Serious Evaluation of Storage as an Alternative in the North Carolina Integrated Resource Planning Process

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I. Introduction

The key to unlocking the potential of renewable energy is utilization of storage technologies which allow energy to be captured and kept for later use.[1] A more stringent integrated resource planning ("IRP") standard requiring serious evaluation of situations in which storage could be cost-effective would promote storage and encourage utilities to consider new applications. California's carefully-worded IRP requirements promote energy storage implementation where it is cost-effective and feasible. North Carolina should similarly adjust its IRP process to ensure a more rigorous approach to strategic planning that will capture the added value of storage as it evolves and becomes more economically viable.

II. Why does storage matter?

North Carolina is one of the most geographically wide-ranging and distinctive regions in the United States.[2] It stretches from a 300-mile coastline with rare Outer Banks[3] through a wide coastal plain and swamplands of complex river systems to the beautiful Blue Ridge Mountains. These fragile biomes are particularly sensitive to both environmental and economic forces.[4]

Fossil fuel generation, and its loosely regulated handling of byproducts, has particularly been shown vulnerable to error and abuse.[5] In 2014, a broken pipe at the Dan River coal plant

[1] *See generally*, ENERGY STORAGE ASS'N, *Energy Storage Technologies*, http://energystorage.org/energy-storage-1 (last visited Jan. 4, 2018).
[2] *See* David Walbert, *Natural Diversity*, LEARN NC/UNC CHAPEL HILL SCH. OF EDUC., http://www.learnnc.org/lp/editions/nchist-twoworlds/1670 (last visited Jan. 4, 2018).
[3] VISIT NC, *Coast*, https://www.visitnc.com/coast (last visited Dec. 18, 2017).
[4] *See* Lisa Sorg, *Ten of North Carolina's worst environmental fiascos of 2016*, NC POLICY WATCH (Dec. 30, 2016), http://www.ncpolicywatch.com/2016/12/30/ten-north-carolinas-worst-environmental-fiascos-2016/.
[5] *See Id.*

leaked approximately 39,000 tons[6] of toxic coal ash, releasing arsenic and heavy metals into the water system. [7] Painful environmental and economic consequences persist from that spill. In Duke Energy's 2017 rate case, the majority of the requested average 13.6% rate increase was due to the inclusion of $336M earmarked for annual coal ash recovery.[8] The ongoing controversy concerning how to handle remaining unlined coal ash sites[9] demonstrates both the immediate and long-term challenges of fossil fuel generation. "Cheap fossil fuel" is a misnomer when the very real monetary and physical costs are shoved onto another generation.

The renewable energy industry has the potential to greatly improve the economic, environmental and physical well-being of North Carolina citizens. However, for renewable generation to provide any region with uninterrupted output, storage is necessary. Because solar and wind on their own are intermittent (not continuously available) and non-dispatchable (cannot be reliably turned on to meet fluctuating load), they currently require backup generation.[10] This backup generation is provided by quick-starting fossil fuel systems that do not depend on whether the sun is shining or the wind is blowing.[11] More quick-response storage means fewer fossil fuel reserves are required to cover fluctuations and emergencies.

Storage provides capacity firming which allows renewable generation to sustain a committed output level for a specific period by storing the energy and then releasing it during the

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[6] U.S. ENVTL. PROTECTION AGENCY, *Duke Energy Coal Ash Spill in Eden, NC: History and Response Timeline*, https://www.epa.gov/dukeenergy-coalash/history-and-response-timeline (last visited Jan. 4, 2018).
[7] U.S. ENVTL. PROTECTION AGENCY, *Case Summary: Duke Energy Agrees to $3 Million Cleanup for Coal Ash Release in the Dan River*, https://www.epa.gov/enforcement/case-summary-duke-energy-agrees-3-million-cleanup-coal-ash-release-dan-river#pollutants (last visited Jan. 4, 2018).
[8] Julia Pyper, *Duke Cancels the Lee Nuclear Project, Files for 13.6% Rate Increase*, GREENTECH MEDIA (Aug. 25, 2017), https://www.greentechmedia.com/articles/read/duke-cancels-lee-nuclear-project-rate-increase?utm_campaign=deliver_digest&utm_medium=email&utm_source=mailer#gs.LRCKtIQ.
[9] S. ENVTL. LAW CTR., *Coal Ash*, https://www.southernenvironment.org/cases-and-projects/coal-waste (last visited Jan. 4, 2018).
[10] Elena Verdolini et al., *Bridging The Gap: Do Fast Reacting Fossil Technologies Facilitate Renewable Energy Diffusion?*, NAT'L BUREAU OF ECON. RESEARCH (July 2016), http://www.nber.org/papers/w22454.pdf.
[11] *Id.*

