lower cost solar panels, and by putting solar panels on TfL buildings**
- support programmes to replace old polluting commercial boilers with new cleaner ones
- make sure that new developments are zero carbon from 2019, with clean supplies of energy and high energy efficiency designed in from the start
- tender for the delivery of an energy supply company, aiming to offer fairer energy bills to Londoners
- trial low carbon technologies like heat pumps and batteries and new ways to make expensive insulation more affordable

Zero carbon London by 2050

- London is responsible for 8% of the UK's GHG emissions.
- As of 2015 London's GHG emissions were 25% lower than 1990 levels.
- Achieving (net) zero carbon will require Negative Emission Technologies (sequestration)

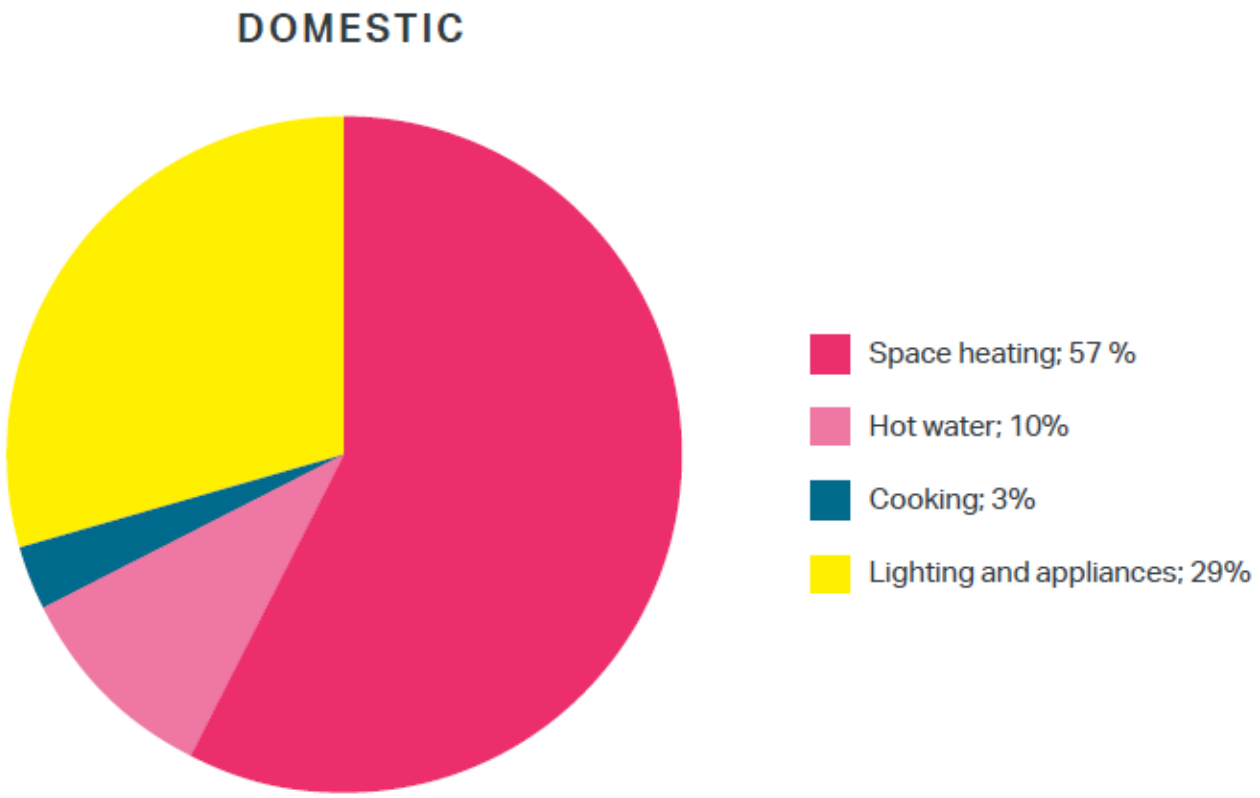


Achieving London's zero carbon ambition



Decarbonising heat

- Most energy in buildings is used for heating space and water
- Majority of this is fuelled by natural gas
- Heat for space and water is responsible for 35% of London's total GHG emissions



The role of decentralised energy

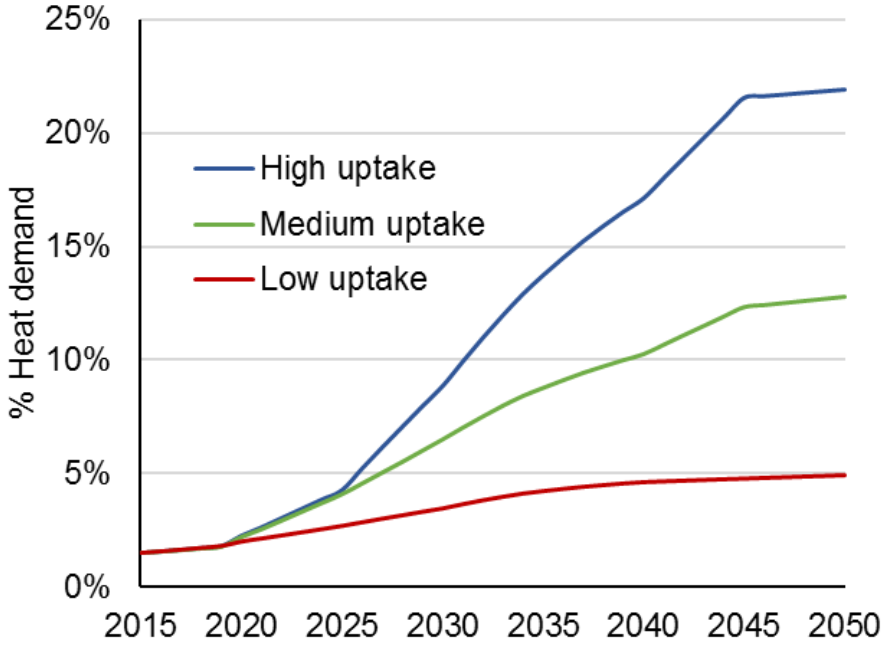
- London's total energy demand for buildings is around 97,000 GWh pa
- Majority of electricity is sourced from the national grid.
- In 2017 renewables reached record level of 29% of annual generation
- The Mayor wants to produce/utilise more local energy:

Meet 15% of London's energy demand through renewables and district heating by 2030

So far:

- District heating provides around 1,600 GWh pa, renewables 1,000 GWh (2016)
- Around 110 MW of solar in London to date. The potential is much larger – our studies estimated that under an ambitious scenario solar PV installations could reach around 550 MW capacity by 2025 and 2 GW capacity by 2050.

The role of decentralised energy



- Roll out of **heat networks** in new and existing buildings. In all scenarios, more than 100,000 London homes are connected to a heat network by 2025. We estimate this to at least double the number of heat networks in London.
- Roll out of **heat pumps,** to drive high uptake in new buildings and substantial uptake in suitable existing buildings.
- Support for **distributed renewable energy, particularly solar PV;** London has a target to achieve 100 MW of solar by 2030 and 2 GW by 2050

Challenges & opportunities for DE

- Energy efficiency retrofit – scale of delivery required for heat networks to serve existing buildings
- Renewables – low baseline and declining national incentives
- Infrastructure costs – District Heating Network Delivery Body
- National support but still regulatory void (and business rates) and technical support needed - DEEP
- Long term role of gas in a decarbonised UK
- Air quality
- Integration with smart as part of energy system

Energy for Londoners

Make London's homes warm, healthy and affordable, and London's workplaces more energy efficient

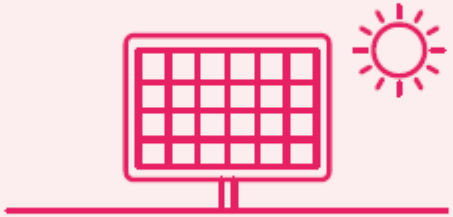
Energy efficiency for homes:

Energy efficiency for workplaces :

Fuel poverty support and fairer tarrifs:

Supply the capital with more local clean energy

Integrated local energy systems:



Solar generation and community energy:

Smart energy:

