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Additional submitted attachment is included below.

INDUSTRIAL END USE SURVEY
PRELIMINARY SAMPLE DESIGN AND SURVEY COST ESTIMATES
MAY 31, 2006

Following is a discussion of the different levels of survey effort and associated costs. Next we present preliminary survey sample sizes that were estimated using utility billing data from the 2002 period for the IOU's and more recent data for LADWP. We then combine survey unit cost estimates with sample size estimates to provide overall project cost estimates. The analysis addresses two levels of onsite survey effort and several different sample designs. Finally, we present some incremental survey unit costs for developing additional end use loadshape estimates and more information regarding applicability and feasibility of installing energy efficiency measures at surveyed sites.

1 SURVEY TYPES AND UNIT COSTS

We address two levels of onsite surveys (basic Title 20 and enhanced) and mail surveys.

Title 20 Onsite Surveys and Analysis

The Title 20 level of onsite survey effort is consistent with the unit costs built into the initial KEMA proposal. The following are Title 20 Requirements (see Attachment A for a complete list):

- Basic site data
  - Location
  - Industry type
  - # Employees
  - Value of shipments
  - Production processes
  - Identification of utility service providers
  - Utility data
- Presence of energy using/producing equipment or fuel supply
- Characteristics of equipment
  - Installed energy efficiency measures
  - INFORM data, see Attachment B
  - Efficiency levels (standard or high efficiency)
  - Equipment age
  - Hours of use)
- Building characteristics
  - Square footage
  - Number of stories
  - Wall construction
  - Foundation type
  - Characteristics of windows
- Patterns of behavior and equipment operations

- Presence/characteristics of building management controls, measures designed to shift load, and metering equipment

For the Title 20 level of onsite surveys, all these data would be collected at a basic level. INFORM data would be collected as it provides a reasonable list of end use characteristics. Analysis would be at an annual level. Patterns of behavior/equipment operations would be collected (facility schedule and major equipment schedules), but would not be analyzed to provide end use load shapes. The end use analysis would be conducted at an annual level to provide annual consumption estimates by end use. This analysis would be developed using a combination of engineering analysis and engineer/customer judgment.

In addition, the basic Title 20 survey would collect information from the customer regarding business plans, knowledge of energy efficiency, equipment changes, and participation in programs. These data would rely on customers' ability to recall events and would focus on key pieces of equipment. Key energy efficiency opportunities would be noted, but would not be quantified.

Enhanced Onsite Surveys and Analysis

The enhanced analysis would focus on much of the same elements as for the basic analysis, but would do so with increased rigor. Key increased in this analysis would include:

- A more comprehensive analysis of end use energy consumption that involves a site energy balance;
- Development of end use load shapes for each facility that has interval metering;
- Use of end use metering/monitoring to assist in the consumption and loadshape analysis – this would required development of a monitoring plan and several visits to each metered site; and
- A more thorough analysis of energy efficiency opportunities, including assessment of measure applicability and feasibility and calculations of expected energy savings, peak reductions, and project costs that would allow for cost effectiveness estimates.

We expect that significant additional effort would be required to conduct end use metering and loadshape analysis. In addition, post survey research of energy efficiency costs and benefits would be required to provide audit-level information. Also, end use consumption estimates would be developed using a more thorough analysis.

Mail Surveys

Mail surveys would collect much of the same information as the basic Title 20 onsite surveys, but would rely on customer input for most of the data.

Unit Costs

The following table shows survey costs by facility size.

Table 1: Survey Costs by Facility Size and Survey Type

Size	T 20 Basic	Enhanced	Mail
Very Large	$3,800	$16,000	$300
Large	$2,800	$12,000	$260
Medium	$1,800	$8,000	$235
Small	$1,000	$4,000	$200

2 SAMPLE SIZES

Sample sizes were developed for several different sample designs utilizing utility billing data and the Delanius Hodges technique. Similar to the cost breakdown, sites were broken into four size strata for the analysis: very large, large, medium, and small. (Strata cut points by segment are provided in Attachment C.) In all cases, we have removed petroleum refining and construction sites from the analysis. For this preliminary analysis, size was based on annual kWh consumption. While natural gas data was available, the link between electric and natural gas consumption at the site level did not appear to be adequate to allow this preliminary analysis to address both fuels. In addition to size, the sample design looks at stratification by utility and by INFORM industrial segment. Refining sites were deemed out of scope for the project, and construction sites added a considerable amount of sample points to the design without a clear indication that a good understanding of construction energy use would be achieved by the IEUS. The construction segment accounts for about 30% of the industrial sites but only 2% of the industrial electricity consumption.

