Programme Area: Distributed Energy

Project: Macro DE

Title: Project Baseline Objectives

Abstract:

This deliverable is number 1 of 3 in Work Package 1. Its intention is to ensure full alignment between the project consortium and the ETI on the detailed processes to achieve the key project objectives and the assessment criteria at the start of the project. To this end it specifically covers: -The process for achieving the project's key objectives

- Detailed performance criteria for the assessment of DE zone approach and UK benefits, at a minimum CO2 reduction, security of energy supply and cost of delivery
- Baseline assessment assumptions, including the target end users

Context:

This project quantified the opportunity for Macro level Distributed Energy (DE) across the UK and accelerate the development of appropriate technology by 2020 for the purposes of significant implementation by 2030. The project studied energy demand such as residential accommodation, local services, hospitals, business parks and equipment, and is developing a software methodology to analyse local combinations of sites and technologies. This enabled the design of optimised distributed energy delivery solutions for these areas. The project identified a number of larger scale technology development and demonstration projects for the ETI to consider developing. The findings from this project is now being distilled into our Smart Systems and Heat programme. The ETI acknowledges that the project was undertaken and reports produced by Caterpillar, EDF, and the University of Manchester.

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Business confidential

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Macro DE – Task 1.1 Project Framework Deliverable

1 Introduction:

The UK's commitment to an 80% reduction in greenhouse gas emissions by 2050 and 34% reduction target by 2020 will require significant carbon reductions from electricity, heating and transport. While there is no single solution, Distributed Energy (DE) offers a proven way to maximize the efficient use of our natural resources for heating, electricity and cooling delivery. DE and Combined Heat and Power (CHP) can increase fuel efficiency by 30% [Energy White Paper, 2007] and has the potential to reduce carbon emissions cost effectively, while enabling the transition to locally sourced and secure low carbon energy sources. Deployment of DE is a cornerstone of the UK Government energy policy and is strongly supported by Regional Development Agencies (RDAs) and Local Authorities. This project will clearly illustrate the current industry practices (both successes and failures) for DE schemes, including software tools. By developing demand zones, based on aggregated temporal demand by site, optimized schemes for DE can be developed. A software tool methodology will be developed to design these DE schemes by zone. This approach will allow these schemes to be optimised throughout the UK. The project will evaluate the costs and benefits from such an approach focusing on potential cost savings, increased energy efficiency & security, and reduced CO_2

2 Purpose:

This memorandum is the Task 1.1 Project Framework Deliverable. It outlines the agreed approach to achieve the desired project outcomes described in the RFP:

1. A clear understanding of existing industry practices and tools, particularly with respect to demand aggregation.
2. Identification of the deployment and CO_2 reduction opportunity for Medium to Large Scale DE Systems that would be facilitated by the development and use of a system design tool which aggregates Sites into Zones to increase system efficiencies.

3. Clear UK benefits case analysis for the development and implementation of zonal DE system aggregation and optimisation approaches, and for the development of a system design software tool to support the implementation and optimisation of these approaches.
4. Identification of other DE efficiency improvement and CO_2 reduction opportunities arising from the above analysis.
5. Assess, characterise and map the industrial waste heat recoverable across the UK (in GWh/yr) per location.
6. Develop a pre-prototype tool using data from existing DE installations to validate the tool methodology and DE schemes by zone

3 Technology Evaluations

The evaluation criteria for the benefits and costs of the system improvements and the UK Benefits case have been broadly developed around the ETI Objectives, i.e.:

- *Affordability* - Do macro DE technologies have the potential to be commercially viable in 2020/2030.
- *CO_2 Reduction* - What scale of CO_{2e} abatement is likely to be achieved through deployment of distributed energy systems?
- *Energy Security* - What is the likely impact on UK energy security? What is the % of UK energy that could be delivered by DE and how many units does this include?
- *Robustness* - How resilient are technologies under different scenarios identified by the DECC pathways (ETI to provide, report being compiled and published in March)
- *ETI Leverage* – Can the skills and capabilities of the ETI contribute to a step-change in technology improvement?

The ETI does not expect ETI leverage to be assessed as part of the UK benefits case deliverable; however, it is anticipated a discussion will be held with the consortium.

4 Definitions, calculations and assumptions:

- Tool Methodology – A written summary of the approach used by this consortium, regimented within a MatLAB/Excel framework, that defines how the demand and supply data is incorporated to define optimised DE system designs by zone.

- Pre-prototype tool – MatLAB code that implements the defined methodology for use by the ETI, with the ability to incorporate additional supply and demand information in the specified format.

- Medium to Large Scale DE systems: For the purposes of this Project, Medium to Large Scale DE Systems are defined as those generating or consuming, individually or when aggregated, 100 kWe – 50 MWe.

- Technology costing will include all of the components required to make the thermal or electrical energy useable for the specific technology (e.g. heat exchangers, generators, equipment control panel, etc), but will not include the distribution costs to the point of use

- Distribution equipment includes all the additional components and systems to take the useable energy from the technology to the point of integration into the residence or site (i.e. includes piping costs, metering, controls equipment, HIU, etc) and is included in this project.

- For the purpose of this project, it is assumed that there will be no cost associated with the installation of an electricity distribution grid because the existing infrastructure will be utilised.

- The viability of DE for each of the Characteristic Zones will be thermally demand led– this means that any surplus or deficit in electricity production will either be imported or exported to the Grid according to the rates detailed in Section 5.