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THE LONDON PLAN

THE SPATIAL DEVELOPMENT STRATEGY FOR GREATER LONDON
DRAFT FOR PUBLIC CONSULTATION

DECEMBER 2017

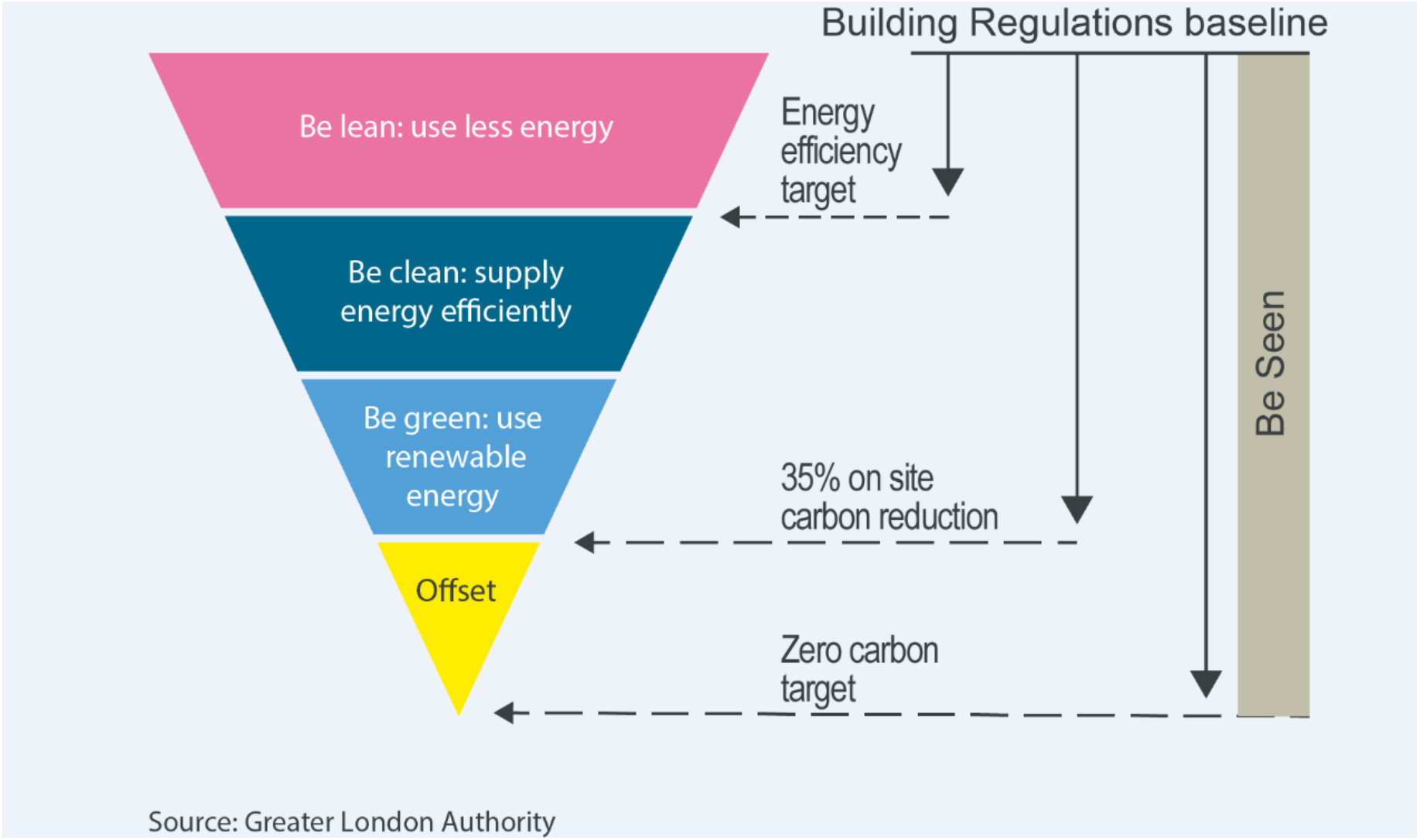
Policies can be found here: www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan

The London Plan

- The Mayor's spatial planning strategy – new version in development
- Local Planning Authorities need to be in conformity with it
- The Mayor has important influence over large new buildings:
  - Reducing estimated greenhouse gas emissions beyond national building regulations and introducing a zero carbon requirement
  - Promoting technologies to minimise air quality impacts
  - Promoting district heating
  - Setting ambitious targets for energy efficiency
- The GLA review ~400 large developments referred to the Mayor each year and so have greatest influence over these applications

Zero carbon development

- Policy 5.2 current London Plan, SI2 draft new London Plan



Zero carbon development

- Currently applies to homes & non-residential from 2019
- Minimum on-site reduction of at least 35 per cent beyond Building Regulations for MAJOR development
- Where it is clearly demonstrated that the zero carbon target cannot be fully achieved on-site, any shortfall should be provided:
  - through a cash in lieu contribution to the relevant borough's carbon offset fund, and/or
  - off-site provided that an alternative proposal is identified and delivery is certain
- New London Plan requires boroughs to report annually to the GLA on offset funds: amount collected, spent and types of project.

Solar Action Plan

Ambition for 1 GW by 2030, 2 GW by 2050 across London. Mayoral actions:

- map the potential
- maximise solar on GLA group buildings and land
- encourage solar energy installations through the planning system
- pilot a solar collective purchasing scheme to reduce installation costs for Londoners
- develop a grants scheme to help community solar energy projects get off the ground

Final SAP was published in June:

https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/solar-action-plan

London Community Energy Fund

- A proposal in the London Environment Strategy and SAP
- 15k grants to help get community solar energy projects off the ground
- Funding for project development (design, feasibility, financial business case, legal and planning issues) - this was identified as the largest barrier to community energy projects when we engaged stakeholders in summer 2017

Phase 1

- £150,000 to 13 projects in 8 London boroughs
- Funding provided for development and feasibility studies for a diverse mix of solar and battery storage projects on housing blocks, schools, community buildings and more

Phase 2 – coming soon

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London.gov.uk/environment-newsletter

matthew.thomas@london.gov.uk

@LDN_environment

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Heat Pumps and Future Energy Systems

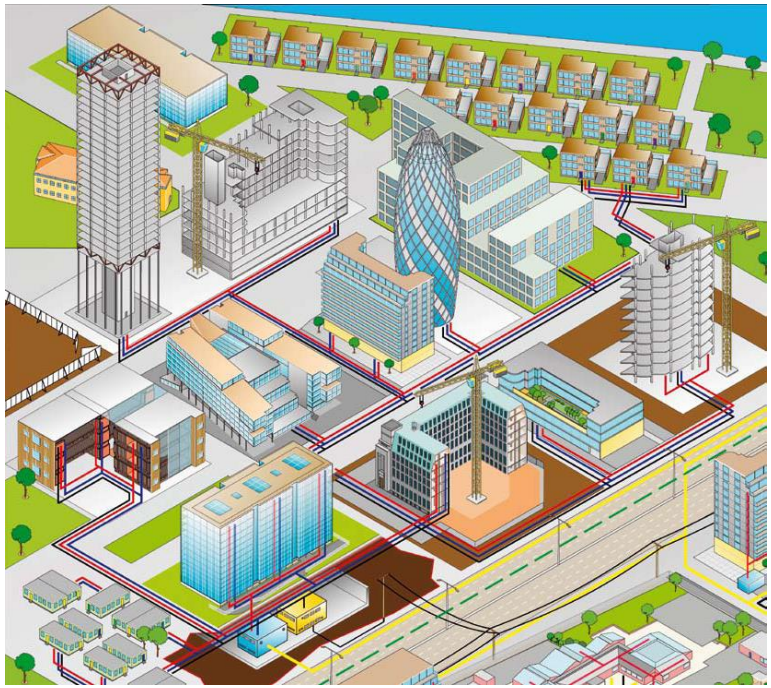
Peter North

Senior Manager, Smart Energy Systems

24th July 2018

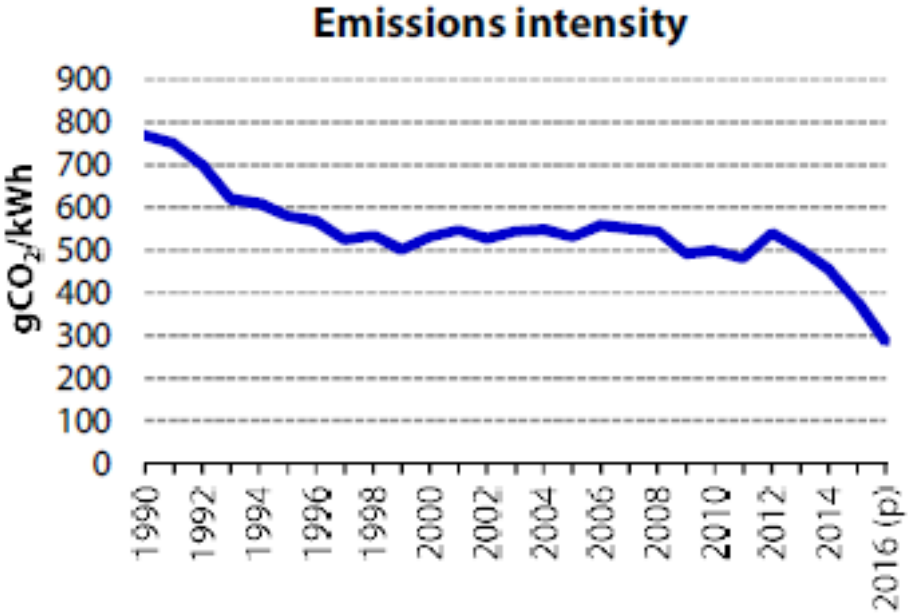
Reducing London's CO_2 Emissions

- Over 30% of London's CO_2 emissions are attributable to consumption of heat (mostly mains gas)
- Greatest opportunity for CO_2 reduction within London is to reduce demand for heat through building retrofit and low carbon, local (decentralised) heat supply.
- Decarbonising electricity supply is taking as a national action (nuclear and renewables)



ELECTRICITY EMISSION FACTORS

- 30% reduction in grid emission factors over the last 10 years
- 21st April 2017: GB power generation first coal-free day since 1882
- 2017: more generation from low carbon sources than fossil fuel
- Gas engine CHP likely not to save more carbon in supplying heat than a gas boiler in its lifetime



THE LONDON ENVIRONMENT STRATEGY (MAY 2018)

