ENERGY STORAGE WORKING GROUP

INTERIM REPORT

NC SUSTAINABLE ENERGY ASSOCIATION

Background: Why Energy Storage, Why Now?

The NC Sustainable Energy Association (NCSEA) identified the need for a collaborative dialogue on how North Carolina may deploy energy storage. The importance of this work is now attributable to a number of factors.

First, it builds on NCSEA's other work on clean energy technologies, including a recent publication, Batteries ~~Not~~ Included, which focused on the barriers to energy storage deployment for North Carolina.

Second, North Carolina has over 4.2 GW of installed renewable generation capacity, is currently ranked third in the country for total solar photovoltaic (PV) capacity, and in 2015 the state installed the second most solar PV capacity in the country. Active management of North Carolina's grid can allow the integration of additional renewable energy generation by providing a key opportunity for energy storage. In addition, North Carolina's renewable generation capacity makes the state a desirable market for energy storage, given their complementary nature.

Third, there are increasing business opportunities in the energy storage market. From 2014 to 2015, according to Advanced Energy Economy (AEE), the energy storage market in the U.S. increased ten-fold, from $58 million to $734 million. In 2015, NCSEA's Clean Energy Industry Census found there were 486 full-time equivalent (FTE) employees in the energy storage industry in North Carolina, making it the largest contributor to clean energy manufacturing jobs in the state, and the third highest in revenues of all clean energy manufacturing sectors.

Finally, over the past few years, the cost of energy storage has declined significantly and the performance of energy storage technologies has advanced appreciably. Utilities in the state, notably Duke Energy Carolinas, Duke Energy Progress, Dominion North Carolina Power, and the NC Electric Membership Cooperatives, are researching the value of energy storage and its applications on the state's grid by installing pilot projects and demonstrations.

In short, energy storage is beginning to penetrate North Carolina's market. North Carolina has a clear opportunity to again be a leader in energy policy and forge a path that can be emulated in other similarly-situated electricity markets. To do so, however, North Carolina must provide clear guidance on how energy storage can be deployed commercially.

Working Group Goals and Composition

With that as background, NCSEA identified the following goals for the working group:

- Develop guidance that allows energy storage to be utilized for all of its possible purposes;
- Create a model for deploying energy storage that can be implemented in similarly situated states; and,
- Determine any outstanding considerations that impact energy storage deployment in North Carolina.

NCSEA's Energy Storage Working Group held three meetings and several subcommittee discussions, between April 2016 and September 2016. Participants, identified in the *Appendix,* include North Carolina's electric utilities, clean energy companies (including energy storage companies), institutions of higher education, the NC Utilities Commission Public Staff, non-profit organizations, and national leaders with experience in energy storage deployment. Discussions uncovered the complicated nature of energy storage deployment, including how to value services, markets, and appropriate use. The Working Group identified which challenges to energy storage apply to various applications and how energy storage may alleviate challenges to North Carolina's grid. Because North Carolina's electric utilities are currently implementing energy storage pilot projects, the Working Group will reconvene in 2017 for additional discussion. The highlights of the Working Group meetings and subcommittee discussions are provided below.

Working Group Meeting 1

The Working Group held its first meeting in late April, in conjunction with the Energy Storage Association (ESA) annual conference in Charlotte, North Carolina. Attendees heard from the New York Battery and Energy Storage Technology Consortium (NY-BEST) regarding that state's energy storage initiatives. New York has undertaken demonstration projects for emerging technologies, clarified regulations on where energy storage can be placed on the grid, identified possible energy storage sites, and provided a clear path for technology deployment. In addition, participants were provided updates on what actions states such as California, Texas, New Mexico, Oregon, Massachusetts, and Minnesota have taken regarding energy storage. Notably, all of these states have organized stakeholders, including the energy storage industry, end customers, and utilities, to find state-specific solutions to facilitate energy storage deployment.

Following these presentations, the Working Group considered the most significant challenges for utility-scale energy storage deployment in North Carolina. The discussion identified that the three most significant challenges, in no particular order, are:

- A lack of regulatory and policy clarity regarding the role of energy storage in long-term planning (*a regulatory barrier*);
- The difficulty of measuring and monetizing the values provided by energy storage in the market (*a financial barrier*); and,
- A lack of market designs and business models (*a market barrier*).

Working Group Meeting 2

The Working Group's second meeting started with three questions crafted to address the barriers to utility-scale energy storage deployment identified at the first meeting:

- Do the three identified barriers need to be addressed in a particular order?
- Have any of the three identified barriers been adequately addressed in another state or by another organization?
- What actions must be taken to address the three identified barriers in North Carolina?

Participants agreed that the difficulty of measuring and monetizing the values provided by energy storage in the market must be addressed prior to addressing the identified regulatory and market barriers.

