FUTURE CITY • GLASGOW

ENERGY EFFICIENCY

END STAGE REPORT

Future City Glasgow

Build Phase

Energy Efficiency Demonstrator

Published Date: July 2015

Energy Efficiency End Stage Report

Future City Glasgow
Energy Efficiency
Demonstrator

Build Phase
Published Date: July 2015

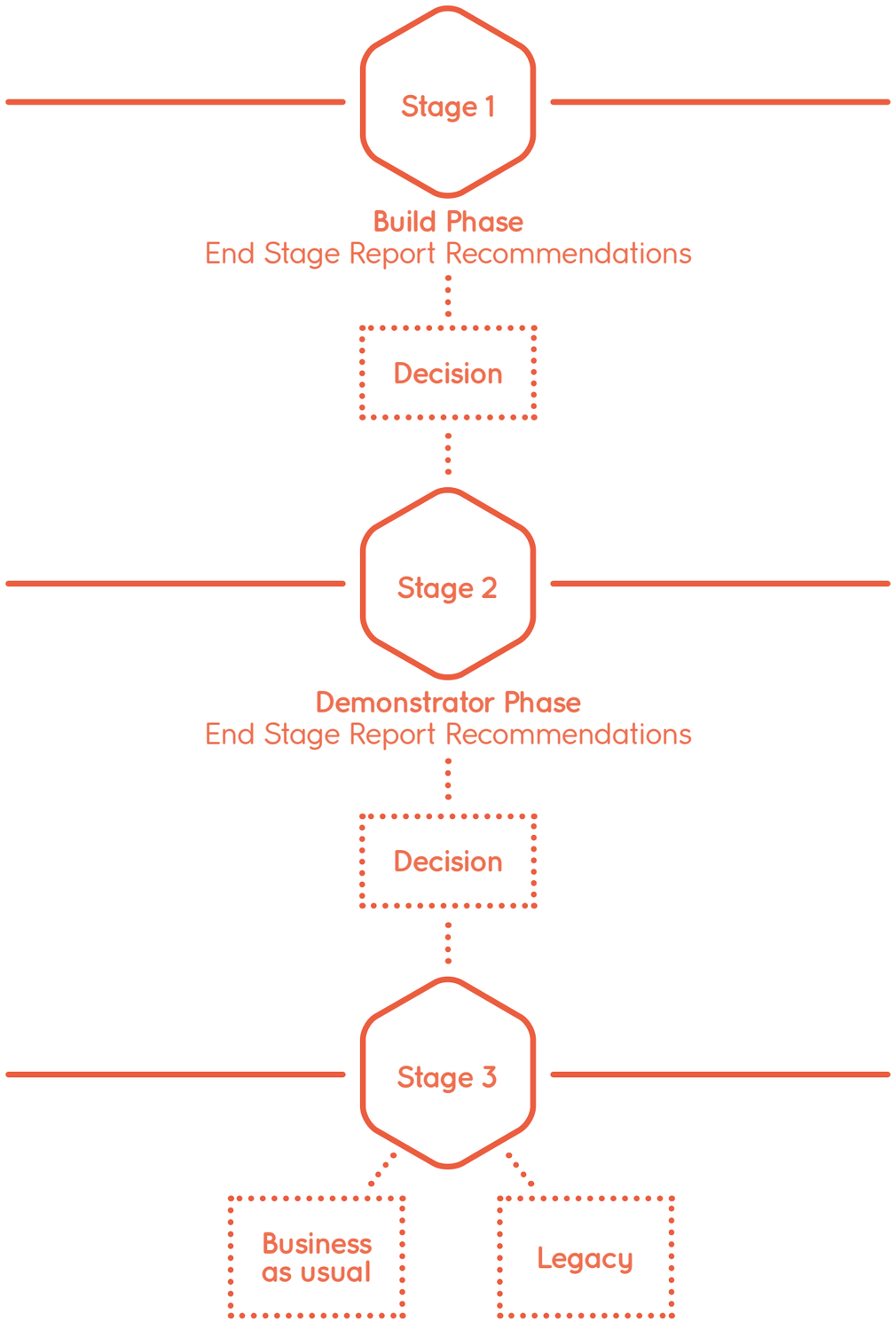
Table of Contents

1/
Introduction

This document provides an overview of the project reporting structure within the Future City Glasgow programme, summarising progress to date on the build phase of the Energy Efficiency project.

