HB 6360 AAC Implementation of Connecticut's Comprehensive Energy Strategy

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Senator Duff, Representative Reed, Committee Members and diligent staff. My name is Joel Gordes and I am an independent energy consultant purely representing myself. It is unfortunate I cannot be with you today in person to answer any questions but I appreciate the opportunity to comment on Section 8 of this bill. That section states:

> Sec. 8. (NEW) (*Effective July 1, 2013*) The Public Utilities Regulatory Authority shall authorize any municipality, state or federal governmental entity that owns, leases or operates any Class I renewable energy source, as defined in section 16-1 of the general statutes, or Class III source, as defined in section 16-1 of the general statutes, to independently distribute electricity generated from any such Class I renewable energy source or Class III source, or any other generation resource under five megawatts that is connected to a municipal microgrid, across a public highway or street for the sole purpose of serving critical facilities, as defined in subdivision (2) of subsection (a) of section 16-243y of the general statutes.

First let me applaud the Governor and DEEP for taking this bold beginning to ensure that we are able to move toward a new grid architecture that is far more resilient but I expect there will be some degree of opposition to this section. Those opposing it will likely propose enhanced hardening to prop up the existing grid to make the outage frequency (SAIFI) and duration-of-outages (SAIDI) ratings look better but large storms are not included in those metrics by which utilities are rated. Additionally, hardening, for many grid threats, is akin to the French-built, defensive Maginot Line that was rendered useless in WWII by total changes in technology and tactics. As the Maginot Line was unable to meet the challenges of mechanized warfare in 1940, the current grid is incapable of providing the degree of public health, safety, security and restoration demanded and expected by the public, legislators and regulators today. This is particularly true in our increasing digitally-dependent age where higher reliability and power quality must be assured. If it were just The Two Storms in 2012 and Hurricane Sandy in 2012 we faced, I might agree with the hardening tactic but the multiple threats to the grid call for a more holistic, all-hazards approach rather than a piecemeal effort of directed task forces or obligatory PURA dockets to pick up the pieces afterwards.

Drivers of Grid Vulnerability That Argue for Section 8:

- Fuel supply interruption/cost escalation.
- Physical security of generation, transmission, distribution, Supervisory Control and Data Acquisition (SCADA). Includes natural hazards such as The Two Storms, Hurricane Sandy & Solar Storms
- Foreign dependency/disruption of globalized supply chains for critical materials (Generation Step-Up transformers, rare earth ores, other minerals like lithium, etc.)
- Cyberthreats including distributed denial of service, worms, viruses, electromagnetic pulse, embedded codes in foreign sourced components and cyber weaknesses in SCADA/IPC and premature Smart Grid deployment. Gas supply lines can also be at risk.

- A combined or "blended" combination of the aforementioned threats. For instance, a cyberattack in the midst of a blizzard might amplify casualties.

- Other threats and considerations including "unintended consequences" including adding complexity to an already tightly-coupled, complex system

Section 8 sets in motion the beginning of a several decades long journey to decentralize our energy systems. Let me clarify that this should not be taken an attempt to disenfranchise the utilities. In fact, I recommend new incentives for them to undertake large parts of what is required and to be rewarded commensurate with how well they accomplish future goals. This is similar to how they currently profit from energy efficiency programs via being paid what was originally termed a "bonus rate of return" (see PA 88-57) and is currently called a management fee. Many never foresaw their large scale entry into that venue either.

The decentralization via microgrids that Section 8 allows may be best defined as having these attributes:[1]

- Consist of many small units of supply and distribution with redundancy to back each other up;
- Units are geographically dispersed but close to demand centers;
- Interconnected with many units and not dependent on just a few critical links and nodes;
- Continue to operate if in isolated modes, so failures tend to be more isolated;
- Provides storage as a buffer so that failures tend to be gradual and "elegant" rather than abrupt;
- Short links at the distribution level;
- Employ qualities conducive to user-controllability, comprehensibility, and user independence.

Anything that increases the distance and system complexity between a plant and the end users, such as additional, large transmission lines, tends to further centralize the grid. This leaves it more vulnerable to interruptions as well as adding to the already large, complex interconnected system. For this reason, after the 9/11 attacks the National Science Council (Academies of Science and Engineering) stated:

> A direct way to address vulnerable transmission bottlenecks and make the grid more robust is to build additional transmission capacity, but there are indications that redundancy has a dark side (in addition to increased costs). The likelihood of hidden failures in any large-scale system increases as the number of components increases. Modeling techniques are only now emerging for the analysis of such hidden failures. *[Emphasis added.]*[2]

By example, the Comprehensive Energy Strategy contemplates importing "cheap" hydroelectric power from Quebec. Placing this under a security-oriented lens reveals that even the sizeable distances involved builds additional weakness into the grid that when coupled with past history sends up red flags. In 1998 a massive ice storm in Canada destroyed numerous, large transmission towers and power was lost over a vast region for a lengthy period. In 1989 a geomagnetic storm (coronal mass ejection, a form of solar storm) knocked out power in a large portion of Canada and even affected large generation step-up transformers as far south as New Jersey. We are currently entering a period of increased solar activity. Transmission lines act as large antennas for such events and Connecticut might find itself in a position that the power from Quebec is compromised at times

