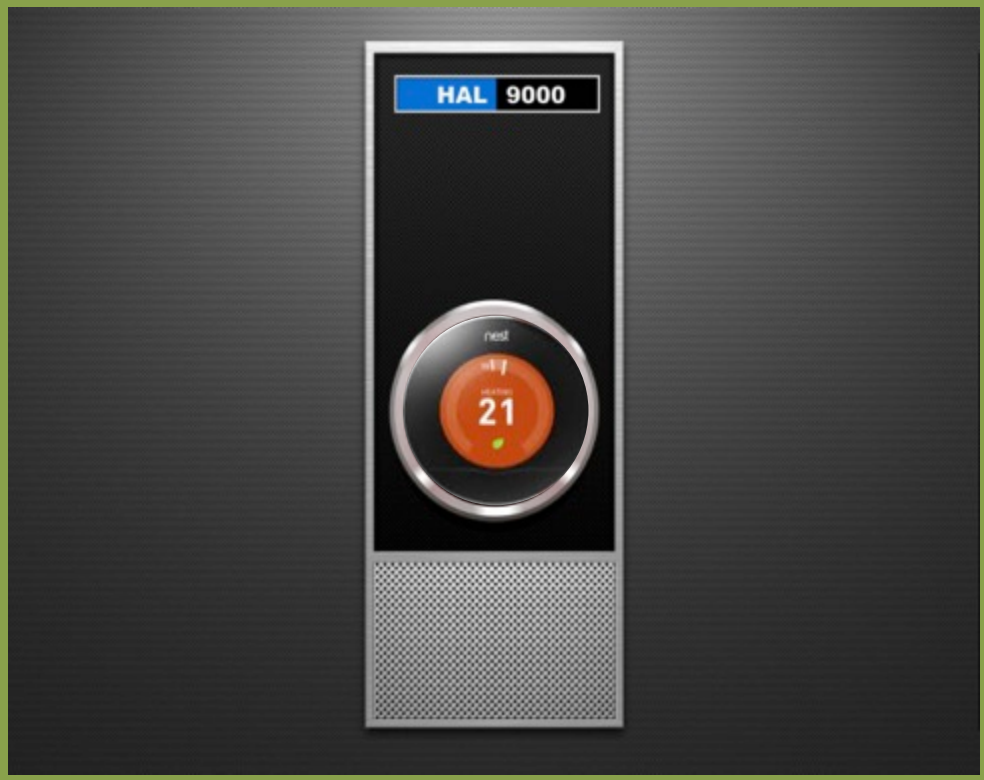
Smart energy and Passivhaus

…is my smart thermostat bored?

AECB Annual Conference 2014
12th July 2014
Bristol

Steven Harris
Catherine Roberts and Steven Harris
Architecture and Energy

crsharchitects.co.uk



Who am I?

Steven Harris BscDipArch ARB RIBA

Principal - CRSH Architects

Zero energy houses and domestic architecture

Director - Steven Harris Ltd.

Energy Efficiency and Renewable Energy Consultancy

Technical and Policy Director - Energence Ltd. (The Energy Monitoring Platform)

Smart metering, field trials and regulation compliance monitoring

Director - Abergavenny Energy CIC

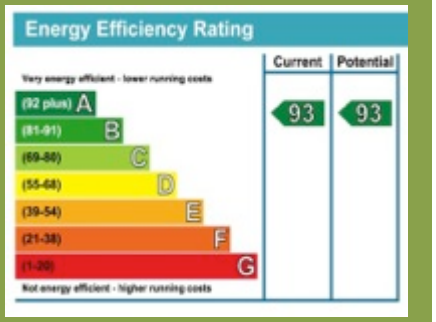
A community energy company

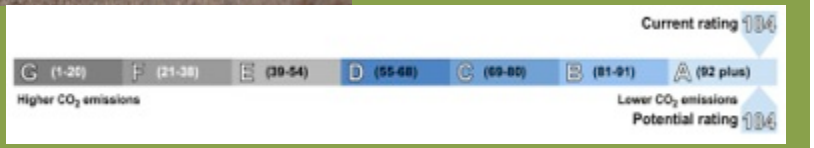
I also sit on the (English) **Zero Carbon Hub**

Previously I have been…

- Technical Lead at **The Energy Saving Co-operative**
- Head of Low Carbon Technologies at the **Energy Saving Trust**
- Associate at the **Energy Saving Trust**
- Technical Director (and co founder) of **ZEDfactory**
- Senior Lecturer at **The University of East London**
- Architect at **Michael Hopkins and Partners**

One the Orchard – **new build**





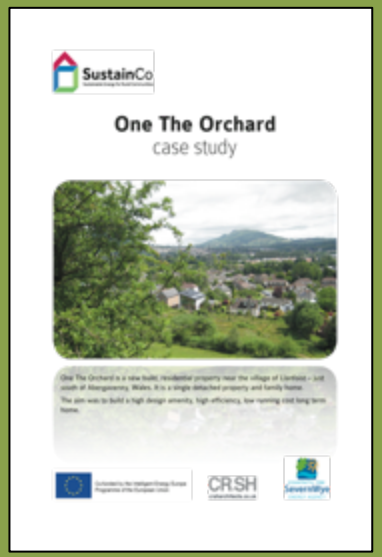
One the Orchard – **studies**

BBC NEWYDDION

9 Gorffennaf 2013 Diweddarwyd 09:48

Rhestr fer Medal Aur am Bensaernïaeth yr Eisteddfod

Eisteddfod Genedlaethol Sir Ddinbych yn Cyflwyno
3 – 10 Awst / August 2013
Denbighshire and District National Eisteddfod

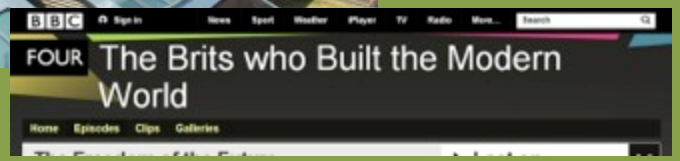


One the Orchard – **our aims**

Portcullis House
Michael Hopkins Architects 1999

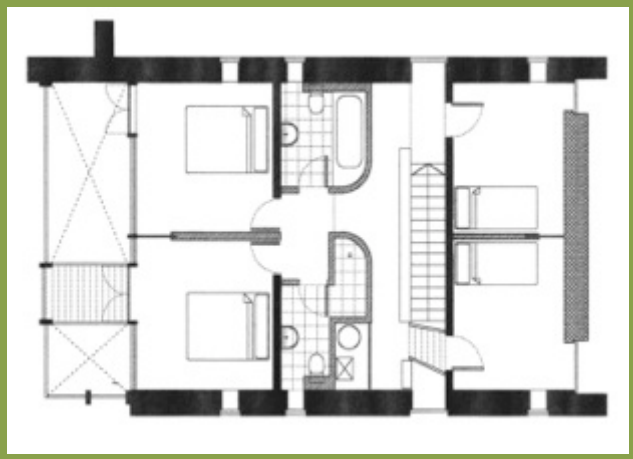
University of Nottingham
Michael Hopkins Architects 1998

BedZED zero energy housing
ZEDfactory 2001



Ziggurat penthouse apartment
Form Design Architecture

One the Orchard – **designed for C21st living**



One the Orchard – **thermal mass and superinsulation**

One the Orchard – **local trades and materials**

One the Orchard – **south facing sunspace**

One the Orchard – **ventilation**

- **One the Orchard** uses wind to push and pull air through the house

One the Orchard – **(very) local biomass**

One the Orchard – **Under Floor Heating**

Maximising heat storage in the thermal mass

Technologies – **solar thermal**

Energy Saving Trust Solar Thermal Field Trial 2010 -11

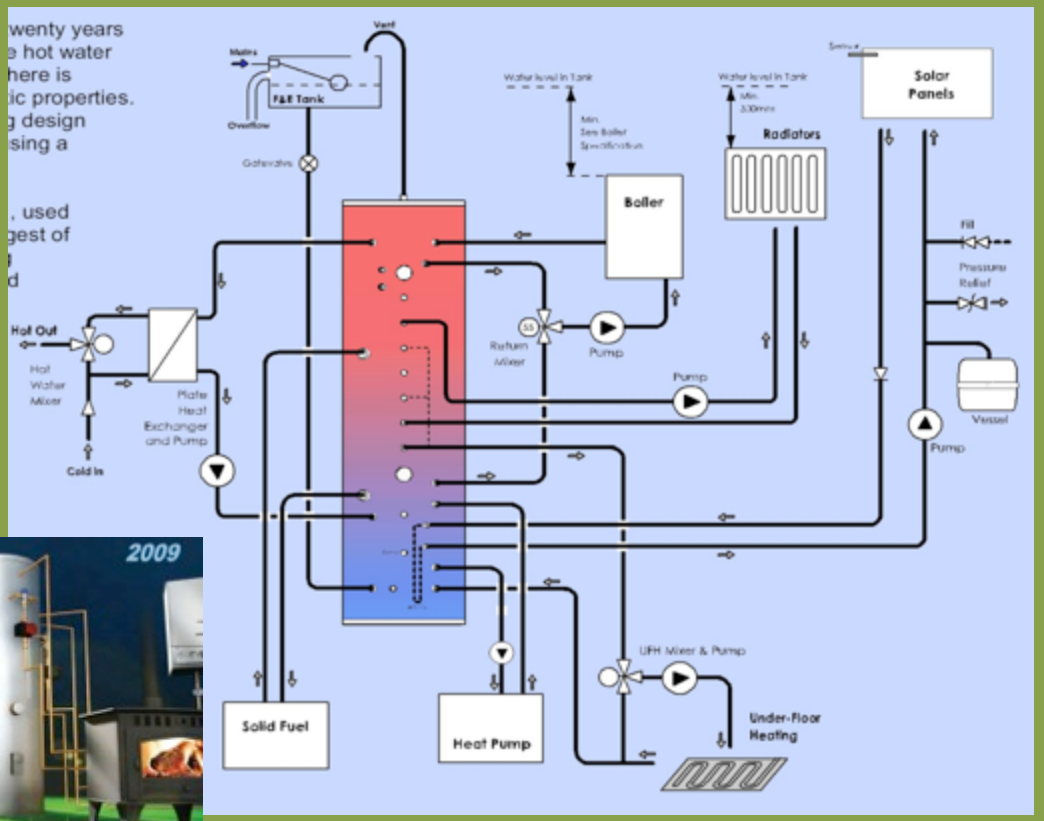
- Most widespread microgeneration technology installed in UK (6,000+)
- EST monitoring a representative sample of 100+ domestic sites
- Monitored for 1+ year

Answers the long standing argument…. are tubes better than flat panels?