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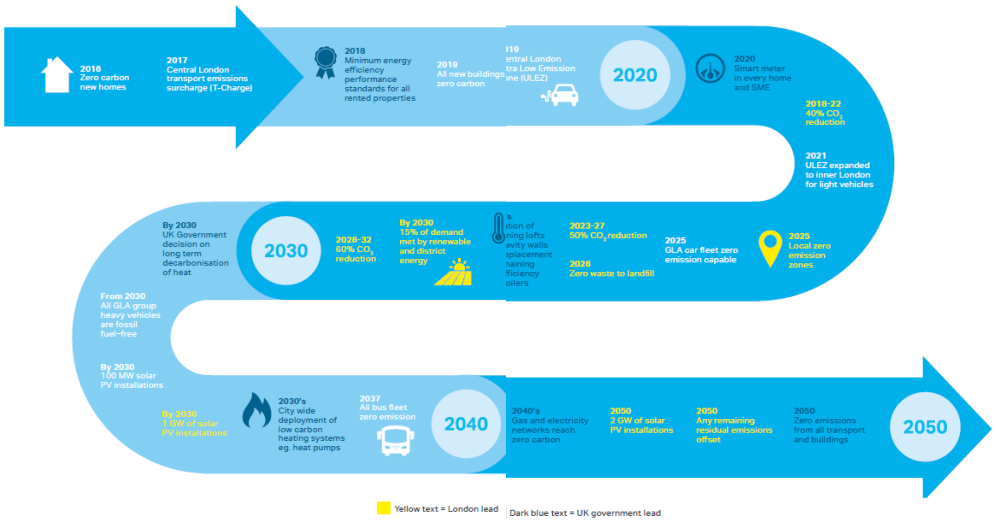
MAYOR'S CLIMATE CHANGE MITIGATION & ENERGY STRATEGY

- Use carbon budgeting
- DE target replaced with 15% energy supply from renewable and district heating by 2030
- Why the change:
  - Decarbonising grid is rendering gas CHP in effective
  - Air quality issues coming to the for
- Emphasis on local energy sources
- Heat networks still important in conjunction with heat pumps and thermal stores



OBJECTIVE 6.2 DEVELOP CLEAN AND SMART, INTEGRATED ENERGY SYSTEMS UTILISING LOCAL AND RENEWABLE ENERGY RESOURCES

- District heating networks and renewable energy supply account for approximately half of London's decentralised energy systems, delivering the equivalent of two per cent of total demand. There is the opportunity to increase this type
- 15 per cent of London's energy demand to be supplied from local and renewable energy sources by 2030.
- There is potential for decentralised energy including large-scale solar PV installations and heat networks utilising technologies such as heat pumps in combination with secondary heat sources.
- To facilitate implementation the Mayor is providing support to boroughs and the private sector through the Decentralised Energy Enabling Project (DEEP)
- DEEP will provide technical, commercial, financial and other support services to assist public and private sectors to develop, procure and bring into operation these large scale projects.

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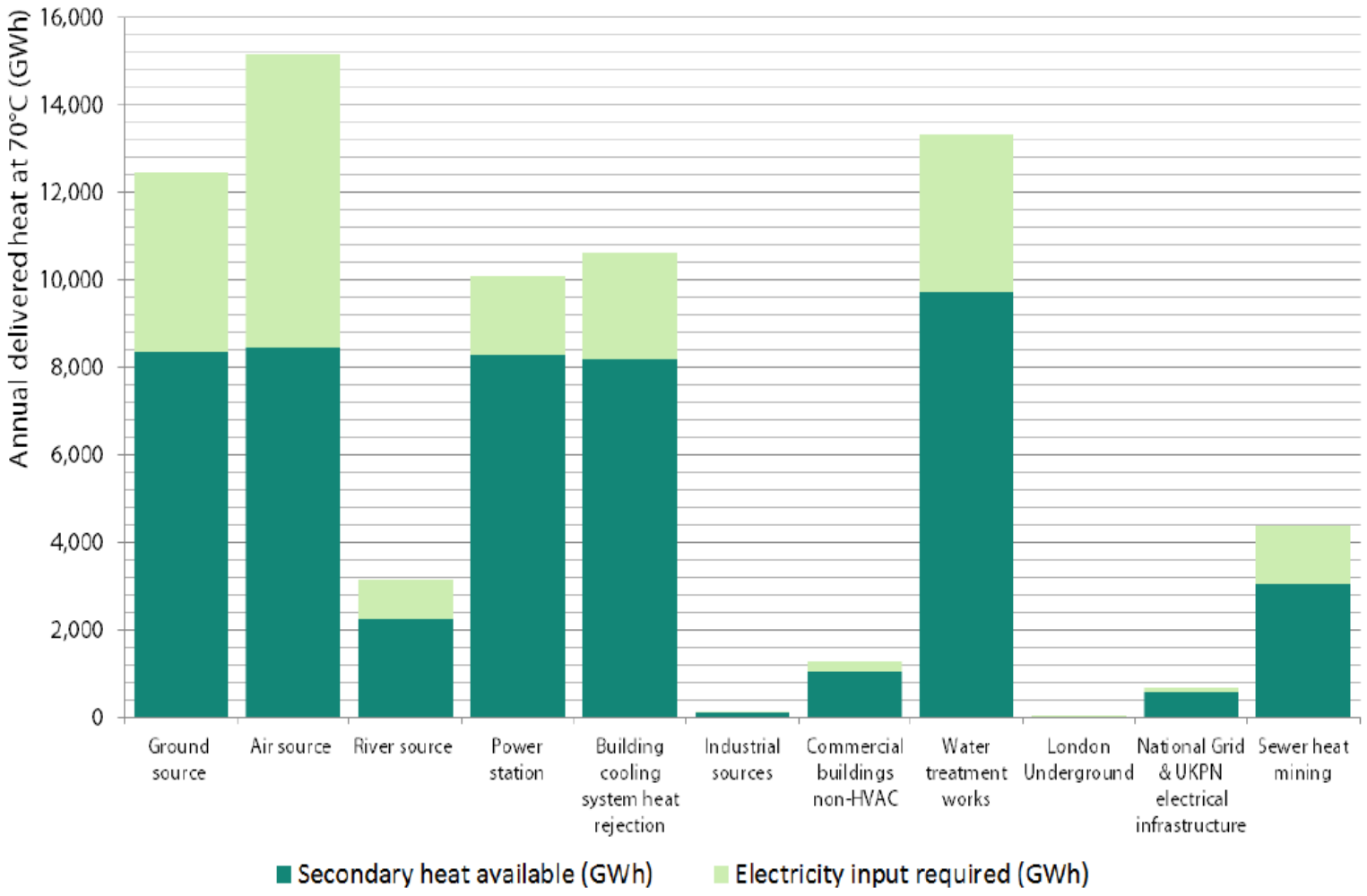
SECONDARY HEAT - DELIVERED HEAT



