Enabling energy micro-management through ICT

Fabrice Saffre

Reducing the need for travel

" Use of Communications Technology is a key element in helping to reduce the impact of BT's operations on the environment. BT's Conferencing services have helped deliver our targets to reduce emissions of Green House gases and are increasingly being used to reduce daily commutes and traveling for meetings."

Mike Hughes
Head of Environment

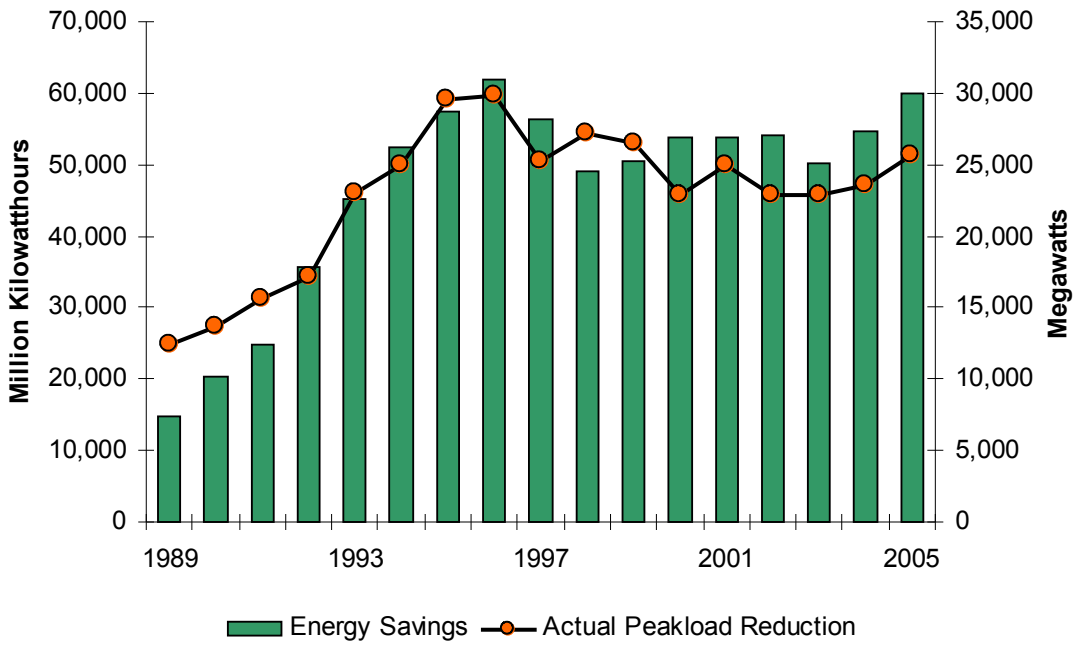
BT Group

Reducing the need for “material goods” manufacturing and transport

Demand Side Management (DSM)

- *Demand-side management (DSM) programs consist of the planning, implementing, and monitoring activities that are designed to encourage consumers to modify their level and pattern of electricity usage.*

