Low Carbon London
Project Progress Report
June 2014

UK Power Networks
Delivering your electricity

Contents

Glossary of Terms

Abbreviation	Term
ANM	Active Network Management
BMRS	Balancing Mechanism Reporting System
CHP	Combined Heat and Power
CNO	Charging Network Operator
CP	Charge Post
DG	Distributed Generation
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
*d*ToU	Dynamic Time-of-Use tariff trial
EIZ	Engineering Instrumentation Zone
EV	Electric Vehicle
FAQ	Frequently Asked Questions
GB	Great Britain
GPRS	General Packet Radio Service
GSP	Grid Supply Point
HH	Half-hourly
HP	Heat pump
HV	High Voltage
I&C	Industrial and Commercial
IFI	Innovation Funding Incentive
IHD	In-home Display
kWh	Kilo-watt hour
LCL	Low Carbon London
LCNF	Low Carbon Network Fund
LCT	Low Carbon Technology / Technologies
LUL	London Underground Limited
LV	Low Voltage
MWh	Mega-watt hour
ODS	Operational Data Store
OLEV	Office for Low Emission Vehicles
PHEV	Plug-in Hybrid Electric Vehicle
PMS	Participant Management System
PORB	Programme Outputs Review Board
PV	Photo-Voltaic
RTU	Remote Terminal Unit
SDRC	Successful Delivery Reward Criterion / Criteria
SMS	Short Message Service
TfL	Transport for London
ULEV	Ultra-Low Emission Vehicles

Executive Summary

The Low Carbon London (LCL) project is funded through the Second Tier of Ofgem's Low Carbon Network Fund (LCNF). It commenced in January 2011 and is due to complete in December 2014. This is the seventh in the series of project progress reports submitted to Ofgem and covers the period January 2014 – 30 June 2014.

There are no SDRC due for delivery this reporting period.

The project has started to collate a set of Imperial College reports, which constitute contributory SDRC evidence in order to feed into the September reports and completed SDRC due on that date:

- 1-1 Accessibility and validity of smart meter data;
- 2-1 Network state estimation and optimal sensor placement;
- 2-2 Accessibility and validity of substation sensor data;
- 3-1 Impact of LV connected DER on power quality;
- 4-1 Impact of energy efficient appliances on network utilisation;
- 4-2 Impact of LV DERs on network utilisation;
- 5-1 Impact of opportunities for wide-scale electric vehicle deployment;
- 6-1 Residential consumer attitudes to time varying pricing;
- 6-2 Residential consumer responsiveness to time varying pricing;
- 6-4 Smart appliances for residential demand response; and
- 7-1 Opportunities for DG in the distribution network.

The summary reports are a collaborative effort between the project partners, UK Power Networks, and expert consultancy where required. All reports and SDRC due for delivery by 30 September and 31 December 2014 are on schedule.

In January 2014, Ofgem formally recognised that LCL became the first LCNF project to earn a revenue stream for customers, in the form of an access fee allowing Shell International Petroleum Company Limited (Shell) to use the Active Network Management (ANM) system and the Operational Data Store (ODS) developed by the project. This arrangement results in £420,000 being returned to customers, this being the full fee paid by Shell for use of the aforementioned artefacts developed by the project. It should also be noted that UK Power Networks did not claim any part of the fee or deduct any costs expensed for the work to arrive at this arrangement with Shell.

This reporting period has also seen the project complete and close down most of its trials and focus efforts on the creation and delivery of the portfolio of final reports. One new risk has arisen in the reporting period associated with our Engineering Instrumentation Zones (EIZs) and which would have an impact on one part of one of the final reports ("DNO learning report on the use of smart meter information for network planning and operation"). This is discussed in detail in Section 6.

The ground-breaking dynamic time-of-use tariff trial (*d*ToU), which stopped operating the dynamic tariff at the end of December 2013, continued to collect meter readings until the end of February 2014 to allow post-trial consumption levels and patterns to be recorded and analysed as part of the overall trial. The trial formally finished all data collection on 28 February 2014.

The close-down process also featured a comprehensive end of trial survey, as well as each trial participant processed through an annual bill reconciliation process, which was the central feature of the trial's "safety-net", that ensured no participant ended up actually paying more for their electricity whilst on the *d*ToU trial than the amount they would have paid had they remained on their previous tariff that was in operation prior to engaging on the trial; conversely, trial participants got to keep any savings made by them during the trial through shifting demand and

by consuming electricity during the low tariff operation periods. All trial and control group participants were sent a thank-you letter to mark their involvement in this unique and important trial.

The project has also received all the half-hourly meter reading data for the complete calendar year January-December 2013 for the additional 10,900 customers enrolled to the trials through British Gas. Together with the 6,000 trial participant base from EDF Energy, this aggregated dataset represents what is believed to be the largest electricity smart meter data set ever assembled within GB by the DNOs.

The winter 2013 Industrial & Commercial (I&C) DSR trial completed successfully in February 2014; in total, 130.12MWh of DSR was contracted across 120 unique events. Of those, 24 were sourced from diesel generation, comprising 47.38WMh of DSR, 37 sourced from CHP, comprising 71.66MWh of DSR and 59 events comprising 11.08MWh of DSR from building turn-down. 65MWh of the total was despatched as part of the wind twinning trial carried out in conjunction with Flexitricity and within that, 36MWH was sourced from diesel generation and 29MWh from CHP generation. The overall success of the I&C DSR trial has been taken forward with real purpose in UK Power Networks' operational business, such that the recently re-submitted RIIO ED1 business plan included an increase of £5.2m in committed savings from that contained in the original ED1 submission, through reduced network reinforcement underpinned specifically by DSR, to a total of £43.4m.

The EV monitoring trial completed at the end of March 2014 and decommissioning of trial instrumentation equipment installed in residential participants' homes has commenced, with the removal of trial smart meters. The regulated EV charging trial, using 62 public EV charge posts across London completed 19 April 2014.

The work to supplement the installed heat pumps with data from other sources also successfully finished in this reporting period, with data from 18 additional heat pumps obtained from installations managed by the Energy Savings Trust and Passiv Systems Limited. This data was provided from portable power quality analysers installed in the heat pump locations. A further trial was successfully carried out over the Easter period to undertake detailed assessment of the voltage characteristics of an array of PV inverters.

The project also completed its work to instrument the LV network in the three EIZs, with 106 three-phase smart meters installed at pot-end locations. The data from these meters is routinely collected and stored in the project's operational data store (ODS) and used in trial analysis. Within the reporting period, however, analysis has identified a significant amount of data loss from the substation sensors at substations (not pot-end locations). In order to mitigate this, sites are being visited manually to download sensor data and address data gaps where possible. In addition, data communication methods are being replaced where appropriate with supplementary plans in place to continue to manually visit sites as a contingency in order to ensure reliable data capture in the short. These mitigations will be vital to delivering the DNO learning report on the use of smart meter information for network planning and operation.

One notable trial is on-going within this reporting period to enrich the project's overall trial portfolio, the fully-active Active Network Management (ANM) trial using TfL's Greenwich Power installation.

The project has also continued to produce regular carbon impact reports, based on the empirical data gathered from the trials carried out.

The project has commissioned a number of external specialist consultancies to assist in the production of the DNO-centric reports and will leverage the existing skills and expertise these entities bring to the project to augment the richness of the project's trials and the empirical data gathered from them.

Risks

The project has operated a comprehensive risk management framework from its inception. There are no identified uncontrolled risks that present a threat to the project successfully completing its objectives or the delivery of its remaining SDRC.

The project manages and mitigates a number of controlled risks and the key controlled risks to the project are outlined in Table 1 – Key project risks, below.

Table 1 – Key project risks

Risk	Impact/ Probability	Mitigation
Programme final reports – coordination of analysis, reporting and presentation of findings between UK Power Networks and Imperial College.	High/Low	1. Several meetings held with Imperial College to agree detailed contents of final reports. Executive summaries produced for all reports to assist in alignment across reports between Imperial College and UK Power Networks. 2. Draft overall themed report architecture produced for review and comment. 3. Detailed project plans developed for DNO-centric and Imperial College report portfolios. 4. Regular governance meetings in place with UK Power Networks and Imperial College. 5. Project co-ordinator appointed to manage report interdependencies between Imperial College and DNO reports. 6. Weekly call held with all DNO report authors and Imperial College to co-ordinate requests for data & information to Imperial College from DNO report authors. 7. Timely workshops arranged with Imperial College to discuss detailed DNO report data requirements from Imperial College.
Ensure all reports are delivered to time, quality and budget	High/Low	1. Established comprehensive governance framework 2. Established contracts with report-contributing third parties on a fixed-price basis, with staged payments tied to delivery of approved-quality drafts milestone stage payments.
Poor quality of substation data in EIZs	Medium/ High	1. Checked that all RTUs are correctly configured. 2. Ensured data integrity is maintained and preserved when moving data across different software operating systems, data paths and data interfaces (e.g. signage and units of measure). 3. Ensured all relevant data has been collected and loaded into the ODS. 4. Implemented manual data collection measures as contingency to address data communications issues. 5. Undertake comprehensive lessons learned exercise to identify root causes of issues and make recommendations to minimise or prevent further recurrences in the future.
Installation risks		
Greenwich Power – fully-active ANM trial	Medium/ Medium	1. Refurbishment of Greenwich Power installation may impact trial – work closely with TfL minimise any disruption. 2. Undertake timely installation of ANM management console at TfL offices in the Palestra building, Southwark, in conjunction with TfL facilities management staff.

Learning outcomes

The learning outcomes arising during this reporting period reflect the project activities undertaken during this reporting period and focus on trials undertaken and the removal of residential trial equipment.

Wind twinning trial

- The I&C wind twinning trial undertaken with Flexitricity is a significant proof of concept that establishes the ability to contribute to the mitigation in the variability of wind generation through I&C demand response contracts. The trial established a fully-automated DSR process driven by alerts from Elexon's Balancing Mechanism Reporting System (BMRS).

Regulated EV charging trial

- The trial to regulate EV charging with public charge posts has to date been carried out with no complaints received from members of the public using the charge posts during peak times (when the regulation regime is enacted), reinforcing the design principle that the regulation impact is imperceptible to the end user. The trial uses technology that enables regulation of the EV charge cycle with no perceptible degradation in charging times or impact on the overall charging experience from the user's perspective.

Removal of residential trial equipment

- The removal of some residential EV trial monitoring equipment is proving to be challenging in some instances where those participants have valued the equipment installed and are appearing to be reluctant to allow the equipment to be decommissioned. The project is continuing to work with the equipment decommissioning team and UK Power Networks legal team to ensure the enduring situation is acceptable to all parties. The decommissioning process of any equipment installed in any residential premises needs to be articulated clearly as part of the sign-up process to avoid any subsequent misunderstandings.

The project continues to lodge relevant information on the UK Power Networks innovation portal within its main public website (www.ukpowernetworks.co.uk/innovation).

The project continues to enjoy a high profile both nationally and internationally and is regularly presenting at conferences on its trials, objectives and emerging findings – these are detailed in Section 6 below.

1 Project manager's report

1.1 Project overview

The project has no SDRCs scheduled for delivery during this reporting period; however there are several SDRC-related evidence artefacts which are being internally collated in this period as part of the package of SDRC to be delivered by 30 September 2014. These are all on track and contribute towards the SDRC due for delivery by 30 September 2014.

All the remaining SDRC and related evidence artefacts are final-report related and are on schedule to be delivered by 31 December 2014.

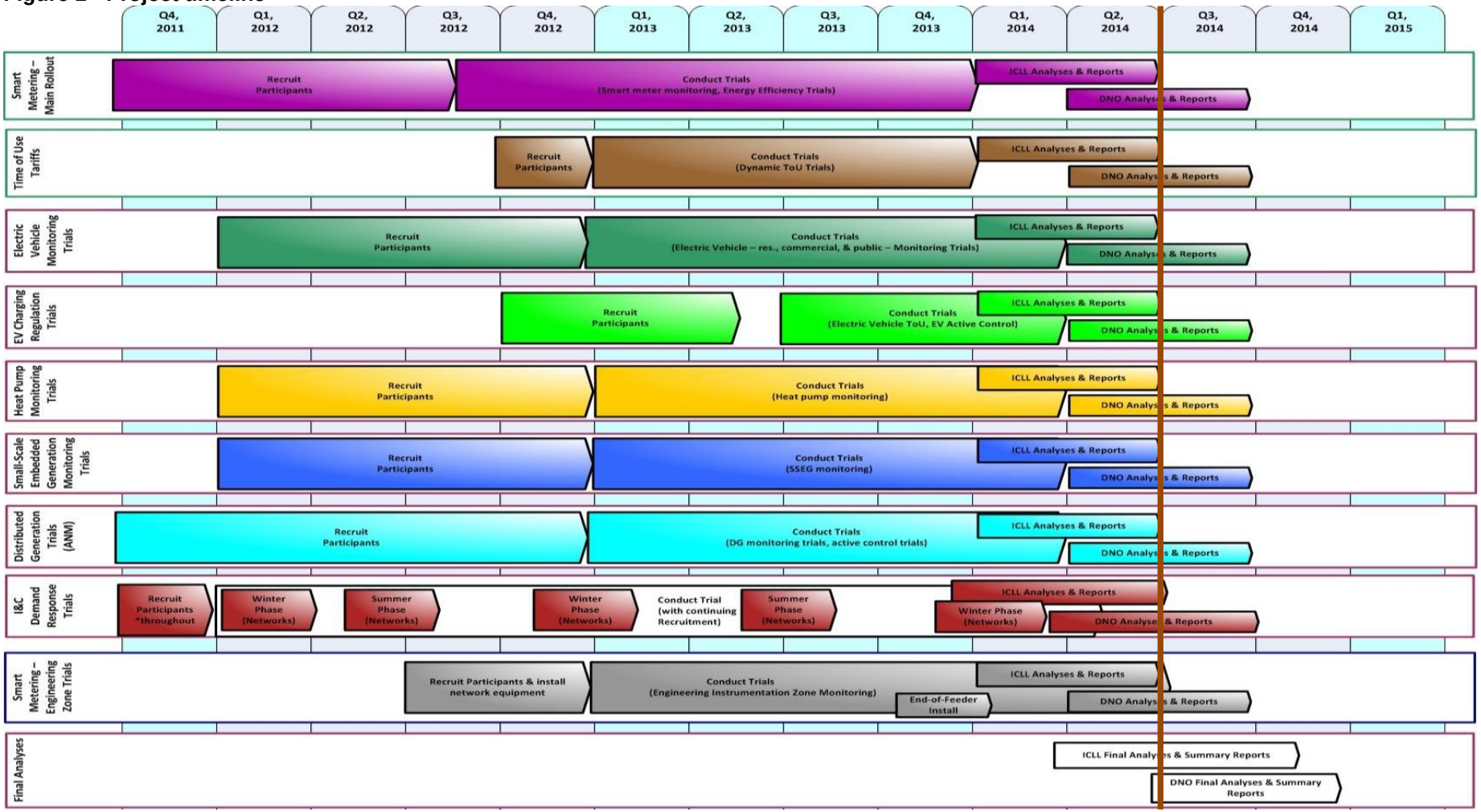
The main activities of the project in this reporting period have been concentrated in the following areas:

- Closedown and completion of the majority of the project's trials and accompanying measurement and instrumentation work:
    - smart metering – closing the trial with 4,414 participants;
    - dynamic time-of-use tariff – closing the trial with 1,119 participants;
    - EV monitoring – closing the trial with residential and commercial EV users;
    - Heat pump monitoring – incorporating external heat pump data with the project's own dataset;
    - I&C DSR – completing the final winter 2013 DSR trial; and
    - Instrumentation of the network – installing and commissioning 106 LV measurement devices at key points on the LV network within the EIZs.
- Continuation of a key trial – full active network management of distributed generation;
- Production of carbon impact reports based on the empirical data gathered from the project's various trials;
- Establishment of the final reports governance framework;
- Recruitment, contracting and on-boarding of external specialist consultancy resource to assist in the production of some of the DNO final reports;
- Initiation of trial equipment decommissioning; and
- Management of final report production.

This report section describes each of these activity areas in more detail.

The high-level timeline of the project is illustrated in Figure 1 - Project timeline on the following page.

Figure 1 - Project timeline



1.2 Trial updates

1.2.1 Smart meter and dynamic time-of-use tariff trials

The smart meter and dynamic time-of-use trials both completed successfully on 31 December 2013. No further consumption data was collected from the smart meter trial participants; however at the request of Imperial College, a further month of consumption data was collected from those participants on the dynamic time-of-use trial, so that the immediate post-trial consumption patterns could be tracked and recorded for comparison with on-trial consumption patterns.

Letters of thanks for participating in the trials were sent to all smart meter and dToU trial participants with a commitment to write again to participants at the end of the trial when the findings are available.

1.2.2 EV monitoring

The EV monitoring trial closed down in this reporting period. The trial comprised;

a) 78 residential users who charge EVs on their respective existing electricity tariffs;

b) 10 residential users on EDF Energy's "ECO 20:20" tariff, which offers off-peak usage discounts between 2100 and 0700 hours on weekdays and all weekend and is aimed at residential customers with micro-generation and/or an EV; and

c) 65 commercial charge posts used across a number of EVs.