night or when weather conditions inhibit generation. [12] The ability to mitigate the intermittency of renewable energy through firming is why storage is essential to a clean energy future.

Capacity firming also alleviates the current pressures to curtail or dump renewable energy when generation is high at low demand.[13] Baseload generation sources normally operate at constant power production and therefore are used to meet the minimum demand.[14] Therefore, when demand is low, the energy from renewable sources is simply dumped or curtailed in order to allow the baseload generation to maintain their output. California's independent system operator, CAISO, estimated that 6-8 GW of renewable energy would need to be curtailed in 2017 while approximately 2 GW of imported fossil fuel and gas sources would be untouched. [15]

Some remarkable successes have already been achieved with storage. Under the pressure of importing high-cost fossil fuels, Hawaii has been pushing the boundaries of distributed generation[16] which is smaller-scale, mostly renewable, and located near the point of consumption.[17] A 2016 pilot project was able to achieve several days of zero grid-buy (no energy purchased from the grid); all energy needs were met through optimized usage of a solar PV system paired with lithium-ion ("Li-ion") batteries and thermal storage.[18]

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[12] *See generally,* ABB, *Capacity firming*, http://new.abb.com/substations/energy-storage-applications/capacity-firming (last visited Jan. 4, 2018).
[13] Ahmed Muhammed, *Energy Storage + Renewables*, NEC ENERGY SOLS., http://www.jccme.or.jp/japanese/wpjpn/assets/7.nec.pdf (last visited Jan. 4, 2018).
[14] *See Id*.
[15] Bentham Paulos, *Too Much of a Good Thing? An Illustrated Guide to Solar Curtailment on California's Grid*, GREENTECH MEDIA (Apr. 3, 2017), https://www.greentechmedia.com/articles/read/an-illustrated-guide-to-solar-curtailment-in-california#gs.k1G3frA.
[16] Julian Spector, *How Hawaii's New Shared Renewables Program Could Benefit the Electric Grid*, GREENTECH MEDIA (Feb. 14, 2017), https://www.greentechmedia.com/articles/read/hawaii-shared-renewables-program-incentivize-dispatchable-peak-capacity#gs.ytxPa_c.
[17] *See generally*, U.S. ENVTL. PROTECTION AGENCY, *Distributed Generation of Electricity and its Environmental Impacts*, https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts (last visited Jan. 4, 2018)
[18] John Borland et al., *Achieving 100 Percent Residential Renewables in Hawaii with Solar+Multi-Storage*, RENEWABLE ENERGY WORLD (Aug. 2, 2017), http://www.renewableenergyworld.com/ugc/articles/2017/07/28/achieving-100-renewable-residential-hawaii-energy-needs-economically-using-solar-energy--multistorag.html.

Simply put, storage unleashes renewable energy. It is key to sustaining wholly clean-energy solutions, and technology is now sufficiently advanced for investment.[19] Storage encompasses a vast array of both proven and cutting-edge technologies from pumped hydro, flywheels, compressed air, thermal, and capacitors to the long list of battery technologies[20], of which Li-ion has become the frontrunner. Each technology has unique characteristics, advantages, and restrictions, so matching the correct technology to the planned application and location is crucial. Battery storage in particular can be placed virtually anywhere and is a modular solution that can be quickly ramped up by simply adding new battery racks as needed. Typically, such batteries require little maintenance,[21] usually only capacity augmentation as determined by regular State of Health ("SOH") tests.

a. California, Hawaii, Texas, and Illinois have several successful major storage installations already operational with more planned.

