CONTENTS

1 Executive Summary 14
  1.1 Aims and Opportunity 14
  1.2 Benefits 14
  1.3 Development 15
  1.4 Results 15
  1.5 Recommended Key Actions 17

2 Introduction 19
  2.2 Framework Conditions 19
  2.3 Methodology 20

3 Heat sources 21
  3.2 Edmonton Incinerator and the North London Waste Authority 21
  3.3 KEDCO – Biomass Gasifier 28
  3.4 Enfield Power Station 30
  3.5 Small-Scale Energy Generation Technologies 34
  3.6 Technology progression over project timescales 35
  3.7 Comparison of key heat sources 37

4 Heat demands 41
  4.1 London Heat Map Database 41
  4.2 Dealing with gaps in the data 44

5 Heat networks 45
  5.1 Key technical decisions 45
  5.2 Potential heat network changes over time 48
  5.3 Network Constraints 49
  5.4 The River Lea Navigation Towpath 49

6 Electricity Networks and the Sale of Electricity 51
  6.1 Electricity networks 51
  6.2 Specific electrical supply arrangements 52
  6.3 Sale of generated electricity 53
  6.4 Electricity Network Conclusions 55

7 Planning: Mechanisms to Facilitate and Implement A DEN 57
  7.2 Planning policy framework 57
  7.3 Local Policy Analysis 59
  7.4 The Next 40 Years 62
  7.5 Key mechanisms for DEN implementation 63
  7.6 Planning Mechanism Conclusions 64

8 Stakeholder Aspirations 67
  8.2 Aspirations Workshop 67
  8.3 Questions and Outputs 67
  8.4 Option assessment matrix 70
<table>
<thead>
<tr>
<th>9</th>
<th>Strategic Development Model</th>
<th>71</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1</td>
<td>Aims and rationale</td>
<td>71</td>
</tr>
<tr>
<td>9.2</td>
<td>Network Extent</td>
<td>71</td>
</tr>
<tr>
<td>9.3</td>
<td>NPV analysis for network extent</td>
<td>74</td>
</tr>
<tr>
<td>9.4</td>
<td>Network Phasing</td>
<td>78</td>
</tr>
<tr>
<td>9.5</td>
<td>Phasing and viability</td>
<td>82</td>
</tr>
<tr>
<td>9.6</td>
<td>Key Assumptions</td>
<td>84</td>
</tr>
<tr>
<td>9.7</td>
<td>Individual cluster growth</td>
<td>85</td>
</tr>
</tbody>
</table>

| 10   | Carbon Savings                | 95 |
| 10.1 | Baseline and additionality    | 95 |
| 10.2 | Carbon intensity of heat sources | 95 |

| 11   | Inward Investment and the ULV DEN - SQW | 98 |
| 11.1 | Scope of Work                  | 98 |
| 11.2 | Local Economic and Business Context | 98 |
| 11.3 | Potential Options for a DEN    | 99 |
| 11.4 | Business Clustering Driven by Low Cost or Green Energy | 100 |
| 11.5 | UK and European Experience     | 100 |
| 11.6 | Elsewhere in the World         | 102 |
| 11.7 | Business and Investment Potential from the DEN | 103 |
| 11.8 | Potential list of opportunity sectors (LTHW network) | 104 |
| 11.9 | Prospective opportunity sectors (HTHW or steam network) | 104 |
| 11.10| Economic Prospects and Uplift  | 106 |
| 11.11| Inward investment conclusions and implications | 108 |

| 12   | Vision Map                    | 110 |
| 12.2 | Option assessment against stakeholder priorities | 110 |
| 12.3 | Scheme Growth                 | 112 |
| 12.4 | Network diameters             | 117 |
| 12.5 | Interface between individual clusters and DEN | 119 |
| 12.6 | Capital Spend Profile         | 121 |

<p>| 13   | Delivery Vehicles             | 123 |
| 13.1 | Potential commercial arrangements | 123 |
| 13.2 | Background to commercial arrangements for district heating in the UK | 123 |
| 13.3 | Potential Approaches for development of DH | 123 |
| 13.4 | Appraisal of potential options | 127 |
| 13.5 | Cost of Funding               | 127 |
| 13.6 | Funding Gaps                  | 127 |
| 13.7 | Risk versus Control          | 128 |
| 13.8 | Regulations and Licensing     | 128 |
| 13.9 | Availability of Resources and Skills | 128 |
| 13.10| Operation of Schemes         | 129 |
| 13.11| Analysis of ULV schemes       | 129 |
| 13.12| Next Steps                    | 131 |</p>
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Risks and Uncertainties</td>
<td>132</td>
</tr>
<tr>
<td>14.1</td>
<td>Regulatory / Political</td>
<td>132</td>
</tr>
<tr>
<td>14.2</td>
<td>Technical / viability</td>
<td>132</td>
</tr>
<tr>
<td>15</td>
<td>Conclusions and Recommendations</td>
<td>134</td>
</tr>
<tr>
<td>15.1</td>
<td>Conclusions</td>
<td>134</td>
</tr>
<tr>
<td>15.2</td>
<td>Recommended Actions</td>
<td>137</td>
</tr>
<tr>
<td>15.3</td>
<td>Recommended Actions by Borough</td>
<td>139</td>
</tr>
<tr>
<td>15.4</td>
<td>Waltham Forest</td>
<td>140</td>
</tr>
<tr>
<td>16</td>
<td>Appendix A – Cluster Analysis Assumptions</td>
<td>142</td>
</tr>
<tr>
<td>16.2</td>
<td>ESCO Operational Costs</td>
<td>144</td>
</tr>
<tr>
<td>17</td>
<td>Appendix B – Cluster Analysis Results</td>
<td>146</td>
</tr>
<tr>
<td>17.1</td>
<td>Introduction</td>
<td>146</td>
</tr>
<tr>
<td>17.2</td>
<td>LBWF Cluster A: Town Hall Scheme</td>
<td>146</td>
</tr>
<tr>
<td>17.3</td>
<td>LBWF Cluster B: Blackhorse Lane North</td>
<td>147</td>
</tr>
<tr>
<td>17.4</td>
<td>LBWF Cluster C: Blackhorse Lane South</td>
<td>148</td>
</tr>
<tr>
<td>17.5</td>
<td>LBWF Cluster D: Wood Street North</td>
<td>149</td>
</tr>
<tr>
<td>17.6</td>
<td>LBWF Cluster D: Wood Street South</td>
<td>150</td>
</tr>
<tr>
<td>17.7</td>
<td>LBWF Cluster E: Northern Olympic Fringe / Leyton Orient</td>
<td>151</td>
</tr>
<tr>
<td>17.8</td>
<td>LB Waltham Forest – Walthamstow Town Centre</td>
<td>152</td>
</tr>
<tr>
<td>17.9</td>
<td>LB Enfield – Innova Park</td>
<td>153</td>
</tr>
<tr>
<td>17.10</td>
<td>LB Enfield – Southbury</td>
<td>154</td>
</tr>
<tr>
<td>17.11</td>
<td>LB Enfield – Ponders End / Southern Brimsdown</td>
<td>155</td>
</tr>
<tr>
<td>17.12</td>
<td>LB Enfield – Enfield Town</td>
<td>156</td>
</tr>
<tr>
<td>17.13</td>
<td>LB Enfield – Edmonton</td>
<td>157</td>
</tr>
<tr>
<td>17.14</td>
<td>LB Enfield – Palmers Green</td>
<td>158</td>
</tr>
<tr>
<td>17.15</td>
<td>LB Enfield – New Southgate</td>
<td>159</td>
</tr>
<tr>
<td>17.16</td>
<td>LB Enfield – Cockfosters</td>
<td>160</td>
</tr>
<tr>
<td>17.17</td>
<td>LB Haringey – Wood Green North</td>
<td>161</td>
</tr>
<tr>
<td>17.18</td>
<td>LB Haringey – Tottenham Town Hall</td>
<td>162</td>
</tr>
<tr>
<td>17.19</td>
<td>LB Haringey – Hornsey High Street</td>
<td>163</td>
</tr>
<tr>
<td>17.20</td>
<td>LB Haringey – Wood Green East</td>
<td>164</td>
</tr>
<tr>
<td>17.21</td>
<td>LB Haringey – South Northumberland Park</td>
<td>165</td>
</tr>
<tr>
<td>17.22</td>
<td>LB Haringey – Haringey Heartlands</td>
<td>166</td>
</tr>
<tr>
<td>18</td>
<td>Appendix C – Aspirations Workshop Agenda and attendees</td>
<td>167</td>
</tr>
<tr>
<td>18.1</td>
<td>Attendees</td>
<td>168</td>
</tr>
<tr>
<td>19</td>
<td>Appendix D – Small Scale Generation Technologies</td>
<td>169</td>
</tr>
<tr>
<td>19.1</td>
<td>Spark-ignition Gas Engines</td>
<td>169</td>
</tr>
<tr>
<td>19.2</td>
<td>Compression Ignition</td>
<td>171</td>
</tr>
<tr>
<td>19.3</td>
<td>GT Open cycle</td>
<td>173</td>
</tr>
<tr>
<td>19.4</td>
<td>Solid Biomass boilers</td>
<td>174</td>
</tr>
<tr>
<td>20.1</td>
<td>Introduction</td>
<td>178</td>
</tr>
</tbody>
</table>
20.2 National Level: Planning Policy Statements 178
20.3 Regional Level: London Plan 179
20.4 Local Level – London Boroughs’ Local Planning Frameworks 180
20.5 LB Enfield 181
20.6 LB Haringey 181
20.7 LB Waltham Forest 182

21 APPENDIX F - Copy of British Waterways Costs Undertaking 184

22 Appendix G – Phasing of Loads and Options Results Illustrations (PDF only) 186
22.1 Scenario A1 - Scenario A1 – Edmonton EcoPark as heat source, post 2023, 120ktpa throughput, gasifier technology 186
22.2 Scenario A2 – Edmonton EcoPark as heat source post 2023, 327ktpa throughput, gasifier technology 186
22.3 Scenario A3 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 120ktpa 186
22.4 Scenario A4 - Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 327ktpa 186
22.5 Scenario B1 – Kedco gasifier as heat source circa 2015 onwards 186
22.6 Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023 (Olympic Route) 186
22.7 Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023 (Tottenham Route) 186
22.8 Scenario C1 – Enfield power station circa 2025 – assumed to operate to provide base load power to the grid (e.g. 8000hrs operation) 186

23 Appendix H – Strategic Network Modelling Assumptions 187
23.1 Energy costs 187
23.2 Connection Charges 187
23.3 Availability Charges 187
23.4 Closure of Edmonton Incinerator site 187
23.5 Cost of Network in ULV Industrial Corridor Employment Areas 187

24 Appendix I - NLWA and Solid Recovered Fuel 189
24.1 Solid Recovered Fuel and Refuse Derived Fuel 189
24.2 How is SRF produced? 189
24.3 How is SRF used? 191
24.4 Production and Use of Solid Recovered Fuel in the UK 194

25 Appendix J – Individual Cluster Load Maps (PDF only) 198

26 Appendix K – Technical Connection Information 199
26.1 Primary and secondary network interface 199
26.2 Heat exchanger substations 199
26.3 Heating 200
26.4 Secondary System Designs 200
26.5 Domestic hot water supply 200
26.6 Domestic hydraulic interface units (HIUs) 201
26.7 Plant Layouts 203
Table of Figures
Figure 1-1 DEN development process ................................................................. 15
Figure 1-2 Vision Map Network Scenario B2 'Olympic Park' configuration ............ 16
Figure 1-3 Vision Map Network Scenario B2 'Tottenham' configuration ............... 17
Figure 3-1 Existing waste management and waste transfer sites in the Upper Lee Valley 26
Figure 3-2 Edmonton Incinerator site timeline .................................................. 28
Figure 3-3 Kedco gasifier Site Plan ................................................................. 29
Figure 3-4 Schematic drawing of Enfield Power Station cycle ......................... 31
Figure 3-5 Enfield Power Station site layout drawing ....................................... 33
Figure 3-6 Conceptual vision of technology progression ................................. 36
Figure 3-7 Value of heat distribution to key heat sources ............................... 37
Figure 3-8 Heat source supply capacities ......................................................... 38
Figure 3-9 Options modelled ........................................................................ 40
Figure 5-1 High level network constraints .................................................... 49
Figure 6-1 Selected substation locations in study area ..................................... 53
Figure 6-2 Sensitivity of heat generation costs to electricity price fluctuations .... 54
Figure 7-1 London Plan (2011) Policy 5.2 ......................................................... 59
Figure 7-2 Planning 'Connection Zone' ............................................................. 65
Figure 8-1 Chart of weighted aspirations from workshop ............................... 68
Figure 8-2 Option performance against aspirations rating chart .................... 70
Figure 9-1 Network Viability Testing Groupings ............................................. 72
Figure 9-2 Results of Cluster Permutation Analysis by Network Return Metric .... 73
Figure 9-3 NPV analysis of cluster permutations (3.5% discount rate) ............. 74
Figure 9-4 NPV analysis of cluster permutations (6% discount rate) ............... 75
Figure 9-5 NPV analysis of cluster permutations (9% discount rate) ............... 75
Figure 9-6 NPV analysis of cluster permutations (12% discount rate) ............. 76
Figure 9-7 Proposed Strategic Network Extent .............................................. 77
Figure 9-8 Linkage between ULV DEN and LTGHN .................................... 78
Figure 9-9 Option A1- 120ktpa Edmonton EcoPark gasifier – recommended loads illustrating network extent ................................................................. 79
Figure 9-10 Option A2- 327ktpa Edmonton EcoPark gasifier – recommended loads illustrating network extent ................................................................. 80
Figure 9-11 Option B1- Kedco gasifier – recommended loads illustrating network extent ................................................................. 81
Figure 9-12 Option B2- Kedco gasifier and Edmonton EcoPark 120ktpa gasifier – recommended network extent ................................................................. 81
Figure 9-13 Option C1- Enfield Power Station (10% steam extraction) – recommended network extent ................................................................. 82
Figure 9-14 Comparison of options (NPV basis) ............................................ 83
Figure 9-15 Comparison of options (NPV basis) ............................................ 84
Figure 9-16 Illustration of scope of cluster analysis ....................................... 86
Figure 9-17 Cluster Linear Heat Density ......................................................... 87
Figure 9-18 Linear Heat Density of Clusters (kWh / m network) .................... 88
Figure 9-19 Cluster Designation ................................................................. 92
Figure 9-20 Indicative Cluster Viability ......................................................... 93
Figure 10-1 Comparative Heat Emissions Factors ........................................ 96
Figure 11-1 Kalunborg schematic of symbiosis ............................................. 102
Figure 12-1 DEN development process ............................................................. 110
Figure 12-2 Total Weighted Scores against Aspiration Workshop Criteria ...... 111
Figure 12-3 Scenario B2 (Tottenham Configuration) Scheme Growth 2015 ........ 112
Figure 12-4 Scenario B2 (Tottenham Configuration) Scheme Growth 2020 .... 112
Figure 12-5 Scenario B2 (Tottenham Configuration) Scheme Growth 2025 .... 113
## Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAP</td>
<td>Area Action Plan</td>
</tr>
<tr>
<td>AMR</td>
<td>Annual Monitoring Report</td>
</tr>
<tr>
<td>CCGT</td>
<td>Combined cycle gas turbine</td>
</tr>
<tr>
<td>CCL</td>
<td>Climate Change Levy</td>
</tr>
<tr>
<td>CEM</td>
<td>Contract Energy Management</td>
</tr>
<tr>
<td>CHP</td>
<td>Combined Heat and Power</td>
</tr>
<tr>
<td>CIBSE</td>
<td>Chartered Institute of Building Services Engineers</td>
</tr>
<tr>
<td>CIL</td>
<td>Community Infrastructure Levy</td>
</tr>
<tr>
<td>CRBO</td>
<td>Community Right to Build Order</td>
</tr>
<tr>
<td>DCLG</td>
<td>Department for Communities and Local Government</td>
</tr>
<tr>
<td>DEN</td>
<td>Decentralised Energy Network</td>
</tr>
<tr>
<td>DG</td>
<td>Distributed generation</td>
</tr>
<tr>
<td>DH</td>
<td>District Heating</td>
</tr>
<tr>
<td>DNO</td>
<td>Distribution network operator</td>
</tr>
<tr>
<td>DPCR</td>
<td>Distribution Price Control Review</td>
</tr>
<tr>
<td>DPD</td>
<td>Development Plan Documents</td>
</tr>
<tr>
<td>DUoS</td>
<td>Distribution use of system</td>
</tr>
<tr>
<td>EIW</td>
<td>Energy from Waste</td>
</tr>
<tr>
<td>EPN</td>
<td>Eastern Power Networks</td>
</tr>
<tr>
<td>ESCo</td>
<td>Energy Services Company</td>
</tr>
<tr>
<td>ETC</td>
<td>Environmental Technologies Complex</td>
</tr>
<tr>
<td>FTE</td>
<td>Full Time Equivalent</td>
</tr>
<tr>
<td>GCV</td>
<td>Gross calorific value</td>
</tr>
<tr>
<td>GFA</td>
<td>Gross Floor Area</td>
</tr>
<tr>
<td>GLA</td>
<td>Greater London Authority</td>
</tr>
<tr>
<td>HTHW</td>
<td>High temperature hot water</td>
</tr>
<tr>
<td>HV</td>
<td>High voltage</td>
</tr>
<tr>
<td>IWMF</td>
<td>Integrated Waste Management Facility</td>
</tr>
<tr>
<td>ktpa</td>
<td>Kilo tonnes per annum</td>
</tr>
<tr>
<td>LBWF</td>
<td>London Borough of Waltham Forest</td>
</tr>
<tr>
<td>LDA</td>
<td>London Development Agency</td>
</tr>
<tr>
<td>LDDs</td>
<td>Local Development Documents</td>
</tr>
<tr>
<td>LDO</td>
<td>Local Development Order</td>
</tr>
<tr>
<td>LPN</td>
<td>London Power Networks</td>
</tr>
<tr>
<td>MSW</td>
<td>Municipal Solid Waste</td>
</tr>
<tr>
<td>MUSCo</td>
<td>Multi-utility Services Company</td>
</tr>
<tr>
<td>MW(e)(th)</td>
<td>Mega-watt (electrical) (thermal)</td>
</tr>
<tr>
<td>NDO</td>
<td>Neighbourhood Development Order</td>
</tr>
<tr>
<td>NDP</td>
<td>Neighbourhood Development Plan</td>
</tr>
<tr>
<td>NLSA</td>
<td>North London Strategic Alliance</td>
</tr>
<tr>
<td>NLWA</td>
<td>North London Waste Authority</td>
</tr>
<tr>
<td>NLWP</td>
<td>North London Waste Plan</td>
</tr>
<tr>
<td>NPV</td>
<td>Net present value</td>
</tr>
<tr>
<td>OAPF</td>
<td>Opportunity Area Planning Framework</td>
</tr>
<tr>
<td>PB</td>
<td>Parsons Brinckerhoff</td>
</tr>
<tr>
<td>PPA</td>
<td>Power Purchase Agreement</td>
</tr>
<tr>
<td>PPA</td>
<td>Planning Performance Agreement</td>
</tr>
<tr>
<td>PPS</td>
<td>Planning Policy Statement</td>
</tr>
<tr>
<td>RDF</td>
<td>Refuse Derived Fuel</td>
</tr>
<tr>
<td>RHI</td>
<td>Renewable Heat Incentive</td>
</tr>
<tr>
<td>ROC</td>
<td>Renewable Obligation Certificate</td>
</tr>
<tr>
<td>RRP</td>
<td>Resource Recovery Plant</td>
</tr>
<tr>
<td>SIGE</td>
<td>Spark ignition gas engine</td>
</tr>
<tr>
<td>SPD</td>
<td>Supplementary Planning Document</td>
</tr>
<tr>
<td>SPG</td>
<td>Supplementary Planning Guidance</td>
</tr>
<tr>
<td>SPV</td>
<td>Special purpose vehicle</td>
</tr>
<tr>
<td>SRF</td>
<td>Solid Recovered Fuel</td>
</tr>
<tr>
<td>TIL</td>
<td>Transport for London</td>
</tr>
<tr>
<td>UKPN</td>
<td>United Kingdom Power Networks</td>
</tr>
<tr>
<td>ULV</td>
<td>Upper Lee Valley</td>
</tr>
<tr>
<td>WID</td>
<td>Waste incineration directive</td>
</tr>
</tbody>
</table>
1 EXECUTIVE SUMMARY

1.1 Aims and Opportunity

1.1.1 The Upper Lee Valley (ULV) is one of London’s most exciting areas of change. This report addresses how planning the future of energy provision in the sub-region could help catalyse positive outcomes in terms of economic rejuvenation and environmental improvements.

1.1.2 This pre-feasibility study demonstrates that there is a unique opportunity to deliver a commercially sustainable decentralised energy network (DEN) which would put the Upper Lee Valley at the forefront of energy production in London and give it a clear competitive advantage over other areas. The area combines strategic energy assets, including Edmonton incinerator, major waste resources, significant regeneration activities, and a vibrant industrial corridor that hosts several significant users of energy. This report demonstrates that these assets can be developed to become a source of low-cost, low carbon heat where local waste streams represent a significant renewable fuel resource.

1.1.3 The vision is to deliver cost-competitive, low to zero carbon energy supplies (heating, cooling and power). This will assist with job creation, reduce overall carbon emissions, facilitate the transition to a low carbon economy, and support development in a coherent, unified fashion that prevents the emergence of piecemeal, standalone, sub-optimal energy solutions.

1.1.4 There is also long term potential for inter-connection to a ‘London-wide’ network including the Olympic Park and the London Thames Gateway Heat Network.

1.2 Benefits

1.2.1 The efficient production of low to zero carbon energy from waste would give the ULV a clear competitive advantage over other areas. A Decentralised Energy Network (DEN) would:

- provide low carbon, low cost energy to 10,000 homes and more than 150 key businesses utilising either the available waste as a fuel or waste heat as an energy source
- help to alleviate fuel poverty in some of London’s most deprived areas
- secure at least 1,700 additional jobs for the area for the period to 2026
- provide energy that is increasingly disconnected from fossil fuel price volatility over the coming years, supporting an emerging and strengthening low carbon sector in the ULV
- reduce the cost for developers of compliance with the Code for Sustainable Homes, BREEAM and anticipated revisions of the Building Regulations
- cut carbon dioxide emissions by 41,000 tonnes per annum, the equivalent of 9,750 homes annual CO₂ production. Council property portfolios could see 25% reductions in emissions for those buildings connected
- Provide long life energy infrastructure to allow the sub-region to benefit from future technological improvements cost effectively. This project would act as an incubator / pilot scheme for the low carbon economy.
1.3 Development

1.3.1 This pre-feasibility report addressing the ULV in the London Boroughs of Enfield, Waltham Forest and Haringey is the first step in the project delivery cycle. It identifies options for further development. The wider process is outlined below:

![DEN development process diagram]

1.4 Results

1.4.1 The key conclusions of this study are as follows:

- Strategic heat supply locations identified for further development for a DEN include the Edmonton EcoPark and the Kedco biomass gasifier sites in the Central Leeside / Picketts Lock area.

- Two immediate development opportunities can be pursued. Initial development of the DEN could be based on heat from the Kedco gasifier to a ‘core scheme’ area including Edmonton, Commercial Road / Silver Street, Northumberland Park, Marsh Lane, Central Leeside and Picketts Lock. Alternatively, heat to serve this area could be sourced from the existing Edmonton Incinerator. This approach would meet strategic objectives by kick-starting network growth without the up-front cost of primary plant investment, would deliver a project without reliance on third-party project development, and enhance land values.

- These initial options could be supplemented in the medium term by local gasifier plant installation on the EcoPark site – producing heat and power from local waste streams. The SRF that is currently being procured via the NLWA could be a key fuel source for the medium term gasifier plant.

- Development of Enfield power station as a heat source for the DEN is not recommended, on the basis of both uncertainty in terms of its operation and on the estimated cost of heat available.

- Viable local networks that would support development of the strategic network have been identified at Blackhorse Lane, the Tottenham Town Hall area, Waltham Forest Town Hall / Wood Street area, and Walthamstow Town Centre. These schemes are envisaged to be based around local gas-fired CHP plant initially, which would be superseded by the strategic network supply as the DEN expands to these areas. These schemes will complement other existing and emerging communal systems, including the Tottenham Hale Village network supplied by gas-fired CHP and biomass boilers.
A local network has also been identified at Wood Green / Haringey Heartlands. This is unlikely to connect to the strategic network in the short to medium term due to the distance of the connection to the strategic network, but should be developed independently based around gas-fired CHP.

Detailed feasibility studies for two potential strategic network routes for heat distribution should be undertaken:

- ‘Olympic Park’ configuration – a network focussed on strategic linkages with the Olympic Park site which could enhance the potential for development of further heat from waste to energy plants
- ‘Tottenham’ configuration – a network focussed on delivery to major developments within the ULV sub region

These networks are presented in the vision maps contained in this study. The scale of these networks is limited by the fuel supply identified under the different heat source options considered. The networks below are based around Option B2 – sourcing heat from Kedco gasifier or Edmonton incinerator in the short to medium term, supplemented by a new gasifier on the EcoPark site in the longer term.

*Figure 1-2 Vision Map Network Scenario B2 ‘Olympic Park’ configuration*
1.5 **Recommended Key Actions**

1.5.1 Pursue core DEN development around Kedco and/or modifications to Edmonton incinerator. Areas served should include Edmonton, Commercial Road / Silver Street, Northumberland Park, Marsh Lane, Central Leeside and Picketts Lock.

1.5.2 Develop local CHP schemes in Blackhorse Lane, the Tottenham Town Hall area, Waltham Forest Town Hall / Wood Street area, Walthamstow Town Centre, and Wood Green / Haringey Heartlands.

1.5.3 **Governance**

1.5.4 A single joint public / private delivery vehicle should be established to oversee both cluster level schemes and the growth of the strategic network. This body would be responsible for enforcing the strategic aims of the project and aiding the delivery of local cluster-level schemes to complement the strategic network. The three ULV boroughs will need to work together to ensure that there is a sufficient and effective decision-making framework with key leadership and players, and significant political support to ensure successful implementation of DEN initiatives.

1.5.5 The three boroughs will need to work together to ensure that the leadership level support required for the development of this project is in place.

1.5.6 A rapid assessment of the risks and benefits of attempting to influence the NLWA procurement process, to secure a longer-term supply of MSW-derived SRF to generate heat and power at the Edmonton EcoPark site, is required.

1.5.7 **Planning Policy**
1.5.8 Enfield power station site should be safeguarded for future development as a CHP plant rather than a power generation-only facility. A general requirement should be imposed that new power generation plant and other major potential sources of waste heat are designed for heat recovery - with the cost of these designs borne as part of the plant development.

1.5.9 There are several planning mechanisms that could be employed to support DEN delivery. Cross-borough partnership working should continue in the development of policy. Key policy vehicles for consideration should include the use of Area Action Plans, Supplementary Planning Documents, the emerging Opportunity Area Planning Framework, Local Development Orders, and the Community Infrastructure Levy.

1.5.10 Technical

1.5.11 Put technical standards in place for Developers to follow to ensure that new-build schemes and local cluster heat networks are designed in a manner compatible with the emerging strategic network.

1.5.12 Engage with the Operators / Developers of Kedco gasifier as soon as possible to ensure compatibility between the NLSA’s strategic network project and the Kedco development.

1.5.13 Carry out more detailed feasibility work relating to the following technical aspects of design (particularly focussing on early phase growth zones):

- Loads – obtain commitments in principle from potential heat customers with technical details of temperature / pressure requirements, and load projections into the future
- Routings – develop network route maps for the first phases of network growth, and investigate the constraints and obstacles posed by existing infrastructure such as pipes, tunnels, transport infrastructure already in place
- Easements – identifying where easements are necessary, and obtain early quotations for these areas. Early engagement with TfL and British Waterways is strongly recommended

1.5.14 Engage with operators of premises along the proposed early phase strategic network route to understand plant replacement cycles which could tie in with potential connection to a DEN.
2 INTRODUCTION

2.1.1 Parsons Brinckerhoff was appointed by the North London Strategic Alliance to conduct a strategic pre-feasibility study into the potential for a decentralised energy network (DEN) in the Upper Lee Valley (ULV). The scope of this study encompasses three ULV London boroughs of the Enfield, Haringey and Waltham Forest over a 40 year period, a range of potential energy sources, and addresses the potential for energy networks to contribute to inward investment opportunities in the area.

2.1.2 The approach adopted in this report is a mixture of ‘top-down’ analysis (based on both the heat that is anticipated to be available from various low carbon sources, and a vision of the infrastructure enabling secure, low-carbon supply in the area), and on a ‘bottom-up’ approach that investigates the commercial viability of ‘kick-start’ schemes to help the emergence of a DEN gain momentum.

2.2 Framework Conditions

2.2.1 The Upper Lee Valley is a six-mile corridor extending north from the Lee Bridge Road through Tottenham Hale to the M25, with the Lee Valley Regional Park as its spine. It comprises one of the largest clusters of manufacturing and technology-led industrial estates in London, and at over 3,000ha represents by far the largest Opportunity Area in the London Plan. The Draft Replacement London Plan, October 2009 identifies growth potential of at least 7,000 new homes and up to 15,000 new jobs to be created in the area by 2026.

2.2.2 The ULV has long been recognised as an area for regeneration. The boroughs of Enfield, Haringey and Waltham Forest have formed the Upper Lee Valley Partnership, supported by the North London Strategic Alliance, and have been working with other stakeholders to promote the regeneration of the area. Most recently, NLSA launched a new vision for the ULV and the need and opportunity remains for inward investment, job creation and regeneration across the area. The Upper Lee Valley figures strongly in borough regeneration strategies and LDFs, all of which include a commitment to decentralised energy supply as a key strategy for reducing carbon emissions.

2.2.3 The Draft Energy Strategy for the Upper Lee Valley, prepared by the LDA in April 2010 as part of the Opportunity Area Planning Framework (OAPF), identified the potential for a decentralised heating / energy network in the Upper Lee Valley considering the heat potentially available from existing and planned power plants in the area and existing and future green industry developments.

2.2.4 At the outset of the study, stakeholders identified the following drivers for a decentralised energy network in the Upper Lee Valley:

- Ability to generate inward investment
- Reduction in fuel poverty
- Reduction in carbon emissions across the ULV
- Cost and value, now and in the future
- Return on investment, social, economic and environmental

2.2.5 These headlines and other aspirations were explored in an ‘Aspirations Workshop’ that was led by PB as part of this study. The purpose of this workshop was to capture the key drivers for a network of this nature. These drivers were then used as a guide to inform the direction
and strategic design of the schemes proposed within this report. The outputs of this workshop were also used in preferred scheme selection. Details of the ‘Aspirations Workshop’ are contained in Section 8.

2.3 Methodology

2.3.1 This study considers a 40 year development period. In this context, it must be recognised that there is both considerable potential for incremental change, but also that existing infrastructure will dominate the physical environment for the first period of the study. Hence, the study has attempted to balance the need for robust data to inform the baseline starting point of the study, against the potentially fluid changes that may occur in the future to 2050. This is combined via the following methodology to generate a vision map for the sub-region, illustrating a strategic approach to energy masterplanning of the area.

2.3.2 The outline methodology adopted in the study has:

- Assessed a number of potential sources of heat to supply a sub-regional heat network
- Collated current and future heat demands in the Upper Lee Valley region
- Engaged with stakeholders\(^1\) both to respond to aspirations, and also to ensure that local information is gathered
- Carried out GIS mapping of the demands and supply potential
- Analysed heat demand clusters, providing initial recommendations on heat supply technologies
- Identified key ‘points of potential intervention’ in the timeline of key areas / demands / heat sources in the ULV
- Identified how energy networks could promote inward investment in the ULV
- Considered the powers available to local authorities and other bodies to intervene and shape the development of the sub-region
- Assessed the viability of various configurations of heat network
- Combined the considerations above to generate a vision map for the ULV

2.3.3 The following sections of the report describe how these various tasks have been addressed.

\(^1\) See appendices for list of consultees
3 HEAT SOURCES

3.1 A number of key individual large-scale heat sources are analysed in this section of the report, alongside commentary on heat sources for smaller-scale decentralised energy schemes (i.e. local clusters).

3.2 Edmonton Incinerator and the North London Waste Authority

The North London Waste Authority

3.2.1 The North London Waste Authority (NLWA) is the waste disposal authority for seven local authorities in north London: Barnet, Camden, Enfield, Hackney, Haringey, Islington, and Waltham Forest. These local authorities are responsible for collecting waste and recycling in their local areas and delivering them to the NLWA’s transfer and treatment facilities.

3.2.2 The NLWA is the UK’s second largest waste disposal authority, after Greater Manchester. It handles around 3% of the national municipal waste, which it expects to be around 1.3 million tonnes per annum by 2045. In 2009/10, the NLWA was responsible for recycling, treating or disposing of 892,130 tonnes of municipal solid waste via the following waste management methods:

<table>
<thead>
<tr>
<th>Waste management method</th>
<th>Quantity (tonnes)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill</td>
<td>358,790</td>
<td>40%</td>
</tr>
<tr>
<td>Incineration (with energy recovery)</td>
<td>318,607</td>
<td>36%</td>
</tr>
<tr>
<td>Recycling / composting</td>
<td>206,629</td>
<td>23%</td>
</tr>
<tr>
<td>Other</td>
<td>8,104</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>892,130</td>
<td>100%</td>
</tr>
</tbody>
</table>


3.2.3 The NLWA and its constituent boroughs have set themselves the following targets for managing their waste:

- A 50% recycling and composting rate by 2020
- A reduction in the amount of waste sent to landfill to 35% (of 1995 amounts) by 2020
- Recovery of energy from 31.5% of rubbish by 2015

3.2.4 The NLWA currently has a contract with LondonWaste Ltd for waste treatment and disposal, which ends in December 2014. LondonWaste, which is a wholly-owned subsidiary of the NLWA, owns a 43-acre site on the A406 in Edmonton, north London, where it has a 550,000

---

tonnes per annum incinerator, as well as an in-vessel compost plant and a bulky waste recycling facility.

**Procurement**

3.2.5 With its contract with LondonWaste coming to an end in 2014, the NLWA is obliged to procure new waste management services. It is currently undertaking a procurement process for two contracts: a waste services contract, and a fuel use contract. The contracts are likely to run for 25 to 35 years from 2014\(^4\) (i.e. ending in 2040 or 2050), in order to secure funding and repay the £500-600m investment\(^5\).

3.2.6 In developing its procurement strategy, the NLWA identified as its preferred solution Mechanical Biological Treatment using anaerobic digestion to produce SRF. It has chosen to procure separate contracts for SRF production and use, as it considered this would ‘attract as wide a market as possible for the fuel, ranging from large scale industrial users to smaller decentralised energy / district heating scheme\(^6\).

3.2.7 The NLWA expected to complete the evaluation of the outline solutions in April 2011, following which a shortlist of tenderers were to be invited to submit detailed solutions for each of the contracts. The contracts are expected to reach financial close in March 2013, with facilities operational in 2016 to 2017.

3.2.8 Please refer to Section 24 for more information on SRF and the NLWA.

**Waste services contract**

3.2.9 The waste services contractor will be responsible for\(^7\):

- Providing sites where the local authorities can deliver the waste that they have collected
- Managing the waste to maximise recycling and composting and diversion of waste from landfill to meet the NLWA’s targets (as stated above)
- Producing SRF from the waste that cannot be recycled or composted
- Managing the household waste and recycling centres

3.2.10 The NLWA has received outline solutions from five bidders for the waste services contract:

---


\(^6\) North London Waste Authority, Outline Business Case, 29 January 2010, Page 8

### Table 3-2 NLWA Waste services contract bidders

<table>
<thead>
<tr>
<th>Waste services contract bidders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biffa Waste Services Ltd</td>
</tr>
<tr>
<td>FCC Skanska (Fomento de Construcciones y Contratas SA and Skanska</td>
</tr>
<tr>
<td>Infrastructure Development UK Ltd (consortium)</td>
</tr>
<tr>
<td>SITA Lend Lease (SITA UK Ltd and Catalyst Lend Lease (consortium)</td>
</tr>
<tr>
<td>Urbaser SA (with Shanks PFI Investment Ltd, Covanta Energy Ltd and</td>
</tr>
<tr>
<td>Balfour Beatty) (consortium)</td>
</tr>
<tr>
<td>Veolia ES Aurora Ltd</td>
</tr>
</tbody>
</table>

Source: NLWA update on the Procurement - supplementary information,
http://www.nlwa.gov.uk/news/nlwa_update_on_the_procurement_-_supplementary_information

3.2.11 The bidders’ outline solutions for the waste services contract have offered a variety of technical solutions for producing the SRF, and the NLWA expects that it can probably achieve its recycling target and exceed its landfill diversion target\(^8\).

3.2.12 The specific technologies that have been proposed by the bidders for the preparation of the SRF are confidential at this stage of the procurement. The contractor is expected to produce approximately 327,000 tonnes per annum of SRF\(^9\) to the following specification\(^10\):

### Table 3-3 NLWA SRF specification

<table>
<thead>
<tr>
<th>NLWA’s SRF specification (summary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorific value 11 – 15 MJ / kg</td>
</tr>
<tr>
<td>Moisture content 15% - 20%</td>
</tr>
<tr>
<td>Particle size &lt; 150 mm</td>
</tr>
<tr>
<td>Chlorine &lt; 1%</td>
</tr>
</tbody>
</table>

**Fuel use contract**

3.2.13 The fuel use contractor will be responsible for accepting the SRF produced by the waste services contractor and using it in a cost effective manner to generate energy, making the best use of the heat as well as the electricity.

3.2.14 At an early stage in its procurement process, the NLWA identified two local regeneration schemes that may have had district heating potential. Neither of these schemes would have been able to use the entire output of SRF and therefore to enable these or other smaller

---


\(^9\) Tim Judson, NLWA, personal communication, April 2010

\(^10\) NLWA, Draft Output Specification: Waste Services Contract,
organisations to participate in the procurement, the NLWA decided to let its fuel use contract as either one large or two smaller fuel use contracts\textsuperscript{11,12}.

3.2.15 The NLWA has received outline solutions from five bidders for the fuel use contract:

\textbf{Table 3-4 NLWA fuel use contract bidders}

<table>
<thead>
<tr>
<th>Fuel use contract bidders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covanta Energy Ltd</td>
</tr>
<tr>
<td>E.ON Energy from Waste AG / Wheelabrator Technologies Inc (consortium)</td>
</tr>
<tr>
<td>SSE Generation Ltd</td>
</tr>
<tr>
<td>Veolia ES Aurora Ltd</td>
</tr>
<tr>
<td>Viridor Waste Management Ltd (Viridor and Keppel Seghers Engineering Singapore Pte Ltd (consortium)</td>
</tr>
</tbody>
</table>


3.2.16 The outline solutions for the fuel use include London-based and non-London based solutions, with those outside of London involving the following transport mechanisms: potentially by rail from the Hendon site, by water from Edmonton, or a combination of the two. The solutions propose industrial or commercial use of the energy, including CHP, however there are no proposals for district heating (DH).\textsuperscript{13} The lack of proposals including DH is symptomatic of the commercial aspects of DH installation – i.e. they generally have high investment costs with little certainty of the long-term connection of heat customers (and heat sales income), corresponding to a high level of commercial risk. This demonstrates the need for public sector intervention in strategically beneficial projects such as the DEN under consideration here.

