Modified: March 2005

Residential Automated Demand Response System (ADRS) Pilot Economic Analysis Report

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Results of load impact analysis for the 2004 pilot both for average of all customers and high-consumptions are the basis for ADRS economic evaluation

- The basis of the ADRS pilot economic analysis is the amount of on-peak energy demand reduced per pilot home. The avoided costs resulting from demand and energy savings are evaluated against the estimated technology and program costs needed to implement the program, assuming a large-scale rollout

- Results of the energy impact evaluation showed that ADRS achieved significant load reductions relative to both control groups. Additional results regarding load impact are detailed in the Load Impact Report

- Over the twelve Super Peak days, technology-enabled ADRS homes consumed considerably less on-peak energy per home than their comparable control groups
  - Participants that were deemed high-consumption, consistently achieved 1.6 kWh drop or higher during peak periods
  - Overall ADRS average, for all participants, for all days, was 1.48 kWh (A03), and 0.72 kWh (A07)

Source: RMI
Detailed load impact evaluation can be found on RMI's ADRS 2004 Load Impact Report

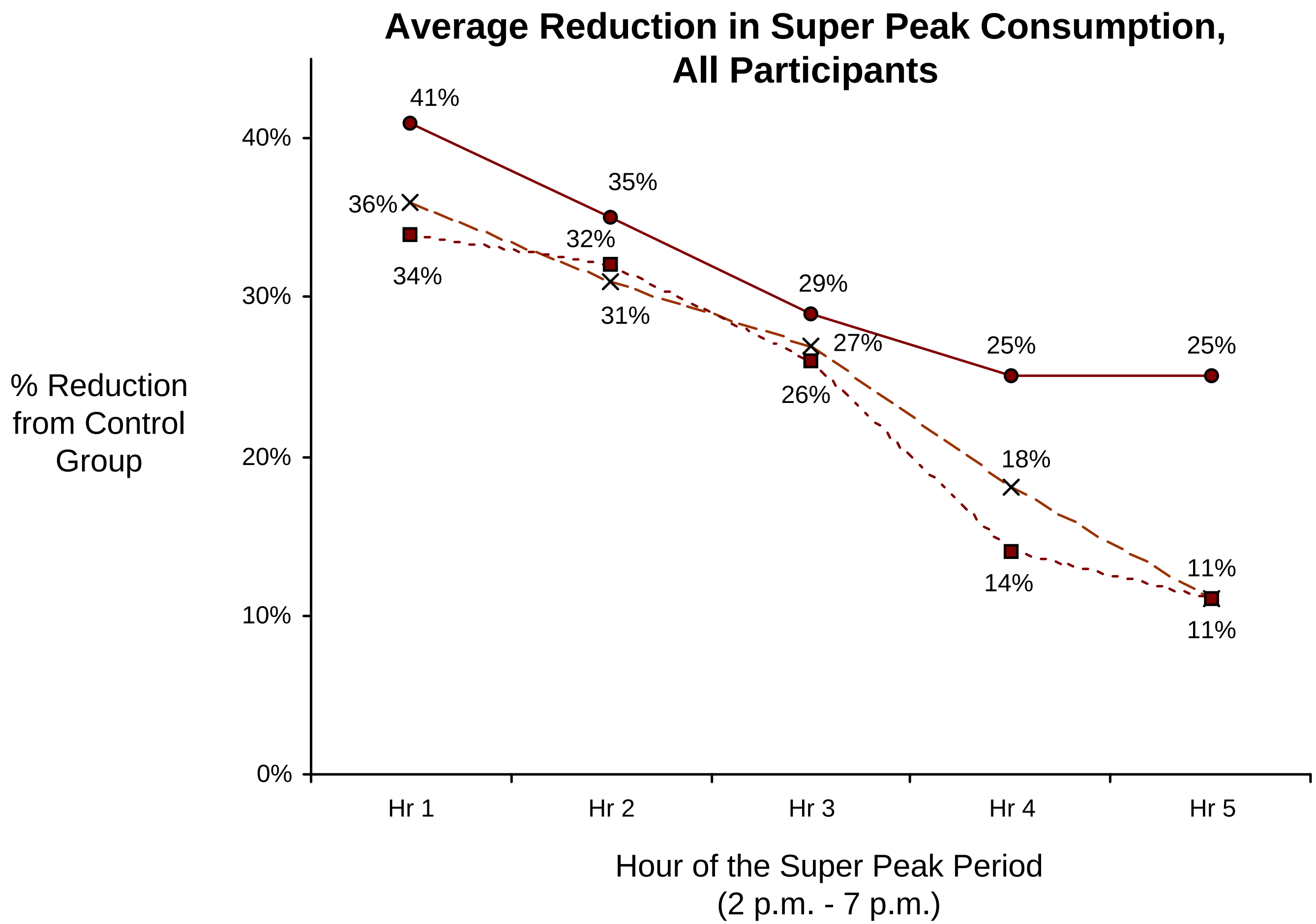
Project economics are extremely sensitive to the magnitude of load reduction of ADRS relative to control groups

- Load achieved by household dwarfs other drivers in the model economics – while costs of other components are also important
- ADRS however, was not at the outset designed to reach households that could yield higher efficacy levels
  - ADRS pilot homes were recruited at random *regardless of historical consumption,* screened for eligibility only with respect to presence of central air conditioning, within prescribed zip codes in climate zone 3
  - This was the customer's first summer. CPP-F events were first called on July 14. The bill that the customer would have received from the July events, would be received towards the end of August. All CPP-F days were called by September 10th – thus the customer did not have an appropriate time to identify cause of effect (of changing behavior = lower bill).
  - Load impact analysis has shown that customers have progressively increased their load shed over the summer period, with the higher observed load impact in September – yet, load shed was calculated for the average of the entire pilot period

*Both the standard rate only homes and the CPPF rate only homes are subsets of populations in climate zone 3 studied in the Statewide Pricing Pilot (SPP) begun in 2003. Thus the CPPF rate only control group has been on the experimental CPPF rates one year longer than the ADRS participants.