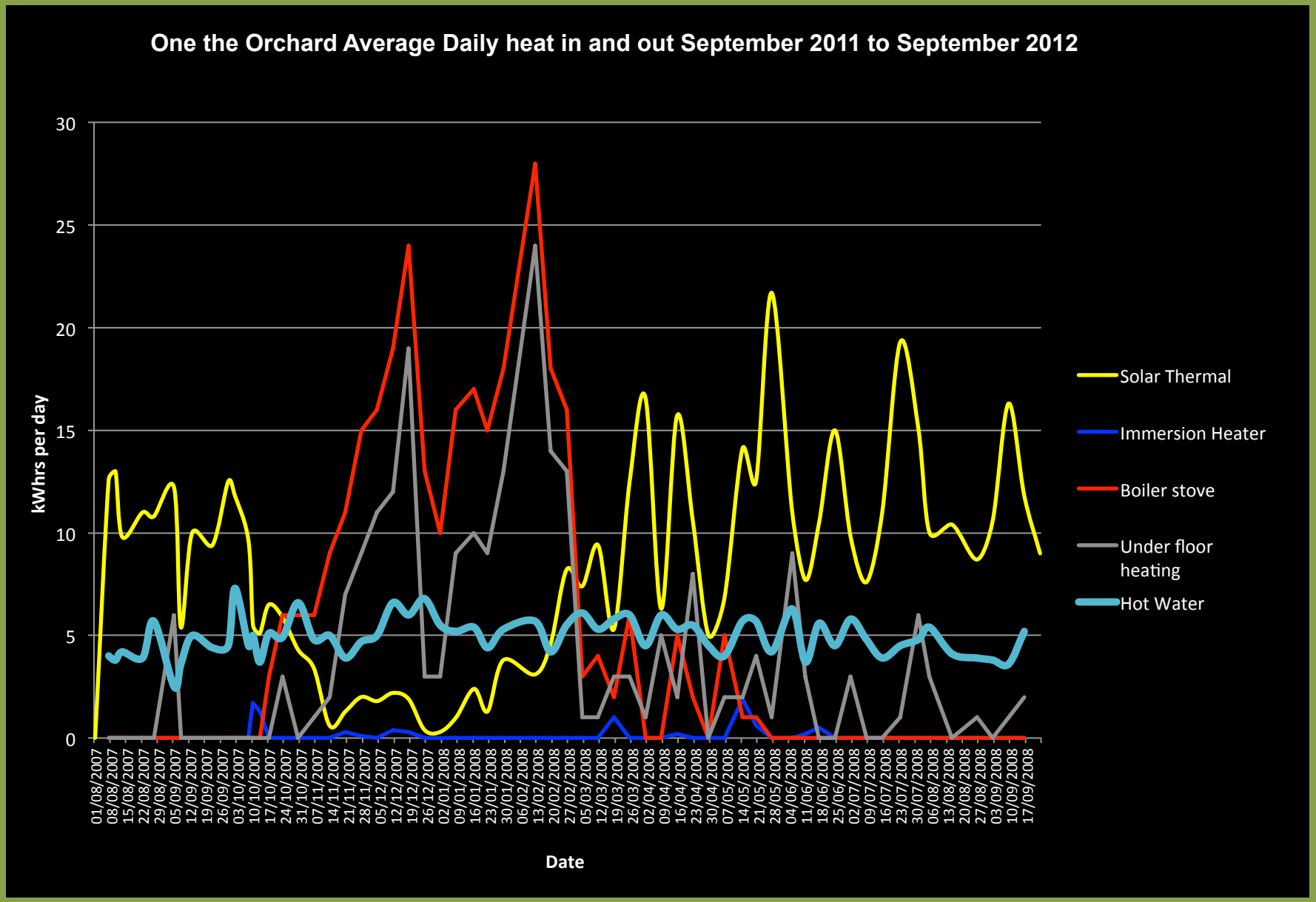
vs

Turns out… Doesn't matter !

Technologies – **thermal storage**



It’s what you do with it that counts!


One the Orchard Average Daily heat in and out September 2011 to September 2012
kWhrs per day
30
25
20
15
10
5
0
01/08/2007
08/08/2007
15/08/2007
22/08/2007
29/08/2007
05/09/2007
12/09/2007
19/09/2007
26/09/2007
03/10/2007
10/10/2007
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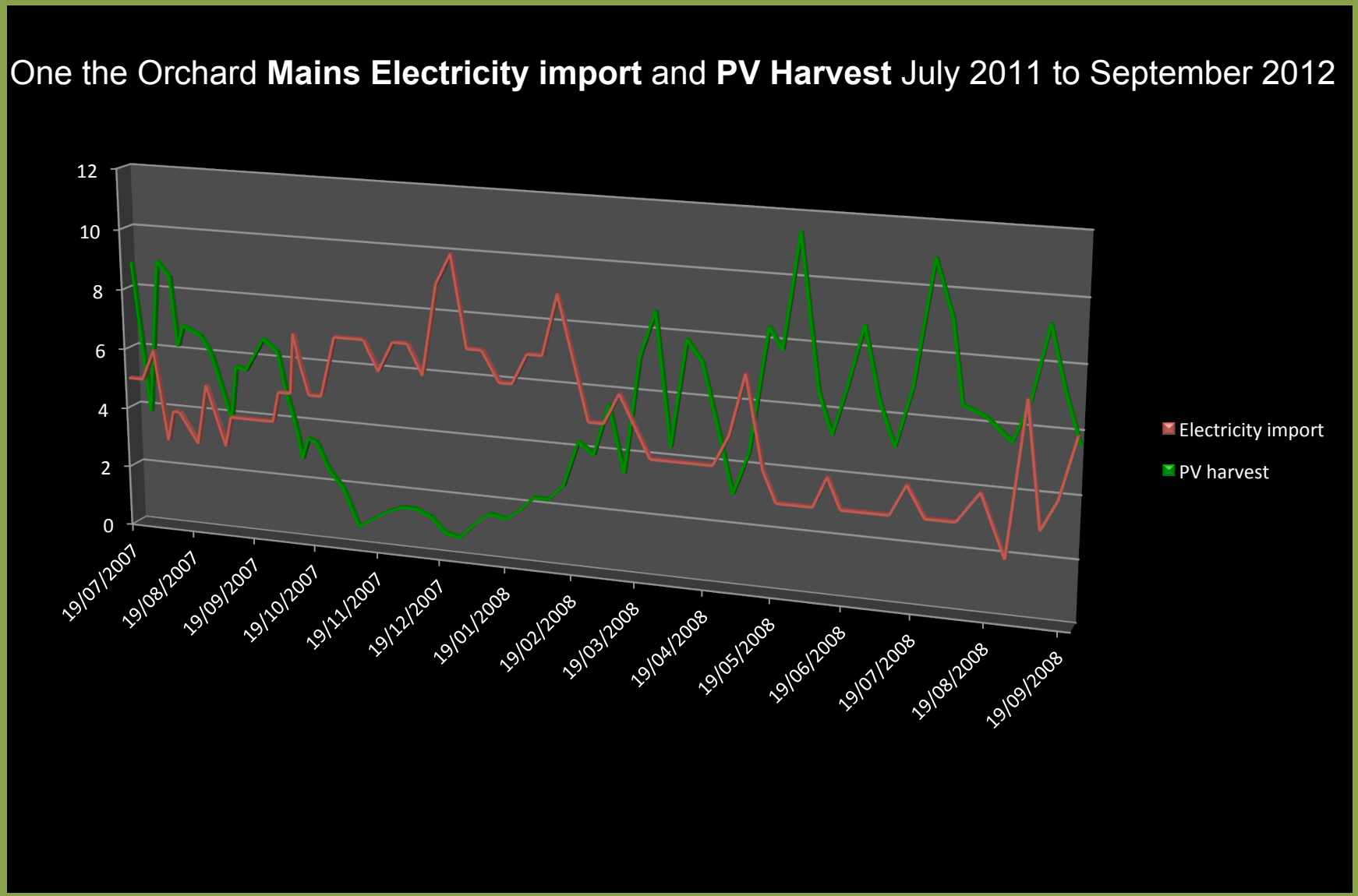
16/07/2008
23/07/2008
30/07/2008
06/08/2008
13/08/2008
20/08/2008
27/08/2008
03/09/2008
10/09/2008
17/09/2008
Date
Solar Thermal
Immersion Heater
Boiler stove
Under floor heating
Hot Water

One the Orchard **Mains Electricity import** and **PV Harvest** July 2011 to September 2012



Heat - (no gas or oil) 2011 - 12

From logs 716kWhrs
(metered to water so (say) 1000kwhrs including the heat from the stove body)

Cost £210
(from Treescape Abergavenny plus small coppice harvest and waste wood)

Equivalent to 6kWhrs/M2

(Passive house requires less than 15kWhrs/m2 of applied heat)

However for the much colder winter of 2012 -13 it was 15kWhrs/m2 which meant we spent an extra £140 on logs

From solar thermal 3422kWhrs
(including summer dump harvest)