The North London Waste Plan

3.2.17 The seven north London local authorities are currently developing the North London Waste Plan, which will identify sites within their boundaries that are suitable for waste facilities. The draft ‘preferred options’ plan\textsuperscript{14} was published for consultation in 2009 and a ‘proposed submission version’ was issued for consultation in May 2011.

3.2.18 The current draft identifies 35 existing waste management sites, including nine local authority-owned waste management sites, and 22 existing waste transfer sites, all of which will be safeguarded for waste management purposes. The draft plan also identifies two new waste management sites. The locations of the existing sites are concentrated in the Upper Lee Valley (as shown in Figure 3-1 below), although the two new sites are further west, in Barnet and on the Barnet/Haringey border.

\textsuperscript{12} Tim Judson, NLWA, personal communication, April 2010
\textsuperscript{13} Tim Judson, North London Waste Authority – securing an affordable waste and energy solution, The 7\textsuperscript{th} International EfW Conference: Energy from Waste – Tomorrow’s Energy Today, London, 16-17 February 2011
3.2.19 Only one of the existing sites is currently used for energy recovery: the EfW facility at the Edmonton Ecopark in Enfield. The draft plan does not specify uses for the existing or new sites that it identifies, although it does estimate the land take required for different types of waste facilities.

3.2.20 The plan identifies the Edmonton EcoPark as the key existing site for waste management. The draft plan sets out the site’s opportunities and constraints and, regarding the potential for decentralised energy, it states:

The site includes an existing energy from waste facility that currently generates 55MW electricity and uses some of the heat to run processes on site. The plant is expected to close in 2020. The site is within the Upper Lee Valley Opportunity Area set out in the London Plan and within close proximity to the proposed new community at Meridian Water (see above). Any development on the site should consider opportunities for local energy provision, taking account of the findings and recommendations of the emerging Upper Lee Valley energy strategy and Enfield’s Renewable and Low Carbon Energy Study.

3.2.21 The draft plan specifically refers to the Upper Lee Valley Decentralised Energy Project and proposes the following policy, NLWP 5, for decentralised energy:

All waste facilities that are capable of directly producing energy or a fuel must secure:

a. the local use of any excess heat in either an existing heat network or through the creation of a new network; or
b. the utilisation of biogas/syngas in Combined Heat and Power facilities, either directly through piped supply or indirectly through pressurisation and transport; or

c. the utilisation of any solid recovered fuel in Combined Heat and Power facilities or as a direct replacement for fossil fuels; or

d. any other contribution to decentralised energy, unless it can be demonstrated to the borough’s satisfaction that this is not economically or technically feasible, in which case the development shall be designed to enable the future capture, reuse and export of heat and/or electricity and connection to a wider local energy network.
Figure 3-1 Existing waste management and waste transfer sites in the Upper Lee Valley

Existing waste management sites

Existing waste transfer sites
**NLWA’s plans for its Edmonton site and EfW facility**

3.2.22 As part of the contractual arrangements, the NLWA intends to sell LondonWaste Ltd to the waste services contractor, however the NLWA will retain ownership of LondonWaste Ltd’s site in Edmonton. The NLWA expects the waste services contractor to lease its Pinkham Way, Haringey, site and part of its Edmonton site for the construction of MBT facilities.\(^{15}\)

3.2.23 The waste services contractor will, under a separate lease, be able to operate the existing EfW facility through to the end of its working life (expected to be 2020). This represents an opportunity for the ULV to benefit from available waste heat from this facility from now until the time of its decommissioning. The NLWA has not yet determined the future use of the EfW portion of the site following the closure and dismantling of the EfW facility, however it considers a smaller EfW facility such as a gasifier for treating approximately 120ktpa SRF may be appropriate.\(^{16}\)

3.2.24 The NLWA would be supportive of any proposal to use the existing EfW for district heating, and considers that the plan for a replacement EfW plant would make district heating more viable. The NLWA believes that district heating would enhance the value of the site and be of benefit for a future planning application.\(^{17}\)

**PB assumptions regarding Edmonton’s future in the context of the ULV DEN**

3.2.25 The discussions above illustrate that there is currently some uncertainty over the medium to long term SRF facilities, with associated implications for the potential for integration of heat recovery for DH. However, the economic modelling assumption adopted in this report is that under all scenarios of re-development of a waste treatment facility on the site that the business case for a facility would be made on the basis of the electricity generation and waste treatment services alone. This effectively means that if heat were recovered from the facility, that it could be procured at very low cost. It has been assumed that heat generated at future gasifier plants supplied by SRF would qualify for the Renewable Heat Incentive.

3.2.26 The existing energy from waste facility at Edmonton generates heat as part of the treatment process. It could be feasible to access a portion of this heat to serve a DEN. The modification of the existing cycle implies costs and risks, and hence the commercial case for doing so must be clear for the NLWA. Nevertheless, the availability of significant volumes of heat at the existing EfW plant represents an early-phase opportunity for the DEN which is important to recognise as an option for kick-starting DEN growth.

3.2.27 A schematic timeline of the potential routes for development of the Edmonton site and facilities is illustrated below:

\(^{15}\) Tim Judson, NLWA, personal communication, April 2010

\(^{16}\) Tim Judson, NLWA, personal communication, April 2010

\(^{17}\) Tim Judson, NLWA, personal communication, April 2010
3.2.28 This drawing illustrates that under the current contract structure and anticipated development lines, that the most likely timescale in which heat off-take for a decentralised energy network could be integrated into the master-planning of the ULV is around 2023, when it is expected that a new energy from waste treatment facility will be developed on the existing Edmonton incinerator site.

3.2.29 As noted above (3.2.26), there is nothing to preclude the potential off-take of heat from the existing incinerator, albeit this would have to be on a commercial basis – i.e. without the benefit of intervention via the planning system.

3.3 KEDCO – Biomass Gasifier

3.3.1 At the time of writing, it is understood that outline planning permission has recently been awarded for the development by Kedco of a biomass gasification CHP plant, subject to completion of a S106 Agreement with Enfield Borough Council. Once developed, the plant is expected to produce a thermal output of 10MWth in the form of hot water, which could be used for district heating.
3.3.2 Initial assessment of heat demand and local interest in alternative heat provision has already been undertaken by the developer as part of the planning application process\textsuperscript{18}.

3.3.3 The proposed plant site is located on Gibbs Road, Edmonton in the Montagu Industrial Estate. The surrounding buildings are industrial units dedicated to numerous industries including waste transfer / management, scrap metal recycling, transport and construction activities. The following shows a site plan of the proposed facilities.

\textit{Figure 3-3 Kedco gasifier Site Plan}

3.3.4 The gasification technology is a “down draught” design with a feedstock of reprocessed waste wood. It works by passing a “gasification agent” (oxygen, steam and/or air) down through the feedstock to create “syngas”, which would then be used as a fuel for six CHP units (2MWe each) at the site.

3.3.5 PB has contacted the Agent acting for Kedco, LRS consultancy and the current anticipated timeline for development is that construction would begin on site in the latter half of 2012, and that the first gasifier module should be operational at around end 2013 or beginning of 2014. Each module will consist of a 20,000 tonne gasifier and two 2MWe engines. This timeline is linked to Kedco’s involvement in another similar project in Ireland and the financial draw-down between the two projects. Further modules at the north London site would be anticipated to be developed soon after the initial phase, with completion anticipated around 2016.

3.3.6 It is understood that an agreement and sum of money has already been set aside in order to link the heat output of the gasifier plant to local businesses.

\textsuperscript{18} Development of Gasification Facility at Gibbs Storage – Heat Assessment, London Remade Solutions, 2009
3.3.7 Kedco / LRS are keen to explore the potential for the distribution of heat recovered from the plant, and the existing planning conditions require heat recovery modules to be installed.

3.3.8 Although there are currently relatively few gasification plants in the UK, it is more widely used in a number of other countries, including Japan. Investment in research and development has increased more recently as the viability of different feedstocks, such as municipal solid waste, has been realised. However, uncertainty still exists around the issue of fuel (syngas) cleaning to levels suitable for gas engine combustion.

3.3.9 The Kedco gasifier is based around reprocessed waste wood as its feedstock.

3.3.10 The gasification of MSW or other less homogenous feedstocks is less well developed, but it is assumed in this report that greater reliability and commercial viability will have been achieved for SRF / MSW gasification by the time a new facility could be constructed on the EcoPark site around 2023. There are very few gasification and pyrolysis systems treating residual MSW that have been commercially proven at full scale outside of Japan and South Korea. There are several demonstration plants in the UK, and many sites with planning permission, however there are only three full scale commercial plants: a 30,000 tonnes per annum Energos gasification facility on the Isle of Wight, which suffered from emissions breaches in 2010 but is currently complying with its Environmental Permit; an 18,000 tonnes per annum GEM pyrolysis facility in Scarborough, which has been mothballed and is currently seeking investors; and a 40,000 tonnes per annum Scotgen plant in Dumfries, which uses Planet Advantage gasification technology. While the operation of full scale gasification or pyrolysis plants is currently limited in the UK, there are a number operational elsewhere in Europe, including six Energos plants.

3.4 Enfield Power Station

3.4.1 Rupert Green of PB met with the Production Manager of Enfield power station on the 31st March 2011. The following items were discussed:

- General information relating to the power station
- Schematic drawing of power / steam cycle
- Current operation schedule – merit order
- Ability to supply waste heat and location for additional plant
- Investment plans, including any timetable for re-planting
- Investment hurdles, what return on investment would need to make the changes
- Would any wider business /environmental objectives be achieved if plant were CHP enabled

3.4.2 Outline plant description

3.4.3 Enfield power station is a combined cycle natural gas fired power station with a total electrical capacity of 400MWe. At present the waste heat from the power generation cycle is rejected to atmosphere at 40°C via air cooled condensers.
3.4.4 Schematic drawing of power / steam cycle

Figure 3-4 Schematic drawing of Enfield Power Station cycle

3.4.5 This schematic illustrates the complexity of power station operation, and the importance of not impinging upon power generation through the integration of a heat extract process that is not within the power station operator’s control. This diagram also illustrates that the heat available from the condenser system would be at approximately 50 deg C – too low a temperature for direct use in a DH system.

3.4.6 Current operation schedule – merit order

3.4.7 The Eon generation assets across the UK are controlled according to the marginal cost of generation. Those units that are able to generate power at the lowest cost are prioritised above generating at a higher cost. The Enfield power station has historically operated at around 90% of available operating hours, however for the previous 12 months this figure was around 50% of available hours. The key determinant of utilisation hours is the cost differential between gas fired generation and coal fired generation. The long term trend of plant operation is anticipated to be downward as new generation capacity comes on line and is able to out-compete Enfield power station in terms of cost of generation.

3.4.8 Ability to supply waste heat

3.4.9 Three potential options for taking waste heat from the Enfield power station have been identified:

1. Taking steam from the power cycle and supplying a district heating network via a heat exchanger. The removal of steam from the power cycle will result in a loss of generation, the magnitude of which is a function of the temperature and pressure of the steam being used. This option does not technically represent a source of waste heat because the steam still has...
sufficient energy remaining to produce additional power. For a system of this design it is anticipated that around 1 unit of electrical generation will be lost for every 5 units of heat produced.

2. If the 50°C condenser circuit water is passed through a heat pump to raise the temperature to 80°C or thereabouts this could be used to supply a low temperature DH network. The power requirement for the heat pump would be seen as a parasitic load on the power cycle. It is anticipated that the heat pump would use 1 unit of electricity to supply 4.5 units of heat.

3. Using the 50°C condenser circuit water to supply a low temperature DH network – this would require total re-design of all customer heating systems. At present there is no precedent for a system operating at this temperature to supply existing buildings.

3.4.10 The operation schedule of the power station means that there may be a mismatch between the customer heat demand profile and the heat availability profile from the power station. A potential means to overcome this mismatch is the use of thermal storage. The most common thermal store design is a highly insulated tank that has a height-to-width ratio of 2:1 in order to encourage stratification. The store is controlled by pumps that charge the store with heat when supply is greater than demand and draws down the heat when customer demand is greater than the available heat from the plant.

3.4.11 Potential location for waste heat recovery plant

3.4.12 The discussions with Eon included the potential location of the equipment required to capture the waste heat from the power station.
3.4.13 The site has a moderate amount of under-utilised brownfield site that was previously occupied by fuel storage tanks. This site has the potential to be used to locate the thermal store and ancillary plant required to supply the district heating network. The anticipated plant requirements for the three options for waste heat utilisation are:

**Figure 3-5 Enfield Power Station site layout drawing**
a. If steam is taken from the power generation cycle the heat exchanger would need to be accommodated within the existing building. This poses a number of potential risks in terms of ability to modify the existing system and locate the additional plant.

b. The heat pump to take advantage of the waste heat would be located external to the existing building, it is possible that this plant could be located adjacent to the air cooled condensers

c. The direct utilisation of the 40°C waste heat would require a heat exchanger that could be located external to the existing building. The capture of this heat is anticipated to have the least disruption to the operation of the plan; however it represents a high risk option in terms of technical viability.

3.4.14 Investment plans for Enfield power station

3.4.15 The power station is scheduled to operate until 2023, at which point Eon have a binary decision point based on the ability to mitigate CO₂ emissions from the plant:

a. Discontinue operation of the Enfield power station and decommission the site. The generation capacity would be moved to a location where carbon capture and storage was possible.

b. Construct a new power station at the Enfield site / major recondition of existing station with additional carbon mitigation technology on site. It is possible that the CO₂ mitigation technology could include operating in CHP mode.

3.4.16 The ability to supply heat from the power station to a district heating network represents a potential opportunity for Eon in terms of complying with CO₂ reduction requirements and the additional revenue that could be derived from heat sales to the network. Eon should continue to be engaged in the development of an Upper Lee Valley DEN. It is important that Eon is kept informed of the proposed development timeframes of the DEN and the potential quantum of heat sales that could be generated. Likewise it is important that Eon share long-term investment plans with NLSA in order that the supply of the DEN accurately reflects the available heat sources over the project timeframes.

3.4.17 A new power station at Enfield should be designed to operate in CHP mode to enable the cost-effective extraction of heat, however it is recommended that the design allows the plant to operate in power only mode should the DEN load not be available. The viability of the financial model for the new plant should not be reliant on CHP operation given the risks associated with the development of the ULV DEN, and the dependency in terms of viability of the ULV on the availability of very low cost heat.

3.4.18 The long term aspiration should be that new power stations should be able to supply low grade heat onto district heating networks. In order to do this the buildings connected to the DH network would need heating systems suitably designed to make use of this heat. In situations where the majority of buildings being supplied are new this can be enforced through the planning system. It is more challenging to encourage the occupants of existing buildings to modify their heating systems; however, given the long term nature of this study it is not implausible to expect a step change in attitude towards the use of district heating and the retro-fitting of compatible heating systems.

3.5 Small-Scale Energy Generation Technologies

3.5.1 A detailed description of a range of key small-scale generation technologies is included within Appendix D (Section 19). The summary points to note for emerging clusters of demands here are as follows:
3.5.2 In London in particular, emissions to air are a significant concern in the interest of maintaining low levels of airborne pollutants and their concomitant health risks. This is particularly relevant to the use of biomass combustion plant, where at small scale, the use of extensive exhaust gas filters/scrubbers cannot be supported by the economic performance of the plant. Hence there is often an understandable and justifiable reluctance to install biomass plant. Coupled with low margins of profit without subsidy, this technology is generally not preferred for situations where only relatively low levels of carbon reduction are required. However, in larger installations, and where very significant carbon reductions are required (as per the long term horizon of this study) it would be anticipated that biomass CHP becomes a more competitive solution, particularly with government subsidy for renewable electricity and heat. In this context it is worth noting that at the small scale, the cumulative emissions from many appliances without sophisticated emissions abatement technologies are likely to exceed the emissions from a larger single source where exhaust filtration and treatment is viable.

3.5.3 Spark Ignition Gas Engines (SIGEs) are CHP prime movers based upon internal combustion engine technology. Engines are available with outputs from 5kW up to approximately 10,000kW, and may be purpose built engines, or more commonly at the larger size range, they may be modifications of marine / stationary compression ignition engines. The huge wealth of experience in various transport applications means that engines of this nature are well developed, albeit that the heat recovery element is arguably less optimised in a developmental sense. Nonetheless, in terms of low-carbon CHP technologies, spark-ignition gas engines are the proven and have an excellent track-record. There is established competition in supply in the market. Depending on the nature of the loads being served, typically gas-fired spark-ignition CHP can deliver carbon savings of approximately 15% - 40%.

3.5.4 In the medium term, as regulatory stringency increases (e.g. with the advent of ‘zero-carbon’ homes and non-domestic buildings) in terms of required carbon reductions in new developments, gas-CHP will only be able to supply a portion of the required carbon reductions. Hence, for later date new developments the technology displaced by a low-carbon DEN would be either gas-CHP plus other low-carbon technologies, or biofuel-based (including biomass) CHP generation. This means that the financial benefit of connection to a strategic DEN for Developers is likely to increase through time. As this study is based upon current prices this potential uplift has not been taken into account in modelling at this stage.

3.6 Technology progression over project timescales

3.6.1 Whilst individual schemes may have particular requirements and local circumstances that may dictate a particular technology choice, the general anticipated trend in technologies would be as illustrated below in Figure 3-6.
3.6.2 This figure reflects the status and viability of current technologies. At the left-hand end of the time axis, where at the scale of ‘cluster’ schemes as envisaged in the development of the DEN, gas-fired CHP is the most suitable technology. As time progresses and environmental standards become more stringent in terms of allowable emissions, markets for biomass and biofuels are expected to develop, leading to small to medium-scale biomass CHP or liquid biofuel CHP becoming dominant, particularly where clusters are linked and larger schemes develop (allowing for economies of scale in emissions abatement technologies to be realised). The end-point vision for the DEN is then to further aggregate clusters to enable the economic exploitation of ‘more difficult’, less homogenous fuels such as municipal solid waste (MSW) or solid recovered fuel (SRF).

3.6.3 The further that waste can be brought forward along the time axis toward the present, the greater the potential environmental and economic advantage. The ideal situation would be an immediate transition to waste as primary fuel, but on a sub-regional basis, this is likely to emerge gradually as a strategic network is installed on a phased basis.
3.7 Comparison of key heat sources

3.7.1 PB has carried out an assessment of the likely value to generators of the distribution of heat. This assessment has taken into account the following factors:

- The potential loss of power generation for steam turbine technologies with the extraction of steam from the turbine cycle (z-factor);
- The Renewable Heat Incentive (RHI) support mechanism for renewable fuels;
- The Climate Change Levy exemption scheme for CHP installations.

3.7.2 The value to generators of the distribution of heat is critical to the success of the DEN. It is anticipated for the technologies for which there is most value in the use of waste heat, that they should be willing to make a capital contribution to the installation of the network that facilitates the distribution. The following chart illustrates the value of heat distribution to the key heat sources considered.

3.7.3 This chart displays important findings for the strategic development of the network. It illustrates that the use of a renewable fuel allows the Kedco Gasifier to benefit from the full value of the RHI for solid fuels. In annual terms (and not taking account of the capital cost of the heat recovery equipment required to capture the waste heat), the recovery of heat would allow the generator to receive an additional approx £2.5m of revenue per annum at full operation. This suggests that heat from this facility should be available at no, or extremely low cost (a figure of 0.1p/kWh has been adopted in viability modelling). Further, the gasifier operators should also be willing to make a capital contribution to the cost of the distribution system.

3.7.4 Equally, the chart shows that for Enfield Power Station, even when taking the benefits of CCL into account, the use of heat from condenser water (via heat pumps) or from the steam cycle does not add value to the power station’s operation. The reduction in
profitability of the power generation cycle would have to be compensated through a heat charge that reflects this cost plus a further margin for the risk, administration etc. A minimum estimated realistic cost of heat from Enfield has been assumed to be 0.6p/kWh. This is the figure that has been used in viability modelling.

3.7.5 The Edmonton EcoPark options reflect the fact that there is RHI support for the biological fraction of MSW. This fraction has been assumed to be 50%, and the figure above illustrates that there is still considerable benefit to all of the Edmonton EcoPark technology variants examined from the distribution of heat. It is worth noting that in terms of benefit, the gasifier schemes would see greater value from heat distribution than heat extract options from a mass burn incinerator scenario.

3.7.6 On this basis, it would appear that the preferred options to pursue as heat sources for the ULV DEN are the Kedco gasifier and the installation of gasification plant on the Edmonton EcoPark site. The extraction of heat from Edmonton Incinerator is an alternative, immediately available source of heat for early-phase scheme development.

3.7.7 In terms of capacity of available heat, the following chart illustrates the potential capacities of the different heat sources:

**Figure 3-8 Heat source supply capacities**

Estimated Peak Heat Supply Capacity (MW)

3.7.8 This illustrates that the level of available heat from all of the Edmonton EcoPark options and the Kedco is small in comparison with the level of condenser heat rejection from Enfield power station. However, the combination of the Kedco gasifier heat output and the Edmonton EcoPark gasifier option gives a total heat output of close to 50MWth. This is sufficient to supply a large proportion of the demand of the heat demand clusters identified.

3.7.9 Modelling options

---

19 Assuming 327ktpa throughput post 2023
3.7.10 Given the results illustrated above, a reduced set of options have been modelled through the remainder of the project analysis. In particular, the scenarios where Enfield Power station operates for only part of the year are not considered suitable for further investigation both on the basis of the heat price analysis above, but also as short power station running hours would dramatically increase the heat supplied by top-up and standby boilers, and reduce the overall carbon savings and viability achievable via the DEN.

3.7.11 Hence, the options modelled are:

- Scenario A1 – Edmonton EcoPark as heat source, post 2023, 120ktpa throughput, gasifier technology
- Scenario A2 – Edmonton EcoPark as heat source post 2023, 327ktpa throughput, gasifier technology
- Scenario A3 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 120ktpa
- Scenario A4 - Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 327ktpa
- Scenario B1 – Kedco gasifier as heat source circa 2015 onwards
- Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023.
- Scenario C1 – Enfield power station circa 2025 – assumed to operate to provide base load power to the grid (e.g. 8000hrs operation). Scenario included to illustrate performance against other options.

3.7.12 This list does not include a mass burn replacement plant scenario for the Edmonton EcoPark, as this would require a wholesale volte-face of the NLWA procurement process and commitments to date. This would also face considerable public opposition and is not considered a possible option within current planning powers.

3.7.13 These options are displayed below, illustrating the timelines for centralised heat sources anticipated to be available:
### Figure 3-9 Options modelled

<table>
<thead>
<tr>
<th>Scenarios modelled</th>
<th>TIMELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>A1 – Edmonton EcoPark as heat source, post 2023, 120ktpa throughput, gasifier technology</td>
<td></td>
</tr>
<tr>
<td>A2 – Edmonton EcoPark as heat source post 2023, 327ktpa throughput, gasifier technology</td>
<td></td>
</tr>
<tr>
<td>A3 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 120ktpa</td>
<td>Edmonton Incinerator modifications</td>
</tr>
<tr>
<td>A4 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 327ktpa</td>
<td>Edmonton Incinerator modifications</td>
</tr>
<tr>
<td>B1 – Kedco gasifier as heat source circa 2015 onwards</td>
<td></td>
</tr>
<tr>
<td>B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023, 120ktpa gasifier (Edmonton EcoPark)</td>
<td></td>
</tr>
<tr>
<td>C1 – New fossil fuel power station at existing Enfield Power Station Site operating as base-load provider</td>
<td></td>
</tr>
</tbody>
</table>

3.7.14 This study also considers the use of smaller scale technologies for local clusters, as outlined in Section 9.7.
4 HEAT DEMANDS

4.1 London Heat Map Database

4.1.1 A key element of this study is the calculation and forecast of heat demands that are projected into the future for the Upper Lee Valley.

4.1.2 The main source of information used in this study is the London Heat Map database. Recent heat mapping studies have been completed for LB Waltham Forest, Enfield and Haringey, and this recent data represents a significant element of the basis of the loads assumed. A normalisation of data has been carried out by introducing a minimum threshold of load magnitude for inclusion in the study – e.g. a nominal demand figure below which the value of connection to a DEN would be anticipated to be marginal. A figure of 200MWh (thermal) has been adopted as this threshold, and this is the reason for differences clusters identified between the heat mapping studies and this report.

4.1.3 A brief description of the key heat load clusters and existing CHP and district heating networks identified in each borough is included here. Section 9.7 outlines the analysis that PB has undertaken of the potential for these clusters to support decentralised energy networks in the ULV DEN context.

4.1.4 Enfield

4.1.5 Key heat load clusters

4.1.6 Enfield Council commissioned a heat mapping study of the borough to support the development of the London Heat Map (July 2011), in which ten key clusters of buildings with large annual heating demands that could have the potential for the development of district heating networks were identified in the borough. Within each cluster, the study identified significant existing public sector loads as well as planned future developments and their expected heat loads. PB used this data as a core heat demand data from which to develop heat demands for each cluster. Those ten clusters are:

Table 4-1 Key Heat Demand Clusters in Enfield

<table>
<thead>
<tr>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innova Park</td>
</tr>
<tr>
<td>Commercial Road / Silver Street</td>
</tr>
<tr>
<td>Ponders End</td>
</tr>
<tr>
<td>Central Leeside (Meridian Water / Edmonton Ecopark / other industrial)</td>
</tr>
<tr>
<td>Southbury</td>
</tr>
<tr>
<td>Palmers Green</td>
</tr>
<tr>
<td>Enfield Town</td>
</tr>
<tr>
<td>New Southgate</td>
</tr>
<tr>
<td>Edmonton</td>
</tr>
<tr>
<td>Cockfosters</td>
</tr>
</tbody>
</table>

4.1.7 Further analysis was then undertaken to identify additional buildings within each borough that could be connected to a ULV DEN. This is particularly important for LB Enfield due to the high number of employment loads within the industrial corridor running through the borough. These loads were not picked up in the Heat Mapping Study as no records of energy consumption are available publicly for this sector.

4.1.8 Identification of employment sector loads was aided by a GVA Grimley presentation\(^{20}\) that highlights a number of key employment clusters in the Upper Lea Valley industrial corridor. These employment clusters were analysed using Google Earth

---

\(^{20}\) Upper Lea Valley Green Enterprise, Initial sector and cluster analysis, 2\(^{nd}\) March 2011, GVA Grimley
and Street View. Heat loads for key buildings identified in this process were then calculated using a benchmarking methodology, as described in Section 4.2.

4.1.9 A series of maps and accompanying tables showing the location of each load within each of the LB Enfield clusters can be found in Appendix J (Section 25).

4.1.10 **Existing District Heating Networks**

4.1.11 PB is not aware of any existing district heating networks within LB Enfield; however there are a number of communally heated systems serving multi-dwelling residential blocks and supplied by on-site boilers identified in the previous heat mapping study. These buildings were included in the heat load analysis for this study.

4.1.12 **Existing CHP**

4.1.13 There are a number of existing CHP sites in LB Enfield. They are:

<table>
<thead>
<tr>
<th>Location</th>
<th>System Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany Leisure Centre</td>
<td>2 x 40 kWe</td>
</tr>
<tr>
<td>Southbury Leisure Centre</td>
<td>80 kWe</td>
</tr>
<tr>
<td>Edmonton Leisure Centre</td>
<td>70 kWe</td>
</tr>
<tr>
<td>Southgate Leisure Centre</td>
<td>80 kWe</td>
</tr>
<tr>
<td>North London Clinic (Edmonton)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Deephams Sewage Treatment Works (Edmonton)</td>
<td>3 MWe</td>
</tr>
<tr>
<td>Johnson Matthey (Brimsdown)</td>
<td>3 MWe</td>
</tr>
</tbody>
</table>

4.1.14 **Waltham Forest**

4.1.15 **Key heat load clusters**

4.1.16 PB has previously conducted a heat mapping study for LB Waltham Forest. Seven key heat load clusters for the area have already been identified and were used to inform this study. They are:

<table>
<thead>
<tr>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackhorse Lane North</td>
</tr>
<tr>
<td>Blackhorse Lane South</td>
</tr>
<tr>
<td>Walthamstow Town Hall</td>
</tr>
<tr>
<td>Walthamstow Town Centre</td>
</tr>
<tr>
<td>Wood Street North</td>
</tr>
<tr>
<td>Wood Street South</td>
</tr>
<tr>
<td>Leyton Orient / Leyton Mills</td>
</tr>
<tr>
<td>(known as Northern Olympic Fringe in heat mapping report)</td>
</tr>
</tbody>
</table>

4.1.17 As with LB Enfield, additional surveying of the Borough close to the ULV was conducted to ensure that any additional significant heat loads were identified and included in this study.

4.1.18 A series of maps and accompanying tables showing the location of each load within each of the LB Waltham Forest clusters can be found in Appendix J (Section 25).

4.1.19 **Existing District Heating Networks**
4.1.20 PB is not aware of any existing district heating networks within LB Waltham Forest, although there are a number of residential apartment blocks with communal boilers. These buildings have been included in the heat load analysis for this study where they fall within key heat load clusters.

4.1.21 Existing CHP

4.1.22 There are a number of existing CHP plants in LB Waltham Forest. They are:

<table>
<thead>
<tr>
<th>Location</th>
<th>System Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulwer Court</td>
<td>1 x 26 kWe</td>
</tr>
<tr>
<td>John Walsh Tower</td>
<td>1 x 85 kWe; 1 x 165 kWe</td>
</tr>
<tr>
<td>St. Nicholas Tower</td>
<td>1 x 85 kWe; 1 x 165 kWe</td>
</tr>
<tr>
<td>Marlowe Road</td>
<td>2 x 165 kWe</td>
</tr>
<tr>
<td>Stocksfield Estate</td>
<td>1 x 85 kWe; 1 x 165 kWe</td>
</tr>
<tr>
<td>Holmcroft House (sheltered housing)</td>
<td>1 x 12 kWe</td>
</tr>
<tr>
<td>Goddarts House (sheltered housing)</td>
<td>1 x 13 kWe</td>
</tr>
<tr>
<td>Walton House</td>
<td>1 x 15 kWe</td>
</tr>
<tr>
<td>Chingford Municipal Offices</td>
<td>2 x 15 kWe</td>
</tr>
<tr>
<td>Waltham Forest Council</td>
<td>1 x 165 kWe</td>
</tr>
<tr>
<td>Waltham Forest Pool and Track</td>
<td>1 x 45 kWe</td>
</tr>
<tr>
<td>Bakers Arms Almshouses</td>
<td>1 x 26 kWe</td>
</tr>
<tr>
<td>SCORE Centre</td>
<td>1 x 5.5 kWe</td>
</tr>
</tbody>
</table>

4.1.23 Haringey

4.1.24 Key heat load clusters

4.1.25 LB Haringey provided PB with heat load data for key public sector buildings from which PB were able to identify key clusters of demand for the purposes of this study. It is noted that LB Haringey has commissioned an infrastructure study of the area containing a map of areas of high potential for decentralised energy. PB was therefore able to cross-reference with this study in order to ensure that the clusters of key loads identified herein correspond with the areas highlighted in the infrastructure study.

4.1.26 As the borough contains part of the ULV industrial corridor, PB identified additional key employment heat loads within the area for inclusion in the final heat load analysis.

4.1.27 Key heat load clusters identified in LB Haringey are:

| Table 4-3 Key Heat Demand Clusters in Haringey |
|-----------------------------------------------|-----------------------------------------------|
| Broadwater Farm                               | Tottenham Hale / Hale Village / Greater Ashley Road |
| Tottenham Town Hall                           | Northumberland Park                           |
| Marsh Lane                                    | Haringey Heartlands                           |
| Wood Green North (Haringey Civic Centre)      | Hornsey                                       |
| Wood Green East                               |                                               |
4.1.28 A series of maps and accompanying tables showing the location of each load within each of the LB Haringey clusters can be found in Appendix J (Section 25).

4.1.29 Existing District Heating Networks

4.1.30 PB is not aware of any existing district heating networks within LB Haringey, although there are a number of residential apartment blocks with communal heating systems. These buildings have been included in the heat load analysis for this study where they fall within key heat load clusters.

4.1.31 A special mention should be made of Broadwater Farm where work is understood to be on-going to rejuvenate the communal heating system, although only a portion of the overall estate is currently supplied from a central boiler house.

4.2 Dealing with gaps in the data

4.2.1 Where there were gaps in the available data, PB has used a benchmarking methodology to calculate heat loads from buildings not included in the London Heat Map reports.

4.2.2 Gross Floor Areas (GFA) for identified buildings were calculated using Google Earth by multiplying polygon measurements (i.e. two-dimensional area) by the number of storeys for each building. Having determined the GFA, the type / usage of each building was determined (using Google Street View or knowledge of the building) so that an appropriate benchmark could be applied.

4.2.3 Benchmark figures are published by CIBSE with different sets of benchmarks used for older (CIBSE Guide F) and more modern (CIBSE TM46) buildings. PB used CIBSE Guide F benchmark figures which, having been published in 2004, are more appropriate for buildings not built in the last few years.

4.2.4 Annual fuel demand can then be calculated by multiplying the GFA (in m²) by the annual fossil fuel (i.e. gas) consumption benchmark (in kWh/m²). In order to calculate the annual heat demand, PB assumed a seasonal boiler efficiency of 75 percent (gross calorific value basis)
5 HEAT NETWORKS

5.1 Key technical decisions

5.1.1 Heat energy can be distributed in a number of mediums. One basic consideration is the choice between transporting a fuel (e.g. gas / waste) and the transport of heat in an appropriate medium (e.g. steam / hot water). Within the ULV area, there is, of course, an existing natural gas network, which contains energy that is both relatively cheap and is at the ‘cleaner end’ of the fossil fuel spectrum (from a carbon emissions perspective). However, a step change is needed to help prevent climate change, and the continuation of ‘business as usual’ is not a desirable option in terms of either the sub-region’s environmental impact or the need for regeneration and providing an impetus for inward investment.

5.1.2 The transport and use of other fuels (such as municipal solid waste or other waste streams) that are generated locally has been considered. A table listing the advantages and disadvantages associated with some common fuels and heat transport mediums is shown below:

<table>
<thead>
<tr>
<th>Heat transport medium</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Existing gas network, low costs in continuing fuel use</td>
<td>Fossil fuel with significant carbon emissions, anticipated rising costs and concerns over UK imports from unstable countries in terms of supply resilience.</td>
</tr>
<tr>
<td>Waste</td>
<td>Fuel is produced locally by households and businesses, and disposal of these wastes comes at a cost.</td>
<td>Difficult to extract heat energy from waste stream at small or medium scales without causing other environmental problems – e.g. emissions to air of dioxins / other airborne pollutants. All facilities must comply with EU Waste Incineration Directive standards.</td>
</tr>
<tr>
<td>Biomass</td>
<td>Sustainable, low carbon fuel. Pellet boilers available at small scale.</td>
<td>Not produced locally. Transport of fuel would increase traffic movements, and combustion leads to NOx and particulate emissions increase over gas boilers. Fuel and capital installation costs not directly competitive with gas. Large space requirements for fuel storage and boiler equipment.</td>
</tr>
</tbody>
</table>
### Heat transport medium

<table>
<thead>
<tr>
<th>Heat transport medium</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam</td>
<td>The high temperatures achievable in steam transmission increase compatibility with process industries. Single pipe (with condensate return). Pipe diameter small due to high temperature. Compatible with some large users (e.g. hospitals). Distribution pipework not generally direct buried due to need for maintenance access.</td>
<td>Expensive installation due to need for inspection access, high temperature and pressure components and incorporation of expansion loops / chambers etc.. Annual inspection requirements and therefore high maintenance cost. Reduced overall pipe life expectancy due to elevated temperatures / pressures.</td>
</tr>
<tr>
<td>High temperature hot water (HTHW) (e.g. 120 deg C and greater)</td>
<td>Can be operated at sufficient temperature to generate steam in secondary systems, and therefore provide compatibility with process industries. Flow and return pipework would have smaller diameters than the equivalent low temperature system due the increased temperature differential between flow and return legs. Compatible with double effect (e.g. high efficiency) absorption chillers.</td>
<td>Expensive installation due to need for inspection access, high temperature and pressure components and incorporation of expansion loops / chambers etc.. Annual inspection requirements and therefore high maintenance cost. Reduced overall pipe life expectancy due to elevated temperatures / pressures.</td>
</tr>
<tr>
<td>Low temperature hot water (LTHW) (e.g. up to around 95 deg C)</td>
<td>Proven track record. Long system life (e.g. at least 40 years) for steel pipe systems. Temperatures compatible with single effect absorption chillers.</td>
<td>Maximum secondary (e.g. building system) flow temperatures of around 85 or 90 deg C, therefore cannot be used for steam production. Larger diameter pipes means co-ordination with other services can be difficult. Temperature losses across large distances can be significant at times of low flow.</td>
</tr>
</tbody>
</table>

5.1.3 The table above illustrates that there is no system with absolute advantage over others. However, as key strategic considerations two factors are considered to have overarching significance in this study. First, that the use of a heat transport medium (rather than a particular fuel) allows for flexibility at the heat source in terms of technology and operation. Second, that longevity is a crucial factor in a study that is considering a 40-year time horizon.

5.1.4 On this basis, it is recommended that two potential solutions are considered for the ULV:

- either a hybrid system consisting of a section of HTHW transmission main combined with more widespread LTHW distribution, or
- an LTHW system.
5.1.5 The hybrid system has the following advantages:

- Over the HTHW section, the availability of HTHW and steam could attract key industries that require this grade of heat. This might include:
  - Processes requiring steam
  - Processes requiring cooling (via double-effect absorption chillers).

5.1.6 It is recommended that at feasibility stage this hybrid network is considered particularly with a view to linking the Edmonton EcoPark with the North Middlesex Hospital, passing through the Central Leeside, Northumberland Park and Commercial Road areas. These areas could then be targeted (in marketing terms) for processes requiring higher grades of heat.

5.1.7 The LTHW option has been modelled in this study, and has the advantage of ensuring that high efficiencies in heat recovery are feasible at the heat sources, thereby delivering low heat prices and assisting viability from a heat production perspective.

- The LTHW sections of the network can be installed and buried in public highways and do not require maintenance access. This type of network would be the preferred medium for non-industrial consumers of heat, reducing the maintenance and inspection costs of consumer interface units at each customer connection.

5.1.8 The specialist nature of modern district heating (DH) pipework means that it is not normally advised or feasible to re-use existing buried assets. However, installation costs of DH mains are lower in soft ground than in hardstanding. It is therefore generally preferable to select soft-ground routes wherever possible.

