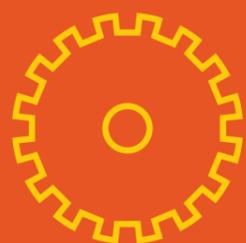


London 2062

Decentralised Energy: Could London Emulate Copenhagen?



About the Contributors

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All views expressed in this collection of essays are those of the authors, and do not necessarily represent the views of Future of London.

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Future of London is an independent, not-for-profit forum and policy unit focused on the big challenges facing urban regeneration, housing and economic development practitioners.

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Introduction

In March and April 2012, Future of London and UCL held a seminar series, London 2062, looking at the challenges facing London over the next 50 years. The first seminar focused on London's energy future, and we heard from a number of academics and practitioners. All the experts mentioned 'the Danish model' at some point or other, and it became clear that many feel that this is a reference point from which lessons could be drawn to ensure London's long-term energy security, and in the face of stringent carbon reduction targets.

Principally, the Danish model is a Decentralised Energy network using Combined Heat and Power (CHP). Decentralised Energy (DE) is defined by the GLA as the local generation of electricity and where appropriate, the recovery of the surplus heat (combined heat and power – CHP) for purposes such as building space heating and domestic hot water production. CHP is often used in District Heating systems, with the heat generated as a by-product of electricity generation being pumped into homes, either as hot water or as steam, through networks of reinforced pipes.

The Danish model relies heavily on CHP for District Heating, and they found that it requires approximately 30 per cent less fuel than separate heat and power plantsⁱ. However, it should be noted that CHP is one fuel source for both District Heating and DE, and a number of alternatives can be used in both cases. Plus London is already utilising, or working towards using, a number of other urban heat sources.

Nationwide, Denmark provides 60 per cent of its space and water heating through district heating. In Copenhagen, the figure is 98 per cent. This compares with 1-2 per cent in the UK, and approximately 5 per cent in London.

Of course, this isn't necessarily a fair comparison; London's population is around two and a half million higher than the whole of Denmark. But it demonstrates how Denmark began a concerted national effort to reduce its fuel usage in the 1970s, at the same time as the UK decided that its energy security could be found in North Sea Oil and privatisation.

This collection of essays investigates the Danish model in more detail, and considers whether lessons from their experiences can truly be applied in London. Firstly, Luke Hildyard gives an overview of Danish energy policy, which is considered to be a European exemplar, and outlines the main challenges to London following in its footsteps. Peter North then outlines the regional efforts taking place to grow London's urban District Heating network. Finally, Bob Fiddik, LB Croydon, provides a technical perspective on the challenges of decarbonising London's current energy landscape, and suggests some policies that could help overcome them.

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Decentralised Energy and the Danish Model

Luke Hildyard outlines the history of the model and key factors of its success, before considering how it could be replicated elsewhere.

If London's Decentralised Energy targets seem daunting, then it is simultaneously comforting and depressing to think that the Danish government's strategy for decentralising the country's energy supply dates back to 1979, while most of the policy mechanisms designed to facilitate the transfer were developed in the 80s and 90s.

In the aftermath of the energy crisis that unfolded in the early 70s, the Danish Government launched a comprehensive heat planning process, involving local authorities and energy companies, with the intention of securing Danish energy supply, and ensuring that all households had access to adequate warmth.

The 1979 Heat Supply Act required local authorities to provide a regional heat plan, outlining their existing and future heat requirements, and how these could be met.ⁱⁱ The plans were expected to detail which forms of energy supply should be prioritised in which areas, and where heat supply installations and pipelines were to be located.ⁱⁱⁱ The main change resulting from the Heat Plans was the zoning of district heating networks to replace individual oil boilers.^{iv} Crucially, the expanded provision of district heating was supported by a new power for local authorities to require households to connect to the networks.^v

In the Capital, the Copenhagen Heat Plan was launched in 1984, with the local authorities forming two companies, CTR in the East of the city and VEKS in the Western suburbs.^{vi} New Combined Heat and Power (CHP) units were built across the city, delivering energy to households and businesses via 1,500km of piping, much of which dated back to the 1920s. The power to mandate connection to networks was enforced.^{vii}

Throughout the 1980s, further policy measures were put in place to ensure efficient, sustainable and strategic energy use. High levels of taxation were applied to fossil fuels, and in 1986, the Co-generated Heat and Electricity agreement required utilities to provide capacity for 450MW of electricity via decentralised CHP.^{viii}

To support District Heating networks further, a ban on electrical heating in new buildings was introduced in 1988 (extended to existing buildings in 1994). The Danish Energy Agency note that:

