A National Energy Security Necessity

Minority Report on the "Recommend changes to Market and Utility policy to promote development of Ocean Renewables"
by Suzanne Sayer, PhD

"A modernized grid diminishes the magnitude of traditional base load plants required for system stability",[1] and puts us onto the path to have the majority of our electricity needs met using renewables by 2020.[1]

A bold statement, but the USA has accomplished projects this revolutionary before[2]. Eighty to 100% renewable electricity can be incorporated in an amazingly short time, but depends upon the dynamic transformation of the aging US electric grid to a modern smart grid (SG)[1]. This transformation scope is like that which occurred during the depression when the USA under the Roosevelt administration started the REA program. In a brief period the US built the Hoover Dam, initiated the TVA, BPA, and scores of other projects that built the current electrical infrastructure of the USA. In a similar bold move Eisenhower overhauled the highway system. We have to do this again – again for our National security to halt the 700 billion petro dollar drain on our economy that nurtures terrorists. We are in a war; we should willingly upgrade our national infrastructure including the electrical grid. SG will minimize the uneconomical, expensive overbuild of base power plants, peaking units, and spinning reserves. SG will save the USA between $80 to $188 billion per year in outage costs.[3] (See Table A) SG includes multiple levels of technology that will evolve as did music recordings from wax, then vinyl records that were replaced by magnetic tape that morphed into cassettes, CDs and now MP3s. Technology is not static, but the electrical infrastructure has been. Maine should not try to implement "the ultimate" SG configuration. The SG is like the internet, when originally envisioned the applications that it engendered were unheard of, likewise the SG will have applications of which we haven't any knowledge. Remember your first computer, how you almost had to hire someone to set it up, and now its "plug and play." This technology is growing as fast. In Maine we use meters to measure electricity; meters will evolve to control, optimize, and anticipate usage. Some of this technology is in use now.[4] Regulations are out of date[5], the population is more concerned with digital TV transition rather than national security initiatives, and the permitting process needs to be streamlined. The USA has to move into the 21st century- it's already 2009!

Accomplishing a SG in Maine necessitates a revolutionary change in thinking, acting, and regulations[6] above all. Utilities invest minimally in R&D.[7] (see Figures 1 and 2)[8]. Both utilities and regulators are historically risk averse since they are responsible for providing reliable service.[7] They are immune to market forces because they regulate/are regulated monopolies. Current regulatory processes hamper upgrading and building new transmission lines. Maine needs to implement new laws and encourage actions such as these:[9]

1) Streamline permitting processes (look at the Oregon Model that Jeff Thaler emailed around). (m,l)
2) Empower the Maine delegation to insist FERC incorporate off shore Maine generation in planning.
3) Allow competition in building transmission and distribution[10]. (m,l)
4) Eliminate standby costs so entities can produce their own electricity[10]. (l)
5) Abandon the current queuing process at ISO-NE. (one project holds up all those behind it) [11]
6) Split utility bills into a flat connection cost and separate dynamic pricing energy costs (l)
7) Educate citizens that we are at war to conserve energy and modernize with advertisements like the "Scarecrow" ad (l) "
8) Encourage using time delay settings already on washing machines and dishwashers(m)
9) Include "smart grid" technology topics in engineering coursework (m,l)
10) Educate house inspectors about technology and smart meters(l)
11) Add exam question on PE Exam about smart grids(l)
12) Encourage open and interoperable standards (standardize communications protocol) (m,l)
13) Establish a model locale to experiment with the SG technologies (Orono?) (h)
14) Implement State PHEV, EREV, BEV charging stations for state vehicles (h)
15) Put in place dynamic pricing and correct pricing models, decouple profits from total consumption(m)
    a. Require utilities to provide the option for customers of real-time or TOU pricing for all. (m,l)
    b. FERC has allowed/MPUC should allow a larger ROE to utilities for promoting/installing smart equipment.
16) Use Federal ARRA monies to provide capital support for transmission projects (h)
17) Encourage demand response capability and management.(m, l)