5.1.9 Base load vs peak load network

5.1.10 A further decision to be made in terms of heat network design, is whether the network should be sized for base load provision, or for peak demands. A base load network would provide low-carbon heat throughout the year but be sized such that peaks in demand are met by boiler plant at the individual connection points. A peak load network would be sized sufficiently to cater for the sum of all individual peak loads across the networks. The following table illustrates some of the considerations around these options:
### Table 5-2 Peak load vs base load networks

<table>
<thead>
<tr>
<th>Peak load network</th>
<th>Base load network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger diameter heating mains required</td>
<td>Smaller diameter heating mains required</td>
</tr>
<tr>
<td>More expensive to install</td>
<td>Less expensive to install</td>
</tr>
<tr>
<td>Allows heat sales prices to reflect customers’ avoided costs for boiler maintenance and replacement.</td>
<td>Must be competitive with heat provision from alternative means of heat provision (e.g. local boilers) on basis of energy costs alone.</td>
</tr>
<tr>
<td>Must have high level of resilience in heat supply to meet all customers’ requirements</td>
<td>If all customers retain their own boilers, then heat supply outages on the strategic network could be acceptable.</td>
</tr>
<tr>
<td>Has potential to serve a wider area through conversion to a partially base-load network – greater degree of ‘future proofing’ through larger diameter mains installed</td>
<td>Less potential for strategic expansion</td>
</tr>
</tbody>
</table>

5.1.11 **At this stage it is recommended to adopt a network sized for peak load provision.** It has been assumed that the overarching priority for the ULV is the strategic nature of the network and the value of a long-term asset.

5.1.12 On the basis of this assumption this report has included costs for peak boiler supply plant and other ancillary equipment associated with peak supply.

5.2 Potential heat network changes over time

5.2.1 There are a number of aspects of district heating network operation that could influence the design and evolution of networks. For example, by decreasing the return temperatures seen on a transmission main network, the overall heat transfer capacity is increased (e.g. by increasing the temperature differential between flow and return pipework). Hence, if return temperatures can progressively be lowered on a generalised basis, then the additional capacity that this effectively generates in transmission can be used to serve additional loads on the network.

5.2.2 Equally, by increasing the temperature differential on a network, the flow rate required to deliver a given quantity of heat is also reduced, thereby reducing pumping requirements, and hence increasing overall efficiency in heat delivery.

5.2.3 For many heat generation technologies, it is also the case that with lower network return temperatures, greater efficiency can be derived in heat recovery. This is often relevant to both large and small scale systems. For example, for a small scale reciprocating engine CHP plant as might be suitable for local cluster ‘kick-start’ schemes, the lower return temperatures, the greater the overall efficiency of heat recovery, as low temperatures mean that heat can be recovered from charge air cooling and lube-oil cooling circuits of reciprocating engines. Equally, low return temperatures at a large power station could mean that heat can be recovered from the condenser cooling circuits, where large volumes of low-grade heat is typically simply rejected to atmosphere.

5.2.4 Some lowering of return temperatures would be anticipated over time as a result of the shift towards demands that are more dominated by hot water requirements (as opposed to space heating), particularly with new development, where higher levels of fabric insulation are required.
5.3 Network Constraints

5.3.1 Given the high-level nature of this study and the scale of the network implied, it has not been possible to develop anything beyond a high-level view of the physical constraints imposed on network design. A map showing some of the key impediments to network interlinkage is shown below:

Figure 5-1 High level network constraints

5.3.2 This map highlights that there are a series of linear constraints aligned north-south consisting in railways, reservoirs and a major road (Great Cambridge Road (A10) that must be crossed to link between the heat sources identified and the western demand clusters. Key to network design will be the identification of cost-effective crossing points of these barriers in suitable locations to link the network load clusters.

5.4 The River Lea Navigation Towpath

5.4.1 Preliminary analysis of the optimal route for a district heating network in the ULV suggests that certain sections of the network (specifically those in LB Enfield) would be best reached from the River Lea Navigation towpath, which runs north – south alongside the reservoirs. The benefits of using the towpath arise from the minimal disruption to local infrastructure, (i.e. road closures) and the likelihood of some of the excavation being soft dig, and therefore cheaper.

5.4.2 However, in order to determine the feasibility of routing part of the ULV DEN network along the towpath, it was necessary to seek advice from British Waterways, who manage the majority of the UK’s network of rivers and canals, on the appropriate procedures for requesting permission to undertake these works.

5.4.3 A British Waterways engineer responded to PB’s request for information and stated that a land use agreement must first be obtained before any works can be carried out and that, in doing so, those works must be within the terms of the Code of Practice for Works Affecting British Waterways. In applying for a land use agreement, details of
the proposed works should be accompanied by any method statements and risk assessments that may be available as well as design drawings and construction programmes. This application will then be assessed by British Waterways engineers and the probable scope of any appraisals, and the level of technical resources British Waterways will need to provide to service the works, will be determined on this basis.

5.4.4 The application is subject to a fee of £456 (inclusive of VAT), which covers approximately 3 hours of engineering time for the initial assessment of the project. Furthermore, a Cost Undertaking must be signed and returned to British Waterways, which obligates the developer to meet any further legal, engineering or administrative costs incurred by British Waterways up to the sum of £1,856 + VAT (any costs incurred above this value are subject to further notification from British Waterways). A copy of this undertaking can be found in the appendices (Section 21).

5.4.5 In order to begin this process, a Notification Form must be completed and returned to British Waterways. This can be found in Appendix 1 of the Code of Practice.

5.4.6 Some experience of requesting easements from British Waterways has been gained through the London Thames Gateway Heat Network project – initial British Waterways costs for an easement are understood to have been prohibitive. This suggests that for the feasibility level design of an ULV DEN, it is important to develop designs that are not dependent upon British Waterways routes, i.e. that alternatives on public highways should be developed in parallel.
6 ELECTRICITY NETWORKS AND THE SALE OF ELECTRICITY

6.1 Electricity networks

6.1.1 The London boroughs of Haringey and Enfield are in the Eastern Power Networks (EPN) area of UK Power Networks, while part of Waltham Forest is in EPN (Chingford) and the rest in London Power Networks (LPN) area.

6.1.2 The EPN and LPN Planning Engineers have responsibilities associated with reinforcement/new connections/asset replacement on the HV network (11kV, 33kV, 132kV) within their areas.

6.1.3 The EPN and LPN Long Term Development statements have an overview map of their distribution areas and show both the 132kV and 33kV substations in the three boroughs of Waltham Forest, Haringey and Enfield. This is included in Section 6.2 below.

6.1.4 In urban areas 11kV networks are predominantly underground.

6.1.5 As part of the regulatory requirements, UKPN provides load forecast for the next 10 years and as such the reinforcement plans are relatively accurate within this timeframe, forming part of the DNO submission to OFGEM for each distribution price control review (DPCR).

6.1.6 A 40 year forecast is very difficult especially as new strategies are being developed as part of the Low Carbon Transition Plan. UK Power Networks is moving towards Smart Grids with new projects under evaluation/test which will also enable an increasing level of DG to be connected to the network. A new team within UKPN was recently formed to focus on several projects in London including enabling and integrating Distributed Generation.

6.1.7 From a DNO perspective, in any particular area of the network, the connection of medium scale generation (~5-20MVA) may be limited by an available 11kV or 33kV point of connection (usually at a Primary or Grid substation) and high fault level. This may result in costly system reinforcement before connection is allowed.

6.1.8 Substations like Tottenham Grid have a high fault level due to substantial generation connected at 33kV. This can be mitigated by changing the network running arrangement (for example opening the bus section) resulting in operational constraints and increased network risk. There are other solutions such as use of fault current limiter which are under review. There is also potential impact on power quality, network losses and load flow. Depending on the type and availability of the proposed generation, the connection of DG may be an option to avoid network reinforcement but this would be determined by system study for any particular proposal.

6.1.9 The fault level of equipment can limit the amount or available points of connection for generation. This is the result of several factors such as age of equipment (technology level), location and density of the network and connection of generation assets.

6.1.10 Implementation of DG, especially at lower voltage level, can result in a decrease of demand from the upstream network. For example on 33/11kV primary substations where the demand is close to or above the firm capacity (i.e. capacity available immediately following an N-1 situation) UKPN would consider several options such as load transfer to adjacent substations or reinforcement (i.e. increase firm capacity). If generation is connected to the 11kV network it will decrease the demand from the primary substation to values below the firm capacity thus removing the need to reinforce. This is a simplified view as ability to connect will depend on factors such as
type of generation, availability and network topology. It will also require a greater visibility and control of the network as the generation will mask the load of that feeder/substation. However, even this simplification illustrates the complexity of the considerations involved in network design, and the difficulty of commenting on specific locations under present conditions without carrying out detailed network analysis. Predictions of future conditions carry further complexity.

6.1.11 The assessment of generation connections is made on a case by case basis due to the varied nature of the EPN network and the specific impact of the proposed generation connection.

6.1.12 Whilst it is difficult to predict costs or available capacities at different points in time and different locations, as a general rule, it is worth highlighting that where significant generation capacity currently exists, the network’s capabilities reflect this, and the replacement of this generation is less likely to incur significant costs for network reinforcement or rearrangement than an equivalent application for generation plant in other locations.

6.2 Specific electrical supply arrangements

6.2.1 Below is a location map showing the location of the boroughs of Enfield, Haringey and Waltham Forest with their associated grid supply substations.

6.2.2 Grid supply substations are shown in red and UKPN primary 11kV substations are shown in green. Schematic diagrams are available in the UKPN Development Plans\(^2\). These show more detail of the supply arrangements but indicative feed points are also shown on the map below:

\(^2\) [www.ukpowernetworks.co.uk](http://www.ukpowernetworks.co.uk) - PB can provide the documents referred to in this study on request.
6.3 Sale of generated electricity

6.3.1 Electricity generated at small / medium scale can attract value to operators in a number of ways:

- Generated power is used on-site, displacing the need for imported electricity. Generated power is therefore valued at the relevant import tariff (medium to very small industrial users prices range from around 7.3p/kWh to 12p/kWh\(^2\))

- Generated power is exported to grid and sold via a power purchase agreement (PPA). Values vary with scale and firmness of generation, but typically might be in the range of 3p/kWh to 5p/kWh.

- Generated power is supplied to specific customers, either using a ‘netting off’ agreement, or via the ‘supply licence exemption’ for small generators. This could be over private wires or distribution network operator-owned grid. This type of arrangement leads to sales values that are competitive with the retail market, but there are administrative costs associated with the sales.

6.3.2 The sales price of electricity is important to this study, as the value of heat compared with the potential loss of electrical revenue forms the basis of the economic incentive for the steam turbine operators (e.g. existing Edmonton Incinerator, Enfield Power

\(^2\) Table 3.4.2, QEP March 2011, referring to last quarter 2010 prices.
Station CCGT) to export heat. As the value of each unit of electricity sale increases (as is widely anticipated over the next decade), the lost revenue has to be recouped through heat sales.

Figure 6-2 Sensitivity of heat generation costs to electricity price fluctuations

6.3.3 The projection that electricity prices are likely to rise has potentially positive implications for those options where the generation of power is largely decoupled from the wider traditional utility markets (e.g. Kedco gasifier, Edmonton gasifier options). For these options, profitability of power generation alone should increase, leaving greater potential for these generators to contribute to heat network development. The cost of heat generation itself would not change – hence for these options no variation is shown on the figure above.

6.3.4 Electricity ‘supply licence lite’

6.3.5 Increasing the value of electrical export

6.3.6 One key mechanism that is under development is the use of an ‘electricity supply licence lite’. This is a new electricity supply licensing arrangement contained in proposals that Ofgem published in February 2009. The broad rationale behind these proposals was to provide a cost-effective means for smaller electricity generators / supply companies to operate as licensed suppliers on the public networks. It is widely acknowledged that the existing licensed supply and generation markets are complex and difficult to access, with high levels of fixed cost that require large volumes of sales to be delivered commercially.

6.3.7 The ‘supply licence lite’ seeks to disaggregate the electricity industry-facing services that are intrinsic to the functioning of the wider system (e.g. Balancing and Settlement Code, Master Registration Agreement), from the customer facing services (e.g. meter reading / billing) that can be carried out by an ESCo or other special purpose vehicle.

---

23 Distributed Energy – Final Proposals and Statutory Notice for Electricity Supply Licence Modification: Ref:08/09, Ofgem
However, a licensed body needs to carry out the industry-facing services, and hence the proposal is that an organisation wishing to benefit from the ‘supply licence lite’ would have to procure certain services from a registered supply company (e.g. one of the ‘big six’). These services would be covered by a ‘Supplier Services Agreement’ and work is on-going to define these services to the extent that they could be priced by licensed suppliers.

6.3.8 However, barriers to the realisation of this system include:

- There is no legal obligation on existing licenced suppliers to provide the services encompassed by a ‘Supplier Services Agreement’, and indeed they have a vested interest to preserve their markets (e.g. to prevent the entry of smaller suppliers).

- A lack of price control and transparency on the ‘Supplier Services Agreement’ services could lead to prices that render the whole arrangement uneconomic.

6.3.9 PB has consulted with Robert Tudway (who has been instrumental in the development and continuing progress on the ‘electricity supply licence lite’), and the strong recommendation at this stage is that the mechanism should not form part of any financial models of scheme viability, given the level of uncertainty of its development.

6.3.10 PB’s concern when looking at this option is that it is difficult to see where the additional value to an ESCO would come from. The licence arrangement would still require the electricity supply company to undertake all the normal processes (and therefore incur the same costs as they would under their normal operations). There are no changes to the DUoS charges (and indeed in some cases the DNOs have argued that the charges should be higher where assets are notionally used both up and down the voltage chain. The ESCo would have to carry the costs of customer management which may actually be higher than for a larger supplier benefiting from scale economies.

6.3.11 The critical issue in relation to the ‘light licence’ is the electricity supply company arrangement. The general understanding that DECC has is that the provision of these services to a ‘light’ licence holder should represent a negligible cost to the electricity supply company. The rationale for introducing the light licence was to be able to introduce the opportunity of selling electricity directly to customers, without the burdens of being a signatory to the various industry codes (Master Registration Agreement; the Distribution Connection and Use of System Agreement, the Connection and Use of System Code, and the Balancing and Settlement Code) and having to invest in the IT systems required to administer these.

6.3.12 The only area where the electricity supply company may be willing to offer something extra is in sharing margin, it is not apparent at present how this would differ to a normal negotiation on sale price for export. It therefore appears that any net revenue benefit would be marginal at best and that the ESCo would carry some significant additional risks.

6.4 Electricity Network Conclusions

6.4.1 Current strategic planning for power infrastructure is carried out on a 5-year basis, and hence it is difficult to comment on long-term strategic development of apparatus. However, in broad terms, the proposals outlined the preferred options identified in this report do not imply significant change in power generation capacity - i.e. it is assumed that allowance has been made in UKPN’s plans for the Kedco Gasifier’s additional
generation output. The decommissioning of the Edmonton Incinerator would reduce capacity by approximately 32MWe, to be potentially replaced with other EfW plant that is likely to have a reduced level of total output. On this basis no significant implications on electricity infrastructure are anticipated, and no ‘abnormal’ costs for connection have been factored into viability assessment.
7 PLANNING: MECHANISMS TO FACILITATE AND IMPLEMENT A DEN

7.1.1 Adapting to climate change is a key strategic objective embedded in the planning system via the planning policy framework. The general policy driver which filters down through national, regional and local policy levels is the aim to reduce greenhouse gas emissions and increase the use of low carbon energy. This can be achieved through the deployment of decentralised energy networks (DENs) and schemes including CHP systems.

7.1.2 This chapter considers existing and emerging policies and how the planning system can be utilised to deliver the implementation of decentralised energy.

7.1.3 The main potential functions envisaged for the planning system in encouraging DENs could perhaps broadly be summarised as:

- Requiring developments where appropriate to connect to existing and planned networks
- Securing contributions to strategic infrastructure from developments
- Safeguarding pipework routes and strategic locations, and facilitating DH infrastructure installation (e.g. by identifying corridors and zones and preventing development of ‘obstacles’ to strategic DH infrastructure)
- Requiring, where appropriate, potential sources of heat to make their waste heat available to networks through appropriate design
- Requiring new developments to meet technical standards such that they are ‘DH – compatible’

7.1.4 This summary is not intended as a definitive list, but captures some of the key means through which DENs should be encouraged in the ULV.

7.2 Planning policy framework

7.2.1 The planning policy framework is made up of national policy and policy advice statements, London-wide strategic policies in the London Plan and borough-specific policies in Local Development Frameworks. The importance of DENs in contributing to the reduction of greenhouse gas emissions is recognised at all policy levels from the national Planning Policy Statement 1 (PPS1) and the Planning & Climate Change Supplement to PPS1, to the regional level (The London Plan), and in local emerging and adopted Local Development Documents (LDDs).

7.2.2 Planning Policy Statement (PPS) 1: Delivering Sustainable Development advises planning bodies to prepare policies which:

... seek to minimise the need to consume new resources over the lifetime of the development by making more efficient use or reuse of existing resources, rather than making new demands on the environment; and should seek to promote and encourage, rather than restrict, the use of renewable resources (for example, by the development of renewable energy). Regional planning authorities and local authorities should promote resource and energy efficient buildings; community heating schemes, the use of combined heat and power, small scale renewable and low carbon energy schemes in developments...

7.2.3 Planning & Climate Change Supplement to PPS1 recommends planning bodies integrate climate change considerations into all spatial planning concerns, with a focus on making good use of opportunities for decentralised and renewable or low

---

25 ODPM (2005), Pg9, PPS1: Delivering Sustainable Development, HMSO
carbon energy. This should be reflected in regional and local planning policies. In drawing together local requirements for decentralised energy in local policies, local planning authorities should:

(i) set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured;
(ii) where there are particular and demonstrable opportunities for greater use of decentralised and renewable or low-carbon energy than the target percentage, bring forward development area or site-specific targets to secure this potential; and,
(iii) set out the type and size of development to which the target will be applied; and
(iv) ensure there is a clear rationale for the target and it is properly tested26.

7.2.4 The national policy framework reflects low carbon energy targets, which stem from international agreements to reduce greenhouse gas emissions and are set by the government. At the regional level the London Plan also contains ambitious targets for greenhouse gas emissions reductions. The Mayor of London aims to achieve a 60% savings in London’s annual CO\(_2\) emissions against the 1990s levels by 2025 – this is equivalent to 18 million tonnes of CO\(_2\) emissions per annum. This target highlights supplying 25% of London’s energy demand through DE networks by 2025.

7.2.5 The London Boroughs of Enfield, Haringey and Waltham Forest are taking forward policies through their adopted or emerging LDF Core Strategies and other Development Plan Documents (DPDs). These refine the energy policies set at the strategic city-wide level in the London Plan to become more locally focussed. The adopted local and London Plan policies form the overall development plan. A review of the policy framework applicable to the three London Boroughs can be found in Appendix E (Section 20).

7.2.6 Developments that are key to the success of implementing a DEN will be of a scale that puts them in the ‘major development’ or ‘strategic development’ categories as defined by the London Plan, and hence would be referred to the GLA. The London Plan and borough’s LDF policies would be used as part of the overall development plan framework against which the compliance of all applications would be assessed. The key London Plan policies most relevant to DEN emergence are the energy hierarchy and other elements of Policy 5.2:

26 ODPM (2007), Pg16, PPS1: Planning and Climate Change Supplement to PPS 1, HMSO
7.2.7 Through this policy, a mechanism to prioritise the use of decentralised energy is already in place for the London area via the ‘be clean’ hierarchy level and by London Plan Policy 5.5 in particular (see Figure 20-1 London Plan Policy 5.5). The implementation of this policy would fulfil some of the key planning requirements in assisting DEN emergence, however, additional DPDs and supporting documents are required to meet all of the objectives outlined at the start of this section (section 7.1.3).

7.2.8 An emerging sub-regional planning document that is currently being produced by the GLA in close collaboration with the ULV boroughs is the Opportunity Area Planning Framework (OAPF) for the Upper Lee Valley. This document will constitute strategic planning guidance and set out the vision for the sub-region. The OAPF will build upon the London Plan’s policies, clarify their implementation in the local context, and will form a material planning consideration for the ULV boroughs. A draft of the ULV OAPF is anticipated to be released for public consultation in late 2011, and adoption planned in Spring 2012. The strategic and cross-borough nature of this document mean that it is an excellent planning vehicle in which the benefits and requirements on development to connect to an emerging DEN can be emphasized.

7.2.9 A key resource to support DEN emergence is the LDA’s Decentralised Energy and Energy Masterplanning (DEMaP) project. This provides expertise to facilitate and accelerate delivery of decentralised energy projects across London. The DEMaP project is working towards a vision for DE via the London Heat Map. The three ULV boroughs engagement with this process demonstrates their motivation to develop DE networks. In the context of the new Government’s emphasis on local leadership, taking local initiative by developing cross-borough interaction on DE networks appears appropriate to the direction of wider policy. The analysis below (and in the accompany appendices) details the plans and policies set out by the three ULV boroughs.

7.3 Local Policy Analysis

7.3.1 London Borough of Haringey

7.3.2 Haringey are currently (June 2011) going through their Examination-in-public phase of the adoption of their draft Core Strategy. Within this draft document, Strategic Policy 4 – Working towards a Low Carbon Haringey, is the key policy supporting...
decentralised energy. The Policy is focused on decentralised energy networks and provides a strong basis for steering developments towards connection:

_The Council will promote low- and zero-carbon energy generation through the following measures:_

a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;
b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;
c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and
d. All new developments will be required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration which can include connections to local sources of decentralised renewable energy.  

7.3.3 As for many policies of this nature, the critical element in implementation relates to the interpretation / proof of feasibility and viability. In this context, this report gives a high level indication of the overall viability of a strategic decentralised energy network, but it is not the role of this study to indicate whether connection of individual premises or development loads is likely to be economic – too many specific local factors are involved in negotiations of this nature. However, as experience of planning applications under similar circumstances illustrates, it is important for planning officers to be able to point to strong Policy frameworks in this area. One means of potentially strengthening the Haringey draft policy would be to place the burden of proof on the Developer. Rather than the use of ‘where feasible’, an alternative formulation might be ‘unless the Developer can demonstrate that this is not feasible’.

7.3.4 London Borough of Enfield

7.3.5 Enfield Council adopted its LDF Core Strategy in November 2010. One of the London Plan’s objectives it cites is “increasing the proportion of London’s energy supplied from decentralised, renewable and low carbon sources”. This action is facilitated by Core Policy 20 – Sustainable Energy Use and Energy Infrastructure which states:

..._The Council will set local standards and targets, based on an understanding of local potential and opportunities for renewable or low carbon energy and existing or planned decentralised energy infrastructure._

7.3.6 This local Policy does not explicitly re-iterate the London Plan energy hierarchy, but as noted above, the London Plan policies are the _de facto_ framework against which applications will be assessed. Nevertheless, the emergence of a DEN in Enfield would benefit from the inclusion of Policy that shifts the burden of proof of viability onto Developers, which could be contained within a modified ‘energy hierarchy’ similar to that developed by LB Haringey.

7.3.7 London Borough of Waltham Forest

---

27 LB Haringey, (2011), Strategic Policy 4, Pg 91, Haringey Core Strategy Proposed Submission May 2010, LB Haringey
7.3.8 LBWF has prepared its Core Strategy Proposed Submission, which was out to consultation until February 2011. Core Strategy Policy CS5 - Minimising and Adapting to Climate Change commits the Council to tackling:

...climate change locally and promote resource efficiency and high environmental development (by)...

...E) working with partners and developers to promote and facilitate the delivery of local decentralised energy capacity and networks, especially district heating systems in appropriate areas of the Borough, in particular in the key growth areas.\(^{29}\)

7.3.9 The Core Strategy will be supplemented by the Development Management Policies DPD. The DM DPD provides further details and targets and set out criteria base policies which will be used to assess and determine planning applications. Preferred Options DM11 and DM12 address low carbon standards and the DPD contains draft requirements for Developers to meet. Preferred Options DM12 states “The Council will seek to reduce carbon emissions by:

B. Requiring new developments to assess opportunities for and implement decentralised heat and energy networks where appropriate, including links into and expansion of existing networks, unless it is demonstrated that there is not enough heating demand for an efficient connection;

C. Requiring major developments that have demonstrated that the connection to an existing or the implementation of a new decentralised energy network is not feasible, to be connection ready for future networks and to make a contribution towards the installation of an area wide decentralised energy network or other carbon reduction measures within the borough, where appropriate;

7.3.10 This policy introduces the important concept of being ‘connection ready’.

7.3.11 Other related mechanisms

7.3.12 Whilst not strictly part of the planning framework, it is also worth noting that there are a number of key initiatives and existing mechanisms / measures that support the development of DE Networks. These include at a national and EU level:

- The Carbon Reduction Commitment
- JESSICA – with £64m for DE development
- The Low Carbon Transition Plan and supporting strategies
- Renewable Obligation
- Feed-in tariffs
- Renewable Heat Incentive

7.3.13 At a regional level important mechanisms include:

\(^{29}\) LB Waltham Forest, (2011), Policy CS 5, Pg 75, Waltham Forest LDF Core Strategy - Proposed Submission 2011, LB Waltham Forest
7.3.14 Environmental Considerations

7.3.15 The deployment and implementation of decentralised energy systems need to be carried out in a manner that is sensitive to the both the environmental impacts that might arise, and environmental designations. These two aspects of DEN delivery are analysed briefly in the paragraphs below:

7.3.16 Air Quality Considerations

7.3.17 The use of some decentralised low carbon technologies can increase emissions of local pollutants to air. In London, where air quality is an important health issue, this can lead to a conflict of interest between the need for carbon reductions and the need to preserve local air quality. The three boroughs in this study have all been declared Air Quality Management Areas. In the case of the technologies under consideration here, it must be noted that the Waste Incineration Directive (WID) imposes very stringent standards on emissions to air from installations disposing of waste. Similarly, the use of gasification technology as a means of chemical conversion of the energy in biomass results in much lower emissions to air than a comparable scale of biomass combustion plant. As such, whilst the impacts of the key technologies addressed in this report must be assessed and gauged against the general background level of pollution, the additional impact must be also be considered against the potential cumulative impact of many small scale plants. If there is no strategic energy masterplanning of the area, and piecemeal energy solutions emerge, the cumulative impacts of the small-scale plants installed are likely to exceed the emissions of a single large facility with sophisticated emissions abatement technologies. However, the balance between impacts and benefits can only be decided upon on a site by site basis when details of technologies, attenuation plant and their associated emissions (alongside the avoided emissions of the ‘business as usual case’) are proposed.

7.3.18 Local Environmental Designations

7.3.19 Some areas that provide excellent routes for district heating pipework installation may be subject to local environmental designations (e.g. Sites of Special Scientific Interest, Areas of Outstanding Natural Beauty, etc). At this stage, network routes have not been designed or tested with regard to these areas. At feasibility stage, the acceptability of pipework installation in these areas should be tested with relevant stakeholders to gauge whether the cost benefits of the route justify the disruption caused to the designated areas.

7.4 The Next 40 Years

7.4.1 Strategic planning conventionally looks ahead over 15 year periods, with updates in delivery and implementation mechanisms typically carried out every 5 years. A wide variety of factors such as government ideology, international politics, economic conditions, demographics, and the successes and failures of previous policy influence policy evolution, and mean that it is difficult to predict the long term direction of planning strategy.

7.4.2 However, there are a number of policy drivers which seem unlikely to change, of which sustainable development generally and the need to adapt to and mitigate against the impacts of climate change specifically are key. Policy over the coming
decades is expected to continue to steer development towards achieving this. Economic drivers such as the increasing cost of energy as a result of increased global demand are expected to drive spatial planning policy in the same direction.

7.4.3 The outcomes of these drivers are most likely to include a continued or increased focus on resource-efficient development together with locational policies that reduce the demand for travel and thus enhance opportunities for integrated patterns of development which are well matched to DEN.

7.5 Key mechanisms for DEN implementation

7.5.1 A description of some of the key planning mechanisms / tools available, and which have been considered in this study are outlined in Appendix L (Section 27). The table and paragraphs below summarise the recommendations of the planning analysis carried out around these tools and what mechanisms best suit the planning system objectives outlined at the start of this section (7.1.3).

Table 7-1 Planning system key objectives and potential mechanisms

<table>
<thead>
<tr>
<th>Objective</th>
<th>Mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requiring developments to connect to existing and planned networks where</td>
<td>Exists in London Plan policy, and some LDF policies. Could be supplemented by additional guidance on how this will be implemented (SPD or OAPF).</td>
</tr>
<tr>
<td>appropriate</td>
<td></td>
</tr>
<tr>
<td>Securing contributions to infrastructure from developments</td>
<td>CIL primarily. S106 agreements in the short term (e.g. to 2014 or earlier if a CIL schedule is adopted prior to 2014). Allowable Solutions mechanism may emerge, but this is still in development.</td>
</tr>
<tr>
<td>Safeguarding pipework routes and strategic locations</td>
<td>AAP / other DPD</td>
</tr>
<tr>
<td>Facilitating DH infrastructure installation</td>
<td>LDO / NDO</td>
</tr>
<tr>
<td>Requiring potential sources of heat to make their waste heat available</td>
<td>AAP / other DPD</td>
</tr>
<tr>
<td>to networks through appropriate design</td>
<td></td>
</tr>
<tr>
<td>Establishing principle of DH compatibility for development</td>
<td>AAP / other DPD</td>
</tr>
<tr>
<td>Setting technical standards to achieve DH compatibility</td>
<td>SPD in conjunction with DPD policy</td>
</tr>
</tbody>
</table>

7.5.2 There are several different options listed to achieve some of the key objectives, and the benefits of each approach should be considered by the three boroughs to come to a joint agreement on what the most suitable vehicle for supporting the DEN growth in each area would be. It may be possible to achieve all of the objectives via several
different planning mechanisms, and hence the key recommendation here is that the boroughs should continue to work in partnership to develop a collaborative approach that can be developed efficiently and applied effectively across the ULV.

7.6 Planning Mechanism Conclusions

7.6.1 The London Plan includes policies that require developments to consider connection to existing and planned decentralised energy networks. LB Haringey has a similar policy in its proposed Core Strategy. Waltham Forest also has a similar policy requirement in its emerging Development Management DPD. London Plan policy forms part of the development plan framework against which applications are assessed.

7.6.2 The above table has outlined a number of planning mechanisms that could be involved in supporting DEN delivery. It is expected that the preferred approach will include a combination of several of these mechanisms to maximise the likelihood of success of a DEN. However, identifying the best suited approach will require further discussions and agreement between the 3 ULV boroughs at the next stage of the project.

7.6.3 Within the chosen delivery policies and supporting documents, it is important to be clear where and when it is anticipated that the ULV DEN is most likely to emerge, such that the implementation of policy can be targeted to appropriate areas and timescales for new development. The following map illustrates an initial proposal of a DH network route, together with key heat demand clusters. A ‘connection zone’ is proposed around this route (and key demand areas) to illustrate an area within which all new development (and refurbishments subject to planning control) would be expected to connect to the network. It is important to recognise that this is only indicative at this stage, and subsequent feasibility stages of work will need to firm up on these routes, requirements, and dates when they would apply.
7.6.4 The planning documents developed should clarify that buildings within this zone are required to connect to the DEN, unless they can demonstrate that on a whole life cost basis connection is significantly less economic than their proposed alternative. The policy wording could include figures that are to be used in calculations of this value, stipulate how the comparison of economic viability is to be assessed, including for example, an explanation of ‘significant’ in this context. The development of suitable criteria for this document could form part of the next stages of project development.

7.6.5 **Partnership working** – It is recommended that the three ULV boroughs continue to work on a spatial planning partnership, based on existing partnership arrangements, with a focus on coordinating a cross-boundary strategy addressing the promotion, identification, and delivery of DEN at both site and area levels. As a priority, this strategy should focus on policy document development between the three ULV borough Planning teams, in conjunction with the GLA. Further partnership working could include preferred routing workshops and engagement with the low carbon industry sector and developers to help develop the physical aspects of the scheme and promote information exchange. Such partnership should carry forward to the planning application stage through pre-application discussion, which, where appropriate, may be best delivered via a Planning Performance Agreement.

7.6.6 The key benefit of partnership working between the boroughs would be an integrated approach which can be spatially applied without the constraints of administrative boundaries. This may open up opportunities for transboundary DENs (e.g. potentially resulting from cross-boundary industry sector discussions) or opportunities which drew upon a multi-authority approach (e.g. from Planning team collaborations) potentially extending to a strategic CIL approach.
7.6.7  Ill-coordinated partnerships can bear risks, particularly in terms of delivery and implementation, which often come at a financial cost. Good partnerships should be built on clear objectives agreed by all partners and executed by distinct leadership, sound consultation with key stakeholders and implemented with an organised and robust strategy.

7.6.8  **Neighbourhood planning** – It is recommended that the three boroughs give consideration to working with local communities in developing minor scale DENs. This could be implemented by building on the principles of partnership working with the low carbon industry and developers forming relationships with local communities to deliver such schemes. Furthermore, such schemes could benefit from Neighbourhood Development Orders (NDOs) to enhance their financial viability.

7.6.9  **Planning obligation** – It is recommended that the three boroughs utilise CIL mechanisms in generating funding for low carbon initiatives such as DENs, thus spreading the burden of DEN development costs on developers. With an adopted CIL charging schedule as part of the boroughs’ Local Development Frameworks, it would be possible to lever contributions to DEN delivery through the CIL system. The boroughs should address this funding requirement in relevant policy documents as well as in their Infrastructure Delivery Plans. These mechanisms may be supplemented by the ‘Allowable Solutions’ route in the future, but this has yet to be fully developed and confirmed.
8 STAKEHOLDER ASPIRATIONS

8.1.1 In order to assess what would constitute success to key stakeholders in terms of the emergence of a decentralised energy network. An aspirations workshop led by PB was held on the 31st March 2011.

8.1.2 The purpose of the workshop was to establish a “long list” of aspirations. These were then prioritised to establish which were the most significant so that they could be highlighted in subsequent work, and to establish whether there were any conflicts between the priorities or areas where clarifications were needed to specific aspirations.

8.1.3 All aspirations were noted, and an indicative tool developed to assist stakeholders to understand the performance of different options for the DEN against those aspirations.

8.2 Aspirations Workshop

8.2.1 The stakeholders present at the workshop included representatives of the three London boroughs, the NLSA, the LDA, and the North London Waste Authority. SQW, who have contributed to work around inward investment for the study, also attended the workshop, albeit as an observer rather than a stakeholder participant. A full list of attendees is included in Appendix C.

8.2.2 The format of the aspirations workshop followed the agenda contained within Appendix C, and the section below summarises the key questions that respondents were asked, and the output responses.

8.3 Questions and Outputs

8.3.1 Attendees were initially asked to ‘brainstorm’ their aspirations for what the network should deliver onto post-it notes. These were then categorised and displayed for the participants to consider and comment on.

8.3.2 This initial round delivered the following numerical results according to categories, and effectively forms an ‘unweighted’ set of priorities.

<table>
<thead>
<tr>
<th>Category</th>
<th>Fuel poverty reduction</th>
<th>Low Carbon</th>
<th>Deliverability</th>
<th>Using waste heat</th>
<th>Inward Investment</th>
<th>Facilitating the growth of DE as a technology</th>
<th>Involvement and “buy in” of outside partners</th>
<th>Linking to existing businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of aspirations listed</td>
<td>7</td>
<td>10</td>
<td>7</td>
<td>2</td>
<td>13</td>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

8.3.3 As can be seen from the results table above, there is a relatively even split of priorities and reflects to a degree the wide range of key interests and aspirations for the stakeholders represented at the meeting.

8.3.4 A further round of prioritisation was then requested from the workshop attendees. Attendees were requested to ‘spend’ 6 dots to the key priorities of their organisation of those listed above – i.e. by appending 3 dots to their top priority, 2 to their second, and 1 dot to their third ranking priority. This resulted in a ‘weighted’ set of priorities, as displayed below:
Table 8-2 Aspirations workshop - weighted aspirations

<table>
<thead>
<tr>
<th>Category</th>
<th>Fuel poverty reduction</th>
<th>Low Carbon</th>
<th>Deliverability</th>
<th>Using waste heat</th>
<th>Inward Investment</th>
<th>Facilitating the growth of DE as a technology</th>
<th>Involvement and “buy in” of outside partners</th>
<th>Linking to existing businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of aspirations listed</td>
<td>10</td>
<td>20</td>
<td>26</td>
<td>5</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

8.3.5 This set of results is displayed in graphical format below:

8.3.6 This chart shows a clear set of priorities as listed by the stakeholder groups represented by the workshop attendees. As a set of ‘headline’ categories the top priorities are:

- **Deliverability** (e.g. reflecting the need for commercial viability and technically balanced solution)
- **Generating inward investment** (e.g. job creation and attracting businesses)
- **Low carbon** (e.g. reducing overall carbon emissions from the area)
- **Reducing fuel poverty**

8.3.7 Attendees were then asked to identify other key stakeholder groups or organisations that would also hold a view on the form of successful outcomes of a decentralised energy network in the ULV. The groups identified here were:
Developers
Land owners
  o Thames Water
  o Network Rail
  o British Waterways
Lee Valley Park Authority
Business support organisations
Key large businesses in the ULV
Energy regulators
Housing groups – e.g. ALMOs
NHS
ESCo / MUSCos

8.3.8 The group was asked about conflicts of interests between these groups and the stakeholders present. This gave rise to a number of discussions, some key points of which were:

- Private sector ESCo / MUSCos will have a very different agenda from the public sector bodies involved in the project. A key difference will be the rates of return expected from an infrastructure project of this nature. Raising the required rate of return expected from any particular project will reduce the ‘headroom’ for offering cost reductions to customers (e.g. also impacting the potential for fuel poverty reduction and attracting inward investment).

- That it is potentially not the low carbon agenda that has brought participants around the table to explore the opportunities for the ULV DEN, but rather the inward investment concept.

- That the delivery of a low carbon supply of heat is an expectation of the project that underpins its conception. There may be different levels of carbon savings that different heat supply sources deliver but it is anticipated that the delivery of other priorities will take precedence over maximising carbon savings.

- Timing of project delivery – the point was made that a short-term win is likely to be a key element in terms of gathering support and momentum for the emergence of a larger-scale scheme. The strategic approach suggested was therefore that short-term wins are designed in such a way as to be compatible with the longer-term, wider-area vision.

8.3.9 A further question addressed the question of what might constitute show-stoppers – e.g. what might prevent your organisation from supporting a scheme of the nature of the DEN under consideration? The key response in this context appeared to be commercial viability. However, several methods of potential financing of a scheme of this nature were also mentioned, e.g. tax increment finance, the use of prudential borrowing.

8.3.10 Other points that were also raised in discussions included:

- That there are a few key sectors that are anticipated to be fast-growing in the future – e.g. food and drink, distribution, and waste and recycling, and that the role of these sectors in the ULV and for a DEN should be examined.
- That some stakeholders have to make decisions with long-term impacts (e.g. long-term contracts) that may not match the technical imperatives of scheme development

- That there are also political cycles to take into account – e.g. that changes in administrations in the three boroughs involved may also impact the political support available to a scheme of this nature. This reinforces the view that enshrining the support of a network of this nature in Policy Documents is critical.