Sample Design by Utility

In this part of the analysis, samples were developed by utility for PG&E, SCE, LADWP, and SDG&E. It is assumed that SCG customers would be covered in the SCE/LADWP segments.

In each case, we developed onsite sample sizes for the 95-5 and 90-10 confidence levels, on a utility-specific basis. In addition we provide a combination onsite/mail sample design that reflect utilization of onsite surveys to get to the 90-10 confidence level and mail surveys to expand the sample to reach the 95-5 confidence level.

Results are show by facility size, which relates to survey cost, and by utility.

Table 2: Utility Sample Design by Facility Size

	Onsite		Onsite/Mail 95-5 Precision		
Size	90-10 Precision	95-5 Precision	Onsites	Mail	Total
Very Large	60	90	60	30	90
Large	105	402	105	297	402
Medium	127	482	127	355	482
Small	136	538	136	402	538
Total	**428**	**1,512**	428	1,084	**1,512**

Table 3: Utility Sample Design by Utility

	Onsite		Onsite/Mail 95-5 Precision		
Size	90-10 Precision	95-5 Precision	Onsites	Mail	Total
PG&E	121	443	121	322	443
SCE	126	465	126	339	465
SDG&E	87	285	87	198	285
LADWP	94	319	94	225	319
Total	**428**	**1,512**	428	1,084	**1,512**

Sample Design by INFORM Segment

Similar to the utility sample design, we developed several sample designs for the 27 INFORM categories (excluding petroleum refining). We initially looked at 95-5 precision levels, but this lead to very large sample sizes, due the larger number of INFORM categories. We then developed onsite sample sizes for the 90-10 and 90-15 precision levels, plus the combination onsite/mail sample design that utilizes onsite surveys to get to the 90-15 precision level and mail surveys to bring precision up to the 90-10 level. Results are presented by facility size category in the following table. Results by INFORM category are shown in Table 5.

Table 4: INFORM Sample Design by Facility Size

	Onsites			Onsite/mail 90-10		
Size	90-15 Precision	90-10 Precision	95-5 Precision	Onsites	Mail	Total
Very Large	168	243	316	168	75	243
Large	166	313	810	166	147	313
Medium	207	389	1,032	207	182	389
Small	205	390	1,054	205	185	390
Total	746	1,335	3,212	746	589	1,335

Table 5: INFORM Sample Design by INFORM CATEGORY*

INFORM	Onsites			Onsite/mail 90-10		
CATEGORY	90-15 Precision	90-10 Precision	95-5 Precision	Onsites	Mail	Total
01WOODPR	31	58	134	31	27	58
02OILEXT	30	49	106	30	19	49
03MINING	20	37	68	20	17	37
05FOODPR	21	40	88	21	19	40
06PAPMFG	22	39	91	22	17	39
07PAPMIL	7	9	16	7	2	9
09GLASSM	15	22	33	15	7	22
10CEMENT	17	25	40	17	8	25
11FOODBV	40	71	192	40	31	71
12TEXMIL	19	33	73	19	14	33
13TEXPRD	27	50	118	27	23	50
14APPARL	31	63	160	31	32	63
15PRINTG	45	79	213	45	34	79
16CHEMIC	28	47	103	28	19	47
17PLASTC	30	60	158	30	30	60
18MINMFG	23	40	88	23	17	40
19PRIMET	24	45	102	24	21	45
20FABMET	49	94	225	49	45	94
21MACHIN	50	90	256	50	40	90
22COMPUT	28	47	119	28	19	47
23SEMICD	34	58	151	34	24	58
24ELECEQ	28	49	108	28	21	49
25TRANSP	34	59	145	34	25	59
26FURNIT	30	56	128	30	26	56
27MISCMF	41	75	213	41	34	75
28PUBBRD	22	40	84	22	18	40
Total	746	1,335	3,212	746	589	1,335

3 SURVEY COST ESTIMATES

Combining survey unit costs and sample sizes provides estimates of total survey costs. The following tables show how costs are built up by facility size for the various survey-level and sample design combinations. We then summarize results in a final table. Note that costs in the "build up" tables are for survey implementation costs only. While fixed project costs of $656,000 are included in the summary table (Table 14) at the end of this section.

