PARSONS BRINCKERHOFF

July 2013

NINE ELMS VAUXHALL - DISTRICT HEATING FEASIBILITY STUDY

Wandsworth Council

Final

3512246B-BEL

Nine Elms Vauxhall - District Heating Feasibility Study

3512246B-BEL

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CONTENTS

EXECUTIVE SUMMARY

3512246B	Nine Elms Vauxhall – Decentralised Energy Feasibility Study

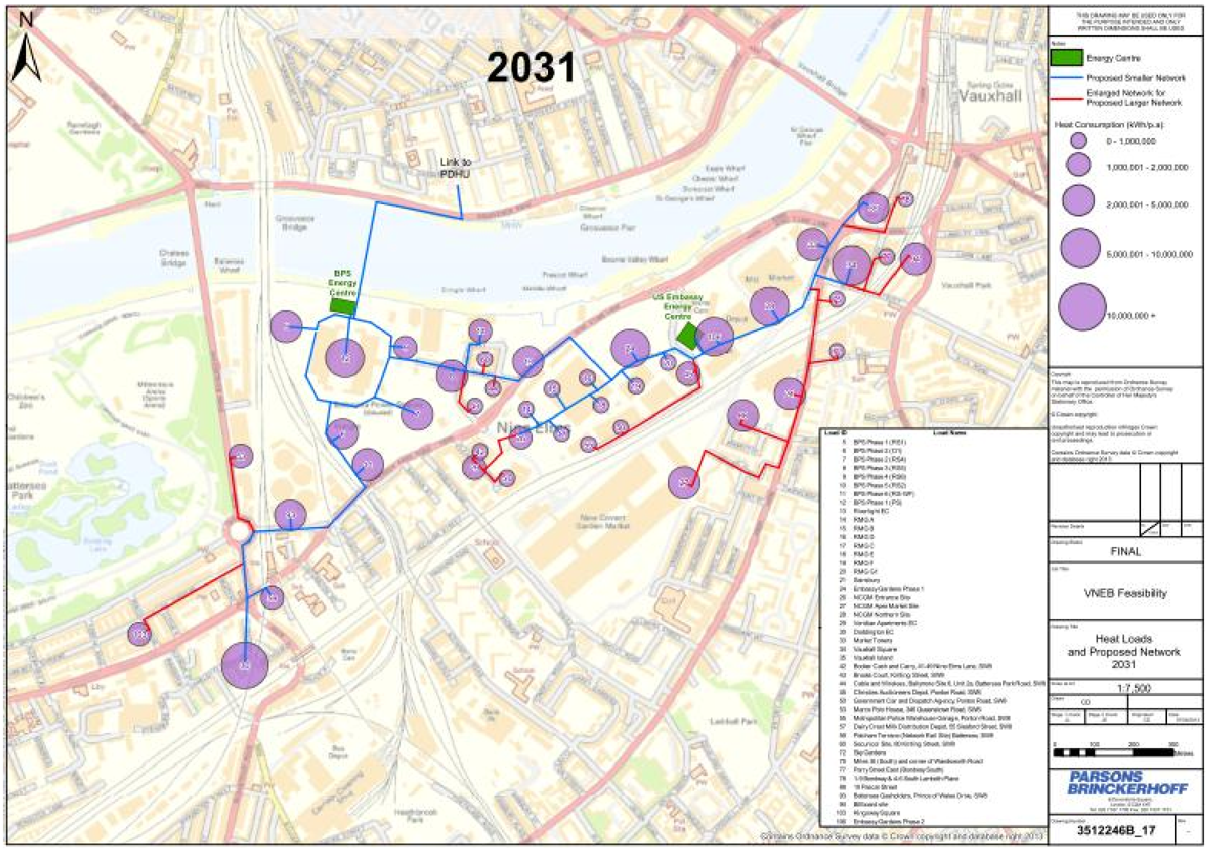
This study develops the approach put forward in the ‘Energy Masterplan’ for the Nine Elms Vauxhall Opportunity Area. It demonstrates the commercial case both for individual developers and a centralised operator of a district heating network.

To do this the study addresses two different perspectives on the commercial impact of a Nine Elms Wide Area Decentralised Energy Network (NEWEDEN). First, the developers’ non-networked approach (as expressed in individual site energy strategy documents) is compared with the NEWEDEN approach. Heat prices are then set to offer a fixed level of whole life cost benefit to developers connecting to the system. Second, the economic performance of heat delivery for the central scheme operator is demonstrated based on the heat prices identified from the developer perspective.

Two scales of network have been analysed. First, a larger network that has a greater scope, and offers a more strategic long-term vision for the area. Second, a more compact network whose extent implies reduced need for capital investment and hence reduced risk.

These two network scales are illustrated here (at 2031, equivalent to full build-out), with the additional sections for the larger network option shown in red:

Figure 12.1 Network scales analysed



The analysis conducted is based on current knowledge of phasing of development sites. It considers the energy and cost implications of development sites emerging before the NEWEDEN is in place. The following table shows the anticipated phasing of development, and the buildings which are provided with heat from the NEWEDEN.

Figure 12.2 Phasing illustration

Heat available from US Embassy Energy Centre (2017 →)

Heat available from US Embassy & BPS Energy Centre (2022 →)

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Riverlight	317,306	827,100	1,692,112	2,891,370	3,354,837	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062
Sainsbury		802,672	1,605,345	2,408,017	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689
Embassy Gardens Phase 1	1,795,000	5,413,000	6,295,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000
Embassy Gardens Phase 2				1,769,600	3,539,200	5,308,800	7,078,400	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000
BPS Phase 1 (RS1)			1,813,492	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985
BPS Phase 2 (O1)					1,782,959	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918
BPS Phase 2 (RS4)						1,819,230	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461
BPS Phase 3 (RS5)							2,005,259	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518
BPS Phase 4 (RS6)								533,465	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930
BPS Phase 5 (RS2)									2,279,533	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067
BPS Phase 6 (RS-WF)										634,141	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281
BPS Phase 1 (PS)				2,707,968	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936
RMG A				309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
RMG B						309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
RMG D								309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
RMG C										309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999
RMG E												309,400	609,699	909,999	909,999	909,999	909,999	909,999
RMG F														309,400	609,699	909,999	909,999	909,999
RMG G1																309,400	609,699	909,999
NCGM Entrance Site								651,734	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468
NCGM Apex Market Site			170,371	340,742	511,113	709,879	709,879	709,879	1,774,698	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517
NCGM Northern Site					1,432,986	2,865,973	4,298,959	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945
Market Towers		330,231	2,406,197	2,866,941	3,327,685	3,807,008	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577
Vauxhall Square				6,206,122	6,839,509	7,948,597	8,738,941	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548
Vauxhall Island			1,316,370	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739
Billboard Site		2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623
Booker Cash and Carry, 41-49 Nine Elms Lane										371,047	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569
Brooks Court, Kirtling Street															168,736	168,736	168,736	168,736
Cable & Wireless, Ballymore Site 6																	317,671	317,671
Christies Auctioneers Depot, Ponton Road														462,302	775,668	1,002,945	1,002,945	1,002,945
Government Car and Dispatch Agency											428,727	733,484	778,251	778,251	778,251	778,251	778,251	778,251
Marco Polo House, 346 Queenstown Road, SW8			290,050	567,005	839,810	1,034,530	1,077,345	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324
Metropolitan Police Warehouse Garage, Ponton Road, SW8												389,125	516,538	516,538	516,538	516,538	516,538	516,538
Dairy Crest Milk Distribution Depot, 55 Sleaford Street, SW8						366,742	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569
Patcham Terrace (Network Rail Site) Battersea, SW8				1,210,102	1,523,469	1,832,531	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854
Securicor Site, 80 Kirtling Street, SW8													374,490	431,309	431,309	431,309	431,309	431,309
Sky Gardens		437,971	715,765	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753
Miles St (South) and corner of Wandsworth Road												289,261	289,261	289,261	289,261	289,261	289,261	289,261
Parry Street East (Bondway South)					694,616	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097
1-9 Bondway & 4-6 South Lambeth Place	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589
10 Pascal Street London SW8 4SH				2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758
Battersea Gasholders, Prince of Wales Drive, SW8					278,357	645,673	1,006,101	1,478,710	1,890,271	2,170,350	2,670,108	2,957,934	2,968,265	2,968,265	2,968,265	2,968,265	2,968,265	2,968,265
Kingsway Square	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809
Veridian Apartments EC	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680
Doddington EC	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491

The green on this table illustrates sites whose full demands are supplied by the NEWEDEN system. The yellow on this table shows buildings which are supplied with a portion of their total heat demand under the system modelled. Demand not met by the NEWEDEN system would be met by individual building top-up and standby boiler plant (or on-site CHP).

It can be expected that there will be minor changes in phasing and quanta of development at all sites as plans are refined These changes are unlikely to be of a scale that will significantly alter the overall outcomes of this study.

One key change that does impact on the approach set out in the Energy Masterplan is the New Covent Garden Market (NCGM) phasing and approach. The site is now anticipated to submit a hybrid planning application in early 2014, and there have been preliminary discussions that indicate a changed approach to energy provision on the site. This leads to uncertainty in terms of the availability of an energy centre in this area. This study is therefore based on the conservative assumption that the scheme should not rely on an energy centre on the NCGM site. From this assumption the overall scheme proposed is now based on two distinct phases:

> **Phase 1 (2017 to 2021)** – During this period, low carbon heat is supplied to the network from the CHP units installed in the US Embassy. However, this facility does not have peak boiler plant to meet all of the demands of the developments connected in this phase, and hence connected buildings during this period will be required to retain their own top-up and standby peak boiler plant. The network installed to distribute this heat has been sized to have the capacity to supply peak demands of the system at full build-out (i.e. Phase 2 in 2031).
>
> **Phase 2 (2022 – onwards) –** In 2022, the low carbon energy supply at the US Embassy is supplemented by additional energy supply plant housed in the Battersea Power Station energy centre. This could be supplemented by heat derived from the Pimlico District Heating Undertaking using the existing pipework infrastructure under the Thames, although this potential supply has not been modelled in this study. In this analysis, the BPS energy centre

houses sufficient CHP and boiler plant to meet the full peak heat demands of all connected loads of the network at full build-out, and hence any buildings connected to the network from 2022 will no longer require their own gas boilers.

The ‘central case’ financial modelling in this study is based on the following main assumptions:

- Energy prices change in line with DECC central utility price projections
- Connected developments are provided with heat under the NEWEDEN case at a whole life cost that is 10% lower than their non-networked case
- Connected developments benefit from reduced capital costs on the basis that no connection charge has been applied in the modelling

A bespoke approach has been adopted for Battersea Power Station (BPS), where it is anticipated that, under the ‘counterfactual’ case, an ESCO would provide energy to the end-user. Hence for this site, the two delivery structures that are modelled are a BPS-only ESCo or a NEV-wide ESCo.

The overall results of this analysis are set out in the table below:

	Larger Network	Smaller Network
IRR	12.1%	10.6%
NPV (12%, 25 years from 2015)	£89k	-£924k
NPV (6%, 25 years from 2015)	£10,089k	£5,493k

This shows that a viable commercial model can be developed for both developers and a central scheme operator.

The early emergence of an energy centre site on the New Covent Garden site (ideally in the early phase Apex Market area) would provide additional benefit to the scheme. Some key sites, such as RMG phases A, B, D, NCGM Northern Site, Vauxhall Square, Embassy Gardens would then be able to avoid the need to install their own boiler plant. This would provide the potential for additional revenue to the scheme. This additional revenue could be shared between the developers (through lower energy and availability charges) and the central scheme operator.

Key actions moving forward to take this to commercialisation are:

- To secure a delivery vehicle as soon as possible such that individual Developers have both confidence in delivery of the NEWEDEN, and also have a clear point of contact to deal with liaison / demarcation / technical compatibility / commercial issues
- To identify a ‘project champion’ within the delivery vehicle to provide impetus and encouragement to the private sector to participate in the scheme
- To engage with developers to ensure that there is general ‘buy-in’ to the assumptions made in this report
- To liaise with the US Embassy to confirm the commercial terms under which heat would be provided to the NEWEDEN
- Securing a corridor within the linear park for the installation of DH infrastructure
- Ensuring that Battersea Power Station is willing to entertain an ESCo for the whole project from its inception (this will avoid transfer problems of operation should a different ESCO be selected for the wider scheme)
- Ensuring that Battersea Power Station makes space provision for the installation of sufficient plant in their energy centre to meet the full peak demands of the NEWEDEN network

- Ensuring that the heating distribution pipework around the Battersea Power Station site is installed at the final NEWEDEN dimensions in order to facilitate future fully rationalised supply from the BPS energy centre
- To liaise with PDHU to evaluate the potential to make use of the PDHU supply plant or demand available on the PDHU network to help improve the overall business case for both parties.

1 INTRODUCTION

1.1 Aims and scope

1.1.1 Parsons Brinckerhoff Ltd (PB) has been appointed to develop the Energy Masterplan for the Nine Elms Vauxhall area to outline feasibility level. This means the development of a commercial case for the individual developers of the plots within the Opportunity Area to connect to the proposed Nine Elms Vauxhall Wide Area Decentralised Energy Network (NEWEDEN). At the same time, the investment in the infrastructure required to support the distribution of energy must also be capable of generating suitable returns. Hence this study addresses two perspectives simultaneously, trying to balance the needs of both: the perspective of the individual developers and the perspective of a putative SPV delivering the NEWEDEN scheme.

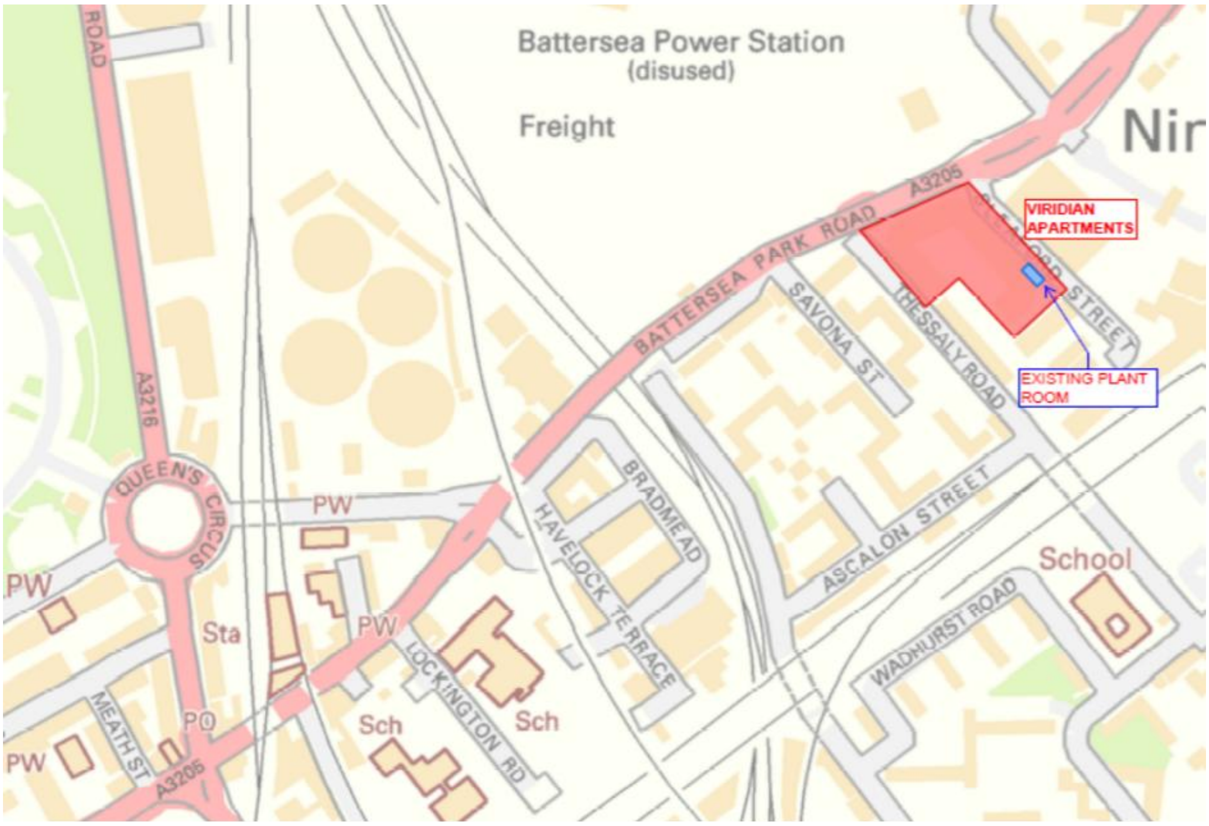
1.1.2 This study refines some of the assumptions made in the Energy Masterplan. In particular, phasing and demands have been updated, and the 'non-networked', or 'counterfactual' case, has been refined to reflect technologies that would otherwise be applied at individual sites. There have also been changes in terms of assumptions made around available energy centres that are incorporated in this study.

2 STAKEHOLDER LIAISON / SITE SURVEYS

2.1.1 The majority of the energy demands within (or easily accessible from) the Opportunity Area will derive from the development sites emerging. However, some key existing sites could help de-risk the project by providing an immediate demand for heat.

2.2 Existing stock – Viridian Apartments

Figure 2.1 Viridian Apartments site location



2.2.1 PB surveyed this site on the 12th Feb 2013. This new-build apartment block was completed in approx 2009, and contains 240 dwellings. The site was developed by Barratts Homes and the Facilities Management company for the site is Mainstay.

2.2.2 Heat is supplied by 3 no. 438kWth (rating at 80/60deg C flow / return) gas-fired boilers. The plant room is located on the Sleaford Street side of the site. There is direct access from the basement plant room to street level. At the time of PB's visit there was light snowfall (indicating outside air temperatures approaching design conditions), and the flow / return temperature indicated on the temperature sensors on the main headers in the plant room were 78 deg C flow and 55 deg C return.

