EVALUATING UTILITY EXECUTIVES' PERCEPTIONS OF SMART GRID COSTS, BENEFITS AND ADOPTION PLANS TO ASSESS IMPACTS ON BUILDING DESIGN AND CONSTRUCTION

A Thesis

by

AMEYA VINAYAK RAO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2010

Subject: Construction Management

Evaluating Utility Executives' Perceptions of Smart Grid Costs, Benefits and Adoption Plans to Assess Impacts on Building Design and Construction

EVALUATING UTILITY EXECUTIVES' PERCEPTIONS OF SMART GRID COSTS, BENEFITS AND ADOPTION PLANS TO ASSESS IMPACTS ON BUILDING DESIGN AND CONSTRUCTION

A Thesis

by

AMEYA VINAYAK RAO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Approved by:

Co-Chairs of Committee,	Jerry Jackson
	Joe Horlen
Committee Member,	Jesse Saginor
Head of Department,	Joe Horlen

August 2010

Major Subject: Construction Management

ABSTRACT

Evaluating Utility Executives' Perceptions of Smart Grid Costs, Benefits and Adoption Plans to Assess Impacts on Building Design and Construction. (August 2010)

Ameya Vinayak Rao, B.E, University of Pune

Co-Chairs of Advisory Committee: Dr. Jerry Jackson
Prof. Joe Horlen

Smart Grid technology is likely to be implemented in various magnitudes across utilities in the near future. To accommodate these technologies significant changes will have to be incorporated in building design construction and planning. This research paper attempts to evaluate public utility executives' plans to adopt smart grid technologies and to assess timing of smart grid impacts on future design and construction practices.

Telephone survey was the data collection method used to collect information from executives at cooperative and municipal utilities. The study focuses on small and medium utilities with more than five thousand customers and fewer than one hundred thousand customers. A stratified random sampling approach was applied and sample results for fifty-nine survey responses were used to predict the timing of smart grid implementation and the timing of smart grid impacts on future design and construction practices.

Results of this research indicate that design and construction professionals should already be developing knowledge and experience to accommodate smart grid impacts on the built environment.

DEDICATION

To my Brother

ACKNOWLEDGEMENTS

I would like to thank my committee co-chairs, Dr. Jerry Jackson, and Professor Joe Horlen, and my committee member, Dr. Jesse Saginor, for their guidance and support throughout the course of this research.

Thanks also to the department faculty and staff for making my time at Texas A&M University a great and memorable experience. I would also like to thank my friends and colleagues at Texas A&M and elsewhere for their constant support and encouragement.

Finally, thanks to my mother and father for providing me with everything I ever needed.

TABLE OF CONTENTS

Page

Page

LIST OF FIGURES

Page

Page

Page

LIST OF TABLES

Page

1. INTRODUCTION

1.1 BACKGROUND

The electric system in the United States including generation, transmission, distribution and buildings electricity use is undergoing a major transformation because of "smart grid" technologies and practices. The impact of the smart grid is considered by many to be as big as the internet and the interstate highway system (US Department of Energy, 2004). The smart grid can provide advanced communication, automation and control over the entire electric system from generating plants to the operation of electric equipment inside homes, commercial buildings and industrial plants. Smart grid benefits include reducing carbon dioxide emissions, energy consumption and the need for new generating plants by optimizing the use of existing energy.

Smart grids are also viewed as the next utility business model providing increased utility system efficiency and enhanced participatory customer energy use management. However the investments required for implementing a comprehensive smart grid system are extensive. Smart grid hardware and software technologies are in the evolving stage and returns on smart grid investments are uncertain.

1.2 NEED FOR RESEARCH

The transformation of the electric system will have a significant impact on the built environment including design and construction of residential, commercial buildings and

---

This thesis follows the style of *Energy Policy*.

industrial plants. In this new system, HVAC and other equipment will respond to signals from utilities, building owners and occupants. However this transformation appears to be slow for most public utilities including electric cooperatives, municipalities and public utility districts. Most utilities are concerned about the return on investment. Utilities also fear that mistakes in making short-term smart grid decisions may increase their customer's costs without providing sufficient benefits.

Determining the business case for smart grid investments is especially difficult for publicly owned utilities because most are smaller in size, have limited staff and suffer from greater importance of IT, and other overhead expenses relative to the number of their customers. However publicly owned utilities form an important part of electric infrastructure providing 24 percent of total US electric sales and 31 percent of residential electric sales (US Energy Information Administration, 2008).

The smart grid transformation will have important impacts on design and construction of the built environment. Designs will change to help buildings reduce electricity use in peak hours and to provide controls for all energy systems in the building. Buildings will be constructed with advanced digital communication and control systems where building occupants and the utility interact to reduce electricity use (Freidman, 2009; Miller, 2008; Gallagher, 2010; Smart Grid Maryland , 2009). While the concept of "smart buildings" has been around for many years (Flax, 1991; Drewer, 1994; Smith, 1984; Soonian, 2003), buildings that are part of the smart grid are different because they can automatically interact with the electric system to modify building electricity use.

The impact of smart grids on the built environment depends largely on the timing of the utility industry smart grid transition. If utilities move ahead quickly as some people predict (Leeds, 2010) design firms and construction companies will have to adjust quickly to include smart grid technologies in building designs and construction which will require a rapid change in current practices.

1.3 PROBLEM STATEMENT

The objective of this research is to determine public utility executives' plans to adopt smart grid technologies and to assess timing of smart grid impacts on future design and construction practices.

1.4 SUB PROBLEMS

The following sub problems are addressed in this research:

1. To find out what public utilities have done so far to implement a smart grid.
2. To find out what plans public utility executives have for implementing smart grids.
3. To evaluate the extent to which smart grid technologies will become important in building design and construction over the near term, medium term and long term.

1.5 HYPOTHESIS

Utility implementation of smart grid technologies will be so slow that related changes in design and construction will occur very slowly over a long period of time.

1.6 DELIMITATIONS

The study has been delimited to following constraints:

1. Only publicly-owned utilities will be considered
2. Utilities with fewer than five thousand customers or more than one hundred thousand customers will be excluded from the study.
3. Information will be collected from a sample of utilities

1.7 DEFINITIONS

The following definitions have been taken verbatim from the online journal, Smart Grid Today (Smart Grid Today 2010).

Smart grid: A nickname for the utility power distribution grid enabled with computer technology and two-way digital communications networking. The term encompasses the ever widening palette of utility applications that enhance and automate the monitoring and control of electrical distribution networks for added reliability, efficiency and cost effective operations.

Smart meter: A utility meter for electricity, natural gas or water, usually, that always includes two-way communications technology.

AMI: Automated or advanced metering infrastructure, utility infrastructure with two-way communications for metering and associated systems allowing delivery of a wide variety of services and applications to the utility and customer.

DA: Distribution automation, a general term referring to a class of technology that lets electric utilities monitor and remotely control their power distribution networks with two-way computer networking and computerized data handling.

ROI: Return on investment, a financial term referring to the revenue generated by an investment. In the world of networks it usually refers to revenue generated by investing in network infrastructure.

WAN: Wide area network, a computer network connecting all the buildings in a building complex to each other or all the homes and businesses in a neighborhood, town or city to the internet.

Wi-Fi: Wireless fidelity -- a standard for sending and receiving data -- such as in a home or small office network or LAN (or even an entire city). The standard includes a number of sub-standards under the IEEE's 802.11 standards.

AMR: Automated or advanced meter reading -- that uses one-way communications technology to collect data from the meter via PLC, radio or other networking technology.

PSC: Public Service Commission.

PUC: Public Utilities Commission.

2. LITERATURE REVIEW

The major advantage that the smart grid can provide is efficient and optimal utilization of assets and hence energy. The smart grid transformation will bring with it numerous other benefits like active involvement of consumers, anticipation and response to electric system disturbances, operational resiliently during emergencies, and accommodation of all energy generation, including distributed generation, and electricity storage options (Miller, 2008).

Studies indicate that smart grids can reduce peak period electricity use by as much as 20 percent (Jackson, 2009; Baer, et al, 2004; Faruqui, et al., 2009; Faruqui and Sanem, 2010). Reductions in the number of power plants will be similar to this reduction in peak period electricity use.

Since smart grids will automate building electricity use; installing and calibrating these systems will immediately reduce electricity and other energy use. A study conducted by the Department of Energy indicated that between 4 and 20 percent of energy utilized by HVAC, lighting and refrigeration is wasted due to problematic system operation (Roth, et al, 2005). These savings are in addition to the 20 percent reduction mentioned in the previous paragraph.

Many utilities are considering smart grid investments now. The federal government has not only shown interest in the technology but it has also extended funding in the form of grants to those utilities committed to smart grid advances (Isensee, 2009).

Several surveys have been undertaken on electric utility plans to implement smart grid programs. According to a survey conducted by Mosaic Services, utility executives found cost, complexity, questionable ROI, initial funding, technology being too immature, shortage of skilled manpower and lack of regulatory incentives to be the barriers in implementing the smart grid. Among all of these factors cost is the biggest barrier (Berger, 2009).

Other surveys conducted by Microsoft Corporation and Oracle, Incorporated have found that utility companies, who are actively moving ahead with smart grid systems with significant investments range between 8 and 20 percent of companies (Microsoft News Center, 2010; Peters, 2010). However surveys conducted by Greentech Media Company and The McDonnell Group indicate that approximately 87 percent of utilities are giving special attention to smart grid technology investments (Leeds, 2010; Smart Electric News, 2009). These results suggest that while current initiatives may be underway at a relatively small percentage of utilities, a majority of utilities are ready to begin making smart grid investments.

While utility companies are developing plans to implement smart grids, consumers in the US seem to be generally unaware of smart grid technologies. A survey conducted by GE Energy, indicated that just 4 percent of the consumers in the US have a good understanding of smart grid (Joshi, 2010). Hence reaching out to customers is likely to be an important task that the utility companies will have to perform to achieve smart grid benefits.

However, none of these surveys appears to have used a sample design that would provide statistical confidence for the results. One contribution of this study is to apply statistical sample design principles to provide a reliable estimate of public utility perceptions and plans for the entire public utility population in the United States.

3. METHODOLOGY

3.1 STAGE 1: SURVEY QUESTIONNAIRE

This research study began with a review of literature pertaining to opinions, analysis, and surveys of the public utility executives. This information was used to develop a survey questionnaire designed to determine public utility executive perceptions about smart grid investments and likely timing.

A questionnaire was intended to address current smart grid activities, plans for future smart grid initiatives, perceptions about payback period, etc.

The following questions were posed to utility executives during a telephone interview.

1. Please identify from the following list your organizations' approach to smart grid investment strategies
    (1) Waiting to see what our peers are doing.
    (2) Actively evaluating smart grid investment costs and benefits.
    (3) Initiated some smart grid trials or pilot programs.
    (4) Begun system-wide implementation of smart grid technologies.

    1. A. Only for those who answer either (3) or (4) “Would you please describe?" and record the response.

2. How quickly would smart grid investments have to pay for themselves to be considered viable at your organization? (don't know, months or years or record other comments).

3. Have you developed a formal business model for evaluating and implementing smart grid technologies? (not sure, yes, no or record other comments)

   3. A. If question 3 answer is yes, ask, "Have you identified key technologies that meet your business requirements?" (Y/N)

   3. B. If question 3. A. if yes, ask: "Would you please identify those technologies?" and "What time frame do you expect for these investments?"

4. (only for respondents who answered question 1 with answers (1) or (2)) When do you expect that your organization might initiate smart grid trials or pilot programs (record response, could be not sure, months, years, etc).
5. (only for respondents who answered question 1 with answers (1) or (2) or (3)) Please provide an estimate of when you think your organization is likely to begin a system-wide smart grid implementation. (Not sure, never, months, years, etc.)
6. How soon do you expect the majority of your customers to have customer-side technologies with two-way response capabilities to support demand response, critical peak pricing and so on? (not sure, never, months or years)
7. Please identify the following answer that best describes likely peak hour impacts at your utility associated with smart grid demand response programs.
   (1) We have no information.
   (2) We use rule-of-thumb estimates.

(3) We use estimates from programs at other utilities.

(4) We have developed estimates based on analysis of our customer's electricity use.

8. Please identify the value you would assign to the following information where 1 is no value and 5 is a great deal of value

(1) Objective descriptions of available technologies and systems (I will get 1 to 5 answer before going on to (2), etc.)

(2) Case study information describing actual experiences at other utilities.

(3) Smart grid implementation "best practices" to date.

(4) A conference devoted exclusively to discussing experience to date and best practices.

3.2 STAGE 2: SAMPLE DESIGN

Stratified sampling was used to draw random samples from a list of cooperative and municipal utilities. The list is attached as Appendix B. Cooperative utilities and municipal utilities were both considered as separate subsets of populations with sample utilities drawn from each subset individually.

Cooperatives were divided into five separate strata. The basis of their categorization was the number of residential customers as shown in Table 1.

Table 1 Stratification Based on Number of Residential Customers

#	Strata	Number of residential customers
1	Stratum 1	50,000 to 100,000
2	Stratum 2	25,000 to 50,000
3	Stratum 3	15,000 to 25,000
4	Stratum 4	10,000 to 15,000
5	Stratum 5	5,000 to 10,000

Each of these strata was further stratified by using normal Cooling Degree Days (CDD) as the second stratification variable. The CDD data were compiled by the U.S. Department of Commerce National Oceanic And Atmospheric Administration National Environmental Satellite, Data, and Information Service for individual states using population weighted data from individual weather stations within each state (NOAA 2010).

The states were categorized into 3 groups based on their normal CDD values as shown in Table 2. The list of states and their corresponding CDD values has been attached as Appendix C.

Table 2 Stratification Based on Accumulated Normal CDD Values

#	CDD Strata	Accumulated Normal CDD Value Range
1	1	198 to 738
2	2	738 to 1349
3	3	1349 to 5595

By doing this, the individual stratum in the primary stratification was further divided into 3 sub strata based on the normal CDD values. Thus, for every size stratum there are 3 possible combinations. For each of these combinations 2 randomly selected utilities were selected to survey. A random number generator formula in Microsoft Excel was used to draw 2 utilities from the population of utilities within each size/CDD strata. This process was performed separately for electric cooperatives and municipal utilities. Table 3 illustrates the 30 possible combinations under both municipals and cooperatives.

Table 3 Possible 30 Combinations

Cooperative Utilities			Municipal Utilities		
Strata	CDD	Number of Surveys	Strata	CDD	Number of Surveys
1	1	2	1	1	2
	2	2		2	2
	3	2		3	2
2	1	2	2	1	2
	2	2		2	2
	3	2		3	2
3	1	2	3	1	2
	2	2		2	2
	3	2		3	2
4	1	2	4	1	2
	2	2		2	2
	3	2		3	2
5	1	2	5	1	2
	2	2		2	2
	3	2		3	2
Total Surveys		30	Total Surveys		30

Cooperative and municipal utilities were evaluated separately because differences in their governance and service area characteristics raise the possibility that these two utility categories view the smart grid differently. Cooperatives are organizations owned

by their customers, or members, they serve and are governed by a board of directors elected from their members. Most cooperatives serve rural areas or a combination of small towns and rural areas. Municipal utilities are owned by towns or cities and governed by town or city governments. The potential difference in smart grid investment views resulting from this difference in customer density and governance is recognized by treating these two utility types as separate strata in addition to the size and CDD strata described above.

Size was chosen as a strata variable to reflect the possibility that larger utilities are likely to have larger staffs who can more confidently evaluate smart grid investments. Cooling degree days (CDD) was chosen as a strata variable because much of the benefit of smart grids is associated with the reduction in air conditioning hourly loads during peak periods.

3.3 STAGE 3: DATA COLLECTION THROUGH TELEPHONE INTERVIEWS

Telephone interviews were the medium used to collect data. First the contact information for all the utilities was located from utility websites. Then random samples were drawn and the phone calls were made. After the initial phone contacts, the responses collected were classified into three types as shown in Table 4. For every type of response a corresponding action was taken.

Table 4 Telephone Responses

#	Response	Action Taken
1	We will not participate in the interview.	These utilities were marked.
2	Call at a later time.	Appointment was scheduled
3	Can participate in the survey immediately.	Interview was conducted

Thus during the interview process a constantly updated status list was maintained which indicated utilities that had participated in surveys, that were to participate in the survey at a later time, and the ones that did not wish to participate in the survey. This list provided a systematic framework to complete the survey process. A random number generator was used to insure a random selection of sample utilities drawn from the population until the required number of surveys was completed from every combination.

The entire interviewing process was conducted from approximately 7:00 am to 7:00 pm for 9 working days. At the end of each day the data collected was entered into a spreadsheet and stored.

Table 5 indicates the number of refusals, the number of calls made; but contact not established, the number of successful calls, and total number of calls attempts:

Table 5 Call Attempts

Strata	Response	CDD Cooperatives			CDD Municipals		
		1	2	3	1	2	3
1	Successful Calls	2	2	2	1	2	2
	Refusals	0	0	0	0	0	0
	Not able to contact	2	7	20	3	6	4
	Total Call Attempts	4	9	22	4	8	6
2	Successful Calls	2	2	2	2	2	2
	Refusals	1	0	0	0	1	5
	Not able to contact	27	29	49	4	15	16
	Total Call Attempts	30	31	51	6	18	23
3	Successful Calls	2	2	2	2	2	2
	Refusals	0	0	0	0	0	0
	Not able to contact	24	35	32	7	23	19
	Total Call Attempts	26	37	34	9	25	21
4	Successful Calls	2	2	2	2	2	2
	Refusals	0	0	0	0	0	0
	Not able to contact	27	16	23	17	14	15
	Total Call Attempts	29	18	25	19	16	17
5	Successful Calls	2	2	2	2	2	2
	Refusals	2	1	0	0	0	0
	Not able to contact	26	28	18	34	10	8
	Total Call Attempts	30	31	20	36	12	10

3.4 STAGE 4: DATA INTERPRETATION AND ANALYSIS

The objective of the research was to develop information on utility executive's plans regarding the timing of future smart grid investments. Consequently, results of the survey are primarily descriptive and no attempt was made to collect information to explain why or how executives have developed these plans.

By applying population weights to the sample results, the analysis estimates the number of utilities in the population of one thousand forty-seven utilities who are likely to present these same views. The population weight is the inverse ratio of the likelihood that the sample utility was drawn from its stratum. For example, the number of cooperatives in the smallest size category in the warmest climate strata is fifty. Two sample utilities were drawn from the population so each utility has a population weight of twenty-five. This weight is multiplied by each of the responses of the two utilities and added to those of other utilities weighted in a similar manner from other strata to determine the population estimate.

Qualitative observations can be made concerning differences in responses between cooperative municipal utilities and between size and CDD strata. These observations are noted in the following section for each question where appropriate.

4. RESULTS AND FINDINGS

4.1 RESULTS FOR QUESTION # 1

As shown in Figures 1, 2 and 3, only 25 % of municipals are either involved in smart grid trials / pilots or have initiated system wide implementation of some technologies as against 49% of cooperatives. Figures 4 and 5 are pictorial representations of these results.

4.1.1 Detail Workings and Results

Question #1 Please identify from the following list your organizations' approach to smart grid investment strategies

1 Waiting to see what our peers are doing.
2 Actively evaluating smart grid investment costs and benefits.
3 Initiated some smart grid trials or pilot programs.
4 Begun system-wide implementation of smart grid technologies.

			Sample Responses						Population Estimates				
Type	Strata Size.CDD	Total Population	Waiting	Evaluating	Pilot	Initiated	Total	Weights	Waiting	Evaluating	Pilot	Initiated	Total
Coop	1.1	4		2			2	2	0	4	0	0	4
Coop	1.2	13		2			2	6.5	0	13	0	0	13
Coop	1.3	31		2			2	15.5	0	31	0	0	31
Coop	2.1	29			2		2	14.5	0	0	29	0	29
Coop	2.2	35			1	1	2	17.5	0	0	17.5	17.5	35
Coop	2.3	61	1			1	2	30.5	30.5	0	0	30.5	61
Coop	3.1	36			1	1	2	18	0	0	18	18	36
Coop	3.2	43			2		2	21.5	0	0	43	0	43
Coop	3.3	69		1		1	2	34.5	0	34.5	0	34.5	69
Coop	4.1	39	1		1		2	19.5	19.5	0	19.5	0	39
Coop	4.2	38	1	1			2	19	19	19	0	0	38
Coop	4.3	55	1			1	2	27.5	27.5	0	0	27.5	55
Coop	5.1	69	2				2	34.5	69	0	0	0	69
Coop	5.2	62		1	1		2	31	0	31	31	0	62
Coop	5.3	50	1		1		2	25	25	0	25	0	50
	Total	634	7	9	9	5	30	634	190.5	132.5	183	128	634
	Size Strata												
Coop	1		0	6	0	0	6		0	48	0	0	48
Coop	2		1	0	3	2	6		30.5	0	46.5	48	125
Coop	3		0	1	3	2	6		0	34.5	61	52.5	148
Coop	4		3	1	1	1	6		66	19	19.5	27.5	132
Coop	5		3	1	2	0	6		94	31	56	0	181
		Total	7	9	9	5	30		190.5	132.5	183	128	634
	CDD Strata												
Coop	1		3	2	4	1	10		88.5	4	66.5	18	177
Coop	2		1	4	4	1	10		19	63	91.5	17.5	191
Coop	3		3	3	1	3	10		83	65.5	25	92.5	266
									190.5	132.5	183	128	634
		Total	7	9	9	5	30						

Figure 1 Results for Question 1 (Cooperatives)

	Strata	Total	Sample Responses						Population Estimates				
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**Total**
Municipal	1.1	4	1				1	4	4	0	0	0	4
Municipal	1.2	9		1	1		2	4.5	0	4.5	4.5	0	9
Municipal	1.3	9		1		1	2	4.5	0	4.5	0	4.5	9
Municipal	2.1	6	1		1		2	3	3	0	3	0	6
Municipal	2.2	18	1		1		2	9	9	0	9	0	18
Municipal	2.3	20	2				2	10	20	0	0	0	20
Municipal	3.1	14	2				2	7	14	0	0	0	14
Municipal	3.2	28		1	1		2	14	0	14	14	0	28
Municipal	3.3	25		1	1		2	12.5	0	12.5	12.5	0	25
Municipal	4.1	24	1	1			2	12	12	12	0	0	24
Municipal	4.2	22			1	1	2	11	0	0	11	11	22
Municipal	4.3	37	1	1			2	18.5	18.5	18.5	0	0	37
Municipal	5.1	68	1		1		2	34	34	0	34	0	68
Municipal	5.2	60		2			2	30	0	60	0	0	60
Municipal	5.3	69	1	1			2	34.5	34.5	34.5	0	0	69
	Total	413	11	9	7	2	29	413	149	160.5	88	15.5	413
	Size Strata												
Municipal	1		1	2	1	1	5		4	9	4.5	4.5	22
Municipal	2		4	0	2	0	6		32	0	12	0	44
Municipal	3		2	2	2	0	6		14	26.5	26.5	0	67
Municipal	4		2	2	1	1	6		30.5	30.5	11	11	83
Municipal	5		2	3	1	0	6		68.5	94.5	34	0	197
		Total	11	9	7	2	29		149	160.5	88	15.5	413
	CDD Strata												
Municipal	1		6	1	2	0	9		67	12	37	0	116
Municipal	2		1	4	4	1	10		9	78.5	38.5	11	137
Municipal	3		4	4	1	1	10		73	70	12.5	4.5	160
									149	160.5	88	15.5	413
		Total	11	9	7	2	29						

Figure 2 Results for Question 1 (Municipals)

	Strata	Total	Sample Responses						Population Estimates				
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**Total**		**1**	**2**	**3**	**4**	**Total**
Coop & Municipal	1.1	8	1	2	0	0	3		4	4	0	0	8
Coop & Municipal	1.2	22	0	3	1	0	4		0	17.5	4.5	0	22
Coop & Municipal	1.3	40	0	3	0	1	4		0	35.5	0	4.5	40
Coop & Municipal	2.1	35	1	0	3	0	4		3	0	32	0	35
Coop & Municipal	2.2	53	1	0	2	1	4		9	0	26.5	17.5	53
Coop & Municipal	2.3	81	3	0	0	1	4		50.5	0	0	30.5	81
Coop & Municipal	3.1	50	2	0	1	1	4		14	0	18	18	50
Coop & Municipal	3.2	71	0	1	3	0	4		0	14	57	0	71
Coop & Municipal	3.3	94	0	2	1	1	4		0	47	12.5	34.5	94
Coop & Municipal	4.1	63	2	1	1	0	4		31.5	12	19.5	0	63
Coop & Municipal	4.2	60	1	1	1	1	4		19	19	11	11	60
Coop & Municipal	4.3	92	2	1	0	1	4		46	18.5	0	27.5	92
Coop & Municipal	5.1	137	3	0	1	0	4		103	0	34	0	137
Coop & Municipal	5.2	122	0	3	1	0	4		0	91	31	0	122
Coop & Municipal	5.3	119	2	1	1	0	4		59.5	34.5	25	0	119
	Total	1047	18	18	16	7	59		339.5	293	271	143.5	1047
	Size Strata												
Coop & Municipal	1		1	8	1	1	11		4	57	4.5	4.5	70
Coop & Municipal	2		1	6	4	1	12		62.5	0	58.5	48	169
Coop & Municipal	3		2	3	5	2	12		14	61	87.5	52.5	215
Coop & Municipal	4		5	0	5	2	12		96.5	49.5	30.5	38.5	215
Coop & Municipal	5		5	4	3	0	12		162.5	125.5	90	0	378
		Total	14	21	18	6	59		339.5	293	271	143.5	1047
	CDD Strata												
Coop & Municipal	1		9	3	6	1	19		155.5	16	103.5	18	293
Coop & Municipal	2		2	8	8	2	20		28	141.5	130	28.5	328
Coop & Municipal	3		7	7	2	4	20		156	135.5	37.5	97	426
									339.5	293	271	143.5	1047
		Total	18	18	16	7	59						

