SMART STREET

Session 3.3
Voltage Management, LV Modelling and System Control

LCNI Conference
Wednesday 12 October 2016

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Smart Street project overview

£11.5m, four-year innovation project

Started in Jan 2014 and finishes in Apr 2018

Quicker connection of LCTs

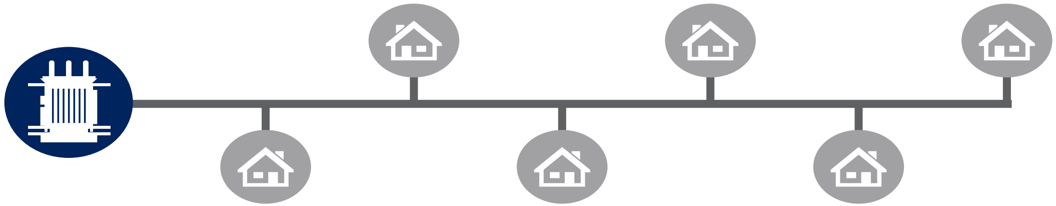
Lower energy bills

Improved supply reliability

Trials period Jan 2016 – Dec 2017

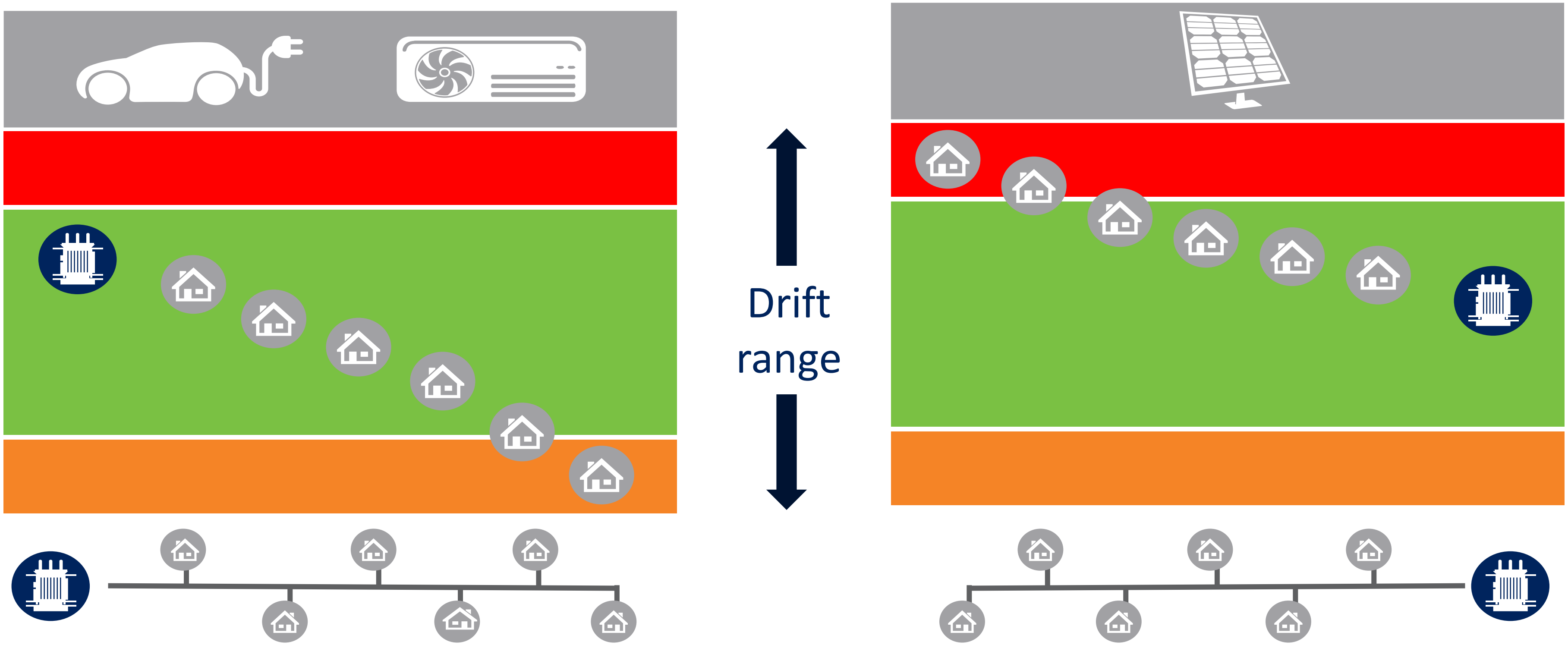
Extensive customer engagement programme throughout project