Participants then discussed how the Federal Energy Regulatory Commission (FERC), California, New York, Oregon, Hawaii, and New Jersey have attempted to address these barriers. *FERC* ordered that markets subject to its jurisdictions consider allowing non-generation resources, such as energy storage and demand response, to provide ancillary and grid services. *FERC's* orders allow energy storage to be fairly compensated for the services it provides. *California* is actively promoting energy storage deployment and currently subsidizes energy storage through its Self-Generation Incentive Program. The California Public Utilities Commission has also mandated that the state's electric utilities procure 1.3 GW of energy storage by 2020. *New York* has created the New York Battery and Energy Storage Technology Consortium and is introducing incentives for energy storage. *Oregon* adopted legislation requiring each of its electric utilities to obtain 5 MWh of energy storage by 2020 and instructing the Oregon Public Utility Commission to develop a methodology for valuing the services provided by energy storage. *Hawaii* has adopted regulations changing the state's energy incentives in order to promote deploying solar PV and energy storage together. Finally, *New Jersey* has established an incentive program for behind-the-meter energy storage and several other states have considered regulatory or legislative actions regarding energy storage.

After that discussion, the participants considered what actions need to be taken to overcome the financial, regulatory, and market barriers facing energy storage in North Carolina. The participants agreed that North Carolina's electric utilities are best situated to present a business case for large-scale deployment of energy storage. The electric utilities' energy storage pilot projects may offer some insights in the future, but they are still underway. In addition, standardization, improved software communications, and device interoperability are necessary for energy storage deployment.

Subcommittee Meeting

After the second Working Group meeting, a subcommittee of six participants met to broaden the Working Group's discussion to include how challenges vary depending on the asset owner and the location of the storage system relative to the point of interconnection. The subcommittee developed a matrix that would allow the Working Group to identify challenges to energy storage deployment for these specific situations.

Working Group Meeting 3

At the third Working Group meeting, participants completed the matrix of how challenges to energy storage deployment vary based on asset owner and location. The matrix, as completed by the Working Group, is included in the *Appendix*.

Working Group participants considered how three important questions apply to residential, commercial and industrial customers:

- What actions must be taken to justify the value proposition of energy storage to these customers?
- What amount of space and level of active management is necessary for these customers to deploy energy storage?
- What performance criteria are needed to justify an investment in energy storage to these customers?

Working Group participants identified *residential customers* would require price signals from the electric utility and demand response programs to justify an investment in energy storage. Furthermore, participants noted the success of demand response programs for residential customers is more readily assured if the customer wants energy storage, the program can be easily understood, and billing is not particularly onerous.

Working Group participants identified *commercial and industrial (C&I)* customers are more prepared to adopt energy storage for several reasons. First, many C&I customers have sustainability goals, in-house energy managers, and tools that can incorporate storage into their operations. C&I customers want to reduce their energy expenses and may be excited to implement new technologies to manage these expenses. However, C&I customers also require a swift return on their investment and may require the interest and initiative of their electric utility before considering the adoption of energy storage. Working Group participants noted North Carolina's electricity rates have relatively low demand charges, and there needs to be additional revenue streams for energy storage to be economical for the state's C&I customers.

Working Group participants noted utilities have been impacted by the level of solar generation in North Carolina. Energy storage may allow utilities to most efficiently operate a grid that now includes intermittent generation resources. Finally, participants noted grid-wide adoption of energy storage would be advanced by a rate design that would encourage its deployment.

Next Steps

NCSEA's Energy Storage Working Group agreed to reconvene in 2017, after pilot projects operated by Duke Energy and the NC Electric Membership Cooperatives have generated additional information and data that can provide a better understanding of the performance of energy storage in real-world applications. Upon its reconvening, the Working Group will consider any legislative and regulatory actions related to energy storage as well as the conclusions of the Working Group.