18) Insist State, county/municipal government fleets transition to PHEVs in 5 years (except heavy equipment)
19) Encouraging personal HEV and PHEVs with tax credits (l)
20) Encourage ground source heat pumps and HAN with tax credits.(l)
21) Upgrade long and short distance high voltage transmission(h) [12]
22) Encourage use of voltage sensors (GFA) to reduce specific demands when grid is stressed. (m,l)
23) Publically value electrical transmission more than coupons for boxes for Digital TV compatibility.
24) Allow utilities to accelerate depreciation and get rid of stranded costs.
25) Resolve to phase out all coal-fired grandfathered utilities nationwide.
26) Encourage permits for pollution abatement rather than upgrading old facilities (speeds up permitting processes).[10]
27) Use the $1 "voluntary" monthly alternative energy fee for the Smart Grid appliance chips and meters rather than Efficiency Maine projects like the Kittery Wind turbine that got $50K
28) Provide for an implementation of cyber security to collect, analyze, distribute and maintain data.

The SG is essentially a communications highway similar to that of the internet or wireless phone cellular network. There are different specifications in use in various localities. An open source communications protocol needs to be chosen by a Federal Task Force, and our PUC, utilities and congressional delegation should demand quick adoption of national or at least regional protocol.[13]

China, a centralized controlled society, is well on the way to having a SG[14] using a method called WAMS. With real leadership and personal courage by Maine and national legislators the USA can accomplish a similar feat. The USA already has experiments in SG technology (see Table B). Xcel Energy[15] is installing infrastructure in Boulder for a SG at a price of $2000/home, and building their own plug in vehicles[16]. In Maine the cost of a similar advanced project could be borne by a fee on the transfer of a house when it is sold and/or using some of the ARRA funds with accelerated depreciation (from the TARp) for the utility that partners on the first Maine project. This could be done in 2-3 years.

The SG could be piggybacked on one of the 4 grid systems that already enter premises: 1) electric transmission wires 2) telephone wires 3) fiber optics 4) wireless internet and 5) television signals (dish, cable, etc). Inside the house a HAN can give the homeowner the ability to control electricity consumption. A rudimentary SG can be as simple as the electric utility superimposing a signal on the electric wires used for transmission that communicates with a controller, sort of like "pinging." This can be used by electric utilities to determine the location of power outages, and areas of high stress on distribution lines[17]. Potential SG comprises a wireless system like the Wi-Fi (already on Amtrak) or a fiber optic system like that used for TV/ internet connections or a SCADA used by wind turbines or a hybrid of several WANs or LANs, phone lines or even use GPS signals to condition electrical waveforms. A SG could ultimately be designed to "heal itself" from outages. [18]

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[1] http://www.repoweramerica.org/plan/analysis/
[2] building 300,000 planes during WWII
[3] The Smart Grid: An Introduction, USDOE and http://www.repoweramerica.org/plan/unified-national-smart-grid/
[4] Capgemini, Pontin, Scott – multiple sources.
[5] www.smartgridnews.com, editorial
[6] "Congress must cut the Gordian knot of regulatory processes that can add five to ten years to the time needed to get new transmission sited and approved. If we have the political courage, we should give FERC the authority to mandate transmission corridors through states and to allocate the cost burden" Staff Report Transmission_a_weak_spot_of_the_stimulus_package.html
[7] Friedman; Casten; DOE; smartgridnews.com, multiple sources, etc.
[8] Figures 1-3 from The Smart Grid: An Introduction, pages 6, 8 and 9
[9] ([9]Minimal cost (m), low cost (l), High cost (h))
[10] Casten
[11] Moeller
[12] Eckelberger
[13] Rowland
[14] Wikipedia article on Smart Grids footnote 8.
[15] Talbot
[16] Personal Communication John Bryan, Xcel Corp.
[17] Pullins, Bryan, multiple sources, AMR, load control, in-home displays, distribution monitoring and control, TOU pricing, Theft detection and automated billing functions, direct and /or premises-based load control, real time outage information, distribution grid monitoring, distribution automation
[18] Causey, Bryan, multiple sources.