Voltage profile



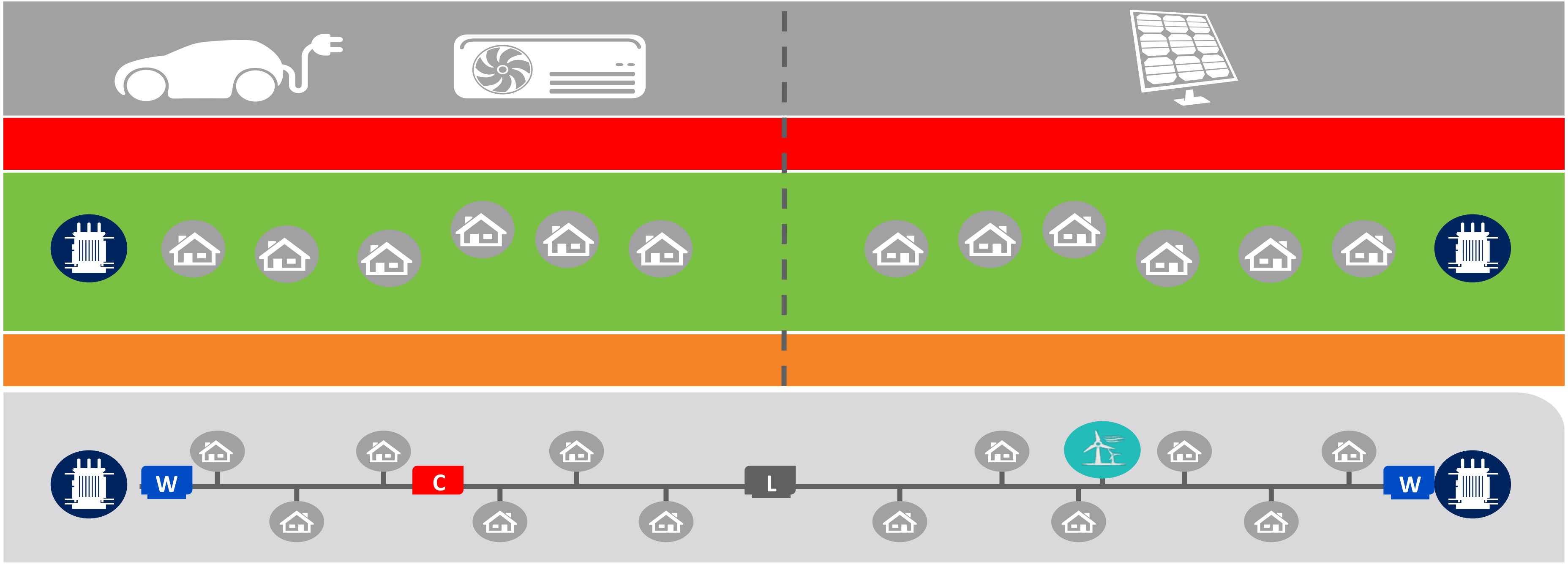
Historic networks have no active voltage regulation

Problem - LCTs create network issues



LCTs rapidly surpass voltage and thermal network capacity

Smart Street – the first intervention

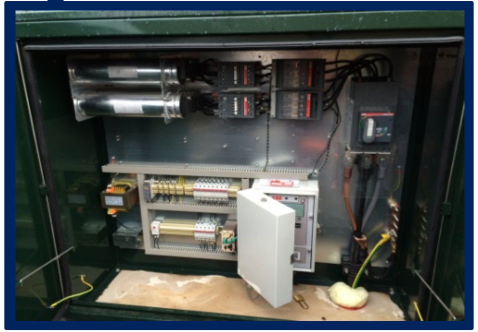


Low cost ● Quick fit ● Minimal disruption ● Low carbon ● Low loss ● Invisible to customers