2.2.3 There is sufficient space for the installation of a plate heat exchanger substation, following the recent decommissioning of solar hot water plant and their ancillary hot water storage vessels that were located in the plant room. This technology has been replaced with photovoltaic cells.

2.2.4 Unconfirmed, anecdotal evidence pointed to the gas main supplying the building in Sleaford Street being of insufficient diameter to deliver peak gas volumes at sufficient pressure to allow the boilers to operate. This has been partially mitigated by the installation of an 'oversize' gas supply to the boilers (5") to minimise pressure loss between the street and the combustion plant.

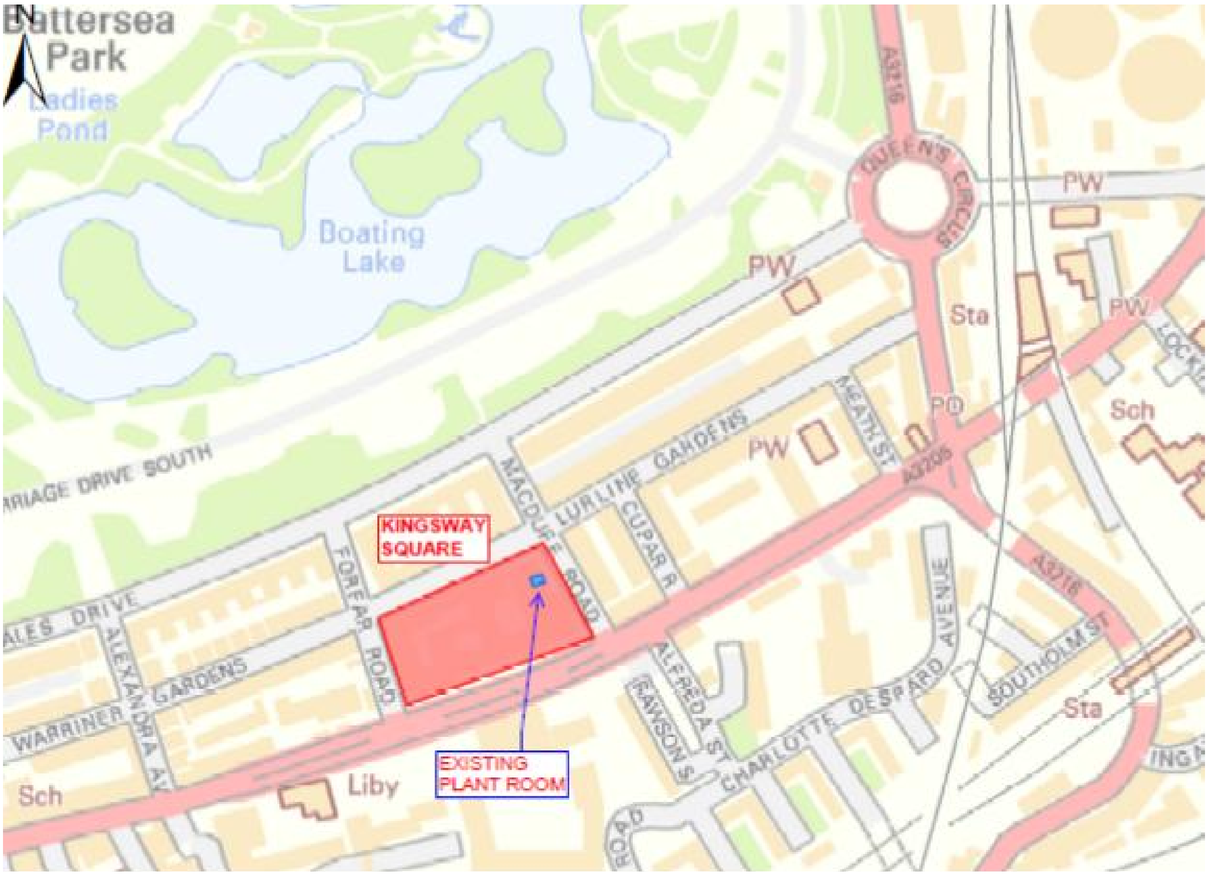
2.2.5 There are HIUs installed in each apartment, and it could be of interest to the facilities management company if another operator could take over the billing / metering reading duties associated with these units.

2.2.6 Mainstay has supplied gas invoice data for the boiler plant.

2.2.7 The drawing 3512246A-BEL-1-M001 within the appendix illustrates a typical layout and schematic enabling the existing system to be connected onto a district heating network.

2.3 Existing stock – Kingsway Square

Figure 2.2 Kingsway Square site location

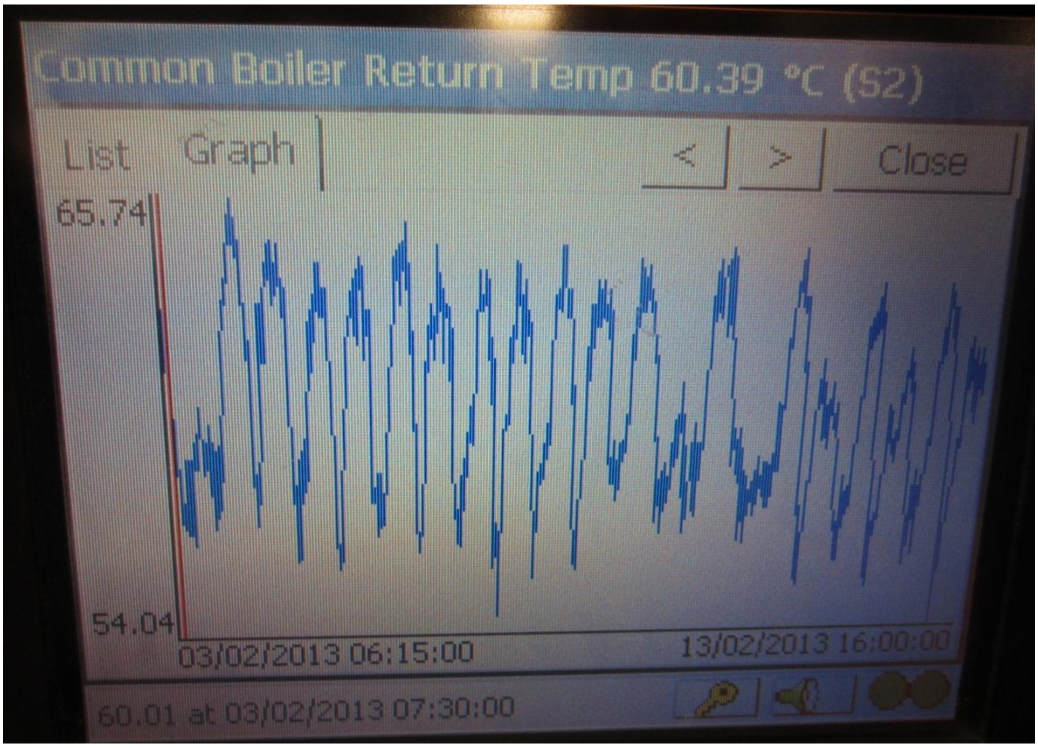


2.3.1 PB surveyed this site on the 12th and 13th Feb 2013. This site has been converted from the former Westminster Kingsway College, and now consists of around 204 apartments. This conversion was completed around 2008 / 2009.

2.3.2 Heat is supplied by 3 no. 720KWth gas-fired boilers. The plant room is located at lower-ground level towards the corner of MacDuff Rd and Lurline Gardens. There is good access for district heating pipework connection into the plantroom from Macduff Rd via the small car park facing onto Macduff Rd. There is space for a new heat exchanger substation at the back of the plant room, in the room currently housing the electrical panel for the car park ventilation system, albeit access for easy installation is somewhat restricted to this area.

2.3.3 During PB's site visit, when outside air temperature was estimated to be close to freezing, the boiler output temperatures on the two boilers operating were 79 deg C and 80 deg C. The BMS system showed the following graph of common boiler return temperatures:

Figure 2.3 Kingsway Square BMS common boiler return temps (3rd Feb to 13th Feb 2013)



2.3.4 This graph shows that return temperatures seem to peak at around 65 deg C.

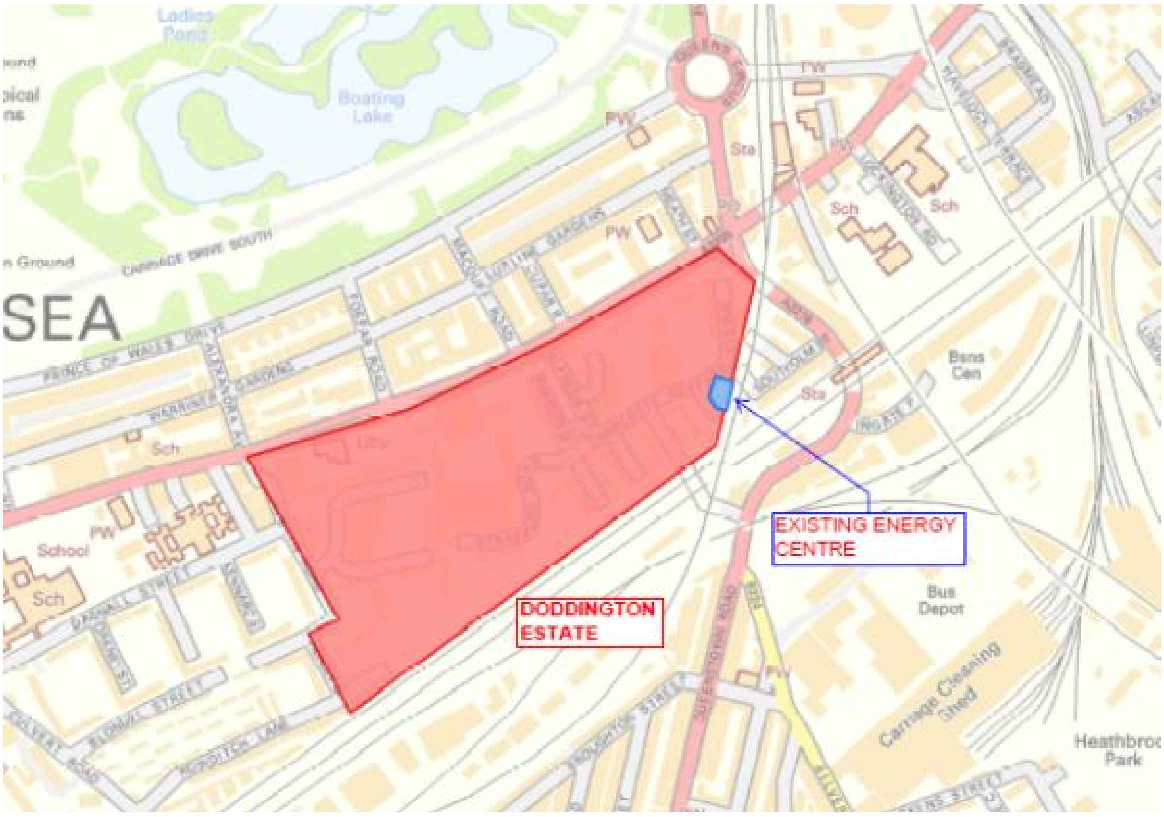
2.3.5 Flats have metered HIUs.

2.3.6 Mainstay has supplied gas invoice data for the central boiler plant. The facilities management (FM) role for Kingsway Square will be let to a new FM company from April 2013.

2.3.7 The drawing 3512246A-BEL-1-M002 within the appendix illustrates a typical layout and schematic enabling the existing system to be connected onto a district heating network.

2.4 Existing stock – Doddington and Rollo Estate

Figure 2.4 Doddington Estate site location



2.4.1 This estate was constructed in the 1950s and 1960s and contains multi-storey buildings with either individual gas boilers (e.g. Newton Court, Ravenet Court, Alfreda Court, Rollo Court, Rawson Court), electric heating (Park Court), or heat supplied (currently) from two centralised energy centres.

2.4.2 One of these energy centres is the 'old' energy centre located towards the centre of the estate. This is being progressively decommissioned. The new CHP energy centre is operational, but does not currently (Feb 2013) serve the full estate. There are two blocks currently undergoing refurbishment and upgrade of the DH supply plant (Connor Court and Turpin House) due to be complete by the end of 2013. At this point the full load of the estate will be met by the new boiler house, which is located at the Queenstown Rd station end of the estate. Currently the load is split between the 'old' energy centre and the new 'energy centre' plant.

2.4.3 The new energy centre contains 3 no. gas fired boilers (2 no. 3700KWth output Bruderus units, and a 3500kWth unit fitted with an economizer). There are also 3 no. CHP units (2 no. 12kWe units, and a 30kWe unit) and a thermal store installed.

2.4.4 PB surveyed the new energy centre, and on a day when outside air temperatures were estimated to be around 4 deg C (approximate), the return temperature to the boilers appeared to be between approx 69 and 72 deg C.

2.4.5 Following the DH modernisation of the estate, the hydraulic interface units in the dwellings have the ability to meter heat consumption for billing. However, the administrative burden of this billing / payment is such that Wandsworth BC do not currently plan to make use of this facility.

2.4.6 The drawing 3512246A-BEL-1-M003 within the appendix illustrates a typical layout and schematic enabling the existing system to be connected onto a district heating network.

2.5 Existing stock – other sites

2.5.1 PB held discussions with Wandsworth BC Housing in order to establish whether there are further communally heated blocks under Wandsworth BC control in the area close to the Opportunity Area.

2.5.2 Figure 2.5 shows the estates close to the OA. The table below this figure identifies the estates and comments on their potential to form part of a wide-area DH network.

Figure 2.5 Wandsworth BC estates near to NEV OA

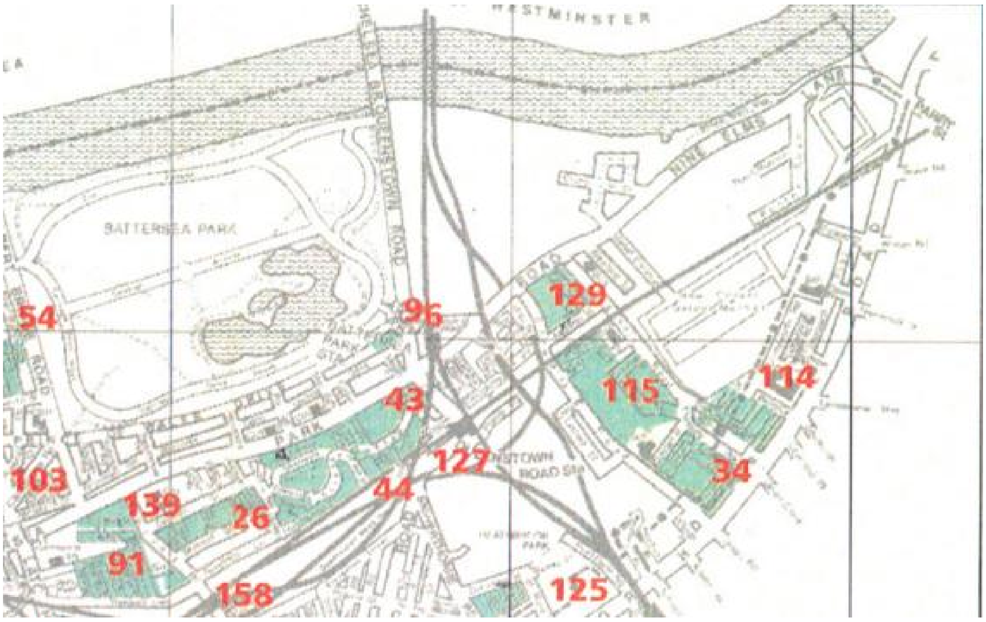


Table 2-1 Map key and estate commentary

Map ID	Estate Name	Commentary
26	Battersea Park	Individual gas boiler systems – was previously communal, but has undergone conversion
34	Carey Gardens	Individual gas boiler systems – was previously communal, but has undergone conversion
43	Doddington East	Part of Doddington and Rollo Estate with communal heating – opportunity for connection of new energy centre to district heating network
44	Doddington West	Part of Doddington and Rollo Estate with communal heating – opportunity for connection of new energy centre to district heating network
54	Ethelburga	Individual systems. Never had communal supply. Uncertain technical feasibility and acceptability of conversion. Very high proportion of

		private ownership (400 of 531 units).
91	Latchmere	Cottage dwellings – 90% now in private ownership – highly unlikely to be economic to connect
96	Lurline Gardens	Small, maisonette-style estate. Unlikely to be economic to connect, but proximity to potential DH route suggests that the option to connect to this estate should be kept open. Had communal system until removal in 2011. Currently managed by resident management organisation. 54 units in total, of which 31 are private leaseholds. Mix of houses (16) and flats (38).
103	McCarthy Court	Tenants have just voted to abandon the existing communal system. Conversion to individual system is therefore imminent. Contains approximately 78 dwellings, of which half are private leaseholders.
114	Patmore East	Individual systems. Never had communal supply. Uncertain technical feasibility and acceptability of conversion. Given proximity to proposed DH route, connection should be considered when network operational and supply costs demonstrable and de-risked.
115	Patmore West	Individual systems. Never had communal supply. Uncertain technical feasibility and acceptability of conversion. Given proximity to proposed DH route, connection should be considered when network operational and supply costs demonstrable and de-risked.
125	Robertson Street	Difficult access given impediments of railway crossings. Not considered viable for connection.
127	Rollo	Part of Doddington and Rollo Estate with communal heating – opportunity for connection of new energy centre to district heating network
129	Savona	Individual systems. Never had communal supply. Uncertain technical feasibility and acceptability of conversion. Given proximity to proposed DH route, connection should be considered when network operational and supply costs demonstrable and de-risked.
139	St James's Grove	Individual systems with exception of Castlemain Tower, which has communal supply. Distance to remainder of connection nodes – i.e. Doddington energy centre, Kingsway Square render the viability of this connection questionable.
158	Wilditch	Location and small size render viability of connection highly unlikely. Currently supplied by individual gas boilers. Was previously a communal system. 184 units, of which 63 are leashold sales.

