

Application No.: A.08-09-  
Exhibit No.: SCG – 5  
Date: September 29, 2008  
Witness: Sarah J. Darby, Environmental Change Institute, University of Oxford

**SOUTHERN CALIFORNIA GAS COMPANY**  
**ADVANCED METERING INFRASTRUCTURE**

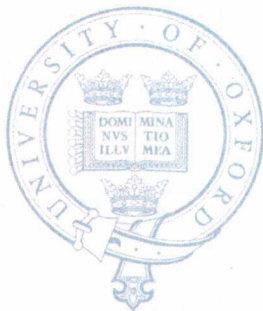
**CHAPTER V**

**ESTIMATED CONSERVATION IMPACT OF PROVIDING DAILY GAS  
INFORMATION TO CUSTOMERS**

**Prepared Direct Testimony**  
**of**  
**Sarah J. Darby**

**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF CALIFORNIA**

**September 29, 2008**



# OXFORD UNIVERSITY

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## CONSULTING

**Company Name: Southern California Gas Company**

**Report:**

**Reference: R001/2008/3687**

## TABLE OF CONTENTS

<b>I.</b>	<b>INTRODUCTION.....</b>	<b>1</b>
<b>II.</b>	<b>SUMMARY .....</b>	<b>1</b>
<b>III.</b>	<b>BACKGROUND .....</b>	<b>2</b>
<b>IV.</b>	<b>THE RESEARCH LITERATURE ON ENERGY FEEDBACK.....</b>	<b>3</b>
<b>V.</b>	<b>RESEARCH DIRECTLY RELEVANT TO THIS TESTIMONY .....</b>	<b>5</b>
<b>VI.</b>	<b>SCOPE FOR SAVINGS AMONG SOCALGAS CUSTOMERS.....</b>	<b>7</b>
<b>VII.</b>	<b>LIKLEY PARTICIPATION IN A FEEDBACK PROGRAMME .....</b>	<b>11</b>
<b>VIII.</b>	<b>WITNESS QUALIFICATIONS.....</b>	<b>14</b>
<b>IX.</b>	<b>NOTICE.....</b>	<b>16</b>

1  
2 **I. INTRODUCTION**

3 The purpose of my testimony is to present evidence for the potential conservation impact  
4 of using AMI technology and making timely usage information available to customers. The  
5 focus is on how customers change their behaviour in relation to information feedback.  
6

7 **II. SUMMARY**

8 The Southern California Gas Company (SoCalGas) proposes communication  
9 technologies and supporting systems to provide online next-day gas usage information for their  
10 customers. The total conservation impact from these information presentation tools will depend  
11 on the scope for conservation in customers' homes, the quality of feedback and the level of  
12 customer participation in a feedback programme.

13 On the basis of the research literature regarding the impact of feedback on heating- and  
14 cooling-related behaviour, I estimate an average conservation impact of approximately 5% per  
15 participating household from the adoption of AMI and regular use of next-day feedback on the  
16 SoCalGas website. This saving would result from changes in routine behaviour and resetting of  
17 controls.

18 A second option under consideration by SoCalGas is a dedicated in-home display. My  
19 estimate of the conservation effect from adoption of AMI with display-based feedback is 10%.  
20 The higher figure results from the information being more easily accessible than it is when  
21 online: the consumer does not have to go and seek it out.<sup>1</sup>

22 Over 75% of households in southern California are estimated to have Internet access<sup>2</sup>; the  
23 display-based feedback would be the default option for those who are not online. In-premise  
24 displays and web-based feedback are not mutually exclusive and can be complementary.

25  
26 <sup>1</sup> SoCalGas witness Mr. Olmsted discusses the capabilities of the available AMI technologies, including responses  
27 that will communicate with home information gateway devices or home area network (HAN) display devices.

<sup>2</sup> Nielsen figures for local internet penetration, Q4 2006

1 I have estimated the overall conservation impact of web-based and display-based  
2 feedback on the assumption that initial participation levels will be 6.5% of the customer base for  
3 each. This gives a total conservation impact of **just under 1%** in the first year for those  
4 customers with the arrangements in place for next-day feedback. If participation were then to  
5 increase at a rate of an additional 1% per year, this total would rise to approximately **1.6%** of  
6 total gas consumption 5 years after the start of the rollout, averaged over the customer base.