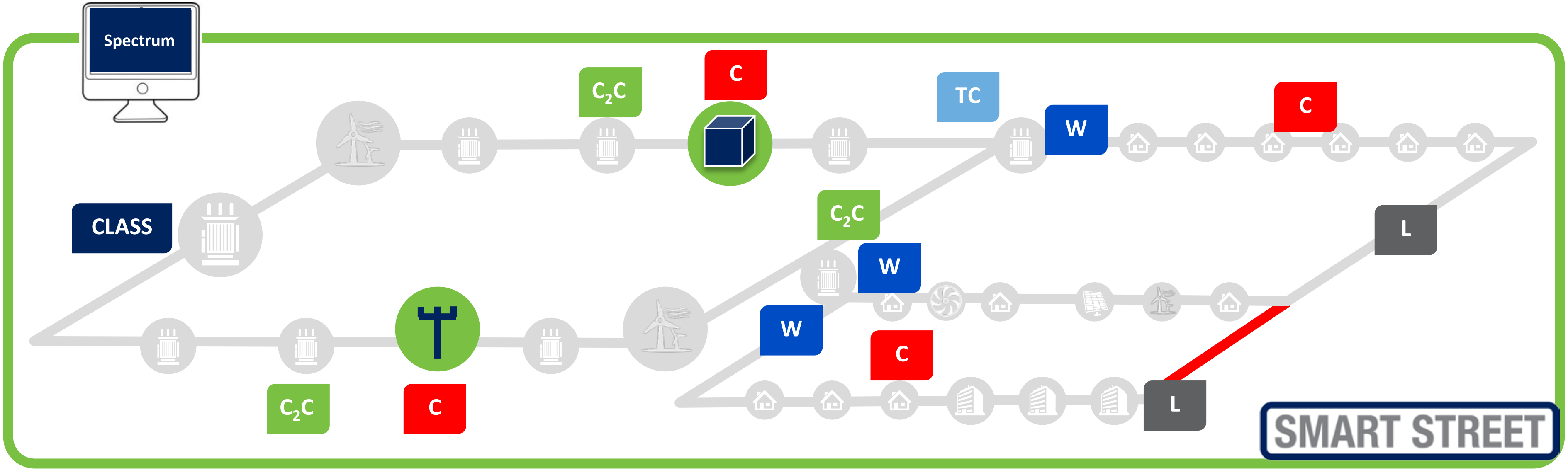
Voltage stabilised across the load range ● Power flows optimised

The Smart Street System

Spectrum 5 (NMS)



Network reliability improvement



C_2C Capacity to Customers

C Capacitor

W WEEZAP

L LYNX

TC On-load tap changer

Builds on C_2C and CLASS ● Storage compatible ● Transferable solutions

Trials – test regimes

Smart Street trial	Test regime
LV voltage control	1. On-load tap changing distribution transformer only
	2. On-load tap changing distribution transformer and capacitor(s) on LV circuits
	3. Capacitors at distribution substation only
	4. Capacitors at distribution substation and on LV circuits
	5. Capacitor(s) on LV circuits only
LV network management & interconnection	1. LV radial circuits
	2. LV interconnected circuits
HV voltage control	1. Voltage controllers at primary substation only
	2. Voltage controllers at primary substation and capacitor(s) on HV circuits
HV network management & interconnection	1. HV radial circuits
	2. HV interconnected circuits
Network configuration & voltage optimisation	1. Losses reduction
	2. Energy consumption reduction

Trials

W/C 14/3/2016	14/06/2016 – 24/06/2016	19/07/2016 – 01/08/2016	09/08/2016 – 22/08/2016	W/C 22/08/2016
Successful operation of OLTC and LV capacitor banks	OLTCs only	Use of LV meshing & OLTCs	HV and LV meshing	HV meshed circuits only