Summary 2011 - 12

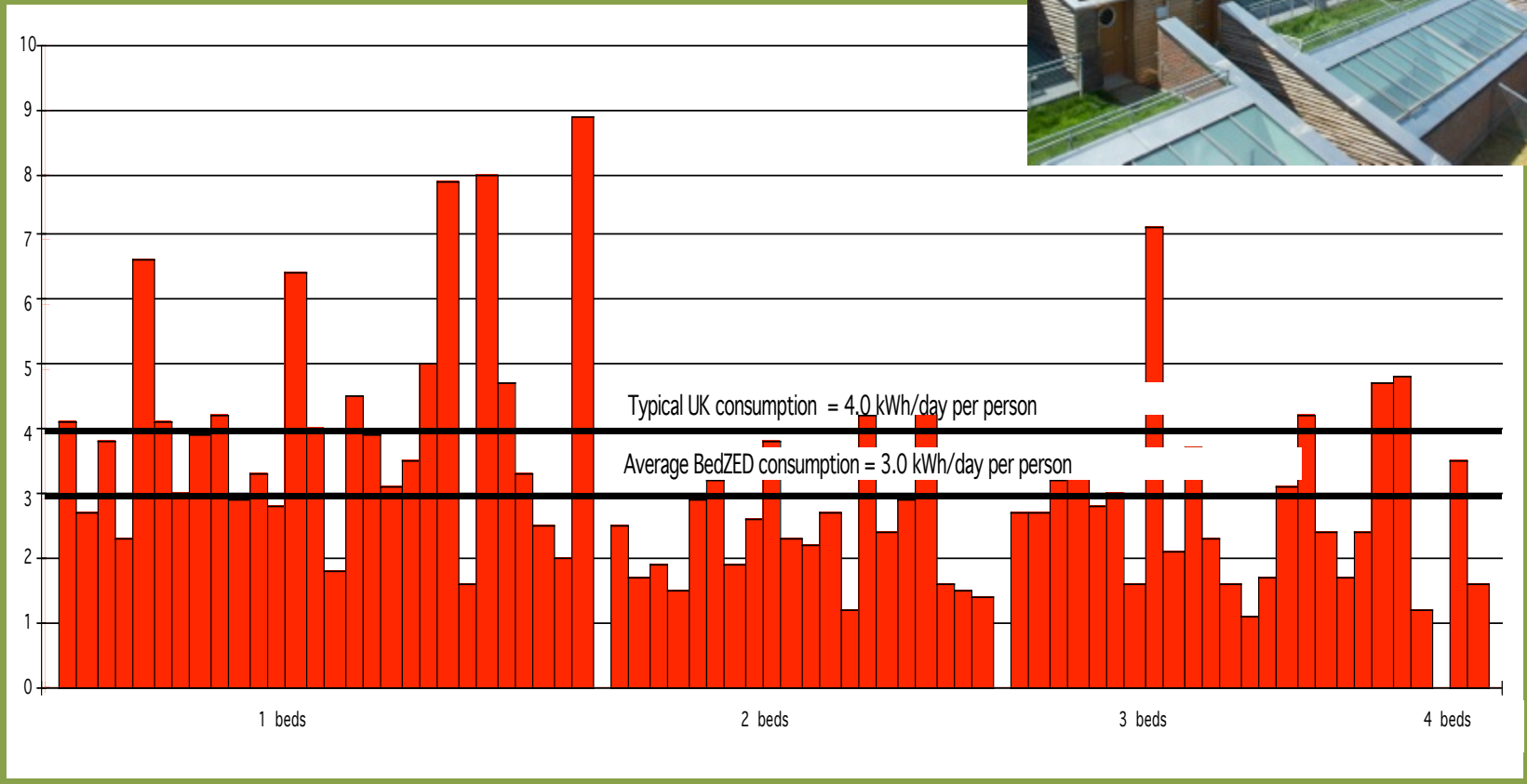
Electricity	£366.66 (Good Energy)
Logs	£210
Water	£139.75 (87m3 = 59L/person/day)
Total	**£716.41**
Income from PV	**£926.19**
Income from Hot Rocs RHI	**£132.32**

Total Energy cost of running the house

£342.10 Profit

So why do we need Smart controls anyway?

- BedZED Electricity
- Zero Heating – Zero Carbon housing
- Monitored 25% average saving, but 400% divergence



And…

what's so smart about meters?

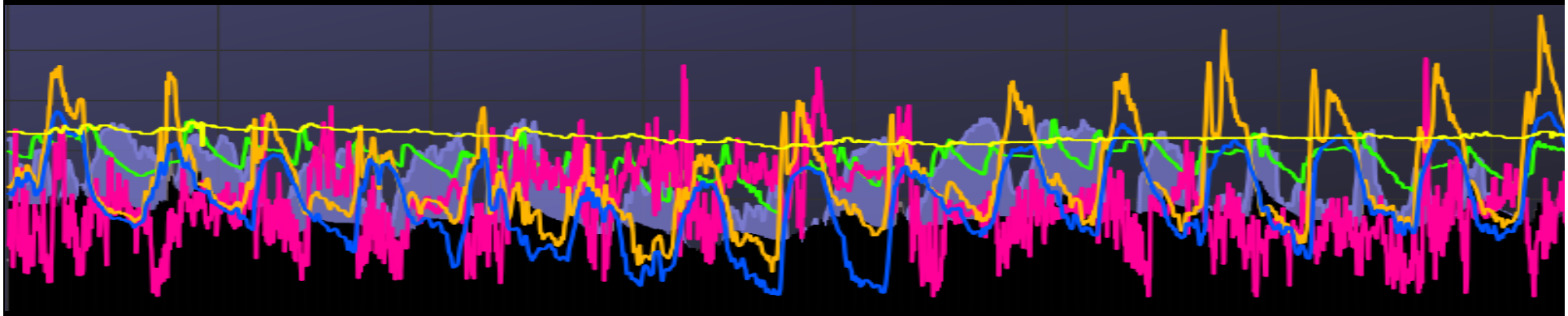
- All they are doing is recording how much energy goes past them and when it went past. What is so smart about that?

- Data 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.

- **To be truly smart a technology should be able to make decisions based on knowledge it is receiving in real time.**
  (The householder might also want to have some say in what it decides!)

AECB Annual Conference 2014

Metrics & Monitoring



Key metrics for proving compliance

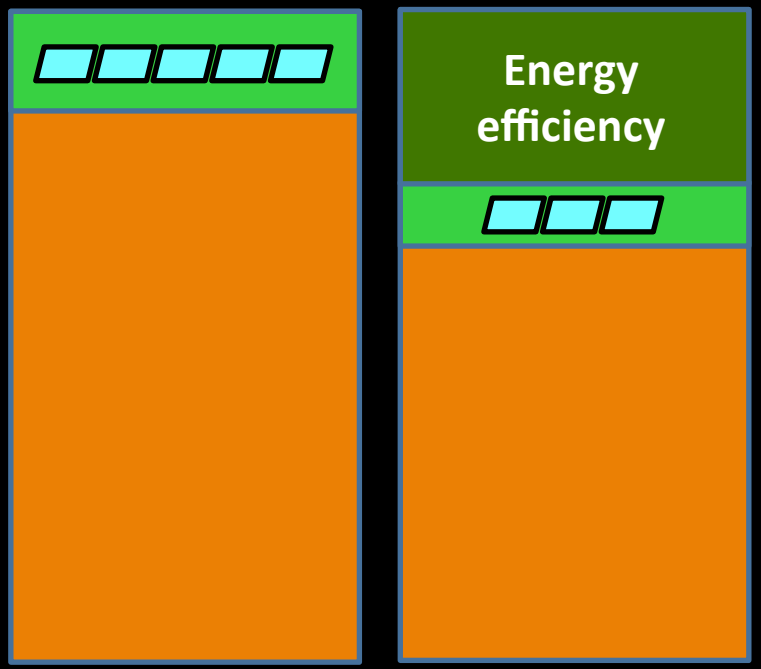
Steven Harris
Technical and Policy Director
Energence Ltd
www.energence.co.uk
www.EnergyMonitoringPlatform.co.uk - *you need to know….*

Domestic regulatory metrics

- **Building Regs –** no account of local circumstances
- **Code / BREEAM –** continually under threat
- **Merton Rule** (Planning & Energy Act)
- **Ealing Condition –** monitoring & compliance

SAVED..!!

"Merton Rule" principle



"Ealing Condition" "Provide an energy monitoring system for tracking and confirming compliance with renewable/ low carbon (and CO_2 reduction) planning policies."

Building robust evidence base

- What was installed?
- Is it working?
- How well is it working?
- Is it meeting the target?
- What has been learned?

Monitoring & Compliance – *administratively painful*

Developer

Planning Officer

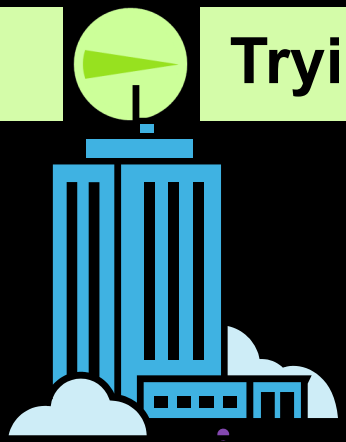
Energy consultant

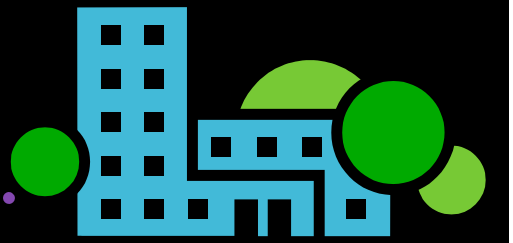
Energy Officer

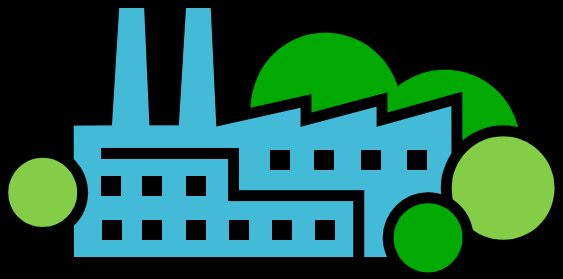
What was installed ?

Time consuming “hunter gathering”

Trying (struggling) **to confirm compliance**





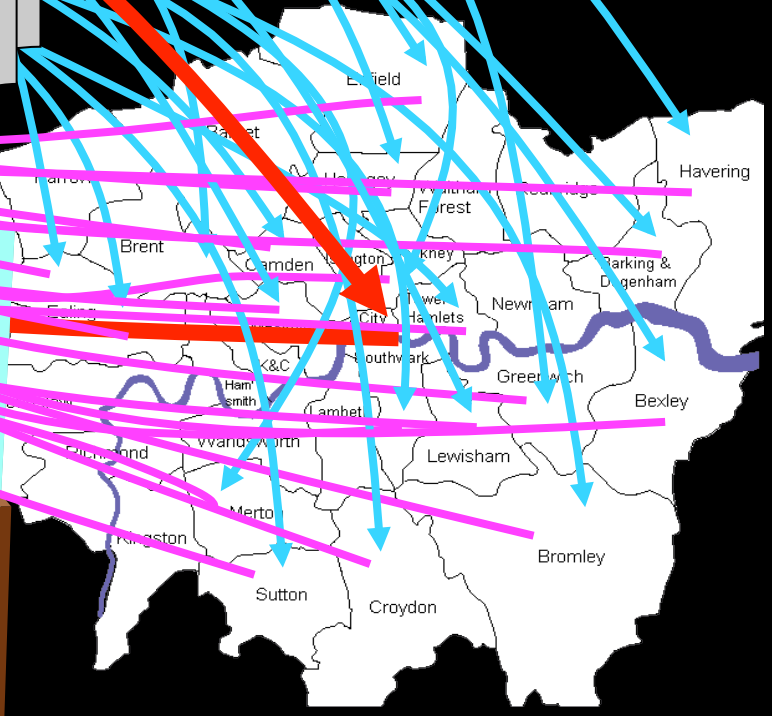


Development	kWh	% RE
Totleigh Towers	17,862	11.8
Acacia Avenue	8,347	3.6
Gove Academy	????	?
Plastica Works	23,804	7.4
Bates Motel	52	0.2

