Citizen Advisory Board

Meeting Agenda

Mon, Aug 9, 2021 2:00 PM

Zoom

Port Townsend, WA 98368

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1. Call to Order

Per the Governor's Extended Proclamation 20-28 and in response to the COVID-19 Pandemic, Jefferson County PUD is no longer providing an in-person room for meetings of the BOC. All meetings will be held remotely via Zoom until otherwise informed by the Governor. Participant audio will be muted upon entry. Please unmute at the appropriate time to speak. If you are calling in, use **6 to mute and unmute and *9 to raise a hand to request to speak.*

2. Introductions

3. Agenda Approval

4. Public Comment

This public comment period of up to 15 minutes is for any items not on the agenda. During the meeting, the Chair may also permit public comments on other discussion items. Each speaker is limited to 3 minutes.

5. Review of Past Minutes

6. CAB Business

6.1. FCS Meter Presentation 3 - 65

JPUD Metering Approach 8-9-2021.pdf

JPUD Meter Replacement Approach Tech Memo 8-5-2021.docx

6.2. Future Meetings

6.3. Other Business

7. BOC Update

8. GM Report

9. Adjourn

Electric Metering Approach Business Case Analysis

Citizen Advisory Board Meeting

Presented by:
Gordon Wilson
August 9, 2021

FCS GROUP
Solutions-Oriented Consulting

Purpose and Sequence of Topics

- **Purpose of presentation**
  - Share findings from research and analysis into electric metering approach
- **Sequence of Topics**
  - Options Considered
  - Criteria
  - Economic Analysis
  - Non-Economic Analysis
  - Summary and Recommendation

- **Vocabulary**
  - **AMR** – Automated Meter Reading – allows one-way radio transmission
  - **AMI** – Advanced Metering Infrastructure – allows two-way radio transmission
  - **Collectors** – equipment that gathers data from a group of meters
  - **Backhaul** – Process of sending information from collectors to District office
  - **Net Present Value (NPV)** – up-front equivalent value of a future stream of payments, using an assumed discount rate
  - **Net Revenue** – Additional revenue minus the cost of a given option
  - **Change in Net Revenue** – Difference between net revenue of an option and the status quo

Updated Options and Criteria

Options

- **Status Quo – Old L&G meters being gradually replaced with drive-by AMR meters**
  - » Used for frame of reference, but not preferred option
  - » Goal is to help the District choose an intentional approach to metering, using best available information
- **Meter Replacement Options**
  - » Digital Hand-Read Meters
  - » Mechanical Hand-Read Meters
  - » Drive-by AMR Meters
  - » Hybrid AMR/AMI Meters
    - – AMR meters with one TUNet device per 8 meters; TUNet devices can be collectors or AMI meters
  - » AMI Meters

Criteria

Economic analysis:

- **Net Present Value**
  - » Change in net revenue from status quo

Non-economic analysis:

- **Potential Radio Frequency (RF) Health Impacts**
- **Privacy**
- **Vulnerability to Hacking**
- **Reliability/Accuracy**
- **Compatibility**
- **Functionality**
- **Allows Time of Use (TOU) Metering**

Economic Analysis – Introduction to Cost Model

- **Cost Model**
  - » Assumptions
  - » Financial Calculations – capital costs, operating costs and revenue by year
    - – Spread over 25-year forecast, to account for full replacement cycle
  - » Summary of Results
  - » Supporting tabs
    - – Meter Capital $
    - – Meter Accuracy
    - – Other Capital $
    - – Number of Meters
    - – Vehicle Calculations
    - – Revenue Calculations

Economic Analysis – Assumptions

- **Overall Economic Assumptions**
  - » Inflation factors
  - » Sales tax rates
  - » Discount rate for Net Present Value
- **Current Meters**
  - » Meter inventory
  - » Number of L&G meters replaced each year
- **Cost of meters**
  - » Used AMR drive-by
  - » New digital walk-up
  - » Refurbished mechanical walk-up
  - » New AMR
  - » New AMI
- **Collectors**
  - » Cost per collector
  - » Number of collectors needed
  - » Cost of batteries for collectors
  - » Frequency of battery replacement
- **Installation costs**
  - – Time to install new meter (by PUD employees)
  - – Loaded hourly rate
  - – Time to install collectors
  - – Cellular backhaul cost per collector (10-year lease)
  - – Project management/other up-front cost
  - » Software and equipment cost
  - » Shipping and taxes

Economic Analysis – More Assumptions

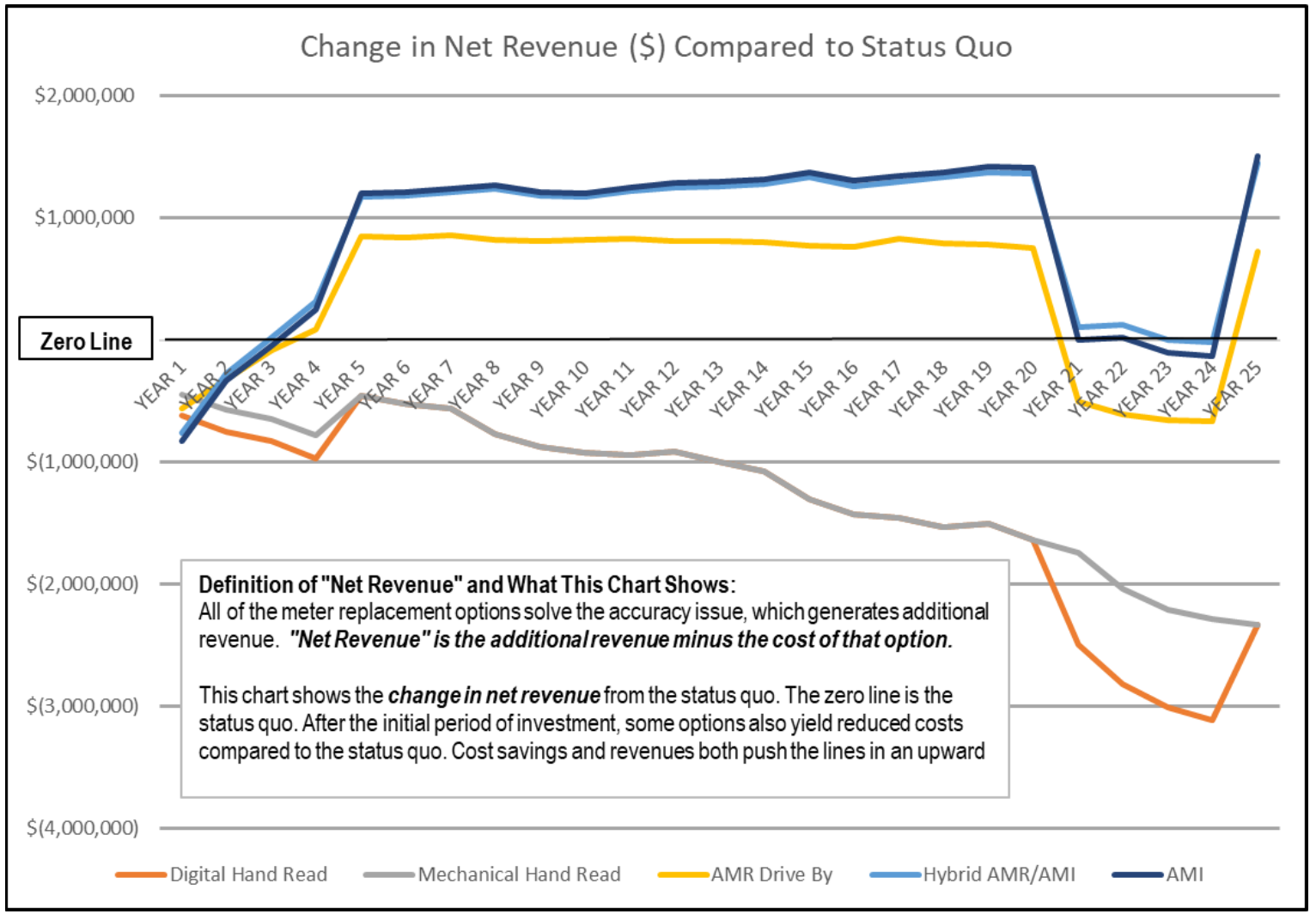
- **Ongoing Costs – Equipment & Software**
  - System/software support
  - Annual maintenance of collector units
- **Ongoing Costs – Labor and Vehicles**
  - Meter reading costs
  - Time required per drive-by read
  - Time required per walk-up read
  - New FTEs needed
  - Current L&G contract – weighted cost per meter
  - Number of vehicles needed
  - Gas/maintenance cost per AMR and manual-read meter
  - Cost per new vehicle
  - Life expectancy of vehicle
- **Current L&G contract – weighted cost per meter**
- **Assumptions Related to AMI System Management Functionality**
  - Number of annual disconnects
  - Time required per disconnect
  - Number of on-demand (move out) reads
  - Time required per on-demand read
  - Number of annual outages
  - Number of line workers per outage
  - Time required per outage
  - Loaded hourly rate for line workers
  - Percentage of outages reported after hours (requiring OT)
  - Overtime labor multiplier
  - Percent revenue loss due to inaccurate reads

Economic Analysis – Flow of Calculation

- **Assumptions**
- **Financial Projections by Year for Each Option**
  - » Capital costs
  - » Meter reading and other operating costs
  - » Additional revenue
  - » Additional revenue minus capital and operating costs
- **Result: Net Revenue by Year for Each Option**
  - » Subtract net revenue by year for Status Quo
- **Result: *Change in Net Revenue* by Year for Each Option**
  - » Discount each year to calculate equivalent present value
  - » Sum the present values for each year
- **Result: Net Present Value for each Option**

Results of Economic Analysis – Change in Net Revenue

- On this chart, the zero line is the status quo. Cost savings and revenue both push the lines upward.
- Data points above the zero line are economically better than the status quo.
- Data points below the zero line are worse than the status quo, because their costs (downward direction) exceed the cost of the status quo, even after taking into account the added revenue.
- The dip after Year 20 is from future replacement of meters



Net Present Value

- **Collapses the year-by-year Change in Net Revenue results into a single overall number**
- **Because money now is more valuable than money in a future year, future dollars "shrink" when converted into today's equivalent**
  - » Dollars in the near future shrink by a little; dollars in the distant future shrink a lot
- **Discount rate:**
  - » A measure of the District's willingness to exchange money today for money tomorrow
  - » Similar to interest rate, long-term cost of capital
  - » The higher the discount rate, the faster the dollars shrink
- **Example: AMR Drive-by option:**
  - » The discounted ("shrunken") cash flows summed together equal about $7.5 million
- **Net Present Value is useful for comparing alternatives**

Net Present Value (NPV) Illustration - AMR Drive-By Option

Assumed discount rate:		2.50%	
	Change in Net Revenue (from Status Quo)	Present Value of Change in Net Revenue	Discounted Value as % of Future Value
Year 0 ("The Present")	$ -	$ -	
Year 1	$ (560,217)	$ (546,553)	98%
Year 2	$ (327,503)	$ (311,722)	95%
Year 3	$ (89,673)	$ (83,270)	93%
Year 4	$ 79,817	$ 72,310	91%
Year 5	$ 837,759	$ 740,457	88%
Year 6	$ 832,654	$ 717,995	86%
Year 7	$ 844,907	$ 710,791	84%
Year 8	$ 804,069	$ 659,937	82%
Year 9	$ 797,952	$ 638,943	80%
Year 10	$ 809,147	$ 632,105	78%
Year 11	$ 820,833	$ 625,593	76%
Year 12	$ 799,542	$ 594,504	74%
Year 13	$ 792,263	$ 574,724	73%
Year 14	$ 784,611	$ 555,291	71%
Year 15	$ 758,682	$ 523,844	69%
Year 16	$ 750,227	$ 505,371	67%
Year 17	$ 808,861	$ 531,579	66%
Year 18	$ 775,662	$ 497,328	64%
Year 19	$ 766,839	$ 479,679	63%
Year 20	$ 730,140	$ 445,583	61%
Year 21	$ (524,844)	$ (312,485)	60%
Year 22	$ (622,978)	$ (361,866)	58%
Year 23	$ (676,704)	$ (383,486)	57%
Year 24	$ (683,252)	$ (377,753)	55%
Year 25	$ 704,553	$ 380,029	54%
Net Present Value of AMR Drive-By Option		$ 7,508,928	
Net Present Value (rounded)		$ 7,500,000	

Results of Economic Analysis – Change in Net Revenue

- **Hand-read is more costly than the status quo due to meter reading labor.**
  - » The last two options substitute collectors and backhaul costs for employee time. The annual savings justifies the initial capital investment.
- **Hybrid AMR/AMI and full AMI are very close economically.**
  - » Full AMI has higher average cost per meter but also higher ongoing savings.
- **Drive-by is better than the status quo but more costly than AMI or hybrid.**
- **By replacing old meters, all replacement options will eliminate the inaccuracy problem equally**

Change in Net Revenue - Net Present Value at 2.50%	
Digital Hand Read	($22,800,000)
Mechanical Hand Read	($20,300,000)
AMR Drive By	$7,500,000
Hybrid AMR	$14,500,000
AMI	$14,500,000

- **Positive numbers are better than the status quo; negative numbers worse**
- **Sensitivity analysis**
  - » We tested meter replacement cycle, discount rate, inaccuracy percentage
  - » Robust results – NPV changed but not priority of options

Non-Economic Analysis

- **Potential Health Impact of Radio Frequency (RF)**
  - » Ionizing radiation does have health impacts – e.g. X-rays, gamma rays
  - » Non-ionizing radiation carries frequencies many thousands of times weaker
  - » For decisions about cellular or AMR/AMI, the question has to do with whether there are potential impacts from *non-ionizing* radiation
  - » On that question, the science is inconclusive
    - – Standard-setting bodies (IEEE, U.S. Food & Drug Administration) so far consider the risk of health impacts to be minimal or inconclusive
    - – There are public health advocates who argue that RF is a non-negligible risk
    - – All agree that further research is needed
  - » The question for the PUD is what decision to make in the absence of conclusive scientific evidence
  - » We suggest that consumer behavior is the best indicator of acceptable risk – whether people continue to carry around a cell phone in their pocket
  - » If so, allowing individual customers to opt out is sufficient protection to the public

Non-Economic Analysis

- **Privacy**
  - » Concern is potential for misuse of data about individual customer electricity usage
  - » Again, we suggest following consumer behavior to gauge acceptable risk
  - » If most customers use social media, then they must be willing to accept significant exposure of personal data
    - – In its potential use of data, the PUD is much more benign than social media companies
  - » Again, allowing customers to opt out is sufficient to address this concern

- **Vulnerability to Hacking**
  - » Because AMI has operational capability, choosing AMI would increase potential consequences of hacking
  - » Choosing AMI would put a greater premium on data hygiene

Non-Economic Analysis

- **Reliability/Accuracy**
  - » All of the options would solve the current inaccuracy problem
  - » No differentiation
- **Compatibility**
  - » All of the options would have to be compatible with existing software
  - » No differentiation
- **Functionality – System Management**
  - » Only AMI has operational functionality – real-time system view, improved system control, allows customers to track their own usage
- **Functionality – Allows TOU Metering**
  - » AMR can support Time of Use rates but only inefficiently. Only AMI has the ability to offer TOU metering for residential meters in a cost-effective way

Non-Economic Analysis

Non-Economic Considerations	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR/AMI	AMI	Implications
Potential RF Health Impacts	=	+	+	=	Partial +	Partial +	Opt-out should be allowed.
Privacy	=	+	+	=	=	=	Opt-out should be allowed.
Vulnerability to Hacking	=	=	=	=	=	-	AMI requires good data hygiene.
Reliability/Accuracy	=	+	+	+	+	+	Any new option will solve accuracy issue.
Compatibility	=	=	=	=	=	=	Any new option has to be compatible.
Functionality	=	=	=	=	=	+	AMI allows quicker response, more control.
Allows Time of Use metering	=	=	=	=	=	+	Only AMI allows residential TOU rates.