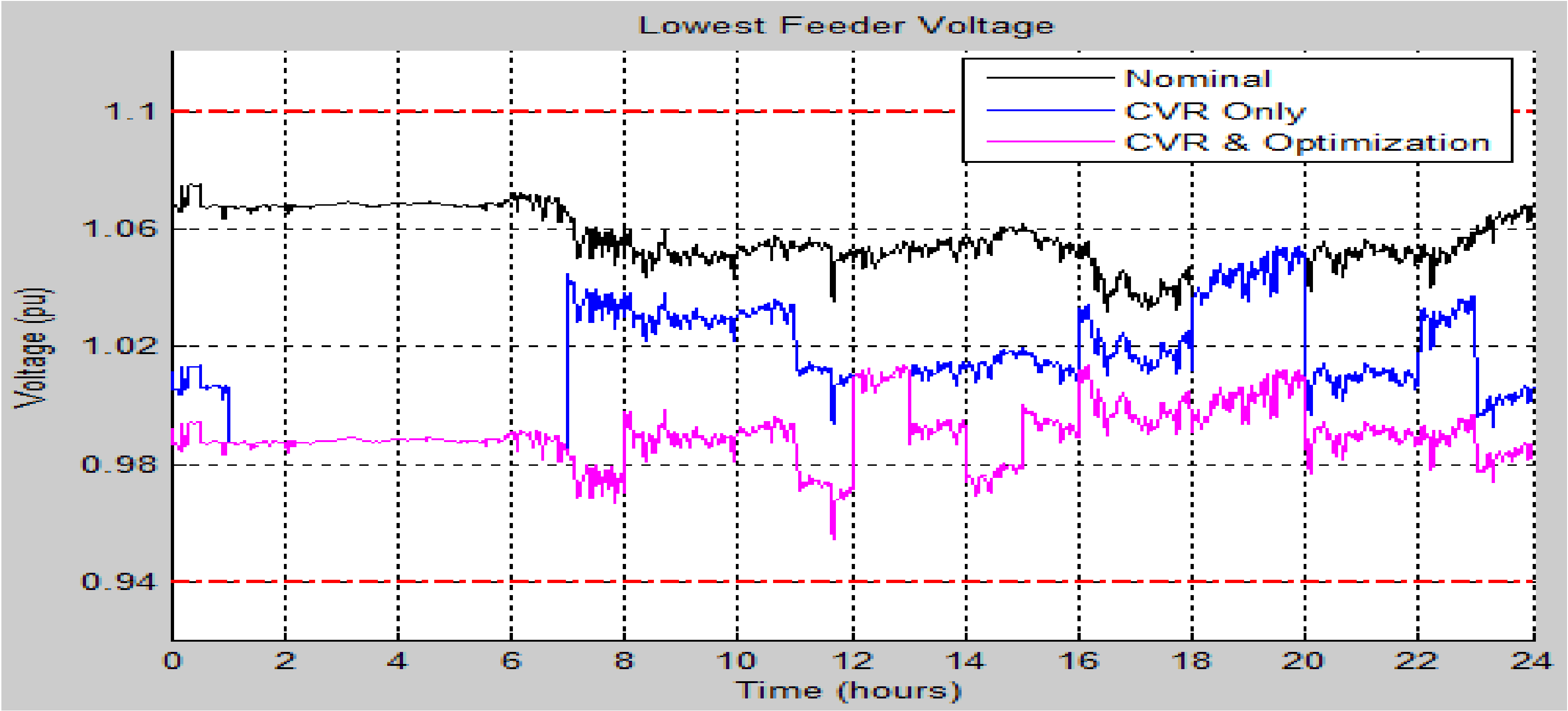
Aims

Quantification of CVR benefits

Validation of optimisation techniques

Identify potential power quality and customer side impacts

CVR modelling

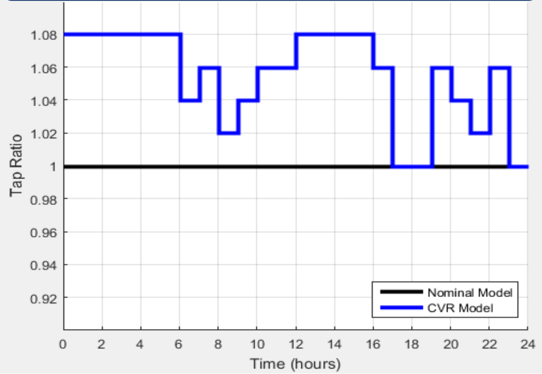


Graphs taken from UoM research – L Gutierrez/ Y Shen

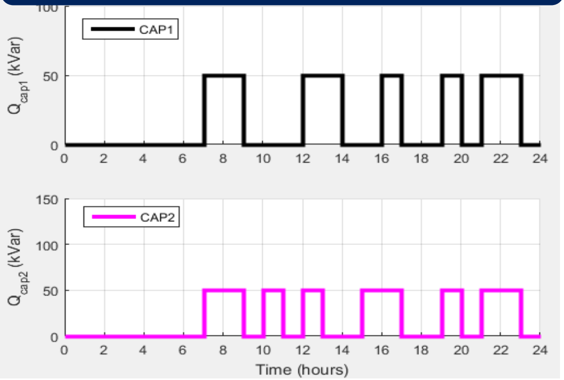
CVR modelling

CVR on LV Networks
Case study (Brynton Rd 171279)

Operation of OLTC



Operation of capacitors



Result of all LV networks

Average voltage reduction = 4.88%

Total energy savings = 5.12%

Total loss savings = 1.83%

CVR factor = 1.10

No voltage problem or overload

Outcomes to date

- ~25GB of data recorded so far
- Trial area networks modelled
- Predicted CVR factor of 1.10 for LV and 1.01 for HV networks
- Analysis techniques indicate optimisation algorithm is close to optimal
- Ring operation modelled and compared to radial

Still to come

Effects of voltage reduction on lighting and domestic appliances under investigation

Carbon impact being studied

Analysis of trials data ongoing

Smart Street summary

SMART STREET

Challenge

Combine into one end-to-end system

Optimisation

Learning

First example of centrally controlled LV network

Range of intervention solutions

Carbon Footprint

CO_2

Faster LCT adoption

Less embedded carbon

Re-usable technology

Optimise energy and losses

Benefit

£

Lower energy bills

More reliable supply

Reinforcement savings

For more information

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Please contact us if you have any questions or would like to arrange a one-to-one briefing about our innovation projects

Smart Community Demonstration Project in Manchester, U.K.

