

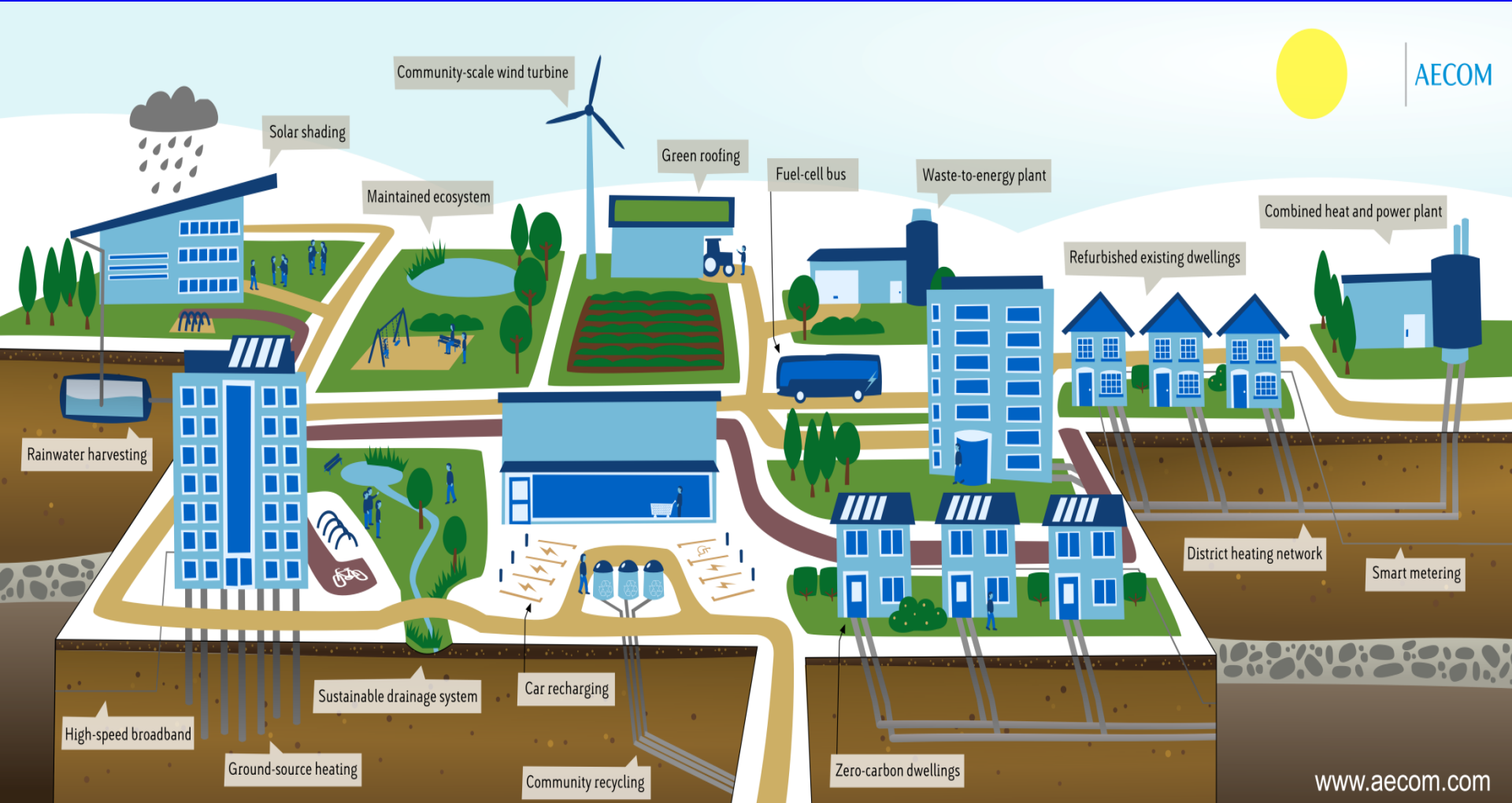
Michael King

Associate

Combined Heat & Power Association

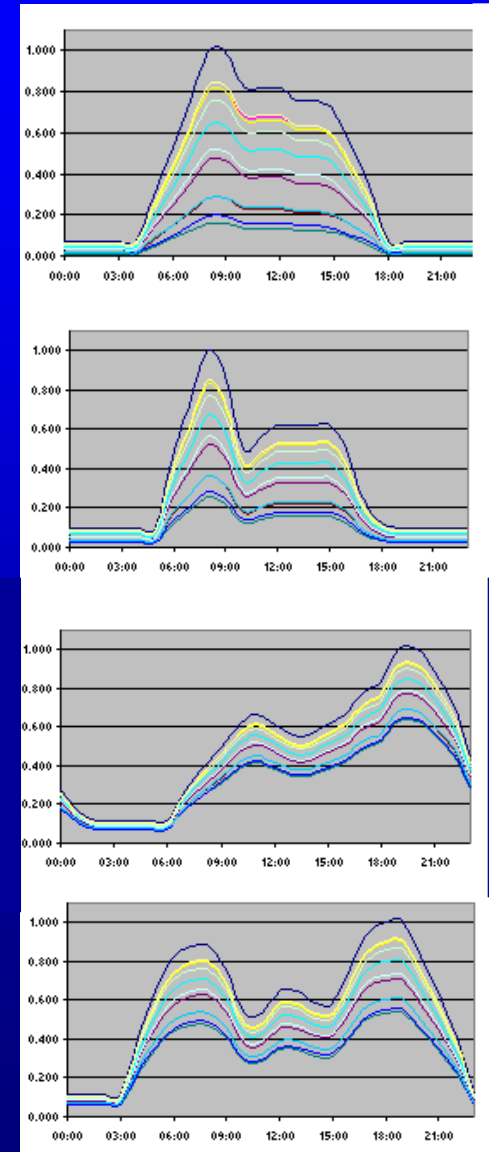
Decentralised Energy

Decentralized energy is the generation of heat & power close to the point of use



Demand - Load Profiles

- Load is the building user's demand for heat
- Different user types have different patterns of use
- Building Load Profiles
 - Retail
 - Commercial
 - Hotels
 - Assembly and Leisure
 - Residential



Networks facilitate aggregated loads

- Complementary or overlapping loads
- Capacity/load ratio - sizing
- Optimisation of plant
- Capital & maintenance costs shared across connected buildings
- Lower customer costs



Distribution Network Pipes

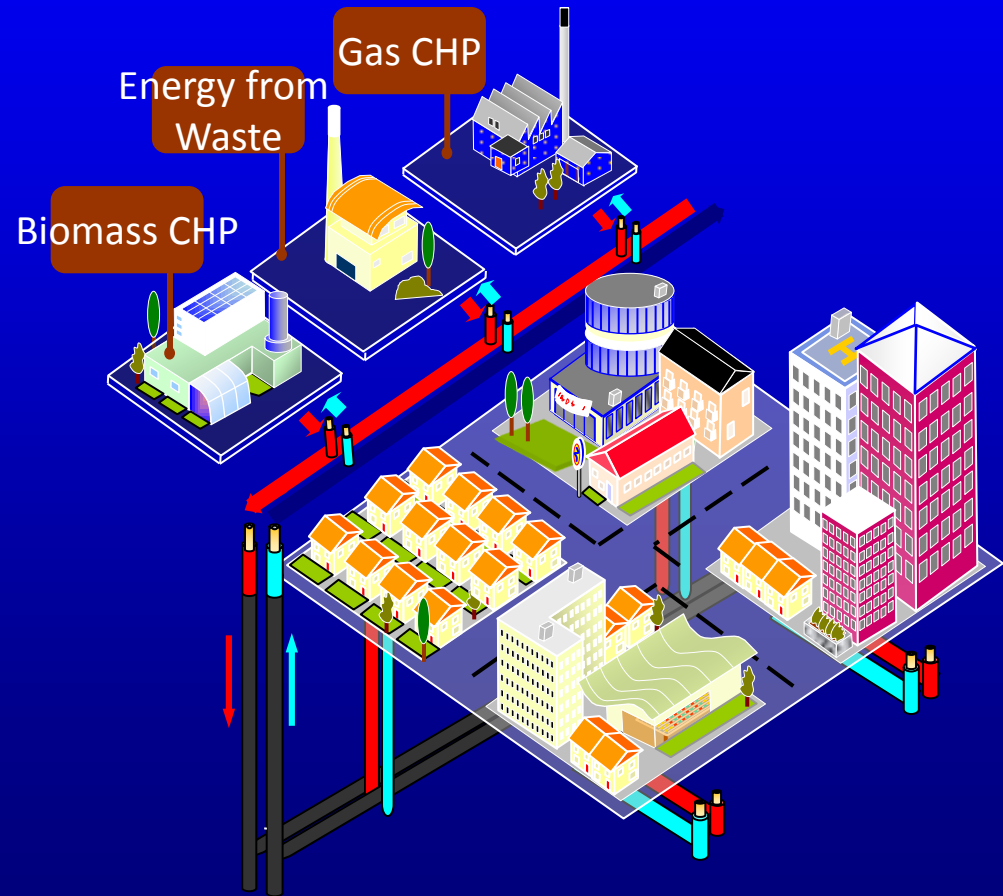


Inside the home



Heat Generation Technologies

- **Accesses technologies at scale**
- **Multiple heat sources include Combined Heat & Power (CHP), renewables: biomass, solar & geothermal, E-f-W, waste heat**
- **Diverse fuel sources improves supply security**
- **Reduces price volatility**
- **Simplicity in retro-fitting new and emerging technologies**



