

Big Brother, Grumpy Dad or Clever Uncle ?

What will Smart Home Energy Management become in the UK?

Field trials at the Energy Saving Trust

Steven Harris

Head of Low Carbon Technologies

Talk delivered at
CIR HEAT10 Conference Expo
Cambridge 2 December 2010
<http://www.cir-strategy.com>



energy saving trust®



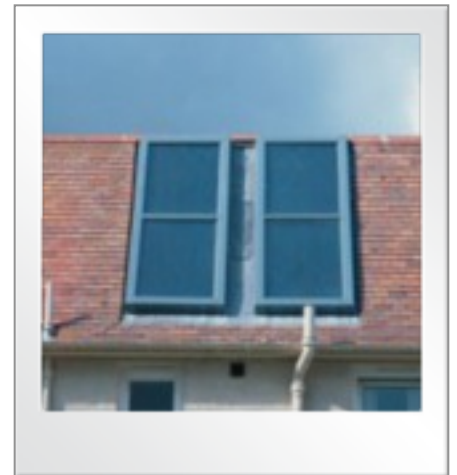
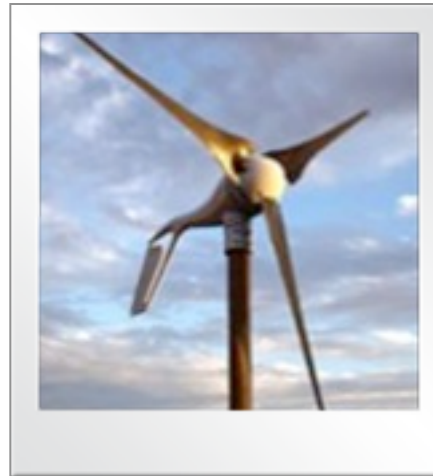
Energy Saving Trust

- We are the UK's leading impartial organisation helping people save energy and reduce carbon emissions.



Finding out how technology really works in peoples homes....

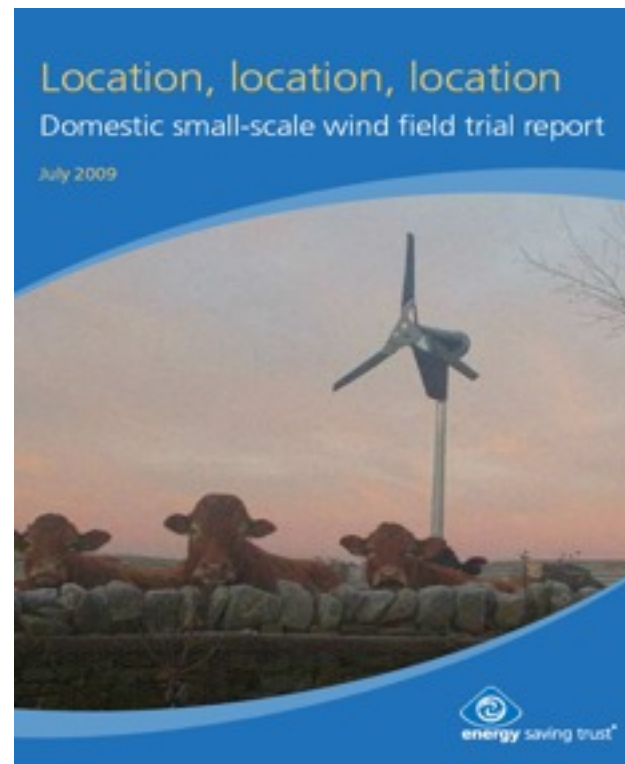
- Micro-wind field trials
- Heat pumps
- Solar water heating
- Condensing boilers
- Heating controls
- Future...
 - Smart Home Energy Management
 - Multivalent heating systems
 - PV microinverters and micro MPP
 - Thermal Stores
 - Micro CHP
 - Domestic Fuel Cells



Domestic Wind Field Trial

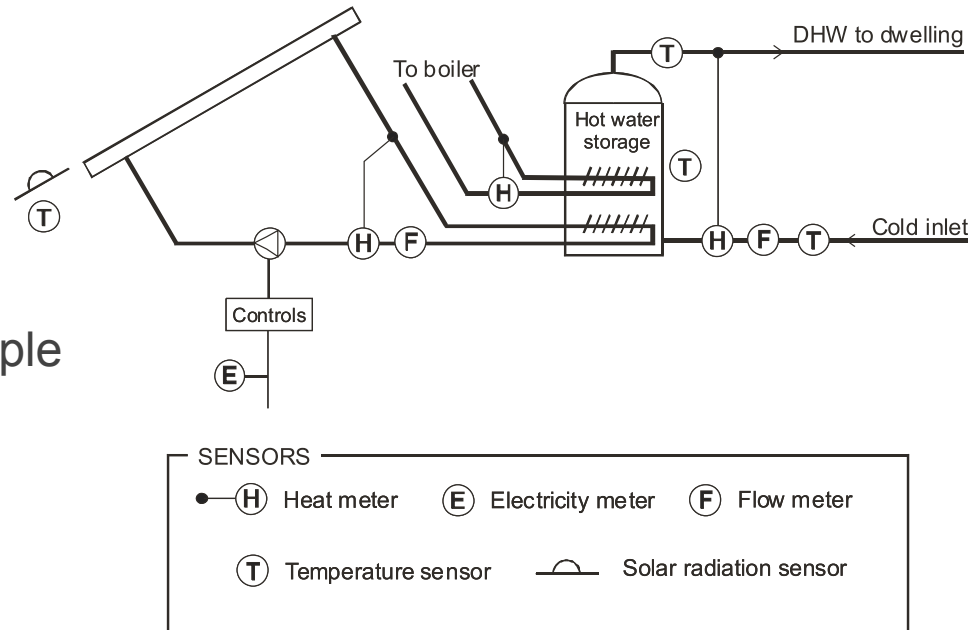
- In excess of 600 grant funded installations across the UK – but do they work? Do they save carbon?
- Are customers satisfied?
- Unique datasets collected from 8 types of turbines at 154 UK sites.
- And the results - Performance depends upon....