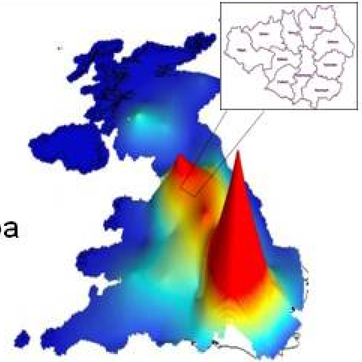
Low Carbon Networks and Innovation Conference

Wednesday 12th October, 2016

Mark Atherton
Director of Environment, Greater Manchester

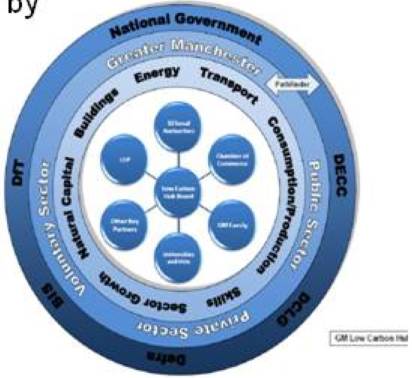
Greater Manchester Combined Authority

Greater Manchester (GM)



- UK's **largest** & fastest growing regional economy: GVA **£46bn**
- 2.6 million residents and a workforce of 7.2 million people
- Low carbon and environmental goods sector worth **£5.4 billion**, which supports 37,000 jobs - projected to grow at more than 4% pa
- 1.2m households, 25% are social homes
- 95% of homes use gas for space and water heating
- Asset management plan to replace boilers in 160,000 properties by early 2020's

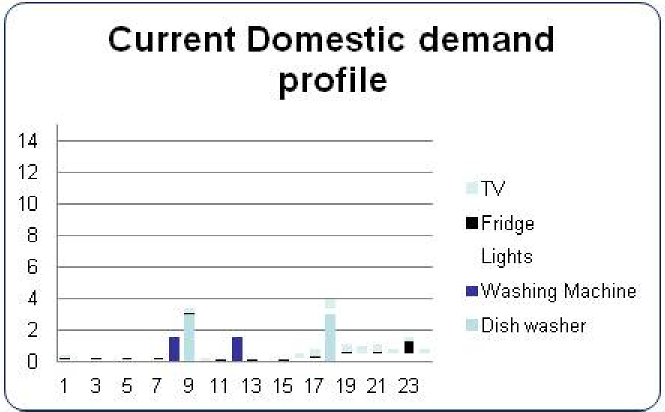
Combined Authority (GMCA)

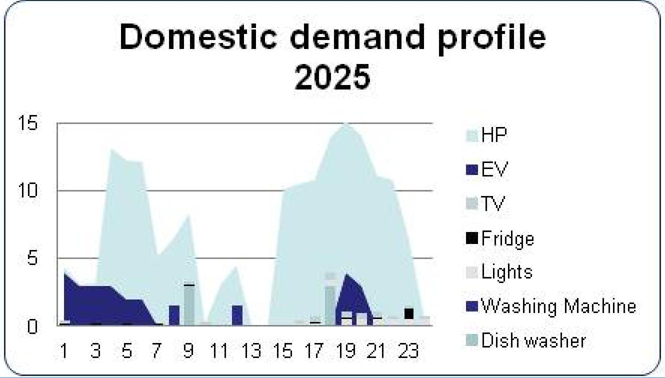


- AGMA established in 1986, GMCA formed in 2011
- 10 Local Authorities of Greater Manchester working at scale
- Established a Low Carbon Hub in 2012
  - A centre of excellence for achieving economic gain through integrated delivery of carbon reduction.