2.6 Lambeth Housing

2.6.1 PB surveyed a number of council owned housing estates within the north area which included Hemans estate, Mawbey Brough estate, Springfield estate, Ethelred estate on 4th April 2013.

2.6.2 The dwellings within the Hemans and Mawbey Brough estates each have their own individual gas fired boilers providing heating and hot water.

2.6.3 Within the Springfield estate, only Goldsborough House has a central system providing heat from the boiler house to the dwellings in their block. 3 no. gas fired boilers located in the 4th floor boiler room serve these 27 dwelling via plate heat exchangers. The rest of the dwellings on the estate have their own individual boiler installation.

2.6.4 Early in the feasibility, the Sugden House plant room was identified as a potential location to house a central energy centre to serve the developments within the northern area of Lambeth. However, following from the site visit on 29th November 2007, it was found that the existing plant room could not cater for any additional boilers due to space constraints. The existing layout has been illustrated on drawing 3512246A-BEL-1-M004 within the appendix. The drawing also illustrates a typical schematic enabling the existing system to be connected onto a district heating network.

2.6.5 The central boiler room within the basement of Sugden House provides the heating to the 322 dwellings throughout the Ethelred estate. The central plant consists of 3 no. gas fired boilers where heating water is pumped to each individual block and then terminated via plate heat exchangers within each dwelling.

2.6.6 The 295 dwellings within the Ethelred Towers estate are provided with heat via a central system located within the basement of Ward Point. This system consists of 4 no. gas fired boilers and a CHP unit. Each of the dwellings has their own plate heat exchangers providing heating and hot water.

2.6.7 Connection of the developments mentioned above to the NEWEDEN was mainly not pursued due to the distance from the proposed network. Most of these developments are located within the northern area of Lambeth, where a ‘Northern’ scheme was considered at the early stages of feasibility, but discounted as described below.

2.6.8 Following from the survey on 4th April 2013, PB was provided spreadsheet from Lambeth Council detailing the boiler rooms within the north area of Lambeth. This spreadsheet also detailed the number of dwellings served from each of the boiler rooms with the associated addresses. Information from this spreadsheet has been extracted with the relevant information listed below. Note that only the boiler rooms serving more than 50 dwellings have been shown in Table 2.2.

2.6.9 The estates with less than 50 dwellings have not been considered to be connected onto the proposed district network due to the size of heat load expected. On further assessment on the viability of connecting these estates to the network, it was found that they were located too far from the proposed core network.

Table 2-2 Lambeth estates boiler information

Estate Name	Address	Boiler Reference	Dwellings
China Walk	Wedgewood House 1	BR014	54
China Walk	Wedgewood House 4	BR017	54
Ethelred Towers	Ward Point	BR040	295
Non Estate	Brixton Road (91-141 Odd)	BR042	102
Cotton Gardens	Ebenezer House	BR069	80
Cotton Gardens	Fairford House	BR070	82
Cotton Gardens	Hurley House	BR071	80
Penwith Manor	Falmouth House	BR121	68
Penwith Manor	Penryn House	BR170	66
Myatts Field South	Akerman Road Myatts Field	BR104	280
Paulet Road	Paulet Road (2-200 Even)	BR120	99
Rusper Court	Rusper Court	BR127	59
Spurgeon	Kelvedon House	BR135	81
Mursell	Rundle Towers	BR162	82
Cowley	Annesley House	BR026	53
Cowley	Kingsgate House	BR027	54

Ethelred	Sugden House	BR039	322
Holland Rise	Holland Rise House	BR066	80
Wellington Mills	Oakey Lane	BR156	137

2.7 Other Developments considered

2.7.1 A number of other developments, new and existing, were also considered when assessing the scale of the proposed district network. The details of which have been listed below.

2.7.2 Osiers Estates (Barratt Homes) is a development consisting of 275 new one, two and three bedroom apartments adjacent to Wandsworth Park and the River Thames. Even though there would be a significant heating load for the site, the distance from the proposed network is considered to be too far for connection.

2.7.3 The Battersea Bridge (Barratt Homes) development located at the cross section between Battersea Park Road and Latchmere Street consists of 46 new one, two and three bedroom apartments. The heat load from this development is expected to be small due to the number of dwellings and so connection to the network has not been pursued.

2.7.4 The following sites below were considered but were not pursued due to either their small expected heat load or the distance from the proposed 'core' network. The focus of this study has been on the 'Central' and 'Battersea' schemes identified in the Energy Masterplan Study. The 'Northern' scheme identified in the Energy Masterplan has not been pursued at this stage as it has not been possible to readily identify an energy centre of suitable size and location to serve the demands of the 'Northern cluster' economically[1].

- Tideway Industrial Estate, Nine Elms
- 30-60 South Lambeth Road
- Lord Clyde, 90 Tyers Street (Cabinet Gallery)
- Cobalt Square (Metropolitan Police HQ)
- Eastbury House
- Hampton House
- Battersea Studios
- National Express Bus Depot
- Cringle Dock, Nine Elms , SW8
- Depot, Kirtling Street, SW8
- Former Petrol Filling Station, 2 Battersea Park Road, SW8
- Heathwall Pumping Station, 54-56 Nine Elms Lane, SW8
- Ingate Place
- RMC Battersea (Metro Greenham), Nine Elms, SW8
- Operational Land, Cringle Street
- Silverthorne Road (Network Rail Site) Battersea, SW8
- Site adjacent to 103-125 Battersea Park Road
- Sleaford Street, SW8
- Tidbury Court, Stewarts Road, SW8
- 2-14 Tinworth Street and 108-110 Vauxhall Walk (Spring Mews)
- Albert Embankment Arch Units and Open Space

[1] The outstanding opportunity that PB has not yet investigated is the potential to make use of the space around or within the Ethelred TMO boiler house.

- Albert Embankment Riverside sites
- Keybridge House and Wyvil Road
- London Fire Bridgade HQ, 8 Albert Embankment
- 81 Black Prince Road (Parliament House)
- MPS Office Building, 109 Lambeth Road
- Spring Gardens Railway Arch No. 1 & 2
- Vauxhall Tower, St. George Wharf
- Texaco Garage, 38-46 Albert Embankment
- Vauxhall Station Arches
- Vauxhall Tavern, 372 Kennington Lane
- Warehouse, Lambeth High Street/Whitgift Street
- Wah Kwong House, 10 Albert Embankment
- 49-59 Battersea Park Road SW8
- Costa Brewing House
- SWD IMO Building and Westminster Tower, Albert Embankment, SE1 7SR
- Bondway Commercial Centre, 69-71 Bondway
- 5 and 21 Miles Street
- Pensbury Place Waste Management Site, SW8
- Queensborough House

3 ENERGY DEMAND PROJECTIONS

3.1 Existing stock

3.1.1 This report has considered the existing stock demands as listed below.

Table 3-1 Heat demand of existing stock

Site	Annual Heat Demand (kWh p.a.)	Source of demand projection
Doddington & Rollo Estate	11,243,491	Annual heat demand calculated using gas consumption data provided by Wandsworth Council and an assumed 75% boiler efficiency.
Viridian Apartments	1,699,680	Gas invoices were provided by Mainstay Group where the demand was interpolated using these figures and an assumed 80% boiler efficiency.
Kingsway Square	1,543,809	Gas invoices were provided by Mainstay Group where the demand was interpolated using these figures and an assumed 80% boiler efficiency.

3.2 Development sites

3.2.1 The following table summarises the projections of demands adopted in this study. This table only illustrates demand at completion.

Table 3-2 Heat demand of new developments

Site	Annual Heat Demand (kWh p.a.)	Source of demand projection
BPS	27,152,096	Figure taken from the energy strategy produced by Roger Preston Environmental. Heat demand for each phase were a pro-rata based on areas.
Embassy Gardens	16,025,000	Figure taken from the energy strategy produced by Element Energy
Vauxhall Square	9,488,548	Figure taken from the energy strategy produced by Haore Lea
RMG	6,369,992	Figure taken from the energy strategy produced by URS. Heat demand was split equally between the phases.
NCGM Northern Site	5,731,945	Figure taken from the draft energy strategy produced by URS
Market Towers	4,276,577	Figure taken from the energy strategy produced by Grontmij
Riverlight	3,797,062	Figure taken from the energy strategy produced by Richard Hodkinson Consultancy

Sainsbury	3,210,689	Figure taken from the energy strategy produced by Haore Lea
Battersea Gasholders	2,968,265	Figure taken from the master schedule phasing data provided by Wandsworth Council
NCGM Apex Market Site	2,839,517	Figure taken from the draft energy strategy produced by URS
Vauxhall Island	2,632,739	Figure taken from the energy strategy produced by Roger Preston Environmental
Billboard Site	2,250,623	Figure taken from the planning application data
10 Pascal Street	2,151,758	Figure estimated based on benchmarks from TM46 and an assumed 83% boiler efficiency. Areas and resi unit numbers provided by Lambeth and Wandsworth Council.
Patcham Terrace	1,873,854	Figure taken from the master schedule phasing data provided by Wandsworth Council
NCGM Entrance Site	1,303,468	Figure taken from the draft energy strategy produced by URS
Marco Polo House	1,104,324	Figure taken from the planning application data
Christies Auctioneers Depot	1,002,945	Figure taken from the master schedule phasing data provided by Wandsworth Council
Sky Gardens	822,753	Figure taken from the master schedule phasing data provided by Wandsworth Council
Gov Car & Dispatch Agency	778,251	Figure taken from the master schedule phasing data provided by Wandsworth Council
Parry St East (Bondway South)	772,097	Figure taken from the master schedule phasing data provided by Wandsworth Council
Met Police Warehouse Garage	516,538	Figure taken from the master schedule phasing data provided by Wandsworth Council
1-9 Bondway & 4-6 South Lambeth Place	446,589	Figure taken from the planning application data
Securicor Site, 80 Kirtling Street	431,309	Figure taken from the master schedule phasing data provided by Wandsworth Council
Dairy Crest Milk Distribution Depot	392,569	Figure taken from the master schedule phasing data provided by Wandsworth Council

Booker Cash and Carry	392,569	Figure taken from the master schedule phasing data provided by Wandsworth Council
Cable and Wireless, Ballymore Site 6	317,671	Figure taken from the master schedule phasing data provided by Wandsworth Council
Miles St (South) & Wandsworth Rd	289,261	Figure taken from the master schedule phasing data provided by Wandsworth Council
Brooks Court, Kirtling Street	168,736	Figure taken from the master schedule phasing data provided by Wandsworth Council

3.2.2 A table showing the projection of growth through time for each site is included within the appendices.

4 ENERGY DISTRIBUTION

4.1 Relation to other utilities

4.1.1 There is a parallel study being carried out on the key utilities that are required by the Opportunity Area. This utilities study draws together the projected utility demand requirements for a number of different key sites, and has made joint applications on this basis to the statutory utility companies. The aim of this utilities study is, similarly in philosophy to this district energy study, to avoid the piecemeal provision of utilities to the area. The joint utilities approach aims to rationalise the reinforcement required for the provision of utilities.

4.1.2 PB has liaised with the lead consultants carrying out the Utilities work, in order to ensure that there is compatibility between the solutions developed. The key areas for this collaboration are considered to be the following:

- Gas supply provision (date, route and capacity)
- Electrical substation location (date, route and capacity)
- Use of the linear park for utility provision (dates)

4.1.3 Whilst we are currently awaiting confirmation of the implications of the response from the statutory utilities in terms of gas and electrical supplies, it is clear from the timing of developments coming forward, that the use of the linear park as a primary corridor for utilities will be very challenging. One reason for this is the incompatibility with the requirements for power and other utility provision in the short term to sites such as Embassy Gardens, Riverlight, Market Towers, whilst the linear park is not yet a coherent corridor through the wider development area (given the need to clear and remediate the land on the Royal Mail Group site, for example).

4.1.4 This incompatibility of dates for utilities does not, however, pose a significant threat to the potential to use the linear park as a route for district heating infrastructure.

4.2 Network routes

4.2.1 The extents of the NEWEDEN are identified in this study on the basis of anticipated financial return for the scheme operator. The preferred route for the DH pipework has been developed on the basis of avoiding Nine Elms Lane wherever possible, as this is both congested with existing utilities, and an important transport corridor for both the construction phase of new development and normal traffic.

4.2.2 Whilst the linear park is likely to be difficult to adopt for other utilities (as noted above given phasing difficulties), the installation of the NEWEDEN in this location should be possible given the phasing of heat requirement, and the use of local boilers in individual development to provide early-years heat.

4.3 Network scenarios

4.3.1 Two scales of network have been analysed. First, a larger network that has a greater scope, and offers a more strategic long-term vision for the area. Second, a more compact network whose extent implies reduces need for capital investment and hence reduced risk.

4.3.2 These have been illustrated in the figures below.

Figure 4.1 Larger network

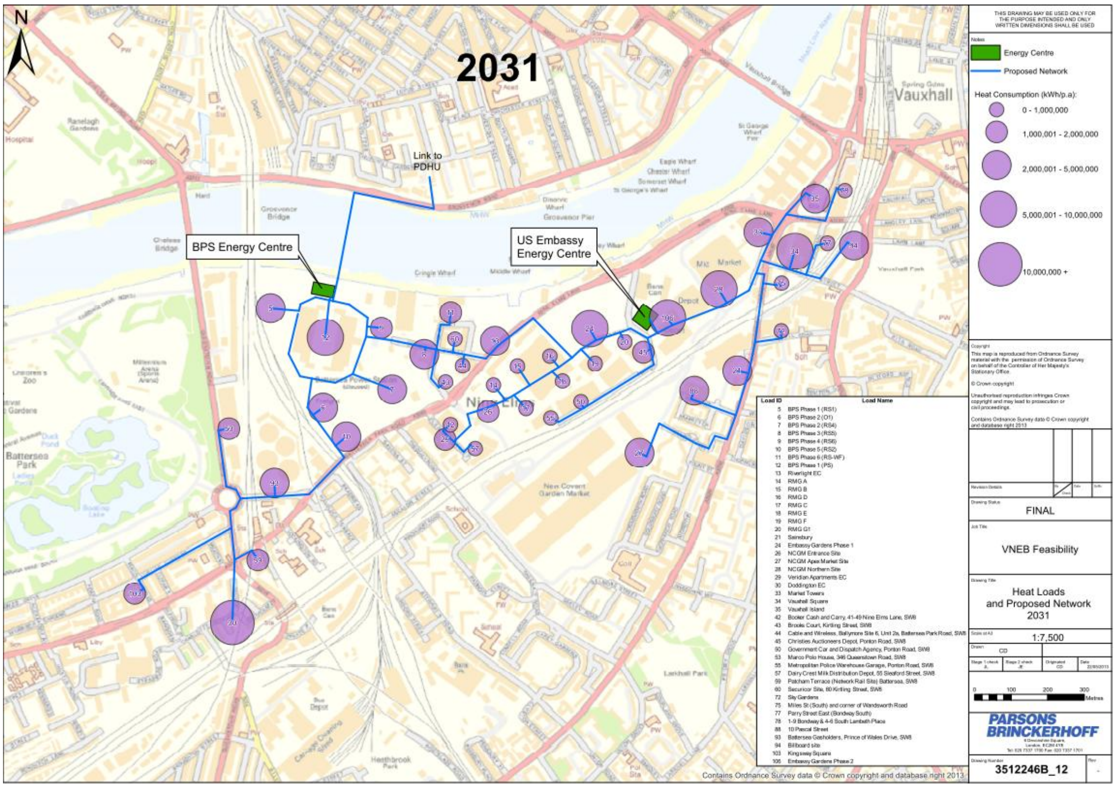
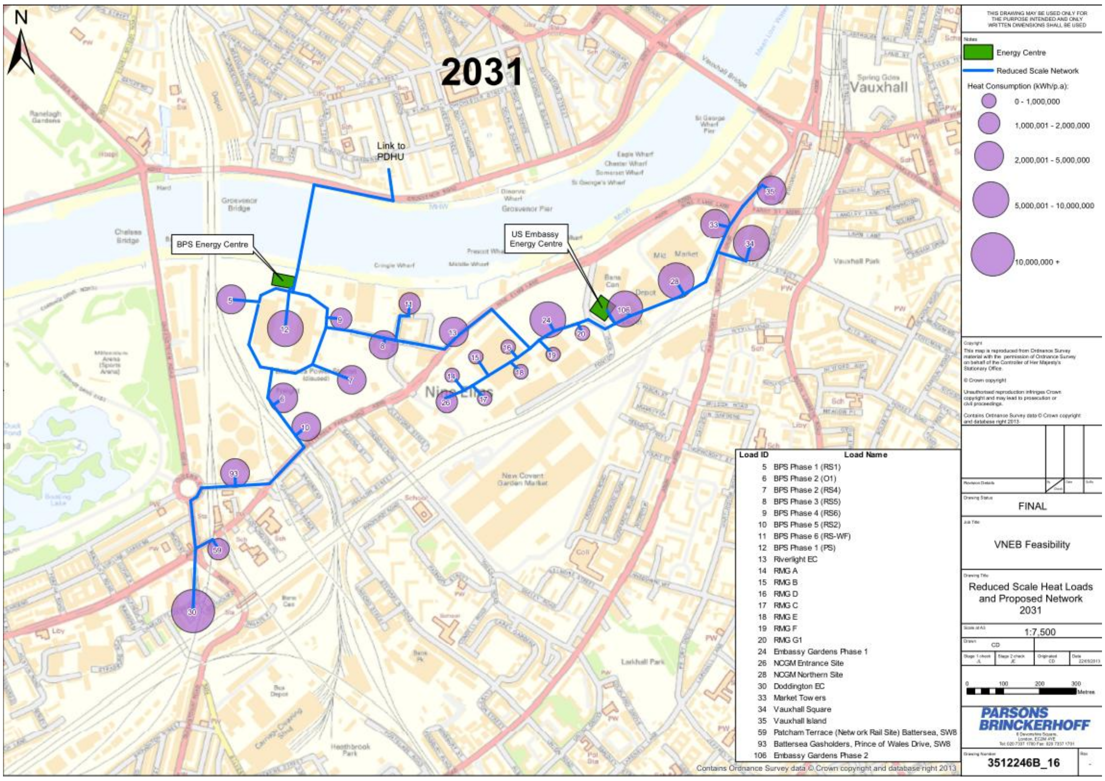


Figure 4.2 Smaller network



5 HEAT SUPPLY PLANT

5.1 Energy Centre Availability

5.1.1 A key difference that has emerged from stakeholder engagement since the development of the Energy Masterplan, is that from early phase discussion (Feb 2013) with the site's developers and their consultants, on the New Covent Garden Market (NCGM) site there no clear location identified for a large energy centre in its preliminary development of concepts. New Covent Garden Market is now being developed by St Modwen / Vinci, and it is understood that the current intention is to have 3 small separate energy centres to serve the key areas of the site (Market, Entrance and Northern). This is not in conformity with either GLA nor Wandsworth Policy, nor with the precedent set by the previous application. Nevertheless, given that this approach indicated uncertainty surrounding both the phasing and location of an energy centre, an approach has been adopted in this study that removes this energy centre availability as a risk for the scheme. This leaves a potential upside benefit for the scheme should a suitable space for top-up and standby plant be secured.

