Households as energy end-users – and more

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Energy systems and our place in them

Sources – solar*,* wind, marine*, g*as, oil, coal, nuclear, biomass (including food)

Users - households, businesses, industry, transport

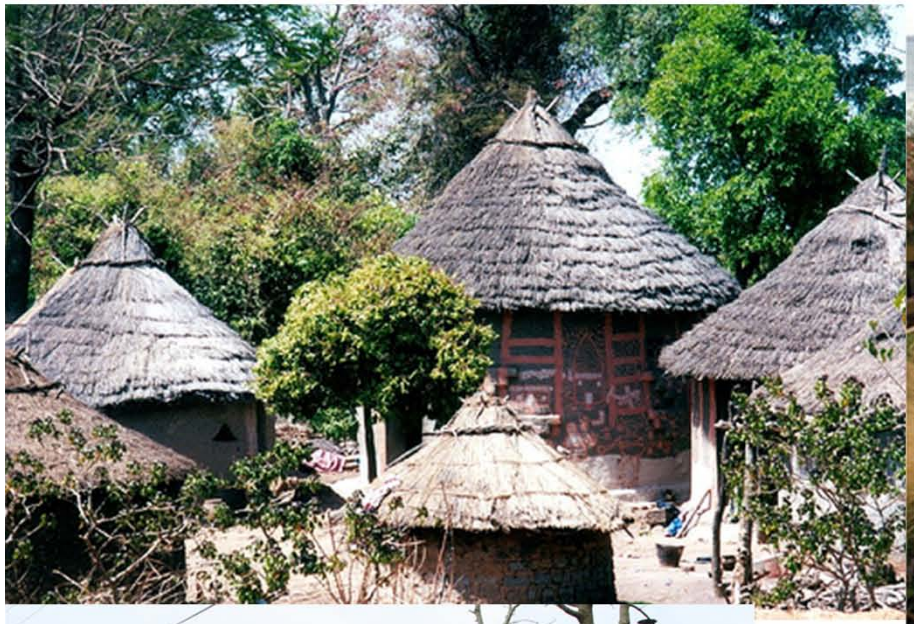
Services - heat, light, sound, cleaning, tools, communications

Infrastructure for delivery of services - gas pipelines, electricity networks, metering services, petrol stations, potentially hydrogen; heating systems, lights, machines, appliances

Governance and regulation

'End-users' are active in these systems as designers, manufacturers, administrators, suppliers, builders, installers, maintenance workers, academics, policy makers, citizens …

Climate and building design affect the energy *services* we need and want – also demand for fuel. Householder roles vary in different circumstances

