

Energy in the home: are we using more than we need?

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Agenda

- Background of the problem
- Different Drivers
- Possible approaches
- Intra-Building Networking
 - ❑ Commercial building management
 - ❑ Options for the home
- Digital Living's approach
 - ❑ Energy Monitoring
 - ❑ Technology Challenges
 - ❑ Automatically reducing energy consumption



How Much?

- There are approximately 26m homes in the UK
 - Between them they consume around 430TWh or energy each year
 - This amounts to 27% of the carbon emissions from the UK *
 - This energy usage is increasing!
 - We will need 30-35GW more generating capacity by 2020 (+ replacing old generating capacity)
- * 2007 Energy white paper



Net Zero Carbon homes

- In current homes ¾ of the carbon emissions come from space heating and water heating
- It is the governments aim to have all new homes "zero carbon" from 2016
- The existing housing stock needs to be improved too – "the big refurb"
- Being enacted through changes to the Building Regulations



FIGURE 2.1 CARBON EMISSIONS FROM THE UK ECONOMY (NETCEN 2004 INCLUDES INTERNATIONAL AVIATION AND ANZ)
Source: NETCEN 2004

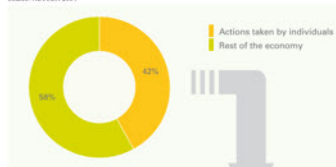
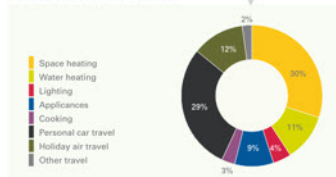


FIGURE 2.2 INDIVIDUAL ANNUAL CARBON EMISSIONS AVERAGE PER CAPITA CARBON EMISSIONS IN 2005: 1.14 TONNES OF CARBON PER YEAR
Source: Delta



Drivers

- Different Drivers
- Global Warming
- Government's commitments
- Security of supply
- Cost Savings
- Reducing peak loading
- Not wanting to build lots of new power stations
- Don't believe renewables will deliver...
- Will alternative technology be available in time?
- Etc



Reduction of energy usage

Department of Energy & Climate Change suggests a number of approaches:

- Information
- Tariffs
- Sponsored schemes
- Technology Tools



INFORMATION



Information

- General and tailored education of consumers and the supply chain
- Better billing
- Total energy consumption raw data
- Presentation of interpreted energy consumption data
- Appliance-level consumption data



Information (2)

- Information on efficiency of consumer goods and buildings
 - Energy Labels
 - Procurement advice
- Information on reducing emissions
 - Generic advice on energy reductions
 - Tailored advice: energy audits



TARIFFS



Tariffs

- Time of Use
- Interruptible contracts
- Increasing block tariffs
- Pay as you go



SPONSORED SCHEMES



Sponsored Schemes

- The Energy Efficiency Commitment (EEC)
 - 2002 – 2005 - 2008 in 2 phases
- Carbon Emissions Reduction Target (CERT)
 - 2008 – 2011
- Community Energy Saving Programme (CESP)
 - 2008 - 2012
- Home Energy Savings Programme(HESP)
 - End of 2008 -



EEC / CERT

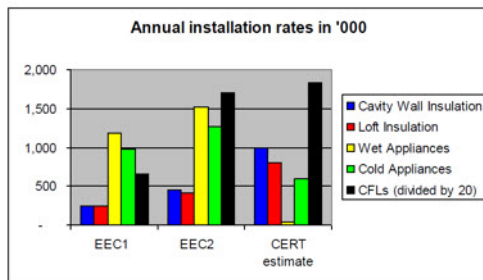


Figure 1.2: Average number of installations per year supported by energy suppliers in the most recent phases of the GB Energy Efficiency Obligations.

Evaluation of the Energy Efficiency Commitment 2005-08



Easy to do things

- Insulating your home
 - Put a jacket on your hot water tank
 - Insulate your loft
 - Fill your wall cavities
 - Dodge the draughts
- Energy saving light bulbs
- Switching off
 - Don't leave it on standby
 - Turn off the lights
- Take control of your heating

List from <http://campaigns2.direct.gov.uk/actonco2/home/in-the-home/save-energy.html>



TECHNOLOGY TOOLS



Technology Tools

- Standby "Killers"
- Device grouped control
- Smart heating controllers
- More efficient heat sources
- Automated lighting
- Distributed / renewable energy production Smart appliances
- Load-sensing consumption reducers

Lotsof isolated solutions!



DIGITAL LIVING TECHNOLOGY

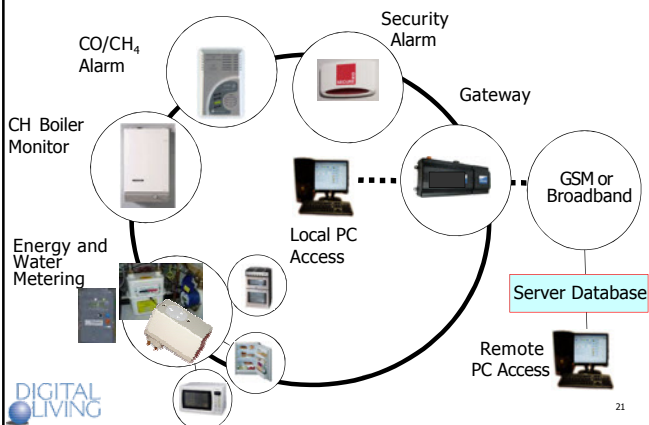


• Digital Living

- Energy usage monitoring
- Based on commercial-style equipment
- Aim to gather data about a number of real homes:
 - 5 minute data on electricity consumption
 - 30 minute data on gas consumption
 - 30 minute data on inside and outside temperatures