Source: RMI

Still, ADRS customers on average did exhibit higher load impact savings over time – attributed to the learning curve and communication treatments



Source: Utility Data, Invensys GoodWatts Reports Server, RMI analysis

A business case focuses on assessing the potential of a deployment given design conditions that would be relevant to a target area

ADRS 2004 – Sample Parameters

- One-third of the participating homes were low-consumption homes – ADU < 24 kWh
- Forty percent of the homes were responsible for 74% of all the load shed, and had an average load shed to 1.6 kW or higher
- Not enough feedback: Super-Peaks called between July 14 and September 10th – First bill reflecting July events, not received until late August, early September
- Market research confirmed that there was no link between bills and Super Peak events – a feature that would be desired and needed by customers to understand impact of their behavior

Optimal ADRS – Sample Parameters

- Focus on higher-consumption homes
- Connecting Super Peak events performance to information in customers' bills (to create a reinforcing message, and to incentivize behavior)
- Efficacy research performed where it allows for feedback of earlier actions to be reflected in later actions

Additional program design elements could also improve economic performance

- Recover some of program costs out of participating customers' savings*
- ADRS will be more cost-effective if implemented as an opt-in program *in the absence of universal CPP rates*, rather than as an enabling technology with universal CPP rates
- Finally, further reductions in ADRS program costs, especially annual operating costs, would improve economics performance
  - If deployed in AMI ready sites, annual O&M costs would be cut in half
  - Clustering deployments allows for reduction in installation and service costs

*Participants' willingness to pay is studied in more detail by Boice Dunham Group in their Customer Insight Report, which suggests that it is in part dependent on timely feedback of bill savings impact resulting from load shifting behavior, among other factors.

Source: RMI

The Economic analysis are then presented based on two scenarios

- Scaling Up of 2004 ADRS results
- Using observed efficacy levels of ADRS high-consumption homes

Note that both observations are subject to the issues highlighted earlier related to sample design, project design and timing

Scaling Up Pilot Results:

Costs associated with the program would be the same under A03 or A07 – overall the project would be NPV positive under A03 using the CPUC scenario

ADRS Project NPV of NET Benefits ($1000s)

Avoided Cost Methodology	E3/CPUC	CPUC
Roll Out (# of homes)	100,000	100,000
A07-ADRS	($50,925)	($38,938)
A03-ADRS	($31,083)	$1,455

ADRS Net Cost of Capacity ($/kW-yr), by Scenario

Rollout	100,000
A07-ADRS	$187.35kW-yr
A03-ADRS	$83.64/kW-yr

Source: Invensys Climate Controls updates of costs using RMI economic valuation model

High-Consumption Homes:
However, if results from high-consumption homes are used, deployment effectiveness could be achieved immediately

ADRS Project NPV of NET Benefits ($1000s)

Avoided Cost Methodology	E3/CPUC	CPUC
Roll Out (# of homes)	100,000	100,000
A07-ADRS > High Consumption Homes	($31,314)	($51,156)
A03-ADRS > High-Consumption Homes	$8,355	$26,789

ADRS Net Cost of Capacity ($/kW-yr), by Scenario

Rollout	100,000
A03-ADRS	$77.78/kW-yr

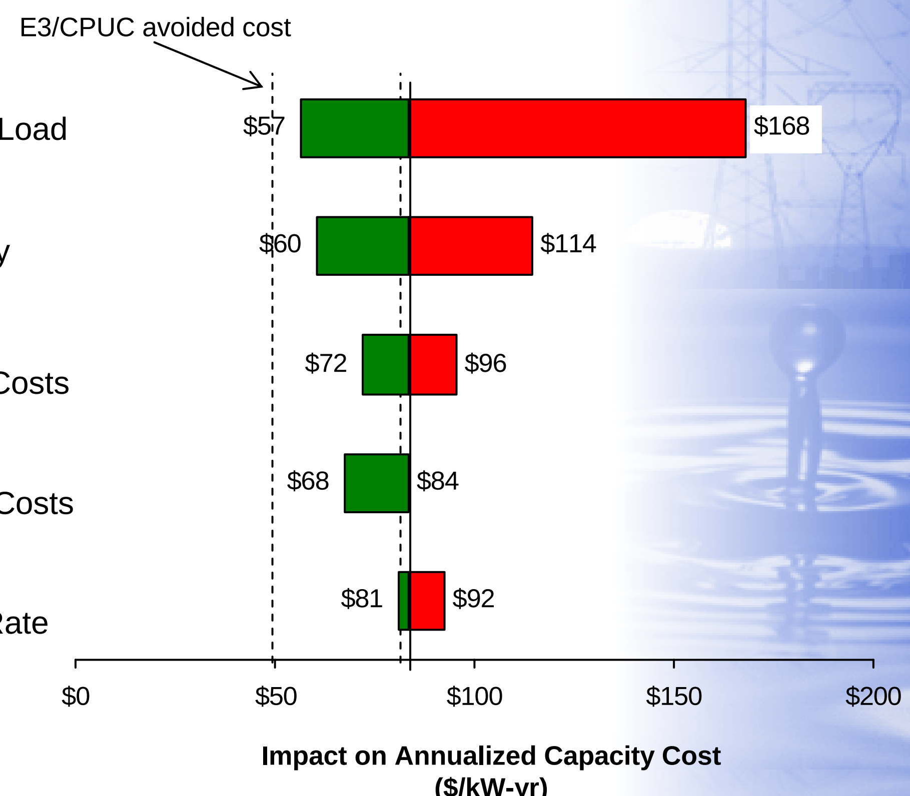
Scaling Up Pilot Results:

Sensitivity analysis shows that the super peak load reduction is the strongest driver of program economics; Load reductions in the A03-ADRS base case scenario cost $84/kW-yr, but cost-effective scenarios also exist under alternate O&M and capital equipment costs, with some even approaching E3/CPUC costs

Possible Range of Key Input Variables

Upside Case	Base Case	Downside Case	Key Input Variables
2.2 kW	1.48 kW	0.74 kW	Curtailed Super Peak Load per Home
$33	$60	$99	ADRS Technology O&M Costs
Less 50%	Base	Plus 50%	Capital Equipment Costs
$24*	$0	N/A	Customer Share of Costs
4.6%	2.3%	1.2%	Churn (drop out) Rate

Impact on Annualized Net Cost ($/kW-yr)



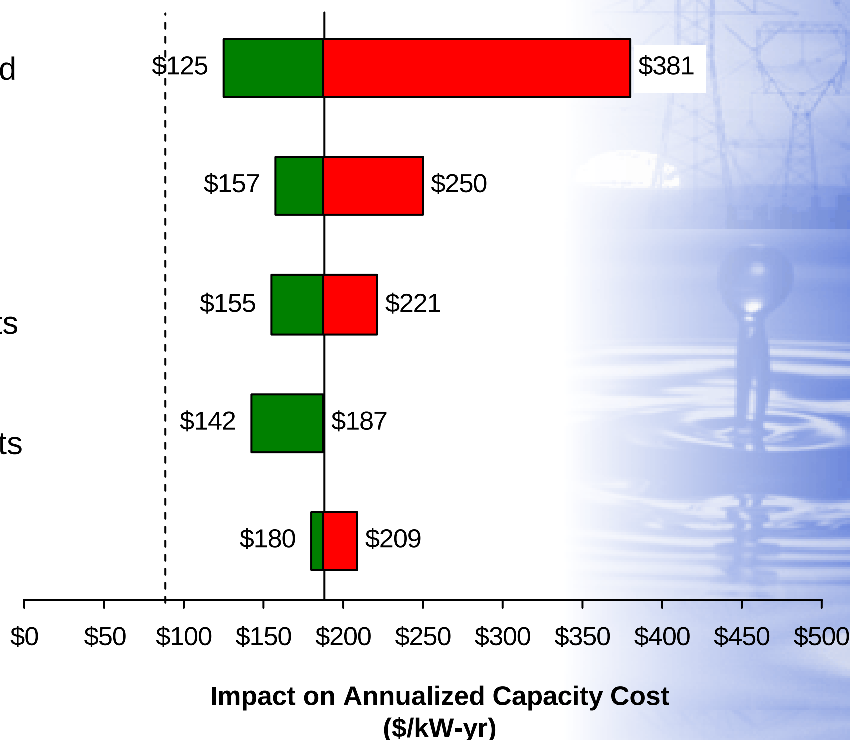
* Customer cost share assumes $2 charge per month to take part in ADRS program.

Source: Invensys Climate Controls updates of costs using RMI economic valuation model

Super peak load reduction is the strongest driver of program economics; load reductions in the A07-ADRS base case scenario cost about $187/kW-yr vs. the CPUC avoided cost of $85/kW-yr

Possible Range of Key Input Variables | **Key Input Variables** | **Impact on Annualized Net Cost ($/kW-yr)**

Upside Case	Base Case	Downside Case	Key Input Variables
0.79 kW	0.53 kW	0.26 kW	Curtailed Super Peak Load per Home
$21	$36	$63	ADRS Technology O&M Costs
Less 50%	Base	Plus 50%	Capital Equipment Costs
$24*	$0	N/A	Customer Share of Costs
4.6%	2.3%	1.2%	Churn (drop out) Rate