LOCATION, LOCATION, LOCATION!



Solar Thermal Field Trial

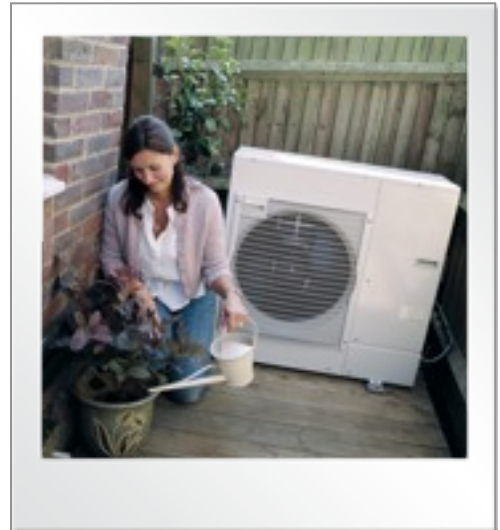
- Most widespread microgeneration technology installed in UK (6,000+)
- Seen as most 'cost effective'
- EST monitoring a representative sample of 100+ domestic sites
- Monitor for 1+ year,
- Report in summer 2011



Heat pump field trial

Heat pumps are a proven technology in Europe but relatively new to the UK residential sector. **The study objective – to determine the efficiency of the ‘system’**

- **Technical focus:**
 - Factors that influence performance of the technology
 - Potential energy and carbon savings
 - Implications for policy and standards
- **Consumer focus:**
 - Evaluate how householders use the technology
 - Which measures are most appropriate?
 - Should heat pumps be adopted by the mass market?