Combined Heat and Power *simultaneous generation of heat and electricity*



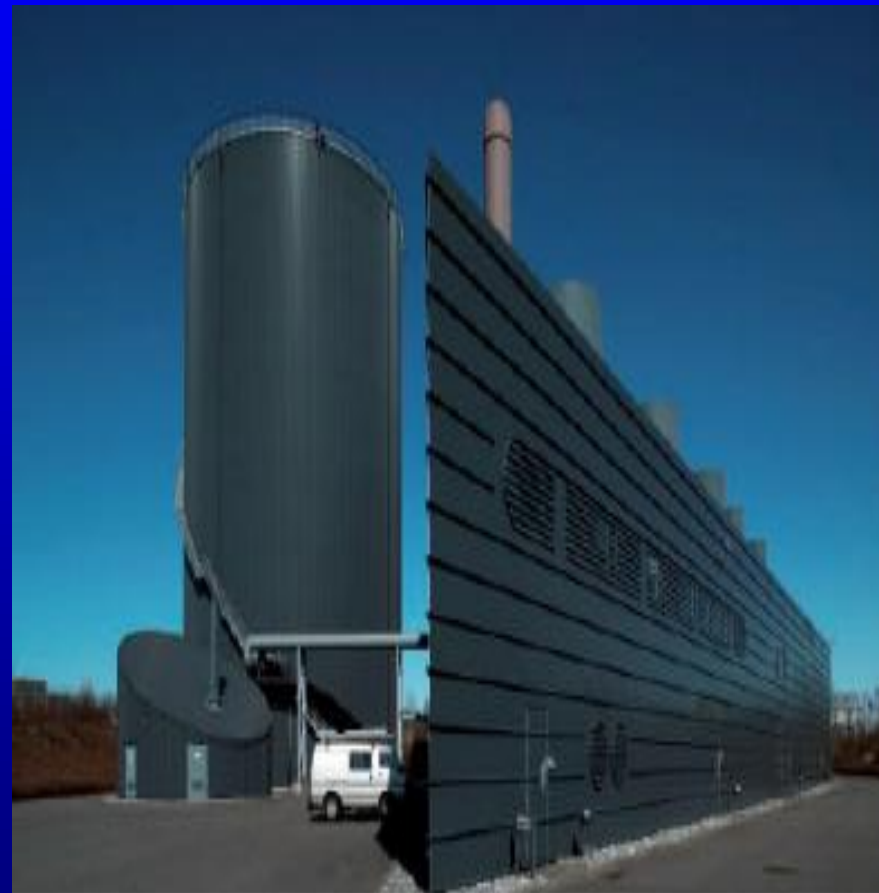
Packaged CHP unit



Inside plant room



Energy Centres



Key requirements for District Heating

High heat density:

- High absolute building density
- Age of buildings - thermal performance

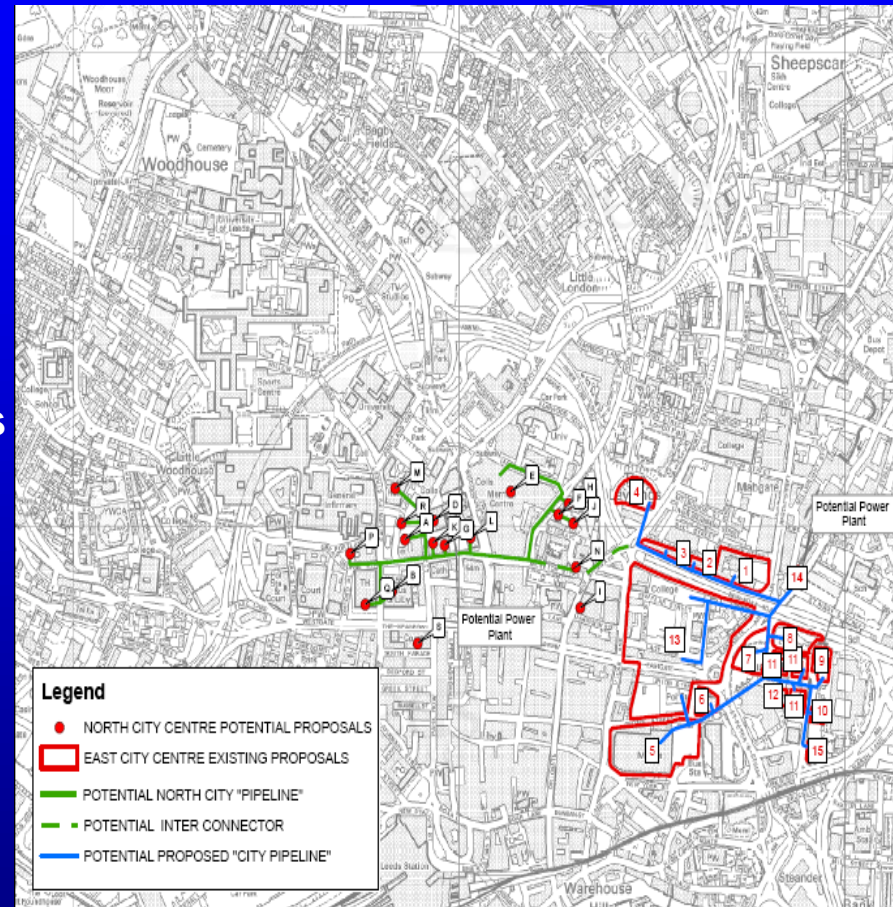
Diversity of loads:

- Mixed uses of buildings
- Domestic/non-domestic/age of buildings

Presence of anchor loads:

- Public sector – hospitals, prisons, universities, civic buildings, leisure centres, social housing
- Private sector – hotels, leisure centres, process industries

District heating not appropriate everywhere



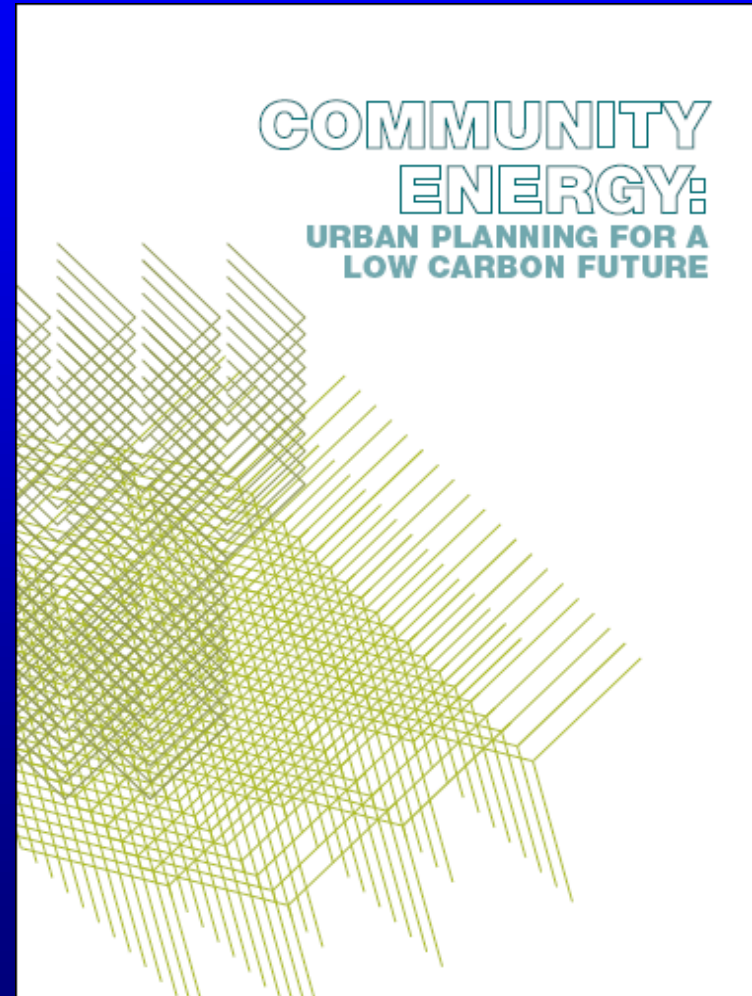
Leeds City Centre

Character Areas

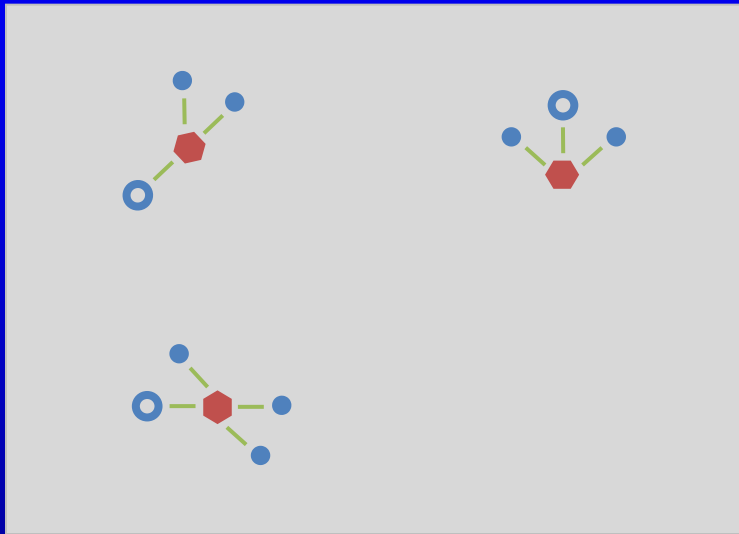
TCPA/CHPA Low Carbon Planning Guide
Generation technologies - location specific

- **Character areas:**
 - - **city centre**
 - - **edge of centre**
 - - **inner city**
 - - **suburban**
 - - **urban extensions**
 - - **industrial areas**

Different portfolio of technologies for each area

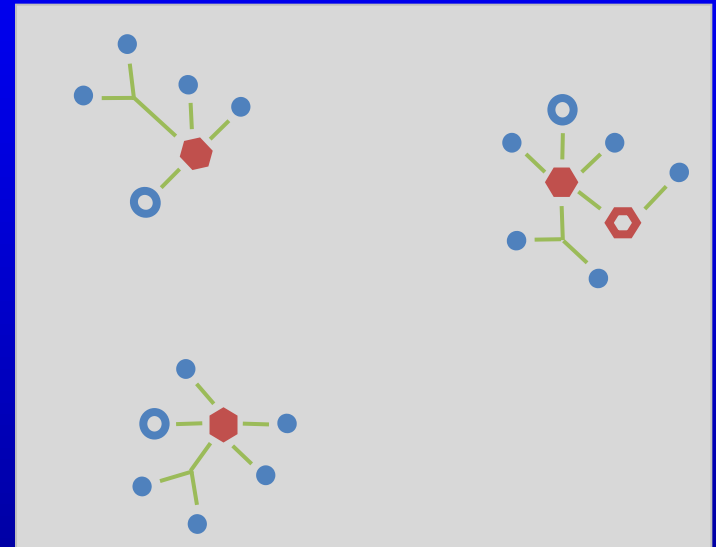


Development of Network



Stage 1. Initial Development.