7 There are potential further savings from investment in energy efficiency measures and  
8 low-carbon technologies, once customers' interest and commitment are engaged more fully, but  
9 these are likely to be accounted for elsewhere.

10 Approximately 40% of gas consumption in homes in the SoCalGas territory is used for  
11 space heating and 47% for water heating. These two end-uses offer the main potential for  
12 conservation.

13 Estimates for the conservation effect of web-based and display-based feedback are based  
14 on the studies summarised in the Attachments. They can only be a guide to what is possible.  
15 The outcome for SoCalGas customers will depend to some extent on how the feedback is  
16 implemented and supported, and on the overall drive towards fuel conservation in California.  
17 However, the trend over recent years has been for domestic energy users to show increased  
18 concern about their usage and about its environmental impact, and to expect greater access to  
19 timely information.

### 21 **III. BACKGROUND**

22 The California Energy Efficiency Strategic Plan sets targets for deep energy reduction  
23 and envisages a 'rapid evolution in both technology and customer behaviour to make energy  
24 efficiency "a way of life" among Californians by 2020' (pp.2-3). Visual displays of real-time or  
25 near-real-time energy use are seen as part of this evolution (p.17), enabling households to  
26 manage their energy use more effectively and to reduce emissions through changes in behaviour  
27 and adoption of low-carbon technologies and efficiency measures.

1 This testimony deals with the potential for energy conservation resulting from adoption  
2 of AMI by the Southern California Gas Company. It relates to the likely impact of improved  
3 feedback on customer behaviour.

4 AMI can provide energy usage information to both customer and utility on a defined,  
5 regular basis. By doing so, it can improve the quality of feedback to both, which can lead to  
6 better understanding of how to manage and to conserve fuel. Data from an AMI also provides a  
7 shared point of reference in the event of complaints or requests for advice.

#### 8 9 **IV. THE RESEARCH LITERATURE ON ENERGY FEEDBACK**

10 Several of the studies on energy information feedback that were reviewed for this  
11 testimony were conducted before advanced metering was available. However, they are still  
12 relevant because these studies involved changes in the energy user's information environment of  
13 the type proposed by SoCalGas, i.e., more timely, accurate information, comparisons of energy  
14 usage with previous periods, and identification of consumption goals or benchmarks.

15 In 2006 I carried out a review of some 35 papers and reports in the literature on energy  
16 feedback in the residential sector for the UK Department of Environment, Food and Rural  
17 Affairs<sup>3</sup>. I concluded that

18  
19 *Indirect feedback [that is, feedback that is processed in some way before reaching*  
20 *the energy user] ... is usually more suitable than direct feedback [immediately*  
21 *available to the user] for demonstrating any effect on consumption of changes in*  
22 *space heating, household composition and ... investments in efficiency measures...*

23  
24  
25 <sup>3</sup> Darby S (2006) *The effectiveness of feedback on energy consumption. A review for DEFRA of the literature on*  
26 *metering, billing and direct displays.* Environmental Change Institute, University of Oxford  
27 <http://www.defra.gov.uk/environment/climatechange/uk/energy/research/pdf/energyconsump-feedback.pdf> and  
[http://www.defra.gov.uk/environment/climatechange/uk/energy/research/pdf/energyconsump-feedback-](http://www.defra.gov.uk/environment/climatechange/uk/energy/research/pdf/energyconsump-feedback-appendix.pdf)  
28 [appendix.pdf](http://www.defra.gov.uk/environment/climatechange/uk/energy/research/pdf/energyconsump-feedback-appendix.pdf)

1 *Savings have ranged from 0-10%, but they vary according to context and the quality*  
2 *of information given. Historic feedback (comparing with previous recorded periods*  
3 *of consumption) appears to be more effective than comparative or normative*  
4 *(comparing with other households, or with a target figure)...*