"The ban made it possible for local authorities to ensure that energy supply companies' earnings were not undermined by an insufficient number of connected consumers, in turn ensuring that investments made were not lost."^{ix}

As environmental concerns became more prominent in the early 90s, CHP and District Heating took on an important role in reducing Copenhagen's carbon footprint. Two CHP plants were converted from fossil fuels to biomass, while production of energy from waste increased to the point that it now meets

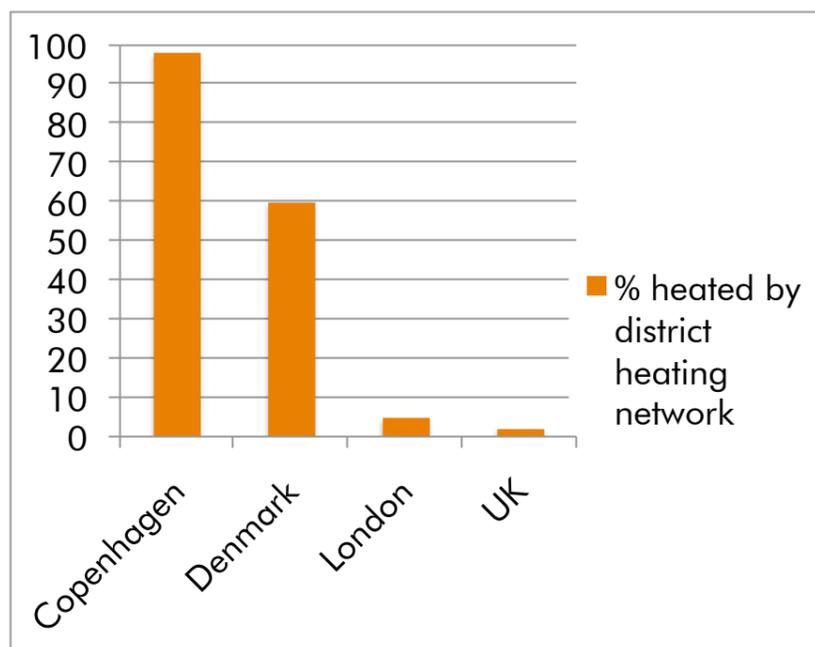
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approximately 30 per cent of the heat demand in Copenhagen.^x

A new planning system was also launched in 1990, via an amendment to the 1979 Heat Supply Act, mandating local authorities to oversee the conversion of District Heating providers that produced heat only to CHP providers.^{xi} In 1992, subsidies for renewable electricity production were also extended to CHP and decentralised energy produced from natural gas (these subsidies were recently replaced with a surcharge on the electricity producers' electricity transfer price).^{xii}

Figure 1: District heating in Denmark and UK



► Source: DECC, District Heating; Copenhagen Energy, District Heating in Copenhagen