Source: US Energy Information Administration

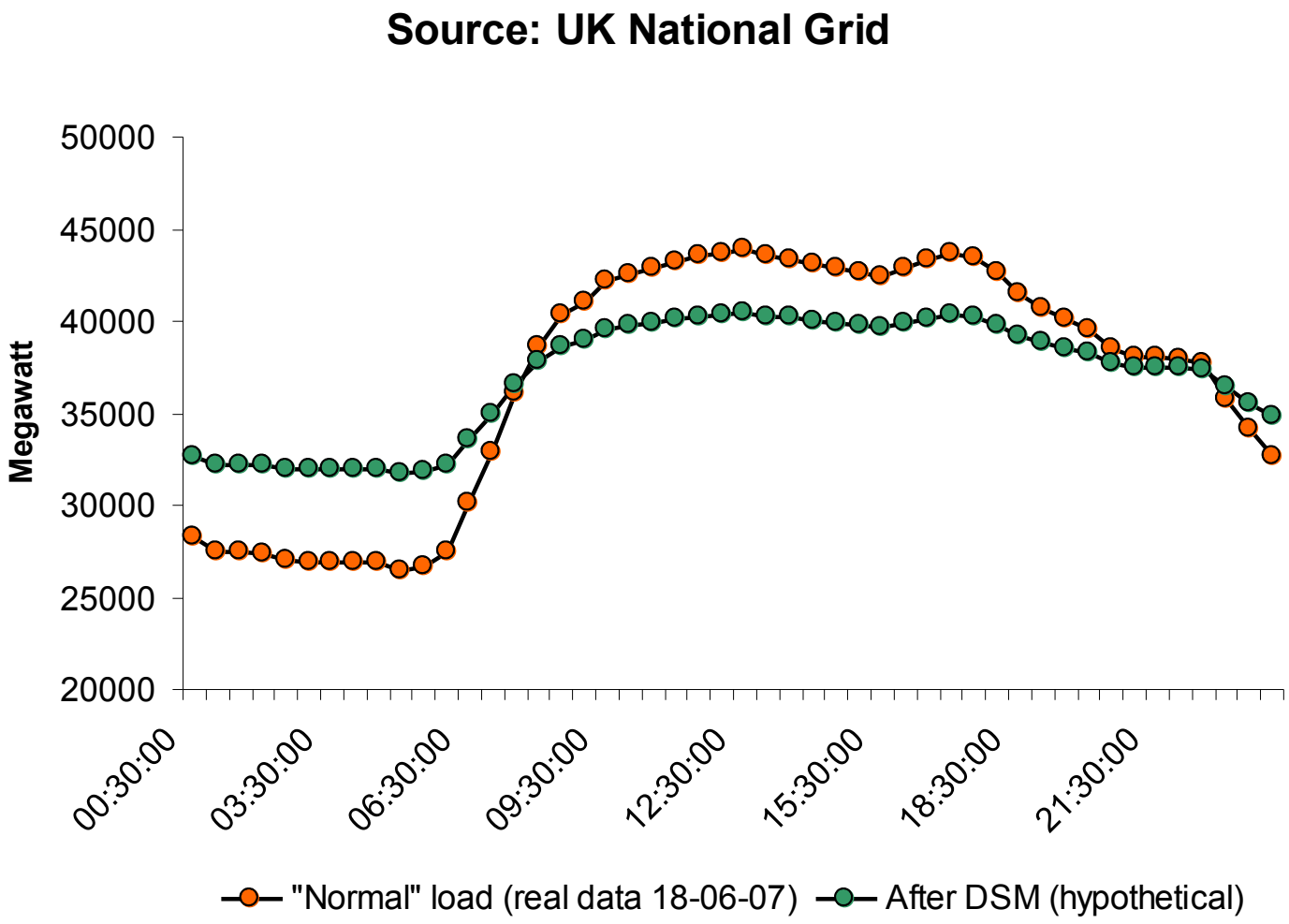


- Combines:
  - Energy Efficiency
  - Load Management
- Needs new techniques and practices to reach full potential

Load Management

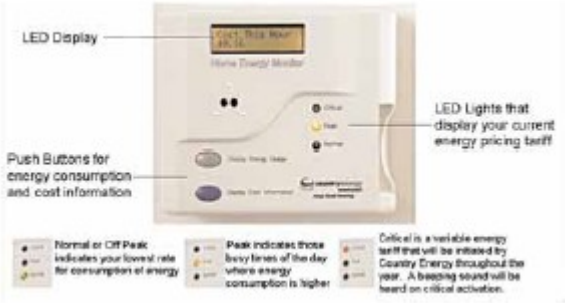
- Contractual agreement giving the utility system operator the power to shape consumer load at peak time, through direct or indirect control (applies primarily to commercial and industrial consumers)
- Price incentives to move the flexible load to off-peak periods
  - Applicable to residential consumers but…
  - By definition, it requires that the end-user is informed of (and able to act upon) price differentials
  - This effectively limits DSM to simplistic, “coarse-grained” pricing strategies (e.g. “day-rate” vs. “night-rate”)
  - Mostly suitable to *macro*-management