5  
6 *Persistence of savings will happen when feedback has supported 'intrinsic'*  
7 *behaviour controls – when individuals develop new habits – and when it has acted as*  
8 *a spur to investment in efficiency measures...As a rule of thumb, a new type of*  
9 *behaviour formed over a three-month period or longer seems likely to persist – but*  
10 *continued feedback is needed to help maintain the change and, in time, encourage*  
11 *other changes.*

12  
13 Dr. Corinna Fischer, a psychologist working at the Free University of Berlin, recently  
14 reviewed the same literature and also some German-language studies.<sup>4</sup> She found that feedback  
15 stimulates energy savings that are usually between 5-12%, provided that there is some  
16 motivation to conserve. She concludes that

17  
18 *'With all due care because of data restraints, there are reasons to identify some likely*  
19 *features for successful feedback (meaning, both effective in stimulating conservation and*  
20 *satisfying to households). Such feedback*

- 21 • *is based on actual consumption*
- 22 • *is given frequently (ideally, daily or more)*
- 23 • *involves interaction and choice for households*
- 24 • *involves appliance-specific breakdown [the review relates to electricity]*
- 25 • *is given over a longer period [prolonged period]*

26 <sup>4</sup> Fischer C (2008) Feedback on household electricity consumption: a tool for saving energy?. *Energy Efficiency* 1  
27 (1), 79-104

- 1 • *may involve historical or normative comparisons (although these are appreciated by*  
2 *households, the effects are less clear)*
- 3 • *is presented in an understandable and appealing way.'*

4  
5 I concur with Dr. Fischer's conclusions. For the SoCalGas situation, the most important  
6 characteristics are actual, frequent consumption feedback information over a long (continuing)  
7 period of time, interactivity, comparisons with consumption in previous periods and presentation  
8 in a user-friendly format. I would also argue that more than one option for mode of feedback is  
9 desirable, in order to engage as many customers as possible; and more than one metric for  
10 feedback (for example, allowing customers to choose between cost or energy units, and to select  
11 time periods for comparison and goals or benchmarks).

## 12 13 **V. RESEARCH DIRECTLY RELEVANT TO THIS TESTIMONY**

14 There are not many fully-documented trials of feedback carried out with large numbers of  
15 people in 'normal' conditions, and those that exist have shown a range of conservation impacts,  
16 as indicated above. For this testimony, I selected four case studies of 'indirect' feedback that  
17 seemed most relevant to the SoCalGas situation, in that they relate to gas usage and use a  
18 computer-based interface with the customer. These case studies are summarized in Attachment  
19 SD-1.

20 I also selected eight studies and reports that deal with more direct feedback modes (where  
21 the end-user has instant access to the consumption data), where space- and water heating are  
22 included among the end-uses. These are summarized in Attachment SD-2. The main point is  
23 that the feedback in these trials included relatively high energy loads, which do not change  
24 rapidly from moment to moment and which lend themselves to next-day feedback more than to  
25 real-time feedback.

26 The only instance in the English-language literature of a trial of next-day feedback on  
27 domestic gas consumption alone, given via a dedicated display rather than online, produced 12%



1 savings against a baseline and 10% against a control group for the duration of the experiment<sup>5</sup>.  
2 The feedback was given for the previous day's consumption in relation to a 10% conservation  
3 target. However, a year after the displays had been removed, consumption had reverted to the  
4 same level as that in the control groups: feedback needs to be integrated into the energy system,  
5 not offered as a temporary expedient.

6 We have evidence of durable or sustainable change – that is, changed habits – in the  
7 available studies, and we have evidence that people who monitor their energy usage also tend to  
8 have a more active interest in installing long-lasting efficiency measures and low-carbon  
9 technologies.<sup>6</sup>

10 Some of the selected research shows the combined effect of feedback and advice.  
11 Feedback information may prompt energy users to seek advice and it can also be used to check  
12 that the advice is productive. A study of low-income households in West Lothian in Scotland  
13 demonstrated that basic feedback from self-meter-reading gave average savings of 11% within  
14 three months from behaviour change when it was combined with personalised advice; there were  
15 further savings from energy efficiency measures which were installed later<sup>7</sup>. In Germany,  
16 participants in the Home Resource Account programme have averaged 5% gas savings per year  
17 over a period of four years when given graphical online feedback on their meter readings in  
18 combination with online or phone advice, including advice on improving the efficiency with  
19 which their central heating pumps work<sup>8</sup>. This indicates something of what is possible with  
20 motivated participants over an extended period. The participants in this scheme do not have  
21 smart meters but record their meter readings on the HRA website whenever they wish. A third

