APPENDIX: SUMMARY OF QUANTITATIVE FINDINGS

1: Direct feedback studies

Study	Date	Savings	Persistence	Sample size	Control	Location	Energy source	feedback type	Other change	Comments by authors [and by SD]
Seligman, Darley and Becker	1979	16% against controls for feedback+light or light alone	4-week study, summer	10 with blue light and feedback, 10 blue light, 10 feedback	10	USA	electricity	Flashing light went on as outdoor temperature cooled beyond 68F; feedback 3 times/ week, giving ratio of actual:predicted consumption		The feedback was ignored because it jumped around and did not seem credible.
McClelland and Cook	1979	12%	11 month study, Sep-Jul	25	75	USA	electric, in new, insulated, all-electric homes	Fitch energy monitors with display of cents/hr.	none	Displays 'may have served more to teach residents what activities consume the most energy than simply to draw attention to the cost of energy.' Homes with monitors had lower consumption than controls in all 11 months (Sept -July) with greatest differences in months with moderate weather. Suggests that conservation actions taken by households with monitors primarily affected energy uses other than heating and cooling.
Gaskell, Ellis and Pike	1982	9% from feedback, 11% from fb + info	4 weeks	80 had fb/fb + info	80 had info alone/nothing	UK	electricity	Meter readings	weekly visits, daily diaries	information alone gave 8% saving
Gaskell, Ellis and Pike	1982	5% and 22%	4 weeks	80 had fb/fb + info	80 had info alone/nothing	UK	gas	Meter readings	weekly visits, daily diaries	information alone gave 9% saving
Winett et al	1982	15% against controls for feedback and/or video	3-week baseline + 5-week intervention, winter and summer	85 winter, 53 summer	yes	USA	electricity	Daily, plus weekly visits from experimenters	Videos demonstrating alternatives for comfort	Feedback alone and feedback+video were more effective than video alone. The video showed ways of being comfortable without recourse to overheating or air-conditioning, using positive language.
Hutton, Mauser, Filiatrault and Ahtola	1986	up to 7% over controls, depending on context	unclear	3x25 (I city in US and 2 cities in Canada): ECI + education	3x75: education only, experimental control, blind control	USA + Canada	gas + electricity	Energy Cost Indicator (ECI)	Education materials for 2 groups	Consumer response influenced by situation, eg all-electric homes, extreme weather=high motivation. Quebec, the coldest area, gave strongest behavioural effect and had highest levels of knowledge about usage and savings. 'It does appear that the ECI enhances learning in low-knowledge situations' - California. No evidence from Quebec and BC that the ECI made a significant difference to knowledge about energy-saving actions. For Quebec, ECI+info gave 4.1% savings over exptal control; BC, 5% less increase in consumption than control. In California, only middle-class, educated consumers made savings, 7% over control.
Sluce and Tong	1987	13%	5-month study	31	25	UK	gas + electricity	Fortnightly advice visits including meter readings by adviser	Energy diaries	Low-income households in town houses. All received draughtproofing in the course of the study
van Houwelingen and van Raaij	1989	12% compared with previous; 10% with control; 7% with self-monitoring; 4% with external feedback	1 year experiment. 1 year later, differences between groups ceased to be significant	50	5x 55	Netherlands	gas	Indicator showing daily gas use along with reference figure (agreed norm), adjusted for weather. Signal light to show when heating was on.	None	Supports view that commitment in combination with feedback leads to greater savings than external feedback or self-monitoring alone. Cumulative daily feedback via a display/indicator better than monthly external feedback or self-monitoring. 'People seem to need a permanent reminder and a regular check in their home in order to save energy' [savings lessened when the indicator was taken away]. Interviews with participants showed growing awareness of energy use. Self-monitoring did not work, perhaps because people could not distinguish between weather-related change and other change.
