FULCRUMCONSULTING

ELSENHAM ECO-TOWN

SUSTAINABLE INFRASTRUCTURE UPDATE

December 16, 2008

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1 INTRODUCTION

Meetings with the department for Communities and Local Government (CLG) and their assessment team consultants have taken place on the proposals for the Elsenham Eco-town, during which requests were made for more information on the energy, water and waste strategies that are under consideration in order to meet the aspirations of the Eco-town concept and delivery.

This document provides a brief update on the current status of strategy development, and outlines further activities which will be progressed through the planning process in relation to energy, water, climate change and waste. This information should be considered alongside that which was previously outlined in the earlier bid proposals by The Fairfield Partnership for the development of an Eco-town of at least 5,000 homes on land north-east of Elsenham in Essex.

1.1 ECO-TOWN STANDARDS

Since the submission of the initial Eco-town Bid for The Fairfield Partnership development in Elsenham, a draft Planning Policy Statement (PPS) for Eco-towns has been issued by CLG.

The following table provides a breakdown of key aspects of the proposed standards that pertain to energy, water, waste, and climate change. The proposals for the Elsenham Eco-town would be consistent with the Eco-town standards set out in the PPS and any subsequent revisions. The PPS has outlined its own definition of zero-carbon, however the Elsenham proposals will also take sure account of any changes to the definition of zero-carbon that may arise following the consultation on 'Definition of zero carbon homes and non-domestic buildings', published December 17, 2008.

Category	Eco-town Standard
Zero carbon	Over a year the net carbon dioxide emissions from all energy use within the buildings on the development are zero or below
Water	Reduce water demand through incorporating measures to increase efficient water use, improve water quality, Sustainable Drainage Systems (SUDS), aspire to water neutrality in areas of 'serious' water stress and meet the water consumption targets Code level 5.
Waste	Set targets for residual waste recycling, and landfill diversion in advance of those set in the Waste Strategy for England 2007 and provide onsite features to enable meeting the targets.
Climate Change	Be resilient and take into account the appropriate local climate change scenarios and to deliver a high quality local environment by complying the Eco-town standards on water, flooding, green infrastructure and biodiversity and to limit the risk of climate change impact on the natural and built environment.

2 ENERGY STRATEGY

2.1 BUILDINGS - OPERATIONAL CARBON

An Interim Energy Assessment was prepared by Fulcrum Consulting and submitted in August 2008, exploring the opportunities for delivering zero carbon developments. This report should be read in conjunction with the Interim Energy Assessment.

The draft PPS for Eco-towns has identified that over a year the net carbon dioxide emissions from all energy use within the buildings on the development are zero or below. The requirement for a net zero (or below) carbon dioxide (CO_2) development requires that the net emissions take into account, as outlined below:

> A. "Emissions associated with the use of locally produced energy;
>
> B. Emissions associated with production of energy imported from centralised energy networks, taking account of the carbon intensity of those imports as set out in the Government's Standard Assessment Procedure, and
>
> C. Emissions displaced by exports of locally produced energy to centralised energy networks where that energy is produced from a plant (1) whose primary purpose is to support the needs of the eco town and (2) has a production capacity reasonably related to the overall energy requirement of the eco town."
>
> [draft PPS: Eco-town Consultation, CLG 2008]

The Interim Energy Assessment incorporated a preliminary analysis of a number of energy strategy scenarios, which are currently being further investigated, that have the potential to achieve net zero carbon for all building operational energy as set out in the PPS for the Elsenham Eco-town development.

Using an 'energy patchwork' principle for energy services delivery, the current options explore several scenarios with a mix of technologies. Energy strategy options with and without wind turbines have been explored, as have various combined heat and power technology/sizing scenarios, some of which have the potential to export heat to existing neighbouring communities.

At this point in time a final preferred technology combination has not been identified, as further more detailed feasibility and options appraisal work will need to take place through the planning process. The scenarios analysed in the Interim Energy Assessment provide a range of deliverable technology combinations and fuel sources that will be further analysed, along with further consideration of energy from waste options and new technology innovations.