- That currently the heat market is not regulated. This reflects the physical difficulty of creating competition in supply without extensive heat networks with multiple heat sources, and the ‘natural monopoly’ of small scale schemes. This also has implication on the setting of heat prices, and the need for strong contractual control of the prices that ESCos can levy on its customers.

- That the long-term vision for a city-wide network would see the linking of the London Thames Gateway Heat Network and the ULV DEN in order to improve security of supply, ease of maintenance, greater resilience of overall heat sources.

### 8.4 Option assessment matrix

8.4.1 Given the key aspirations identified above, PB has identified the potential options developed for the study against the key criteria listed above. The assessment of options has been conducted on a qualitative basis, and presented in the spider format shown below. Results are included in Section 12.2:

*Figure 8-2 Option performance against aspirations rating chart*
9 STRATEGIC DEVELOPMENT MODEL

9.1 Aims and rationale

9.1.1 The modelling undertaken as part of this study has endeavoured to address a number of interrelated questions:

- What is the appropriate extent of the DEN?
  - Which load clusters is it economic to connect to the DEN?
  - How does the quantity of heat available from the various sources of heat match the extent (demand) of the DEN?

- What timetable and strategy for growth generates the best level of viability?

- Is there a particular sequence of growth of individual clusters that should be pursued?

- To what degree are various configurations of the DEN viable?

9.2 Network Extent

9.2.1 A key decision that should be made early in the strategic network design process, is the anticipated full extent of the network, such that central, early phase heat transmission infrastructure can be sized appropriately not to require replacement as other loads are added to the system and as it expands through time.

9.2.2 In order to provide an analysis of the comparative performance of different configurations of the network as a whole, taking account of the cost of the shared network elements, a calculation process has been undertaken as described below.

9.2.3 A database of the potential loads and connections has been constructed such that the sizing and cost of the shared network alters depending on the selection of loads. This allows permutations of possible loads to be analysed, with a view to illustrating which connections appear to be more economic than others.

9.2.4 In order to conduct this analysis, the individual loads clusters of the ULV have been agglomerated into 16 groups on the basis that, for example, if a strategic network were to be installed to connect to the Waltham Forest Town Hall cluster (26), then it would also connect to the Wood Street North and South clusters (32, 33). A ‘core’ selection of loads has been assumed to be always part of the scheme. These groupings are illustrated below:
9.2.5 All of the permutations of the agglomerated loads have been tested via computer modelling, and various parameters recorded for each permutation. The key parameter that is reported here is a “network cost return metric”, which is calculated by dividing the total installation cost of the network (non-discounted) by the annual heat sales volume.

\[
\text{Network Cost Return Metric} = \frac{\text{Total network installation cost (£)}}{\text{Annual heat sales volume (kWh)}}
\]

9.2.6 This represents a reasonably accurate metric of viability. The lower the value of the ‘network cost return metric’ the greater the anticipated viability.

9.2.7 Network extent results

9.2.8 The analysis process outlined above gives rise to over 65,000 permutations of loads and not all of these are reported here. Many of these are self-evidently not sensible (e.g. the connection of Cockfosters only), and can therefore be discounted. The top 100 most viable permutations of loads have been analysed, and the frequency of occurrences of the different clusters within these permutations are shown here:
9.2.9 This analysis assists in strategic scheme design in terms of extent – i.e. in deciding which clusters are likely to deliver best value to a strategic network, and second, in showing which load clusters appear least likely to add value to a strategic network.

9.2.10 The figure above shows three areas which consistently form part of the top 100 permutations of the Network Cost Return Metric analysis – these are:

- The Blackhorse Lane area
- Ponders End
- Great Cambridge Road Industrial Park

9.2.11 At the other end of the spectrum, there are also areas which do not feature more than 10 times in the top 100 permutation:

- Wood Green and Hornsey
- Innova Park
- Leyton Orient and Leyton Mills
- Northern Olympic Fringe (Lea Bridge and Marsh Lane)
- Cockfosters
- New Southgate

9.2.12 This suggests that these clusters should not be prioritised for inclusion in the DEN.
9.3 NPV analysis for network extent

9.3.1 A second, similar analysis to the Network Cost Return Metric approach outlined above has also be carried out, based on net present values at different discount rates. This is considered valuable, as it gives an indication of the balance between the cost of network installation and future income based on anticipated heat sales values for different customer types. This analysis adopts the simplified approach of assuming that the full network is installed in Year 0, and that income is seen from the whole network from Year 1 of the analysis period.

9.3.2 This analysis is intended to inform discussions of network extent, and hence the sizing of the network under this analysis has been allowed to vary with anticipated loads – i.e. when only Palmers Green is connected (rather than Palmers Green and New Southgate), then the network connection is designed only to cater for the Palmers Green peak demand, rather than being-future proofed for further expansion.

9.3.3 The results of the NPV analysis of load cluster permutations at different discount rates are shown below:

\[ Figure \ 9-3 \ NPV \ analysis \ of \ cluster \ permutations \ (3.5\% \ discount \ rate) \]
Figure 9-4 NPV analysis of cluster permutations (6% discount rate)

Number of occurrences in top 100 permutations of clusters by 6% NPV

Figure 9-5 NPV analysis of cluster permutations (9% discount rate)

Number of occurrences in top 100 permutations of clusters by 9% NPV
9.3.4 This shows that as a whole, progressively less occurrences of loads occur in the most viable schemes as the discount rate is increased. Network extent is reduced at higher discount rates. This illustrates the impact of discount rates on the balance between initial spend and future income. In terms of the selection of clusters, the results at 3.5% discount rate are considered to be the most relevant for a strategic network where its long-term performance is the most critical factor. On this basis, the only key difference between this analysis and the Network Cost Return Metric is that the loads around Tottenham perform better under the 3.5% discount analysis, and hence they are included in the strategic network design.

9.3.5 On the basis of the analysis described above, PB suggests that the extent of strategic network should be based initially around the configuration shown below (assuming sufficient heat supply capacity).
9.3.6 This network extent maintains the potential link southwards towards the Olympic Park and London Thames Gateway Heat Networks via the Leyton Mills connection point, and hence preserves the aspiration to create a city-wide network with its accompanying benefits in terms of security of supply and flexibility in operation. An illustration of the potential linking of these two schemes is included below.
9.3.7 This graph shows how the two networks effectively converge on the Olympic park where site-wide heating networks have already been installed. The existing and planned heat supply plant at the Olympic Park energy centres consists of gas-fired CHP units, biomass boilers and gas-fired top-up and standby boiler plant. Under the vision of interconnecting networks, this plant would be able to provide additional resilience to customers on the ULV network, or vice versa.

9.4 Network Phasing

9.4.1 Having established a rationale for the full extent of the strategic network (assuming no constraints on heat availability at source), further analysis has been undertaken to gain a better understanding of network viability based on additional factors such as the phasing of the installation of the network, heat supply capacity, and taking account of other factors such as connection charges for Developers of new-build schemes that are obliged to connect.

9.4.2 This analysis is based on a whole-life costing calculation, where the costs for each phase are considered to be borne in the first year of each 5-year cycle, and the revenues from income are borne in years 1 through 5.

9.4.3 Several combinations of heat demand phasing were analysed with each of the potential heat source options (see section 3.7.11) in order to move towards an optimisation of the extent and build-out suited to each option.

9.4.4 The extent of full network build-out for each heat source option has been based on matching the heat source capacity with the demands connected. The following figures illustrate the loads that have been selected to match heat demands to the heat sources of the options considered (at full build out). These effectively form the end-points of network growth phasing. Extending the networks beyond these load clusters would not result in additional low carbon heat supply, but would require significant additional gas-boiler operation (as top-up and standby) to meet demands,
decreasing the viability and increasing the average carbon content of the heat supplied.

- **Scenario A1** – Edmonton EcoPark as heat source, post 2023, 120kt pa throughput, gasifier technology

*Figure 9-9 Option A1- 120ktpa Edmonton EcoPark gasifier – recommended loads illustrating network extent*

- **Scenario A2** – Edmonton EcoPark as heat source post 2023, 327kt pa throughput, gasifier technology
Figure 9-10 Option A2- 327ktpa Edmonton EcoPark gasifier – recommended loads illustrating network extent

- Scenario A3 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 120ktpa
  - The extent of this network would be the same as for Option A1, where the total anticipated output at completion is equal to the A1 scenario

- Scenario A4 - Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 327ktpa
  - The extent of this network would be the same as for Option A2, where the total anticipated output at completion is equal to the A2 scenario

- Scenario B1 – Kedco gasifier as heat source circa 2015 onwards
Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023.
• Scenario C1 – Enfield power station steam extraction circa 2025 – assumed to operate to provide base load power to the grid (e.g. 8000hrs operation).

![Figure 9-13 Option C1- Enfield Power Station (10% steam extraction) – recommended network extent](image-url)

### 9.5 Phasing and viability

9.5.1 For each of the options above phasing variations have been tested, respecting geography and the anticipated build-out of new development. The process of developing these phasing decisions has been iterative, testing several different combinations of loads in different years in order to provide a sensible rate of network growth, a reasonable spread of capital spend over the project, and as swift a development of loads as possible to support the network installation cost. The overall viability of each scheme has then been assessed by conducting a whole life cost assessment that takes account of both connection charges that could be levied on new developments, and contributions to network costs from heat sources.

9.5.2 The phasing of development build-out and changing loads across time, alongside other metrics are displayed in Section 22 (Appendix G).

9.5.3 The following table and graphic illustrates the financial performance of the different options.
### Figure 9-14 Comparison of options (NPV basis)

<table>
<thead>
<tr>
<th>Option</th>
<th>NPV, 40 year period, various discount rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.50%</td>
</tr>
<tr>
<td>A1</td>
<td>£25,916,045</td>
</tr>
<tr>
<td>A2</td>
<td>£12,732,572</td>
</tr>
<tr>
<td>A3</td>
<td>£11,733,852</td>
</tr>
<tr>
<td>A4</td>
<td>-£582,617</td>
</tr>
<tr>
<td>B1</td>
<td>£14,484,585</td>
</tr>
<tr>
<td>B2 (Tottenham Route)</td>
<td>£15,459,160</td>
</tr>
<tr>
<td>C1</td>
<td>-£21,838,006</td>
</tr>
</tbody>
</table>

9.5.4 For ease of reference the option designations and descriptions are re-listed here:

- Scenario A1 – Edmonton EcoPark as heat source, post 2023, 120ktpa throughput, gasifier technology
- Scenario A2 – Edmonton EcoPark as heat source post 2023, 327ktpa throughput, gasifier technology
- Scenario A3 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 120ktpa
- Scenario A4 - Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 327ktpa
- Scenario B1 – Kedco gasifier as heat source circa 2015 onwards
- Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023.
- Scenario C1 – Enfield power station circa 2025 – assumed to operate to provide base load power to the grid (e.g. 8000hrs operation). Scenario included to illustrate performance against other options.

9.5.5 These figures effectively also represent the funding gaps of the different schemes at different discount rates. E.g. to make Option B2 viable at a discount rate of 9%, grant funding of approximately £10.2 million would be required.
9.5.6 These results suggest that Options A1, A2, A3, B1 and B2 display the most positive net present values across the range of discount rates used. However, a caveat must be noted with regard to this figure – the different starting dates for the different schemes (e.g. A1 and A2 start post-2023) mean that these results are not strictly directly comparable. The modelling process and development of loads through time (e.g. as new developments have greater loads that can be connected to the strategic network from a single connection), mean that schemes that develop later (e.g. A1 and A2) benefit from greater income streams over their NPV calculation period and hence appear more economically viable. Schemes that start later (e.g. A1, A2) also benefit from the larger loads anticipated in the later years. The schemes that start earlier (e.g. A3, A4, B1 and B2) are effectively penalised by having high costs upfront, but reduced income streams in the early years of their economic valuation period in comparison with those schemes starting later. This impact is increased for those schemes that are larger in extent, e.g. A2, A4, and B2, as the costs of installing larger diameter heating mains in the early years is recouped at a slower rate from the reduced level of heat sales income from the development loads.

9.5.7 The other key element to note from this high-level set of results is that the Enfield power station scheme has a set of NPV results at all discount rates that is an order of magnitude less viable than the other options. This illustrates the impact that the requirement to purchase heat at a higher price from Enfield power has on overall viability. On this basis, and also as the future of the operation of Enfield power station is uncertain, the use of Enfield as a source of heat for the ULV DEN is not recommended.

9.5.8 These figures suggest that at low discount rates (e.g. 3.5%) a number of different configurations of schemes are viable. At higher discount rates, all of the schemes that represent more strategic, larger network extents have funding gaps.

9.6 Key Assumptions

9.6.1 There are several assumptions embedded within this modelling. Some key assumptions are listed here. Appendix H summarises the key elements of the modelling process.
NPVs have been calculated over 40 years, at a range of discount rates, and starting at the time that the DEN would emerge under the different options.

Total scheme capital costs are displayed in Appendix G.

Heat sales prices are based around the mix of residential and commercial customers on each scheme, ranging from approximately 4p/kWh to 4.5p/kWh heat supplied. This figure includes an allowance for avoided maintenance and plant replacement costs.

Connection charges – for those clusters where new development is planned, connection charges per connection of £1200 per dwelling and £150 per kW capacity for non-residential units have been adopted.

The contributions that different heat sources could make to network growth have been calculated on the basis of a 15 year NPV calculation at commercial rates (12%), based upon the additional revenue that each heat source could see from Government incentives and heat sales. It is then assumed that 60% of this NPV figure could be contributed to the construction / emergence of the network, and that the heat source operator would retain 40% of this figure.

NPV calculations for central generation plant excludes the value of electricity sales – e.g. it is assumed that the construction of generation plant is justified on the basis of electricity sales alone. The only costs associated with heat sales are any modifications necessary to extract heat from the power generation process.

9.7 Individual cluster growth

9.7.1 Individual clusters of loads within the Upper Lee Valley have been assessed in two key respects for the ULV DEN Study. First, PB has gathered data on the anticipated development programme for new development within each cluster, and has used this to illustrate a ‘timeline’ of the emergence of the schemes. This makes the assumption that where clusters of loads have a significant new-build component, that a DH network would only emerge when a significant portion of the new development is constructed. Where all key loads are existing buildings, then a cluster-level network is anticipated to emerge in the short-term. For those areas dominated by industrial / commercial operations, it is assumed that buildings would connect only when a strategic heat network passes through the area.

9.7.2 Second, PB has analysed cost and performance of technologies for local networks within each cluster to give an indication of the likely viability of individual cluster-based networks. This process effectively addresses the part of the heat distribution system illustrated below labelled “Cluster area heat network”. The cost of the portion of DH distribution system that is contained within a single development (e.g. the “Network for Development A” on the illustration below) is assumed to be borne by the Developer of that scheme in order to comply with the London Plan under all possible scenarios), and no allowance for this cost has been included within this analysis.

---

30 i.e. a single entry line on the LHM database
9.7.3 The accuracy of the costs developed through this approach is limited by the available level of data available for each entry in the London Heat Map database. In some cases, for example, a range of new development sites are represented by a single line of the database (e.g. Wood Street AAP within the Wood Street South cluster). In this instance, the cost of network to link various elements of the new development cannot be assessed as no data on the geographic spread of loads is available. As a result the linear heat density analysis of different clusters and their potential viability must be viewed as indicative only. Greater depth of analysis of each cluster would be appropriate at feasibility level for specific proposals.

9.7.4 An initial indication of viability can be derived from the metric ‘Linear Heat Density’. This effectively expresses the quantum of heat demand for a given network divided by the length of network required to link all loads.
9.7.5 The higher linear heat densities displayed above represent clusters where networks are likely to be more viable. These comparative linear heat densities are shown on the map below:
9.7.6 This chart illustrates those clusters that would be anticipated to be most viable based on their heat loads and the geographic spread of loads within each cluster. This analysis does not include those areas that are primarily commercial / industrial in nature, as it is anticipated in these areas that connections would only be made with the emergence of a strategic heat network.

9.7.7 This is an important piece of spatial analysis as it gives an indication of which clusters are likely to be most viable (i.e. those illustrated by larger radii on the figure above), as well as showing which are closest to the proposed centre of the DEN.

9.7.8 This (alongside the NPV analysis outlined below in 9.7.9) leads to the recommendation that the Blackhorse Lane area and the Tottenham Town Hall clusters should be developed for two reasons – e.g. as they indicate both good level of viability and also represent useful locations with relation to the growth of the strategic DEN.

9.7.9 NPV analysis of local cluster networks

9.7.10 PB has carried out a viability assessment of the emergence of clusters on the basis of the same initial data. This process must equally acknowledge its limitations in terms of the geographic detail of some aggregated load points. This analysis reflects the networks and assumptions listed in Appendix A (Section 16) and Appendix B (Section 17).

9.7.11 Some key assumptions in modelling are listed here:
• NPVs have been calculated over 25 years, at a 3.5% discount rate

• Total scheme capital costs are displayed in the table below

• Heat sales prices are based around the mix of residential and commercial customers on each scheme, ranging from approximately 3.5p/kWh to 5p/kWh heat supplied. This figure includes an allowance for avoided maintenance and plant replacement costs. For those customers where it is anticipated that they will be subject to Carbon Reduction Commitment charges, this has also been taken into account.

• Connection charges – for those clusters where new development is planned, connection charges per connection of £1200 per dwelling and £150 per kW capacity for non-residential units have been adopted.

• Electricity sales from generation have been based around export power purchase agreements of 4.89p/kWh. In some cases, significant single-point local power consumption could allow a much higher value to be associated with generation, and this assumption therefore represents a conservative assessment of the opportunities offered by individual schemes. Feasibility level work is required to develop the detail required to confirm whether suitable electrical connection could increase the value of generation.

9.7.12 A further key caveat to note in this analysis is that the heat mapping data has not been optimised in terms of load selection to optimise DH scheme viability. The only rule that has been applied to maintain comparability between schemes is to apply a threshold level below which loads were excluded from schemes. The figure of 200MWh of heat demand was used in this normalisation. These two aspects of the cluster modelling lead to viability figures that are more pessimistic than would be the case if greater optimisation of load selection had been carried out, and with the inclusion of loads of all scales. However, equally, it has not been possible to evaluate the secondary system types and temperature requirements of the 500 loads considered, and the assumption has been made that heat demands recorded on the heat map database could be met by the DEN system. This assumption arguably leads to a somewhat optimistic assessment of viability.

9.7.13 The following table (and accompanying location map) lists the comparative anticipated level of carbon saving for each scheme, an outline anticipated capital cost, a 25 year NPV (based on a 3.5% discount rate). This analysis has taken the potential connection charge that Developers could make towards each scheme into account, introduced to the whole life cost calculation as a capital contribution figure in year 0 of the spend profile. The different shadings indicate the notional threshold at which schemes have been considered to be viable.

9.7.14 Please also note that the Hale Village scheme has not been assessed here as a site-wide DH system supplied by CHP and biomass boiler plant is already being installed.

31 Blackhorse Lane North has been included above this viability threshold line because of the potential to combine the loads of this area with those of Blackhorse Lane South to form a wider network where their combined NPVs at 3.5% are above zero.
## Table 9-1 Cluster scheme indicative viability

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no reduction on existing estimated heat sales prices, and including Developer Connection Charges) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Wood Street South</td>
<td>33</td>
<td>Approx 1.1MWe gas-fired CHP</td>
<td>2,100</td>
<td>2.8</td>
<td>£2,756</td>
</tr>
<tr>
<td>LBWF Walthamstow Town Centre</td>
<td>25</td>
<td>Approx 1.2MWe gas-fired CHP</td>
<td>1,545</td>
<td>3.6</td>
<td>£948</td>
</tr>
<tr>
<td>Haringey Heartlands</td>
<td>31</td>
<td>307kWe gas-fired CHP</td>
<td>296</td>
<td>1.3</td>
<td>£891</td>
</tr>
<tr>
<td>LBWF Blackhorse Lane South</td>
<td>2</td>
<td>635kWe gas-fired CHP</td>
<td>903</td>
<td>2.1</td>
<td>£428</td>
</tr>
<tr>
<td>LBWF Town Hall</td>
<td>26</td>
<td>Approx 1.1MWe gas-fired CHP</td>
<td>1,700</td>
<td>2.8</td>
<td>£332</td>
</tr>
<tr>
<td>Tottenham Town Hall</td>
<td>23</td>
<td>526kWe gas-fired CHP</td>
<td>846</td>
<td>1.6</td>
<td>£331</td>
</tr>
<tr>
<td>LBWF Blackhorse Lane North</td>
<td>1</td>
<td>526kWe gas-fired CHP</td>
<td>773</td>
<td>1.9</td>
<td>£340</td>
</tr>
<tr>
<td>Hornsey High Street</td>
<td>9</td>
<td>635kWe gas-fired CHP</td>
<td>896</td>
<td>3.3</td>
<td>£914</td>
</tr>
<tr>
<td>LBWF Wood Street North</td>
<td>32</td>
<td>Approx 300kWe gas-fired CHP</td>
<td>498</td>
<td>1.5</td>
<td>£1,012</td>
</tr>
<tr>
<td>Enfield Town</td>
<td>8</td>
<td>2002kWe gas-fired CHP</td>
<td>2,788</td>
<td>7.2</td>
<td>£1,160</td>
</tr>
<tr>
<td>Palmers Green</td>
<td>18</td>
<td>307kWe gas-fired CHP</td>
<td>243</td>
<td>2.7</td>
<td>£1,291</td>
</tr>
<tr>
<td>Wood Green North</td>
<td>30</td>
<td>500kWe gas-fired CHP</td>
<td>438</td>
<td>2.5</td>
<td>£1,455</td>
</tr>
<tr>
<td>Southbury</td>
<td>21</td>
<td>526kWe gas-fired CHP</td>
<td>771</td>
<td>2.3</td>
<td>£1,475</td>
</tr>
<tr>
<td>Wood Green East</td>
<td>29</td>
<td>500kWe gas-fired CHP</td>
<td>433</td>
<td>2.1</td>
<td>£1,505</td>
</tr>
<tr>
<td>LBWF NOF Leyton Orient</td>
<td>11</td>
<td>Approx 185kWe gas-fired CHP</td>
<td>248</td>
<td>1.1</td>
<td>£1,512</td>
</tr>
<tr>
<td>South Northumberland Park</td>
<td>37</td>
<td>165kWe gas-fired CHP</td>
<td>193</td>
<td>1.4</td>
<td>£1,621</td>
</tr>
<tr>
<td>Innova Park</td>
<td>10</td>
<td>526kWe gas-fired CHP</td>
<td>797</td>
<td>3.3</td>
<td>£2,236</td>
</tr>
<tr>
<td>New Southgate</td>
<td>13</td>
<td>844kWe gas-fired CHP</td>
<td>1,028</td>
<td>4.2</td>
<td>£2,567</td>
</tr>
<tr>
<td>Edmonton</td>
<td>6</td>
<td>1487kWe gas-fired CHP</td>
<td>1,970</td>
<td>6.6</td>
<td>£3,387</td>
</tr>
</tbody>
</table>
For these schemes the following table illustrates their funding gaps at different discount rates.

**Table 9-2 Individual Cluster Funding Gaps**

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>3.50%</th>
<th>6%</th>
<th>9%</th>
<th>12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Wood Street South</td>
<td>No gap</td>
<td>No gap</td>
<td>No gap</td>
<td>No gap</td>
</tr>
<tr>
<td>LBWF Walthamstow Town Centre</td>
<td>No gap</td>
<td>No gap</td>
<td>£155</td>
<td>£496</td>
</tr>
<tr>
<td>Haringey Heartlands</td>
<td>No gap</td>
<td>No gap</td>
<td>£36</td>
<td>£322</td>
</tr>
<tr>
<td>LBWF Blackhorse Lane South</td>
<td>No gap</td>
<td>No gap</td>
<td>No gap</td>
<td>£104</td>
</tr>
<tr>
<td>LBWF Town Hall</td>
<td>No gap</td>
<td>No gap</td>
<td>£155</td>
<td>£496</td>
</tr>
<tr>
<td>Tottenham Town Hall</td>
<td>No gap</td>
<td>No gap</td>
<td>£93</td>
<td>£224</td>
</tr>
<tr>
<td>LBWF Blackhorse Lane North</td>
<td>£340</td>
<td>£494</td>
<td>£623</td>
<td>£714</td>
</tr>
<tr>
<td>Hornsey High Street</td>
<td>£914</td>
<td>£1,241</td>
<td>£1,519</td>
<td>£1,716</td>
</tr>
<tr>
<td>LBWF Wood Street North</td>
<td>£1,012</td>
<td>£1,025</td>
<td>£1,040</td>
<td>£1,053</td>
</tr>
<tr>
<td>Enfield Town</td>
<td>£1,160</td>
<td>£2,268</td>
<td>£3,177</td>
<td>£3,798</td>
</tr>
<tr>
<td>Palmers Green</td>
<td>£1,291</td>
<td>£1,175</td>
<td>£1,087</td>
<td>£1,031</td>
</tr>
<tr>
<td>Wood Green North</td>
<td>£1,455</td>
<td>£1,822</td>
<td>£2,133</td>
<td>£2,354</td>
</tr>
<tr>
<td>Southbury</td>
<td>£1,475</td>
<td>£1,640</td>
<td>£1,779</td>
<td>£1,875</td>
</tr>
<tr>
<td>Wood Green East</td>
<td>£1,505</td>
<td>£1,594</td>
<td>£1,677</td>
<td>£1,740</td>
</tr>
<tr>
<td>LBWF Leyton Orient</td>
<td>£1,512</td>
<td>£1,416</td>
<td>£1,344</td>
<td>£1,298</td>
</tr>
<tr>
<td>South Northumberland Park</td>
<td>£1,621</td>
<td>£1,561</td>
<td>£1,519</td>
<td>£1,494</td>
</tr>
<tr>
<td>Innova Park</td>
<td>£2,236</td>
<td>£2,360</td>
<td>£2,467</td>
<td>£2,544</td>
</tr>
<tr>
<td>New Southgate</td>
<td>£2,567</td>
<td>£2,815</td>
<td>£3,024</td>
<td>£3,170</td>
</tr>
<tr>
<td>Edmonton</td>
<td>£3,387</td>
<td>£4,054</td>
<td>£4,604</td>
<td>£4,983</td>
</tr>
</tbody>
</table>
9.7.16 PB notes that the necessarily high-level nature of the analysis carried out at for this study means that these outputs can only be indicative. As noted above, the detail of the raw data available for the analysis means that additional optimisation of the schemes would be required to deliver directly comparable results. A further caveat to note regarding these figures is that a single Developer connection charge across time has been used. However, as noted in Section 3.5.4, this value can be anticipated to rise through time, as increased stringency of carbon targets is imposed. Using a higher Developer Connection charge level would increase the indicated viability levels on the chart above.

9.7.17 However, it is worth noting that for some smaller schemes, the figures represent a positive message. One example would be the LBWF Town Hall scheme which is based around existing single-user point loads. The combination of point loads forming the cluster allows the scheme to return a positive net present value at low discount rates (3.5% and 6%). This indicates that the scheme could be self-funding if low-cost finance can be secured.

9.7.18 These initial results have contributed to the analysis of the clusters in terms of overall viability alongside their geographic location and their timeframe of potential realisation. This is the basis on which a strategic approach to the energy masterplanning of the ULV has been developed.

9.7.19 Individual cluster growth conclusions

9.7.20 The individual cluster analysis outlined here has limitations and requires further optimisation at feasibility level. However, the overall strategic direction of this report points towards strategic network growth centred around the Kedco gasifier and Edmonton EcoPark site. This in turn suggests that the development of local cluster area networks closer to these central sites would be preferable from a strategic growth point of view.
9.7.21 This linear heat density and economic analysis conducted above, coupled with the locations of the different clusters, suggest the following:

9.7.22 Key clusters close to the core of the strategic network that should be optimised and developed as a priority in line with their new build components are:

- Blackhorse Lane North and South (either as a combined system or individually with strategic network compatibility)
- Tottenham Town Hall
- LBWF Town Hall (considering supply of neighbouring Wood Street North and South clusters in line with their development)
- Walthamstow Town Centre

9.7.23 The following remaining clusters are outside of the central area that is suggested could be supplied directly from the strategic network, but where network viability appears high, and should therefore be tested and optimised at feasibility level:

- Haringey Heartlands
- Walthamstow Town Centre

9.7.24 The heat mapping process and subsequent work has effectively identified all of the remaining clusters as having potential for local network cluster development, and hence at ‘catalyst’ times, i.e. when significant new development is emerging, the choice between direct connection to the strategic network and local networks should be assessed.
10 CARBON SAVINGS

10.1 Baseline and additionality

10.1.1 It is a key factor in terms of network strategic planning to recognise where a DEN is most likely to generate carbon savings. There are three broad categories of buildings that must be considered here.

10.1.2 For new developments (which are likely to be key to network viability through leveraging contributions from Developers), only marginal carbon savings can be expected from a DEN. This is because stringent environmental standards are required for all new buildings as a matter of course. A DEN will provide a mechanism for Developers to meet targets rather than generating additional savings.

10.1.3 For existing buildings that could be anchor load customers, e.g. local authority buildings, the network has potential to displace the supply of heat by traditional generation plant (e.g. gas boilers or other heat source), and therefore significant carbon savings can be anticipated.

10.1.4 For existing commercial sector buildings, the primary incentive for connection is likely to be low cost of heat, and the delivery of carbon savings is as a general rule, likely to be a secondary consideration. Hence, in order to generate carbon savings, viability must be achieved as a pre-requisite.

10.1.5 The above highlights that carbon savings would be generated primarily from the connection of existing buildings.

10.1.6 The baseline of calculations of potential carbon emissions savings has been assumed to be the supply of heat from gas boilers.

10.2 Carbon intensity of heat sources

10.2.1 The carbon intensity of the various heat sources examined here can be ranked. However, there is to PB’s knowledge no concrete guidance on how to calculate emissions factors for the all of the types of scenarios under consideration here, and where there is a potential disconnect between power generation processes and the use of waste heat.

10.2.2 The following figure illustrates a view on the environmental ranking of the heat sources. The chart shows carbon intensity of 1kWh of heat by considering the change in emissions from a power-only generation scenario to a heat-recovery scenario. There are no published data to PB’s knowledge on the carbon intensity of SRF or other waste sources, and hence there is some uncertainty here.
10.2.3 This chart shows that the gasifier solutions represent the best environmental options, as for this technology, there is no loss of electricity generation in the production of heat for this technology. In fact, it could be argued that there is an environmental benefit in the recovery of heat as this would save electricity consumption in heat dump radiator fan operation.

10.2.4 At the end user, all of the heat supply options illustrated here would contain a further element of emissions related to the electrical pumping to distribute heat. The figures shown above also do not take into account the element of top-up and standby fuel-use that would be seen on the DEN.

10.2.5 Two levels of carbon intensity of heat have been used in modelling. First, to reflect current understanding of Building Regulation guidance on waste heat, a blanket waste-heat factor of 0.058g\(\text{CO}_2\)/kWh has been adopted in the modelling results sheets contained within Appendix G (Section 22). This represents the level of savings that buildings connecting to a waste heat network could potentially be accredited with via the Building Regulations system. Second, for the gasifier options where no loss of electricity generation is anticipated as illustrated above (Figure Figure 10-1 Comparative Heat Emissions Factors), zero carbon heat has been assumed for headline savings figures.

10.2.6 The zero carbon heat generated under the preferred scheme would deliver a level of emissions savings for end-users currently operating gas-fired boiler plant of approximately 70% on their heat use, given the use of top-up gas-fired boilers and parasitic losses (e.g. heat losses and pumping energy). Overall carbon emissions savings (i.e. relating to both electricity and heat consumption) would depend upon the balance of power and heat use on any individual site, but the following approximate overall savings for different building types would be typical:

---

32 Based on CIBSE TM46, 2008.
General office - 21%
Large non-food shop 32%
Hotel 36%
Leisure Centre (wet) 43%

10.2.7 These typical levels of emission savings suggest that for council property portfolios, savings in the region of 25% would be achieved for buildings connecting to the strategic heat network.
11 INWARD INVESTMENT AND THE ULV DEN - SQW

11.1 Scope of Work

11.1.1 SQW was asked to provide a short report section covering evidence-based research of any positive impacts that low-carbon and low cost energy supplies have had in terms of attracting business and employment to particular areas of the UK.

11.1.2 SQW was also tasked with providing a short report collating evidence and SQW’s projections of what types/sizes of industries and businesses could be attracted to an area such as the Upper Lee Valley should a low carbon / low cost energy network become available there.

11.1.3 SQW’s work would build on the technical pre-feasibility work that PB was undertaking for the North London Strategic Alliance in specifying options for a potential decentralised energy network (DEN) that is currently being investigated for the Upper Lee Valley (ULV) area of north London. In particular, PB undertook responsibility for providing data on the quantum and type of energy that might become available from one or more of the potential technical options for a DEN.

11.2 Local Economic and Business Context

11.2.1 The three local authorities in the North London Strategic Alliance area together possess a large employment basis, hosting around 26,000 business/workplace establishments which together provide around 210,000 jobs. A number of industrial and business sectors that are potentially relevant to a DEN are particularly well represented in the local economy, including:

- food and drink manufacturing and packaging
- warehousing and distribution
- engineering
- waste management and recycling

11.2.2 Moreover, the study area is already a strategic location for waste handling, processing and recycling, and the conversion of waste to energy.

11.2.3 A number of important businesses are located in the ULV area, including the following:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Some key businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food production</td>
<td>Coca-Cola</td>
</tr>
<tr>
<td></td>
<td>Warburton</td>
</tr>
<tr>
<td></td>
<td>Greggs</td>
</tr>
<tr>
<td>Engineering</td>
<td>Turnomatic</td>
</tr>
<tr>
<td></td>
<td>Hydraulic Engineering Ltd</td>
</tr>
<tr>
<td></td>
<td>Vibra Engineering</td>
</tr>
<tr>
<td>Logistics</td>
<td>Wincanton</td>
</tr>
<tr>
<td></td>
<td>DHL</td>
</tr>
</tbody>
</table>
11.2.4 Previous work (undertaken by GVA Grimley, in 2010) has identified seven spatial concentrations of businesses (including ‘green’ enterprises) in the ULV area. These clusters cover the following locations.

Table 11-2 Key spatial concentrations of businesses

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Characteristics</th>
<th>Key Occupiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innova Park</td>
<td>Ready access to M25</td>
<td>Iceland</td>
</tr>
<tr>
<td></td>
<td>Distribution focus</td>
<td>DHL</td>
</tr>
<tr>
<td></td>
<td>Modern stock</td>
<td>Sony</td>
</tr>
<tr>
<td></td>
<td>SMEs at Business Incubator</td>
<td></td>
</tr>
<tr>
<td>Greater Brimsdown</td>
<td>Good access to M25</td>
<td>Warburtons</td>
</tr>
<tr>
<td></td>
<td>Mixed quality stock</td>
<td>DHL</td>
</tr>
<tr>
<td></td>
<td>Wide range/size of occupiers</td>
<td>Powerday Recycling</td>
</tr>
<tr>
<td>Eley’s Estate</td>
<td>Mixed quality stock</td>
<td>Coca Cola</td>
</tr>
<tr>
<td></td>
<td>Wide range/size of occupiers</td>
<td>Lubritech</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Biffa</td>
</tr>
<tr>
<td>East Tottenham</td>
<td>Poor quality stock</td>
<td>ELV</td>
</tr>
<tr>
<td></td>
<td>Wide range/size of occupiers</td>
<td>Arriva</td>
</tr>
<tr>
<td>Tottenham Hale</td>
<td>Smaller stock</td>
<td>Kardex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Murphy Ltd</td>
</tr>
<tr>
<td>Blackhorse Lane</td>
<td>Mixed quality stock</td>
<td>Warren Evans</td>
</tr>
<tr>
<td></td>
<td>Wide range/size of occupiers</td>
<td>AG Barr</td>
</tr>
<tr>
<td>Lea Bridge</td>
<td>Mixed quality stock</td>
<td>Allied Bakeries</td>
</tr>
</tbody>
</table>

11.2.5 The expectation is that the existing and potential business users located at one or more of the seven commercial clusters identified above would play a significant role in the emergence of a DEN.

11.3 Potential Options for a DEN

11.3.1 The potential sources of low cost, low carbon heat energy in the ULV include:

- waste heat from local power stations
- energy from waste at locations such as the Edmonton Eco Park, a facility jointly managed by Sita UK and the North London Waste Authority
11.3.2 The key options for the ULV decentralised heat network identified by PB were as follows:

1. A LTHW network that allows greater efficiency in heat recovery at the network heat source but which does not enable steam supply to customers, and significantly reduces the potential for chilled water supply via absorption cooling.
   - This system is understood to be capable of delivering large volumes of water to potential users along the DEN at a temperature of around 90°C Celsius.

2. A hybrid network, with:
   - a section close to the primary heat source operating at high temperature (probably as high temperature hot water (HTHW) or steam network)
     - Within the HTHW section it would be possible to provide steam to customers, and to drive high-efficiency double effect absorption chillers to provide cooling
   - a heat transfer station that downgrades the HTHW heat for further distribution in an low temperature hot water (LTHW) network
   - A wider LTHW section network has relatively high efficiency in heat distribution (e.g. in terms of low levels of heat losses) but which does not enable steam supply to customers, and offers only limited potential for cost-effective or environmentally beneficial chilled water supply via absorption cooling

11.4 Business Clustering Driven by Low Cost or Green Energy

11.4.1 The hypothesis that additional business investment (either reinvestment or new investment) can be encouraged by the availability of cheap or low carbon energy via a DEN is a potential instance of industrial ecology: the concept that industrial processes can be aligned in a system or loop, as opposed to individual processes operating linearly.

11.4.2 A number of instances from international experience demonstrate that decentralised energy systems are feasible and generate business competitiveness advantage. In the UK, operational instances of such systems are few, but several private sector-led proposals are understood to be at various stages of development and planning.

11.4.3 The following sub-section presents a brief review of relevant UK, European and other international experience with decentralised energy systems, focusing on instances that have potentially greater relevance to the situation in the ULV.

11.5 UK and European Experience

11.5.1 The best examples of industrial ecology operate in sectors such as petro-chemicals, where the waste or by-products of one industrial process provides feedstock for other
processes. The Wilton complex near Redcar on Teesside provides a good example: once a site in single (ICI) ownership, it now provides a home for over a dozen different businesses in various ownerships, with utilities (including steam and hot water) provided by an overarching site operating company (Sembcorp, a Singaporean utilities company). More recently the Wilton site has begun to attract ‘green’ businesses, including the generation of energy from waste and the production of bio-ethanol. Part of the site is currently under consideration for inclusion in the Tees Valley Enterprise Zone, with a proposed focus of encouraging investment in low-carbon chemical sector businesses.