Figure 3 Results for Question 1 (Cooperatives and Municipals)

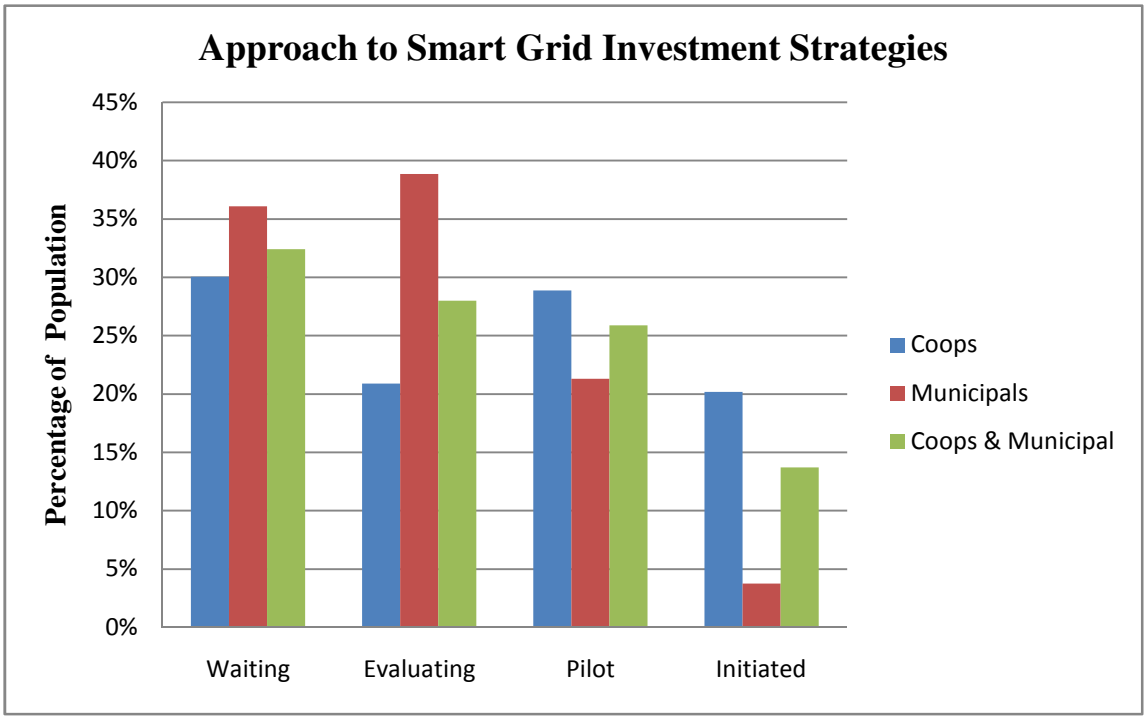


Figure 4 Chart for Question 1 Percentage

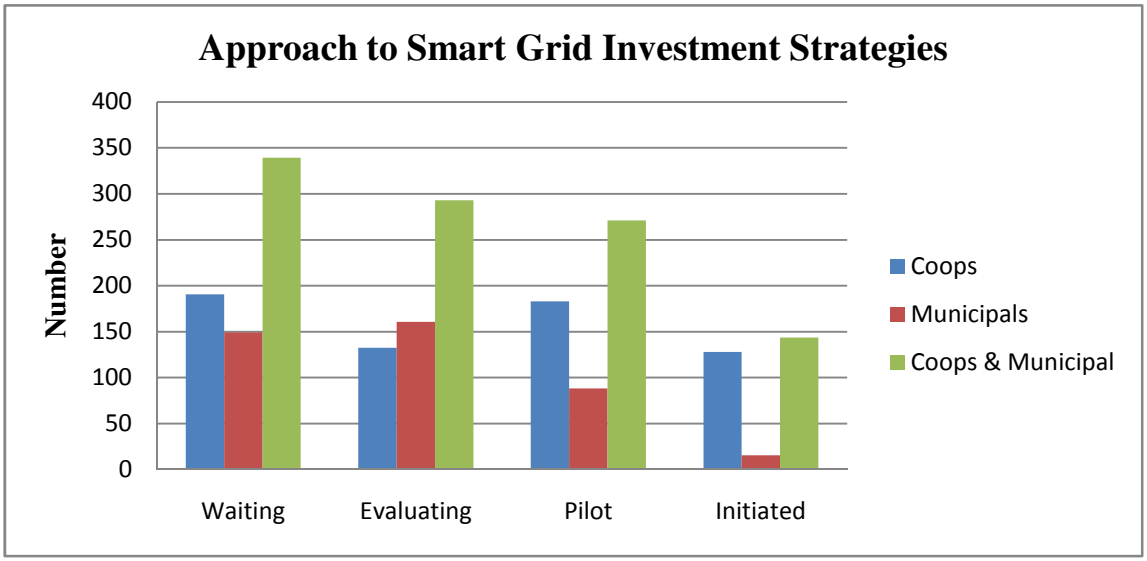


Figure 5 Chart for Question 1 Number

4.2 RESULTS FOR QUESTION # 2

Figures 6, 7 and 8 indicate that the average payback period that the utility executives consider enough before making smart grid investment decision is 5.73 years for cooperatives and 6.13 for the municipals. Figure 9 is a pictorial representation of these results.

4.2.1 Detail Workings and Results

Question # 2 How quickly would smart grid investments have to pay for themselves to be considered viable at your organization?

			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Coop	1.1	4	6.75	2	2	13.5
Coop	1.2	13	7.833	0	6.5	50.9145
Coop	1.3	31	10	1	15.5	155
Coop	2.1	29	4	2	14.5	58
Coop	2.2	35	5	2	17.5	87.5
Coop	2.3	61	4.5	0	30.5	137.25
Coop	3.1	36	7.5	0	18	135
Coop	3.2	43	5	1	21.5	107.5
Coop	3.3	69	10	1	34.5	345
Coop	4.1	39	6	1	19.5	117
Coop	4.2	38	8	2	19	152
Coop	4.3	55	7.33	0	27.5	201.575
Coop	5.1	69	5	1	34.5	172.5
Coop	5.2	62	0.5	1	31	15.5
Coop	5.3	50	2.75	0	25	68.75
	Total	634		14	Average	5.73
	Size Strata					
Coop	1	48	24.583	3	Average	9.14
Coop	2	125	13.5	4	Average	4.52
Coop	3	148	22.5	2	Average	7.94
Coop	4	132	21.33	3	Average	7.13
Coop	5	181	8.25	2	Average	2.84
	Total	634		14		
	CDD Strata					
Coop	1	177	29.25	6	Average	5.60
Coop	2	191	26.333	6	Average	4.33
Coop	3	266	34.58	2	Average	6.82
	Total	634		14		

Figure 6 Results for Question 2 (Cooperatives)

			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Municipal	1.1	4	5.5	0	4	22
Municipal	1.2	9	5.5	1	4.5	24.75
Municipal	1.3	9	5.5	0	4.5	24.75
Municipal	2.1	6	6.5	1	3	19.5
Municipal	2.2	18	5.25	2	9	47.25
Municipal	2.3	20	5.667	0	10	56.67
Municipal	3.1	14	3	1	7	21
Municipal	3.2	28	6	1	14	84
Municipal	3.3	25	3.5	1	12.5	43.75
Municipal	4.1	24	5	1	12	60
Municipal	4.2	22	7.5	1	11	82.5
Municipal	4.3	37	5	1	18.5	92.5
Municipal	5.1	68	10	1	34	340
Municipal	5.2	60	4	1	30	120
Municipal	5.3	69	7	0	34.5	241.5
	Total	413		12	Average	6.139904077
	Size Strata					
Municipal	1	22	16.5	1	Average	5.50
Municipal	2	44	17.417	3	Average	5.61
Municipal	3	67	12.5	3	Average	4.44
Municipal	4	83	17.5	3	Average	5.66
Municipal	5	197	21	2	Average	7.12
	Total	413		12		
	CDD Strata					
Municipal	1	116	30	4	Average	7.71
Municipal	2	137	28.25	6	Average	5.23
Municipal	3	160	26.667	2	Average	5.74
	Total	413		12		

Figure 7 Results for Question 2 (Municipals)

	Strata			Sample Responses	Population Estimates	
Type	**Size.CDD**	**Strata Population**		**Sample**	**Weights**	**Weighted Average**
Coop & Municipal	1.1	8		2	6	5.92
Coop & Municipal	1.2	22		1	11	6.88
Coop & Municipal	1.3	40		1	20	8.99
Coop & Municipal	2.1	35		3	17.5	4.43
Coop & Municipal	2.2	53		4	26.5	5.08
Coop & Municipal	2.3	81		0	40.5	4.79
Coop & Municipal	3.1	50		1	25	6.24
Coop & Municipal	3.2	71		2	35.5	5.39
Coop & Municipal	3.3	94		2	47	8.27
Coop & Municipal	4.1	63		2	31.5	5.62
Coop & Municipal	4.2	60		3	30	7.82
Coop & Municipal	4.3	92		1	46	6.39
Coop & Municipal	5.1	137		2	68.5	7.48
Coop & Municipal	5.2	122		2	61	2.22
Coop & Municipal	5.3	119		0	59.5	5.21
	Total	1047		26	Average	5.89
	Size Strata					
Coop & Municipal	1	70		4	Average	7.86
Coop & Municipal	2	169		7	Average	4.81
Coop & Municipal	3	215		5	Average	6.85
Coop & Municipal	4	215		6	Average	6.56
Coop & Municipal	5	378		4	Average	5.07
	Total	1047		26		
	CDD Strata					
Coop & Municipal	1	293		10	Average	6.45
Coop & Municipal	2	328		12	Average	4.71
Coop & Municipal	3	426		4	Average	6.42
	Total	1047		26		

Figure 8 Results for Question 2 (Cooperatives and Municipals)

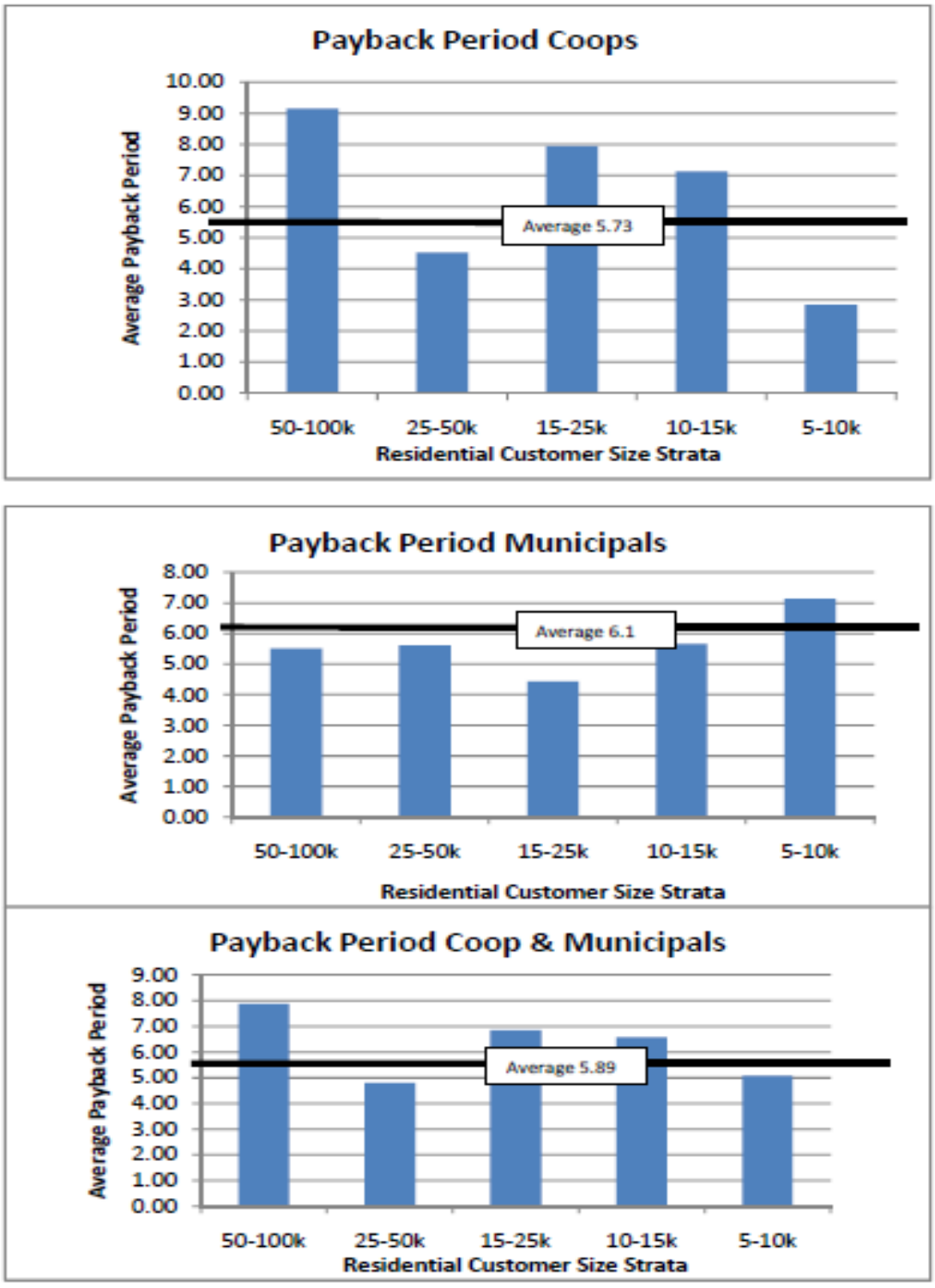


Figure 9 Charts for Question 2

4.3 RESULTS FOR QUESTION # 3

As shown in Figures 10, 11 and 12 executives at both, cooperatives as well as at municipals agreed that their organization had not developed any formal business models for evaluating and implementing smart grid. The survey indicated that around 71% both cooperatives and municipals combined had no formal business model. Figure 13 is a pictorial representation of these results.

4.3.1 Detail Workings and Results

Question #3. Have you developed a formal business model for evaluating and implementing smart grid technologies?

1 Yes
2 No
3 Not Sure

	Strata	Total	Sample Responses					Population Estimates			
Type	**Size.CDD**	**Population**	**Yes**	**No**	**Not Sure**	**Total**	**Weights**	**Yes**	**No**	**Not Sure**	**Total**
Coop	1.1	4	1	1		2	2	2	2	0	4
Coop	1.2	13		2		2	6.5	0	13	0	13
Coop	1.3	31	1		1	2	15.5	15.5	0	15.5	31
Coop	2.1	29		2		2	14.5	0	29	0	29
Coop	2.2	35		2		2	17.5	0	35	0	35
Coop	2.3	61		2		2	30.5	0	61	0	61
Coop	3.1	36	1		1	2	18	18	0	18	36
Coop	3.2	43	1		1	2	21.5	21.5	0	21.5	43
Coop	3.3	69		1	1	2	34.5	0	34.5	34.5	69
Coop	4.1	39		1	1	2	19.5	0	19.5	19.5	39
Coop	4.2	38		2		2	19	0	38	0	38
Coop	4.3	55		1	1	2	27.5	0	27.5	27.5	55
Coop	5.1	69		2		2	34.5	0	69	0	69
Coop	5.2	62		1	1	2	31	0	31	31	62
Coop	5.3	50		2		2	25	0	50	0	50
	Total	634	4	19	7	30	634	57	409.5	167.5	634
	Size Strata										
Coop	1		2	3	1	6		17.5	15	15.5	48
Coop	2		0	6	0	6		0	125	0	125
Coop	3		2	1	3	6		39.5	34.5	74	148
Coop	4		0	4	2	6		0	85	47	132
Coop	5		0	5	1	6		0	150	31	181
		Total	4	19	7	30		57	409.5	167.5	634
	CDD Strata										
Coop	1		2	6	2	10		20	119.5	37.5	177
Coop	2		1	7	2	10		21.5	117	52.5	191
Coop	3		1	6	3	10		15.5	173	77.5	266
		Total	4	19	7	30		57	409.5	167.5	634

Figure 10 Results for Question 3 (Cooperatives)

	Strata	Total	Sample Responses					Population Estimates			
Type	**Size.CDD**	**Population**	**Yes**	**No**	**Not Sure**	**Total**	**Weights**	**Yes**	**No**	**Not Sure**	**Total**
Municipal	1.1	4		1		1	4	0	4	0	4
Municipal	1.2	9	1	1		2	4.5	4.5	4.5	0	9
Municipal	1.3	9		2		2	4.5	0	9	0	9
Municipal	2.1	6		2		2	3	0	6	0	6
Municipal	2.2	18	1	1		2	9	9	9	0	18
Municipal	2.3	20	1	1		2	10	10	10	0	20
Municipal	3.1	14		2		2	7	0	14	0	14
Municipal	3.2	28		2		2	14	0	28	0	28
Municipal	3.3	25		2		2	12.5	0	25	0	25
Municipal	4.1	24	1	1		2	12	12	12	0	24
Municipal	4.2	22	1	1		2	11	11	11	0	22
Municipal	4.3	37		2		2	18.5	0	37	0	37
Municipal	5.1	68	1	1		2	34	34	34	0	68
Municipal	5.2	60		2		2	30	0	60	0	60
Municipal	5.3	69		2		2	34.5	0	69	0	69
	Total	413	6	23	0	29		80.5	332.5	0	413
	Size Strata										
Municipal	1		1	4	0	5		4.5	17.5	0	22
Municipal	2		2	4	0	6		19	25	0	44
Municipal	3		0	6	0	6		0	67	0	67
Municipal	4		2	4	0	6		23	60	0	83
Municipal	5		1	5	0	6		34	163	0	197
		Total	6	23	0	29		80.5	332.5	0	413
	CDD Strata										
Municipal	1		2	7	0	9		46	70	0	116
Municipal	2		3	7	0	10		24.5	112.5	0	137
Municipal	3		1	9	0	10		10	150	0	160
		Total	6	23	0	29		80.5	332.5	0	413

Figure 11 Results for Question 3 (Municipals)

	Strata	Total	Sample Responses					Population Estimates			
Type	Size.CDD	Population	Yes	No	Not Sure	Total		1	2	3	Total
Coop & Municipal	1.1	8	1	2	0	3		2	6	0	8
Coop & Municipal	1.2	22	1	3	0	4		4.5	17.5	0	22
Coop & Municipal	1.3	40	1	2	1	4		15.5	9	15.5	40
Coop & Municipal	2.1	35	0	4	0	4		0	35	0	35
Coop & Municipal	2.2	53	1	3	0	4		9	44	0	53
Coop & Municipal	2.3	81	1	3	0	4		10	71	0	81
Coop & Municipal	3.1	50	1	2	1	4		18	14	18	50
Coop & Municipal	3.2	71	1	2	1	4		21.5	28	21.5	71
Coop & Municipal	3.3	94	0	3	1	4		0	59.5	34.5	94
Coop & Municipal	4.1	63	1	2	1	4		12	31.5	19.5	63
Coop & Municipal	4.2	60	1	3	0	4		11	49	0	60
Coop & Municipal	4.3	92	0	3	1	4		0	64.5	27.5	92
Coop & Municipal	5.1	137	1	3	0	4		34	103	0	137
Coop & Municipal	5.2	122	0	3	1	4		0	91	31	122
Coop & Municipal	5.3	119	0	4	0	4		0	119	0	119
	Total	1047	10	42	7	59		137.5	742	167.5	1047
	Size Strata										
Coop & Municipal	1		3	7	1	11		22	32.5	15.5	70
Coop & Municipal	2		2	10	0	12		19	150	0	169
Coop & Municipal	3		2	7	3	12		39.5	101.5	74	215
Coop & Municipal	4		2	8	2	12		23	145	47	215
Coop & Municipal	5		1	10	1	12		34	313	31	378
		Total	10	42	7	59		137.5	742	167.5	1047
	CDD Strata										
Coop & Municipal	1		4	13	2	19		66	189.5	37.5	293
Coop & Municipal	2		4	14	2	20		46	229.5	52.5	328
Coop & Municipal	3		2	15	3	20		25.5	323	77.5	426
		Total	10	42	7	59		137.5	742	167.5	1047

Figure 12 Results for Question 3 (Cooperatives and Municipals)

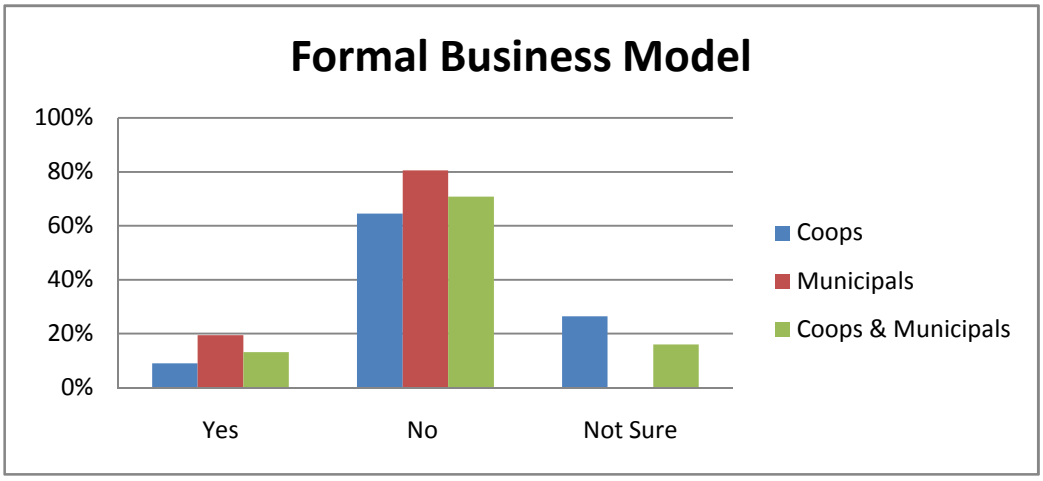


Figure 13 Chart for Question 3

4.4 RESULTS FOR QUESTION # 4

Figures 14, 15 and 16 indicate that executives at both, cooperatives as well as municipals feel that they might initiate smart grid trials and pilot programs in approximately 4 years. Figures 17 and 18 are pictorial representations of these results.

4.4.1 Detail Workings and Results

Question # 4. When do you expect that your organization might initiate smart grid trials or pilot programs ?