2.2 BIOMASS FUELS

The opportunity for incorporating of a variety of biomass fuels to generate energy is identified in the Interim Energy Assessment report. It is important to note that within the classification of 'biomass', we would include consideration of various forms of energy from waste, such as refuse derived fuel (RDF), biogas or dried digestate from organic waste treatment, straw, or woody fuels (e.g. wood chip and short rotation coppice - SRC).

The following table provides a preliminary estimate of the biomass demand for various fuel types that would be needed to provide the Elsenham Eco-town

development with zero-carbon energy. The scenarios and predicted energy demands are based on the options set out in the Interim Energy Assessment report.

These amounts are used to inform a preliminary assessment of fuel availability within Uttlesford and Essex, shown in oven dry tonnes per year (ODT/yr)

Energy Scenario	Components*	Fuel Demand (for Heat)
Scenario 1: 5000 dwellings + 1000 dwellings hot water	Biomass CHP (~1MWe) + Neighbour Client Gas Boilers (2.2MWe) ATES Wind Turbines	16,700ODT/yr (dried digestate); or, 11,100ODT/yr (wood chip); or, 10,500ODT/yr (SRC).
Scenario 2: 5000 dwellings + 1000 dwellings hot water	Biomass Boilers (2.6MWth) + Neighbour Client Gas CHP (4MWe) ATES Wind Turbines	2,800ODT/yr (dried digestate); or, 2,000ODT/yr (wood chip); or, 1,800ODT/yr (SRC).
Scenario 3: 5000dwellings + 3500 dwellings hot water	Biomass CHP (3MWe) + Neighbour Client Gas Boilers (2.2MWth) ATES	33,700ODT/yr (dried digestate); or, 22,500ODT/yr (wood chip); or, 21,300ODT/yr (SRC).
Scenario 4: 5000 dwellings	Biomass CHP (3MWe) Biomass Boiler (1MWth) Gas Boiler (1.3MWth) ATES	28,800ODT/yr (dried digestate); or, 20,000ODT/yr (wood chip); or, 18,000ODT/yr (SRC).
Scenario 5: 5000 dwellings	Biomass CHP (2.8MWe) Biomass Boiler (1MWth) Gas Boiler (1.2MWth) + 200 Homes Independent	28,000ODT/yr (dried digestate); or, 18,600ODT/yr (wood chip); or, 18,000ODT/yr (SRC).
* heat and power shown in megawatt electric (MWe) or megawatt thermal (MWth) depending on technology type, sizing is first order approximation only; ATES is aquifer thermal energy storage system		

Table 1 - Predicted biomass fuel demand for Elsenham zero-carbon scenarios

An initial review has been undertaken to identify some possible sources of biomass that may be available within the local market of the Uttlesford area.

A study done for Uttlesford District Council has provided the following indication of the potential yield within the Uttlesford District (see Table 2 below).

Source	Description	Potential Yield (ODT/yr)
Woody Fuels	1700ha of woodland within Uttlesford, which could yield @ 3ODT/ha/yr	5,100ODT/yr
Crop Residue	26,000ha for wheat @ 3.3ODT/ha/yr	86,000ODT/yr
Short Rotation Coppice	50% of 5,600ha of 'set aside land area' @ 13ODT/ha/yr	72,800ODT/yr
Miscanthus	50% 5,600ha of 'set aside land area' @ 5.9ODT/ha/yr	33,000ODT/year
Food Wastes	1,843tonnes/yr of kitchen waste (50% of the Uttlesford food wastes yield) 1,011tonnes/yr of green waste	250tonnes of biogas

Table 2 - Local biomass yield estimates (Low/Zero Carbon Renewable Energy For Uttlesford, UDC, 2008)

The use of crop residue as fuel for a CHP and district heating energy scheme has strong potential, given that approximately 28,000ha of the Uttlesford District is given over to cereal agriculture, for which 95% of the cereal land area is for wheat. An example of a crop residue energy centre, albeit at a larger scale, is the 36MW Ely power station in Sutton, which is fed with 200,000tonnes of straw per year collected from 80km around the station.

Initial discussions with local biomass providers within Uttlesford and Essex have taken place. As one example, a provider in the Essex area is able to provide 5,000ODT/yr of straw, and has stated that they would be capable of supplying 20,000ODT/yr or more under contract.