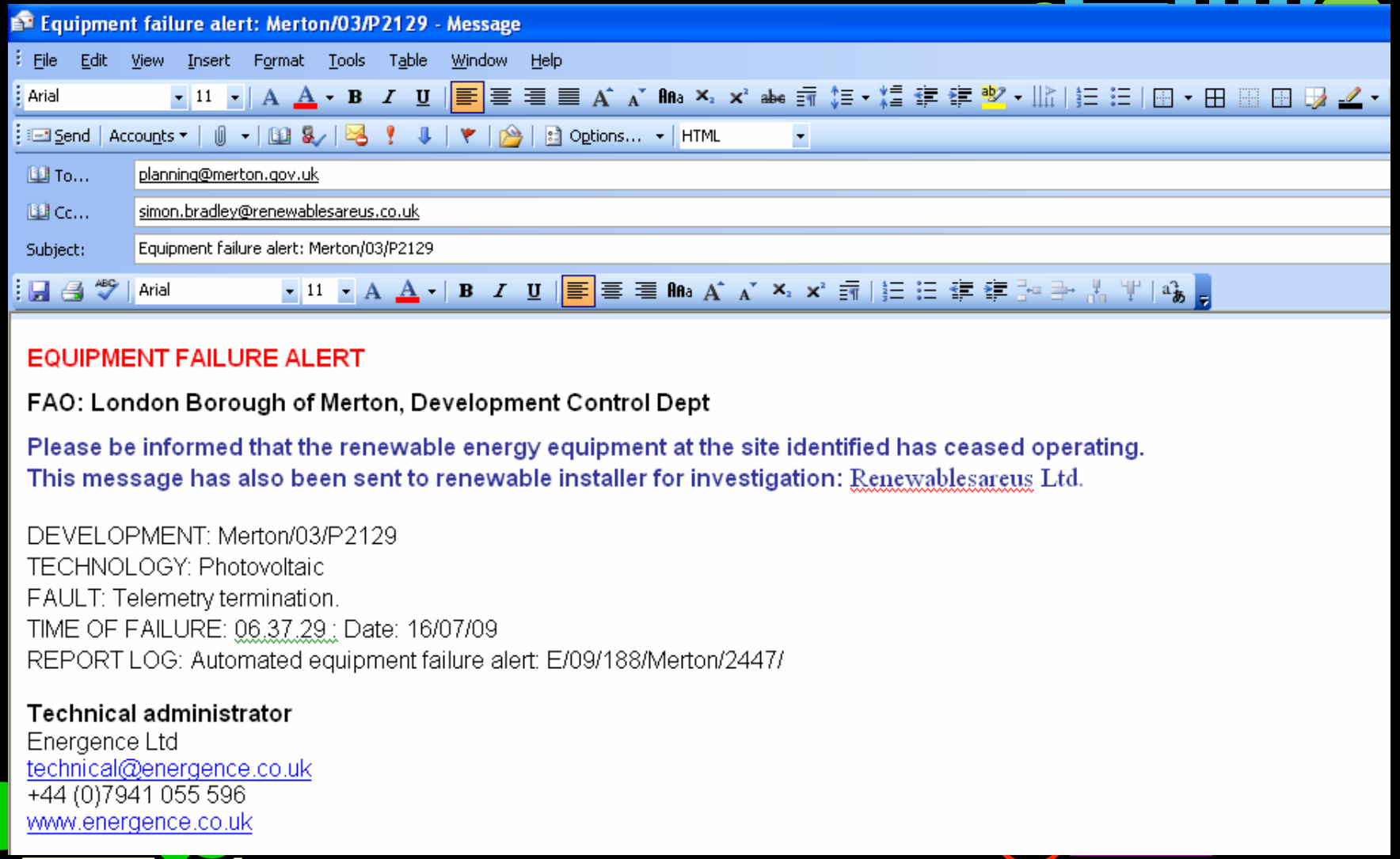
?

Ultimate "*Hunter Gathering*" - Uptake of the Mayor's energy policy

London Renewable snapshot



Farming energy data

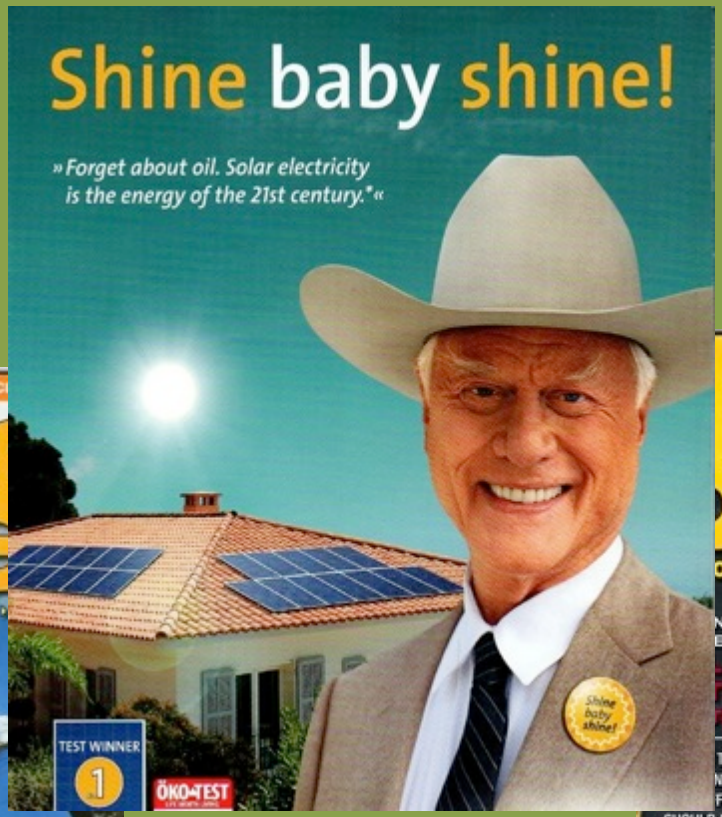


And times are a'changing
Big Change 1 **- Electric Heating**

Big Change 2 - **Electric Transport**

Big Change 2$_{1/2}$ - **Electric Storage!**

Big Change 3 – Affordable renewable energy



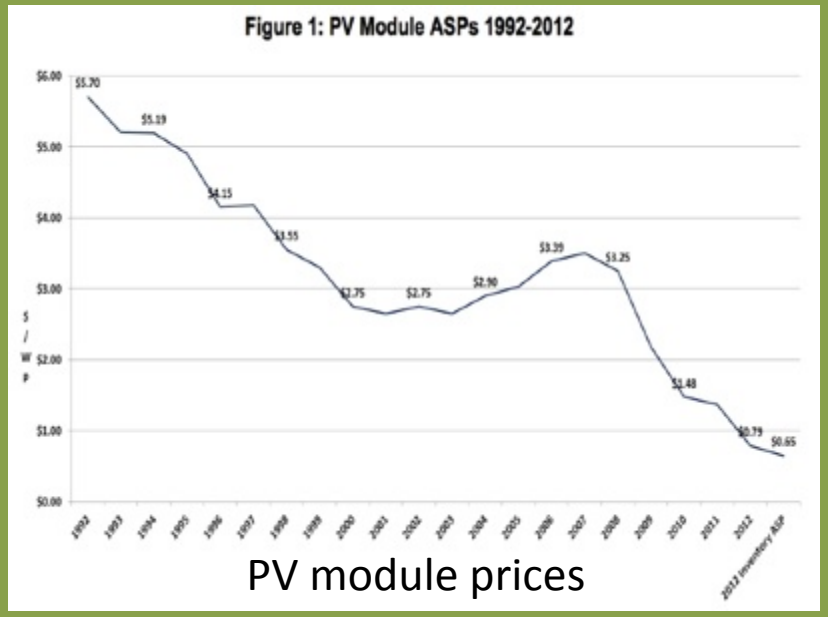
Technologies – **photo voltaic (PV)**

PV close to **'Grid Parity'**

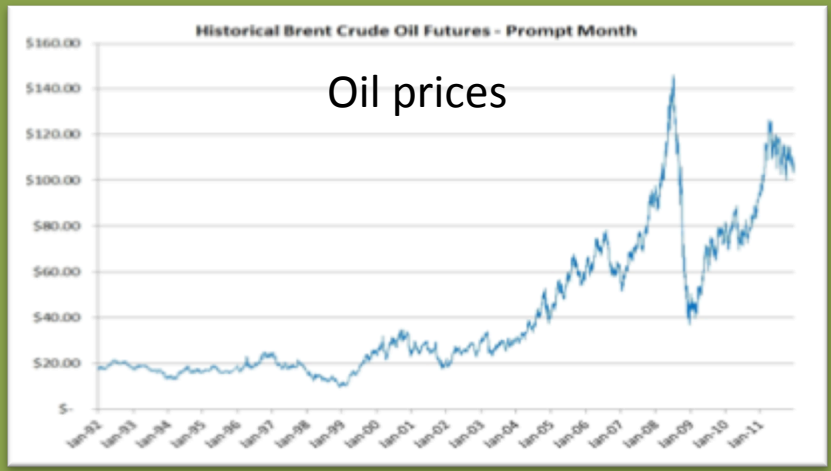
Or, to put it (very) simply for a domestic array

4 kWp x 850kWhrs/kWp
= 3400kWhrs x 25 years
= 85,000kWhrs
(Panels can last 50 years (and counting!)