Demand-side macro-management



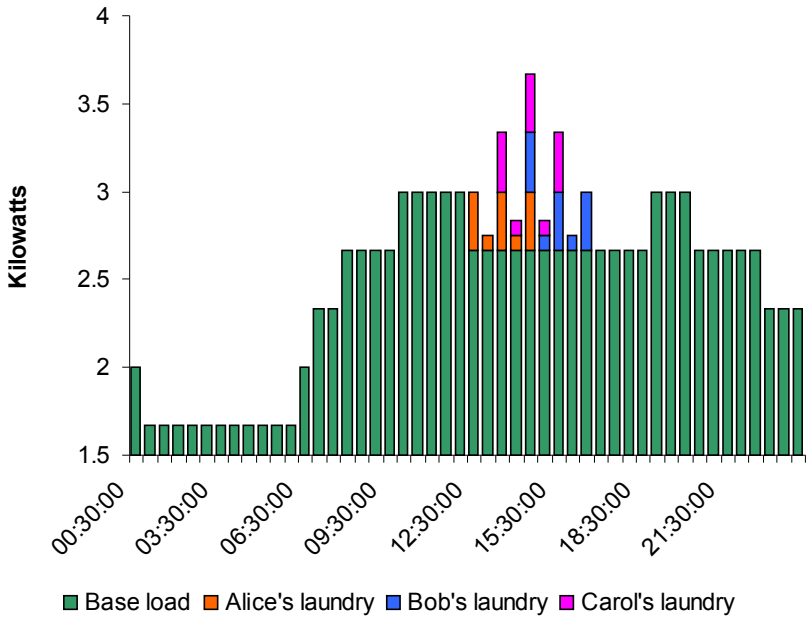
Impact

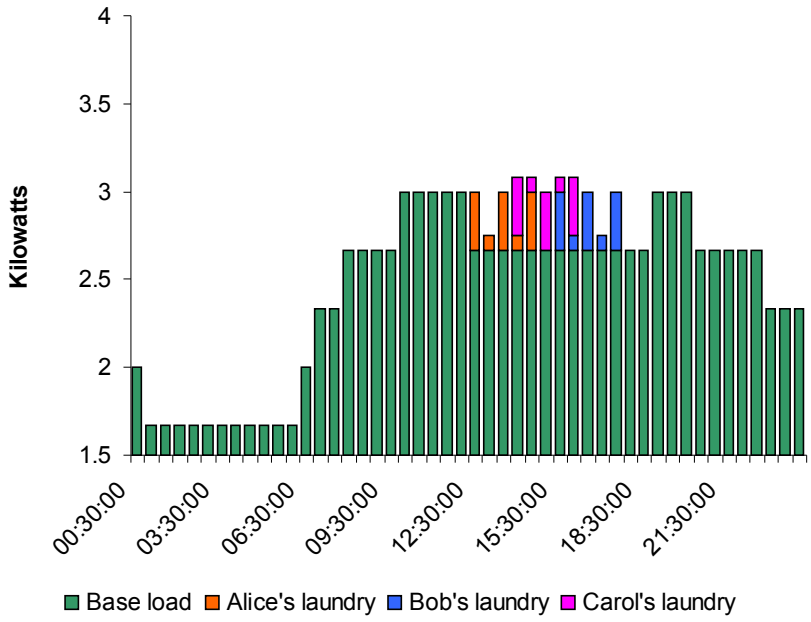
- Total demand on the grid is unchanged, but it is more homogeneously distributed over time
- Can potentially contribute to reducing carbon emissions through downscaling and optimisation of the power generation infrastructure (currently designed to support peak-load)
- Provides some opportunities for ICT, e.g. at the interface of smart metering and billing
- However, it does not directly improve our ability to use micro-generation and/or unpredictable renewable sources



Demand-side micro-management

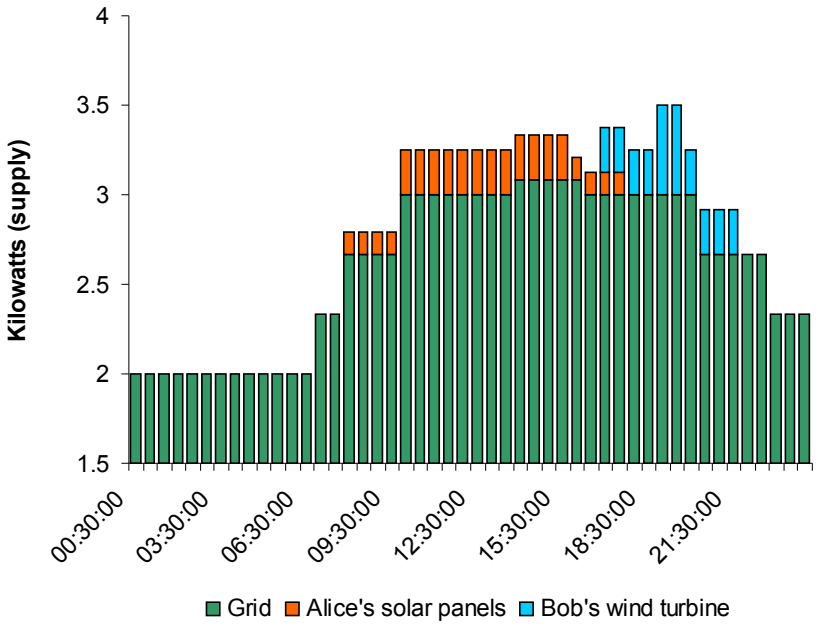
- Fine-grained scheduling of individual energy-consuming processes
- Potentially makes a big difference, *if applied to local communities*