22 <sup>5</sup> Van Houwelingen, JH and van Raaij, WF (1989) The effect of goal-setting and daily electronic feedback on in-  
23 home energy use. *Journal of consumer research* 16, 98-105.

24 <sup>6</sup> Darby 2006 as in footnote 1; Darby S (2006) Social learning and public policy: lessons from an energy-conscious  
25 village. *Energy Policy* 34, 2929-2940; CO2 Online, a German website offering personal energy advice in  
26 conjunction with meter readings; Harrigan MS and Gregory JM (1994) Do savings from energy education persist?  
27 Alliance to Save Energy, Washington DC; Staats H, Harland P and Wilke HAM (2004) Effecting durable change:  
28 a team approach to improve environmental behaviour in the Netherlands. *Environment and Behaviour* 36 (3), 341-  
367

<sup>7</sup> Annual reports of the West Lothian Energy Advice Project; referred to in Darby S (1999) *Energy advice – what is  
it worth?* Proceedings, European Council for an Energy-Efficient Economy, III.05

<sup>8</sup> CO2online.de, accessed July 2008. Home Resources Account

1 example, that of the ‘Ecoteams’ in the Netherlands, shows what is possible with neighbourhood  
2 groups of motivated individuals: weather-adjusted gas savings of 20% against baseline were  
3 achieved during the first year of the programme and three years after the programme began,  
4 savings were still at 16% against the baseline<sup>9</sup>. There is more information on these three  
5 programmes in Attachment SD-2.

6 Attachment SD-2 includes summaries of the conservation impact of three pay-as-you-go  
7 systems. This payment method intrinsically involves a degree of feedback to the customer, but  
8 these programmes also included in-premise displays. They systems produced substantial  
9 conservation effects of up to 20%, though it is not known whether some of this was due to self-  
10 disconnection by customers from their electricity supply.

11 In summary, the evidence from these selected studies is that gas conservation and electric  
12 space- and water-heating conservation have resulted from both ‘indirect’ and ‘direct’ feedback;  
13 that durable effects have been measured, and that the effect of feedback can be enhanced by  
14 combining it with advice and/or community initiatives.

## 15 16 **VI. SCOPE FOR SAVINGS AMONG SOCALGAS CUSTOMERS**

17 The scope for savings will be affected by factors such as initial consumption levels (how  
18 much scope is there for reductions in usage without sacrificing comfort?); ability and willingness  
19 to invest in energy efficiency measures or low-carbon technologies; and tenure (is the customer  
20 in a position to make alterations to the property or the gas appliances?).

21 SoCalGas workpapers<sup>10</sup> give eight principal end-uses for natural gas in dwellings, with  
22 varying scope for demand reduction. They are:

23  
24  
25  
26 \_\_\_\_\_  
27 <sup>9</sup> Staats, Harland and Wilke as in footnote 4.

28 <sup>10</sup> 2006 California Gas Report workpapers, redacted. Prepared by the Gas Company. P117.

1 1. Space heating (39% of residential gas consumption in California)<sup>11</sup> . This will vary  
2 according to location but conservation gains can be made in the short- and long-term  
3 through behavioural and physical changes such as

- 4 • improving furnace efficiency or replacing old, inefficient furnaces;
- 5 • turning the central heating thermostat down in winter: a rule of thumb is that a  
6 reduction of 1°C (1.8°F) leads to a reduction in consumption of around 10%;
- 7 • heating less of the building – turning off heaters or shutting vents in unused  
8 rooms;
- 9 • heating it for less time, e.g. use of timer to switch off and setback at night and  
10 during absences from home;
- 11 • using area-specific thermostats to control heating better in different areas of the  
12 building;
- 13 • improving the insulation of the home (this would also have the effect of keeping  
14 the building cooler in summer and reducing air-conditioning loads);
- 15 • building and refurbishing for solar gain in winter.