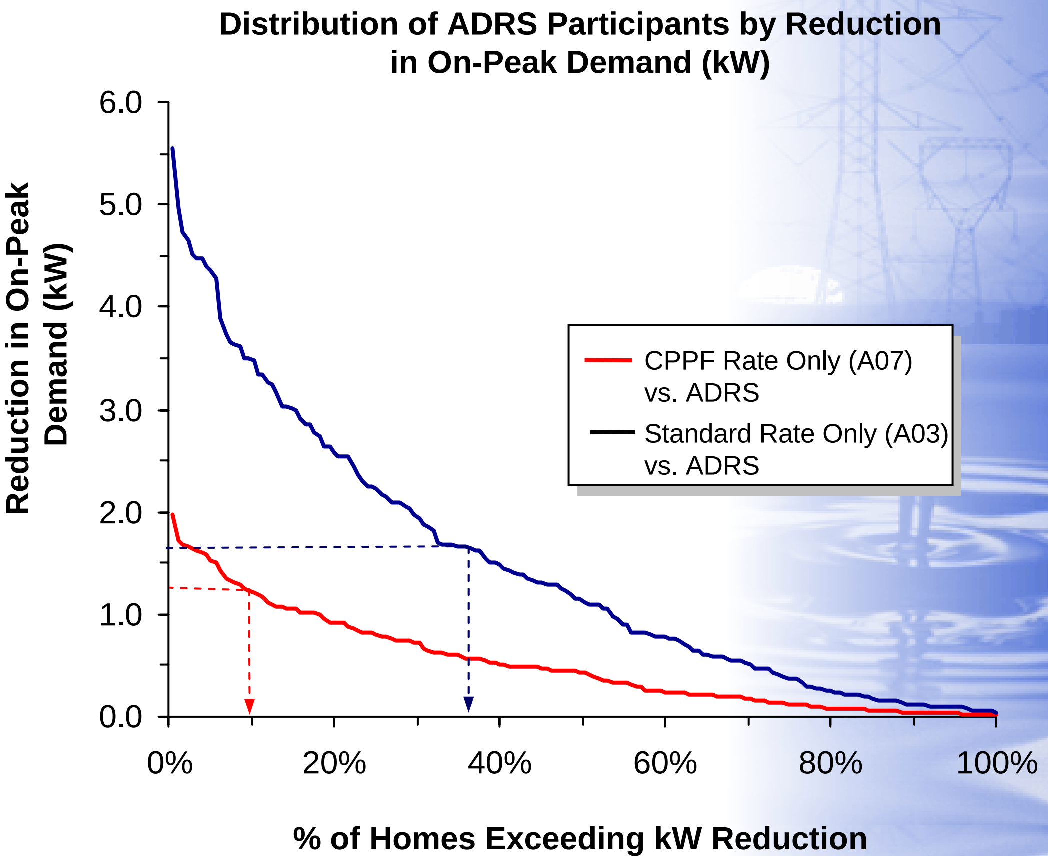


* Customer cost share assumes $2 charge per month to take part in ADRS program.

Source: Invensys Climate Controls updates of costs using RMI economic valuation model

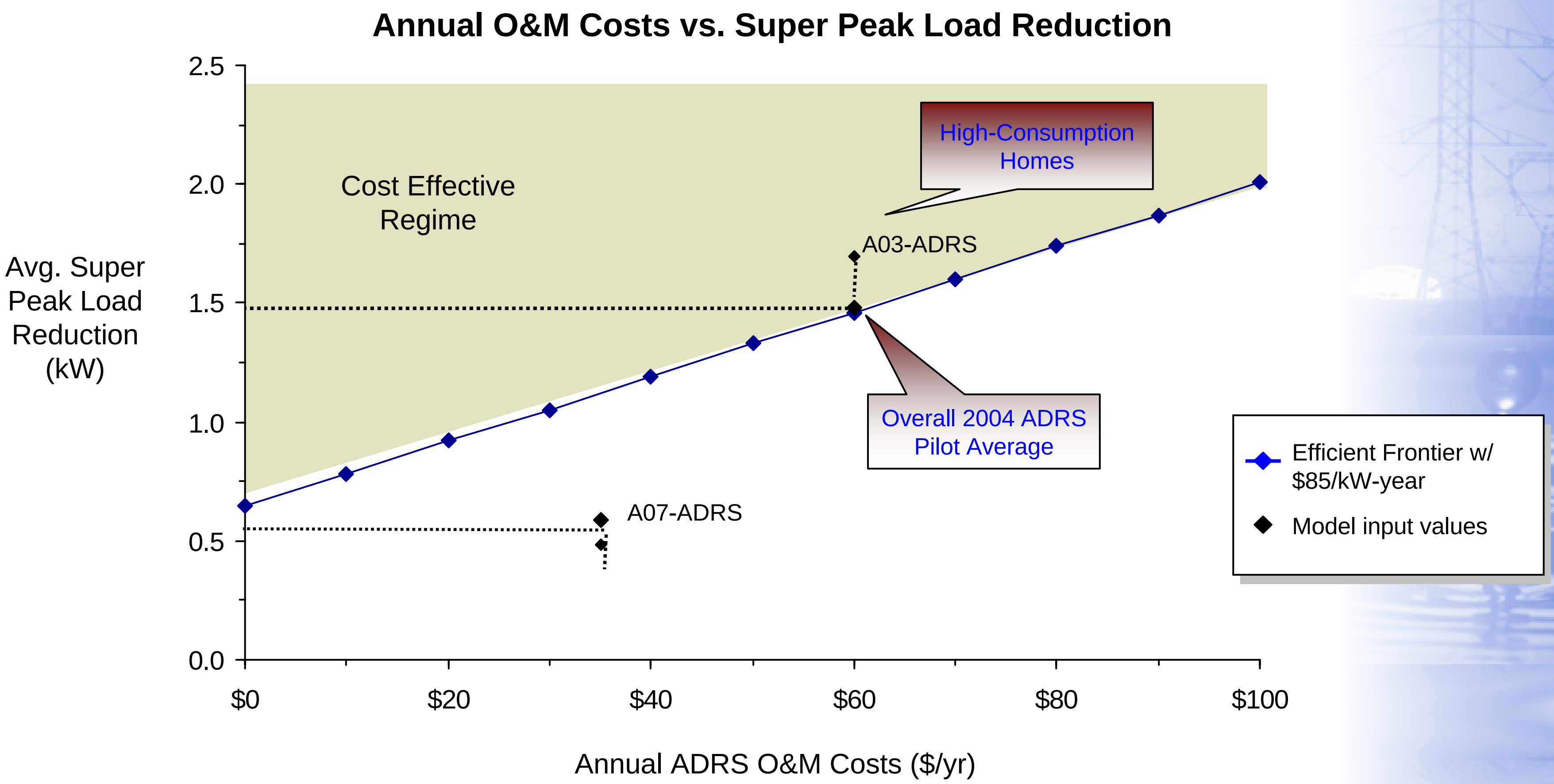
Consumer targeting and utilities' deployment plans with respect to AMI influences ADRS economics