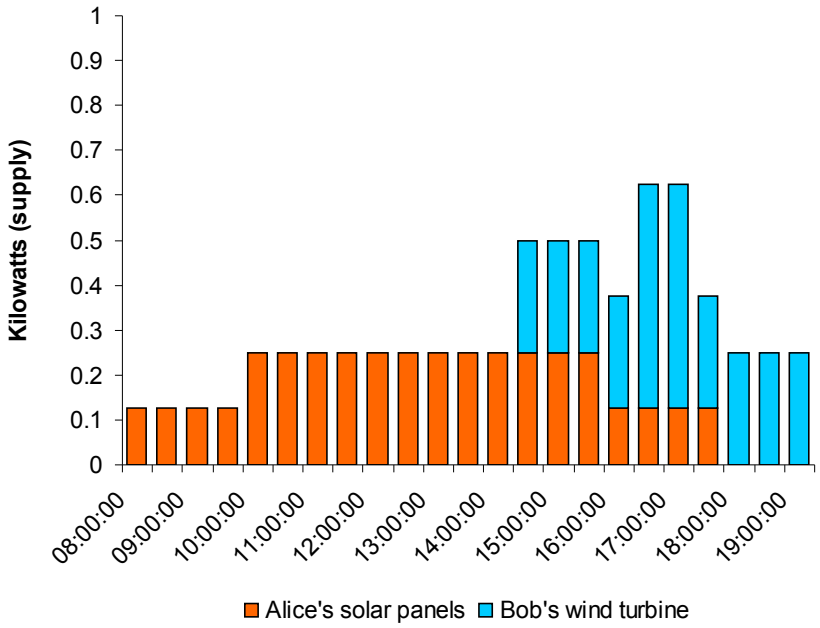




But even better…

- Demand-side micro-management makes it possible to shape the load so as to match the *local* energy supply
- The output of (renewable) micro-generation can be factored in…





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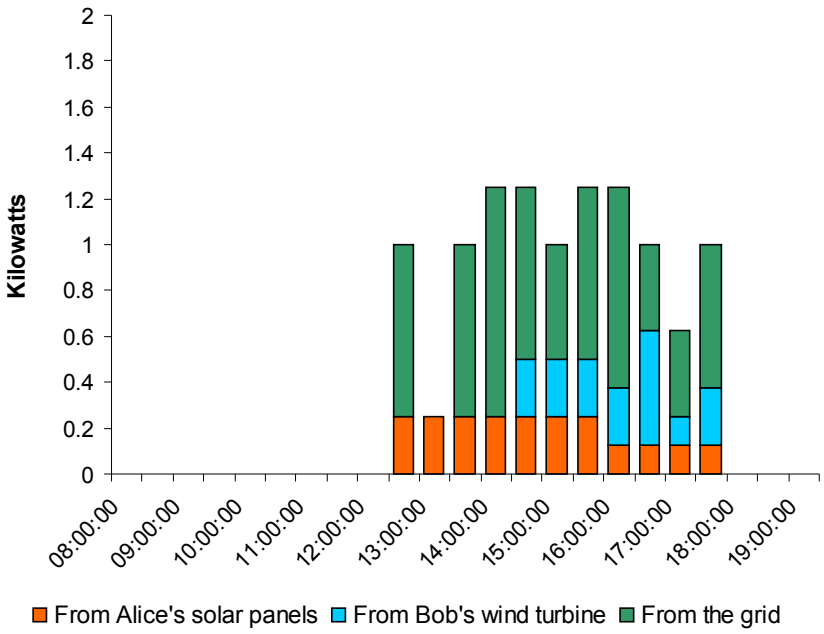
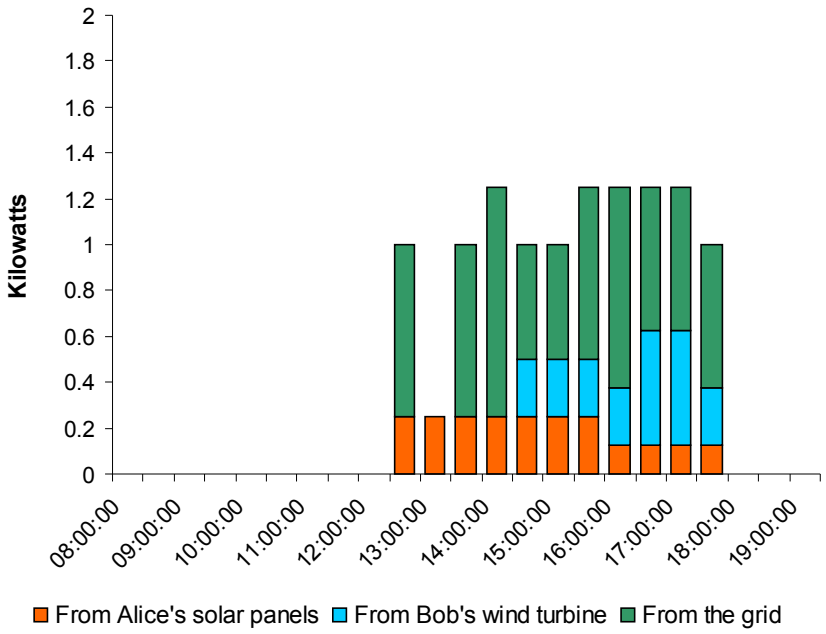


