Every watt counts

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Abstract

The benefits of smart metering promise to deliver unparalleled return on investment to utilities. However, depending on the characteristics of the smart meter and the AMI system which is used, the benefits could quickly be eroded or negated by the watt burden of powering and operating the smart grid meters. When comparing one smart meter to another, does an additional watt of usage really matter? This article explains that there is a substantial difference in meter manufactures and why utilities should pay very close attention to this.

One watt of burden across one million meters requires an additional 8,760 MWhs of power per year and creates an additional 5,801 metric tons of carbon dioxide, 31 metric tons of methane, and 58 metric of nitrous oxide emissions per year. This article examines the hidden cost and environmental impact of smart meters and proposes a solution to address this issue.

Executive summary

There is little doubt that within the next decade, most North American utilities will deploy smart meters to enable the smart grid. The frenzy of federal stimulus applications to deploy smart grid technology indicates that the deployment of smart meters is a foregone conclusion. Much of the interest is due to the fact that in recent years there has been an explosion of technological advancements leading to a dependable multi-service architecture. For many utilities this means the necessary value of the smart grid is finally here and those utilities are ready to take the leap into a new generation of meters and system which can enable a true smart grid.

The promise of the smart grid goes well beyond automated meter reading. Smart metering systems with real time two-way communications are a key element in enabling the smart grid and provide a paradigm-changing infrastructure not available from one-way automated meter reading systems. Smart meter systems will enable utilities to deliver more cost effective and reliable services to consumers and empower consumers to actively participate in the resource delivery cycle. This combination provides creates an economical and environmentally sustainable energy infrastructure for our nation.

However, deploying smart meters with heavy watt burden can substantially reduce the benefits of the smart grid. This white paper examines the cost of powering the smart meter, the economic and environmental impact, and proposes a solution that supports technological advancements while ensuring an environmental sustainability.

The impact to the utility

Utilities have always strived to lower costs. Savings of a thousandth of a penny per meter per kWh will provide a positive impact to earnings and lower costs to consumers. Given this, utilities invest significant sums in personnel, field equipment and IT systems that help them improve the efficiency of power production and delivery. Unfortunately, in the rush to deploy smart meters, some utilities are overlooking a criterion long used by utility engineers as an evaluation factor in equipment selection has been overlooked by many.

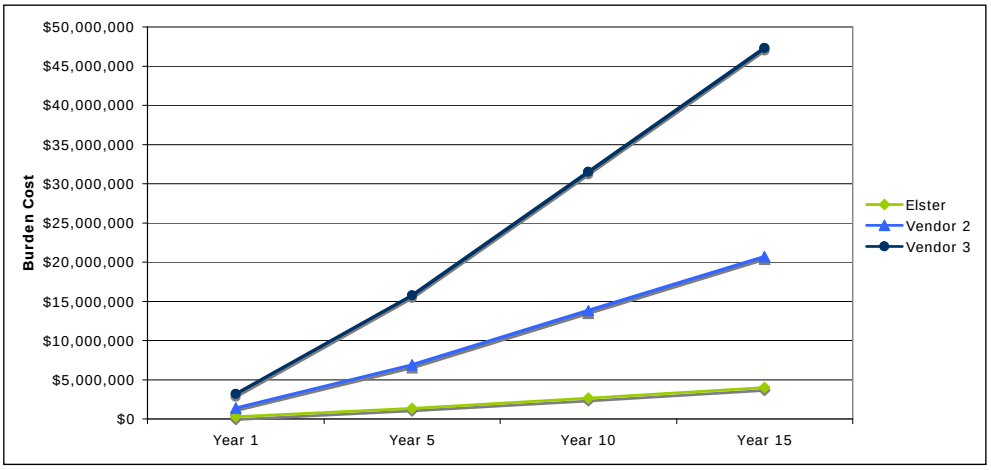
Historically, watt burdens of standard watt-hour meters were typically less than a watt and all manufacturers' meters had very similar watt burdens. Depending on the configuration and manufacture of the smart meter, the watt burden can vary significantly from one meter to another.

