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

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

- 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

- 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 supplier in the most recent phases of the GB Energy Efficiency Obligations.

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

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

Lots of 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**

- Security Alarm
- Gateway
- GSM or Broadband
- Local PC Access
- Remote PC Access
- Server Database
- CH Boiler Monitor
- Energy and Water Metering
- CO/CH₄ Alarm

**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 LONworks PLC 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
  - 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

Use of appliances
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!