All cable spurs to relevant charge post are instrumented with an EDMI smart meter, which captures both consumption and a range of voltage characteristics. A small subset have also had data loggers fitted, that have enable more precise data to be collected on driving patterns, driving routes used, average speeds etc.)

Data has been collected in the ODS and analysis subsequently carried out to determine charging behaviours and EV charge characteristics by Imperial College London's Centre for Transport Studies (CTS) and the Department of Electrical and Electronic Engineering.

Data will continue to be collected from EV charge posts to enrich the datasets until the smart meters used are decommissioned. Residential EV smart meters will be decommissioned first.

1.2.3 Regulated EV Charging Trial

The project has undertaken a significant trial in conjunction with POD Point and Smarter Grid Solutions to explore opportunities and learning from regulated EV charging at peak times. The trial uses technology developed by POD Point, which is coupled with ANM infrastructure from SGS, to enable peak time EV charging which may cause local network issues to be regulated to avoid such occurrences.

The method of EV charging regulation is such that there is no perceptible impact on the end-user, who experiences a normal EV charge. The trial has been carried out using 62 of POD Point's EV charge post network across London, linked to specific substations on London Power Networks' network.

Figure 2 below sets out the trial configuration, showing the linkage between EV charge posts, UK Power Networks substations, ANM infrastructure and POD Point Carbon Sync technology.

The trial completed on 19 April 2014.

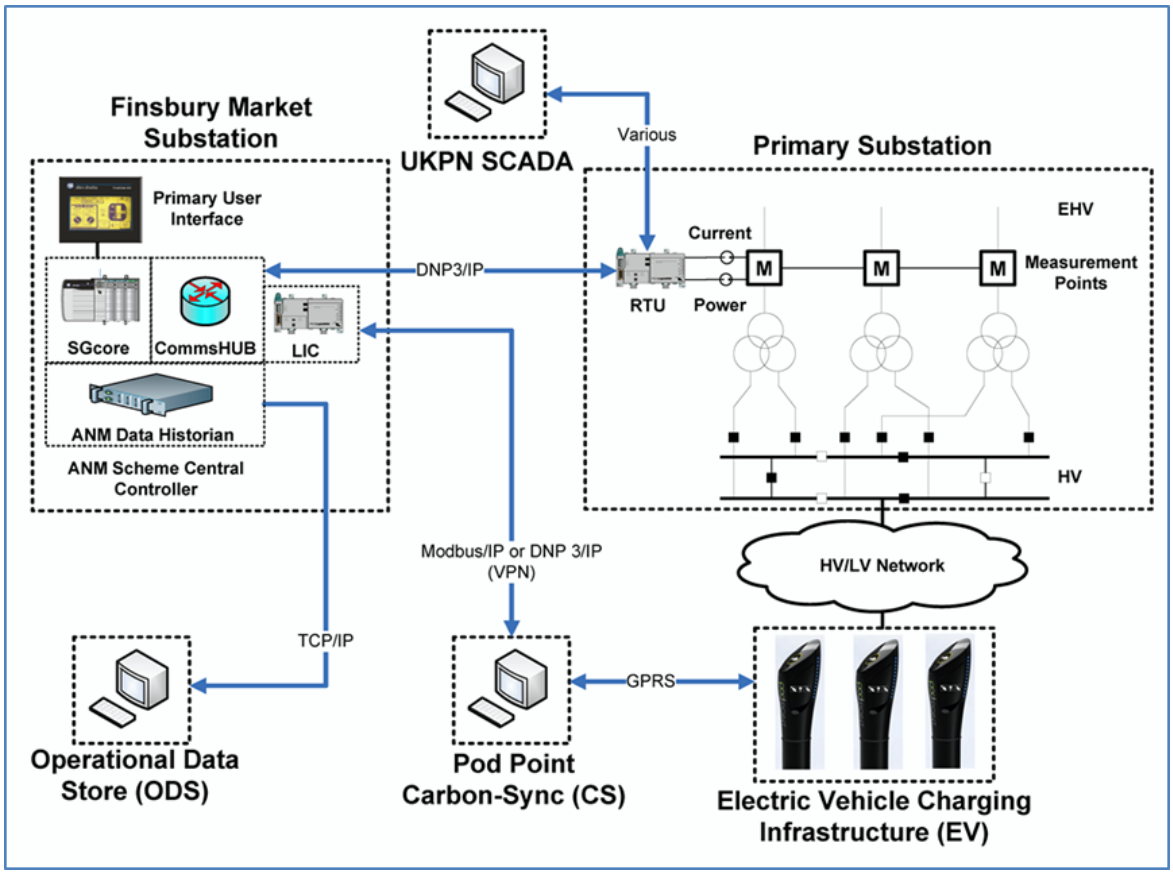


Figure 2 – Regulated EV charging configuration

1.2.4 Heat pump monitoring

The project has completed its heat pump monitoring trial during this reporting period, with the trial ending in March 2014. The trial comprised of two components, data from the three heat pumps recruited by the trial and additional data from 18 further heat pumps.

This data was collected from heat pumps working with the Energy Savings Trust and Passiv Systems Limited. The data was collected from portable power quality analysers which were deployed to collect a range of voltage measurements.

The data has been stored in the ODS and Imperial College have been undertaking detailed analysis of the data to inform their final reports.

1.2.5 I&C DSR and Wind Twinning trials

The winter 2013 DSR trial ran from 1 November 2013 until 28 February 2014. The trial focused on three components:

- Building turn-down sources;
- ANM-triggered events; and
- The wind twinning trial ran in conjunction with wind-generation drop-off data provided by Elexon from the BMRS (Balancing Mechanism Reporting System).

In total, 130.12MWh of DSR was contracted across 120 unique events. Of those, 24 were sourced from diesel generation, comprising 47.38WMh of DSR, 37 sourced from CHP, comprising 71.66MWh of DSR and 59 events comprising 11.08MWh of DSR from building turn-down. 65MWh of the total demand response was triggered as part of the wind-twinning trial, carried out in conjunction with Flexitricity, and 36MWh of that was sourced from diesel generation and 29MWh sourced from CHP generation.

The portfolio of demand that was input to the trial was carefully built up using portfolios from three demand aggregators in the preceding months to avoid any duplicate commissioning at substation level. In addition, new instrumentation equipment had to be installed on some installations which were part of the ANM-triggered portfolio candidates and which led to a short delay in their inclusion in the trial to early December 2013. The wind twinning trial started in earnest on 19 November 2013 after initial data interfacing issues were resolved.

Variability in substation demand throughout January was far greater than that displayed throughout the summer trial and from previous years. Thresholds for automated event triggering were therefore difficult to set at a reasonable level, resulting in events every day of the week or no events for a number of days. This meant that the commercial constraints placed for the number of events permitted throughout the trial was reached in three weeks (7/1/13-28/1/13). As a consequence no further events took place in February for one particular aggregator's sites, whilst the remaining two aggregators remained in the trial until the end. Variability in the ambient temperature was the key factor in the substation demand fluctuation and illustrates the need to develop a dynamic threshold-setting algorithm for future winter ANM-triggering DSR activities.

Nine Wind Twinning events were dispatched without problem; two of these events only dispatched one installation as a second proposed installation was undeclared due to a maintenance window in line with contracted terms.

The trial included six new sites from one participant who also participated in a recognised TRIAD-avoidance scheme which was also in operation during the trial period. This resulted in those sites on nine occasions being declared as unavailable due to the TRIAD-avoidance scheme being in play. This scenario highlights an interesting area of potential synergy or conflict, which impacts the availability of distributed generation to the DNO for demand side response in the winter (TRIAD) period. It is also worth noting that when National Grid subsequently declared the actual TRIAD periods for the winter, only one of the days (30 January 2014) when the DSR trial conflicted with the TRIAD-avoidance being in operation subsequently turned out to be an actual TRIAD day.

The winter 2013 DSR trial received more occasional declarations of unavailability from participant locations than the previous summer trial. This is largely due to the increase in diesel sites and the conflicts with TRIAD however there also were more fault notifications in the diesel and CHP sites, which may be a factor of their increased operational use in winter.

1.2.6 Instrumentation of the network

The work to instrument the network was completed in this reporting period.

Table 2 below describes the measurement framework in detail.

Monitoring Equipment	Measurement	Statistic	Units	Phase
EDMI MK7B	Real power	avg.	W	Single
	Reactive power	avg.	VAR	Single
	Apparent Power	avg.	VA	single
	Phase Angle Main	avg.		single
	Current	min, max, avg.	A	single
	Voltage	min, max, avg.	V	Single
	Voltage THD	avg.	%	Single
	Current THD	avg.	%	Single
EDMI MK 10A	Real power	avg.	W	A,B,C
	Reactive power	avg.	VAR	A,B,C
	Voltage	min, max, avg.	V	A,B,C
	Voltage THD	avg.	%	A,B,C
	Current THD	avg.	%	A,B,C
HV Substation Monitoring Device Remsdaq Callisto 1 RTU	Current	avg.	I	A,B,C
	Voltage	avg.	V	A,B,C
	Real Power	avg.	kW	A,B,C
	Reactive power	avg.	kVAR	A,B,C
	Apparent Power	avg.	kVA	A,B,C
	Power Factor	avg.	n/a	A,B,C
	Voltage THD	avg.	%	A,B,C
	Air temperature	avg.	degrees	A,B,C
	Current THD	avg.	%	A,B,C
	Harmonic Content (1st-50th)	avg.	%	A,B,C
Primary Substation Monitoring Device GE Converteam T5000 or 5500 RTU	Current	avg.	I	A,B,C
	Voltage	avg.	V	A,B,C
	Real Power	avg.	kW	A,B,C
	Reactive power	avg.	kVAR	A,B,C
	Frequency	avg.	hz	A,B,C
	Power Factor	avg.	n/a	A,B,C
LV Substation Monitoring Device EMS Sub.net LV	Current	Max, min, avg.	I	A,B,C
	Current THD			
	Voltage	Max, min, avg.	V	A,B,C
	Voltage THD			
	Real Power	Max, min, avg.	kW	A,B,C
	Reactive power	Max, min, avg.	kVAR	A,B,C
	Apparent Power	Max, min, avg.	kVA	A,B,C
	Voltage Harmonic Content (1st-50th)	Max, min, avg.		A,B,C
	Current Harmonic Content (1st-50th)	Max, min, avg.	%	A,B,C
LV Feeder Monitoring Device - 3 phase connections EDMI MK 10A	Current	Max, min, avg.	I	A,B,C
	Voltage	Max, min, avg.	V	A,B,C
	Real Power	Max, min, avg.	kW	A,B,C
	Reactive power	Max, min, avg.	kVAR	A,B,C
	Apparent Power	Max, min, avg.	kVA	A,B,C
	THD	Max, min, avg.	%	A,B,C
LV Feeder Monitoring Device -	Voltage	Max, min, avg.	V	A

Monitoring Equipment	Measurement	Statistic	Units	Phase
single phase connections Outram PM100	Voltage THD	Max, min, avg.	%	A
	Current THD	Max, min, avg.	%	A
	Harmonic Content (1st-50th)	Max, min, avg.	%	A
	Flicker			A
	Transients			A
LV Feeder Monitoring Device - Temporary installations Outram PM7000	voltage	Max, min, avg.	V	A,B,C,N
	Voltage THD	Max, min, avg.	%	A,B,C,N
	Current THD	Max, min, avg.	%	A,B,C,N
	Harmonic Content (1st-50th)	Max, min, avg.	%	A,B,C,N
	Flicker			A,B,C,N
	Transients			A,B,C,N
	Real Power	Max, min, avg.	kW	A,B,C,N
	Reactive Power	Max, min, avg.	kVAR	A,B,C,N
	Apparent Power	Max, min, avg.	kVA	A,B,C,N

Table 2 – Monitoring equipment

Within the reporting period analysis has identified a significant amount of data loss from the LV substation monitors (EMS Sub.net LV). Thorough investigation of the root cause has highlighted the root cause to be the use of alternative routings which employed the UK Power Networks corporate IT network rather than the UK Power Networks SCADA network to transmit data, since the SCADA network was under lock-down during the 2012 Olympic period.

To mitigate this, sites are being regularly visited to manually recover and download data from RTUs and address data gaps where possible. In addition, alternative communication solutions are also being put in place where needed in order to ensure reliable data capture for the next three months.

These mitigations will be vital to delivering the DNO learning report on the use of smart meter information for network planning and operation. A total of 27GB of data, equivalent to 23 days' worth of data from the substations involved, has been recovered, and the focus will be on ensuring reliable data capture for the next three months.

The project completed the deployment of 106 devices on the LV network within the three EIZs to measure the impact of LCTs on the distribution network. These devices are EDMI three-phase smart meters, capturing voltage characteristics at pot-end locations on the LV network.

Figure 3 - Typical EIZ installation below illustrates a typical installation.

Figure 3 - Typical EIZ installation

The work to complete installation and commissioning finished in March 2014 with data from 106 devices successfully transmitting data which is collected in the ODS for onward analysis.

1.2.7 Distributed generation trial

The distributed generation monitoring trials underpinned by active network management equipment have continued to run smoothly during this reporting period. In addition, ANM infrastructure has been successfully used in a central role in two other trials operated during the last six months; in the regulated EV charging trial, which continues to function and in the ANM-enabled DSR winter 2013 trial, which concluded in February 2014.

In addition, the engagement work to recruit a fully-active ANM trial participant has progressed well with Transport for London, based on the use of their back-up power generation plant at Greenwich, with contracts now signed and equipment installation work well underway with a trial start for July 2014.

Data from this trial will be collected and reported in the final reports delivered in the second half of 2014.

Originally a coal-fired power station and completed in 1910 to supply electricity to the London Tram Network, it currently houses embedded generation plant consisting of eight Rolls Royce Avon gas turbine engines. These are fuelled by natural gas and are also capable of running on fuel oil which is stored as an emergency reserve at the site. Each turbine generates up to 14.7MW.

Figure 4 - Greenwich Power Station below, illustrates the turbine hall located in the original power station building.

Figure 4 - Greenwich Power Station

Figure 5 - Greenwich fully-active ANM trial, below describes the fully-active ANM configuration for the trial with TfL's Greenwich Power Station (GPS) installation. The trial is centred on TfL's/London Underground's (LUL) single remaining source of non-National Grid electricity.

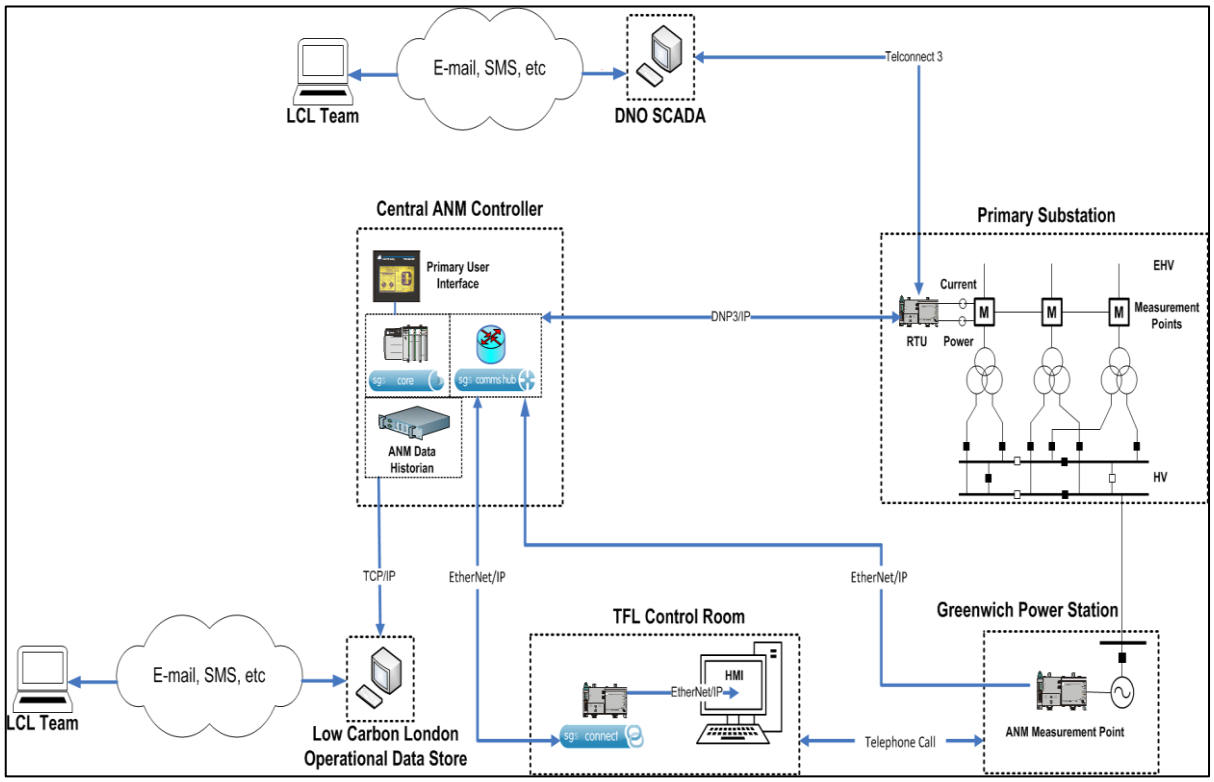


Figure 5 - Greenwich fully-active ANM trial

The trial is based upon utilising one turbine through installed ANM infrastructure, to export via TfL's own substation at Lots Road, to the Grid Supply Point (GSP) substation Wimbledon Grid. The trial will be a fully-automated active ANM trial and demonstrates the process for how a DNO can contract directly with a customer, utilising an EHV connected customer (and hence the management of a GSP site) with links to an operational network constraint (Wimbledon GSP is at risk of becoming non-compliant). The trial is scheduled to operate from 1 June – 31 August 2014.