			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Coop	1.1	4	2	2	2	4
Coop	1.2	13	3	2	6.5	19.5
Coop	1.3	31	2	2	15.5	31
Coop	2.1	29	2.333	0	14.5	33.8285
Coop	2.2	35	2.333	0	17.5	40.8275
Coop	2.3	61	2.333	0	30.5	71.1565
Coop	3.1	36	2	0	18	36
Coop	3.2	43	2	0	21.5	43
Coop	3.3	69	2	1	34.5	69
Coop	4.1	39	7.5	0	19.5	146.25
Coop	4.2	38	7.5	1	19	142.5
Coop	4.3	55	7.5	0	27.5	206.25
Coop	5.1	69	5	0	34.5	172.5
Coop	5.2	62	5	1	31	155
Coop	5.3	50	5	0	25	125
	Total	634		9	Average	4.09
	Size Strata					
Coop	1	48	7	6	Average	2.27
Coop	2	125	6.999	0	Average	2.33
Coop	3	148	6	1	Average	2.00
Coop	4	132	22.5	1	Average	7.50
Coop	5	181	15	1	Average	5.00
	Total	634		9		
CDD Strata						
Coop	1	177	18.833	2	Average	4.44
Coop	2	191	19.833	4	Average	4.20
Coop	3	266	18.833	3	Average	3.78
	Total	634		9		

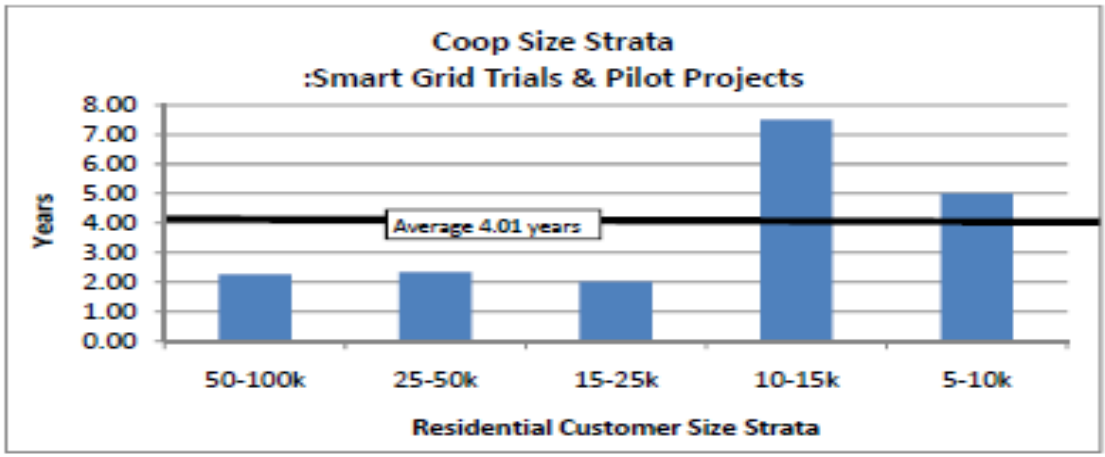
Figure 14 Results for Question 4 (Cooperatives)

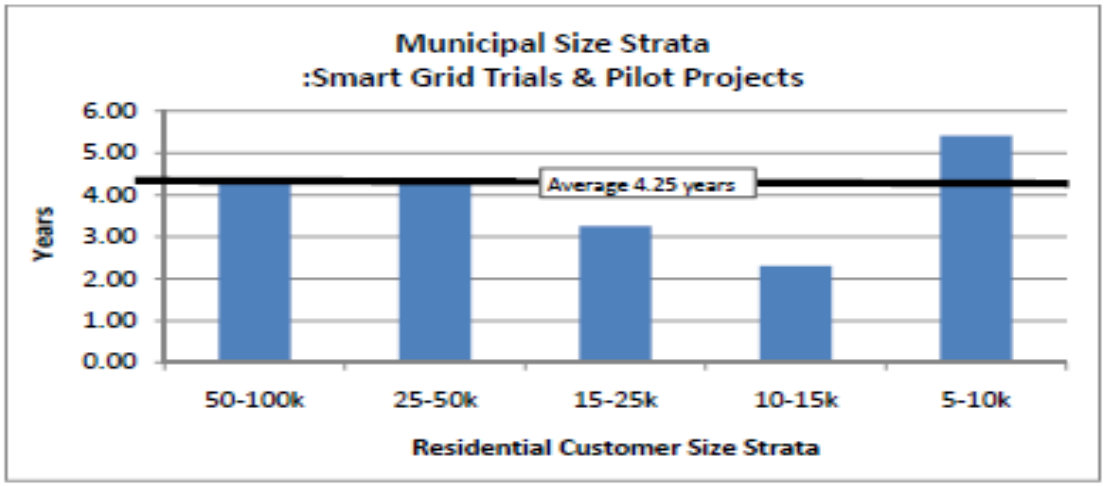
			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Municipal	1.1	4	4.25	0	4	17
Municipal	1.2	9	1	1	4.5	4.5
Municipal	1.3	9	7.5	1	4.5	33.75
Municipal	2.1	6	4.25	0	3	12.75
Municipal	2.2	18	4.25	0	9	38.25
Municipal	2.3	20	4.25	0	10	42.5
Municipal	3.1	14	5	1	7	35
Municipal	3.2	28	3.5	0	14	49
Municipal	3.3	25	2	1	12.5	25
Municipal	4.1	24	1.5	2	12	18
Municipal	4.2	22	2	0	11	22
Municipal	4.3	37	3	1	18.5	55.5
Municipal	5.1	68	10	1	34	340
Municipal	5.2	60	3	2	30	90
Municipal	5.3	69	3	1	34.5	103.5
	Total	413		11	Average	4.252997602
	Size Strata					
Municipal	1	22	12.75	2	Average	4.25
Municipal	2	44	12.75	0	Average	4.25
Municipal	3	67	10.5	2	Average	3.25
Municipal	4	83	6.5	3	Average	2.30
Municipal	5	197	16	4	Average	5.42
	Total	413		11		
CDD Strata						
Municipal	1	116	25	4	Average	7.05
Municipal	2	137	13.75	3	Average	2.97
Municipal	3	160	19.75	4	Average	3.25
	Total	413		11		

Figure 15 Results for Question 4 (Municipals)

	Strata				Population Estimates	
Type	**Size.CDD**	**Total Population**		**Sample**	**Weights**	**Weighted Average**
Coop & Municipal	1.1	8		2	6	3.50
Coop & Municipal	1.2	22		3	11	2.18
Coop & Municipal	1.3	40		3	20	3.24
Coop & Municipal	2.1	35		0	17.5	2.66
Coop & Municipal	2.2	53		0	26.5	2.98
Coop & Municipal	2.3	81		0	40.5	2.81
Coop & Municipal	3.1	50		1	25	2.84
Coop & Municipal	3.2	71		0	35.5	2.59
Coop & Municipal	3.3	94		2	47	2.00
Coop & Municipal	4.1	63		2	31.5	5.21
Coop & Municipal	4.2	60		1	30	5.48
Coop & Municipal	4.3	92		1	46	5.69
Coop & Municipal	5.1	137		1	68.5	7.48
Coop & Municipal	5.2	122		3	61	4.02
Coop & Municipal	5.3	119		1	59.5	3.84
	Total	1047		20	Average	4.15
	Size Strata					
Coop & Municipal	1	70		8	Average	2.97
Coop & Municipal	2	169		0	Average	2.83
Coop & Municipal	3	215		3	Average	2.39
Coop & Municipal	4	215		4	Average	5.49
Coop & Municipal	5	378		5	Average	5.22
	Total	1047		20		
CDD Strata						
Coop & Municipal	1	293		6	Average	5.49
Coop & Municipal	2	328		7	Average	3.69
Coop & Municipal	3	426		7	Average	3.58
	Total	1047		20		

Figure 16 Results for Question 4 (Cooperatives and Municipals)





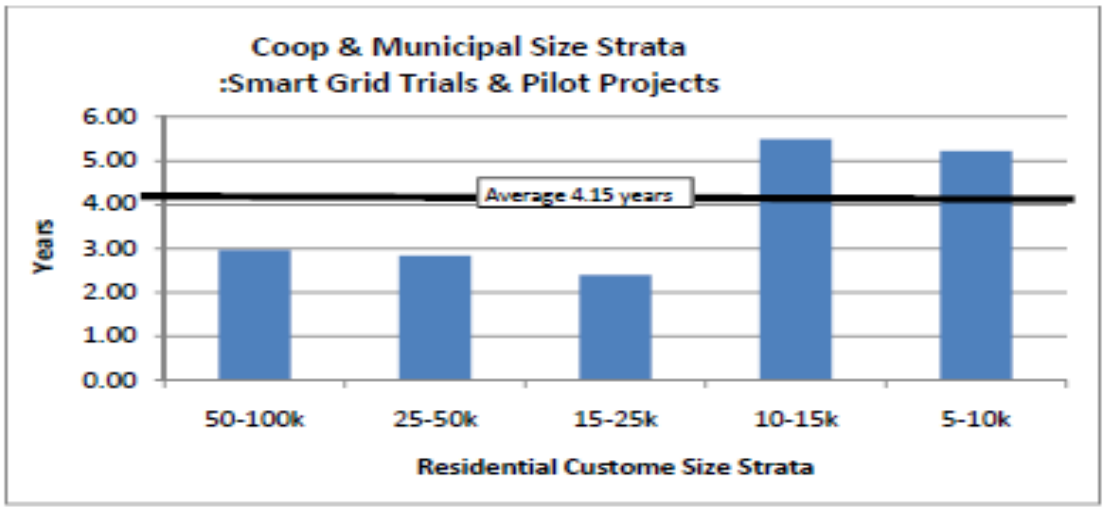


Figure 17 Charts for Question 4 Residential Customer Size Strata

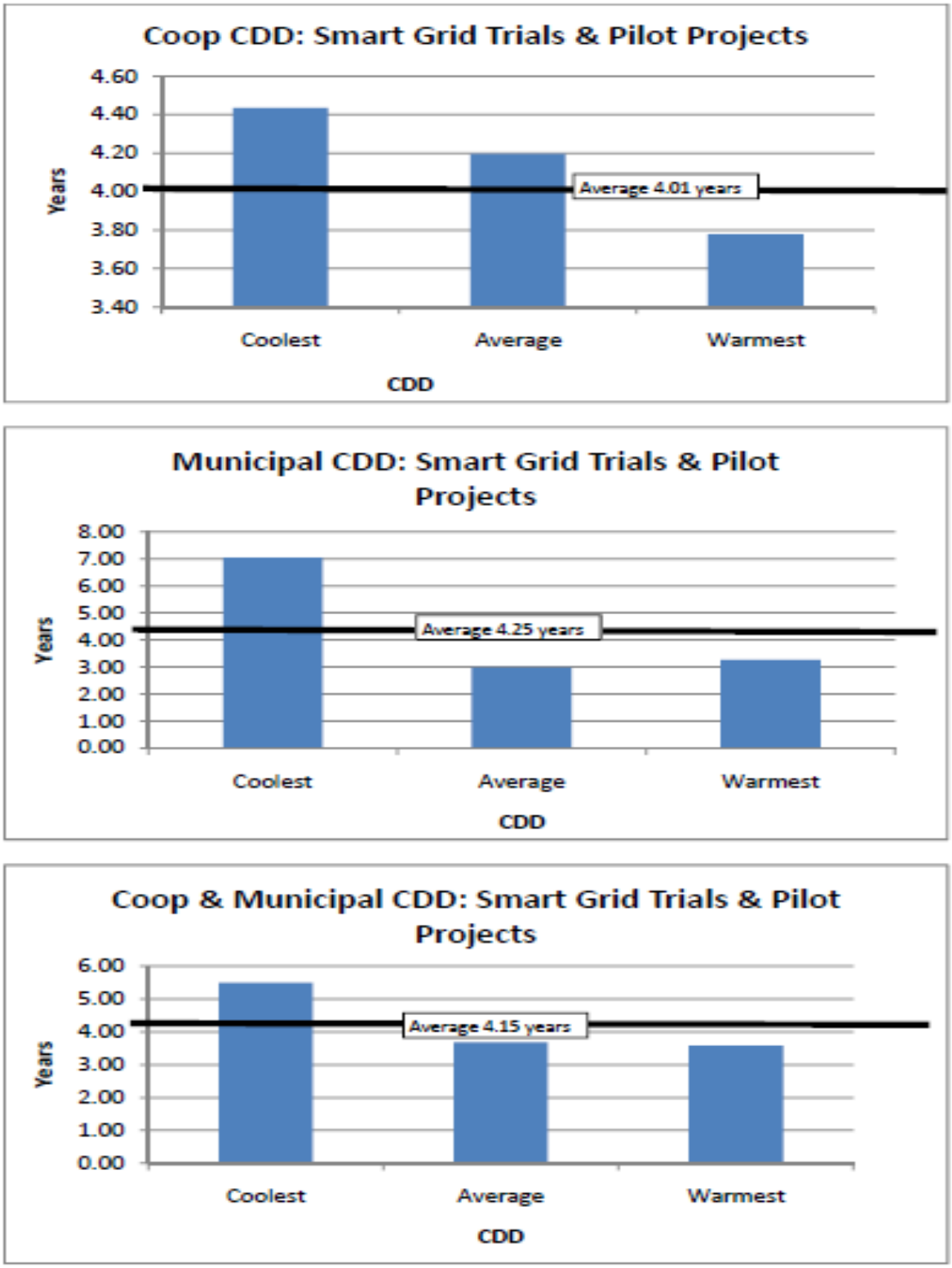


Figure 18 Charts for Question 4 CDD

4.5 RESULTS FOR QUESTION # 5

As shown in Figures 19, 20 and 21, the executives also share a similar view on system wide smart grid implementation. They think that their organization would begin system-wide smart grid implementation in 5 years. Figures 22 and 23 are pictorial representations of these results.

4.5.1 Detail Workings and Results

Question # 5 Please provide an estimate of when you think your organization is likely to begin a system-wide smart grid implementation.

			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Coop	1.1	4	4	2	2	8
Coop	1.2	13	3	0	6.5	19.5
Coop	1.3	31	1	1	15.5	15.5
Coop	2.1	29	7	2	14.5	101.5
Coop	2.2	35	7	0	17.5	122.5
Coop	2.3	61	7	0	30.5	213.5
Coop	3.1	36	1	1	18	18
Coop	3.2	43	3.5	1	21.5	75.25
Coop	3.3	69	2.25	0	34.5	77.625
Coop	4.1	39	3.5	1	19.5	68.25
Coop	4.2	38	10	2	19	190
Coop	4.3	55	7.833	0	27.5	215.4075
Coop	5.1	69	5.5	0	34.5	189.75
Coop	5.2	62	5.5	0	31	170.5
Coop	5.3	50	5.5	2	25	137.5
	Total	634		12	Average	5.12
	Size Strata					
Coop	1	48	8	3	Average	1.79
Coop	2	125	21	2	Average	7.00
Coop	3	148	6.75	2	Average	2.31
Coop	4	132	21.333	3	Average	7.18
Coop	5	181	16.5	2	Average	5.50
	Total	634		12		
	CDD Strata					
Coop	1	177	21	6	Average	4.36
Coop	2	191	29	3	Average	6.05
Coop	3	266	23.583	3	Average	4.96
	Total	634		12		

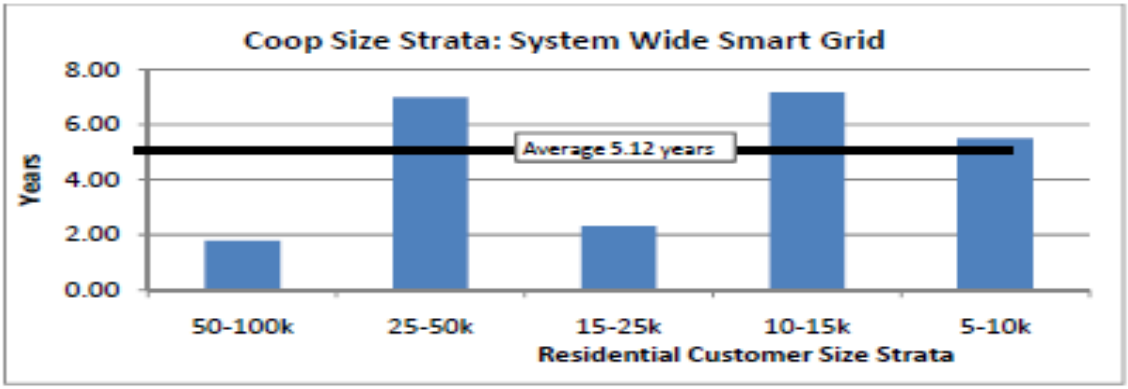
Figure 19 Results for Question 5 (Cooperatives)

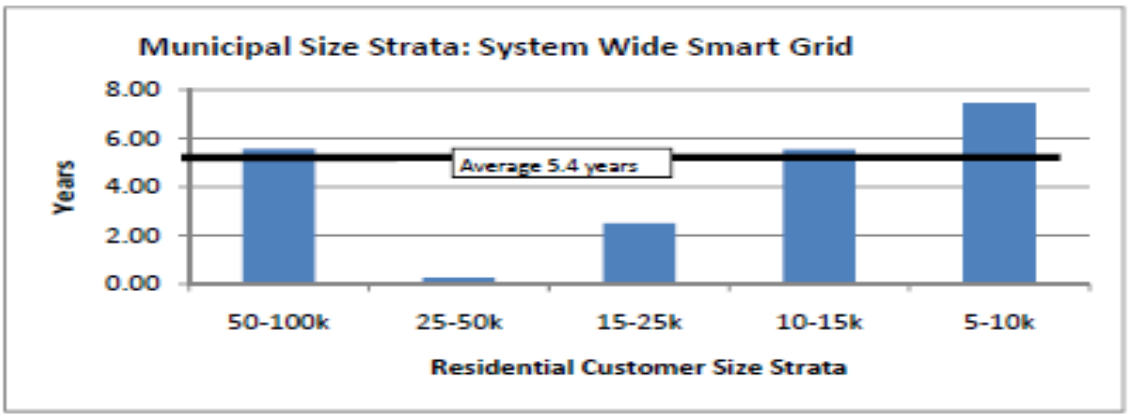
			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Municipal	1.1	4	5.167	0	4	20.668
Municipal	1.2	9	4	2	4.5	18
Municipal	1.3	9	7.5	1	4.5	33.75
Municipal	2.1	6	0.25	0	3	0.75
Municipal	2.2	18	0.25	1	9	2.25
Municipal	2.3	20	0.25	0	10	2.5
Municipal	3.1	14	2.5	0	7	17.5
Municipal	3.2	28	2.5	0	14	35
Municipal	3.3	25	2.5	2	12.5	31.25
Municipal	4.1	24	4.5	2	12	54
Municipal	4.2	22	7	1	11	77
Municipal	4.3	37	5.33	0	18.5	98.605
Municipal	5.1	68	12.5	1	34	425
Municipal	5.2	60	2	1	30	60
Municipal	5.3	69	7.25	0	34.5	250.125
	Total	413		11	Average	5.40238849
	Size Strata					
Municipal	1	22	16.667	3	Average	5.57
Municipal	2	44	0.75	1	Average	0.25
Municipal	3	67	7.5	2	Average	2.50
Municipal	4	83	16.83	3	Average	5.53
Municipal	5	197	21.75	2	Average	7.46
	Total	413		11		
	CDD Strata					
Municipal	1	116	24.917	3	Average	8.63
Municipal	2	137	15.75	5	Average	2.81
Municipal	3	160	22.83	3	Average	5.20
	Total	413		11		

Figure 20 Results for Question 5 (Municipals)

	Strata				Population Estimates	
Type	Size.CDD	Total Population		Sample	Weights	Weighted Average
Coop & Municipal	1.1	8		2	6	4.78
Coop & Municipal	1.2	22		2	11	3.41
Coop & Municipal	1.3	40		2	20	2.46
Coop & Municipal	2.1	35		2	17.5	5.84
Coop & Municipal	2.2	53		1	26.5	4.71
Coop & Municipal	2.3	81		0	40.5	5.33
Coop & Municipal	3.1	50		1	25	1.42
Coop & Municipal	3.2	71		1	35.5	3.11
Coop & Municipal	3.3	94		2	47	2.32
Coop & Municipal	4.1	63		3	31.5	3.88
Coop & Municipal	4.2	60		3	30	8.90
Coop & Municipal	4.3	92		0	46	6.83
Coop & Municipal	5.1	137		1	68.5	8.97
Coop & Municipal	5.2	122		1	61	3.78
Coop & Municipal	5.3	119		2	59.5	6.51
	Total	1047		23	Average	5.23
	Size Strata					
Coop & Municipal	1	70		6	Average	3.12
Coop & Municipal	2	169		3	Average	5.24
Coop & Municipal	3	215		4	Average	2.37
Coop & Municipal	4	215		6	Average	6.54
Coop & Municipal	5	378		4	Average	6.52
	Total	1047		23		
	CDD Strata					
Coop & Municipal	1	293		9	Average	6.08
Coop & Municipal	2	328		8	Average	4.70
Coop & Municipal	3	426		6	Average	5.05
	Total	1047		23		

Figure 21 Results for Questions 6 (Cooperatives and Municipals)





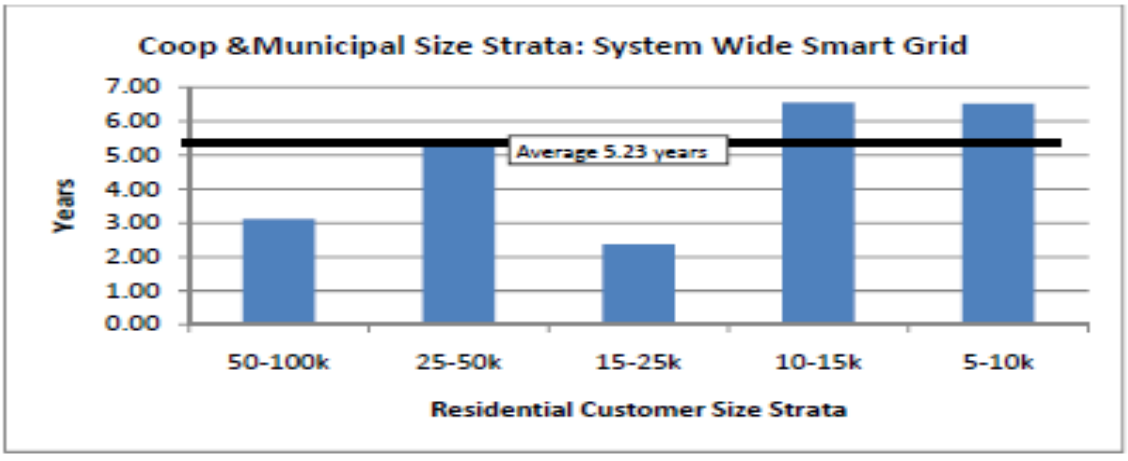
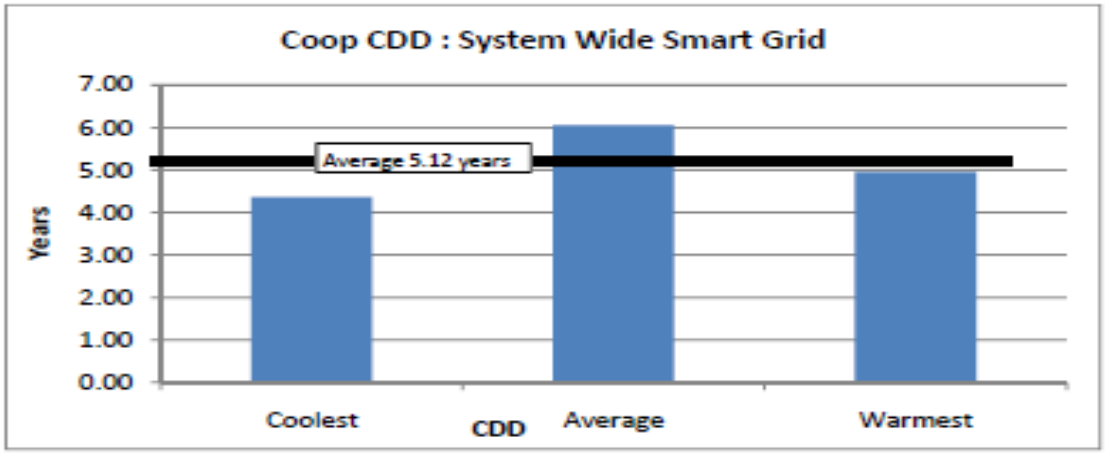
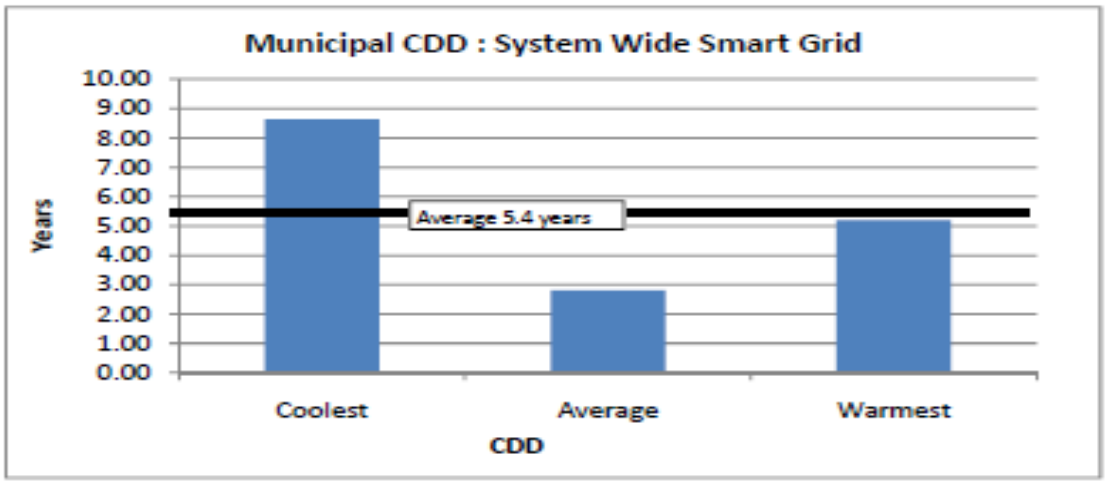


Figure 22 Charts for Question 6 Residential Customer Size Strata





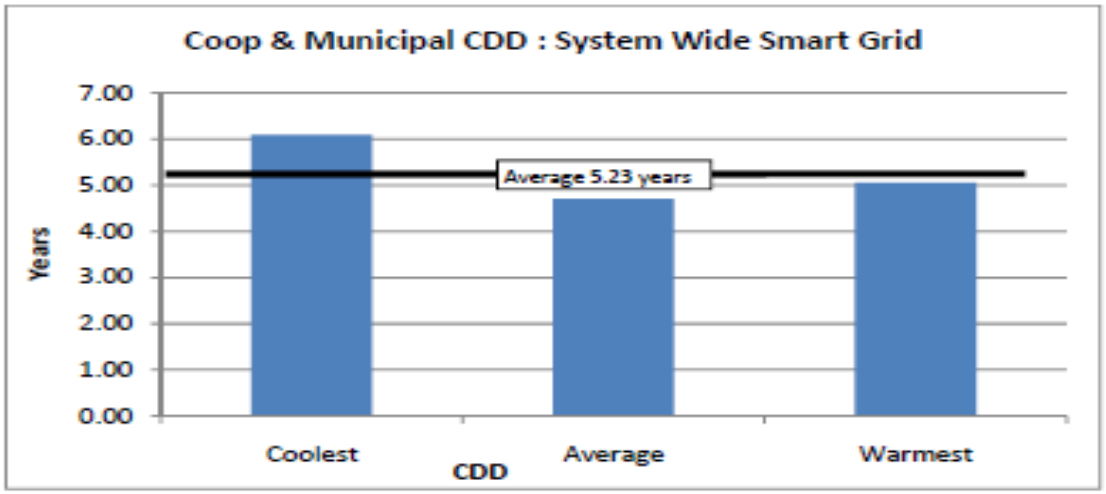


Figure 23 Charts for Question 6 CDD

4.6 RESULTS FOR QUESTION # 6

As shown in Figures 24, 25 and 26 the executives from both cooperatives as well as municipals felt that approximately in 6 years the utilities will start to incorporate customer side technologies like two-way response capabilities to support demand response, critical peak pricing and so on. Figures 27 and 28 are pictorial representations of these results.