Costs for Utility Sample Design

Table 6 shows survey cost calculations, assuming 100% onsite surveys, for meeting the 90-10 and 95-5 precision levels for basic Title 20 surveys. Table 7 shows costs for the combined

onsite/mail strategy that meets the 95-5 precision level. Tables 8 and 9 show the same information, but for enhanced onsite surveys, which require much more effort.

Table 6: Survey Costs, All Onsites, Basic Title 20 Survey Level, Utility Basis

		Precision Level			
		90-10		95-5	
Size	Unit Cost	#	Cost	#	Cost
Very Large	$3,800	60	$228,000	90	$342,000
Large	$2,800	105	$294,000	402	$1,125,600
Medium	$1,800	127	$228,600	482	$867,600
Small	$1,000	136	$136,000	538	$538,000
Total		428	**$886,600**	1,512	**$2,873,200**

Table 7: Survey Costs, Onsite/Mail, Basic Title 20 Survey Level, Utility Basis

	On-Site			Mail			Total
Size	Unit Cost	#	Cost	Unit Cost	#	Cost	Cost
Very Large	$3,800	60	$228,000	$300	30	$9,000	$237,000
Large	$2,800	105	$294,000	$260	297	$77,220	$371,220
Medium	$1,800	127	$228,600	$235	355	$83,425	$312,025
Small	$1,000	136	$136,000	$200	402	$80,400	$216,400
Total		428	$886,600		1,084	$250,045	**$1,136,645**

Table 8: Survey Costs, All Onsites, Enhanced Survey Level, Utility Basis

		Precision Level			
		90-10		95-5	
Size	Unit Cost	#	Cost	#	Cost
Very Large	$16,000	60	$960,000	90	$1,440,000
Large	$12,000	105	$1,260,000	402	$4,824,000
Medium	$8,000	127	$1,016,000	482	$3,856,000
Small	$4,000	136	$544,000	538	$2,152,000
Total		428	**$3,780,000**	1,512	**$12,272,000**

Table 9: Survey Costs, Onsite/Mail, Enhanced Survey Level, Utility Basis

	On-Site			Mail			Total
Size	Unit Cost	#	Cost	Unit Cost	#	Cost	Cost
Very Large	$16,000	60	$960,000	$300	30	$9,000	$969,000
Large	$12,000	105	$1,260,000	$260	297	$77,220	$1,337,220
Medium	$8,000	127	$1,016,000	$235	355	$83,425	$1,099,425
Small	$4,000	136	$544,000	$200	402	$80,400	$624,400
Total		428	$3,780,000		1,084	$250,045	**$4,030,045**

Costs for INFORM Sample Design

Tables 10 through 13 show the same cost calculations as above, but using the INFORM sample design sample sizes and precision levels.

Table 10: Survey Costs, All Onsites, Basic Title 20 Survey Level, INFORM Basis

		Precision Level					
		90-15		90-10		95-5	
Size	Unit Cost	#	Cost	#	Cost	#	Cost
Very Large	$3,800	168	$638,400	243	$923,400	316	$1,200,800
Large	$2,800	166	$464,800	313	$876,400	810	$2,268,000
Medium	$1,800	207	$372,600	389	$700,200	1,032	$1,857,600
Small	$1,000	205	$205,000	390	$390,000	1,054	$1,054,000
Total		746	$1,680,800	1,335	$2,890,000	3,212	$6,380,400

Table 11: Survey Costs, Onsite/Mail, Basic Title 20 Survey Level, INFORM Basis

	On-Site			Mail			Total
Size	Unit Cost	#	Cost	Unit Cost	#	Cost	Cost
Very Large	$3,800	168	$638,400	$300	75	$22,500	$660,900
Large	$2,800	166	$464,800	$260	147	$38,220	$503,020
Medium	$1,800	207	$372,600	$235	182	$42,770	$415,370
Small	$1,000	205	$205,000	$200	185	$37,000	$242,000
Total		746	$1,680,800		589	$140,490	**$1,821,290**