The DG monitoring trials will continue to collect data until 30 September, as the dataset provides a useful baseline of core data of detail from installed DG equipment and the more data contained in it the richer the dataset.

1.3 Carbon impact reports

The project has been able to produce a series of carbon impact reports using the reporting tool developed by CGI. This tool enables accurate carbon impacts to be calculated using NPL-certified algorithms applied to the empirical data collected from the project's trials.

All these will be published as part of the final report portfolio and Appendix Two contains an example report, based on real trial data from the I&C DSR trial.

Figure 6 - Carbon impact reporting below, illustrates an example carbon impact analysis from real residential dynamic time-of-use trial data for the month of December 2013. The graphs illustrate the difference in carbon emissions from electricity consumed for the dynamic time of use trial group when compared to the trial control group. The lower graph shows that on most days there was a positive carbon impact from the trial group; the few days where the carbon impact was negative corresponded to days that the trial group were encouraged to shift demand (and hence use more electricity than the control group) by the operation of the "low" dynamic time-of-use tariff.

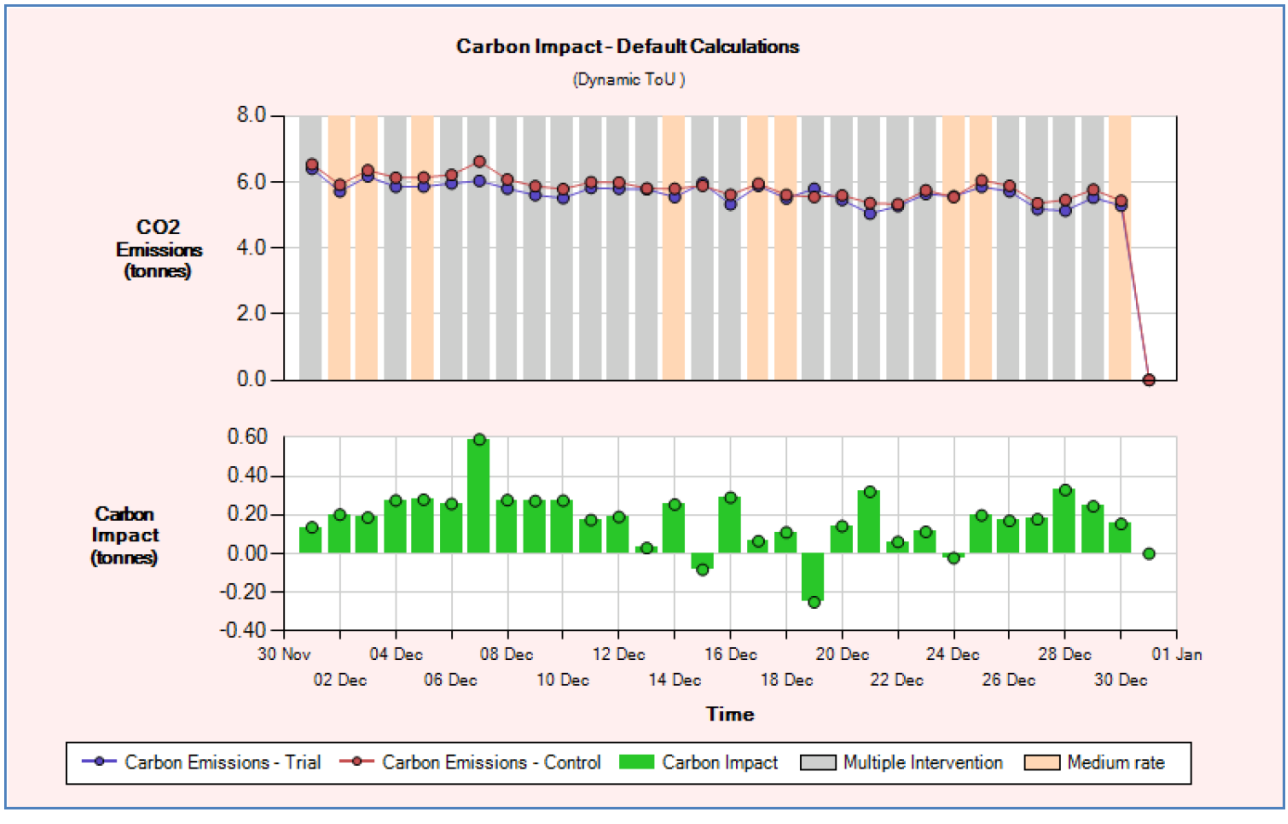


Figure 6 - Carbon impact reporting

The carbon impact using the carbon tool has been calculated at a net reduction of 5.414 tonnes of carbon emissions due to the operation of the time-of-use tariff during December 2013, when compared to the equivalent control group.

1.4 Establishment of report governance framework

The project has developed a comprehensive governance framework to oversee the delivery of the project's final reports based upon quality, timeliness and budget. Each report is developed according to a four-stage process, comprising of a conceptual draft, first draft, second draft and final draft. In addition, technical reviews can be held at any time to address any matters arising or to provide clarification on options and issues.

Formal acceptance certificates will be issued upon successful review at each report and these are used to trigger appropriate stage payments to those third parties engaged on a commercial basis to contribute to the final report production.

Each DNO final report has an appointed UK Power Networks lead officer, who is responsible for all aspects of the creation, development and delivery of the report and acts as a focal point for all involved parties and as an escalation point for any questions of data, analysis and findings.

The reports governance framework and timeline for final reports due by 30 September 2014, is set out in Figure 7 below.

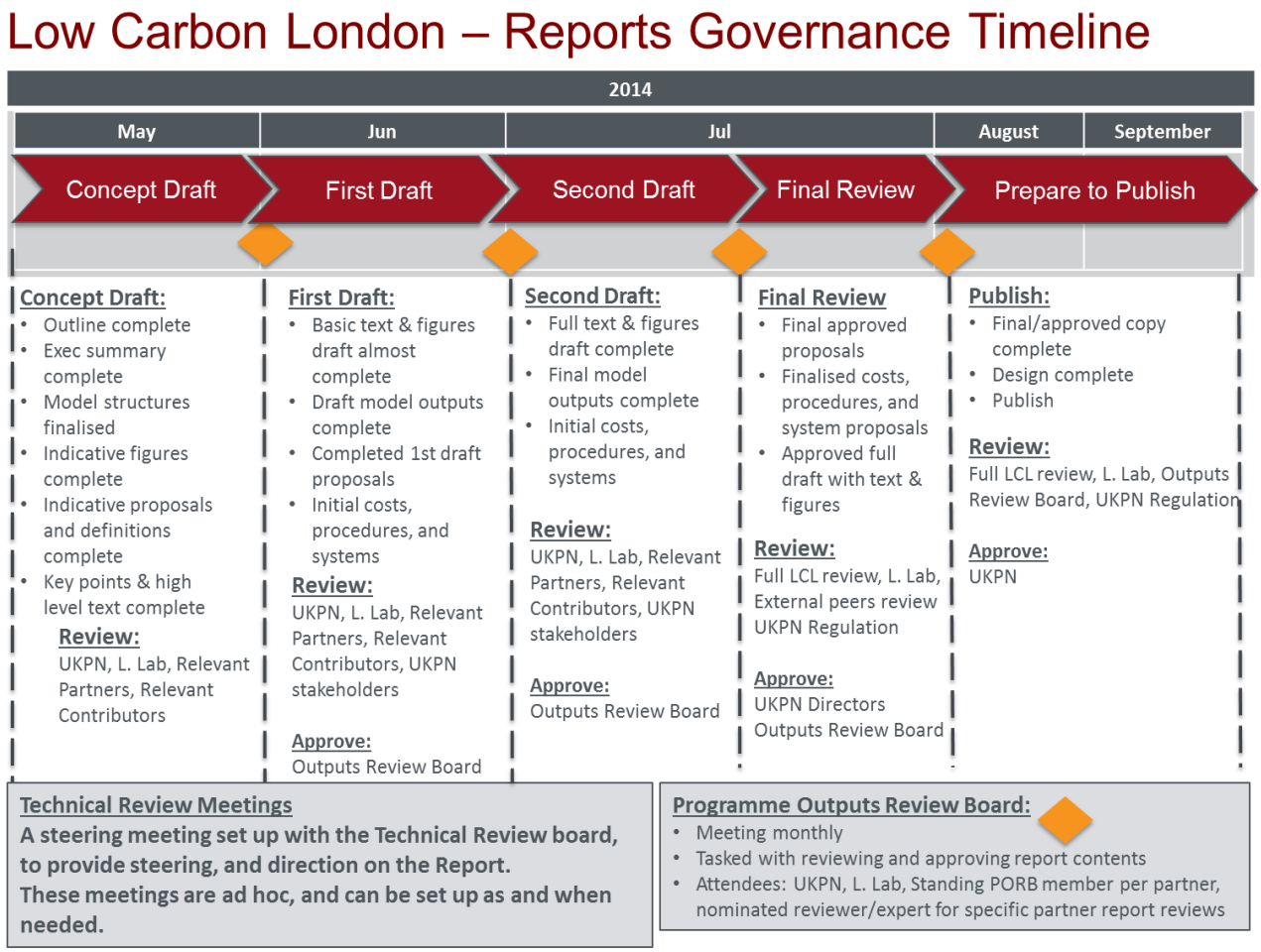


Figure 7 - Q3 DNO reports governance timetable

The framework enables all parties to have a regular touch-point with the project and for cross-report themes to be identified and managed at the appropriate time. The framework is augmented by regular review sessions with Imperial College to address requests for data or to clarify matters arising between the reports produced by Imperial College and those with a strong DNO focus.

The project also maintains the matrix of trial learning points and actively tracks the mapping of learning points to reports as the reports content is developed. The project has also established a dedicated "war room" that acts as a focal point for all report-delivery related activities.

1.5 Final report delivery

At the time of the formal change request in December 2012, the project committed to the delivery of an additional portfolio of final reports, specifically aimed at the DNO community. These were to act as a complementary and practical guide to DNOs that supplemented the final reports delivered by Imperial College.

UK Power Networks has led the specification and detailed development of each of these additional reports and in this reporting period and is working with a number of project partners and other third parties to assist in the delivery of content and writing of the reports.

As stated above, each "DNO report" has an appointed UK Power Networks lead person, to oversee all aspects of the report delivery and all reports are delivered through the governance framework outlined in 1.4 above.

Commercially, all third parties are engaged on a fixed price arrangement with staged payments aligned to the successful approval of each of the four draft stages set out in the governance framework. Further details of the contractual arrangements are contained in the confidential annexe.

1.6 Final report structure

The project will deliver a comprehensive portfolio of 29 reports – 15 delivered by Imperial College and 14 by UK Power Networks. Figure 8 below describes the overall structure of this set of reports and themes, together with the delivery schedules.

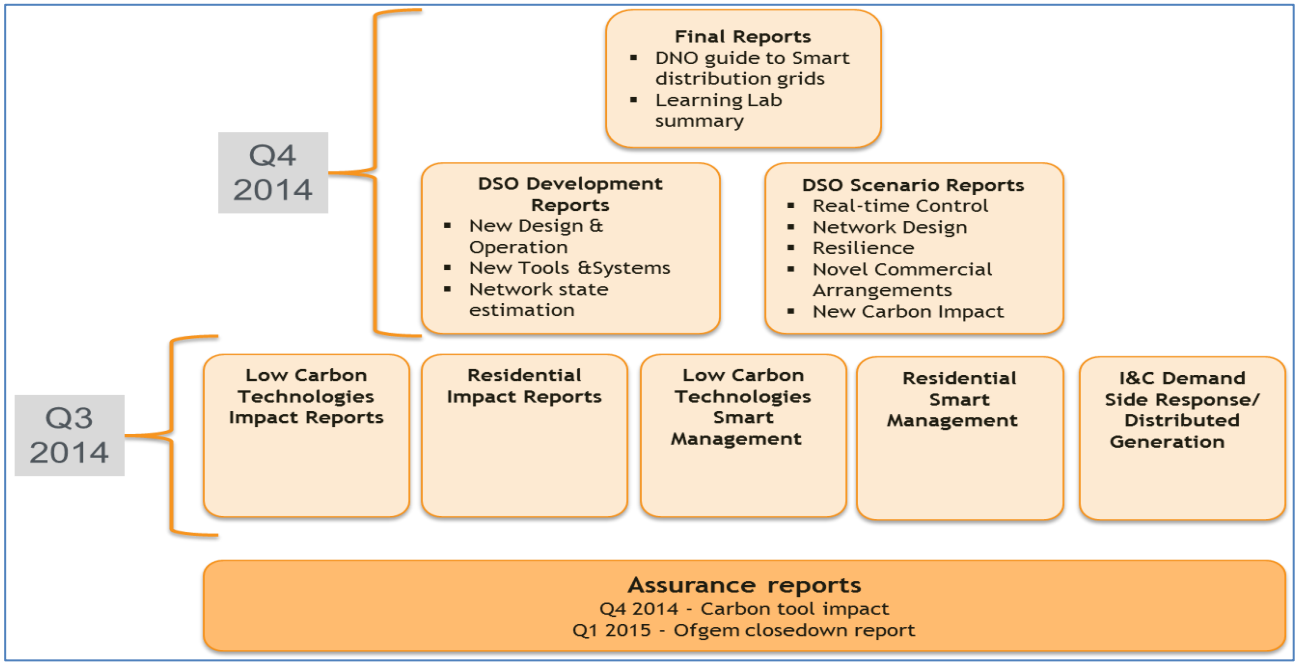


Figure 8 - Reports structure

The reports delivered by Imperial College focus on four key areas:

a) Analysis of the accessibility of smart meter and substation sensor data though the ODS and the placement of these sensors in the network;
b) Analysis of the nature of load profiles in scenarios of increased energy efficiency, electric vehicles and electric heating;
c) Investigation of the various types of system intervention to alleviate system stress, including generation and demand response; and
d) A set of reports that combine the above analysis to consider their combined effect in terms system planning and operation.

The reports delivered by UK Power Networks focus on the distribution network impacts of the trialled low carbon technologies, with the emphasis on practical guides and way points to assist the DNO community in the efficient development and management of low carbon electricity networks.

1.7 IT Architecture

The IT solution has continued to be enhanced through this reporting period, with minor enhancements made to components as requirements are identified. The overall IT solution has also evolved to accommodate the additional trials of ANM-triggered DSR, additional smart meter data from British Gas and the regulated EV charging trial employing ANM and POD Point's Carbon Sync solution. All have all required the IT solution to be enhanced.

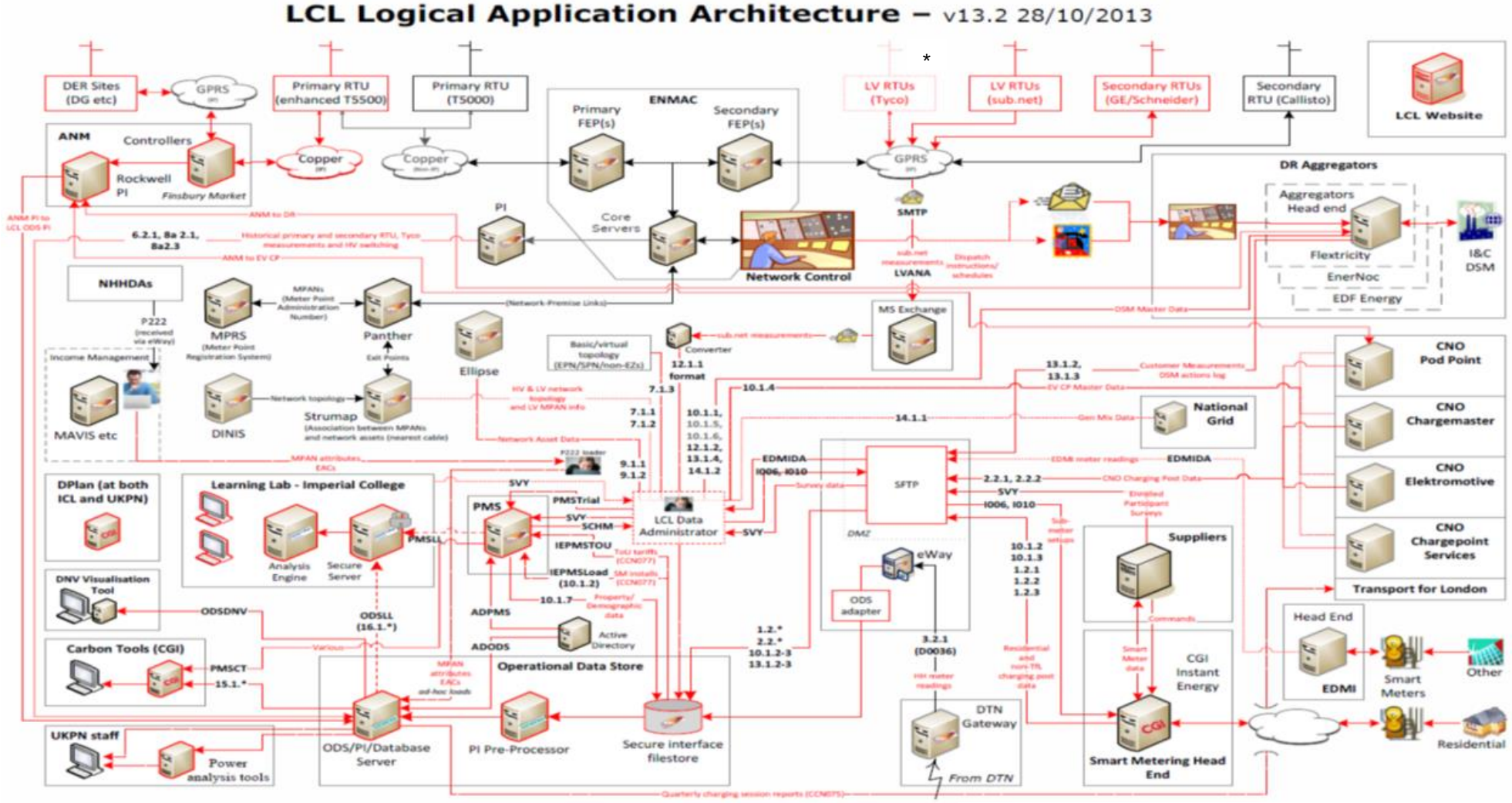
Figure 9 - LCL Logical IT Architecture on the next page, illustrates the current IT architecture.