- The 2010 baseline case for the Grid electricity CO_2 intensity is taken as 0.485 g/kWh
    - Marginal grid intensity will be evaluated using sensitivities to the baseline CO2.

- 2010 Baseline Natural gas prices 2-tier system, market price and wholesale price to define the difference between commercial, industrial and residential.
    - Market price 7.5 p/kWh which is equivalent to 219p per therm
    - Whole sale price 1.13p/kWh which is equivalent to 33p per therm

5 Detailed Objectives Requiring Agreement:

Affordability: The cost of electricity and heat generated by the optimised system(s), which includes distribution equipment, is intended to enable the ETI to determine the value of subsequent projects to carry out the identified technology developments and demonstrate these on a commercial basis.

For the base comparison case for 2010 therefore it will be assumed that:

- 2010 will be used as the baseline assuming individual boilers in residential homes
- Boiler life expectancy 10 years
- Oil filed boiler residential locations will still use gas fired boilers as the baseline for the purposes of this project

	Residential	Industrial	Commercial
Electric	As mentioned in Section 4	As mentioned in Section 4	As mentioned in Section 4
Heating	80% efficient heat boiler	80% efficient heat boiler	80% efficient heat boiler
Cooling	Not in scope	Not in scope	1.4*

*Factor to be applied to the electric demand for the cooling in the commercial sector based on conversion of electricity to cooling.

Utilize 2 – 3 scenarios for 2020-2030 based on the DECC and ETI pathways (ETI will provide the report at the end of March)

- The specific scenarios will be kept open, but it is believed that they will include the following: High / Low Cost of NG, High / Low availability of NG
- Incentives will not be included in the costing
- Generated heat will be provided to the gate of the plant thus the flow rate and quality will be outlined *and valued at a single tariff of 7p/kWh.(Include report reference))*
- Electricity sold back into the national grid at the rates defined below.
- Electricity bought from the national grid at the rates below.

	Residential (p/kWh)	Commercial (p/kWh)
Buying from grid	9 (average price)	7 (average price)
Selling to grid (Baseload, off peak)	3.62	3.62
Selling to grid (peak demand)	4.02	4.02
Sensitivities	Range sufficient to understand where each technology becomes “cost effective”	

(figures from Platts UK assessment, peak is 07.00-19.00hrs)

- CO_2 reduction

- GHG emissions from technology and distribution system output will be provided as a fixed and operating emission.
- GHG avoided from power generated by other sources based on the agreed baseline criteria.

- Technology Acceleration: Technology Improvement or Standard improvement will include:
  - Scope of potential technology developments and sub-system to which identified development applies
  - Description of physical incarnation of development
  - Key risks of the development
  - Initial cost of the development (estimated R&D costs)
  - Estimated Capital Expenditure and Operational Expenditure

  - Comparison of costs to the existing state of that technology system
  - Defined output and dates of the project for the ETI

	Baseline	Tool solution	Technology Assessment
Details	Assessment of the UK as is	Potential improvement for the UK if the aggregated DE zonal approach were implemented	Potential improvement for DE systems with suggested technology upgrades
Date data available	23/08/2010	12/11/2010	17/09/2010

  - Information provided in September will highlight where the suggested technology improvements have been selected in preference to alternative technologies
  - The full UK assessment will be provided in November when the tool solution is available for comparison.

- Security of Supply:
  - Defined improvement in Efficiency
  - Description of the Fuel Diversity
  - Breakdown of the Domestic vs International fuel supply
  - Intermittency is resolved with backup based on design requirements

Supply side seasonality will be addressed for Heat Pump, Solar Thermal and Heat Storage)

- Linked to the twenty four time scenarios

	Summer	Winter	Spring/Autumn
(Indicative Times)	Week Day	Week Day	Week Day
Morning 05.00-09.00			
Afternoon 09.00-16.00			
Evening 16.00-24.00			
Night 24.00-05.00			
	Weekend	Weekend	Weekend
Morning 06.00-10.00			
Afternoon 10.00-17.00			
Evening 17.00-01.00			
Night 01.00-06.00			

- Robustness:
  - Viability in different scenarios (NG prices and availability)

- Test how robust the benefits are with the identified 2020 ETI scenarios, again report will be issued in March.
- CO_2, cost and performance indicators

6 Pre-prototype tool and its requirements for ETI's use

In scope / Out of scope

In Scope	Out of Scope
Space cooling for commercial (air conditioning ~~or absorption chilling~~)	Cooling for specialised processes
Space heating for residential and commercial	Heating for specialised processes
Infrastructure required only if DE is implemented	District cooling networks
	Space cooling for residential
	Space heating and cooling for industrial
The District Heating system will use low temperature hot water, operating at a maximum temperature of 100˚C	
Development of pre-prototype DE design tool	Development of prototype design tool
Surplus electricity is sold into the grid	Grid infrastructure which is already present and connected to sites in the UK
DE systems using renewable fuels (bio-gas)	
Only DE systems that are established, technology-ready, commercially proven and economically viable will be applied	
Sensitivity studies will consider effect of different zone sizes and compositions on impact of DE solutions (Task 4.2)	Inter-zone integration not explicitly considered;
Non-zoned sites accounted for by assuming non-distributed solutions employed within zone	
Quantitative assessment of impact and cost of envisaged technology developments	