Feedback in context – a reflection

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It's very good to have so many of us here today, from so many disciplines and backgrounds. I'm very happy to be here because I was an undergraduate at Edinburgh and spent three wonderful years here in the 1970s on what was then a new course in Ecological Science. The most important single message I took away from my studies was that everything is connected to everything else. So from the start of my work in relation to energy feedback, I've been interested in it as it operates in complex socio-technical systems, and I wanted to start our symposium by taking a look at some of the implications of a systems approach, and some of the challenges it raises.

Last week I went through some of my old papers, to see what I'd written on the subject of feedback over the last 20 years and to try to get some perspective on what we have learned in that time and what it might imply for our work in future, with the advent of 'smart systems'.

Feedback in energy advice programmes

The first research report I ever worked on was one that I and three fuel poverty specialists produced for the EAGA Charitable Trust in 1997, on the effectiveness of energy advice programmes. We contacted 118 organisations that offered energy advice and interviewed 37 of them, looking at their monitoring and evaluation practices, and we reviewed some of the limited amount of research that seemed relevant. Already, in that report, were five references to feedback research[1], because feedback to clients and advisers emerged as a factor in the advice

[1] These were a mix of experimental/psychological and ecological/sociological studies: Arvola et al. (1994) Billing feedback as a means of encouraging conservation of electricity in households: a field experiment in Helsinki. *Energy and the consumer,* Finnish Ministry of Trade and Industry; Gaskell G, Ellis P and Pike R (1982) *The energy literate consumer: the effects of consumption feedback and information on beliefs, knowledge and behaviour.* Dept of Social Psychology, London School of Economics; Haakana M, Sillanpaa L and Talsi M (1997) *The effect of feedback and focused advice on household energy consumption.* Proceedings, European Council for an Energy-Efficient Economy, **Panel 4 - ID 38**; Wilhite H (1997) *Experiences with the implementation of an informative energy bill in Norway*. Ressurskonsult report 750; Wilhite H (1997) *Experiences with the implementation of an informative energy bill in Norway*. Ressurskonsult Report 750.

programmes that seemed to have been most effective in terms of what was achieved and even in terms of cost-effectiveness. We concluded that feedback could be productive at a very simple level, with clients and advisors using quantitative (meter readings) and qualitative (client satisfaction) indicators and measurements. It was an important element in raising energy awareness, building literacy and leading to savings in fuel consumption. It's worth stressing that this was the case **among fuel poor households.** It is often assumed that fuel poor households are not able to make any energy savings without compromising their health, but it isn't necessarily so.

From this experience, I started to think of feedback on two levels: as an *activity* in examining and understanding our lives, buildings and appliances in relation to energy use; and as a crucial element in *evaluating* the effectiveness of entire programmes. This piece of work also led me to the West Lothian energy advice programme, supported by the local authority – this was in the days when local authorities still had funding for this sort of work – which emerged as particularly effective, with measured savings for heating of around 10% from changes in behaviour and controls alone, averaged over about 1,000 households a year. (This figure for savings could rise later on, with the installation of insulation or improved heating.) So a few years later, when working on my PhD thesis, I carried out some of the fieldwork there, observing interviewing the advisers and some of their clients.

West Lothian District includes a number of small towns and some seriously deprived areas with poorly-designed and built housing; many of the more complex energy advice enquiries came from tenants in these homes, where affordable warmth was hard to achieve. The clients were mainly concerned about affordable energy, sometimes desperate because they could no longer pay their bills. They were usually the first movers: they wanted the advice. But energy was often only one of the issues of concern, and the energy advisors were well-versed in many aspects of social welfare and housing and worked in liaison with a larger team of local authority advisors.

West Lothian Council Energy Services reported dealing with 7,700 enquiries in 2001-2, from almost 10% of the homes in the district. Over 1900 of those enquiries led to the opening of a file with details of a series of contacts, and almost 1700 homes visit were carried out. So this advice was not just 'advice tips'. It was relatively in-depth advice that involved interaction, commitment, time and skill. A case labelled as 'straightforward' might involve a home visit, two letters and two phonecalls, while one labelled 'complex' could take five home visits and letters along with 15 phonecalls and two hours of office casework by the advisor.