The recommendations contained within this document will provide the basis for formal approval of the Energy Efficiency project proceeding to stage 2 demonstration phase.

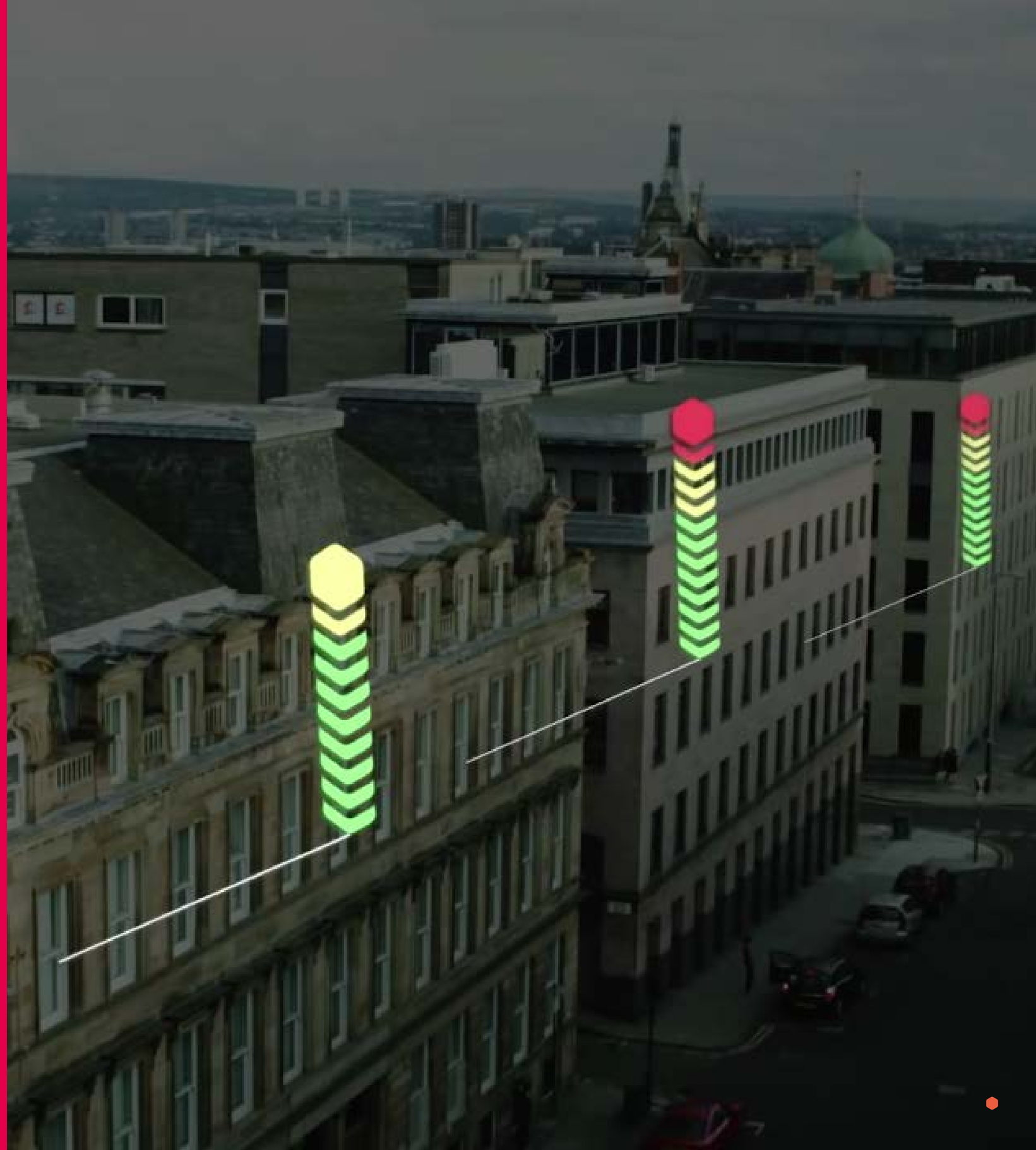
Project Structure



2/

Overview of Stage 1: Build Phase

Improve energy efficiency, planning and transparency through the use of integrated technology and data to promote and enhance energy efficiency in buildings and housing in Glasgow.



Current Position

2.1 Objectives

The objectives of the Energy Efficiency Demonstrators (EED) are:

- Improve Energy Efficiency – through the use of integrated technology to promote and enhance energy efficiency in buildings and housing in Glasgow.
- Improve Energy Planning Data - open up actual consumption information for buildings across Glasgow for energy planning purposes. Enhance GIS mapping and online mapping tools to enable better energy planning in the City.
- Increase Transparency of Energy Data - open up Glasgow City Council energy data produced via half hourly meters, automatic meter readers (AMR), building management systems, and buildings sensors. Ensure all data produced via the Demonstrator project is integrated with the City Data Hub and where applicable, the Glasgow Operations Centre.
- Identify Research Opportunities - link with the city's universities to identify research opportunities that will support the energy efficiency objectives of the Demonstrator.
- Identify Replicable Demonstrator Projects for Energy Efficiency - engage with partner organisations through the Sustainable Glasgow network to identify replicable Demonstrator projects for energy efficiency and smart grid applications.
- Increase Opportunities to Secure Energy Efficiencies - utilise and analyse the data outputs and other materials to generate a wider understanding of energy and the opportunities to secure efficiencies at macro and micro levels.

2.2 Scope

There were five individual projects within the Energy Efficiency Demonstrator. In recognition of the broad holistic scope of Energy, each project is being progressed in partnership with another key stakeholder. The scope of each project is detailed below.

Virtual Building Modelling / City Energy Model
Project partner:
Integrated Environmental Solutions (IES) Limited