Definitions

AMI – advance metering infrastructure - 2-way, fixed network technology that can be read multiple times a day – robust, gives detailed data - the marketplace might determine what protocols to use (i.e. BETAMAX vs VHS)
BEV – battery electric vehicle
AMR- automated meter reading – remote technology that records the meter reading – can be very simple system.
ARRA – American Recovery and Reinvestment Act of 2009
AWE – Aroostook Wind Energy
BPA - Bonneville Power Administration started in 1937
DER- Distributed Energy Resource – collected distributed generation and/or energy storage. (Generally small, modular natural gas or hydrogen generators, but can encompass a range of technologies including fuel cells, microturbines, reciprocating engines, load reduction, and other energy management technologies.
DG – distributed generation
DR – demand response - the ability to reduce power consumption at the consumer side during peak hours
EREV – extended range electric vehicles (Volt 2010)
dynamic pricing – time of use pricing, real-time pricing, critical peak pricing, and peak-time rebates
GFA controller – circuit board that detects stress in the electricity grid prompting appliances to modify operations - on devices to turn off large resistance when power starts to overload (hot water heaters, dryers, dishwashers, etc
GPS – Global positioning satellites
HAN – Home Area Network, possibly a submetered system that telemeters data to an AMI device
HEV – Hybrid Electric Vehicles
FERC – Federal Energy Regulatory Commission
LAN – Local area net
MPUC – Maine Public Utilities Commission
NARUC – National Association of Regulatory Utility Commissioners
PHEV – Plug-in Hybrid Electric Vehicles
"ping" – signal sent from one computer to another to establish connectivity.
PMU – Phasor measurement units - can use Global positioning to condition electrical waveforms
PNNL – Pacific Northwest National Laboratory
REA – Rural Electrification Administration started in 1935
Reactive power – power phasing due to inductors and capacitors rather than straight resistive loads. Inductors consume reactive power and capacitors create reactive power. Ideally you would like UUno reactive power.
ROE – Return on Equity
SCADA – Supervisory Control and Data Acquisition – a monodirectional computer system that monitors and controls something usually a manufacturing process such as a refinery or industrial plant.
SG – smart grid – an electrical transmission and delivery system that can monitor and balance the load, accommodate distributed energy from local areas and, in the near future, capitalize on a massive national fleet of clean plug-in cars.
TARP – Troubled Asset Relief Program
TOU – time of use – charging higher rates during peak demand hours and lower rates at night and other off-peak times
TVA – Tennessee Valley Authority
WAMS – Wide area monitoring system using a network of phasor measuring devices to condition the electrical network using waveform synchronization that would minimize brownouts and blackouts from overload conditions as has happened in the Northeast.
WAN – Wide area net
Wi-Fi – Wireless Local Area Network (WLAN) based on IEEE 802.11 standard
Zigbee – an independent, neutral, non-profit interested in promoting open global standards for wireless networking.

Table A[3]

Cost of Power Outages for Selected Commercial Customers

Brokerage Operations	$6,480,000 per hour
Credit Card Operations	$2,580,000 per hour
Airline Reservations	$90,000 per hour
Telephone Ticket Sales	$72,000 per hour
Cellular Communications	$41,000 per hour
Hospitals, Medical facilities	Unknown
Continuous process manufacturing incl.	$45.7B/annually
(Transit, sewage, water purification)	$6.7B/annually power quality

Source: *"Reliability and Distributed Generation,"*
A White Paper by Arthur D. Little.
Adapted from **Smart Grid: An Introduction**