Table 12: Survey Costs, All Onsites, Enhanced Survey Level, INFORM Basis

		Precision Level					
		90-15		90-10		95-5	
Size	Unit Cost	#	Cost	#	Cost	#	Cost
Very Large	$16,000	168	$2,688,000	243	$3,888,000	316	$5,056,000
Large	$12,000	166	$1,992,000	313	$3,756,000	810	$9,720,000
Medium	$8,000	207	$1,656,000	389	$3,112,000	1,032	$8,256,000
Small	$4,000	205	$820,000	390	$1,560,000	1,054	$4,216,000
Total		746	$7,156,000	1,335	$12,316,000	3,212	$27,248,000

Table 13: Survey Costs, Onsite/Mail, Enhanced Survey Level, INFORM Basis

	On-Site			Mail			Total
Size	Unit Cost	#	Cost	Unit Cost	#	Cost	Cost
Very Large	$16,000	168	$2,688,000	$300	75	$22,500	$2,710,500
Large	$12,000	166	$1,992,000	$260	147	$38,220	$2,030,220
Medium	$8,000	207	$1,656,000	$235	182	$42,770	$1,698,770
Small	$4,000	205	$820,000	$200	185	$37,000	$857,000
Total		746	$7,156,000		589	$140,490	**$7,296,490**

Sample Size and Cost Summary

The following table summarizes the sample sizes and survey costs for the key options provided above. In addition, the final rows of the table show estimated sample sizes and project costs for a sample design that meets the INFORM 90-10 precision level but include additional mail surveys such that the Utility 95-5 precision level for end use saturations would also be maintained. We estimate that an additional 665 mail surveys would be required to increase the 90-10 INFORM-based sample in order to reach the Utility 95-5 precision level.

The costs that are most similar to those in the original KEMA proposal and in compliance with Title 20 requirements, are those associated with the Utility 95-5 precision level, utilizing both onsite and mail surveys. The sample sizes for this option are 428 onsites and 1,084 mail surveys, with an associated cost of about $1.14 million for the survey component of the model and a total project cost of $1.79 million (the fixed component of the project is $656,000).

As one would expect, the highest survey costs are associated with the Enhanced surveys combined with the highest precision sample design. For a utility-based sample design utilizing all onsite surveys and 95-5 precision, a total of 1,512 surveys are required, with an associated cost of $12.93 million. The INFORM-based sample design using all onsite surveys and the enhanced level of effort requires 3,212 surveys with a cost of $27.25 million.

The costs associated with the Title 20 Basic surveys are most in line with current budgets. The combined onsite/mail survey approaches provide considerable cost reductions over the "all onsite" approaches.

Table 14: Summary of Sample Sizes and Total Project Costs, Various Options

Sample Type and Precision Level		Level of Survey Effort			
		Title 20 Basic		Enhanced	
		Onsite	Mail	Onsite	Mail
Utility 95-5	Surveys	1,512	0	1,512	0
All Onsite	Cost	$3,529,200		$12,928,000	
Utility 95-5	Surveys	428	1,084	428	1,084
Onsite/Mail	Cost	$1,792,645		$4,686,045	
INFORM 95-5	Surveys	3,212	0	3,212	0
All Onsite	Cost	$6,380,400		$27,248,000	
INFORM 90-10	Surveys	1,335	0	1,335	0
All Onsite	Cost	$3,546,000		$12,972,000	
INFORM 90-10	Surveys	746	589	746	589
Onsite/Mail	Cost	$2,477,290		$7,952,490	
INFORM 90-10, with Utility 95-5	Surveys	746	1,254	746	1,254
Onsite/Mail	Cost	$2,635,925		$8,111,125	

4 INCREMENTAL COSTS FOR END USE LOADSHAPES AND ADDITIONAL ENERGY EFFICIENCY POTENTIAL DATA

In discussions with the California utilities, it was determined that an intermediate level of survey effort may be useful to provide estimates of end use loadshapes and/or provide additional information on data used to estimate energy efficiency potential. In this section we lay out site-specific cost estimates for these incremental survey elements. We conclude with an example of how to integrate an enhanced end use loadshape analysis into project, with associated sample sizes and survey costs.