In summary, investigation of local biomass suppliers has indicated that a sufficient amount of biomass is likely to be available from sustainable sources in the Uttlesford and Essex areas which could be used in the Elsenham Eco-town scheme. A sample of potential suppliers is listed in Appendix A.

Further investigation will take place on the range of potential biomass sources that exist, including the various types of waste biomass products that are present. Their availability and suitability for meeting the demand will be assessed in accordance with the final energy strategy proposal being progressed through the planning process.

2.3 OPERATIONAL ENERGY MANAGEMENT

The structure of energy system management, maintenance and billing is a key item being discussed for the Elsenham Eco-town. An energy services company (ESCO) arrangement is proposed, incorporated under the umbrella of the Elsenham Cooperative Limited (ECL) community management organisation.

A development of the scale of Elsenham Eco-town has significant critical mass, and is likely to bring significant interest and potential capital injection from potential ESCO operators.

Dialogue has been initiated with potential ESCO operators, which will be further progressed in 2009 as part of the development of the ECL enterprise business plan and outline governance/contract structure.

The ECL would be an enterprise-based structure, offering a wide range of community and lifestyle related services beyond energy, including such things as local food production, data services, water services, bus operations and landscape management. The ECL would provide the role of a MUSCO (Multi-utility Service Company), and much more beyond. A separate report has been produced on the ECL which provides more detail on the proposal.

2.4 ONGOING WORK PROGRAMME

A full energy strategy for the Elsenham Eco-town will be developed as proposals progress through the planning process. Discussions will be held with potential service providers; technology options and feasibility of technologies will be appraised; scoping of offsite infrastructure re-enforcement will be progressed; and preliminary design work for onsite infrastructure (e.g. heat networks) will be prepared.

3 WATER STRATEGY

An Interim Water Demand & Supply Assessment has been prepared by Fulcrum Consulting, which explores opportunities for achieving exemplary levels of reduction in impact of the Elsenham development, with proposals to work towards water neutrality. Options discussed include water demand reduction strategies, alternative water sources available, and the possibility of using onsite wastewater treatment systems. This work will inform and augment the Water Cycle study that will be undertaken, which will assess and integrate the wider water cycle impacts beyond the development boundaries.

The fundamental principles to be applied in the development of the water strategy for Elsenham Eco-town will be those of integrated water management. This includes consideration of all potentially suitable sources of water and treatment options for re-use and disposal, and their interrelationship opportunities, both at site-wide scale and building scale.

3.1 WATER DEMAND AND SUPPLY OPTIONS

The need to value water, thus reducing reliance on mains water to a minimum and working towards a goal of water neutrality, will be a fundamental part of making Elsenham an exemplar of sustainable development.

The intention of the water strategy is to reduce the use of mains water. This is both a climate change mitigation response, to reduce CO_2 emissions from the energy needed to treat and pump the water supplied and disposed of, and an adaptation response, because there are regional water availability issues that may be further affected according to climate change predictions.

This proposed interim water assessment is a response to the Supplement to PPS1 and the Draft PPS on Eco-towns consultation document from CLG.

The aspiration to reduce the need for mains water has always been rewarded in sustainable development rating methods such as Eco-homes and the Code for Sustainable Homes and is now proposed to be incorporated in the Building Regulations. Currently proposed amendments to Part G: Hygiene states that households are to have a design maximum 'wholesome' or potable water use requirement of 125litres per person per day (l/p/d), which is likely to come in to effect in 2009.

The recently released draft PPS for Eco-towns has outlined how these towns will be expected to reduce water consumption through incorporating measures to reduce water demand, improving water quality, and make use of Sustainable Urban Drainage features. Those towns, such as Elsenham, that are in areas of 'serious' water stress are expected to aspire to water neutrality, and as a minimum meet the water consumption targets (WAT1) from Level 5 of the Code for Sustainable Homes (the Code). This Level stipulates a maximum mains water use per person per day of 80 litres, which is achievable only with reduced water consumption coupled with an alternative water source, as efficiency measures alone are not capable of reaching this target.