SECONDARY HEAT- HEAT PUMP COP

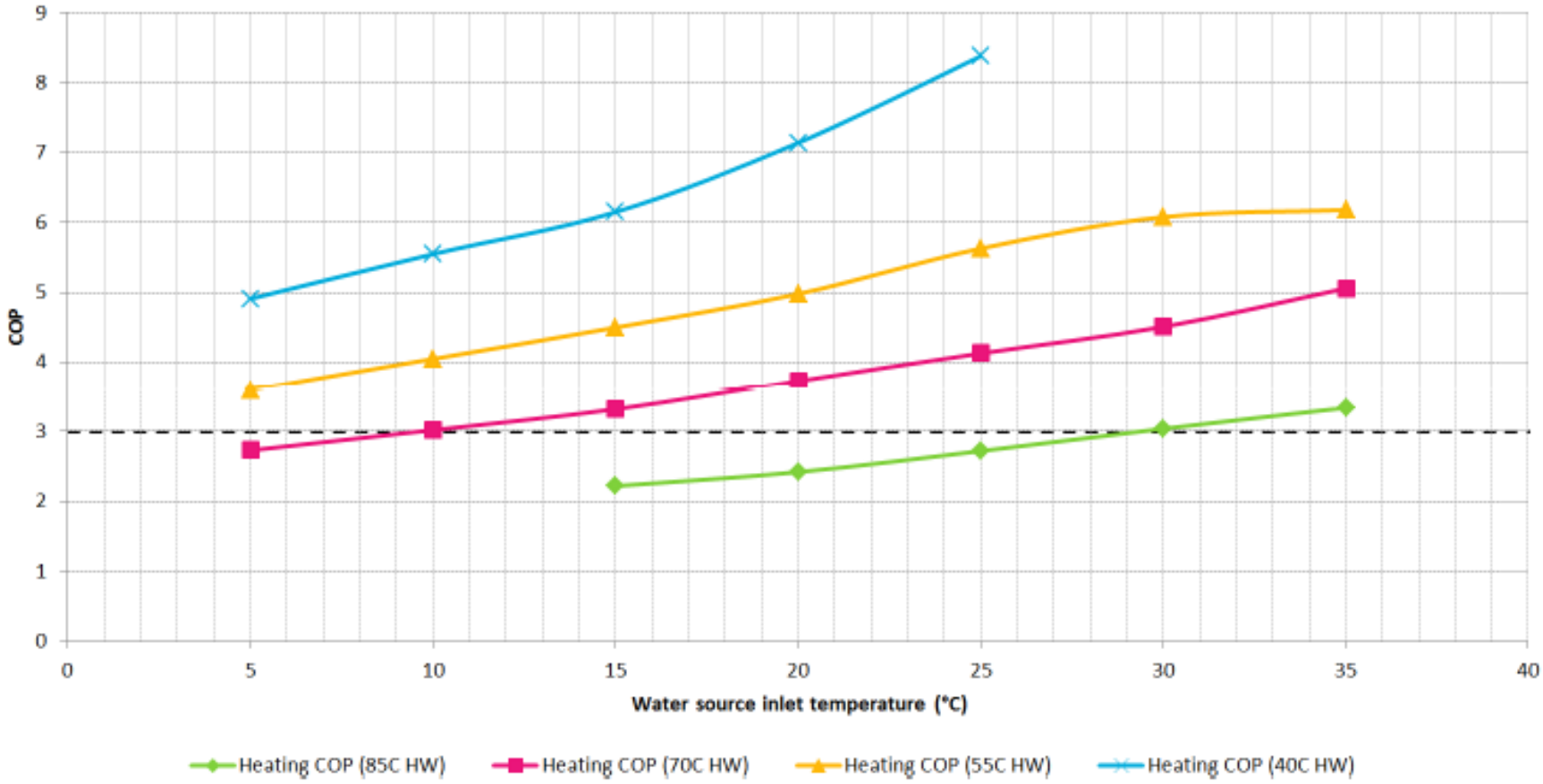
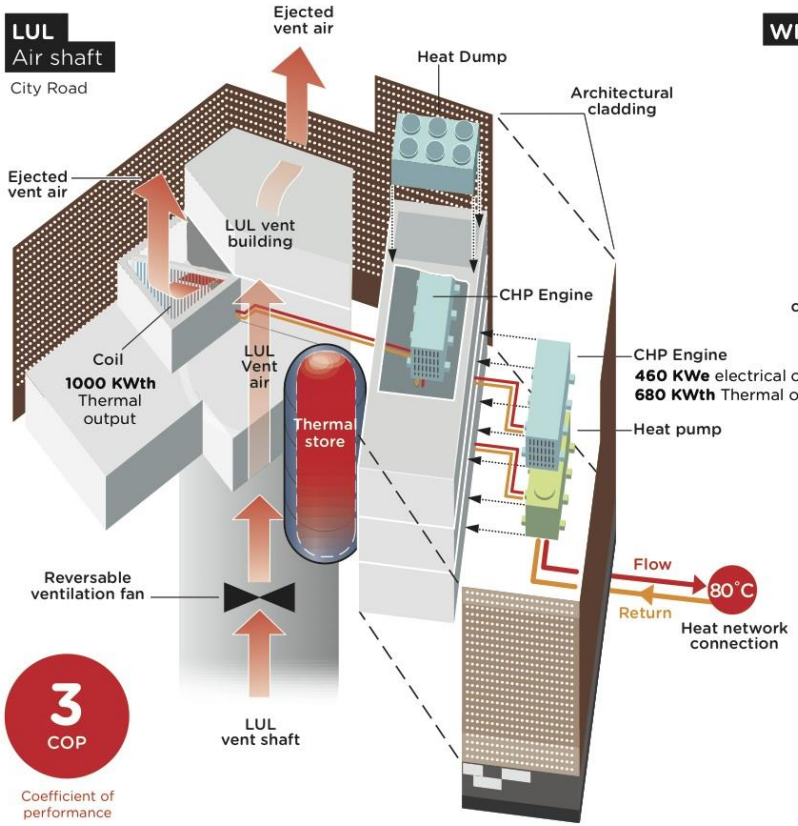


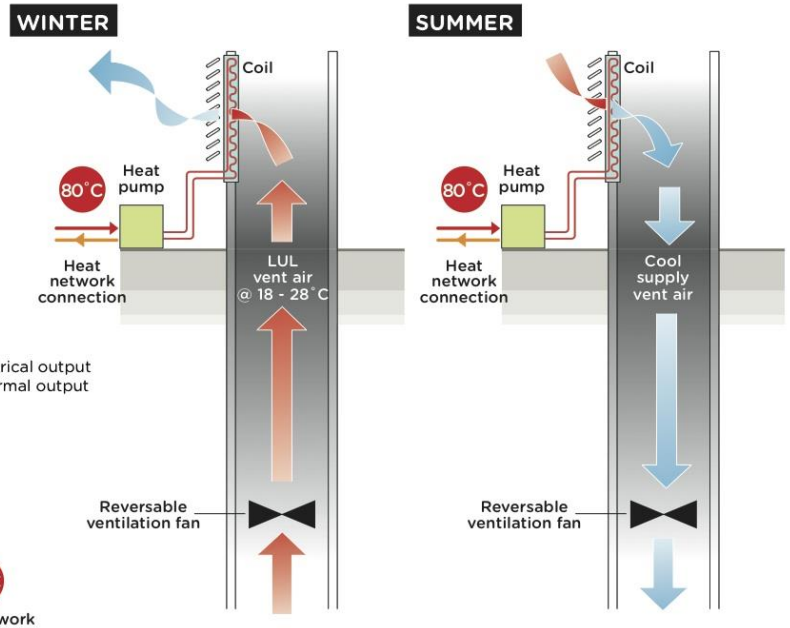
Figure 2 - Heat pump COPs for four different heat output temperatures (500-1000kW scale heat pump).

WASTE HEAT RECOVERY - BUNHILL PHASE 2

Heat source and ventilation opportunities



Ventilation shaft heat pump operation



infographic: www.paulweston.info

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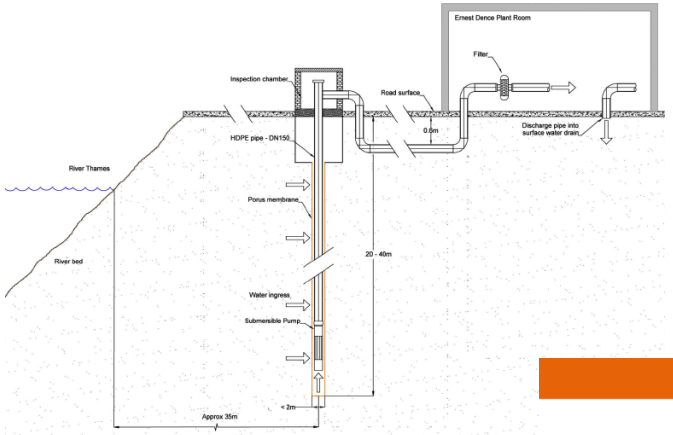
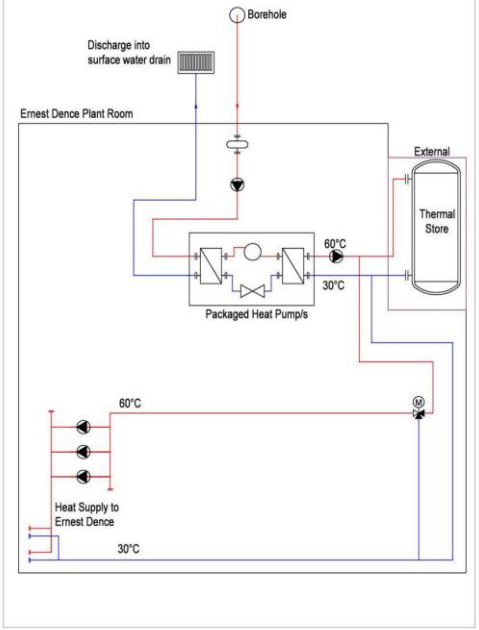
Water Source Heat Pump District Heating Retro-Fit





	Option 2a	Option 2b
	River abstraction	Borehole
Residents heat demand, kWh	1,111,124	1,111,124
Network & thermal store losses, kWh	85,449	85,449
Total network heat demand, kWh	1,196,573	1,196,573
Heat generated by heat pump, kWh	1,196,573	1,196,573
Capital costs (including contingency & excluding heating system refurbishment)	£805,358	£739,155

	20 year business case	40 year business case	20 year business case	40 year business case
Internal rate of return (IRR)	2.8%	3.0%	4.8%	5.3%
Net present value (NPV)	-£51,006	-£40,114	£88,914	£137,606
Simple payback (years)	16 years	16 years	13 years	13 years
Net income	£1,065,746	£1,097,313	£1,176,108	£1,317,223
Annual carbon savings, tonnesCO_2e	253		249	
Cost of carbon saved, £/tonne	£3,186		£2,974	
Lifetime carbon savings, tonnesCO_2e	12,496		12,437	

Peter North
Senior Manager
Smart Energy Systems
Greater London Authority

peter.north@london.gov.uk

https://www.london.gov.uk/what-we-do/environment/energy/energy-supply

New technologies: Sustainable Energy Management System (SEMS)

Shaun Gibbon

Senior Project Officer,
Greater London Authority

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INNOVATION IN DISTRICT HEAT NETWORKS

