Exploring the green side of AMI in the smart grid

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Everyone knows that in addition to being efficient and reliable, the smart grid is also supposed to be environmentally friendly and socially responsible. Over coffee or cocktails, we nod agreement over concepts like energy efficiency, demand response, reduced use of high carbon generation, and renewable energy.

But what do "green" and "socially responsible" really mean when it comes to choosing and implementing advanced metering infrastructure (AMI) and smart grid solutions?

To help you weigh the environmental advantages versus practical reality, this quick guide gives you a cradle-to-grave check-list of potential ways you can incorporate environmental and social responsibility into your smart grid program.

1. Partner with your solution provider

The solution provider you choose should be your ally and your guide—and not for only the technology. They should know utility issues and environment well enough to help you dodge any pitfalls.

1.1 Understand and communicate benefits to the environment and community

Why you should care:

Every utility has supporters and critics. Your solution provider should be able to provide information that can be used by your public relations team to inform investors, regulators, rate payers, and the media.

What you can do:

Beautifully printed materials with sentimental photographs or sound bites may not equate to real actions or beneficial technology. Look for substantive information that is reality-based and field proven, not theoretical.

1.2 Flexible and creative long-term partnership

Why you should care:

Although the basic requirements for AMI and smart grid may be the same from region to region, we feel certain that you have at least one concern that defies an easy fix. A flexible and creative partnership between you and your solution provider can help you develop an extraordinary solution to your out-of-the-ordinary challenge.

What you can do:

Select a solution provider that is firmly grounded and experienced in the utility industry. Innovations must work reliably and effectively within existing grid infrastructure and processes. Look also for a flexible, creative approach to challenges, a team that is open to incorporating new ideas, thinking beyond what they have today.

2. Impacts throughout the solution lifecycle

While it is true that AMI/smart grid solutions can deliver a wide range of benefits to the utility and the community, it is also true that there are some trade-offs.

When selecting a solution, it is relevant to consider the complete solution lifecycle. After all, you are looking for a solution that will actually reduce costs and environmental impact and not simply "shift it" to another part of the world or to a younger generation. You don't want to compromise system performance or reliability either.

Solutions that improve performance efficiencies and reduce waste throughout the system lifecycle may make it easier for your utility to achieve key smart grid goals without imposing other penalties along the way.

3. Design

3.1 Use of hazardous materials

Why you should care:

The less hazardous material designed into the product (or used in its manufacture), the fewer environmental impacts throughout its life cycle.

The trade-off may be higher up-front material cost and/or diminished long-term system performance. Product longevity, system reliability or low cost may require the use of hazardous materials for which there is no acceptable alternative.

What you can do:

Ask your solution provider about the materials used in the manufacture of their products. Hazardous materials that may be found in AMI/smart grid hardware include:

- Lead in electronic components and solder
- Lead in plastic parts
- Asbestos, mercury and cadmium
- PCBs, PCTs, PCNs, CFCs and HCFCs.
- Brominated flame retardants PBB and PBDE

Ask your solution provider to help you understand where and why any hazardous materials are used.

3.2 Recycled content or future capability to be recycled/refurbished

Why you should care:

Recycling during manufacturing minimizes landfill volume. Recycling by the utility of the packaging (at deployment) and products (at end-of-life) can reduce solid waste and possibly cost to the utility.

What you can do:

Determine the lifecycle expectations for the components. Is it ten years or twenty? Keep in mind that advances in key technologies may obsolete some components earlier than anticipated. (Note: See section 7.1, "Extending life expectancy through upgrade capability," for more on extending system life.)

Ask your solution provider if the product or packaging include any recycled content. Ask about cost or performance penalties for using recycled content. Environmental regulations are likely to stiffen over time. The projected cost of future disposal may justify today's selection of a recyclable material or future refurbishment option.

3.3 Batteries

Why you should care:

Batteries are most frequently used in AMI/smart grid devices that lack direct access to electric power—such as communications modules for gas or water meters. Some utilities specify batteries in key components for back-up power during system outages.

What you can do:

You can extend battery life through operational choices. For example: batteries used in water modules last longer if the module transmits data less frequently. The battery draining characteristics are frequency of transmissions and the transmit power. Consult with your solution provider to learn how you can optimize system features to extend battery life.