- Develop an online virtual building modelling tool, which will allow businesses and homeowners in the city to enter key data about their building and receive bespoke advice on opportunities to make those buildings more energy efficient.
- Utilise the data entered into this tool to refine the models within the tool, provide the council with greater insight into the energy consumption patterns across the city for energy planning.
- Work collaboratively with Open Glasgow to anonymise data and where appropriate publish on the City Data Hub.
- Develop a method of incorporating building energy information into the data observatory to facilitate the use of real energy consumption data in research across the city.

Demand-Side Management (DSM)
Project partner:
Scottish Power Energy Networks

- Work with the project partners to increase the scope and further enhance the Demand Side Management (DSM) works being undertaken as part of a pilot.
- Publish the data flows produced by the DSM equipment for enhanced building management to be used for: staff training; integrated building management systems; and energy efficiency opportunity identification.

Housing Tenement Retrofit
Project partner:
University of Strathclyde

- Work with the University of Strathclyde to develop/support a pilot remote monitoring programme testing the effectiveness of insulation methods for tenement flats as well as other various construction types throughout the city.
- Create a database that will enable decisions to be made on how and where to apply insulation measures using real data.

Renewables – Photovoltaic (PV) Mapping
Project partner:
University of Strathclyde

- Work with the University of Strathclyde to deliver innovation around mapping of renewables opportunities (photovoltaic - PV) within the city.

Behavioural Change
Project partner:
University of Glasgow

- Work with the University of Glasgow to explore opportunities and examine methods to engage with the citizens of Glasgow to better understand what they would like to see developed in the city to enhance energy efficiency and energy security.
- Investigate what different motivations citizens have regarding energy, and develop a strategy to ensure continued engagement with citizens.