- Heat Source
- Storage
- Metering
- Payment Services

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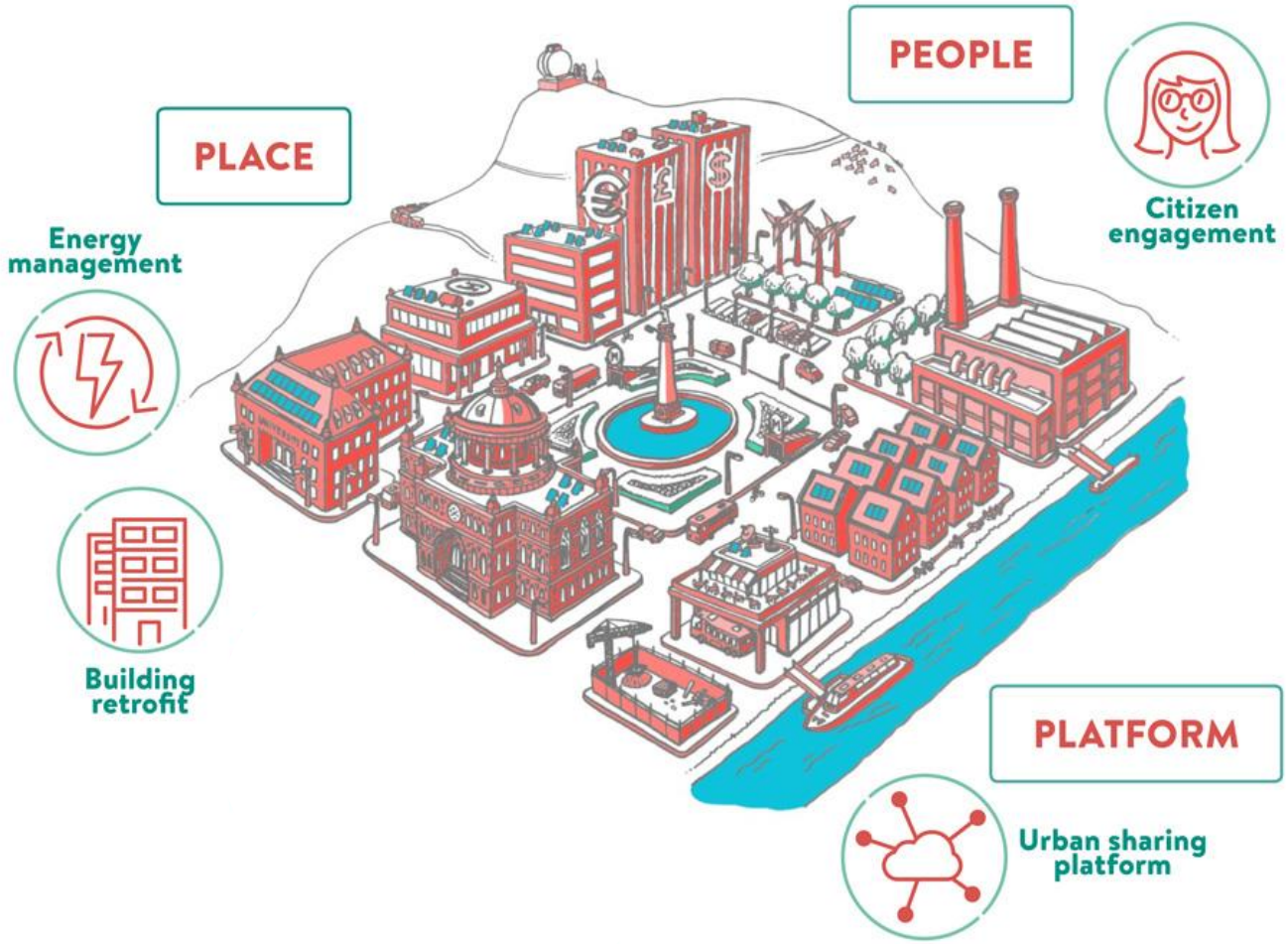
WHOLE SYSTEM APPROACH



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Installation of devices such as sensors achieves load reduction

Process control and optimisation achieves further load reductions

System integration + external signals = optimisation of generation, storage and controllable load assets

However…

No private sector incentive for whole system integration.

- **Lack of city/regional perspective**
- **Diverse sectors**
- **Lack of information**
- **Proprietary systems**
- **Free-rider problem**

MISSION STATEMENT

'to provide an advanced energy management service that integrates energy vectors, optimises system performance, increases and improves energy efficiency adoption and allows for the active participation of citizens in the energy system.'

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SOLUTION

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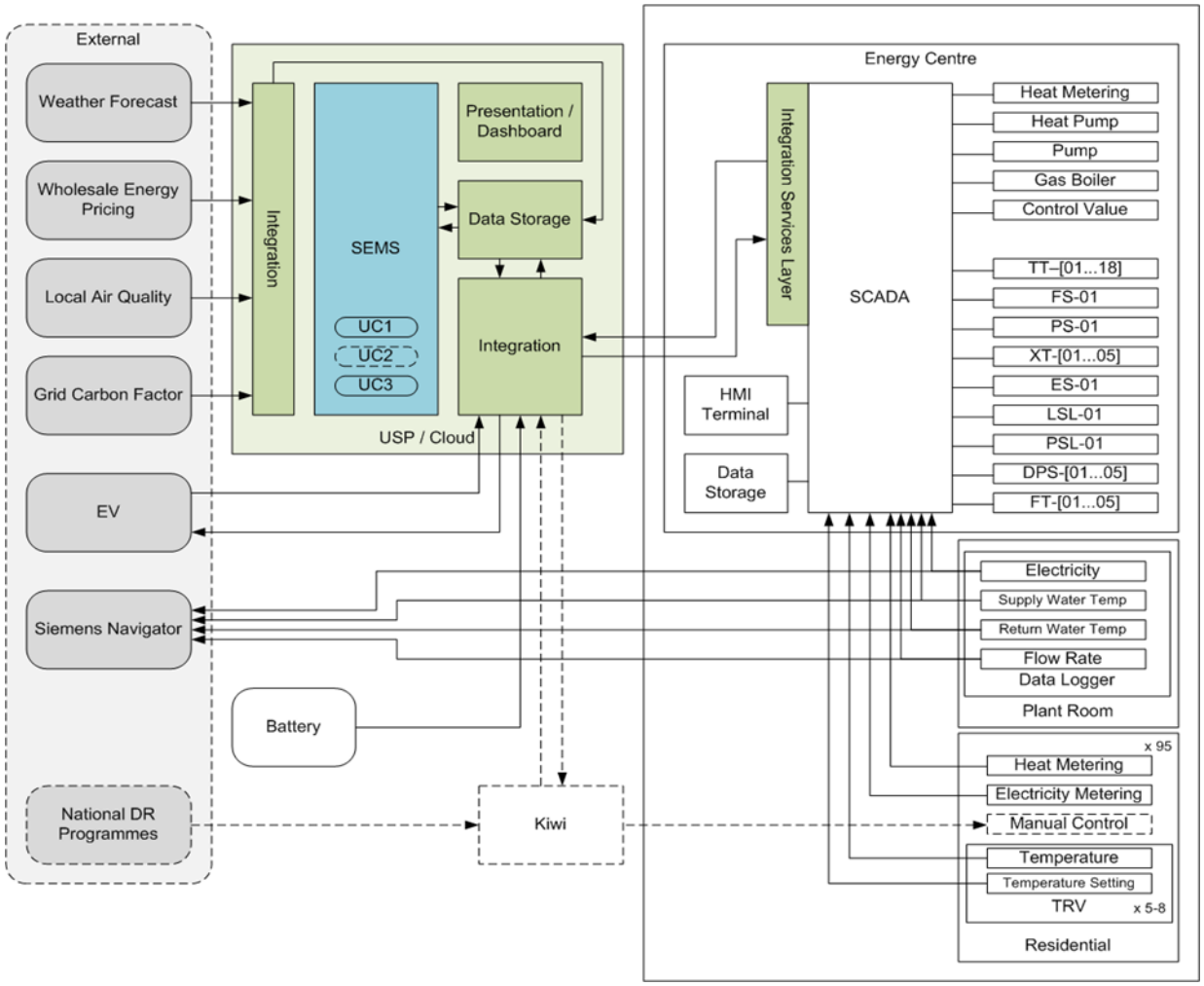
INTEGRATION & OPTIMISATION