An average 4kWp domestic array
can be installed for around £6000
£6000 / 85,000kWhrs
= 7p/kWhr
(mains electricity currently retails at 14p and wholesales at around 6p/kWhr)

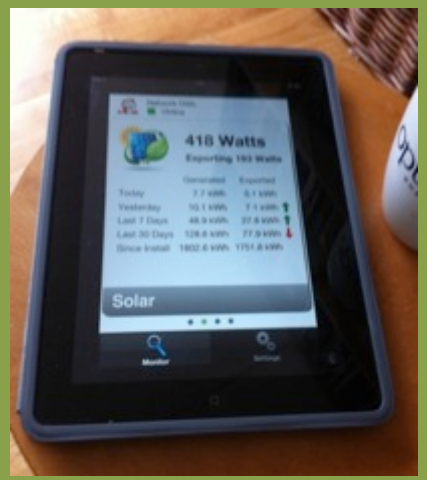


PV module prices

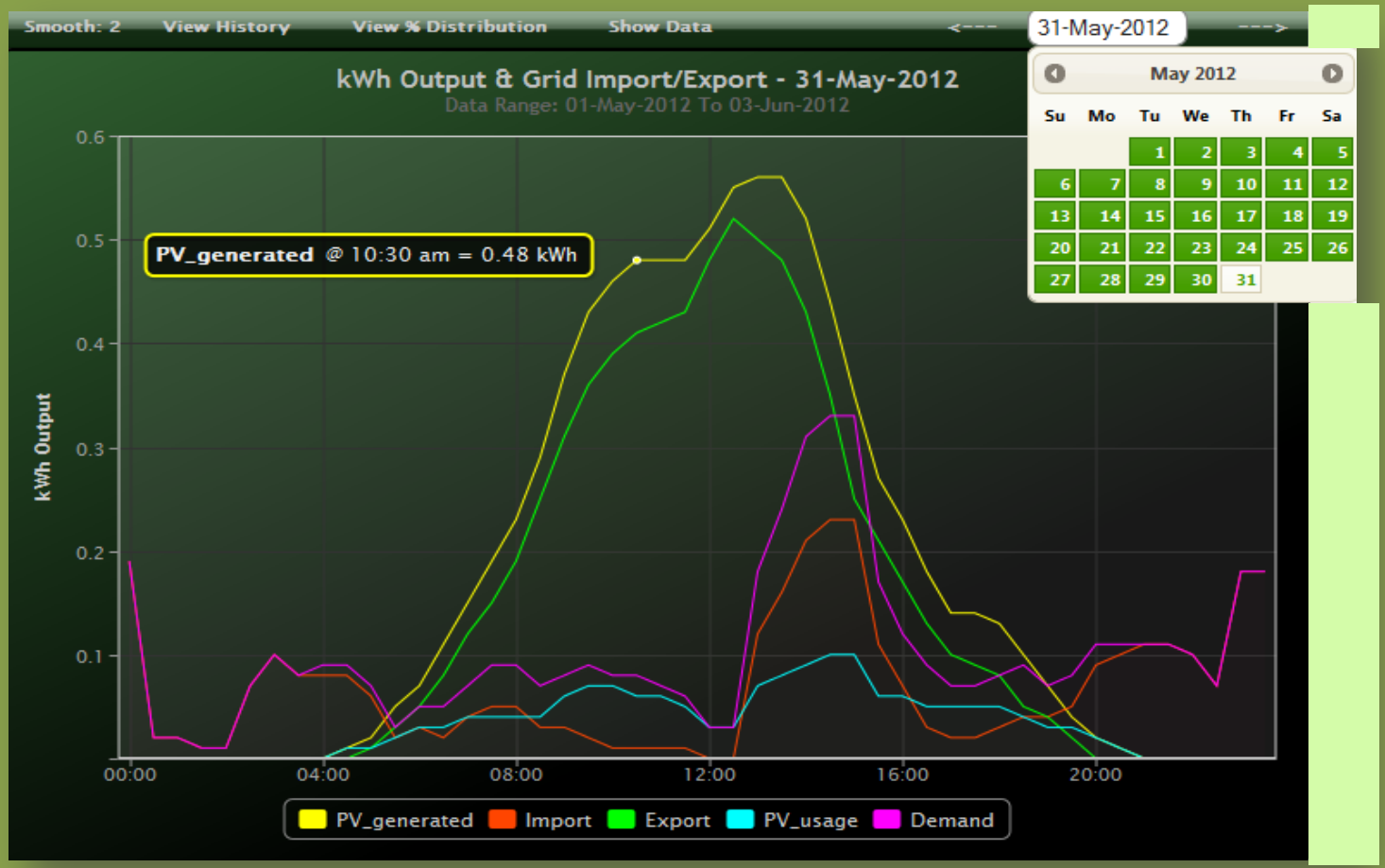


Oil prices

Big Change 4 – intuitive technology



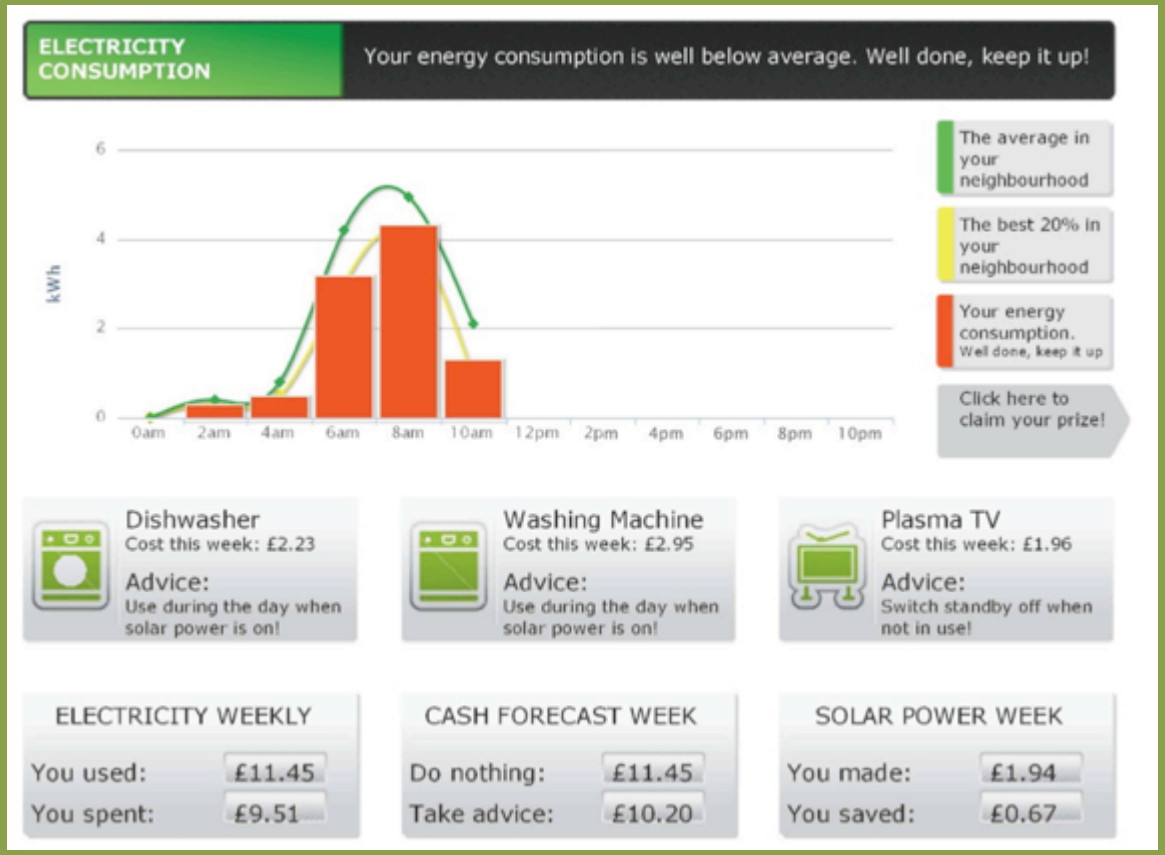
Big Change 5 – Affordable monitoring and communication



Real Life monitoring

Energence Energy Monitoring Platform © www.energence.co.uk : 01865 423 678

Big Change 6? - Micro Financial Services

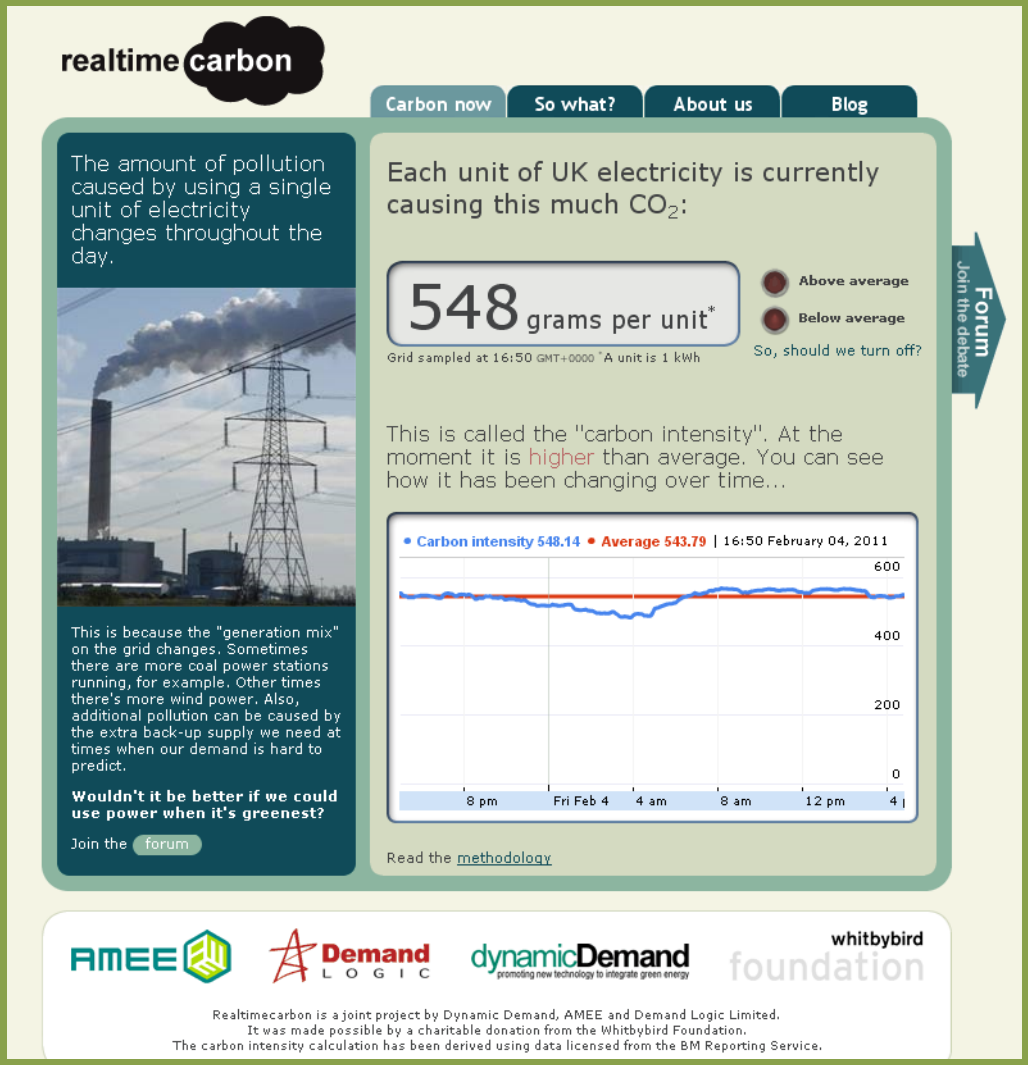


Has your clever house met the golden rule today?