Project Funders

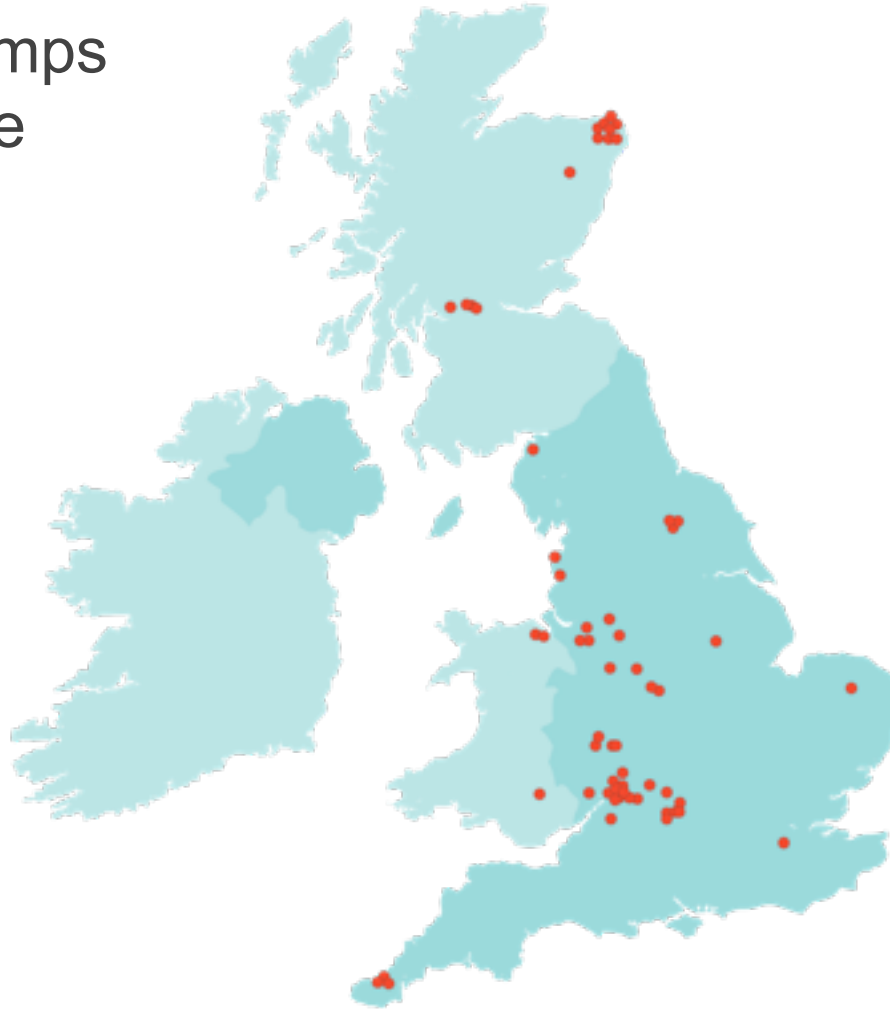


Site selection

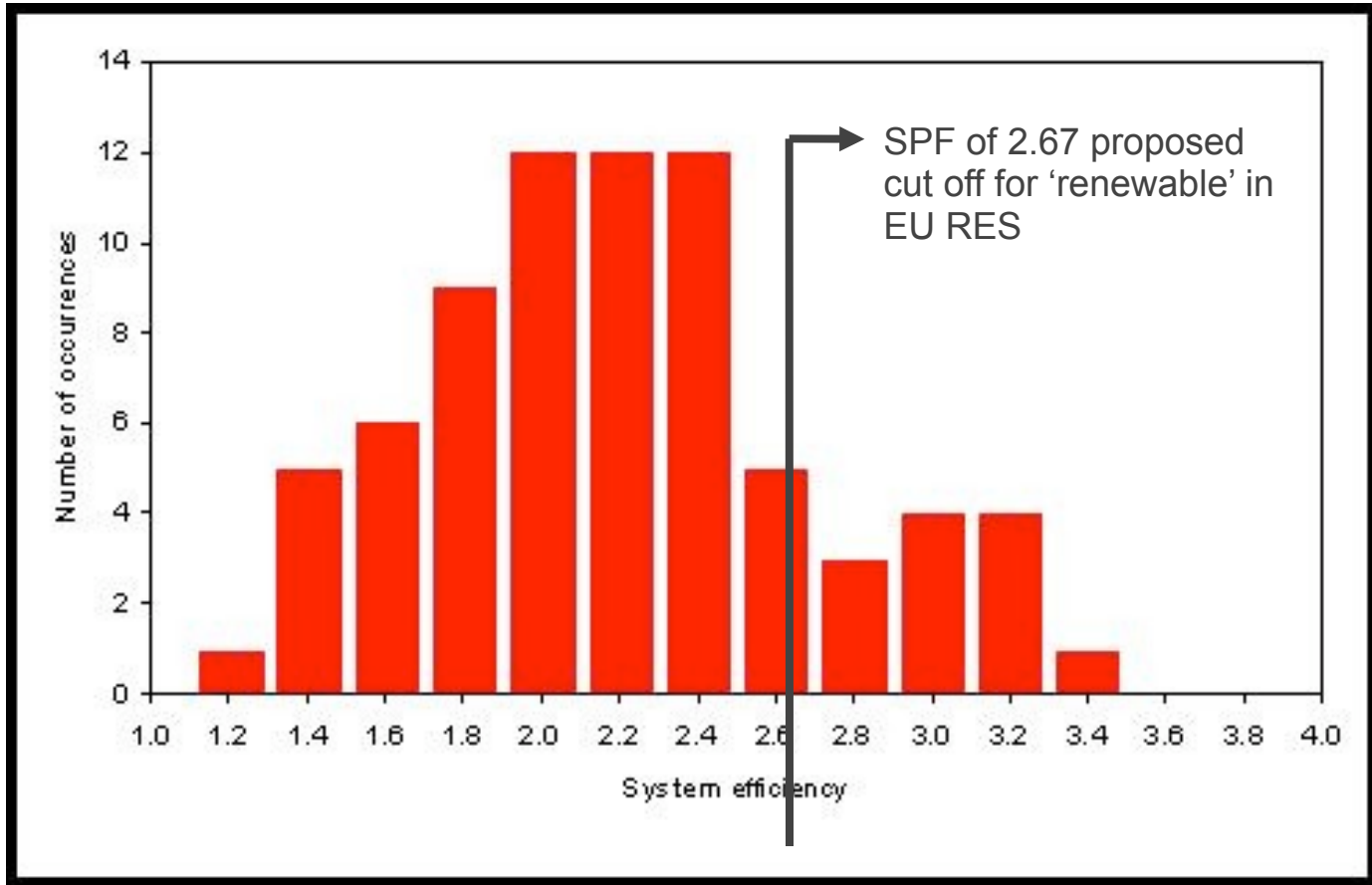
Manufacturer	Source	Sink	Property Type
Dimplex	Air	Underfloor	1 bed semi bungalow
Thermia	Borehole	Air blown	3 bed semi house
Nibe	Slinky	Heating	4 bed house
IDM	Aquifer	Radiators	3 bed house
IVT	Exhaust air	DHW	1 bed flat
Global Energy	Pond	Space heating only	Barn conversion
Heat King	Ground panels		
Baxi			
Ecodan			
Daikin			
Daalderop			
Worcester Bosch			
ERW			
Calorex			
Kensa			

Heat pump locations

A total of 83 heat pumps distributed across the UK



The results - system efficiency



Mean: 2.28

Median: 2.28

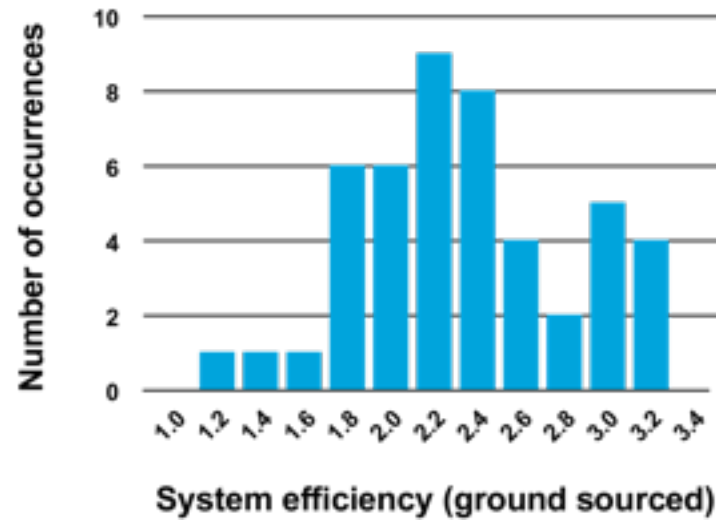
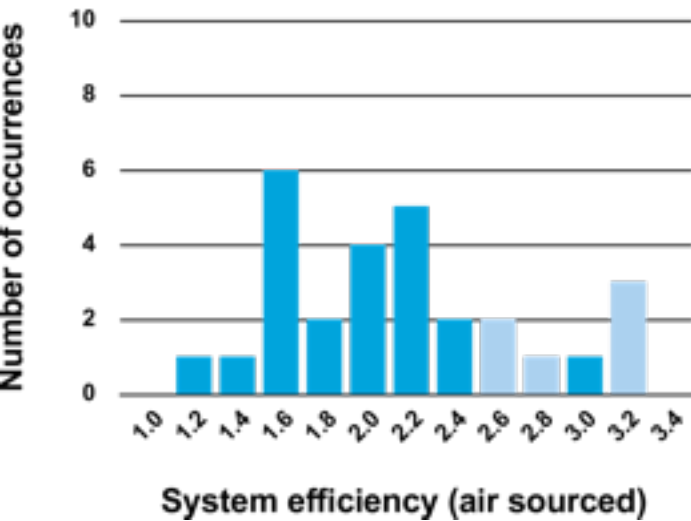
90th percentile 3.21