11.5.2 A principal driver for the ‘greening’ of a switch to biological feedstocks, apart from carbon taxation, is the demand by supermarkets and multinational food and drink suppliers (like Coca Cola and Walkers Crisps) who want their packaging to derive from non-fossil fuel feedstocks as part of a drive towards achieving low carbon or carbon-neutral corporate responsibility objectives.

11.5.3 This same driver also provides a stimulus for greater usage of low carbon heat energy, and is highly relevant to the ULV because of the presence of businesses such as Coca Cola who have embraced this type of Corporate Social Responsibility (CSR) goal.

11.5.4 Having been proven to be efficient and effective in petro-chemicals over many decades, the concept of industrial ecology is increasingly being advocated for use in ‘green’ industries such as resource recovery and recycling and green energy production.

11.5.5 An outstanding example of industrial ecology in action is provided by the Kalundborg site in Denmark, which has been operating since the early 1960s. There, excess heat from an electricity power station is used as process steam in a number of adjacent industrial enterprises (including pharmaceuticals, building materials, horticulture, aquaculture and food processing) and as district heating for nearby residential areas and municipal facilities.

11.5.6 In particular, waste heat from the power station at Kalundborg is used in a number of processes, including:

- steam provided to adjacent oil refining and pharmaceuticals manufacturing and packaging operations
- steam and hot water used in the adjacent bioethanol plant
- treatment of waste water from a variety of industrial processes
- production of plasterboard and other building materials
- production of animal feeds for agriculture
- district heating for nearby residential areas and municipal facilities

11.5.7 The diagram below summarises the complexity of the relationships between 25 symbiotic projects that are present at Kalundborg. As can be seen from the schematic, the transfer of heat energy in the form of hot water and steam is an important element of the overall symbiosis present.
11.5.8 The concept of co-locating businesses involved in production/recovery of materials and energy – the Energy Park, Eco-Park or Resource Recovery Park (RRP) – has been around for several decades. As yet there is no full working example of an Eco-Park in the UK but several have received planning permission and are at various stages of development. One of the most interesting ‘in the pipeline’ examples is the Ince Marsh RRP project near Runcorn in the North West, promoted by Peel Environmental and which (after appeal) was granted planning permission in 2010.

11.5.9 The Ince Marsh site will contain:

- a Refuse Derived Fuel (RDF) Plant – 95MW
- an Integrated Waste Management Facility (IWMF)
- an Environmental Technologies Complex (ETC) which will provide a home for a range of businesses attracted by the availability of recovered resources and/or green energy.

11.5.10 The overall scheme is expected to require investment of around £300 million and is expected to provide around 1,800 FTE jobs when built and fully operational.

11.5.11 A similar concept to Ince Marshes in scale and character is also currently being developed in the Midlands by a private developer with the support of the local planning authority and the sub-regional waste authority partnership.

11.6 Elsewhere in the World

11.6.1 Elsewhere in the world there are a number of Energy and Eco-Park concepts operating, some of which involve the transmission of waste heat via networks. Some examples include:

- Sapporo (Japan) – a 20 hectare site hosting 10 private and public/private enterprises driven by resource recovery and green energy
- Kitakyushu (Japan) – green energy supplying recycling facilities, hazardous waste treatment and various manufacturing enterprises
- Singapore – Sarimbun Recycling Park and Tuas EcoPark
- Australasia – various RRPs in the major cities (e.g. Sydney, Adelaide, Canberra), some of which involve energy production and waste heat distribution
- North America – Monterey (California); Pearson Eco-Business Zone (Toronto).

11.7 Business and Investment Potential from the DEN

11.7.1 SQW was tasked with assessing the potential for attracting new and/or developing existing business investment in the ULV area based on the potential availability of a low carbon / low cost energy network there.

11.7.2 The incentives for business to respond to the potential availability of such a network could be driven by some or all of the follow considerations

- cost savings from reduced fuel usage and reduced carbon emissions
- the potential for improved summer production by removal of bottlenecks (e.g. in column overhead systems that are constrained by the availability of cooling when ambient temperatures are higher)
- energy security
- marketing and image benefits

11.7.3 Of these four streams of potential benefits, we consider that the first (cost savings) and the fourth (image benefits) are potentially the most important. This is based on evidence from a number of studies of the main location influencing factors for business location decisions, such as that identified by the Audit Commission:

- site availability (70% of businesses interviewed saying it was important or very important)
- skills (70%)
- cost of labour (61%)
- financial incentives (40%)
- proximity to customers (36%)
- transport connections (32%)
- environment (32%)

---

33 Audit Commission A Life’s Work 1999
11.7.4 Advice from PB suggests that the implementation of a DEN in the ULV might result in a reduction in average energy cost savings of 10% compared to standard sources. Clearly, such financial incentives are more powerful for businesses whose processes and activities have a larger energy requirement, albeit within the technical parameters of a either a LTHW network or a HTHW network.

11.7.5 The analysis below suggests the broad types of industrial and commercial activities that might be encouraged following the deployment of, first, an LTHW network and, second, a HTHW network.

11.8 Potential list of opportunity sectors (LTHW network)

11.8.1 A LTHW network could stimulate industrial and business activity in a range of processing industries and other business sectors, including the following:

- warehousing and distribution (space warming / hot water provision)
- commercial developments:
- such as a ‘zero carbon’ office park with space heating/hot water provided via the DEN
- targeting at any business with a ‘green’ office space requirement in North London (e.g. where the availability of ‘green’ office space is part of the business’ overall carbon reduction strategy)
- horticulture
- aquaculture

11.8.2 PB estimates that the implementation of a DEN in the ULV might result in a reduction in average energy cost savings of 10% compared to standard sources. However, even for businesses whose need is for water at high temperatures, the availability of cheaper low temperature hot water can still deliver significant cost savings. SQW estimate that the potential cost savings for businesses that require low temperature water could be as follows.

<table>
<thead>
<tr>
<th>Temperature at which water is used</th>
<th>20°C</th>
<th>30°C</th>
<th>40°C</th>
<th>50°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual savings per 1 million litres</td>
<td>£7,800</td>
<td>£15,600</td>
<td>£23,450</td>
<td>£31,300</td>
</tr>
</tbody>
</table>

*Source: SQW, based on information obtained from Anglian Water*

11.8.3 That is, for businesses requiring water at 50 degrees Celsius, annual financial savings might amount to over £31,000 per 1 million litres used. For businesses using large volumes of low temperature hot water, the potential cost advantages can, therefore, become significant.

11.9 Prospective opportunity sectors (HTHW or steam network)

11.9.1 In addition to the uses above, a HTHW or steam network could stimulate industrial and business activity in a range of processing industries, including the following:
- basic metals
  - rubber and plastics
  - engineering and light manufacturing
  - fabricated products
  - electrical equipment

- food & drink manufacture
  - production, processing and preserving of meat and poultry
  - processing of edible oils
  - production, processing and preserving of fruit and vegetables
  - manufacture of dairy products
  - production of bread, cakes and biscuits and similar products
  - production of non-alcoholic beverages (soft drinks, bottled waters)
  - production of animal feeds

- production of alcoholic beverages
  - beer
  - spirits

- manufacture of wood products, including kiln drying of timber

- paper, printing and packaging
  - paper products
  - printing
  - plastic and non-plastic packaging

- pharmaceuticals

- environmental technologies:
  - waste separation and waste treatment processes (e.g. soil and other organic material)
  - waste electrical and electronic equipment recovery
  - waste water treatment facilities
11.10 Economic Prospects and Uplift

11.10.1 In order to estimate in broad terms of economic potential for attracting additional business investment – and, ultimately, employment – to the ULV as a consequence of the availability of a DEN, we have developed three scenarios for the NLSA area. The three scenarios are specified as follows:

<table>
<thead>
<tr>
<th>Scenario Specifications</th>
<th>DEN Specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 – future without DEN</td>
<td>No DEN</td>
<td>This scenario provides a base case against which the performance of the two alternative ‘with DEN’ scenarios can be tested</td>
</tr>
<tr>
<td>Scenario 2 – LTHW DEN only</td>
<td>LTHW DEN</td>
<td>A LTHW network that allows greater efficiency in heat recovery at the network heat source but which does not enable steam supply to customers. This system is capable of delivering large volumes of low temperature hot water to potential industrial and commercial customers.</td>
</tr>
<tr>
<td>Scenario 3 – Hybrid DEN</td>
<td>LTHW + HTHT segment DEN</td>
<td>A hybrid network, with a section close to the primary heat source operating as a HTHW network (in which it would be possible to provide steam to customers, and to drive high-efficiency double effect absorption chillers to provide cooling) as well as a LTHW network operating elsewhere in the system</td>
</tr>
</tbody>
</table>

Source: SQW, with input from PB in terms of the notes provided in column 3 of the table

11.10.2 The process of quantifying the potential employment impacts of the three scenarios was as follows:

- First, we obtained up-to-date data for employment in the NLSA area, broken down into broad industrial sectors using Standard Industrial Classifications (SICs). The data source is the Annual Business Survey (ABS) survey conducted by the ONS, and is the most reliable estimate of employment in sub-national areas in the UK. The most up-to-date data at the time of writing is December 2010 data – that is, for the period up to 2009.

- Second, the latest sector growth estimates for the period 2010-2026 have been obtained for the London region. The source used for these future growth forecasts is Oxford Economic Forecasting (OEF), a highly respected source of econometric forecasts for the UK and its sub-national areas covering employment, investment and productivity growth variables.

- Third, the regional OEF sectoral forecasts are applied to the 2009 sector-based employment data for London.

- The assumption for the ‘baseline’ scenario is that businesses and organisations based in the NLSA area will change in line with the
averages for their respective industrial and business sectors across the London region as a whole over the period from 2010 to 2026.

- In order to develop the two alternative ‘with DEN’ scenarios, adjustments were made to the sector growth rates for the NLSA for the sectors that – as discussed in a previous sub-section of this report – are considered to have the potential to respond positively to the availability of cheaper, more secure or ‘greener’ (in terms of image benefits, etc.) energy via either of the alternative specifications for the DEN.

11.10.3 The results of the scenarios in term of the employment impacts for the three scenarios are set out in the table below.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Base Line</th>
<th>Scenario 1 (Reference Case)</th>
<th>Scenario 2 (LTHW DEN)</th>
<th>Scenario 3 (HTHW + LTHW segment DEN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010 employment</td>
<td>2026 employment</td>
<td>2026 employment</td>
<td>2026 employment</td>
</tr>
<tr>
<td>Agriculture</td>
<td>220</td>
<td>165</td>
<td>231</td>
<td>231</td>
</tr>
<tr>
<td>Food and Drink</td>
<td>2,876</td>
<td>2,189</td>
<td>2,698</td>
<td>2,698</td>
</tr>
<tr>
<td>Paper and packaging</td>
<td>2,146</td>
<td>1,351</td>
<td>1,528</td>
<td>1,708</td>
</tr>
<tr>
<td>Chemicals</td>
<td>201</td>
<td>137</td>
<td>175</td>
<td>187</td>
</tr>
<tr>
<td>Non-metallic materials</td>
<td>281</td>
<td>188</td>
<td>204</td>
<td>228</td>
</tr>
<tr>
<td>Metals</td>
<td>1,118</td>
<td>685</td>
<td>810</td>
<td>905</td>
</tr>
<tr>
<td>Machinery</td>
<td>522</td>
<td>340</td>
<td>382</td>
<td>427</td>
</tr>
<tr>
<td>Other manufacturing</td>
<td>668</td>
<td>594</td>
<td>632</td>
<td>632</td>
</tr>
<tr>
<td>Transport-logistics</td>
<td>11,598</td>
<td>12,908</td>
<td>13,149</td>
<td>13,149</td>
</tr>
<tr>
<td>Financial services</td>
<td>3,610</td>
<td>3,927</td>
<td>3,957</td>
<td>3,957</td>
</tr>
<tr>
<td>Business services</td>
<td>35,944</td>
<td>54,172</td>
<td>54,589</td>
<td>54,589</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59,184</strong></td>
<td><strong>76,656</strong></td>
<td><strong>78,355</strong></td>
<td><strong>78,711</strong></td>
</tr>
</tbody>
</table>

11.10.4 The results of the scenarios can be summarised as follows:

- The baseline (2010) employment in the NLSA area among the sectors that are considered to be capable of being influenced by the presence of a DEN amounts to around 59,200 FTEs.

- In Scenario 1 (no DEN), by 2026 the employment base in these sectors is expected to grow to just over 76,650. These numbers are based on underlying sectoral employment forecasts for London, generated by OEF.

- Under baseline conditions, employment growth is dominated by the growth of the business services sector. Employment in the seven
manufacturing sectors (food & drink through to other manufacturing) is expected to fall by about 30%, from around 7,800 in 2010 to around 5,500 in 2026.

- Under Scenario 2 (LTHW DEN), total employment in the NLSA area is expected to increase to 78,350 by 2026, which is an increment of 1,700 jobs compared to the Scenario 1 reference case. The main contributors to the expected increase in employment in Scenario 2 (compared to Scenario 1) are:
  - 240 additional jobs in the transport-logistics sector
  - 450 additional jobs in the combined financial and business services sector
  - the safeguarding of 950 manufacturing sector jobs that are otherwise expected to be lost under the Scenario 1 assumptions

- Under Scenario 3 (Hybrid DEN), total employment in the NLSA area is expected to increase to 78,710 by 2026, which is an increment of 2,050 jobs compared to the Scenario 1 reference case (and an extra 350 jobs compared to Scenario 2 – LTHW DEN only).

  The main contributors to the expected increase in employment in Scenario 3, compared to Scenario 1 is the safeguarding of 1,350 manufacturing sector jobs that are otherwise expected to be lost under the Scenario 1 assumptions (i.e. an increase in safeguarding of 400 jobs compared to the Scenario 2)

### 11.11 Inward investment conclusions and implications

11.11.1 The results of the scenarios indicate that there could be significant economic gains – in terms of employment (safeguarded and net additional), investment and economic output – from the creation of a DEN in the ULV area. The ability to secure these potential benefits depends on a number of factors, including the availability of suitable sites and premises to accommodate new and expanded business operations that could be attracted because of the availability of the DEN:

- the investigation of sites undertaken by GVA Grimley indicates that sufficient industrial development potential exists at the seven location nodes introduced earlier in this report

- in addition to existing development potential, industrial restructuring over the next 10-15 years may create opportunities for the recycling of sites on some of the older industrial estates in the ULV area to create platforms for new investment from users of low carbon, low cost energy that would be attracted by the proposed DEN

- We have identified that there may be opportunities to attract food producing activity (horticulture, aquaculture) into the area if low cost heating was available (LTHW) from the DEN. The potential availability of sites for such activity was not part of the remit of the GVA Grimley study,
and this aspect would need to be considered in more detail in any subsequent feasibility work.

11.11.2 The other conditions that are likely to require to be satisfied in order that the potential economic and business benefits of a proposed DEN be captured in full include the following:

- the availability of planning permissions and other necessary permits
- a strong promoter/developer or, if public sector led, the leadership and ongoing support of a strong partnership mechanism, particularly if a combination of industrial, commercial, institutional, municipal and residential uses are in the proposed mix of uses for the heat/energy to be supplied by the DEN.

11.11.3 The availability of financial incentives may also be useful in the early stages to aid development infrastructure and to encourage the first few occupiers to move in. This would assist in lending credibility to the business location aspects of the DEN, and would help secure critical mass.

11.11.4 It is interesting that the Environmental Technology Centre proposed as part of the Ince Marshes scheme in the North West has been proposed for inclusion in the emerging bid for a Cheshire & Warrington Local Enterprise Partnership (LEP). We understand that similar proposals are also under development in the Tees Valley.

11.11.5 However, we do not consider that the availability of these types of incentives is a necessary condition for a successful scheme in the ULV, although their presence would probably accelerate the rate at which businesses would be encouraged to invest and locate in the area.
12 VISION MAP

12.1.1 The development of a vision map for the ULV has attempted to balance the top-down aspiration to develop strategic infrastructure serving a wide area against the need to develop a network in a viable and realistic way. The aspiration is that the ULV network should encompass as wide an area as possible, whilst maintaining an appropriate level of heat demand density and viability. The rationale for this approach is two-fold. First, the anticipation is that over the long-term there will be power generation facilities on at least one or more of the existing sites identified in this report, and that the available level of waste heat from the sum of these sites is of the order of magnitude that is well suited to a wide-area network. Second, once a viable network is in place, it is assumed that the anticipated level of take-up from private sector customers will increase, creating a snow-ball effect in terms of overall cost-efficiency of the system. This anticipation cannot be used to form the basis of initial viability estimations, but could drive future heat supply costs down, and thereby contribute to overall competitiveness and viability of the sub-region’s network.

12.1.2 The methodology adopted bases early phase loads primarily on core customers (e.g. public sector, new development) and reflects the desire to create momentum by developing a kick-start system that could provide impetus to the connection of private sector customers, and also by demonstrating the technical and commercial potential of the design.

12.2 Option assessment against stakeholder priorities

12.2.1 PB has scored the Scenarios considered against the key objectives identified in the stakeholder workshop held at the start of the project. Not all of these elements can be assessed quantitatively, and hence some criteria have been scored qualitatively.

Figure 12-1 Comparison of Options against Stakeholder Workshop Criteria

![Comparison of Scenarios against Stakeholder Workshop Criteria](image-url)
12.2.2 This graph does not reflect different weightings for the various attributes that were considered important at the stakeholder aspirations workshop (as described in Section 8), but illustrates the anticipated performance of the Scenarios against the criteria identified.

12.2.3 The stakeholder aspirations workshop identified 4 key criteria for Scenario assessment:

- Deliverability
- Inward investment
- Low carbon
- Fuel poverty reduction

12.2.4 By multiplying the weightings derived from the stakeholder aspirations workshop with the scores outline above, the following overall weighted scores for the different scenarios are obtained.

Figure 12-2 Total Weighted Scores against Aspirations Workshop Criteria

12.2.5 This illustrates that the two options based around the Kedco biomass gasifier appear to offer the best match to the identified stakeholders’ aspirations.

12.2.6 Scenario B2 – representing a kick-start scheme based around the Kedco biomass gasifier and the expansion of the waste heat capability in 2023 with the addition of gasifier plant the Edmonton EcoPark site – is the preferred option.
12.3 Scheme Growth

12.3.1 The configuration of network growth that appears to generate the most viable growth strategy is the ‘Tottenham configuration’ – e.g. excluding the long length of connection towards the Leyton Mills area of Waltham Forest.

12.3.2 The following images illustrate the growth of the ‘Tottenham configuration’ of network.

*Figure 12-3 Scenario B2 (Tottenham Configuration) Scheme Growth 2015*

*Figure 12-4 Scenario B2 (Tottenham Configuration) Scheme Growth 2020*
12.3.3 A similar growth strategy for Scenario B2 ‘Olympic configuration’ is suggested. This is illustrated below:
Figure 12-9 Scenario B2 Scheme Growth 2020

Figure 12-10 Scenario B2 Scheme Growth 2025
12.3.4 After this point the networks have been modelled to expand only to other commercial customers adjoining this main spine network route.
12.3.5 This vision map illustrates a slightly reduced scale of network in comparison with the totality of the load clusters identified in the heat mapping phase of the study. This is designed to match the anticipated available heat from the central sources with the demands identified. However, two key comments on this aspect of the vision map are as follows:

- As noted in the ‘Heat Networks’ section, it would be anticipated that connected loads could deliver progressively lower return temperatures to the strategic network over time. This will lead to greater capacity for heat transfer in the main spine of a pipework than was initially sized on the basis of higher return temperatures. This should allow for the connection of other demand clusters to the strategic through time.

- It would be possible to specify the diameters of key sections of the strategic main for a scheme of larger scope than the vision map Scenario B2 configurations illustrated here. This would ensure that the infrastructure has the capacity to supply a wider area, even without improvements to system operation such as return temperature reduction. This approach would have an impact on the cost of the heat network installation, both in terms of pipework capital cost and required accompanying civil works. This oversizing has not been modelled in viability modelling presented in this report, but could be considered at feasibility stages.

12.4 Network diameters

12.4.1 One approach to network sizing would be to install network sections that are designed for a greater heat supply capacity than is illustrated under Scenario B2. Network leg diameters for sizing on this basis are illustrated below:

---

34 Through new development adherence to design standards contained within an SPD, for example.
12.5 Interface between individual clusters and DEN

12.5.1 One of the key ‘chicken and egg’ issues around strategic network growth is the interface between locally-operated networks and connection to a strategic system. On the one hand, technical and commercial arrangements are simplified if a strategic network supplies heat to an area from day one, whilst on the other, the strategic network is easier to justify if clusters of loads can be added to the system via a single energy centre connection.

12.5.2 What should the recommended approach be on a strategic basis? The construction costs of both the local distribution system and the strategic networks have to be recouped through heat sales margins in either approach. The use of a local energy centre feeding a local network (with gas-fired CHP, for example), means that the local network costs have to be repaid by the margin between heat generation costs (incorporating the value of generated electricity from CHP) and the heat selling price. With connection to a strategic network, these costs and the additional costs of the strategic network effectively have to be recouped through the margin gained through using more ‘advanced’ fuels, which attract more price support (i.e. ROCs / RHI), and the economies and efficiencies of scale from larger central generation facilities.

12.5.3 The advantage of moving directly to a strategic system are that some costs can be avoided – e.g. for new build, under a DEN connection solution there are no requirements for flues, a reduced footprint for heating plant would be required, and there is no element of abortive cost for plant that is not required to operate until the end of its useful life. On this basis, one of the most important criteria in this decision is therefore the timing of the emergence of the DEN. The earlier that a viable network can be established with an obligation on development to connect, the greater cost-efficiency that is likely to result on a global basis, as abortive costs (of individual energy centre/ plantroom installations) are reduced. This timing must also reflect the new build elements of the key development areas, and aim to provide certainty to development of the availability of heat. In the case of the preferred options for the DEN, when the availability of heat from Kedco is confirmed, then efforts should be directed to establishing a kick-start network linking existing sites and key development areas (e.g. Meridian Water), such that these initial sections of network can be de-risked and refinancing of the scheme can occur on a more established basis.

12.5.4 Conflict of interest

12.5.5 It is possible to envisage the instance where a private sector ESCo is operating a local network in a location that could connect to the strategic network. The private sector ESCo would want to ensure that it sees a return on the investment it has made in the local assets. At any point in time there would potentially be residual value in the primary plant the ESCo has installed. Therefore, at this local level, negotiation for the strategic network operator to ‘buy into’ the heat loads on the local network before the ESCo has returned a profit on its initial investment would be a key arena where the public sector interest and the private sector market collide. The private sector would wish to push up the price for access to the network that reflects the risk they incurred and their anticipated profit margins in the future. The public sector would wish to minimise this cost of access to the heat demands, to increase the value of the strategic network and maximise growth.

12.5.6 It is difficult to envisage means by which the local network operator could be obliged to relinquish control of its asset, and hence in this scenario the price of access to heat demands could be set at a prohibitively high level.

12.5.7 In order to avoid this potential conflict, it is suggested that within the key demand areas where local heat distribution networks are envisaged to emerge, that the public
sector should have a controlling interest in the local ESCo. This could take the form of a single organisation across the ULV.

12.5.8 A single organisation that leverages in private sector involvement could benefit from the private sector expertise, whilst enabling the strategic aims of the wider project to be upheld.

12.5.9 It would be this overarching body’s role to ensure that the development of the local schemes reflect the anticipated wider development of the district heating network. In the case of satellite cluster development, for example, it would be strategically desirable to size sections of network to suit later connection of strategic network links. This is illustrated below:

*Figure 12-14 Strategic Cluster Reinforcement*

12.5.10 In terms of the decision as to whether to progress on a localised energy centre basis, or whether to wait for the strategic network expansion, it is recommended that a simple geographic delineation should be used as an initial basis from which to move forward. The core loads around the Edmonton EcoPark / Commercial Rd / Silver Street / Northumberland Park should be targeted as potential direct customers on an emerging strategic network, and these loads should be connected directly from the Kedco Gasifier / Edmonton EcoPark network in the first instance. These core loads are as illustrated here.
12.5.11 The non-core clusters identified should move forward with local energy centres wherever possible, taking account both of local expansion potential, and the future linkages that could be required with the strategic network. If a single overarching body were to oversee this development, then a rolling programme of moving generation assets is envisaged. As interim schemes emerge, they are initially supplied by gas-fired CHP units (or alternative technology if this is deemed more appropriate through feasibility level study) that are operated until a strategic network connection is made. The heat generation assets (CHP units and possibly boilers) could then be relocated to a new local cluster.

12.6 Capital Spend Profile

12.6.1 The following tables illustrate an initial view of the capital spend profile required to implement the schemes identified within this report (based on Scenario B2 ‘Tottenham configuration’). The dark green squares illustrate the timeline of dates of key expenditure, and the lower half of the table breaks out some primary cost items along the timeline. Some of the key local clusters are included within this profile.
## ULV DEN Pre-feasibility Study

### Timeline of primary expenditure

<table>
<thead>
<tr>
<th>Item</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishing primary distribution station and waste heat capture plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First phase of network growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second phase of network growth - connection north to Ponders End</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third phase of network growth - Blackhorse Lane and Hale Village</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth phase of network growth - Wood Street (LBWF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifth phase of network growth - Whips Cross Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-going network expansion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBWF Town Hall - Establish gas-fired CHP cluster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBH - Tottenham Town Hall - Establish gas-fired CHP cluster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackhorse Lane cluster growth based on local CHP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haringey Heartlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walthamstow Town Centre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Spend Profile (£m)

<table>
<thead>
<tr>
<th>Subtasks</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishing primary distribution station and waste heat capture plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kedco to primary distribution network</td>
<td>£1.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top-up energy centre / primary distribution</td>
<td>£4.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration of gasifiers at Edmonton</td>
<td>£1.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First phase of network growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Links to central loads</td>
<td>£14.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second phase of network growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection to Ponders End</td>
<td>£18.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third phase of network growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackhorse Lane and Hale Village</td>
<td>£15.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth phase of network growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Street (LBWF), WF Town Hall</td>
<td>£12.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifth phase of network growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whips Cross Hospital</td>
<td>£8.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-going network expansion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBWF Town Hall - Establish gas-fired CHP cluster</td>
<td>£2.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBH - Tottenham Town Hall - Establish gas-fired CHP cluster</td>
<td>£1.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackhorse Lane cluster growth based on local CHP</td>
<td>£1.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haringey Heartlands</td>
<td>£2.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walthamstow Town Centre</td>
<td>£3.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total capital requirement</td>
<td>£27.93</td>
<td>£26.77</td>
<td>£16.02</td>
<td>£12.31</td>
<td>£8.18</td>
<td>£2.99</td>
<td>£1.49</td>
<td>£4.34</td>
</tr>
</tbody>
</table>
13 DELIVERY VEHICLES

13.1 Potential commercial arrangements

13.1.1 This section of the report considers the structures, approaches and funding sources that are available for the formation of a DH scheme, discusses the advantages and disadvantages of these, using case studies to illustrate these, and suggests the most likely procurement route that should be followed by the NLSA.

13.2 Background to commercial arrangements for district heating in the UK

13.2.1 Historically the development of district heating in the UK has been, with some significant but isolated exceptions (see below), relatively small scale. Networks were developed by local authorities to serve social housing, funded from public finances and were often not maintained or developed in a commercially sustainable way. More recently there has been a move to develop schemes in partnership with the private sector and specifically towards the creation of Energy Service Companies (ESCOs). This move has been primarily due to the lack of public funding for infrastructure projects but has also been driven by the acceptance that systems need to be managed and maintained in a commercially viable manner and that this requires a range of technical and commercial skills which are not always available in the public sector.

13.2.2 Therefore the process of investigating potential business models for district heating based ESCo’s and energy services schemes starts with an acknowledgement that, until recently, there were no private sector companies capable of delivering large scale DH projects connecting existing buildings without specific local authority sponsorship. This is now a growth market, and the potential is such that the opportunities to develop such projects are substantial. A decentralised energy approach provides the opportunities for energy cost and carbon emission reduction under which developers responsible for large new-build projects may build flexible energy systems for the future. The development of such schemes can also act as a catalyst for the decarbonisation of existing buildings in the surrounding area.

13.2.3 There are a few examples of city DH schemes that have successfully developed beyond the “estate project” scale and have delivered significant private sector commercial connections, of new and existing development, in Nottingham, Sheffield and Southampton. These are now wholly private sector owned but were originally developed with significant support from the local authority or central government, both in terms of access to funding and in provision of base load, long term connection agreements.

13.2.4 The development of the private sector ESCo market reflects the requirement from planning authorities that energy generation and supply to buildings be considered with the aim of minimising carbon footprint of buildings overall. This has created a market for ESCOs amongst developers seeking to contract out their carbon commitments under planning permissions. The planning process is likely to remain a key driver in the short-term but there are also more strategic approaches being developed towards the use of district heating in London and other major cities such as Leicester, Coventry and Newcastle. Birmingham in particular is partnering with a private sector firm to develop schemes in the city with a view to developing a city-wide district energy network. Two schemes are currently operational, both of which centre around public sector core loads.

13.3 Potential Approaches for development of DH

13.3.1 There are a number of potential approaches to the general development of district energy schemes under sponsorship by the public sector; these are summarised in the
table on the following page. It should be noted that this is not an exhaustive list of all the potential commercial arrangements possible for public-private partnerships but it does cover the main types of scheme development that have been undertaken to date. It should also be noted that there is no restriction on using different forms of organisation during different phases of the project life. For example the ownership of the Sheffield scheme was originally a mix of public and private but the local authority disposed of its share once the scheme was developed and could be re-financed. This is a good example of a local authority taking some risk early in a project to reduce the costs of finance and then disposing of its interest once these risks have fallen away.
### Table 13-1: Potential commercial approached to delivering district heating

<table>
<thead>
<tr>
<th>Description</th>
<th>Funding</th>
<th>Construction</th>
<th>Ownership</th>
<th>O&amp;M</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Sector - traditional</td>
<td>Local authority funds</td>
<td>Public procurement of construction contracts by Local authority</td>
<td>Local authority direct</td>
<td>Local authority internal or public procurement of O&amp;M contract</td>
<td>Lerwick, Shetland</td>
</tr>
<tr>
<td></td>
<td>Grant funding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over public funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public sector – arms length organisation</td>
<td>Local authority funds</td>
<td>Public procurement of construction contracts by ALMO</td>
<td>ALMO</td>
<td>ALMO direct or public procurement of O&amp;M contract</td>
<td>Pimlico District Heating Undertaking, Aberdeen Heat and Power</td>
</tr>
<tr>
<td></td>
<td>Grant funding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over public funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALMO Borrowing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Private Partnership – JV company</td>
<td>Part as Public Sector plus private sector equity plus private sector debt</td>
<td>Public/private sector procurement of construction contracts (depends on JV structure and partner capabilities)</td>
<td>JV Co Ltd</td>
<td>JV Co direct or Public/private sector procurement of O&amp;M contracts (depends on JV structure and partner capabilities)</td>
<td>Thameswey Woking, initial Sheffield scheme, Birmingham CC/Utilicom</td>
</tr>
<tr>
<td></td>
<td>Grant funding – limited availability</td>
<td>Supported by contract for services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private sector – concession</td>
<td>Private sector debt/equity</td>
<td>Public procurement for concession – fixed area/service variable scope (likely base case fixed scope required). Private sector construction contracts</td>
<td>Private sector – possible future reversion to public after defined period</td>
<td>Private sector</td>
<td>Olympic Park/Stratford City</td>
</tr>
<tr>
<td></td>
<td>Grant funding – limited availability</td>
<td>Supported by concession</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private sector speculative</td>
<td>Private sector debt/equity</td>
<td>Private sector</td>
<td>Private sector</td>
<td>Private sector</td>
<td>Southampton</td>
</tr>
<tr>
<td></td>
<td>Grant funding – limited availability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13.4 Appraisal of potential options

13.4.1 The options given in the table above have varying advantages and disadvantages which generally fall under the following headings:

- Cost of funding
- Risk versus control
- Regulations and licensing
- Availability of resources/skills

13.5 Cost of Funding

13.5.1 The cost of funding is critical for DH projects as the cost of infrastructure is generally high and the length of the system long. This has been recognised by central Government and also by development agencies that have set up, or are setting up, a number of funding arrangements including grant funding and low cost loans for low carbon infrastructure projects. There has historically been a mismatch between the nature of returns for these projects and the needs of private sector finance. Due to the lack of regulatory structure and high costs of market entry DH projects are treated individually (i.e. project financed) and the costs of private sector funds is driven by competition with other generally faster return projects rather than as a low risk, long term investment.

13.5.2 Generally the public sector has better access to grant funding and funding from other public sector organisations at lower cost than the private sector. The private sector generally has access to more funding from the debt markets albeit that this is now less easy to obtain and available at a higher rate than has previously been the case. The private sector generally has a shorter timeframe for economic analysis and a stronger focus on pure financial returns than the public sector, which are often more able to take account of the value of other potential returns such as environmental and social improvements in their overall appraisal of projects.

13.6 Funding Gaps

13.6.1 The viability analysis conducted as part of this study illustrates that at higher discount rates (equivalent to higher costs of capital), there is a funding gap to be closed to render the recommended schemes viable. One means of closing this gap has recently been clarified by the ‘Zero Carbon Hub’ in a report entitled ‘Allowable Solutions for Tomorrow’s New Homes’ (July 2011).

13.6.2 Allowable Solutions are a concept whereby developers are able make a payment to a 3rd party provider whose responsibility it is to deliver the required emissions reductions for the development to comply with building control. The concept of Allowable Solutions has been developed to facilitate the delivery of zero carbon development; therefore in order to be beneficial, they must represent a lower cost to carbon compliance than alternative means.

13.6.3 This is important for the ULV DEN, as instead of relying only upon the developer contributions of schemes that are connecting to the network to make the scheme viable, assuming that the network can deliver certifiable and approved carbon savings, the Allowable Solutions route could provide for the means for more remote projects throughout London (or indeed further afield) to achieve carbon compliance via paying into an ‘ULV DEN Allowable Solutions’ fund. It is envisaged that this fund could be used to fund the ULV DEN projects (i.e. strategic...
network or local clusters) that have the ability to reduce CO\textsubscript{2} emissions, including the district energy network.

13.6.4 The Allowable Solution framework is still in development, however if it is correctly designed Allowable Solutions could help to catalyse both new development and the deployment of a district energy scheme. It is conceivable that a ULV DEN Allowable Solutions fund could, subject to appropriate accreditation, receive capital from any developer wishing to offset their carbon reduction obligation.

13.7 Risk versus Control

13.7.1 Public sector organisations are generally risk averse and there has historically been a tension between the desire from local authorities, and others, to move all risk to the private sector and the desire to retain control over the development of potentially high profile and high impact projects. If there is a full transfer of risk to one party then that party will, naturally, require full control over management of the risks and will be unwilling to allow outside influence on the operation and development of a project.

13.7.2 The transfer of risk also has implications for the costs of funding and a realistic approach to risk needs to be adopted to give a project a chance of proceeding. The principle by which an ESCo should operate in terms of dealing with risk is the same as any other business operation. This is to allocate the risks to the party most familiar with the specific risk and by implication most able to deal with it as a result of their normal operational practices and structures. The means by which risk is dealt with (transfer, distribution, mitigation and tolerance) aims to reduce the possibility of occurrence and impact as far as is practically possible, thereby minimising obstacles to the long-term financial stability of the organisation ultimately responsible for the projects.

13.7.3 Responsibility for risk has important implications financially for the partners engaged in the development of the ESCo; where risk is allocated within a partnership also broadly determines where the financial benefits are distributed. Capital and operational risks will have a proportion of finance or a share of profits associated with them; this is where the objectives of the cluster development ESCo and the strategic aims of the ULV DEN need to be considered.

13.8 Regulations and Licensing

13.8.1 The heat market in the UK is unregulated at present. There are proposals being developed for various types of regulation both at a national and at a local level. This lack of specific regulation may act as both a help and a hindrance to the development of DH. Whilst the lack of regulation provides commercial freedom to develop schemes as required by local circumstances, schemes are generally caught by a range of different regulations related to issues such as town planning, carrying out streetworks and environmental compliance without a national framework for how these will be applied. This can mean a significant amount of work being required to mutually agree the way in which regulations will be applied to this type of scheme and restrictions on ability to access equipment which can create difficulties throughout the project life.

13.9 Availability of Resources and Skills

13.9.1 No matter which approach is taken, the delivery of schemes must be achieved safely, to programme and to a quality specification. Achievement of this requires the use of high quality resources, with sufficient experience of delivery of this type of schemes. What must be noted is that, even where an organisation has an excellent track record in project delivery, the specific personnel who will be in key positions will have a significant impact on actual project
outcomes. Which ever approach is taken it is important to have the ability to monitor progress and quality – the self-interest of a concessionaire will not necessarily make up for lack of experience of key people and there will be some reputation risk whatever the structure adopted for delivery.

13.10 Operation of Schemes

13.10.1 The requirement for skilled and experienced resources is not restricted to scheme development. There has been a history of scheme performance deteriorating over time in the UK due to inadequate training and supervision of operations and maintenance. There has also been a tendency towards short-term thinking in relation to maintenance, particularly of CHP units but also of DH assets. Finally whilst short-term contracting for maintenance is undesirable there are also pitfalls in long term arrangements particularly in ensuring performance is incentivised appropriately over the life of the contract, and in dealing with indexation for cost increases over time.

13.10.2 Arrangements will ideally be:

- long term - preferably matched to the expected life of the asset and with provisions for handback of plant at the end of the term in a suitable condition for ongoing operation for at least 12-24 months
- simple - avoiding trying to address all possibilities for the future now but with straightforward management procedures which allow each party appropriate control over changes requested by the other
- flexible - able to adapt straightforward to changing market conditions preferably via defined negotiation and modelling processes
- with sufficient provision for oversight and reporting that the asset owners and end-users of the system can be assured they are getting good value over time.

13.11 Analysis of ULV schemes

13.11.1 PB has considered the preferred ULV DEN Scenario B2 outlined in this report in light of the most appropriate means by which it could be taken forward from this pre-feasibility stage through to delivery. As the various Scenarios considered have a similar customer base the approach to taking them forward is likely to be similar.

13.11.2 As a basic structure, the following diagram illustrates how it is an anticipated that an ESCo SPV would operate, and where its investment and responsibility demarcations would lie, in outline terms.
13.11.3 The pre-feasibility modelling undertaken for this study shows that the preferred scheme appears to have a positive NPV at 3.5% discount rate. It is anticipated that the means of delivery would be a special purpose vehicle (SPV) where the local authorities would wish to retain control over the operation and expansion of these schemes; representation at board level or though a majority equity share could provide leverage. Scenario B2 could therefore be delivered via a joint venture or public-private partnership type approach. As the analysis outlined above regarding the interface between cluster growth and the strategic network suggests, it is recommended that a single overarching body should manage the growth of both the strategic network, and simultaneously the development of local cluster networks that can later connect to the strategic network.