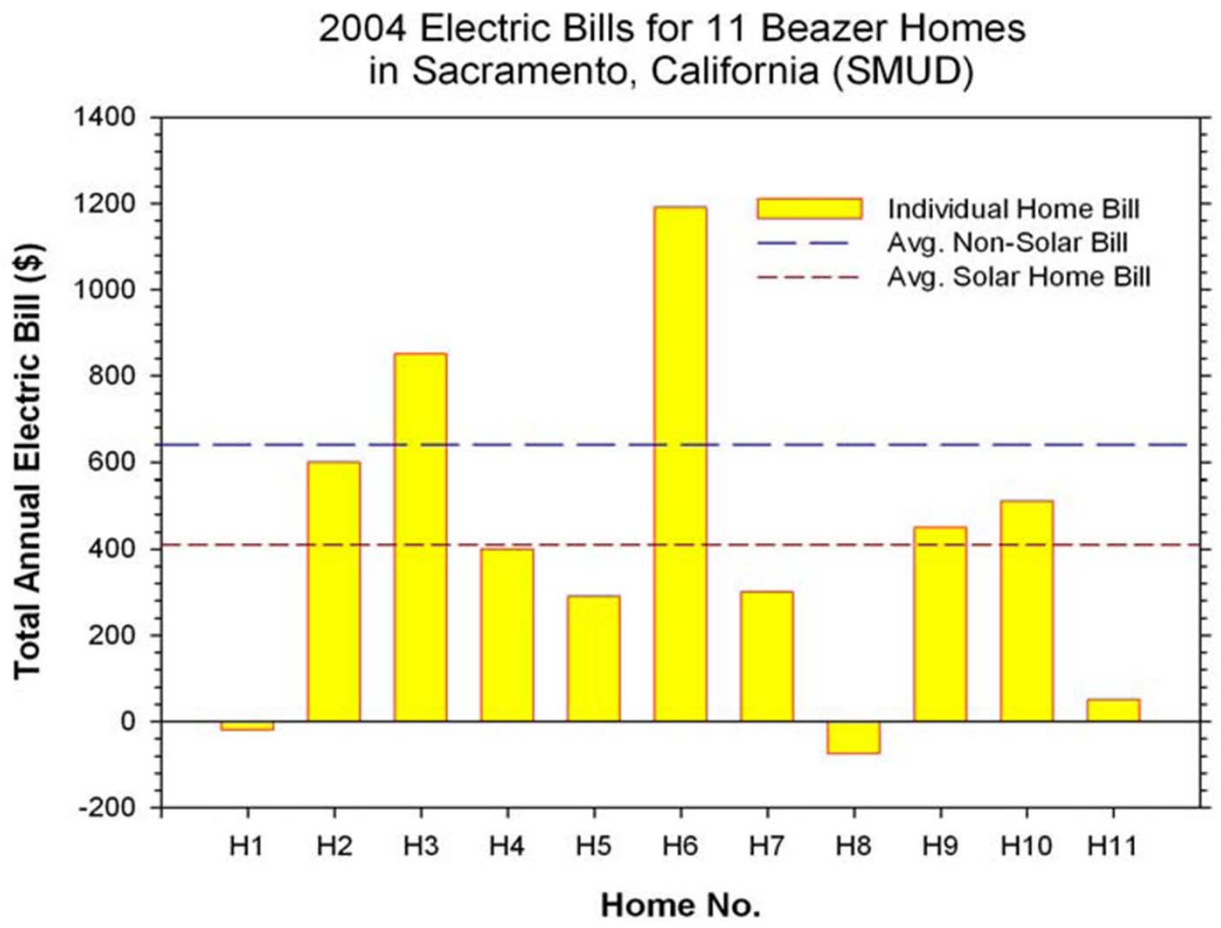


Can a zero-energy home be guaranteed?

Solar PV on well-insulated new homes with efficient appliances in Sacramento , CA. These are intended to be ‘zero energy’, = zero net electricity consumption.

Source: Keesee 2006

Varied consumption in 11 of the identical ‘zero-energy’ homes.
‘Fit and forget’ PV on buildings is only effective up to a point.



Source: Keesee 2006

Smart design for the user? Need for simple controls even in ‘sustainable’ housing

Family complained about feeling unable to do much apart from opening windows in their low-energy house.

They did not use instruction book, but tended to rely on trial and error, which worked for cooker and washing machine, but not for heating, ventilation and lighting.

Consequence: usage considerably higher than planned.

(account of a Sigma ‘environmentally-friendly’ home, Stevenson and Rijal, 2008)

In domestic electricity use, daily routines affect usage at least as much as physical factors

e.g., from detailed household-level analysis of el and gas use in 1627 California households

- 9% variation in electricity usage was due to building characteristics
- 17% 'environment' = other physical factors
- 36% social variables
- 39% *joint effects of people, environment and buildings (impossible to differentiate)*

(Lutzenhiser and Bender, 2008; see also Gram-Hanssen, 2010)

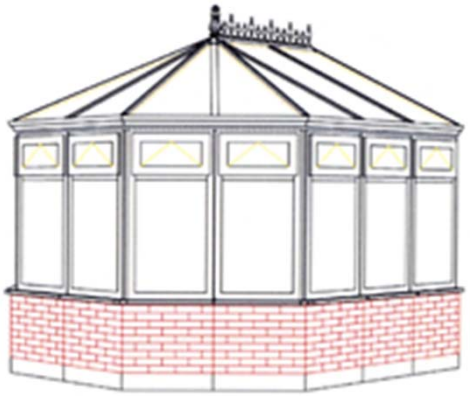
Agency and intelligence are *distributed* among people and things, so policy also needs to be distributed – many small solutions rather than a few big solutions.