4. Manufacture

4.1 Environmentally and socially responsible manufacturing

Why you should care:

One of the objectives of the smart grid is to reduce environmental impact. Transferring those burdens to another region or to a younger generation does not align with the spirit of this objective. There are also matters of social responsibility such as workplace safety and paying a living wage.

What you can do:

If these issues are (or may become) important to your utility's public image, take time to query your suppliers.

Ask your solution provider where the components are manufactured, as well as where they are assembled. Does manufacturing occur in environmentally responsible countries? If not, does the solution provider set its own environmental standards for itself and its suppliers? How do they assure compliance?

Ask your solution provider which agencies regulate and inspect the manufacturing operation for environmental compliance. Ask for documentation of inspections or air, water, or hazmat permit applications.

Ask if factory workers are paid a living wage. Ask your solution provider which agencies regulate and inspect the manufacturing operation for workplace safety and child labor. Ask to see the statistics on workplace accidents.

4.2 Reducing environmental impacts of manufacturing

Why you should care:

Over time, legislation, and regulation may raise the cost of manufacturing. A pattern of good environmental practices today helps assure future component cost containment.

What you can do:

Ask your solution provider to show examples of changes they have made to key operations or processes to reduce emissions/waste. Find out when these changes were made and if they continue to make improvements.

5. Delivery and deployment

5.1 Environmentally responsible solution delivery and deployment

Why you should care:

As AMI/smart grid components are delivered to your warehouses and become your responsibility, advance planning can help ensure that this phase generates a minimum of waste, emissions and other environmental impacts.

What you can do:

Packaging: Ask the solution provider to use minimal packaging. Recyclable or returnable packaging is preferred. Ensure that your installation team follows through by recycling or returning by including this requirement in the statement of work. (Disposition of hazardous materials such as batteries or switches containing mercury are required by law to be tracked. Disposition of ordinary recyclables should be written into the contract to assure compliance.)

Documentation: Require that all documentation and training materials be delivered electronically (CD or online). If printed copies are needed, get the minimum and ask the solution provider to print double-side on recycled paper.

Delivery: Work with your solution provider to optimize the delivery schedule—from the environmental, as well as from the deployment perspective. For example: one full truckload of product has a smaller carbon footprint than four partial truckloads.

Consider the distance and the shipping methods available to your solution provider and work with them to plan orders in advance. Express shipments are expensive to the environment as well.

5.2 Socially responsible component appearance

Why you should care:

Consider the agendas of the political leadership and media in the communities you serve. They may take an interest in the appearance of the devices you introduce into their homes and neighborhoods.

For example, does your service area include:

- Historic old neighborhoods?
- Pricy and appearance conscious developments?
- Neighborhoods where service disconnects may draw the media or community activists?

Component configuration options will help you meet the desires of consumers and the community while serving the utilities own needs.

What you can do:

Take a good look at the network elements offered by your solution provider.

Meters are meters; no one is likely to have issue with a meter that looks like every other meter.

Data collectors on posts or towers are a different matter; it is hard to argue that boxy, industrial devices are either inconspicuous or attractive.

6. Operations and maintenance

6.1 System-wide energy consumption burden

Why you should care:

Imagine that you bought a new appliance expecting to save on energy costs…only to discover that it consumed more energy than the old one.

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, energy savings could quickly be eroded or negated by the watt burden of operating the smart meters themselves.

What you can do:

Today there is no EnergyStar equivalent for AMI systems, so you must conduct your own investigation. Ask your solution provider to prove how much of an energy burden its system places on the utility and consumers—both the devices and communications.

Once you have the data, multiply that burden by the number of endpoints in your service territory. For example, 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 tons of nitrous oxide emissions per year.

To download a detailed white paper on the hidden cost and environmental impact of smart meters, visit the EnergyAxis site. You will find an easy-to-use Watt Savings Calculator on the same page.

6.2 Leaks, losses and conservation

Why you should care:

Everyone agrees that waste, leaks and losses of electricity, water, and gas should be controlled and minimized whenever possible.

AMI/smart grid solutions should offer the ability to detect technical losses, tampering, theft, and leaks, as well as violations of water conservation measures during drought.

What you can do:

Find out if and how your solution provider's system detects and isolates electricity technical losses. Does the system flag meter tampering events (electric, water, and gas) and report anomalies that may indicate non-technical losses?