- **AMI would bring increased responsibility for good data security practices**
- **AMI would offer system management capability**
  - Remote disconnects and reconnects
  - Outage notifications
  - On-demand reads (for move-outs)
  - Power theft notifications, low voltage notifications, hot socket detections (notify customers of fire hazards)
  - Daily reads that allow customers to track their own usage through an app
- **AMI would also offer cost-effective Time of Use rates for residential customers.**

Summary and Recommendation

- The strongest options economically are AMI and AMR/AMI hybrid.
- As long as opt-out is allowed and good data hygiene is practiced, the non-economic factors do not swing the business decision away from AMI.
- Two of the non-economic considerations favor AMI – the system management functionality and the ability to efficiently implement TOU metering for residential customers.
- We recommend AMI overall. The economics clearly favor the AMI and hybrid options, and between those two, the AMI has stronger non-economic advantages that justify the higher initial cost of the meters.

Questions?

FCS GROUP
Solutions-Oriented Consulting

Technical Memorandum

To: Kevin Streett, Jefferson Public Utility District **Date:** August 5, 2021

From: Gordon Wilson, FCS GROUP

Subject: Business Case Analysis – Electric Meter Replacement

INTRODUCTION

The purpose of this memo is to document our business case analysis of the potential approaches that Jefferson Public Utility District (JPUD) might take to electric meter replacement. This memo will describe the purpose and guiding principles for the metering decision, background about current metering practices, the options considered, and the criteria used to evaluate the options. The background information and guiding principles are similar to what was contained in the project plan that we discussed with the Board of Commissioners and the Citizen Advisory Board (CAB) on May 10. The list of options and the criteria have been updated since that discussion.

The memo will then present the assumptions and results of the financial analysis, a discussion of how the options were evaluated using the non-economic criteria, and our recommended approach to electric meter replacement.

PURPOSE OF BUSINESS CASE ANALYSIS

The purpose of this project has been to help JPUD reach a decision about what approach to take to electric metering in the future. The District needs to update its electric meters. To do so, it must make a choice about the type of technology to use to collect and transmit meter data. This analysis is intended to provide guidance for a Request for Proposals (RFP) process if the District moves forward with the acquisition of new meters.

The decision process is timely because the current metering service contract with Landis & Gyr (L&G) will expire in February 2023, and because the current mixture of metering systems presents persistent operational challenges and inaccurate data.

GUIDING PRINCIPLES FOR DECISION PROCESS

- The analysis should include credible research and a comparison of alternatives.
- The status quo must be evaluated so the analysis will have a frame of reference. However, truly doing nothing is not a preferred option. This effort should result in one intentional approach to metering, whether it be manual-read, AMR, or AMI metering.
- Among the other alternatives, the analysis should not have a predetermined outcome.

Terminology:

"AMR" stands for Automated Meter Reading, which uses one-way radio communication.

"AMI" stands for Advanced Metering Infrastructure, and it uses two-way radio communication. The implications of this difference are discussed

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- An effort will be made to engage members of the public in the decision, with transparency and full access to available information.
- Decision criteria will be applied to the designated options.
- The recommendation is to be based on the best available information, following the research, analysis, and discussion.

BACKGROUND

Current Meters

Jefferson Public Utilities District (JPUD) currently relies on about 19,500 meters to provide data for its account billing and system management. It currently has two main groups of meters, with different capabilities and limitations.

Landis & Gyr Meters

About 16,300 of the current meters are legacy Landis & Gyr (L&G) meters received when JPUD purchased the electric system from Puget Sound Energy in 2013. JPUD owns the meters but L&G owns the cell net monitoring inside the meters that allows connectivity to their network. L&G reads these meters under contract for a fixed charge per meter per month. The total contract costs about $355,000 per year.

The meters are considered AMR-capable meters because they send out a radio signal. A few drive-by or walk-up reads are needed just because the customer locations are out of range of the L&G transmission equipment. However, most of these meters (about 16,000) are within range of the L&G collectors, and these allow daily reads.

Approximately half of the L&G meters are mechanical meters, which lose accuracy over time. Because they are old, they understate actual electric usage. We reviewed data from the District's accuracy testing of a sample of 157 meters. The average understatement is estimated to be about 2.4% of all meters, or 5.8% of the mechanical meters.

In the years prior to 2017, about 450 of the L&G meters were failing each year and had to be replaced. By 2017, the most unreliable of the meters had already been replaced, but because of their age, a substantial number still fail each year. During the period from 2017-2020, an average of 101 legacy meters were replaced each year.

Itron Aftermarket Meters

As the L&G meters fail, they have been replaced by Itron meters purchased as replacements. Initially, the spot replacements were new meters, but over the past 2-3 years, used Itron meters have been available for purchase from Overton Power in Nevada, which is going through a meter upgrade project. The purchase of new or used Itron meters was intended as a stop-gap solution, but JPUD now has about 3,050 of them. JPUD owns the Itron meters.

The Itron meters are technically considered AMR meters because they send out a radio signal, but they require drive-by meter reading. Two staff members read them each month, which

requires about 8 days per month per employee. As more L&G meters fail and more Itron meters are acquired, the demand on staff time will grow. Because these meters require drive-by reading, they cannot provide daily reads.

The Itron meters are digital meters without moving parts, so they do not lose accuracy over time. As a result, there is a growing inequity between customers who are billed with digital meters and those billed with mechanical meters.

Opt-Out Meters

There are also about 150 walk-up meters with no telecommunications capability. These are used upon request by customers who opt out of the existing AMR metering. "Opt out" customers are charged a monthly fee to recover the extra labor time required for walk-up reads.

AMR and AMI Technology

AMR, which uses one-way radio communication, is an older technology, but it is more advanced than "manual read" meters that require a person walk up and visually take a reading on site. Depending on whether it requires drive-by reads or not, AMR can be an efficient way to do one thing: measure electric usage for the sake of calculating customer bills.

AMI is a newer class of meters with two-way radio communication capability, and they are not limited to measuring electric usage for billing purposes. They can also be used for operational tasks, such as:

- Remote disconnects and reconnects;
- Outage notifications;
- On-demand reads (for move-outs);
- Daily reads that allow customers (through an app) to track their own usage;
- Power theft notification;
- Hot socket detection (to notify customers of fire hazards); and
- Notifications of low voltage.

In general, the two-way capability of AMI allows more efficient operational control and a real-time view of system demand, including problems and anomalies. With AMI, the system operator does not depend as much on customer call-ins to find out what is happening across the system.

AMI technology also allows greater control of the frequency of the radio signals sent by the meters. The current L&G meters broadcast every five minutes. Newer AMI meters are programmable, and they allow the data to be transmitted as few as two times per day. This feature could reduce the total level of RF (radio frequency) in the County.

Previous Consideration of Meter Replacement

In 2017, JPUD staff initiated a Request for Proposals (RFP) process to replace all of the meters with a single type of meter with advanced technology. After concerns were expressed by the public, the Board decided to hold off on the project, pending further research and public discussion. The current business case analysis is an attempt to step back from an RFP process and first examine the preliminary questions: should the meters be replaced, and if so, with what?

The 2017 effort yielded useful information about potential vendors, options, and the cost of potential replacement systems. JPUD also recently received unsolicited proposals from two firms for replacement metering systems, which gives us further information about options and costs.

Collection and Transmission of the Meter Data

With manual-read meters or drive-by meters, the data would be transported to the JPUD office by the employees who collect the metering information.

With AMI meters or AMR meters that do not require drive-by collection, a group of meters would send data to a limited number of "collectors" spread throughout the District's service area. In this memo, the term "collector" is a simplified label for any piece of equipment that gathers data from a group of meters.

Terminology: In this memo, the term "collector" is a simplified label for any piece of equipment that gathers data from a group of meters.

"Backhaul" refers to the transmission of data from the collectors to the central office

The 2017 bids contained information on the equipment that would be required to collect data from the meters. In the bids, the collection equipment is described as gateways, relays, collectors, routers, repeater nodes, collector/base stations, or just "data collection units." While these might represent different types of equipment that are not directly comparable, their overall cost was comparable. In the bids, the average number of collection devices was 73, and their average cost per unit was $2,885, or $3,344 in 2021 dollars.

After the data is gathered by a collector, it must be transmitted to the District's central office. The process of transmitting the data from the collectors to the central office is sometimes referred to as the "backhaul" process. There is more than one type of technology that can be used to transmit data to the central office. The backhaul methods can include an RF mesh network, fiber cables, WiFi, powerline transmission, or the existing cellular network. The optimal method may be different for different parts of the JPUD service area. The backhaul method would need to be chosen by the District, and its costs are generally separate from the meter acquisition cost. In our financial analysis we assumed the backhaul cost consisting of a 10-year lease of cellular network capacity, as described in one of the 2017 bids.

OPTIONS FOR CONSIDERATION

1. **Status Quo**

   Continue current mixture of metering systems, with limited annual meter replacements and a continuation of a service contract with Landis & Gyr. This might not be a realistic option for the long term, because L&G might not want to extend the current contract. However, the status quo is the frame of reference for evaluating the other options.

2. **Replacement with Digital Hand-Read Meters**

   Replace meters over 3-5 years with digital hand-read meters, including the necessary staffing, vehicles and equipment.

3. **Replacement with Mechanical Hand-Read Meters**

   Replace meters over 3-5 years with mechanical hand-read meters, including the necessary staffing, vehicles and equipment.

4. **Replacement with Drive-by AMR meters**

   Replace meters over 3-5 years with drive-by AMR meters and the communications technology to support their use.

5. **Replacement with Hybrid AMR System**

   Replace meters over 3-5 years with AMR meters and the communications technology to support their use without requiring drive-by meter reading. Based on conversations with a vendor, this option assumes that there needs to be one TUNet device per eight meters and that the TUNet devices can be either collectors or AMI meters.

6. **Replacement with AMI System**

   Replace meters over 3-5 years with AMI meters and the communications technology to support their use.

For Option 2, 3, and 4, we assume that the manual reads and drive-by reads would be done by District employees.

Previous public comments included an inquiry about the potential for self-read meters as one of the options to be considered. Self-read metering has been adopted by some utilities for their most remote areas, but according to District staff, the self-read approach is subject to significant inaccuracies due to either neglect or deception. In addition, they create an administrative burden, because the self-read data needs to be hand-entered into the billing system by staff, and any verification procedures (such as reviewing photographs submitted by the customers) must be reviewed by staff. For those reasons, we did not include a self-read option for the PUD to consider as its primary approach to electric metering.

CRITERIA

Economic Analysis:

- **Net Revenue Compared to the Status Quo**

  The chosen approach to metering should be available for a reasonable and affordable cost, as measured by the change in net revenue from the status quo. "Net Revenue" for each option is the additional revenue from improving meter accuracy, minus the costs—total up-front installed cost, projected ongoing O&M costs, and projected meter replacement costs.

Non-Economic Analysis:

- **Potential Radio Frequency (RF) Health Impacts**

  The chosen approach to metering should entail an acceptable level of risk with respect to the negative health impacts from radio frequency.

- **Privacy**

  The chosen approach to metering should entail an acceptable level of risk with respect to the misuse of customers' private data.

- **Vulnerability to Hacking**

  The chosen approach to metering should entail an acceptable level of risk with respect to malicious hacking.

- **Reliability and Safety**

  The chosen approach to metering should allow reliable and accurate service, including well established technology offered by reputable vendors, with support during installation.

- **Compatibility**

  The chosen approach to metering should be compatible with the JPUD billing software, both current software and any projected updates from the vendor. If possible, it should also allow compatibility with future investments in the water metering system.

- **Functionality – System Management**

  The chosen approach to metering should at least provide electric usage data for customer billing purposes. It would be advantageous for the chosen approach also to provide system management capability, such as improved operational control, flexibility, resilience, a real-time view of system operations, and data available to customers. The functionality assessment should take into account the potential for long-term changes to the nature of electric demand.

- **Functionality – Time-of-Use Metering**

  It would be advantageous for the chosen approach to allow time-of-use metering to be implemented cost effectively for residential customers.

ECONOMIC ANALYSIS - OVERVIEW

To assess the economic advantages of the various options, we built a financial forecast model that projects the net revenue of each meter replacement option in relation to the net revenue of the status quo option. The forecast model has a horizon of 25 years, to allow meter replacements to be included in the forecast. The detailed tables from the model are contained in **Appendix A** at the end of this memo.

In order to make the results understandable, we will explain some key variables.

The model results in year-by-year projections for three of the key variables: *Additional Revenue*, *Net Revenue*, and *Change in Net Revenue*. The forecast shows these three variables for each year and each option. At the very end of the economic analysis, the year-by-year projections for each option are combined across years into a single *Net Present Value* number.

Additional Revenue

Because the current meter inaccuracy problem is a function of very old meters, all five of the meter replacement options – digital hand-read, mechanical hand-read, drive-by AMR, hybrid AMR, and AMI – result in *Additional Revenue*, because all five would mean replacing the old meters. The meter replacement project is assumed to be carried out over four years. By Year 5, the Additional Revenue is projected to be about $826,000 per year. That figure is the same for all replacement options, and it is assumed to grow with inflation. Prior to Year 5, the Additional Revenue figure is assumed to grow gradually to the $826,000 level.

Net Revenue

The Additional Revenue does not differentiate between the various options, but the *costs* are different for each option. The *Net Revenue* for each option consists of the Additional Revenue minus all of the applicable costs of the option—the cost of purchasing and installing the meters and related equipment, the ongoing cost of maintaining and reading the meters, and the eventual cost of having to replace the meters.

In some years—including Years 1 through 4, when the initial meter replacement program is underway—the cost of all the options will exceed the increased revenue. In those years, the Net Revenue will be a negative number. In subsequent years, the Additional Revenue may exceed the cost of reading and maintaining the meters, and in those years, the Net Revenue may be a positive number. Near the end of the forecast period, as the meters need to be replaced, the Net Revenue figures will be negative numbers again, as the cost of another replacement exceeds the Additional Revenue.

Change in Net Revenue

The *Change in Net Revenue* is the difference between the Net Revenue of each replacement option and the Net Revenue of the status quo in a given year. Again, this can be a positive or negative number. A positive number means that the Net Revenue of the option exceeds that of the status quo—the option is better than the status quo economically. A negative number means that the option is less favorable than the status quo in that particular year.

Net Present Value

After we have calculated the Change in Net Revenue for each option for each forecast year, we need a way to characterize the overall favorability or unfavorability of each option across all the years. The final step in our economic analysis is to collapse the year-by-year Change in Net Revenue results into a single figure. We do this by calculating a Net Present Value for each option, assuming a discount rate of 2.5%. For the Net Present Value, negative numbers mean that the overall option is less favorable than the status quo, and positive numbers mean that the option is more favorable than the status quo.

Net Present Value is the up-front equivalent value of a stream of payments over a given number of years at an assumed discount rate. Because money now is more valuable than money in a future year, future dollars "shrink" when they are converted into today's equivalents. To use a simple example, $10,000 received 10 years from now would be equivalent to $7,812 today at 2.5% interest, because if a person had $7,812 today and invested it at 2.5% per year, it would grow to $10,000 by Year 10.

In general terms, the discount rate is a measure of JPUD's willingness to exchange money today for money tomorrow. There are different ways to estimate it, but for this analysis, we treat it as equivalent to the long-term cost of capital, which we assume at 2.5% per year.