As 'western' buildings become more efficient, householder practices become more significant in determining consumption and impact. Meanwhile, traditional buildings may offer useful design ideas for fuel-free comfort.

Energy users adapt technology to their own ends: conservatories in the UK

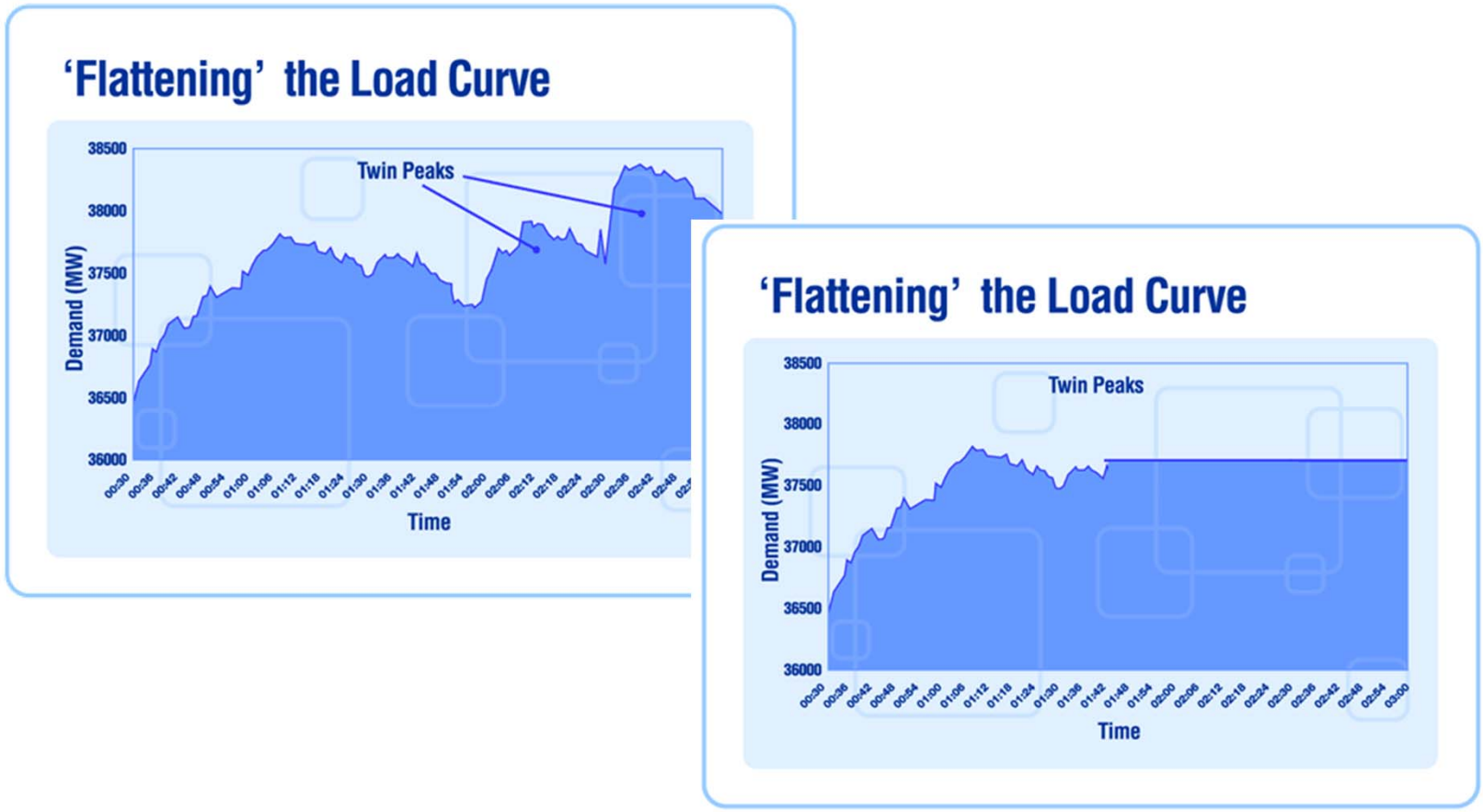
Theoretical models showed that a conservatory could reduce a dwellings energy consumption by 5% through capturing the sun's energy ,,, [it was identified as one of the main passive solar retrofit options in northern climates.