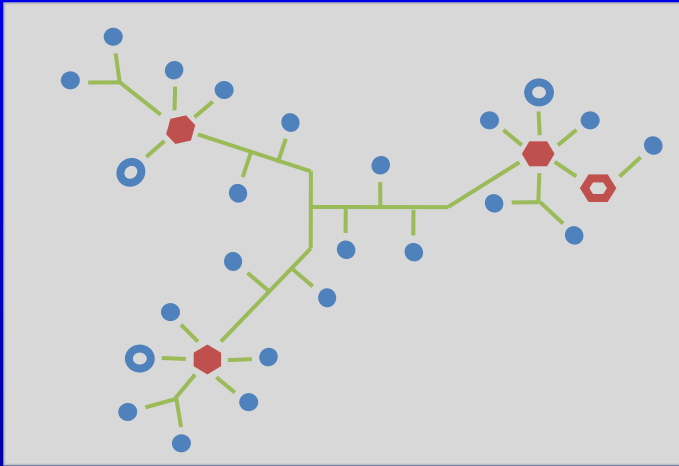
One or more independent cluster networks developed based around key “anchor” loads (e.g. social housing, hospitals, universities etc.) and other loads in the vicinity. Each cluster served by a single, small heat source (e.g. gas CHP)



Stage 2. Expansion

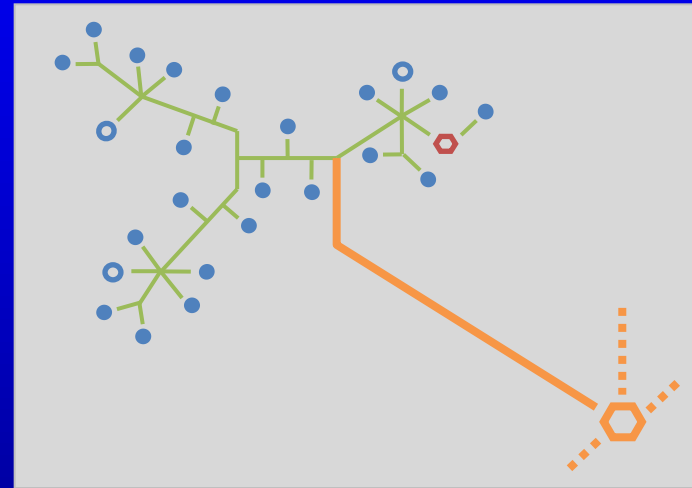
Clusters expand as they become more established to connect additional loads that have become economically viable. Individual heat sources grow in capacity to meet demand or are reinforced with larger heat sources (e.g. EfW CHP)

Development of Network



Stage 3. Interlinking

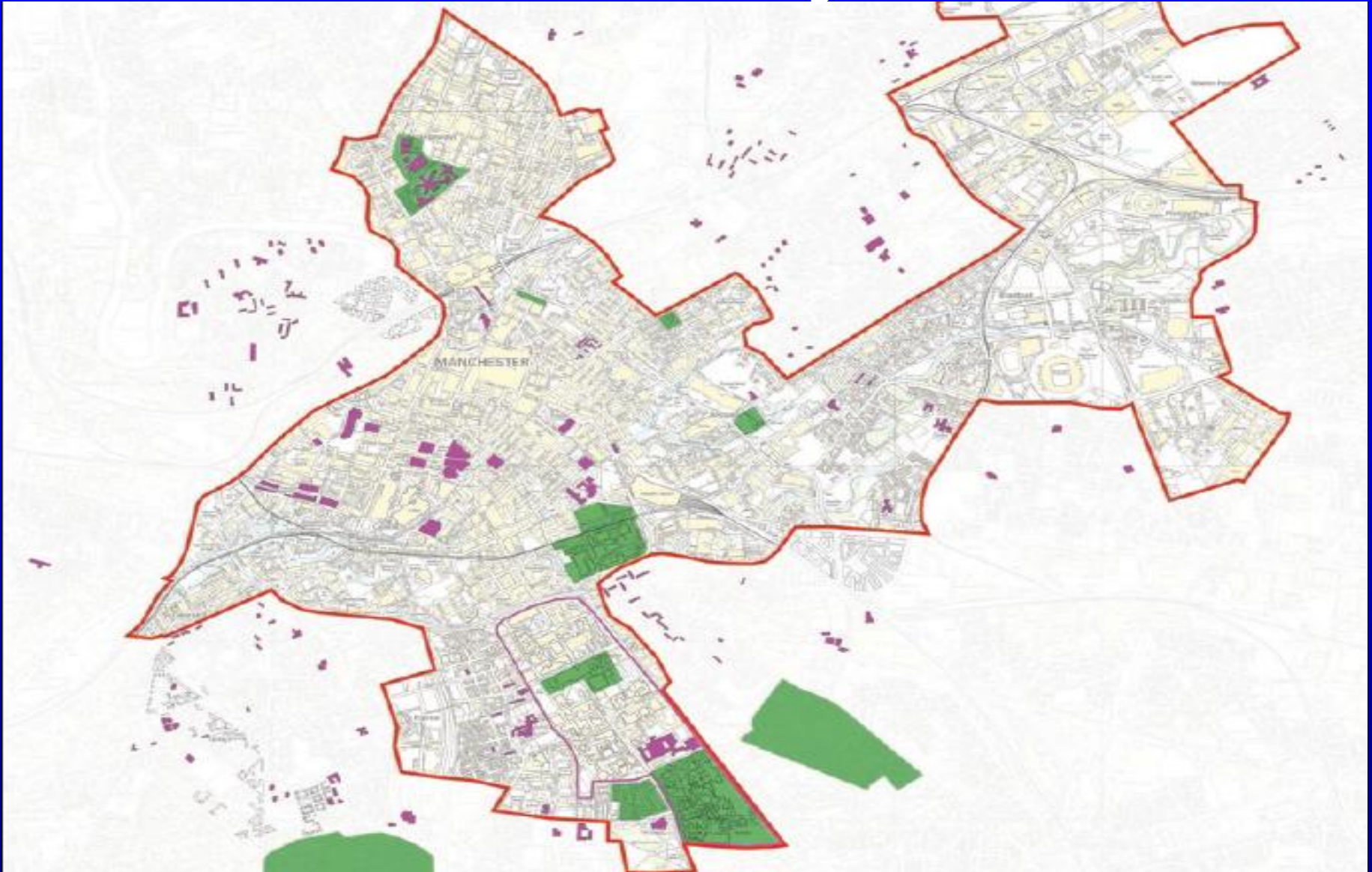
Inter-connectors installed to share excess heat capacity between clusters. Inter-connector routes selected to permit further connection with economic demands situated between clusters



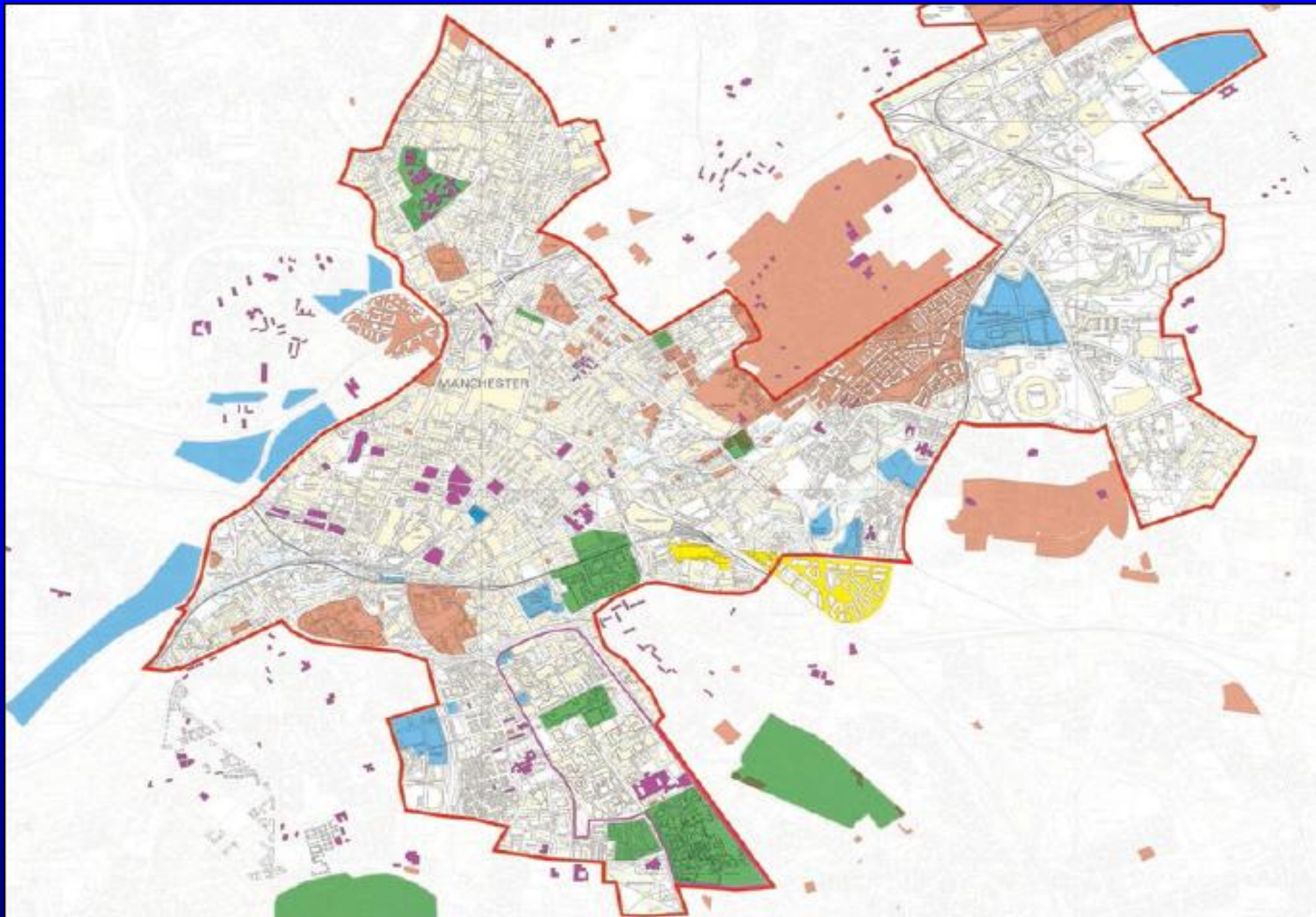
Stage 4. Regeneration

Original heat sources will have reaching the end of their lives. These will need to be replaced with new heat sources, which may include surplus heat from power stations. This may be carried over long distances using high capacity “transmission” mains.