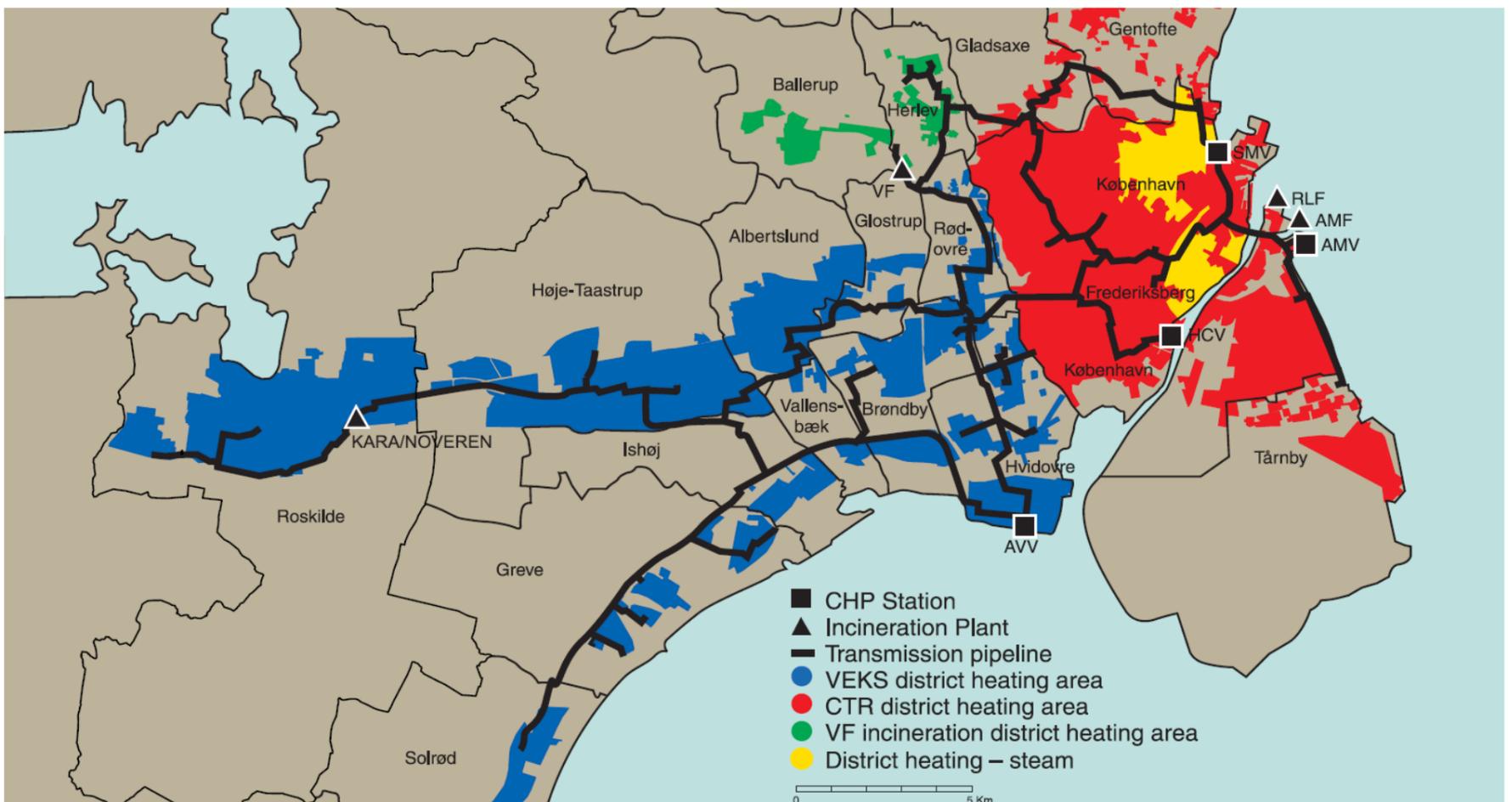
Denmark's achievements to date

- High take-up – District Heating networks currently supply over 60 per cent of Denmark's space and water heating. This compares to just 1-2 per cent in the UK.^{xiii} Because District Heating is more efficient in urban areas, with denser housing, and therefore more concentrated heat demand, the proportion in Danish cities is even higher.
- In Copenhagen, 98 per cent of heating is supplied by District Heating networks. (Figure 1 shows the different District Heating networks extending across the Greater Copenhagen metropolitan area).^{xiv}
- Potential to export energy – The high proportion of energy provided from CHP has enabled Denmark to become the only net exporter of energy in the EU.^{xv}
- Cuts carbon emissions – The Copenhagen District Heating Network also implies 40 per cent lower carbon emissions than individual gas boiler systems, and 50 per cent lower than oil boilers.^{xvi}
- Saves money – In 2009, Copenhagen Energy, which manages the city's District Heating network, estimated that District Heating costs were around 45 per cent of those for oil heating and 56 per cent of natural gas for a typical home.^{xvii}

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Figure 2: District heating in the Greater Copenhagen area



In the case of London, the Greater London Authority provides regional leadership, and has already

► Source: Copenhagen Energy

Challenges of replicating the Danish model

Perhaps the salient lesson from the Danish policy experience relates to the importance of a clear, consistent and coordinated strategy on the part of the Danish national Government. As has been highlighted, Denmark’s achievements in relation to decentralised energy are based on 30 years of policy commitment. Key parts of the process – for example, the local authority audits of the potential for District Heating across their area – required legislation, and substantial commitments in terms of time and resource.

made progress with developing a decentralised energy framework for the Capital (outlined in the next essay). However, the Mayor and GLA must work within the confines of national policy, so a transformation on a scale comparable with Denmark would likely require further and continued support from Central Government.

It is also important to note that the power to mandate households to connect to local authority district heating networks, which is a key part of the Danish system, is in many ways monopolist. It would

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potentially be difficult to operate such a system – as noted, a vital means of guaranteeing a return on investment in Denmark – in London.

The Danish Board of District Heating argue that the local authority’s requirement to deliver an energy supply network that best fits with the strategic energy policy objectives effectively creates competition between the various fuel suppliers.