In 1990, [a researcher] found that out of 10 conservatories she visited, 9 were heated. Since 50,000 conservatories were being built every year the potential energy use of conservatories was therefore high… a later survey found that 2/3 heated their conservatories directly, and ¼ indirectly. This energy use was not controlled by the Building Regulations, as the assumption was that conservatories were used only in spring and autumn, unheated.



Source: Oreszczyn 2009

Night storage heating – a solution driven by cheap base-load power from large generators. A very early piece of ‘smartness’ in the UK grid, but not very popular due to lack of user control



http://www.energynetworks.org/rts/moreinfo.asp

European Technology Platform definition of a Smart Grid

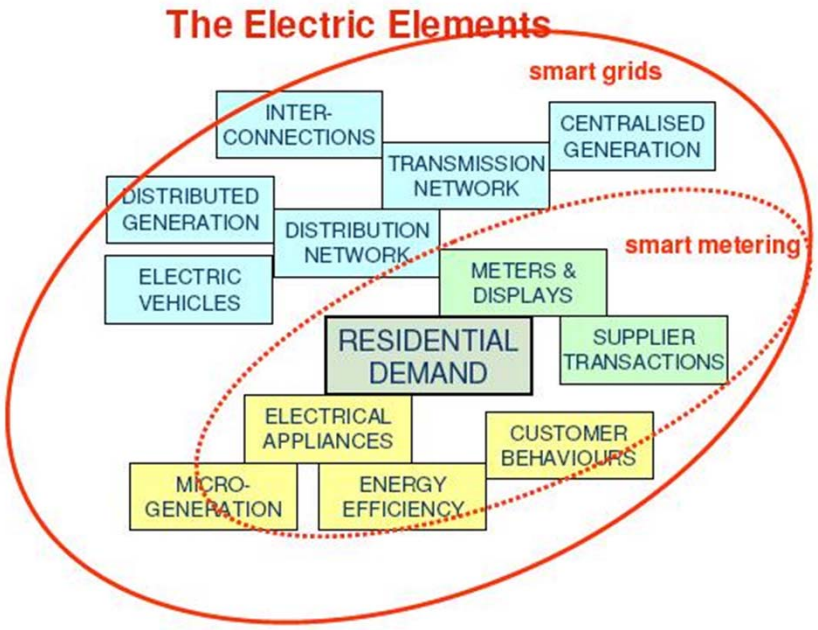
electricity networks that can intelligently integrate the behaviour and actions of all users connected to it - generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

and

- facilitate connection and operation of generators of all sizes and technologies;
- *allow consumers to play a part in optimising the operation of the system;*
- *provide consumers with greater information and options for choice of supply;*
- reduce the environmental impact of the whole electricity supply system;
- maintain or improve system reliability, quality and security of supply;
- maintain and improve existing services;
- foster market integration towards European integrated market.

http://www.smartgrids.eu/?q=node/163

The householder and the smart grid: from the end of the line to the centre of the system? Where will we fit in new electricity systems, and how will we adapt? Who will benefit most?



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‘Soft’ and ‘hard’ energy paths: where does the user belong on each?