10th percentile 1.52

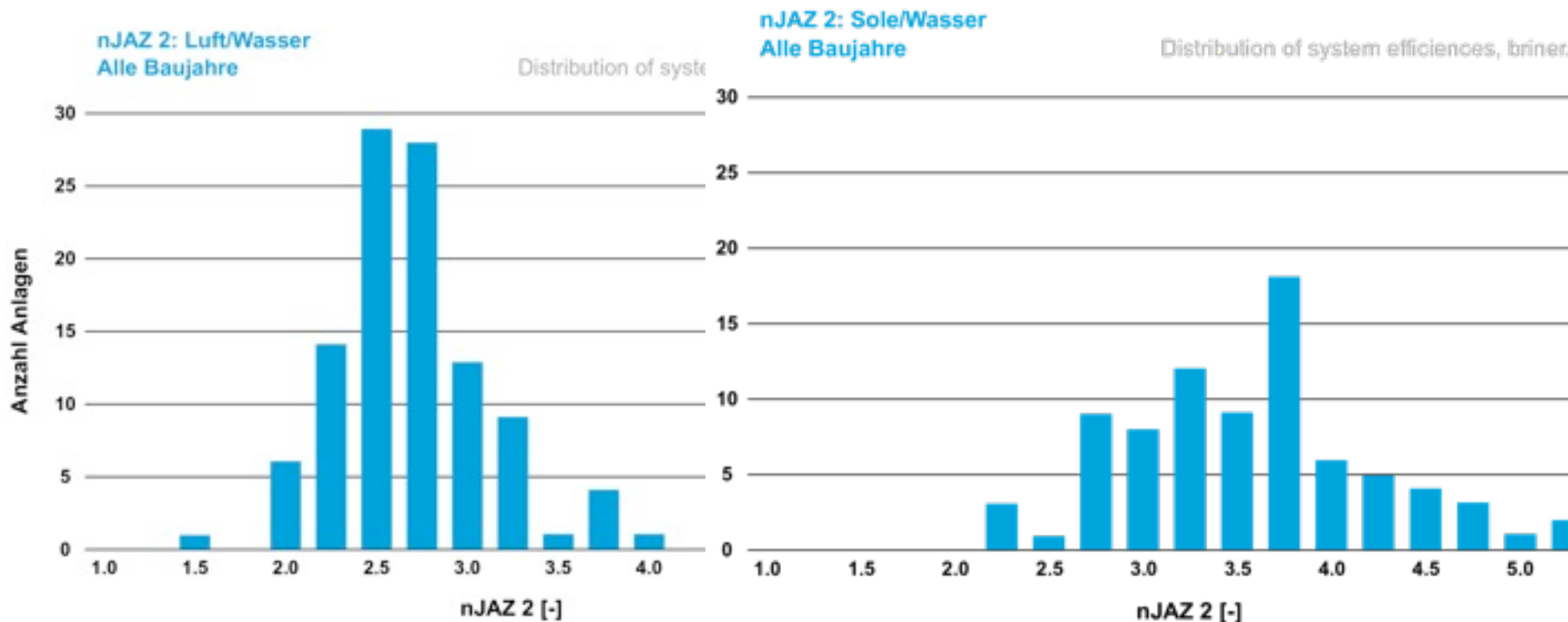
Mode: 2.2

System efficiency UK

System Efficiency - ASHP / GSHP



System efficiency Switzerland



Year 2

The field trial has been extended for a second year to:

- Collect data for an additional year (was last year special?)
- Attempt to improve underperforming sites (expert tinkering)
- Identify and understand good performing sites (why were they good?)
- Undertake additional analysis of existing data
- More engagement with manufacturers & installer
- Add new sites and new partners

***Supported by DECC, ETI, & EST members –
additional manufacturers and study partners are still
welcome to join with additional sites and funding***

SMARTs

Smart Home Energy Management



energy saving trust®

What is so Smart about meters?

All they are doing is recording how much energy goes past them and when it went past.
What is so smart about that?

To be truly smart a technology should be able to make decisions based on knowledge it is receiving in real time.

Essential knowledge will be coming from so called “smart” meters, but it may also be coming from wired internet, wireless GPRS, terrestrial radio or even satellite broadcast.

The householder might also want to have some say in what it decides!

How does Smart Home Energy Management work?

It's so simple...

6pm November – Tea time

- Electrical power is in short supply, the expensive to run power stations are being brought on line and the pumped storage stations are on instantaneous standby.
- Tariff could be broadcast at **50p/kwhr**.
- The SHEM system “hears” this, switches off the immersion, stops charging the electric car, switches off the fridge and freezer if they are within safe cold limits, switches off the washing machines, tumble dryers and dishwashers (unless set to override),....**and then starts selling back power from the household second hand EV batteries and microgen capacity, (at a very profitable 50p per kWhr).**

3am November – a windy night

- Currently, on an unplanned windy night, wind turbines have to be turned out of the wind as the current system of energy purchase makes energy generators book their generation slot up to a month in advance. An obvious waste!
- On a very windy night, and if big wind and nuclear are implemented as forecast, there may come situations where the standby power from nuclear stations and big wind is greater than demand.
- On such a night, tariff may drop to **1p a kWhr**. It may even go negative. The SHEM “listens” to this broadcast (and has indeed prepared for

It's so simple...

Party mode - *I want it all, I want it now!*

Standard mode – *least cost/max amenity*

Economy mode – *least cost/least amenity*

Profit mode with microgen and/or household batteries – *max profit/least amenity*