In this forecast, the Change in Net Revenue for each year is separately "shrunk"—that is, converted into a value at Year 0 (the present). Then the "shrunken dollars" (present values) corresponding to each future year are summed to yield the Net Present Value for the entire option. Later in this memo, when we report the results of the economic analysis, we will show an example that illustrates the shrinking of dollars from the future to their equivalent present values, along with the summing of the present values of all of the forecast years.

ECONOMIC ANALYSIS – KEY ASSUMPTIONS

The following assumptions were used to test and compare the net revenue for each option. The detailed values for each assumption are shown in **Appendix A, Exhibit A-1**.

Overall Economic Assumptions

- The model assumes 2.0% per year for general cost inflation, 3% per year for construction cost inflation, and approximately 4% for labor and benefits inflation. These factors are consistent with the escalation assumptions in our recent rate study.
- The applicable sales taxes are 6.5% for Washington State and an additional 2.6% in Port Townsend.

Meters, Capital, and Annual System Costs

- The current meter inventory was provided by staff--approximately 16,300 L&G meters, 3,050 aftermarket Itron meters, and 150 opt-out meters. Based on the average for 2017-2020, we assumed that 101 meters per year are replaced in the status quo scenario.

- The cost estimates for AMI meters came from the 2017 low bid, inflated to 2021. The used Itron meters currently being purchased were included at their actual cost. Because Itron was the low bidder in 2017 and we wanted to have a valid comparison with the other options, the staff obtained Itron prices for a new digital meter, a refurbished mechanical meter, and a new AMR meter. This does not imply that Itron would necessarily be the selected vendor if the District decides to replace its meters. In this business case analysis, we are not evaluating *companies*; we are evaluating *types of technology*. Obtaining cost estimates for Itron products is simply a way to get an apples-to-apples comparison of different technological approaches. Following are the price and useful life assumptions for the different options:
  - Used Itron meters (drive-by, status quo): $15.52 per meter, 10 years remaining useful life.
  - Refurbished Itron mechanical meters (hand-read): $20.69 per meter, 40 years useful life.
  - New Itron digital meters (hand-read): $53.06 per meter, 20 years useful life.
  - New Itron AMR meters: $103.47 per meter, 20 years useful life.
  - New Itron AMI meters: $119.05 per meter, 20 years useful life.
- We assumed that 150 customers would continue to use opt-out meters. For those meters, we assumed the price and expected useful life of new digital hand-read meters.
- Based on the average from the 2017 bids, we assumed that 73 collectors would be needed for an AMI system, at an average price (in 2021 dollars) of $3,344 per collector.
- According to one of the vendors, the AMR Hybrid option would require one TUNet device for every eight meters, and a TUNet device could be either a collector or an AMI meter. So for that option, we assumed 74 collectors and 2,102 AMI meters to serve as TUNet devices.
- Based on information from vendors or staff, we assumed that each collector would require a battery costing $2,000, and that each battery would last seven years. In addition, collectors would require twice-yearly maintenance of 30 minutes each at a loaded hourly employee cost of $44.52.
- Installation of the new meters would be performed by District employees. Based on estimates provided by the staff, we assumed installation time of 15 minutes per meter, 60 minutes per collector, and a loaded hourly rate of $44.52 for employee time.
- Based on the average of the 2017 bids (inflated to 2021 dollars), we assumed project management and related costs for the meter replacement program of about $208,000.
- We added sales tax to the capital costs, and we assumed shipping at 2% of total capital cost.
- Based on Aclara's response to the 2017 RFP, we assumed an up-front cellular backhaul cost of $220 per collector for a 10-year lease (applicable to the Hybrid and AMI options). This is in addition to system/software costs of over $60,000/year (which was the average of the bids), also for the Hybrid and AMI approaches.

- For AMI options, up-front software costs were $138,000 (the average of the bids), with another $36,000 of equipment required for both AMR and AMI options.

Meter Reading Costs

- Currently two employees spend about 8 days per month each to read 3,050 drive-by meters and 150 walk-up meters. Based on this data, an average of 1.6 minutes is required per drive-by read and an average of 19.2 minutes per walk-up read.
- However, if the entire district were using walk-up reads, the transportation would be more efficient than at present, when only 150 customers receive walk-up reads. After consulting with the staff, the model assumes that if either of the hand-read options were chosen, reading the meters would require an average of 8 minutes per walk-up read from employees.
- The L&G contract comes with a weighted average cost of $1.68 per meter.
- We assumed an average of 1,800 hours of time on task per full-time equivalent (FTE) employee. In other words, 40 hours per week times 52 weeks equals 2,080 hours, but some of that time is spent on sick or vacation leave, holidays, training, staff meetings, and other overhead tasks. So 1,800 hours per year per FTE is the assumption for time spent actually reading meters.
- Currently, two vehicles are used for meter reading. Based on this information and input from the staff, we assumed that $1.25 per drive-by meter would be spent on gas and vehicle maintenance if the entire system consisted of hand-read meters. If the system is replaced with AMI, Hybrid, or AMR drive-by, then the vehicle operation cost per meter for the opt-out hand-read meters would be $8.62 in today's dollars, consistent with the current costs.
- We also assumed that new vehicles would cost $28,000 each and last 7 years.

Assumed Benefits from Reduced Costs or Increased Revenue

- Based on previous meter testing, we assumed that electric usage is undercounted by 2.43% of all meters, or about $826,000 per year. This additional revenue would apply to all of the meter replacement options.
- Three kinds of cost savings would apply only to the AMI option. Our assumptions are based on data provided by the staff.
  - There are about 775 disconnects per year, each of which currently requires a field meter read averaging 30 minutes per read. These field reads would not be needed with an AMI system.
  - There are about 1,850 on-demand reads per year, each requiring about 30 minutes, with a loaded hourly rate of meter readers of $44.52. With an AMI system, these would not need to be done in the field.
  - Finally, there are about 350 outages per year. A team of four line workers is required to respond to each outage, requiring an average of 120 minutes to resolve each outage.

The loaded hourly rate of line workers is $80.82. According to the staff, about 2% of these outages are reported after hours even though the outage occurred during the day, as someone arrives home from work and sees that the power is out. The workers who respond to the after-hours outages are paid overtime at two times the normal hourly rate. With AMI, outages would only require overtime to resolve if they actually occur after hours, since the system operators would be notified in real time through the AMI network if an outage occurs, without relying on customer reporting. This would be a savings in overtime labor.

ECONOMIC ANALYSIS - RESULTS

Exhibit 1 shows the detailed calculation of total costs, total revenue, and net revenue for one of the options—the AMR drive-by option. (**Appendix A, Exhibit A-2** contains these same tables for all of the options.) The bottom row is the Net Revenue—that is, the Additional Revenue minus the total cost—for each year. To focus on one example, we can see that in Year 5, Additional Revenue of $832,039 more than offsets the $437,323 in costs, resulting in Net Revenue of $394,716.

Exhibit 2 summarizes the Net Revenue for each forecast year for each option, including the status quo option. In the column labeled "AMR Drive-by," we see that in Year 5 the result is a net revenue of $394,716. This is the figure we saw on the bottom line of **Exhibit 1**.

Exhibit 3 summarizes the Change in Net Revenue for each forecast year for each option. In this table, there is no status quo option, since the Change in Net Revenue subtracts the Net Revenue of the status quo option from the figures for each of the other options.

For example, in **Exhibit 2** we saw that the status quo Net Revenue in Year 5 is a negative $443,044. We already observed that the AMR Drive-by Net Revenue in Year 4 is a positive $394,716. The difference between the two is $837,759. So **Exhibit 3** shows that the Year 5 number for the AMR Drive-by option is a positive $837,759.

The chart on **Exhibit 4** depicts the Change in Net Revenue for all of the options across the entire forecast. During the initial investment period (Years 1-3) and the re-investment period (Years 21-24), all of the options are "worse" than the status quo—that is, the Change in Net Revenue is less than zero. However, the three options using technological devices to read the meters—AMR Drive-by, Hybrid AMR, and AMI—have a long stretch of years where the Change in Net Revenue is positive, ranging from $800,000 to $1.3 million. On the other hand, the two options using employee labor to read the meters—Digital Hand-Read and Mechanical Hand-Read—are consistently negative throughout the forecast period.

Exhibit 1: Costs and Additional Revenues – AMR Drive-by Option

AMR Drive By	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 502,515	$ 517,590	$ 533,118	$ 549,112	$ -	$ -	$ -	$ -	$ -	$ -
Collector Units	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Batteries	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Software	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	36,053	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	84,000	28,560	-	29,714	-	-	-	110,836	-	45,036
Other	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 622,568**	**$ 546,150**	**$ 533,118**	**$ 578,825**	**$ -**	**$ -**	**$ -**	**$ 110,836**	**$ -**	**$ 45,036**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	54,259	56,470	58,771	61,166	-	-	-	-	-	-
Collector Unit Installation	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	51,910	54,026	56,227	58,519	-	-	-	-	-	-
Installation Costs		**$ 106,169**	**$ 110,496**	**$ 114,998**	**$ 119,684**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sales Taxes		56,654	49,700	48,514	52,673	-	-	-	10,086	-	4,098
Shipping Costs		12,451	10,923	10,662	11,577	-	-	-	2,217	-	901
Other Capital Costs		**$ 69,105**	**$ 60,623**	**$ 59,176**	**$ 64,250**	**$ -**	**$ -**	**$ -**	**$ 12,303**	**$ -**	**$ 4,999**
Total Capital Costs		**$ 797,843**	**$ 717,269**	**$ 707,292**	**$ 762,760**	**$ -**	**$ -**	**$ -**	**$ 123,139**	**$ -**	**$ 50,035**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 8,014	$ 5,560	$ 2,893	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Itron Meter Reads	Labor/Benefits Cost Inflation	32,049	22,237	11,571	-	-	-	-	-	-	-
Current L&G Meter Reading	General Cost Inflation	245,965	167,256	85,301	-	-	-	-	-	-	-
New Meter Reads (incl. future Opt Out)	Labor/Benefits Cost Inflation	70,447	146,636	228,917	317,661	330,605	344,078	358,099	492,917	601,875	734,917
Vehicle Maintenance	General Cost Inflation	10,187	15,578	21,181	27,003	27,543	28,093	28,655	33,574	37,069	40,927
Annual System Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Collector Unit Maintenance	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Total Operating Costs		**$ 366,662**	**$ 357,268**	**$ 349,864**	**$ 344,663**	**$ 358,148**	**$ 372,171**	**$ 386,754**	**$ 526,492**	**$ 638,944**	**$ 775,844**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ 17,252	$ 17,954	$ 18,686	$ 19,448	$ 20,240	$ 21,065	$ 21,923	$ 30,177	$ 36,848	$ 44,993
On Demand Reads	Labor/Benefits Cost Inflation	41,181	42,859	44,606	46,423	48,315	50,284	52,333	72,036	87,959	107,402
Outage Response - OT Hours	Labor/Benefits Cost Inflation	9,052	9,421	9,805	10,204	10,620	11,053	11,503	15,834	19,334	23,608
Total Other Service Costs		**$ 67,484**	**$ 70,234**	**$ 73,096**	**$ 76,075**	**$ 79,175**	**$ 82,401**	**$ 85,759**	**$ 118,046**	**$ 144,140**	**$ 176,002**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 1,231,989**	**$ 1,144,771**	**$ 1,130,253**	**$ 1,183,498**	**$ 437,323**	**$ 454,573**	**$ 472,513**	**$ 767,677**	**$ 783,084**	**$ 1,001,881**
Revenue											
Increased Revenue from Retiring Old Meters		$ 188,311	$ 390,850	$ 609,033	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Total Revenue		**$ 188,311**	**$ 390,850**	**$ 609,033**	**$ 826,250**	**$ 832,039**	**$ 837,884**	**$ 843,787**	**$ 893,139**	**$ 925,997**	**$ 960,498**
Net Revenue		**$(1,043,678)**	**$ (753,920)**	**$ (521,221)**	**$ (357,248)**	**$ 394,716**	**$ 383,311**	**$ 371,273**	**$ 125,462**	**$ 142,914**	**$ (41,383)**

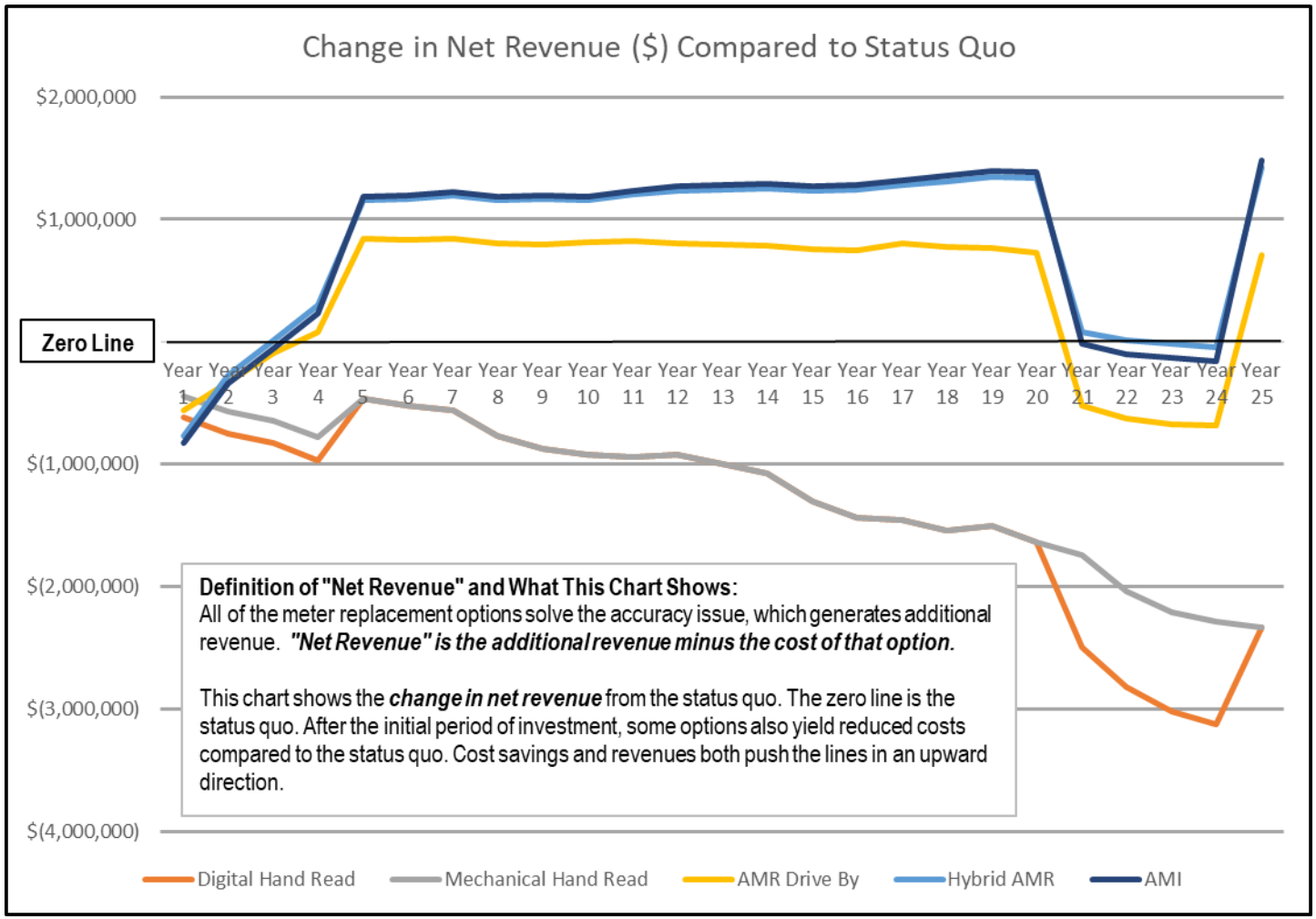
Exhibit 2: Summary of Net Revenue (Additional Revenue minus Cost)