2.3 Resource

Project Manager
DRS Housing Officer
Security Consultant
External Consultants

2.4 Deliverables

Virtual Building Modelling / City Energy Model
- Development of an Energy App.
- Enhanced understanding of energy consumption of homes and business across the city.
- Access to detailed consumption information.

Demand-Side Management
- Installation of demand side equipment in 10 Glasgow City Council buildings.
- Improved understanding of potential to use demand side management for both energy efficiency improvements in buildings and to support the electrical network through: load shifting; peak shaving; and emergency response.
- Development of a third-party hosted software interface that allows demand side events to be scheduled remotely.

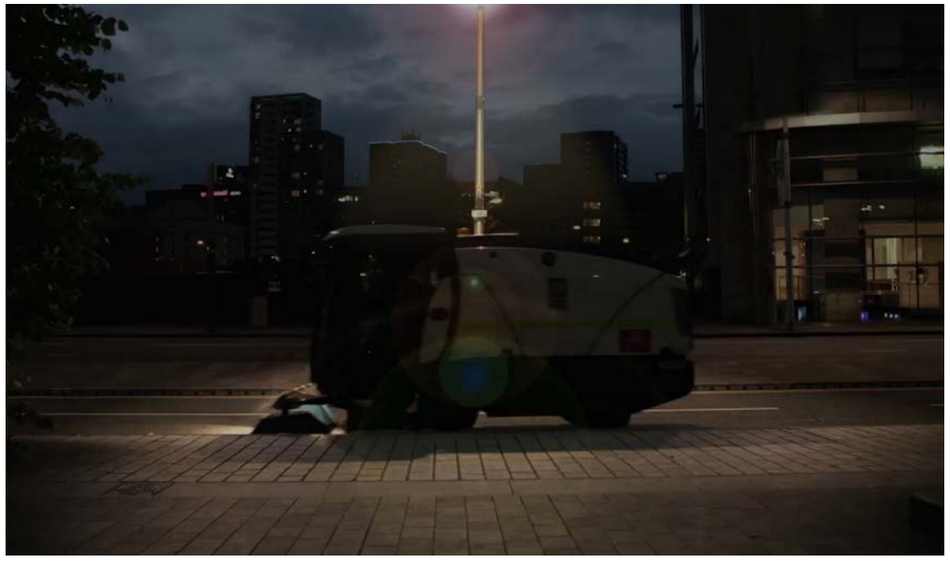
Housing Tenement Retrofit
- Installation of sensors in 60 homes, of diverse building types, across Glasgow.
- Understanding the impact of retrofit insulation to each property, both positive (energy savings) and negative (potentially increased moisture levels).
- Development of a database of building types and insulation systems which have been demonstrated to work.
- Extrapolation of the database to identify similar properties across Glasgow that proven insulation systems can be applied to.

Renewables (PV) Mapping
- Development of a Renewables Opportunity Map.
- Identification of Vacant & Derelict Land sites suitable for renewables (photovoltaic) deployments.
- Improved understanding of renewables opportunity and likely constraints to developments within the council planning department.

Behavioural Change
- Understanding the views and concerns of citizens around energy.
- Understanding of the ways in which Glaswegians are most likely to be influenced to change their energy behaviour.
- Development of media material (video) that highlights those issues most likely to affect change in Glaswegians in the context of energy reduction.
- Development of a 'gamified' engagement tool that will be used to influence the behaviour of Glaswegians to reduce energy usage.

2.5 Constraints

Time Pressures
At project inception the suggested timeline for completion was September 2014. Given the scale and nature of each project there was an acknowledgement within the project and with contractors that the completion date would be difficult to achieve. This resulted in an additional pressure on contractor relations and solutions being chosen to meet the timelines.



3/
Current Position

"The way in which the data can be displayed publicly has also been enhanced, which will benefit communities seeking to develop energy projects.