1.8 Project organisation

The project continues to flex and adapt to emerging requirements as it moves into the final phases of its remit and the organisation of the project has evolved over this reporting period to reflect the priorities of report delivery, learning dissemination and decommissioning.

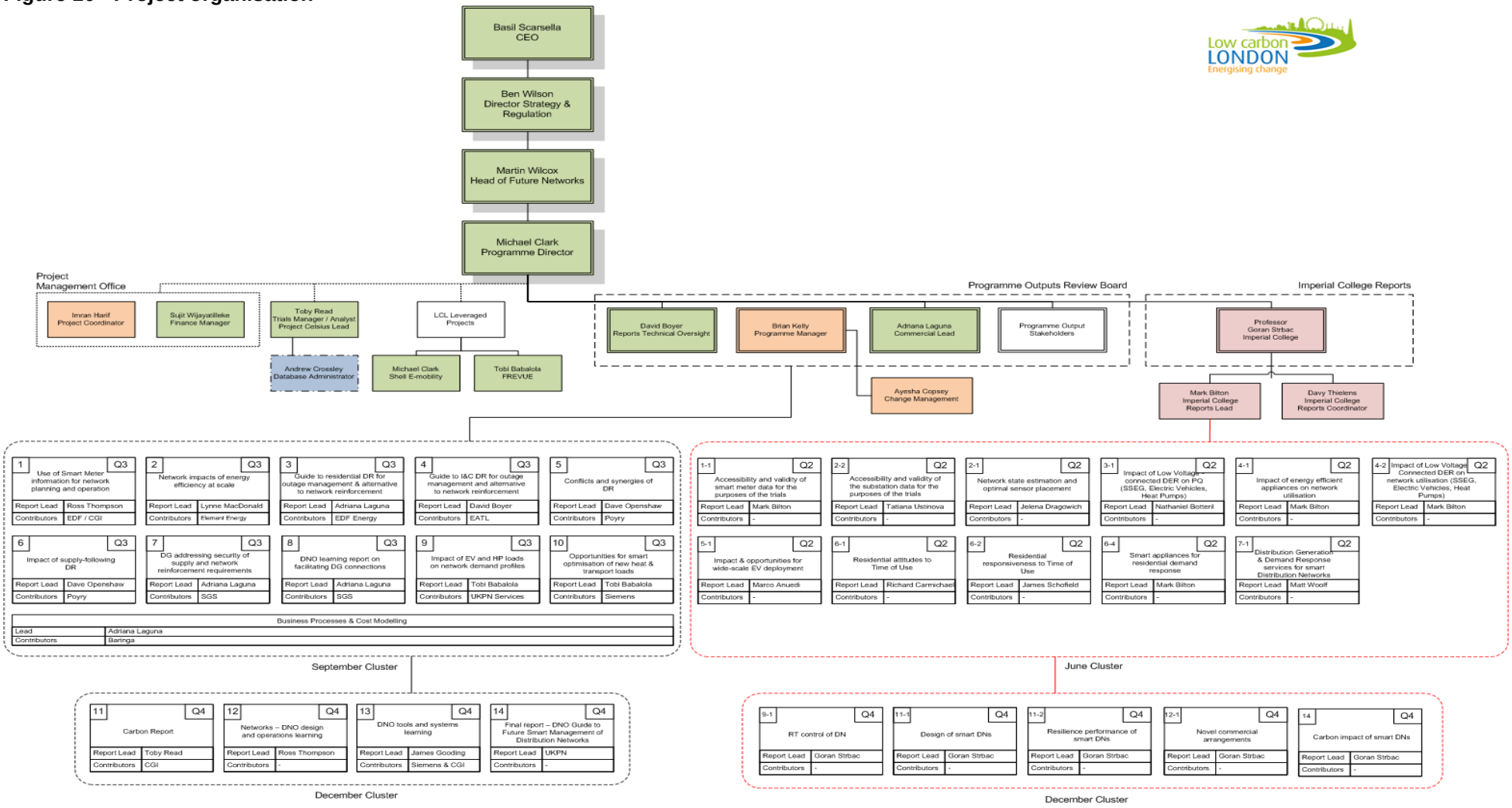
Figure 10 - Project organisation on the page following, outlines the current organisation based on those priorities.

Figure 9 - LCL Logical IT Architecture



* Tyco LV RTUs were never fitted but have had no impact on project outcomes

Figure 10 - Project organisation



1.9 Project external revenue stream

In January 2014, it was formally announced by Ofgem that Low Carbon London had reached agreement with Shell International Petroleum Group, for two artefacts created within the Low Carbon London project to be used in a separate project being led by UK Power Networks, involving Shell and others. The two project components are the ODS and the ANM system. An access fee of £420,000 has been paid by Shell for the use of these artefacts within the other project.

UK Power Networks has agreed that the entire fee should be paid back to customers and has not claimed for any costs incurred during the establishment and negotiation of the access fee. This represents an important milestone, being the first LCNF project to attract additional revenues.

1.10 Outlook for next period

The project has clear priorities for the next and final period of the project:

a) Recovery of data and reliable future operation of the substation monitors within the Engineering Instrumentation Zone, in order to complete gathering trial data;

b) Delivery of final reports:

   I. A set of reports to be delivered by 30 September 2014;
   II. The project's summary reports to be delivered by 31 December 2014; and
   III. Project closedown report to be delivered by 31 March 2015.

c) Decommissioning of trial equipment:

   Ramp up of activities to remove trial equipment where prudent to do so. In some cases, equipment will be left in situ and data continued to be collected for the foreseeable future. The continued use of the ODS in other projects (see 1.8 above) allows for datasets to be continued to be enriched through additional data to be collected.

d) Learning dissemination – these activities are set out in section six below;

e) Closedown of the project's remaining fully-active ANM trial with Greenwich Power Station; and

f) Preparation of the project's formal closedown report for Ofgem.

2 Business case update

Through the I&C DSR trials, the project has already delivered the committed savings of £1.8m of deferred network reinforcement, specifically delivered through the DSR trial involving Ebury Bridge substation. The success of the DSR trials has also enabled UK Power Networks to commit to a total of £43.4m of savings in its published re-submitted business plan for the RIIO-ED1 period 2015-2023, with £13.9m of that total delivered directly through savings within the London Power Networks' network.

As detailed in section 1.8 above, the project has also attracted additional benefit of £420,000 through revenues accrued to the project by access fees paid by Shell for use of some of its artefacts in another project led by UK Power Networks. These have been paid back to customers in this financial year.

The carbon impacts and benefits of the trials are analysed and reported through the custom-built carbon tool, with Appendix Two illustrating an example report using real trial data.

Indirect benefits are built around use case learning points, which have been disseminated throughout the project via the various learning events organised. No formal learning events were held during this reporting period, however the project continues to disseminate its learning through magazine and national newspaper articles.

3 Progress against budget

The project is on track to meet all its commitments and SDRCs on schedule and within budget. Details of the project finances are contained in the confidential annexe.

4 Bank account

This section is contained in the confidential annexe.

5 SDRC

There are no SDRCs scheduled for delivery during this reporting period.

The project will internally collate a set of 11 final reports by 30 June 2014, which act as SDRC evidence artefacts due for delivery on 30 September 2014. All these are on track to be delivered on time, and comprise of the following reports:

- 1-1 Accessibility and validity of smart meter data;
- 2-1 Network state estimation and optimal sensor placement;
- 2-2 Accessibility and validity of substation sensor data;
- 3-1 Impact of LV connected DER on power quality;
- 4-1 Impact of energy efficient appliances on network utilisation;
- 4-2 Impact of LV DERs on network utilisation;
- 5-1 Impact of opportunities for wide-scale electric vehicle deployment;
- 6-1 Residential consumer attitudes to time varying pricing;
- 6-2 Residential consumer responsiveness to time varying pricing;
- 6-4 Smart appliances for residential demand response; and
- 7-1 Opportunities for DG in the distribution network.

The remaining SDRC for the project are all reports and due for delivery in two tranches; one set of reports will be delivered by 30 September 2014 and the further set of reports will be delivered by 31 December 2014.

Appendix One details the complete list of SDRCs and the status of each one.

The September and December reports are a collaborative effort between the project partners, UK Power Networks, and expert consultancy where required. All reports had a brief and detailed content list agreed early February and individuals were appointed to lead delivery of each report by the end of April. As discussed, one of these reports is linked to activities to recover data from the substation monitors in the Engineering Instrumentation Zones.

6 Learning outcomes

The project is strongly committed to the effective dissemination of the learning accumulated during the project. The portfolio of final reports to be delivered in 2014 will represent a significant body of learning available to other DNOs and other interested parties and will cover both in-depth

academic analyses of the trials by the reports produced by Imperial College as well as practical guidance and insights for DNOs in the set of reports delivered by UK Power Networks.

In addition, the project although not conducting any formal learning dissemination events in this reporting period, continues to present at conferences and attract attention from around the world. The learning and dissemination plans to the DNOs and wider public during the second half of 2014 are currently being finalised.

6.1 Learning outcomes this period

The learning outcomes arising during this reporting period reflect the project activities undertaken and the focus on the closedown of project trials and production and delivery of the portfolio of final reports.

6.1.1 Data loss from LV substation monitors

Within the reporting period, analysis of substation data has identified a significant amount of data loss from the LV substation monitors (EMS Sub.net LV). The root cause has been identified as the use of data communication solutions which used data transmission paths based upon the UK Power Networks corporate IT network rather than the UK Power Networks SCADA network to transmit data, due to the SCADA network being under lock-down during the 2012 Olympic period.

To mitigate this, sites are being regularly visited to manually recover and download data from RTUs and address data gaps where possible. In addition, alternative communication solutions are also being put in place where needed in order to ensure reliable data capture for the next three months.

6.1.2 Removal of residential trial equipment

The removal of trial monitoring equipment is proving to be challenging in some instances where those participants have valued the equipment installed and are appearing to be reluctant to allow the equipment to be decommissioned. The project is continuing to work with the equipment decommissioning team and UK Power Networks' legal team to ensure the enduring situation is acceptable to all parties. The decommissioning process of any equipment installed in any residential premises needs to be articulated clearly as part of the sign-up process to avoid any subsequent misunderstandings.

6.1.3 Wind twinning trial

The I&C wind twinning trial undertaken with Flexitricity demonstrates a significant proof of concept that establishes the ability to contribute to the mitigation in the variability of wind generation through I&C demand response contracts. The trial established a fully-automated DSR process driven by alerts from Elexon's Balancing Mechanism Reporting System (BMRS).

6.1.4 Regulated EV charging trial

The trial to regulate EV charging with public charge posts has to date been carried out with no complaints received from members of the public using the charge posts during peak times (when the regulation regime is enacted), reinforcing the design principle that the regulation impact is imperceptible to the end user. The trial uses technology that enables regulation of the EV charge cycle with no degradation in charging times or impact on the overall charging experience from the user's perspective.

6.2 Learning dissemination

The project maintains a comprehensive register of learning outcome artefacts, built up as part of the project's routine learning dissemination activities. Table Three below details the learning outcome artefacts to date.

Output	Title	Comments
Paper	CIRED'14	March 2014
Paper	Network Benefits of Energy Efficient Lighting - *22nd International Conference on Electricity Distribution Stockholm*,	June 2013
Paper	Application of demand Side Response and Energy Storage to Enhance the Utilisation of the Existing Distribution Network Capacity - *22nd International Conference on Electricity Distribution Stockholm*,	June 2013
Report	Distribution Network Impact of Electric Vehicles	December 2012
Report	200028-ANM3-06A HMI Specification	November 2013
Report	200028-ANM3-07A Demand Response Notification Interface Specification	April 2014
Report	ANMDR Winter Trials - Bankside C and Lithos Road Analysis	November 2013
Report	200028-LIC-05B Security of Supply Trials Local Interface Controller Specification	November 2013
Report	200028-ANM1-07B ANM Drop 1 Bankside C Demand Response	August 2013
Report	200028-ANM1-08A ANM Drop 1 Moreton St Demand Response Analysis Report	January 2013
Report	200028-ANM1-09A ANM Drop 1 Bankside C Threshold Analysis Report	November 2013
Report	200028-ANM1-04B Drop 1 FDS as built	January 2014
Report	200028-ANM1-05B Drop 1 Site Acceptance Test Specification SCAN	January 2014
Report	200028-ANM2-02A ANM Drop 2 Moreton Street Demand Response	January 2014
Report	200028-ANM2-04B Drop 2 FDS as built	January 2014
Report	200028-ANM2-05B Drop 2 Site Acceptance Test Specification SCAN	January 2014
Report	200028-ANM2-06A Drop2 Lithos Road Demand Response Analysis Report	November 2013
Report	200028-ANM4-04B Drop 4 FDS as built	October 2013
Report	200028-ANM4-05B SAT Issue	October 2013
Report	200028-ANM4-06A Drop 4 Carbon Sync Integration Specification	July 2013
Report	200028-ANM4-06B Drop 4 Carbon Sync Integration Specification	August 2013
Report	200028-ANM4-07A Test Evidence	October 2013
Report	Data requirements briefing for power quality report	October 2013
Presentation	Learning Lab objectives and infrastructure	September 2011
Presentation	Understanding Consumer Behaviour, presentation for Low Carbon London Learning Laboratory Launch	October 2011
Presentation	Bottom-up modelling for application to Low Carbon London (Ofgem visit)	March 2012
Presentation	Learning Lab progress update	March 2012
Presentation	Low Carbon London - Project Update, Presentation for Ofgem	March 2012
Presentation	Understanding the Consumer - Residential ToU Trial	June 2012
Presentation	Learning Lab infrastructure and analysis	July 2012
Presentation	Network benefits of energy efficient lighting	February 2013
Presentation	Low Carbon London Dynamic time-of-use Tariff Trial	April 2013
Presentation	Dynamic Time-of-Use tariff trial (ToU learning event)	May 2013
Presentation	Learning lab workflow and tool requirements	July 2013
Presentation	Low Carbon London / Preparing Smart Grids – Arup event, London	October 2013
Presentation	Consumer engagement & the LCL Residential Dynamic Pricing Trial	November 2013
Presentation	Consumer acceptance, engagement and responsiveness on the UK's	April 2014

Output	Title	Comments
	first trial of a dynamic time-of-use tariff for residential electricity - Norwegian University of Science and Technology, Trondheim, Norway	
Document	Research Aims by Report	October 2011
Document	Briefing document on issues for SM/ToU trial design and recruitment	December 2011
Document	Control Group and Pre-treatment measure	January 2012
Document	Metadata requirements	May 2012
Document	Monthly dToU feedback design	July 2012
Document	*d*ToU notification strategy	August 2012
Document	Ofgem change request appendices one and two	October 2012
Document	Briefing document for Smart Meter trial design	December 2012
Document	ToU interview Discussion Guide	February 2013
Document	*d*ToU Control Group Exclusions	July 2013
Document	Planning Analyses of DSR and Savings	July 2013
Survey	Smart meter / dToU Household appliance survey	April 2013
Survey	dToU closing survey	November 2013

Table 3 - learning dissemination outputs

As mentioned above, the project is planning to investigate the feasibility of developing a knowledge access tool to facilitate search and location of themed report content across the portfolio of reports.

The project's original learning dissemination framework still drives the project's approach and is set out in Figure 11 below.