Smart storage and trading Matrix

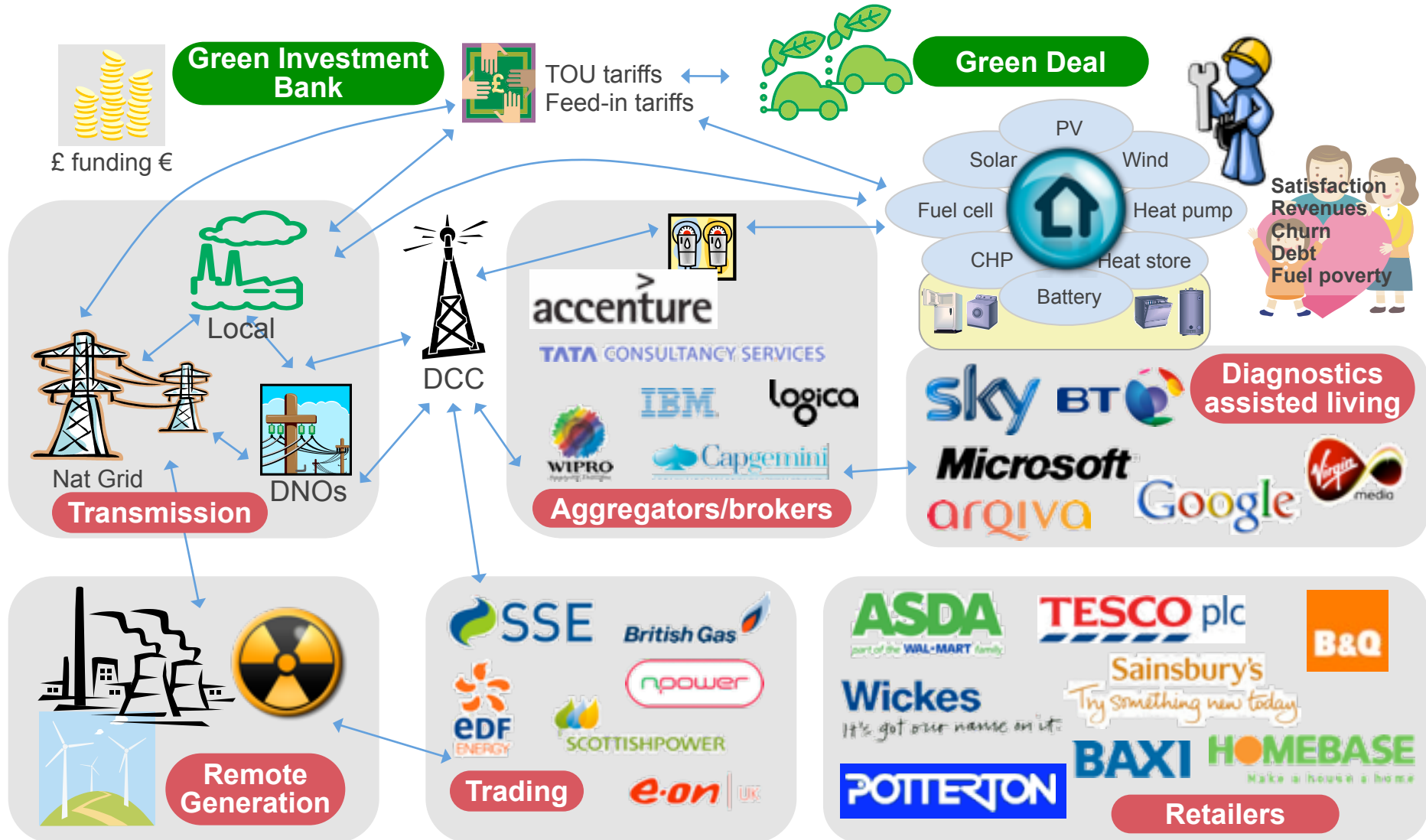
Time	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
Rules																								
input rate	£ 0.08	£ 0.04	£ 0.02	£ 0.02	£ 0.02	£ 0.02	£ 0.02	£ 0.07	£ 0.12	£ 0.40	£ 0.25	£ 0.20	£ 0.28	£ 0.40	£ 0.20	£ 0.25	£ 0.30	£ 0.50	£ 0.90	£ 0.45	£ 0.25	£ 0.20	£ 0.15	£ 0.10
export rate	£ 0.07	£ 0.02	£ -	£ -	£ -	£ -	£ 0.01	£ 0.05	£ 0.10	£ 0.20	£ 0.25	£ 0.15	£ 0.18	£ 0.30	£ 0.15	£ 0.21	£ 0.28	£ 0.45	£ 0.45	£ 0.43	£ 0.25	£ 0.15	£ 0.13	£ 0.08
RT rate (exposed)	£ 0.17	£ 0.31	£ 0.01	£ 0.01	£ 0.01	£ 0.01	£ 0.01	£ 0.11	£ 0.31	£ 0.61	£ 0.51	£ 0.31	£ 0.31	£ 0.51	£ 0.31	£ 0.31	£ 0.51	£ 0.91	£ 0.31	£ 0.01	£ 0.01	£ 0.01	£ 0.01	£ 0.01
Rules																								
export store if D+	£ -0.35	£ -	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35	£ 0.35
import to store if L	£ -0.05	£ -	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05
export rate (kW)	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
store rate (kW)	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Store capacity -3 (kW/hrs)	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Use and harvest																								
Use	0.5	0.2	0.2	0.2	0.2	0.2	0.3	0.5	1	0.5	0.5	1	1	0.5	0.5	0.5	1	2	1	0.5	0.5	0.5	0.2	0.2
Cost of use if no harvest and store	£ 0.05	£ 0.01	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.04	£ 0.12	£ 0.28	£ 0.15	£ 0.10	£ 0.28	£ 0.40	£ 0.10	£ 0.13	£ 0.15	£ 0.50	£ 1.00	£ 0.45	£ 0.15	£ 0.10	£ 0.08	£ 0.02
harvest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cost of use if no store	£ 0.05	£ 0.01	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.05	£ 0.04	£ 0.06	£ 0.28	£ 0.15	£ 0.10	£ 0.28	£ 0.28	£ 0.28	£ 0.10	£ -	£ -	£ 0.50	£ 1.00	£ 0.45	£ 0.15	£ 0.10	£ 0.08
store as electric	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net import	0.5	0.2	0.2	0.2	0.2	0.2	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	2	1	0.5	0.5	0.5	0.2
Store and harvest available																								
harvest available	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
turning put into store	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
store efficiency	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Total Available to export	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Import costs																								
to use	0.5	0.2	0.2	0.2	0.2	0.2	0.3	0.5	0.5	0	0	0	0	0	0	0	0	1	2	1	0.5	0.5	0.5	0.2
cost	£ 0.045	£ 0.005	£ 0.004	£ 0.004	£ 0.004	£ 0.004	£ 0.004	£ 0.005	£ 0.005	£ 0.005	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ 0.000	£ 0.000	£ 0.000	£ 0.000	£ 0.000	£ 0.000	£ 0.000
to store	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cost	£ -	£ 0.120	£ 0.000	£ 0.000	£ 0.000	£ 0.000	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Exports																								
from harvest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
from store	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Hourly Cost/Profit																								
Hourly Cost/Profit	-£0.85	-£0.13	-£0.06	-£0.06	-£0.06	-£0.06	-£0.01	-£0.04	-£0.06	£1.33	£0.12	£0.18	£0.18	£1.33	£0.89	£0.06	£0.00	£0.94	£0.44	£0.65	-£0.15	-£0.10	-£0.08	-£0.03
Running Cost/profit																								
Running Cost/profit	-£0.85	-£0.17	-£0.24	-£0.30	-£0.37	-£0.43	-£0.44	-£0.47	-£0.53	£0.88	£0.91	£1.09	£1.27	£2.60	£2.89	£2.89	£2.89	£3.83	£4.97	£4.72	£4.59	£4.49	£4.42	£4.40