5.1.2 This is a significant change from the previous application, and the acceptability of current NCGM proposals has not yet been tested from a planning perspective.

5.1.3 Below is a table of the key dates of when heat will be available from the different energy centres as assumed within the study.

Table 5-1 Energy Centre Availability

From	Energy Centre Source	Heat supplied to the network	Primary equipment expected
2017	US Embassy energy centre	Heat supplied will be limited to the equipment already proposed with the energy strategy. Top-up boilers required for developments connecting during 2017-2021 (inclusive)	CHP's
2022	BPS energy centre	Heat supplied will cater for the peak demand	CHP's, boilers, thermal stores

5.1.4 It is proposed that the CHP units within the US Embassy energy centre will provide heat to the network from 2017 onwards. As the peak supply capacity is limited by the size of these units, the developments connecting onto the network during these early years (Phase 1 of the NEWEDEN) will require their own boiler plant for standby and top-up heat. The boiler plant within each development will need to be sized for peak demand in events of heat not being available because of US Embassy CHP downtime[2]. The DH network installed at the start of Phase 1 has been sized to ensure that the peak demands of all individual sites can be supplied at full build-out of the scheme (where all supply plant is rationalised to BPS).

5.1.5 Heat from the BPS energy centre will become available from 2022 onwards where the primary plant will be able to cater for the combined peak demand of all of the developments on the NEWEDEN. When this occurs, each network connection will

[2] CHP downtime is a natural function of the need to maintain gas-fired spark-ignition engines at regular intervals.

only require plate heat exchangers in duty standby configuration as their primary heat source, negating the need for boilers. The resilience improvement to be delivered by this system is illustrated in section 6.

5.1.6 The table below illustrates the phasing assumed for the emergence of new demands across the heat loads considered in the study and when they would be expected to connect onto the network. Existing developments have also been included within this table with illustration of when they are expected to connect to the NEWEDEN system.

5.1.7 The phasing details for both network scenarios, larger and smaller network, have been illustrated below. These tables illustrate periods in yellow where the NEWEDEN only supplies a portion of the total demand of the sites connected. This is either because of the Phase 1 baseload supply, or because sites are assumed to retain their own CHP plant post 2022, until the life-expiry of these units. The periods shown in green are when the full demands of the developments are anticipated to be met by the NEWEDEN heat supply.

Figure 5.1 Emergence of loads (larger network)

Heat available from US Embassy Energy Centre (from 2017) →

Heat available from US Embassy & BPS Energy Centre (from 2022) →

Load ID		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
13	**Riverlight**	317,306	827,100	1,692,112	2,891,370	3,354,837	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062
21	**Sainsbury**		802,672	1,605,345	2,408,017	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689	3,210,689
24	**Embassy Gardens Phase 1**	1,795,000	5,413,000	6,295,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000
106	**Embassy Gardens Phase 2**				1,769,600	3,539,200	5,308,800	7,078,400	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000
5	**BPS Phase 1 (RS1)**			1,813,492	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985
6	**BPS Phase 2 (O1)**					1,782,959	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918
7	**BPS Phase 2 (RS4)**						1,819,230	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461
8	**BPS Phase 3 (RS5)**							2,005,259	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518
9	**BPS Phase 4 (RS6)**								533,465	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930
10	**BPS Phase 5 (RS2)**									2,279,533	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067
11	**BPS Phase 6 (RS-WF)**										634,141	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281
12	**BPS Phase 1 (PS)**				2,707,968	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936
14	**RMG A**				309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
15	**RMG B**						309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
16	**RMG D**								309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
17	**RMG C**										309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999
18	**RMG E**												309,400	609,699	909,999	909,999	909,999	909,999	909,999
19	**RMG F**														309,400	609,699	909,999	909,999	909,999
20	**RMG G1**																309,400	609,699	909,999
26	**NCGM Entrance Site**								651,734	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468
27	**NCGM Apex Market Site**			170,371	340,742	511,113	709,879	709,879	709,879	1,774,698	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517	2,839,517
28	**NCGM Northern Site**					1,432,986	2,865,973	4,298,959	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945
33	**Market Towers**		330,231	2,406,197	2,866,941	3,327,685	3,807,008	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577
34	**Vauxhall Square**				6,206,122	6,839,509	7,948,597	8,738,941	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548
35	**Vauxhall Island**			1,316,370	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739
94	**Billboard Site**		2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623	2,250,623
42	**Booker Cash and Carry, 41-49 Nine Elms Lane**										371,047	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569
43	**Brooks Court, Kirtling Street**															168,736	168,736	168,736	168,736
44	**Cable & Wireless, Ballymore Site 6**																	317,671	317,671
45	**Christies Auctioneers Depot, Ponton Road**														462,302	775,668	1,002,945	1,002,945	1,002,945
50	**Government Car and Dispatch Agency**											428,727	733,484	778,251	778,251	778,251	778,251	778,251	778,251
53	**Marco Polo House, 346 Queenstown Road, SW8**			290,050	567,005	839,810	1,034,530	1,077,345	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324	1,104,324
55	**Metropolitan Police Warehouse Garage, Ponton Road, SW8**												389,125	516,538	516,538	516,538	516,538	516,538	516,538
57	**Dairy Crest Milk Distribution Depot, 55 Sleaford Street, SW8**						366,742	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569	392,569
59	**Patcham Terrace (Network Rail Site) Battersea, SW8**				1,210,102	1,523,469	1,832,531	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854
60	**Securicor Site, 80 Kirtling Street, SW8**													374,490	431,309	431,309	431,309	431,309	431,309
72	**Sky Gardens**		437,971	715,765	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753	822,753
75	**Miles St (South) and corner of Wandsworth Road**												289,261	289,261	289,261	289,261	289,261	289,261	289,261
77	**Parry Street East (Bondway South)**					694,616	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097	772,097
78	**1-9 Bondway & 4-6 South Lambeth Place**	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589	446,589
88	**10 Pascal Street□London□SW8 4SH**				2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758	2,151,758
93	**Battersea Gasholders, Prince of Wales Drive, SW8**					278,357	645,673	1,006,101	1,478,710	1,890,271	2,170,350	2,670,108	2,957,934	2,968,265	2,968,265	2,968,265	2,968,265	2,968,265	2,968,265
103	**Kingsway Square**	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809	1,543,809
29	**Veridian Apartments EC**	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680	1,699,680
30	**Doddington EC**	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491

Legend

- (Yellow) Building system connected to DEN with only top up or base-load heat being provided from network
- (Green) Building system connected to DEN with all heat required being provided by network

Figure 5.2 Phasing of emergence of loads (smaller network extent)

Heat available from US Embassy Energy Centre (from 2017) →

Heat available from US Embassy & BPS Energy Centre (from 2022) →

Load ID		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
13	**Riverlight**	317,306	827,100	1,692,112	2,891,370	3,354,837	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062	3,797,062
24	**Embassy Gardens Phase 1**	1,795,000	5,413,000	6,295,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000	7,177,000
106	**Embassy Gardens Phase 2**				1,769,600	3,539,200	5,308,800	7,078,400	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000	8,848,000
5	**BPS Phase 1 (RS1)**			1,813,492	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985	3,626,985
6	**BPS Phase 2 (O1)**					1,782,959	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918	3,565,918
7	**BPS Phase 2 (RS4)**						1,819,230	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461	3,638,461
8	**BPS Phase 3 (RS5)**							2,005,259	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518	4,010,518
9	**BPS Phase 4 (RS6)**								533,465	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930	1,066,930
10	**BPS Phase 5 (RS2)**									2,279,533	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067	4,559,067
11	**BPS Phase 6 (RS-WF)**										634,141	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281	1,268,281
12	**BPS Phase 1 (PS)**				2,707,968	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936	5,415,936
14	**RMG A**				309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
15	**RMG B**						309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
16	**RMG D**								309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999	909,999
17	**RMG C**										309,400	609,699	909,999	909,999	909,999	909,999	909,999	909,999	909,999
18	**RMG E**												309,400	609,699	909,999	909,999	909,999	909,999	909,999
19	**RMG F**														309,400	609,699	909,999	909,999	909,999
20	**RMG G1**																309,400	609,699	909,999
26	**NCGM Entrance Site**								651,734	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468	1,303,468
28	**NCGM Northern Site**					1,432,986	2,865,973	4,298,959	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945	5,731,945
33	**Market Towers**		330,231	2,406,197	2,866,941	3,327,685	3,807,008	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577	4,276,577
34	**Vauxhall Square**				6,206,122	6,839,509	7,948,597	8,738,941	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548	9,488,548
35	**Vauxhall Island**			1,316,370	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739	2,632,739
59	**Patcham Terrace (Network Rail Site) Battersea, SW8**				1,210,102	1,523,469	1,832,531	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854	1,873,854
93	**Battersea Gasholders, Prince of Wales Drive, SW8**					278,357	645,673	1,006,101	1,478,710	1,890,271	2,170,350	2,670,108	2,957,934	2,968,265	2,968,265	2,968,265	2,968,265	2,968,265	2,968,265
30	**Doddington EC**	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491	11,243,491

Legend
- (yellow) Building system connected to DEN with only top up heat being provided from network
- (green) Building system connected to DEN with all heat required being provided by network

5.2 First phase approach (2017-2021)

5.2.1 Figure 5.2 above details the loads (listed below) expected to connect onto the network whilst heat is available from the US Embassy energy centre. It also illustrates the phasing assumed for the emergence of these demands across the heat loads considered in the study.

- Embassy Gardens Phase 1
- Embassy Gardens Phase 2
- Parts of the RMG development
- NCGM Northern Site
- Market Towers
- Vauxhall Square
- Vauxhall Island
- Billboard Site

5.2.2 This table illustrates that there are a number of sites that will have a demand for heat even before the NEWEDEN might emerge[3]. However, even more critically, the current anticipated development dates of the NCGM sites (and the change in approach to energy provision) means that there is no certainty at this stage of an early phase energy centre of sufficient capacity to supply the NEWEDEN first phase.

5.2.3 A further significant evolution from the Energy Masterplan is the current understanding of the US Embassy's position with regard to heat supply to the NEWEDEN. It is now understood that the US Embassy will:

- Procure and install 2 no. 1.6MWe CHP engines, with anticipated heat available for export to NEWEDEN of up to approximately 2.85MWth/3MWth

- Export heat to the NEWEDEN at no cost, in return for the operation and maintenance of the CHP plant installed within the Embassy energy centre

- Aim to start to operate the CHP plant at the end of 2016, with official opening of the US Embassy anticipated on the 4th July 2017

5.2.4 This is of significance for the NEWEDEN project, as this provides a source of low-cost, low carbon heat for the period post-2017 and would allow some developments to avoid the cost of installing their own CHP plant.

5.2.5 The US Embassy's position is not contractually agreed at this stage and hence a key action as this project progresses will be to obtain firmer commitment from this prospective project partner.

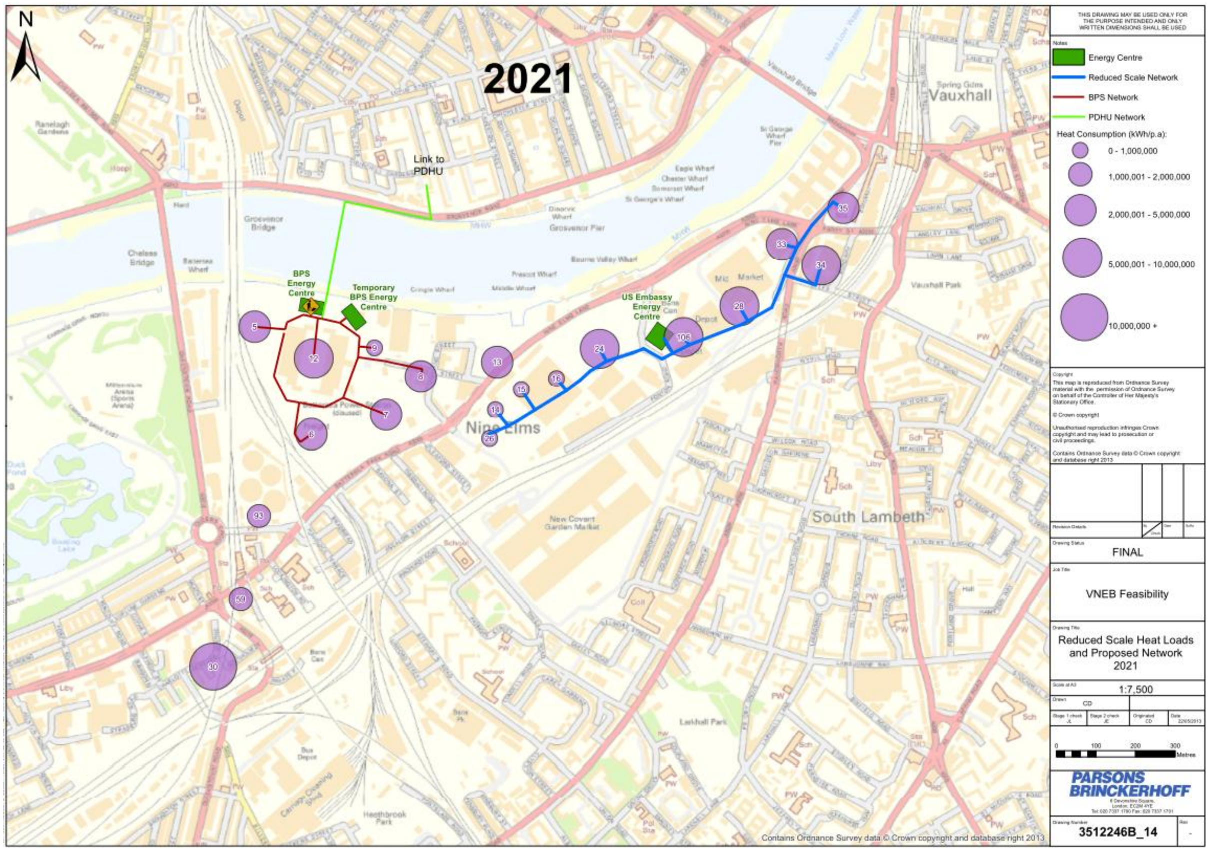
5.2.6 Peak network vs base-load network (first phase)

5.2.7 The approach adopted in this report is for a first-phase base-load network (as illustrated below, and representing the period 2017 to 2021). Note that the illustration below represents the network in 2021.

[3] Given procurement, design, financing etc., it is anticipated that 2016 would be the earliest that any form of NEWEDEN might emerge.

5.2.8 The illustration below also indicates the expected emergence of the loads at Battersea Power Station (BPS), where it expected that their parts of their own network will be in place prior to connection onto NEWEDEN. As the main energy centre at BPS will not be available until 2022, a temporary energy centre will be located within their site to serve the phases of development prior to this. A connection to the PDHU system could influence the requirement for this plant. The BPS network installed during this early period will be sized from installation to cater for the final full build out of NEWEDEN to avoid the costs and works associated with re-laying the larger sections of pipework at a later date.

Figure 5.3 First phase network



5.2.9 It would be preferable to operate this first phase as a peak-load network – e.g. with top-up and standby boiler plant operated by the same entity that will supply heat to the network and sell heat to customers. This peak-load approach is generally preferable for DH networks as it allows site developers to avoid costs for a number of items such as:

- Gas supply
- Flues
- CHP (or other low-carbon heat supply plant)
- Boilers
- Other plant room items such as ventilation plant, pumps, etc…

5.2.10 These avoided costs that would have benefited the developer would typically be charged (normally as a connection charge), by the DH Network operator for the supply of heat from the peak network.

5.2.11 However, in the case of a base-load network, the avoided costs seen by the developer are limited to their avoided low-carbon supply plant (i.e. CHP). This limits the level of avoided cost. This is normally less economically viable than a peak-load configuration.

5.2.12 Under this study, it is intended that the private sector developers will be offered maximum cost savings (CAPEX) by not imposing connection charges for taking heat from the NEWEDEN. Developers will also see a whole life cost saving from the avoided cost of maintaining and replacing the plant that would otherwise have been installed under the non networked option. This approach of not imposing a connection charge means that there is a slower positive cashflow for the central scheme operator, and hence the central scheme's 'bankability' is decreased. However, in this case, the high density of loads and overall modelled performance of the scheme suggests that finance should be obtainable even without the injection of 'connection charges' into the central operator's cashflow model.