Dobson and Griffin	1992	13% compared with controls and compared with weather-adjusted baseline	a persistence of conservation behaviour... with electrical consumption declining by approx 5% over the 60 days' [for the households with displays]	25, random sample	75, randomly selected	Canada	electricity in all-electric homes	Residential Electricity Cost Speedometer, showing cost on hourly, daily, monthly and annual basis; also breaks down by end-use	No change	A post-test interview indicates that households with the RECS 'began thinking about their electricity usage in ways not possible without specific feedback. Two contacted the supplier for information on heat pumps. The group reported increasing their use of the RECS over the period of the test.
Harrigan and Gregory	1994	26% over controls for feedback+education+ weatherisation. 26% for education+ weatherisation. 14%, weatherisation only	14-month study, then reevaluation in 3rd year. Persistence of 84% of 1st-year savings for the education+feedback+ weatherisation group in year 3, comparable with weatherisation-only group (90%).	47 x 3	39 in yr 1; 13 in yr 3	USA	gas	Energy Log display	Weatherisation+education sessions+ electric DSM measures+ payment plan	No significant difference between education and education+feedback: the difference was between the groups that did or did not have three intensive in-home sessions on energy and money management. The educational focus had been on space and water heating (both gas);
Nielsen	1993	1% (flats), 10% (houses)	3-year study	approx 1500		Denmark	electricity in non-electrically heated homes	meter reading	written information	Savings were low in the flats - relatively low-income householders.
Staats and Harland	1995	27%	savings were measured 6-9 months after the 6-month project was over.	93		Netherlands	electricity	Householders read their meters and compared readings with the others in their 'Eco-team'		Social factors and commitment a key element. Savings persisted/ increased 6-9 months after programme ended. Participants installed more low-energy lights and low-flow showers than Dutch population
Staats and Harland	1995	23%	savings were assessed bewtween Jan-Feb and Oct)	144		Netherlands	gas	Householders read their meters and compared readings with the others in their 'Eco-team'		Social factors and commitment a key element in the Eco-teams
Brandon and Lewis	1999	12% for PC feedback over baseline for those who saved; 3% increase for those who did not.	9 months	120 in 7 groups, including control group	yes	UK	gas and electricity	Written or via the PC	various information materials for some groups	Income and demographics predicted historic consumption but not changes during the study, where environmental attitudes and feedback were influential. The only feedback form the authors are confident about is interactive via the computer (smart metering and household-specific systems may do away with need for a PC).'Visibility may be the key to change.'
McCalley 2000	2000	Up to 21% over baseline, according to experimental conditions.		1	25	Netherlands	washing machines	Simulation using a copy of washing machine control panel	various items of information	Emphasises the importance of goals and social or self-orientation as determinants of effectiveness of feedback.
Wood and Newborough	2003	14% over baseline for ECI only; 12% for ECI+information; 3% for information only	12-month baseline, then 2-months+ for trial of display. No data on persistence after experiment	10 with Energy Consumption Indicator; 10 with ECI+ information pack	12 with information pack only, 9 in no-action control	UK	electric cookers	Direct, through ECI attached to cooker		The use of electronic feedback indicators deserves further attention and optimisation. The units that the ECI displayed were cenbtral to the user being able to understand the display.
NIE	2002?	11% compared with previous usage		former prepayment customers		UK	electricity	Keypad display, pay-as-you-go	no bills; induction/advice	Keypad fitted in room of customer's choice.
NIE	2003?	4% compared with controls	12 months	26 former credit customers	national consumption	UK	electricity	Keypad display, pay-as-you-go	no bills; induction/advice	Keypad fitted in room of customer's choice.
Mountain	2006	6.5% against baseline (adjusted for weather, appliances, demographics)	2.5-year study. Response was persistent across the study period.	505	52	Canada	electricity	Portable monitor with instantaneous feedback, consumption in kWh, $ and CO2, per hour, in total and predicted		Only 2% of the selected customers refused to have one in their house for the study. Highest savings (16.7%) came from homes with electric WH but not SH (air-conditioning made no difference to this figure) . Separating feedback from the heating load and the rest of the load would be needed to encourage conservation in this sector.'