Net Cost/profit at end of day (Difference between Profit and Net cost or ordinary use) **£5.82**

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It's so Complex

"Smart System"...risks

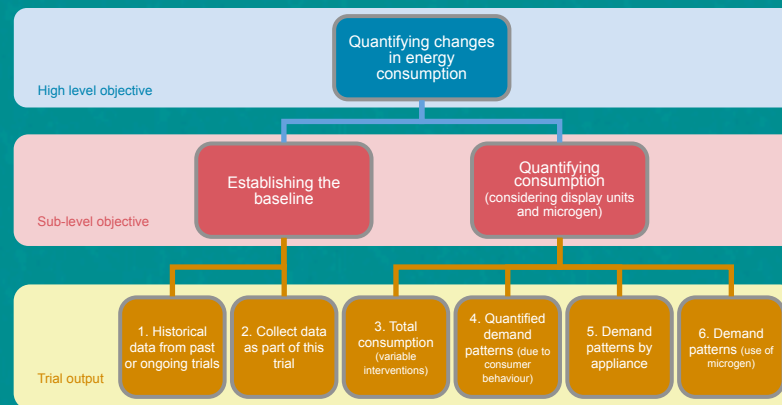


Smart field trial design

Assume **1000 households** for each smart management technology tested

Subset testing of different technologies e.g. EV's, microgen at “local” levels at 10%

Representative sample & mix occupants, incomes, ages, employment patterns, energy consumption needed



Other Smart (ish) Monitoring projects we are currently doing...



energy saving trust®

SHIMMER

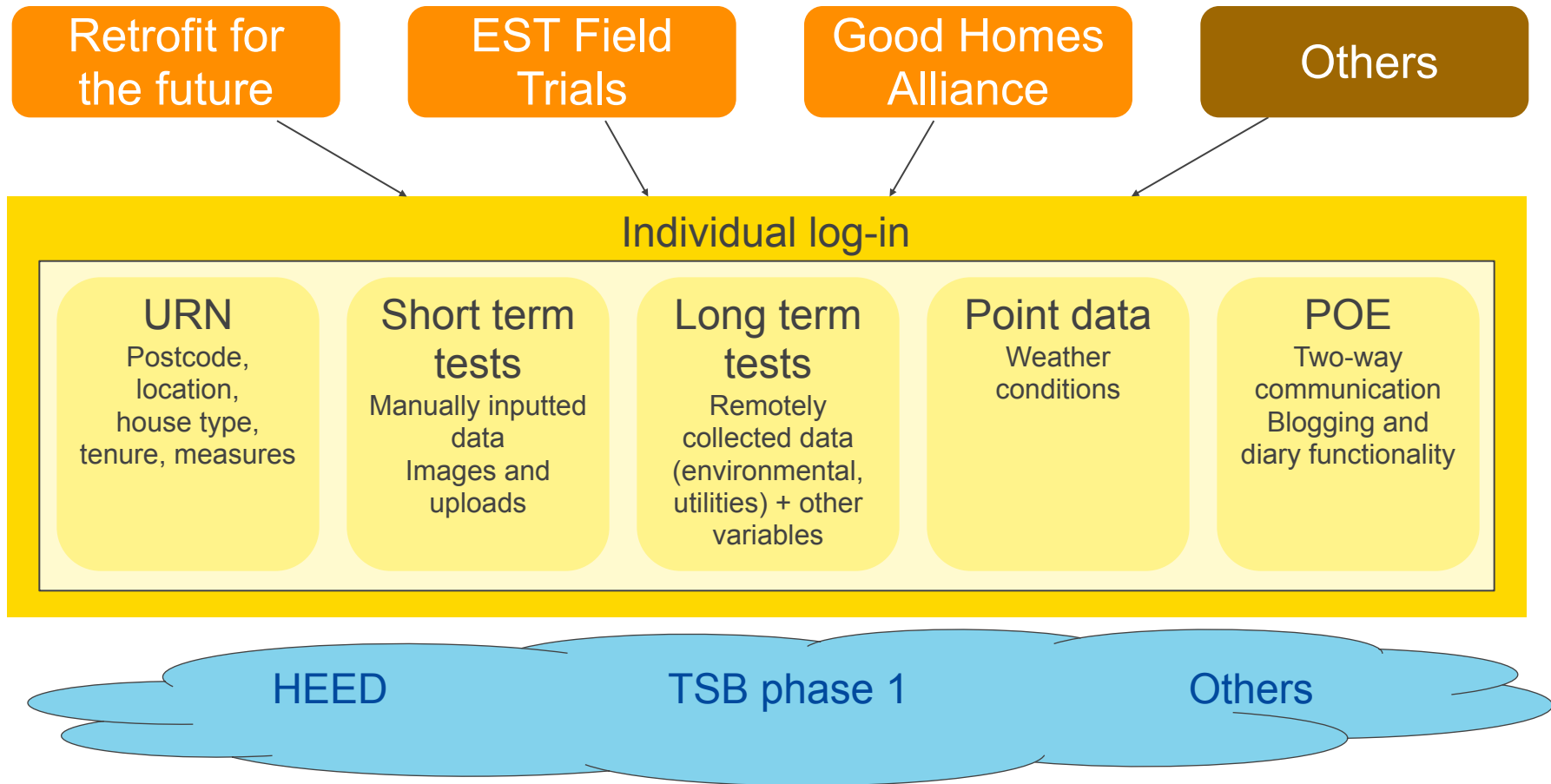
Partners Smart Homes Integrating Metering Money and Energy Research

- Energy Savings Trust
- London Rebuilding Society
- EasyTown CIC
- Technology and Strategy Board

SHIMMER will allow the user to access the system through a device with which they are already comfortable using such as their **television set top box, PC, or smart phone**.