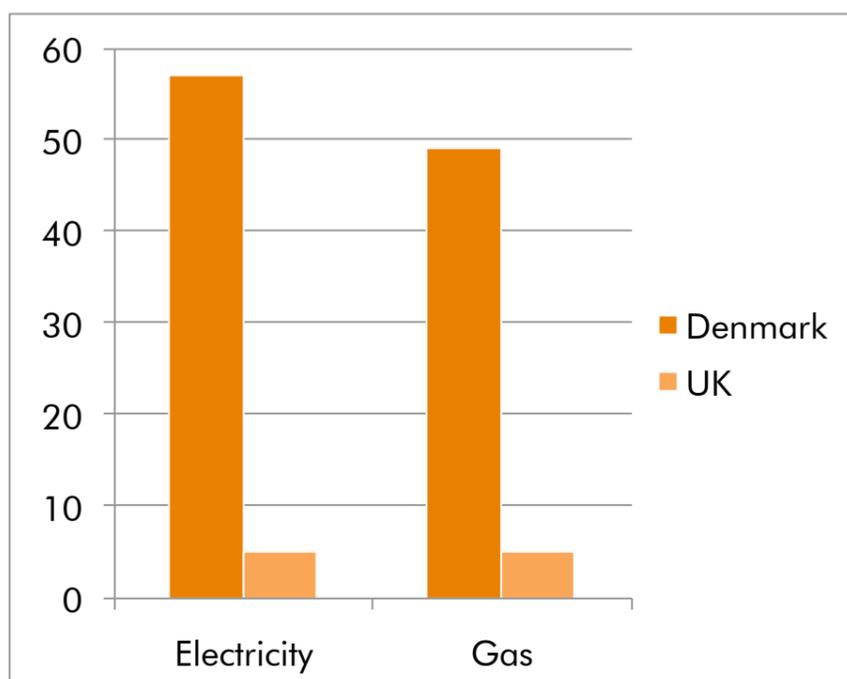
“The company, able to offer the alternative that best meets the objectives of the national energy strategy, such as lowest long term costs, high security of supply, low environmental impact, use of local resources etc., will win the competition. That will give the basis for monopoly of heat supply in the district in question in at least a period equal to the economic lifetime of the investment. That could, for example, be 25 years for district heating and 10 years for natural gas. The alternative would be wild

competition, duplication of investments, bankruptcy and loss of assets.”^{xviii}

There is a good deal of logic in this, and in some ways a more collective approach to energy supply would be in keeping with the recent direction of travel in the UK – for example, proposals for energy cooperatives, and community owned renewable energy installations. Indeed, the Climate Change Minister Greg Barker has stated that “community energy is a perfect expression of the transformative power of the Big Society.”^{xix}

The mandate to connect to District Heating networks – effectively requiring households to become customers of particular companies – is also compatible with EU competition law, because it meets particular common interest objectives i.e. more efficient energy production, ongoing energy security and climate change mitigation.

Fig 3: Percentage tax rate on energy in Denmark and UK



► Source: Eurostat

In practice, however, a Danish style element of compulsion is unlikely to sit well with the individualist principles of the Conservative (and Liberal Democrat) party in the UK. It was a Conservative Government who privatised the UK gas and electricity utilities in the 1980s, and a belief in the primacy of free markets, and the rights of consumers to make choices within them free from state regulations or requirements has long been central to Conservative thinking. Therefore, it seems highly unlikely that this would be introduced under the current administrations, either at Westminster or at City Hall. A more acceptable form of encouragement in the UK would be incentives or ‘nudges’, such as subsidies or council tax rebates. However, in the current financial climate, the scope to offer such incentives is limited.

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In addition, it is important to note the scale of finance that will be required to meet the decentralisation target. A report from London First put the cost in the region of £7 billion, though the report also observed that much of this would generate a return on investment and would therefore be attractive to commercial lenders.^{xx}

Finally, it should be pointed out that Denmark's household energy prices for electricity and natural gas are the highest in Europe.^{xxi} This owes much to the high levels of tax to which both electricity and gas are subject (comprising 57 per cent of electricity bills and 49 per cent for gas, compared with 5 per cent each in the UK) and is also an average taken over all households, rather than just those on District Heating Networks. It does, however, expose some of the limitations of broader Danish energy policy, and the contrasting attitude to taxation between Denmark and the UK.

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London's Decentralised Energy Future to 2062

Peter North, CEng, FIMechE, provides an overview of London-wide efforts to hit the Mayor's rigorous targets for decentralising London's energy systems, many of which closely resemble elements of the Danish model.