Consider this, Elster's combined communications and meter circuit board watt burden is 0.67 watts. In contrast, the watt burden of a similarly configured meter from another manufacture is 3.5 watts and another manufacturer is as high as 8 watts. While this may not seem like much on an individual meter basis, when this is compounded across a utility's entire meter population, the impact can be dramatic.

By using the average U.S. utility power production cost of $.045 per kWh this equates to $1.1 million more per year in power production cost for a smart meter with 3.5 watt burden. A smart meter with 8 watts of burden will cost a $2.9 million more per year in power production. Over a 15 year life this could cost a utility over $43 million by selecting a smart meter system with excessive watt burden. You can calculate the watt burden cost for your utility by using the Elster WattSavings calculator located at www.energyaxis.com/ea-inf-white-papers.asp.

System	Watt burden	Annual MWh consumed	Annual cost	Annual excess cost	Excess cost over 15 years
EnergyAxis	0.67	5,869	$264,114	$0	$0
Vendor 2	3.50	30,660	$1,379,700	-$1,115,586,	-$16,733,790
Vendor 3	8.00	70,080	$3,153,600	-$2,889,486	-$43,342,290

Another way to look at the burden is as an operating cost compared to the capital investment. Assuming that the average smart meter cost is $150 and this is depreciated over 15 years, the capital expenditure cost of the smart meter is $10/year. Compounded over one million meters, this is $10 million per year in capital depreciation cost. In addition to this, a utility should account for the associated operating cost of the meter. Depending on the smart meter a utility chooses to deploy, the Elster EnergyAxis smart meter will cost the utility $0.26 per year to operate. In comparison, the smart meter with 3.5 watt burden will cost $1.38 per year, and the smart with 8 watt burden will cost $3.15 per year. This is an additional 11% to 28% of the original cost of the meter.



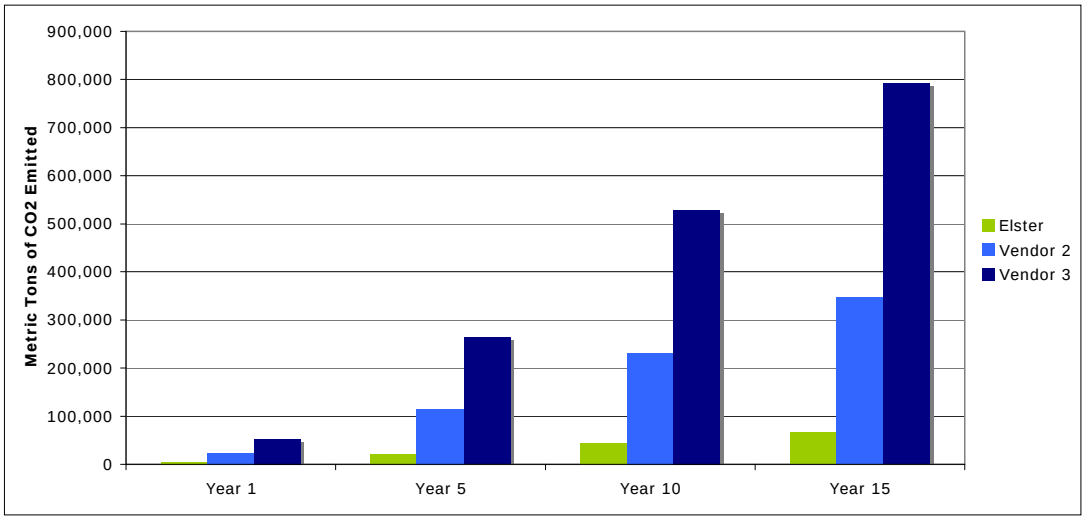
When analyzed across the U.S., utilities could spend an additional $59 million per year powering just one additional watt burden between smart meters. If the meter watt burden is 7 watts U.S. utilities will spend an additional **$435 million per year** powering the smart meters.

The impact to the environment

With growing societal and governmental concerns over environmental sustainability and energy conservation, the environmental impact of the smart meter watt burden has even more relevance. Depending on which smart meter system a utility chooses, the negative impact to the environment can be significant when analyzed across an entire meter population.