5.2.13 The NEWEDEN case is limited in its options for the first phase supply of heat for the following key reasons also outlined above:

- Lack of certainty of availability of suitable plant room space (at the correct point in time) to house top-up and standby boiler plant for the early phase network

- The challenge of delivering the NEWEDEN sufficiently early (and with sufficient certainty of its emergence and programme) to allow developments to avoid the need for their own heat supply plant.

5.2.14 In light of the above, it has been assumed that during the early years, a base load network will be available.

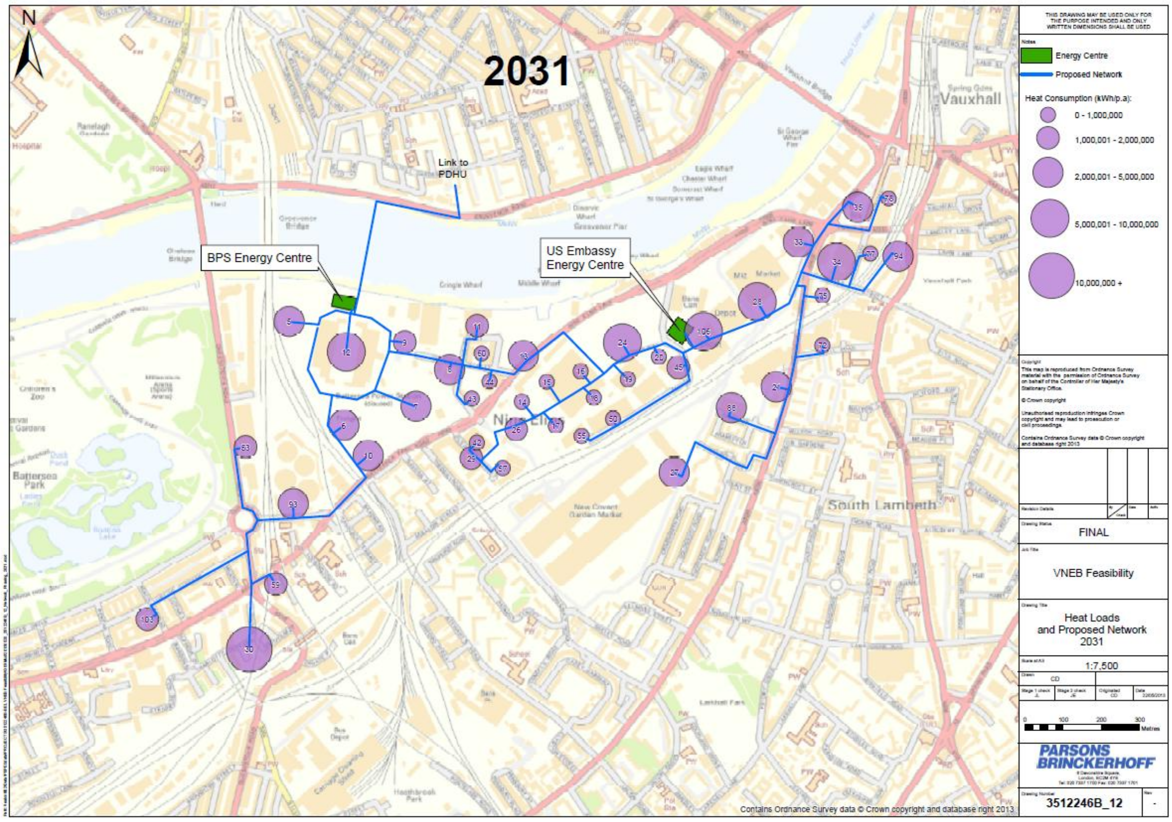
5.3 Second phase (from 2022 onwards)

5.3.1 One key asset in the OA in terms of energy supply is the space secured through planning for energy plant and the flues of the iconic shell of Battersea Power Station.

5.3.2 It is the aspiration of the national, regional and local policy to push towards decentralised energy and that these networks should benefit from economies of scale. Hence the target of the approach developed through the energy masterplan and this feasibility work is a rationalised energy supply from a single location.

5.3.3 The key asset of Battersea Power Station is the most suitable nexus for this rationalisation, both given its physical attributes, but also given its existing connection across the Thames to the PDHU pump house. Hence at the earliest opportunity that appears sensible in the timeline of project growth, the proposal is that the networks should start to operate as a peak-load network with the energy centre at Battersea Power Station as the key location for energy plant. This rationalisation is assumed to only be able to take place in 2022, as this is the date when it is anticipated that the main energy centre at Battersea will become operational.

5.3.4 At the point in time when the BPS energy centre becomes operational (i.e. 2022), it is anticipated that the majority of key loads in the area could connect to the NEWEDEN, as illustrated below (6% IRR case). Note that the illustration below represents the network after full build out of the second phase, i.e. in 2031.



5.3.5 The availability of the main energy centre from 2022 onwards will enable the temporary BPS energy centre to be decommissioned. The ring main around the BPS site will already be suitably reinforced with capped off connections ready for linking to the network from US Embassy. The US Embassy network has been sized in this study to have capacity to supply the peak load demands of the connected buildings at full build-out of the system.

5.3.6 The network will also be linked to the PDHU pump house via the existing pipework link under the Thames when heat is made available from the main energy centre. The impact of the additional potential heat demands from PDHU that could be served from this link is not assessed within this study.

5.4 Use of waste heat

5.4.1 In the development of a long-term strategy for efficient, low-carbon heat provision, one key consideration is how better use could be made of ‘waste heat’, or more precisely, heat rejected at too low a grade currently to be used directly in heating systems.

5.4.2 There is a widespread anticipation that the supply of electricity from the grid will decarbonise over time, as the UK generation mix changes to a more sustainable portfolio of generation assets. This will lead to greater carbon savings being achievable from the implementation of heat pump technology. Heat pumps can ‘upgrade’ low grade heat to useful energy for heating systems. The widespread conversion of secondary heating systems to operate at low temperatures would allow heat pumps to operate more efficiently, and hence the strategy envisaged for significant networks such as the NEWEDEN, is to implement them as a low temperature systems, that will, in the future, allow heat pumps to recover low grade heat and supply useful energy back into distribution systems.

5.4.3 London Underground

5.4.4 One source of heat in this context is the mix of ground-sourced, metabolic, motor and braking heat found in the London Underground system. Whilst it currently does not seem to be economically viable to recovery this heat, nor of great environmental benefit over alternative technologies, this situation is anticipated to improve in the future.

5.4.5 Data centres

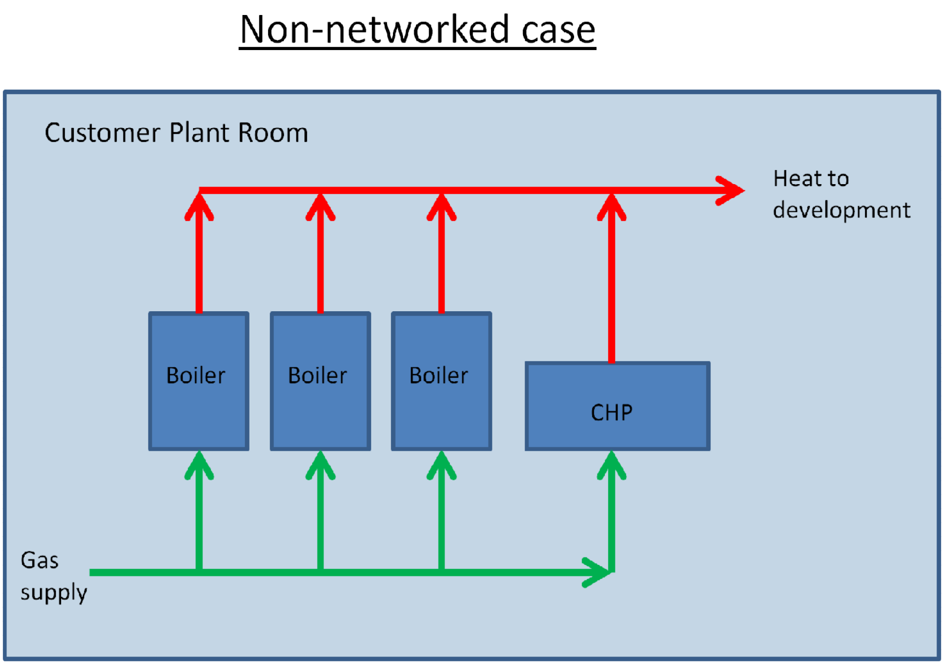
5.4.6 Data centres are also recognised as a potential source of 'waste heat' and there is already one data centre operating on the boundary of the OA, close to the existing Covent Garden Market site. The anticipated increase in land value in this area might suggest that this data centre operation may relocate in the medium to long term, and hence PB would caution against the development of a long-term strategy that relies too heavily upon the long-term existence of single, private sector operations in this context. However, the principle of specifying network operating parameters and the secondary side design of connected loads should allow for the economic recovery and injection of 'waste' heat into the network in the future, and this general concept of future proofing design and operation is fully supported by this study.

6 PLANT RESILIENCE

6.1 Non-networked case

6.1.1 Under the non-networked scenario, it is expected that each of the developments will have their own heating system comprising of a multiple boiler configuration, generally with CHP acting as a lead heat source. This plant would normally be configured to provide resilience to cater for failure of any one item of the primary plant. The likelihood of multiple primary plant items failing at the same time (and at the time of peak demand on the system) would be small, and this is therefore considered to be a 'resilient' configuration.

Figure 6.1 Non-networked option resilience illustration

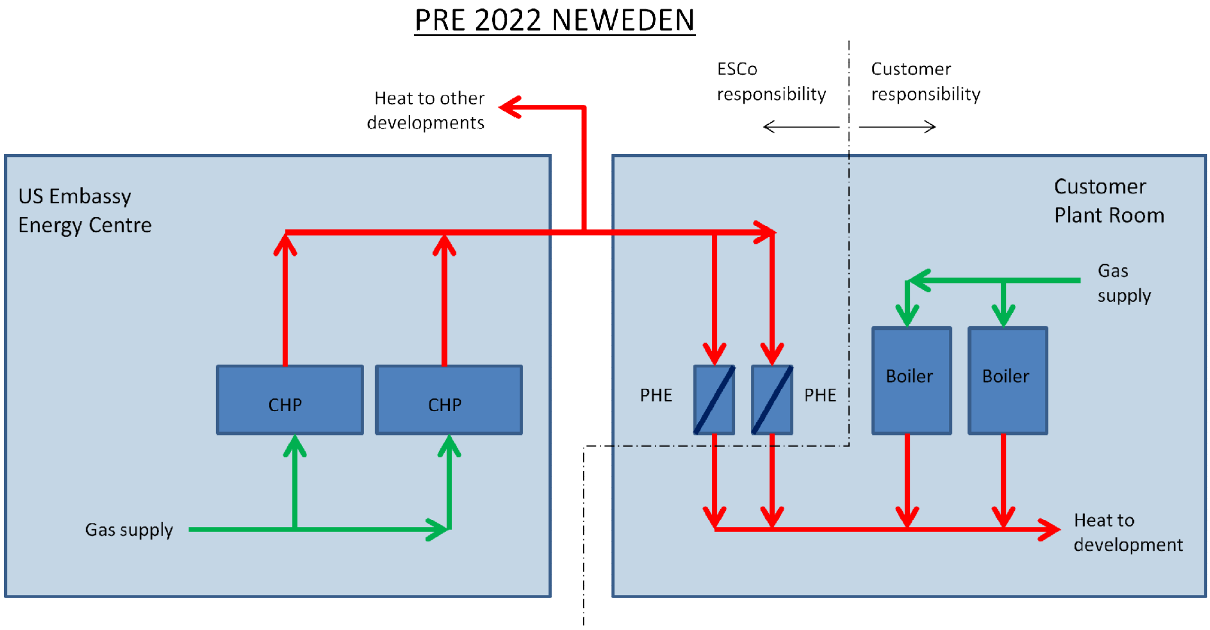


6.1.2 As all of the primary plant under this arrangement would typically be gas-fired, the key potential single point of failure for this system is an interrupted gas supply.

6.2 First phase NEWEDEN

6.2.1 Under the Phase 1 of the NEWEDEN, the following comparable resilience diagram applies:

Figure 6.2 NEWEDEN Phase 1 resilience illustration



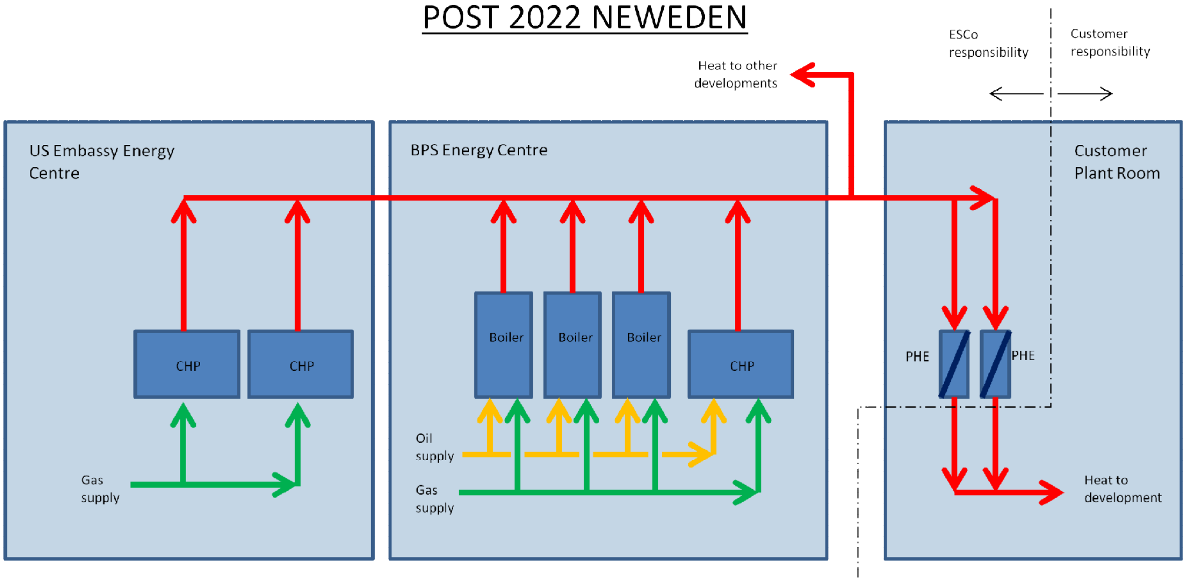
6.2.2 During the early years of the network, from 2017 to 2021, when heat will be available from the US Embassy energy centre, the reliability of heat supply will be marginally improved when compared to the non-networked case. This is due to the addition of the dual plate heat exchangers (taking heat from two CHP units) within each of the plant rooms. The top-up and standby boiler plant within each development remains identical to the non-networked alternative.

6.3 Second phase NEWEDEN

6.3.1 Under the second NEWEDEN phase (i.e. peak heat supply from the BPS EC); the heat provided to each development will be supplied via plate heat exchangers instead of individual site boilers and CHP. The proposed heat exchangers will be of a duty standby configuration which will ensure security of heat in event of one of the units failing, and to allow for preventive maintenance without loss of supply.

6.3.2 The level of resilience under this phase will be improved over the non-networked case, as the primary BPS energy centre will have multiple energy sources, dual fuel boilers and CHP plant. The only single point of failure risk is the district heating distribution pipework. However, this is installed in the same way as a statutory utility, and also will be installed with a leak-detection system to alert the system operator to any ingress of water into the outer shell of the insulation (either from the ground or from the carrier pipe).

Figure 6.3 NEWEDEN Phase 2 resilience illustration



7 FUTURE PROOFING

7.1 Gas Grid Decarbonisation

7.1.1 It should be noted that there is a level of future proofing inherent in the use of decentralised networks supplied with energy via spark ignition gas engines as proposed. In general these engines can operate on a variety of gases including bio gas (eg from anaerobic digestion) and syngas (eg from gasification of biomass).

7.1.2 There are ongoing developments in supply of this type of bio gas both to individual sites and via the existing gas grid. The Renewable Heat Incentive has a technology band specifically to encourage biogas production and injection to the grid.

7.1.3 The key factor in ensuring that this inherent future proofing can be fully utilised is to recognise that running engines on these bio gases typically means that the engine produces less output than when running on natural (fossil) gas. The potential for layouts to be adopted which would allow for larger engines to be installed at a later date should be considered.

7.2 Renewable CHP (Compression Ignition (CI) engines)

7.2.1 Compression Ignition Engines (CI) are CHP prime movers based upon large internal combustion engine technology and are available with outputs from 5kW up to approximately 80MW.

7.2.2 CHP (compression ignition) engines can be specified with a variety of liquid fuels including light fuel oil, heavy fuel oil, diesel, straight vegetable oil (bio-oil) and biodiesel. Compression ignition (CI) engines are also available as dual-fuel and gas-diesel variants, which can run on natural gas or similar but are capable of switching over to liquid fuel operation without interruption in operation.

7.2.3 The development of this technology has opened up the possibility of using renewable bio-oil fuels to which fall into the three categories below.

- Pure plant oil is a liquid bio-fuel that has not been refined beyond the filtration stage. Pure plant oil can be produced in the United Kingdom without supplementary energy or chemical use being required for refinement.
- Bio-diesel is plant oil (virgin or reclaimed) that has been processed to reduce the viscosity and improve the combustion characteristics of the fuel. Bio-diesel is increasingly being used as a transport fuel, and many compression-ignition engines can use it without modification, or with minimal modification.
- Glycerine is produced as a by-product of the biodiesel production process. For every tonne of biodiesel produced, 100kg of crude glycerine is produced.

7.2.4 Significant progress is also being made in the development of oils produced directly from algae. It is likely that this type of oil will initially be consumed for higher value mobile power applications (ie transport and off gas grid generation). The potential for it to be used in stationary power applications cannot be discounted however as yields increase and costs fall.