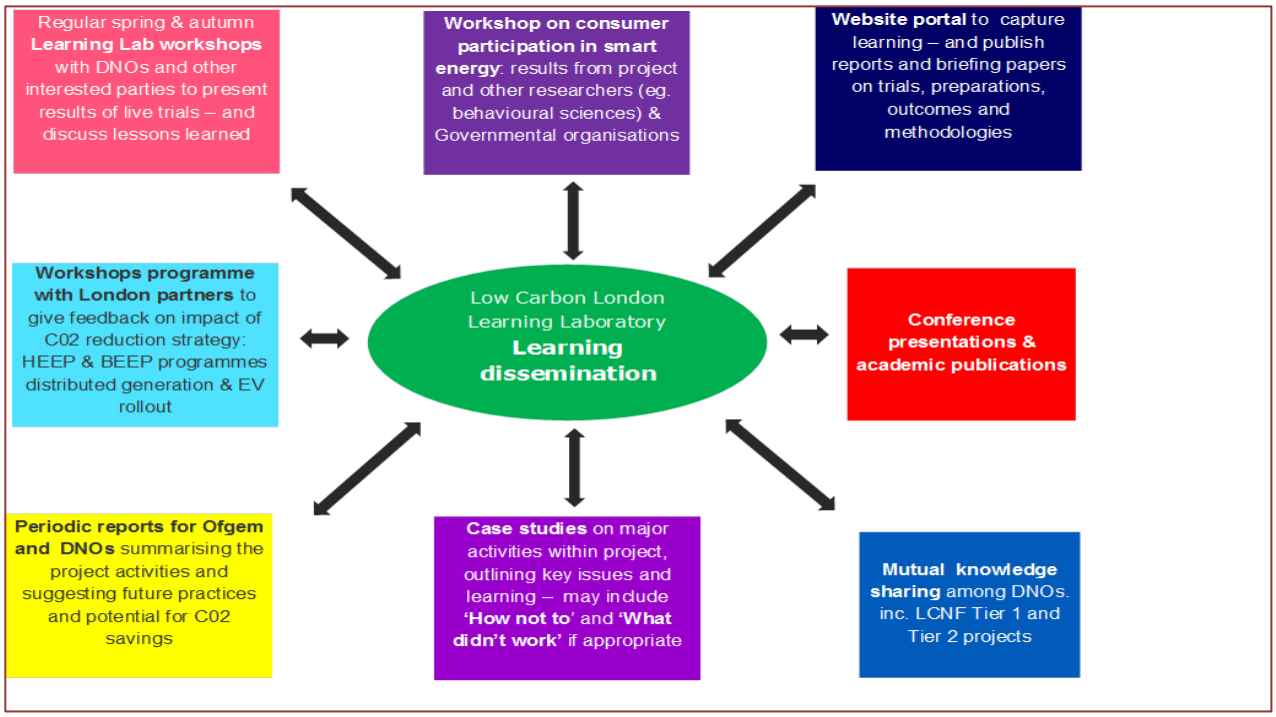


Figure 11 - LCL learning dissemination framework

7 IPR

The project maintains a register of prospective candidates that may contain foreground IPR. The register is reviewed on a quarterly basis. Partners copyright potential artefacts to protect IPR emerging from the project. The IPR register will be finalised as part of the project closedown process in late 2014 and early 2015.

The current list of prospective candidates is included in the confidential annexe.

8 Risk management

LCL identified a number of key risks to the delivery of the project as part of its original full submission. The subsequent amendment request and revised full submission identified further key risks that had arisen since the original full submission. All these risks are detailed below, together with additional current key risks the project is mitigating. As previously mentioned, one new risk related to data loss from the LV substation monitors (EMS Sub.net LV) is being actively managed and mitigated as described 6.1.1 above.

The project maintains a comprehensive risk register and regularly reviews all risks as part of the routine project management framework. Risk status is reported in both weekly and monthly cycles, with the status of key risks reported to the project steering group on a regular basis.

Risk	Category / Owner	Impact/ Probability	Mitigation
INDUSTRIAL & COMMERCIAL			
Demand response – unable to recruit sufficient demand of the required type (*previously identified in original full submission*).	Recruitment DNO	High Medium	1. Business proposition positioned in the market-place to be attractive to existing National Grid STOR providers. 2. Additional aggregators brought in to fill gaps. **Closed – summer and winter 2013 trials have a wide range of generation types and demand**
DISTRIBUTED GENERATION			
Insufficient levels of distributed generation available *(previously identified in original full submission and highlighted in formal Ofgem-approved change request December 2012.)*	Recruitment DNO	High High	1. Detailed market research undertaken with prospective participants. 2. Incentives offered to participate. 3. Innovative ANM solutions developed to expand potential trial participants. 4. ANM-triggering DSR trial undertaken. 5. Regulated EV charging trial with POD Point and Smarter Grid Solutions underway. 6. Three prospects (Greenwich Power, Bunhill Energy centre and City of Westminster College) being progressed with a view to full ANM trial participation. **Closed - Greenwich Power Station have agreed a contract to participate as a fully-active ANM trial participant, starting in June 2014.**
SMART METERS			
May not be sufficient energy efficiency measures in place in the smart meter locations *(previously identified in original full submission)*	Recruitment DNO	Medium Medium	1. Develop detailed energy appliance survey to determine exact measures in place with trial participants. 2. Supplement with external data and known trends. **Closed – surveys completed, external information on trends collected for analysis**

Risk	Category / Owner	Impact/ Probability	Mitigation
Installation issues relating to the installation of smart meters: a) site accessibility b) functionality c) data confidentiality *(previously identified in original full submission)*	Recruitment DNO	Medium High	**Closed – Smart Meter installs complete. Roaming SIM cards used, inaccessible locations dropped from trial. See data security risk below for mitigations with respect to data confidentiality.**
Take up of ToU tariffs may be low *(previously identified in original full submission)*	Recruitment DNO	Medium High	1. Provide incentives to participate and operate a safety net to ensure no customer is worse off when compared to what they would have paid on their current tariff. **Closed – trial has recruited sufficient numbers and with the required demographic spread to meet required statistical confidence levels.**
Poor SIM-card reception is smart meters *(identified in amended full submission)*	Recruitment DNO	Medium High	1. Use roaming SIM-cards to maximise telecommunications provider coverage **Closed – trial has successfully used roaming SIM cards and learning fed into national rollout planning**
Mayor's Low Carbon Zones represent a skewed demographic London, inhibiting potential extrapolation of findings to London and GB-wide levels of analysis *(identified in amended full submission)*	Recruitment DNO	High High	**Closed – Imperial College confirmed that the Smart Meter roll-out met its demographic spread targets**
Unavailability of a SMETS-2 meter (*previously identified risk in amended full submission*)	Procurement DNO	High High	**Closed – Smart Metering installs complete, and used the various technical work-around mitigations discussed in previous 6-monthly reports.**
ELECTRIC VEHICLES			
Insufficient numbers of electric vehicles *(previously identified in original full submission)*	Recruitment DNO	High High	1. Offer incentives (e.g. free EV charging post) and discounted EV leasing schemes to attract participants. **Closed – project has recruited sufficient numbers of EV users**
The project is unable to add monitoring software to electric vehicle charging posts or control the use of the posts *(previously identified in original full submission).*	Installation DNO	Medium Medium	1. Residential EV charging posts are being instrumented with smart meters in-line with the dedicated EV charging post spur. 2. A number of EDF Energy "eco 20:20" EV owners have EDMI smart meters fitted to their residential EV charge post spur. **Closed – EDMI MK7A smart meters have been installed. Data loggers installed on leased Nissan LEAFS.**

Risk	Category / Owner	Impact/ Probability	Mitigation
The majority of charging posts are privately owned and cannot be monitored *(previously identified in original full submission).*	Other DNO	Medium Medium	**Closed – The project has gained access to sufficient charge post data, as set out in Section 2.2.3.2. On-going monitoring takes place to ensure data continues to flow into the database (ODS) from these.**
Data security – requirements on 3rd party access to personal data (*previously identified risk in amended full submission*).	Other DNO	High High	1. Undertake data privacy impact assessment. 2. Establish data privacy governance framework. 3. Establish data privacy steering group. 4. Monitor all data access regularly to ensure compliance. 5. Work with partners' IT Security teams to ensure required data security measures are enacted and fit for purpose. 6. Data catalogue developed to documents all data sources, formats and storage arrangements 7. Protocol agreed to halt data collection for customers who elect to leave the trial. 8. Anonymise data where possible.
EIZ exit point instrumentation will all be in place by the end of Q2 2013 *(new risk not previously identified in original or amended full submissions)*	Other DNO	Medium High	1. Potential sites identified in all three EIZ. 2. Prices obtained for installation from Skanska to determine how many can be budgeted. 3. Prices obtained for feeder pillars and three phase meters, orders to be placed once Skanska price known. 4. Installations sites to be selected and prioritised. 5. Installation delayed due to wider Skanska parent contract negotiations, now in place. 6. Installation underway, forecast to complete in January 2014. **Closed – 106 devices installed and commissioned by March 2014. Data being routinely collected in ODS.**
Installation of measurement equipment in LV substations may require derogations (*previously identified in original full submission).*	Installation DNO	Medium Low	1. No derogations required to date, nor expected in the future. **Closed – all LV substation monitoring installed without derogations.**
The collaborative nature of the project may lead to an infringement of the Competition Act (*previously identified in original full submission).*	Other DNO	High Low	1. The project works closely with UK Power Networks procurement to ensure no potential infringements 2. The project issued a formal invitation for expressions of interest to the demand response market-place when considering additional aggregators. 3. Briefings given to project team members on Competition Act requirements **Closed – all project contractual arrangements complete**

Risk	Category / Owner	Impact/ Probability	Mitigation
A partner may withdraw from the project (*previously identified in original full submission).*	Other DNO	High Low	1. All delivery partners have signed collaboration agreements, enabling partners signatures are being finalised. 2. No partner has withdrawn to date and none are expected to withdraw. 3. All partners represented on project steering group and quarterly project partners meeting with UK Power Networks Chief Executive Officer to ensure engagement and pro-active management of any emerging issues.

Risk controls assurance

The project assures the effectiveness of the controls in place to manage risks through two key processes. Regular risk management workshops are held, as a minimum on a quarterly basis, where the existing risks held on the risk register are all individually reviewed in detail. In addition, any new risks identified are proposed and reviewed at the workshop, for inclusion on the register, together with an owner and initial impact/probability assessment. The owner of the risk subsequently undertakes a full impact assessment and detailed mitigation, updating the risk register accordingly.

On a more regular basis, the status of existing risks is updated on a monthly basis through the reporting framework together. This is supplemented by a weekly review of key risks as part of the weekly project review meeting.

The effectiveness of the risk controls in place is managed through the Project Management Office providing an oversight analysis of risk status, highlighting those risks where the mitigation is not improving the risk status over time (i.e. ineffective mitigation). In addition, key risks are reported to the bi-monthly project steering group, where steering group members are encouraged to actively challenge the effectiveness of risk controls in place.

Learning from risk mitigation activities is captured as part of the project's workstream learning logs.

9 Consistency with full submission

The project is working to the full submission that was amended by the change request approved by Ofgem in December 2012. Following approval of the change request by Ofgem the project undertook detailed configuration reviews to ensure all aspects of the project were consistent with the amended full submission. This work was completed in January 2013 and continues to be monitored on a regular basis through the workings of the project's solution design authority and change management process.

Figure 12 below illustrates the current project scope which is fully compliant and consistent with the full submission.

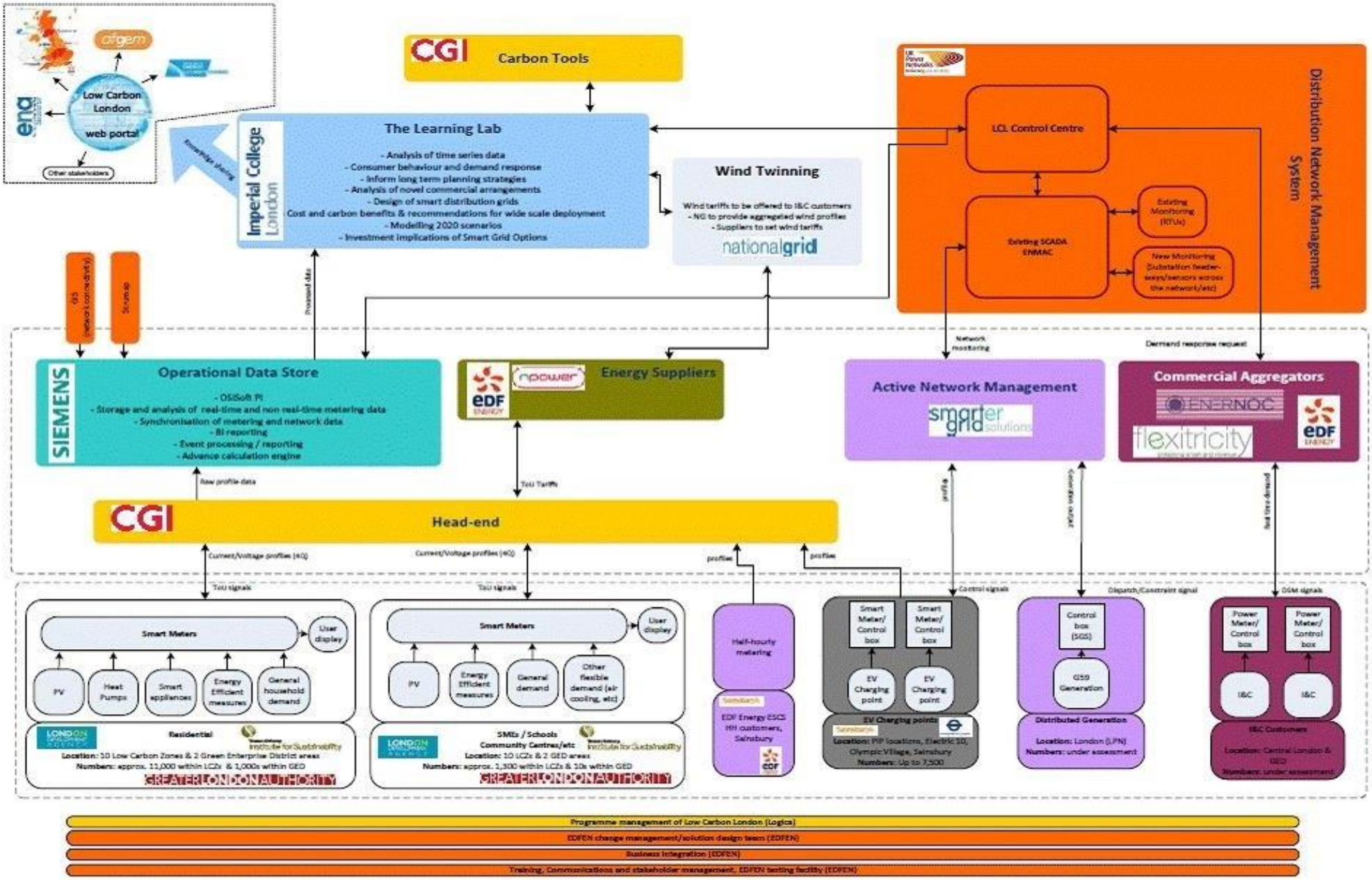


Figure 12 - Project scope

10. Other

There are no other items to report.

11. Accuracy assurance statement

I hereby confirm that this report represents a true, complete and accurate statement on the progress of the Low Carbon London project in its sixth six-month period and an accurate view of our understanding of the activities for the next reporting period. A robust process was in place to produce the report.

Signed ……

Date ……

Ben Wilson
Director of Strategy & Regulation and CFO
UK Power Networks

Appendix 1 Successful delivery reward criteria

Successful Delivery Reward criterion	Evidence

Build Phase:
 	
• Preparation of solution implementation complete: Logica smart metering Head End solution and Learning Laboratory commissioned (Appendix 2, Use Case U07.1 and U07.2)
 	
• Preparation for c.5000 smart meter roll out complete, including address selection, acceptance surveys, privacy and security measures (working with GLA and Consumer Focus)
 	
Completed Q3, 2011
	Evidence – Outputs and Learning
	
	• Demonstration of the Learning Laboratory facilities at Imperial College with documented schedule of trials
	  ○ Clear visibility of scope of work packages
	  ○ Clear alignment to Use Cases
	  ○ Clear identification of project deliverables
	
	• Results of customer smart meter acceptance surveys
	  ○ Overall quantification of acceptance
	  ○ Identification of key concerns
	  ○ Actions to improve level of acceptance
	
	• Documented Privacy and Security strategy
	  ○ Overall risk assessment
	  ○ Identification of pinch points
	  ○ Scope for risk mitigation through data aggregation
	  ○ Risk minimisation plan
	
	• Statistical analysis of smart meter trial sample size
	  ○ To ensure statistical validity for extrapolation
	  ○ Ensure samples sufficient to address variables (e.g. method of home heating / socio-economic consumer groupings / etc.)
	