For a one million meter deployment, smart meters will require a utility to generate up to an additional 38,000[1] metric tons of carbon dioxide, 228[1] metric tons of methane, and 501[1] metric tons of nitrous oxide more per year assuming conventional generation technologies. Over a 15 year system life, the watt burden of one million smart meters will generate an additional 572,000 metric tons of carbon dioxide to the environment by selecting a smart meter with high watt burden.

Carbon emissions are traded in the U.S but not on the open market like in Europe. A metric ton of carbon dioxide in the European market is being traded for €14.37[2] or $21.35[3] USD. In the U.S., a metric ton of carbon dioxide is traded for approximately $3.00[4]. Depending on market conditions, regulatory factors, and the efficiency of each U.S. utility, the price per metric ton of carbon dioxide will fluctuate. For example, new U.S. laws could force all utilities to participate in a cap and trade market. If this were to occur, then demand for carbon dioxide credits could escalate to levels similar to Europe's $21.35/metric ton. Given the environmental initiatives in the U.S., it is likely that the current $3.00 per metric ton in the U.S. will rise over time. Consequently, a utility with one million meters could easily trade their carbon watt burden savings for $120,000 today, but over time if the carbon value grows to the European value of a metric ton of carbon, the utility could trade its carbon watt burden savings for an additional $813,000 per year.



The impact to the consumer

The reality is that the cost of powering the smart meter is passed on to the consumer as part of their kWh usage charge. The more efficient a utility can operate its infrastructure, the more savings can be passed on to the consumer. If the smart grid promises to lower operational cost by providing more data to utilities and consumers so that they can make informed decisions and in turn be more efficient, shouldn't consumers see lower utility bills? Unfortunately, this may not be true depending on the smart meter deployed. If the smart meter has a heavy watt burden, eventually the utility will pass the extra cost of powering the smart meter onto the consumer and consumers will not see the savings that the smart grid promises to deliver.

Is the DOE paying attention to these hidden costs when approving ARRA funding of smart grid initiatives and is the state regulatory commissions concerned with the efficiency or the payback of the smart grid. After surveying many of the most recent state utility commission pubic filings, there were no filings that mentioned the efficiency or watt burden of the smart meter. One would think that all aspects of the smart grid would be analyzed especially a metric that utilities used to pay attention to.

Recommendations

Without a doubt, the smart grid is complex, and it is challenging to digest all components and technologies that make up the smart grid. We also understand that the manufacturers do not readily make the watt burden of the smart meter available and if you are fortunate enough to find meter watt burden, this might only be for the communications or metrology card. What is needed is an aggregate watts loss burden by evaluating the burden when a smart meter is fully configured with all the components. So given the fact that the meter watt burden is a shell game, it is understandable why this has not been a focus for utilities and a key factor in choosing a smart meter system.

The reality of the situation is that currently there are no an industry test processes for determining the watt burden as was the case with traditional meters. Nor is there a third party testing facility capable of evaluating smart meter watts loss burden under typical operating conditions. In addition, there are no regulatory requirements for stating smart meter watt burden for typical system operating conditions.

If the watt burden of a smart meter is not readily available, how would a utility determine environmental and economic impact of the various smart meter solutions it is considering? Unfortunately, utilities have little support for finding and comparing the necessary data due to the complexities in measuring and comparing watt-hour burdens between smart meter systems.

There are concerns among system vendors that with any regulation technological advancements will be obstructed or stymied. One such concern is if a mandated maximum watt burden were to be enacted. Although this concern has some validity, it is still important to proceed with regulations that will foster the creation of a certification process and sharing of watt burden information with utilities and regulators. It is important that the industry develops an apple to apples comparison process.

One model to consider is to create an Energy Star program for smart metering. This would provide: 1) a common industry test process 2) a qualification program 3) a central publicly accessible repository for the test results and 4) it is a voluntary program so it will not obstruct innovation.

An acceptable test process and regulations for the utility industry could take years to develop. In the meantime, it is important for each utility to evaluate the technical characteristics of the smart meter systems it is considering and conduct fully configured smart meter watt burden comparison test based on the operating scenario. In addition, utilize the Elster WattSavings calculator located at www.energyaxis.com/ea-inf-white-papers.asp to help you compare the cost between smart meter manufactures.