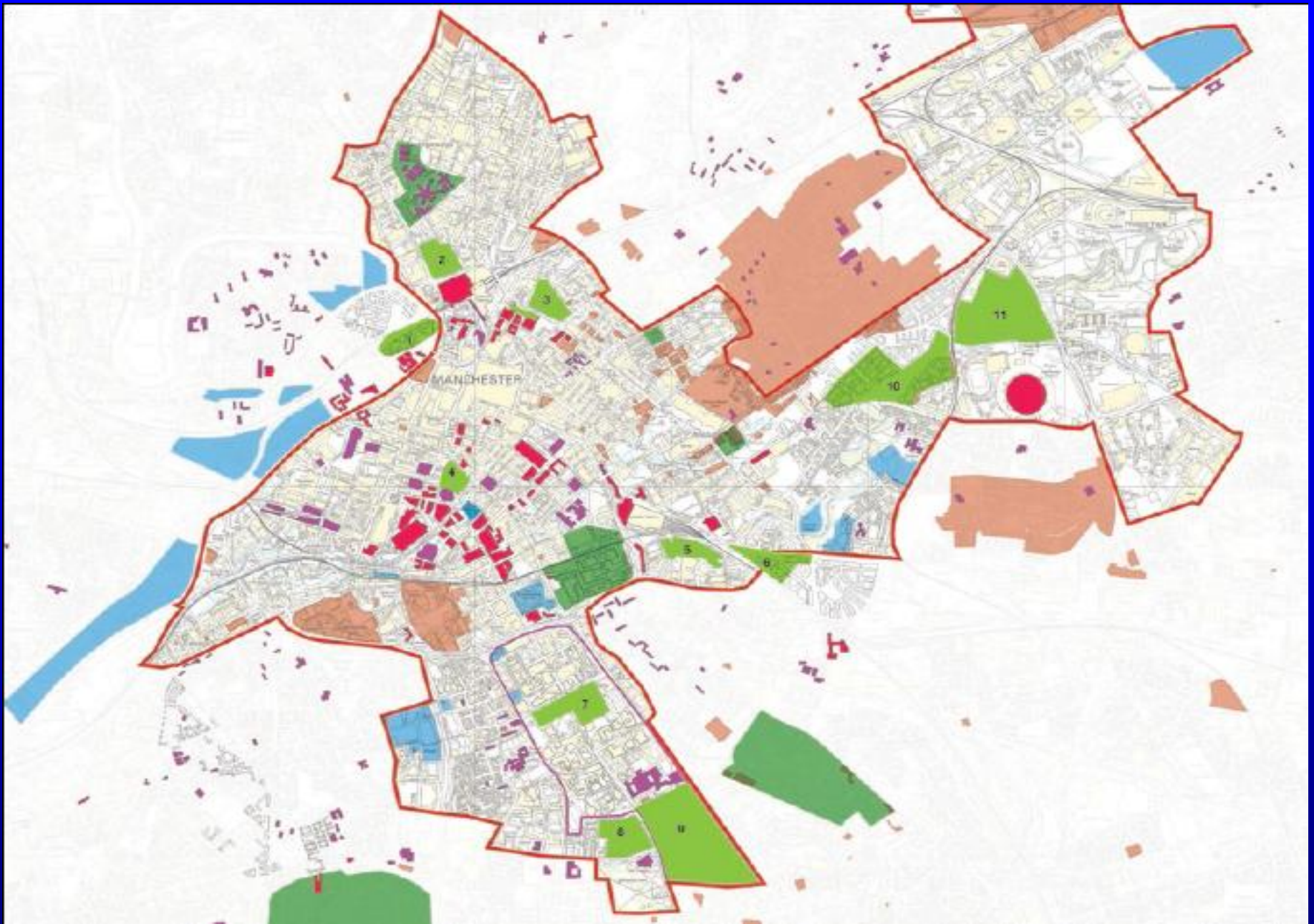
Manchester City Centre



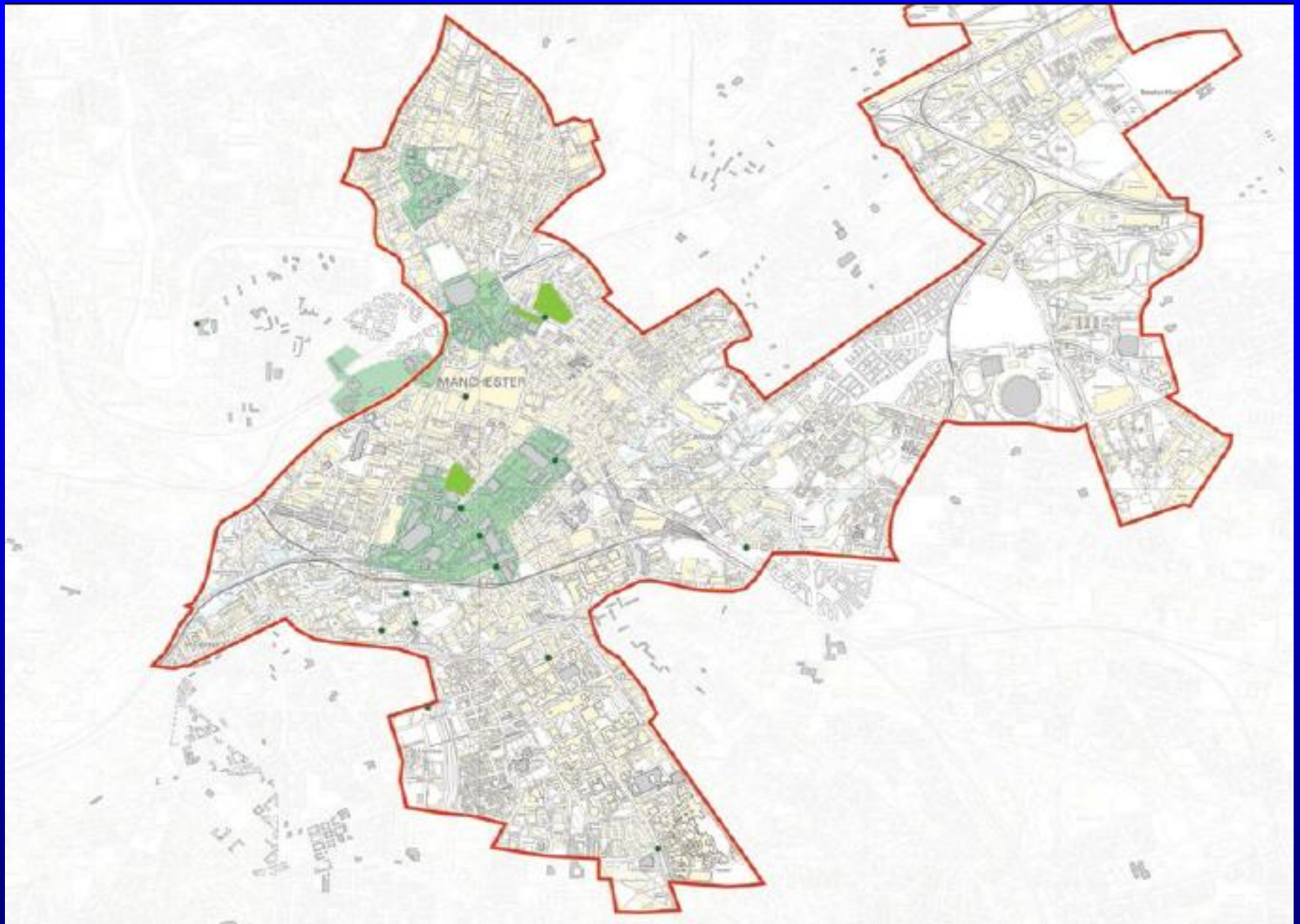
Existing networks and public buildings



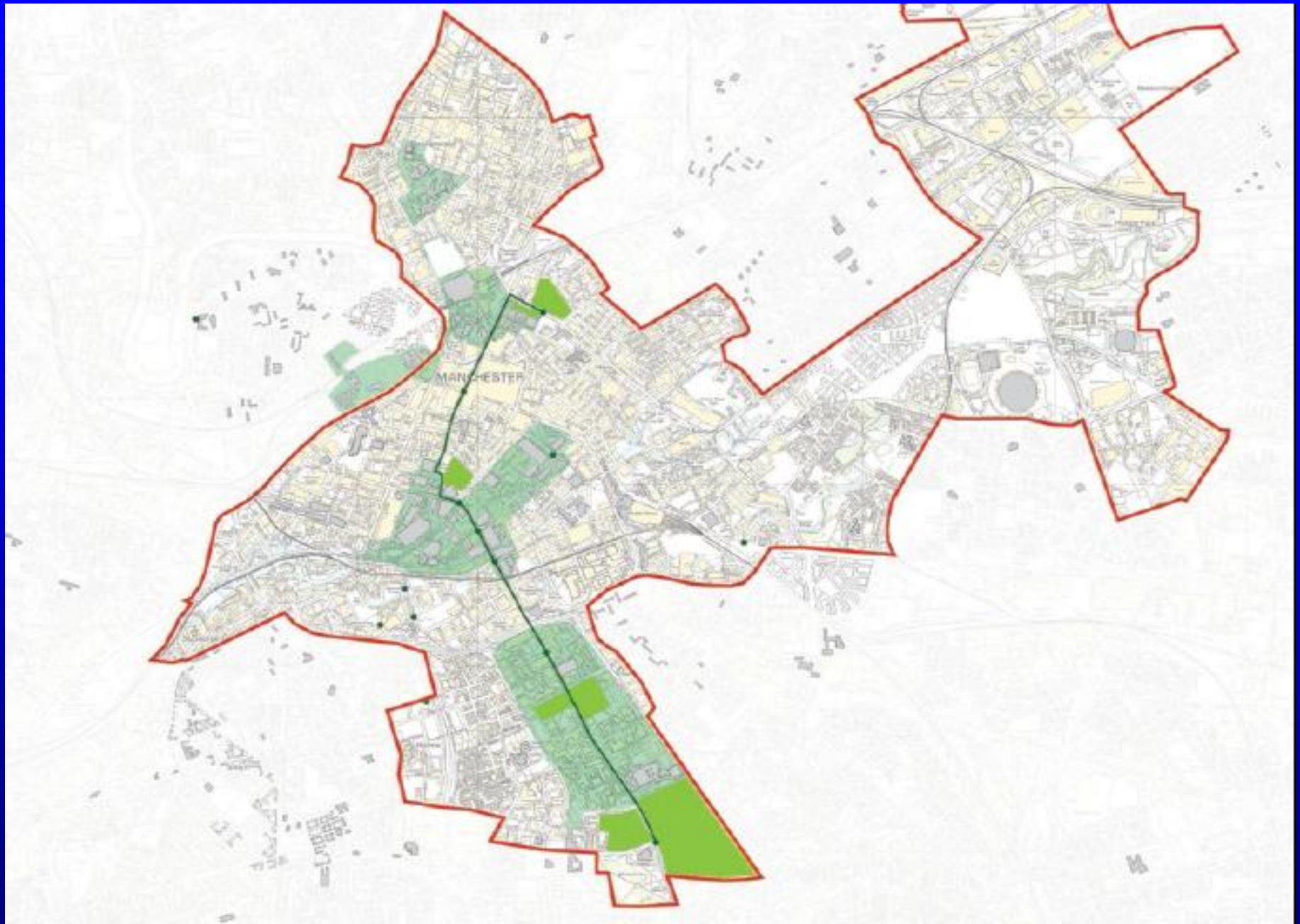
Development areas with varying levels of certainty