Net Revenue (Additional Revenue minus Cost)	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
Year 1	$ (483,461)	$ (1,101,725)	$ (926,433)	$ (1,043,678)	$ (1,249,072)	$ (1,311,029)
Year 2	(426,417)	(1,176,838)	(996,288)	(753,920)	(701,816)	(765,398)
Year 3	(431,548)	(1,261,590)	(1,075,624)	(521,221)	(418,977)	(484,223)
Year 4	(437,065)	(1,407,249)	(1,215,704)	(357,248)	(133,779)	(200,729)
Year 5	(443,044)	(903,135)	(903,135)	394,716	717,921	743,471
Year 6	(449,343)	(967,452)	(967,452)	383,311	720,505	747,096
Year 7	(473,634)	(1,034,559)	(1,034,559)	371,273	723,040	750,715
Year 8	(552,696)	(1,318,972)	(1,318,972)	251,374	604,185	632,988
Year 9	(489,216)	(1,359,852)	(1,359,852)	308,736	676,586	706,562
Year 10	(478,073)	(1,402,510)	(1,402,510)	331,074	677,417	708,615
Year 11	(542,540)	(1,484,956)	(1,484,956)	278,293	658,564	691,033
Year 12	(498,972)	(1,416,162)	(1,416,162)	300,570	734,884	768,677
Year 13	(508,153)	(1,502,607)	(1,502,607)	284,110	737,061	772,231
Year 14	(517,812)	(1,592,756)	(1,592,756)	266,799	739,165	775,767
Year 15	(633,221)	(1,933,039)	(1,933,039)	125,462	597,761	635,855
Year 16	(562,617)	(1,994,118)	(1,994,118)	187,609	679,958	719,605
Year 17	(599,473)	(2,057,801)	(2,057,801)	209,388	679,921	721,183
Year 18	(630,927)	(2,167,770)	(2,167,770)	144,734	679,736	722,680
Year 19	(600,689)	(2,104,620)	(2,104,620)	166,150	748,433	793,126
Year 20	(587,226)	(2,220,423)	(2,220,423)	142,914	750,003	796,517
Year 21	(600,967)	(3,096,168)	(2,341,138)	(1,125,811)	(516,748)	(619,573)
Year 22	(709,711)	(3,530,081)	(2,749,862)	(1,332,689)	(701,137)	(806,526)
Year 23	(630,597)	(3,644,846)	(2,838,581)	(1,307,301)	(649,037)	(757,045)
Year 24	(646,555)	(3,764,233)	(2,931,031)	(1,329,808)	(692,769)	(803,455)
Year 25	(745,936)	(3,077,421)	(3,077,421)	(41,383)	673,700	730,496

Exhibit 3: Change in Net Revenue from Status Quo Option

Change in Net Revenue (from Status Quo)	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
Year 1		$ (618,264)	$ (442,972)	$ (560,217)	$ (765,610)	$ (827,568)
Year 2		(750,421)	(569,871)	(327,503)	(275,399)	(338,981)
Year 3		(830,042)	(644,076)	(89,673)	12,571	(52,675)
Year 4		(970,185)	(778,639)	79,817	303,285	236,336
Year 5		(460,092)	(460,092)	837,759	1,160,965	1,186,515
Year 6		(518,109)	(518,109)	832,654	1,169,847	1,196,438
Year 7		(560,925)	(560,925)	844,907	1,196,674	1,224,349
Year 8		(766,277)	(766,277)	804,069	1,156,880	1,185,683
Year 9		(870,635)	(870,635)	797,952	1,165,802	1,195,778
Year 10		(924,437)	(924,437)	809,147	1,155,490	1,186,688
Year 11		(942,416)	(942,416)	820,833	1,201,104	1,233,573
Year 12		(917,189)	(917,189)	799,542	1,233,857	1,267,649
Year 13		(994,454)	(994,454)	792,263	1,245,214	1,280,384
Year 14		(1,074,944)	(1,074,944)	784,611	1,256,977	1,293,580
Year 15		(1,299,818)	(1,299,818)	758,682	1,230,982	1,269,076
Year 16		(1,431,500)	(1,431,500)	750,227	1,242,576	1,282,222
Year 17		(1,458,327)	(1,458,327)	808,861	1,279,395	1,320,656
Year 18		(1,536,843)	(1,536,843)	775,662	1,310,664	1,353,607
Year 19		(1,503,931)	(1,503,931)	766,839	1,349,122	1,393,815
Year 20		(1,633,197)	(1,633,197)	730,140	1,337,229	1,383,743
Year 21		(2,495,201)	(1,740,170)	(524,844)	84,219	(18,605)
Year 22		(2,820,370)	(2,040,151)	(622,978)	8,574	(96,815)
Year 23		(3,014,250)	(2,207,984)	(676,704)	(18,440)	(126,449)
Year 24		(3,117,677)	(2,284,475)	(683,252)	(46,214)	(156,899)
Year 25		(2,331,485)	(2,331,485)	704,553	1,419,636	1,476,432

Exhibit 4: Change in Net Revenue Compared to Status Quo



There is one more step in summarizing the results of the economic analysis: collapsing all of the years for each option into a single Net Present Value figure. To do this, the Change in Net Revenue for each year must be "shrunk" from the future year to Year 0, the present. Then the present-day equivalents of each future Change in Net Revenue is summed together into a single number.

Exhibit 5 illustrates this process for the AMR Drive-by option, assuming a 2.5% discount rate.

Exhibit 5: Illustration of Net Present Value Calculation

Net Present Value (NPV) Illustration - AMR Drive-By Option			
Assumed discount rate:		2.50%	
	Change in Net Revenue (from Status Quo)	Present Value of Change in Net Revenue	Discounted Value as % of Future Value
Year 0 ("The Present")	$ -	$ -	
Year 1	$ (560,217)	$ (546,553)	98%
Year 2	$ (327,503)	$ (311,722)	95%
Year 3	$ (89,673)	$ (83,270)	93%
Year 4	$ 79,817	$ 72,310	91%
Year 5	$ 837,759	$ 740,457	88%
Year 6	$ 832,654	$ 717,995	86%
Year 7	$ 844,907	$ 710,791	84%
Year 8	$ 804,069	$ 659,937	82%
Year 9	$ 797,952	$ 638,943	80%
Year 10	$ 809,147	$ 632,105	78%
Year 11	$ 820,833	$ 625,593	76%
Year 12	$ 799,542	$ 594,504	74%
Year 13	$ 792,263	$ 574,724	73%
Year 14	$ 784,611	$ 555,291	71%
Year 15	$ 758,682	$ 523,844	69%
Year 16	$ 750,227	$ 505,371	67%
Year 17	$ 808,861	$ 531,579	66%
Year 18	$ 775,662	$ 497,328	64%
Year 19	$ 766,839	$ 479,679	63%
Year 20	$ 730,140	$ 445,583	61%
Year 21	$ (524,844)	$ (312,485)	60%
Year 22	$ (622,978)	$ (361,866)	58%
Year 23	$ (676,704)	$ (383,486)	57%
Year 24	$ (683,252)	$ (377,753)	55%
Year 25	$ 704,553	$ 380,029	54%
Net Present Value of AMR Drive-By Option		$ 7,508,928	
Net Present Value (rounded)		$ 7,500,000	

As we saw previously, the Change in Net Revenue is negative in the early years, while the initial investment is made in the new meters. Then there is a long period in which the Change in Net Revenue is positive, because once the initial investment is made, the new technology has relatively low ongoing costs—much lower than the status quo. Then, beginning in Year 21, another period of re-investment is needed, and the Change in Net Revenue becomes negative again.

This table also shows the impact of the discounting. Net revenue in Year 1 is worth 98% as much as net revenue now. In contrast, net revenue in Year 25 is only worth 54% as much as net revenue now.

The Net Present Value for the AMR Drive-by option as a whole is derived by adding together all of the discounted values for the individual years. For comparison purposes, the total of $7,508,928 has been rounded off to a Net Present Value of $7.5 million.

Exhibit 6 shows the Net Present Value figures for each option. It shows that the digital hand-read and mechanical hand-read options are far more costly than the status quo, with a discounted net cost ranging from $20.3 million and $22.8 million. This is primarily because of the amount of labor that would be needed to read the meters. About 16.5 FTEs would be needed to read all 19,500 meters manually using employee time.

Exhibit 6: Net Present Value of All Options

Change in Net Revenue - Net Present Value at 2.50%	
Digital Hand Read	($22,800,000)
Mechanical Hand Read	($20,300,000)
AMR Drive By	$7,500,000
Hybrid AMR	$14,500,000
AMI	$14,500,000

The AMR Drive-by is the middle option. It is more advantageous than the status quo but not the most favorable option economically. It takes advantage of efficiencies by having data collection take place in vehicles instead of on foot, but it is not as efficient as using collectors and the backhaul process to transmit data to the District office.

The Hybrid AMR and full AMI options are equivalent economically, and both have a Net Present Value of $14.5 million compared with the status quo. It is clear that there would be substantial economic advantages from using collectors and the backhaul process to collect meter data in place of employee labor, and that cost advantage is easily enough to justify the initial investment that would be required.

NON-ECONOMIC ANALYSIS

The following comments address the non-economic criteria.

Potential Health Impact of Radio Frequency (RF)

It is clear that some forms of electromagnetic radiation can cause negative health effects—that is evident whenever an X-ray technician steps behind a screen before flipping the switch. However, X-rays and gamma rays are *ionizing* radiation. Non-ionizing radiation carries frequencies many thousands of times weaker than ionizing radiation. For decisions about 5G cellular transmission or AMR/AMI radio frequencies, the question has to do with whether there are potential impacts from *non-ionizing* radiation.

On that question, the science appears to be inconclusive. Standard-setting bodies such as IEEE or the U.S. Food & Drug Administration so far consider the risk of health impacts to be minimal or inconclusive. However, there are public health advocates who argue that radio frequency (RF) is a non-negligible risk.

The basis for many of the concerns of public health advocates is *in vivo* research—testing done with animals. However, a recurring theme of those most concerned about the health effects of RF is the need for more research.

The FDA in February 2020 published a document, *Review of Published Literature Between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer*. This document reviewed findings from 125 *in vivo* studies and 70 epidemiological studies. The Executive Summary (pp. 4-6) notes some significant limitations in the ability to draw conclusions about human health impacts from *in vivo* research. "Given the difficulties of conducting *in vivo* studies on the effect of RFR exposure experienced by humans . . . and the widespread use of cell phones, strong epidemiological studies generally provide more relevant and accurate information. In vivo studies are of immense value in medical science, but they are less useful than studying effects on the human population [i.e., epidemiological research], where that is feasible." The report notes "cancer rates that show a slight decrease in brain tumors despite the enormous increase in cell phone use over the last two decades." The Executive Summary concludes: "Based on the studies that are described in detail in this report, there is insufficient evidence to support a causal association between RFR exposure and tumorigenesis. There is a lack of clear dose response relationship, a lack of consistent findings or specificity, and a lack of biological mechanistic plausibility." However, the FDA acknowledges many points of uncertainty throughout the report.

If the science is not settled, the question for the PUD is what decision to make in the absence of conclusive scientific evidence. We would suggest that consumer behavior is the best indicator of acceptable risk—whether people continue to carry around cell phones and place them at their ear. Since most people do that, then the PUD can conclude that most people find the risk of RF health impacts to be tolerable. In that case, allowing individual customers to opt out of AMR or AMI metering would be sufficient response to this issue.

The status quo is based on AMR technology, which does use radio transmission to communicate metering data. The current L&G meters broadcast every five minutes. The more advanced technology is programmable and offers greater control—data can be transmitted as few as two times per day. This feature means that the AMI and AMR hybrid options could reduce the total level of RF in the PUD service area compared to the current level.

Privacy

The privacy concern has to do with the potential for misuse of data about individual customer electricity usage. Again, we suggest following consumer behavior to gauge acceptable risk. If most customers use social media, then they must be willing to accept significant exposure of personal data. In its potential use of metering data, the PUD is much more benign than social

media companies. Based on this reasoning, we suggest that offering customers the ability to opt out of AMI or AMR would be sufficient response to privacy concerns.

Vulnerability to Hacking

Because AMI has operational capability, choosing AMI would increase the potential consequences of hacking. Choosing AMI would therefore put a greater premium on good data security practices. With regard to data security, the other options are not significantly different from the status quo.

Reliability/Accuracy

All of the options would solve the current inaccuracy problem, so there is no differentiation among them with regard to this criterion.

Compatibility

All of the options would have to be compatible with the District's existing software—that would be a requirement in any RFP that might be issued. So again, we do not see any differentiation with regard to this criterion.

Functionality – System Management

Only AMI has operational functionality—the real-time system view, improved system control, and the ability to allow customers to track their own usage in between billing periods. Some of those operational advantages were quantified in the economic analysis, but not all. For example, there would be a benefit to customer relations from identifying outages as they occur so they can be addressed more quickly.

Functionality – Time-of-Use Metering

According to the staff, AMR can be used to provide time-of-use metering but not cost effectively, so it would only make sense to do it for the largest commercial or industrial customers. AMI is the only option that could practically be used to implement TOU metering for all customers, including residential customers.

Summary of Non-Economic Analysis

Exhibit 7 summarizes our evaluation of the non-economic criteria, using a simple three-part classification. A plus sign and green shading indicates that an option is more advantageous than the status quo with respect to a given criterion. A minus sign and orange shading indicates that the option is less advantageous than the status quo with respect to this criterion. An equal sign with no shading indicates that the option is neutral compared to the status quo with respect to a given criterion.

In general, AMI would entail more responsibility for good data security practices, but on the other hand, it would have system management functionality—remote disconnects and reconnects, outage notifications, on-demand reads, power theft notifications, low voltage notifications, hot socket detections (allowing the PUD to notify customers of fire hazards), and daily reads that allow customers to track their own usage through an app. AMI could also realistically be used to offer TOU metering to all customers.

Both AMI and the Hybrid option would offer greater control over the amount of RF, and the two hand-read options would eliminate the District's contribution to RF in its service area. All of the options would improve the billing accuracy by replacing old meters with new meters.

Exhibit 7: Summary of Non-Economic Considerations

Non-Economic Considerations	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI	Implications
Potential RF Health Impacts	=	+	+	=	Partial +	Partial +	Opt-out should be allowed.
Privacy	=	+	+	=	=	=	Opt-out should be allowed.
Vulnerability to Hacking	=	=	=	=	=	-	AMI requires good data hygiene.
Reliability/Accuracy	=	+	+	+	+	+	Any new option will solve accuracy issue.
Compatibility	=	=	=	=	=	=	Any new option has to be compatible.
Functionality	=	=	=	=	=	+	AMI allows quicker response, more control.
Allows Time of Use metering	=	=	=	=	=	+	Only AMI allows cost-effective TOU rates.

SUMMARY OBSERVATIONS AND RECOMMENDATION

Following are some summary observations from this business case analysis.

- In general, substituting collectors and backhaul costs for employee labor is worth the initial capital investment.
- The AMI and Hybrid options are very close economically.
- A shorter assumed useful life reduces the Net Present Value but does not change the relative ranking of the options.
- If opt-out is allowed and good data security is practiced, the non-economic factors do not swing the business case decision away from the Hybrid and AMI options.
- However, the non-economic factors do differentiate between the Hybrid and AMI approaches. Two of the non-economic considerations favor the AMI option—the system management functionality and the ability to implement time-of-use metering in a cost effective way for residential customers.