13.11.4 If this public / private joint venture ESCo route is pursued (e.g. as would suit a mixed public / private customer base), the significant public sector proportion of loads is advantageous for the SPV, as the private sector element will welcome the security that a significant public sector / long-term contract would provide.

13.11.5 It is possible that the heat providers (eg. Kedco, Edmonton gasifier operator) could provide the heat on a Contract Energy Management (CEM) type arrangement. The customers on the network would contract for a specified capacity and volume of heat, this would then be supplied by the private sector heat provider. The means by which the heat is provided is up to the heat provider. The revenue necessary for the heat provider to pay for the infrastructure
required would be realised from the margin between the heat sales tariff and the cost of heat production.

13.11.6 Given the single hydraulic network that would be the preferred technical scenario for the ULV DEN, it is anticipated that a single, overarching SPV would:

- Control the development of both the emerging strategic network and individual clusters to protect the long-term strategic aims of the project
- Provide a rolling programme of cluster growth to maximise cost efficiency in scheme development
- Organise the regular refinancing of the network to reflect the growing value of the network to central waste-heat plant operators as its growth is realised and de-risked
- Maintain a technical and commercial knowledge base and benefit from lessons learned over time
- Provide customer management, metering and billing services for all connected loads
- Provide technical staff for operation and maintenance of the network and interfaces
- Allow reduced fuel cost from increased purchasing power available through large-scale purchasing (e.g. particulary for top-up and standby boiler gas).

13.11.7 State Aid Rules

13.11.8 A potentially significant factor that needs to be taken into consideration are the state aid rules. These are complex and must be considered at later stages on a case-specific basis. However, in outline terms, the implications of state aid legislation are that there will be limits on the amount of public funding that can be made available to a project from which a private sector organisation will profit. In the case of the ULV schemes, this means that as and when the projects are progressed from feasibility stage a full and thorough review of the proposed commercial structures for each scheme is undertaken, the implications of state aid legislation must be considered and adhered to.

13.12 Next Steps

13.12.1 In order to progress the delivery of district heating in the ULV, the first stage towards delivery is a feasibility level study that addresses greater detail in terms of specific point loads, temperatures, network routings, displaced energy costs and connection charges. When this is complete, and assuming that this work also indicates that there is a viable scheme to take forward, Councils and heat sources should work together to draw up heads of terms for the formation of an ESCo SPV that will act as an umbrella organisation to oversee the design, implementation, operation and ongoing growth of a Decentralised Energy Network. It is envisaged that the SPV would maintain a controlling interest over key developments / design of the systems under discussion, and that key overarching political / planning bodies such as the GLA / LDA would have a voice on the board in order to protect London’s wider interests in a strategic scheme of this nature.
14 RISKS AND UNCERTAINTIES

14.1 Regulatory / Political

14.1.1 This document has been compiled at a time of rapid change in both the wider political landscape, and more specifically in the electricity and waste markets. This report acknowledges that some relevant policies and that will impact the emergence of the DEN are still at consultation stage, and that the conclusions drawn here should not be dependent upon emerging documents that could still significantly change.

14.1.2 In particular, areas of uncertainty that should be noted would include:

- The North London Waste Plan – this is a draft submission document at this stage, and has not yet been through Examination in Public.

- Pinkham Way planning application – this proposal from the NLWA for an MBT facility needs to be fully assessed by Haringey. The planning-decision making process has yet to take its course, and this may have a bearing on the future of the Edmonton EcoPark and other NLWA facilities.

- Renewable Heat Incentive – a second phase of the RHI is proposed in 2012. This may impact the eligibility of waste fuel streams for support, which could impact the fuel sources and locations of heat supply technologies in this project.

- London Plan – the Draft London Plan has been through examination in public (end 2010), and the Planning Inspector’s comments are available on the GLA website. These do not appear to significantly impact the relevant policies to the ULVDEN. However, the draft London Plan has not been adopted, and hence there is some potential for changes to policy wording.

- Electricity Market Reform – the current Administration is moving towards greater efficiency in the administrative burden of some mechanisms – e.g. exemptions from the Climate Change Levy. The simplification of this system could lead to differences (from the current situation illustrated in this report) in the incentives to the sale of low-carbon heat for generators.

- Kedco site – the negotiation of the S106 agreement for this site is on-going.

- Electricity Supply licence lite – the development of this mechanism could impact the value of electricity for generator operators.

14.2 Technical / viability

14.2.1 Areas of technical risk that should be highlighted in this study include:

- Heat demand data – this is a high level study that attempts to assess scenarios for a strategic DEN. The scope of this study has not included an audit of the London Heat Map heat demand data that has formed the basis of forming heat demand clusters and connection routes for the strategic network. However, this is an important input to modelling and viability assessments, and feasibility level studies should address the loads available in key geographic locations in some detail – e.g. with attention to temperature requirements, seasonality of load, diurnal profiles, resilience requirements and other aspects of heat supply.
• Network routes – over the scale of the study area, there are a multitude of potential network routes to link demand clusters. The approach adopted here has attempted to select a reasonable approach towards minimising network distances and offering good potential accessibility to the network for future connections. Again, feasibility study level work should conduct more detailed work to identify optimised route selections based on physical constraints, opportunities for future connections, and minimising pipe costs.

• Energy costs for networks and other prices have been based on current levels. There is inherent uncertainty in future energy prices, and parties should be aware of the impact that future prices changes could have on a DEN. It is worth stressing in this context that whilst there is a general expectation that fossil-fuel energy prices will rise, the same level of rise is not forecast for waste. Hence the expectation is that an increasing margin of value will emerge between the use of waste as a fuel and the continuing use of fossil-derived fuels.

• Technologies – whilst some technologies have already benefited from a long development period (e.g. reciprocating engines / compression engines), other technologies are currently in an early phase of their development cycle (e.g. organic ranking cycle CHP, biofuel CHP, SRF gasification, waste pyrolysis, etc). Over the study period some level of technology improvement can realistically be expected, and the possibility of a technology breakthrough in terms of system efficiencies also exists. Technology performance in this report is based upon current plant.
15 CONCLUSIONS AND RECOMMENDATIONS

15.1 Conclusions

15.1.1 Consideration of the different potential heat sources for the ULV DEN points to the following:

- The Kedco gasifier appears to have the greatest financial incentive to distribute heat, relating to the tariff structure of the Renewable Heat Incentive, and given the fully renewable fuel for the plant.

- The use of gasifiers fired on SRF derived from MSW on the Edmonton EcoPark site would also see significant financial incentive to distribute heat under the current support mechanisms.

- The adaptation of the existing Edmonton incinerator plant for the supply of heat in the short term would generate value for the plant operators, but there would be capital costs associated with this, and potential service disruption. A clear commercial case would have to be constructed to ensure operator buy-in to this concept. Given the length of service life remaining for the existing incinerator, the commercial case for this is marginal and cannot be relied upon to kick-start the DEN.

- The extraction of heat from Enfield power station could be marginally economic for the plant operators, but given both the uncertainty of the Enfield plant operation and the marginal viability of heat extraction, this is not a recommended source of heat for the ULV DEN.

15.1.2 In terms of capacity, the most plentiful source of heat would be the condenser heat at Enfield power station but, as noted above, the use of this heat is not considered economically viable in the context of the ULV DEN, nor can operation be guaranteed in the future, and hence other heat sources are preferred.

15.1.3 The Kedco gasifier plant is anticipated to have an available level of heat output of 10MWth at completion (anticipated around 2016). The 120ktpa scenario for the Edmonton gasifier is anticipated to generate around 16MWth (circa 2023). Changes to the current waste procurement strategy could lead to greater waste throughput at the Edmonton site, and a 327ktpa scenario has been considered, giving rise to an estimated 43MWth heat available for distribution.

15.1.4 There are also some potential additional low cost heat suppliers in the region, including Johnson Matthey, and potentially Deephams Sewage works during the summer period, which could also contribute to the overall supply capacity of the network from low cost / low carbon sources.

15.1.5 Any shortfall in heat supply capacity against demand is envisaged to be met by dedicated top-up and standby boiler plant located in a purpose-built energy centre incorporating the primary pumping within, or close to the Edmonton EcoPark, with connectivity to the Kedco gasifier plant.

15.1.6 Analysis of the heat demand data that has emerged from the Heat Mapping Studies carried out in Enfield, Waltham Forest and Haringey shows that within key clusters of demand, a total level of heat demand in the order of 250GWh is anticipated by 2050. Key heat loads include three hospitals (Chase Green, Whipps Cross and North Middlesex), development at Meridian Water, Blackhorse Lane and Ponders End / Southbury, and other key public sector loads such as communally heated housing and council properties.
15.1.7 An outline network route has been developed to capture the potential demands of key industrial areas within the ULV, as well as the ‘core demand’ areas identified within the heat mapping studies. For preferred Scenario B2 (Tottenham configuration), the total length of strategic network proposed is approximately 29km with an associated cost of approximately £71m including customer interface units. A potential phased growth strategy for this network is shown in Section 12.3 of this report.

15.1.8 There are on-going developments in the regulatory framework surrounding the mechanisms for sales for electricity as discussed in Section 6. In particular, the concept of an ‘electricity supply licence lite’ is being developed, which could result in higher value electricity sales for small scale generators. It is advised by those involved in these developments that changes are at too early a stage to be incorporated in any financial modelling of options.

15.1.9 PB has discussed the strategic development of electricity infrastructure in the ULV with UK Power Networks. Current strategic planning for power infrastructure is carried out on a 5-year basis, and hence it is difficult to comment on long-term strategic development of apparatus. However, in broad terms, the proposals outlined under Option B2 do not result in a significant change in power generation capacity\(^\text{35}\) and hence no significant implications on electricity infrastructure are anticipated.

15.1.10 Given the status of local and regional planning documents, and their anticipated policies, consideration has been given to various planning tools available to facilitate the implementation of the DEN in the ULV. All developments critical to the ULV DEN’s success will be ‘major’ or ‘strategic’ developments, and the London Plan policies and boroughs’ LDFs will form part of the planning framework against which planning applications will be assessed and considered. The suite of energy policies in the London Plan (2011) impose an obligation for developments to connect to planned and existing energy networks. With this policy hook already in place, priority should be given to developing the other key areas of policy that could assist DEN emergence. Key policy work should also include developing the Opportunity Area Planning Framework being led by the GLA.

15.1.11 Pre-feasibility level modelling of the emergence of a DEN has been conducted, testing the phasing, heat source capacities, demand growth and anticipated heat generation costs of the various scenarios. PB has tested several variants of phasing and load inclusion in different models and the results shown in this report, in terms of viability, represent a balance between realistic growth rates and the strategic aim to serve a wide area of north London.

15.1.12 The results of viability modelling show the following results at a range of discount rates for different scenarios.

---

\(^{35}\) I.e. it is assumed that allowance has been made in UKPN’s plans for the Kedco Gasifier’s additional generation output. The decommissioning of the Edmonton Incinerator would reduce capacity by approximately 32MWe, to be potentially replaced with gasifier plant with a reduced level of total output.
15.1.13 These viability results show that the smaller schemes generally deliver better economic performance. However, smaller schemes do not deliver the same level of strategic benefit to the region, and hence the recommended option for further feasibility development is Option B2 – representing kick-start network growth based around the Kedco gasifier, with further strategic development resulting from the heat available from a new energy-from-waste installation on the EcoPark site. The NLWA has indicated that a 120ktpa gasifier option may be suitable for the site and this is the technology that has been modelled in this study.

15.1.14 Overall, the scheme recommended for further development appears to be viable at low discount rates (e.g. 3.5%). At higher discount rates (e.g. 6% to 12%) there is a funding gap ranging from around £1.25m to £13.5m. This range illustrates the importance of identifying a delivery method around low cost finance.

15.1.15 The recent publication of a proposed framework for the ‘Allowable Solutions’ mechanism suggests that one potential means of closing this funding gap will be through the establishment of an accredited scheme (e.g. the ‘ULV DEN Allowable Solutions’ fund), which effectively accepts payments from other developers in exchange for delivering accredited global carbon savings.

15.1.16 A key uncertainty that the NLSA steering group must address is the potential source of fuel for a new EfW plant on the Edmonton EcoPark site. Currently, the NLWA procurement strategy precludes the use of SRF locally on the EcoPark site – all SRF produced is to be transported off-site. Influencing this procurement to retain some SRF would provide a secure source of fuel for an EfW scheme, and could lead to reduced transport requirements in North London.

15.1.17 A workshop was held to clarify the key priorities for the emergence of a DEN for the ULV. The results of this were that four key areas emerged as critical metrics of success.

- Deliverability
- Ability to generate inward investment in the area
Being a low carbon solution

Ability to alleviate fuel poverty

15.1.18 The solutions outlined in this pre-feasibility study are anticipated to deliver carbon savings in the region of 70% on the heat consumption element of connected loads. Taking into account electrical consumption, overall savings of around 25% would be anticipated for ‘typical’ local authority users. At full build-out, the annual carbon savings from Option B2 would be around 41,000 tonnes CO\textsubscript{2} p.a. – equivalent to the emissions of around 9,750 existing dwellings\textsuperscript{36}.

15.1.19 SQW has investigated the potential for a DEN in the ULV to generate inward investment opportunities (Section 11) and deliver new jobs to the region. Scenario modelling indicates a positive result, and over the period to 2026, a total of 1,700 jobs are predicted to be created or safeguarded with the emergence of a DEN. Target sectors to attract to the area would include food and drink processing, aquaculture, horticulture and ‘green enterprises’ with stringent CSR objectives.

15.1.20 The delivery of a DEN depends on several interlinked factors: technical design, commercial models, market utility prices, Government support mechanisms, etc. However, the ‘soft’ aspects of scheme delivery, including winning hearts and minds, garnering support politically, finding ‘champions’ to encourage take-up of heat supply, correct positive message development, and other factors are also acknowledged. At this stage, when more accurate studies need to be carried out at feasibility level, the delivery of a positive message surrounding this exciting venture is critical.

15.1.21 Given the mixed customer base and potentially multi-lateral contracting with heat sources, the delivery mechanism suggested for the ULV DEN would be a joint venture public / private partnership scheme that maintained overall control of both the development of local clusters and the growth of the strategic network scheme. This control is crucial to avoid conflicts of commercial interests at the point of interface between local scheme growth and connection to the strategic network.

15.2 Recommended Actions

15.2.1 Recommendations listed here are divided into three headings ‘Governance and delivery structure’, ‘Planning policy’, and ‘Technical’.

15.2.2 Governance and Delivery Structure

15.2.3 In order to avoid potential conflict between the operators of individual local heat networks and the delivery of a strategic area-wide scheme, a single joint public / private delivery vehicle is considered appropriate for both scales of scheme. This should take the form of an overarching body that oversees both cluster level schemes and the growth of the strategic network. This body would be responsible for enforcing the strategic aims of the project, and at the same time would aid the delivery of local cluster-level schemes within the strategic ULV DEN area, ensuring that they develop to complement the strategic network. In order to establish this delivery vehicle, there must be a sufficient and effective decision-making framework across the three boroughs involved.

\textsuperscript{36} These figures based on ‘conservative’ adoption of waste heat emissions factor as per Building Regulations. It could also be argued that heat recovered from gasifier systems could be considered to have a much lower carbon emissions factor, as there is no loss of power generation resulting from the recovery of heat. Assumes typical London dwelling emissions associated with energy consumptions of approximately 12MWh/yr gas and 3.5MWh/yr electricity.
15.2.4 The implementation of the DEN will require significant political leadership, and the three boroughs should work to ensure that leadership level support is in place for this scheme. Political leadership is required for the allocation of resources to assist the development of this project.

15.2.5 Develop a strategic procurement timeframe to give confidence to Developers and existing organisations that a strategic network is emerging, with a foreseeable timeline for connectivity of different areas.

15.2.6 Review the value and benefits against the risks and disruption of attempting to change the direction of the on-going NLWA procurement process, with a view to securing a longer-term supply of MSW-derived SRF for gasifier technology located at the EcoPark site.

15.2.7 Actively engage with NLWA regarding potential fuel streams for Edmonton Ecopark, future plant and means of influencing current trajectories in terms of SRF contracting.

15.2.8 Continue cross-borough working and start developing a structure for an SPV to deliver the ULV DEN, considering the tendering process required to select partners. This SPV should include representation from London-wide bodies such as the GLA, and should provide an interface between policy and delivery.

15.2.9 Continue to engage with the GLA strategic energy planning team.

15.2.10 Following formation of an SPV, move forward with ‘easy-win work packages’ where confidence, experience and momentum can be gained. Schemes might include the development of a network around LBWF Town Hall, and Tottenham Town Hall, for example. This should be done concurrently with the growth of the strategic network based around heat from Kedco gasifier.

15.2.11 Develop marketing messages to attract new enterprises to the sub-region based on the emerging low/carbon low cost network.

15.2.12 Planning Policy

15.2.13 There are several planning mechanisms that could be employed to support the implementation of the DEN which require further consideration and agreement between the three ULV boroughs. A number of these mechanisms are likely to be required to maximise the likelihood of success of a DEN. It is recommended that the delivery partners discuss and agree a preferred selection of policy vehicles. Key vehicles for consideration could include the use of Area Action Plans, Supplementary Planning Documents, the emerging Opportunity Area Planning Framework, Local Development Orders, and the Community Infrastructure Levy.

15.2.14 Key headline objectives of a unified policy approach should include placing obligations on developers (both to connection and make financial contribution to scheme delivery), protection and facilitation of strategic routes, and obligations on potential new heat sources (to facilitate the extraction of low cost / low carbon heat).

15.2.15 Critical in policy development for the ULV is an appropriately structured cross-borough partnership approach that sets clear objectives and working methods agreed by all partners and executed by distinct leadership in consultation with key stakeholders.

15.2.16 Technical
15.2.17 Put technical standards in place for Developers to follow to ensure that new-build schemes and local cluster heat networks are designed in a manner compatible with the emerging strategic network.

15.2.18 Engage with the operators / developers of Kedco gasifier to ensure compatibility between the NLSA’s strategic network project and the Kedco development.

15.2.19 Carry out more detailed feasibility work relating to the following technical aspects of design (particularly focussing on early phase growth zones):

- Loads – with a view to obtaining commitments in principle from potential customers to be supplied with heat from the strategic network, together with technical details of temperature / pressure requirements, and load projections into the future
- Routings – drawing up detailed initial network route maps for the first phases of network growth, and investigate the constraints posed by existing infrastructure
- Easements – identifying areas where easements are necessary, and obtaining early quotations for these areas. Early engagement with TfL and British Waterways is strongly recommended.

15.2.20 Engage with operators of premises along the proposed early phase strategic network route to discuss how plant maintenance and replacement cycles could tie in with potential connection to a DEN.

15.2.21 Engage with statutory utility companies to identify strategic potential for collaboration and also suitable network routes avoiding excessive cost.

15.2.22 Ensure that the development of the ULV DEN strategy responds to development of the Renewable Heat Incentive and other support mechanisms for renewable / waste fuels. In particular, the treatment of SRF derived from Commercial and Industrial Waste should be closely followed, as this may influence the cost of heat production from gasifier technology on the Edmonton EcoPark site post-2023.

15.2.23 Identify a site for a heat interface station to house primary plant including top-up and standby boilers, associated flues, heat exchangers, primary pumps. The initial assumption adopted in this report is that a site on the Edmonton EcoPark can be found.

15.2.24 Develop a GIS based land-ownership database to help investigation into wayleaves / easements for the network route.

15.2.25 Continue to follow regulatory developments surrounding ‘electricity supply licence lite’, which may influence the operation of small-scale CHP schemes in particular.

15.3 Recommended Actions by Borough

15.3.1 All boroughs / NLSA

15.3.2 Work in partnership with the NLSA and the other boroughs to form an overarching body that can manage the deployment of the local schemes and strategic network across the study area.

15.3.3 Work to ensure that political leadership is supportive of the DEN’s emergence and ready to allocate appropriate resources to help its emergence.
15.3.4 Engage with the GLA to help develop the spatial guidance and timelines that could be included within the SPD / OAPF relating to DEN area growth and coverage.

15.3.5 Engage with the GLA to develop technical design standards for new development to adhere to.

15.3.6 Engage with the NLWA to discuss the potential for diverting SRF supply in the future (e.g. around 2023) from its current procurement route to an on-site use in the Edmonton EcoPark.

15.3.7 Following confirmation of the availability of heat from the Kedco site, commission feasibility level work around the kick-start network in the core load areas of: Edmonton, West and Central Leeside (including North Middlesex Hospital), Meridian Water, Northumberland Park and Commercial Road / Silver Street.

15.3.8 Haringey

15.3.9 Engage with key businesses in the Marsh Lane, Northumberland Park (and Central Leeside boundary) areas with a view to increasing awareness and enthusiasm for the prospect of decentralised energy sourced from the DEN. This engagement could also aim to obtain projections and greater detail of heat energy use (e.g. volumes / temperatures / pressures / diurnal and seasonal profiles) at individual sites.

15.3.10 Commission a feasibility level study for decentralised energy centred around Tottenham Town Hall, investigating the potential to link to the Hale Village area and the Greater Ashley Road development sites.

15.3.11 Commission a feasibility level study for decentralised energy centred around the Wood Green Area, investigating the potential to link the Haringey Heartlands, Civic Centre and Wood Green East areas

15.3.12 Enfield

15.3.13 Engage with the Kedco gasifier developers (or their agents) to develop open discussions surrounding the DEN growth strategy.

15.3.14 Engage with the NLWA to identify a site on the Edmonton EcoPark, or close by, that could serve as a primary pumping station and top-up and standby heating plant for the DEN. An initial estimate of the floorplate footprint required for this site would be in the region of 1,000m² (e.g. 20m by 50m). This size will need to be confirmed at feasibility level, and depending on access arrangements for plant delivery etc…

15.3.15 Engage with key businesses in the Central Leeside, Meridian Water, Picketts Lock, Edmonton, Commercial Road / Silver Street areas with a view to increasing awareness and enthusiasm for the prospect of decentralised energy sourced from the DEN. This engagement could also aim to obtain projections and greater detail of heat energy use (e.g. volumes / temperatures / pressures / diurnal and seasonal profiles) at individual sites.

15.4 Waltham Forest

15.4.1 Commission a feasibility level study for a decentralised energy scheme centred around the Waltham Forest Town Hall cluster, investigating linkage to Wood Street areas. This should be initiated as soon as there is reasonable clarity on the nature of the loads anticipated in the Wood Street area. A single energy centre could then be considered for the combined loads of the combined sites.
15.4.2 Commission a feasibility level study for decentralised energy for the Walthamstow Town Centre area, such that the Station Car Park and High Street developments can be incorporated in an emerging network. This should ideally focus on maintaining maximum compatibility with a strategic network by locating the energy centre to the north of the scheme – e.g. in the area around Goddarts’ House. This study should be linked to the timeframes for the key developments in the area – i.e. should be conducted early enough to inform Developers designs and procurement decisions.

15.4.3 Develop local strategic priorities in terms of decentralised energy for the Blackhorse Lane area, (e.g. points of interconnectivity to ensure that linkages to the DEN are preserved / protected), and engage with developers in a partnership arrangement to clarify the strategic priorities, and develop how a local network could be funded and implemented as part of the development process. This study should be linked to key development timeframes.

15.4.4 Engage with Cofely to encourage linkage to the Leyton Mills and Leyton Orient area from the Olympic Park site.
16 APPENDIX A – CLUSTER ANALYSIS ASSUMPTIONS

16.1.1 The costs estimated for each cluster represent the costs that have been assumed to be incurred by an ESCO SPV to establish a working heat delivery system from energy centre to end-users, comprising the following:

- Energy centre with appropriate primary plant
- Primary pumping / heat distribution (energy centre)
- Top-up and standby heat plant (gas-fired boilers)
- DH distribution mains
- Customer connections (including heat / hydraulic interface units)

16.1.2 DH Distribution Mains

16.1.3 All DH networks between the energy centre and consumer units would be direct buried, welded steel pre-insulated sections, with appropriate reinstatement. The capital costs have been estimated based on an assumption for each section of network depending on whether the network installation would require excavation and reinstatement of hard finished ground or whether it would require a ‘soft’ finish – e.g. grass verge or similar.

16.1.4 Where existing buildings are to be connected, a temperature differential between flow and return pipework of 20°C has been assumed (e.g. 95°C flow, 75°C return) to reflect typical heating system performance.

16.1.5 Where new buildings are connected, a 40°C temperature differential has been assumed (e.g. 95°C flow, 55°C return). This reflects current good practice in heating system designs.

16.1.6 Network heat losses have been calculated on the basis of proposed network length, and an average temperature differential between district heating pipework and average ground temperature. Figures for heat loss per metre of different diameter pre-insulated pipework have been derived from pipework manufacturers' details.

16.1.7 For new non-domestic connections it has been assumed that the developer would pay for all internal systems, and that the notional ESCo for the site would be responsible for the installation of the interface unit for the building.

16.1.8 It is important to note that the method used to size the district heating main spine are conservative and tend to slightly oversize the network. It is possible to operate the network to supply a higher load than that originally designed for, therefore providing a degree of future proofing. It is expected that an additional 10-15% of load can be added to the network by increasing pressure loss and pumping head. The amount of additional load that can be added would need to be investigated at the later design stages of a project using detailed hydraulic modelling and whole life cost optimisation.

16.1.9 Heat losses for different diameter pipes are assumed as follows per m of trench:
Table 16-1 Heat losses for varying diameter mains

<table>
<thead>
<tr>
<th>Diameters (nominal internal mm)</th>
<th>Heat loss (W/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>32</td>
<td>11</td>
</tr>
<tr>
<td>40</td>
<td>13</td>
</tr>
<tr>
<td>50</td>
<td>14</td>
</tr>
<tr>
<td>65</td>
<td>15</td>
</tr>
<tr>
<td>80</td>
<td>16</td>
</tr>
<tr>
<td>100</td>
<td>18</td>
</tr>
<tr>
<td>125</td>
<td>19</td>
</tr>
<tr>
<td>150</td>
<td>20</td>
</tr>
<tr>
<td>200</td>
<td>25</td>
</tr>
<tr>
<td>250</td>
<td>28</td>
</tr>
<tr>
<td>300</td>
<td>35</td>
</tr>
<tr>
<td>350</td>
<td>42</td>
</tr>
<tr>
<td>400</td>
<td>49</td>
</tr>
<tr>
<td>450</td>
<td>53</td>
</tr>
<tr>
<td>500</td>
<td>56</td>
</tr>
<tr>
<td>600</td>
<td>60</td>
</tr>
</tbody>
</table>

16.1.10 Energy centre

16.1.11 The energy centre including primary pumping is assumed to be built at cost to the ESCo on land made available to it (no cost). Costs associated with this building have therefore been restricted to energy centre building construction and design costs.

16.1.12 Top-up and Standby Heat Plant and Ancillaries (Balance of Plant)

16.1.13 At the scale required for the central plant, a figure of £40/kW for the gas-boiler plant installation has been assumed, with an allowance for 2 boilers sized at 66% of anticipated peak demand.

16.1.14 ‘Balance of plant’ items encompass all those items (beyond the main plant costed individually) that are required to comprise a fully functioning energy centre. This includes items such as controls, pumps, variable speed drives, make-up water systems, dosing equipment, water treatment systems, filters, degassing, ventilation, alarm and security systems, electrical cabling and switchgear, cleaning and system filling, etc.

16.1.15 The cost of these items is related to the size of the total thermal capacity of the energy centre and network length (e.g. pumps), or has a more significant fixed element (e.g. controls). For many of these items individual formulas based on required capacities have been used, and for all sundries, an algorithm for approximating the sum of remaining elements has been derived from previous PB project experience.
16.1.15.1 Thermal storage

16.1.16 It has also been assumed that there may be diurnal variation in the differential between available heat from the low carbon sources and demands, and that thermal storage could help primary, low-carbon heat sources deliver a greater percentage of heat over the year. The inclusion or exclusion and sizing of this plant will need to be refined at later stages of feasibility.

16.1.16.1 Boiler efficiencies

16.1.17 The following assumptions were made:

- Existing boilers – 70% efficient (GCV)
- New energy centre top-up and standby boilers – 83% efficient (GCV)

16.1.18 Customer Connection Costs

16.1.19 Customer connection costs include both the length of DH pipework linking the load to the main spine of the DH system, and also the hydraulic interface unit that provides the demarcation between the DH system and the customers' secondary plant.

16.1.20 The connecting length of pipework between the spine and the hydraulic connection has been measured to a notional point within each building (exact location of plant rooms are not known at this stage). Heat exchanger costs have been calculated on the basis of a non-linear relationship developed from previous projects to reflect required capacity.

16.2 ESCO Operational Costs

16.2.1 Heat / fuel procurement

*Table 16-2 Utility Price Assumptions*

<table>
<thead>
<tr>
<th>Utility / Other</th>
<th>Cost per kWh (p/kWh)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas for boilers</td>
<td>Variable (see figure below)</td>
<td>QEP, MARCH 2010 edition, Table 3.1.1 and 3.4.1</td>
</tr>
<tr>
<td>CCL on gas for boilers</td>
<td>0.164</td>
<td>HM Revenues and Customs</td>
</tr>
<tr>
<td>Electricity Import (Energy Centre parasitic loads)</td>
<td>8.3</td>
<td>QEP, MARCH 2010 edition, Table 3.1.1 Prices of fuels purchased by manufacturing industry in Great Britain, Excluding the Climate Change Levy, 4th quarter 2009, medium consumer</td>
</tr>
<tr>
<td>£ p.a. per customer</td>
<td></td>
<td>Estimated cost per customer (aggregated over whole customer base - e.g. marginal cost of additional customer)</td>
</tr>
<tr>
<td>Metering and billing costs for ESCO</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>
16.2.2 This trendline has been used to calculate cost of top-up and standby fuel required in the energy centre.

**16.2.3 Maintenance and Replacement**

16.2.4 The key maintenance cost for the ESCo SPV will be the maintenance of the buried pre-insulated pipework, and securing a contract for the timely repairs of any leaks detected by the leak detection system. This cost has been calculated at 1% annually of the total installation cost.

16.2.5 Other items with maintenance and replacement requirements include all of the energy centre plant and the customer connection outstations (estimated at an annual cost of £250 per connection).

**16.2.6 Customer management**

16.2.7 Customer management costs have been estimated at £50 per connection. This has been based upon the assumption that the ESCo SPV has an existing customer base and established metering / billing system etc., that can be expanded to accommodate the additional customers that this scheme represents.
17 APPENDIX B – CLUSTER ANALYSIS RESULTS

17.1 Introduction

17.1.1 **IMPORTANT NOTE** - These network layouts are notional and have not been optimised or made ‘realistic’ to any significant extent. The purpose of the indicative network layouts is to give an indication of the overall likely viability of the schemes proposed. These layouts therefore only reflect the approximate extent of the network rather than any detailed routing or design.

17.1.2 The rationale for this approach is to allow a more direct comparison between clusters of heat loads – e.g. to ‘normalise’ the economic performance of each, which is not immediately apparent from the groupings of loads as presented in the heat mapping work carried out to date.

17.1.3 The NPV figures presented here include an allowance for developer contributions, on the assumption that the cost of connecting to the network would be borne by the developer.

17.2 LBWF Cluster A: Town Hall Scheme

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Town Hall</td>
<td>26</td>
<td>Gas-fired CHP, approx 1.1MWe</td>
<td>1,700</td>
<td>2.8</td>
<td>2015</td>
<td>332</td>
</tr>
</tbody>
</table>
### 17.3 LBWF Cluster B: Blackhorse Lane North

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Blackhorse Lane North</td>
<td>1</td>
<td>526kWe gas-fired engine CHP</td>
<td>773</td>
<td>1.9</td>
<td>2016 (build out from 2013)</td>
<td>-340</td>
</tr>
</tbody>
</table>
17.4 LBWF Cluster C: Blackhorse Lane South

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Blackhorse Lane South</td>
<td>2</td>
<td>635kWe gas-fired engine CHP</td>
<td>903</td>
<td>2.1</td>
<td>2018 (build out from 2013)</td>
<td>428</td>
</tr>
</tbody>
</table>
### 17.5 LBWF Cluster D: Wood Street North

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO₂ p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Wood Street North</td>
<td>32</td>
<td>Approx 300kWe gas-fired reciprocating engine CHP</td>
<td>498</td>
<td>1.5</td>
<td>2020 (first units completed 2013)</td>
<td>-1,012</td>
</tr>
</tbody>
</table>
### 17.6 LBWF Cluster D: Wood Street South

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Wood Street South</td>
<td>33</td>
<td>Approx 1.1MWe gas-fired reciprocating engine CHP</td>
<td>2,100</td>
<td>2.8</td>
<td>2010, some major loads existing. AAP build-out to 2020, starting 2013.</td>
<td>2,756</td>
</tr>
</tbody>
</table>
**17.7 LBWF Cluster E: Northern Olympic Fringe / Leyton Orient**

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leyton Orient</td>
<td>11</td>
<td>Gas-fired CHP – approximately 185kWe</td>
<td>248</td>
<td>1.1</td>
<td>2015 (existing loads, but see notes below)</td>
<td>-1,512</td>
</tr>
</tbody>
</table>

17.7.1 It should be noted that the network shown here is slightly reduced against the cluster listed in the LBWF heat mapping study report, as the Municipal offices load (which is now in private ownership) to the south-east of the stadium has been excluded on the basis that this load does not appear to be commercially viable given its distance from the other cluster loads identified.

17.7.2 The other caveat regarding this scheme is that there is potentially some duplication of stadium demands in the heat mapping data. It was not possible to resolve this issue in the heat mapping study.
17.8  LB Waltham Forest – Walthamstow Town Centre

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>Assumed date by which complete 25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBWF Walthamstow Town Centre</td>
<td>25</td>
<td>Approx 1.2MWe CHP (gas fired)</td>
<td>1,545</td>
<td>3.6</td>
<td>2020</td>
</tr>
</tbody>
</table>

17.8.1 NB that this scheme loads include the High Street Area AAP regeneration, and that all retail outlets are obliged to connect to a DH scheme.
### 17.9 LB Enfield – Innova Park

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO₂ p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innova Park</td>
<td>10</td>
<td>526kWe CHP</td>
<td>797</td>
<td>3.3</td>
<td>-2,236</td>
</tr>
</tbody>
</table>
### 17.10 LB Enfield – Southbury

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southbury</td>
<td>21</td>
<td>526kWe CHP</td>
<td>771</td>
<td>2.3</td>
<td>-£1,475</td>
</tr>
</tbody>
</table>
### 17.11 LB Enfield – Ponders End / Southern Brimsdown

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponders End / Southern Brimsdown</td>
<td>20</td>
<td>2679kWe CHP</td>
<td>3,448</td>
<td>9.8</td>
<td>-2,090</td>
</tr>
</tbody>
</table>
17.12 LB Enfield – Enfield Town

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enfield Town</td>
<td>8</td>
<td>2002kWe CHP</td>
<td>2,788</td>
<td>7.2</td>
<td>-1,160</td>
</tr>
</tbody>
</table>
### 17.13 LB Enfield – Edmonton

![Map Image](image)

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edmonton</td>
<td>6</td>
<td>1487kWe CHP</td>
<td>1,970</td>
<td>6.6</td>
<td>-3,387</td>
</tr>
</tbody>
</table>
### 17.14 LB Enfield – Palmers Green

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmers Green</td>
<td>18</td>
<td>307kWe CHP</td>
<td>243</td>
<td>2.7</td>
<td>-1,291</td>
</tr>
</tbody>
</table>
### 17.15 LB Enfield – New Southgate

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Southgate</td>
<td>13</td>
<td>844kWe CHP</td>
<td>1,028</td>
<td>4.2</td>
<td>-2,567</td>
</tr>
</tbody>
</table>
### 17.16 LB Enfield – Cockfosters

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO₂ p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockfosters</td>
<td>5</td>
<td>888kWe CHP</td>
<td>1,424</td>
<td>4.9</td>
<td>-2,427</td>
</tr>
</tbody>
</table>
### 17.17 LB Haringey – Wood Green North

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Green North</td>
<td>30</td>
<td>500kWe CHP</td>
<td>438</td>
<td>2.5</td>
<td>-1,455</td>
</tr>
</tbody>
</table>
### 17.18 LB Haringey – Tottenham Town Hall

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tottenham Town Hall</td>
<td>23</td>
<td>526kWe gas-fired CHP</td>
<td>846</td>
<td>1.6</td>
<td>331</td>
</tr>
</tbody>
</table>
### 17.19 LB Haringey – Hornsey High Street

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hornsey High Street</td>
<td>9</td>
<td>635kWe CHP</td>
<td>896</td>
<td>3.3</td>
<td>£914</td>
</tr>
</tbody>
</table>
### 17.20 LB Haringey – Wood Green East

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Green East</td>
<td>29</td>
<td>500kWe CHP</td>
<td>433</td>
<td>2.1</td>
<td>-£1,505</td>
</tr>
</tbody>
</table>
### 17.21 LB Haringey – South Northumberland Park

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO2 p.a.)</th>
<th>Estimated capital cost (£m)</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Northumberland Park</td>
<td>37</td>
<td>165kWe CHP</td>
<td>193</td>
<td>1.4</td>
<td>-1,621</td>
</tr>
</tbody>
</table>
### 17.22 LB Haringey – Haringey Heartlands

<table>
<thead>
<tr>
<th>Scheme name</th>
<th>Location designation on ULV area map (e.g. covering whole ULV)</th>
<th>Proposed technology for individual scheme</th>
<th>Anticipated level of carbon savings (tonnes CO₂ p.a.)</th>
<th>Estimated capital cost £m</th>
<th>25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haringey Heartlands</td>
<td>31</td>
<td>307kWe CHP</td>
<td>296</td>
<td>1.3</td>
<td>891</td>
</tr>
</tbody>
</table>
### Appendix C – Aspirations Workshop Agenda and Attendees

Upper Lee Valley Decentralised Energy Network Study  
Stakeholder aspirations meeting  
Haringey Town Hall, 2pm 31st March 2011

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Illustrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400</td>
<td>Welcome and introductions</td>
<td>JE</td>
</tr>
<tr>
<td>1410</td>
<td>Purpose of the session</td>
<td>Illustration of target diagram</td>
</tr>
<tr>
<td>1420</td>
<td>Initial aspirations – for your organisation and your function within it.</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td>One aspiration on each post it, and mark as short, medium or long term.</td>
<td>Green post its</td>
</tr>
<tr>
<td>1430</td>
<td>Grouping in order of number of mentions</td>
<td>LC</td>
</tr>
<tr>
<td>1440</td>
<td>Top three priorities – highest (3 dots), second highest (2 dots), third highest (1 dot) (6 dots each)</td>
<td>All</td>
</tr>
<tr>
<td>1450</td>
<td>Discussion and re grouping and weighting (number of people prioritising)</td>
<td>Rearrange post its</td>
</tr>
<tr>
<td>1500</td>
<td>Are there any show stoppers? Things which would stop your organisation backing the DEN or could stop it going ahead?</td>
<td>Red post its</td>
</tr>
<tr>
<td>1510</td>
<td>Analysis – any obvious conflicts</td>
<td>Discussion LC / JE prompt</td>
</tr>
<tr>
<td>1520</td>
<td>Thinking wider now – who else needs to be involved to make the scheme work?</td>
<td>Discuss and record – flip chart</td>
</tr>
<tr>
<td></td>
<td>Prompt list: Existing local businesses, business support organisations (to attract future business), domestic customers c/o RSLs, owner occupiers (?) heat suppliers (power station, incinerator, gasifiers), developers, ESCOs</td>
<td>LC / JE prompt</td>
</tr>
<tr>
<td></td>
<td>Which are critical?</td>
<td>All</td>
</tr>
<tr>
<td>1530</td>
<td>What would their key aspirations be?</td>
<td>Yellow post its</td>
</tr>
<tr>
<td>1540</td>
<td>Group and discuss – any obvious conflicts? Do people want to reprioritise?</td>
<td>Rearrange post its</td>
</tr>
<tr>
<td>1550</td>
<td>Next steps – are there other representatives who should be at the next stakeholder workshop or kept in touch?</td>
<td>List All Notes JE</td>
</tr>
<tr>
<td>1555</td>
<td>AOB</td>
<td>Notes JE</td>
</tr>
<tr>
<td>1600</td>
<td>Close</td>
<td></td>
</tr>
</tbody>
</table>

**To take:**  
Post its – green, red, yellow  
Blue dots  
Flip chart paper  
Pad for recording  
Camera to take pictures of post its and layout  
Illustration of target diagram
Example of evaluation of option performance:

### 18.1 Attendees

<table>
<thead>
<tr>
<th>Attendee</th>
<th>31/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter North, LDA</td>
<td>✓</td>
</tr>
<tr>
<td>Clive Tritton, LB Enfield</td>
<td>✓</td>
</tr>
<tr>
<td>May Lam, LB Enfield</td>
<td>✓</td>
</tr>
<tr>
<td>John Haslem, LB Enfield</td>
<td>✓</td>
</tr>
<tr>
<td>Lewis Stevens, LB Haringey</td>
<td>✓</td>
</tr>
<tr>
<td>Karin Derstroff, LB Waltham Forest</td>
<td>✓</td>
</tr>
<tr>
<td>Carolyn Seymour, LB Waltham Forest</td>
<td>✓</td>
</tr>
<tr>
<td>John McGill, NLSA</td>
<td>✓</td>
</tr>
<tr>
<td>Yemi Raiwe, NLSA</td>
<td>✓</td>
</tr>
<tr>
<td>Alison Dickens, NLSA Project Manager</td>
<td>✓</td>
</tr>
<tr>
<td>Andrew Lappage, NLWA</td>
<td>✓</td>
</tr>
<tr>
<td>Bunmi Sangosanya, NLWA</td>
<td>✓</td>
</tr>
<tr>
<td>James Eland, Parsons Brinckerhoff</td>
<td>✓</td>
</tr>
<tr>
<td>Lynne Ceeney, Parsons Brinckerhoff</td>
<td>✓</td>
</tr>
<tr>
<td>Sean Walsh, LBWF</td>
<td>✓</td>
</tr>
<tr>
<td>Steve Lucas, SQW</td>
<td>✓</td>
</tr>
</tbody>
</table>
19 APPENDIX D – SMALL SCALE GENERATION TECHNOLOGIES

19.1 Spark-ignition Gas Engines

19.1.1 Spark Ignition Gas Engines (SIGE) are CHP prime movers based upon large internal combustion engine technology. Engines are available with outputs from 5kW up to approximately 10,000kW, and may be purpose built spark ignition engines, or more commonly at the larger size range, they may be modifications of marine / stationary compression ignition engines.