3.1 Benefits achieved to date

The build phase of the project has provided an opportunity to promote and enhance energy efficiency in buildings and housing in Glasgow. Working with the Development and Regeneration Services (DRS) Housing Team and several housing associations across the city, the impact of insulation on several different house types has been assessed and presented to each housing association in the form of reports that will go to each board.

A database of house types that have been monitored has been developed, which will identify new opportunities for the retrofit of insulation in the future.

The monitoring and assessment methodology developed by the University of Strathclyde has been successfully delivered to the DRS Housing Team, along with bespoke software designed to interpret data from the sensors. As a result, all future insulation that is installed with funding support from Glasgow City Council (which administers the majority of funds across the city) will be required to install sensors and supply data back to the Housing Team to confirm that it has had a positive impact on the housing. This allows problems to be identified quickly and, more importantly, within the warranty period so that contractors go back and investigate/rectify any issues.

The monitoring methodology has been presented at a number of energy efficiency events across the city, such that housing associations are approaching the council to understand how the sensors could be deployed in their stock.

Understanding and sharing the actual energy consumption information for buildings across Glasgow, through the Energy Model has presented a hierarchy of energy data for use internally for energy planning purposes: benchmark data for each property, based on internal building stock information obtained within the council, which is subsequently processed using IES building simulation software; and actual consumption information submitted by users of the online portal made available to populate the City Energy Model. In the future, it is intended to build on this and incorporate real-time consumption information as the tool is designed to accept data of this form.

The way in which the data can be displayed publicly has also been enhanced, which will benefit communities seeking to develop energy projects. Previously, data was only made available at Datazone level, which often intersected communities/streets and was too high-level to understand what the consumption of a few streets was (for example). While developing the Privacy Impact Assessment, which governs the data that can be collected and held by the council, the justification for doing so and the manner in which it can be presented back to the public, it was agreed that areas smaller than Datazones would be used – Postcode minus the last digit was finally settled upon – which would be much more meaningful and useful to community groups and council officers seeking to develop energy projects in a particular area. The revised obfuscation methodology developed has been proposed to the UK Government through the Smart Cities Forum as an improvement to the Datazone levels currently used when publishing historical energy data.

By opening up Glasgow City Council energy data produced via half hourly meters, automatic meter readers (AMR), building management systems, and buildings sensors there is an opportunity to reduce the number of requests for information. People/organisations can simply be pointed to the City Data Hub, rather than an officer having to collate and send the data electronically, which can be cumbersome and time-consuming.

The Renewables Map for PV potential has been developed and has been made available to the public at map.glasgow.gov.uk. A reusable tool in QGIS has also been developed and is embedded within the City Energy Team at Glasgow City Council to assess either: alternative technologies; alternative parcels of land (vacant and derelict land was focussed on during the Demonstrator); or revised development and technical constraints. A process flow has been developed that articulates the steps that must be taken to revise the map.

Close links have been formed with both the University of Strathclyde (involved in two projects) and the University of Glasgow (involved in one project) and future collaboration opportunities are being actively sought. Glasgow Caledonian University, which did not take part in the Demonstrator Programme, has been subsequently engaged and is a partner in a funding bid the council has recently submitted.

The demand-side management project was done in collaboration with Scottish Power Energy Networks and the council is seeking future opportunities to collaborate further for the mutual benefit of the infrastructure both organisations are responsible for across the city.

The relationship developed with Siemens on the demand-side management project has also been built upon and they are a partner with the council on a European funding bid.

All data that can be made available to the public (subject to the Privacy Impact Assessments carried out for the projects that handle personal information) either has been or is in the process of being presented to the City Data Hub.

There is currently no Use Case that supports integration of data with the Operations Centre, but the means by which this integration could happen in the future is well understood.