End Use Loadshape Costs

The following table shows costs of adding end use loadshape estimates to the site-specific data collection and analyses. This option would provide site-specific loadshapes at lower cost than the total Enhanced survey option, with a lower emphasis on end use metering. Some strategic monitoring/metering would be combined with collection of data to support engineering calculations of load shapes for end uses such as lighting, HVAC, and refrigeration. These end uses could then be backed out of the whole-facility load shapes gleaned from AMR data to provide a remaining estimate of the process load shape.

Table 15: Unit Costs for Estimating End Use Loadshapes

	Unit Survey Costs		
Size	Title 20 Basic	Loadshape Increment	Basic plus Loadshapes
Very Large	$3,800	$1,900	$5,700
Large	$2,800	$1,400	$4,200
Medium	$1,800	$900	$2,700
Small	$1,000	$500	$1,500

Additional Energy Efficiency Data Costs

The following table provides survey cost estimates for collecting additional data on the potential to install energy efficiency measures. These costs reflect a reasonable expansion of the Basic surveys that could address energy efficiency feasibility and applicability as well as a broad characterization of potential. This approach would be short of an audit-level analysis, and would mainly reflect identification of whether various measures were applicable to a given site and feasible to install. This expansion could possibly tap into existing facility audit data that has been previously collected by the utilities, provided the sampled facilities had recently been audited. This level of effort would *not* develop measure cost or savings data that would be required to do cost effectiveness testing.

Table 16: Unit Costs for Enhancing Data Collection for Estimating Energy Efficiency Potential

	Unit Survey Costs		
Size	Title 20 Basic	EE Potential Increment	Basic plus EE Potential
Very Large	$3,800	$1,140	$4,940
Large	$2,800	$840	$3,640
Medium	$1,800	$540	$2,340
Small	$1,000	$300	$1,300

Example of a Study Design with End Use Loadshape Estimation

By combining the costs from Table 15 above with some additional sample design analysis, we provide below an example of how the project could be expanded to include estimation of end use loadshapes for the *12 largest INFORM model categories at an 80-20 precision level*. Based on our initial analysis of utility billing data, each of these categories represents at least 3.5% of total industrial electricity consumption and together account for over 75% of total industrial electricity use.

For the example, we start with the INFORM 90-10 onsite/mail survey level of effort, with additional mail surveys to ensure a Utility 95-5 precision, as shown in the last rows of Table 14 above. Our additional sample design analysis indicates that it would take approximately 200 loadshape surveys to provide estimates of end use loadshapes at an 80-20 precision level for 12 INFORM segments. Additional onsite surveys would bring the level of precision for other survey components to the 90-15 level, and additional mail surveys would bring the level of precision for end use saturations to the 90-10 level and the 95-5 Utility precision level for end use saturations.

The following table summarizes survey costs for adding the 200 nested loadshape surveys into the study. Overall survey implementation costs for this option are $2.21 million. When fixed project costs of $656,000 are added to these survey costs, total project costs under this scenario are $2.87 million.

Table 17: Survey Cost Estimates for Adding 200 Loadshape Surveys

	Loadshape Onsite			Basic Title 20 On-Site			Mail			Total
Size	Unit Cost	#	Cost	Unit Cost	#	Cost	Unit Cost	#	Cost	Cost
Very Large	$5,700	51	$290,700	$3,800	117	$444,600	$300	160	$48,000	$783,300
Large	$4,200	43	$180,600	$2,800	123	$344,400	$260	313	$81,380	$606,380
Medium	$2,700	53	$143,100	$1,800	154	$277,200	$235	387	$90,945	$511,245
Small	$1,500	53	$79,500	$1,000	152	$152,000	$200	394	$78,800	$310,300
Survey Total		200	$693,900		546	$1,218,200		1,254	$299,125	$2,211,225
Project Total										$2,867,225

Loadshape onsites would provide 80-20 precision for the 12 largest INFORM categories; additional onsites would increase the INFORM precision to 90-15 for other survey elements; and additional mail surveys would increase the INFORM precision above the 90-10 level and ensure a 95-5 Utility precision level for end use saturations.