The Mayor's Climate Change Mitigation and Energy Strategy sets ambitious targets to reduce London's CO2 emissions to 60 per cent of 1990 levels by the year 2025. With 30 per cent of the capital's emissions attributable to heating, mostly from mains gas, one of the greatest opportunities is to reduce demand for heat through building retrofit and low carbon, local (decentralised) heat supply by means of Decentralised Energy (DE^{xxii}). Decarbonising the other big energy related emitter, electricity supply, is best placed as a national action through nuclear, wind and carbon capture etc.

The Mayor recognises the importance of DE technology in contributing towards CO2 emission reductions and has set a further target of supplying 25 per cent of London's energy supply from DE by 2025. Current Greater London Authority (GLA) planning policies require relevant developments to consider a) connecting to local district heating networks or b) installing their own CHP, and c) meeting 20 per cent of the site energy demand from renewable energy sources. The current uptake of DE is falling short of the trajectory required to meet the 2025 target, yet work carried out by the GLA concluded that London has the capacity to deliver the targets. So the market is failing to deliver the

potential for DE that GLA strategy Powering Ahead^{xxiii} estimated to be worth £5 to £7 billion of investment to deliver annual CO2 savings in the range 2.2 to 3.5 million tonnes.

Learning from the Thames Gateway

During 2007, the London Development Agency (LDA), the Mayor's now abolished delivery agency, investigated the DE market failure as part of the London Thames Gateway Heat Network (LTGHN) project. It concluded that the largest quantum of CO2 savings could be delivered at market competitive rates (i.e. without government energy subsidy) in dense urban areas through industrial-scale Combined Heat and Power involving extensive district heating (DH) networks.

A city-wide DH network could kickstart the creation of a heat market by providing an entry point for low and zero carbon heat suppliers (industrial undertakings such as energy from waste, combined cycle gas turbine plant and energy intensive industry) to heat consumers for building space heating and domestic hot water (DHW) production and other heat requirements.

The LTGHN project was estimated to cost £160m (at 2008 prices), and serve the equivalent of over 110,000 homes. Principally it involved the creation of a district heating network that would involve:

- The phased construction of 70 km of DH pipework over a 10 to 15 year period connecting private sector industrial plant to consumers (a small to medium sized system in European city terms)
- The buying of heat from industrial undertakings

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- The selling of a secure^{xxiv} supply of heat to consumers in the form of hot water;
- The operation and maintenance of the heat network;
- The expansion and development of the heat network and new connections; and,
- Where appropriate, facilitate the bilateral supply of heat between suppliers and consumers by allowing system access and charging 'use of system' for the transfer of their heat.

The project development was suspended in 2010 following the failure of the private sector to respond to a formal invitation to negotiate heat supplies. Considerable strategic, technical and commercial principles were established that continue to be deployed on London's current DE developments. Had it proceeded, the LTGHN would in fact have looked very similar to the city-wide CHP district heating schemes that have been operating in Northern European cities for many decades. Most of these schemes were undertaken by the municipality for reasons of national energy security (Denmark), to deliver the most economic form of urban energy supply (Finland), or most efficient utilisation energy.

In contrast, the delivery of the LTGHN project was predicated on CO₂ savings at market competitive heat prices. In reality, the scope to deliver projects on the scale of LTGHN would be greatly enhanced by the derisking effect of initiatives from Government to facilitate the involvement of local authorities in promoting heat networks at scale, to encourage connections of heat sources and heat loads to these networks and co-ordination between local

authorities. This role for DH networks is mirrored in the Government's Heat Strategy which also came to a similar conclusion. Published in March of this year, the strategy highlights a potentially major role for networks in areas of high heat demand which can remove carbon from commercial and domestic building heat supply. The implementation of the Government's Heat Strategy therefore provides an opportunity to secure that.

The development of large scale DE in London continues primarily through the activities of London Boroughs following a systematic methodology of local policy formulation, heat mapping to identify the most heat dense areas and energy master planning to establish the evidence basis and high level costs of specific area-wide DH systems.

Boroughs are then able to deploy their powers to de-risk projects by requiring developments to investigate connecting to the DH network, require financial contributions from new developments and facilitating other 'buy-out' arrangements, bringing forward their own heat loads to secure long-term heat income for the project and possibly accessing additional finance at public sector rates.

Similarly, Boroughs may also have an interest in existing and proposed Energy From Waste schemes and can require new energy developments to be built with heat off-take to supply local DH network. With a number of London's DE projects currently completing the feasibility stage and moving towards commercialisation, it will be interesting to reflect on the public sector role in their delivery.