Test procedure recommendations

Regardless of the manufacture, each smart meter must have a communications and metrology circuit board. The metrology circuit board measures the power usage while the communications circuit board either receives instructions or transmits data. In addition to these circuit boards, a smart meter may have an optional service disconnect switch and Home Area Network (HAN) board. Depending on the smart grid services a utility is implementing, the smart meter will be configured with two to four integrated circuit boards with each meter manufacture and each configuration having a different watt burden. The watt burden of the smart meter will also vary depending on the ANSI form (example, 1S, 2S, 3S, 4S, 12S) and the meter voltage.

To perform a true “apples to apples” comparison of different manufactures of smart meters, the component configuration must be the same, the ANSI form and meter voltage must be the same, and the operating scenario needs to be the same. Once the configuration is equal, there are two states of the meter where the watt burden should be measured:

- **Powered Metering watt burden:** includes powering all the circuit boards (including the communication circuit board) in a non-communications state while powered and actively metering electricity. The meter is not transmitting or using its communications board.
- **Transmitting watt burden:** the meter is transmitting messages to a collector, gateway, cellular tower, Home Area Network device, or another meter.

In the initial phases of smart meter deployments, the meter will be in the Powered Metering state the majority of time, so initially this watt burden should be sufficient and it is the value used in this article. However, as new smart grid services are created and the utility uses the 2-way communications of the smart grid more and more to implement these services, the Transmitting state will become more and more relevant. Therefore, over time utilities should consider using a Duty Cycle

- **Duty Cycle watt burden:** blended average applying a percentage of time the meter is in the Powered Metering stated with the percentage of time the meter is in the Transmitting state.

Consequently, the watt burden could be much larger and the dollar savings and emission could be much larger once the Duty Cycle watt burden is determined.

Conclusion

Meters have been around since the beginning of the electrical utility industry and meters have always had a watt burden placed on the electrical grid. Utilities have historically treated this as an infrastructure cost. Now, as utilities are deploying smart meters in ever increasing numbers, the meter watt burden could grow to be more than six times the electrical mechanical or AMR meter generating hundreds of thousands of metric tons in additional carbon dioxide, methane, and nitrous oxide as well as increasing the utilities operational cost.

The benefits of the smart grid far out way the a few additional watts and by no means should this article suggest or infer that utilities should halt their smart grid plans. However, to minimize the impact of smart meters on the environment, it is suggested that the utility industry create a standard test procedure or Energy Star like program for smart meter systems for utilities to utilize in deciding which smart meter is a better fit for their carbon emission and OPEX budget.

About Elster's smart meter

Elster's residential smart meter, 120V REX2 Form 2S combined communications and metrology watt burden is 0.67 watts (ANSI tested). Elster engineered EnergyAxis to be efficient by building a mesh network communicating over the unlicensed 902 – 928 Mhz frequency. Each smart meter is a repeater, allowing thousands of meters and smart grid devices to network in layers or hops and communicate effectively and efficiently over long distances.

The REX2 and the A3 ALPHA (C&I) use frequency hopping spread spectrum, AES 128 encryption, and dynamic symmetric key generation to ensure effective and secured effective and secure communication throughout the fastest true two-way LAN mesh in the industry.

Elster is the industry leading manufacture of smart meters with over 3 million meters in operation today at 60+ customers. Elster's has engineered the lowest meter watt burden, lowest operating costs, and lowest environmental impact of any smart meter manufacture. This is just another way that Elster is powering smart grid innovation for the benefit of utilities, their customers, and the environment.

Sources of information

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4. www.rggi.com

About the author

Robert Swiatkowski is a Regional Director of Smart Grid Solutions at Elster Solutions where he plays a pivotal role in helping define Elster’s Smart grid solutions. He is a graduate of the East Carolina University in BSCS and holds an MBA from the University of North Carolina, Chapel Hill. During his 15 years at Nortel Networks, Rob helped architect and develop the standards and technology of large real time complex inter-telecom switch interoperability for TDM and VoIP. He uses a conservative business approach in analyzing technological changes and industry needs based on solid ROI and an achievable payback period while promoting the advancement of technology using standards based interoperability of elements. He is a member of the UCA Open-SG and is presently engaged with numerous U.S. and Latin American utilities researching a wide variety of Smart grid areas in the development of the Smart Grid Networks.

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