4.6.1 Detail Workings and Results

Question # 6. How soon do you expect the majority of your customers to have customer-side tech with two-way response capabilities to support demand response, critical peak pricing and so on?

			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Coop	1.1	4	7	1	2	14
Coop	1.2	13	7	0	6.5	45.5
Coop	1.3	31	7	1	15.5	108.5
Coop	2.1	29	10	1	14.5	145
Coop	2.2	35	2	1	17.5	35
Coop	2.3	61	6	0	30.5	183
Coop	3.1	36	3.75	2	18	67.5
Coop	3.2	43	6	2	21.5	129
Coop	3.3	69	4.875	0	34.5	168.1875
Coop	4.1	39	8.5	1	19.5	165.75
Coop	4.2	38	5.25	2	19	99.75
Coop	4.3	55	6.333	0	27.5	174.1575
Coop	5.1	69	5	0	34.5	172.5
Coop	5.2	62	5	0	31	155
Coop	5.3	50	5	2	25	125
	Total	634		13	Average	5.64
	Size Strata					
Coop	1	48	21	2	Average	7.00
Coop	2	125	18	2	Average	5.81
Coop	3	148	14.625	4	Average	4.93
Coop	4	132	20.083	3	Average	6.66
Coop	5	181	15	2	Average	5.00
	Total	634		13		
	CDD Strata					
Coop	1	177	34.25	5	Average	6.38
Coop	2	191	25.25	5	Average	4.86
Coop	3	266	29.208	3	Average	5.71
	Total	634		13		

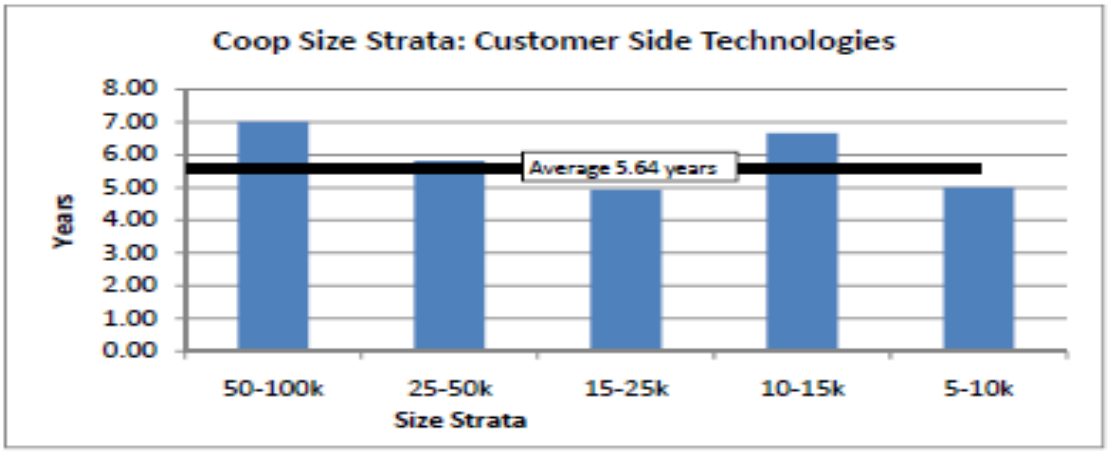
Figure 24 Results for Question 6 (Cooperatives)

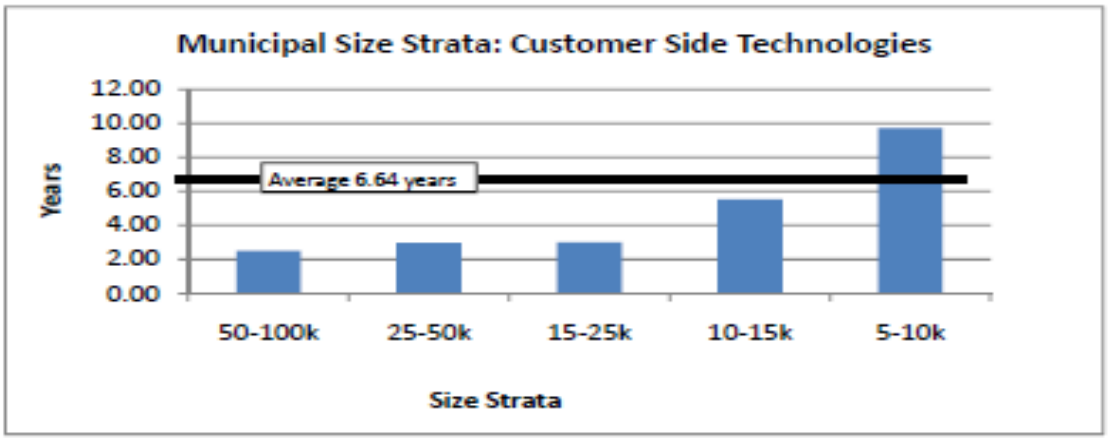
			Sample Responses		Population Estimates	
	Strata	Total	Average	Number of		Weighted
Type	Size.CDD	Population	Years	Responses	Weights	Years
Municipal	1.1	4	2.833	0	4	11.332
Municipal	1.2	9	3.75	2	4.5	16.875
Municipal	1.3	9	1	1	4.5	4.5
Municipal	2.1	6	6	1	3	18
Municipal	2.2	18	1.75	2	9	15.75
Municipal	2.3	20	3.167	0	10	31.67
Municipal	3.1	14	3	0	7	21
Municipal	3.2	28	3	0	14	42
Municipal	3.3	25	3	2	12.5	37.5
Municipal	4.1	24	6	2	12	72
Municipal	4.2	22	5	2	11	55
Municipal	4.3	37	5.5	0	18.5	101.75
Municipal	5.1	68	15	1	34	510
Municipal	5.2	60	4	1	30	120
Municipal	5.3	69	9.5	0	34.5	327.75
	Total	413		14	Average	6.643294964
	Size Strata					
Municipal	1	22	7.583	3	Average	2.52
Municipal	2	44	10.917	3	Average	2.97
Municipal	3	67	9	2	Average	3.00
Municipal	4	83	16.5	4	Average	5.51
Municipal	5	197	28.5	2	Average	9.72
	Total	413		14		
	CDD Strata					
Municipal	1	116	32.833	4	Average	10.54
Municipal	2	137	17.5	7	Average	3.64
Municipal	3	160	22.167	3	Average	6.29
	Total	413		14		

Figure 25 Results for Question 6 (Municipals)

	Strata			Sample Responses	Population Estimates	
Type	**Size.CDD**	**Total Population**		**Sample**	**Weights**	**Weighted Average**
Coop & Municipal	1.1	8		1	6	4.22
Coop & Municipal	1.2	22		2	11	5.67
Coop & Municipal	1.3	40		2	20	5.65
Coop & Municipal	2.1	35		2	17.5	9.31
Coop & Municipal	2.2	53		3	26.5	1.92
Coop & Municipal	2.3	81		0	40.5	5.30
Coop & Municipal	3.1	50		2	25	3.54
Coop & Municipal	3.2	71		2	35.5	4.82
Coop & Municipal	3.3	94		2	47	4.38
Coop & Municipal	4.1	63		3	31.5	7.55
Coop & Municipal	4.2	60		4	30	5.16
Coop & Municipal	4.3	92		0	46	6.00
Coop & Municipal	5.1	137		1	68.5	9.96
Coop & Municipal	5.2	122		1	61	4.51
Coop & Municipal	5.3	119		2	59.5	7.61
	Total	1047		27	Average	6.04
	Size Strata					
Coop & Municipal	1	70		5	Average	5.42
Coop & Municipal	2	169		5	Average	5.07
Coop & Municipal	3	215		6	Average	4.33
Coop & Municipal	4	215		7	Average	6.22
Coop & Municipal	5	378		4	Average	7.46
	Total	1047		27		
	CDD Strata					
Coop & Municipal	1	293		9	Average	8.06
Coop & Municipal	2	328		12	Average	4.35
Coop & Municipal	3	426		6	Average	5.92
	Total	1047		27		

Figure 26 Results for Question 6 (Cooperatives and Municipals)





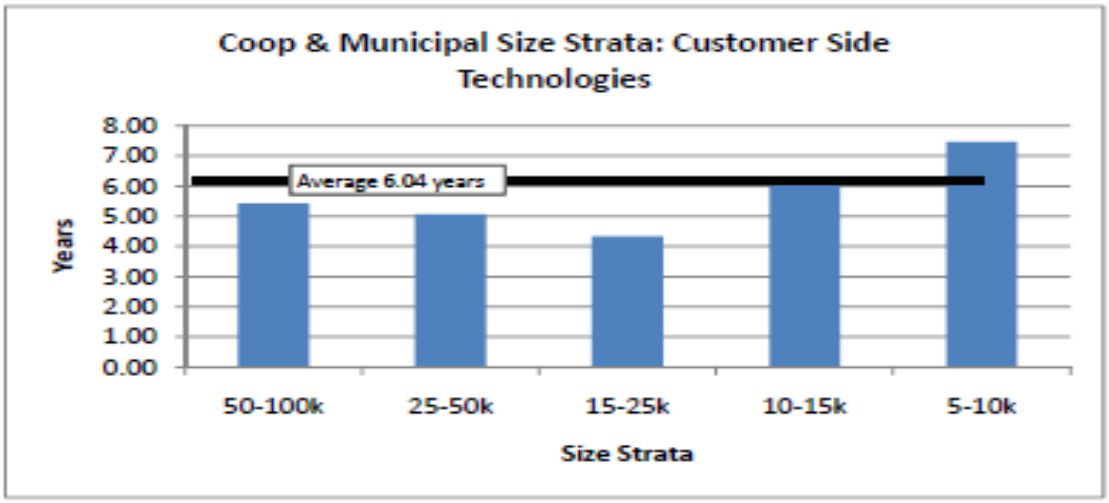
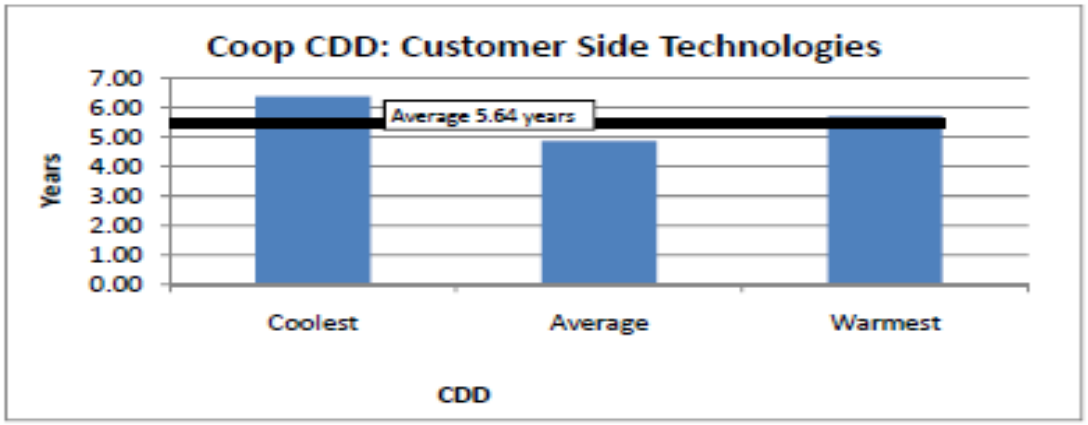
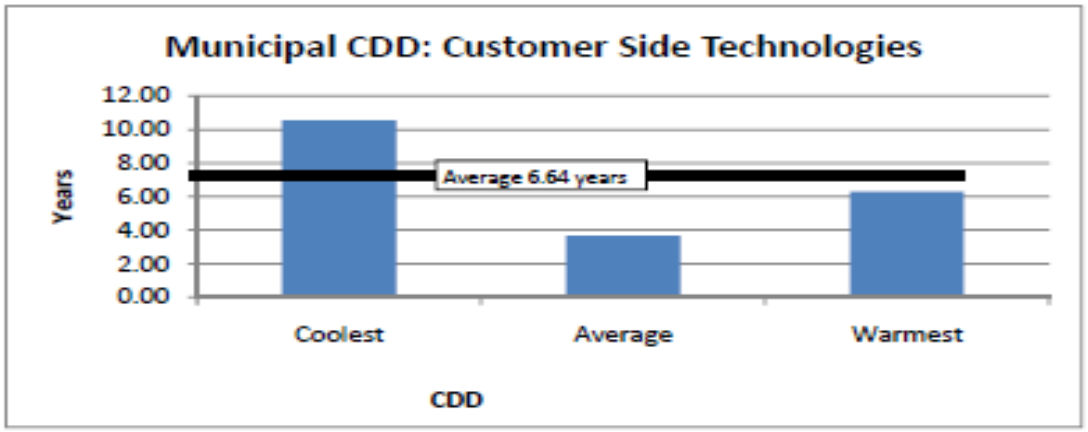


Figure 27 Charts for Question 6 Size Strata





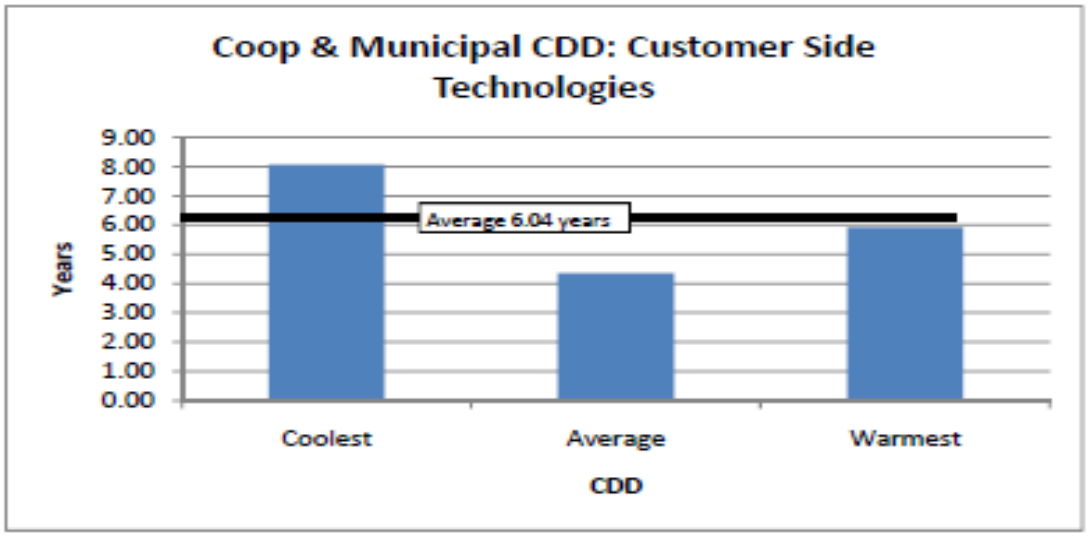


Figure 28 Charts for Question 6 CDD

4.7 RESULTS FOR QUESTION # 7

Figures 29, 30 and 31 indicate that only 33% of cooperatives and 24% of municipals calculate their likely peak hour impacts using their own customers' data. Figures 32 and 33 are pictorial representations of these results.

4.7.1 Detail Workings and Results

Question # 7. Please identify the following answer that best describes likely peak hour impacts at your utility associated with smart grid demand response programs.

1 We have no information
2 We use rule-of-thumb estimates
3 We use estimates from programs at other utilities
4 We have developed estimates based on analysis of our customer's electricity use

	Strata	Total	Sample Responses						Population Estimates				
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**Total**
Coop	1.1	4	2				2	2	4	0	0	0	4
Coop	1.2	13		1	1		2	6.5	0	6.5	6.5	0	13
Coop	1.3	31			2		2	15.5	0	0	31	0	31
Coop	2.1	29		1		1	2	14.5	0	14.5	0	14.5	29
Coop	2.2	35	1	1			2	17.5	17.5	17.5	0	0	35
Coop	2.3	61	2				2	30.5	61	0	0	0	61
Coop	3.1	36				2	2	18	0	0	0	36	36
Coop	3.2	43				2	2	21.5	0	0	0	43	43
Coop	3.3	69	1		1		2	34.5	34.5	0	34.5	0	69
Coop	4.1	39		1	1		2	19.5	0	19.5	19.5	0	39
Coop	4.2	38	1		1		2	19	19	0	19	0	38
Coop	4.3	55			1	1	2	27.5	0	0	27.5	27.5	55
Coop	5.1	69			2		2	34.5	0	0	69	0	69
Coop	5.2	62				2	2	31	0	0	0	62	62
Coop	5.3	50		1		1	2	25	0	25	0	25	50
	Total	634	7	5	9	9	30		136	83	207	208	634
	Size Strata												
Coop	1		2	1	3	0	6		4	6.5	37.5	0	48
Coop	2		3	2	0	1	6		78.5	32	0	14.5	125
Coop	3		1	0	1	4	6		34.5	0	34.5	79	148
Coop	4		1	1	3	1	6		19	19.5	66	27.5	132
Coop	5		0	1	2	3	6		0	25	69	87	181
		Total	7	5	9	9	30		136	83	207	208	634
	CDD Strata												
Coop	1		2	2	3	3	10		4	34	88.5	50.5	177
Coop	2		2	2	2	4	10		36.5	24	25.5	105	191
Coop	3		3	1	4	2	10		95.5	25	93	52.5	266
		Total	7	5	9	9	30		136	83	207	208	634

Figure 29 Results for Question 7 (Cooperatives)

	Strata	Total	Sample Responses						Population Estimates				
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**Total**
Municipal	1.1	4	1				1	4	4	0	0	0	4
Municipal	1.2	9			1	1	2	4.5	0	0	4.5	4.5	9
Municipal	1.3	9			1	1	2	4.5	0	0	4.5	4.5	9
Municipal	2.1	6	2				2	3	6	0	0	0	6
Municipal	2.2	18	1			1	2	9	9	0	0	9	18
Municipal	2.3	20	1	1			2	10	10	10	0	0	20
Municipal	3.1	14	1			1	2	7	7	0	0	7	14
Municipal	3.2	28	1			1	2	14	14	0	0	14	28
Municipal	3.3	25				2	2	12.5	0	0	0	25	25
Municipal	4.1	24			1	1	2	12	0	0	12	12	24
Municipal	4.2	22				2	2	11	0	0	0	22	22
Municipal	4.3	37	1		1		2	18.5	18.5	0	18.5	0	37
Municipal	5.1	68	2				2	34	68	0	0	0	68
Municipal	5.2	60	1	1			2	30	30	30	0	0	60
Municipal	5.3	69	1	1			2	34.5	34.5	34.5	0	0	69
	Total	413	12	3	4	10	29		201	74.5	39.5	98	413
	Size Strata												
Municipal	1		1	0	2	2	5		4	0	9	9	22
Municipal	2		4	1	0	1	6		25	10	0	9	44
Municipal	3		2	0	0	4	6		21	0	0	46	67
Municipal	4		1	0	2	3	6		18.5	0	30.5	34	83
Municipal	5		4	2	0	0	6		132.5	64.5	0	0	197
		Total	12	3	4	10	29		201	74.5	39.5	98	413
	CDD Strata												
Municipal	1		6	0	1	2	9		85	0	12	19	116
Municipal	2		3	1	1	5	10		53	30	4.5	49.5	137
Municipal	3		3	2	2	3	10		63	44.5	23	29.5	160
		Total	12	3	4	10	29		201	74.5	39.5	98	413

Figure 30 Results for Question 7 (Municipals)

	Strata	Total	Sample Responses						Population Estimates				
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**Total**		**1**	**2**	**3**	**4**	**Total**
Coop & Municipal	1.1	8	3	0	0	0	3		8	0	0	0	8
Coop & Municipal	1.2	22	0	1	2	1	4		0	6.5	11	4.5	22
Coop & Municipal	1.3	40	0	0	3	1	4		0	0	35.5	4.5	40
Coop & Municipal	2.1	35	2	1	0	1	4		6	14.5	0	14.5	35
Coop & Municipal	2.2	53	2	1	0	1	4		26.5	17.5	0	9	53
Coop & Municipal	2.3	81	3	1	0	0	4		71	10	0	0	81
Coop & Municipal	3.1	50	1	0	0	3	4		7	0	0	43	50
Coop & Municipal	3.2	71	1	0	0	3	4		14	0	0	57	71
Coop & Municipal	3.3	94	1	0	1	2	4		34.5	0	34.5	25	94
Coop & Municipal	4.1	63	0	1	2	1	4		0	19.5	31.5	12	63
Coop & Municipal	4.2	60	1	0	1	2	4		19	0	19	22	60
Coop & Municipal	4.3	92	1	0	2	1	4		18.5	0	46	27.5	92
Coop & Municipal	5.1	137	2	0	2	0	4		68	0	69	0	137
Coop & Municipal	5.2	122	1	1	0	2	4		30	30	0	62	122
Coop & Municipal	5.3	119	1	2	0	1	4		34.5	59.5	0	25	119
	Total	1047	19	8	13	19	59		337	157.5	246.5	306	1047
	Size Strata												
Coop & Municipal	1		3	1	5	2	11		8	6.5	46.5	9	70
Coop & Municipal	2		7	3	0	2	12		103.5	42	0	23.5	169
Coop & Municipal	3		3	0	1	8	12		55.5	0	34.5	125	215
Coop & Municipal	4		2	1	5	4	12		37.5	19.5	96.5	61.5	215
Coop & Municipal	5		4	3	2	3	12		132.5	89.5	69	87	378
		Total	19	8	13	19	59		337	157.5	246.5	306	1047
	CDD Strata												
Municipal	1		8	2	4	5	19		89	34	100.5	69.5	293
Municipal	2		5	3	3	9	20		89.5	54	30	154.5	328
Municipal	3		6	3	6	5	20		158.5	69.5	116	82	426
		Total	19	8	13	19	59		337	157.5	246.5	306	1047

Figure 31 Results for Question 7 (Cooperatives and Municipals)

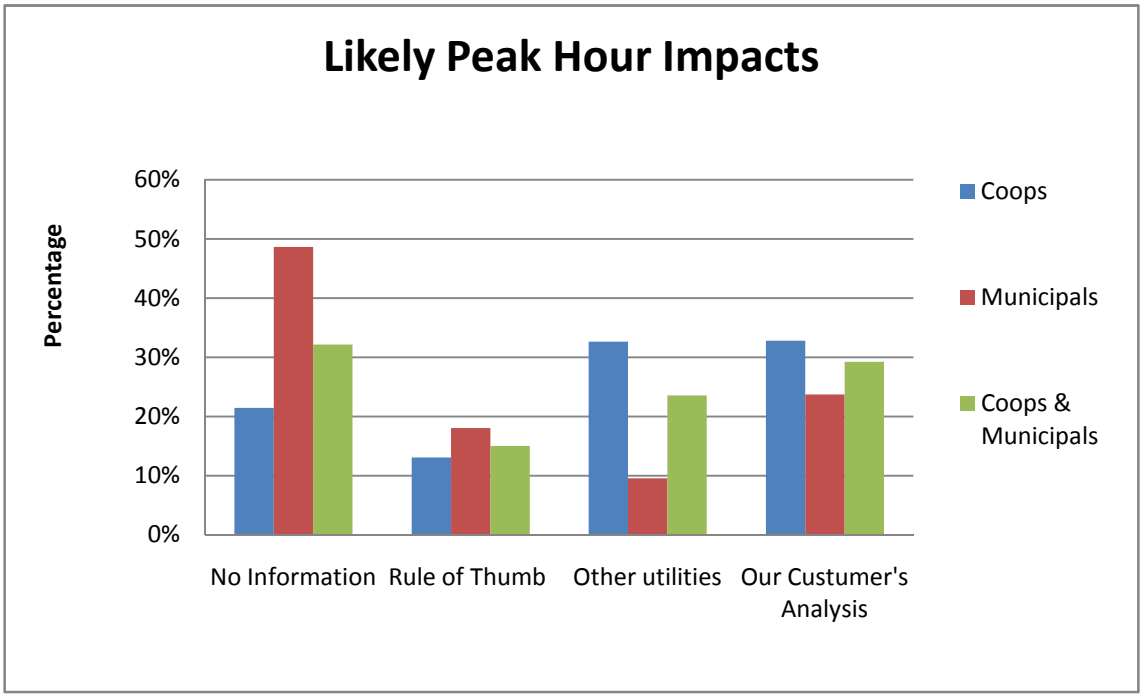


Figure 32 Chart for Question 7 Percentage

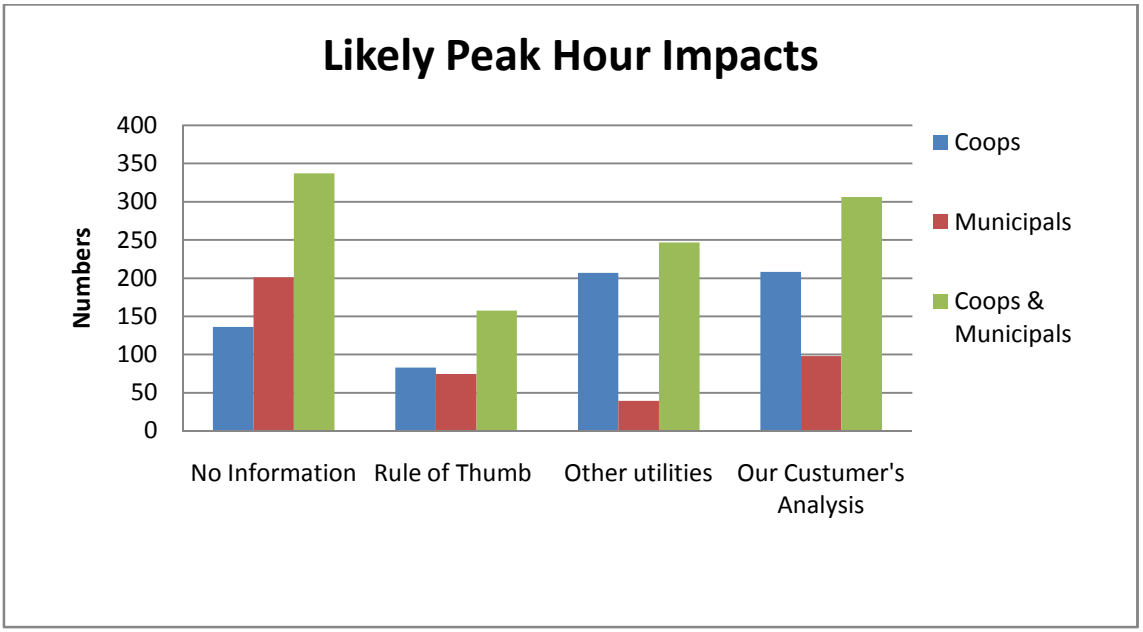


Figure 33 Chart for Question 7 Numbers

4.8 RESULTS FOR QUESTION # 8

All Figures from 34 to 49 indicate that majority of the utility executives have assigned average or above average value each of the following information:

1. Objective descriptions of available technologies and systems.
2. Case study information describing actual experience at other utilities.
3. Smart Grid implementation best practices.
4. Conference devoted to sharing experiences and best practices.