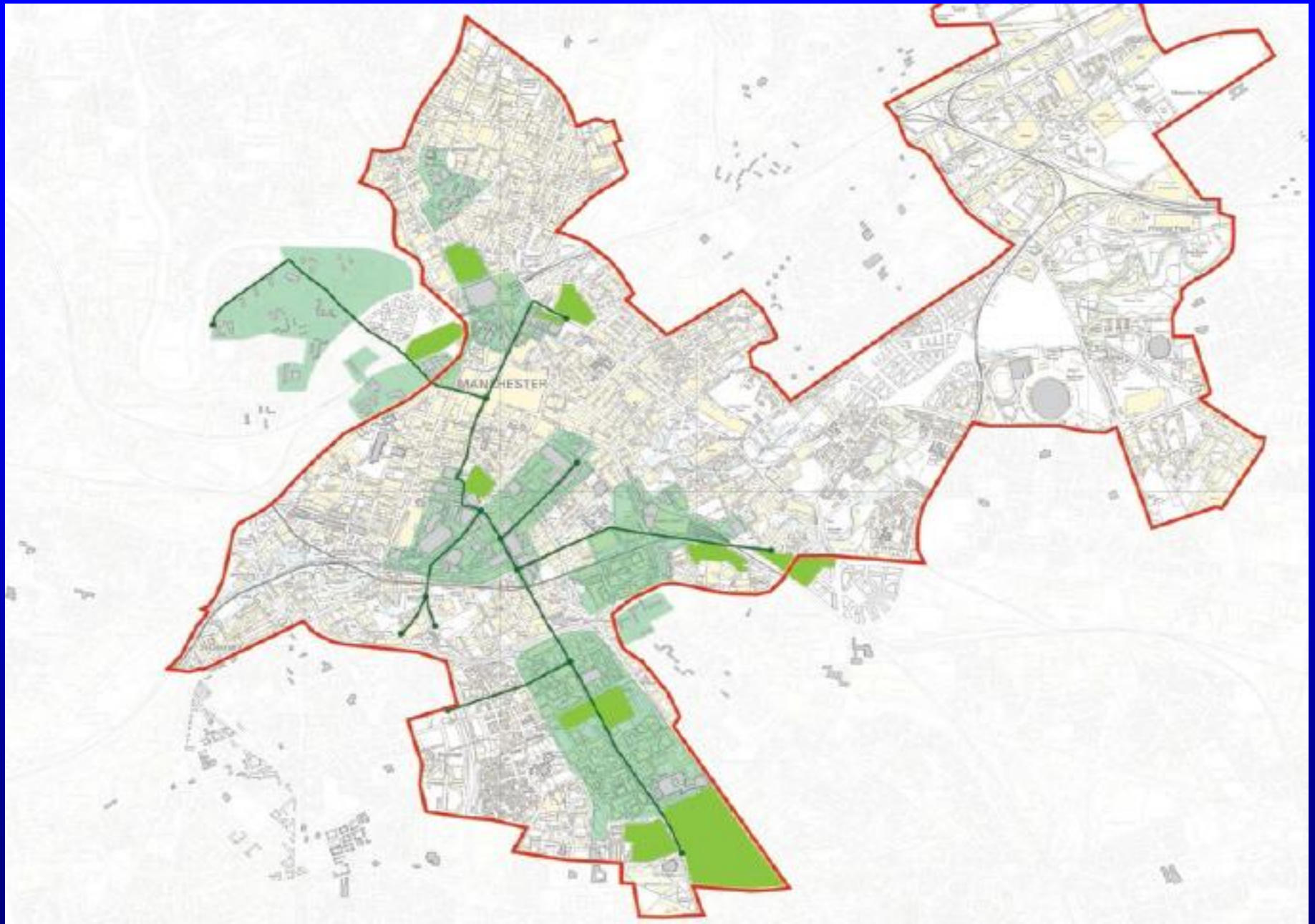
Major commercial buildings



Potential clusters



Spine main

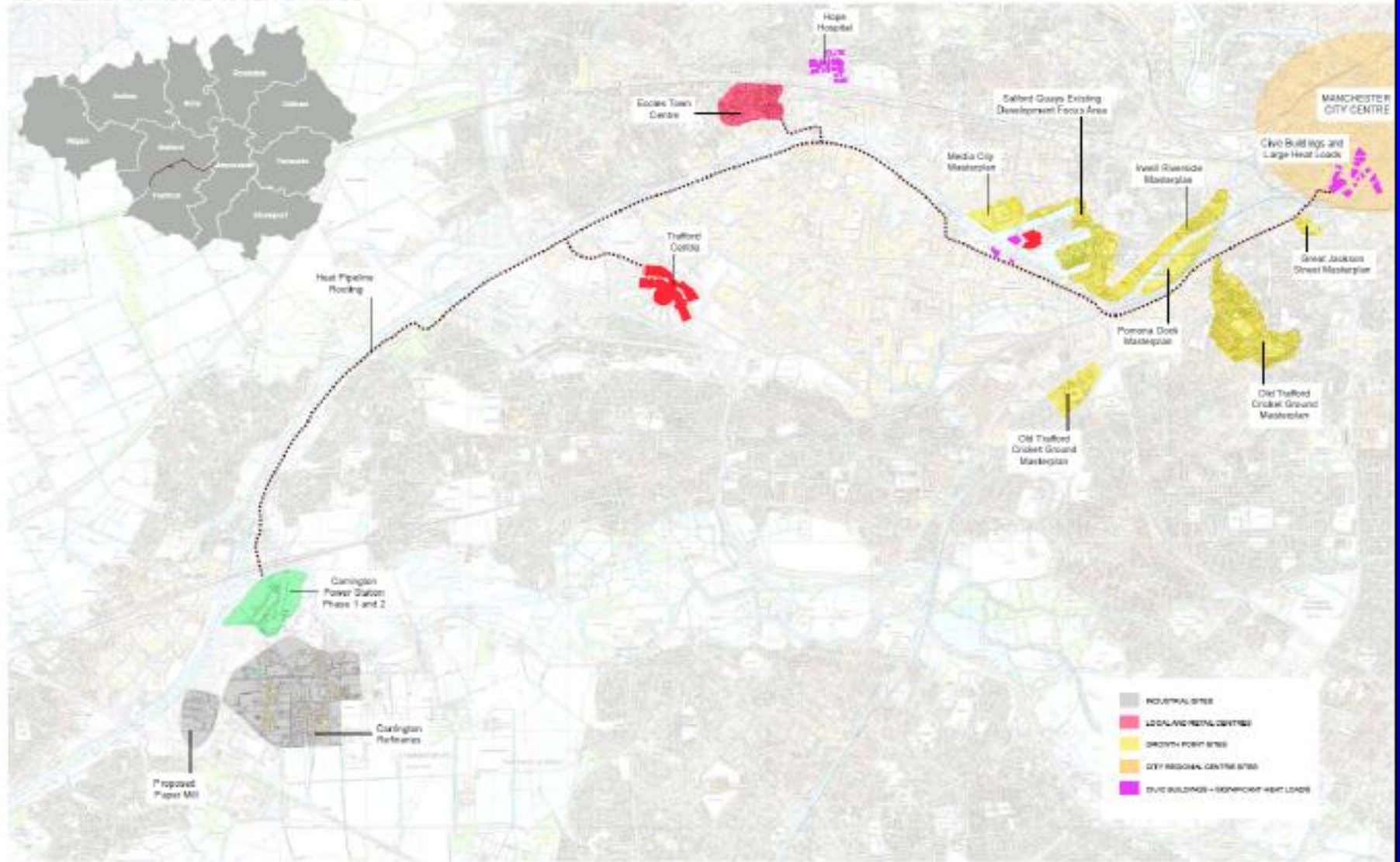


Branching out

CARRINGTON, POWER STATION

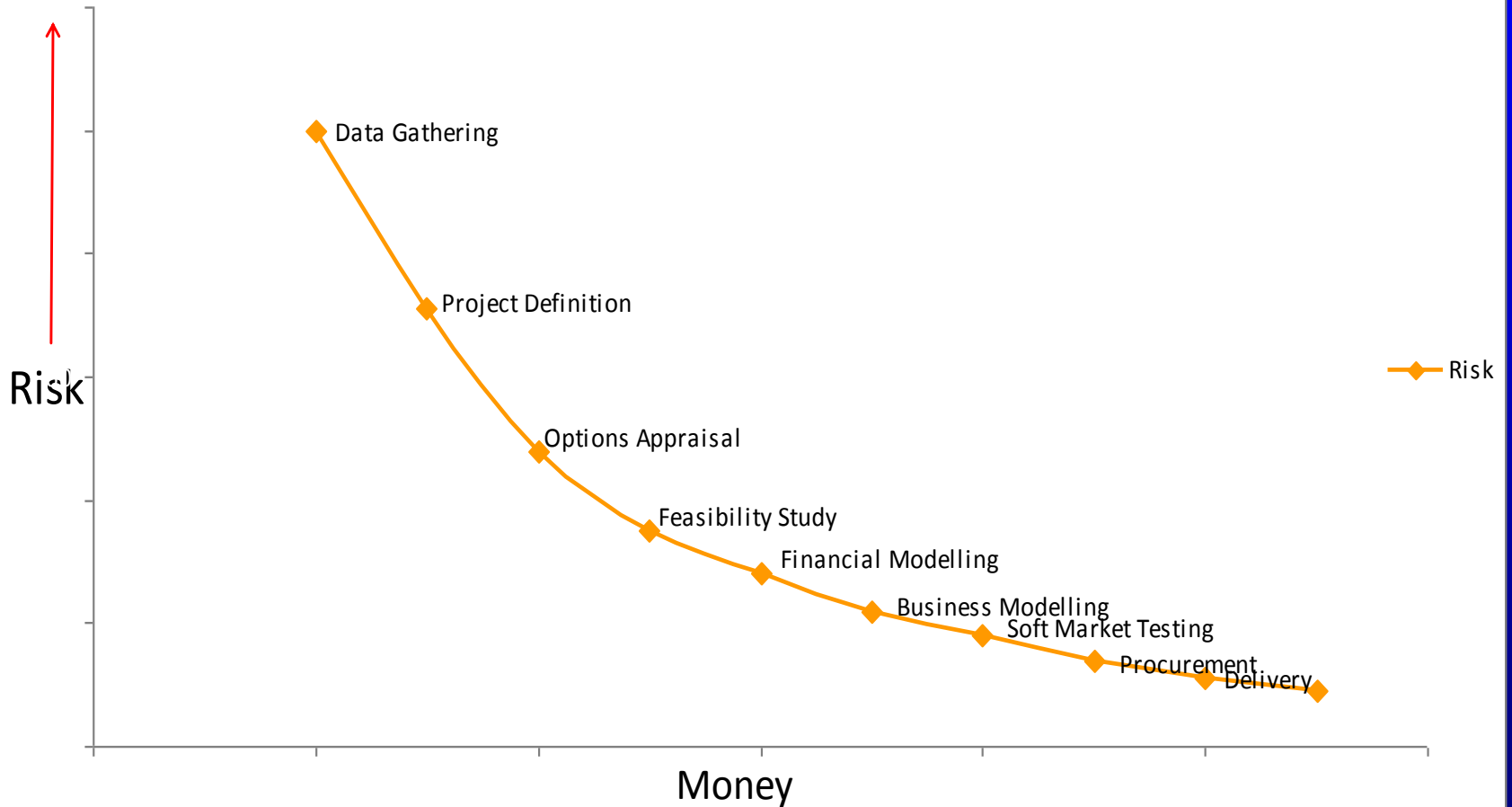
HEAT PIPELINE ROUTING AND TARGET HEAT LOADS