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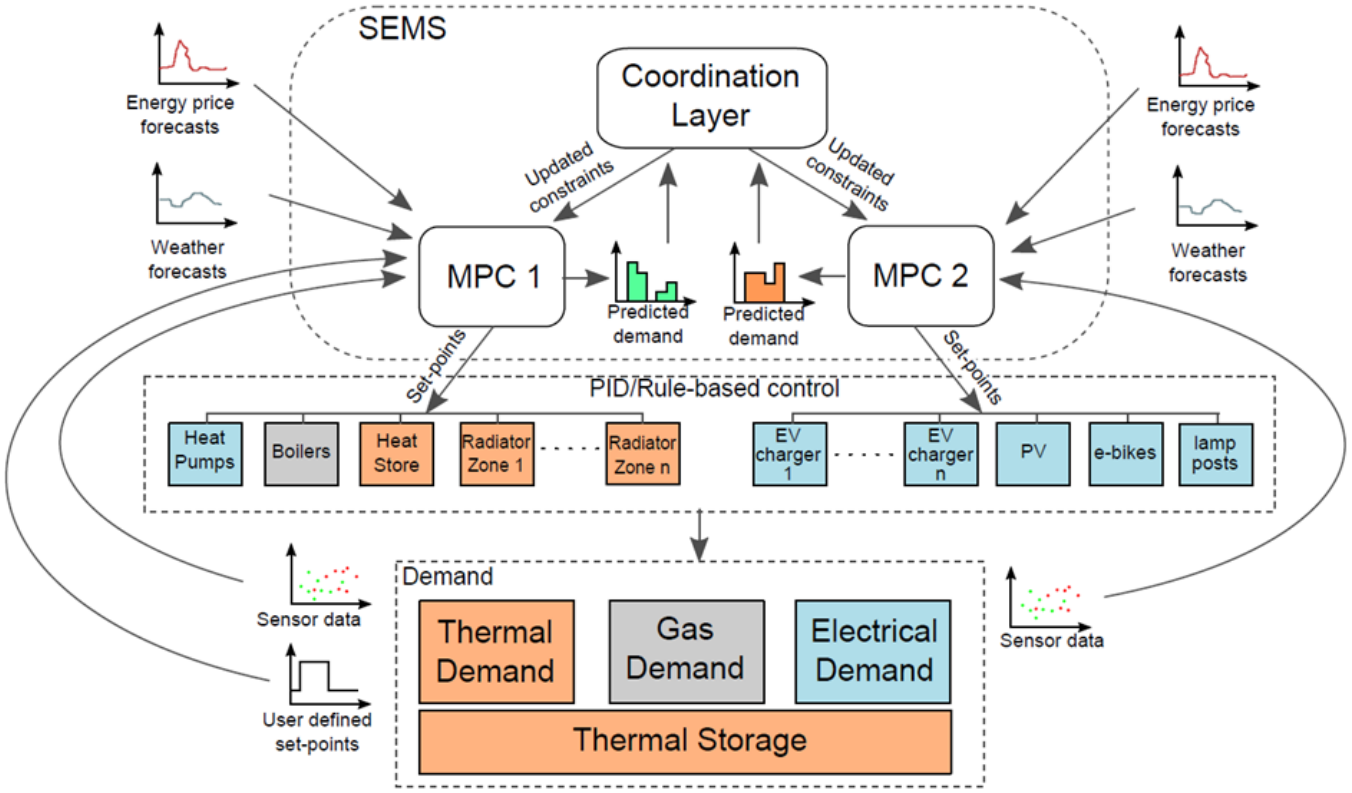
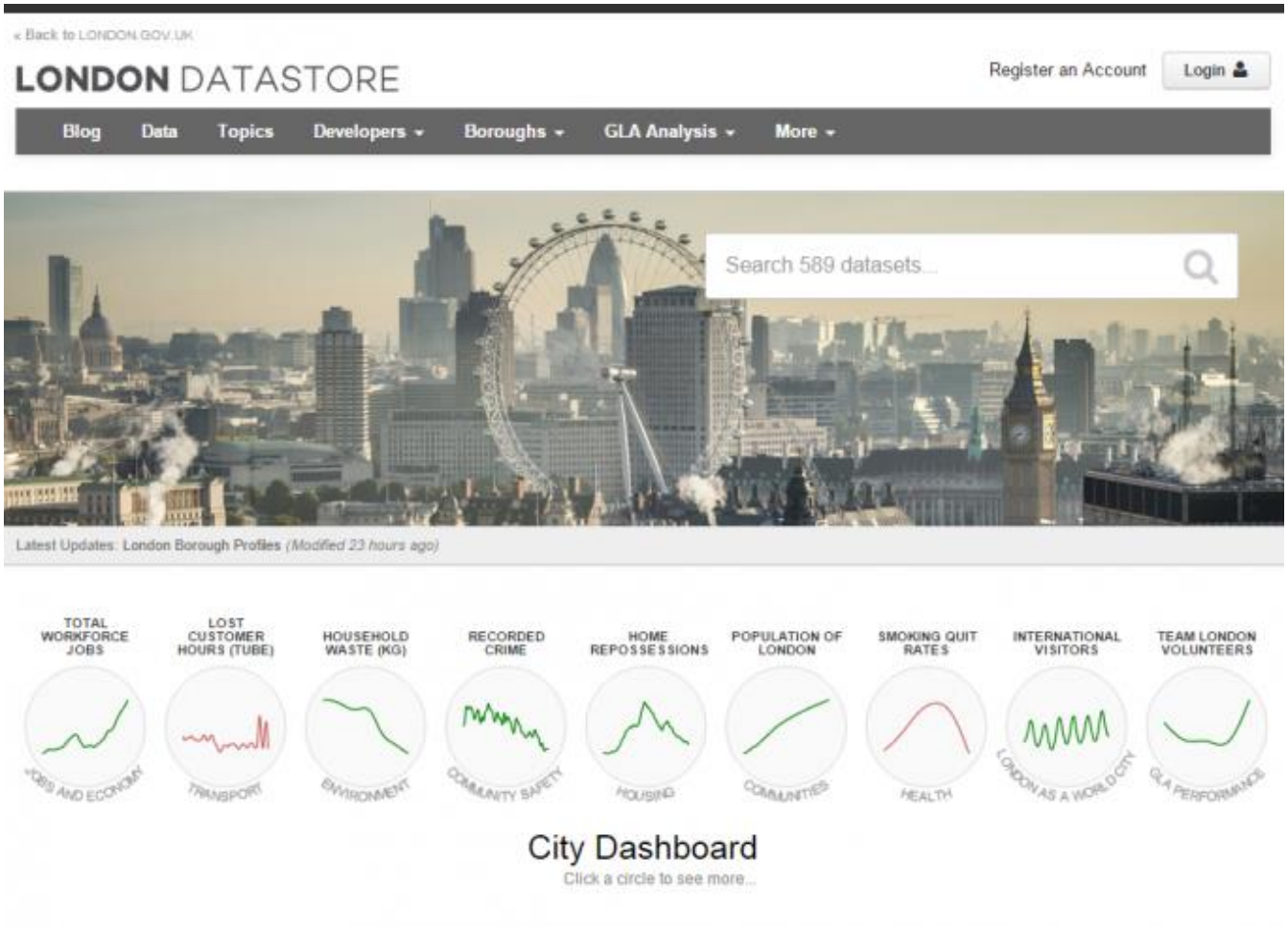
CONTROL STRATEGY



DATA STORAGE & COMMUNICATION



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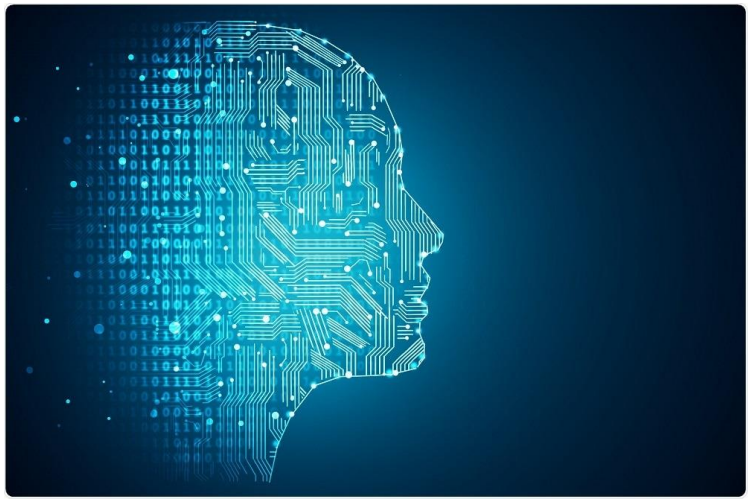
ARTIFICIAL INTELLIGENCE



- Software engineering
- Established and open communication protocols
- Real time, historical and forecasting algorithms
- Deployment of Advanced Process Control (APC) and Model Predictive Control (MPC) at city-level allowing the smart integration of city infrastructure and equipment to achieve optimised and predictive control.

BENEFITS

- **Balanced Energy Supply/Demand**
- **Access to new markets**
- **Avoided network reinforcement costs**
- **Increased stability & security of supply**
- **Financial & Environmental Savings**

CHALLENGES

- **Human element and citizen engagement to maximise optimisation and demand reduction**
- **Ownership and maintenance arrangements**
- **Regulatory and legal framework lags behind technology**

WIDER APPLICATION & REPLICATION

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SUSTAINABLE ENERGY MANAGEMENT SYSTEM (SEMS)

An overarching advanced control strategy and data system focusing on city-level energy system integration and optimisation.

- **SEMS integrates devices, systems, and controls, including:**
  - **Energy generation**
  - **Energy supply**
  - **Local BMS/asset management systems**

- **Energy system optimisation:**
  - **Model predictive control**
  - **Advanced process control**

- **Real time control strategy:**
  - **Environmental, market, citizen etc data inputs**
  - **Hard and soft actuation**

- **Financial & Environmental benefits**

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THANK YOU

CONTACT US

Shaun.Gibbons@london.gov.uk
020 7084 2506

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Decentralised Energy Enabling Project (DEEP)

Questions & Answers

European Union
European Regional Development Fund

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Decentralised Energy Enabling Project (DEEP)

-Work to date-

Alex Hobley, Project Manager. 24th July 2018

European Union
European Regional Development Fund

Presentation Content

1. Where we are at

2. Headlines

3. Themes coming out of DEEP so far

European Union
European Regional
Development Fund

What is DEEP?

- Decentralised Energy Enabling Project
- Supports beneficiaries to develop larger-scale decentralised energy (DE) projects in London with £3.5m of revenue funding
- Procures strategic, technical, commercial/financial and legal advisory support services through an OJEU framework
- Outputs related to CO2 emissions reduction and at renewable energy generation

European Union
European Regional Development Fund

Who is funding DEEP?