4.8.1 Detail Workings and Results

Question # 8. Please identify the value you would assign to the following information where 1 is no value and 5 is a great deal of value.

Objective descriptions of available technologies and systems

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Coop	1.1	4		1		1		2	2	0	2	0	2	0	4
Coop	1.2	13			1	1		2	6.5	0	0	6.5	6.5	0	13
Coop	1.3	31		1	1			2	15.5	0	15.5	15.5	0	0	31
Coop	2.1	29		1			1	2	14.5	0	14.5	0	0	14.5	29
Coop	2.2	35			1	1		2	17.5	0	0	17.5	17.5	0	35
Coop	2.3	61		2				2	30.5	0	61	0	0	0	61
Coop	3.1	36			1		1	2	18	0	0	18	0	18	36
Coop	3.2	43				2		2	21.5	0	0	0	43	0	43
Coop	3.3	69			1		1	2	34.5	0	0	34.5	0	34.5	69
Coop	4.1	39			1	1		2	19.5	0	0	19.5	19.5	0	39
Coop	4.2	38		1	1			2	19	0	19	19	0	0	38
Coop	4.3	55			2			2	27.5	0	0	55	0	0	55
Coop	5.1	69			1		1	2	34.5	0	0	34.5	0	34.5	69
Coop	5.2	62				1	1	2	31	0	0	0	31	31	62
Coop	5.3	50		1	1			2	25	0	25	25	0	0	50
	Total	634	0	7	11	7	5	30		0	137	245	120	133	634
	Size Strata														
Coop	1		0	2	2	2	0	6		0	17.5	22	8.5	0	48
Coop	2		0	3	1	1	1	6		0	75.5	17.5	17.5	14.5	125
Coop	3		0	0	2	2	2	6		0	0	52.5	43	52.5	148
Coop	4		0	1	4	1	0	6		0	19	93.5	19.5	0	132
Coop	5		0	1	2	1	2	6		0	25	59.5	31	65.5	181
		Total	0	7	11	7	5	30		0	137	245	120	133	634
	CDD Strata														
Coop	1		0	2	3	2	3	10		0	16.5	72	21.5	67	177
Coop	2		0	1	3	5	1	10		0	19	43	98	31	191
Coop	3		0	4	5	0	1	10		0	102	130	0	34.5	266
		Total	0	7	11	7	5	30			137	245	120	133	634

Figure 34 Results for Question 8-1 (Cooperatives)

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Municipal	1.1	4				1		1	4	0	0	0	4	0	4
Municipal	1.2	9			1	1		2	4.5	0	0	4.5	4.5	0	9
Municipal	1.3	9		1			1	2	4.5	0	4.5	0	0	4.5	9
Municipal	2.1	6		1	1			2	3	0	3	3	0	0	6
Municipal	2.2	18				2		2	9	0	0	0	18	0	18
Municipal	2.3	20			2			2	10	0	0	20	0	0	20
Municipal	3.1	14			1		1	2	7	0	0	7	0	7	14
Municipal	3.2	28				2		2	14	0	0	0	28	0	28
Municipal	3.3	25					2	2	12.5	0	0	0	0	25	25
Municipal	4.1	24				1	1	2	12	0	0	0	12	12	24
Municipal	4.2	22			1		1	2	11	0	0	11	0	11	22
Municipal	4.3	37				2		2	18.5	0	0	0	37	0	37
Municipal	5.1	68	1			1		2	34	34	0	0	34	0	68
Municipal	5.2	60			1	1		2	30	0	0	30	30	0	60
Municipal	5.3	69	1			1		2	34.5	34.5	0	0	34.5	0	69
	Total	413	2	2	7	12	6	29		68.5	7.5	75.5	202	59.5	413
	Size Strata														
Municipal	1		0	1	1	2	1	5		0	4.5	4.5	8.5	4.5	22
Municipal	2		0	1	3	2	0	6		0	3	23	18	0	44
Municipal	3		0	0	1	2	3	6		0	0	7	28	32	67
Municipal	4		0	0	1	3	2	6		0	0	11	49	23	83
Municipal	5		2	0	1	3	0	6		68.5	0	30	98.5	0	197
		Total	2	2	7	12	6	29		68.5	7.5	75.5	202	59.5	413
CDD Strata															
Municipal	1		1	1	2	3	2	9			3	10	50	19	116
Municipal	2		0	0	3	6	1	10			0	45.5	80.5	11	137
Municipal	3		1	1	2	3	3	10			4.5	20	71.5	29.5	160
		Total	2	2	7	12	6	29			7.5	75.5	202	59.5	413

Figure 35 Results for Question 8-1 (Municipals)

	Strata	Total	Sample Responses							Population Estimates					
Type	Size.CDD	Population	1	2	3	4	5	Total		1	2	3	4	5	Total
Coop & Municipal	1.1	8	0	1	0	2	0	3		0	2	0	6	0	8
Coop & Municipal	1.2	22	0	0	2	2	0	4		0	0	11	11	0	22
Coop & Municipal	1.3	40	0	2	1	0	1	4		0	20	15.5	0	4.5	40
Coop & Municipal	2.1	35	0	2	1	0	1	4		0	17.5	3	0	14.5	35
Coop & Municipal	2.2	53	0	0	1	3	0	4		0	0	17.5	35.5	0	53
Coop & Municipal	2.3	81	0	2	2	0	0	4		0	61	20	0	0	81
Coop & Municipal	3.1	50	0	0	2	0	2	4		0	0	25	0	25	50
Coop & Municipal	3.2	71	0	0	0	4	0	4		0	0	0	71	0	71
Coop & Municipal	3.3	94	0	0	1	0	3	4		0	0	34.5	0	59.5	94
Coop & Municipal	4.1	63	0	0	1	2	1	4		0	0	19.5	31.5	12	63
Coop & Municipal	4.2	60	0	1	2	0	1	4		0	19	30	0	11	60
Coop & Municipal	4.3	92	0	0	2	2	0	4		0	0	55	37	0	92
Coop & Municipal	5.1	137	1	0	1	1	1	4		34	0	34.5	34	34.5	137
Coop & Municipal	5.2	122	0	0	1	2	1	4		0	0	30	61	31	122
Coop & Municipal	5.3	119	1	1	1	1	0	4		34.5	25	25	34.5	0	119
	Total	1047	2	9	18	19	11	59		68.5	145	321	322		1047
	Size Strata														
Coop & Municipal	1		0	3	3	4	1	11		0	22	26.5	17	4.5	70
Coop & Municipal	2		0	4	4	3	1	12		0	78.5	40.5	35.5	14.5	169
Coop & Municipal	3		0	0	3	4	5	12		0	0	59.5	71	84.5	215
Coop & Municipal	4		0	1	5	4	2	12		0	19	105	68.5	23	215
Coop & Municipal	5		2	1	3	4	2	12		68.5	25	89.5	130	65.5	378
		Total	2	9	18	19	11	59		68.5	145	321	322	192	1047
	CDD Strata														
Coop & Municipal	1		1	3	5	5	5	19			19.5	82	71.5	86	293
Coop & Municipal	2		0	1	6	11	2	20			19	88.5	179	42	328
Coop & Municipal	3		1	5	7	3	4	20			106	150	71.5	64	426
		Total	2	9	18	19	11	59			145	321	322	192	1047

Figure 36 Results for Question 8-1 (Cooperatives and Municipals)

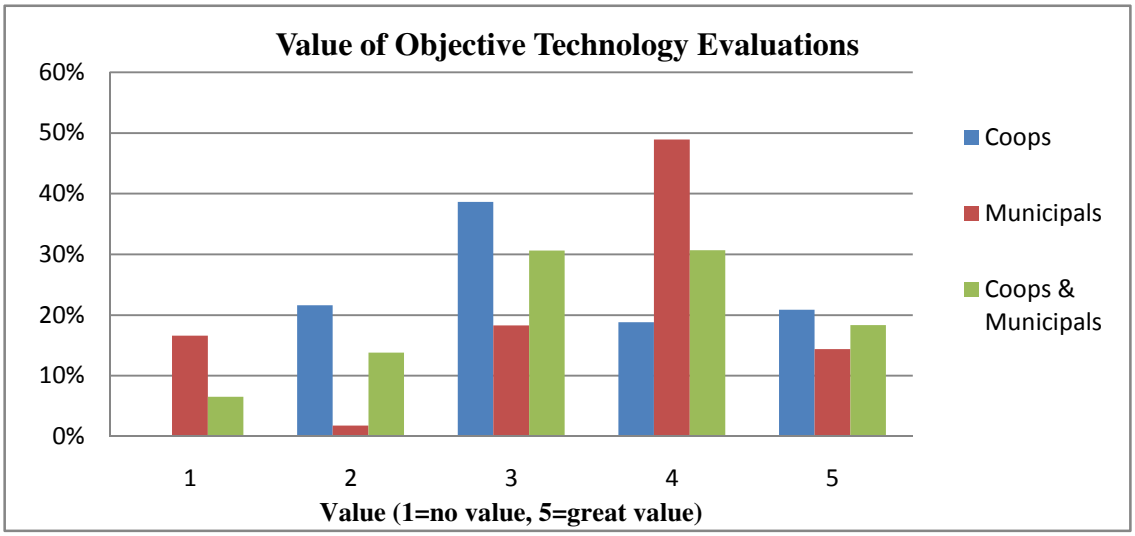


Figure 37 Results for Question 8

Question # 8. Please identify the value you would assign to the following information where 1 is no value and 5 is a great deal of value.

Case study information describing actual experiences at other utilities.

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Coop	1.1	4			1	1		2	2	0	0	2	2	0	4
Coop	1.2	13				2		2	6.5	0	0	0	13	0	13
Coop	1.3	31				1	1	2	15.5	0	0	0	15.5	15.5	31
Coop	2.1	29					2	2	14.5	0	0	0	0	29	29
Coop	2.2	35				2		2	17.5	0	0	0	35	0	35
Coop	2.3	61			1	1		2	30.5	0	0	30.5	30.5	0	61
Coop	3.1	36			1		1	2	18	0	0	18	0	18	36
Coop	3.2	43			2			2	21.5	0	0	43	0	0	43
Coop	3.3	69				2		2	34.5	0	0	0	69	0	69
Coop	4.1	39			1		1	2	19.5	0	0	19.5	0	19.5	39
Coop	4.2	38			1	1		2	19	0	0	19	19	0	38
Coop	4.3	55			1		1	2	27.5	0	0	27.5	0	27.5	55
Coop	5.1	69					2	2	34.5	0	0	0	0	69	69
Coop	5.2	62			1		1	2	31	0	0	31	0	31	62
Coop	5.3	50			1		1	2	25	0	0	25	0	25	50
	Total	634	0	0	10	10	10	30		0	0	216	184	235	634
	Size Strata														
Coop	1		0	0	1	4	1	6		0	0	2	30.5	15.5	48
Coop	2		0	0	1	3	2	6		0	0	30.5	65.5	29	125
Coop	3		0	0	3	2	1	6		0	0	61	69	18	148
Coop	4		0	0	3	1	2	6		0	0	66	19	47	132
Coop	5		0	0	2	0	4	6		0	0	56	0	125	181
		Total	0	0	10	10	10	30		0	0	216	184	235	634
	CDD Strata														
Coop	1		0	0	3	1	6	10			0	39.5	2	136	177
Coop	2		0	0	4	5	1	10			0	93	67	31	191
Coop	3		0	0	3	4	3	10			0	83	115	68	266
		Total	0	0	10	10	10	30			0	216	184	235	634

Figure 38 Results for Question 8-2 (Cooperatives)

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Municipal	1.1	4			1			1	4	0	0	4	0	0	4
Municipal	1.2	9				1	1	2	4.5	0	0	0	4.5	4.5	9
Municipal	1.3	9				1	1	2	4.5	0	0	0	4.5	4.5	9
Municipal	2.1	6		1	1			2	3	0	3	3	0	0	6
Municipal	2.2	18	1			1		2	9	9	0	0	9	0	18
Municipal	2.3	20			1	1		2	10	0	0	10	10	0	20
Municipal	3.1	14				1	1	2	7	0	0	0	7	7	14
Municipal	3.2	28				2		2	14	0	0	0	28	0	28
Municipal	3.3	25				1	1	2	12.5	0	0	0	12.5	12.5	25
Municipal	4.1	24			2			2	12	0	0	24	0	0	24
Municipal	4.2	22				2		2	11	0	0	0	22	0	22
Municipal	4.3	37			1	1		2	18.5	0	0	18.5	18.5	0	37
Municipal	5.1	68			2			2	34	0	0	68	0	0	68
Municipal	5.2	60			1		1	2	30	0	0	30	0	30	60
Municipal	5.3	69	1			1		2	34.5	34.5	0	0	34.5	0	69
	Total	413	2	1	9	12	5	29		43.5	3	158	151	58.5	413
	Size Strata														
Municipal	1		0	0	1	2	2	5		0	0	4	9	9	22
Municipal	2		1	1	2	2	0	6		9	3	13	19	0	44
Municipal	3		0	0	0	4	2	6		0	0	0	47.5	19.5	67
Municipal	4		0	0	3	3	0	6		0	0	42.5	40.5	0	83
Municipal	5		1	0	3	1	1	6		34.5	0	98	34.5	30	197
		Total	2	1	9	12	5	29		43.5	3	158	151	58.5	413
	CDD Strata														
Municipal	1		0	1	6	1	1	9			3	99	7	7	116
Municipal	2		1	0	1	6	2	10			0	30	63.5	34.5	137
Municipal	3		1	0	2	5	2	10			0	28.5	80	17	160
		Total	2	1	9	12	5	29			3	158	151	58.5	413

Figure 39 Results for Question 8-2 (Municipals)

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**		**1**	**2**	**3**	**4**	**5**	**Total**
Coop & Municipal	1.1	8	0	0	2	1	0	3		0	0	6	2	0	8
Coop & Municipal	1.2	22	0	0	0	3	1	4		0	0	0	17.5	4.5	22
Coop & Municipal	1.3	40	0	0	0	2	2	4		0	0	0	20	20	40
Coop & Municipal	2.1	35	0	1	1	0	2	4		0	3	3	0	29	35
Coop & Municipal	2.2	53	1	0	0	3	0	4		9	0	0	44	0	53
Coop & Municipal	2.3	81	0	0	2	2	0	4		0	0	40.5	40.5	0	81
Coop & Municipal	3.1	50	0	0	1	1	2	4		0	0	18	7	25	50
Coop & Municipal	3.2	71	0	0	2	2	0	4		0	0	43	28	0	71
Coop & Municipal	3.3	94	0	0	0	3	1	4		0	0	0	81.5	12.5	94
Coop & Municipal	4.1	63	0	0	3	0	1	4		0	0	43.5	0	19.5	63
Coop & Municipal	4.2	60	0	0	1	3	0	4		0	0	19	41	0	60
Coop & Municipal	4.3	92	0	0	2	1	1	4		0	0	46	18.5	27.5	92
Coop & Municipal	5.1	137	0	0	2	0	2	4		0	0	68	0	69	137
Coop & Municipal	5.2	122	0	0	2	0	2	4		0	0	61	0	61	122
Coop & Municipal	5.3	119	1	0	1	1	1	4		34.5	0	25	34.5	25	119
	Total	1047	2	1	19	22	15	59		43.5	3	373	335	293	1047
	Size Strata														
Coop & Municipal	1		0	0	2	6	3	11		0	0	6	39.5	24.5	70
Coop & Municipal	2		1	1	3	5	2	12		9	3	43.5	84.5	29	169
Coop & Municipal	3		0	0	3	6	3	12		0	0	61	117	37.5	215
Coop & Municipal	4		0	0	6	4	2	12		0	0	109	59.5	47	215
Coop & Municipal	5		1	0	5	1	5	12		34.5	0	154	34.5	155	378
		Total	2	1	19	22	15	59		43.5	3	373	335	293	1047
CDD Strata															
Coop & Municipal	1		0	1	9	2	7	19			3	139	9	143	293
Coop & Municipal	2		1	0	5	11	3	20			0	123	131	65.5	328
Coop & Municipal	3		1	0	5	9	5	20			0	112	195	85	426
		Total	2	1	19	22	15	59			3	373	335	293	1047

Figure 40 Results for Question 8-2 (Cooperatives and Municipals)

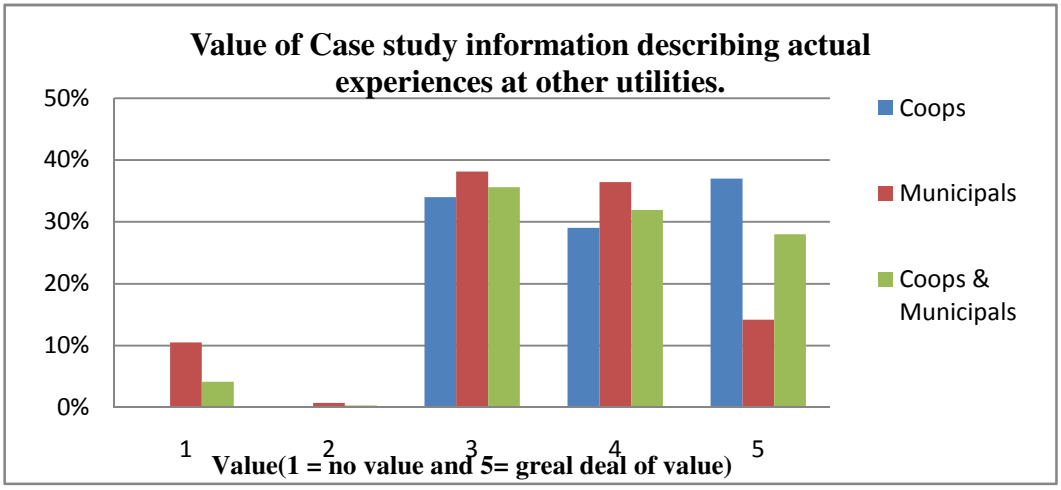


Figure 41 Results for Question 8

Question # 8. Please identify the value you would assign to the following information where 1 is no value and 5 is a great deal of value.

Smart grid implementation "best practices" to date.

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Coop	1.1	4			2			2	2	0	0	4	0	0	4
Coop	1.2	13			1	1		2	6.5	0	0	6.5	6.5	0	13
Coop	1.3	31				1	1	2	15.5	0	0	0	15.5	15.5	31
Coop	2.1	29				2		2	14.5	0	0	0	29	0	29
Coop	2.2	35				2		2	17.5	0	0	0	35	0	35
Coop	2.3	61		1	1			2	30.5	0	30.5	30.5	0	0	61
Coop	3.1	36		1			1	2	18	0	18	0	0	18	36
Coop	3.2	43			2			2	21.5	0	0	43	0	0	43
Coop	3.3	69			1	1		2	34.5	0	0	34.5	34.5	0	69
Coop	4.1	39			1	1		2	19.5	0	0	19.5	19.5	0	39
Coop	4.2	38		1		1		2	19	0	19	0	19	0	38
Coop	4.3	55			1	1		2	27.5	0	0	27.5	27.5	0	55
Coop	5.1	69			1	1		2	34.5	0	0	34.5	34.5	0	69
Coop	5.2	62			1	1		2	31	0	0	31	31	0	62
Coop	5.3	50		1		1		2	25	0	25	0	25	0	50
	Total	634	0	4	11	13	2	30		0	92.5	231	277	33.5	634
	Size Strata														
Coop	1		0	0	3	2	1	6		0	0	10.5	22	15.5	48
Coop	2		0	1	1	4	0	6		0	30.5	30.5	64	0	125
Coop	3		0	1	3	1	1	6		0	18	77.5	34.5	18	148
Coop	4		0	1	2	3	0	6		0	19	47	66	0	132
Coop	5		0	1	2	3	0	6		0	25	65.5	90.5	0	181
		Total	0	4	11	13	2	30		0	92.5	231	277	33.5	634
	CDD Strata														
Coop	1		0	1	4	4	1	10			18	58	83	18	177
Coop	2		0	1	4	5	0	10			19	80.5	91.5	0	191
Coop	3		0	2	3	4	1	10			55.5	92.5	102.5	15.5	266
		Total	0	4	11	13	2	30			92.5	231	277	33.5	634

Figure 42 Results for Question 8-3 (Cooperatives)

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Municipal	1.1	4			1			1	4	0	0	4	0	0	4
Municipal	1.2	9				2		2	4.5	0	0	0	9	0	9
Municipal	1.3	9		2				2	4.5	0	9	0	0	0	9
Municipal	2.1	6		1	1			2	3	0	3	3	0	0	6
Municipal	2.2	18				1	1	2	9	0	0	0	9	9	18
Municipal	2.3	20			1	1		2	10	0	0	10	10	0	20
Municipal	3.1	14			1	1		2	7	0	0	7	7	0	14
Municipal	3.2	28			1	1		2	14	0	0	14	14	0	28
Municipal	3.3	25				1	1	2	12.5	0	0	0	12.5	12.5	25
Municipal	4.1	24		1	1			2	12	0	12	12	0	0	24
Municipal	4.2	22			1		1	2	11	0	0	11	0	11	22
Municipal	4.3	37			2			2	18.5	0	0	37	0	0	37
Municipal	5.1	68	1		1			2	34	34	0	34	0	0	68
Municipal	5.2	60				2		2	30	0	0	0	60	0	60
Municipal	5.3	69	1		1			2	34.5	34.5	0	34.5	0	0	69
	Total	413	2	4	11	9	3	29		68.5	24	167	121.5	32.5	413
	Size Strata														
Municipal	1		0	2	1	2	0	5		0	9	4	9	0	22
Municipal	2		0	1	2	2	1	6		0	3	13	19	9	44
Municipal	3		0	0	2	3	1	6		0	0	21	33.5	12.5	67
Municipal	4		0	1	4	0	1	6		0	12	60	0	11	83
Municipal	5		2	0	2	2	0	6		68.5	0	68.5	60	0	197
		Total	2	4	11	9	3	29		68.5	24	167	121.5	32.5	413
CDD Strata															
Municipal	1		1	2	5	1	0	9			15	60	7	0	116
Municipal	2		0	0	2	6	2	10			0	25	92	20	137
Municipal	3		1	2	4	2	1	10			9	81.5	22.5	12.5	160
		Total	2	4	11	9	3	29			24	167	121.5	32.5	413

Figure 43 Results for Question 8-3 (Municipals)