energy saving trust®

London rebuilding society

Big Change 7 – Real time communication with power stations



Smart Home Energy *...fag packet example*

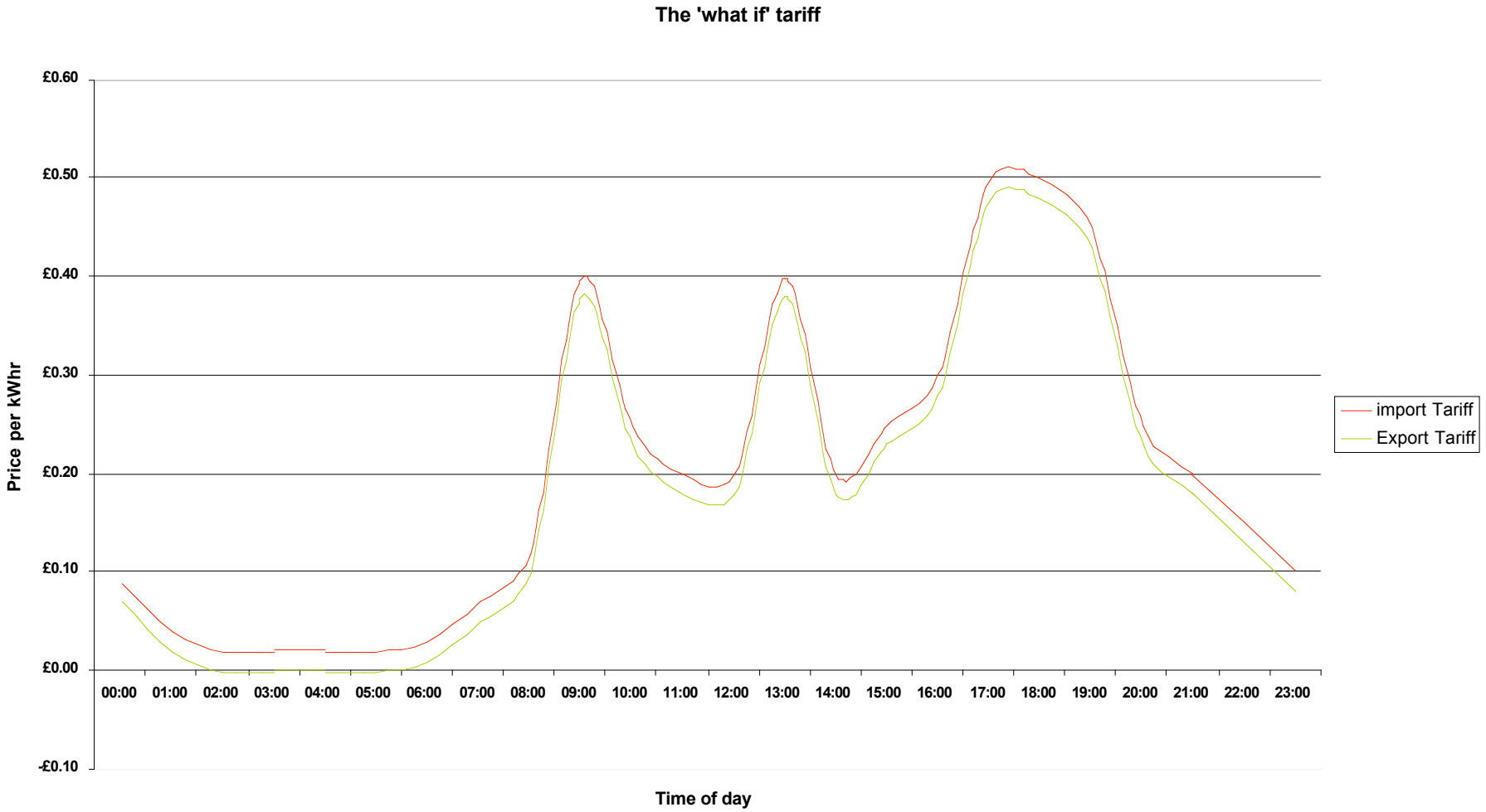
6pm November – Tea time

- 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 Automatic Home Energy Management 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

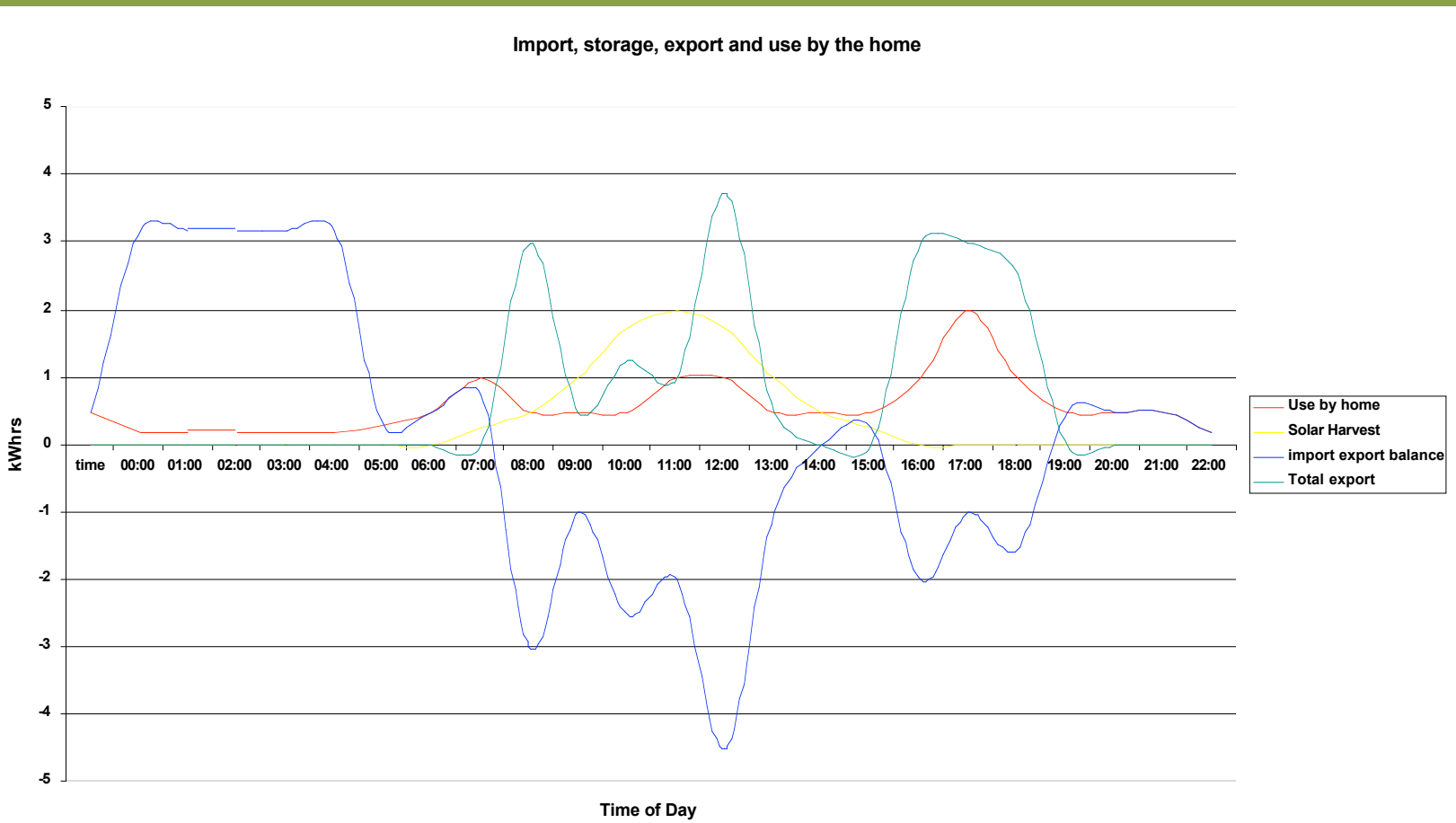
- Currently, on an unplanned windy night, wind turbines have to be turned out of the wind as the current system of energy purchase makes energy generators book their generation slot in advance.
- On a very windy night, and if big wind and nuclear are implemented as forecast, there may come situations 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 from the tariff forecast) and once the signal is given, turns on everything which power can be stored in.
- **The electric car and household batteries are charged, fridges and freezers are chilled down to their deepest temperatures, dishwashers, washing machines and tumble dryers are all turned on** (unless overridden due to noise), and **immersion heaters and heat pumps are turned on and heat stored in water or thermal mass** (perhaps via screed based under floor heating systems).

Variable tariff Negawatts



Only four simple rules

Rules	
export store if £>	**£ 0.35**
Import to store if £<	**£ 0.05**
export rate (kW)	**3**
store rate (kW)	**3**
Store capacity (kWhrs)	*15*


Import, storage, export and use by the home
kWhrs
5
4
3
2
1
0
-1
-2
-3
-4
-5
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
Time of Day
Use by home
Solar Harvest
import export balance
Total export

Could it be so simple?