- Currently, only ~10% of ADRS participants (32% of total load) shed the 6.5 kWh relative to A07 control homes with CPP-F rates over the five Super Peak hours necessary to achieve cost effectiveness. The incremental cost of ADRS in this scenario assuming full CPP rate deployment lies beyond the reach of the typical homeowner. Marketing & education campaigns may increase homeowner awareness of optimal ADRS programming and thereby increase peak period savings
- However, almost 40% of ADRS homes already reduce load by the 8 kWh (1.6 kWh/hr) needed in the five Super Peak hours to achieve cost effectiveness relative to the A03 control homes. These homes are 74% of total sample load. This implies that ADRS could be cost effective if implemented in the *absence* of universal CPP rates, assuming targeted participant recruiting.



Source: RMI, does not reflect updated costs

If only high-consumption homes are targeted (70% of homes), average Super Peak reduction compared to A03 would make the project economics even more attractive against CPUC avoided costs ($85/kW-yr). A07-ADRS cost effectiveness improves negligibly, indicating need for even more precise targeting efforts within the high stratum

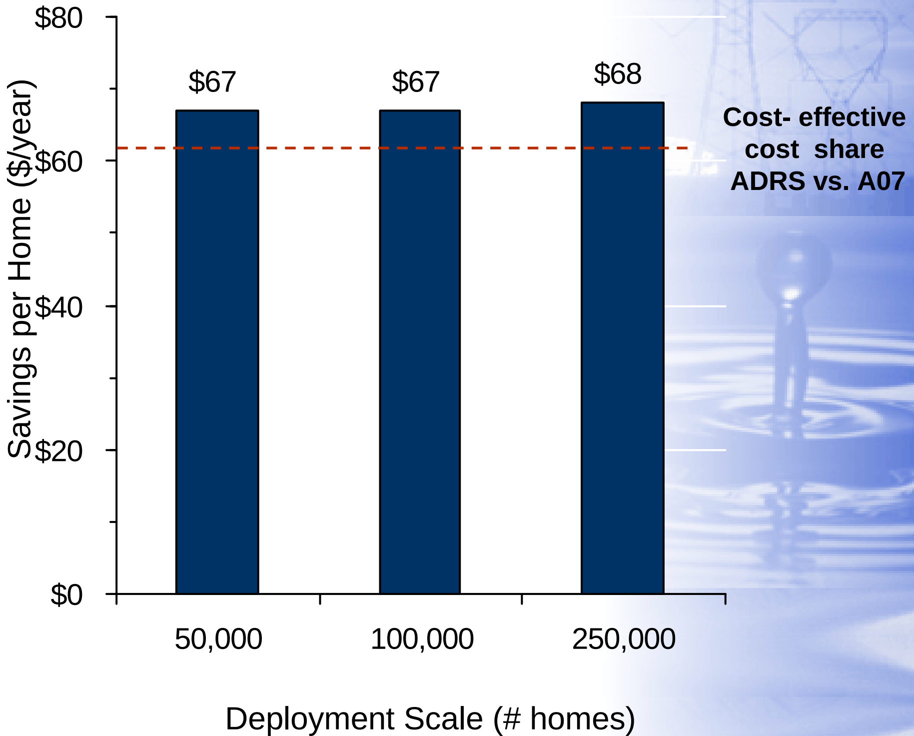


Source: Invensys Climate Controls updates of costs using RMI economic valuation model

ADRS homes would need to contribute >90% (~$60/yr) to achieve cost effectiveness against the A07 control group

- ADRS customers save money on average from reducing energy consumption using ADRS, relative to A07
- These savings occur primarily during the peak hours on both Super Peak and non-Super Peak days
- ADRS customers would need to give back almost all (90%) of the average bill savings vs. A07 in order to move the project into the cost effective regime, assuming an avoided cost of $85/kW-yr
- The value to A03 could also be significantly increased if small amounts are charged to customer's monthly bill for participating.

Average ADRS Bill Savings* Relative to A07 Homes ($/yr)



*ADRS participants did not receive bill comparisons until late summer. Willingness to pay is studied in more detail by Boice Dunham Group in their Customer Insight Report, which suggests that it is in part dependent on timely feedback of bill savings impact resulting from load shifting behavior, among other factors.