	• Demonstration of initial functionality of Head End
	  ○ Ability to (two-way) communicate with smart meters
	  ○ Data volume capability proven

Successful Delivery Reward criterion	Evidence
Build Phase: • 1st stage of solution implementation complete: Operational Data Store and interface to Logica head end commissioned, smart meter installation underway and ”carbon impact tools” delivered Trial Phase: • Implementation of initial trials based on data from the initial smart meters and half hourly industrial & commercial (I&C) customer meters with analysed results **Completed Q2, 2012**	Evidence – Outputs and Learning: • Functioning Operational Date Store and head end accessing/processing smart meter information • Multipartite Demand side management (DSM) contracts between Aggregators, I&C customers, and EDF Energy Networks (documented contract implementation) • Initial CO2 impact assessments
Build Phase: • Final stage of solution implementation complete: Operational Data Store and interface to Logica head end commissioned, smart meter installation completed **Completed Q4, 2012**	Evidence – Outputs and Learning: • Functioning Operational Date Store and head end accessing/processing smart meter information ○ Proven capability to process data from head end, undertake event processing to identify key data, aggregate and map data to network nodes
Trial Phase: Conclusion of “Using Smart Meters and Substation Sensors to Facilitate Smart Grids” trials: • Understanding customer behaviour and potential network impact (Appendix 2, Use Case U04.1) • Use of smart meter information to support distribution network planning and design (Appendix 2, Use Case U04.2) • Use of smart meter data to support network operations (Appendix 2, Use Case U04.3) Due date: Q3, 2014	Evidence – Learning: • Assimilation of network voltage and load profiles from smart meter data (up to 6,500 smart meters) to validate ADMD assumptions and determine critical design criteria as a guide to the more efficient planning of LV networks (for example with regard to thermal limits, losses, power quality and voltage optimisation) Evidence – Outputs: Learning Lab reports (Q2, 2014): • 1-1 Accessibility and validity of smart meter data • 2-1 Network state estimation and optimal sensor placement • 2-2 Accessibility and validity of substation sensor data DNO learning reports (Q3, 2014): • DNO learning report on the use of smart meter information for network planning and operation
Conclusion of “Enabling and Integrating	Evidence – Learning:

Successful Delivery Reward criterion	Evidence
Distributed Generation" trials: • Facilitating connections to LV and HV distribution networks (Appendix 2, Use Case U02.1) • Active management of DG to address security of supply concerns and postpone network reinforcement (Appendix 2, Use Case U02.2) • Exploring the impact of LV, G83 connected generation Due date: Q3, 2014	• Proven capability of technical and commercial dispatch / curtailment of generation (est. 5 Active Network Management Schemes) with beneficial impact on network utilisation, voltage, load factor and/or fault level • Validation of ER P2/6 / ETR130 assumptions including Tm and F factors for specific generation technologies and applications • Guidance on successful approaches to, and value of, managing SSEG connections in order to preserve network operation and power quality while best enabling their connection Evidence – Outputs: Learning Lab Reports (Q2, 2014): • 3-1 Impact of LV connected DER on power quality • 4-2 Impact of LV DERs on network utilisation • 7-1 Opportunities for DG in the distribution network DNO learning reports (Q3, 2014): • DNO learning report for facilitating DG connections • DNO learning report for DG addressing security of supply and network reinforcement requirements

Conclusion of "Enabling Electrification of Heat and Transport" trials:
 	
• Exploring impact of electric vehicle charging (Appendix 2, Use Case U03.1)
 	
Exploring the impact of heat pump demand (Appendix 2, Use Case U03.2)
 	
Due date: Q3, 2014
	Evidence – Learning:
	
	• Evidence of real changes in load patterns due to: ()
	  ○ Heat pumps
	  ○ Electric Vehicles
	  ○ Micro-generation
	
	• Guidance on successful approaches to, and value of, smart optimisation of EV charging to minimise peak demand and losses impact (maximising load factor) and to minimise need for reinforcement (maximising utilisation)

Successful Delivery Reward criterion	Evidence
	Evidence – Outputs: Learning Lab Reports (Q2, 2014): • 3-1 Impact of LV connected DER on power quality • 5-1 Impact of opportunities for wide-scale electric vehicle deployment • 4-2 Impact of LV DERs on network utilisation DNO learning reports (Q3, 2014): • DNO learning report on the impact of EV and HP loads on network demand profiles • DNO learning report on opportunities for smart optimisation of new heat & transport loads
Conclusion of "Residential and SME Demand Side Management" trials: • Energy efficiency programmes and technologies (Appendix 2, Use Case U05.1.a) • Consumer behaviour demand response and responsiveness to TOU tariffs" trials (Appendix 2, Use Case U05.1.b) Due date: Q3, 2014	Evidence – Learning: • Quantified impact of DSM and energy efficiency measures in terms of reduced peak demand • Effectiveness of TOU tariffs and analysis of price elasticity and hence necessary level of tariff incentive to deliver effective response Evidence – Outputs: Learning Lab Reports (Q2, 2014): • 6-1 Residential consumer attitudes to time varying pricing • 6-2 Residential consumer responsiveness to time varying pricing6-4 Smart appliances for residential demand response • 4-1 Impact of energy efficient appliances on network utilisation DNO learning reports (Q3, 2014): • DNO learning report on network impacts of energy efficiency at scale • DNO guide to residential DR for outage management and as an alternative to network reinforcement

Successful Delivery Reward criterion	Evidence
Conclusion of "I&C Demand Side Management" trials: • Demand side management with I&C customers (Appendix 2, Use Case U05.2) • Demand side management conflicts and synergies (Appendix 2, Use Case U05.3) Due date: Q3, 2014	Evidence – Learning: • Real examples of DSM contracts with I&C customers covering highly utilised networks with clear benefits of peak demand shifting capability under unplanned outage conditions • Quantification of risk and benefit of using I&C DSM as an alternative to network reinforcement - as a guide to more efficient planning for network security and as an input to an expanded version of ETR 130 (for example deriving equivalent F and Tm factors) Visibility of synergies (and/or method of resolving conflicts) between NG and EDF Energy Networks requirements for responsive demand Evidence – Outputs: Learning Lab Reports (Q2, 2014): • 7-1 Distributed generation and demand response services for the smart distribution network DNO learning reports (Q3, 2014): • DNO guide to I&C DR for outage management and as an alternative to network reinforcement • Conflicts and synergies of DR • DNO impacts of supply-following DR report

Conclusion of "Wind Twinning" trials:
 	
• Wind twinning through ToU tariffs with suppliers (Appendix 2, Use Case U01.1)
 	
• Wind twinning through responsive demand contracts with commercial aggregators (Appendix 2, Use Case U01.2)
 	
Due date: Q3, 2014
	Evidence – Learning:
	
	• Identification of scope for manipulating demand (through commercial incentivisation) to follow wind output
	
	• Assessment of potential for:
	  ○ optimisation of system level real time demand to minimise CO2 emissions;
	  ○ reducing cost of system residual balancing;
	  ○ minimising requirement for generation plant margin; and
	  ○ minimising price volatility

Successful Delivery Reward criterion	Evidence
	Evidence – Outputs: Learning Lab Reports (Q2,2014): • 7-1 Distributed generation and demand response services for the smart distribution network DNO learning reports (Q3, 2014): • DNO impacts of supply-following DR report
Conclusion of final analyses: • New network design and operational practices (Appendix 2, Use Case U08) • New network planning and operational tools (Appendix 2, Use Case U06) Due date: Q4, 2014	Evidence – Learning: • Consolidation of outputs from all trials as a comprehensive guide to the future smart management of distribution networks with high penetrations of DERs and low carbon applications, including the applicability of commercial contracts and incentives to encourage smart management of demand and generation • Quantified overall CO2 savings and LCTP contributions Evidence - Outputs: Learning Lab Reports (Q4, 2014): • 11-1 Design of smart distribution networks • 11-2 Resilience performance of smart distribution networks • 12-1 Novel commercial arrangements and the smart distribution network • 14-2 Carbon impact of smart distribution networks • 14-3 Overall summary report DNO learning reports (Q4, 2014): • DNO design and operations learning report • DNO tools and systems learning report • Final Report - DNO Guide to Future Smart Management of Distribution Networks

Appendix Two – sample carbon impact report

Table of Contents

1. Introduction

Purpose

The purpose of this report is to provide commentary on the Carbon Impact of the LCL Demand Side Management trials. Data used in this report is available from the Carbon Tool.

Additional graphs, charts, tables are available through the Carbon Tool, which can be accessed by all members of the LCL team.

This report covers the period from 01/12/2013 – 31/12/2013

Previous reports are available on the Low Carbon London sharepoint site.

Queries

Any queries should be raised in the first instance directly with the carbon consultancy workstream team. If and when necessary, these queries will be escalated to the carbon consultancy IT lead or the carbon consultancy team lead for a response and resolution.

Residential Dynamic Time of Use

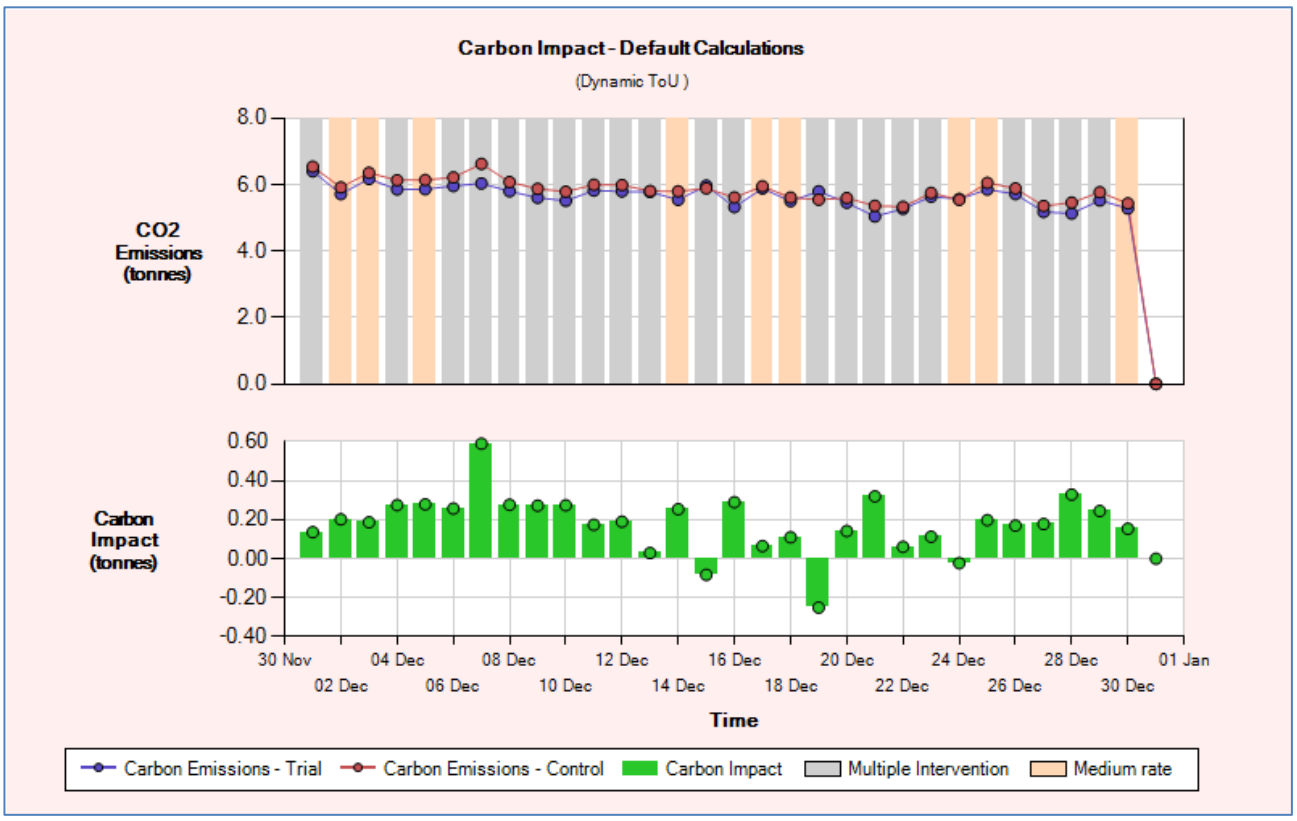
Residential Dynamic ToU: Headline figures – December 2013

	Net Carbon Impact (tonnes)	Demand Reduction (kWh)	Demand Increase (kWh)	Demand Reduction %	Demand Increase %
This Month	5.414	11,149.120	-	3.18	-
To Date	82.171	161,160.717	-	4.25	-

The headline data shows a clear difference in demand between the trial (Dynamic ToU Tariff) and Control (Static Tariff) groups. The Trial group used 3.2% less electricity on average.

Under the grid generation conditions for this month, the demand reduction led to a positive Carbon Impact (i.e. a reduction of CO2 emissions) of about five and a half tonnes.

Residential Dynamic ToU: Carbon Impact – December 2013 (Daily)

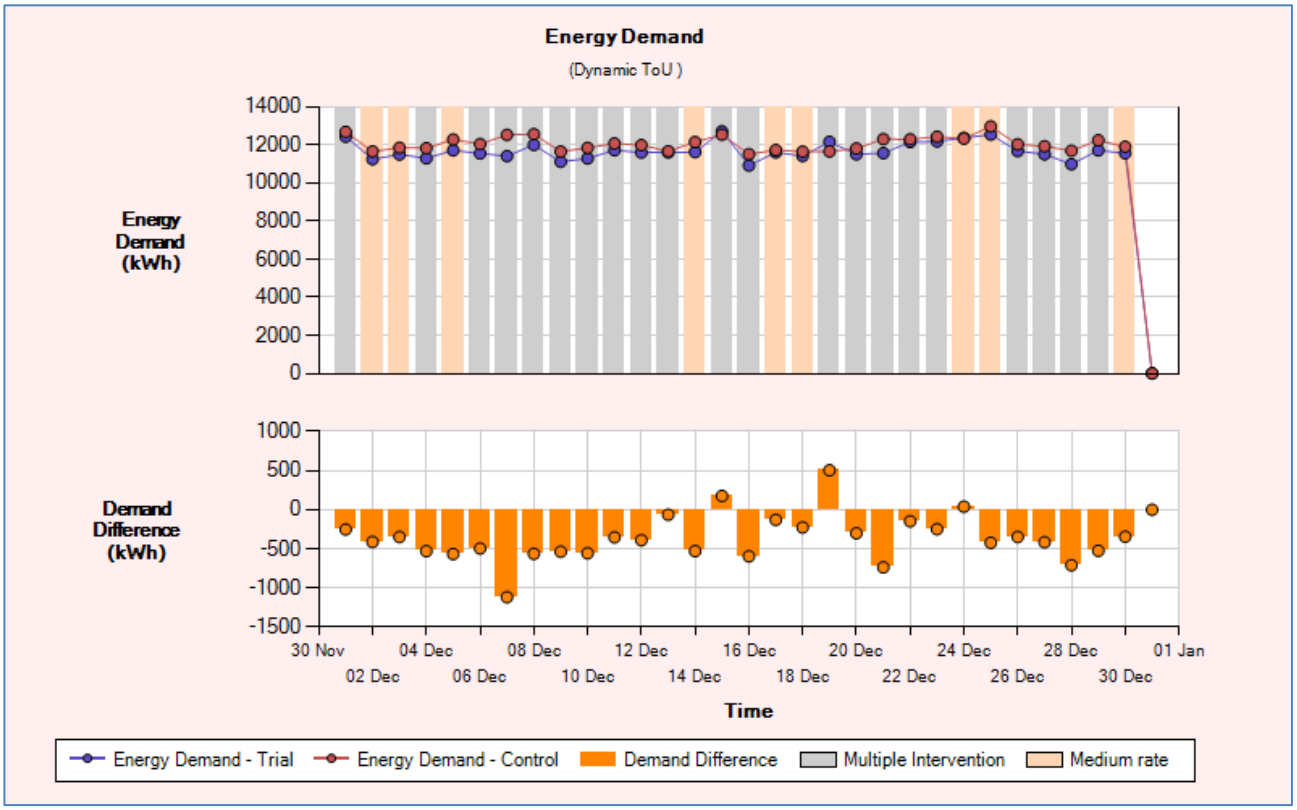


The daily graph for December shows a positive carbon impact on most days, indicating that the trial group generated less CO2 than the control group. This impact is largely due to the demand difference between the two groups as explained in the Headline data. The grey columns indicate days on which ToU tariff intervention(s) occurred. On some of these days the carbon impact was less because the Trial group was encouraged to use more electricity due to reduced rate tariffs. On other days it was higher than average because the Trial group was encouraged to curtail energy use by a High rate tariff.

A genuine demand shifting carbon impact cannot be assessed in this study because the ToU tariff bands were not related to times at which the grid generation was less or more carbon intensive – therefore the only impact measurable is due to demand reduction, not demand shifting.

The more interesting data to focus on is the energy demand because this shows how the Trial group was influenced by and responded to the ToU tariff.