Benders et al	in press	8.5% over control	5months	137 households, Groningen	53	Netherlands	gas and electricity	Web-based tool, using billing data	information as well as feedback	Quite a high drop-out due to lack of time, computer difficulties, lack of Internet connection. Those who persevered were +ve about the website.

2: Indirect feedback studies (billing)

Study	Date	Savings	Persistence	Sample size	Control?	Location	Energy source	feedback type	Other change	Comments
Bittle, Valesano and Thaler	1979	Mixed effect	2-month study, summer	353	delay group' with no feedback from days 18-28. 16-day baseline study	USA	electricity	6 days/week, historic feedback, 4 types, from the experimenters. kWh/day, cumulative kWh since start of month, cost/day and cumulative cost..		Feedback led to 18% reductions by high consumers but had opposite effect for some med and low consumers. Baseline study was not a true baseline - it involved experimenters coming to the house to read the meter.
Seligman, Darley and Becker	1979	10%	3-week study, summer	15	14	USA	electricity	Almost daily from the experimenters, giving ratio of actual:predicted consumption		Providing homeowners with feedback about their rate of consumption can be an effective strategy for conservation.
Seligman, Darley and Becker	1979	13%	4-week study, summer	80 in 4 groups	20	USA	electricity	3 times/week from the experimenters	householders asked to set a difficult or easy conservation goal	Feedback especially effective if the homeowners are motivated to save a considerable amount of energy. Controls also had a notice in their kitchen window that was ticked each time the meter was read - ie, likely Hawthorne effect.
Arvola et al	1994	3% against controls for feedback; 5% for feedback+ advice tips	2 year study	525	175	Finland	all-electric	Bills every 36 days; in the 2nd year, historic feedback was added to the bills.		Frequent billing seemed to have the largest single effect. The experiment had most influence on families with lower incomes and those with high baseline consumption.
Garay and Lindholm	1995	A 'tendency of red. consumption in electrically heated homes', but an inc in district heating. .	15 month project	600	600	Sweden	electricity+ district heating	Monthly bill with measured energy use + historic and comparative feedback		Through interviews, discovered that the new bill improved householders' control over their energy costs. 96% satisfaction. Treatment and control groups were not similar enough to give good comparisons.
Haakana et al	1998	7% over internal controls	2.5yrs after end of study, almost 1/2 h/holds still making savings. Monitoring still frequent; most freq in h/holds which had made savings.in electricity and water.	105		Finland	electricity, no electric heating	H/holds sent monthly form with meter readings. Utility sent monthly comparative+ weather-adjusted historic feedback .		Advice after feedback had no further effect. The 7% may be an underestimate - it comes from comparing monthly consumption from Dec-March with monthly consumption April-November.
Haakana et al	1998	4-5% over blind control	2.5yrs after end of study, almost 1/2 h/holds still making savings. Monitoring still frequent; most frequent in h/holds which had made savings.in electricity and water.	79 with fb	26 w no fb or info; 650 blind controls	Finland	gas	H/holds sent in mnthly form from meter readings. Utility sent monthly comparative+ weather-adjusted historic feedback.	advisory material as requested - video or written - for 2 exptal gps.	Savings were not necessarily according to the written advice recd.Internal controls made almost as many beh changes as exptal gps. Type of (video, written. Meter) made no diff.
Wilhite and Ling	1995	10% over controls	3 years. 'our impression from interviews is that after 3 years the changes people made had become so routine that they had trouble identifying them.'	191 with frequent bill;209 with feedback; 211 with feedback+tips	675, matched for ownership status, size of home and stage in family cycle	Norway	electricity	6 bills/year based on meter readings, with simplified text and a graphic showing each period compared with the previous year, temperature-corrected.		Wasteful habits linked to misunderstandings about where energy is used in the home. Recipients of the new bills paid more attention to them, were more likely to discuss them and wanted to continue with the new system. Costs minimal in relation to savings - about $0.01/kWh saved. A small amount of saving may have been achieved by fuel-switching. Younger customers more likely to reduce consumption than older.