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Alternative Energy Sources

The question has been asked, 'So what happens when the gas runs out and we're so efficient at recycling, there is no longer any waste?' By then, interconnected DH networks would have been established in the short term from gas CHP, in the medium-term larger schemes based on EfW and sources of surplus heat, and finally the networks interconnected to form city-wide systems with multiple heat suppliers.

As DH networks have the simple role of circulating hot water as the energy carrier, they are heat technology agnostic. It doesn't matter where the heat comes from, so it is entirely feasible that when the gas runs out and there is no longer any waste, the future energy source will be electricity from nuclear power and wind – CHP would therefore be replaced by industrial heat pumps. But there are other more efficient and effective possibilities.

Further consideration of alternative city-level energy sources has found there to be considerable potential in low grade (temperature) surplus heat from the likes of data centre cooling, underground train ventilation (23°C to 28°C), electricity substations and sewage works. Heat pumps can elevate this low grade heat to DH supply temperatures (70°C to 110°C). However, the higher the temperature elevation, the lower the heat pump efficiency, and there is a limit to what people are willing to pay for heat from such as system.

By way of example, waste heat from an underground train vent would be limited to 55°C to 60°C using a heat pump so as not to exceed the market

price of heat. This would relate to a coefficient of performance (CoP) of around three. In fact lower supply temperatures may be entirely viable if building heating systems could either accommodate the lower supply and return temperatures or are designed for this from the outset.

Taking this to a natural conclusion, why bother with the heat pump? Why not simply collect and supply heat to the DH network at low temperature and elevate the temperature to the end user requirements by a local heat pump at the point of consumption. Even the need for a heat pump for the user could be minimised or eliminated if the building heating system was designed for low temperature, i.e. under-floor heating or close-coupled wall heating. Or maybe the traditional wet radiator system operating at low temperature would be sufficient where properties are highly insulated following retrofit.

A DH Network for London

So the future London urban DH network will evolve from natural gas CHP, energy from waste and surplus heat operating at higher temperatures, with the networks becoming more interconnected. The systems could mature into low temperature networks scavenging low grade surplus heat, minimising the need for primary energy input. Such a system will be very efficient due to the low heat loss and cheaper local distribution legs to consumers resulting from less onerous pipe work material requirements, with any high temperature water requirement being met by a local heat pump.

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But how do we get there? Regulation should require industrial and commercial cooling systems to be designed to connect to low temperature DH systems, while the use of air radiator/river water cooling should be discouraged. Inter-seasonal aquifer heat storage would also become an attractive option. Such systems have already been thought about and exist as small campus-type pilots where it has been possible to carry out the overall design and specification from production to consumption. Connecting and multiplying these into a London-wide network is an essential route to London's low carbon future.

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Decarbonising heat in London

Bob Fiddik, London Borough of Croydon, provides a technical perspective of the challenges in decarbonising heat in London.

If government targets are to be met, by 2062 all London's homes and workplaces will have been virtually zero carbon for 12 years. Currently the energy used by London's buildings are responsible for 80 per cent of the city's CO₂ emissions. And almost 50 per cent of these emissions arise from demand for heating and hot water. The majority of this demand is currently met through the national gas network supplying individual gas boilers in homes and workplaces.

Taking carbon out of heat is also an immense retro-fitting problem as around 80 per cent of the buildings with us now will still be in use in 2050.

The government's approach to meeting these targets has been to:

- Move heating from gas to electricity – primarily by installing heat pumps.
- Move transport to electricity – electric vehicles and charging points.
- Decarbonise the electricity grid – using nuclear, carbon capture and storage (CCS) and large scale wind.

But there are some serious obstacles along this path to low carbon heating. Adding heat loads onto the electricity network would make electricity demand

highly seasonal. Nuclear, CCS and wind generators all seek to cover the baseload electricity demand. But around 60 per cent of the extra electricity plant that will be required to meet winter peak heat demand will be idle for six months of the year – this requires subsidy which would be added to the price of electricity. In addition, transmission and distribution networks will need to be upgraded to carry the increased loads along with all the substations. Electricity customers will have to foot this bill as well.

The next obstacle is retro-fitting heat pumps into homes, and getting them to run at optimum efficiency. Heat pump efficiency – or coefficient of performance (COP) – decreases with increasing temperature difference between the 'source' (where the pump gets the heat) and the 'sink' (where the pump delivers the heat). Ground source heat pumps (GSHP) supplying underfloor heating achieve the highest COP values as ground temperature (the source) is higher in winter than ambient air and underfloor heating (the sink) can be supplied at 40 – 45°C.