Potable water demand reduction measures would be applied to all dwellings and non-domestic buildings within the Elsenham Eco-town development. These would be in the form of water efficient fittings coupled with ongoing and continuous occupant behaviour education to reinforce the advantages of a low water use lifestyle. The use of alternative water supplies for local or district distribution will

also be considered, as will how wastewater treatment could be most efficiently addressed.

The application of water efficiency and alternative supply options in line with the domestic Code Level 5 water target (80l/p/d), coupled with best practice industry standards for non-domestic buildings, could produce an overall mains water saving at Elsenham Eco town of around 300Ml/yr, which is a reduction of 50% compared to the average present water use in the Three Valleys.

Alternative supply sources of water for consideration in the move towards water neutrality include: treated rainwater and greywater (wastewater from non-foul sources), or re-use of treated water from sewage treatment.

Harvesting rainwater from the roofs of the development has the potential to yield around 177Ml/yr (adjusted for predicted climate change variation) which is equivalent to 69% of the total annual demand (see Section **Error! Reference source not found.**).

Greywater harvesting from the whole Elsenham development has the potential to yield around a further 164Ml/yr which is equivalent to 64% of the total annual demand, based on collection from wash basins, showers and baths in both domestic and non-domestic buildings, (see Section **Error! Reference source not found.**),

There is sufficient critical mass to provide an opportunity to make use of a combination of greywater reuse in addition to the rainwater collection to meet the total annual water demand. It would be a prerequisite that one or both of these sources of water are treated to a potable standard in order to potentially provide a water neutral solution.

Further design development will consider how water efficient features would be applied in the Elsenham Eco-town and the most appropriate methods of harvesting alternative water sources and treating these to a potable standard. For example, the potential for rainwater harvesting from roofs and paved areas for high level treatment to potable standards and/or greywater, treated to a lower standard, considered for the flushing of toilets. This may also include treating greywater and/or wastewater to a potable water standard, but this will be considered against issues such as costs and perception. Precedent from other countries, including Australia and Japan, where such water recycling systems are currently applied will be referred to as the strategy is developed.

3.2 OPERATIONAL WATER MANAGEMENT

Further investigations will be made into the potential for a centralised management body to undertake the operation, maintenance and billing of a complete (or partial) water supply and disposal system. This body could be a component of the Elsenham Cooperative Limited (ECL), who could either act directly as the operating body or work in a licensing partnership with a water undertaker. The integration of energy supply under the ECL in addition to other services would be part of a multi utility or MUSCo approach.. Operation, management and billing costs under the ECL of MUSCo become more efficient with an increasing number of utilities/services supplied to a single community. The involvement of an water operating partner could relate to the infrastructure investment phase (e.g. expressing a preference for a technology or distribution type) or the billing and maintenance considerations. The level of involvement is

likely to be based on the preference of a particular undertaker and the influence of their financial model.

There is potential of supporting the cost of management and maintenance of rainwater and greywater systems via a significant reduction in mains water brought into the development. The net water imported to the development could be close to nothing if water neutrality is worked towards, with the site operator receiving a percentage of a consumers cost savings compared to costs from the local incumbent utility supplier.

All potential technology/finance/partnering options will be further appraised as the water strategy is developed leading up to outline planning, including those focusing on the local incumbent utility suppliers and those involving a more independent focused approach.

3.3 ONGOING WORK PROGRAMME

This water benchmarking study provides a prediction of the likely demand that may be required as a part of an Eco-town development at Elsenham. A full water strategy will be developed, integrated with the Water Cycle study and discussions with the appropriate water and wastewater suppliers/operators, Environment Agency, and other key stakeholders as proposals progress through the planning process.

4 WASTE STRATEGY

The draft PPS for Eco-towns states that Eco-town planning applications should include a sustainable waste and resources plan that covers both domestic and non-domestic uses. Targets for residual waste, recycling levels and landfill diversion will be set through an assessment process that considers the likely waste resources and streams arising in the Elsenham Eco-town. This would include measures for source separation and onsite storage of the priority waste materials outlined in the UK Waste Strategy.