	Strata	Total	Sample Responses							Population Estimates					
Type	Size.CDD	Population	1	2	3	4	5	Total		1	2	3	4	5	Total
Coop & Municipal	1.1	8	0	0	3	0	0	3		0	0	8	0	0	8
Coop & Municipal	1.2	22	0	0	1	3	0	4		0	0	6.5	15.5	0	22
Coop & Municipal	1.3	40	0	2	0	1	1	4		0	9	0	15.5	15.5	40
Coop & Municipal	2.1	35	0	1	1	2	0	4		0	3	3	29	0	35
Coop & Municipal	2.2	53	0	0	0	3	1	4		0	0	0	44	9	53
Coop & Municipal	2.3	81	0	1	2	1	0	4		0	30.5	40.5	10	0	81
Coop & Municipal	3.1	50	0	1	1	1	1	4		0	18	7	7	18	50
Coop & Municipal	3.2	71	0	0	3	1	0	4		0	0	57	14	0	71
Coop & Municipal	3.3	94	0	0	1	2	1	4		0	0	34.5	47	12.5	94
Coop & Municipal	4.1	63	0	1	2	1	0	4		0	12	31.5	19.5	0	63
Coop & Municipal	4.2	60	0	1	1	1	1	4		0	19	11	19	11	60
Coop & Municipal	4.3	92	0	0	3	1	0	4		0	0	64.5	27.5	0	92
Coop & Municipal	5.1	137	1	0	2	1	0	4		34	0	68.5	34.5	0	137
Coop & Municipal	5.2	122	0	0	1	3	0	4		0	0	31	91	0	122
Coop & Municipal	5.3	119	1	1	1	1	0	4		34.5	25	34.5	25	0	119
	Total	1047	2	8	22	22	5	59		68.5	117	398	398.5	66	1047
	Size Strata														
Coop & Municipal	1		0	2	4	4	1	11		0	9	14.5	31	15.5	70
Coop & Municipal	2		0	2	3	6	1	12		0	33.5	43.5	83	9	169
Coop & Municipal	3		0	1	5	4	2	12		0	18	98.5	68	30.5	215
Coop & Municipal	4		0	2	6	3	1	12		0	31	107	66	11	215
Coop & Municipal	5		2	1	4	5	0	12		68.5	25	134	150.5	0	378
		Total	2	8	22	22	5	59	0	68.5	117	398	398.5	66	1047
CDD Strata															
Coop & Municipal	1		1	3	9	5	1	19			33	118	90	18	293
Coop & Municipal	2		0	1	6	11	2	20			19	106	183.5	20	328
Coop & Municipal	3		1	4	7	6	2	20			64.5	174	125	28	426
		Total	2	8	22	22	5	59			117	398	398.5	66	1047

Figure 44 Results for Question 8-3 (Cooperatives and Municipals)

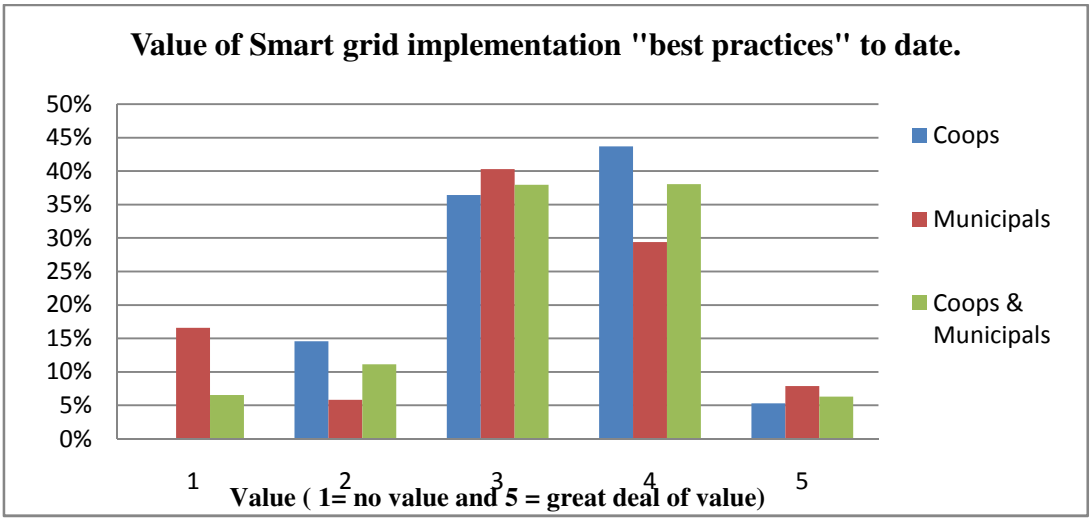


Figure 45 Results for Question 8

Question # 8. Please identify the value you would assign to the following information where 1 is no value and 5 is a great deal of value.

A conference devoted exclusively to discussing experience to date and best practices.

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Coop	1.1	4			2			2	2	0	0	4	0	0	4
Coop	1.2	13		1	1			2	6.5	0	6.5	6.5	0	0	13
Coop	1.3	31		1	1			2	15.5	0	15.5	15.5	0	0	31
Coop	2.1	29			2			2	14.5	0	0	29	0	0	29
Coop	2.2	35			2			2	17.5	0	0	35	0	0	35
Coop	2.3	61			1	1		2	30.5	0	0	30.5	30.5	0	61
Coop	3.1	36	1		1			2	18	18	0	18	0	0	36
Coop	3.2	43		2				2	21.5	0	43	0	0	0	43
Coop	3.3	69			2			2	34.5	0	0	69	0	0	69
Coop	4.1	39			2			2	19.5	0	0	39	0	0	39
Coop	4.2	38		2				2	19	0	38	0	0	0	38
Coop	4.3	55		1	1			2	27.5	0	27.5	27.5	0	0	55
Coop	5.1	69			2			2	34.5	0	0	69	0	0	69
Coop	5.2	62		1		1		2	31	0	31	0	31	0	62
Coop	5.3	50	1		1			2	25	25	0	25	0	0	50
	Total	634	2	8	18	2	0	30		43	162	368	61.5	0	634
	Size Strata														
Coop	1		0	2	4	0	0	6		0	22	26	0	0	48
Coop	2		0	0	5	1	0	6		0	0	94.5	30.5	0	125
Coop	3		1	2	3	0	0	6		18	43	87	0	0	148
Coop	4		0	3	3	0	0	6		0	65.5	66.5	0	0	132
Coop	5		1	1	3	1	0	6		25	31	94	31	0	181
		Total	2	8	18	2	0	30		43	162	368	61.5	0	634
	CDD Strata														
Coop	1		1	0	9	0	0	10			0	159	0	0	177
Coop	2		0	6	3	1	0	10			119	41.5	31	0	191
Coop	3		1	2	6	1	0	10			43	168	30.5	0	266
		Total	2	8	18	2	0	30			162	368	61.5	0	634

Figure 46 Results for Question 8-4 (Cooperatives)

	Strata	Total	Sample Responses							Population Estimates					
Type	**Size.CDD**	**Population**	**1**	**2**	**3**	**4**	**5**	**Total**	**Weights**	**1**	**2**	**3**	**4**	**5**	**Total**
Municipal	1.1	4		1				1	4	0	4	0	0	0	4
Municipal	1.2	9			1	1		2	4.5	0	0	4.5	4.5	0	9
Municipal	1.3	9			1		1	2	4.5	0	0	4.5	0	4.5	9
Municipal	2.1	6		1	1			2	3	0	3	3	0	0	6
Municipal	2.2	18		1		1		2	9	0	9	0	9	0	18
Municipal	2.3	20			1	1		2	10	0	0	10	10	0	20
Municipal	3.1	14		1	1			2	7	0	7	7	0	0	14
Municipal	3.2	28			1	1		2	14	0	0	14	14	0	28
Municipal	3.3	25				2		2	12.5	0	0	0	25	0	25
Municipal	4.1	24		1	1			2	12	0	12	12	0	0	24
Municipal	4.2	22			1	1		2	11	0	0	11	11	0	22
Municipal	4.3	37				2		2	18.5	0	0	0	37	0	37
Municipal	5.1	68		1	1			2	34	0	34	34	0	0	68
Municipal	5.2	60			1	1		2	30	0	0	30	30	0	60
Municipal	5.3	69	1		1			2	34.5	34.5	0	34.5	0	0	69
	Total	413	1	6	11	10	1	29		34.5	69	165	141	4.5	413
	Size Strata														
Municipal	1		0	1	2	1	1	5		0	4	9	4.5	4.5	22
Municipal	2		0	2	2	2	0	6		0	12	13	19	0	44
Municipal	3		0	1	2	3	0	6		0	7	21	39	0	67
Municipal	4		0	1	2	3	0	6		0	12	23	48	0	83
Municipal	5		1	1	3	1	0	6		34.5	34	98.5	30	0	197
		Total	1	6	11	10	1	29	0	34.5	69	165	141	4.5	413
	CDD Strata														
Municipal	1		0	5	4	0	0	9			60	56	0	0	116
Municipal	2		0	1	4	5	0	10			9	59.5	68.5	0	137
Municipal	3		1	0	3	5	1	10			0	49	72	4.5	160
		Total	1	6	11	10	1	29			69	165	141	4.5	413

Figure 47 Results for Question 8-4 (Municipals)

	Strata	Total	Sample Responses							Population Estimates					
Type	Size.CDD	Population	1	2	3	4	5	Total		1	2	3	4	5	Total
Coop & Municipal	1.1	8	0	1	2	0	0	3		0	4	4	0	0	8
Coop & Municipal	1.2	22	0	1	2	1	0	4		0	6.5	11	4.5	0	22
Coop & Municipal	1.3	40	0	1	2	0	1	4		0	15.5	20	0	4.5	40
Coop & Municipal	2.1	35	0	1	3	0	0	4		0	3	32	0	0	35
Coop & Municipal	2.2	53	0	1	2	1	0	4		0	9	35	9	0	53
Coop & Municipal	2.3	81	0	0	2	2	0	4		0	0	40.5	40.5	0	81
Coop & Municipal	3.1	50	1	1	2	0	0	4		18	7	25	0	0	50
Coop & Municipal	3.2	71	0	2	1	1	0	4		0	43	14	14	0	71
Coop & Municipal	3.3	94	0	0	2	2	0	4		0	0	69	25	0	94
Coop & Municipal	4.1	63	0	1	3	0	0	4		0	12	51	0	0	63
Coop & Municipal	4.2	60	0	2	1	1	0	4		0	38	11	11	0	60
Coop & Municipal	4.3	92	0	1	1	2	0	4		0	27.5	27.5	37	0	92
Coop & Municipal	5.1	137	0	1	3	0	0	4		0	34	103	0	0	137
Coop & Municipal	5.2	122	0	1	1	2	0	4		0	31	30	61	0	122
Coop & Municipal	5.3	119	2	0	2	0	0	4		59.5	0	59.5	0	0	119
	Total	1047	3	14	29	12	1	59		77.5	231	533	202	4.5	1047
	Size Strata														
Coop & Municipal	1		0	3	6	1	1	11		0	26	35	4.5	4.5	70
Coop & Municipal	2		0	2	7	3	0	12		0	12	108	49.5	0	169
Coop & Municipal	3		1	3	5	3	0	12		18	50	108	39	0	215
Coop & Municipal	4		0	4	5	3	0	12		0	77.5	89.5	48	0	215
Coop & Municipal	5		2	2	6	2	0	12		59.5	65	193	61	0	378
		Total	3	14	29	12	1	59		77.5	231	533	202	4.5	1047
	CDD Strata														
Coop & Municipal	1		1	5	13	0	0	19			60	215	0	0	293
Coop & Municipal	2		0	7	7	6	0	20			128	101	99.5	0	328
Coop & Municipal	3		2	2	9	6	1	20			43	217	103	4.5	426
		Total	3	14	29	12	1	59			231	533	202	4.5	1047

Figure 48 Results for Question 8-4 (Cooperatives and Municipals)

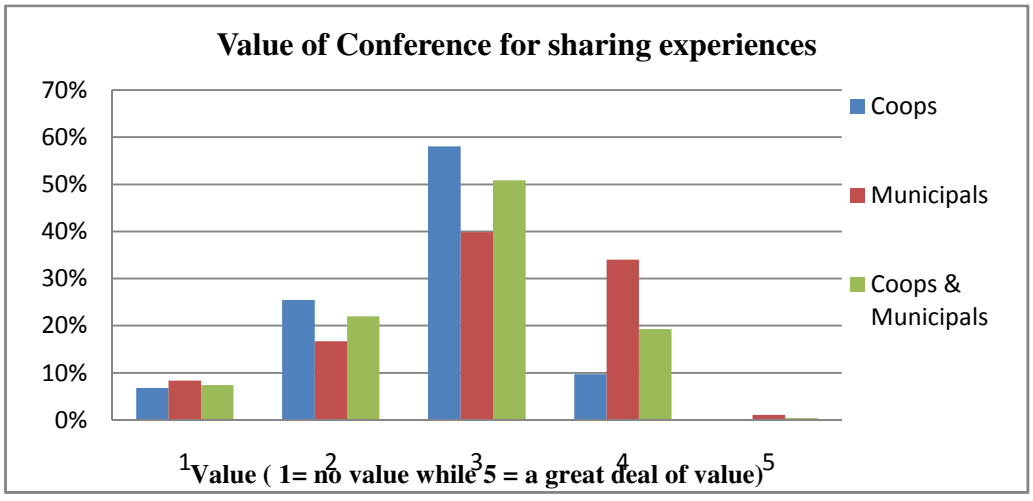


Figure 49 Results for Question 8

5. CONCLUSIONS

5.1 SUMMARY

According to the survey results the customer side technologies which will impact practices of designers and buildings in the built environment will on average require 6 years to start implementation. Thus existing buildings will benefit from modifications to existing systems in a relatively short time period. Similarly, new building designs should currently be incorporating smart grid enabling technologies to take advantage of energy efficiency and cost reduction possibilities associated with smart grid implementations. These results indicate that professionals in the design and construction industries should be gaining knowledge of smart grid issues and applications. Cost savings that accrue to buildings with smart systems are likely to motivate building owners to request smart design and construction which can provide market advantages to design and construction firms that gain expertise and experience accommodating utility smart grid systems.

5.2 SIGNIFICANCE OF RESEARCH

The smart grid transformation is widely recognized as a disruptive technology (Pothamsetty & Malik, 2009; Microsoft News Center, 2010) that will change the way utilities do business and the way that electric customers will integrate their energy use patterns with requirements of the electric utility system. If this transition occurs slowly over time, design and construction professionals will have time to slowly adapt to the related new technologies; however, a rapid transition from current utility system practices to smart grids will require a rapid transition in design and construction

practices to accommodate the new role that buildings will play in reducing electricity costs and carbon emissions.

Results of this research indicate that design and construction professionals should already be developing knowledge and experience to accommodate smart grid impacts on the built environment.

5.3 RECOMMENDATIONS FOR FUTURE RESEARCH

While this study determined future smart grid investment plans and utility executive expectations concerning the likely timing of smart grid impacts on the built environment, no attempt was made to develop information to understand how these expectations are formed or what events might impact these expectations.

It is suggested that future studies recognize the immediacy of the smart grid technology transformation and collect and analyze information to understand how external factors such as government funding, government regulations, energy prices and other factors impact utility investment plans. These insights will provide government agencies with insights on policies and programs that can be developed to encourage more rapid deployment of smart grid technologies.

REFERENCES

Baer, W. S., Fulton, B., Mahnovski,S. 2004. Estimating the Benefits of the GridWise Initiative. Phase I Report. Rand Science and Technology Technical Report Prepared for the Pacific Northwest National Laboratory.

Berger, J. 2009, November 10. Survey:Cost Remains Primary Barrier to Smart Grid. <http://www.smartgridnews.com/artman/publish/News_News/Survey-Cost-Remains-Primary-Barrier-to-Smart-Grid-1398.html>.

Drewer, S. 1994. Smart Buildings.Journal of Facilities 12 (13), 19-24.

Faruqui, A., and Sanem, S. 2010, February. Household Response to Dynamic Pricing of Electricity - A Survey of the Empirical Evidence. From Social Science Research Network, Tomorrow's Research Today. <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1134132>.

Faruqui, A., Hledik, R., George, S. S., Bode, J., Mangasarian, P., Rohmund, I., et al. 2009, June. A National Assessment and Action Plan on Demand Response Potential. From Federal Energy Regulatory Energy Commission. <http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf#xml=http://search.atomz.com/search/pdfhelper.tk?sp_o=2,100000,0>.

Flax, B. M. 1991. Intelligent Buildings. IEEE Communications Magazine 29 (24), 24-27.

Freidman, H. 2009, July. Wiring the Smart Grid for Energy Savings: Integrating Buildings to Maximize Investment. Portland Energy Conservation, Inc. Portland, Oregon, USA.

Gallagher, P. D. 2010. NIST Framework and Roadmap forSmart Grid Interoperability Standards.Release 1.0 National Institute of Standards and Technology.NIST Special Publication 1108. Office of National Coordinator for Smart Grid Interoperability. US Department of Commerce, Washington D.C.

Isensee, L. 2009, September 18. Environment Forum: Global Environmental Challenges. From Reuters. <http://blogs.reuters.com/environment/2009/09/19/the-race-for-us-smart-grid-cash/>.

Jackson, J. 2009. Research Papers : Smart Grid. Harvard Electricity Policy Group. Cambridge, Massachusetts.

Joshi, S. 2010, March 23. National Survey: Americans Feel a Smart Grid Will Help Reduce Power Outages, Personal Energy Usage. From GE Energy. <http://www.gepower.com/about/press/en/2010_press/032310a.htm>.

Leeds, D. 2010, February 10. The 2010 North American Utility Smart Grid Deployment Survey. From GTM Research. <http://www.gtmresearch.com/report/the-2010-north-american-utility-smart-grid-deployment-survey>.

Microsoft News Center. 2010, March 11. From Microsoft News Center Web site. <http://www.microsoft.com/presspass/press/2010/mar10/03-11SmartGridPR.mspx>.

Miller, J. 2008. Understanding the Smart Grid: Features, Benefits and Costs. Illinois Smart Grid Initiative. From National Energy Technology Laboratory website. <http://www.netl.doe.gov/smartgrid/referenceshelf/presentations/ISGI%20Workshop_070808_Rev%20C_NETL-APPROVED_2008_07_02.pdf>.

NOAA Satellite and Information Service. 2010, May. From NOAA Satellite and Information Service Website. <http://www.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200901-201001.pdf>.

Peters, K. M. 2010, March 26. Goverment Executive. From Goverment Executive Web site. <http://www.govexec.com/dailyfed/0310/032610kp2.htm>.

Pothamsetty, V., and Malik, S. 2009, February. Cisco. From Cisco Web site. <http://www.cisco.com/web/about/citizenship/environment/docs/sGrid_wp_c11-532328.pdf>.

Roth, K. W., Feng, M. Y., Llana, P., and Quartararo, L. 2005, November. Tiax LLC. From Tiax LLC Website. <http://www.tiaxllc.com/aboutus/pdfs/energy_imp_comm_bldg_cntrls_perf_diag_110105.pdf>.

Smart Electric News. 2009, February 10. From Smart Electric News Web site. <http://smartelectricnews.blogspot.com/2009/02/utilities-are-responding-to-smart-grid.html>.

Smart Grid Maryland . 2009, May. From Smart Grid Maryland Web site. <http://www.smartgridmd.org/events/Documents/MSG%20Final%206-8-09.pdf>.

Smart Grid Today. n.d. From Smart Grid Today Website. <http://www.smartgridtoday.com/public/department40.cfm>.

Smith, J. 1984. The cushy new world of smart buildings. International Management , 73-7.

Soonian, D. 2003. Smart Buildings. Spectrum, IEEE , 18-23.

US Department of Energy. 2004. From US Department of Energy Web site. <http://www.oe.energy.gov/DOE_SG_Book_Single_Pages.pdf>.

US Energy Information Administration. 2008. From US Energy Information Administration. <http://www.eia.doe.gov/cneaf/electricity/page/eia861.html>.

APPENDIX A

TELEPHONE INTERVIEW SCRIPT

Hello, my name is Ameya Rao and I am conducting a survey of executives at public utilities concerning smart grid activities; as part of my master thesis at Texas A & M University. The survey takes about 5 minutes and consists of 8 questions. Your answers will be kept confidential and only the summary results of the survey will be released. I will be happy to provide you with a copy of the survey results. May I ask you these questions?

If initial contact says they are not the best person to talk to, I will ask, "Would you mind providing me with the name of someone in your organization who is familiar with smart grid planning?", and ask for the person's title and telephone number.

If I have no title for the interviewee, I will ask "Please provide your title"

Before beginning with the questions I will provide each participant with the following information about the research:

The purpose of this study is to evaluate the extent and timing of impacts of utility smart grid initiatives on building design and construction practices. You were selected to be a possible participant because executives of publically owned utilities are considered for this survey. If you agree to participate in this study, you will be asked to respond to a few questions pertaining to smart grid costs, benefits and adoption plans to assess impacts on building design and construction. This will be a confidential survey. The

participant name will not be disclosed; also there will be no videotaping, voice recording or pictures taken.

I would also like to inform you that," Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A & M University being affected. Also, the records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only I and my faculty guide will have access to the records. You may contact me – Ameya Rao at 617-291-5967 or ameya.rao@gmail.com, or you could contact Dr. Jerry Jackson at jerryrjackson@tamu.edu

I will first record the interviewee's name, title and telephone number

1. Please identify from the following list your organizations' approach to smart grid investment strategies

(1) Waiting to see what our peers are doing.

(2) Actively evaluating smart grid investment costs and benefits.

(3) Initiated some smart grid trials or pilot programs.

(4) Begun system-wide implementation of smart grid technologies.

If the interviewee answers with some other response, I will record.

1. A. If answer to question 1 is (3) or (4) I will ask, "Would you please describe?" and record the response.

2. How quickly would smart grid investments have to pay for themselves to be considered viable at your organization? (don't know, months or years or record other comments)

3. Have you developed a formal business model for evaluating and implementing smart grid technologies? (not sure, yes, no or record other comments)

3. A. If question 3 answer is yes, I will ask, "Have you identified key technologies that meet your business requirements?" (Y/N)

3. B. If question 3. A. answer is yes, I will ask: "Would you please identify those technologies?" and "What time frame do you expect for these investments?"

4. (only for respondents who answered question 1 with answers (1) or (2)) When do you expect that your organization might initiate smart grid trials or pilot programs (record response, could be not sure, months, years, etc).

5. (only for respondents who answered question 1 with answers (1) or (2) or (3)) Please provide an estimate of when you think your organization is likely to begin a system-wide smart grid implementation. (Not sure, never, months, years, etc.)

6. How soon do you expect the majority of your customers to have customer-side technologies with two-way response capabilities to support demand response, critical peak pricing and so on? (not sure, never, months or years)

7. Please identify the following answer that best describes likely peak hour impacts at your utility associated with smart grid demand response programs.
   (1) We have no information
   (2) We use rule-of-thumb estimates
   (3) We use estimates from programs at other utilities
   (4) We have developed estimates based on analysis of our customer's electricity use

8. Please identify the value you would assign to the following information where 1 is no value and 5 is a great deal of value
   (1) Objective descriptions of available technologies and systems (I will get 1 to 5 answer before going on to (2), etc.)
   (2) Case study information describing actual experiences at other utilities.
   (3) Smart grid implementation "best practices" to date.
   (4) A conference devoted exclusively to discussing experience to date and best practices.