Though storage is a rapidly evolving technology, certain applications paired with their appropriate technology have already proven successful. The Department of Energy ("DOE") database on energy storage shows 24.12 GW of installed storage projects as of 2016 with pumped-hydro accounting for the largest power ratings and includes 292 electro-chemical installations of 0.57 GW. [22]

Due to aggressive legislative and regulatory efforts, many of the electro-chemical projects are clustered in California and Texas where there are specific wind integration requirements. Due to favorable ancillary services pricing, the PJM Interconnection region which

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[19] Peter Maloney, *Utilities see benefits in energy storage, even without mandates*, UTILITY DIVE (Sept. 12, 2017), https://www.utilitydive.com/news/utilities-see-benefits-in-energy-storage-even-without-mandates/504587/.
[20] *See generally*, ENERGY STORAGE ASS'N, *supra* note 1.
[21] See Kathie Zipp, *Batteries: Which is best for solar storage?*, SOLAR POWER WORLD (Nov. 2017), https://www.solarpowerworldonline.com/2015/08/what-is-the-best-type-of-battery-for-solar-storage/.
[22] SANDIA CORP. AND STRATEGEN CONSULTING, *DOE Global Energy Storage Database*, (Aug. 16, 2016) http://www.energystorageexchange.org/projects/data_visualization.

spans several states is another hub. Invenergy's twin sister Li-ion projects of Grand Ridge (Illinois) and Beech Ridge (West Virginia), each rated 31.5 MW,[23] have served the ancillary services market with frequency response since 2015.[24]

Due to California's 2013 legislative mandate requiring three utilities to install 1.3 GW of storage by 2024,[25] Pacific Gas & Electric ("PG&E"), San Diego Gas & Electric ("SDG&E") and Southern California Edison ("SCE") have been leading the United States in storage implementation. In partnership with the DOE in 2014, SCE installed a storage demonstration project of 8 MW of Li-ion attached to the major 4.5 GW Tehachapi wind farm.[26] Though Tehachapi experienced numerous challenges related to initial design flaws and struggled with multiple versions of control software,[27] the pilot project has significantly tested thirteen different applications, such as smoothing, capacity deferral, frequency regulation, voltage support, arbitrage, and renewables integration.[28]

In 2016, a significant fossil fuel leak near Los Angeles drained methane reserves so greatly that system operators struggled to prevent rolling blackouts due to fuel shortages. Energy storage solutions were a positive result of this emergency; SDG&E and SCE began installing one of the largest storage expansions in the United States of 104.5 MW.[29] Such new storage installations are leading a trend in longer duration services capable of actually replacing

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[23] Herman K. Trabish, *Invenergy adds 31.5 MW battery to booming PJM frequency regulation market*, UTILITY DIVE (Nov. 4, 2015), https://www.utilitydive.com/news/invenergy-adds-315-mw-battery-to-booming-pjm-frequency-regulation-market/408558/.
[24] *Id.*
[25] CAL. PUB. UTILITIES COMM'N, *Energy Storage*, http://www.cpuc.ca.gov/General.aspx?id=3462 (last visited Jan. 4, 2018).
[26] BETTER WORLD SOLUTIONS, *US Energy Storage Update*, (May 30, 2016), https://www.betterworldsolutions.eu/us-energy-storage-update/.
[27] *Id.*
[28] U.S. DEP'T OF ENERGY, *Tehachapi Wind Energy Storage Project*, https://energy.gov/sites/prod/files/Tehachapi.pdf (last visited Jan. 4, 2018).
[29] Daniel Cusick, *Battery Storage Poised to Expand Rapidly*, SCI. AMERICAN (Jan. 1, 2017), https://www.scientificamerican.com/article/battery-storage-poised-to-expand-rapidly/.

generation, instead of simply providing quick ancillary services.[30] In 2014, encouraged by a SCE 20-year power purchase agreement ("PPA"), Advancion Energy Storage ("AES") began developing Alamitos, a 100 MW Li-ion facility in Long Beach, California, to provide electric supply capacity following retirement of aging generating resources near Los Angeles.[31] In 2016, AES proposed expanding that capacity by another 200 MW,[32] which would make the expected final installation capable of partially replacing a natural gas plant.