Ask if the system can help detect water leaks. Is it capable of identifying both slow or "burst pipe" events? Ask if and how it can help detect and document water conservation violations during periods of drought.

6.3 Energy efficiency and demand response

Why you should care:

When enabling technology is coupled with pricing incentives, demand response (DR) programs are shown to be an effective means of encouraging consumers to reduce consumption and shift energy use to off peak times. This can enable utilities to minimize peak energy production, reducing generation costs and minimizing consumption of hydrocarbon fuels.

According to the National Energy Efficiency Plan, 50 percent of future load growth can be met with demand response programs. Recent EPRI studies suggest that enabling almost all residential customers by 2019 could reduce demand by 188 GW which represents 20 percent of the national peak demand.

What you can do:

Choose an AMI/smart grid system with two-way communications to in home displays, thermostats and appliance control devices. Look for a wide range of devices that are easy to install and provision as well as being easy to understand and use. Very intuitive devices (such as those with color-coded alerts) tend to engage the entire family in conservation, including small children and non-tech savvy elders.

Demand response programs that use Internet portals, text messages, and voice messages have also been proven successful. Utilities communicate rate schedules, and make up-to-date account data available to consumers. This approach tends to appeal more to adults and heads of households.

6.4 Load control (with benefits) for agricultural and other C&I applications

Why you should care:

Large agricultural or industrial accounts have been actively participating in load management, but until recently lacked automated shut-off devices for remote or isolated systems.

EnergyAxis recently commercialized a load shed application to remotely disconnect polyphase irrigation pumps. On full deployment, farmers can shed megawatts of load on these pumps within seconds. Bottom line: Remote load control of agricultural pumps can conserve water, reduce emissions from road travel, and enable the utility to minimize peak generation from fossil fuels.

What you can do:

Perhaps your service territory doesn't have irrigation pumps. There are probably other remote or unstaffed systems for agricultural, mining, or other industrial processes. Analyze your service territory and query large agricultural and industrial customers for opportunities to offer remote disconnect and reconnect services as well as peak load shed capability.

Select an AMI system that offers remote disconnect capability for polyphase as well as single phase services. Look also for a flexible and creative partnership between you and your solution provider to help you develop and deploy innovative solutions.

6.5 Voltage conservation

Why you should care:

Most utilities find it hard to get cost effective and near-real-time access to actual voltage data at feeder endpoints. Without the data, they must estimate voltages; typically this means a conservative approach and excess voltage to avoid rate penalties. The utility may experience peak system delivery losses, excess generation, and potential equipment damage.

What you can do:

Select an AMI system that offers voltage monitoring capability both on the meters and through other grid infrastructure sensors. This capability will enable you to reduce the voltage on the lines and yet easily stay within regulated service delivery levels. This has enabled at least one large utility to generate impressive savings from avoidance of losses on the distribution system.

6.6 Basics: meter reads, disconnect switches, outage and restoration reports

Why you should care:

From an environmental standpoint, any feature that eliminates or minimizes truck rolls is helpful. For example, your AMI/smart grid technology should:

- eliminate driving the entire service area to read meters
- minimize field activities for services such as move-in/move-out, disconnect and reconnect
- limit excess trips/mileage by pinpointing outage location and enabling the utility headquarters to confirm service restoration prior to recalling field technicians

What you can do:

Confirm that your AMI solution provider offers these features and more to minimize truck rolls.

6.7 System scalability

Why you should care:

While scalability is not intrinsically a green concern, early replacement of infrastructure because it could not grow raises both environmental and financial red flags.

Add-on applications such as demand response and distribution automation within an AMI/smart grid solution means that in addition to meters, the system must support multiple HAN devices in each home and an array of grid monitors and controllers. And we can only imagine the requirements the next decade will bring!

What you can do:

Understand how your solution provider's system will scale up in size or adapt to future bandwidth requirements with minimal replacement or disposal of infrastructure.