Table B
Locations with Smart Grids or proto smart grids

Countries Location	Utility	Customer Base	Deployment Started	Deployment Accomplished	Capitalized
Italy	Telegestore Project	27 million	2000		
Malta (AMI by IBM)	Enemalta & Water services	250,000	2009	2014	$89.76 million
Sweden					
Denmark (see Figure 3)					
Finland					
Canada					
Australia	Victoria	2.4 million	2008	deployed smart meters by USA Corp Echelon	
New Zealand		load controls based on rippled control allowing utility to switch off water heaters			
France		Stand by private diesels and EJP Tariff – Cut usage in 30 minutes or pay 4 times the normal cost			
United Kingdom		disconnectable industrial loads, crude night storage heaters. Standby private diesels			
The Netherlands		Much of country uses prepayment for toasters, hair dryers etc, put coins in to use the electricity			

Location	Utility	Customer Base	Deployment Started	Deployment Accomplished	Capitalized
Kansas City	Great Plains Energy	400,000	1996	1998 (AMR deployment)	
Austin, Texas	Austin Energy Utility	1 million	2004		Owned by the City of Austin
Oklahoma	OG&E	6600	2008	pilot project	
Ontario, Canada	Hydro One Networks	4.5 million	2006	2010	Mandated by Province
Rockwall, Texas	Oncor Electric	3 million	2008	2012 (customers look at web site)	Paid for by $2.29/month - 11 yrs
Maui, Hawaii					
Michigan	Consumers Energy		Phased - 6k meters in 2008 - mass deployment in 2010		
GridWise Demo Project			Two part project		DOE PNNL
Grid Friendly Appliance Project		300	2006		DOE, PNNL, and Northwest Util.
Olympic Peninsula Project					BPA, Pacific Corp, Portland GE, Port Angeles,/Clallam County PURD #1
					Appliances, manuf. & tech companies.
Boulder, CO	Xcel Corp	50,000	2008	2009	Xcel Corp & donations from manuf. & tech companies.
Google	Power Meter	200	2009	N/A	Google
San Diego	SD G&E				
Illinois					
West Virginia	Allegheny Energy				
Fort Collins, Co					
Baltimore	BGE/Constellation	pilot program for AMI	2007-2008		

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Integrating Wind, C. Moeller, EnergyBiz. Jan/Feb 2009, p. 60-61
Notes: Process in ISO for interconnection queues method is outmoded. Old method was FIFO, reserving a place in the queue was relatively inexpensive with a $10,000 refundable fee resulted in a dramatic potential oversupply. And the developer could put project on hold for up to 3 years holding up everyone behind him. In June 20089 the Midwest ISO submitted to FERC a list of proposed reforms. Developers will invest an estimated $500 billion in wind turbines and an additional investment of $80 billion will be needed in transmission.

GridWise Demonstration Project Fast Facts, Dec 2007, Pacific Northwest National Lab.
Notes: Technically feasible, adoption is more limited by regulations than technology. Calling upon reductions in demand is much less expensive for utilities and cleaner than ramping power plants up and down to follow load fluctuations.

AMI as a Foundational Component of the Smart Grid, S. Pontin, Jan/Feb 2009, EnergyBiz, p. 48-51.

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http://www.smartgridnews.com/artman/publish/commentary/Start_with_the_End_in_Mind_Utility_of_the_Near_Future.html

State Grid Initiatives, Here Come Renewable Energy Zones, P. Ratdtke-Russell, EnergyBiz, Jan/Feb 2009, p. 30-32

Focus on Collaboration, P. Radtke-Russell, EnergyBiz, Jan/Feb 2009, p. 32-34

Working on Smart Grid, K. Rowland, EnergyBiz, Jan/Feb 2009 p. 58-60.
Notes: $1 Trillion dollar investment in Grid between 2010 and 2030 Title XIII, Smart Grid – States are to encourage but not require utilities to adopt smart grid technology and allow them to recover their costs through rate increases. Currently FERC and NARUC are studying AMI pilot projects to analyze their benefits and costs.

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Interesting News Items

Part of 2008 November 8th Editorial from http://www.smartgridnews.com/

Forces in Favor of Smart Grid Investments
Past federal incentives. The October economic stimulus bill included provisions that let utilities accelerate the depreciation of smart meters and Smart Grids, cutting the depreciation period from 20 years to 10.