In 2012, Duke Energy developed one of the world's largest battery energy storage installations (36 MW)[33] in conjunction with the 153 MW Notrees wind farm in Texas. Although the company initially installed lead-acid batteries, it realized that those batteries were not capable of the more profitable[34]quick response services, and so replaced them with Li-ion.[35] Notrees exemplifies the importance of carefully pairing appropriate storage technology with planned application in order to avoid the necessity for costly modifications.

b. Storage is already being used in North Carolina to address unique challenges.

Storage, though quite limited, is actually already on the ground in North Carolina. [36] Tesla is providing storage to Ocracoke Island on the Outer Banks, which has enabled the community to decrease dependence on the 3MW diesel generator that helps alleviate peak

[30] Christian Roselund, *U.S. energy storage MWhs double in 2016*, PV MAGAZINE (Mar. 7, 2017), https://pv-magazine-usa.com/2017/03/07/u-s-energy-storage-mwhs-double-in-2016/.
[31] ADVANCION ENERGY STORAGE, *AES Alamitos Energy Storage*, http://aesenergystorage.com/wp-content/uploads/2016/08/AES-Alamitos-Case-Study.pdf (last visited Jan. 4, 2018).
[32] Robert Walton, *AES to partially replace California gas plant with 300 MW of battery storage*, UTILITY DIVE (July 25, 2016), https://www.utilitydive.com/news/aes-to-partially-replace-california-gas-plant-with-300-mw-of-battery-storag/423171/.
[33] DUKE ENERGY, *Notrees Battery Storage Project*, https://www.duke-energy.com/our-company/about-us/businesses/renewable-energy/wind-energy/notrees-battery-storage-project (last visited Jan. 4, 2018).
[34] BETTER WORLD SOLUTIONS, *supra* note 26.
[35] Andy Colthorpe, *'Minimal downtime': Younicos swaps out lead-acid for lithium at Texas' Notrees wind farm,* ENERGY STORAGE NEWS (Dec. 14, 2017), https://www.energy-storage.news/news/minimal-downtime-younicos-swaps-out-lead-acid-for-lithium-at-texas-notrees.
[36] Robert Walton, *Tesla batteries help power small North Carolina island*, UTILITY DIVE (Jan. 23, 2017) http://www.utilitydive.com/news/tesla-batteries-help-power-small-north-carolina-island/434536/.

demand pressures from reliance on a single transmission line from the mainland.[37] Instead, several solar arrays, a new microgrid system and Tesla powerpacks are enabling one of North Carolina's most beautiful areas to move away from burning smog-inducing diesel oil.[38]

A small microgrid that pairs solar with zinc-air battery storage serves a difficult-to-reach emergency communications tower atop Mt. Sterling in Great Smoky Mountains National Park.[39] Duke Energy believes the estimated "less than $1 million expense" of the microgrid will be cheaper than continuing to maintain the poles and lines up the mountainside.[40]

In September 2017, Duke Energy announced plans for what will be the largest storage expansion in North Carolina.[41] The Asheville region is of particular concern as the location of the last coal plant still operating despite being identified as "high risk" for coal ash leaks by the state commission formed after the Dan River accident.[42] The coal plant coincidentally is in close proximity to the water treatment facility on the banks of the French Broad River that provides drinking water to Asheville.[43] Duke Energy plans to take the coal plant offline in 2019, replace it with a natural gas plant, and bolster this new system with a 9 MW Li-ion battery near Rock Hill in Asheville to be used for frequency regulation, peak reduction, and other applications.[44] A few miles downstream on the French Broad is the town of Hot Springs where Duke Energy also plans to install a smaller 4 MW Li-ion battery, primarily to improve system reliability.[45]