16  
17 There appears to be a price-response effect at work in conservation of space heating.  
18 When comparable trials of feedback via an in-premise display were carried out in Newfoundland  
19 and British Columbia<sup>12</sup>, the Newfoundland householders with electric space heating reduced  
20 their demand by 20% compared with the control group. In British Columbia, where electricity is  
21 much less expensive than in Newfoundland, comparable figures were 3% and 2%. This could be  
22 relevant at a time of rapidly rising gas prices.

23 2. Water heating (47% of residential gas use). Potential conservation measures include

- 24 • insulating the water tank;
- 25 • installing low-flow taps and shower heads

26 <sup>11</sup> California Statewide Residential Appliance Saturation Study. Final Report, June 2004

27 <sup>12</sup> Mountain, DC (2007) real-time feedback and residential electricity consumption: British Columbia and  
28 Newfoundland and Labrador pilots. Mountain Economic Consulting and Associates Inc., Ontario

- 1 • using less hot water day by day, e.g. shorter showers
- 2 • turning down the water tank thermostat to 140°F/ 60°C
- 3 • replacing the water heating system either with solar water heating or with a more
- 4 efficient tank-less system. It is estimated that installing solar water heating could
- 5 reduce natural gas demand in homes for water heating by 50-75%.<sup>13</sup>

6

7 3. Cooking (10% of residential use). We have no research data on use of feedback

8 specifically for gas cooking; only for the real-time displays that were tried with

9 electric cookers, where the volunteer users saved an average of 14%.<sup>14</sup> There is no

10 suggestion that this would be separately available to SoCalGas customers, so any

11 savings here would come from increased general awareness of consumption.

12 Cooking would be likely to show up in the feedback if data were available three or

13 four times a day, as proposed by SoCalGas, but might otherwise be ‘lost in the noise’

14 of daily data.

15

16 4. Drying (4%). There is scope for reducing this consumption through line-drying.

17 Again, data three or four times daily would be likely to show the impact of dryers.

18

19 5-8. Pool heating, spa heating, fireplaces and barbecues (very small proportions of overall

20 consumption, but may be significant for the customers who use them). The first two

21 of these lend themselves to solar heating technologies – a step involving investment

22 but one that is becoming more likely in the light of recent policy on solar water

23

24

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25 <sup>13</sup> Del Chiaro B and Telleen-Lawton T (2007) Solar water heating: how California can reduce its dependence on

26 natural gas. Environment California Research and Policy Center

27 [http://www.arb.ca.gov/cc/ccea/comments/jan/environment\\_california\\_swh.pdf](http://www.arb.ca.gov/cc/ccea/comments/jan/environment_california_swh.pdf)

28 <sup>14</sup> Wood, G. and Newborough, M. (2003) Dynamic energy-consumption indicators for domestic appliances: environment, behaviour and design. *Energy and Buildings* 35, 821-841

1 heating and the California Energy Efficiency Strategic Plan. Fireplaces and  
 2 barbecues offer some prospect of incremental savings.

3  
 4 From the above, there is clearly substantial scope for gas conservation in the SoCalGas  
 5 area. The question is how much of it can be realised through provision of gas usage and bill  
 6 information feedback to customers, using AMI.

7 Table 1 summarises the findings from the most relevant research literature, dealing with  
 8 feedback on gas consumption and/or space heating and cooling. Findings from the studies from  
 9 which Table 1 is drawn are set out in more detail in the Attachments, as noted above.

10  
 11 **Table 1: Summary of findings from the research literature on feedback to households\*<sup>15</sup>**

	Number of studies from which a figure for savings is derived	Indicative figure for savings per participant	Range
Indirect feedback, PC / web-based	4	5%	4 - 9%*
Direct feedback through a moveable in-premise display monitor or self- meter-reading	9	10%	1 - 20%
Pay-as-you-go metering with feedback	3	12%	5 - 20%

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 13  
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 18  
 19  
 20  
 21  
 22  
 23  
 24 \*The data for German homes show 5% savings year-on-year over a period of four years for a combination  
 25 of self-monitoring, website use and availability of targeted advice.