Where does feedback enter into this? It was integral to the approach. When a client phoned the service, the adviser would ask them to go to their meter(s) and report the reading(s). When the adviser visited the home, usually within a few days, they took another reading and used the two readings to get an idea of normal (baseline) consumption. Typically, the householder was then asked to phone in readings to the advice office for around four weeks following the visit, so that the impact of the early advice could be measured against the baseline and adjusted for weather

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Wilhite H and Ling R (1995) Measured energy savings from a more informative energy bill. *Energy and buildings* **22,** 145-155.

conditions, and clients and advisers could see whether they were making progress towards their affordability target. If so, there would be a follow-up call and a final meter reading eight weeks later to check that the client was satisfied. That is, one home visit and seven meter readings for a standard case; more for a complex case. Most of the people I interviewed paid for their fuel and electricity through a prepayment meter, so that they had built-in feedback thereafter.

Any early savings (typically averaging 10-11%) would be down to changes in control settings and behaviour, and the tracking of meter readings or expenditure demonstrated how effective these had been. For example, a young woman who had contacted the service because of her high fuel bills told me that she saw how she was now spending £20 per week on prepayment tokens rather than £25 as a result of 'just doing wee different things.' Later, her expenditure went down further because the Council installed gas central heating to replace her electric storage heaters.

You will have noticed how very basic this activity was, and how heavily it relied on personal contact. We're not talking here about detailed, appliance-specific feedback through ingeniously-designed interfaces. Simply about addressing a fundamental difficulty faced by householders who often struggled to keep warm in winter, on low incomes, in poorly-insulated housing. The policy issues were: how do we provide affordable support programmes that have a lasting effect – and how do we demonstrate effectiveness? And part of the answer seemed to be: in close communication with clients, find out about their situation and look at what can be done; carry out basic feedback checks on what happens when they make specific changes in their homes and in their way of going about their lives. I noticed how important it was that the advisers belonged to their community, and their capable, unpatronising way of jointly diagnosing problems with their clients and working with them to find a resolution. Kevin Burchell and his colleagues put this well in a recent paper about energy know-how:

> *'much of the success of the Home Energy Action Visits in Smart Communities appears to have been due to the nature of the social interactions between the local experts with whom we worked and the householders. To a considerable extent, we attribute this to the distinctive style of the local experts, whose personal attributes were simultaneously: authoritative, informal, respectful, understanding, informative and modest.'*[2]

The advent of 'smart' systems

From that early experience of seeing how feedback worked in the context of an advice programme, and how it could be applied in specific situations with the help of an experienced adviser, I want to fast-forward a few years. Around 2004, I started getting requests for a conference paper I'd written four years previously in which I reviewed a range of feedback studies.[3] They came mostly from industry rather than academics, because smart metering was

[2] Burchell K, Rettie R and Roberts TC (2015) *What is energy know-how, and how can it be shared and acquired?* Proceedings, ECEEE Summer Study, paper 9-048-15, p. 1985

[3] Darby S (2000) *Making it obvious: designing feedback into energy consumption.* Proceedings, 2nd International Conference on Energy Efficiency in Household Appliances and Lighting. Italian Association of Energy Economists/ EC-SAVE programme

becoming a big issue and the possible impact of improved feedback was of commercial interest. Then in 2006, DEFRA[4] got in touch and asked me to bring that conference paper up to date.

As far as I can make out, a DTI[5]/DEFRA dispute formed the background to this request. DEFRA thought it might well be worthwhile to develop policy to improve residential feedback without waiting for smart metering, to realise energy and carbon benefits. This could be implemented relatively easily, and would moreover leave consumption data in the hands of customers, without any obligation to share. But they wanted an idea of what sort of outcomes they might expect.

By contrast, DTI were under industry pressure to give the go-ahead to smart metering as soon as possible, without any formal consideration of customer feedback – something along the lines of the Italian smart meter rollout, with a simple replacement of one meter by another.

At this point I started to realise how many interests were at stake in this business of 'smarting' energy systems, and how many issues it raised. This was something I tried to set out in a paper in 2008.[6] I commented that

> *Smart metering and the call for improved feedback have posed technical and organisational challenges to both utilities and policymakers in the UK. One of the main debates has been between advocates of … displays (limited in capability but expected to yield early carbon savings) and those who claimed that [these] would be an unwelcome distraction from a government-mandated rollout of smart meters … The dispute has been in some ways a surrogate for a wider disagreement between those who prioritise a process (feedback)… and those who prioritise a technology or set of technologies. This persists. Meanwhile, microgenerators pose a separate but related set of challenges to energy infrastructures. Displays emerge… as a catalyst: they have concentrated attention on the potential for better feedback between agents in energy systems, for developing energy literacy and for an overhaul of customer/utility relations. They are bringing together behavioural and technical considerations in energy systems in a way that is both complicating and informing the experiment on which the supply industry, government and end-users have embarked.'*