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[37] *Id.*
[38] *Id.*
[39] DUKE ENERGY, *Duke Energy plans North Carolina's largest battery storage projects as part of Western Carolinas Modernization Plan*, (Sept. 21, 2017), https://news.duke-energy.com/releases/duke-energy-plans-north-carolina-s-largest-battery-storage-projects-as-part-of-western-carolinas-modernization-plan.
[40] John Murawski, *Duke Energy Progress going off the grid in Great Smoky Mountains National Park*, THE NEWS AND OBSERVER (Nov. 10, 2016), http://www.newsobserver.com/news/business/article113994353.html.
[41] DUKE ENERGY, *supra* note 39.
[42] Bruce Henderson, *Duke Energy gets approval for Asheville plant*, CHARLOTTE OBSERVER (Feb. 29, 2016), http://www.charlotteobserver.com/news/business/article63198132.html.
[43] Ky Delaney, *The French Broad River Threatened by Toxic Waste*, BLUE RIDGE OUTDOORS (June 25, 2013), http://www.blueridgeoutdoors.com/go-outside/the-french-broad-river-threatened-by-toxic-waste/.
[44] DUKE ENERGY, *supra* note 39.
[45] *Id.*

III. How are other states addressing storage?

States have many different ways of regulating energy resource planning. One of these methods is through requiring an Integrated Resource Plan ("IRP") which is submitted for approval to the state utility commission outlining means by which a utility expects to meet forecasted demand, generally for the upcoming 15-20 years.[46] Ideally, this process serves as a checkpoint on a utility's expected major capital expenditures to uphold consistency with the state's public code, establish a holistic view of the system to avoid the possibility of stranded assets, and most importantly, ensure planned projects meet the needs of citizens.

Most states require IRPs or similar long-term planning documents; however, each state has different requirements. The history of nuclear power production particularly highlights the critical role of proper planning. One of the most painful cases of poor resource planning was the 1965-commissioned Shoreham nuclear power plant in New York.[47] In the 20 years of its development, growing public awareness of nuclear disaster concerns led to the eventual realization that Long Island could not be properly evacuated in event of an emergency.[48] This led to a decision to never place this fully working and licensed nuclear power plant into commercial production. Over a million New Yorkers are still paying on the six billion dollar debt for Shoreham construction.[49]

Unfortunately, poor planning is not exclusive to New York. North Carolina is currently grappling with what to do with the Lee Nuclear Station located in Gaffney, South Carolina.[50] After development halted in the 1970s, Duke Energy revived the project in 2005. Finally in

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[46] Bob Stelling, *What Is An Integrated Resource Plan & Why Is It Important?*, ENERGY ACUITY (July 13, 2017), https://www.energyacuity.com/blog/integrated-resource-plan.
[47] John Rather, *Planning the Fate of a Nuclear Plant's Land*, N.Y. TIMES (Jan. 1, 2009), http://www.nytimes.com/2009/01/04/nyregion/long-island/04shorehamli.html?n=Top%2FNews%2FScience%2FTopics%2FAtomic%20Energy&_r=0.
[48] *Id.*
[49] *Id*.
[50] Julia Pyper, *supra* note 8.

2017, the company cancelled the project due to Westinghouse's 2017 bankruptcy and uncertain market conditions.[51] The 2017 rate case from Duke Energy requests North Carolina ratepayers shoulder the 636 million dollars of sunken costs of the failed plant over the next twelve years which, like Shoreham, will never provide a single day of power.[52]

Many states have formally recognized the dangers of a fossil-fueled future, as well as the unique opportunity of cleaner energy paired with storage. Innovative states like California, Oregon, Massachusetts and New York have vigorously pushed their electrical grid stakeholders to better incorporate storage through a variety of approaches including legislative and regulatory mandates, incentive programs for companies as well as ratepayers, and thoughtful IRP processes. An overview of energy policy and practice in these pioneering states offers valuable information and experience to North Carolina planners.

a. New York is exploring a state mandate and innovative compensation initiatives.