26  
 27 <sup>15</sup> with the exception of the Carbon Trust trial of web-based feedback to SMEs.

1 The 5% and 10% indicative figures relate to savings in the short- to medium-term, mostly  
2 from behavioural change (change of habits) arising from increased awareness. They do not  
3 include any further conservation effects that may come about as householders become more  
4 knowledgeable about the options open to them and more likely to invest in energy efficiency and  
5 low-carbon technologies.<sup>16</sup> (These may be accounted for elsewhere, for example as a result of  
6 specific marketing programmes.)

## 8 **VII. LIKELY PARTICIPATION IN A FEEDBACK PROGRAMME**

9 Evidence on the effectiveness of feedback is mostly drawn from samples that are unlikely  
10 to be representative of the whole (especially in the early studies), and I had to make a judgement  
11 as to how much we could expect customers to take an interest in feedback. Participation in a  
12 utility-led, feedback-based conservation programme will depend to a large extent on customer  
13 motivation to conserve, and on the extent to which the utility engages them. The research  
14 literature shows that feedback is effective in two main ways. First, it builds awareness in people  
15 who have had a more or less fatalistic attitude to their energy bills, seeing them as something  
16 over which they have little or no control. This mindset is summarised in a recent study of  
17 householders in London:

18  
19 *Energy and power are not terms within the natural language of mainstream*  
20 *householders. Gas and electricity operate at the level of the subconscious within the*  
21 *home ... there appeared to be virtually no sense of being able to actively and*  
22 *significantly reduce energy consumption in the household.*<sup>17</sup>

25 <sup>16</sup> Darby S (2006) Social learning and public policy: lessons from an energy-conscious village. *Energy Policy* 34,  
2929-2940

26 <sup>17</sup> Dobbyn, J and Thomas, J (2005) *Seeing the light: the impact of micro-generation on our use of energy*. Report to  
27 the UK Sustainable Development Commission. <http://www.sd-commission.org.uk/publications/downloads/Micro-generationreport.pdf>

1 For this group of people, response depends in the first instance on the extent to which the  
2 feedback seizes their attention. Once they are more aware of their consumption, they are in a  
3 position to start doing something about altering it. Once they have started experimenting, the  
4 feedback then tells them which actions and measures are most worthwhile.

5 Second, feedback acts as a tool for people who are already motivated to save energy. A  
6 psychologist evaluating a community trial of digital electricity real-time monitors in Wales noted  
7 that

8  
9 *The [monitors] had the most effect in households where discretionary electricity use*  
10 *was fairly high and they were motivated to reduce it for either environmental or cost*  
11 *reasons.*<sup>18</sup>

12  
13 Something similar could be expected for those SoCalGas customers who are motivated  
14 by environmental and/or financial concerns, frequently online and comfortable with web-based  
15 interactive tools. Research carried out with 563 members of the SoCalGas online customer  
16 insight panel (a 51% response rate) showed 68% agreeing (38% strongly and 30% somewhat)  
17 that if their daily gas usage and cost were made available, it would influence their usage, with  
18 only 13% disagreeing. 47% of the panel said that they would prefer to have daily information on  
19 the SoCalGas website. This fits with the finding by a recent Pew Centre study that 41% of ICT  
20 users are either 'elite' or 'middle of the road' users who are at ease with the technology and  
21 value it<sup>19</sup>. On the combined SoCalGas and Pew figures, we could expect nearly 15% of all  
22 SoCalGas customers (51% response rate x 68% interest x 41% highly computer-literate) to show  
23 some interest in online feedback information at the outset of an AMI-related programme.

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25  
26 <sup>18</sup> Kidd and Williams, 2008

27 <sup>19</sup> Pew (2007) *A Typology of Information and Communication Technology Users*. Pew Internet and American Life  
28 Project, Washing DC, May 7 2007.

1 29% of the SoCalGas customer panel said that they would prefer daily feedback on an in-  
2 home display; however, this was an *online* panel. For those customers who are not online, a  
3 standalone display would be the default option.