50% Mayor of London & 50% ERDF:

- 2014 - 2020 Funding Call
- Priority Axis 4: Supporting the shift towards a low carbon economy in all sectors
- Investment Priority 4a: Promoting the reduction and distribution of energy derived from renewable sources

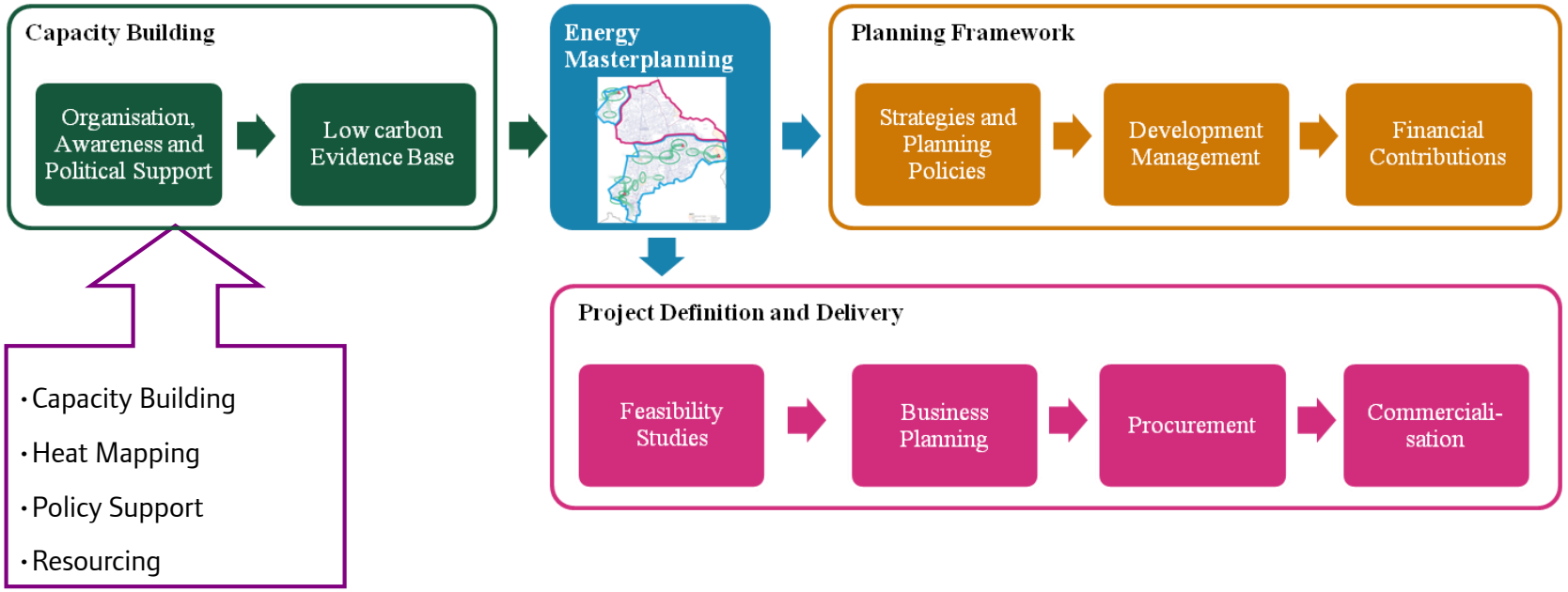
Where are we at?

Start date: 1st April 2016

End date: 30th September 2019

Time wise: A third of the project remaining

DEEP support offering to beneficiaries



DEEP Support offering to beneficiaries

- Specification writing
- Tender evaluation
- Attend inception meeting
- Attend progress meetings

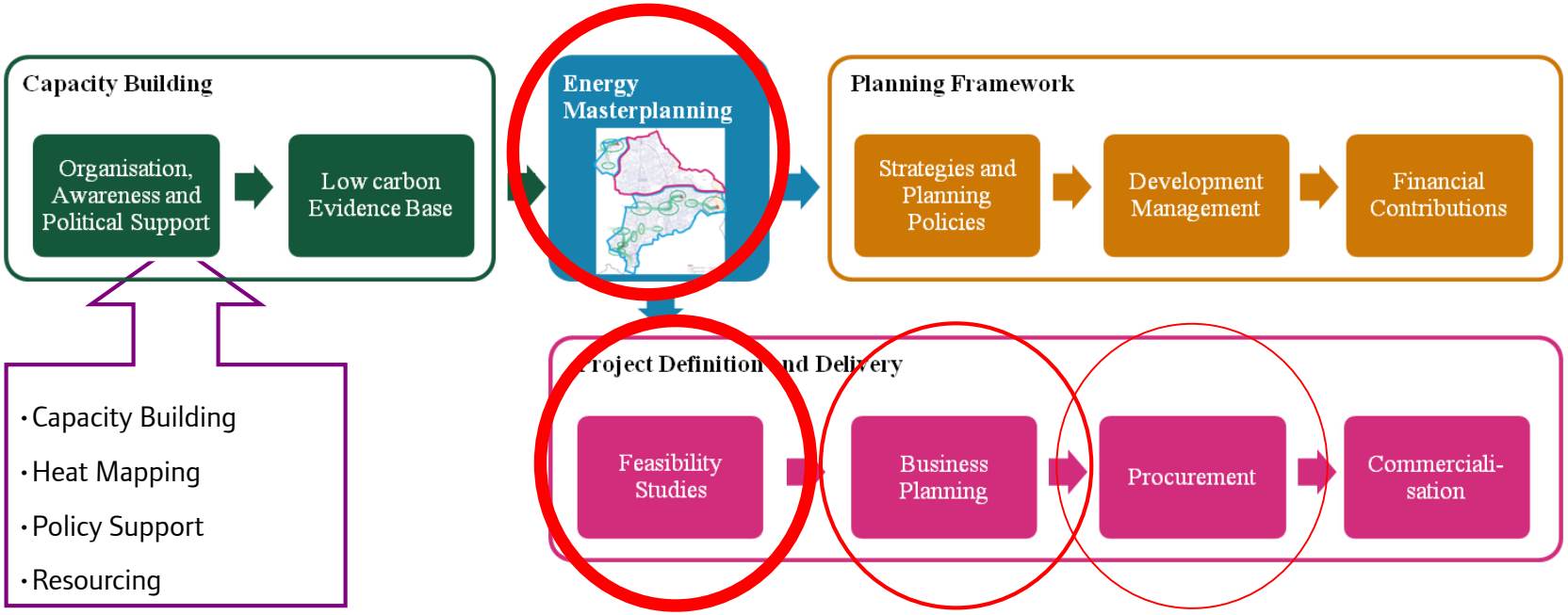
European Union
European Regional
Development Fund

Headlines

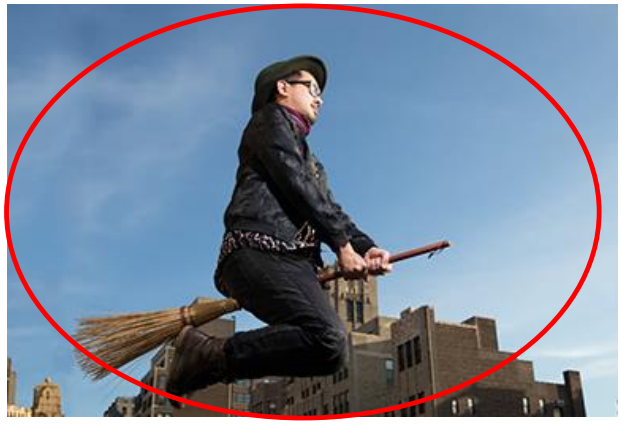
- 11 Mini-competitions undertaken
- 3 further mini-competitions in train
- A total pipeline of potential projects at 30+
- Beyond DEEP: Other organisations beginning to make use of FW (England & Wales)

European Union
European Regional Development Fund

Support themes



Support themes



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Going forward?

- Some projects similar to types we've seen so far
- Heat Network Investment Project (HNIP) applications
- Revised London Heat Network Manual