7.2.5 The use of such fuels are supported by the Renewable Obligation, where it has the potential to offer further carbon savings by reducing the carbon footprint of the primary plant solution.

7.2.6 The economics of operating biofuel CHP depends upon the cost of sourcing and (if applicable) processing the feedstock. As there are currently very limited supply chains in place, it is currently not generally economically viable to utilise biofuels due to the cost of transport and storage.

7.2.7 Biofuel CHP appears to be a technically promising solution for offering more carbon savings and should not be excluded at this current time. It is anticipated that in the future, the supply lines will be in place to make this option economically viable. It is hence recommended that space be allowed in the BPS EC to enable the future integration of biofuels.

7.2.8 Ultimately, the key to making biofuels viable is to be able to sustainably source (in terms of land and net carbon saved) a reliable supply at a price which enables economic operation.

7.3 Vauxhall crossing

7.3.1 The current proposed network does not extend further north into Lambeth due to the extensive works required to cross the major junction at Vauxhall Bridge, however, Wandsworth and Lambeth Councils have expressed their aspiration of being able to link to further developments in Lambeth with the goal of contributing to the creation of a wider pan-London district heating system.

7.3.2 The cost of the works required to solely enable the new pipework to be laid is estimated to be in the region of £700k and does not include for transport cost implications, such as road closures, diversions, etc. The transport costs are expected to be high as the anticipated network route crosses one of London's most significant junctions.

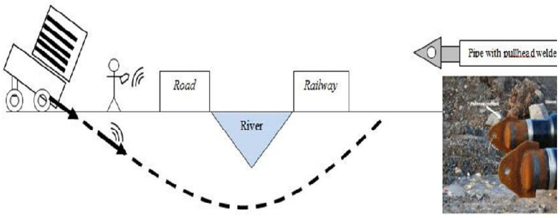
7.3.3 Currently, it is not economically viable to extend the network past this major junction due to the costs associated and the loads expected. However, it is expected that in the near future, significant utilities works across this main junction will be required, providing a window of opportunity whilst the roads are dug up and diversions in place to lay this new section of pipework. It is recommended these works be coordinated to coincide with each other in order to minimise disruptions and reduce impact on costs.

7.3.4 The difficulty of organising and implementing road closures at a junction of this significance is such that it is recommended that future-proofed pipework to protect the link to Albert Embankment is installed at the time of other works.

7.3.5 The alterrnative to this joint-installation-of-DH-with-other-utilities approach would be to adopt a novel installation technique such as horizontal directional drilling, thrust-boring, or tunnelling. These are described in brief below:

7.3.5.1 Horizontal directional drilling is a technique used relatively frequently on the continent to install various utilities without the need for major civil works. An indicative sketch of the principle and a typical machine is shown below.

Figure 7.1 Horizontal directional drilling



7.3.5.2 Thrust-boring or tunnelling involves the excavation of a pit, and the progressive excavation and reinforcement of a tunnel from this starting pit. The following table compares these two options:

Table 7-1 Comparison of alternative pipework installation techniques

Horizontal directional drilling	Tunnelling / thrust boring
Significantly lower installation cost	Low risk of pipe damage
Lower impact construction	Maintenance access provided by access pits
Shorter construction duration	Planning permissions required for construction only
Planning only required for construction	Medium construction risk and contingency
Higher risk installation method	Higher cost
No access to maintain or repair pipe	Most significant construction impact

7.3.6 Both of the techniques described here would allow pipework to be installed with minimal traffic disruption if technically feasible. However, this is a major caveat, as both techniques would also require significant investigation of the buried services in the area to identify an appropriate route for pipework. It cannot be guaranteed that this is possible in this congested location.

8 DELIVERY STRUCTURE

8.1.1 The delivery structure for the NEWEDEN is not within the scope of this study. A separate workstream led by DEPDU (Decentralised Energy Programme Delivery Unit) has been taking this element of work forward. Only brief comments are provided below.

8.2 Private sector feedback

8.2.1 PB recently attended a discussion group[4] designed to elicit feedback from private sector developers on district heating delivery structures and methods, and among other items, two key points that arose were:

- It would be desirable from a developer point of view, particularly in the early development phase of projects to have clear sight and confidence in the partner who would deliver energy to the site. This implies confidence in the ability and longevity of the organisation, and a clear point of contact for correspondence

- Some developers will view their constructions as tradeable assets, and hence maximising the liquidity and tradability of these assets is important. This implies not having complex contractual obligations or arrangements in place regarding DH infrastructure. The concept of district heating as a utility (like other existing utilities) was preferred.

8.3 Preferred Structure

8.3.1 The vehicle (SPV) delivering this project must:

- Be developed in a structure that suits the roles of the wide range and number of stakeholders involved

- Engender confidence amongst the private sector community

- Have a visible project champion and single point of contact

- Liaise with the US Embassy to derive confirmation of the commercial terms under which heat would be provided to the NEWEDEN

- For many developers cost parity or savings opportunities will be secondary to quality of service and resilience of supply. Hence it must be emphasised that the formation of a credible vehicle for delivery is of crucial importance. .

[4] Westminster Property Association and WCC, May 2013

9 FINANCIAL MODELLING

9.1 Inputs / assumptions

9.1.1 A key progression from the Energy Masterplan study to this Feasibility Study is the level of resolution that has been developed for the 'non-networked option' (also called 'counterfactual' case).

9.1.2 In order to assess the viability of the scheme and to demonstrate the benefits seen by the developers, a comparison between the networked versus the non-networked option costs in terms of capital, operational and whole life costs has been carried out.

9.2 Non-networked option technology assumptions (site by site)

9.2.1 For the key, larger sites within the OAPF, PB's dialogue with stakeholders and planning documentation has provided a view of the base-case technologies proposed. A summary of these technology assumptions is included below.

Table 9-1 Non networked option technologies – main sites

Site (OAPF ID)	Site name	Non-networked option primary low-carbon plant
35	Riverlight	428 kWth CHP, 60m^3 thermal store
52	Sainsbury	363 kWth CHP, 50m^3 thermal store
17	Embassy Gardens Phase 1	731 kWth CHP, 75m^3 thermal store,
17	Embassy Gardens Phase 2	1193 kWth CHP, 125m^3 thermal store,
4	BPS	3155 kWth CHP, 200m^3 thermal store
33	RMG	695 kWth CHP, 75m^3 thermal store
25	NCGM Northern Site	363 kWth CHP, 35m^3 thermal store
19	Market Towers	739 kWth CHP, 90m^3 thermal store
37	Vauxhall Square	731 kWth CHP, 85m^3 thermal store
58	Vauxhall Island	428 kWth CHP, 50m^3 thermal store
41	Billboard Site	363 kWth CHP, 40m^3 thermal store

9.2.2 Specific commentary is provided on RMG and BPS below.

9.3 BPS

9.3.1 Under the non-networked option for the BPS development, it has been assumed that heat will be provided from a central energy centre which would be managed by an ESCo.

9.3.2 This strategy proposed for BPS should not have a cost impact on the developers when compared to the NEWEDEN case as an ESCo or SPV will still be expected to manage the network, where larger primary plant within the energy centre would be anticipated.

9.3.3 The works associated with the transfer of heat from the temporary to the main energy centre under both options are expected to be managed and financed by the ESCo or SPV.

9.4 RMG

9.4.1 From the liaison with the RMG developers, it is currently uncertain as to how the site will be developed (i.e. by a single entity, or by multiple developers each dealing with an individual plot). For the non-NEWEDEN solution, for the purposes of this study, it has been assumed that this site will adopt a site-wide DH solution supplied from a single energy centre located in the first plot developed (A).

9.4.2 Under the NEWEDEN (networked) option for the RMG development, a number of phases (RMG A, B & D) will be connected onto the network during the first phase (2017-2021) when the base-load network will be operational. Hence, these early phase developments will need to have their own top-up and standby boiler plant. The remaining phases of the development will not require their own boiler plant as the peak demand network will be operational by the time heat will be required (post 2022).

9.5 Other sites

9.5.1 For other, smaller sites, the following set of assumptions has been adopted:

- Gas CHP supplemented by gas boilers is the default technology choice
- Efficiencies of CHP plant were based on notional sizes developed by rule of thumb (60% of heat demand met over 5,500 hours of operation).
- CHP characteristics over the relevant size range derived from figures contained within the publication "BHKW – Kenndaten[5]" ("CHP performance data")

9.5.2 A summary of these technology assumptions is detailed below.

Table 9-2 Non networked option technologies – other sites

Site (OAPF ID)	Site name	Non-networked option primary low-carbon plant
6	Booker Cash and Carry	43 kWth CHP
7	Brooks Court	18 kWth CHP
8	Cable and Wireless	35 kWth CHP
9	Christies Auctioneers Depot	109 kWth CHP
14	Gov. Car and Despatch Agency	85 kWth CHP
18	Marco Polo House	120 kWth CHP
21	Met. Police Warehouse Garage	56 kWth CHP
23	Dairy Crest Milk Distribution Depot	43 kWth CHP
28	Patcham Terrace	204 kWth CHP
29	Securicor Site	47 kWth CHP
44	Sky Gardens	90 kWth CHP
49	Miles Street (South)	32 kWth CHP

[5] http://asue.de/cms/upload/broschueren/2011/bhkw-kenndaten/asue-bhkw-kenndaten-0311.pdf, accessed May 2013

51	Parry Street East (Bondway South)	84 kWth CHP
53	1-9 Bondway & 4-6 Sth Lambeth Place	49 kWth CHP
65	10 Pascal Street	235 kWth CHP
3	Battersea Gasholders	324 kWth CHP

9.6 Cost comparison

9.6.1 There are a number of differences between developments involved in this analysis, both in terms of their planning status and their scale. Hence the study has created a structure that allows the anticipated cost savings to be estimated for the different types of developers/customers depending on their specific development.

9.6.2 The different types of customers have been detailed below.

Table 9-3 Cost implications of NEWEDEN connection for different customer types

Date of development emergence	Non-networked plant requirements	NEWEDEN (networked) plant requirements	Developments
Existing	Will have existing boiler and CHP plant.	Will require plate heat exchangers	Riverlight Sainsbury Embassy Gardens Phase 1 1-9 Bondway & 4-6 Sth Lambeth Place Sky Gardens Kingsway Square Viridian Apartments Doddington Estate
2014 – 2022	Will require boiler and CHP plant	Will require boiler and plate heat exchangers	Embassy Gardens Phase 2 NCGM Entrance Site NCGM Apex Market Site NCGM Northern Site Market Towers Vauxhall Square Vauxhall Island Billboard Site Marco Polo House Dairy Crest Milk Distribution Depot Patcham Terrace 10 Pascal Street Battersea Gasholders
2016 – 2023	Each phase will have their own plate heat exchangers	Each phase will have their own plate heat exchangers	BPS
2017 – 2029	Each phase will have their own plate heat exchangers	Phases emerging pre 2022 (i.e. RMG A, B & D) will require boilers and plate heat exchangers. Phases emerging post 2022 will only require	RMG

		plate heat exchangers.	
Post 2022	Will require boiler and CHP	Will require plate heat exchangers	Booker Cash and Carry Brooks Court Cable and Wireless Christies Auctioneers Depot Gov. Car and Dispatch Agency Met. Police Warehouse Garage Securicor Site Miles Street (South)

9.6.3 An exercise of comparing the networked and non networked options with respect to the capital (CAPEX) and replacement (REPEX) costs, from the point of view of the developer/customer, was done to highlight which aspects (e.g. plant, etc.) were anticipated to offer cost savings. The headlines of this comparison are outlined in Table 9-3 above, and in more detail in the appendices.

9.6.4 In addition to the costs identified in this report, it should be noted that there are other less-easily-definable savings that could be accrued by developers from connection to the NEWEDEN. These additional savings would be linked to the space savings in terms of plantroom space and structural costs (both for plant and thermal storage where applicable), avoided permitting and other professional fees through not having to install flues and other combustion plant, and reduced design complexity (architectural and mechanical interfaces).

9.7 Common assumptions to NEWEDEN and non networked option

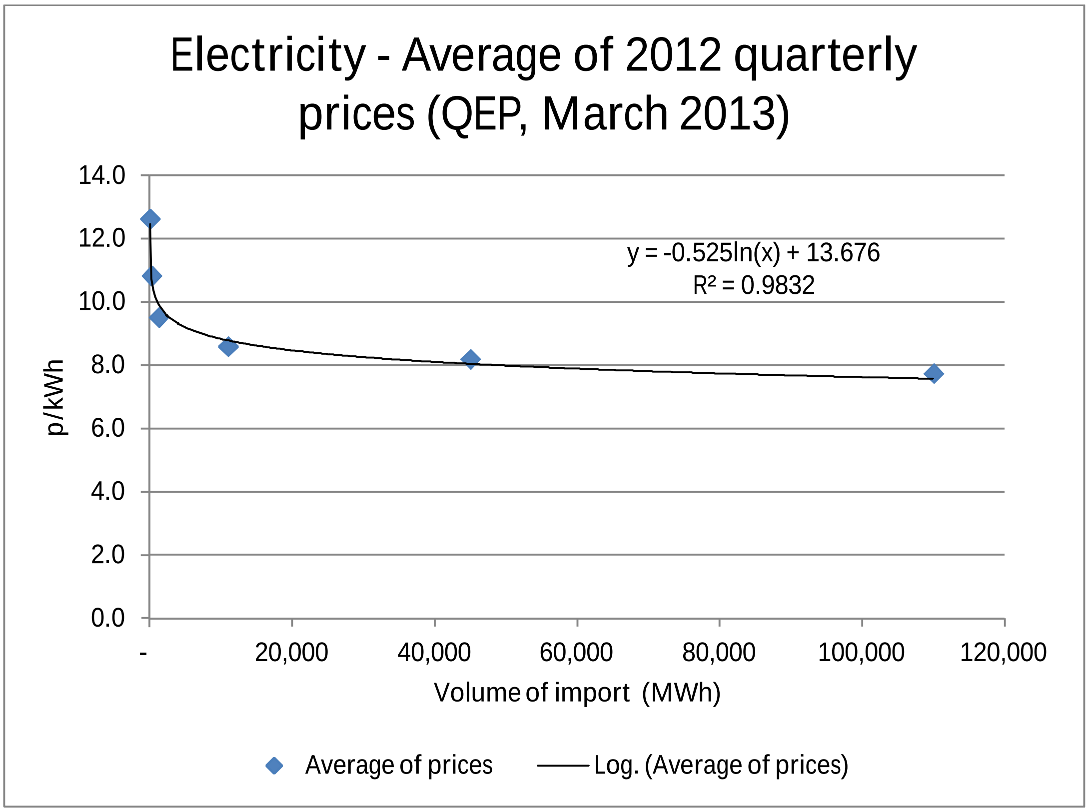
9.7.1 The analysis carried out attempts to create a 'level playing field' between the two cases analysed. A number of key assumptions common to both bases include:

9.7.2 Utility prices

9.7.3 The central utility prices assumptions of this analysis are based around the DECC 'central projections'. However, organisations operating the different scale energy centres will have significantly different levels of 'procurement power' and there are also assumed to be differences in utility cost relating to volume of energy procured. For example, it is anticipated that the cost of gas at the rationalised energy centre at Battersea Power Station would be lower than for the individual operation of, say, the Patcham Terrace site. The following graphs illustrate the utility price variation developed around the different scales of purchase /sale. These have been based around published volumes and prices from Quarterly Energy Prices[6] (March 2013)

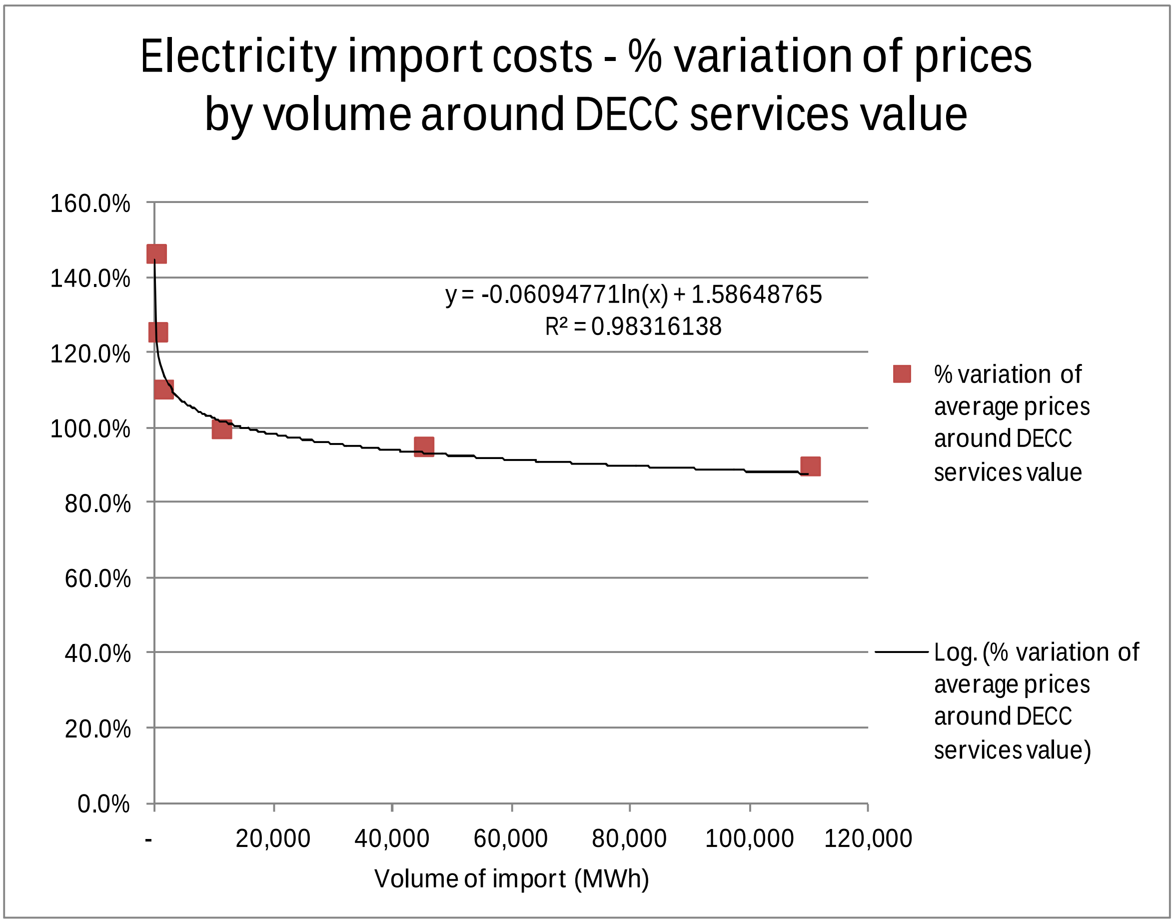
[6] https://www.gov.uk/government/publications/quarterly-energy-prices-march-2013, accessed 19 May 2013

Figure 9.1 Electricity import values by size of consumption



9.7.4 This variation by size has been converted to a percentage variation around the average value as illustrated below:

Figure 9.2 Percentage variation in price by volume (electricity import)



9.7.5 The same approach has been used to develop trendlines for price variation by volume for gas and power export. There are no published figures for power export values by volume, and hence the proxy of using an inverse of the import variation by size has been adopted.