Overall, we recommend that the PUD move forward with an AMI approach to electric metering. The economics clearly favor the AMI and Hybrid options, and between those two, the AMI approach has stronger non-economic advantages that justify the higher initial cost of the meters.

APPENDIX A

MODEL USED FOR FINANCIAL ANALYSIS

Following are the detailed tables from the financial model.

- First is the Assumptions tab, which provides key assumptions for each option.
- The second tab, Financial Calculations, converts the assumptions into a year-by-year forecast over a 25-year time horizon. The printouts only show Years 1-6, Year 15, Year 20, and Year 25. Each page in the printout corresponds to one of the options. The bottom row for each option shows the Net Revenue for that option for each year of the forecast. Net Revenue consists of additional revenue from achieving more accurate reads, minus the costs associated with that option.
- The tables in the Summary tab have already been shown in **Exhibits 1-7** above.
- The tabs after the Summary tab provide backup detail that support particular estimates in the Assumptions tab.
  - Meter Capital $ – Summarizes data from the 2017 bids and the number of meters by size. This tab also calculates the weighted average cost per meter in 2017 dollars.
  - Meter Accuracy – Summarizes the average percentage inaccuracy of the District's old mechanical meters.
  - Other Capital $ — Summarizes capital costs other than meters from the 2017 bids.
  - Number of Meters – This is a 25-year projection of the number of meters needed by year.
  - Vehicle Calculation – This is a 25-year projection of labor hours and vehicles needed. It includes the finding that the hand-read options would require about 16.5 FTEs for meter reading.
  - Revenue Calculation – Calculates revenue currently not collected due to meter inaccuracy.

Exhibit A-1: Model Assumptions

Escalation Rates, Taxes, and Discount Rate	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
General Cost Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Labor/Benefits Cost Inflation	4.08%	4.08%	4.08%	4.08%	4.08%	4.08%
Construction Cost Inflation	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Washington State Sales Tax	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%
Port Townsend Sales Tax	2.60%	2.60%	2.60%	2.60%	2.60%	2.60%
Discount Rate (for NPV)	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
[Extra]						

Meters & Capital Costs	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
Current Meters						
L&G	16,300	16,300	16,300	16,300	16,300	16,300
Itron Aftermarket	3,050	3,050	3,050	3,050	3,050	3,050
Opt-Out	150	150	150	150	150	150
Total	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
# of L&G Meters Replaced per Year	101	n/a	n/a	n/a	n/a	n/a
Cost of Meters						
1st Type of Meter	Used Itron	New Itron	Refurb. Itron	New Itron	New Itron-AMR	2017 RFP AMI
Cost per Meter	$ 15.52	$ 53.06	$ 20.69	$ 103.47	$ 103.47	$ 119.05
# of Meters	-	19,500	19,500	19,350	17,248	19,350
# of Years to Install New Meters	-	4.0	4.0	4.0	4.0	4.0
Life Expectancy (Years) of Meter	10.0	20.0	40.0	20.0	20.0	20.0
2nd Type of Meter					2017 RFP AMI	
Cost per Meter	$ -	$ -	$ -	$ -	$ 119.05	$ -
# of Meters	-	-	-	-	2,102	-
# of Years to Install New Meters	-	4.0	4.0	4.0	4.0	4.0
Life Expectancy (Years) of Meter	10.0	20.0	40.0	20.0	20.0	20.0
3rd Type of Meter (Future Opt-Out)						
Cost per Meter	$ -	$ -	$ -	$ 53.06	$ 53.06	$ 53.06
# of Meters	-	-	-	150	150	150
# of Years to Install New Meters	-	4.0	4.0	4.0	4.0	4.0
Life Expectancy (Years) of Meter	20.0	20.0	20.0	20.0	20.0	20.0

Exhibit A-1: Model Assumptions, continued

Meters & Capital Costs, continued	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
Collectors						
# of Collectors	-	-	-	-	73	73
Cost per Collector	$ -	$ -	$ -	$ -	$ 3,344	$ 3,344
Battery Cost	$ -	$ -	$ -	$ -	$ 2,000	$ 2,000
Life Expectancy (Years) of Battery	-	-	-	-	7.0	7.0
Installation Costs						
Time (Minutes) to Install Each Meter	15.0	15.0	15.0	15.0	15.0	15.0
Loaded Hourly Rate	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52
Time (Minutes) to Install Collectors	-	-	-	-	60.0	60.0
Loaded Hourly Rate	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52
Cellular Backhaul Cost per Collection Unit - 10yr Lease	$ -	$ -	$ -	$ -	$ 220	$ 220
					Based in Aclara's response to 2017 RFP	
Project Mgmt/Other	$ -	$ 207,642	$ 207,642	$ 207,642	$ 207,642	$ 207,642
Software & Equipment Costs						
Software	$ -	$ -	$ -	$ -	$ 137,522	$ 137,522
Equipment	$ -	$ -	$ -	$ 36,053	$ 36,053	$ 36,053
Other	$ -	$ -	$ -	$ -	$ 10,931	$ 10,931
Annual Costs						
System/Software Support	$ -	$ -	$ -	$ -	$ 60,519	$ 60,519
Number of Times per Year Collector Units Maintained	-	-	-	-	2.0	2.0
Time (Minutes) to Maintain Collector Units	-	-	-	-	30.0	30.0
Load Hourly Rate	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52
Shipping Costs						
% of Total Capital - Estimated Shipping	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%

Exhibit A-1: Model Assumptions, continued

Meter Reading Costs	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
Meter Reading						
# of Hours per Month per Employee - Meter Reads	64	64	64	64	64	64
# of Drive by Reads per Month	3,050	3,050	3,050	3,050	3,050	3,050
# of Walk Up/Hand Reads per Month	150	150	150	150	150	150
Multiplier (Hand Read Time vs. Drive by Time)	12.2x	12.2x	12.2x	12.2x	12.2x	12.2x
Time (Minutes) Required per Drive by Read	1.6	1.6	1.6	1.6	1.6	1.6
Time (Minutes) Required per Walk Up Read	8.0	8.0	8.0	8.0	8.0	8.0
Currently 19.2 minutes per walk-up read for opt-out only. Assume more efficient travel if walk-up reads are systemwide.						
Loaded Hourly Rate	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52
New FTEs - Available Annual On-Task Hours per FTE	1,800	1,800	1,800	1,800	1,800	1,800
L&G Contract						
Weighted Cost per Meter	$ 1.68	$ 1.68	$ 1.68	$ 1.68	$ 1.68	$ 1.68
Vehicles						
# of Current Vehicles (Current Fleet)	2	2	2	2	2	2
Gas/Maintenance Cost per AMR Meter	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25
Gas/Maintenance Cost per Manual Read Meter	8.62	1.25	1.25	8.62	8.62	8.62
Cost of New Vehicle	$ 28,000	$ 28,000	$ 28,000	$ 28,000	$ 28,000	$ 28,000
Life Expectancy (Years) of Vehicle	7	7	7	7	7	7

Exhibit A-1: Model Assumptions, continued

Potential Cost/Revenue Benefits	Status Quo	Digital Hand Read	Mechanical Hand Read	AMR Drive By	Hybrid AMR	AMI
Disconnects/Remote Disconnects						
# of Annual Disconnects	775	775	775	775	775	775
Time (Minutes) per Disconnect	30.0	30.0	30.0	30.0	30.0	-
Loaded Hourly Rate	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52
On-Demand/Move Out Reads						
# of Annual On-Demand Reads	1,850	1,850	1,850	1,850	1,850	1,850
Time (Minutes) per On-Demand Read	30.0	30.0	30.0	30.0	-	-
Loaded Hourly Rate	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52	$ 44.52
Outages - Overtime						
# of Annual Outages	350	350	350	350	350	350
# of Linemen per Outage	4	4	4	4	4	4
Time (Minutes) Required per Outage	120.0	120.0	120.0	120.0	120.0	120.0
Loaded Hourly Rate	$ 80.82	$ 80.82	$ 80.82	$ 80.82	$ 80.82	$ 80.82
Labor Multiplier for Overtime	2.0x	2.0x	2.0x	2.0x	2.0x	1.0x
% of Outages During Normal Hours Reported After Hours	2%	2%	2%	2%	2%	2%
Meter Accuracy & Correct Reads						
Average System Accuracy Loss	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Average System Incorrect Read Loss	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%
Total System Losses - Averaged Across All Meters	**2.43%**	**2.43%**	**2.43%**	**2.43%**	**2.43%**	**2.43%**

Exhibit A-2: Financial Calculations for Options – Status Quo

Status Quo	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 1,568	$ 1,615	$ 1,663	$ 1,713	$ 1,764	$ 1,817	$ 11,292	$ 16,676	$ 5,497	$ 22,411
Collector Units	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Batteries	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Software	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	56,000	-	-	-	-	-	-	73,891	-	45,036
Other	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 57,568**	**$ 1,615**	**$ 1,663**	**$ 1,713**	**$ 1,764**	**$ 1,817**	**$ 11,292**	**$ 90,566**	**$ 5,497**	**$ 67,447**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	1,124	1,170	1,218	1,267	1,319	1,373	8,618	13,830	4,802	20,619
Collector Unit Installation	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Installation Costs		**$ 1,124**	**$ 1,170**	**$ 1,218**	**$ 1,267**	**$ 1,319**	**$ 1,373**	**$ 8,618**	**$ 13,830**	**$ 4,802**	**$ 20,619**
Sales Taxes		5,239	147	151	156	161	165	1,028	8,242	500	6,138
Shipping Costs		1,151	32	33	34	35	36	226	1,811	110	1,349
Other Capital Costs		**$ 6,390**	**$ 179**	**$ 185**	**$ 190**	**$ 196**	**$ 202**	**$ 1,253**	**$ 10,053**	**$ 610**	**$ 7,487**
Total Capital Costs		**$ 65,082**	**$ 2,964**	**$ 3,065**	**$ 3,170**	**$ 3,279**	**$ 3,392**	**$ 21,164**	**$ 114,449**	**$ 10,910**	**$ 95,553**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 10,685	$ 11,120	$ 11,573	$ 12,045	$ 12,536	$ 13,047	$ 13,578	$ 18,690	$ 22,822	$ 27,866
Current Itron Meter Reads	Labor/Benefits Cost Inflation	44,147	47,419	50,884	54,553	58,436	62,545	66,892	111,878	151,721	203,711
Current L&G Meter Reading	General Cost Inflation	325,922	330,367	334,860	339,401	343,990	348,626	353,310	392,508	418,559	445,780
New Meter Reads (incl. future Opt Out)	General Cost Inflation	5,227	5,460	5,700	5,948	6,203	6,466	6,738	9,225	11,103	13,273
Annual System Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Collector Unit Maintenance	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Total Operating Costs		**$ 385,980**	**$ 394,366**	**$ 403,018**	**$ 411,947**	**$ 421,165**	**$ 430,684**	**$ 440,518**	**$ 532,302**	**$ 604,205**	**$ 690,630**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ 17,252	$ 17,954	$ 18,686	$ 19,448	$ 20,240	$ 21,065	$ 21,923	$ 30,177	$ 36,848	$ 44,993
On Demand Reads	Labor/Benefits Cost Inflation	10,763	11,399	12,069	12,775	13,518	14,300	15,124	23,472	30,686	39,942
Outage Response - OT Hours	Labor/Benefits Cost Inflation	9,052	9,421	9,805	10,204	10,620	11,053	11,503	15,834	19,334	23,608
Total Other Service Costs		**$ 37,066**	**$ 38,774**	**$ 40,560**	**$ 42,426**	**$ 44,378**	**$ 46,418**	**$ 48,550**	**$ 69,483**	**$ 86,867**	**$ 108,542**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 488,128**	**$ 436,104**	**$ 446,643**	**$ 457,543**	**$ 468,821**	**$ 480,493**	**$ 510,232**	**$ 716,233**	**$ 701,982**	**$ 894,725**
Revenue											
Increased Revenue from Retiring Old Meters		$ 4,667	$ 9,687	$ 15,095	$ 20,479	$ 25,778	$ 31,151	$ 36,599	$ 83,013	$ 114,756	$ 148,789
Total Revenue		**$ 4,667**	**$ 9,687**	**$ 15,095**	**$ 20,479**	**$ 25,778**	**$ 31,151**	**$ 36,599**	**$ 83,013**	**$ 114,756**	**$ 148,789**
Net Revenue		**$ (483,461)**	**$ (426,417)**	**$ (431,548)**	**$ (437,065)**	**$ (443,044)**	**$ (449,343)**	**$ (473,634)**	**$ (633,221)**	**$ (587,226)**	**$ (745,936)**

Exhibit A-2, continued: Financial Calculations for Options – Digital Hand-Read

Digital Hand Read	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 258,659	$ 266,419	$ 274,411	$ 282,644	$ -	$ -	$ -	$ -	$ -	$ -
Collector Units	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Batteries	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Software	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	168,000	142,800	116,525	118,855	-	-	-	221,672	-	180,145
Other	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 426,659**	**$ 409,219**	**$ 390,936**	**$ 401,499**	**$ -**	**$ -**	**$ -**	**$ 221,672**	**$ -**	**$ 180,145**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	54,259	56,470	58,771	61,166	-	-	-	-	-	-
Collector Unit Installation	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	51,910	54,026	56,227	58,519	-	-	-	-	-	-
Installation Costs		**$ 106,169**	**$ 110,496**	**$ 114,998**	**$ 119,684**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sales Taxes		38,826	37,239	35,575	36,536	-	-	-	20,172	-	16,393
Shipping Costs		8,533	8,184	7,819	8,030	-	-	-	4,433	-	3,603
Other Capital Costs		**$ 47,359**	**$ 45,423**	**$ 43,394**	**$ 44,566**	**$ -**	**$ -**	**$ -**	**$ 24,606**	**$ -**	**$ 19,996**
Total Capital Costs		**$ 580,187**	**$ 565,138**	**$ 549,328**	**$ 565,750**	**$ -**	**$ -**	**$ -**	**$ 246,278**	**$ -**	**$ 200,141**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 8,014	$ 5,560	$ 2,893	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Itron Meter Reads	Labor/Benefits Cost Inflation	32,049	22,237	11,571	-	-	-	-	-	-	-
Current L&G Meter Reading	General Cost Inflation	245,965	167,256	85,301	-	-	-	-	-	-	-
New Meter Reads (incl. future Opt Out)	Labor/Benefits Cost Inflation	347,256	722,813	1,128,402	1,565,846	1,629,654	1,696,062	1,765,177	2,429,739	2,966,824	3,622,629
Vehicle Maintenance	General Cost Inflation	9,080	14,450	20,030	25,828	26,345	26,872	27,409	32,114	35,457	39,147
Annual System Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Collector Unit Maintenance	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Total Operating Costs		**$ 642,364**	**$ 932,316**	**$ 1,248,198**	**$ 1,591,674**	**$ 1,655,999**	**$ 1,722,934**	**$ 1,792,586**	**$ 2,461,853**	**$ 3,002,280**	**$ 3,661,776**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ 17,252	$ 17,954	$ 18,686	$ 19,448	$ 20,240	$ 21,065	$ 21,923	$ 30,177	$ 36,848	$ 44,993
On Demand Reads	Labor/Benefits Cost Inflation	41,181	42,859	44,606	46,423	48,315	50,284	52,333	72,036	87,959	107,402
Outage Response - OT Hours	Labor/Benefits Cost Inflation	9,052	9,421	9,805	10,204	10,620	11,053	11,503	15,834	19,334	23,608
Total Other Service Costs		**$ 67,484**	**$ 70,234**	**$ 73,096**	**$ 76,075**	**$ 79,175**	**$ 82,401**	**$ 85,759**	**$ 118,046**	**$ 144,140**	**$ 176,002**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 1,290,036**	**$ 1,567,688**	**$ 1,870,623**	**$ 2,233,499**	**$ 1,735,174**	**$ 1,805,336**	**$ 1,878,346**	**$ 2,826,178**	**$ 3,146,421**	**$ 4,037,919**
Revenue											
Increased Revenue from Retiring Old Meters		$ 188,311	$ 390,850	$ 609,033	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Total Revenue		**$ 188,311**	**$ 390,850**	**$ 609,033**	**$ 826,250**	**$ 832,039**	**$ 837,884**	**$ 843,787**	**$ 893,139**	**$ 925,997**	**$ 960,498**
Net Revenue		**$(1,101,725)**	**$(1,176,838)**	**$(1,261,590)**	**$(1,407,249)**	**$ (903,135)**	**$ (967,452)**	**$(1,034,559)**	**$(1,933,039)**	**$(2,220,423)**	**$(3,077,421)**