APPENDIX B

LIST OF UTILITIES

Table B1 List of Cooperatives

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Salt River Project	AZ	845,724
Sacramento Municipal Utility District	CA	522,951
Omaha Public Power District	NE	296,648
Snohomish County PUD No 1	WA	288,248
Pedernales Electric Coop, Inc	TX	207,460
Jackson Electric Member Corp	GA	184,888
Withlacoochee River Electric Coop	FL	180,857
Lee County Electric Coop, Inc	FL	175,156
Cobb Electric Membership Corp	GA	173,357
PUD No 1 of Clark County	WA	172,108
Middle Tennessee E M C	TN	156,471
Sumter Electric Coop, Inc	FL	151,089
Clay Electric Cooperative, Inc	FL	146,573
Southern Maryland Electric Coop Inc	MD	132,562
Sawnee Electric Membership Corporation	GA	132,017
Northern Virginia Electric Coop	VA	131,137
Denton County Electric Coop, Inc	TX	130,050
Intermountain Rural Electric Assn	CO	125,886
Imperial Irrigation District	CA	123,529
Connexus Energy	MN	111,793
Great Lakes Energy Coop	MI	110,466
GreyStone Power Corporation	GA	109,379
Walton Electric Member Corp	GA	108,147
South Central Power Company	OH	105,453
Energy United Electric Member Corp	NC	104,083
Dakota Electric Association	MN	92,949
Rappahannock Electric Coop	VA	92,878
Volunteer Electric Coop	TN	92,310
Modesto Irrigation District	CA	91,364
Dixie Electric Membership Corp	LA	90,213
Snapping Shoals El Member Corp	GA	86,562
Southwest Louisiana E M C	LA	86,258

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
North Georgia Electric Member Corp	GA	84,744
Magic Valley Electric Coop Inc	TX	81,518
Brunswick Electric Member Corp	NC	78,795
First Electric Coop Corp	AR	77,656
Cumberland Electric Member Corp	TN	76,127
Delaware Electric Cooperative	DE	71,946
Tri-County Electric Coop, Inc	TX	71,007
Turlock Irrigation District	CA	70,594
Carroll Electric Coop Corp	AR	70,083
Berkeley Electric Coop Inc	SC	70,063
Coast Electric Power Assn	MS	69,479
Nebraska Public Power District	NE	69,159
Coweta-Fayette El Member Corp	GA	68,916
Flint Electric Membership Corp	GA	68,792
Bluebonnet Electric Coop, Inc	TX	68,206
New Hampshire Electric Coop Inc	NH	67,989
United Electric Coop Service Inc	TX	62,828
Rutherford Electric Member Corp	NC	62,457
Union Electric Membership Corp	NC	61,949
Blue Ridge Electric Member Corp	NC	61,640
Sam Houston Electric Coop Inc	TX	60,982
South Kentucky Rural Electric Coop Corp	KY	60,519
Baldwin County El Member Corp	AL	60,281
Southern Pine Electric Power Assn	MS	60,160
Singing River Electric Power Assn	MS	59,954
Duck River Electric Member Corp	TN	59,952
Guadalupe Valley Electric Coop Inc	TX	58,903
Blue Ridge Electric Coop Inc	SC	57,949
Trinity Valley Electric Coop Inc	TX	57,165
United Power, Inc	CO	56,547
Palmetto Electric Coop Inc	SC	56,222
Colquitt Electric Membership Corp	GA	55,764
Horry Electric Coop Inc	SC	55,341
Owen Electric Coop Inc	KY	54,573
Cuivre River Electric Coop Inc	MO	53,283
Jones-Onslow Electric Member Corp	NC	52,500
Blue Grass Energy Coop Corp	KY	52,398
Lumbee River Electric Member Corp	NC	51,265
Southside Electric Coop, Inc	VA	51,231

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Flathead Electric Coop Inc	MT	50,828
Ozarks Electric Coop Corp	AR	50,536
Warren Rural Electric Coop Corp	KY	49,206
Talquin Electric Coop, Inc	FL	49,033
Arkansas Valley Electric Coop Corp	AR	48,443
Satilla Rural Electric Member Corporation	GA	48,158
Jackson Energy Coop Corp	KY	48,086
East Central Energy	MN	47,305
Laurens Electric Coop, Inc	SC	47,140
Choptank Electric Coop, Inc	MD	46,969
Carroll Electric Member Corp	GA	46,659
Central Georgia El Member Corp	GA	45,638
Lake Country Power	MN	45,064
Kenergy Corp	KY	45,039
Holy Cross Electric Assn, Inc	CO	44,844
Washington-St Tammany E C, Inc	LA	44,630
Pearl River Valley El Power Assn	MS	44,117
Oklahoma Electric Coop Inc	OK	43,492
Salt River Electric Coop Corp	KY	43,211
Mid-Carolina Electric Coop Inc	SC	43,026
PUD No 1 of Cowlitz County	WA	42,972
Aiken Electric Coop Inc	SC	41,913
Southwest Tennessee E M C	TN	41,730
Amicalola Electric Member Corp	GA	41,487
Santee Electric Coop, Inc	SC	41,239
Upper Cumberland E M C	TN	41,163
Sulphur Springs Valley E C Inc	AZ	40,708
Farmers Electric Coop, Inc	TX	40,702
Wright-Hennepin Coop Electric Assn	MN	40,673
Mountain View Electric Assn, Inc	CO	40,002
South River Electric Member Corp	NC	39,475
Central Alabama Electric Coop	AL	39,187
Crow Wing Cooperative Power and Light Comp	MN	39,041
PUD No 1 of Benton County	WA	38,855
Appalachian Electric Coop	TN	38,560
Upshur Rural Electric Coop Corp	TX	38,372
York Electric Coop Inc	SC	38,005
Valley Electric Member Corp	LA	37,664

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Pennyrile Rural Electric Coop	KY	37,002
Southwest Electric Coop, Inc	MO	37,001
Choctawhatche Electric Coop, Inc	FL	36,890
Trico Electric Cooperative Inc	AZ	36,859
Deep East Texas Electric Coop Inc	TX	36,023
4-County Electric Power Assn	MS	35,866
White River Valley El Coop Inc	MO	35,866
Beauregard Electric Coop, Inc	LA	35,723
PUD No 1 of Chelan County	WA	35,357
Mohave Electric Cooperative, Inc	AZ	34,924
Navopache Electric Coop, Inc	AZ	34,787
PUD No 1 of Grays Harbor County	WA	34,730
Cullman Electric Coop, Inc	AL	34,695
Joe Wheeler Electric Member Corp	AL	34,607
Dixie Electric Power Assn	MS	34,528
Northeast Oklahoma Electric Coop, Inc	OK	34,496
Carteret-Craven El Member Corp	NC	34,484
PUD No 2 of Grant County	WA	34,326
Vermont Electric Cooperative, Inc.	VT	33,953
Adams-Columbia Electric Coop	WI	33,694
Tombigbee Electric Power Assn	MS	33,346
South Central Indiana REMC	IN	33,338
La Plata Electric Assn, Inc	CO	33,332
Inland Power and Light Company	WA	33,324
North Arkansas Electric Coop, Inc	AR	33,147
Central Texas Electric Coop, Inc	TX	32,796
Central Lincoln People's Utility Dist	OR	32,662
French Broad Electric Member Corp	NC	32,488
Grayson-Collin Electric Coop, Inc	TX	32,460
Bowie-Cass Electric Coop, Inc	TX	32,364
Laclede Electric Coop, Inc	MO	31,882
Ozark Border Electric Coop	MO	31,723
South Plains Electric Coop Inc	TX	31,591
Wake Electric Membership Corp	NC	31,521
Habersham Electric Membership Corp	GA	31,393
Poudre Valley R E A, Inc	CO	31,204
Presque Isle Electricand Gas Coop	MI	31,167
Corn Belt Energy Corporation	IL	31,030
Central Virginia Electric Coop	VA	30,970
Jefferson Electric Member Corp	GA	30,947

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Cherryland Electric Coop Inc	MI	30,900
West Kentucky Rural E C C	KY	30,711
Central Florida Electric Coop, Inc	FL	30,334
Minnesota Valley Electric Coop	MN	30,291
A and N Electric Coop	VA	30,271
PUD No 3 of Mason County	WA	30,269
East Central Oklahoma Electric Coop Inc	OK	30,147
Nolin Rural Electric Coop Corp	KY	29,928
Midwest Energy Inc	KS	29,768
Four County Electric Member Corp	NC	29,618
Nueces Electric Coop, Inc	TX	29,612
Cass County Electric Coop Inc	ND	29,573
Mecklenburg Electric Coop, Inc	VA	29,461
Shenandoah Valley Electric Coop	VA	29,428
Randolph Electric Member Corp	NC	29,398
Intercounty Electric Coop Assn	MO	29,225
Sequachee Valley Electric Coop	TN	29,200
Co-Mo Electric Coop Inc	MO	29,191
Verdigris Valley Electric Coop Inc	OK	29,056
Meriwether Lewis Electric Coop	TN	29,042
Gibson Electric Members Corp	TN	28,833
Central Electric Power Assn	MS	28,826
Ozark Electric Coop Inc	MO	28,775
Midwest Energy Cooperative	MI	28,766
Hart Electric Member Corp	GA	28,725
Delta Montrose Electric Assn	CO	28,692
Adams Electric Cooperative Inc	PA	28,674
Pee Dee Electric Coop, Inc	SC	28,591
Wood County Electric Coop, Inc	TX	28,386
Boone Electric Coop	MO	27,958
Magnolia Electric Power Assn	MS	27,684
Piedmont Electric Member Corp	NC	27,356
Jemez Mountains Electric Coop, Inc	NM	27,340
Fort Loudoun Electric Coop	TN	27,286
Bandera Electric Coop, Inc	TX	27,118
Peninsula Light Company	WA	26,858
Peace River Electric Coop, Inc	FL	26,849
Central Electric Coop Inc	OR	26,831
PUD No 1 of Clallam County	WA	26,745

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Black River Electric Coop, Inc	SC	26,518
Caney Fork Electric Coop, Inc	TN	26,514
Hendricks County Rural E M C	IN	26,246
Surry-Yadkin Electric Member Corp	NC	26,236
Jackson Purchase Energy Corporation	KY	26,038
Meade County Rural E C C	KY	25,907
Florida Keys El Coop Assn, Inc	FL	25,661
PUD No 1 of Lewis County	WA	25,560
Sand Mountain Electric Coop	AL	25,434
Southeastern Indiana R E M C	IN	25,356
West Florida El Coop Assn, Inc	FL	24,940
Holston Electric Coop, Inc	TN	24,906
Haywood Electric Member Corp	NC	24,828
Oregon Trail El Cons Coop, Inc	OR	24,641
Kit Carson Electric Coop, Inc	NM	24,532
Clark Energy Coop Inc	KY	24,344
Citizens Electric Corporation	MO	24,138
Blue Ridge Mountain E M C	GA	24,120
Diverse Power Incorporated	GA	24,070
Inter County Energy Coop Corp	KY	24,045
Northeastern Rural E M C	IN	23,822
Lake Region Coop Electric Assn	MN	23,763
Medina Electric Coop, Inc	TX	23,721
Southwest Arkansas E C C	AR	23,674
Fairfield Electric Coop, Inc	SC	23,355
Jackson County Rural E M C	IN	23,263
Southwest Mississippi E P A	MS	23,194
Central Electric Coop, Inc	PA	23,118
Tipmont Rural Electric Member Corp	IN	23,071
Tallapoosa River Electric Coop Inc	AL	22,957
Licking Rural Electric Inc	OH	22,811
Farmers Rural Electric Coop Corp	KY	22,679
San Bernard Electric Coop, Inc	TX	22,548
Black Warrior Electric Member Corp	AL	22,509
Northcentral Mississippi E P A	MS	22,459
Tri-County Electric Coop	MI	22,312
Taylor County Rural E C C	KY	22,301
Okefenoke Rural El Member Corp	GA	22,232
Fleming-Mason Energy Coop Inc	KY	22,221
Stearns Cooperative Electric Assn	MN	22,214

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Craighead Electric Coop Corp	AR	22,121
Cumberland Valley Rural E C C	KY	22,121
Lake Region Electric Coop, Inc	OK	21,920
Tallahatchie Valley E P A	MS	21,732
Howell-Oregon Electric Coop, Inc	MO	21,540
Southeastern IL Electric Coop, Inc	IL	21,497
Suwannee Valley Electric Coop Inc	FL	21,458
Mitchell Electric Member Corp	GA	21,425
Eastern Iowa Light and Power Coop	IA	21,343
Wheatland Electric Coop, Inc	KS	21,305
Tri-County Electric Member Corp	TN	21,203
Claiborne Electric Coop, Inc	LA	21,174
Wiregrass Electric Coop, Inc	AL	21,168
Delta Electric Power Assn	MS	21,014
Covington Electric Coop, Inc	AL	20,962
Southwestern Electric Coop Inc	IL	20,943
REA Energy Coop Inc	PA	20,897
Canadian Valley Electric Coop, Inc	OK	20,853
Yampa Valley Electric Assn Inc	CO	20,693
Harrison County Rural E M C	IN	20,662
Linn County Rural E C A	IA	20,604
Black River Electric Coop	MO	20,540
Clark County Rural E M C	IN	20,516
Johnson County Rural E M C	IN	20,399
Kootenai Electric Coop Inc	ID	20,323
Mid-South Electric Coop Assn	TX	20,279
San Isabel Electric Assn, Inc	CO	20,232
Continental Divide El Coop Inc	NM	20,139
PUD No 1 of Franklin County	WA	20,001
Pee Dee Electric Member Corp	NC	19,990
Tideland Electric Member Corp	NC	19,699
Three Rivers Electric Coop	MO	19,693
Lynches River Electric Coop, Inc	SC	19,689
Excelsior Electric Member Corp	GA	19,687
Tri-County Electric Member Corp	NC	19,576
Tri-County Electric Member Corp	KY	19,514
Platte-Clay Electric Coop, Inc	MO	19,424
Consumers Power, Inc	OR	19,202
C and L Electric Coop Corp	AR	19,187
Tri-County Electric Member Corp	GA	19,117

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Gulf Coast Electric Coop, Inc	FL	19,101
Broad River Electric Coop, Inc	SC	19,070
Jasper-Newton Electric Coop, Inc	TX	18,941
Canoochee Electric Member Corp	GA	18,813
Valley Rural Electric Coop Inc	PA	18,727
Polk-Burnett Electric Coop	WI	18,726
Southern Pine Electric Coop, Inc	AL	18,659
Clarke-Washington E M C	AL	18,631
Buckeye Rural Electric Coop, Inc	OH	18,616
Powell Valley Electric Coop	TN	18,485
Beltrami Electric Coop, Inc	MN	18,443
Valley Electric Assn, Inc	NV	18,365
Lower Valley Energy Inc	WY	18,354
Dixie Electric Coop	AL	18,327
Kiamichi Electric Coop, Inc	OK	18,280
Tillamook Peoples Utility Dist	OR	18,238
Houston County Electric Coop Inc	TX	18,236
Northwestern Rural E C A, Inc	PA	18,195
Rusk County Electric Coop, Inc	TX	18,115
Utilities Dist-Western IN REMC	IN	18,072
HILCO Electric Cooperative, Inc.	TX	18,012
North East Mississippi E P A	MS	17,995
Kankakee Valley Rural E M C	IN	17,889
Altamaha Electric Member Corp	GA	17,820
Southern Rivers Energy	GA	17,699
Grady Electric Membership Corp	GA	17,680
Crawford Electric Coop, Inc	MO	17,618
Central Electric Membership Corporation	NC	17,600
Emerald People's Utility Dist	OR	17,600
Petit Jean Electric Coop Corp	AR	17,516
Cherokee Electric Coop	AL	17,439
Victoria Electric Coop, Inc	TX	17,427
Tri-County Rural Electric Coop Inc	PA	17,420
Cotton Electric Coop, Inc	OK	17,402
Barron Electric Coop	WI	17,389
Tri-County Electric Coop, Inc	SC	17,379
South Louisiana Electric Coop Assn	LA	17,248
Cloverland Electric Co-op	MI	17,210
Cherokee County Electric Coop Assn	TX	17,197

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Choctaw Electric Coop Inc	OK	17,182
Claverack Rural Electric Coop Inc	PA	17,048
Webster Electric Coop	MO	17,041
Norris Electric Coop	IL	16,943
Northern Neck ElectricCoop, Inc	VA	16,804
New-Mac Electric Coop, Inc	MO	16,720
United Electric Coop, Inc	PA	16,716
Nodak Electric Coop Inc	ND	16,664
Rayle Electric Membership Corp	GA	16,629
PUD No 1 of Okanogan County	WA	16,522
Heart of Texas Electric Coop	TX	16,456
Pickwick Electric Coop	TN	16,389
Salem Electric	OR	16,379
Kosciusko County Rural E M C	IN	16,325
Licking Valley Rural E C C	KY	16,274
Cookson Hills Electric Coop, Inc	OK	16,230
Navasota Valley Electric Coop, Inc	TX	16,179
Central Rural Electric Cooperative, Inc	OK	16,168
Mountain Parks Electric, Inc	CO	16,167
Midstate Electric Coop, Inc	OR	16,132
Jo-Carroll Energy Coop Inc	IL	16,057
Columbia River Peoples Ut Dist	OR	16,011
Tri-County Electric Coop, Inc	FL	15,974
Sioux Valley SW Electric Coop	SD	15,936
PUD No 1 of Douglas County	WA	15,823
Central New Mexico El Coop, Inc	NM	15,794
Tennessee Valley Electric Coop	TN	15,663
Pioneer Rural Electric Coop, Inc	OH	15,647
Electrical Dist No3 Pinal County	AZ	15,574
Hamilton County Electric Coop Assn	TX	15,542
South Alabama Electric Coop, Inc	AL	15,536
Tri-County Electric Coop, Inc	IL	15,485
Coosa Valley Electric Coop Inc	AL	15,462
Riverland Energy Cooperative	WI	15,326
Dawson Power District	NE	15,304
Yellowstone Valley Electric Co-op Inc.	MT	15,212
People's Cooperative Services	MN	15,150
Edisto Electric Coop, Inc	SC	15,115
Southern Public Power District	NE	15,074
Mountain Electric Coop, Inc	TN	14,997

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Caddo Electric Coop, Inc	OK	14,992
Planters Electric Member Corp	GA	14,950
Public Utility District No 2	WA	14,913
Wise Electric Coop Inc	TX	14,835
Osage Valley Electric Coop Assn	MO	14,828
Otero County Electric Coop Inc	NM	14,814
Marshall-De Kalb Electric Coop	AL	14,761
Shelby Energy Co-op, Inc	KY	14,748
Lorain-Medina R E C, Inc	OH	14,745
Guernsey-Muskingum El Coop Inc	OH	14,742
Coos-Curry Electric Coop, Inc	OR	14,724
Western Indiana Energy REMC	IN	14,698
Washington Electric Member Corp	GA	14,685
Pontotoc Electric Power Assn	MS	14,676
Sumter Electric Member Corp	GA	14,660
Loup River Public Power Dist	NE	14,564
Oakdale Electric Coop	WI	14,554
Alcorn County Electric Power Assn	MS	14,505
Grayson Rural Electric Coop Corp	KY	14,422
Pea River Electric Coop	AL	14,419
RushShelby Energy	IN	14,247
Powder River Energy Corporation	WY	14,199
Prairie Land Electric Coop Inc	KS	14,136
Consolidated Electric Coop Inc	OH	14,127
Coastal Electric Member Corp	GA	14,102
Three Notch Electric Member Corp	GA	14,004
North Alabama Electric Coop	AL	14,003
Chickasaw Electric Coop, Inc	TN	13,946
Karnes Electric Coop Inc	TX	13,906
Plateau Electric Cooperative	TN	13,872
Victory Electric Coop Assn Inc	KS	13,867
Indian Electric Coop, Inc	OK	13,852
West Central Electric Coop Inc	MO	13,815
Holmes-Wayne Electric Coop Inc	OH	13,730
Maquoketa Valley Rural Electric Coop	IA	13,694
Woodruff Electric Coop Corp	AR	13,562
Norris Public Power District	NE	13,482
Mille Lacs Electric Coop	MN	13,465
Northern Lights, Inc	ID	13,403
Egyptian Electric Coop Assn	IL	13,398

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Grand Valley Rrl Power Line, Inc	CO	13,291
Capital Electric Coop, Inc	ND	13,264
People's Electric Cooperative	OK	13,255
Red River Valley Rrl Electric Assn	OK	13,156
Elmhurst Mutual Power and Light Co	WA	13,130
West River Electric Assn Inc	SD	13,114
Navarro County Electric Coop, Inc	TX	13,105
Southeastern Electric Coop Inc	OK	13,095
Wild Rice Electric Coop, Inc	MN	12,932
Eastern Illinois Electric Coop	IL	12,847
Blue Earth-Nicollet-Faribault	MN	12,841
Blue Ridge Mountain E M C	NC	12,789
Cooke County Electric Coop Assn	TX	12,741
Roanoke Electric Member Corp	NC	12,660
Southeastern Electric Coop Inc	SD	12,634
Mountain Electric Coop, Inc	NC	12,607
Runestone Electric Assn	MN	12,530
Jackson Electric Coop, Inc	TX	12,517
Scenic Rivers Energy Coop	WI	12,478
Tri-County Electric Coop	MN	12,442
Orcas Power and Light Coop	WA	12,419
Natchez Trace Electric Power Assn	MS	12,414
Wayne-White Counties Electric Coop	IL	12,352
Arab Electric Coop Inc	AL	12,256
Glades Electric Coop, Inc	FL	12,222
Callaway Electric Cooperative	MO	12,216
Missoula Electric Coop, Inc	MT	12,216
Somerset Rural Electric Coop, Inc	PA	12,174
Pioneer Electric Coop, Inc	AL	12,137
Dubois Rural Electric Coop Inc	IN	12,127
Big Sandy Rural Electric Coop Corp	KY	12,083
Empire Electric Assn, Inc	CO	12,045
BARC Electric Coop Inc	VA	12,017
Lane Electric Coop Inc	OR	11,887
Albemarle Electric Member Corp	NC	11,877
Farmers' Electric Coop, Inc	MO	11,846
Taylor Electric Coop Inc	TX	11,829
Cimarron Electric Coop	OK	11,693
Newberry Electric Coop, Inc	SC	11,687
Socorro Electric Coop, Inc	NM	11,639

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Truckee Donner P U D	CA	11,627
Sussex Rural Electric Coop Inc	NJ	11,604
Thumb Electric Coop of Mich	MI	11,512
High Plains Power Inc	WY	11,496
Little River Electric Coop Inc	SC	11,492
Whitewater Valley Rural EMC	IN	11,456
Fayette Electric Coop, Inc	TX	11,418
Oconee Electric Member Corp	GA	11,365
Moon Lake Electric Assn Inc	UT	11,349
Concordia Electric Coop, Inc	LA	11,314
Northeast Louisiana Power Coop Inc.	LA	11,289
Southern Illinois Electric Coop	IL	11,189
Benton Rural Electric Assn	WA	11,099
United Rural Electric Member Corp	IN	11,030
Tri-State Electric Member Corp	GA	11,024
Hancock County Rural E M C	IN	10,990
SEMO Electric Cooperative	MO	10,987
Tishomingo County E P A	MS	10,927
Lamar County Electric Coop Assn	TX	10,898
Carroll Electric Coop, Inc	OH	10,860
Hancock-Wood Electric Coop Inc	OH	10,840
Fall River Rural Electric Coop Inc	ID	10,789
Boone County Rural EMC	IN	10,789
Prentiss County Electric Power Assn	MS	10,782
Butler Rural Electric Coop Inc	OH	10,775
Irwin Electric Membership Corp	GA	10,758
Ozarks Electric Coop Corp	OK	10,704
Edgecombe-Martin County E M C	NC	10,694
Ocmulgee Electric Member Corp	GA	10,693
Umatilla Electric Coop Assn	OR	10,678
Eastern Maine Electric Coop	ME	10,625
Noble County R E M C	IN	10,585
Sangre De Cristo Electric Assn Inc	CO	10,575
Halifax Electric Member Corp	NC	10,565
Overton Power District No 5	NV	10,542
Little Ocmulgee El Member Corp	GA	10,541
Illinois Rural Electric Coop	IL	10,476
Clay County Electric Coop Corp	AR	10,448
Tippah Electric Power Assn	MS	10,415
Dixie Escalante R E A, Inc	UT	10,396

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Coastal Electric Coop, Inc	SC	10,382
Mora-San Miguel Electric Coop, Inc	NM	10,348
San Miguel Power Assn, Inc	CO	10,309
Vernon Electric Coop	WI	10,298
Midwest Electric, Inc	OH	10,261
Bartholomew County Rural E M C	IN	10,250
Carroll Electric Coop Corp	MO	10,221
Macon Electric Coop	MO	10,183
Sac-Osage Electric Coop Inc	MO	10,176
Washington Electric Coop Inc	VT	10,160
Itasca-Mantrap Co-op Electrical Assn	MN	10,131
East Mississippi Electric Power Assn	MS	9,998
Parke County Rural E M C	IN	9,888
Prince George Electric Coop	VA	9,870
Central Missouri Electric Coop Inc	MO	9,831
Eau Claire Electric Coop	WI	9,813
PUD No 1 of Klickitat County	WA	9,806
Twin County Electric Power Assn	MS	9,787
Henry County Rural E M C	IN	9,686
Verendrye Electric Coop Inc	ND	9,685
Northern Plains Electric Coop	ND	9,665
Shelby Electric Coop, Inc	IL	9,664
Lakeview Light and Power	WA	9,631
Heartland Rural Electric Coop, Inc	KS	9,563
Alger-Delta Coop Electric Assn	MI	9,498
Okefenoke Rural El Member Corp	FL	9,485
Yazoo Valley Electric Power Assn	MS	9,429
Tombigbee Electric Coop, Inc	AL	9,427
Farmers' Electric Coop, Inc	NM	9,421
Crisp County Power Comm	GA	9,390
St Croix Electric Coop	WI	9,343
South Central Ark El Coop, Inc	AR	9,300
Oconto Electric Cooperative	WI	9,282
Ravalli County Electric Coop, Inc	MT	9,270
Northern Wasco County PUD	OR	9,142
Midland Power Coop	IA	9,129
Paulding-Putman Electric Coop, Inc	OH	9,126
Allamakee-Clayton El Coop, Inc	IA	9,115
United Electric Coop, Inc	MO	9,087
Community Electric Coop	VA	9,064