- The system will **network household appliances**, central heating systems and any micro-generation technologies.
- Consumers can monitor, control and **automate** their **domestic energy consumption** - enabling them to reduce their energy bills and domestic carbon emissions.
- **Financial savings** from energy saving can be **credited onto a pre pay card** for use online or outside the home
- SHIMMER could be used to provide public services such as **benefits payments and personalised healthcare budgets**.

Building performance database – the Observatory Project



A non EST Project we like which solves a practical problem with a “Smart” practical solution

Welcome: Merton

[Manage Developments](#)

[List Developments](#)

[Reports](#)

[Logout](#)

Development Certificate Data

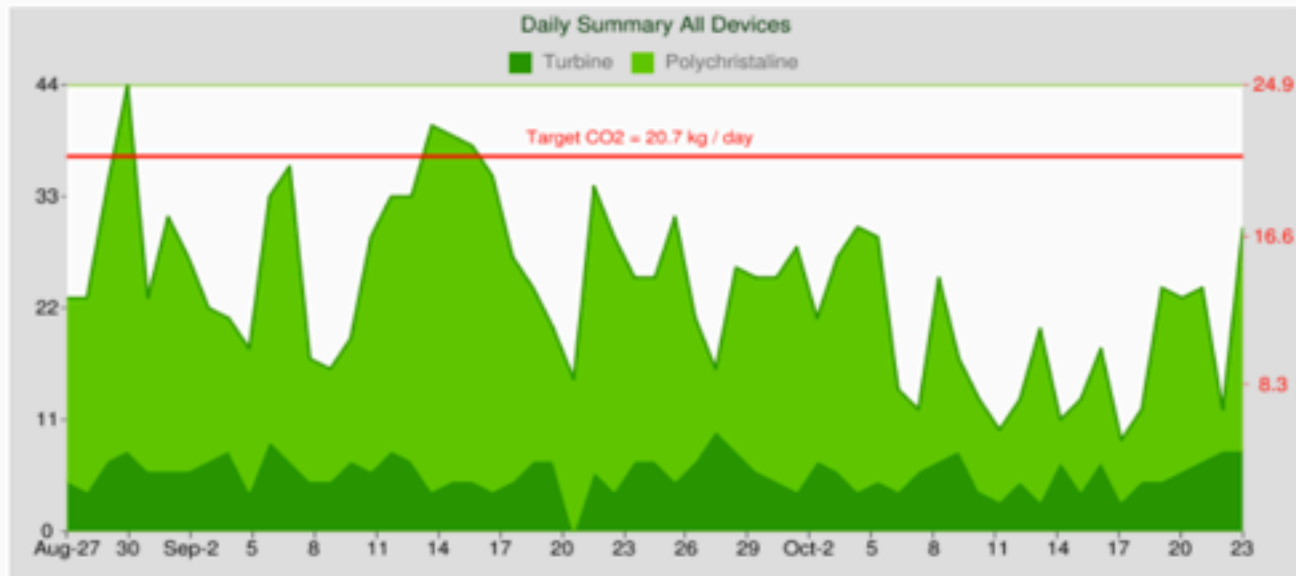
[Development Details](#)

[Predicted energy](#)

[Installed energy equipment](#)

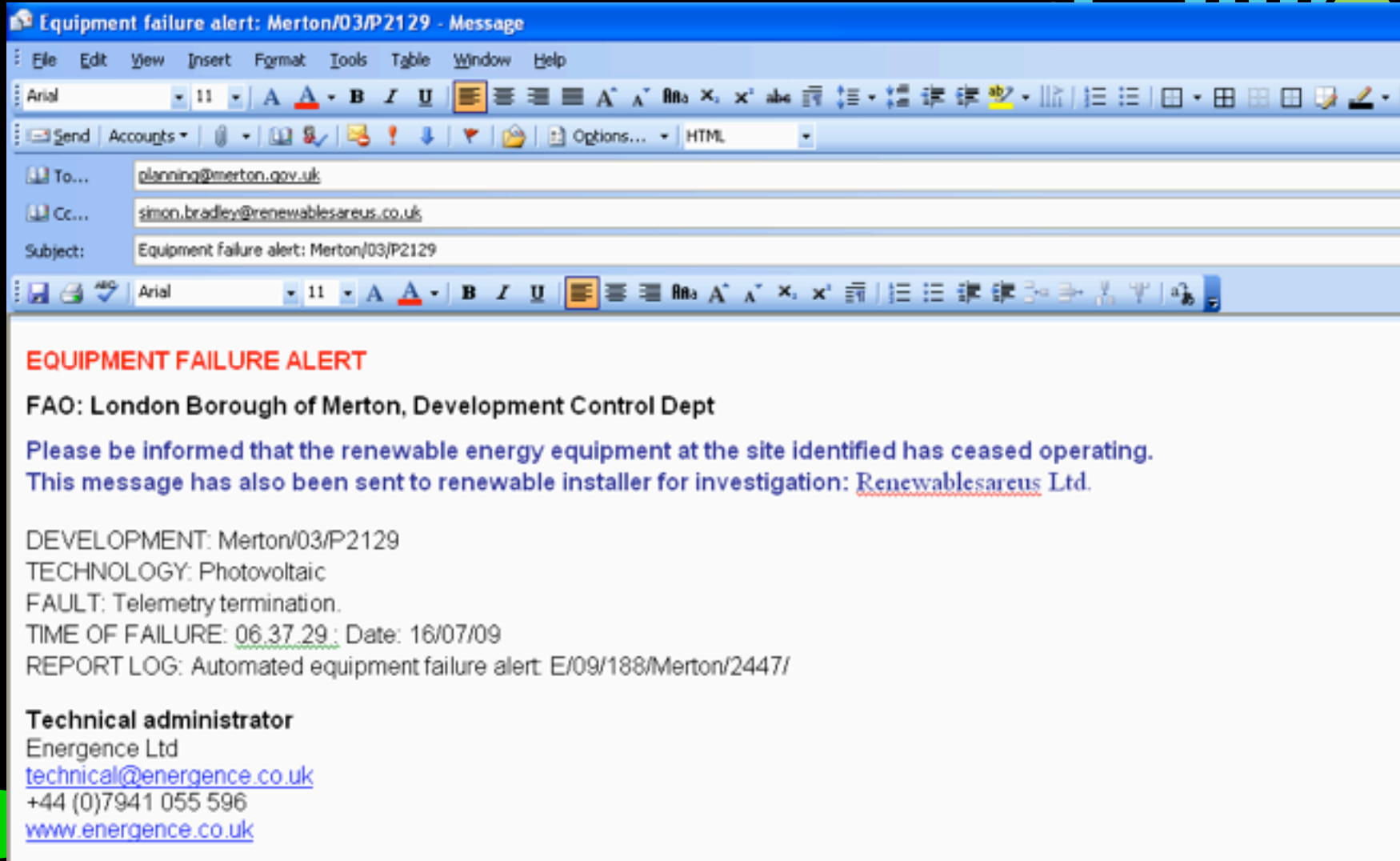
[View energy data](#)