"PLANS ARE FOR ILLUSTRATIVE PURPOSES OF THIS STUDY ONLY"



Connection to Carrington power station

Stages of Development



Set Objectives

- **Carbon emission reductions**
- **Affordability**
- **Security of supply**
- **Regeneration**
- **Revenues**



Heat Loads Map

Legend

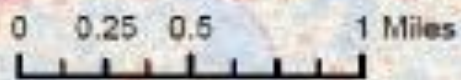
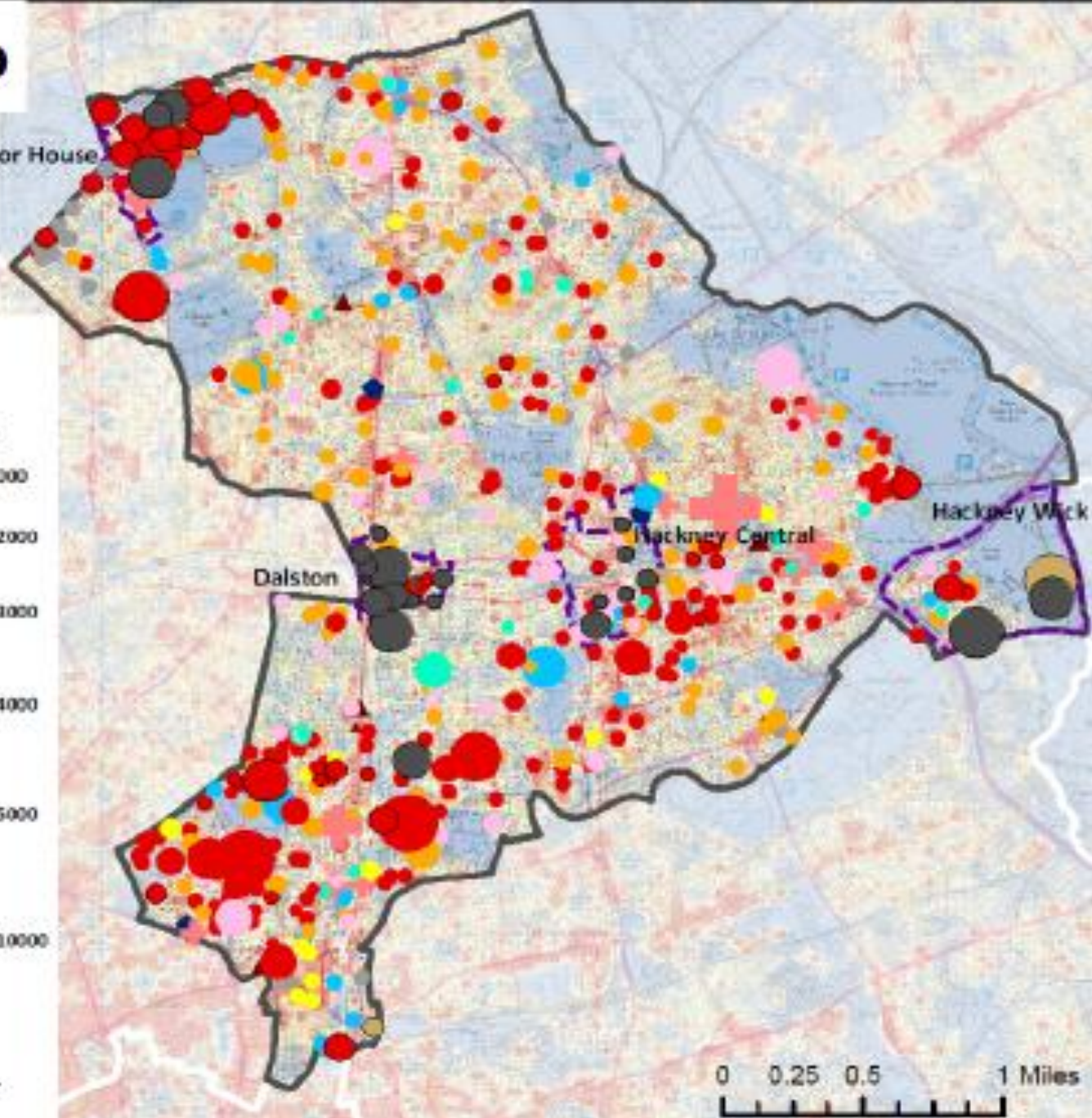
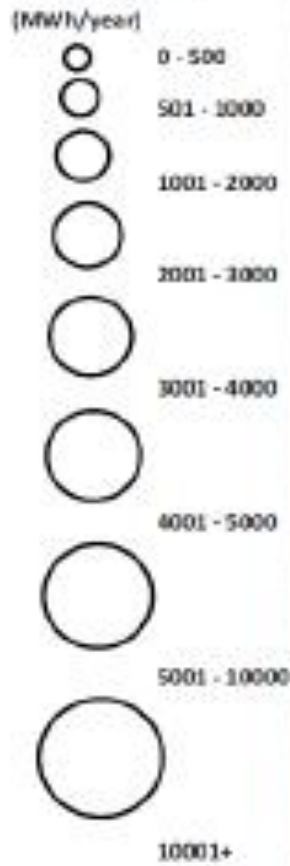
Proposed Buildings

- Multi-address buildings
- ⊕ NHS
- Private commercial
- Education facilities
- Other public buildings
- Mixed use

Existing Buildings

- Multi-address buildings
- Prisons
- Boiler Sites
- IEP CH database
- Private residential
- Borough heat loads
- ⊕ Churches
- Police stations
- ▲ Fire stations
- Hotels
- Museum and art gallery
- ⊕ NHS
- Private commercial
- Sport & Leisure facilities
- Education facilities
- Government estate
- Other public buildings
- Mixed Use

Fuel Consumption (MWh/year)



Financial Modelling Capital Requirements

- Land for plant room
- Plant – back-up and peaking boilers, CHP engine, pumps & ancillaries
- Pipes for distribution network
- Consumer hydraulic interface units (not incl internal heating system)
- Construction & installation costs
- Legal and financial advisers fees



Financial Modelling

Operational Costs

- **Input fuel (natural gas, oil, biomass)**
- **Electricity for lighting and pumping**
- **Maintenance**
- **Billing and revenue collection – incl bad debt provision**
- **Operational management**
- **Customer care – incl emergency cover**
- **Capital interest and re-payments**
- **Insurance**
- **Business rates**
- **Contributions to sinking fund (may be introduced after break even point).**
- **Legal and financial advisers fees**



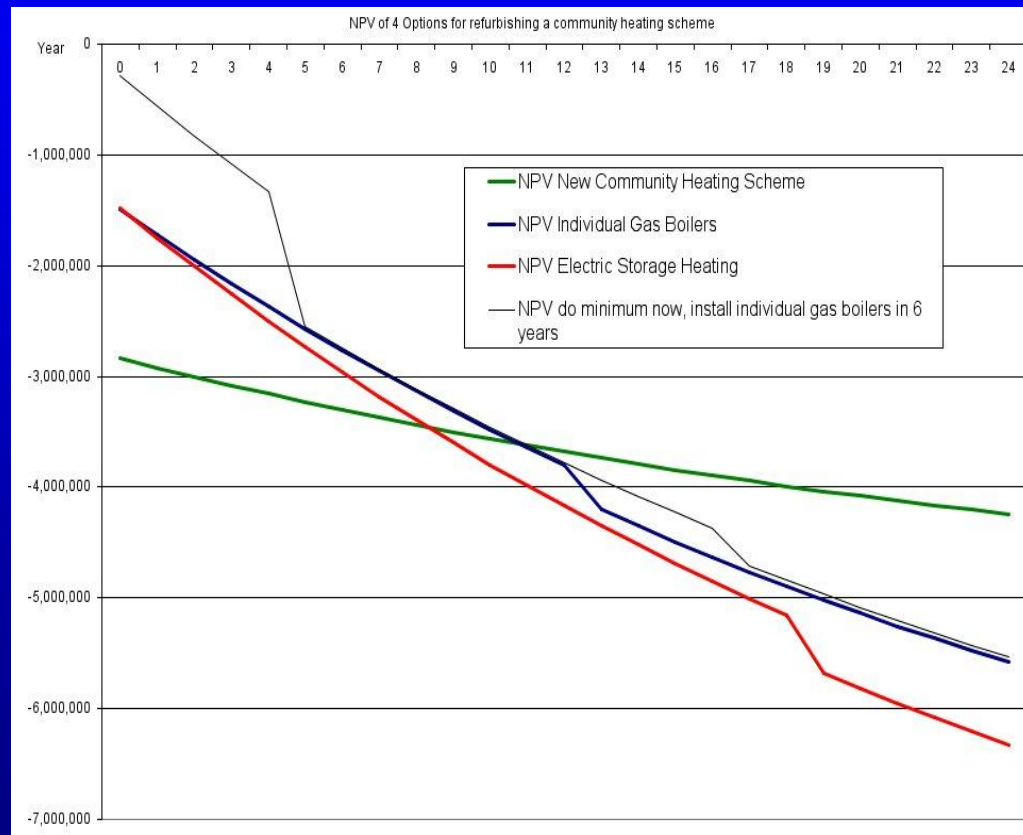
Financial Modelling Revenues

- **Electricity trading**
- **Standing charges**
- **Heat charges**
- **Maintenance charges**
- **ROC income**
- **Renewable Heat incentives**
- **FiT's**
- **Gate Fees**



Appraisal methodologies

- The following methods can be used for the financial appraisal of CHP projects.
 - Payback
 - Discounted Cash Flow
 - Net Present Value
 - Internal Rate of Return
 - Whole life cost analysis
- Each method has advantages & disadvantages – no method is perfect



Financial modelling

- **Set objectives**
- **Capital costs**
- **Operating Costs**
- **Revenues**

Rev must cover capex & opex

Questions?

Does it deliver objectives?