Figure 9.3 Percentage variation in price by volume (gas)

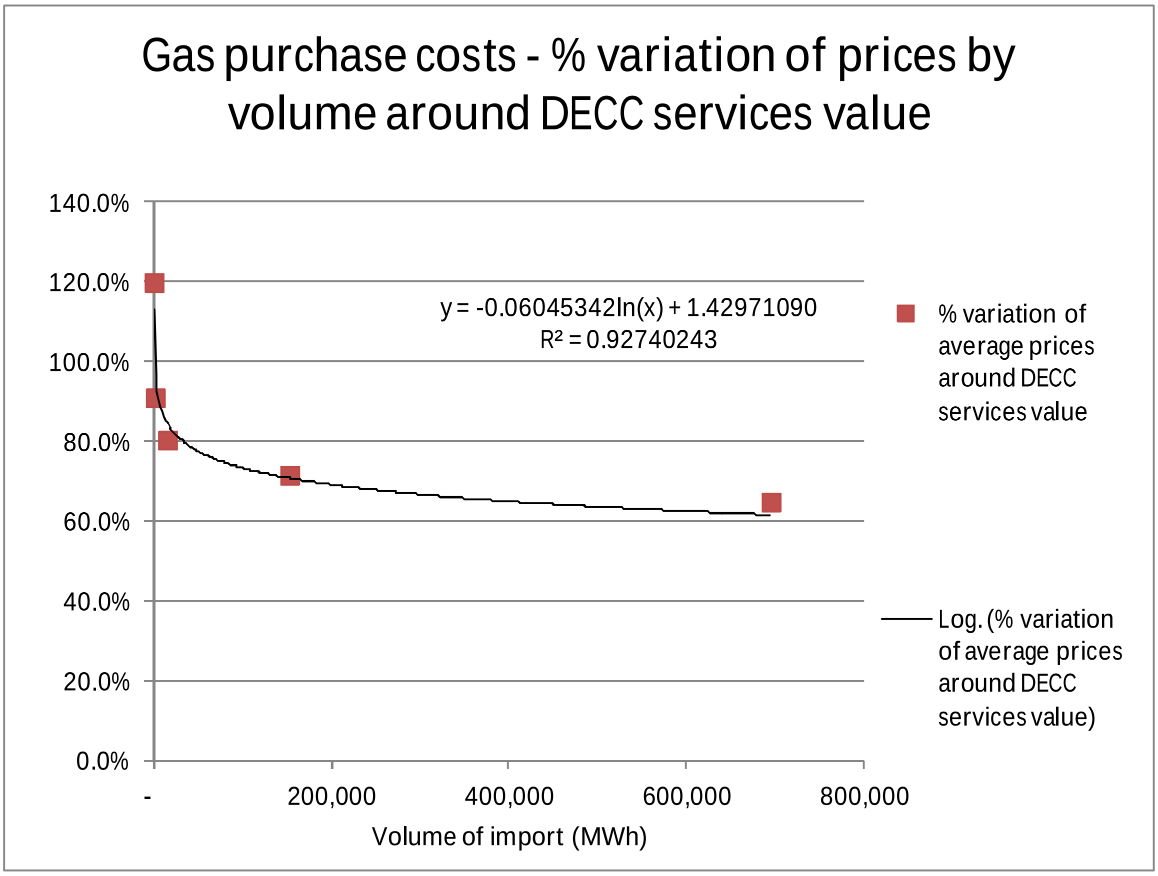
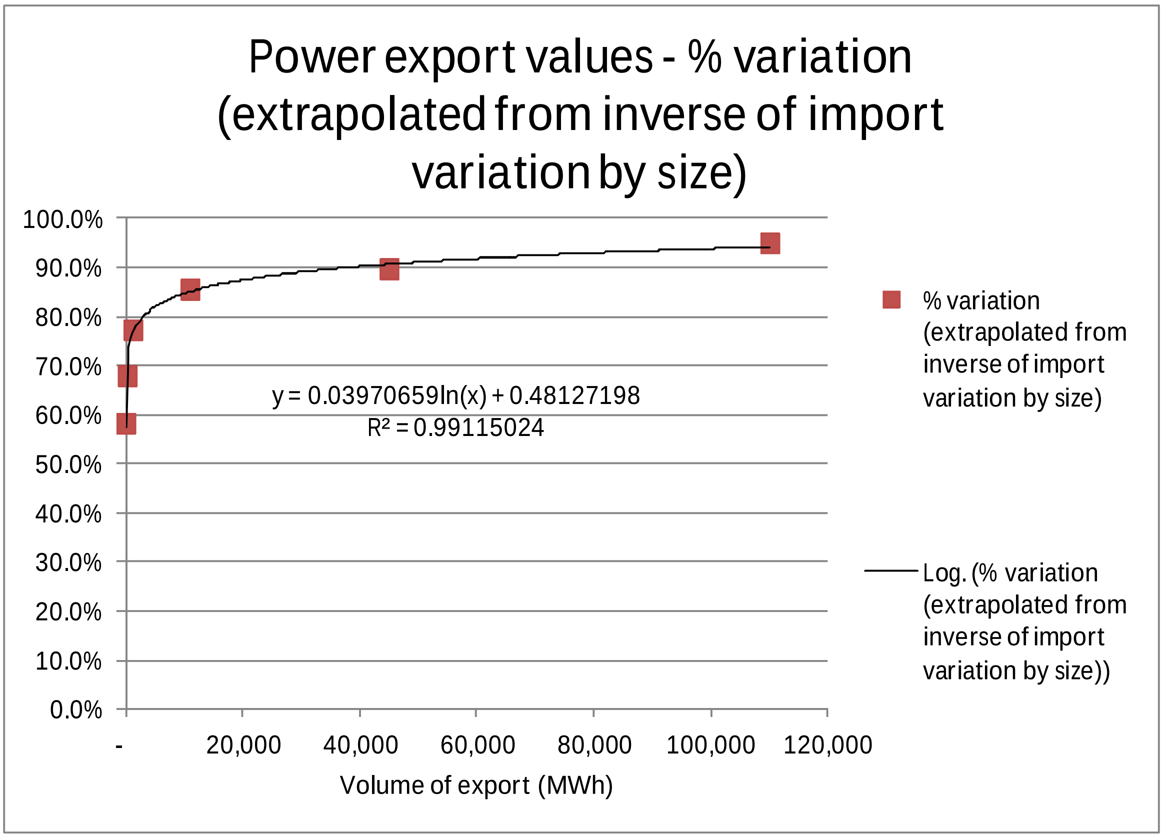


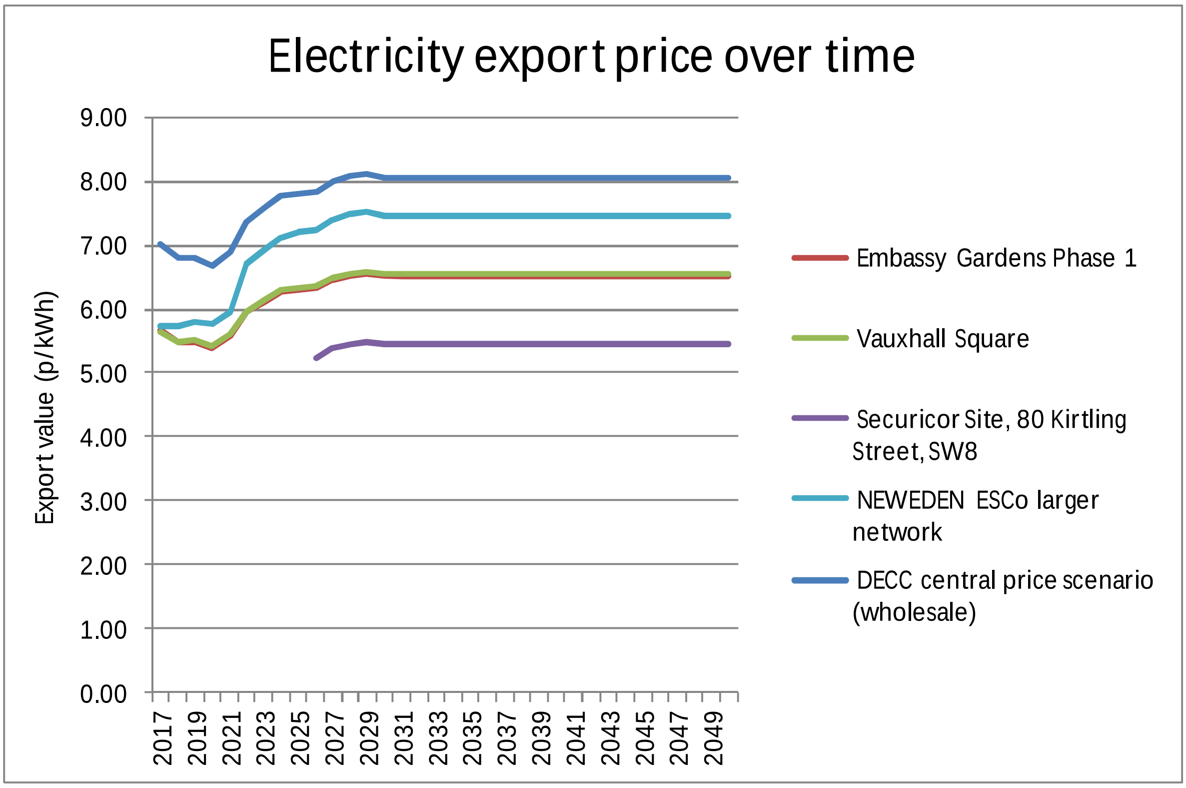
Figure 9.4 Percentage variation in price by volume (power export)



9.7.6 These percentage variations by volume have then been applied to the DECC price projections in order to give a unitised value for utilities for each scenario examined in this report. The prices developed via this methodology (i.e. use of DECC price projections values with percentage adjustment applied to take account of volume), have been applied to both the BAU and NEWEDEN scenarios, and both to individual sites and to the central procurement of utilities under the ‘rationalised’ energy centre.

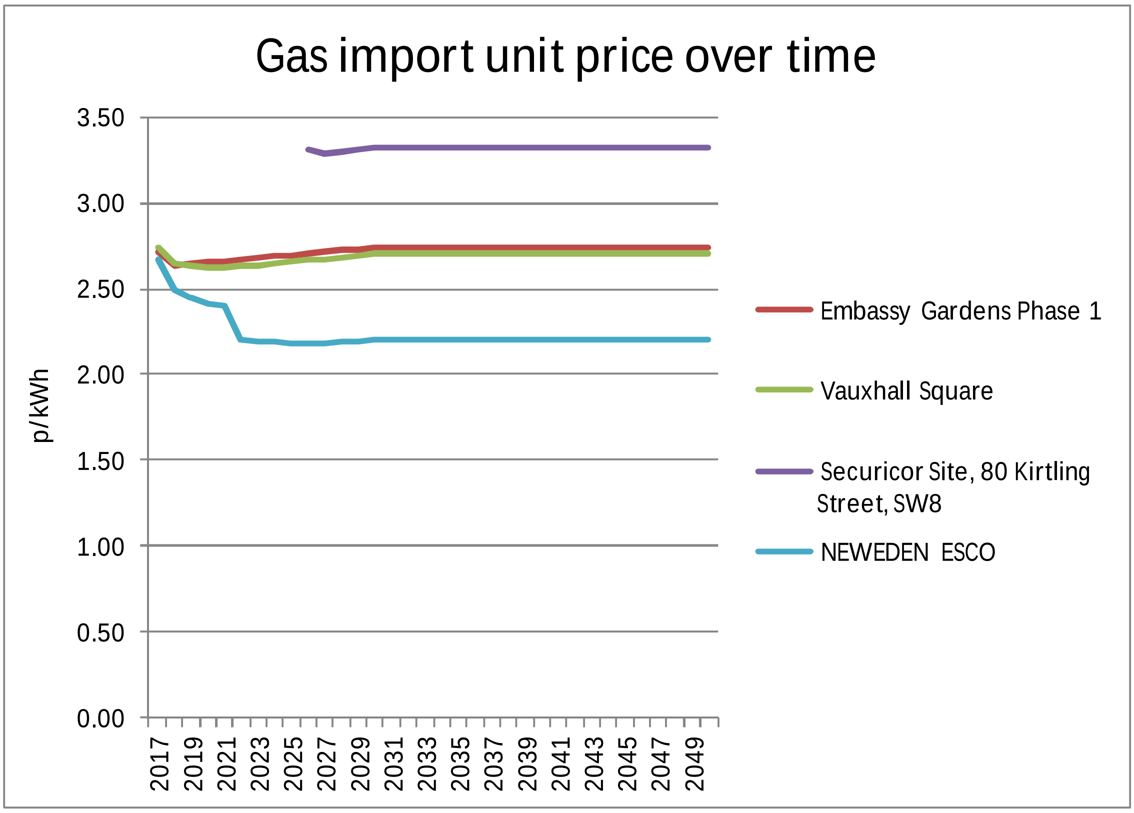
9.7.7 An example of how these price projections play out in the analysis conducted in this study is shown below:

Figure 9.5 Electricity export price comparisons



9.7.8 Figure 9.5 illustrates that for the selected sites / NEWEDEN operator that there is a range of electricity prices modelled, and that the highest scheme value is attributed to the NEWEDEN ESCo operator. A similar graph is shown below for gas import prices.

Figure 9.6 Gas import price comparison



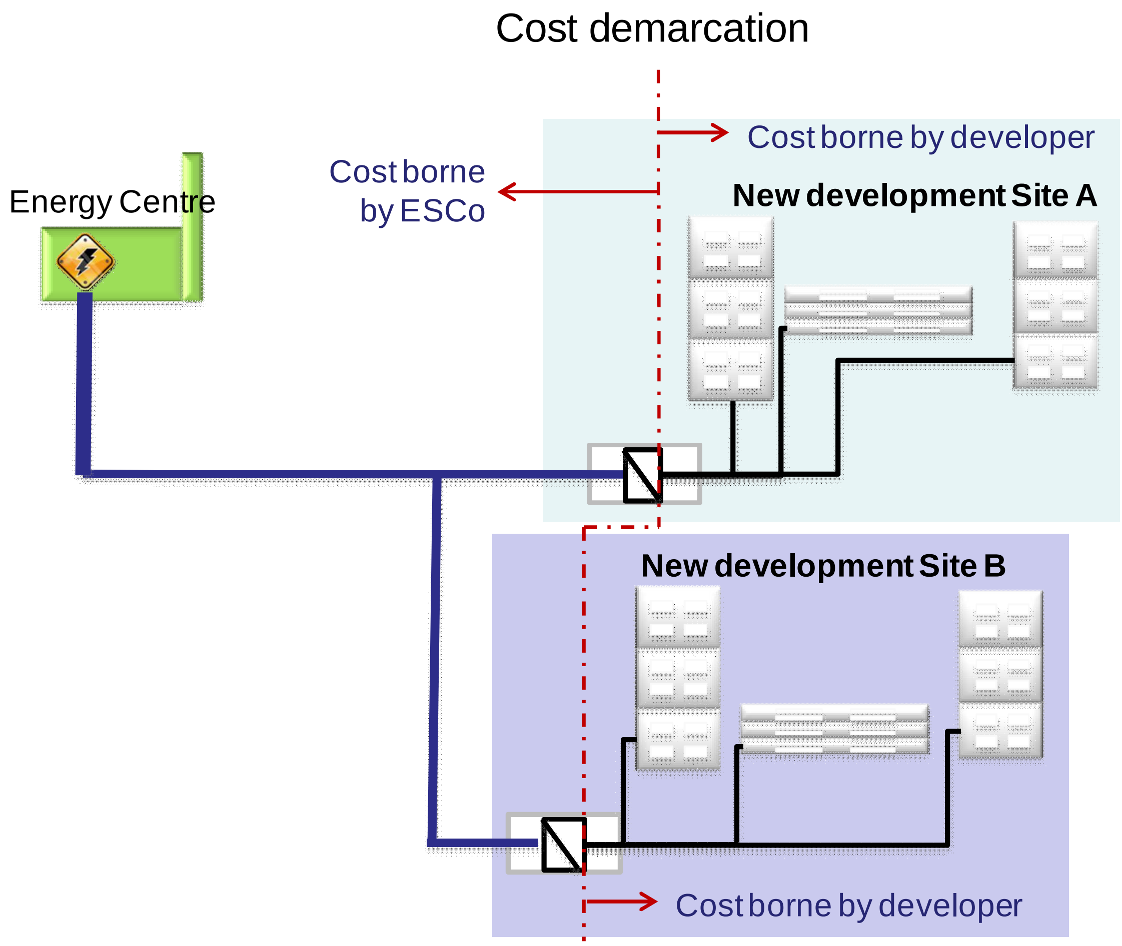
9.8 Heat sales, availability charges and benefit of connection

9.8.1 **Non-network option and NEWEDEN heat sales –** it was agreed at the second project steering group meeting[7] that the approach that should be adopted in modelling is to offer a lifecycle cost saving for all connected customers. This **saving** has been fixed in the analysis of this study at **10%**, as per the project steering group's recommendation. This saving has been calculated on a whole life cost basis as the sum of both capital, operational and replacement costs over a 'commercial' lifecycle of **20 years**, at **12% discount rate**. Given that the replacement and capital elements of the BAU and NEWEDEN scenarios are fixed estimates, the key factor that determines this level of saving is the heat purchase price (and availability charge) for sites to purchase heat from the NEWEDEN network.