Greater Manchester Energy Demand

	Estimated Required By 2035
Domestic demand	➢6GW even with optimal scheduling ➢Domestic ADMD 2kW – 14kW
Heating	Domestic heat pumps 350 000 fitted 8-10kW for 8 hours Additional >2 GW
Transport	31% UK12M vehicles will be EV/hybrid 720 000 domestic EVs 80 000 E-Vans 3-8kW for 8+ hours. 50kW fast chargers. Additional >2 GW Manchester >400MW
Generation	93% from renewable / carbon neutral sources. Potential for 3,710MW across GM from Heat Pumps





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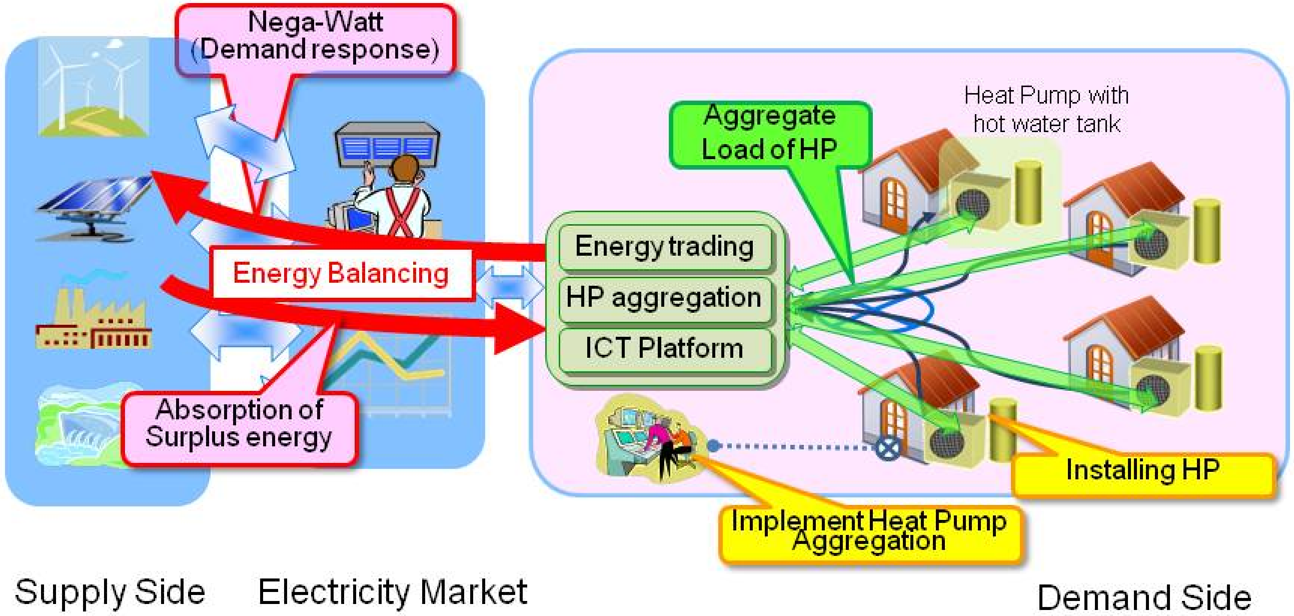
GMCA GREATER MANCHESTER COMBINED AUTHORITY

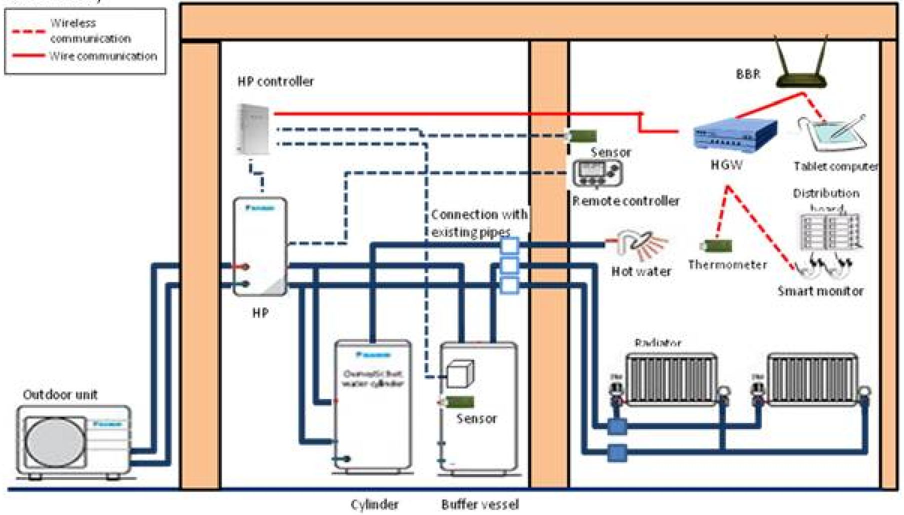
Domestic Smart Energy Proposition

Reduce energy demand and cut carbon emissions by bringing together low carbon energy technologies with advanced IT.