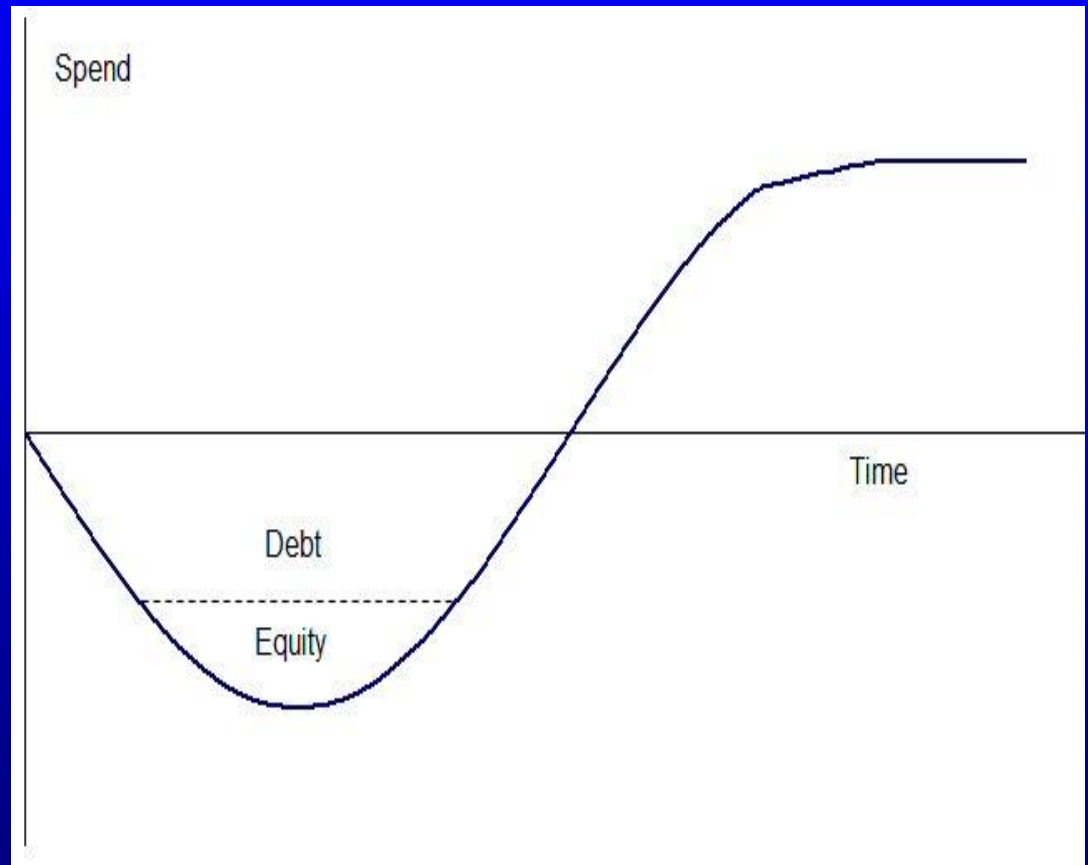
Is it financially viable?

Is there a capital gap?

How deep/wide is it?

How to fill it?

How sensitive is the model?



Business Models

- Long lasting assets
- Requires ongoing O&M
- Complex multiple relationships
- High up-front capital cost
- Financing requires long contracts
- Need to switch costs away from developers and building owners into stand alone business plan that attracts 3rd party investment
- Non-traditional form of energy distribution not integrated in traditional energy companies business model

- Therefore requires body to own, manage and operate. But what type? SPV, JV, in-house, out-house?



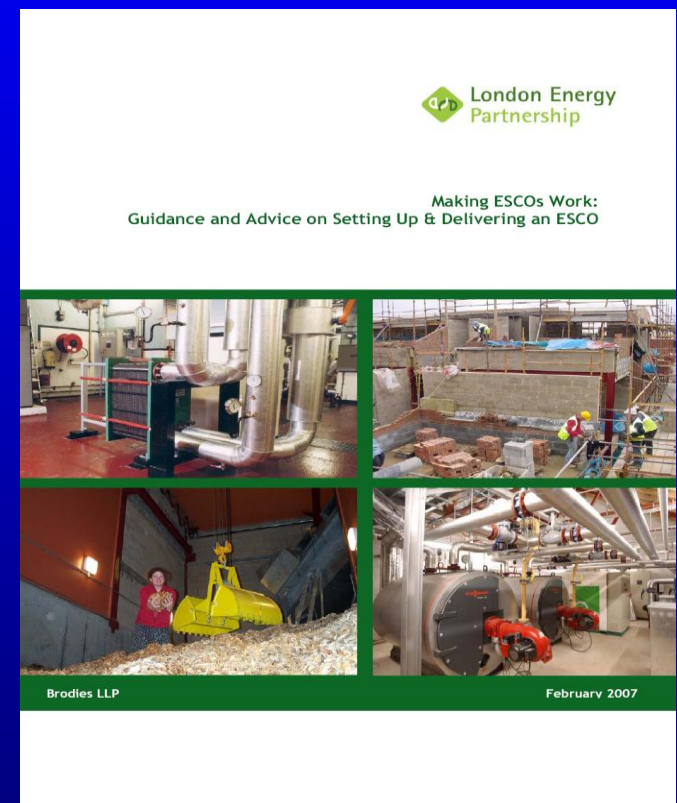
Energy Services Companies

No clear definition of the term. Generally used to describe an entity established to deliver:

- energy efficiency
- energy savings
- sustainable energy
- affordable warmth
- carbon savings

Need not be a company formed and incorporated under Companies House. Maybe an industrial and provident society, trust or even an unincorporated body. But usually a company limited by shares or a company limited by guarantee.

www.lep.org.uk



Definition of ESCO

Generally refers to a business providing a broad range of energy and carbon management solutions, including the design and implementation of energy-saving projects, energy conservation, power generation and energy supply.