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Garkane Energy Coop, Inc	UT	9,060
M J M Electric Cooperative Inc	IL	9,049
Menard Electric Coop	IL	9,014
Bartlett Electric Coop, Inc	TX	8,988
Rock Energy Cooperative	IL	8,972
Iowa Lakes Electric Coop	IA	8,963
Rolling Hills Electric Coop	KS	8,955
Douglas Electric Coop, Inc	OR	8,949
Gascosage Electric Coop	MO	8,919
Dunn County Electric Coop	WI	8,894
Monroe County Electric Power Assn	MS	8,886
Steuben County Rural E M C	IN	8,839
Clark Electric Coop	WI	8,776
Vera Irrigation District #15	WA	8,755
Steele-Waseca Cooperative Electric	MN	8,741
North West Rural Electric Coop	IA	8,701
Gunnison County Electric Assn.	CO	8,685
Fannin County Electric Coop	TX	8,672
North Central Electric Coop, Inc	OH	8,658
Escambia River Electric Coop, Inc	FL	8,639
Price Electric Coop Inc	WI	8,616
Bayfield Electric Coop, Inc	WI	8,613
San Luis Valley R E C, Inc	CO	8,609
Access Energy Coop	IA	8,605
Concho Valley Electric Coop Inc	TX	8,577
Jump River Electric Coop Inc	WI	8,557
Ouachita Electric Coop Corp	AR	8,547
Coles-Moultrie Electric Coop	IL	8,531
Firelands Electric Coop, Inc	OH	8,531
Forked Deer Electric Coop, Inc	TN	8,527
Panola-Harrison Electric Coop, Inc	TX	8,519
Northwestern Electric Coop Inc	OK	8,515
Barry Electric Coop	MO	8,483
Clearwater Power Company	ID	8,462
Bedford Rural Electric Coop, Inc	PA	8,462
Kaw Valley Electric Coop Inc	KS	8,424
Upson Electric Member Corp	GA	8,413
Elkhorn Rural Public Power Dist	NE	8,319
Southern Indiana R E C, Inc	IN	8,316
Modern Electric Water Company	WA	8,278

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Washington Electric Coop, Inc	OH	8,255
Adams Electric Coop	IL	8,243
Roughrider Electric Cooperative	ND	8,152
Warren Electric Coop Inc	PA	8,101
Panola-Harrison Electric Coop, Inc	LA	8,085
Rural Electric Coop, Inc	OK	8,081
Pointe Coupee Electric Member Corp	LA	8,065
Meeker Coop Light and Power Assn	MN	8,053
Frontier Power Company	OH	8,002
Big Country Electric Coop, Inc	TX	7,909
Union Rural Electric Coop, Inc	OH	7,878
White County Rural E M C	IN	7,871
East-Central Iowa Rural Electric Coop	IA	7,830
Black Hills Electric Coop, Inc	SD	7,826
PUD No 1 of Pend Oreille County	WA	7,821
Orange County Rural E M C	IN	7,779
San Patricio Electric Coop Inc	TX	7,685
Leavenworth-Jefferson E C, Inc	KS	7,619
Southeast Colorado Power Assn	CO	7,593
Todd-Wadena Electric Coop	MN	7,560
Graham County Electric Coop Inc	AZ	7,558
Adams Rural Electric Coop, Inc	OH	7,540
Rich Mountain Electric Coop, Inc	AR	7,534
Vigilante Electric Coop, Inc	MT	7,532
Slash Pine Electric Member Corp	GA	7,468
Jasper County Rural E M C	IN	7,456
Jefferson Davis Electric Coop, Inc	LA	7,419
Western Coop Electric Assn Inc	KS	7,403
Central Wisconsin Electric Coop	WI	7,388
Lyntegar Electric Coop, Inc	TX	7,372
Decatur County Rural E M C	IN	7,354
Daviess Martin County R E M C	IN	7,344
Pitt and Greene Electric Member Corp	NC	7,307
Rio Grande Electric Coop, Inc	TX	7,211
Consolidated Electric Coop	MO	7,191
Jackson Electric Coop, Inc	WI	7,183
Mid-Ohio Energy Coop, Inc	OH	7,164
Kandiyohi Power Coop	MN	7,077
Pierce-Pepin Coop Services	WI	7,012
D S and O Rural E C A, Inc	KS	6,872

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Monroe County Electric Coop, Inc	IL	6,858
Lagrange County Rural E M C	IN	6,796
Northeast Nebraska P P D	NE	6,791
Carroll County REMC	IN	6,763
Chippewa Valley Electric Coop	WI	6,757
Cornhusker Public Power Dist	NE	6,757
Franklin Electric Coop	AL	6,706
Powell Valley Electric Coop	VA	6,674
Mor-Gran-Sou Electric Coop Inc	ND	6,661
Plumas-Sierra Rural Electric Coop	CA	6,644
Coleman County Electric Coop, Inc	TX	6,575
Lea County Electric Coop, Inc	NM	6,432
Central Electric Coop, Inc	SD	6,408
Lewis County Rural E C A	MO	6,406
Rock Energy Cooperative	WI	6,377
Cape Hatteras Electric Member Corp	NC	6,295
Marshall County Rural E M C	IN	6,294
Butler Rural El Coop Assn, Inc	KS	6,251
McLeod Cooperative Power Assn	MN	6,239
Comanche County Electric Coop Assn	TX	6,228
Mountrail-Williams Electric Coop	ND	6,158
Roseau Electric Coop, Inc	MN	6,050
Steuben Rural Electric Coop, Inc	NY	6,024
Merced Irrigation District	CA	6,011
Tri-County Electric Coop Assn	MO	5,995
Trinity Public Utilities Dist	CA	5,913
Hawkeye Tri-County El Coop Inc	IA	5,900
T I P Rural Electric Coop	IA	5,898
Freeborn-Mower Coop Services	MN	5,893
North Central Electric Coop, Inc	ND	5,845
Craig-Botetourt Electric Coop	VA	5,829
Southwest Iowa Rural Electric Coop	IA	5,769
North Star Electric Coop, Inc	MN	5,755
Harrison Rural Electric Assn, Inc	WV	5,753
Fergus Electric Coop, Inc	MT	5,713
Tri-County Electric Coop, Inc	OK	5,699
Grundy Electric Coop, Inc	MO	5,685
Glacier Electric Coop, Inc	MT	5,672
Miami-Cass County Rural E M C	IN	5,657
Lyon-Coffey Electric Coop, Inc	KS	5,599

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
West Central Electric Coop Inc	SD	5,588
North Western Electric Coop, Inc	OH	5,582
Moreau-Grand Electric Coop Inc	SD	5,555
Coahoma Electric Power Assn	MS	5,546
Sullivan County R E C, Inc	PA	5,531
LaCreek Electric Assn, Inc	SD	5,502
SE-MA-NO Electric Coop	MO	5,464
Kiwash Electric Coop, Inc	OK	5,430
Flint Hills Rural E C A, Inc	KS	5,397
Ralls County Electric Coop	MO	5,382
Rural Electric Conven Coop	IL	5,381
Cedar-Knox Public Power Dist	NE	5,373
Marlboro Electric Coop, Inc	SC	5,361
Bluestem Electric Coop Inc	KS	5,325
Jay County Rural E M C	IN	5,316
Fulton County Rural E M C	IN	5,284
Cooperative Land P Assn Lake County	MN	5,267
Park Electric Coop Inc	MT	5,258
Northfork Electric Coop, Inc	OK	5,230
Delaware County Electric Coop Inc	NY	5,167
PUD No 1 of Skamania Co	WA	5,165
Carbon Power and Light, Inc	WY	5,147
Clinton County Electric Coop, Inc	IL	5,118
Dakota Valley Electric Coop Inc	ND	5,108
Northern Electric Coop, Inc	SD	5,096
Barton County Electric Coop, Inc	MO	5,095
Western Iowa Power Coop	IA	5,060
Minnesota Valley Coop Land P Assn	MN	5,042
Middle Georgia El Member Corp	GA	5,035
Central Valley Electric Coop, Inc	NM	5,031
Edgar Electric Co-op, Assn	IL	5,020
Sedgwick County El Coop Assn Inc	KS	5,001

Table B2 List of Municipals

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Los Angeles City of	CA	1,264,271
San Antonio City of	TX	611,509
Memphis City of	TN	366,220
JEA	FL	365,872
Austin Energy	TX	355,628
Seattle City of	WA	348,109
Nashville Electric Service	TN	316,005
Colorado Springs City of	CO	183,497
Knoxville Utilities Board	TN	172,978
Orlando Utilities Comm	FL	150,680
Tacoma City of	WA	148,044
Huntsville City of	AL	138,690
Chattanooga City of	TN	137,046
Lincoln Electric System	NE	110,956
City of Lakeland	FL	100,739
City of Anaheim	CA	95,059
City of Riverside	CA	94,704
City of Tallahassee	FL	94,640
City Utilities of Springfield	MO	93,702
Lansing City of	MI	83,166
Gainesville Regional Utilities	FL	82,271
Eugene City of	OR	77,579
City of Glendale	CA	71,380
City of Cleveland	OH	70,117
Public Works Comm-City of Fayetteville	NC	68,921
City of Lubbock	TX	64,629
Johnson City of	TN	63,388
City of Garland	TX	61,625
City of Springfield	IL	58,693
Kansas City City of	KS	56,894
Fort Collins City of	CO	56,659
Greenville Utilities Comm	NC	55,131
City of Pasadena	CA	54,142
Kissimmee Utility Authority	FL	52,512
Independence City of	MO	51,650
City of Lafayette	LA	51,043
Naperville City of	IL	50,865

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Clarksville City of	TN	49,403
Lenoir City of	TN	46,728
City of Roseville	CA	45,068
City of Burbank Water and Power	CA	44,279
City of Murfreesboro	TN	43,618
City of Santa Clara	CA	43,434
Rochester Public Utilities	MN	42,861
City of Ocala	FL	40,911
Florence City of	AL	39,673
City of Denton	TX	39,185
Brownsville Public Utilities Board	TX	38,954
City of Columbia	MO	37,708
City of Danville	VA	37,243
City of Redding	CA	36,546
City of Marietta	GA	34,945
City of Farmington	NM	33,653
City of Rock Hill	SC	33,491
City of Athens	AL	33,445
City of Longmont	CO	33,421
Town of High Point	NC	33,330
City of College Station	TX	32,670
City of North Little Rock	AR	32,443
Albany Water Gas and Light Comm	GA	31,973
Sevier County Electric System	TN	31,856
City of Anderson	IN	31,621
City of Taunton	MA	31,605
Foley Board of Utilities	AL	30,858
Greeneville City of	TN	30,765
City of Edmond	OK	30,562
Provo City Corp	UT	30,346
City of Alameda	CA	30,084
City of Wilson	NC	29,088
Bristol City of	TN	28,581
Beaches Energy Services	FL	28,408
City of Loveland	CO	27,966
City of Vero Beach	FL	27,939
City of Dickson	TN	27,872
City of Jackson	TN	27,851
City of Bryan	TX	27,840
City of Springfield	OR	27,455

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
City Water and Light Plant	AR	26,722
City of Hamilton	OH	26,481
Reading Town of	MA	25,524
Clinton City of	TN	25,357
City of Bountiful	UT	F
City of Dothan	AL	24,779
Cleveland City of	TN	24,724
City of Palo Alto	CA	24,484
Key West City of	FL	24,020
City of Rocky Mount	NC	23,742
City of Alcoa Utilities	TN	23,705
City of New Braunfels	TX	23,617
City of Mishawaka	IN	23,542
Fort Pierce Utilities Auth	FL	23,488
Conway Corporation	AR	23,453
Chicopee City of	MA	23,399
Concord City of	NC	23,323
City of Owensboro	KY	22,896
City of Bowling Green	KY	22,840
City of St George	UT	22,816
City of Holland	MI	22,781
Decatur Utilities	AL	22,622
City of Elizabethton	TN	22,561
City of Gastonia	NC	22,517
City of Cuyahoga Falls	OH	22,286
City of Lodi	CA	22,067
New Smyrna Beach City of	FL	22,034
Idaho Falls City of	ID	21,980
Vineland City of	NJ	21,761
City of Lake Worth	FL	21,744
Ames City of	IA	21,500
City of Orangeburg	SC	21,125
City of Peabody	MA	21,086
Wallingford Town of	CT	20,926
Columbia Power System	TN	20,743
City of Homestead	FL	20,697
City of Richland	WA	20,555
City of Alexandria	LA	20,282
Grand Island City of	NE	19,888
Dover City of	DE	19,549

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
City of LaFollette	TN	19,097
City of Paducah	KY	18,696
City of Leesburg	FL	18,559
Georgetown City of	TX	18,105
City of Lexington	TN	17,937
City of Bay City	MI	17,846
City of Norwich	CT	17,615
Kerrville Public Utility Board	TX	17,486
City of New Bern	NC	17,379
Maryville Utilities	TN	17,243
Frankfort City of	KY	17,115
City of Newport	TN	17,075
Stillwater Utilities Authority	OK	16,940
City of Lawrenceburg	TN	16,755
City of San Marcos	TX	16,690
Jamestown Board of Public Utilities	NY	16,516
Weakley County Municipal Electric Sys	TN	16,501
City of Richmond	IN	16,381
City of Burlington-Electric	VT	16,273
City of Colton	CA	16,032
City of Logan	UT	16,015
City of Lexington	NC	15,947
Harrisonburg City of	VA	15,639
Manitowoc Public Utilities	WI	15,568
City of Westfield	MA	15,504
City of Fayetteville	TN	15,468
Sheffield Utilities	AL	15,333
Hagerstown Light Department	MD	15,200
Village of Fairport	NY	15,181
Cedar Falls Utilities	IA	15,180
City of Paris	TN	15,151
Holyoke City of	MA	14,430
City of Moorhead	MN	14,405
City of Bentonville	AR	14,382
City of Fountain	CO	14,356
Shakopee Public Utilities Comm	MN	14,167
City of Westerville	OH	14,079
City of Ponca City	OK	14,024
City of Marquette	MI	13,971

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
City of Azusa	CA	13,960
Town of Shrewsbury	MA	13,876
City of East Point	GA	13,730
Bristol Virginia Utilities	VA	13,706
City of Murray	UT	13,578
City of Oak Ridge	TN	13,578
Greer Commission of Public Wks	SC	13,461
City of St Charles	IL	13,126
City of Norwood	MA	13,085
Village of Freeport	NY	13,039
City of Mesa	AZ	12,966
City of Lompoc	CA	12,946
Town of Middleborough	MA	12,917
Braintree Town of	MA	12,896
McMinnville City of	OR	12,848
City of Griffin	GA	12,732
Carroll County	TN	12,697
City of Thomasville	GA	12,693
City of Kaukauna	WI	12,648
City of Bowling Green	OH	12,595
Town of Apex	NC	12,515
City of Manassas	VA	12,236
Fremont City of	NE	12,078
City of Gallatin	TN	11,810
Lehi City Corporation	UT	11,775
Town of North Attleborough	MA	11,770
Cookeville City of	TN	11,728
City of Morristown	TN	11,681
City of Pulaski	TN	11,675
City of Rockwood	TN	11,659
Dalton Utilities	GA	11,634
City of Grand Haven	MI	11,609
Sun Prairie Water and Light Comm	WI	11,577
Wyandotte Municipal Serv Comm	MI	11,534
Easley Combined Utility System	SC	11,467
Groton Dept of Utilities	CT	11,340
Wisconsin Rapids W W and L Comm	WI	11,320
Greenwood Commissioners-Pub Wk	SC	11,234
City of Marshfield	WI	11,229

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Watertown Municipal Utilities	SD	11,108
Weatherford Mun Utility System	TX	11,092
City of Floresville	TX	11,046
City of Salem	VA	10,972
Greenville, City of	TX	10,958
Town of Danvers	MA	10,945
City of Washington	NC	10,922
Athens Utility Board	TN	10,883
City of Logansport	IN	10,855
City of North Platte	NE	10,817
Tupelo City of	MS	10,759
City of Wadsworth	OH	10,755
Paragould Light and Water Comm	AR	10,695
Benton City of	AR	10,683
City of West Memphis	AR	10,677
City of La Grange	GA	10,630
Austin City of	MN	10,606
Gillette City of	WY	10,588
Hastings City of	NE	10,583
City of Ashland	OR	10,534
Banning City of	CA	10,528
Town of Hudson	MA	10,510
City of Anoka	MN	10,477
Newark City of	DE	10,465
City of Statesville	NC	10,446
City of Hopkinsville	KY	10,312
Terrebonne Parish Consol Gov't	LA	10,311
City of Owatonna	MN	10,292
Town of Belmont	MA	10,246
City of Niles	OH	10,246
City of Starkville	MS	10,218
City of Kinston	NC	10,195
Town of Wakefield	MA	10,176
City of Bessemer Utilities	AL	10,125
Henderson City Utility Comm	KY	10,105
City of Elizabeth City	NC	10,024
City of Painesville	OH	9,990
City of Marblehead	MA	9,978
Borough of Butler	NJ	9,962
Bartow City of	FL	9,891

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
City of Claremore	OK	9,874
City of Albemarle	NC	9,843
City of Garden City	KS	9,797
Lumberton City of	NC	9,780
City of Columbus	OH	9,753
City of Dyersburg	TN	9,739
Chattanooga City of	GA	9,728
City of Harriman	TN	9,710
Board of Water Electric and Communications	IA	9,650
City of Opelika	AL	9,575
City of Batavia	IL	9,505
City of Piqua	OH	9,504
City of Columbus	MS	9,443
Covington City of	GA	9,364
Lassen Municipal Utility District	CA	9,295
Loudon Utilities Board	TN	9,295
City of Lawrenceville	GA	9,285
City of Camden	SC	9,268
Borough of Chambersburg	PA	9,212
Village of Rockville Centre	NY	9,198
Peru City of	IN	9,153
Spanish Fork City Corporation	UT	9,055
Bolivar Energy Authority	TN	9,049
City of Springville	UT	9,048
Wellesley Town of	MA	8,847
City of Holly Springs	MS	8,839
Port Angeles City of	WA	8,778
City of Kirkwood	MO	8,677
City of Greenfield	IN	8,612
Benton County	TN	8,596
City of Traverse City	MI	8,559
Town of Mansfield	MA	8,548
City of Ruston	LA	8,527
Tullahoma Board-Public Utilities	TN	8,506
City of Monroe	NC	8,421
City of Plattsburgh	NY	8,394
City of Gallup	NM	8,295
City of Centralia	WA	8,264
Town of Estes Park	CO	8,249

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
City of Dayton	TN	8,184
Greenwood Utilities Comm	MS	8,179
City of Chaska	MN	8,160
Town of Massena	NY	8,141
City of Elk River	MN	8,125
Easton Utilities Comm	MD	8,108
Crawfordsville Electric, Light and Power	IN	8,071
City of Menasha	WI	8,033
City of New Albany	MS	8,031
City of Shelbyville	TN	8,029
City of Hingham	MA	8,028
Albertville Municipal Utilitiess Bd	AL	8,017
City of Geneva	IL	7,968
City of South Haven	MI	7,957
City of Forest Grove	OR	7,955
City of Poplar Bluff	MO	7,946
Los Alamos County	NM	7,934
City of Lebanon	OH	7,900
Brookings City of	SD	7,895
Brigham City Corporation	UT	7,869
Willmar Municipal Utilities	MN	7,854
City of Hannibal	MO	7,791
City of Nixa	MO	7,773
City of Frankfort	IN	7,771
City of Ellensburg	WA	7,732
Erwin Town of	TN	7,729
City of Sikeston	MO	7,708
Stoughton City of	WI	7,574
City of Altus	OK	7,561
Newnan Water, Sewer and Light Comm	GA	7,550
Heber Light and Power Company	UT	7,537
Oconomowoc Utilities	WI	7,536
Kaysville City Corporation	UT	7,517
City of Alexandria	MN	7,497
City of Natchitoches	LA	7,422
City of Rolla	MO	7,372
City of Duncan	OK	7,236
City of College Park	GA	7,229

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Hibbing Public Utilities Comm	MN	7,225
Borough of Lansdale	PA	7,194
McPherson City of	KS	7,132
City of Lebanon	IN	7,089
Madisonville Municipal Utilities	KY	7,044
Sturgeon Bay City of	WI	7,009
City of Sweetwater	TN	6,960
City of Springfield	TN	6,918
City of Gardner	KS	6,895
City of Plymouth	WI	6,867
Town of South Hadley	MA	6,851
City of Seneca	SC	6,839
City of Scottsboro	AL	6,801
City of Boulder	NV	6,767
Celina City of	OH	6,765
City of Martinsville	VA	6,758
City of Winfield	KS	6,745
Seguin City of	TX	6,726
City of Milan	TN	6,700
City of Radford	VA	6,561
Town of Holden	MA	6,547
City of Morganton	NC	6,547
Cullman Power Board	AL	6,518
City of Tuskegee	AL	6,502
Brainerd Public Utilities	MN	6,459
City of Carthage	MO	6,401
City of Shelby	NC	6,372
Fort Payne Improvement Auth	AL	6,363
Town of Concord	MA	6,355
Tahlequah Public Works Auth	OK	6,325
Borough of South River	NJ	6,300
Town of Front Royal	VA	6,271
City of Niles	MI	6,259
Washington City of	IN	6,258
City of Murray	KY	6,250
City of Troy	AL	6,203
Cartersville City of	GA	6,139
City of Escanaba	MI	6,138
City of Orrville	OH	6,136
City of Oxford	MS	6,119

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Town of Middletown	DE	6,115
City of Sturgis	MI	6,098
City of Nicholasville	KY	6,079
City of Auburn	IN	6,073
Hutchinson Utilities Comm	MN	6,060
McMinnville Electric System	TN	6,057
Canby Utility Board	OR	6,002
City of Bedford	VA	6,001
City of Siloam Springs	AR	5,987
Clarksdale Public Utilities	MS	5,980
Canby Utility Board	CA	5,969
City of Union	SC	5,968
New Ulm Public Utilities Comm	MN	5,956
Canby Utility Board	UT	5,929
Rochelle Municipal Utilities	IL	5,917
City of Galion	OH	5,905
Town of Ipswich	MA	5,901
Beatrice City of	NE	5,899
City of Muscle Shoals	AL	5,828
City of Miami	OK	5,826
City of Dover	OH	5,822
Borough of Ephrata	PA	5,819
Hartford Electric	WI	5,777
City of Hope	AR	5,771
Pierre City of	SD	5,770
Town of Littleton	MA	5,766
Ottawa City of	KS	5,760
Moultrie City of	GA	5,718
City of North St Paul	MN	5,695
Canby Utility Board	WY	5,688
City of Acworth	GA	5,684
City of Milford	DE	5,681
Hull Municipal Light Plant	MA	5,661
City of Gaffney	SC	5,658
City of Jackson	MO	5,644
Borough of Madison	NJ	5,634
City of Jasper	IN	5,631
Village of Rantoul	IL	5,627
City of Hudson	OH	5,587
City of Highland	IL	5,582

UTILITY NAME	STATE CODE	RESIDENTIAL CONSUMERS
Two Rivers Water and Light	WI	5,575
City of Ripley	TN	5,524
City of Lebanon	MO	5,521
City of Marshall	MN	5,479
Grand Rapids Public Util Comm	MN	5,467
Coldwater Board of Public Util	MI	5,442
City of Farmington	MO	5,437
Sylacauga Utilities Board	AL	5,425
City of Minden	LA	5,423
Fairhope City of	AL	5,404
City of Petoskey	MI	5,399
Canby Utility Board	UT	5,387
Kennebunk Light and Power Dist	ME	5,357
Hillsdale Board of Public Wks	MI	5,323
Canby Utility Board	UT	5,321
Fitzgerald Water Light and Bond Comm	GA	5,303
City of Coffeyville	KS	5,293
City of Amherst	OH	5,283
Indianola Municipal Utilities	IA	5,277
City of Detroit Lakes	MN	5,260
City of Union City	TN	5,258
City of Glasgow	KY	5,256
City of Tipp City	OH	5,230
Town of Tarboro	NC	5,187
City of Brenham	TX	5,184
Cedarburg Light and Water Comm	WI	5,173
City of River Falls	WI	5,169
Fairmont Public Utilities Comm	MN	5,165
Town of Wake Forest	NC	5,161
City of Napoleon	OH	5,133
City of Zeeland	MI	5,105
City of South Norwalk	CT	5,074
Monroe Water, Light and Gas Comm	GA	5,070
Morgan City City of	LA	5,040
Spencer City of	IA	5,030
City of Bryan	OH	5,028

APPENDIX C

Table C1 List of States And Their CDD Values

Strata	State	Normal CDD
1	Washington	198
1	Maine	228
1	Oregon	237
1	Montana	248
1	Colorado	273
1	Vermont	276
1	New Hampshire	304
1	Massachusetts	452
1	North Dakota	452
1	Idaho	456
1	Rhode Island	477
1	Minnesota	483
1	Wisconsin	502
1	Connecticut	567
1	Michigan	568
1	New York	621
1	Pennsylvania	661
1	Utah	671
1	South Dakota	731
1	Ohio	738
2	New Jersey	766
2	West Virginia	771
2	Iowa	838
2	Illinois	876
2	New Mexico	893
2	Indiana	894
2	California	905
2	Nebraska	1,009
2	Maryland	1,024
2	Virginia	1,049

Strata	State	Normal CDD
2	Delaware	1,057
2	Kentucky	1,174
2	Missouri	1,249
2	Tennessee	1,349
3	North Carolina	1,387
3	Kansas	1,441
3	Georgia	1,702
3	Arkansas	1,762
3	South Carolina	1,799
3	Alabama	1,865
3	Oklahoma	1,875
3	Nevada	1,922
3	Mississippi	2,078
3	Louisiana	2,576
3	Texas	2,647
3	Arizona	2,861
3	Florida	3,420
3	Wyoming	5,595

VITA

Name: Ameya Vinayak Rao

Address: c/o Dr. Jerry Jackson

Texas Aand M University,
College of Architecture,
3137 TAMU.
Langford Building - A, Room 318
College Station, Texas 77843-3137

Email Address: ameya.rao@gmail.com

Education: B.E., Civil Engineering, University of Pune, 2005

M.S., Construction Management, Texas A&M University, 2010