A comprehensive waste strategy will be developed for Elsenham eco-town, addressing construction waste and operational waste. The strategy will be developed taking full consideration of the Local and Regional Authority waste strategies and will set targets in accordance with the standards set out in the Eco-towns PPS.

Waste minimisation hierarchy principles will be applied at the Elsenham eco-town, as follows:

- Reduce waste by reducing consumption
- Re-use items and components wherever feasible
- Re-cycle items that cannot be re-used
- Dispose of items that cannot be re-cycled or re-used in a low impact manner

The Waste Strategy for England 2007 proposes that household recycling increase to 50% by 2020. An analysis of household waste composition by WRAP[1] (Parfitt, 2002) has been used to estimate the average UK waste arisings, which is

[1] Analysis of household waste composition and factors driving waste increases, Dr. Julian Parfitt, WRAP, 2002

estimated at 872kg/household/year. Based on the average UK figure, the total annual domestic waste arisings for the Elsenham Eco-town is likely to be approximately 4,360tonnes/yr. The proportion of this waste which is potentially recyclable is approximately 69% of the annual household waste.

The use of advanced thermal treatment (ATT) energy from waste (EfW) systems will be further investigated, and their potential for incorporation into the waste and energy strategies will be appraised. Currently, EfW systems are generally at a scale of 1MW and above, which requires a greater waste feed than the proposed Elsenham Eco-town would likely generate. As an example, the Energos facility on the Isle of Wight provides 1.8MW of electricity and combusts 30,000tpa. The application of smaller systems and emerging technologies will be investigated in terms of their potential deliverability for the Elsenham eco-town.

The waste strategy for Elsenham will review the likely breakdown of the predicted waste generated from residents and employment within the Eco-town and establish where reduction and sorting techniques can be applied at the building scale along with proposals for where the residual, recyclable, and biodegradable streams can be incorporated into onsite treatment/re-use and the local district waste strategy. It will also address exemplary site waste management, including the development of a comprehensive site waste management plan.

Household participation in meeting the Eco-town waste reduction targets would be supported through education and multiple methods of engagement, delivered via the Elsenham Cooperative Limited (ECL). For example, one of the most important elements in succeeding in getting good participation rates in waste reduction and diversion would be to give appropriate information and 'induction' to all residents through a home information pack and/or formalised induction session.

A range of information would be provided, including:

- What facilities are available
- How the system operates
- What is expected of users
- Why the system has been implemented, what benefits it has
- Why the system should not be abused, what problems this would cause
- Who can be contacted for information or assistance

This information would be presented in such a way that people can appreciate the importance of the role they have to play in making it work. Ideally the information would be given as a face to face interaction with someone to whom questions can be directed, with information in a printed format to be taken away for reference. This is likely to have more meaningful results than paper-only or electronic-only information.

4.1 ONGOING WORK PROGRAMME

This development of the waste strategy will assess the likely waste stream arisings, and will propose targets for recycling and diversion for the Elsenham Eco-town. Discussions with the Local and Regional Authorities, as well as waste management operators, will be undertaken, and proposals for how the municipal waste could be integrated with existing energy systems will be further investigated.

5 CLIMATE CHANGE

Climate change, due to its inherent uncertainty (despite increasingly accurate scientific forecasts) presents a nascent field of expertise where one can not necessarily design for absolutes but instead must adopt a risk-based process of design.

At a local level, adaptation strategies will consider methods of designing to respond to the current local climate change scenarios in order to inform strategy to avoid risk against infrastructure interruption or failure during extreme events, such as local networks and backup energy and water supplies.

One of the major issues of failure during the flooding events during the summer of 2007 was the pollution of local water supplies and the inability of the water infrastructure to provide a backup, and the electricity and gas networks being unable to cope with the loss in capacity and plant.

A climate change adaptation strategy will be developed that considers the above issues, but will also address issues such as built form technique to reduce the risk of overheating and poor air quality. In addition, measures to protect the natural environment, such as appropriate species selection for habitat and flood/drought resistance. This strategy will be provided as proposals progress through the planning process.

6 CARBON EMISSIONS PER RESIDENT

The draft Eco-town PPS outlines typical carbon dioxide emissions for an average UK resident, as of 2001, which equates to approximately 11.87tonnesCO_2/person.