Source: RMI, does not reflect updated costs

Similarly, treating ADRS deployment as a real option gives the ADRS project a positive NPV assuming an avoided cost of $85/kW-yr, but only relative to A03 homes

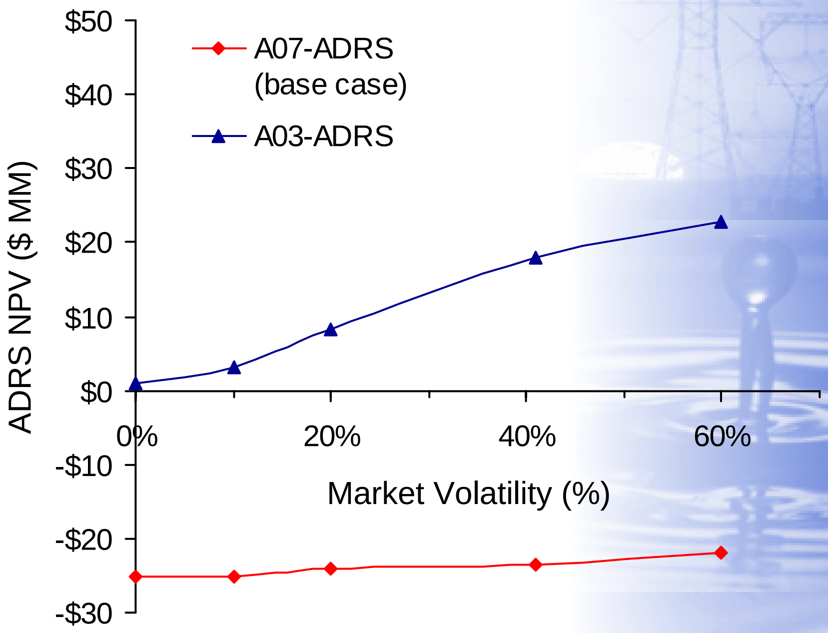
- The current avoided cost scenarios, particularly the E3/CPUC scenario, include a certain degree of market price volatility in the intermediate term. They do not, however, take into account the value of learning and responding to future volatility of power market prices
- RMI accounts for this by estimating the risk-reduction value of demand response as a "real option" --the choice to defer deployment of demand response in customers' homes until needed through the expenditure of small investments upfront via pilots (e.g. ADRS) and initial recruiting
  - This risk-adjustment to the cost analysis is made as part of the evaluation of the ADRS cost; it represents NPV cost savings for more strategic timing of ADRS deployment
  - It does not change the avoided cost analysis
- The value to utilities of having the option to defer ADRS deployment until market conditions are more favorable is $1.7 million in the A07-ADRS base case and $22 million in the A03-ADRS scenario, assuming a 50,000 homes rollout the year the option is exercised
  - Utilities pay an upfront cost to acquire this option, in the form of pilot testing and initial recruitment of customers who would be willing to participate in a full-scale program when needed (an "on call" incentive of $20 home is assumed for this analysis)
  - The option value is sensitive to the magnitude of market uncertainty, program benefits, and "on call" incentive paid per home

Source: RMI

The option value improves project NPV slightly for the comparison against A07; when comparing ADRS against A03, option value is enough to make ADRS cost effective

- The option value to defer deployment of ADRS until conditions are more favorable is $1.7 million for (A07-ADRS) scenario, and $25 million for A03-ADRS scenario, assuming 40% market volatility
- The option value improves the project NPV to –$25 million for (A07-ADRS) scenario, and +$15 million for A03-ADRS scenario, with an avoided cost of $85/kW-yr, assuming 40% market volatility and a 50,000 rollout the year the option is exercised
- Base case average ADRS load reduction relative to the A07 control group is such that the option value cannot completely offset an initial negative project NPV
- On the other hand, average ADRS load reduction relative to the A03 control group is just shy of the cost effective regime, and the option value to manage and defer deployment results in a positive total project NPV

Impact of Option Value on Project NPV by Underlying Market Volatility



Note: Default volatility value is 40%
Assumes 100,000 home deployment

Source: Invensys Climate Controls updates of costs using RMI economic valuation model

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ADRS 2005 will focus on efficacy improvement

- Focus on high-consumption homes – a total of 111 high consumption homes are part of the ADRS sample

	PG&E	SCE	SDG&E
High Consumption	41	62	7
Low Consumption	22	2	11
Total	63	64	18

- Technology Training – participants to receive training video in early June
  - How to optimize technology programming
  - Understanding how to respond to Super Peak events
  - Available to all future ADRS participants
- Learning curve – customers have experienced one Summer, and unlike in 2004, had time to assimilate impact of Super Peak events on electric bill
  - Reminders of upcoming Super peak events to be sent out in mailings
  - Customers now aware of availability of comparison bill analysis

Appendix

ADRS Economic Analysis Model Inputs—Demand Reduction Module

Super Peak savings	0.53	kWh/hr
off-Peak savings, Super Peak days	-0.10	kWh/hr
Avg Energy savings	0.03	kWh

Super Peak Days (A07-ADRS) kWh Reduction per customer

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
July	-0.08	-0.07	-0.13	-0.15	-0.10	-0.04	-0.07	0.00	0.11	0.01	0.03	0.01
August	-0.14	-0.13	-0.19	-0.17	-0.10	0.05	0.06	0.13	0.16	0.11	0.14	0.04
September	-0.22	-0.21	-0.19	-0.15	-0.09	0.05	0.04	0.19	0.23	0.19	0.20	0.04