ATTACHMENT A
TITLE 20 REQUIREMENTS

1. Presence and characteristics of energy-using equipment;
2. installed energy efficiency measures;
3. building management controls, and measures designed to shift load;
4. presence and type of any metering and telemetry equipment used to meter energy use;
5. presence, type and characteristics of any energy-producing equipment or fuel supply;
6. electric and gas retailer identification or type of provider;
7. location of the building surveyed, identified by zip code;
8. patterns of behavior and appliance and equipment operation affecting energy use and load profiles;
9. building characteristics, including wall construction, foundation, number of stories, square footage of the building, and characteristics of windows;
10. type of industry identified by industrial classification code;
11. number of employees;
12. annual monetary value of shipments;
13. energy-using production processes used by the facility;
14. (utility) accounting records, customer identifiers, and associated data that are necessary for analysis and development of weights to expand respondent data to the population;
15. for interval metered accounts, 8760 hours of energy consumption data for each sampled premise. For other accounts, twelve months of energy consumption data for each sampled premise; and
16. for each survey where the survey plan includes a load metering element, load metering data for each metered, sampled account

ATTACHMENT B
ELEMENTS OF INFORM CENTRAL EQUATIONS

Common to most equations: Dollarized value of output capacity for each process.

Motors

1. Hours of use
2. Horsepower size category
3. Load variability category
4. Efficiency
5. % of time an efficient option is used
6. Load factor

Thermal Process (includes both gas and electric technologies)

1. Process heat ratio: heat input required for dollar output
2. Share of heat for a use that is provided by equipment
3. Fuel requirement ratio for each fuel: input fuel requirement per Btu of output heat

Other Process (includes boilers, steam generation, and cogeneration)

1. Process heat ratio: heat input required for dollar output
2. Share of heat for a use that is provided by equipment
3. Fuel requirement ratio for each fuel: input fuel requirement per Btu of output heat

Lighting

1. Lumen capacity ratio: normalized measure of lighting capacity in lumens to the dollar of capacity
2. Share of lumens provided by a source
3. Annual operating hours
4. Average efficiency option for a source

HVAC

1. (for space heating) heat requirements ratio: Heat input required per dollarized output
2. (for space cooling) heat removal requirement per dollarized output
3. Share of delivered (or removed) heat from a fuel
4. Fuel requirement ratio: fuel requirement per Btu of delivered (or removed) heat

Miscellaneous

1. Heat requirements ratio (as above)
2. Fuel requirements ratio (as above)

ATTACHMENT C
STRATA CUT POINTS BY SEGMENT

Utility	Strata Cut Points - kWh per Year		
	Very Large - Large	Large - Medium	Medium - Small
PG&E	19,622,818	2,167,680	189,520
SCE	39,369,985	7,355,600	943,360
SDG&E	49,583,104	6,504,863	791,175
LADWP	20,902,278	1,695,090	73,179

INFORM Category	Strata Cut Points - kWh per Year		
	Very Large - Large	Large - Medium	Medium - Small
01WOODPR	12,605,326	1,926,900	156,319
02OILEXT	49,623,780	9,111,732	855,588
03MINING	15,165,240	3,948,261	528,623
05FOODPR	14,121,643	4,628,690	904,380
06PAPMFG	11,506,264	3,510,134	657,165
07PAPMIL	10,473,492	3,510,134	1,982,477
09GLASSM	39,660,632	7,196,928	162,780
10CEMENT	102,983,540	10,324,259	431,400
11FOODBV	24,184,689	5,972,364	858,900
12TEXMIL	7,178,806	1,673,233	321,320
13TEXPRD	1,351,613	347,120	54,703
14APPARL	816,768	211,760	44,400
15PRINTG	3,914,093	719,484	84,640
16CHEMIC	64,752,911	7,654,692	626,045
17PLASTC	14,222,424	4,627,122	831,680
18MINMFG	10,273,094	1,061,600	4,265
19PRIMET	25,331,002	3,780,600	216,200
20FABMET	42,472,320	3,361,298	342,480
21MACHIN	6,977,155	970,720	135,849
22COMPUT	44,159,190	5,896,000	501,212
23SEMICD	15,694,000	3,518,800	603,264
24ELECEQ	3,352,800	789,697	127,880
25TRANSP	37,878,632	4,867,610	429,440
26FURNIT	1,426,963	408,720	80,599
27MISCMF	8,685,391	2,126,874	311,940
28PUBBRD	8,045,976	1,586,755	152,240