[Daily](#) [Weekly](#) [Monthly](#) [Quarterly](#)



Farming energy data

Presentation Title



Super insulation ($U=0.12\text{W/m}^2/\text{K}$), double skin sunspace, 4000l rainwater system, 64 tube solar thermal array, 2.5kWp photovoltaic array, Biomass (log) boiler stove, Wind assisted passive stack vent heat exchange ventilation (not yet fitted)



One the Orchard

Catherine Roberts and Steven Harris

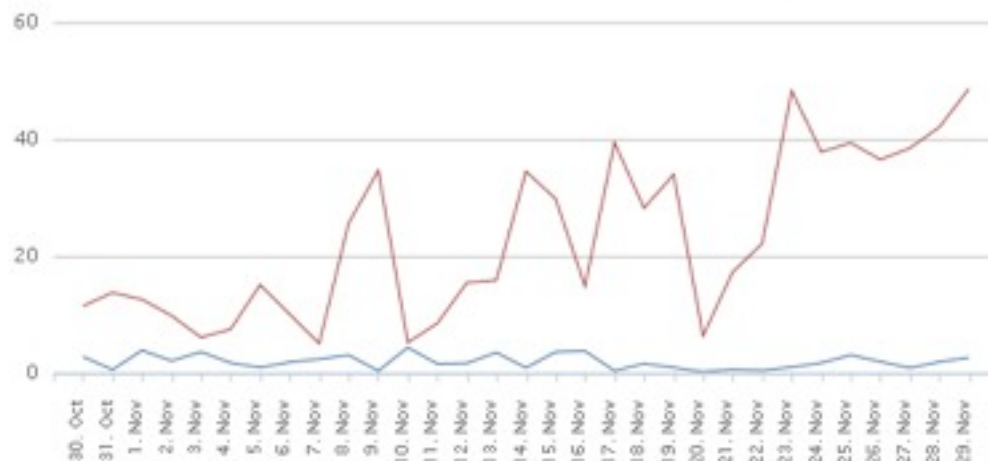
Steven Harris
Energy Savings Trust

Live Data

Farm **Solar Demo**
All Meters (2)

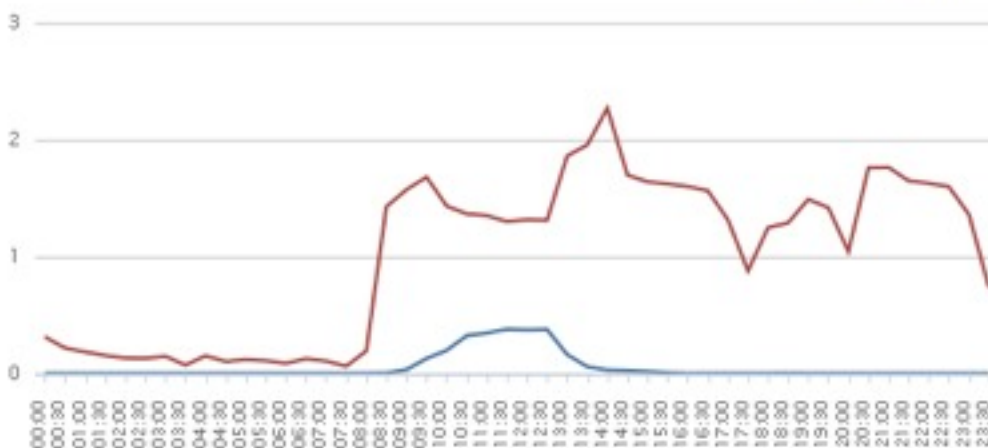
Solar Demo - 31 Day Ending 30 Nov 2010

Months **Days** Settings



Daily Profile For 29 November

Show Today



Email Alerts

Click here to find out how I can be kept aware of my energy usage with an email alert?

[Set Up Email Alerts](#)

How Can I Reduce My Energy Costs?

Click here to find out how your energy cost can be reduced and you can drive energy efficiency into your buildings...

Useful Links

[Tips on How To Reduce Your Carbon Footprint.](#)

[Products That Can Help Me Have Lower Energy Costs.](#)

thank you for listening



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www.energysavingtrust.org.uk

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