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
July	0.03	0.11	0.61	0.57	0.54	0.38	0.23	-0.45	-0.65	-0.43	-0.29	-0.16
August	0.13	0.14	0.58	0.59	0.54	0.31	0.24	-0.23	-0.43	-0.35	-0.34	-0.16
September	-0.02	0.04	0.74	0.71	0.65	0.62	0.59	-0.36	-0.60	-0.49	-0.29	-0.24

Peak Savings	0.21	kWh/hr
off-Peak savings, non-SP days	-0.03	kWh/hr
Average Energy savings	0.02	kWh

non-Super Peak Days kWh reduction (A07-ADRS) kWh Reduction per customer

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
June	-0.06	-0.09	-0.08	-0.06	-0.03	-0.03	-0.09	-0.01	0.17	0.01	0.03	0.10
July	-0.09	-0.06	-0.13	-0.14	-0.10	-0.05	-0.07	-0.06	0.07	-0.03	-0.04	0.04
August	-0.10	-0.09	-0.11	-0.09	-0.07	0.00	0.00	0.01	0.09	0.06	0.05	0.08
September	-0.09	-0.07	-0.09	-0.08	-0.04	0.00	0.00	0.08	0.06	0.06	0.09	0.08
May	-0.06	-0.09	-0.08	-0.06	-0.03	-0.03	-0.09	-0.01	0.17	0.01	0.03	0.10
October	-0.06	-0.09	-0.08	-0.06	-0.03	-0.03	-0.09	-0.01	0.17	0.01	0.03	0.10

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
June	0.16	0.25	0.20	0.20	0.14	0.10	-0.09	-0.21	-0.01	0.01	-0.04	-0.05
July	0.14	0.21	0.39	0.44	0.40	0.30	0.19	-0.29	-0.27	-0.11	-0.20	-0.14
August	0.11	0.20	0.47	0.38	0.37	0.21	0.09	-0.35	-0.36	-0.21	-0.17	-0.11
September	0.10	0.12	0.32	0.36	0.34	0.26	0.18	-0.23	-0.28	-0.27	-0.17	-0.08
May	0.16	0.25	0.20	0.20	0.14	0.10	-0.09	-0.21	-0.01	0.01	-0.04	-0.05
October	0.16	0.25	0.20	0.20	0.14	0.10	-0.09	-0.21	-0.01	0.01	-0.04	-0.05

Source: RMI

ADRS Economic Analysis Model Inputs— Demand Reduction Impact Module

Super Peak savings	1.48	kWh/hr
off-Peak savings, Super Peak days	-0.13	kWh/hr
Avg Energy savings	0.21	kWh

Super Peak Days (A03-ADRS) kWh Reduction per customer

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
July	-0.22	-0.11	-0.02	-0.06	-0.07	-0.03	-0.15	-0.18	-0.25	-0.16	-0.12	0.17
August	-0.14	-0.05	-0.10	-0.08	-0.01	0.02	-0.08	-0.01	-0.06	-0.09	-0.01	0.14
September	-0.22	-0.22	-0.20	-0.14	-0.05	0.06	-0.09	-0.02	-0.18	-0.18	-0.08	0.08

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
July	0.24	0.33	1.52	1.66	1.69	1.47	1.35	-0.11	-0.64	-0.42	-0.33	-0.30
August	0.26	0.27	1.52	1.66	1.48	1.25	1.06	-0.21	-0.54	-0.45	-0.49	-0.27
September	0.14	0.37	1.70	1.53	1.52	1.45	1.41	-0.18	-0.76	-0.50	-0.34	-0.32

Peak Savings	0.58	kWh/hr
off-Peak savings, non-SP days	-0.07	kWh/hr
Average Energy savings	0.07	kWh

non-Super Peak Days (A03-ADRS) kWh Reduction per customer

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
June	-0.07	-0.07	-0.07	-0.05	-0.01	-0.05	-0.20	-0.13	-0.16	-0.07	-0.01	0.08
July	-0.15	-0.12	-0.12	-0.11	-0.09	-0.07	-0.19	-0.14	-0.20	-0.12	-0.04	0.05
August	-0.07	-0.04	-0.01	0.01	0.05	0.06	-0.07	-0.03	-0.15	-0.17	-0.12	0.05
September	-0.13	-0.09	-0.08	-0.05	0.01	0.03	-0.14	-0.06	-0.19	-0.16	-0.13	0.03
May	-0.07	-0.07	-0.07	-0.05	-0.01	-0.05	-0.20	-0.13	-0.16	-0.07	-0.01	0.08
October	-0.07	-0.07	-0.07	-0.05	-0.01	-0.05	-0.20	-0.13	-0.16	-0.07	-0.01	0.08

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
June	0.18	0.39	0.51	0.58	0.47	0.40	0.16	-0.10	-0.12	-0.11	-0.13	-0.09
July	0.16	0.38	0.87	0.90	0.90	0.76	0.61	-0.19	-0.30	-0.22	-0.30	-0.24
August	0.22	0.32	0.98	0.97	0.81	0.61	0.44	-0.35	-0.40	-0.30	-0.30	-0.18
September	0.16	0.24	0.76	0.79	0.69	0.60	0.39	-0.30	-0.35	-0.35	-0.31	-0.15
May	0.18	0.39	0.51	0.58	0.47	0.40	0.16	-0.10	-0.12	-0.11	-0.13	-0.09
October	0.18	0.39	0.51	0.58	0.47	0.40	0.16	-0.10	-0.12	-0.11	-0.13	-0.09