Exhibit A-2, continued: Financial Calculations for Options – Mechanical Hand-Read

Mechanical Hand Read	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 100,881	$ 103,907	$ 107,025	$ 110,235	$ -	$ -	$ -	$ -	$ -	$ -
Collector Units	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Batteries	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Software	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	168,000	142,800	116,525	118,855	-	-	-	221,672	-	180,145
Other	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 268,881**	**$ 246,707**	**$ 223,550**	**$ 229,091**	**$ -**	**$ -**	**$ -**	**$ 221,672**	**$ -**	**$ 180,145**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	54,259	56,470	58,771	61,166	-	-	-	-	-	-
Collector Unit Installation	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	51,910	54,026	56,227	58,519	-	-	-	-	-	-
Installation Costs		**$ 106,169**	**$ 110,496**	**$ 114,998**	**$ 119,684**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sales Taxes		24,468	22,450	20,343	20,847	-	-	-	20,172	-	16,393
Shipping Costs		5,378	4,934	4,471	4,582	-	-	-	4,433	-	3,603
Other Capital Costs		**$ 29,846**	**$ 27,385**	**$ 24,814**	**$ 25,429**	**$ -**	**$ -**	**$ -**	**$ 24,606**	**$ -**	**$ 19,996**
Total Capital Costs		**$ 404,896**	**$ 384,588**	**$ 363,362**	**$ 374,204**	**$ -**	**$ -**	**$ -**	**$ 246,278**	**$ -**	**$ 200,141**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 8,014	$ 5,560	$ 2,893	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Itron Meter Reads	Labor/Benefits Cost Inflation	32,049	22,237	11,571	-	-	-	-	-	-	-
Current L&G Meter Reading	General Cost Inflation	245,965	167,256	85,301	-	-	-	-	-	-	-
New Meter Reads (incl. future Opt Out)	Labor/Benefits Cost Inflation	347,256	722,813	1,128,402	1,565,846	1,629,654	1,696,062	1,765,177	2,429,739	2,966,824	3,622,629
Vehicle Maintenance	General Cost Inflation	9,080	14,450	20,030	25,828	26,345	26,872	27,409	32,114	35,457	39,147
Annual System Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Collector Unit Maintenance	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Total Operating Costs		**$ 642,364**	**$ 932,316**	**$ 1,248,198**	**$ 1,591,674**	**$ 1,655,999**	**$ 1,722,934**	**$ 1,792,586**	**$ 2,461,853**	**$ 3,002,280**	**$ 3,661,776**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ 17,252	$ 17,954	$ 18,686	$ 19,448	$ 20,240	$ 21,065	$ 21,923	$ 30,177	$ 36,848	$ 44,993
On Demand Reads	Labor/Benefits Cost Inflation	41,181	42,859	44,606	46,423	48,315	50,284	52,333	72,036	87,959	107,402
Outage Response - OT Hours	Labor/Benefits Cost Inflation	9,052	9,421	9,805	10,204	10,620	11,053	11,503	15,834	19,334	23,608
Total Other Service Costs		**$ 67,484**	**$ 70,234**	**$ 73,096**	**$ 76,075**	**$ 79,175**	**$ 82,401**	**$ 85,759**	**$ 118,046**	**$ 144,140**	**$ 176,002**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 1,114,745**	**$ 1,387,138**	**$ 1,684,656**	**$ 2,041,954**	**$ 1,735,174**	**$ 1,805,336**	**$ 1,878,346**	**$ 2,826,178**	**$ 3,146,421**	**$ 4,037,919**
Revenue											
Increased Revenue from Retiring Old Meters		$ 188,311	$ 390,850	$ 609,033	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Total Revenue		**$ 188,311**	**$ 390,850**	**$ 609,033**	**$ 826,250**	**$ 832,039**	**$ 837,884**	**$ 843,787**	**$ 893,139**	**$ 925,997**	**$ 960,498**
Net Revenue		**$ (926,433)**	**$ (996,288)**	**$(1,075,624)**	**$(1,215,704)**	**$ (903,135)**	**$ (967,452)**	**$(1,034,559)**	**$(1,933,039)**	**$(2,220,423)**	**$(3,077,421)**

Exhibit A-2, continued: Financial Calculations for Options - AMR Drive-by

AMR Drive By	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 502,515	$ 517,590	$ 533,118	$ 549,112	$ -	$ -	$ -	$ -	$ -	$ -
Collector Units	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Batteries	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Software	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	36,053	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	84,000	28,560	-	29,714	-	-	-	110,836	-	45,036
Other	Construction Cost Inflation	-	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 622,568**	**$ 546,150**	**$ 533,118**	**$ 578,825**	**$ -**	**$ -**	**$ -**	**$ 110,836**	**$ -**	**$ 45,036**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	54,259	56,470	58,771	61,166	-	-	-	-	-	-
Collector Unit Installation	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	51,910	54,026	56,227	58,519	-	-	-	-	-	-
Installation Costs		**$ 106,169**	**$ 110,496**	**$ 114,998**	**$ 119,684**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sales Taxes		56,654	49,700	48,514	52,673	-	-	-	10,086	-	4,098
Shipping Costs		12,451	10,923	10,662	11,577	-	-	-	2,217	-	901
Other Capital Costs		**$ 69,105**	**$ 60,623**	**$ 59,176**	**$ 64,250**	**$ -**	**$ -**	**$ -**	**$ 12,303**	**$ -**	**$ 4,999**
Total Capital Costs		**$ 797,843**	**$ 717,269**	**$ 707,292**	**$ 762,760**	**$ -**	**$ -**	**$ -**	**$ 123,139**	**$ -**	**$ 50,035**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 8,014	$ 5,560	$ 2,893	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Itron Meter Reads	Labor/Benefits Cost Inflation	32,049	22,237	11,571	-	-	-	-	-	-	-
Current L&G Meter Reading	General Cost Inflation	245,965	167,256	85,301	-	-	-	-	-	-	-
New Meter Reads (incl. future Opt Out)	Labor/Benefits Cost Inflation	70,447	146,636	228,917	317,661	330,605	344,078	358,099	492,917	601,875	734,917
Vehicle Maintenance	General Cost Inflation	10,187	15,578	21,181	27,003	27,543	28,093	28,655	33,574	37,069	40,927
Annual System Costs	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
Collector Unit Maintenance	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Total Operating Costs		**$ 366,662**	**$ 357,268**	**$ 349,864**	**$ 344,663**	**$ 358,148**	**$ 372,171**	**$ 386,754**	**$ 526,492**	**$ 638,944**	**$ 775,844**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ 17,252	$ 17,954	$ 18,686	$ 19,448	$ 20,240	$ 21,065	$ 21,923	$ 30,177	$ 36,848	$ 44,993
On Demand Reads	Labor/Benefits Cost Inflation	41,181	42,859	44,606	46,423	48,315	50,284	52,333	72,036	87,959	107,402
Outage Response - OT Hours	Labor/Benefits Cost Inflation	9,052	9,421	9,805	10,204	10,620	11,053	11,503	15,834	19,334	23,608
Total Other Service Costs		**$ 67,484**	**$ 70,234**	**$ 73,096**	**$ 76,075**	**$ 79,175**	**$ 82,401**	**$ 85,759**	**$ 118,046**	**$ 144,140**	**$ 176,002**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 1,231,989**	**$ 1,144,771**	**$ 1,130,253**	**$ 1,183,498**	**$ 437,323**	**$ 454,573**	**$ 472,513**	**$ 767,677**	**$ 783,084**	**$ 1,001,881**
Revenue											
Increased Revenue from Retiring Old Meters		$ 188,311	$ 390,850	$ 609,033	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Total Revenue		**$ 188,311**	**$ 390,850**	**$ 609,033**	**$ 826,250**	**$ 832,039**	**$ 837,884**	**$ 843,787**	**$ 893,139**	**$ 925,997**	**$ 960,498**
Net Revenue		**$(1,043,678)**	**$ (753,920)**	**$ (521,221)**	**$ (357,248)**	**$ 394,716**	**$ 383,311**	**$ 371,273**	**$ 125,462**	**$ 142,914**	**$ (41,383)**

Exhibit A-2, continued: Financial Calculations for Options – Hybrid AMR

Hybrid AMR	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 502,515	$ 517,590	$ 533,118	$ 549,112	$ -	$ -	$ -	$ -	$ -	$ -
Collector Units	Construction Cost Inflation	61,035	62,866	64,752	66,694	-	-	-	-	-	-
Batteries	Construction Cost Inflation	36,500	37,595	38,723	39,885	-	-	-	55,210	-	74,197
Software	Construction Cost Inflation	137,522	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	36,053	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	56,000	-	-	-	-	-	-	73,891	-	-
Other	Construction Cost Inflation	10,931	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 840,556**	**$ 618,051**	**$ 636,593**	**$ 655,690**	**$ -**	**$ -**	**$ -**	**$ 129,100**	**$ -**	**$ 74,197**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	54,259	56,470	58,771	61,166	-	-	-	-	-	-
Collector Unit Installation	Labor/Benefits Cost Inflation	812	846	880	916	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	16,060	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	51,910	54,026	56,227	58,519	-	-	-	-	-	-
Installation Costs		**$ 123,042**	**$ 111,341**	**$ 115,878**	**$ 120,600**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sales Taxes		76,491	56,243	57,930	59,668	-	-	-	11,748	-	6,752
Shipping Costs		16,811	12,361	12,732	13,114	-	-	-	2,582	-	1,484
Other Capital Costs		**$ 93,302**	**$ 68,604**	**$ 70,662**	**$ 72,782**	**$ -**	**$ -**	**$ -**	**$ 14,330**	**$ -**	**$ 8,236**
Total Capital Costs		**$ 1,056,899**	**$ 797,996**	**$ 823,133**	**$ 849,072**	**$ -**	**$ -**	**$ -**	**$ 143,430**	**$ -**	**$ 82,433**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 8,014	$ 5,560	$ 2,893	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Itron Meter Reads	Labor/Benefits Cost Inflation	32,049	22,237	11,571	-	-	-	-	-	-	-
Current L&G Meter Reading	General Cost Inflation	245,965	167,256	85,301	-	-	-	-	-	-	-
New Meter Reads (incl. future Opt Out)	Labor/Benefits Cost Inflation	2,671	5,560	8,680	12,045	12,536	13,047	13,578	18,690	22,822	27,866
Vehicle Maintenance	General Cost Inflation	4,149	3,261	2,336	1,373	1,400	1,428	1,457	1,707	1,885	2,081
Annual System Costs	General Cost Inflation	60,519	61,730	62,964	64,224	65,508	66,818	68,155	79,854	88,165	97,342
Collector Unit Maintenance	Labor/Benefits Cost Inflation	812	1,691	2,640	3,664	3,813	3,968	4,130	5,685	6,942	8,476
Total Operating Costs		**$ 354,180**	**$ 267,295**	**$ 176,386**	**$ 81,305**	**$ 83,257**	**$ 85,262**	**$ 87,320**	**$ 105,936**	**$ 119,813**	**$ 135,765**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ 17,252	$ 17,954	$ 18,686	$ 19,448	$ 20,240	$ 21,065	$ 21,923	$ 30,177	$ 36,848	$ 44,993
On Demand Reads	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Outage Response - OT Hours	Labor/Benefits Cost Inflation	9,052	9,421	9,805	10,204	10,620	11,053	11,503	15,834	19,334	23,608
Total Other Service Costs		**$ 26,303**	**$ 27,375**	**$ 28,491**	**$ 29,652**	**$ 30,860**	**$ 32,118**	**$ 33,426**	**$ 46,011**	**$ 56,181**	**$ 68,600**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 1,437,383**	**$ 1,092,667**	**$ 1,028,010**	**$ 960,029**	**$ 114,117**	**$ 117,379**	**$ 120,746**	**$ 295,378**	**$ 175,995**	**$ 286,798**
Revenue											
Increased Revenue from Retiring Old Meters		$ 188,311	$ 390,850	$ 609,033	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Total Revenue		**$ 188,311**	**$ 390,850**	**$ 609,033**	**$ 826,250**	**$ 832,039**	**$ 837,884**	**$ 843,787**	**$ 893,139**	**$ 925,997**	**$ 960,498**
Net Revenue		**$(1,249,072)**	**$ (701,816)**	**$ (418,977)**	**$ (133,779)**	**$ 717,921**	**$ 720,505**	**$ 723,040**	**$ 597,761**	**$ 750,003**	**$ 673,700**