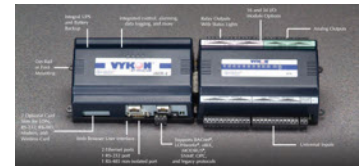
Delivering the Smart Energy Home



Monitoring Gateway

Commercial Building management Unit:

- Tridium Niagara / Jace 2
 - Simple development
 - Multiple protocol support
 - Low Power consumption
- Robust
- Expandable



Electricity Monitoring

Whole house or circuit (LONWorks PLC device)



Individual plug (custom LONworksPLC devices)



Gas Monitoring

Zmart plug-in pulse counter for meter

Communicates back to Mainscom electric meter by Z-Wave



INTRA-BUILDING NETWORKS



Networking for building management

- Has been in use in commercial buildings controlling HVAC for some time
- Also used in "prestige" homes sometimes
- Not done on a large scale or for much equipment in any one property



Commercial Protocols

- LonWorks (Eschelon)
 - Now ISO/IEC 14908.1 Now ISO/IEC 14908.1
 - Twisted pair, power line signalling, or IP tunnelling
- BACnet (ASHRAE)
 - Open system
 - Ethernet, ARCnet, Serial, LonTalk, virtual LANs...
- Modbus
 - Open System
 - Serial (EI-485), ethernet

All Wired

Not too many "home" products support them



Home area networking

- One or more of the commercial idea
 - OK for "local" connections where they can be wired
- Wired temperature sensors
- Ideally wireless to avoid messy re-cabling:
 - Power line communication
 - Radio

Must be low power to support battery operation



Technical Issues

Power line Communications (PLC)

- Vulnerable to other traffic on the mains
 - Baby Monitors
 - Networking (inc BT Video etc)
 - Phone extenders
 - Switch mode power supplies
 - Etc
- Shared with other houses on the same phase



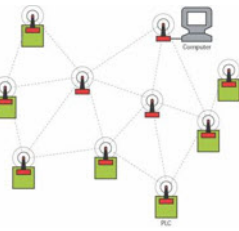
Technical Issues (Wireless)

- TCP/IP
 - Power hungry
- Zigbee
 - Standard (802.15.4)
 - 2.4GHz worldwide
 - Mesh Network
 - Run by an alliance – only just implementing application layers
 - Designed for low bandwidth
- Z-Wave
 - Created by Zensys – now Sigma Designs
 - Mesh Network
 - Designed for low bandwidth Different frequency use in Europe and US (868.42 vs 908.42MHz)



Mesh Network

- Any mains-powered node can act as a relay
- Can be self-healing – if a node fails, messages will route through others
- Low power “sleepy” endpoints



Wide Area Networking

Hubs have limited local storage – data must be retrieved to central database

- Cannot rely on houses having always-on broadband
- Limited to mobile phone coverage
 - ❑ GPRS was available in the form of Siemens MC35i
 - ❑ Vodafone / O2 SIMs on a VPN
- Hubs not located in ideal locations in houses!
 - ❑ Sometimes had to use outside aerials
 - ❑ Some sites very poor coverage



Selected solution

- Power Line communications
 - ❑ Meters available in this technology through partner (HCL)
- Direct Wired
 - ❑ Temperature sensors (inside +outside)
 - ❑ Boiler state monitoring
- GSM WAN

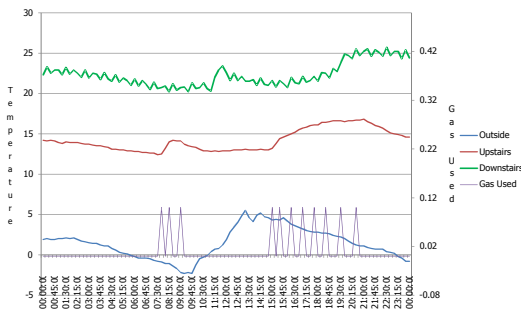


Services Aggregation: Getting Information to the Consumer

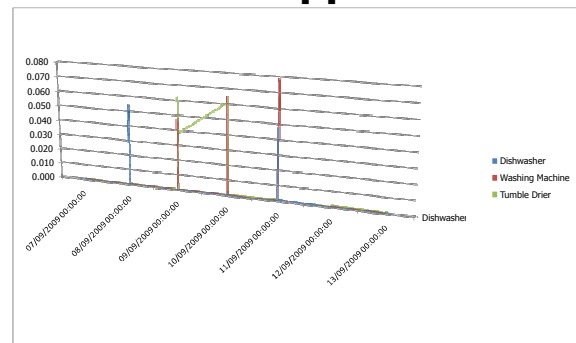


Typical data

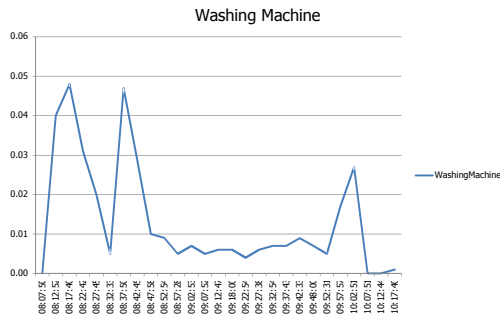
Jace001 03/02/2009



Use of appliances



Detail of appliance run



Control

- Baselines measured
- Control technology being developed by partners
- Primary area to control are heating and white goods
 - Turn heating down automatically to save money and carbon footprint
 - Reschedule white goods runs to take place in cheapest available tariff period / to load limit



Control (2)

- Done with Zigbee & Z-Wave networking
 - All devices not available in a single technology
 - Separate control hub (prototype)
- DL monitoring results of automated interventions to determine how much money / carbon they are saving



THANK YOU!