The data produced by each Demonstrator has already had an impact on the understanding of energy and the opportunities to secure efficiencies. For example: the Renewables Map has informed a feasibility study looking at PV potential across the city; the data collected through the insulation retrofit monitoring project has been supplied back to each housing association to enhance their understanding of their stock, and has improved the knowledge within the Housing Team in the council; the demand-side management project is identifying in-building efficiencies and has led to an increased understanding of the wider demand reduction opportunities across the city incorporating EVs, street lights, domestic buildings, etc; the Behavioural Change engagement tool is tapping into the enthusiasm of school children to stimulate energy efficient behaviour; and the City Energy Model has led to a greater understanding of where in the city energy is consumed and the opportunities to identify credible projects have been greatly enhanced.

> “ Generate awareness and translate that into responsiveness.

Current Position [cont.]

3.2 Residual benefits expected

Virtual Building Modelling / City Energy Model
Energy efficiency in individual homes and businesses is integral to the achievement of breakthrough reductions in carbon emission and energy consumption. The Virtual Building Modelling supports the engagement and empowerment process of getting stakeholders to take ownership of their own energy usage.

By giving building occupiers the ability to more accurately assess their own performance against a relevant peer group and identify the actions and impacts of potential improvements, this Demonstrator generates awareness and translates that into responsiveness.

Through incorporating real householder usage into city energy data, the Demonstrator will provide a richness and robustness that will strengthen the City Energy Model and secure improved partnership with the major energy suppliers in developing broader tactical and strategic solutions.

Demand-Side Management
The Demonstrator will build on and extend our understanding of how DSM can be deployed by a major energy user (GCC) to reduce consumption, securing the toolkit to extend this approach from test-bed to business-as-usual.

The Demonstrator will enable the Energy networks to understand how collaboration and shared objectives with customers can be used to deliver greater gains in peak shaving and demand shifting.

Housing Tenement Retrofit
The Demonstrator provides a key solution to the challenge of being a Future City with a predominately historic housing stock.

The outputs from the Demonstrator will allow cross matching of the largest numbers of properties with the most effective and suitable methods of retrofit insulation. This protects the city and its households from the risks of major insulation intuitive roll outs resulting in sub-optimal energy savings and potential health and building damage through humidity consequences.

The focus on humidity and the utilisation of immediate feedback post-insulation ensures that we not only secure the Energy benefit but also avoid replacing the health risks of fuel poverty with the equally debilitating effect of dampness.

Renewables (PV) Mapping
The Mapping Demonstrator will ensure that the landscape, both physical and bureaucratic, can be clearly understood and navigated.

By minimising the potential barriers for community groups it is hoped to support an uplift in converting aspiration into action

Behavioural Change
The Demonstrator should enable customised coherent communication to support key energy messages in a way that is relevant to the people of Glasgow.

Effective engagement securing behavioural change is the golden thread that runs through all the Energy programmes within Future City Glasgow. The Demonstrator in this area will provide the tools for deployment of that engagement.

3.3 Issues

Virtual Building Modelling / City Energy Model

Data Publication and Use

- Use of building-specific consumption data out with the council was not deemed necessary; therefore, methodology had to be developed to anonymise data for external communication.
- Development of energy benchmark information proved difficult due to restrictions on the use of Assessor data.
- To ensure personal data was held securely, an alternative cloud solution had to be identified to meet ‘IL2’ security requirements.
- The level of security required was only discovered after the project was fully scoped and agreed, therefore retrospective action had to be taken to gain approval from the security consultant.

Demand-Side Management

Unplanned Changes

- Installation of demand side management equipment proved more difficult than expected due to a variety of factors: asbestos discovered; old equipment in buildings; challenging loads.
- Due to age of GCC building stock, many of the loads within each building were not connected to the Building Management System (BMS), which made control of the loads more difficult.

Multiple stakeholders

- Managing the number of stakeholders on the project became problematic at times.

Housing Tenement Retrofit

Identification of Houses

- Identification of houses proved more difficult than anticipated, primarily due to Energy Company Obligation grant funding being cut as the project started, which resulted in a number of retrofit programmes being cancelled.