The Elsenham eco-town will develop a comprehensive strategy for working towards achievement of 80% reduction in carbon emissions per resident. This will include significant emphasis on engagement, education and lifestyle change, facilitated through the establishment of the ECL. It will also include strategies to understand and address those aspects of personal carbon footprint that relate to regional and national infrastructure, as well as infrastructure systems and construction within the cartilage of the site.

The ECL will be a key mechanism for delivering the significant reductions targeted as it can be used as a vehicle to support programmes or local services that help reduce CO2 emissions, such as food programmes or transport mode sharing.

An Ecological Footprint Analysis & Carbon Footprint Considerations report was prepared by Fulcrum Consulting and was submitted for a previous bid submission in August 2008. This report includes an example analysis of a typical resident's carbon emissions living in the Elsenham Eco-town development in 2030 indicates that a combination of delivery of a net zero carbon energy supply infrastructure, exemplary waste and transport measures, combined with significant lifestyle changes would enable an Elsenham resident to exceed a 60% carbon emission reduction compared to current UK average, and identifies way to work towards an 80% reduction.

The measures to be applied for reducing CO_2 emissions include planning the infrastructure in an integrated way, to enable efficient supply of resources, such as energy, water, waste & recycling, along with community services. Further investigations will be made into how renewable energy could be exported in order to reduce CO_2 emissions to below zero.

7 APPENDIX A – BIOMASS SUPPLIERS

Supplier	Location	Fuel type	Fuel availability	Constant supply
Essex Hay & Straw Co Ltd	Clacton On Sea	Straw	5000 tonnes/yr (*)	YES
E P R Ely Ltd	Cambs	Straw	TBC	TBC
H. Gingell Ltd	Cambridge	Straw	TBC	TBC
Sundown Products Ltd	Cambs	Straw	TBC	TBC
Anglia Biofuels	Beccles	Chips Pellets	Tonnes	YES
Astwick Forestry Services	Hitchin	Logs/ Chips	Tonnes	YES
Bedford Estates	Woburn	Logs	Tonnes	YES
Carbon Neutral Fuels Ltd	Great Bentley	Pellets Briquettes	Tonnes	YES
Cholesbury Tree Fellers	Chesham	Logs/ Chips	Tonnes	YES
Country Care Anglia Ltd	Woodbridge	Logs Charcoal	Tonnes	YES
Eastern Woodfuel	Woodbridge	Chips Pellets	Tonnes	YES
ECO Living Solutions Ltd	Bedford	Pellets	On demand tonnes	YES
English Wood Fuels Ltd	Owston	Logs/ Chips/ Pellets	Tonnes	YES
Fletchers Trees Ltd	Cheshunt	Logs/ Chips	Tonnes	YES
Fred Tarry	Northampton	Logs/ Kindling	Tonnes	YES
G. J. Cox Farm & Forestry	Henham	Logs/ Chips	Tonnes	YES
Keith Potter	Copdock	Logs	Tonnes	YES
Lofty Heights	Buckhurst Hill	Logs/ Chips	Tonnes	YES
NJ Bacon Farms	Leiston	Chips	Tonnes	YES
Norfolk Woodfuels	Dereham	Chips Pellets	Tonnes	YES
Practicality Brown Ltd	Iver	Chips	Tonnes	YES
TecEnergy Uk Ltd	Beccles	Chips Kindling	Tonnes	YES
Tree Fella plc	Shoeburyness	Logs	Tonnes	YES
Treemenders Ltd	Towcester	Logs/ Chips	Tonnes	YES

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Schedule of Revisions

Issue	Date	Remarks	Prepared by	Checked by
A	December 15 2008	Final Document	Ian Hamilton	Chani Leahong
B	February 16 2009	For Publication	Ian Hamilton	Clare Wildfire

Distribution	Name	Company
	Stephen Biart	The Fairfield Partnership
	Phil Copsey	David Lock Associates
	Ron Gibbons	David Lock Associates
	Nigel Downes	WSP
	Simon Tucker	WSP
	Robert Tregay	LDA Design
	Chris Laine	LDA Design