Energy Services Companies

Gives self-contained business plan & budget

Focussed management

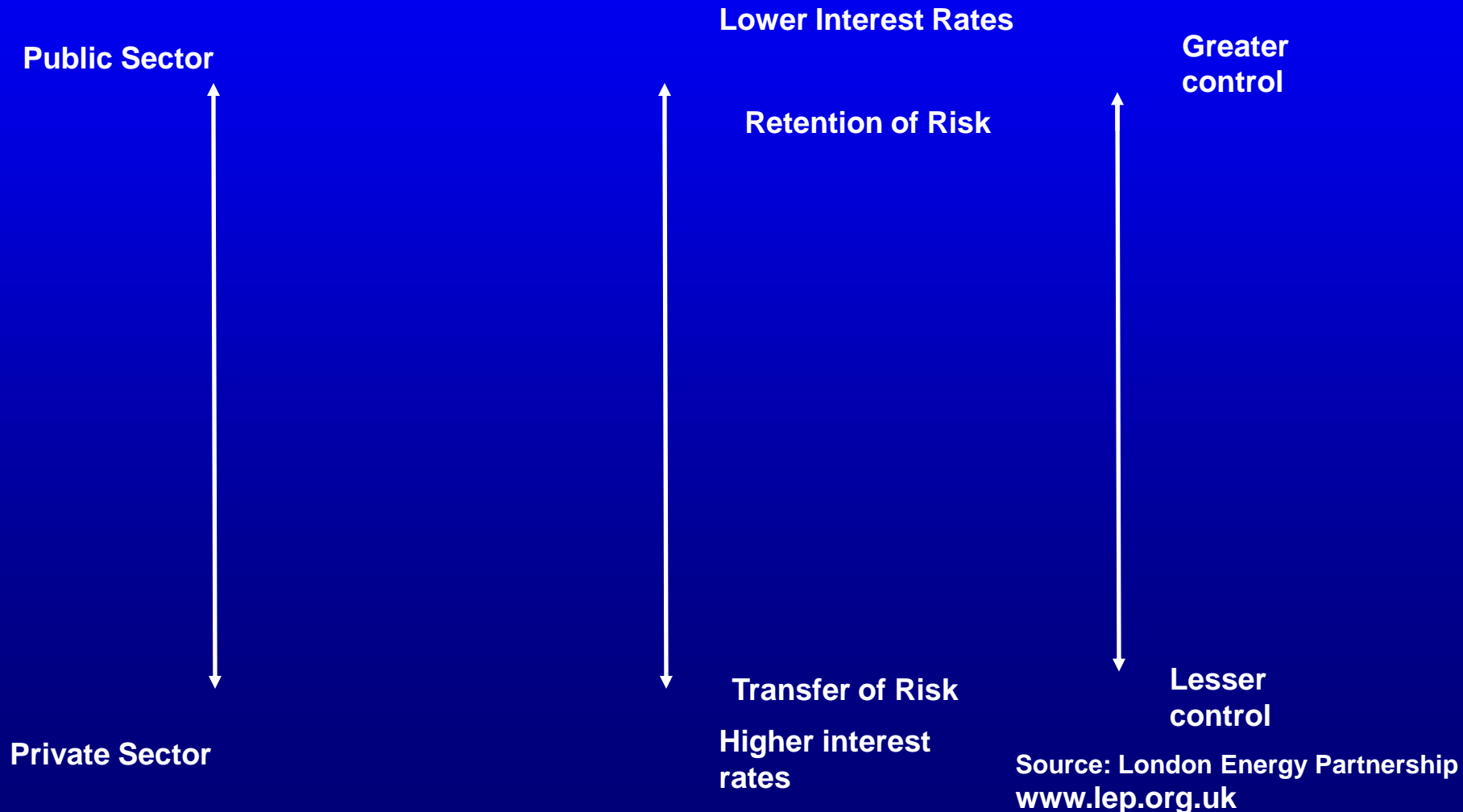
Local control

Four basic models

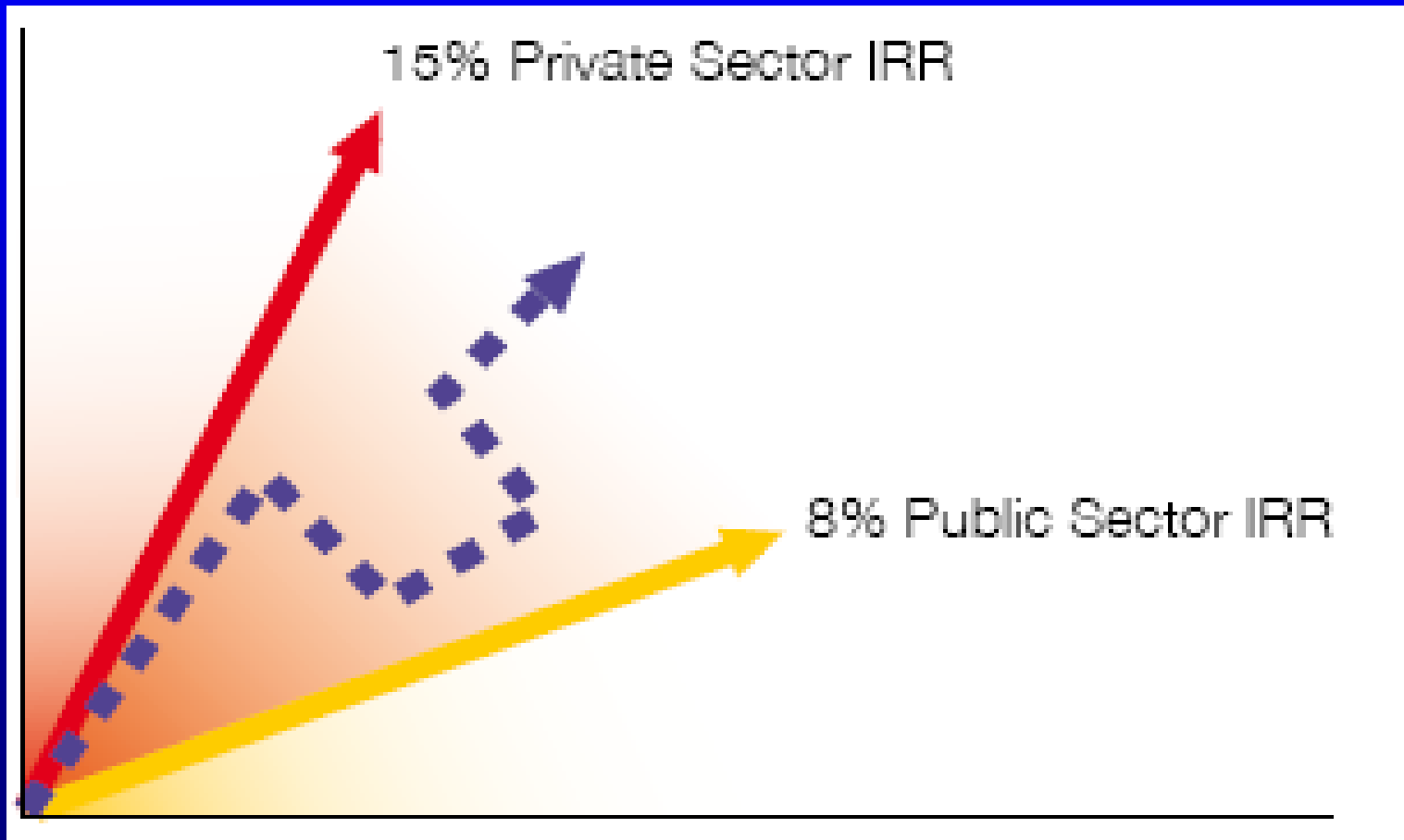
- **wholly public sector**
- **Public/private partnerships, JV's, SPV's**
- **Stakeholder owned eg coop's**
- **Wholly private sector**

Structure determined by attitude of the host organisation to risk and control.

Public/Private Sector ESCO Spectrum



Finding the right Internal Rate of Return



Roles

- Regulation
- Governance
- Project champion
- Developer
- Asset owner
- Operator
- Retailer
- supply chain manager



Type 1 and 2 Projects

Southwark MUSCo



Single entity responsible for generation, infrastructure and selling energy to customer

South East London combined heat and power



Single entity responsible for generation, infrastructure and selling energy to HeatCo who in turns sells to customer

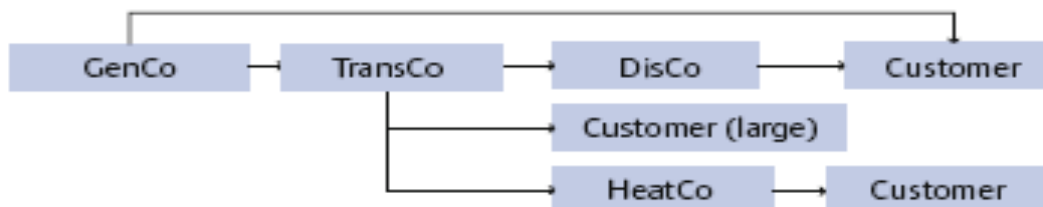
King's Cross Central Development



Two separate vehicles; one vehicle responsible for generating and selling energy and the other responsible for the infrastructure

Type 3 Projects

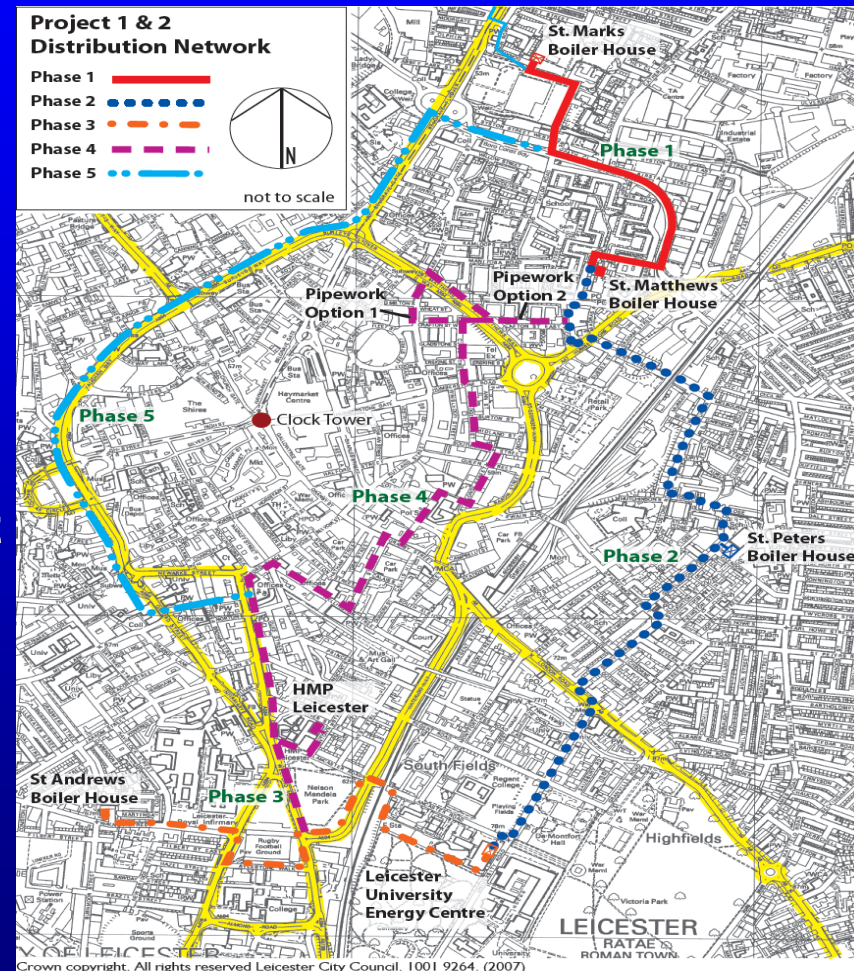
London Thames Gateway Heat Network



Separate vehicles for generation and transmission with various supply arrangements

Procurement from private sector

- OJEU to recruit commercial ESCo
- Well established process
- 25 – 30 year term
- Risk transfer to private sector
- Private sector to invest (??)
- Private sector capital rates – 15% IRR
- Provides gen, distribution, retail
- Terms negotiated in contract at outset
- Control transfer to private sector
- ESCo determines network expansion
- Heat prices match existing prices
- Benchmarked thereafter
- Surpluses taken as profit
- Retain some regulatory function

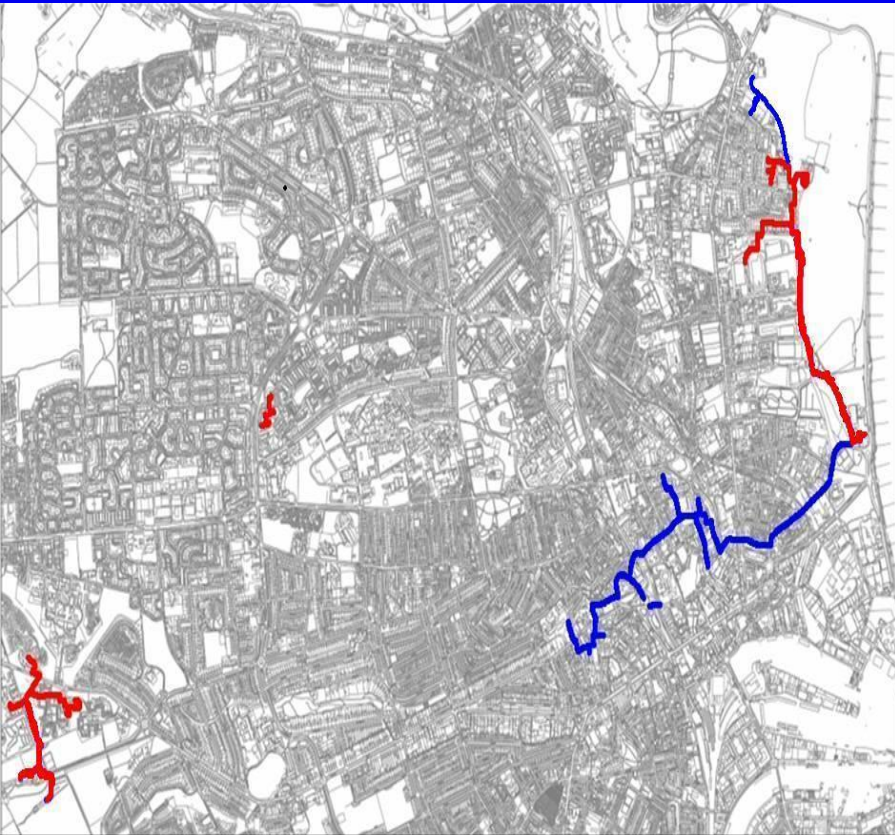


Public Sector ESCo

- Council establish wholly owned ESCo
- Similar to ALMO
- Aims in Mems & Arts
- Risk retained by Council
- Prudential borrowing + capital prog
- Public sector capital rates – 8% IRR
- Provides gen, distribution, retail
- Generation can be from private sector
- Operation typically contracted out
- Retail can be with rent
- Terms in heat contract
- Control retained by public sector
- C’I/ESCo determines network expansion
- Heat prices set at cost
- Surpluses available to Council as d’vd



Special Purpose Vehicle Union Street Flats



- **Establish by Council**
- **Not- for-profit Co Ltd by guarantee**
- **Membership instead of shares**
- **Board comprises of local people**
- **Council retain board membership**
- **Risk shared but underwritten by Council**
- **Funding: Grants, capital prog and debt finance loan from bank**
- **Public/private capital rates – 10% IRR**
- **Operation shared with private sector**
- **Generation owned by ESCo**
- **Retail with rent**
- **Elec sales cross-subsidize heat prices**
- **Surpluses re-invested in network**
- **Works closely with City Council in development of the network**

Stakeholder Owned

- Council establish ESCo
- Co Ltd by guarantee owned by stakeholders
- eg. Council, land/building owners, energy partner, financial inst, community groups
- Need to part of wider network
- Aims in Mems & Arts
- Development risk retained by Council
- Operational risk with stakeholders
- Prudential borrowing, capital prog, debt finance, equity
- Public/private capital rates – 10% IRR
- Provides gen, distribution, retail
- Generation can be from private sector
- Operation typically contracted out
- Retail can be with rent
- Terms in heat contract
- Control retained by public sector
- ESCo determines network expansion
- Heat prices determined by stakeholders
- Surpluses available as d'vd or re-invested



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