Smart Communities Demonstrator Project

- Develop a Smart Communities Trial – MOU signed April 2014
- Combine domestic technologies with a smart network management £20+m
- Trial air source heat pump / demand aggregation in 600 social homes
- GMCA – Housing Companies, Electricity Northwest, UK Government Departments
- NEDO - Hitachi, Daikin, Mizuho,



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Project Objectives, Greater Manchester

Establishment of an aggregation business model which manages energy load of heat pumps in the residential sector

Objective

Aggregation Technology and Systems

Demonstration of usability and efficiency of load-balancing aggregation technology and systems for residential heat pumps (Daikin, Hitachi)

Business Model

Establishment of Business Model (Mizuho Bank, Daikin, Hitachi)

[UK's Target]

2020: The renewable energy ratio : 15%
2030: Heat Pump penetration: 30%

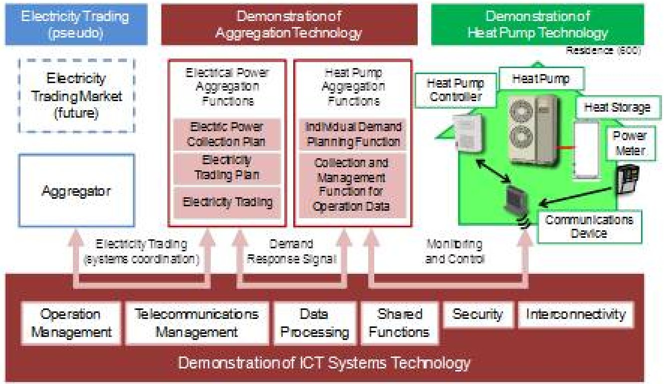
*Demonstration project supported by METI (Ministry of Economy, Trade and Industry) & NEDO (New Energy and Industrial Technology Development Organization)

Overview and features of solutions

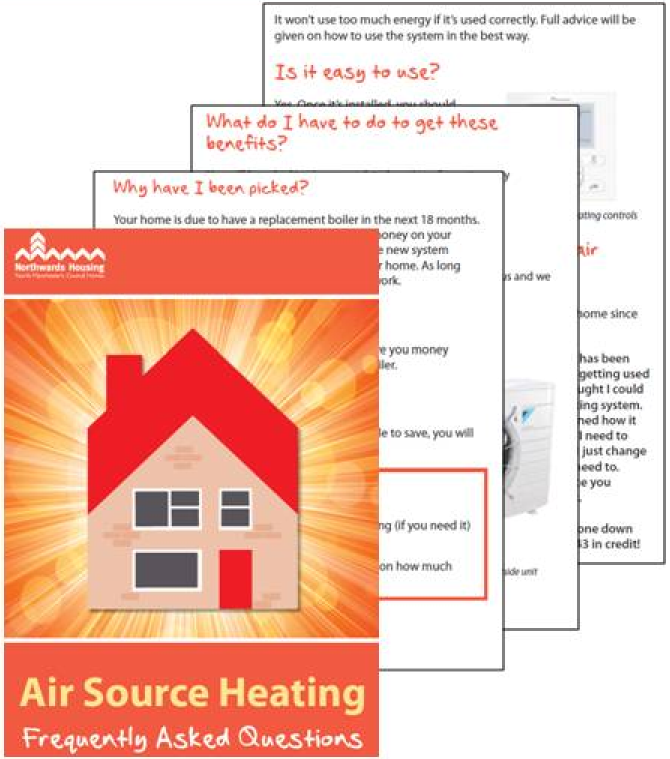
Overview

-Demonstration and Development April 2014 - March 2016

- Installation of heat-pumps (600 houses)
- Development of the aggregation system
- Establishment of ICT systems
- Establishment of Business Model



Key Element: Tenant Engagement



Purpose:

- Recruiting tenants and making the demonstrator a success.