Data Protection and Use

- A suite of documents had to be produced to allow data to be collected and analysed. This proved a more onerous task than first envisaged, due to the personal nature of data collected.

Health and Safety

- Procedures to enter homes had to be developed to ensure appropriate health & safety considerations were taken into account, as well as potential contact with vulnerable residents.

Renewables (PV) Mapping

- No significant issues encountered.

Behavioural Change

- Development of Engagement Tool
- Development of ‘gamified’ engagement tool has taken a lot longer than anticipated.

3.4 Lessons learned

Virtual Building Modelling / City Energy Model

- Security requirements, given the nature of personal data being held, was more onerous than expected, therefore more time should have been spent early in the project on exploring likely solutions.
- Development of Privacy Impact Statements (PIA) identified a lot of issues (and helped develop a number of solutions), therefore for all large data projects it is recommended that a PIA is developed very early in the project cycle.
- There are limitations on who can use the data collected and the roles each stakeholder has – i.e. who is the data controller and who is the data processor – and this should be established early in the project cycle as part of the PIA development, as this had a bearing on contracts developed and expectations of what can and cannot be done with the data.

Demand-Side Management

- Negotiation of the Collaboration Agreement between SP Energy Networks and GCC (backed off with another Collaboration Agreement between SP Energy Networks and Siemens) took a lot longer than anticipated. More face-to-face negotiations would perhaps have made the process less protracted.
- Installation of equipment in a wide variety of GCC buildings has proved difficult due to age of equipment, age of buildings and a variety of solutions that had to be developed for the project. Variety is necessary for project learnings, but led to a lot of complexity that could have been avoided in any subsequent project revisions by selecting a more homogeneous building stock.

Housing Tenement Retrofit

- Earlier identification of data sensitivity issues and of health and safety concerns should have been taken into account at an earlier stage in the project and potential delays in these activities built into the overall timelines.

Renewables (PV) Mapping

- Will continue to monitor.

Behavioural Change

- Need to allow greater time for the development of user interfaces.

4/
Recommendations

The recommendation is that the Energy Efficiency Demonstrators continue through a demonstration phase until August 2015. This phase will be used to help evaluate and quantify the benefits in regards to energy savings and data collection so that they can be incorporated within a business case for sustaining the solution moving forward, expanding the concept across the city, and demonstrating the value to other municipalities.

Recommendations

The programme has a specific workstream that is investigating:-

Legacy
The development the business cases for sustaining and expanding the Demonstrators across the city to maximise the legacy benefits for Glasgow, and the investigation of innovative new business models.

Innovation
The opportunity for further innovation building upon the Demonstrators developed during the programme.

Horizon 2020
Development of:

- DSM to domestic buildings, street lights and electric vehicles (EVs)
- City Energy Model (to Decision Support Platform); Renewables Mapping (to Low Carbon Opportunity Mapping – i.e. looking at more than PV)
- Insulation Retrofit Monitoring (to Building Performance Benchmarking).
- Carbon Management Team looking to enhance DSM project through incorporation of ICT loads.
- Transport Scotland EV charger on street lights funding – link to DSM.
- SP Energy Networks – looking to expand DSM collaboration to include street lights and EV charging.

National Grid
Developing business case for DSM to plug into Short Term Operating Reserve market (essentially DSM at large scale). This will be a medium-to-long-term aspiration, as a large load reduction is required (3MW), which will take several years to: a) identify; and b) put the necessary control around.

Internationalisation
Identifying opportunities to take the learning from Glasgow to help other cities around the world to embrace the future cities market, and (where applicable) provide new opportunities for UK business.

Horizon 2020
Working with Ghent and Umea.

FUTURE CITY • GLASGOW

futurecity.glasgow.gov.uk
open.glasgow.gov.uk
@openglasgow

OPEN GLASGOW

Glasgow CITY COUNCIL

Innovate UK
Technology Strategy Board