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[1] Lovins, Amory and L. Hunter. *Brittle Power*. Brick House Publishing. 1982. Pp. 215-219

[2] *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism.* National Academy Press. Committee on Science and Technology for Countering Terrorism, National Research Council . p.302 .2002.

when it is most needed. Decentralization provides some protection from such occurrences and legislators should be mindful that the movement toward a decentralized grid may later place existing and proposed transmission as stranded cost which ratepayers will pay for needlessly unless construction is moderated. Transmission is also exerting an increasing pressure on rates which negatively affects low income ratepayers.

How Do We Fashion a No Losers Proposition?

Under the current system, the utilities are able to make a decent return on new transmission lines and if they meet certain "reliability" needs the cost is spread over all of New England. This creates an uneven playing field for any instate alternatives in that the total cost of the alternatives would be placed on Connecticut ratepayers. What Section 8 needs to flesh out is a way in which the utilities can profit, or at the least, not lose revenue, but recognize the additional values that a more robust grid provides. Part of this is recognizing that microgrids provide many as-yet-unarticulated monetary value streams both to the utilities and ratepayers. A 2006 paper by Robertson and Cliburn[3] lays out tables showing values for just PV systems for one representative utility[4] and the categories where they provide value. (See page 5.) What is needed is to look at the values streams from microgrids in a similar way to see where they may monetarily benefit a utility and then to develop mechanisms which may add additional value for all parties. How we value resilience for public health, safety and security as well as for must run businesses is yet to be determined.

While not universally loved or accepted, decoupling might provide one method by which to tie utility activity in facilitating the creation of microgrids to their rate of return. Other mechanisms might include allowing utilities back into the generation field for units connected at the distribution level that also provide significant amounts of grid support. There has already been some activity in this direction namely the 200 MW GenConn plant that came online in June 2011. GenConn is a partnership of United Illuminating (UI) and NRG Energy Inc. In a story on the project, UI Chief Executive James Togerson was quoted as saying:[5]

> Bringing the GenConn Middletown facility online…is especially beneficial to our customers because UI's peak demand is driven by summertime air conditioning in the hot summer months.

Since distributed generation is defined as being 65 MW or below and a single project would preferably use more than one source of generation, we are talking about one or more microgrid projects employing substantial resources. Possibly most important, it also demonstrates the ability to divide project responsibilities and profits among a regulated activity and an unregulated private sector firm. This may be useful in developing other models. A resurgence by the utilities into generation must also protect the private sector must from the non-competitive advantages of the monopolies. New business models must be developed amenable to all players. Perhaps that would be the subject for a PURA docket.

Failure for Utilities to Proactively Move Forward May Entail Greater Utility Risks

The failure of legislators and regulators to embrace a profitable role in microgrids for utilities or for the utilities to spurn such a role carries significant risks. Already there has been some discussion and even draft legislation looking at how it might be possible to allow a town or towns to more easily create a municipal utility. For a number of reasons, the existing muni's

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[3] Robertson, Chris and Cliburn, Jill K. *Utility-Driven Solar Energy as a Les- Cost Strategy to Meet RPS Policy Goals and Open New Markets*. American Solar Energy Association Conference. Denver, CO. 2006.

[4] These figures are not for a CT utility but provided as an example of the value streams.

[5] Posada, Janice. *Power Plant Goes Online: Built to Provide Electricity at Peak Times*. The Hartford Courant. June 30, 2011.

physical performance during the storms has been quite exemplary compared to the investor-owned utilities who faced far more widespread damage.

Another trend we may see is "disintermediation" which is best described as:[6]

> In economics, the word means "cutting out the middleman or intermediary." For our purposes, it refers to third-party companies that strike up a direct relationship with customers to sell them energy or energy services. When they do that, they separate the utility from some or all of the potential profits. And they intervene in the customer relationship, closing off future avenues.
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> Utilities are starting to realize that disintermediation could have a meaningful impact in electric power. They see how Dell disintermediated computer resellers, how Amazon disintermediated booksellers and how Google and Apple are disintermediating cell phone companies by shifting customer loyalty from the phone company to the handset. They realize companies such as Wal-Mart or Verizon or Schneider or EnerNOC could someday disintermediate utilities. If not from 100% of power sales, then at least from the high-margin portions.