Future federal incentives. Before the election, the Obama campaign called for matching grants of 25% of qualifying Smart Grid investments as well as support for advanced metering and demand response. What's more, our sources in Washington say the Obama Administration is already circulating concepts for a New Deal-style infrastructure stimulus bill that will spend money on roads, bridges and on a Smart Grid.

Regulatory favor. The National Association of Regulatory Utility Commissions just wrapped up a meeting in New Orleans. According to one attendee, "Smart Grid was all over everything." More and more regulators see the Smart Grid as a path to better reliability and lower rates. They see the Smart Grid occurring elsewhere, and they want its benefits for their own jurisdictions. Although it's always dangerous to make predictions about America's fractious regulators, in general they are neutral at worst and advocates at best.

You can pay me now or you can pay me later. Standard and Poor's says utilities may be able to delay some grid expenditures but they won't be able to eliminate them. Many utilities have an urgent need to upgrade their aging infrastructure. A recent Black & Veatch survey claimed that as much as 60% of the electric power infrastructure is at the end of its life, with as much as 25% now past its design life.

Renewables, PHEVs, and other "fads." Renewable energy and plug-in hybrids are hot topics these days. As they gain more attention, so does the fact that we must upgrade the grid to accommodate them. This puts pressure on utilities and regulators to announce programs to deal with these top-of-mind issues.

The *SmartGridNews* View
We expect utilities to cut back capital expenditures. But as they decide what to leave in and what to leave out, we predict that Smart Grid projects will often end up at the top of the "Keep" list. With everyone from Gore to Google championing the cause, we think most utilities will be reluctant to announce that they favor a Dumb Grid instead. Our conclusion is "cautious optimism."

May 9, 2007 www.smartgridnews.com

Cantwell sponsors U.S. Smart Grid bill. Senator Maria Cantwell (D-WA) has introduced federal legislation to create national standards for a smart grid, and to treat Smart Grid technology as computer equipment, with similar depreciation values for tax purposes. Furthermore, it attempts to reduce the potential for the improper release of private data, establishes peak demand reduction goals and encourages goals for a national renewables portfolio. The bill provides financial incentives for investment in Smart Grid technologies, including an enhanced rate of return for utilities that invest in these technologies.

QuickTake: This is a major legislative effort to set nation-wide standards sorely needed to bring order to a sometimes confusing new world for utilities. Even more important, the bill provides financial incentives for investment in Smart Grid technologies, including an enhanced rate of return for utilities that invest in these technologies.

FERC okays finance model to help connect renewables. The Federal Energy Regulatory Commission (FERC) approved a new financing method to help renewable energy providers finance their links to the grid in California. When a new renewable energy facility such as a wind power plant connects to the new

transmission line, the facility will start paying its share of the cost based on how much of the transmission line's capacity it is using. Other transmission system users will continue to pay the cost of any unused capacity on the line until the line is fully subscribed, that is, until new facilities have signed up to use the full capacity of the line.

QuickTake: Until now, renewable projects have often been saddled with more than their fair share of transmission costs. Rulings like this one should make it easier to cost-justify new projects

IBM launches grid coalition. IBM has begun a new coalition to accelerate the adoption of IBM's Intelligent Utility Network (IUN) software and services. The alliance will be a consortium of IBM customers and partners who will share lessons learned. Initial membership includes IBM along with CenterPoint Energy of Houston and Pepco Holdings of Washington, D.C. Centerpoint is currently working with IBM to implement IUN services such as remote connection and disconnection of service and automated meter reads for customers in the Greater Houston area.

QuickTake: Three or more years ago, we warned you that a major new market opportunity was arising, the remaking of the power infrastructure all around the world. Now the day is at hand, and IBM has moved in strongly to claim a share. Other giants – Oracle, Cisco, Accenture, Microsoft – are beginning to stake out turf. Anyone who wants to be a major player has the next 12 months to carve out mind share. After that, the "short list" will already be in buyers' minds. Vendors who want to be seen in that light will first have to knock someone off the list, a much harder and more expensive prospect.