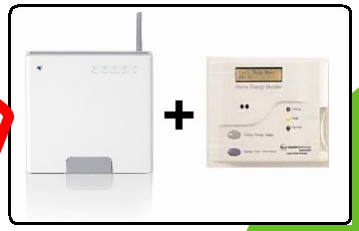


Implementation

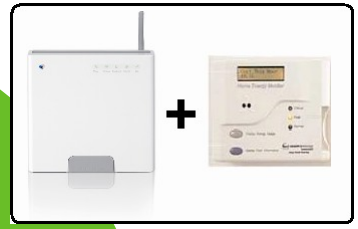
- ICT is a key enabler to any micro-scale combination of power generation and demand-side management
- The whole concept relies upon the ability to
  - Collect and share information about the current and/or predicted output of local renewable sources
  - Identify and evaluate opportunities to redistribute the flexible load so as to maximise autonomy from the grid
  - Implement the preferred schedule by instructing “smart” appliances to start/pause/resume queuing processes
- This can be done from a control centre using “brute force” to compute the optimal solution
- Recent research suggests that a decentralised approach using negotiation between software agents is also feasible

Alternatively…

Ready!



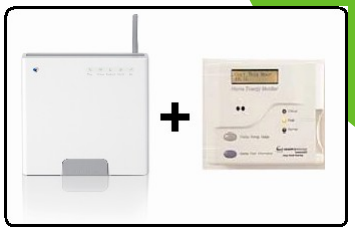
Carol



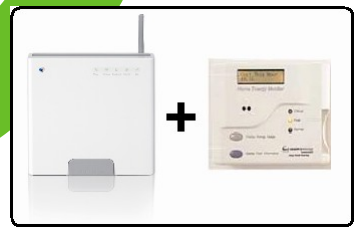
Bob

The Internet

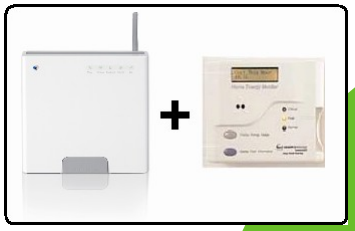
Alice



Dave



Alternatively…



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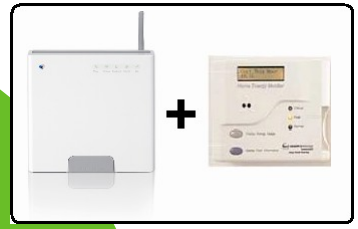

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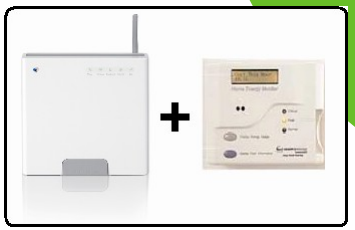

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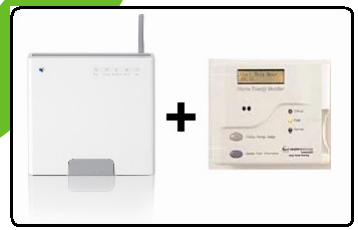

Conclusions

- ICT offers obvious opportunities for substituting information transfer to physical movement
- This is actually where we could make the biggest difference in the short to medium term
- However, the war against climate change has to be fought on several fronts and over multiple timescales
- In the long run, reducing our society's appetite for energy may be unavoidable
- Automated management of the flexible demand and an increased ability to tap into renewable sources could be the key to a soft landing…

Thank you