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Thankyou for listening

Alex Hobley,
Project Manager,
Greater London Authority

alex.hobley@london.gov.uk

@ldn_environment

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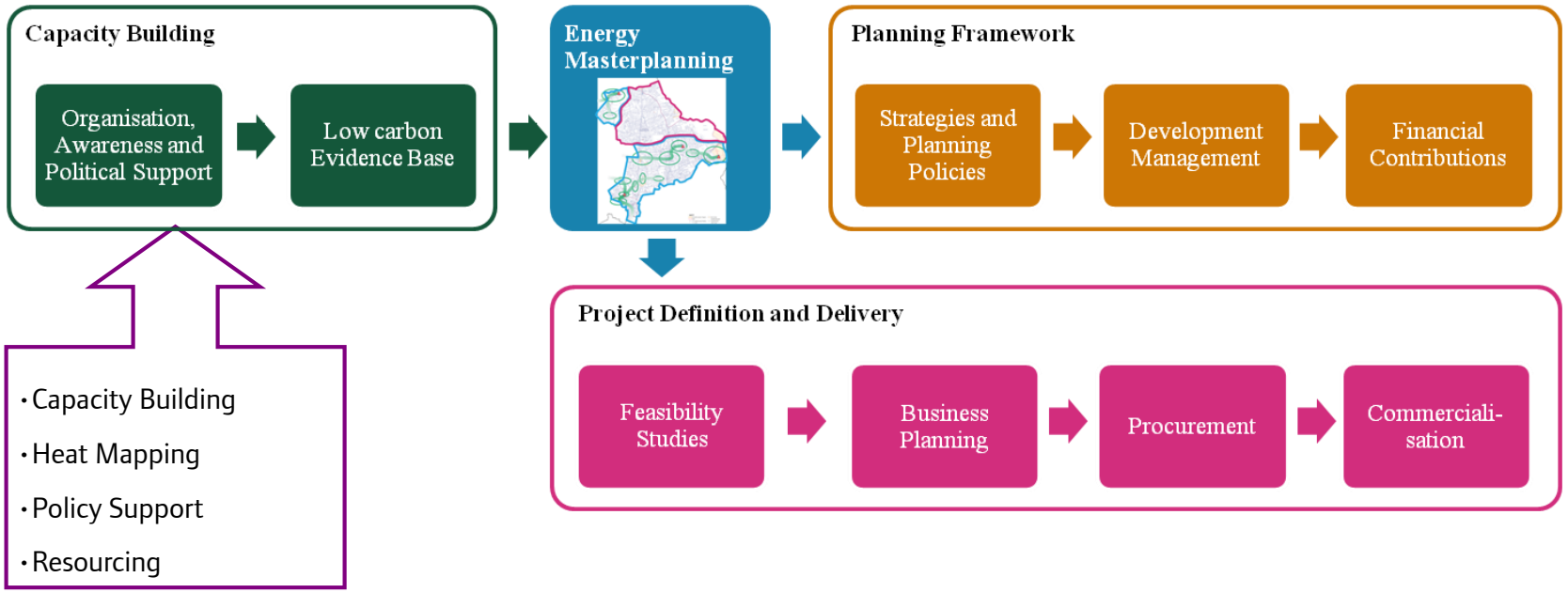
Future Heat Network Support
Your Views

Peter North

Senior Manager, Smart Energy Systems

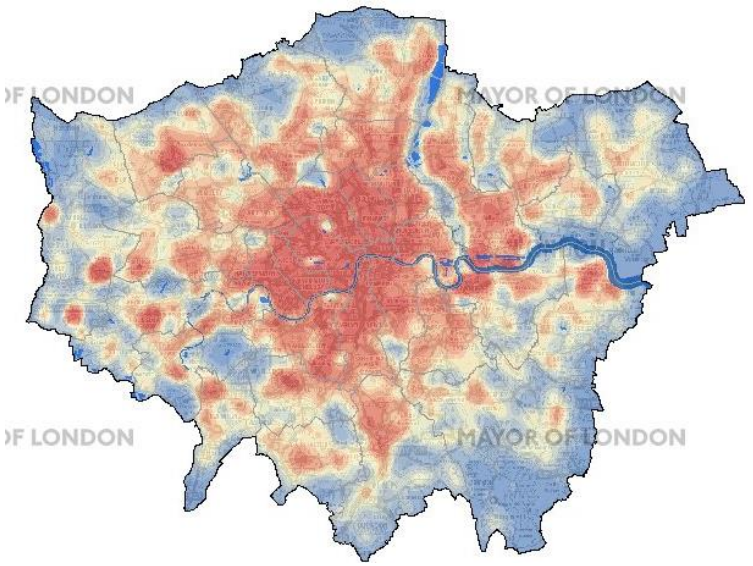
24th July 2018

Decentralised Energy Development Methodology



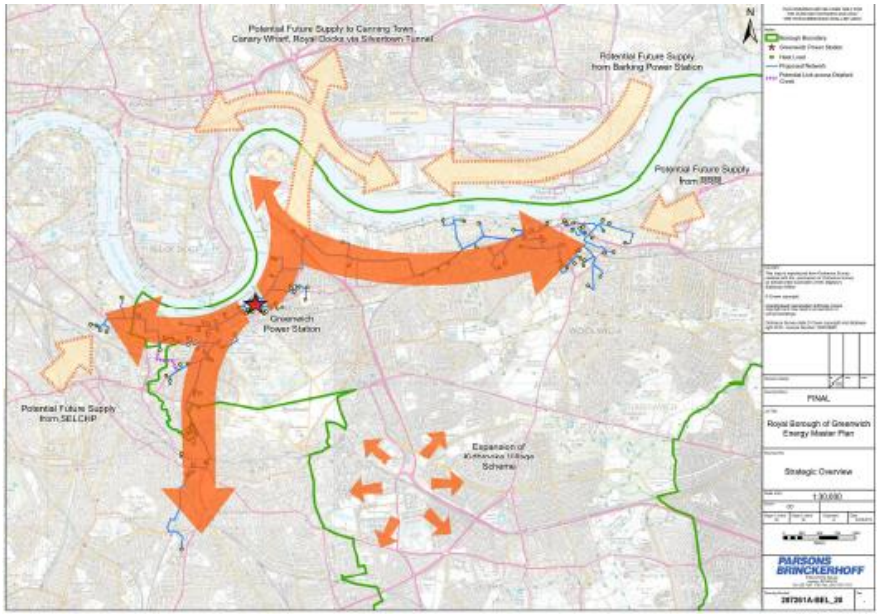
The London Heat Map (www.londonheatmap.org.uk)

- It is owned by the GLA since 2011
- It builds on the 2005 London Community Heating Development Study
- It is in a user friendly format using an interactive GIS system
- It provides spatial intelligence on factors relevant to the identification and development of DE opportunities, such as heat sources, major heat loads and supply plants, heat networks, DE clusters, OAPFs, etc.
- It is publicly accessible to anyone with an interest in DE



DECENTRALISED ENERGY MASTERPLANNING

- Identify new DE opportunities
- Long-term vision for heat network growth
- Develop planning policies to promote heat networks and connection of new developments



MAYOR OF LONDON

Decentralised Energy Support Unit (2011 to 2015)

- Number of projects 18
- Boroughs supported 16
- Private sector supported 5

Max	£217,300
Min	£27,250
Average	£61,350
Total	£2,758,578

	Capex	Capacity (kWth/kWe)	Network length (km)
Max	£24m	40/30	6.6
Min	£1m	0.9/0.8	0.6
Ave	£7m	10/5	2.2
Total	£107m	119/60	36
Total annual CO_2 reduction			50,000 tCO_2/a

Decentralised Energy Enabling Project (DEEP)

£3.5m budget (50% funded by ERDF)

Contracted to deliver by September 2019

- 17,400 tonnes of C02 reduction
- 3 MW of Renewable energy generation capacity

Project to procure support services via DEEP framework to support London Boroughs and other organisations.

Project development work to include all undertaking from heat mapping an area right through to commercialisation of a DE scheme

All information relating to DEEP:
https://www.london.gov.uk/what-we-do/environment/energy/energy-supply

European Union
European Regional Development Fund

What Did We Learn?

- Public sector leadership at local level
- Coordination
- Strong planning policy framework
- Consistent planning decisions
- Commit resource: people and budget
- Engage private sector experience
- Senior level commitment
- Political commitment

- Large-scale scheme delivers least-cost heat and large volumes
- High development costs
- High investment cost, uncertain income revenue timing
- Plan large, start small

Tell us what you think

deep@london.gov.uk

Peter North
Senior Manager
Smart Energy Systems
Greater London Authority

peter.north@london.gov.uk

https://www.london.gov.uk/what-we-do/environment/energy/energy-supply

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London Heatmap II

Joshua Thumim
Centre for Sustainable Energy

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A brief history of heatmaps

London Heatmap 0: at GLA in 2005

- COA and MLSOA estimates
- London Community Heating Development Study

London Heatmap 1: CSE 2009 for GLA

- 50m grid-based demand estimations
- Off-the-shelf ESRI webmaps
- Cutting edge 10 years ago
- GLA added lots of useful extra layers since then

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A brief history of heatmaps

Since 2009

- Bristol Heatmap 2010
- SW Heatmap 2010: first address-level map
- East Mids Heatmap 2011
- National Heatmap, CSE 2012

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A brief history of heatmaps

Since 2012

- More computing power & bandwidth, lower costs
- More open data, e.g.
  - OS addressing and topology
  - Royal Mail PAF
  - EA LIDAR
  - All EPCs and DECs published in a database

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London Heatmap II

Purposes remain the same

- Supporting development of DE in London
- Provide freely accessible tools and data for identifying and communicating DE opportunities
- Supply side focus now less on CHP and more on waste heat, HP etc.

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London Heatmap II

But a good time for an update

- Higher resolution demand estimates (address -> building)
- Better demand data (EPCs, LIDAR)
- More local energy source data
- Heat network planning tools in the browser

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User interface features

- Data map layers
- Context map layers
- Saved state links: share your work
- Network modelling tool

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Data layers

- Demand at buildings
- Supply locations
- Network paths

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Context layers

- Previous study areas (polygons)
- EPC certificate locations (clustered points)
- Existing DH networks (lines)
- AQMA (polygons)
- OAPF (polygons)
- Etc.

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Network modelling tool

- User selection of supplies, paths, demands
- Cost, supply and demand values editable
- Features:
  - Report on capex, opex, revenue, NPV, emissions
  - Export as shapefile, spreadsheet
  - Save edits as link

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Schedule

- First production version of UI: end July 18
- Complete modelling, populate DB: end Sept 18
- Connect UI and DB: Oct-Nov 18
- Publish LHM2: end Nov 18

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Thank you

joshua.thumim@cse.org.uk

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