9.8.2 The demarcation point for this calculation was also agreed to be at a 'bulk supply' heat exchanger at each site – i.e. as illustrated below:

[7] 30th April 2013, CGM

Figure 9.7 Demarcation assumption for setting heat sales tariffs



9.8.3 This demarcation means notionally that individual developers would continue to maintain their own on-site networks, bill their own customers / residents, and replace secondary systems as required. The NEWEDEN operator is assumed to operate all elements of the primary (NEWEDEN) system, up to and including the heat exchanger substation at each site. However, in capital cost terms, for those sites which avoid the need to install CHP, it is assumed that they would bear the capital cost of the installation of the CIU at the time of connection to the DEN.

9.8.4 If the demarcation boundary were to be drawn at the individual residents' HIUs, further cost efficiencies could be realised. The operation, metering reading, billing and maintenance of all of the HIUs in the connected dwellings in the Opportunity Areas, for example, is likely to cheaper on a per-unit basis than the same task being carried out on an individual building / site basis, The same principle would also apply to the procurement of plant items such as the HIUs themselves. Similarly, standardisation of items such as the HIUs and meters would also allow for greater ease of monitoring and control of the system.

9.9 Results – central utility price assumptions

9.9.1 The appendices to this report contain individual developer site summaries of the different scenarios under the NEWEDEN case and the non-network case. These show that for all of these sites (with the exception of BPS[8]), there is a cost reduction offered over the non-networked case.

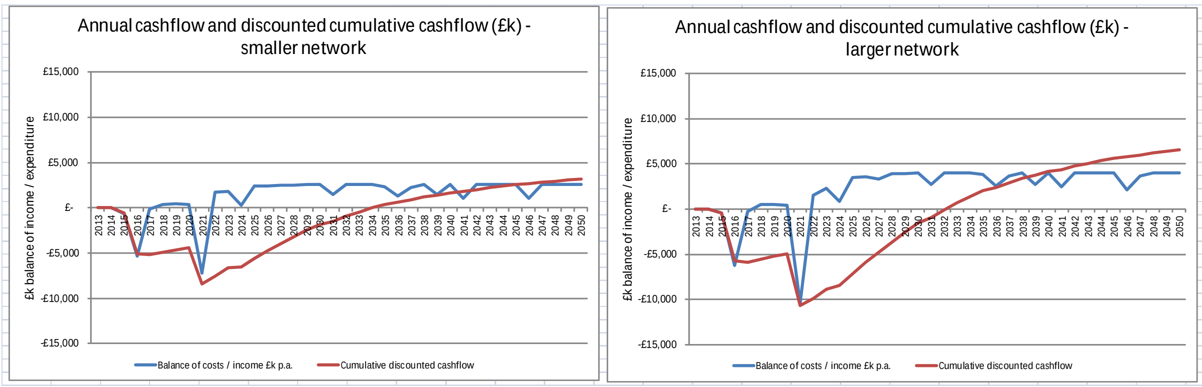
9.9.2 Under this set of savings offered to individual developer plots, the following results are obtained for the central scheme operator:

Table 9-4 Modelling results (DECC central price scenario)

	Larger Network	Smaller Network
IRR	12.1%	10.6%
NPV (12%, 25 years from 2015)	£89k	-£924k
NPV (6%, 25 years from 2015)	£10,089k	£5,493k

9.9.3 The cumulative cashflow graphs for each of these systems (illustrated at 9% discount rate and over the period to 2050) are shown below:

Figure 9.8 Comparison of cumulative discounted cashflows



9.9.4 Detailed results summaries and cashflows are contained within the appendices to this report.

9.9.5 These results show the arguably counter-intuitive trend of the larger, more diffuse network offering a higher internal rate of return (IRR) than the more heat dense network. This reason for this result is primarily that customers that the majority of developments sites that are excluded from the smaller network are sites that are anticipated to emerge (and connect to the network under the larger network option) after the implementation of the NEWEDEN. Hence these customers avoid the need for their own boiler and CHP plant, and realise significant capital cost savings.

9.9.6 In order to realise a 10% *whole life cost* savings over the non-networked case, given their significant capital cost savings, these development sites customers can therefore accept a higher availability charge (an annual fixed payment for the availability of heat from the DH network), and this contributes a significant level of additional income to

[8] BPS non-network case is also assumed to be an ESCo-led scheme, and hence no cost difference is appropriate.

the larger scheme (which has more development sites connecting to the network post 2022).

9.9.7 This analysis illustrates the importance of realising avoided capital costs under a whole-life cost analysis methodology and illustrates the potential benefit that the availability of a peak-load energy centre for the early phases of development might bring (i.e. Covent Garden Market).

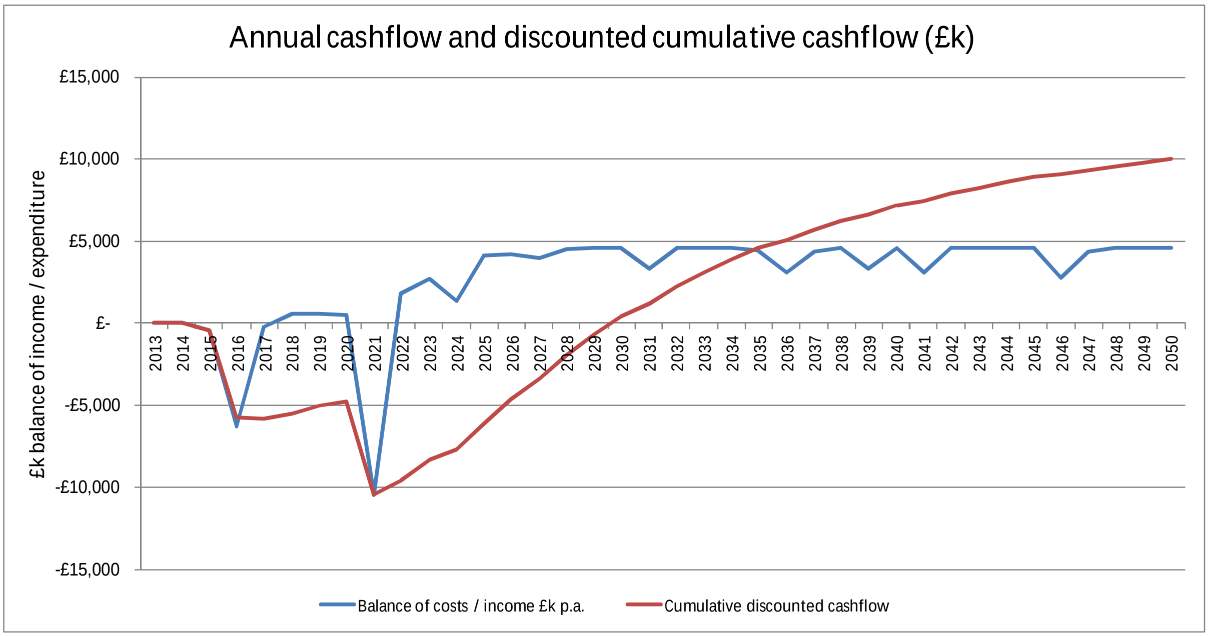
9.9.8 It should be noted however that the larger scheme is inherently more risky and would therefore need to achieve a higher return to compensate for this.

9.10 Results – sensitivity analysis DECC 'high' and 'low' price scenarios

9.10.1 DECC 'high' price scenario

9.10.2 The following graph illustrates the cashflow for the larger scheme under the DECC 'high' price scenario. It can be seen that this scheme delivers a positive whole life cost over the project life under these assumptions. The IRR of this scheme is 14.3% (25 years, from 2015)

Figure 9.9 Cashflow of larger network under DECC high price scenario

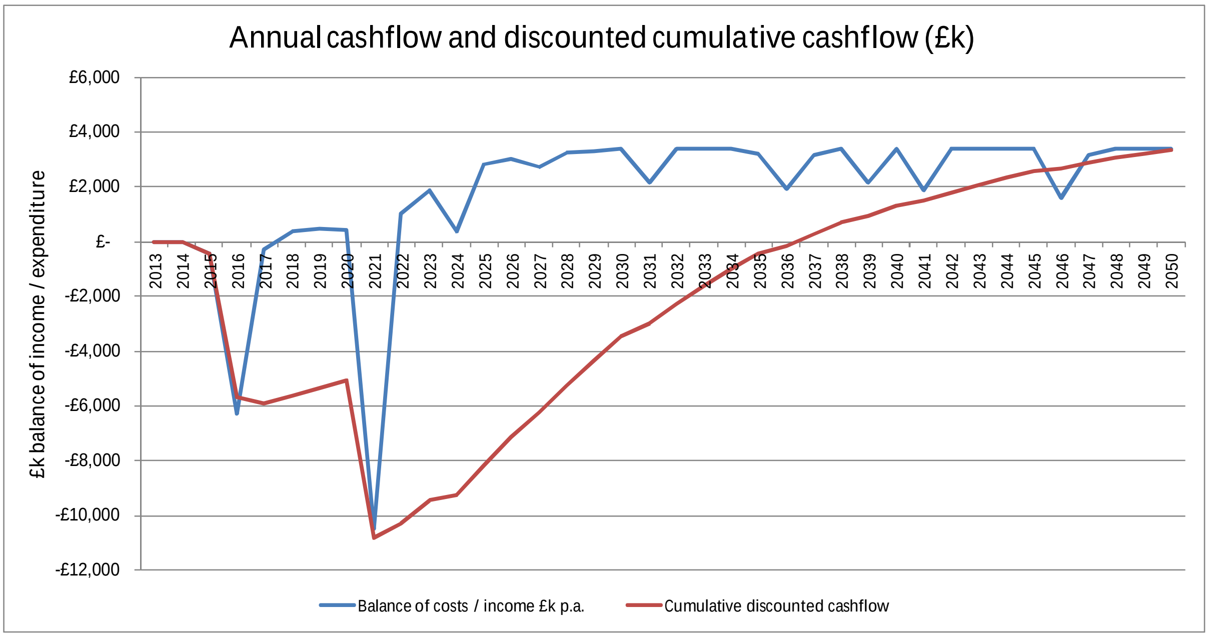


9.10.3 One of the key differences under this high price scenario is the value received for exported electricity. Under this price scenario, wholesale electricity prices rise to 10p/kWh by 2024.

9.10.4 DECC 'low' price scenario

9.10.5 The following graph illustrates the cashflow for the larger scheme under the DECC 'low' price scenario. It can be seen that this scheme still delivers a positive whole life cost over the project life. The IRR of this scheme is 9.8% (25 years, from 2015)

Figure 9.10 DECC low price scenario central operator cashflow

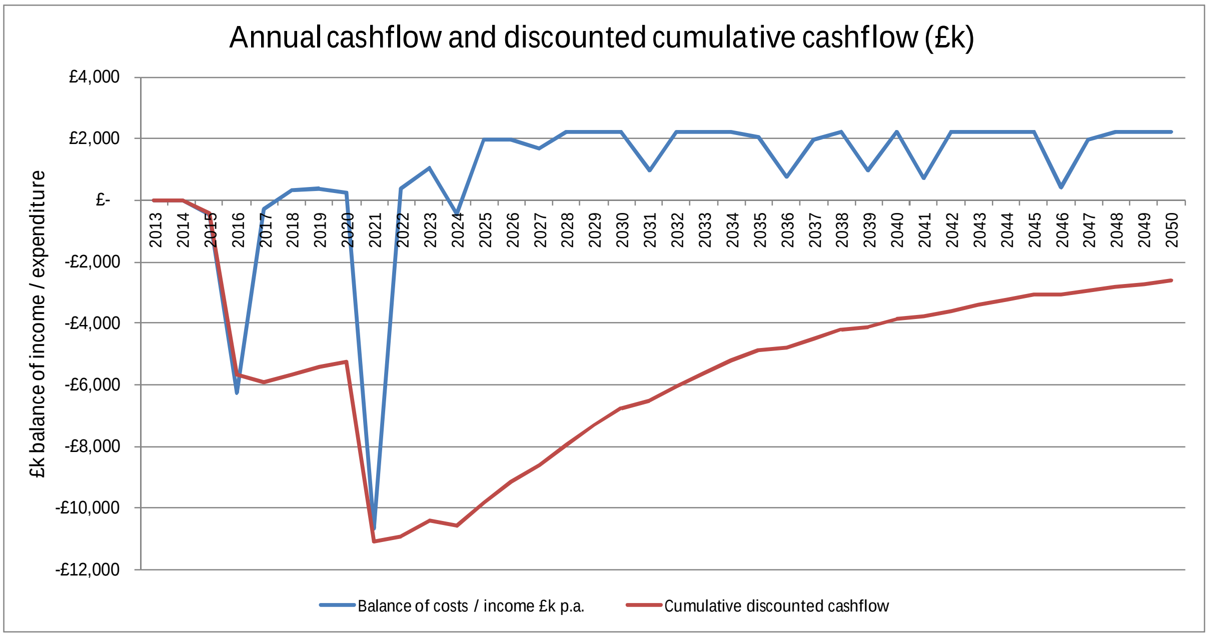


9.10.6 Both of the DECC scenarios shown above also include variation in utility prices by procurement volume.

9.11 Results – DECC 'central' utility scenario, no differentiation by scale of customer

9.11.1 This analysis illustrates the impact of not varying the cost of gas, electricity or heat by size of connected load – i.e. under this analysis there would be parity in gas, electricity and heat costs between all customers on the network and the central scheme operator. This is not considered a realistic scenario, but is included here to show the impact of this assumption on results.

Figure 9.11 DECC central utility prices, no variation in costs by volume



9.11.2 Under these conditions the scheme has an IRR of 4.7%.

10 PROJECT PLAN AND RISKS

10.1 Key actions

10.1.1 Some key actions moving forward include:

- Identifying an appropriate structure and delivery vehicle for this project, and setting it up. This is important so that the private sector stakeholders have visibility of movement and such that confidence can be engendered that the NEWEDEN is emerging. The earlier this is achieved, the greater the likelihood that cost savings from early phase-developments can be realised
- Identify a project champion within the delivery vehicle structure to garner support and disseminate information on the scheme
- Sharing cost and benefit assumptions with developers with a view to increasing cost transparency and robustness of input figures
- Ensuring close liaison with work around Vauxhall Cross to allow for co-installation of DH pipework
- Test different structure of charging for the scheme – i.e. particularly when greater certainty on delivery structure has been developed, it would be interesting to test the impact of a partial 'connection charge' on overall cashflow whilst mitigating reputational risk for the scheme.

10.2 Risks

10.2.1 Some key risks that have emerged as part of this project include:

- Residual uncertainty that the US Embassy will be in a position to provide heat (and at what cost) to the NEWEDEN
- The possibility that BPS will decide to embark upon a site-only ESCo solution, which leaves the NEWEDEN scheme without a key rationalised energy centre site. The mitigation for this option would be to secure a suitable energy centre within the NCGM site.
- The financial structure that has been adopted here is to avoid connection charges to developers, providing a clear incentive for them to connect to the network. This does, however, effectively pass on the cost of the NEWEDEN to the customers who will be purchasing heat from the network. This structure therefore implies an increased level of reputational risk during the operational phase of the scheme – i.e. that customers feel that they are not receiving value for money and that other buildings will therefore not want to connect

10.3 Opportunities

10.3.1 There is great interest within Westminster City Council (WCC) in distributed energy projects, and the link across the Thames from Battersea to PDHU could help facilitate closer working on energy matters between the NEV scheme and WCC.

10.3.2 The GLA is also undertaking additional analysis on the potential to instigate a link between the Whitehall District Heating System and PDHU, which in turn could lead to the availability of Whitehall-generated heat to NEV.

10.3.3 The availability of an energy centre for the First Phase of a network would potentially allow greater savings to be generated by a centralised supply system.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

- From the analysis carried out in this project, the scheme appears viable from developers' perspectives, and also from a central NEWEDEN operator's perspective

- The schemes could be more viable with a peak-load energy centre in first phase of the scheme growth and realisation of cost savings from connected sites

- There is unlikely to be certainty in terms of the availability of an NCGM energy centre in the next months. However, the NEWEDEN scheme must progress in terms of capturing other early development sites.

11.2 Recommendations

11.2.1 The following recommendations are made:

- Ensure that developers are aware and implement the technical requirements for their secondary system design. This is key to successful and economic operation of the scheme. This will also influence the ability of the scheme to accept 'waste heat' sources at later dates

- Progress the scheme on the basis of the solution illustrated within this report, but attempt to secure through planning a peak-load energy centre on the NCGM site, to improve the viability of the NEWEDEN scheme and provide an alternative site for a rationalised supply in later years

- Install a pipework linkage across the Vauxhall Cross intersection at the time of other works. This will enable the scheme to provide or accept heat supply from the Albert Embankment area