4 I have estimated 13% participation in a feedback programme for the early days – a little  
5 lower than the 15% suggested by the customer insight panel and Pew data, but still a substantial  
6 level of interest. This 13% is divided into 6.5% of customers opting for online feedback and  
7 6.5% for display-based feedback.

8 13% is higher than the Southern California Edison estimates of initial uptake of web-  
9 based feedback at 1% (with growth of 1% per year), and uptake of display-device-based  
10 feedback at 1% initially (with growth of 0.1% per year).<sup>20</sup> I believe the higher estimate is  
11 justified, based on the reasoning given above and on recent experience in northern Ontario,  
12 where Hydro One were recently able to roll out real-time electricity displays to 30,000 (20%) of  
13 their customers over a period of nine months, charging them \$9 for postage and handling.<sup>21</sup>

14 SoCalGas is proposing measures as detailed in Chapter VI to encourage participation and  
15 conservation. All of these proposals could assist recruitment and effectiveness. It is worth  
16 noting that they would be introduced at a time when customers would be growing accustomed to  
17 real-time feedback on electricity consumption, and at a time when energy prices, environmental  
18 concern and expectations for high-quality information are rising.

19 Table 2 gives estimates of the initial conservation potential of an online feedback service,  
20 applying estimates of savings potential and participation (as discussed above) across the  
21 customer base.

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25 <sup>20</sup> Rebuttal testimony supporting Edison Smartconnect™ deployment funding and cost recovery. February 19, 2008.  
p12.

26 <sup>21</sup> Personal communication from the Director, Business Transformation, Hydro One. The conservation outcome is  
27 not established yet but is estimated to be in line with the findings of the pilot studies carried out by Mountain  
Consulting: that is, around 6-7%.



**Table 2: Estimates of conservation potential from daily online feedback to SoCalGas customers**

Feedback type	% of customers participating	Savings potential (%)	Initial total conservation estimate (% of participants with 'smarted' meters)	Conservation estimate in Y5, assuming 1% participation growth rate per year
Web-based	6.5	5	0.325	0.525
Display-based	6.5	10	0.65	1.05
Total conservation effect			<b>0.975</b>	<b>1.575</b>

**VIII. WITNESS QUALIFICATIONS**

My name is Sarah J Darby. I am a Research Fellow at the Environmental Change Institute, University of Oxford. The fellowship was awarded for the study of domestic energy feedback, with reference to the introduction of advanced metering, and is funded by the UK Research Councils' Energy Programme. I am a member of the evaluation team for the UK Demand Reduction Trials. I also contribute to the ECRIS project, part-funded by the Department of Business, Enterprise and Regulatory Reform, to develop tools to help people manage their energy usage better. This has led to the launch of the company ONZO.

I hold a BSc in Ecological Science from the University of Edinburgh, a postgraduate diploma in urban and regional planning from Oxford Polytechnic, and a doctorate from Oxford University. I began researching energy issues at the ECI in 1997, evaluating the effectiveness of energy advice programmes for low-income householders. In 2000 I wrote a paper that has been widely cited, '*Making it obvious: designing feedback into energy consumption*', in which I

1 reviewed the evidence on how feedback affects energy consumption. In 2003 I completed a  
2 doctoral thesis on the topic of 'Awareness, action and feedback in domestic energy use'.  
3 Between 2003 and 2007 I contributed to research on policy and practice for low-energy housing  
4 and non-domestic buildings, including the ECI report *40% House* and background research for  
5 the Royal Commission on Environmental Pollution's 2007 report on the urban environment. In  
6 2006 I carried out a further literature review on the effectiveness of feedback for the UK  
7 Department of Environment, Food and Rural Affairs.