0	0	0	0	0	1	2	1	0.5	0.5	0.5	0.2	**8.5**	Net units used
£ -	£ -	£ -	£ -	£ -	£ 0.500	£ 1.000	£ 0.450	£ 0.125	£ 0.100	£ 0.075	£ 0.020	**£ 2.443**	Net cost of units used
0	0	0	0	0	0	0	0	0	0	0	0	**15**	Net units stored
£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	**£ 0.360**	Net cost of units stored
1	0.5	0.5	0	0	0	0	0	0	0	0	0		
£ 0.180	£ 0.190	£ 0.090	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ 0.945	net value of exported harvest
0	3	0	0	0	3	3	2.55	0	0	0	0		
£ -	£ 1.140	£ -	£ -	£ -	£ 1.440	£ 1.440	£ 1.097	£ -	£ -	£ -	£ -	£ 6.257	net value of exported store
												£ 7.202	total value of export
£0.18	**£1.33**	**£0.09**	**£0.00**	**£0.00**	**£0.94**	**£0.44**	**£0.65**	**-£0.13**	**-£0.10**	**-£0.08**	**-£0.02**		
£1.27	**£2.60**	**£2.69**	**£2.69**	**£2.69**	**£3.63**	**£4.07**	**£4.72**	**£4.59**	**£4.49**	**£4.42**	**£4.40**	total Cost/Profit at end of day	

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

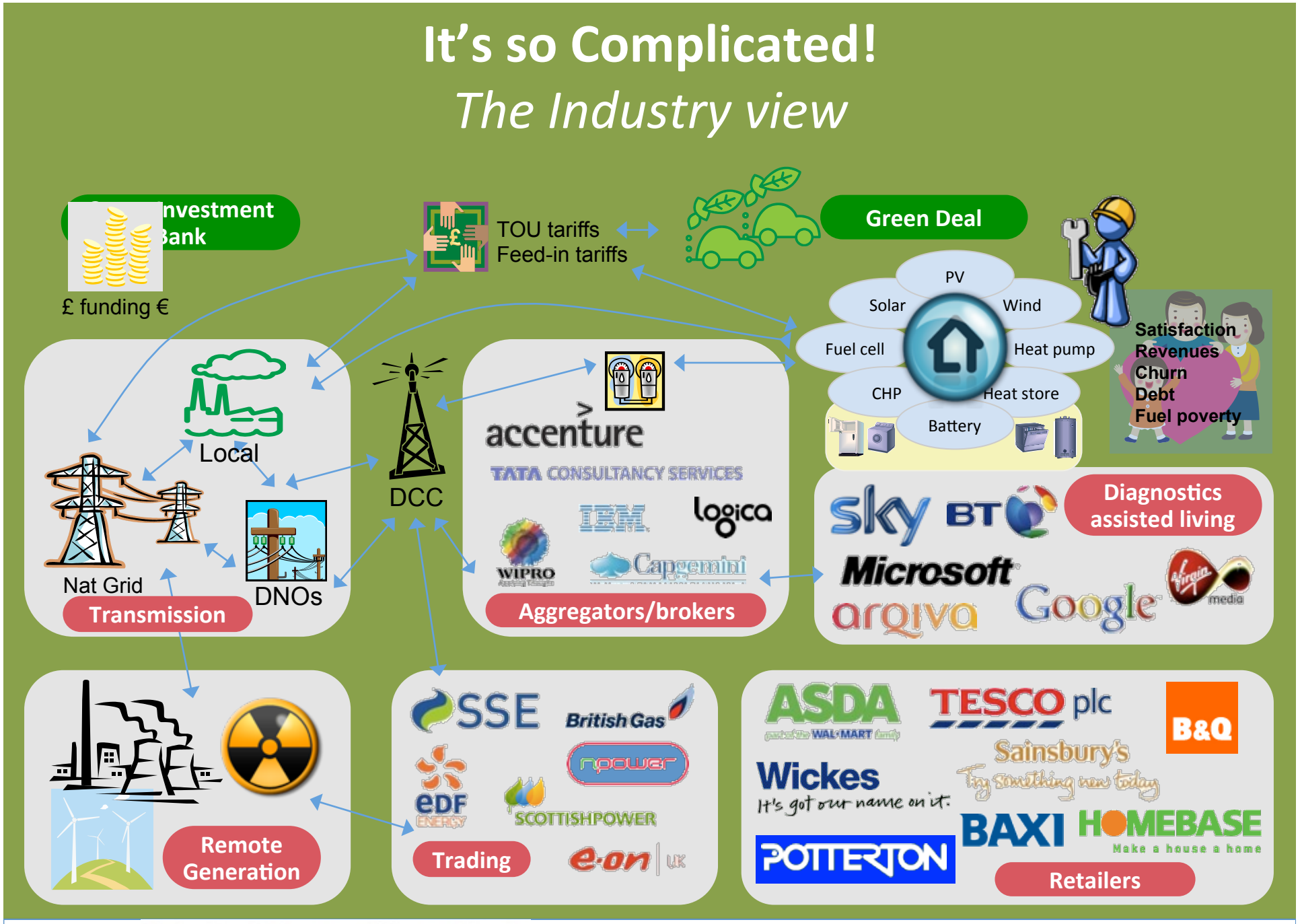
Extrapolated to Month £177.04

Could it be 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*

It's so Complicated!

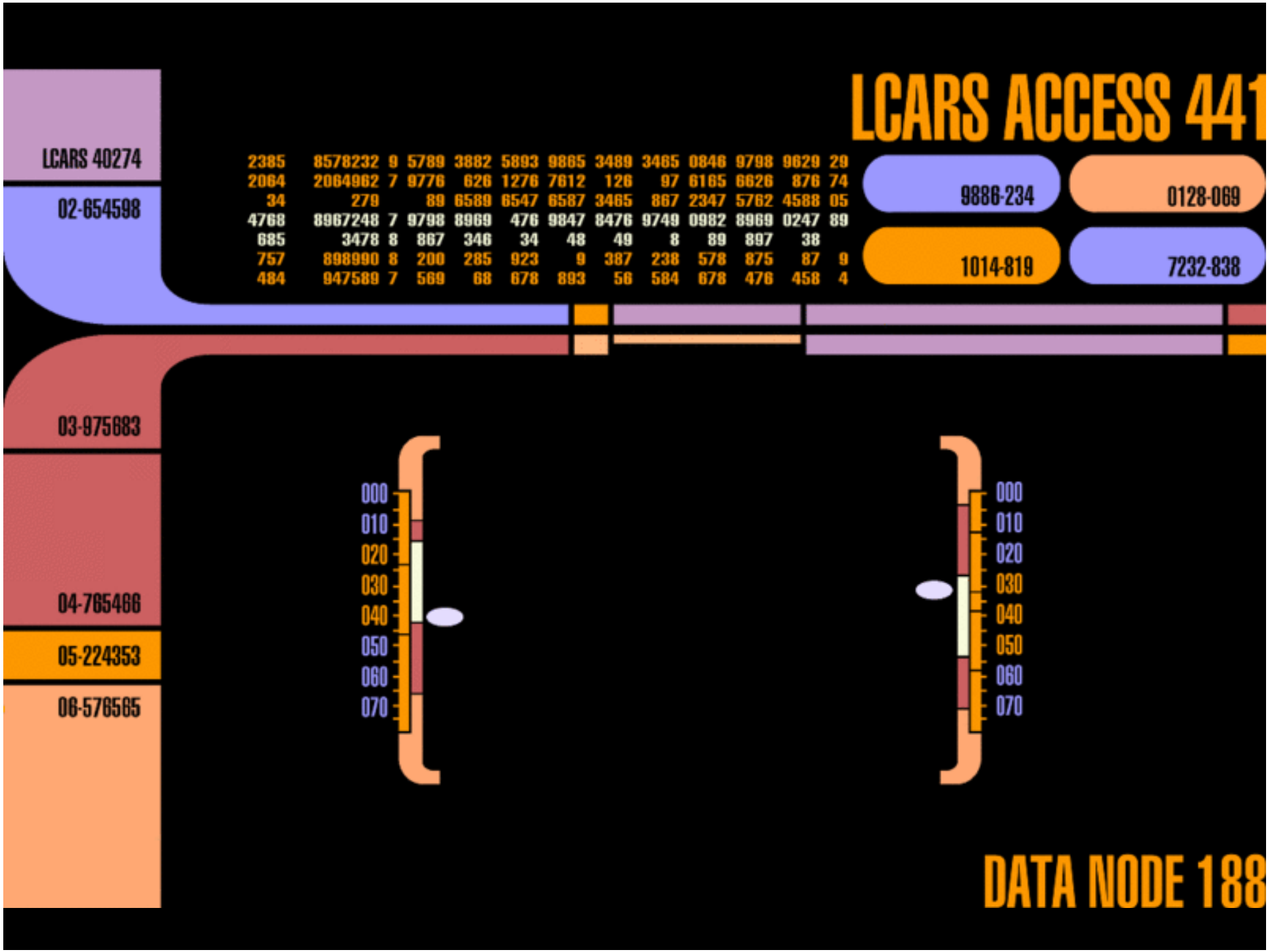
The Industry view



CR.SH crsharchitects.co.uk
Catherine Roberts and Steven Harris
Architecture and Energy

But how do you talk to your clever house?

Me and my clever house blog for the **Energy Saving Trust** - http://bit.ly/1gpE6kP