One potentially ultimate outcome may be the evolution of the grid into what is termed a common pool resource which is maybe best known from " The environmental parable titled The Tragedy of the Commons which comes from a 1968 article in Science by Garrett Hardin explains a social phenomenon characteristic of human activity wherein individuals take care of what personally belongs to them; but destroy shared resources in their haste to get what they can.[7] This, too, may have grid applicability."[8] Follow-on work by Elinor Ostrom, later a Nobel Prize winner, maintained that the mistreatment of resources held in common should not be a given as some cultures have been able to devise workable solutions that did not lead to their destruction. While Ostrom had not envisioned its application to the electric grid, one well-known microgrid pioneer and practitioner has laid out some specific guidelines to prevent mismanagement of grid resources. These include:[9]

- Group boundaries are small areas and clearly defined.
- Rules governing the use of collective properties and
- equipment are well matched to local needs and conditions equipment are well matched to local needs and conditions.
- Most individuals affected by these rules can participate in modifying the rules
- The rights of community members to devise their own rules is respected by external authorities
- A system for monitoring member's behavior exists; the community members themselves undertake this monitoring.

In closing, while there are some indications that decisions already made may be able to allow what is envisioned in Section 8, placing language in statute to clarify technical and institutional uncertainties may still serve a useful purpose and accelerate the deployment of microgrids.

Thank you for the opportunity to comment on this bill.

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[6] *When the future attacks: How "disintermediation" could rob utilities of their customers*. Smart Grid Newsletter. February 22, 2012. Berst, Jesse.

[7] Commoner and http://blogs.asaecenter.org/Acronym/2009/06/tragedy_of_the_commons.html , http://en.wikipedia.org/wiki/Tragedy_of_the_commons

[8] Comments of Joel N. Gordes on *Energy Risks and Considerations* in CT Siting Council Docket #346 *Implementation Of Section 8 Of Public Act No. 07-242 An Act Concerning Electricity And Energy Efficiency*. June 22, 2009.

[9] Warner Guy, Chairman and CEO Pareto Energy. *Energy Improvement Districts and Microgrids A New Approach: Microgrids as a Common Pooled*. Gridweek Conference Sep 21-24, 2009.

Unarticulated Values Streams of Distributed Resources/Microgrids[10]

Table 1: Selected Sources of Value in Utility Budgets from Utility-Driven Distributed Photovoltaics

Source of Value	Example or Value if Publicly Available
Peak Load Value	
Distribution investment deferral[7]	< $0 to > $6000 per marginal kW for 5 year deferral
Transmission congestion relief[8]	$30 - $50/kW-yr
Transmission investment deferral[9]	$45/kW-yr
Generation capacity	$475/kW[10]; $1550 - $2000/kW if IGCC + Carbon sequestration[11]
Generation O&M[12]	~$10/kW-yr
Generation reserve capacity and O&M[13]	$.014/kWh for peak period
Natural gas[14]	$8.50/MMBTU; highly volatile future prices
Purchased power	PV supply curve offsets highest cost power in generation supply curve
Minimum load power plant dispatch[15]	$28/kW-yr
Environmental[16]	$0.014/kWh NO_X; also Mercury, SO_2, CO_2, PM10
Line losses	Up to 25% in some constrained systems
Reactive power[17]	$15/kW-yr
Voltage support	Varies; may be part of distribution investment deferral
Network O&M[18]	~ $16 to >$88/kW-yr
Intermediate Load Value	
Natural gas	$8.50/MMBTU; Peak + intermediate gas cost NPV $1800 - $3500/kW (increasing, with more volatility due to oil and gas depletion)
Environmental	$0.014/kWh NOx; others
Line losses	6% - 8%

Table 2: Policy and Business Model Economic Value from Utility-Driven Distributed Photovoltaics

Source of Value	Example or Value if Publicly Available
Policy-Driven Value	
Net metering payments	Normal utility rate; moving to Time-of-Use rate
Customer rebate payments	Varies by jurisdiction
Solar renewable energy credits	In NE US (PJM) region $200 - $600/MWh; others much less
Business Model Value	
Customer revenue retention	Normal revenue reduces non-participant cost issues
Peak-period DPV revenue	Sell DPV capacity into peak power market
Tax investor participation[19]	30% PV capital cost through '07; 10% after that
PV system portability[20]	~$2000/kW if redeployed 4x to dist. deferral projects
(Payment to PV host site)	Perhaps 10% of rate, plus insurance coverage

Source: ElectricSUN synthesis from published studies of distributed energy resource benefits and costs

Table 3: Risk Management Issues Affected by Utility-Driven Distributed Photovoltaics

Source of Value	Example or Value if Publicly Available
Grid reliability & outage prevention[21]	$Billions & lives lost -- societal
Natural gas availability	Threat of Fuel Use Act; oil and gas depletion; physical disruption from storm damage
Financial	Lower interest rates for PV due to lower risk
Regulatory	Avoid regulatory pre-emption
Carbon	New requirements likely
Insurance	Global warming liability coverage
Share price & fiduciary duty	Investor expectations for risk management leadership
Generation portfolio cost and risk	DPV net fixed cost reduces gen. portfolio cost & risk

[10] Robertson, Chris and Cliburn, Jill K. *Utility-Driven Solar Energy as a Les- Cost Strategy to Meet RPS Policy Goals and Open New Markets*. American Solar Energy Association Conference. Denver, CO. 2006.