Appendix

Name	Title	Organization
Chris Ayers	Director	North Carolina Utilities Commission Public Staff
Don Bailey (observer)	Commissioner	North Carolina Utilities Commission
Cyrus Bhedwar	Policy Director	Southeast Energy Efficiency Alliance
Jenn Bosser	Executive Director	Research Triangle Cleantech Cluster
Paul Brucke	Principal Engineer	Brucke Engineering
Jason Burwen	Policy & Advocacy Advisor	Energy Storage Association
Patrick Buffkin	Government Affairs Manager	North Carolina's Electric Cooperatives
John Cerveny	Director of Resource Development	NY-BEST
Doug Copeland	Regional Project Development Manager	Électricité de France Renewable Energy
Jeff Cramer	Principal	38 North Solutions
Sarah Cosby	Public Policy Projects Manager	Dominion Virginia Power
Kate Daniel	Policy Analyst	North Carolina Clean Energy Technology Center
Ron DiFelice	Managing Partner	Energy Intelligence Partners
David Doctor	President & CEO	E4 Carolinas
Johan Enslin	Director, Energy Production & Infrastructure Center	University of North Carolina at Charlotte
Emily Felt	Renewable Energy Strategy Policy Director	Duke Energy Corporation
Garrett Fitzgerald	Senior Associate	Rocky Mountain Institute
Jack Floyd	Engineer, Electric Division	North Carolina Utilities Commission Public Staff
David Hague	Senior Director of Marketing & Technology Partnerships	Gehrlicher Solar America Corporation
Joe Heinzmann	Senior Account Manager	GE Energy Storage
Carrie Hitt	Senior Project Director	NextEra Energy Resources & NCSEA Board Member
Ken Jennings	Renewable Energy Strategy & Policy Director	Duke Energy Carolinas, LLC
Bob Koger	President	Advanced Energy Corporation
Kiran Kumaraswamy	Market Development Director	AES Storage
Chris Larsen	Business Development Leader	Dynapower Corporation
Ben Lowe	Director, Market & Policy Development	Alevo, Inc.
Randy Lucas	Principal	Lucas Tax & Energy Consulting & NCSEA Board Member
Michelle Meyer	Marketing Manager, Power Grids North America	ABB
Lisa Moerner	Director of FERC, Electric Market & NERC Compliance Policy	Dominion Virginia Power
Jim Musilek	Director, Grid Modernization	North Carolina Electric Membership Cooperatives

Appendix (continued)

Name	Title	Organization
Deaven Laine Niblock	Assistant General Counsel	Alevo, Inc.
Larry Ostema	Of Counsel	Nelson Mullins Riley & Scarborough
Emmit Owens	Manager, Member Services & Programs	Research Triangle Cleantech Cluster
Matt Owens	Director of Business Development	Stem, Inc.
Arch Padmanabhan	Product Development Manager	Tesla Motors
Ewan Pritchard	Associate Director	NC State University FREEDM Systems Center
Gary Rackliffe	Vice-President, Smart Grids North America	ABB
Matt Roberts	Executive Director	Energy Storage Association
Kelly Scallon	Business Analyst	Alevo, Inc.
Ben Schneider	President	PowerSecure Solar
Sam Watson (observer)	Attorney	North Carolina Utilities Commission
Ryan Whitmore	District Sales Manager	Eaton Corporation

Challenges for Energy Storage Deployment Based on Ownership & Location of Storage System

Asset Owner	Location of the Energy Storage System		
	Behind the Meter	In Front of the Meter	
		Utility in an RTO	Utility not in an RTO
Residential Customer	Economics and value proposition • Cost of investment • Existing rate design may provide little incentive to add storage; unclear revenue stream from utility Physical space for device Interest in managing a storage device Validated performance	N/A	N/A
Commercial & Industrial Customer	Economics and value proposition • Cost of investment and return of investment • Existing rate design may not provide a clear revenue stream; cost of storage must be less than cost of electricity at various times Customer must have an internal champion to encourage installation of storage Physical space for device Interest in managing and resources to manage, storage Validated performance	N/A	N/A
Utility	Cost of investment • Cost of storage vs. cost of natural gas generation Regulatory • Cost recovery • Asset classification • Jurisdiction Market design and business model Uncertainty of asset's life Modeling Rate design Service limited to one customer	Regulatory • Cost recovery • Asset classification • Jurisdiction Systems Operations • Modeling • Integration into operations Economics and value proposition Market certainty; shallow market	Regulatory • Cost recovery; proving investment is reasonable and prudent Economics and value proposition Measuring and monetizing impact Transparency Validated performance; certainty of asset's life
Independent Power Producer	Price signals; incentives; unclear revenue stream • Electricity prices must be high to justify storing electricity in order to sell during periods of peak demand Measuring and monetizing value Regulatory and permitting Integrating distributed systems into utility systems operations Demand for product	Economics and value proposition • Price signals Integrating distributed systems into utility systems operations High risk; market volatility; shallow market	Economics and value proposition • Rate design; unclear revenue stream; cost of charging Regulatory Long term planning Deployment and local transparency No market; demand not demonstrated

Definitions:

Behind the Meter - Resources located on the customer's side of the point of interconnection.

Front of Meter – Resources located on the utility's side of the point of interconnection.

Independent Power Producer - An organization, which is not a utility, that operates generation and sells energy to a utility.

RTO - Regional Transmission Authority, an organized electricity market; the only RTO operating in North Carolina is PJM Interconnection, whose territory includes Dominion North Carolina Power and some cooperatives and municipalities.

Utility - An electric utility that owns generation, distribution, and transmission assets