As things turned out, there was a sort of compromise between the DTI and DEFRA positions and the Energy Demand Research Project trials were set up, where four of the Big Six suppliers tried out many different arrangements of feedback, smart metering, information, advice and incentives over more than three years. These produced a complex set of findings[7] that were but pulled together in a comprehensive report.[8] Two headline findings were that (a) we might expect ~3% reductions in both gas and electricity demand if customers were provided with smart meters

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[4] The UK Department for Environment, Food and Rural Affairs
[5] Department for Trade and Industry
[6] Darby, S (2008) *Why, what, when, how, where and who? Developing UK policy on metering, billing and energy display devices.* Proceedings, ACEEE Summer Study, Asilomar, CA., August 17-22. Paper 7_137
[7] Darby S, Anderson W and White V (2011) *Large-scale testing of new technology: some lessons from the UK smart metering and feedback trials.* Proceedings, European Council for an Energy-Efficient Economy summer study, paper 7-524
[8] AECOM (2011) Energy demand research project: final analysis. Report for Ofgem by AECOM Ltd, London. http://www.ofgem.gov.uk/Sustainability/EDRP/Documents1/Energy%20Demand%20Research%20Project%20Final%20Analysis.pdf.

in association with in-home displays by their suppliers (who had no direct incentive to get their customers to reduce usage); and (b) 'more is more': the demand-reduction impact of smart metering improves with multiple sources of feedback, advice etc.[9]

The 'Early Learning' findings from the first years of smart meter rollout in Great Britain are broadly consistent with what was learned during the EDRP trials. The GB rollout is probably unique in requiring not only that all customers are offered in-home displays (IHDs) with their smart meters but that installers are trained to help them use those displays to manage their heating and electricity use. Savings after a year from the first tranche of customers, those with installations in 2011, were 1.5% for gas and 2.3% for electricity, compared with the legacy-metered control group. In the Synthesis report that I and some colleagues produced for DECC[10] last year, we assumed that there would be learning effects over time and concluded that

> *'… it is realistic to expect durable energy savings of 3% based on evidence from the research literature and trials worldwide, the Early Learning Project findings and the potential improvements identified. Greater savings may be achievable over time: for example, the Foundation stage customers who had had their smart meters for longest were most likely to report changes in behaviour and decreased gas and electricity usage since installation… These were not all 'early adopters': in fact, the smart-metered customers in the survey sample were less likely to appreciate having new gadgets in their homes than the GB population in general.'* [11]

British Gas now state, based on data from hundreds of thousands of smart-metered customers and millions of controls, that these early figures of 1.5% and 2.3% have risen to ~3% for both gas and electricity.[12] These average savings figures are modest but they do seem durable.

The findings from surveys of 2000 smart-metered customers for the Early Learning Project[13] gave some insight into the 'how' and 'why' questions surrounding smart metering – for example, how does it work? Why are outcomes are so variable? They showed how important two factors were in realising qualitative gains and reported energy benefits: the preparatory information and the installation experience. As summarised in the Synthesis Report,

> *The in-home display (IHD) was found to be the first and most visible element of smart metering for the customer. The IHDs provided to households covered by the Early Learning Project generally proved easy-to-use, with high levels of satisfaction and continued usage. 96% of consumers with an IHD had plugged it in at some point since the installation visit, and six in ten still had their IHD plugged in and in use when they were interviewed. These*

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[9] AECOM (2011) Energy demand research project: final analysis. Report for Ofgem by AECOM Ltd, London. http://www.ofgem.gov.uk/Sustainability/EDRP/Documents1/Energy%20Demand%20Research%20Project%20Final%20Analysis.pdf.

[10] The Department of Energy and Climate Change

[11] Darby, S.J., Liddell, C., Hills, D. and Drabble, D. (2015) Smart Metering Early Learning Project: synthesis report. For the Department of Energy and Climate Change, London https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/407568/8_Synthesis_FINAL_25feb15.pdf

[12] Evidence to the House of Commons Select Committee on Science and Technology, 3rd May 2016.

[13] IpsosMORI (2016) *Smart Metering Early Learning Project: consumer survey and qualitative research report.* *https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/407543/3_Smart_Metering_Early_Learning_Project_-_Consumer_survey_and_qual_research_-_Main_report_FINAL_CORRECTED.pdf*

customers had their IHDs for between 6 months and over two years by the time they were interviewed, and those who had received them more recently were no more likely than those who had received them two years earlier to still have their IHD plugged in.

Householders who used IHDs to monitor trends and exceptions in their energy consumption over time (a 'monitoring approach') appeared more likely to be experiencing certain benefits than those who simply used them to check on the power demand of different appliances ('information approach'). (pp8-9)

A challenge emerges from this that is familiar to many of us: to work out how best to design feedback into energy systems and programmes so that it is incorporated into everyday life. About 60% of the smart-metered customers in the GB early rollout appeared to have domesticated their IHDs: what about the other 40%.