Exhibit A-2, continued: Financial Calculations for Options - AMI

AMI	Escalation Description	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Capital Costs											
Assets											
Meters	Construction Cost Inflation	$ 577,884	$ 595,220	$ 613,077	$ 631,469	$ -	$ -	$ -	$ -	$ -	$ -
Collector Units	Construction Cost Inflation	61,035	62,866	64,752	66,694	-	-	-	-	-	-
Batteries	Construction Cost Inflation	36,500	37,595	38,723	39,885	-	-	-	55,210	-	74,197
Software	Construction Cost Inflation	137,522	-	-	-	-	-	-	-	-	-
Equipment	Construction Cost Inflation	36,053	-	-	-	-	-	-	-	-	-
Vehicles	General Cost Inflation	56,000	-	-	-	-	-	-	73,890.8	-	-
Other	Construction Cost Inflation	10,931	-	-	-	-	-	-	-	-	-
Asset Costs		**$ 915,925**	**$ 695,681**	**$ 716,551**	**$ 738,048**	**$ -**	**$ -**	**$ -**	**$ 129,100**	**$ -**	**$ 74,197**
Installation											
Meter Installation	Labor/Benefits Cost Inflation	54,259	56,470	58,771	61,166	-	-	-	-	-	-
Collector Unit Installation	Labor/Benefits Cost Inflation	812	846	880	916	-	-	-	-	-	-
Backhaul Costs	General Cost Inflation	16,060	-	-	-	-	-	-	-	-	-
Project Mgmt/Other	Labor/Benefits Cost Inflation	51,910	54,026	56,227	58,519	-	-	-	-	-	-
Installation Costs		**$ 123,042**	**$ 111,341**	**$ 115,878**	**$ 120,600**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sales Taxes		83,349	63,307	65,206	67,162	-	-	-	11,748	-	6,752
Shipping Costs		18,318	13,914	14,331	14,761	-	-	-	2,582	-	1,484
Other Capital Costs		**$ 101,668**	**$ 77,221**	**$ 79,537**	**$ 81,923**	**$ -**	**$ -**	**$ -**	**$ 14,330**	**$ -**	**$ 8,236**
Total Capital Costs		**$ 1,140,634**	**$ 884,243**	**$ 911,967**	**$ 940,572**	**$ -**	**$ -**	**$ -**	**$ 143,430**	**$ -**	**$ 82,433**
Operating Costs											
Current Opt Out Meter Reads	Labor/Benefits Cost Inflation	$ 8,014	$ 5,560	$ 2,893	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Current Itron Meter Reads	Labor/Benefits Cost Inflation	32,049	22,237	11,571	-	-	-	-	-	-	-
Current L&G Meter Reading	General Cost Inflation	245,965	167,256	85,301	-	-	-	-	-	-	-
New Meter Reads (incl. future Opt Out)	Labor/Benefits Cost Inflation	2,671	5,560	8,680	12,045	12,536	13,047	13,578	18,690	22,822	27,866
Vehicle Maintenance	General Cost Inflation	4,149	3,261	2,336	1,373	1,400	1,428	1,457	1,707	1,885	2,081
Annual System Costs	General Cost Inflation	60,519	61,730	62,964	64,224	65,508	66,818	68,155	79,854	88,165	97,342
Collector Unit Maintenance	Labor/Benefits Cost Inflation	812	1,691	2,640	3,664	3,813	3,968	4,130	5,685	6,942	8,476
Total Operating Costs		**$ 354,180**	**$ 267,295**	**$ 176,386**	**$ 81,305**	**$ 83,257**	**$ 85,262**	**$ 87,320**	**$ 105,936**	**$ 119,813**	**$ 135,765**
Other Services - Costs											
Disconnects	Labor/Benefits Cost Inflation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
On Demand Reads	Labor/Benefits Cost Inflation	-	-	-	-	-	-	-	-	-	-
Outage Response - OT Hours	Labor/Benefits Cost Inflation	4,526	4,710	4,902	5,102	5,310	5,526	5,752	7,917	9,667	11,804
Total Other Service Costs		**$ 4,526**	**$ 4,710**	**$ 4,902**	**$ 5,102**	**$ 5,310**	**$ 5,526**	**$ 5,752**	**$ 7,917**	**$ 9,667**	**$ 11,804**
Annual Debt Service		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Costs		**$ 1,499,340**	**$ 1,156,249**	**$ 1,093,256**	**$ 1,026,979**	**$ 88,567**	**$ 90,788**	**$ 93,072**	**$ 257,284**	**$ 129,480**	**$ 230,002**
Revenue											
Increased Revenue from Retiring Old Meters		$ 188,311	$ 390,850	$ 609,033	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Total Revenue		**$ 188,311**	**$ 390,850**	**$ 609,033**	**$ 826,250**	**$ 832,039**	**$ 837,884**	**$ 843,787**	**$ 893,139**	**$ 925,997**	**$ 960,498**
Net Revenue		**$(1,311,029)**	**$ (765,398)**	**$ (484,223)**	**$ (200,729)**	**$ 743,471**	**$ 747,096**	**$ 750,715**	**$ 635,855**	**$ 796,517**	**$ 730,496**

Exhibit A-3: Description of Supporting Tabs in Model

Jefferson PUD
Electric Meter Replacement
Business Case Analysis

Supporting Tabs

Meter Capital $	Summarizes data from 2017 bids and number of meters by size. Also calculates weighted average cost per meter in 2017 dollars.
Meter Accuracy	Summarizes average % inaccuracy of old mechanical meters.
Other Capital $	Summarizes capital costs other than meters from 2017 bids.
Number of Meters	25-year projection of number of meters needed by year.
Vehicle Calculation	25-year projection of labor hours and vehicles needed.
Revenue Calculation	Calculates revenue currently not collected due to meter inaccuracy.

Exhibit A-4: Cost of Meters

Cost of Meters

Meter Type	Quantity	Average Price	Average Cost
Residential Meter - 2S	9,500	$ 122.10	$ 1,159,923
Residential Meter - 2S w/ Remote Disconnect	7,500	122.10	915,729
Small Business Meter - 2S w/ Demand	500	117.02	58,509
Small Business Meter - 2S w/ Demand (Higher Voltage)	500	99.33	49,663
Small Business Meter - 4S w/ Demand	400	201.07	80,427
Small Business Meter - 12S w/ Demand	100	150.83	15,083
Large Business Meter - 9S w/ Demand	80	300.46	24,037
Large Business Meter - 16S w/ Demand	150	300.46	45,069
Residential 12S	200	228.17	45,634
Bidirectional Meter - 2S	250	99.33	24,832
Bidirectional Meter - 9S	20	332.64	6,653
Total	19,200		$ 2,425,558

$ 126.33	Weighted Average per Meter (2017 $)
1.03	Residential Meter-Equivalent Factor (Weighted Avg as Multiple of Res Meter 2S)
81%	Low bid as % of average

Meter Type	Aclara	Tantalus	Itron	Eaton	Sensus	L&G	Honeywell	Average
Residential Meter - 2S	$ 106.15	$ 125.98	$ 78.25	$ 98.00	$ 71.50	$ 95.00	$ 75.00	$ 92.84
Residential Meter - 2S w/ Remote Disconnect	146.98	148.18	99.25	119.00	116.27	115.00	110.00	122.10
Small Business Meter - 2S w/ Demand	145.20	159.58	88.00	148.00	86.35	112.00	80.00	117.02
Small Business Meter - 2S w/ Demand (Higher Voltage)	106.15	125.98	n/a	98.00	71.50	95.00	n/a	99.33
Small Business Meter - 4S w/ Demand	301.80	354.18	175.00	148.00	236.50	112.00	80.00	201.07
Small Business Meter - 12S w/ Demand	145.20	167.05	102.25	172.00	93.50	225.00	n/a	150.83
Large Business Meter - 9S w/ Demand	301.80	353.20	200.00	354.00	255.20	399.00	240.00	300.46
Large Business Meter - 16S w/ Demand	301.80	353.20	200.00	354.00	255.20	399.00	240.00	300.46
Residential 12S	301.80	353.20	200.00	172.00	255.20	225.00	90.00	228.17
Bidirectional Meter - 2S	106.15	125.98	n/a	98.00	71.50	95.00	n/a	99.33
Bidirectional Meter - 9S	301.80	353.20	n/a	354.00	255.20	399.00	n/a	332.64

Meter - Additions for Remote Disconnect	Aclara	Tantalus	Itron	Eaton	Sensus	L&G	Honeywell	Average
Residential Meter - 2S	$ 40.83	$ 22.20	$ 21.00	$ 21.00	$ 44.77	$ 20.00	$ 35.00	$ 29.26

Exhibit A-5: Meter Accuracy

Mechanical Meter Accuracy

Meter Mfg/Type	Digital/Mechanical	#	%Accuracy	Inaccuracy %
L&G	Mechanical	8,150	94.19%	**5.81%**
L&G	Digital	8,150	100.00%	**0.00%**
Itron	Digital	3,050	100.00%	**0.00%**
Hand Read	Digital	150	100.00%	**0.00%**
Total		**19,500**	**97.57%**	**2.43%**

Exhibit A-6: Capital Costs Other Than Meters

Summary of Capital Costs Other Than Meters

AMI	Type of System	Number of Collectors	Cost of Collectors	Other Installation Costs	Software	Software Cost	Equipment Needed	Equipment Costs	Other	Other Costs	Annual Costs Desc.	Annual Costs	Notes
Eaton	RF Mesh | Gateways use Wifi, fiber, or cellular	22 gateways | 184 relays	$ 135,058	$ 90,000	Yukon Platform	$ 35,000	Servers	$ 29,200	RF Mesh field tool kit	$ 3,899	Software Services | System Support	$ 12,700	Does not use licensed RF network
Tantalus	RF Network | Collectors use fiber, wifi, or cellular	68 collectors/ gateways	$ 130,000	$ 98,113		$ 190,791		total included in software costs	Infrastructure Repeaters	$ 21,675	Annual Support	$ 22,679	Does not include water meter reading requirement. Does not use licensed RF network
Itron	RF Mesh | powerline carrier | WiFi	17 Grid Routers | 15 Nodes	$ 106,493	$ 264,815	IoT Device Manager Application	$ 3,250					Cloud Services (Software) & Maintenance	$ 134,686	
Aclara	RF Network | Collectors use fiber, WiFi, or cellular	43 data collection units (DCUs)	$ 309,011	$ 143,410	iiDEAS platform	$ 211,636	3 Servers	total included in software costs			Cellular Backhaul & Software	$ 48,469	Requires licensing of FCC RF networks - 10yr contracts. Annual cost not reflected in bid.
Sensus	RF Network | Base station antennae (non cellular) are collectors	14 Collectors/Base Stations	$ 285,516	$ 173,540	RNI Software License	$ 148,508			RNI Set-Up/ education	$ 17,023	System/Software support | RNI interface	$ 79,312	Does not include potential leasing fees for base station sites (third party infrastructure)
Landis & Gyr	RF Mesh | Collectors use fiber or cellular	11 Collectors | 99 routers	$ 250,679	$ 97,400	Command Center License	$ 47,200			Field Collection Devices	$ 1,850	AMI system support	$ 17,819	
Honeywell	RF Mesh | Collectors use fiber or cellular	20 Repeater Nodes | 19 Synergy Net Routers	$ 260,300	$ 386,518	Connexo Net Sense | FieldSense | Connexo Insight | Consumer Portal	$ 194,007	Servers	$ 33,000	CT-50 | RF Belt Clip	$ 2,700	System maintenance	$ 49,768	Excludes taxes
Verizon	Cellular												
AVERAGE 2017 $		**$ 2,885**	**$ 211,008**	**$ 179,114**		**$ 118,627**		**$ 31,100**		**$ 9,429**		**$ 52,205**	
AVERAGE 2022 $		**$ 3,344**	**$ 244,616**	**$ 207,642**		**$ 137,522**		**$ 36,053**		**$ 10,931**		**$ 60,519**	
Average Number of Collectors		**73**											

Exhibit A-7: Projected Meter Life Schedule

Status Quo	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Beginning L&G Meters	16,300	16,199	16,098	15,997	15,896	15,795	15,694	14,886	14,381	13,876
less: Meters Replaced	(101)	(101)	(101)	(101)	(101)	(101)	(101)	(101)	(101)	(101)
Ending L&G Meters	**16,199**	**16,098**	**15,997**	**15,896**	**15,795**	**15,694**	**15,593**	**14,785**	**14,280**	**13,775**
Beginning Itron Meters	3,050	3,151	3,252	3,353	3,454	3,555	3,656	4,464	4,969	5,474
plus: Meters Replacing L&G	101	101	101	101	101	101	101	101	101	101
plus: Meters Replacing Itron from this Forecast	-	-	-	-	-	-	-	101	101	101
plus: First Replacement of New Meters	-	-	-	-	-	-	508	508	-	508
less: Meters Replacing Itron	-	-	-	-	-	-	(508)	(609)	(101)	(609)
Ending Itron Meters	**3,151**	**3,252**	**3,353**	**3,454**	**3,555**	**3,656**	**3,757**	**4,565**	**5,070**	**5,575**
Beginning Opt Out Meters	150	150	150	150	150	150	150	150	150	150
plus: Meter Replacement	-	-	-	-	-	-	-	-	-	-
less: Meters Replaced	-	-	-	-	-	-	-	-	-	-
Ending Opt Out Meters	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
Total Meters	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
On Demand Reads	*484*	*492*	*501*	*509*	*518*	*526*	*535*	*603*	*645*	*688*

Exhibit A-7: Projected Meter Life Schedule, continued

Digital Hand Read	New Meter Type	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Beginning L&G Meters		16,300	12,225	8,150	4,075	-	-	-	-	-	-
less: Meters Replaced		(4,075)	(4,075)	(4,075)	(4,075)	-	-	-	-	-	-
Ending L&G Meters		**12,225**	**8,150**	**4,075**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Itron Meters		3,050	2,288	1,525	763	-	-	-	-	-	-
less: Meters Replaced		(763)	(763)	(763)	(763)	-	-	-	-	-	-
Ending Itron Meters		**2,288**	**1,525**	**763**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Opt Out Meters		150	113	75	38	-	-	-	-	-	-
less: Meters Replaced		(38)	(38)	(38)	(38)	-	-	-	-	-	-
Ending Opt Out Meters		**113**	**75**	**38**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 1	Hand Read	-	4,875	9,750	14,625	19,500	19,500	19,500	19,500	19,500	19,500
plus: New Meters		4,875	4,875	4,875	4,875	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**4,875**	**9,750**	**14,625**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
Beginning New Meters - Type 2	Hand Read	-	-	-	-	-	-	-	-	-	-
plus: New Meters		-	-	-	-	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 3	Hand Read	-	-	-	-	-	-	-	-	-	-
plus: New Meters		-	-	-	-	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total Meters		**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
Age of New Meters		*1*	2	3	4	5	6	7	15	20	5
Age of Type 3 Meters		*1*	2	3	4	5	6	7	15	20	25

Exhibit A-7: Projected Meter Life Schedule, continued

Mechanical Hand Read	New Meter Type	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Beginning L&G Meters		16,300	12,225	8,150	4,075	-	-	-	-	-	-
less: Meters Replaced		(4,075)	(4,075)	(4,075)	(4,075)	-	-	-	-	-	-
Ending L&G Meters		**12,225**	**8,150**	**4,075**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Itron Meters		3,050	2,288	1,525	763	-	-	-	-	-	-
less: Meters Replaced		(763)	(763)	(763)	(763)	-	-	-	-	-	-
Ending Itron Meters		**2,288**	**1,525**	**763**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Opt Out Meters		150	113	75	38	-	-	-	-	-	-
less: Meters Replaced		(38)	(38)	(38)	(38)	-	-	-	-	-	-
Ending Opt Out Meters		**113**	**75**	**38**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 1	Hand Read	-	4,875	9,750	14,625	19,500	19,500	19,500	19,500	19,500	19,500
plus: New Meters		4,875	4,875	4,875	4,875	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**4,875**	**9,750**	**14,625**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
Beginning New Meters - Type 2	Hand Read	-	-	-	-	-	-	-	-	-	-
plus: New Meters		-	-	-	-	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 3	Hand Read	-	-	-	-	-	-	-	-	-	-
plus: New Meters		-	-	-	-	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total Meters		**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
Age of New Meters		*1*	2	3	4	5	6	7	15	20	25
Age of Type 3 Meters		*1*	2	3	4	5	6	7	15	20	25

Exhibit A-7: Projected Meter Life Schedule, continued

AMR Drive By	New Meter Type	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Beginning L&G Meters		16,300	12,225	8,150	4,075	-	-	-	-	-	-
less: Meters Replaced		(4,075)	(4,075)	(4,075)	(4,075)	-	-	-	-	-	-
Ending L&G Meters		**12,225**	**8,150**	**4,075**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Itron Meters		3,050	2,288	1,525	763	-	-	-	-	-	-
less: Meters Replaced		(763)	(763)	(763)	(763)	-	-	-	-	-	-
Ending Itron Meters		**2,288**	**1,525**	**763**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Opt Out Meters		150	113	75	38	-	-	-	-	-	-
less: Meters Replaced		(38)	(38)	(38)	(38)	-	-	-	-	-	-
Ending Opt Out Meters		**113**	**75**	**38**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 1	Drive-By Read	-	4,838	9,675	14,513	19,350	19,350	19,350	19,350	19,350	19,350
plus: New Meters		4,838	4,838	4,838	4,838	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**4,838**	**9,675**	**14,513**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**
Beginning New Meters - Type 2	Drive-By Read	-	-	-	-	-	-	-	-	-	-
plus: New Meters		-	-	-	-	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 3	Hand Read	-	38	75	113	150	150	150	150	150	150
plus: New Meters		38	38	38	38	-	-	-	-	-	-
plus: First Replacement of New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**38**	**75**	**113**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
Total Meters		**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
Age of New Meters		*1*	2	3	4	5	6	7	15	20	5
Age of Type 3 Meters		*1*	2	3	4	5	6	7	15	20	5