Incentives:

- Free broadband
- Free tablet computer
- Insulation upgrades
- Expert energy advice
- Monitoring equipment
- Telecare function(optional)

Progress and Next Steps

As at October 2016:

- Full aggregation trail commenced (Oct' 16)
- 1740 tenants engaged (Sept '16)
- 631 tenants expressed interest (Oct'16)
- 631 tenants formally signed – up
- 550 heat pumps installed (Oct'16)

Next Steps

- Complete heat pump, home gateways and EDMI Meters installations/reinstallation
- Issue User Interface tablets to users
- Commemorative event (Oct' 16)
- Analyse results and develop business case (Feb '17)
- Complete project (Mar'17)

Lessons Learnt

Issues Experienced:

- Perception of ASHPs
  - Increased noise (additional Planning Permission required for blocks of flats)
  - Lower radiator surface temperature*
- Space and layout
  - Larger, impact on room design*
  - Impact of existing furniture*
- Distribution system
  - Homegateway/EDMI firmware issues
- Customer culture / behaviours
  - Tenants unplugging router*
- Perceived increased customer fuel bills in small number of properties
  - Some installation problems*
- Impact on electricity network
  - Long timescale for implementing grid reinforcement work in some properties

Solutions:

- Increased tenant engagement required*
- Increased pilot testing of all new technology before rollout
- Increased technical expertise available on site when first heat pumps installed
- Earlier tenant engagement for planning/reinforcement

Post Grid Parity:
Technology Push to Customer Services Pull

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Empower People - data & control ecosystem

Establish clear expectation setting, for both comfort and cost

Establish the analytics for designing, pricing and targeting services

Establish commercial value sharing between actors to align motivation

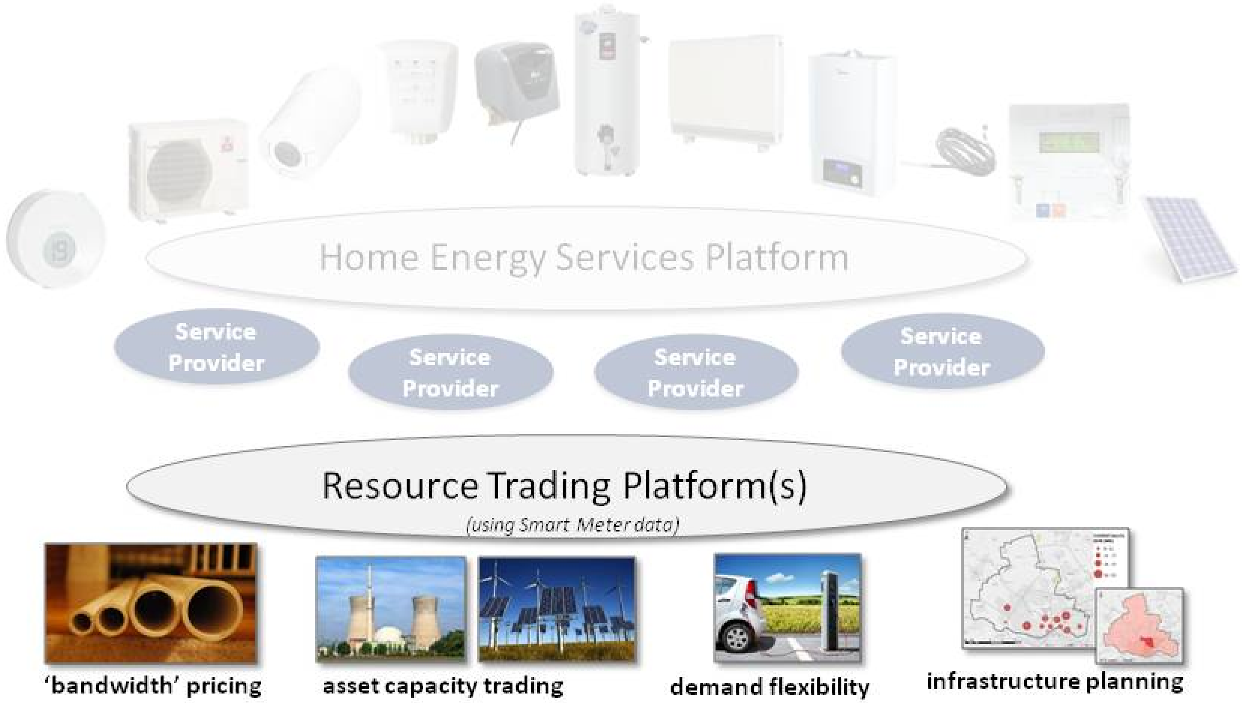
Stimulate Rapid Innovation In Energy Services






Establish rich data and control ecosystem in thousands of homes and make available to innovators

Explore architectures for a services - led supply chain



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Thank You

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NEDO

HITACHI
Inspire the Next

Bury COUNCIL

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DAIKIN

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SIX TOWN HOUSING

Wigan Council

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For a warmer, healthier home

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