But most retro-fits will need to supply radiators (at around 60°C) and London homes would need to install air source heat pumps (ASHP) as there isn't space for GSHP. In any case heat stored in the ground isn't unlimited and dense deployment of GSHP would lower ground temperatures thus reducing overall COP levels.

A further challenge is that 58 per cent of London's homes have solid walls with high heat demands. Installations of ASHP would have to be accompanied with investment in solid wall insulation and oversized

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radiators to operate at acceptable COP levels. The 2008 EST heat pump field trial found that 50 per cent of the ASHP installations monitored had COP below 2.2 – hence at the current grid carbon content they were resulting in higher carbon emissions than condensing gas boilers.

With solid wall insulation being too costly to be delivered via the Green Deal, a portion of the new Energy Company Obligation (ECO) will be used to subsidise it. But uptake of external cladding may well be limited by conservation areas and homeowners' aesthetics, while internal cladding is thought to involve too much hassle and loss of internal space.

The last and perhaps most serious obstacle to the 'all electric' scenario is that new nuclear stations and CCS both look a long way off. CCS is yet to be proven to be technically viable at scale, let alone economically viable. In March RWE and Eon announced that they were dropping plans to develop new nuclear plants in the UK, leaving EDF/Centrica as the remaining investor. But their current plans amount to 6 GW of new capacity by 2025, as opposed to the government target of 16 GW by this date. With 85 per cent of EDF owned by the French state, and following the announcement that France would cut investment in nuclear from 75 per cent to 50 per cent by 2025, the UK's nuclear future is uncertain^{xv}.

Is there another way to take carbon out of heat?

We certainly need to decarbonise electricity supply, but adding heat to what is already an enormous challenge seems crazy when there are other ways to

take carbon out of heat.

In the media and public debates about energy there has been almost no mention of the fact that our centralised power stations dump around two thirds of their input energy as waste heat – in total around the same volume that is required to heat all UK buildings. This isn't a matter of poor design, it's down to the laws of thermodynamics. Most of our electricity is produced by burning a fuel to heat water into steam which then drives a turbine generator. The greater the temperature drop between the steam entering and exiting from the turbine, the greater the electricity output. So UK power stations optimise electricity generation by condensing the exit steam back into water – this results in the rejection of large quantities of heat, but at low temperatures (around 23 °C).

However, countries such as Denmark run their power plants as Combined Heat and Power (CHP) stations where the steam is extracted from the turbine to heat water for large scale district heat networks.

To be useful for heating buildings and providing hot water the steam has to be extracted at around 110 °C and this results in a loss in electrical output. But the critical point is that at this temperature you typically get 7 kWh of heat for every kWh of electricity sacrificed. This is equivalent to a heat pump with a COP of 7 – this beats all practical heat pump installations, and this performance is achieved without having to insulate all those solid walls.

Of course the big ticket item is the cost of installing a heat distribution network. This is most economically

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viable in urban areas like London where heat demand densities are high. While some schemes have been delivered on commercial terms – with heat charges no higher than equivalent individual gas heating – this typically requires specific favourable conditions (e.g. having sufficient long term revenue from public sector heat loads). However, for CHP and heat networks to achieve their full potential some form of financial support will be required – along with more supportive energy policy and regulation.

Another objection to heat networks is that they may become ‘stranded assets’. The most flexible energy networks are those that are based on energy carriers rather than tied to a specific fuel (like gas). Electricity is an ideal energy carrier as there are many processes and fuels for generating it and it can be used for a wide variety of end uses. The production of hot water is just as flexible and networks would be useful for as long as buildings need heat and hot water. But heat has one advantage over electricity in that it can be easily stored. This could help deal with the expected higher levels of intermittent electricity generation on the grid – e.g. by converting excess wind generation into stored heat.

Movements in UK Policy

In March DECC launched its Heat Strategy consultation. In a marked move away from the ‘all electric’ story, the strategy suggests that heat networks may need to play a key role in decarbonising heat in cities. Heat networks and CHP haven’t had such a policy opportunity since Lord Marshall’s report in 1979 which advocated using waste heat from power generation following the oil

price shocks of the 1970s. But it was in Denmark that CHP and district heating was pursued, while the UK became hooked on cheap north sea gas, and soon after all efforts went into energy privatisation.