Wilhite	1997	8% (see next column)	The project ran from March 1995-Dec 1996. In April 1998, consumption of the participants had fallen by 4% compared with baseline, while that of customers in surrounding areas had risen by 4% (Wilhite, pers. comm).	2000	comparison made after the study was over	Norway	electricity	Customers read their meters and sent in the figure to the utility, every 60 days. After a year, they were sent historic feedback.	transfer of meter-reading from utility employee to customer	Good results in terms of customer satisfaction and loyalty. 18% more customers read their bills often or always; 19% more were satisfied with the information; 20% fewer of the younger customers said they did not know whether their consumptioh had changed over the past 2 years; 8% more customers reduced temperatures at night. The costs of billing doubled but the supplier expanded the recipient group from 2000 to 25,000 households in 1997.
Henryson et al	2000	0, 2, 2, 3, 2-4, 10 and 12%		7 studies, samples of 600-1500 inc. Wilhite&Ling		Scandinavia	electricity	Increased energy awareness and customer satisfaction in 6 of the 7 studies. One reports that increased information did not change attitudes.	With and without additional information	The longer the duration of a trial or the larger the quantity of information, the more prolonged the effects.

3: Electricity feedback with time of use pricing

Study	Date	Savings	Sample size	Control?	P:OP ratio	Location	feedback type	Comments
Kasulis et al	1981	some rescheduling of consumption	30			USA	written, with bill: use + cost, peak and offpeak	Participation was mandatory
Sexton et al	1987	26% savings at peak when p:op at 9:1	480	120	various	USA	monitor showing peak, offpeak and total consumption	Customers were informed that the exercise was to do with load-shifting, not conservation
CPUC pilot of DR to CPP with sms cited in Owen and Ward	2003-4	27% peak reductions with automated response at highest CPPs to 5-10% without automated response				USA		Information about peak periods without a price signal gave no savings. No impact on overall demand - just shifting. Though an IEA study cited, which showed 4% average conservation effect
Crossley for IEA, cited in Owen and Ward	2005	12-14% peak reductions	1200					
NIE	2005	11% reduction in evening peak when price signal is applied	100 price message gp - 4 keypad ToD bands+ 3 tariffs	100 - 4 keypad ToD bands + flat tariff	5.8p:8.6p: 15.4p	UK	keypad display	93 in each group finished the trial. Best prospects for load management = wet appliances (12%). Also lighting at 24%. Functionality of meter has changed little - just added display giving real time cost data.
Puget Sound Energy (from IEA DSM subtask 2)	2005	5% peak reduction	300,000		14 Euro-cents, reduced to 12 after a year	USA		Customers left the programme when the P:OP ratio was reduced and they realised they were paying slightly more by participating than they would by not participating.
Gulf Power Company (from IEA DSM subtask 2)	2005	22% reduction against controls at peak periods; 37% in critical peak periods	3000		8:5, with CPP = 3x peak price	USA		Customers were given a thermostat that could be programmed to control their major end-uses when prices exceeded a preset level
SWALEC (in IEA DSM subtask 2)	2005	25% reduction in peak - enough to avoid reinforcing a rural distribution network	100+			UK		Demand control algorithm scheduled charge and release of energy from storage heating based on half-hourly price message 24 hours ahead. No customer override - but acceptable to customers. Could not be used with profile settlements and was not rolled out because of additional cost needed for TOU metering and processing of the data.
Martinez and Geltz	2005	some overall reduction	32 residential, 29 commercial		up to 4:1	USA	ambient - the Energy Orb. Notification the day before a Critical Peak Pricing event	4-month trial. Many reduced consumption well in advance of peak pricing time. Resdential customers more interested in real-time information than commercial