On a soft energy path, householders are

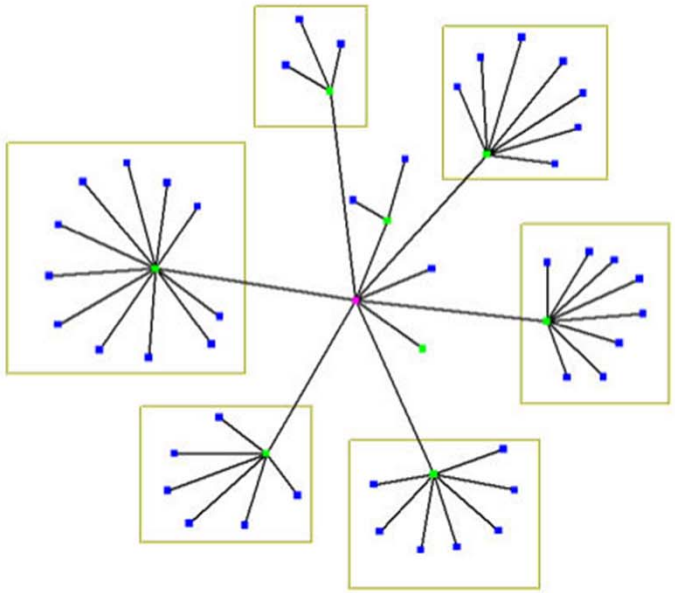
- In buildings designed or adapted to local conditions
- Using renewables
- Using technology at a scale and quality suited to needs
- Understanding that technology

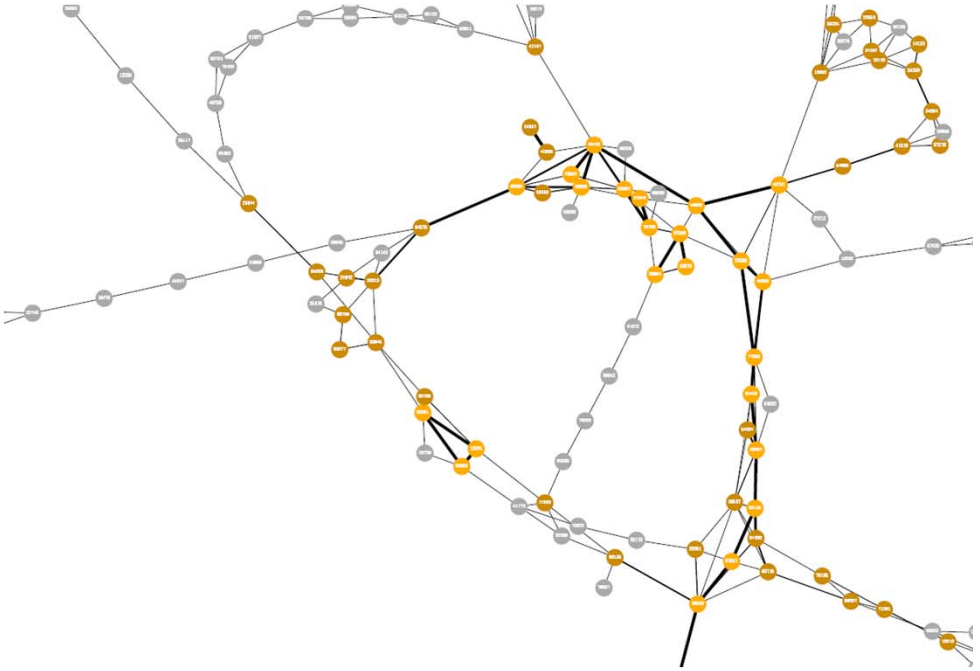
On a hard energy path, they are

- In buildings that [if new] may not be designed for local conditions
- Using large-scale, centralised fuel or electricity systems
- Probably not understanding the technology much

[Amory Lovins (1977) *Soft Energy Paths*]

From hub-and-spoke systems to cell structures?





End-users - and more

- Households use *and provide* energy *services*.
- Energy users are active in *systems* of infrastructure, and in design, planning and policy
- Users adapt technology to their *own* ends – not always doing what the designer intended
- Users will continue to do so, as we develop smart grids and other new technologies
- Renewable energy needs 'renewable users' in order to achieve low-impact energy services. This means users who can learn and adapt. Technology development needs to support this learning. The developers need good feedback from the users. And engineers and social scientists need to communicate better.
- Systems thinking, the concept of soft energy paths, and practice theory, are a rich source of explanations and ideas for future research into households and energy