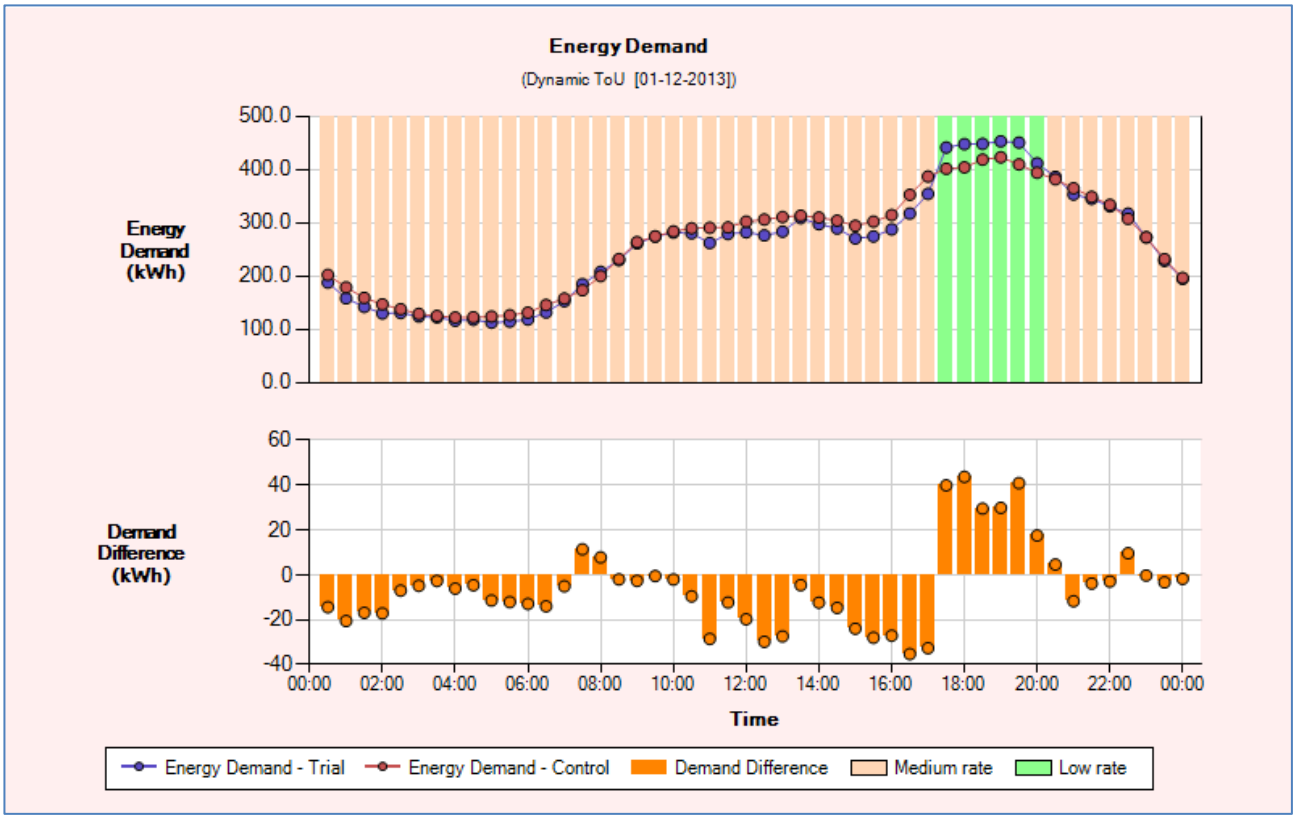
Residential Dynamic ToU: Energy Demand – December 2013 (Daily)



The daily energy demand shows an overall picture of less energy demand in the Trial group. A more detailed look at the consumption on intervention will show how the Trial group responded to the dynamic tariff.

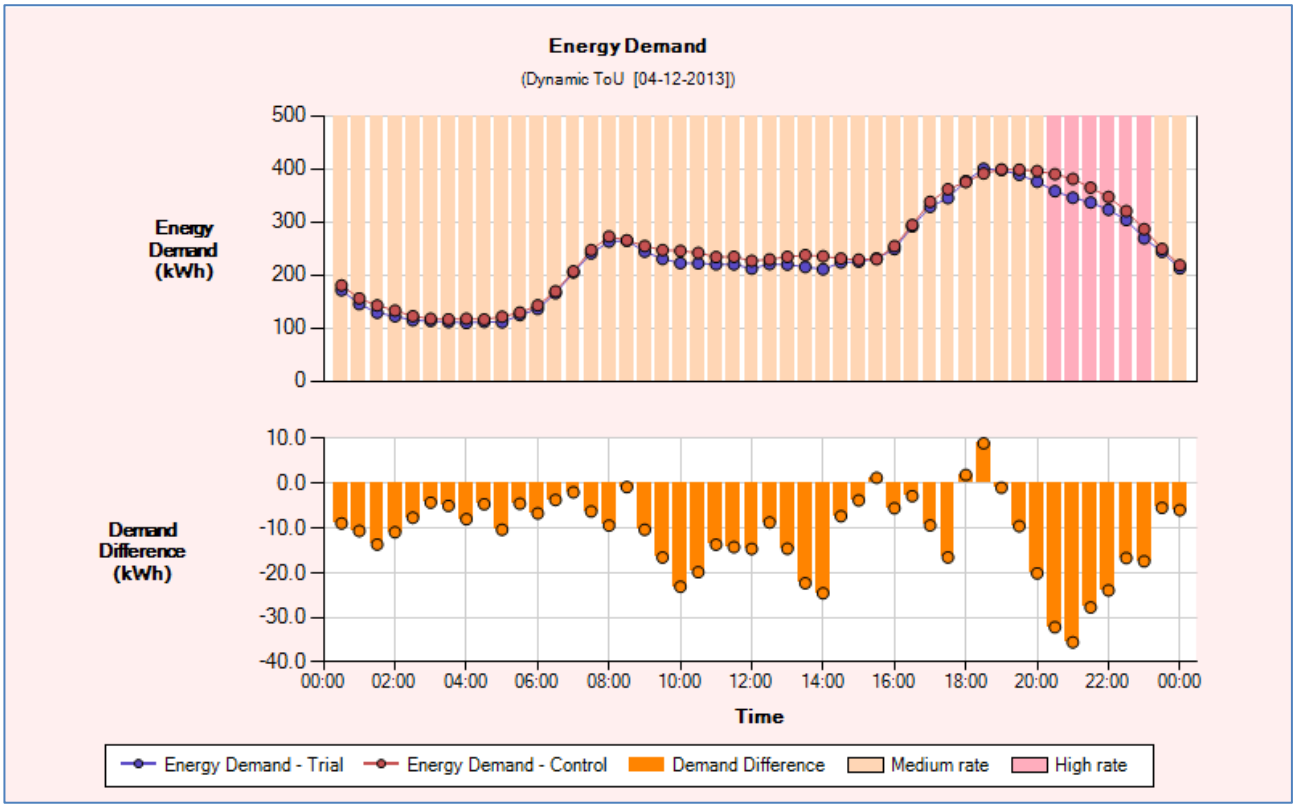
Residential Dynamic ToU: Energy Demand – December 2013

Residential Dynamic ToU: Energy Demand – 1 December 2013:



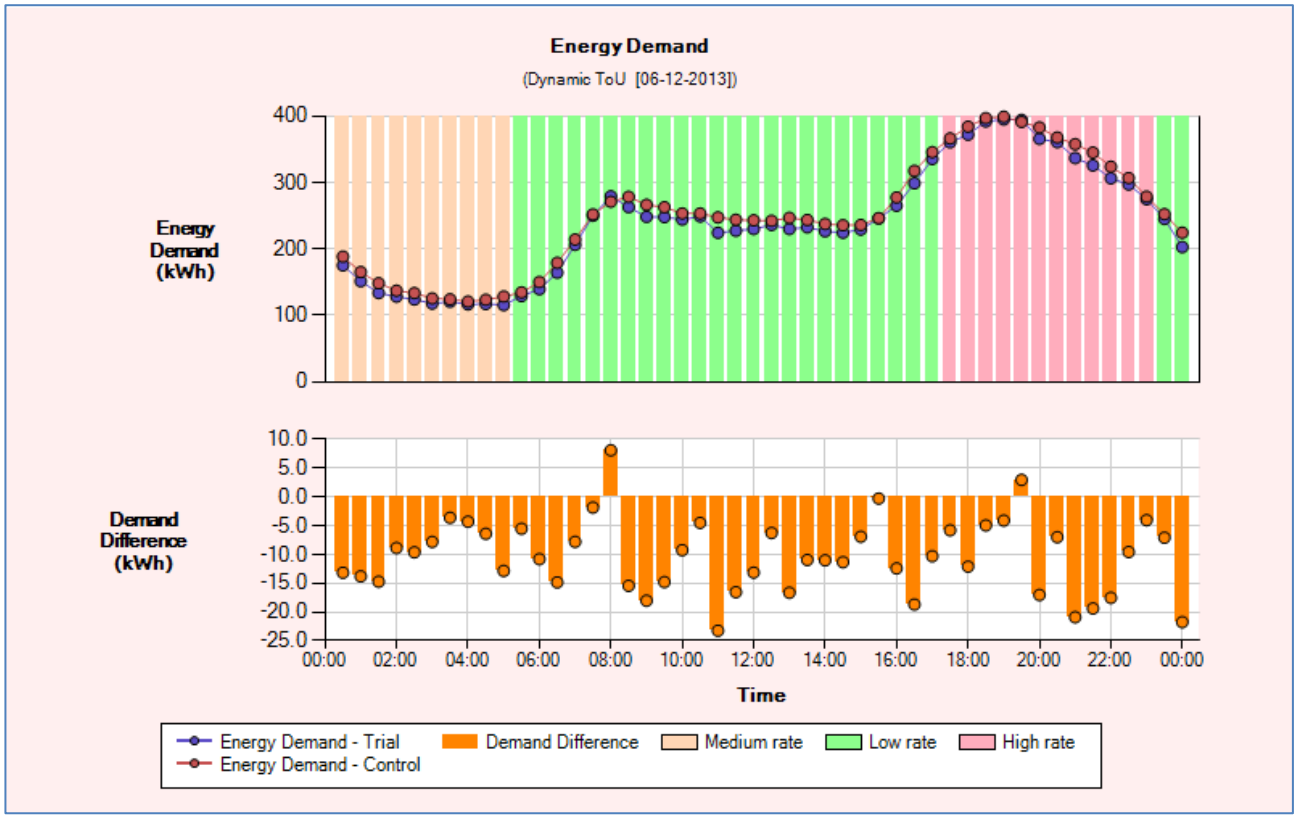
In this intervention a low rate was available between 5pm and 8pm. There appears to be a shift in energy demand in the trial group to take advantage of the low rate.

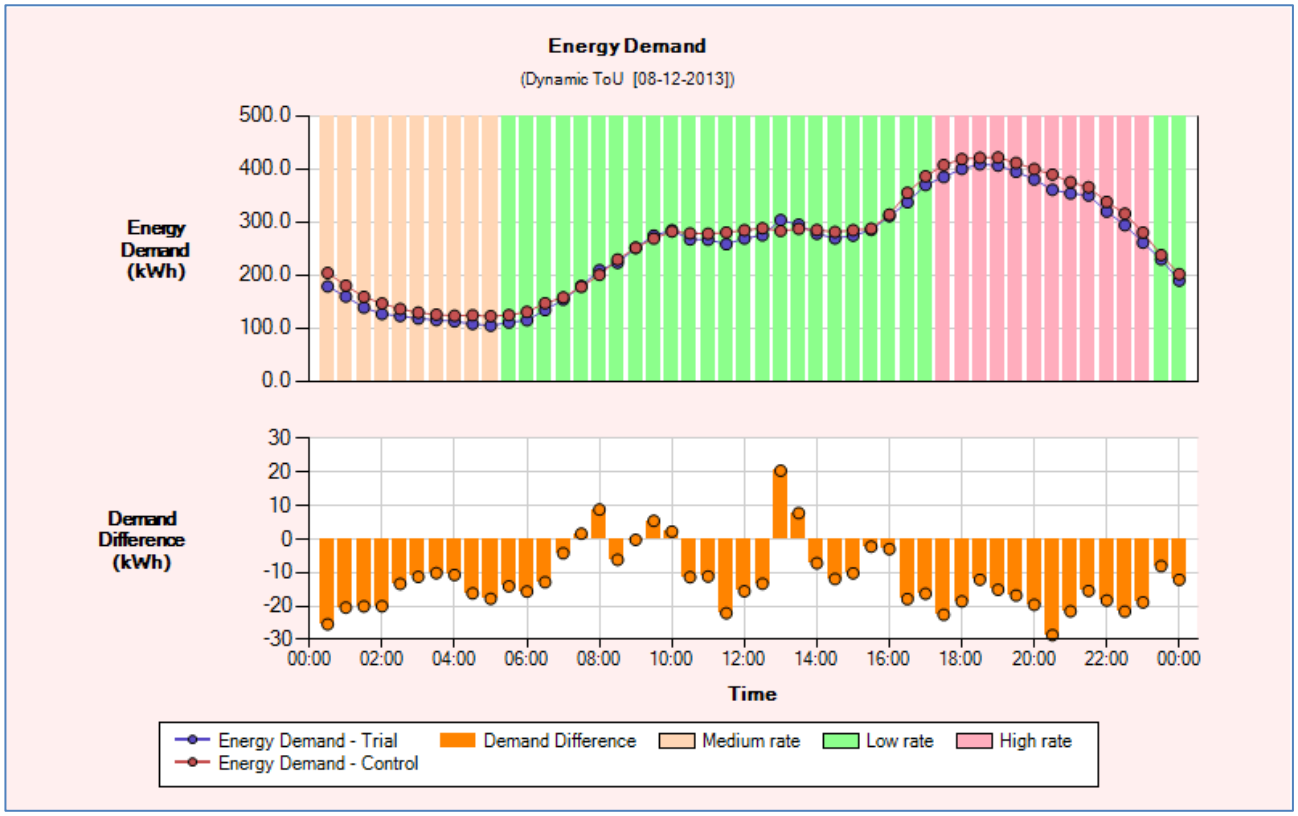
Residential Dynamic ToU: Energy Demand – 4 December 2013:



On the 4 December an evening high rate led to a relative curtailment of demand in the trial group, especially earlier in the evening.

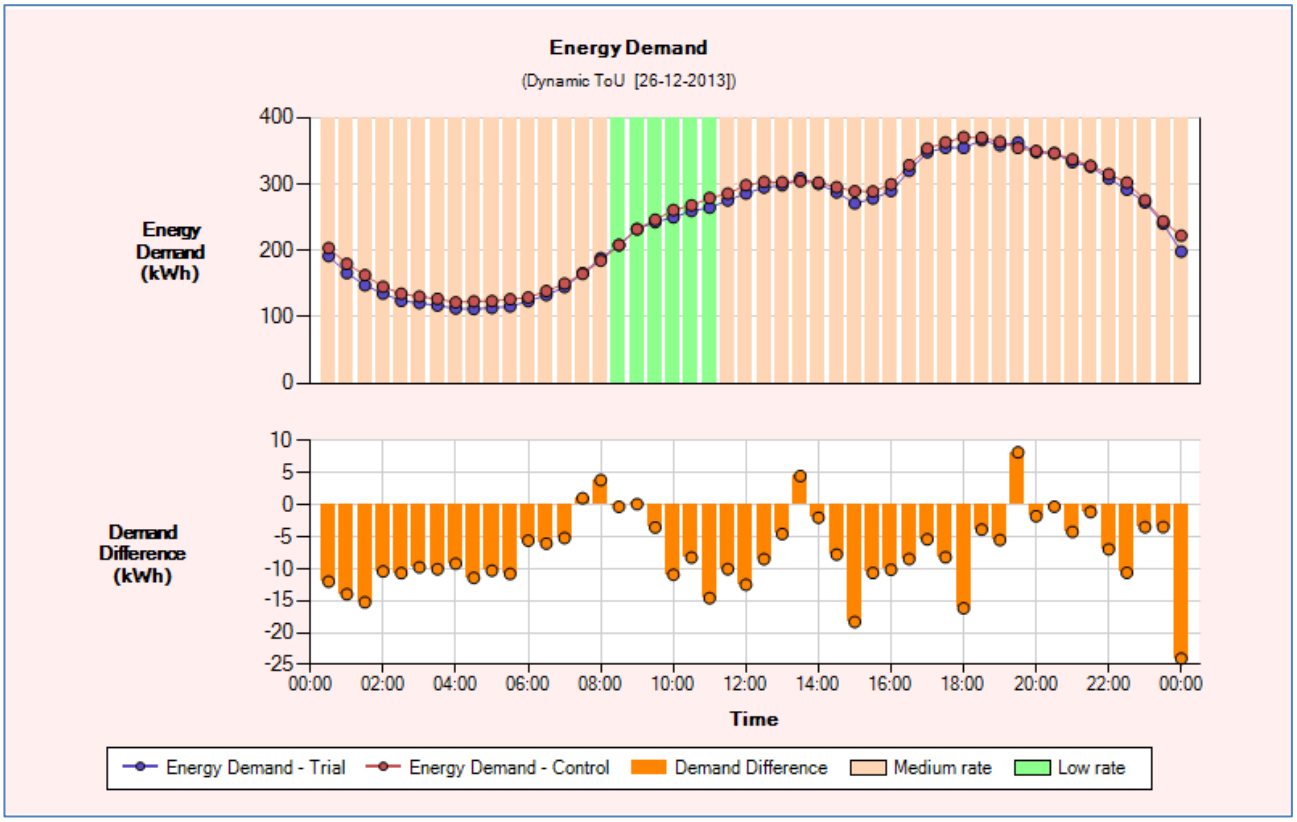
Residential Dynamic ToU: Energy Demand – 6 & 8 December 2013:





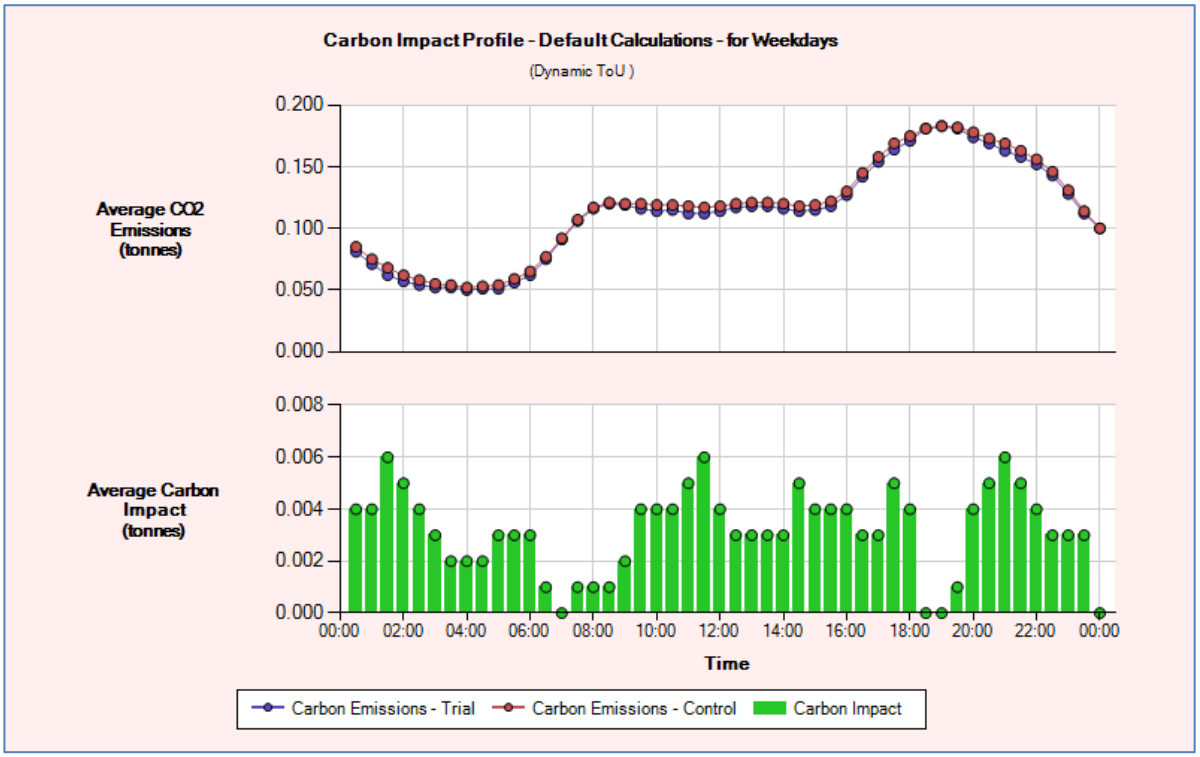
Similar periods of low and high rate tariff show different demand patters for a Friday and a Sunday.

Residential Dynamic ToU: Energy Demand – 26 December 2013:

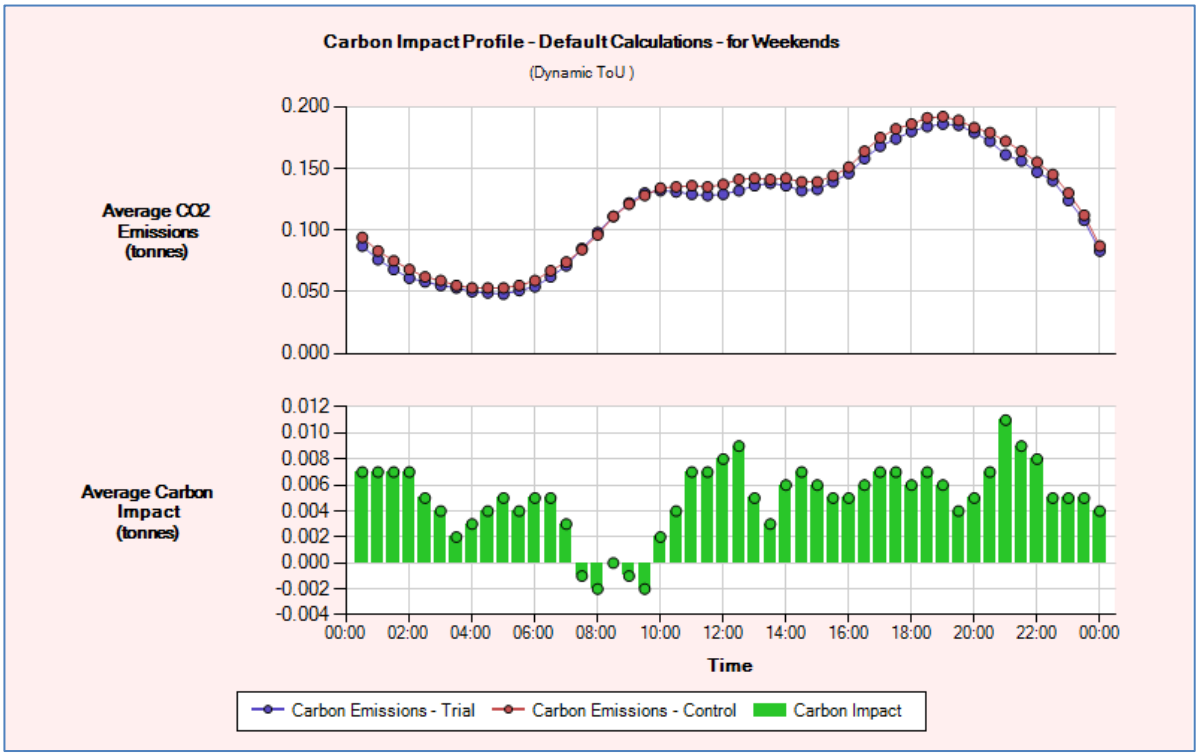


A low rate tariff on Boxing Day seems to have little impact compared with previous examples.

Residential Dynamic ToU: Carbon Impact – Weekdays December 2013

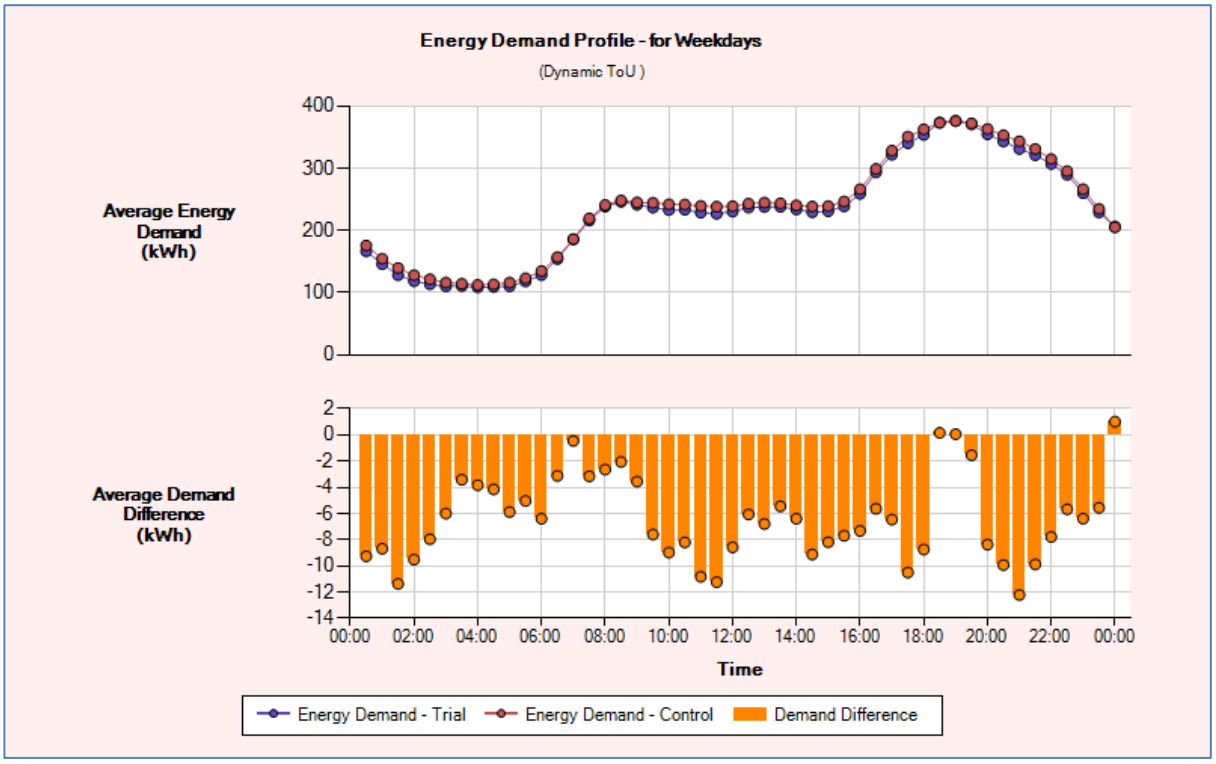


Residential Dynamic ToU: Carbon Impact – Weekends December 2013

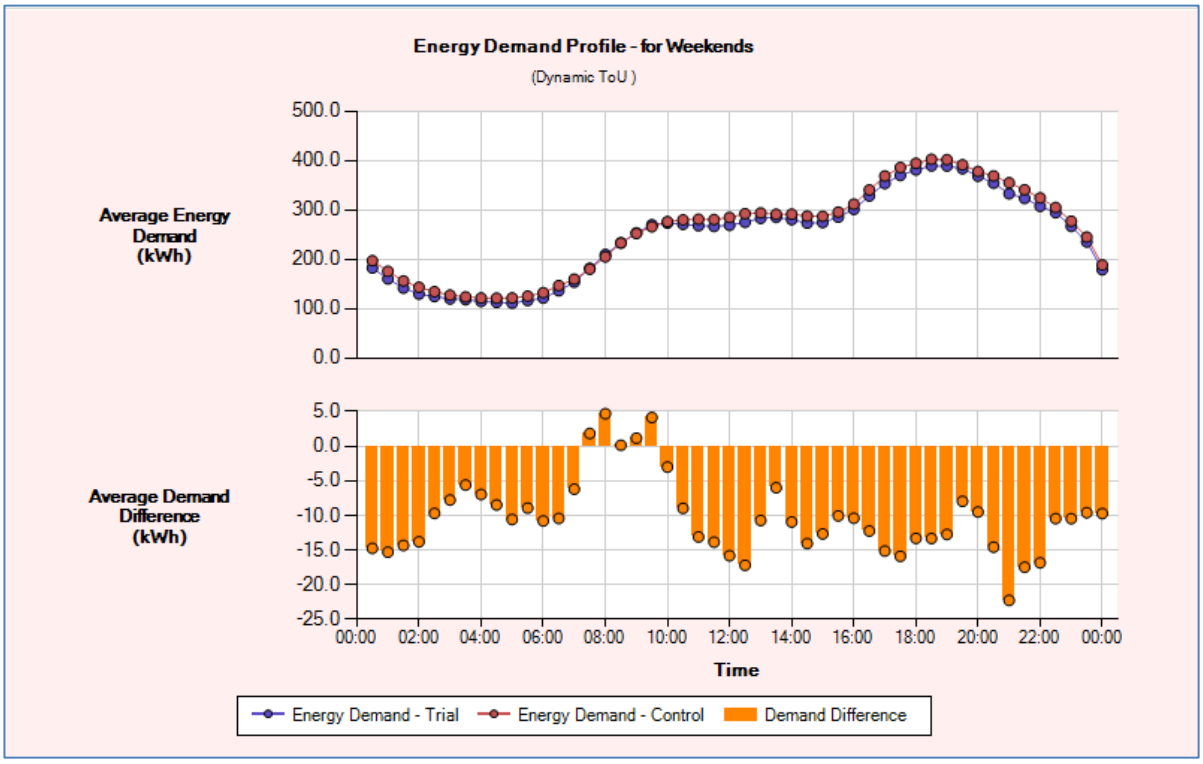


The previous two graphs show the average carbon profile for the ToU trials weekdays and weekend days in December 2013.

Residential Dynamic ToU: Energy Demand – Weekdays December 2013



Residential Dynamic ToU: Energy Demand – Weekends December 2013



Residential Dynamic ToU: Energy Demand – Weekdays & Weekends (Average):

The previous two graphs show the average demand profile for the ToU trials weekdays and weekend days in December 2013.

Assumptions and Limitations

The speculations made in this report are merely notes of points of interest in the data that may lead to areas for more detailed research. The scope of data for a month does not allow any significant conclusions to be drawn from single events, but the number of participants in the trial should mean that patterns seen here are genuine and not just data artefacts.

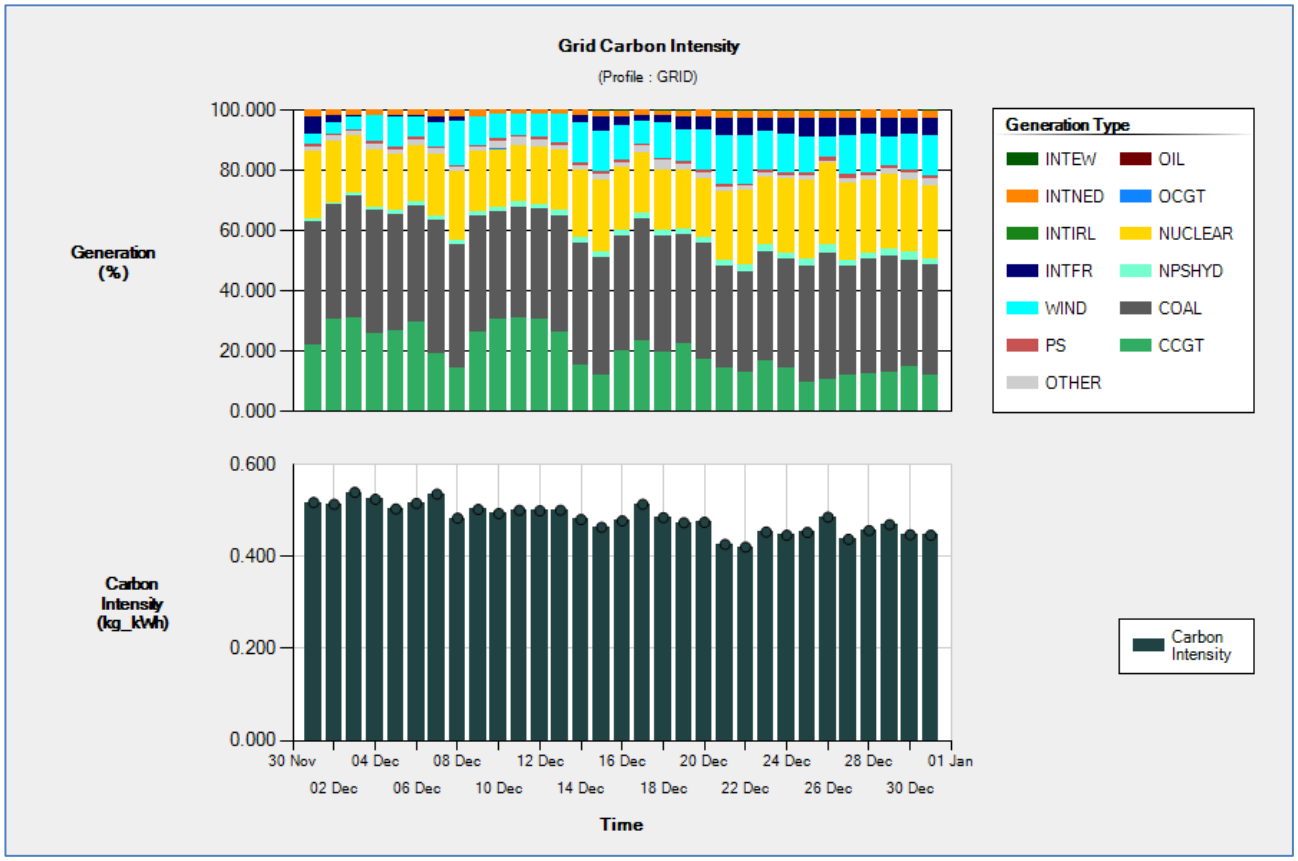
Figures are sometimes given to three decimal places. This is due only to the same accuracy being used throughout out the data gathering and calculation process. It in no way indicates that all the data is precise to this degree. There are many factors involved in the estimation of carbon impacts which mean that only the general positive and negative trends of data are significant, not individual figures.

Carbon Impact

One of the aims of a dynamic ToU tariff relating to Carbon Footprint would be to encourage users to shift demand to times where the overall grid generation was less carbon intensive.

However, this trial cannot show the carbon impact of doing this as the ToU tariff interventions do not correspond to actual times of high and low grid carbon intensity.

The actual daily grid intensity for December 2013 can be seen here:



Demand Difference

This trial is showing a significant reduction in demand in the Trial group over that of the Control group. While the data is scaled to give equivalent use for each group, the difference shown cannot be purely attributed to the effect of the ToU tariff.

There may well be an inherent selection bias in the Trial group as this group is made up of people who actively signed up for a trial whereas the control group are just normal users who did not.

End of report