Over 60 per cent of Denmark’s building heat and hot water demands are met by district heating with the majority of this supplied by CHP plant. In Copenhagen this coverage is around 98 per cent of the city with 35 per cent of CHP plant fuelled by waste and biomass. Key to this success has been a set of simple and stable policies and incentives that support proven carbon reduction technologies – rather than waiting for ‘jam tomorrow’ innovation.

Perhaps the two key Danish policies are:

- Heat planning by local authorities – identifying those zones where district heating is most cost effective or where individual gas boilers will be prioritised.
- Obligation for customers to connect to district heating in the designated zones.

The obligation ensured that the heat network could be installed at the lowest cost (i.e. every building down a street was paying for share of the pipe).

Could we see similar policies in the UK? Such obligations may not be acceptable to UK customers, but at very least the following policies should be introduced:

- Local authorities undertake heat planning and designate zones for heat networks.
- CHP/district heating receives incentives within zones identified for heat networks.

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- Individual renewable heating systems (e.g. heat pumps, solar, biomass) do not receive any incentives within these zones.
- Public sector buildings must connect to district heating where it is demonstrated to be economically viable.

While thinking about London's energy future it's worth reminding ourselves what it was like 50 years ago. In 1962 Battersea power station was producing power for London while also operating as a CHP plant providing heat to London's first district heating scheme in Pimlico. Although fuelled by coal, the heat would have had a carbon content just below a condensing gas boiler. It was a great idea then, and it's still a great idea for the future.

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Conclusions

The Danish model lives up to its exemplar reputation, particularly in the Capital, with an incredible 98 per cent of Copenhagen heated by CHP. No one can dispute the benefits of being able to heat almost an entire city in Northern Europe with a source that goes to waste in other systems. That said, the national policy drive that occurred in Denmark in the 70s, 80s and 90s was fundamental to its success.

The Danish model began with a necessity to reduce reliance on imported fuels in the 1970s. On the other hand, London's ambition is tied to climate change reduction, and one of the key methods of reaching its ambitious carbon reduction targets. Decarbonising energy is a fundamental solution for reaching these targets, and the GLA's work thus far on creating a District Heating network on a London scale is impressive. Furthermore, examples such as Meridian Water, London Borough of Enfield's major regeneration scheme that includes plans for a 45-kilometre Decentralised Energy network, demonstrate that London Boroughs are rising to the challenge.

But beyond regeneration schemes, how decentralised could London's energy systems become? In Denmark, the obligation to connect was crucial in achieving such a comprehensive take-up, and there is general agreement from the authors that such an obligation would not be deemed appropriate in the UK, just as we would not accept the high energy taxes that are the Danish standard. On the other hand, there are plenty of less severe policies which, taken together, could have an enormous effect on our energy landscape. DECC's Heat Strategy took responses until the end of May. The document was indicative of Central Government's understanding that our current energy situation is not sustainable, and set out a framework for transforming heat production and management nationally, including the development of heat networks. With next steps promised within a year, time will tell whether the framework leads to policies that can truly transform our energy system.

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Endnotes

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^{xv} European Union, Europe's Energy Portal via <http://www.energy.eu/> (accessed 6 June 2012).

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^{xvii} Ibid.

^{xviii} Danish Board of District Heating, The Development in Denmark, via <http://www.dbdh.dk/artikel.asp?id=463&mid=24> (accessed 6 June 2012).

^{xix} DECC, Greg Barker sets out Big Society vision for small energy, via http://www.decc.gov.uk/en/content/cms/news/pn10_120/pn10_120.aspx (accessed 6 June 2012).

^{xx} London First, Cutting the Capital's carbon footprint – delivering de-centralised energy, 2008 via http://www.london-first.co.uk/documents/Cutting_the_Capital's_Carbon_Footprint_FULL_Low_res_FINAL.pdf (accessed 7 June 2012).

^{xxi} Eurostat, Energy Price Statistics via http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Energy_price_statistics (accessed 6 June 2012).

^{xxii} Decentralised Energy – defined as the local generation of electricity and where appropriate, the recovery of the surplus heat (combined heat and power – CHP) for purposes such as building space heating and domestic hot water production.

^{xxiii} Powering Ahead – Delivering Low Carbon Energy for London, 2009. <http://legacy.london.gov.uk/mayor/publications/2009/docs/powering-ahead141009.pdf> (accessed 7 June 2012).

^{xxiv} Heat is made 'secure' with the addition of standby and top-up heat only boilers fuelled by mains gas in sufficient number and capacity to meet heat demands in the event of the industrial heat supply failing.

^{xxv} BBC (2012) France to tackle crushing debt, says French PM Ayrault <http://m.bbc.co.uk/news/world-europe-18693089>



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