8 This is my first testimony before the California Public Utilities Commission.  
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1 **IX. NOTICE**

2 This report was commissioned by **Southern California Gas Company** on terms  
3 specifically limiting Isis Innovation Limited trading as Oxford University Consulting's liability.  
4 Our conclusions are the result of our professional judgment, based in part upon the material and  
5 information provided to us by **Southern California Gas Company** and others. Use of this  
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# **Attachment**

Attachment SD-1

Findings from selected 'indirect' feedback studies (data processed and supplied by the utility) involving gas and/or space heating/cooling

Study	Savings	Persistence	Sample size	Control	Location	Energy sources	Feedback type	Other interventions / changes to normal practices	Comments
Brandon G & Lewis A (1999) <i>Reducing Household Energy Consumption: a Qualitative and Quantitative Field Study</i> , Journal of Environmental Psychology 19, 75-85.	4% total energy reduction against baseline (12% for 12 who made savings; 3% increase in usage for the 3 who did not). 12% reduction against controls.	Project ran for 9 months	98 households in 6 groups (15 with PC-based feedback)	22	UK	Gas and electricity	Via PC and showing current and previous year's weather-connected consumption on a graph, (normalised to monthly), in kWh). Other modes included paper-based historic, comparative against other households, cost, environmental values, with advice).	the PC-based feedback was accompanied by a questionnaire on aspects of energy savings and a directory of information and advice.	High users reduced consumption; low users increased it. Focus groups showed that participants were pleased with the graphic displays but disappointed about the lack of personalised information. The only feedback mode the authors are confident about is interactive, via the PC. 'Visibility, in terms of making energy consumption visible as a prompt, may be the key to change.'
Ueno T, Inada R, Sasaki O and Tsuji K (2005) <i>Effectiveness of displaying energy consumption data in residential houses. Analysis on how the residents respond</i> . Proceedings, European Council for an Energy-Efficient Economy, 6, 100	9% gas reduction against baseline and against controls	Data were collected for 28 weekdays (5.5 weeks)	10 households	9	Japan	Gas, electricity and kerosene	Web-based, via PC. <i>Half-hourly</i> consumption data over each day, expressed in cost terms; also 10-day periods. Comparisons with past data (daily data averaged over current month, previous month, previous year) and with other households. No weather correction (note that no data were collected for the coldest month). Data from appliances was disaggregated.	Room temperatures shown, also energy-saving tips.	Complex and expensive system: required 4 meters + lab-based computer to send feedback displays to the homes. 7 of the homes 'paid attention' to their space heating consumption, reducing heating time. 7 cut heating demand by >20%. Both baseline and with-feedback space-heating consumption in the 10 homes varied by a factor of approx 5. The participants were especially interested in the 'daily data'; also interested in comparisons with other households, which 'induced competitive spirit'.
Carbon Trust (2007) <i>Advanced metering for SMEs: benefits and cost savings</i> . The Carbon Trust, London, UK <a href="http://www.carbontrust.co.uk/technology/behavioural/assessing/advanced_metering.html">http://www.carbontrust.co.uk/technology/behavioural/assessing/advanced_metering.html</a>	4% against baseline	Project ran over 2 years	108 SMEs		UK	Gas	<i>Half-hourly</i> data, communicated <i>near day</i> .	Some participants had additional information advice eg emails, face to face advice.	Greatest savings were achieved with consumption profiles and energy saving feedback metering. Savings of 47% identified for SMEs. Savings for SMEs for which customer energy feedback time for advanced metering + feedback in single-site SMEs was 4 years; for multi-site SMEs, 2 years. Over 80% of SMEs opted to continue with the advanced metering service, on a full commercial basis, at the end of the trial.
CO2online.de, accessed July 2008. Home Resources Account	5% per year (21% in all), continuing, weather-adjusted, against baseline	Dataset for 4 years	1247 households		Germany	Gas	Self-reading of meters and reporting to a website ( <a href="http://www.energiesparkonto.de/2747/0.html">http://www.energiesparkonto.de/2747/0.html</a> ), whenever the user wishes. The site shows a graphic display of consumption; also the effect of any recent energy-saving measures. Gives projections of future energy costs, incorporating user's expectations of price increases.	Online advice available. Participants get regular emails to remind them to enter data; also benchmark figures from average ERA users.	No published report of this as yet, but the figures come from the CO2online database of family houses, at <a href="http://www.energiesparkonto.de/zahlenundfakten/0.html">http://www.energiesparkonto.de/zahlenundfakten/0.html</a>