19.1.2 Spark ignition gas engines use the 4-stroke Otto cycle. For each combustion cycle, the main charge of fuel (gas) is mixed with intake air before it reaches the combustion chamber. As the piston reaches the top of its stroke, and the intake valve is closed and a spark plug ignites the fuel/air mix, driving the piston down the cylinder and transferring power to the crankshaft. At the bottom of the piston stroke, the exhaust valve is opened and the piston returns to the top of the cylinder to expel the exhaust gases.

19.1.3 Although the smallest SIGE engines may be single cylinder, larger units will have up to 20 cylinders with in-line or V configurations. Most are usually turbocharged and intercooled. The engine is usually directly coupled to an AC alternator to deliver electrical power. In a CHP application, low temperature (LTHW, up to 95°C) heat is recovered using heat exchangers on the engine jacket water cooling system, and usually the engine oil cooler and intercooler (charge air cooler) 1\textsuperscript{st} stage. Heat may also be recovered from by cooling the exhaust gases; as the exhaust temperatures are commonly around 400°C at the turbocharger outlet, there is an opportunity to convert this into steam or high temperature hot water if required, alternatively larger quantities of LTHW heat may be recovered.

19.1.4 The potential for high temperature heat recovery is usually about 40 to 50% of the total thermal output of the CHP set at 175-185°C. This may be used for steam generation or for high temperature hot water.

19.1.5 SIGE CHP is often partnered with absorption chillers to provide cooling. The absorption chillers can be driven from LTHW or steam / HTHW systems, the latter provides higher efficiency of heat utilisation if the LTHW is required for other purposes, e.g. supplying district heating. Conversely, if a scheme’s priority is to maximise steam output from its power plant, the LTHW heat output could be used to drive single-effect absorption chillers allowing the production of steam to be directed to other uses on site.

19.1.6 For CHP applications, SIGE units are usually supplied as a packaged system including the generator, heat recovery modules and control system optimised for CHP. The heat:power ratio of SIGE CHP sets is typically around 2:1 for the smallest units, up to 0.85:1 for the largest units. Electrical efficiencies tend to increase with increasing size, ranging from 25% for the smallest units up to around 48% for the largest units.

19.1.7 Fuels

19.1.8 SIGE engines are suitable for operation with gaseous or easily vapourised fuels. The majority of applications in the UK use mains natural gas. The consistent quality and low level of impurities in mains natural gas ensures that that the highest output is achieved from SIGE units, with high levels of availability and longest economic lifespan of units. Whilst smaller engines may operate from a low-pressure gas supply, most units over 2000kW output will require an intermediate pressure gas supply (>3.5bar g). Alternatively, a gas compressor may be installed if approval is gained from the gas shipper.
19.1.9 Other gases fuels may be used for SIGE applications, including landfill gas, syn-gas or bio-gas and oil production by-products. The operating parameters of the engine will depend on the properties of the fuel, but typically as these fuels are of lower calorific value with greater impurities, the power output of a generating set will be reduced, and increased maintenance may be anticipated. Engine suppliers will usually provide advice on a case-by-case basis for such applications. However, if the gas supply is generated from renewable sources, such as bio-gas, an SIGE engine CHP set provides a proven means to generate 100% renewable electricity and heat providing flexibility and controllability. The difficulty in such a scheme is to generate the bio-gas successfully; bio-mass based gasifier systems have so far proven unreliable at commercial scale. There has been significant interest in anaerobic digestion as a means of producing bio-gas, however this technology is at early stages of commercial availability. The means of producing bio-gas is effectively a separate issue from the SIGE engine options, and should be treated separately in the consideration of options.

19.1.10 Dual-fuel SIGE engines that allow back-up operation on liquid fuels (e.g. light fuel oil) are available as generating sets, however these are for specialist applications and are not generally available configured as CHP sets.

19.1.11 The rest of this section concentrates on natural gas fuelled SIGE CHP applications. If other gas types are to be considered, the main principles will be the same as regards the engine technology, although compensation may have to be made for reductions in power output and increased operational costs.

19.1.12 Operational characteristics

19.1.13 SIGE units tend to have a flatter torque curve than compression ignition engines, and are thus most suitable for suitable for sustained continuous operation with fairly constant load. They will modulate to load follow, but the minimum output is usually approximately 50% of the rated output, if the load drops below this the CHP unit would normally shut down. There are also limits on the rate of change of load. Although SIGE CHP units can be used as back-up power in island mode operation, the limitations on accepting load mean that in black-start situations, it is often necessary to provide alternative stand-by generation to handle the transition to and from grid power.

19.1.14 SIGE CHP units are equipped with synchronisation controls to ensure stable operation on grid, with the engine being run at the necessary speed to maintain constant generation frequency. Engines normally operate at 1500, 1000 or 750rpm; lower speed engines may benefit from reduced frictional losses and hence increased electrical efficiency, however the higher torque means that the engine will be considerably heavier, which requires a more substantial energy centre building structure and more complex maintenance.

19.1.15 SIGE CHP units typically achieve an annual availability of around 92% on mains natural gas.

19.1.16 SIGE noise emissions are very high, typically 110-120 dBA at 1m from the engine, hence need to be enclosed in an acoustic cell. Suitable silencers need to be provided to reduce noise emissions from plant. Measures may need to be taken to protect against transmission of vibration, especially for larger units which may need substantial foundations.

19.1.17 The main pollutants flue gas emissions from mains gas fired SIGE are oxides of nitrogen (NOx) and carbon monoxide. Most modern engines are designed to be “lean-burn” technologies to reduce NOx, however on a large energy centre, it should be expected that additional emissions abatement plant will be required. The usual technology for this is Selective Catalytic Reduction (SCR) that works by injecting aqueous urea into the exhaust stream. This is likely to be a requirement for any plant operated under Environmental Permitting legislation.
19.2 Compression Ignition

19.2.1 Compression Ignition Engines (CI) are CHP prime movers based upon large internal combustion engine technology. Engines are available with outputs from 5kW up to approximately 80MW, although for the purposes of this report, only units between 2,000 and 10,000KW are considered.

19.2.2 Units in the 2MW to 10MW size are usually 4-stroke, turbocharged and intercooled with between 12 and 20 cylinders in-line or in V configuration. These are generally classed as medium speed engines, operating between 500 and 1500rpm. As per SIGE units, the engine is usually directly coupled to an AC alternator to deliver electrical power.

19.2.3 Generally, CI engines are marketed solely as generating sets, and are not available ready packaged as CHP, hence some degree of adaptation would be necessary to recover heat. For high temperature heat recovery only, an exhaust heat exchanger would be required. Recovery of some low temperature heat could also be accomplished from the exhaust gases, but if there is a significant requirement for LTHW, consideration should be given to providing heat exchangers on the engine jacket water cooling system, the engine oil cooler and intercooler (charge air cooler) 1st stage. This is likely to require a degree of bespoke engineering, and would require more detailed discussion with engine suppliers.

19.2.4 As per SIGE, CI engines can also be deployed with absorption chillers to provide cooling; the absorption chillers could be operated as HTHW/steam driven, or if steam is required elsewhere, the absorption chillers could be specified to operate on LTHW, thus making maximum use of heat recovery from the engines.

19.2.5 Electrical efficiencies are typically around 46 to 47%.

19.2.6 Fuels

19.2.7 CI engines can be specified for use with a variety of liquid fuels including light fuel oil, heavy fuel oil, diesel, straight vegetable oil (bio-oil) and biodiesel. 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.

19.2.8 The operation of generating sets using distillate based fuel oils is generally widely understood and is not explored further here. However, CI engines also open up the possibility of using renewable bio-oil fuels; these generally fall into two categories:

- 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. The unrefined nature of the fuel dictates that it is considerably more viscous than diesel and has similar properties to fossil medium/heavy fuel oil. Pure plant oil usually requires heating to reduce its viscosity prior to combustion and additives to compensate for acidity and reduced “lubricity” to safeguard the engine.

- Bio-diesel; this 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. Biodiesel is available in a number of grades from B100, which is 100% plant oil derived, B80, an 80/20 mix of biodiesel and mineral diesel respectively and so on. The European standard for biodiesel is EN14214:2003; biodiesel produced to this
standard is recognised as having similar combustion qualities to those of mineral diesel.

19.2.9 The way that biodiesel is manufactured may affect claims for ROCs under Renewable Obligation and for Climate Change Levy Exemption Certificates. For instance, one process uses methanol from natural gas at around 10% by volume that is removed after the transesterification process (process of turning oils and fats to biodiesel). OFGEM have stated that this process makes fuels ineligible for ROCs. This is not the case if the feedstock (including any alcohol) comes from non-fossil fuel sources.

19.2.10 Although bio-diesel can be used almost as a straight swap for distillate diesel, the main obstacle is the cost; at around 54p/litre, biodiesel is around 40% more expensive, and thus rules out its use for stationary applications. The main market for bio-diesel is for transport applications, where the reduced road fuel duty offsets this increase.

19.2.11 Due to its higher viscosity pure plant oil cannot readily be used as a transport fuel; as a consequence it has a considerably lower value than bio-diesel and is thus of more interest to stationary applications. Pure plant oil can be sourced from a variety of feedstocks including oil palm, soy, jatropha etc.; one of the main sources in the UK is rapeseed oil which is widely grown. Fuels can also be derived from animal by-products such as fats or fish oils. However, there is still an ongoing debate as to the total supply of plant oil as fuel vs. food and as a consequence there has been limited implementation of plant-oil fuelled generation / CHP systems.

19.2.12 Operational characteristics

19.2.13 CI engines can accommodate a fairly wide range of load variations during operation, and can also “ramp up” to match fairly rapid changes in load. They are thus more suitable for use in island mode and for black start and standby operation.

19.2.14 The engine sizes and weights tend to be similar to SIGE units of similar power output, and similar provisions need to be made for acoustic and vibration protection.

19.2.15 Control of NOx and carbon monoxide emissions can be achieved by SCR plant. Sulphur dioxide is not usually a significant issue as the sulphur content of distillate diesel is very low, and this is usually the case for most bio-oils. However, when using bio-oils, further consideration must be given to the fuel characteristics as some fuels may cause excessive particulate emissions, or if chlorine rich, may lead to the production of carcinogenic dioxins and furans.

19.2.16 Operation of a CI engine with bio-fuels may require additional considerations; these include:

- “Shelf life” of oils which may deteriorate in storage
- Tanks and pipelines often have to be heated to keep oil flowing
- Oil usually has to be filtered, and this will result in some waste material
- If the heating fails, some oils will solidify, blocking pipelines and filters; it can be very difficult to re-liquify the oil as it does not conduct heat readily in the solid form, so down-time can be protracted.
- If an engine “trips”, the oil left in the fuel lines may need to be flushed into a holding tank and the engine restarted on diesel or equivalent. If mineral diesel is used for this there can be problems with claiming ROCs; for this reason it may be
advisable to have a supply of certified renewable bio-diesel available to maintain ROC eligibility in this event.

- The engine management / control system will be more complicated to cope with different fuels, and thus there will be a price premium.

19.3 GT Open cycle

19.3.1 An open cycle gas turbine CHP system would comprise a gas turbine generator package and a heat recovery steam generator (HRSG), sometimes referred to as a waste heat boiler (WHB). The system can be fuelled by gaseous or liquid fuels. These fuels could include natural gas, biogas and fossil or bio oil. The system can be fuelled by natural gas with oil as a back up, referred to here as dual fuel. The system may also include a gas compressor for the fuel gas depending on the pressure of the incoming supply.

19.3.2 An open cycle gas turbine system could supply just steam, a mixture of steam and LTHW or a full energy service including chilling via absorption chillers. Gas turbines emit the majority of the waste heat as high temperature flue gases and so they are ideal for production of large quantities of steam. Depending on scale, LTHW could be supplied either by production of steam and heat exchange to the lower temperature or via a separate section of the waste heat boiler.

19.3.3 Open cycle gas turbine systems tend to have a lower electrical efficiency than reciprocating engines. They therefore have a higher heat to power ratio, typically 1.5-2:1. This ratio can be further increased by inclusion of a supplementary firing system in the flue gas. This burns additional fuel in the excess oxygen of the flue gases raising the inlet temperature to the WHB. This type of additional steam raising is very efficient – typically in excess of 95%. The supplementary firing system can also be arranged to allow for steam to be raised even when the GT is out of service thus providing additional security of heat supply. This is typically known as auxiliary firing of the WHB.

19.3.4 Suppliers and Availability

19.3.5 Gas turbines are available in a wide range of sizes (from 600kWe to 200 MWe) but become significantly more electrically efficient as they increase in size. GT performance is not normally become competitive below 5MWe. The normal preference is to use a single unit of the largest size appropriate for the given heat load.

19.3.6 It should be noted that the electrical efficiencies for gas turbines are very sensitive to specific installations and to temperature variation. Performance declines sharply for installations with significant inlet or outlet duct losses. Performance also degrades for air inlet temperatures above 10°C. Care must be taken when comparing with other technologies such as SIGE which do not degrade in the same way.

19.3.7 On the positive side GTs achieve higher availability than reciprocating engines – typically they will operate for 94% of available hours or more.

19.3.8 The main pollutant flue gas emissions from gas turbines are oxides of nitrogen (NOx) and carbon monoxide. Most modern turbines are designed with “Dry Low Emissions” (DLE) combustion technologies to reduce NOx. Emissions are much lower than for SIGE and typically DLE this is considered Best Available Technology for plant under the Environmental Permitting regime.
19.4 Solid Biomass boilers

19.4.1 Bio-fuel originates from the processing of organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural by-products. Biofuels fall into two main categories: woody biomass (including forest products, untreated wood products, energy crops i.e. crops that are grown specifically for energy) and non-woody biomass (which includes animal wastes, industrial and biodegradable municipal products from food processing and high-energy crops such as rape-seed, sugar cane, maize). The boilers described in this study are all fuelled by woody biomass.

19.4.2 A biomass boiler burns solid biomass in order to generate hot water. Biomass boilers of the scale considered here are able to burn a wide range of solid woody biomass, namely woodchip, wood pellet and refined miscanthus.

19.4.3 Main Plant

19.4.4 The two main items of plant are the biomass boiler and biomass fuel store/ handling plant. The design of the biomass fuel store depends on the scale of boiler. Larger boilers require bespoke solutions, whereas a packaged fuel hopper can be used for smaller boilers. The biomass is fed from the fuel store into the boiler into the combustion chamber, the design of which is dependent on the characteristics of the fuel used. Once within the boiler, the fuel is combusted in a controlled manner and the residual ash is collected for disposal. The hot flue gasses are re-circulated to ensure that complete combustion has taken place and that NOx emissions are kept to a minimum. The flue gas transfers heat to the heating water circuit before passing through to the flue gas filtration mechanism, where solid matter is removed from the before going up the stack. Ash from the combustion grate and flue gas filtration is collected in a container for disposal.

Figure 19-1: Indicative biomass boiler arrangement

19.4.5 Track record and operating reliability

19.4.6 Biomass boilers have been produced commercially for the last 50 years in Europe, however in the UK the number of operational installations is relatively limited.
19.4.7 Biomass boilers are available with a wide range of thermal capacities, similar to that possible with conventional gas boilers. The turndown that is possible with biomass boilers is somewhat dependent on the moisture content of the fuel stock, if wood has a moisture content of around 30-40% it is possible to achieve a turndown of 25%. If wet wood, with a moisture content of around 55% is burned then the turndown is limited owing to the requirement to maintain a sufficiently hot furnace to dry the wood on the combustion grate.

19.4.8 The gross calorific value efficiency of a biomass boiler is around is between 75% and 80%, a consistent fuel specification is required to ensure that the boiler is able to achieve the highest possible efficiencies. The net efficiency of the boiler is highly dependant on the moisture content of the fuel delivered – a large amount of the energy in the wood is lost in evaporating water which is then emitted to atmosphere.

19.4.9 Biomass boilers are considered to be a reliable technology as long as the system is correctly designed, has a systematic maintenance regime with adequately alarmed critical systems and uses high quality fuel of the correct specification. The primary cause of unplanned system outage is the fuel feed mechanism. The irregular nature of biomass has the potential to cause blockages at a number of points in the fuel feed mechanism that will cause the boiler to shut down if not attended to. The majority of fuel feed blockages can be rapidly and safely cleared by semi-skilled staff. The re-starting sequence of boilers is another common cause of problems and un-planned shutdown.

19.4.10 Biomass boilers require semi-skilled staff to clear fuel-feed blockages and undertake day-to-day upkeep and maintenance, for example emptying of ash container and ensuring the fuel store is operating correctly. An annual maintenance period of 1 to 2 weeks is required in the summer to undertake inspections and replace any worn parts.

19.4.11 Fuel Economics

19.4.12 Biomass boilers can accept a wide range of woody biomass, it is however important to note that the specification of the combustion grate and fuel feed mechanism is a function of the fuel characteristics. In general the cost of biomass fuel is a function of the amount of refining that it has undergone. To able to use the lowest cost woodchip fuel the boiler should be able to accept wood with a moisture content up to 50% with a fuel of between 30mm2 by 50mm2. Low-cost wood chip requires a complex and expensive fuel feed mechanism. High-cost refined biomass, for example wood pellets require a lower-cost fully automated fuel silo mechanism because of its uniform nature and low moisture content.

19.4.13 The primary concern associated with biomass is procuring sufficient fuel at an acceptable price, this can be mitigated against through the use of adequate fuel supply contracts and designing the boiler to be able to accept as wide a range of fuel specification as the boiler technology allows.

19.4.14 Careful consideration needs to be given to the basis of the price quoted for woodchip and other unrefined biomass fuels. The impact of high moisture and ash contents on the value of the wood as delivered must be reflected in the price paid. The strong preference would be to pay for the heat supplied rather than the fuel delivered to place the proper incentives on fuel suppliers to invest in provision of drier fuels where economically advantageous. Payments by the wet tonne should be avoided without adjustment mechanisms to take account of the weight of dry wood delivered and the impacts on combustion efficiency.

19.4.15 Environmental Considerations

19.4.16 The primary emission of concern in relation to local air quality is particulates. Particulate emissions from the biomass boiler are generally controlled by post-combustion cyclones or
filtration equipment to ensure that they remain below the permitted emissions limits. In order to maintain the required emission limits it is important to ensure correct maintenance of the filtration system and adequate control of the rate of biomass combustion.

19.4.17 Other potential emissions of concern are oxides of nitrogen, although this is generally only of concern where there are existing high background concentrations, and oxides of sulphur. This latter emission is generally tied to the levels of sulphur in the fuel and relates generally to specific growing conditions. This should be managed through adequate testing of fuels before contracting to ensure that further mitigation measures are not required.

19.4.18 The ash produced by the boiler is considered to be inert if the source wood is uncontaminated. The ash can be used as a construction aggregate or in-fill material. Water produced from boiler blow down and from flue condensate can have a high salt content and require neutralisation before it can be discharged to the drain.

19.4.19 A further environmental consideration is the impact of fuel deliveries on the local road network. To minimise the costs and environmental impact of the fuel supply chain, deliveries should be carried out in the largest available vehicles, proportionate to the scale of the fuel demand. Multiple large vehicle movements may be an issue for local planners when considering an application to install a biomass boiler.

19.4.20 Typically NOx emissions are likely to be around 250mg/Nm3 @ 11% O2. This is a similar level of emission to an unabated gas CHP engine and therefore consideration will need to be given to potential abatement of this emission.

19.4.21 Sustainability of fuel supply

19.4.22 In the short term, access to a local wood fuel resource may be an issue, as the supply chain may require investment and development before it can function reliably. This is an issue in the context of acceptable transport distances for wood fuel (suggested by the Forestry Commission to be 40 miles when using road transport). However, providing that progress towards securing reliable local supply appears achievable in the medium, or long term a technology fuelled by biomass is appropriate.

19.4.23 Choice of solid biomass fuel type

19.4.24 The design of biomass boiler systems is more problematic than fossil fuel boilers as a result of the variability of woody biomass fuel. Two main types of woody biomass are available, chipped and pelletised. Chipped woody biomass is almost exclusively derived from wood and is processed from raw timber into semi-regular chips. Pelletised woody biomass refers to fuel, either wood or Miscanthus, that has been ground-down and re-formed into uniform pellets. The following table outlines the pros and cons of the two fuel types:

<table>
<thead>
<tr>
<th>Table 19.1 Biomass fuel types comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>Chipped woody biomass</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
| Pelletised woody biomass | • Lower maintenance  
• High energy density  
• Uniform dimensions  
• More reliable fuel handling | • Expensive to produce  
• Requires specialised delivery vehicle  
• Potential for higher embedded CO$_2$ |
20 APPENDIX E – ULV DECENTRALISED ENERGY NETWORK – PLANNING POLICY REVIEW

20.1 Introduction

20.1.1 The need to adapt to climate change is an objective embedded in the planning policy framework from top to bottom. The general policy driver which filters down through national, regional and local levels is the need to reduce greenhouse gas emissions and increase the use of renewable energy.

20.1.2 This review concentrates on the key policy statements and policies and any supplementary information at the national, regional and local levels.

20.2 National Level: Planning Policy Statements

20.2.1 Planning Policy Statement (PPS) 1: Delivering Sustainable Development advises planning bodies to prepare policies which:

… seek to minimise the need to consume new resources over the lifetime of the development by making more efficient use or reuse of existing resources, rather than making new demands on the environment; and should seek to promote and encourage, rather than restrict, the use of renewable resources (for example, by the development of renewable energy). Regional planning authorities and local authorities should promote resource and energy efficient buildings; community heating schemes, the use of combined heat and power, small scale renewable and low carbon energy schemes in developments…

20.2.2 Achieving a reduction in greenhouse emissions and increasing the use of renewable energy cannot be done in isolation. Planning bodies are required to work in partnership with each other and with other key stakeholders to deliver policy objectives. This type of working is a key element of spatial planning and should not be restricted by geographical boundaries.

20.2.3 PPS: Planning & Climate Change Supplement to PPS1 recommends planning bodies integrate climate change considerations into all spatial planning concerns, with a focus on making good use of opportunities for decentralised and renewable or low carbon energy. This should be reflected in regional and local planning policies. In drawing together local requirements for decentralised energy in local policies, local planning authorities should:

(i) set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured;
(ii) where there are particular and demonstrable opportunities for greater use of decentralised and renewable or low-carbon energy than the target percentage, bring forward development area or site-specific targets to secure this potential; and,
(iii) set out the type and size of development to which the target will be applied; and
(iv) ensure there is a clear rationale for the target and it is properly tested.

20.2.4 The Climate Change Act 2008 sets legally binding emission reduction targets, which includes a reduction of at least 80 percent in greenhouse gas emissions by 2050. Although PPS 22: Renewable Energy pre-dates the Climate Change Act 2008 by some 4 years, the planning

---

37 ODPM (2005), Pg9, PPS1: Delivering Sustainable Development, HMSO
38 ODPM (2007), Pg16, PPS1: Planning and Climate Change Supplement to PPS 1, HMSO
framework set by the Statement is relevant to facilitating the policy direction required to meet the Climate Change Act's aspirations. This is underpinned by the statement:

“The development of renewable energy, alongside improvements in energy efficiency and the development of combined heat and power, will make a vital contribution to these aims.”

and,

“Increased development of renewable energy resources is vital to facilitating the delivery of the Government’s commitments on both climate change and renewable energy.”

20.2.5 PPS22 compliments PPS1 and its supplementary document by focusing planning bodies on promoting and encouraging, rather than restricting, the development of renewable energy resources regardless of the size of scale.

20.3 Regional Level: London Plan

20.3.1 The London Plan absorbs the policy direction set by PPS 1 and PPS 22 by establishing a strategic spatial planning policy framework which looks to make the fullest and most sustainable use of resources, including energy.

20.3.2 The policies in the Plan promote sustainable development, including mitigating, and adapting to, the impacts of climate change. Chapter Five specifically addresses climate change with an emphasis on tackling the issue through a broad suite of policies aimed at reducing emissions. Decentralised energy systems are referred to throughout the chapter, with Policy 5.5 dealing most directly with the initiative.

20.3.3 The London Plan (2011) places a greater emphasis on decentralised energy networks than its previous versions (2004 and 2008) and raises the profile of decentralised energy as a key contributor to reducing greenhouse emissions. It states:

“Tackling climate change will also require a move towards more sustainable energy sources and the London Plan seeks to support the development of decentralised energy systems, including the use of low carbon and renewable energy and the greater utilisation of energy generated from waste.”

and,

“... the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide level, including larger scale heat transmission networks.”

20.3.4 This is supported by a London Heat Map tool to help boroughs and developers identify decentralised energy opportunities in London. London is thought to have the potential to increase its decentralised energy capacity ten-fold.

20.3.5 The Mayor has set a target for London to generate 25% of its heat and power requirements through the use of local, decentralised energy systems by 2025 (Policy 5.5, London Plan 2011). These will predominantly be based around the use of gas-fired combined heat and power (CHP), district heating and cooling in the first instance.

39 ODPM (2004), Pg6, PPS22: Renewable Energy, HMSO
40 ODPM (2004), Pg6, PPS22: Renewable Energy, HMSO
20.3.6 Policy 5.5 of the London Plan 2011 is replicated below:

Figure 20-1 London Plan Policy 5.5

POLICY 5.5
DECENTRALISED ENERGY NETWORKS

Strategic
A The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

LDF preparation
B Within LDFs boroughs should develop policies and proposals to identify and establish decentralised energy network opportunities. Boroughs may choose to develop this as a supplementary planning document and work jointly with neighbouring boroughs to realise wider decentralised energy network opportunities. As a minimum boroughs should:

a identify and safeguard existing heating and cooling networks
b identify opportunities for expanding existing networks and establishing new networks. Boroughs should use the London Heat Map tool and consider any new developments, planned major infrastructure works and energy supply opportunities which may arise
c develop energy master plans for specific decentralised energy opportunities which identify:
  - major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
  - major heat supply plant
  - possible opportunities to utilise energy from waste
  - possible heating and cooling network routes
  - implementation options for delivering feasible projects, considering issues of procurement, funding and risk and the role of the public sector
d require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

20.4 Local Level – London Boroughs’ Local Planning Frameworks
20.4.1 The three boroughs committed to the Upper Lee Valley Decentralised Energy Network Pre-feasibility Study are at various stages of the Local Development Framework (LDF) process. All three have development plans which include saved local plan policies as a minimum. Emerging Development Plan Documents (DPDs) are important documents which indicate the policy direction of local planning authorities and are given due consideration.

20.4.2 The ‘adaptation to climate change’ theme trickles down to the local level and is a key feature in the emerging LDF policies, rather than extant saved policies of the older unitary development plans. This is perhaps a reflection of the relatively recent acceptance by all levels of the planning system to facilitate measures in the drive to tackle climate change.

20.5 LB Enfield

20.5.1 The LB Enfield Adopted Core Strategy (2010) takes forward the London Plan’s designation of the Upper Lee Valley as an Area of Opportunity and earmarks it for significant regeneration over the next 10-20 years. The regeneration of the area provides a key opportunity to make considerable gains to the implementation of a decentralised energy network. This opportunity is led by Objective 2 of the Core Strategy, which identifies a need, inter alia:

...To mitigate and adapt to the impacts of climate change, promoting energy efficiency and renewable sources of energy including exemplar schemes as part of regeneration of the Upper Lee Valley area.  

20.5.2 The Core Strategy identifies a number of actions required to achieve this Objective, one of which is “increasing the proportion of London’s energy supplied from decentralised, renewable and low carbon sources to a quarter by 2025 and a majority of 2050”. This action will be facilitated by Core Policy 20 – Sustainable Energy Use and Energy Infrastructure which states:

...The Council will set local standards and targets, based on an understanding of local potential and opportunities for renewable or low carbon energy and existing or planned decentralised energy infrastructure.

20.6 LB Haringey

20.6.1 The Haringey Unitary Development Plan (UDP) saved policies (2009) are not specific to climate change nor do they explicitly refer to decentralised energy networks. Policy G1 does, however, require development to “…contribute towards protecting and enhancing the local and global environment and make efficient use of available resources”.

20.6.2 The emerging Core Strategy (currently at Submission stage), recognises climate change as a key policy driver and identifies:

Future developments in the borough will be driven by the need to make better use of key resources such as… energy… whilst reducing emissions that contribute towards climate change.

---

44 LB Enfield, (2010), Strategic Objectives 2, Pg 26, The Enfield Plan Core Strategy 2010-2025, LB Enfield
45 LB Enfield, (2010), Core Policy 20, Pg 98, The Enfield Plan Core Strategy 2010-2025, LB Enfield
20.6.3 Various Strategic Objectives are proposed in the emerging Core Strategy, the objective most explicitly relevant to decentralised networks being:

To increase energy efficiency and increase the use of renewable energy sources through establishing decentralised energy networks at Tottenham Hale and Haringey Heartlands.47

20.6.4 Core Strategy submission Strategic Policy 4 – Working towards a Low Carbon Haringey, is the key policy to delivering the Strategic Objective. The Policy is very focused on decentralised energy networks and illustrates the Council’s commitment to the initiative:

The Council will promote low- and zero-carbon energy generation through the following measures:

a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;
b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;
c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and
d. All new developments will be required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration which can include connections to local sources of decentralised renewable energy.48

20.7 LB Waltham Forest

20.7.1 The Waltham Forest Unitary Development Plan (UDP) saved policies (2009) recognise the importance of renewable energy technology in helping achieve medium / long-term Government objectives to reduce national energy consumption and thus greenhouse gas emissions. In Policy WPM 21:

The Council expects proposals to incorporate and enable 10% of total predicted energy consumption to be from renewable energy sources, through on-site generation for all new commercial/ industrial developments over 1000 sq ms and housing developments of 10 or more units.49

20.7.2 The UDP gives examples of suitable renewable energy technologies and includes Combined Heat Power (CHP) plants.

20.7.3 The emerging Core Strategy (currently at Proposed Submission stage) promotes sustainable regeneration and prides itself on successful development examples which are powered and heated by clean and efficient energy.

47 LB Haringey, (2011), Para 1.5.6, Pg 50, Haringey Core Strategy Proposed Submission May 2010, LB Haringey
48 LB Haringey, (2011), Strategic Policy 4, Pg 91, Haringey Core Strategy Proposed Submission May 2010, LB Haringey
49 LB Waltham Forest, (2006), WPM21, Pg 163, Waltham Forest Unitary Development Plan First Review, LB Waltham Forest
20.7.4 Spatial Objective (SO) 5 aims to …*ensure high environmental standards of development and sustainable resource management and efficiency to support the long term sustainability of our environment and respond to climate change in a practical and effective way*.

20.7.5 The implementation of this Objective is carried through Policy CS5 - Minimising and Adapting to Climate Change. It commits the Council to tackling:

… *climate change locally and promote resource efficiency and high environmental development (by)* …

… *E) working with partners and developers to promote and facilitate the delivery of local decentralised energy capacity and networks, especially district heating systems in appropriate areas of the Borough, in particular in the key growth areas*; 51

20.7.6 The Core Strategy stresses the importance of decentralised energy and CHP for delivering carbon reduction targets and recognises its higher efficiencies in generating useful energy.

20.7.7 Policy CS5 is connected to Policy CS4 - Providing Infrastructure which seeks to ensure the appropriate physical and utility infrastructure is provided where it is required by new development.

---

50 LB Waltham Forest, (2011), Strategic Objective 5, Para 3.13, Pg 28, Waltham Forest LDF Core Strategy - Proposed Submission 2011, LB Waltham Forest

51 LB Waltham Forest, (2011), Policy CS 5, Pg 75, Waltham Forest LDF Core Strategy - Proposed Submission 2011, LB Waltham Forest
Dear Sirs

**Laying Heating Pipes within Towpath within the Upper Lea Valley**

**COSTS UNDERTAKING**

[insert name of Promoter] is proposing to construct [describe works] affecting the interests of British Waterways at [location]. The requirement to cover the costs of British Waterways is acknowledged as follows:

1. In consideration of your proceeding to negotiate and instructing your solicitors, engineers, surveyors or other appropriate professionals (whether external or in-house) to advise you and to subsequently proceed with the requisite work involved in the grant to us of a Contract in respect of [scheme title] affecting British Waterways we hereby agree and undertake to defray your costs and fees (including VAT and disbursements) in relation to the matter and to follow the requirements and conditions set out in Appendix 4 of the Code of Practice for Works affecting British Waterways.

2. This undertaking will apply whether or not the proposal proceeds to a legally binding Contract provided always that in the event that the Board unreasonably withdraws from the negotiations in respect of the Contract in circumstances where we are ready, able and willing to proceed forthwith to a legally binding Contract on terms that have been settled between us in writing then (and in those circumstances only) no liability for costs on the part of this company accrue.

3. This undertaking is given on the basis that fees in relation to this matter shall be charged at the rates set out in the Annex to this letter [but shall in no circumstances without further discussions with us exceed the sum of £1,856 (plus Value Added Tax and disbursements)].

4. If by [insert agreed date] no Contract has been completed (and accordingly no payment pursuant to this undertaking has been made) you will be entitled to deliver to us (and we agree and undertake to pay) a reasonable interim bill (and any further reasonable interim bills thereafter) on account of services rendered to the Board in connection with this matter. Such interim payment or payments shall not in any way affect or compromise the continuing liability of this company pursuant to the terms of this undertaking.

5. The sum of £380+vat is enclosed as a contribution to the administrative costs of British Waterways in making an initial assessment of our Application. We acknowledge that the payment of that sum to British Waterways does not place British Waterways under any further obligation to us in respect of the Application or in the execution of any Works that may arise in connection with the Application. We further acknowledge that
the sum paid is non-returnable whether or not our Application proceeds and that the acceptance by British Waterways of that sum does not constitute any representation or warranty on British Waterways’ part that it will accept the Promoter’s Works.

Yours faithfully

[Director/Officer duly authorised to bind plc/company/organisation]
22  APPENDIX G – PHASING OF LOADS AND OPTIONS RESULTS ILLUSTRATIONS (PDF ONLY)

22.1 Scenario A1 - Edmonton EcoPark as heat source, post 2023, 120ktpa throughput, gasifier technology

22.2 Scenario A2 – Edmonton EcoPark as heat source post 2023, 327ktpa throughput, gasifier technology

22.3 Scenario A3 – Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 120ktpa

22.4 Scenario A4 - Edmonton Incinerator modified to supply heat from 2015, new gasifier facility post 2023 on Edmonton EcoPark site with throughput of 327ktpa

22.5 Scenario B1 – Kedco gasifier as heat source circa 2015 onwards

22.6 Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023 (Olympic Route)

22.7 Scenario B2 – Kedco gasifier as heat source from circa 2015, with addition of 120ktpa throughput gasifier on Edmonton EcoPark as additional heat source post 2023 (Tottenham Route)

22.8 Scenario C1 – Enfield power station circa 2025 – assumed to operate to provide base load power to the grid (e.g. 8000hrs operation).
23 APPENDIX H – STRATEGIC NETWORK MODELLING ASSUMPTIONS

23.1 Energy costs

23.1.1 This study is based upon current energy costs. Energy costs have been derived wherever possible from Quarterly Energy Prices published by DECC, using 2010 rates. Energy prices will, of course, fluctuate over the study period.

23.2 Connection Charges

23.2.1 The connection of new developments is assumed to allow Developers to avoid costs that they would otherwise have borne to comply with carbon targets. These costs do not correspond with the full cost of energy compliance, as many elements will still be paid for by the Developer – e.g. enhanced fabric measures, increased electrical efficiency etc... However, certain elements of the alternative solution will be saved, e.g. on-site heat generation plant, flues, potentially utility connections or reinforcement costs, increased access requirements etc..