The future of feedback?

If we go back to Amory Lovins' seminal paper on energy policy, written in the mid-1970s and astonishingly prescient in several respects, we find him identifying five characteristics of a 'soft' (flexible, resilient, sustainable and benign) energy path:

- reliance on renewable energy flows that are there whether we use them or not, such as sun and wind and vegetation: on energy income, not depletable energy capital;
- diversity, so that supply is an aggregate of many individually modest contributions, each designed for maximum effectiveness in particular circumstances;
- *flexible technology: 'which does not mean unsophisticated, but rather, easy to understand and use without esoteric skills, accessible rather than arcane'* (my italics);
- matched in scale and in geographic distribution to end-use needs, taking advantage of the free distribution of most natural energy flows;
- matched in energy quality to end-use needs. [14]

We are now seeing widespread adoption of distributed energy supply, much of it renewable, and the crumbling of old utility business models. But a major challenge still relates to *flexibility* and the extent to which we *understand* our energy systems in terms of human action as well as demand, storage and supply. Understanding matters greatly for welfare and resilience, as we are reminded whenever something goes wrong with our equipment or power supply. If we don't know how to put it right ourselves, we need access to someone who does.

Electricity networks and grids are networks of power in more than one sense. There are some sharply differing ideas of what constitutes 'smart' planning and action, as we come to rely more and more heavily on electricity for everyday functioning and as supply becomes more distributed.[15] At one extreme of a spectrum of possibilities, everyone could be connected to an internet of things with full interoperability that can be manipulated to achieve smooth

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[14] Lovins, A.B. (1976) Energy Strategy: the road not taken? *Foreign Affairs*, October 1976. Reprint with prefaces available via the Rocky Mountain Institute at http://www.rmi.org/Knowledge-Center/Library/E77-01_EnergyStrategyRoadNotTaken . The quotation is from p5 of the Lovins paper.

[15] for a useful outline, see Verbong, G. and Geels, F. (2010) Exploring sustainability transitions in the electricity sector with socio-technical pathways. *Technological Forecasting and Social Change* 77, 1214-1221

functioning of a supergrid, not only controlling traditional electrical services but heating and transport. At the other, we could have many micro-systems providing shelter, warmth, coolth and electricity, in accordance with local circumstances and resources.

As feedback researchers living with and analysing these rapidly-developing systems, I suggest we need to continue exploring and testing how feedback operates in different modes of living and working, making sure that we stay tuned to the variety of perspectives, metrics and indicators we can bring to this work. We could usefully be doing this in relation to topics such as the rise of the prosumer and prostumer (generation, storage and consumption)[16]; developing social contacts creatively, on- and off-line; feedback in non-domestic contexts, where a lot of the challenge may relate to organisational analysis; and feedback and customer-utility relations in demand response programmes. Note that all of these call for some systems thinking and movement out of our disciplinary comfort zones.

Finally… when I returned to my first paper on the topic of energy feedback,[17] I saw that it included two themes that still seem very relevant. The first was that when we think of energy not just as a commodity but as a basic human need or service and as an ecological resource, we see that it has financial, social, ecological and cultural aspects that are often obscured. I was also keen to stress the idea that learning is an active and situated process: that is why simply providing people with information does not necessarily lead to any change. Feedback is an element in the time-consuming business of sense-making and learning in terms of activity, technology, rules and meanings. I had been struck by what the educationalist John Holt had to say about everyday learning and experimentation, and quoted him as follows:

> *We are obliged to act… as intelligently as possible in a world in which… we know very little, in which, even if the experts know more than we do, we have no way of knowing which expert knows the most. In other words, we are obliged to live out our lives thinking, acting, judging on the basis of the most fragmentary and uncertain and temporary information. The point of all this is that this is what very young children are good at doing… The young child is continually building what I like to call a mental model of the world, the universe, and then checking it against reality as it presents itself … and then tearing it down and rebuilding it as necessary… We have got to learn… this business of continually comparing our mental model against reality and being willing to check it, modify it, change it, in order to take account of circumstances.*[18]

I hope we can go ahead with our discussions on the future of feedback in that sort of spirit.

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[16] e.g. Baborska-Narozny M., Stevenson F. and Ziyad F.J. (2016) User learning and emerging practices in relation to innovative technologies: a case study of domestic photovoltaic systems in the UK. *Energy Research and Social Science* 13, 24-37

[17] see note 3.

[18] Holt J (1970) *The underachieving school.* Penguin. pp 144-145