Source: RMI

ADRS Economic Analysis Model Inputs— Program Costs Module

Total Enrollment Target		**100,000**
Customer Dropout Rate (Percent/Yr.)		2.3%
Program Design (one time)		$132,500
Program Marketing/Development Costs (one time)		$750,000
Customer Acqusition per household		$1.50
Escalation Rate:	2.0% per Yr.	
Marketing Hit Rate (Percent/Yr.) (7%-12%)		12.0%
Total Marketing & Acquisition per household		$20.00
Annual Administration		$154,069
Escalation Rate:	2.0% per Yr.	
Program Incentives per home		$0
Escalation Rate:	2.0% per Yr.	
Total Program Evaluation (conducted on years 1,3,5,10)		$250,000

Source: RMI, Invensys Climate Controls,
average of PG&E, SDG&E & SCE inputs where relevant

ADRS Economic Analysis Model Inputs— Utility Avoided Costs Module

CPUC Capacity value ($/kW-yr)	$85
CPUC Energy value ($/kWh)	$0.063

E3/CPUC values Super Peak days ($/kWh)

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
July	$0.081	$0.061	$0.052	$0.046	$0.041	$0.038	$0.040	$0.046	$0.049	$0.066	$0.104	$0.080
August	$0.065	$0.057	$0.055	$0.052	$0.047	$0.045	$0.046	$0.054	$0.055	$0.062	$0.071	$0.076
September	$0.070	$0.064	$0.062	$0.054	$0.048	$0.047	$0.051	$0.060	$0.062	$0.068	$0.073	$0.111

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
July	$0.136	$0.234	$0.400	$0.521	$0.548	$0.519	$0.301	$0.211	$0.129	$0.097	$0.098	$0.081
August	$0.122	$0.356	$0.425	$0.542	$0.624	$0.760	$0.436	$0.310	$0.118	$0.087	$0.090	$0.075
September	$0.323	$0.498	$0.869	$0.752	$0.501	$0.405	$0.210	$0.145	$0.133	$0.119	$0.115	$0.085

E3/CPUC values non-Super Peak days ($/kWh)

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
June	$0.040	$0.029	$0.022	$0.018	$0.015	$0.014	$0.015	$0.019	$0.026	$0.037	$0.044	$0.062
July	$0.070	$0.057	$0.049	$0.043	$0.038	$0.037	$0.038	$0.043	$0.044	$0.058	$0.063	$0.077
August	$0.069	$0.061	$0.055	$0.052	$0.047	$0.045	$0.046	$0.056	$0.058	$0.066	$0.072	$0.079
September	$0.069	$0.062	$0.058	$0.051	$0.047	$0.045	$0.048	$0.056	$0.060	$0.069	$0.078	$0.084
May	$0.043	$0.034	$0.028	$0.024	$0.021	$0.020	$0.023	$0.032	$0.041	$0.050	$0.053	$0.057
October	$0.075	$0.066	$0.061	$0.054	$0.050	$0.048	$0.055	$0.067	$0.073	$0.079	$0.077	$0.083

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
June	$0.069	$0.083	$0.095	$0.098	$0.109	$0.109	$0.081	$0.066	$0.059	$0.052	$0.060	$0.053
July	$0.089	$0.104	$0.147	$0.183	$0.192	$0.199	$0.169	$0.125	$0.099	$0.086	$0.087	$0.074
August	$0.095	$0.116	$0.160	$0.222	$0.266	$0.256	$0.221	$0.167	$0.113	$0.097	$0.094	$0.078
September	$0.086	$0.117	$0.169	$0.146	$0.155	$0.142	$0.109	$0.094	$0.086	$0.085	$0.084	$0.075
May	$0.062	$0.062	$0.062	$0.065	$0.065	$0.063	$0.059	$0.056	$0.052	$0.053	$0.063	$0.054
October	$0.088	$0.089	$0.095	$0.104	$0.109	$0.111	$0.108	$0.096	$0.099	$0.101	$0.094	$0.082

Source: RMI

ADRS Economic Analysis Model Inputs— Participant Costs and Benefits Module

Experimental rate CPPF Rate A: PG&E **Summer High Ratio**	($Nominal)
Super Peak	$0.73821
Peak	$0.24551
Off Peak	$0.07821

Source: PG&E Schedule E-3: Experimental Residential Critical Peak Pricing Service

Experimental rate CPPF: SCE **Summer High Ratio**	($Nominal)
Super Peak (Delivery+URG+DWR)	$0.68415
Peak (Delivery+URG+DWR)	$0.35415
Off-Peak (Delivery+URG+DWR)	$0.07696

Source: SCE Schedule TOU-D-CPPF-1

Experimental rate CPPF: SDG&E **Summer High Ratio**	($Nominal)
Super Peak (EECC+DR+DWR-BC)	$0.76518
Peak (EECC+DR+DWR-BC)	$0.27248
Off Peak (EECC+DR+DWR-BC)	$0.10518

Sources:
1) SDGE Schedule EECC-CPP-F
2) SDGE Schedule DR (Domestice Service), sheet 1
3) SDGE Schedule DWR-BC

Utilities Average CPPF rate* **Summer High Ratio**	($Nominal)
Super Peak	$0.71879
Peak	$0.29557
Off Peak	$0.08134

*Utility weighted avg by ADRS pilot sample distribution

Source: RMI