6.8 Today's buzz – wind, solar, PHEVs, and maybe others

Why you should care:

US electricity generation today produces approximately 2,400 million metric tons of CO2 per year or about 40% of total US greenhouse gas (GHG) emissions via an existing generation mix of 50% coal, 20% natural gas, 20% nuclear, 8.5% renewables, and 1.5% oil.[1]

To this effect 19 states have already established GHG emission reduction targets. EPRI's PRISM model shows how the electric utility industry can reduce GHG emissions to below 1990 levels by 2030 through the judicious application of: energy efficiency, demand response, renewables, carbon capture and sequestering, nuclear and advanced coal generation, plug-in hybrid electric vehicles (PHEVs) and distributed energy resources. Of these the smart grid brings us all but two.

[1]Note MWh = 1.10 / 0.78 Mt of CO2 for Coal / Gas

What you can do:

Learn how your solution provider is planning to fold renewables and distributed generation into the AMI/smart grid.

7 End of life disposition

7.1 Extending life expectancy through upgrade capability

Why you should care:

The financial value of an extended lifecycle for both system and component is clear. Capital expenditures can be delayed. And the longer you can productively use a large number of system components the less landfill you generate.

Selecting a system with long-life capability is a worthy objective—but also a difficult challenge when key technology is evolving in real time. How often have you replaced your cell phone, laptop or TV? It seems impossible to expect telecommunications, security, and information technology (IT) in the smart grid to remain static for even five years, much less twenty.

What you can do:

At a minimum, you can select utility-grade systems and components designed for and proven to work reliably in heat/cold, humidity and high voltage environments. There is little excuse for components that go to land-fill early as a result of inexperienced design or poor execution.

Next, look for components and systems that can be upgraded or retrofit to accept new or improved technology or performance enhancements using:

- Remote upgrades to device firmware—including the communications component and (if applicable) the metrology
- Field retrofit or upgrade without removing the device
- Factory retrofit or upgrade

Remote or over-the-air (OTA) upgrades offer obvious environmental as well as financial benefits. Large systems can be upgraded very quickly without vehicles, fuel/emissions, potential damage to customers' property, worksite injuries, and so on.

Avoiding component replacement also minimizes the environmental costs of manufacturing, shipping, and installation of new components.

If OTA upgrades are available, be sure you understand exactly what can be upgraded. Look for remote upgrade capability to the communications module, the metrology in the meter, the head-end software, and other functions or components.

Field retrofit/maintenance without removing the device is the next most desirable from a green point of view. Yes, you still need to send a technician to work on the device, but less waste is generated in comparison to replacing it entirely.

Factory retrofit/maintenance requires that technicians remove the device, package and ship it back to the factory for rework. Again, vehicles, fuel, emissions plus packaging and shipping—but reduced landfill and environmental cost of manufacturing.

7.2 Landfill or other options

Why you should care:

Many of the end-of-life issues were covered in section 3, "Design." By recognizing the value of recyclability and avoiding components with hazardous materials at the time of purchase, the utility may minimize environmental costs when system replacement becomes inevitable.

What you can do:

Again, look closely at the component design.

- What percentage of the product is recyclable? Is the plastic housing or other component material recyclable?
- Is the product assembled in such a way that it can be disassembled at end of life? That is, does it use removable screws, pins or other fasteners; or is it glued?
- Does the solution provider offer a recycling option for end-of-life components?

Conclusion

Whether you are just beginning to select a smart grid solution or you have a system in place for many years, you can use this checklist as a tool to help evaluate potential solutions or to measure your progress against environmental goals.

Elster's approach to each of these environmental topics is available from your Elster account executive or by calling +1 800 786 2215.

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As a professional technical communicator with almost 30 years of experience, Ms. Lehenbauer has researched and written reports, permit applications, white papers and other materials focusing on the environmental aspects of businesses as diverse as rocket engine manufacture, manufacture of chemicals and pharmaceutical precursors, military installations, oil refineries, paper mills, gas pipelines, and one of the first superfund sites in California.

About Elster

Elster is one of the world's largest electricity, gas and water measurement and control providers. Our offerings include distribution monitoring and control, advanced smart metering, demand response, networking and software solutions, and numerous related communications and services – key components for enabling consumer choice, operational efficiency and conservation. Our products and solutions are widely used by utilities in the traditional and emerging Smart Grid markets.

With a heritage of more than 170 years of providing utility solutions, Elster enjoys a reputation as a leading innovator and has played, and continues to play, an important role in shaping industry standards with respect to performance, reliability, accuracy and functionality.

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WP42-1008A