23.2.2 The value assumed that developers could contribute to the strategic network are:

- £1200 per residential unit and
- £150 per kW peak thermal demand for non-residential connections.

23.2.3 Connections

23.3 Availability Charges

23.3.1 Availability charges have been modelled on avoided maintenance and replacement costs for the buildings connected. E.g. it is assumed that under the base case scenario that building operators would bear costs for the upkeep and periodic replacement of their heat supply plant. The availability charge is effectively a charge that reflects the cost that would be borne otherwise under the business as usual scenario.

23.4 Closure of Edmonton Incinerator site

23.4.1 Options A3 and A4 span a period when the Edmonton Incinerator would be decommissioned and new plant would be built. The modelling has assumed that during this period (e.g. 2021 to 2023 inclusive) there would be no operational profit for the scheme.

23.5 Cost of Network in ULV Industrial Corridor Employment Areas

23.5.1 In cases where the strategic network is envisaged to serve sections of the ULV industrial corridor, PB has estimated the cost of the distribution network systems to individual premises by creating a proxy model and extrapolating this on an area basis. This approach has been adopted due to the high volume of buildings within these industrial estates and the similarity of layouts of many areas. The model adopted reflects the assumption that not all of the industrial premises in each area are likely to connect to a LTHW network, due to inertia or system incompatibility.

23.5.2 In order to determine an estimated cost of connection, PB selected a small area of one of these clusters and developed a fully costed network for the loads within this sample area. As the industrial estates along the ULV industrial corridor are largely uniform in terms of building density, PB were able to use this model to extrapolate a rough cost per square meter of
network within these whole areas. These costs effectively form part of the strategic network costs.
APPENDIX I - NLWA AND SOLID RECOVERED FUEL

24.1 Solid Recovered Fuel and Refuse Derived Fuel

24.1.1 ‘Solid Recovered Fuel’ (SRF) and ‘Refuse Derived Fuel’ (RDF) are terms that describe waste that has undergone some form of processing or treatment prior to being used as a fuel to generate energy. The terms are generally used interchangeably, however the Environment Agency makes a distinction between them, stating that SRF production requires a heat-treatment or drying stage in the waste treatment process. For the purposes of this report, the term SRF is used to refer to both SRF and RDF.

24.1.2 Untreated ‘raw’ waste may be used directly as a fuel in energy from waste (EfW) facilities, however there are limitations to its use due to the nature of the waste stream. First and foremost, waste quickly becomes odorous as the organic matter (such as food waste) breaks down, therefore untreated waste needs to be treated as quickly as possible. In addition, using unprocessed waste restricts the type of EfW technology that may be used because of the types of materials in the waste streams, such as metals and large items.

24.1.3 Treating waste to produce SRF offers a number of benefits, in particular:

- **Improved fuel quality**: non-combustible materials may be removed and large items reduced in size, which may enable treatment by more efficient advanced thermal technologies
- **Recovery of recyclables**: removal for recycling of materials such as paper, card, glass, wood, plastics and aggregates
- **Stabilisation of the fuel**: the organic component of the waste stream may be treated to reduce leachate and odour, which enables transport and storage

24.1.4 There are a range of treatment technologies that may be used to make SRF, and they produce different types and qualities of SRF. The SRF technology that is chosen will generally depend on how the fuel is to be used.

24.2 How is SRF produced?

**SRF technologies**

24.2.1 SRF may be produced in stand-alone facilities, producing high quality SRF, with separate contracts being secured for the treatment of the SRF. Alternatively, SRF production may be the pre-treatment stage of a thermal treatment facility, such as gasification. The different quality requirements and uses of SRF mean that a wide range of technologies exist to produce it.

24.2.2 Most SRF processes incorporate a mechanical treatment stage and a biological treatment stage, known as a mechanical-biological (MBT) facility. The mechanical treatment stage generally has two purposes: the removal of recyclable materials and non-combustible materials, and reducing the particle size. The biological process aims to reduce the water content of the waste and stabilise the organic matter to reduce odours and leachate. Depending on the configuration of the waste treatment facility, the biological treatment stage may be before or after the mechanical treatment stage.

---

24.2.3 The purpose of the mechanical treatment stage is to separate the SRF from recyclable materials and non-combustible materials. Mechanical sorting uses a variety of equipment, usually including rotary or vibratory screens, air classifiers, eddy current and magnetic separators, shredders, granulators and balers. These are used to separate out oversize items and various streams of recyclables such as paper and card, glass, plastics (including separate streams of HDPE, PET, dense plastics, and plastic film), aggregates, ferrous and non-ferrous metals.

24.2.4 There are generally three types of outputs from the mechanical treatment process: the recyclables, which are sent for further processing; rejects, such as oversize or non-combustible materials, which will be sent to landfill; and the SRF.

24.2.5 The biological treatment can take a variety of forms. The most basic method is bio-drying, which, as the name suggests, reduces the moisture content without significant biodegradation of the organic materials.

24.2.6 Other biological treatment processes are aerobic composting or anaerobic digestion, which use naturally occurring micro-organisms to treat the organic materials to stabilise them, which at the same time may reduce the moisture content. Anaerobic digestion also produces a biogas, which may be used to generate electricity.

24.2.7 The SRF from these processes looks like compost and may be called a Compost-Like Output (CLO), however it is still defined as a waste and may not be applied to land, other than in landfills.

24.2.8 Heat treatment sterilises the waste using heat or steam (autoclaving) prior to mechanical separation of recyclables. The SRF produced by is a fine, homogenous product that looks like compost.

24.2.9 Once the SRF has been produced, it may be compressed into pellets or bricks, or formed into plastic-wrapped bales for storage or shipping.

24.2.10 The quantity of SRF produced by an MBT facility is typically 50% to 70% of the amount of waste entering the facility, a further 10 to 20% may be recycled, along with a small amount of rejects. Facilities that include an aerobic composting process may lose 20% to 30% of the mass of the incoming waste as moisture and evaporative losses as the organic material breaks down.

24.2.11 The quality and characteristics of SRF vary greatly between facilities, due to the differing waste compositions and waste treatment processes. One of the key characteristics of SRF is calorific value, which is a measure of the energy content of the SRF. Untreated ‘raw’ municipal waste has a calorific value in the order of 9.2 MJ/kg. Depending on the process used, an SRF created from municipal waste could have a calorific value anywhere from 10 MJ/kg to 16 MJ/kg. Moisture content is also important, as an SRF with a high moisture
content will use more energy in the combustion process to evaporate the moisture, and therefore is a poorer quality fuel.

24.2.12 A European standard for the production of SRF (EN15359) has been developed and is expected to be published in 2011. The standard will define SRF as ‘a solid fuel prepared from non-hazardous waste to be utilised for energy recovery in incineration or co-incineration plants, and meeting the classification and specification requirements’.  

24.2.13 The standard will specify sampling, analysis and physical testing procedures, and will identify classifications for the SRF according to key properties (such as calorific value, moisture content, and concentrations of chemicals such as mercury or chlorine). SRF classifications are expected to be:

Table 24-1 Anticipated SRF classifications

<table>
<thead>
<tr>
<th>Classification</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses</td>
<td>Cement kilns, district heating boilers</td>
<td>Multi fuel power plants</td>
<td>EfW facilities</td>
</tr>
<tr>
<td>Specification</td>
<td>High CV (16 – 20) Low level of contaminants, to reduce damage / wear in kiln Small particle size, and may be pelletised</td>
<td>Medium CV (~15) Some drying required to achieve moisture content of 15%</td>
<td>Low CV (10 – 12) Flexible on moisture, size and contaminants; determined by transport logistics rather than end user</td>
</tr>
</tbody>
</table>

24.3 How is SRF used?

Energy-from-Waste

24.3.1 SRF may be burnt in energy from waste facilities. The quality of SRF that is required will depend on the EfW technology. The main types of EfW technologies that may use SRF are:

- Conventional (moving grate) incineration
- Fluidised bed incineration
- Advanced thermal treatment – pyrolysis and gasification

24.3.2 Conventional incinerators, which use a moving grate, burn waste in the presence of excess oxygen to ensure complete combustion. As the waste enters the furnace, it lands on the moving grate, which moves the burning waste through the furnace. The combustion air blows up through the grate, both cooling the grate and feeding oxygen into the waste.

---

24.3.3 Conventional incinerators generally do not require any pre-treatment of the waste, other than removal of oversize items such as mattresses, however they can also treat SRF with a relatively low calorific value. Of the UK’s 25 operational EfW facilities, 20 are conventional moving grate incinerators, and worldwide they are the most common form of waste to energy facility.

24.3.4 In a fluidised bed incinerator, the waste enters the combustion chamber and mixes with a bed of inert material (usually sand) and air is blown up through the material to ‘fluidise’ it, which creates good mixing conditions for rapid, complete combustion. In order to burn waste efficiently, a fluidised bed incinerator requires pre-sorting and mechanical processing of the waste to create a homogenous fuel (SRF). Although in practice the pre-treatment may be limited to size reduction and ferrous metal removal, this can impact on the efficiency of the facility, particularly through making it more prone to forced shutdowns. There are two fluidised bed waste incinerators in the UK.

24.3.5 Pyrolysis plants heat the waste (as high as 400 to 700°C) in the absence of oxygen, which breaks down the carbon-based waste materials. This process produces a gas (called “syngas”), which is a mixture of combustible gases (such as hydrogen and methane), which can be cleaned up and burned in a gas engine to generate electricity. The process also produces liquid oil products, which can be further refined to diesel and fuel oil products, and a solid residue or ‘char’ that can be gasified or burnt.

24.3.6 Gasification thermally degrades waste through partial combustion at a higher temperature than pyrolysis (800 to 1200°C) with the controlled addition of air, oxygen and/or steam. The process produces a syngas that is suitable to fuel a gas engine, a gas turbine, or a conventional steam turbine.

24.3.7 Advanced thermal technologies (pyrolysis and gasification) are considered to be more efficient than conventional incineration due to the use of gas engines, which have a higher electrical conversion efficiency than the steam turbine generators used by incinerators. In addition, by restricting the oxygen in the process, advanced thermal technologies require less combustion air than incinerators, which therefore reduces the amount of gas cleanup required (and its associated high cost). However, the gain in the energy efficiency of the processes is offset to some extent by the energy required to processing the waste into SRF prior to treatment.

24.3.8 There are very few gasification and pyrolysis facilities treating residual MSW that have been commercially proven at full scale outside of Japan and South Korea. There are a number of pilot and small-scale demonstration plants in the UK, however there are only three full scale commercial plants: a 30,000 tonnes per annum Energos gasification facility on the Isle of Wight\(^{55}\), an 18,000 tonnes per annum GEM pyrolysis facility in Scarborough\(^{56}\), and a 40,000 tonnes per annum Scotgen gasifier in Dumfries.

**Industrial uses**

24.3.9 SRF can be used by industry to displace other more expensive or more carbon-intensive fuel sources, such as fossil fuels. High specification SRF is widely used by the European cement industry to replace fossil fuels. It is also seen as a viable waste stream alongside biomass in multi-fuel power plants being developed by the power industry. There are benefits to these industries of using SRF, rather than untreated waste. Firstly, the SRF can be produced to


meet the specific industry requirements, such as higher calorific value. Secondly, SRF is considered to be more acceptable during the planning application process.

24.3.10 The cement industry is one of the largest producers of CO$_2$ in the UK and therefore by substituting waste derived fuels for fossil fuels in its kilns, it can lower its greenhouse gas emissions. A further benefit is that the industry gets paid to take SRF, whereas it must pay to use coal or coke.

24.3.11 Cemex, a UK cement manufacturer, has developed its own specification for SRF (called ‘Climafuel’) to be burnt in its kilns.

<table>
<thead>
<tr>
<th>CEMEX’s ‘Climafuel’ SRF specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorific value &gt; 15 MJ / kg</td>
</tr>
<tr>
<td>Moisture content &lt; 15%</td>
</tr>
<tr>
<td>Particle size &lt; 40 mm</td>
</tr>
<tr>
<td>Chlorine &lt; 1%</td>
</tr>
<tr>
<td>Group II metals up to 30 mg / kg</td>
</tr>
<tr>
<td>Group III metals up to 800 mg / kg</td>
</tr>
<tr>
<td>(e.g. mercury)</td>
</tr>
<tr>
<td>(e.g. lead)</td>
</tr>
</tbody>
</table>

24.3.12 Cemex uses a range of waste derived fuels in its kilns including SRF, secondary liquid fuel (industrial wastes such as paint thinners, inks and varnishes), and tyre chips. In 2010, Cemex’s South Ferriby plant replaced 68% of its traditional fuel coal with waste derived fuel. This reduced NOx emissions by 20% and SOx emissions by 27%. Its Rugby plant replaced 48% of its fuel with waste derived fuels and achieved a 60% reduction in NOx emissions.

24.3.13 Cemex has planning permission at its Rugby plant for a 250,000 tonnes per annum MBT facility to produce Climafuel for its operations.

Export

24.3.14 Several countries in Europe, including Germany, the Netherlands and Sweden, currently have excess capacity in their energy from waste facilities, created by a reduction in available waste (caused by higher recycling rates and the recession), as well as recent construction of additional facilities. This spare capacity is being met by importing SRF from other European countries, including the United Kingdom.

24.3.15 Exporting SRF provides an interim solution for UK waste companies as they develop their own capacity. The Environment Agency (EA) has recognised that SRF production in the UK is in excess of treatment capacity and therefore it is permitting storage of up to three years or allowing export as a short-term solution.

---

60 Environment Agency, Storage and use of Refuse Derived Fuel and Solid Recovered Fuel,
24.3.16 In December 2010, it was reported that three waste management companies in the UK had obtained permits from the EA for exporting SRF:\footnote{Let’s Recycle, Agency reveals increase in RDF export permits, 17 December 2010, http://www.letsrecycle.com/news/latest-news/waste-management/agency-reveals-increase-in-rdf-export-permits}

- **Shanks Group** has permission to send 100,000 tonnes of SRF to the Netherlands, Germany, Sweden and Estonia
- **SITA UK** has approval to send 26,000 tonnes of SRF to power generation facilities in Sweden and 2,500 tonnes of pre-sorted waste material to Rotterdam, where it is further processed and the resultant SRF is used in energy generation
- **Peel Ports Recycling and Waste Management** has approval for the export of 50,000 tonnes of SRF to Sweden.

24.3.17 There are in the order of 38 energy from waste facilities (some 7,152,000 tonnes per annum of capacity) in planning or with planning permission across the UK\footnote{Alan Metcalfe, Incineration Transformation, CIWM, June 2010} and therefore the UK is not expected to continue exporting SRF in the long term.

24.4 **Production and Use of Solid Recovered Fuel in the UK**

24.4.1 SRF has been produced in the UK for many years, although finding a use for it has been more problematic and in the past it has been disposed of to landfill. There continues to be insufficient capacity in the UK for treating all of the SRF produced in the UK and therefore some SRF is now being exported.

24.4.2 The majority of the UK’s EfW facilities burn untreated waste, although the two fluidised bed incinerators pre-treat the waste they receive to create a coarse, undried SRF. Advanced thermal technologies (pyrolysis and gasification) generally require a high quality SRF produced to their own specifications, as occurs with the pyrolysis and gasification plants operating in the UK.

24.4.3 It should be noted that SRF is still waste and therefore any thermal treatment facility that uses it must comply with the Waste Incineration Directive. The Directive aims to minimise the negative effects of waste incineration on the environment and risks to human health through setting operational and technical requirements and emissions limits. The Directive states that the flue gases in a waste incinerator must reach a temperature of at least 850°C for 2 seconds in order to ensure proper breakdown of organic substances such as dioxins.

24.4.4 The following table gives an overview of SRF production and use in the UK. This list is not intended to be exhaustive but gives an indication of the range of technologies in operation for the production and use of SRF.

\footnote{http://www.environment-agency.gov.uk/research/library/position/41215.aspx}
<table>
<thead>
<tr>
<th>Facility</th>
<th>SRF production</th>
<th>SRF use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allington incinerator, Kent (500,000 tpa)</td>
<td>Waste is shredded to reduce particle size and put under an electro-magnet to remove ferrous items.</td>
<td>SRF is incinerated directly following onsite pre-treatment.</td>
</tr>
<tr>
<td>Fluidised bed incinerator with pre-treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baldovie incinerator, Dundee (120,000 tpa)</td>
<td>Oversize items are removed, the waste is treated in a hammer mill to reduce particle size, followed by electro-magnet to remove ferrous items and eddy current separator to remove non-ferrous metals.</td>
<td>SRF is incinerated directly following onsite pre-treatment.</td>
</tr>
<tr>
<td>Fluidised bed incinerator with pre-treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEM pyrolysis facility, Scarborough (25,000 tpa waste, producing 18,000 tpa SRF)</td>
<td>Waste undergoes mechanical sorting to remove recyclables. The residual waste is then dried and granulated to produce a fuel with a very small particle size.</td>
<td>SRF is pyrolysed directly following onsite pre-treatment. Note: the facility is not currently operational.</td>
</tr>
<tr>
<td>Flash pyrolysis facility with pre-treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isle of Wight (60,000 tpa waste, producing 30,000 tpa SRF)</td>
<td>The Resource Recovery Facility removes aluminium and ferrous metals for recycling and processes the remaining waste into a ‘floc’ or SRF.</td>
<td>The SRF is treated in the Energos gasification facility.</td>
</tr>
<tr>
<td>Resource recovery facility and Energos gasifier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shanks East London (360,000 tpa)</td>
<td>The waste is subjected to a bio-drying process, and then recyclables are removed.</td>
<td>Predominantly the SRF is landfilled, with some being used for energy recovery. Some of the SRF is being shipped to the continent for use in energy from waste plants. Biossence is building a 100,000 tpa gasifier adjacent to one of the MBT facilities, which would produce CHP for the Ford Dagenham plant.</td>
</tr>
<tr>
<td>Two Ecodeco MBT facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility</td>
<td>SRF production</td>
<td>SRF use</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shanks Dumfries and Galloway (65,000 tpa) Ecodeco MBT facility</td>
<td>Waste is subjected to a bio-drying process, and then recyclables are removed.</td>
<td>Previously landfilled. Some of the SRF is treated in the neighbouring 40,000 tpa Scotgen gasifier.</td>
</tr>
<tr>
<td>Slough Heat and Power</td>
<td>Accepts only commercial waste consisting of paper, card and plastics, which is processed onsite into a pelletised SRF. The quality of the input waste stream means that the SRF does not require drying.</td>
<td>The SRF is incinerated onsite in a conventional EfW CHP facility.</td>
</tr>
<tr>
<td>Sterecycle, Rotherham Autoclave facility</td>
<td>Waste is treated in autoclaves, which effectively ‘cook’ the waste using steam at high temperature and pressure. Treated material goes through a mechanical sorting process to remove recyclable materials. The resulting ‘Sterefibre’ looks like compost.</td>
<td>SRF is landfilled. Sterecycle is currently constructing an AD/CHP facility on its site to treat the SRF.</td>
</tr>
</tbody>
</table>

24.4.5 Other large-scale facilities for using SRF are currently being planned or constructed. These include:

- Ineos Chlor (chemical company), Runcorn – currently building Phase 1 (420,000 tpa) of an 850,000 tpa energy from waste CHP incinerator, which will burn SRF, including SRF from Greater Manchester63.

- Brunner Mond (chemical company) in partnership with energy company E.ON, Lostock, Cheshire – planning to build a 600,000 tpa CHP incinerator, which will burn pre-treated municipal, industrial and commercial waste, SRF, and biomass64.

- Scottish and Southern Energy, Ferrybridge – planning to build a ‘multi-fuel’ power plant that will burn biomass, waste-derived fuels and waste wood to generate around 108MW of electricity and to provide industrial heat65.

---

64 Brunner Mond, Proposal for a sustainable energy plant, http://sustainableenergy.brunnermond.com/
65 Scottish and Southern Energy Ferrybridge, http://www.sse.com/SSEInternet/index.aspx?rightColHeader=30&id=17456&TierSlicer1_TSMenuTargetID=218&TierSlicer1_TSMenuTargetType=4&TierSlicer1_TSMenuID=6
EON and Kemsley Paper Mill, Kent – planning to build an energy plant for the mill. The fuel source will be approximately 500,000 to 550,000 tpa of SRF, which may include up to 25,000 tpa of waste plastics arising from the paper making process.

Incentives for producing and using SRF in the UK

24.4.6 As previously identified, there are a number of benefits of producing and using SRF:

- Improved fuel quality
- Recovery of recyclables
- Easier transport and storage

24.4.7 There are also financial incentives for renewable heat and power that indirectly incentivise the production and use of SRF. Under the Renewables Obligation, electricity suppliers pay a premium for renewable energy. The Renewable Heat Incentive provides long-term financial support for renewable heat installations to encourage the uptake of renewable heat or for direct injection of biomethane into the grid. Both of these schemes include energy from waste, recognising that waste streams are at least partially renewable (ie the food and garden waste, and paper and card). The default position for each of these schemes is that the renewable fraction of a waste stream is 50%.

24.4.8 The Renewables Obligation may double or treble the value of power generated by a power plant, depending on the energy source and technology type. Advanced conversion technologies (gasification or pyrolysis that produce a high quality syngas and anaerobic digestion) both achieve two Renewables Obligation Certificates (ROCs) for each MWh produced from the renewable fraction of the waste stream, whereas a waste incinerator must meet the standard of ‘good quality CHP’ in order to achieve a maximum of one ROC per MWh for the renewable fraction of the waste stream.

24.4.9 The production and use of SRF is thus incentivised, through the incentivisation of gasification or pyrolysis, as these technologies require SRF.

---

26 APPENDIX K – TECHNICAL CONNECTION INFORMATION

26.1 Primary and secondary network interface

26.1.1 Although it is possible to connect the building network directly to the district heating supply, the preferred option is to use an indirect connection. A heat exchanger is used to transfer heat from the primary LTHW supplies to the secondary building LTHW systems. The advantage of the heat exchanger (indirect connection) is that it provides hydraulic separation of the two circuits, creating a contractual demarcation point and eliminating the risk of contamination of the primary LTHW supply network from the secondary (consumer) systems and vice versa.

26.1.2 The hydraulic interface is typically achieved via a heat exchanger sub-station located in a plant room within the building. To achieve compatibility with the primary network, it is important that these substations are designed, installed and operated to a common set of rules that are described in the next section.

26.2 Heat exchanger substations

26.2.1 It is essential that the interface between the primary and secondary networks has a common set of features. The following drawing gives a typical schematic indication for the connection requirements at the interface between the primary LTHW circuits and the relevant building secondary systems. It should be noted that this drawing is for guidance and information only and each connection must be co-ordinated as required with the end user for final design and installation requirements.

Figure 26-1 Substation schematic
26.2.2 Depending on the required load of the individual connection or the level of resilience required, the substation can incorporate multiple heat exchangers to provide the peak requirement. Generally if suitable spares can be held on site the recommendation is that a single unit should be used, although an alternative configuration would be two 50% units operating in parallel.

26.3 Heating

26.3.1 It will be an obligation of the end user to provide suitable designs of the secondary system mechanics and control functions to ensure that the return temperature on the primary system is maintained in line with the design requirement, throughout demand fluctuations down to an acceptable minimum requirement of nominally 10% of the maximum demand. It should be noted that incentives for good operation and provision of the required design return temperatures may well be incorporated into the energy supply agreements for each customer, as applicable.

26.3.2 A reasonable design temperature differential shall be maintained between the primary and secondary flow temperatures to ensure adequate control margins; therefore, it is recommended that the flow temperature in the secondary systems does not exceed the traditional 80°C.

26.3.3 With regard to the heating connection, it is envisaged that all DHW requirements will be served from the customer secondary side of the single substation interface, although specific DHW interface substations can be included and are available as standard package items.

26.4 Secondary System Designs

26.5 Domestic hot water supply

26.5.1 As stated above, the generation of DHW shall be supplied from the customer secondary side system and should be designed such that the mix of return temperatures from this and the other heating circuits will provide the overall required return temperature. The DHW should consider an instantaneous approach, providing the benefit of not only space reduction, heat loss reduction from standing water and the reduction of the risk of infection from Legionella, but will also benefit in providing a minimum return temperature where the cold feed is connected directly to the heat exchanger.

26.5.2 Alternatives to this would include a traditional storage system, although this will raise return temperatures during periods when cylinders are fully recharged, or an instantaneous
connection incorporating a level of buffering. In each case the design for the return temperature should be based on the lowest possible.

26.6 Domestic hydraulic interface units (HIUs)

26.6.1 There are two principal options in terms of domestic HIU design – direct connection or indirect connection. Both options are technically feasible, and some of the pros and cons of each are highlighted below.

26.6.2 Direct connections

26.6.3 Direct connection would be a heating connection without hydraulic separation from the district network - i.e. secondary DH water will be circulating in the dwelling heating system. Hot water would be by an instantaneous heat exchanger, negating the requirement for any storage facility within the dwelling. All components would be mounted within an enclosure of similar size to a domestic boiler. This would commonly be referred to as a Hydraulic Interface Unit (HIU) – shown schematically below:

Figure 26-2 Hydraulic interface unit schematic
26.6.4 The direct connection HIU can be characterised as follows, in comparison with the indirect alternative:

- The direct connection HIU is mechanically less complicated, and contains fewer parts, which leads to higher reliability.

- Direct connection HIUs are less expensive as they contain fewer parts.

- Under a direct connection, water is pumped round domestic radiators at a comparatively high pressure – corresponding to an increased risk in the event of residents tampering with the system.

- At the bottom of blocks, in the event of a leak arising in a flat, the water in the whole the radiator system in all flats above would drain out, potentially causing more significant flooding than in an indirect connection scenario.

- The centralised water purification system keeps internal radiator systems in good condition, and equipment can be expected to have longer working lives, and reduced maintenance costs.

- The use of direct connections allows the temperature differences achieved in the radiator circuits to be transferred directly to the DH system, allowing slightly lower pumping energy requirements on the DH system.

26.6.5 Indirect connections.

26.6.6 Indirect connection would include a hydraulic separation (via a heat exchanger) to the district heating networks.

26.6.7 Indirect connection relies on the performance of the heat exchanger within the HIU. The temperature difference between primary and secondary return temperatures must be reduced to a minimum. This can be done by increasing the heat transfer area which normally means accepting a higher cost. Indirect connection also means pressure isolation from the DH supply circuit, which makes it relevant for connecting blocks of flats, thus allowing the system within the flats to operate at low pressure. Hot water would be supplied in identical manner to the direct system described above. An indicative indirect connection configuration is shown below:
An indirect HIU contains an additional heat exchanger, pump, valves and control logic to suit its additional functionality. This results in a slightly increased risk of mechanical failure.

Indirect HIUs are more expensive due to extra parts.

Indirect connection allows the pressure of all domestic radiators systems to remain at normal domestic pressures.

Reduced risk of significant leaks – only the individual dwelling system would be affected.

The use of indirect connections both reduces the temperature differential seen by the DH system, and also passes on pumping energy costs to the resident, as an additional pump fed from the domestic electricity supply has to be installed for the circulation of water around the domestic circuit.

26.7 Plant Layouts
26.7.1 Heat substations can be provided as single packaged units to suit the required demands. Depending on the level of demand, the units may consist of more than one heat exchanger for larger loads or greater resilience requirements. The following table provides provisional dimension requirements, based on a single supplier assessment, for a number of standard heating connections, with worst case two heat exchangers for the higher loads:

<table>
<thead>
<tr>
<th>Table 26-1 Approximate heat substation dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>District Heating</strong></td>
</tr>
<tr>
<td><strong>Output (kW)</strong></td>
</tr>
<tr>
<td><strong>Number of Heat Exchangers</strong></td>
</tr>
<tr>
<td><strong>Length (mm)</strong></td>
</tr>
<tr>
<td><strong>Width (mm)</strong></td>
</tr>
<tr>
<td><strong>Height (mm)</strong></td>
</tr>
<tr>
<td><strong>Approximate Dry Weight (kg)</strong></td>
</tr>
</tbody>
</table>

26.7.2 The following should be noted regarding the above dimensional data:

- As stated, these are provisional sizes and must be confirmed by the M&E designers appointed for the detailed design of each element of construction.
- The figures indicated are the packaged skid dimensions only and therefore an allowance of 1m should be incorporated all around the skid to facilitate access and maintenance requirements.
- The larger packages with more than one exchanger may provide difficulty in delivery and building access, therefore, it is envisaged that the skids will be broken down into sections based on the number of exchangers. This should be clearly indicated on the eventual supplier details.

26.7.3 Indicative layout drawings for a small selection of sizes of heat exchangers units are included below (PDF only):
27 APPENDIX L: PLANNING MECHANISMS CONSIDERED

27.1.1 This appendix provides a summary of the applicability of some of the available policy mechanisms with regard to DEN emergence.

27.2 The Localism Bill

27.2.1 The Localism Bill has been partly conceived to enable local communities to influence development in their local communities. This concept is proposed to be implemented under the banner of ‘Neighbourhood Planning’. It is the Government’s view that by empowering local communities they will become more supportive and accepting of new development proposals. A range of initiatives are proposed within the Bill to enable local communities to have more influence on development in their areas. The boroughs may wish to consider these in generating better understanding and therefore acceptance of DENs amongst those communities which may be affected by such schemes. Proposals in the Bill which are relevant to DENs are listed below.

27.2.2 Monitoring policies

27.2.3 The monitoring of policies is a key component in the planning policy framework and is critical to the success of policies delivering objectives set out in local development documents (LDDs). Local planning authorities are required to produce an Annual Monitoring Report (AMR), using output indicators to assess the performance of policies in relation to their objectives-based targets. Where the AMR identifies a policy failing to deliver to its objective, authorities should consider solutions to correct this.

27.2.4 The three boroughs are under obligations to implement appropriate monitoring frameworks for the progress review of their local policies and therefore have built this into their emerging LDFs. In developing monitoring frameworks, the authorities must demonstrate their objectives and indicators are appropriately based on the ‘Specific, Measurable, Achievable, Realistic, Timely’

27.2.5 Local Development Orders (LDOs)

27.2.6 Local Development Orders (LDOs) grant permission for the type of development specified in the LDO and by so doing, remove the need for a planning application to be made. They can be used to provide additional permitted development rights across the whole of a local planning authority’s area or for certain types of development in certain parts. An LDO can only be made to implement policy contained in an adopted DPD or in a Local Plan. The Planning and Climate Change Supplement to PPS1 encourages local planning authorities to consider using LDOs as a means to secure low-carbon energy supply systems.

27.2.7 An LDO concerning DENs could remove the need for planning permission for some elements of DEN development. This could offer an incentive to prospective developers by reducing financial and temporal costs associated with implementing DENs. The London Development Agency has been testing a cross-boundary District Heating LDO across the London Boroughs of Barking and Dagenham and Havering to support London Thames Gateway Heat Network development by speeding up the delivery process. The aim of the project is to address cross-boundary issues and test the complexities of adopting and implementing

68 http://legacy.london.gov.uk/mayor/environment/energy/docs/renewables_toolkit.pdf
69 http://www.pas.gov.uk/pas/core/page.do?pageId=194954
measures such as an LDO at multi-authority level. The perceived benefits from this approach are in this case:

- staged rollout of the heat network and minor route changes without the need for planning applications;
- reduction in cost of network development;
- a use class-based LDO that could be used by any developer of a heat network;

27.2.8 Similar benefits would be anticipated from the implementation of a ULV LDO.

27.2.9 The types of installation that are envisaged to be permitted development under this type of LDO would include:

- site investigations, enabling works and temporary works and development
- below-ground works, i.e. trenching and laying of pipe and other apparatus
- above ground apparatus and street furniture
- small buildings and building extensions
- works in the public highway

27.2.10 Neighbourhood Development Plans (NDPs)

27.2.11 NDPs will be instigated by neighbourhood groups, although the geographical area of the proposed plan will need to be confirmed by the local planning authority. The plans will have a policy element which must be set within the context of the local planning authority’s development plan and national policies. They will also have a second element which will concern Neighbourhood Development Orders (NDOs) (see below).

27.2.12 Given that adopted and emerging Core Strategy polices are very supportive of decentralised energy, the policy context is effectively set in the broad sense for schemes to be taken forward at the neighbourhood level. An NDP may be of value in areas of regeneration where existing developments may benefit from proposed development schemes which include proposals for DENs. Neighbourhood planning presents an opportunity for developers to work closely with local communities in preparing schemes which can deliver community benefits. This could counterbalance much of the normal resistance to such schemes.

27.2.13 Neighbourhood Development Orders (NDOs)

27.2.14 Communities will be able to require local planning authorities to make a Neighbourhood Development Order (NDO) where a referendum shows a majority in favour. Working on the same principles as LDOs, planning permission is automatically granted for development proposals that conform to a NDO without the need for a planning application. The NDO could include conditions before building could begin.

27.2.15 Whereas LDOs may be used to address DENs on a wide scale, decentralised energy schemes could form part of an NDO which addresses, say, renewable energy at the very local level e.g. residential area / householder initiatives. NDOs could be built on a community’s desire to accommodate such decentralised energy schemes thereby removing the planning application process and associated costs, thus making such initiatives more attractive to developers.
27.2.16 Community Right to Build Order (CRBO)

27.2.17 A CRBO will be an approval process for local communities to implement specific developments, particularly small scale. The Order could be supported by an LDO or NDO by way of removing the need for planning permission.

27.2.18 This proposed initiative may offer potential for local communities who wish to propose small scale decentralised energy schemes in their areas.

27.2.19 Partnership working

27.2.20 A principle of spatial planning is that of joint-working and collaboration between different organisations representing varying interests, demographics or geographies but each with a common goal. DENs should not be constrained by administrative boundaries, particularly in metropolitan areas where urban zones are agglomerated. Such areas present significant opportunities for local planning authorities to work in partnership to deliver a wider integrated network that can deliver mutual benefits. The NLSA’s approach to this commission is exemplary in this context.

27.2.21 The adopted and emerging Core Strategies of the three boroughs are broadly similar in the way they address partnership working, mirroring the emphasis placed on the topic in the London Plan. These planning documents identify the need to form partnerships and highlight the associated benefits. Policy 5.5B of the London Plan states:

Within LDFs boroughs should develop policies and proposals to identify and establish decentralised energy network opportunities. Boroughs may choose to develop this as a supplementary planning document and work jointly with neighbouring boroughs to realise wider decentralised energy network opportunities. …

27.2.22 Enfield’s LDF Core Strategy adopted in 2010 provides the spatial strategy for development within the borough. Core Policy 20: Sustainable Energy Use and Energy Infrastructure follows the partnership principle by pledging the Council to ensure that the borough’s future energy infrastructure will be in place to accommodate growth by working with its partners. The future energy infrastructure will not be confined to the Borough’s administrative boundaries, reinforcing a partnership requirement with its neighbouring authorities. Likewise, LB Haringey includes supporting text in its submission Core Strategy on cross-boundary working over shared development issues, as does Waltham Forest’s Preferred Option CS5(E).

27.2.23 Partnerships would allow for sharing the resource burden of developing other planning documents.

27.2.24 Community Infrastructure Levy and Section 106 Agreements

27.2.25 The Community Infrastructure Levy (CIL) was introduced in 2008 to secure new community infrastructure in the context of development investment in an area. It reduces the role of Section 106 Agreements (S106) and they (CIL and S106) should be used in conjunction with each other where necessary. Also to note, is that it is understood that from 2014, or once a CIL is adopted, contributions from Section 106 Agreements cannot be pooled for more than 5 developments for infrastructure. This would imply that in the near future, CIL will be the only mechanism to obtain developer contributions for a DEN.

27.2.26 A Section 106 Agreement is a legal agreement normally between the Planning Authority and the applicant and any other party which may have an interest in the development site, although it can also be delivered unilaterally by the applicant in cases where a planning authority does not want to be party to the agreement. It is authorised by Section 106 of the
Town and Country Planning Act 1990 as amended by Planning and Compensation Act 1991 Section 12. The requirements of additions to community infrastructure via Section 106 Agreements are typically known as ‘planning obligations’.

27.2.27 The CIL is considered to be fairer, faster and more certain and transparent than the system of planning obligations (which causes delay as a result of lengthy negotiations) but to be successful it requires a strategic understanding and plan for required infrastructure, often in the form of an Infrastructure Delivery Plan. A CIL schedule also needs to go through an adoption process.

27.3 Planning application process

27.3.1 The planning application process is the part of the planning system which allows planning policies to be brought to bear. Development proposals submitted to local planning authorities are considered and determined against the policy framework unless other material considerations indicate otherwise. There are a number of measures available to developers and local planning authorities as part of the planning application process to facilitate better implementation of development, including DENs. These measures are discussed in more detail below.

27.3.2 Pre-application discussions

27.3.3 The inception of the Planning and Compulsory Purchase Act 2004 heralded a changed approach to Planning, with ‘front-loading’ leading the way to secure a more pro-active system. In the case of the planning application process, front-loading means early engagement between the developer and the local planning authority.

27.3.4 Early engagement can expose issues which may require resolution prior to submission of the application therefore allowing a smoother determination. It can also open the negotiation process over developer contributions and how these will be dealt with, thus enabling a speedier determination and reduction in both developer and authority costs.

27.3.5 Planning performance agreement

27.3.6 A Planning Performance Agreement (PPA) is a development management mechanism used to facilitate pre-application collaboration between the developer and local planning authority. It sets performance requirements for both sides in terms of deliverables and liaison in advance of the application being submitted. They are particularly useful for complex development proposals such as large housing or mixed use schemes, which could include a DEN element. PPAs take forward the front-loading principle by establishing an agreed project vision, key issues and tasks, project team and programme at as early a stage as is possible. Without early implementation, PPAs’ effectiveness reduces.

27.3.7 Since their introduction under the Planning Act 2008, PPAs have become a widely used tool in forming a transparent and organised approach to addressing planning issues in the pre-application stage.

27.3.8 In December 2009, six developments were chosen by the Department for Communities and Local Government (DCLG) to participate in a pilot project: Planning Performance Agreements for Renewable & Low Carbon Projects. The project was supported by the DCLG and ATLAS, an independent advisory service available at the request of local authorities to support them in dealing with complex large scale housing led projects. One of the pilot projects is that for an urban extension at Sowerby Gateway in Yorkshire, where

70 http://www.atlasplanning.com/page/lowcarbon.cfm
proposed development comprises 900+ new dwellings to be constructed by 2026. Other uses include commercial and office space. The development will use a centralised Combined Heat and Power/district heating system.

27.3.9 The DCLG and ATLAS issued a PPA guidance note\textsuperscript{71} in 2008 which helps to steer developers and local planning authorities towards a more streamlined and structured approach to the pre-application stage. As reported previously, considerable developer costs can be saved at this stage of the planning process and thus contribute to making complex development, such as DENs, more financially viable.

\textsuperscript{71} http://www.atlasplanning.com/lib/Download/351/080404%20PPA%20Guidance%20Download.pdf?CFID=5506300&CFTOKEN=35290028