LCARS ACCESS 441
LCARS 40274
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06-576565
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2064 2064982 7 9776 626 1276 7612 126 97 6165 6626 876 74
34 279 89 6589 6547 6587 3465 867 2347 5782 4588 05
4768 8967248 7 9798 8969 476 9847 8476 9749 0982 8969 0247 89
685 3478 8 867 346 34 48 49 8 89 897 38
757 898990 8 200 285 923 9 387 238 578 875 87 9
484 947589 7 569 68 678 893 56 584 678 476 458 4
9886-234
0128-069
1014-819
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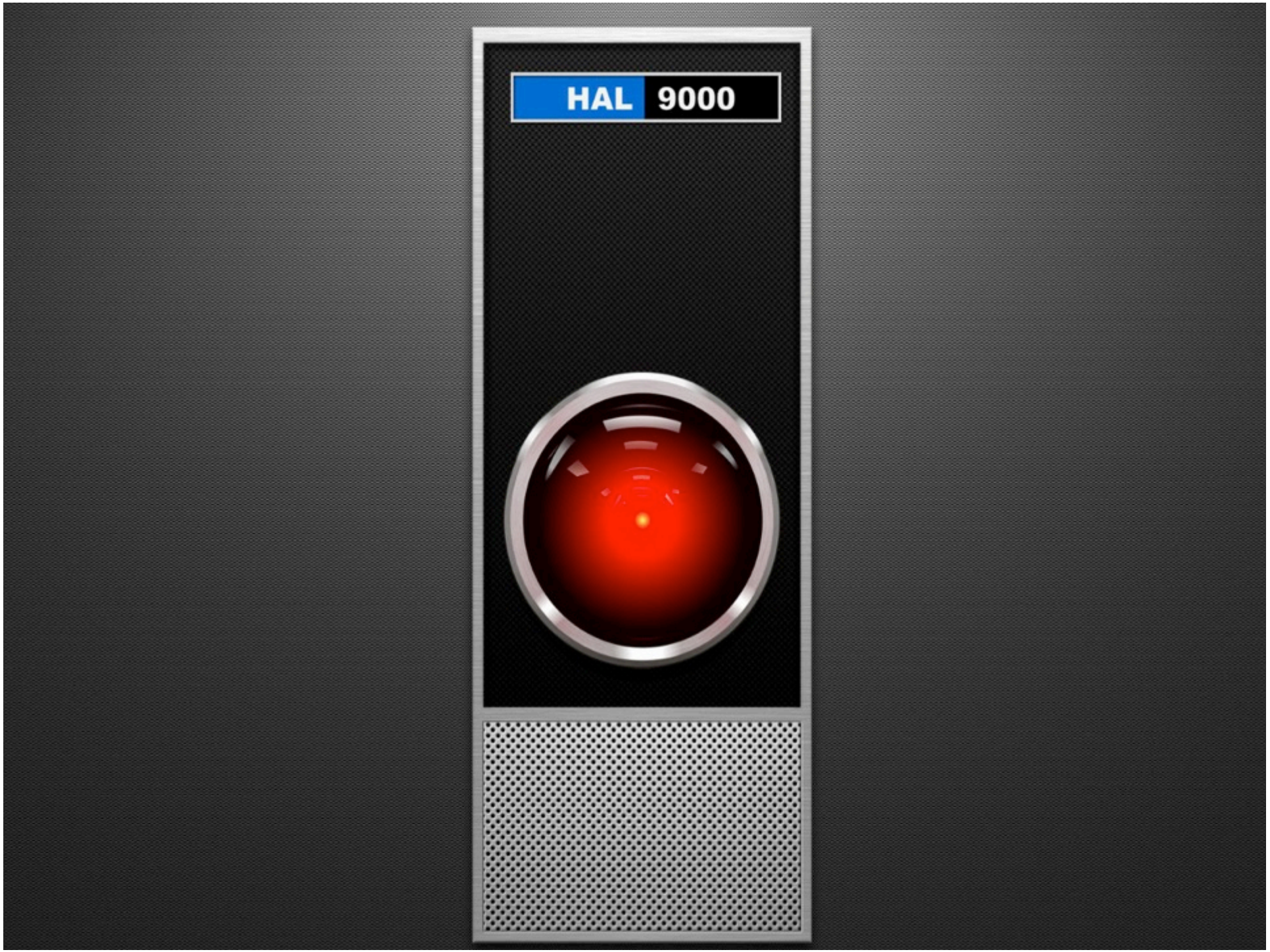
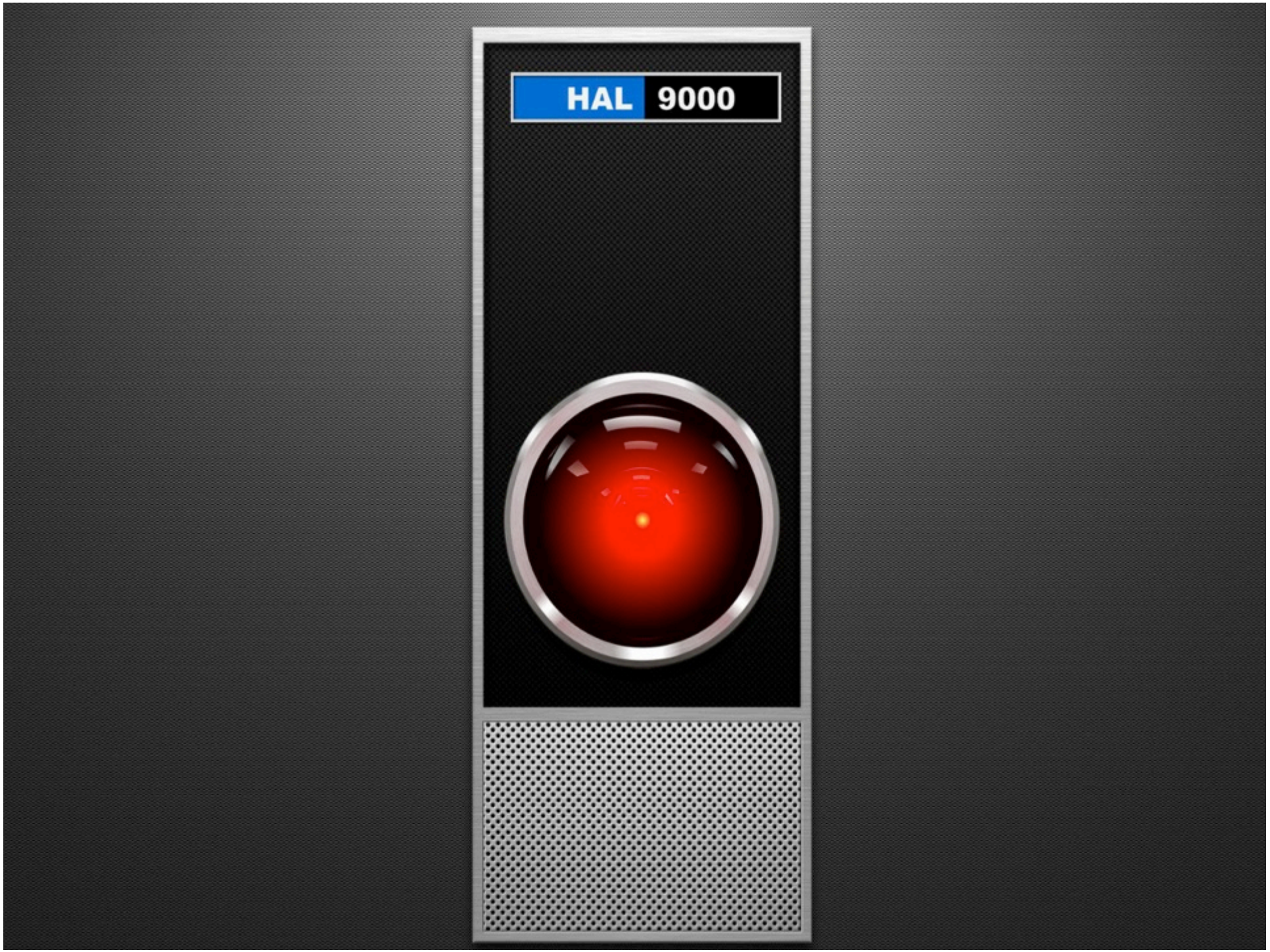

HAL 9000


HAL 9000

nest

A whole range of
'Works with Nest'
products is being developed

Recently bought by Google for $3.2 BILLION...!

OWL® intuition

intelligent wireless energy *monitoring* and *control*

Controls your boiler and (4) zone valves from your smart phone or laptop via your broadband hub

Allows very intuitive programming of your heating as well as monitoring electricity consumption and harvest

HEAT GENIUS

Intelligent Heating Control

Controls thermostatic radiator valves from your smart phone via your broadband hub

Also can have PIRs to sense which room you are in and heat only those rooms (so has elderly care benefits)

hive

Controls your boiler (only) from your smart phone or laptop via your broadband hub

Allows simple programming of your heating

But nothing else…

Controls your boiler and (lots of) TRVs from a in home console, your smart phone or laptop via your broadband hub

No electricity monitoring and £££!

People power – **finding solutions at home**

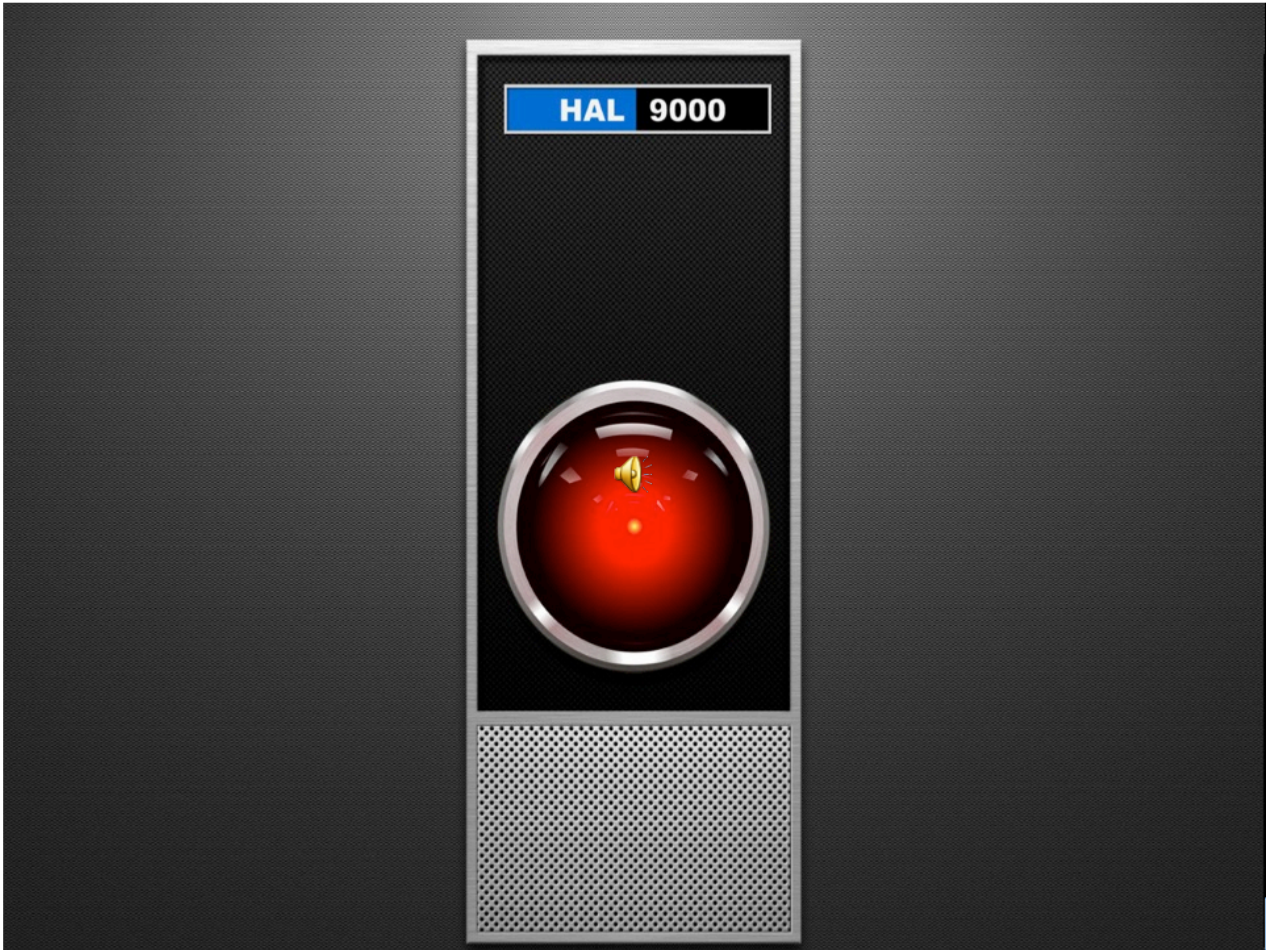
WE'VE ALREADY GOT OUR OWN!

or…!


IF YOU LIKE WHAT STALIN DID
SmartMeter
YOU WILL LOVE WHAT THE SMART METERS ARE DOING
DDees.com


Rat's Nest
nest
You've got to be nuts to put one of these in your home.
Or a fool.
The Fins Report .com


SAY No!
2
SPY
Smart Meters


HAL 9000

Thank you – **Questions**

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