Exhibit A-7: Projected Meter Life Schedule, continued

Hybrid AMR	New Meter Type	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Beginning L&G Meters		16,300	12,225	8,150	4,075	-	-	-	-	-	-
less: Meters Replaced		(4,075)	(4,075)	(4,075)	(4,075)	-	-	-	-	-	-
Ending L&G Meters		**12,225**	**8,150**	**4,075**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Itron Meters		3,050	2,288	1,525	763	-	-	-	-	-	-
less: Meters Replaced		(763)	(763)	(763)	(763)	-	-	-	-	-	-
Ending Itron Meters		**2,288**	**1,525**	**763**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Opt Out Meters		150	113	75	38	-	-	-	-	-	-
less: Meters Replaced		(38)	(38)	(38)	(38)	-	-	-	-	-	-
Ending Opt Out Meters		**113**	**75**	**38**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 1	Remote Read	-	4,312	8,624	12,936	17,248	17,248	17,248	17,248	17,248	17,248
plus: New Meters		4,312	4,312	4,312	4,312	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**4,312**	**8,624**	**12,936**	**17,248**	**17,248**	**17,248**	**17,248**	**17,248**	**17,248**	**17,248**
Beginning New Meters - Type 2	Remote Read	-	526	1,051	1,577	2,102	2,102	2,102	2,102	2,102	2,102
plus: New Meters		526	526	526	526	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**526**	**1,051**	**1,577**	**2,102**	**2,102**	**2,102**	**2,102**	**2,102**	**2,102**	**2,102**
Beginning New Meters - Type 3	Hand Read	-	38	75	113	150	150	150	150	150	150
plus: New Meters		38	38	38	38	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**38**	**75**	**113**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
Total Meters		**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**	**19,500**
Age of New Meters		*1*	2	3	4	5	6	7	15	20	5
Age of Type 3 Meters		*1*	2	3	4	5	6	7	15	20	5

Exhibit A-7: Projected Meter Life Schedule, continued

AMI	New Meter Type	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Beginning L&G Meters		16,300	12,225	8,150	4,075	-	-	-	-	-	-
less: Meters Replaced		(4,075)	(4,075)	(4,075)	(4,075)	-	-	-	-	-	-
Ending L&G Meters		**12,225**	**8,150**	**4,075**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Itron Meters		3,050	2,288	1,525	763	-	-	-	-	-	-
less: Meters Replaced		(763)	(763)	(763)	(763)	-	-	-	-	-	-
Ending Itron Meters		**2,288**	**1,525**	**763**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning Opt Out Meters		150	113	75	38	-	-	-	-	-	-
less: Meters Replaced		(38)	(38)	(38)	(38)	-	-	-	-	-	-
Ending Opt Out Meters		**113**	**75**	**38**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 1	Remote Read	-	4,838	9,675	14,513	19,350	19,350	19,350	19,350	19,350	19,350
plus: New Meters		4,838	4,838	4,838	4,838	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**4,838**	**9,675**	**14,513**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**
Beginning New Meters - Type 2	Remote Read	-	-	-	-	-	-	-	-	-	-
plus: New Meters		-	-	-	-	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Beginning New Meters - Type 3	Hand Read	-	38	75	113	150	150	150	150	150	150
plus: New Meters		38	38	38	38	-	-	-	-	-	-
plus: First Replacement of New Meters		-	-	-	-	-	-	-	-	-	-
less: Meters Replaced		-	-	-	-	-	-	-	-	-	-
Ending New Meters		**38**	**75**	**113**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
Total Meters		**19,463**	**19,425**	**19,388**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**	**19,350**
Age of New Meters		*1*	2	3	4	5	6	7	15	20	5
Age of Type 3 Meters		*1*	2	3	4	5	6	7	15	20	5

Exhibit A-8: New Vehicle Purchases

Number of Meter Reading Hours	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	1,232	1,263	1,295	1,327	1,359	1,391	1,422	1,677	1,836	1,994
Digital Hand Read	8,700	16,200	23,700	31,200	31,200	31,200	31,200	31,200	31,200	31,200
Mechanical Hand Read	8,700	16,200	23,700	31,200	31,200	31,200	31,200	31,200	31,200	31,200
AMR Drive By	2,482	3,765	5,047	6,329	6,329	6,329	6,329	6,329	6,329	6,329
Hybrid AMR	960	720	480	240	240	240	240	240	240	240
AMI	960	720	480	240	240	240	240	240	240	240

Less Current Meter Readers Hours	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)
Digital Hand Read	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)
Mechanical Hand Read	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)
AMR Drive By	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)
Hybrid AMR	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)
AMI	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)	(1,536)

Hours Needed to Fill	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	-	-	-	-	-	-	-	141	300	458
Digital Hand Read	7,164	14,664	22,164	29,664	29,664	29,664	29,664	29,664	29,664	29,664
Mechanical Hand Read	7,164	14,664	22,164	29,664	29,664	29,664	29,664	29,664	29,664	29,664
AMR Drive By	946	2,229	3,511	4,793	4,793	4,793	4,793	4,793	4,793	4,793
Hybrid AMR	-	-	-	-	-	-	-	-	-	-
AMI	-	-	-	-	-	-	-	-	-	-

New FTEs Needed	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	-	-	-	-	-	-	-	0.08	0.17	0.25
Digital Hand Read	3.98	8.15	12.31	16.48	16.48	16.48	16.48	16.48	16.48	16.48
Mechanical Hand Read	3.98	8.15	12.31	16.48	16.48	16.48	16.48	16.48	16.48	16.48
AMR Drive By	0.53	1.24	1.95	2.66	2.66	2.66	2.66	2.66	2.66	2.66
Hybrid AMR	-	-	-	-	-	-	-	-	-	-
AMI	-	-	-	-	-	-	-	-	-	-

New Trucks Needed	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	-	-	-	-	-	-	-	-	-	-
Digital Hand Read	4.00	5.00	4.00	4.00	-	-	-	-	-	-
Mechanical Hand Read	4.00	5.00	4.00	4.00	-	-	-	-	-	-
AMR Drive By	1.00	1.00	-	1.00	-	-	-	-	-	-
Hybrid AMR	-	-	-	-	-	-	-	-	-	-
AMI	-	-	-	-	-	-	-	-	-	-

Exhibit A-8: New Vehicle Purchases, continued

Truck Schedule	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo										
Starting Trucks	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00
New Trucks Purchased	2.00	-	-	-	-	-	-	2.00	-	1.00
Trucks Retired	(2.00)	-	-	-	-	-	-	(2.00)	-	(1.00)
Ending Trucks	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**3.00**	**3.00**	**3.00**
Digital Hand Read										
Starting Trucks	2.00	6.00	11.00	15.00	19.00	19.00	19.00	19.00	19.00	19.00
New Trucks Purchased	6.00	5.00	4.00	4.00	-	-	-	6.00	-	4.00
Trucks Retired	(2.00)	-	-	-	-	-	-	(6.00)	-	(4.00)
Ending Trucks	**6.00**	**11.00**	**15.00**	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**
Mechanical Hand Read										
Starting Trucks	2.00	6.00	11.00	15.00	19.00	19.00	19.00	19.00	19.00	19.00
New Trucks Purchased	6.00	5.00	4.00	4.00	-	-	-	6.00	-	4.00
Trucks Retired	(2.00)	-	-	-	-	-	-	(6.00)	-	(4.00)
Ending Trucks	**6.00**	**11.00**	**15.00**	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**
AMR Drive By										
Starting Trucks	2.00	3.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00
New Trucks Purchased	3.00	1.00	-	1.00	-	-	-	3.00	-	1.00
Trucks Retired	(2.00)	-	-	-	-	-	-	(3.00)	-	(1.00)
Ending Trucks	**3.00**	**4.00**	**4.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**
Hybrid AMR										
Starting Trucks	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
New Trucks Purchased	2.00	-	-	-	-	-	-	2.00	-	-
Trucks Retired	(2.00)	-	-	-	-	-	-	(2.00)	-	-
Ending Trucks	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**
AMI										
Starting Trucks	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
New Trucks Purchased	2.00	-	-	-	-	-	-	2.00	-	-
Trucks Retired	(2.00)	-	-	-	-	-	-	(2.00)	-	-
Ending Trucks	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**

Exhibit A-9: Energy Revenue Calculations excluding Port Townsend Mill

Load Forecast (kWh)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Residential										
Tier 1	100,365,442	101,349,023	102,342,244	103,345,198	104,357,981	105,380,689	106,413,420	115,048,068	120,797,004	126,833,213
Tier 2	76,528,692	77,278,674	78,036,005	78,800,758	79,573,005	80,352,820	81,140,278	87,724,201	92,107,767	96,710,379
Tier 3	32,724,706	33,045,408	33,369,253	33,696,272	34,026,495	34,359,955	34,696,683	37,512,057	39,386,530	41,354,669
General Service	42,254,819	42,254,819	42,254,819	42,254,819	42,254,819	42,254,819	42,254,819	42,254,819	42,254,819	42,254,819
Small Demand General Service	20,907,870	20,907,870	20,907,870	20,907,870	20,907,870	20,907,870	20,907,870	20,907,870	20,907,870	20,907,870
Large Demand General Service	14,324,460	14,324,460	14,324,460	14,324,460	14,324,460	14,324,460	14,324,460	14,324,460	14,324,460	14,324,460
Primary General Service	10,972,500	10,972,500	10,972,500	10,972,500	10,972,500	10,972,500	10,972,500	10,972,500	10,972,500	10,972,500
Irrigation/Drainage	18,540	18,540	18,540	18,540	18,540	18,540	18,540	18,540	18,540	18,540
Interruptible Primary Schools	4,548,462	4,548,462	4,548,462	4,548,462	4,548,462	4,548,462	4,548,462	4,548,462	4,548,462	4,548,462
PUD	1,347,470	1,347,470	1,347,470	1,347,470	1,347,470	1,347,470	1,347,470	1,347,470	1,347,470	1,347,470

$/kWh	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Residential											
Tier 1	0.0882	0.0908	0.0936	0.0966	0.0966	0.0966	0.0966	0.0966	0.0966	0.0966	0.0966
Tier 2	0.1070	0.1102	0.1136	0.1172	0.1172	0.1172	0.1172	0.1172	0.1172	0.1172	0.1172
Tier 3	0.1218	0.1254	0.1293	0.1334	0.1334	0.1334	0.1334	0.1334	0.1334	0.1334	0.1334
General Service	0.1029	0.1055	0.1082	0.1112	0.1112	0.1112	0.1112	0.1112	0.1112	0.1112	0.1112
Small Demand General Service	0.0884	0.0919	0.0956	0.0994	0.0994	0.0994	0.0994	0.0994	0.0994	0.0994	0.0994
Large Demand General Service	0.0785	0.0817	0.0849	0.0883	0.0883	0.0883	0.0883	0.0883	0.0883	0.0883	0.0883
Primary General Service	0.0775	0.0806	0.0838	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872
Irrigation/Drainage	0.0695	0.0710	0.0729	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752
Interruptible Primary Schools	0.0680	0.0679	0.0677	0.0676	0.0676	0.0676	0.0676	0.0676	0.0676	0.0676	0.0676
PUD	0.1029	0.1055	0.1082	0.1112	0.1112	0.1112	0.1112	0.1112	0.1112	0.1112	0.1112

kWh Revenue	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Residential										
Tier 1	$ 9,026,199	$ 9,391,676	$ 9,783,918	$ 9,983,146	$ 10,080,981	$ 10,179,775	$ 10,279,536	$ 11,113,643	$ 11,668,991	$ 12,252,088
Tier 2	8,351,831	8,691,275	9,052,177	9,235,449	9,325,956	9,417,351	9,509,641	10,281,276	10,795,030	11,334,456
Tier 3	4,064,409	4,229,812	4,405,854	4,495,083	4,539,134	4,583,618	4,628,537	5,004,108	5,254,163	5,516,713
General Service	4,421,263	4,533,942	4,656,481	4,698,736	4,698,736	4,698,736	4,698,736	4,698,736	4,698,736	4,698,736
Small Demand General Service	1,897,041	1,973,006	2,051,759	2,078,242	2,078,242	2,078,242	2,078,242	2,078,242	2,078,242	2,078,242
Large Demand General Service	1,155,029	1,200,867	1,248,615	1,264,850	1,264,850	1,264,850	1,264,850	1,264,850	1,264,850	1,264,850
Primary General Service	873,045	907,792	944,367	956,802	956,802	956,802	956,802	956,802	956,802	956,802
Irrigation/Drainage	1,307	1,340	1,380	1,394	1,394	1,394	1,394	1,394	1,394	1,394
Interruptible Primary Schools	308,992	308,234	307,628	307,476	307,476	307,476	307,476	307,476	307,476	307,476
PUD	140,990	144,584	148,491	149,839	149,839	149,839	149,839	149,839	149,839	149,839
Total	**$ 30,240,106**	**$ 31,382,528**	**$ 32,600,670**	**$ 33,171,016**	**$ 33,403,410**	**$ 33,638,082**	**$ 33,875,053**	**$ 35,856,367**	**$ 37,175,523**	**$ 38,560,597**

Exhibit A-9: Energy Revenue Calculations excluding Port Townsend Mill, continued

kWh Revenue w/o Losses	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	$ 30,993,350	$ 32,164,228	$ 33,412,713	$ 33,997,266	$ 34,235,449	$ 34,475,966	$ 34,718,840	$ 36,749,506	$ 38,101,520	$ 39,521,094
Digital Hand Read	30,993,350	32,164,228	33,412,713	33,997,266	34,235,449	34,475,966	34,718,840	36,749,506	38,101,520	39,521,094
Mechanical Hand Read	30,993,350	32,164,228	33,412,713	33,997,266	34,235,449	34,475,966	34,718,840	36,749,506	38,101,520	39,521,094
AMR Drive By	30,993,350	32,164,228	33,412,713	33,997,266	34,235,449	34,475,966	34,718,840	36,749,506	38,101,520	39,521,094
Hybrid AMR	30,993,350	32,164,228	33,412,713	33,997,266	34,235,449	34,475,966	34,718,840	36,749,506	38,101,520	39,521,094
AMI - 10yr	30,993,350	32,164,228	33,412,713	33,997,266	34,235,449	34,475,966	34,718,840	36,749,506	38,101,520	39,521,094
AMI	30,993,350	32,164,228	33,412,713	33,997,266	34,235,449	34,475,966	34,718,840	36,749,506	38,101,520	39,521,094

Missed Revenue	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 15	YEAR 20	YEAR 25
Status Quo	$ 753,245	$ 781,701	$ 812,043	$ 826,250	$ 832,039	$ 837,884	$ 843,787	$ 893,139	$ 925,997	$ 960,498
Digital Hand Read	753,245	781,701	812,043	826,250	832,039	837,884	843,787	893,139	925,997	960,498
Mechanical Hand Read	753,245	781,701	812,043	826,250	832,039	837,884	843,787	893,139	925,997	960,498
AMR Drive By	753,245	781,701	812,043	826,250	832,039	837,884	843,787	893,139	925,997	960,498
Hybrid AMR	753,245	781,701	812,043	826,250	832,039	837,884	843,787	893,139	925,997	960,498
AMI - 10yr	753,245	781,701	812,043	826,250	832,039	837,884	843,787	893,139	925,997	960,498
AMI	753,245	781,701	812,043	826,250	832,039	837,884	843,787	893,139	925,997	960,498