In June 2017, the New York legislature passed SB 5190 and AB 6571 which direct their Public Service Commission to establish a storage procurement target for 2030, as well as to create a storage deployment program.[53] In December 2017, New York became the fourth state to establish a state storage target after California, Oregon, and Massachusetts.[54]

Efforts and incentives to spur storage adoption are not all occurring at a statewide level. In September 2016, New York City determined its own storage target of 100 MW by 2020 and

[51] Julia Pyper, *supra* note 8.
[52] Julia Pyper, *supra* note 8.
[53] Peter Maloney, *Updated: New York lawmakers clear bill creating energy storage targets*, UTILITY DIVE (June 23, 2017), https://www.utilitydive.com/news/updated-new-york-lawmakers-clear-bill-creating-energy-storage-targets/445667/.
[54] John Fitzgerald Weaver, *New York state signs law – 20% of USA has energy storage targets and mandates*, ELECTREK (Dec. 1, 2017), https://electrek.co/2017/12/01/new-york-energy-storage-targets/.

1000 MW by 2030.[55] Drivers included the need for distribution deferral, demand charge reduction, and shifting solar consumption.[56] The major utility, Consolidated Edison, created the Demand Management Program which seeks to reduce peak load through incentivizing battery and thermal storage projects as well as other technologies.[57] For the 2019 cycle, the company has allocated thirty-two million dollars to eligible customers, industry players and aggregators.[58]

Though New York does not have a required IRP process, it has recently been overhauling its rate structure. In 2017 the New York Public Service Commission released the first implementation phase for their Value of Distributed Energy Generation rate structure.[59] In an effort to move away from net metering, this new compensation structure for distributed energy resources employs the use of a revolutionary value-stacking calculator that considers multiple inputs, such as capacity deferral, carbon emissions and locational marginal pricing. A key part of this order establishes a process for "finalizing rules for interconnection and compensation of projects that pair storage with clean distributed generation."[60] Finalizing such interconnection rules and compensation measures for storage is a critical step, since one of the continual impediments to storage development is that all possible services of storage are not presently monetizable in any state.[61]

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[55] Julian Spector, *New York City Sets the First Citywide Energy Storage Target*, GREENTECH MEDIA (Sept. 27, 2016), https://www.greentechmedia.com/articles/read/new-york-city-becomes-first-to-set-citywide-energy-storage-target#gs.J4f_lY8.

[56] *Id*.

[57] CONSOLIDATED EDISON, *Demand Management Incentives for Large Customers*, https://www.coned.com/en/save-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers/demand-management-incentives (last visited Jan. 4, 2018).

[58] *Id*.

[59] N.Y. PUB. SERV. COMM'N, *Order on Phase One Value of Distributed Energy Resources Implementation Proposals, Cost Mitigation Issues, and Related Matters*, (Sept. 14, 2017), http://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=193279&MatterSeq=49770.

[60] *Id*.

[61] Sky Stanfield et al., *Charging Ahead: An Energy Storage Guide for State Policymakers*, INTERSTATE RENEWABLE ENERGY COUNCIL (Apr. 2017), http://www.irecusa.org/wp-content/uploads/2017/04/IREC_Charging-Ahead_Energy-Storage-Guide_FINALApril2017.pdf.

b. The Massachusetts legislature required a substantial storage study, the results of which spurred the Department of Energy Resources to set a statewide storage target.

In 2016 Massachusetts funded a major study that discovered "potential overall benefits to ratepayers of large-scale energy storage deployment at more than two times the cost, and nearly three times the cost when benefits to resource owners are taken into account."[62] However, the report also cautioned that "only a third of the estimated benefits of storage can be monetized and compensated under existing regulations and market designs."[63]

In 2017 based on the recommendations of the 2016 study, the Massachusetts Department of Energy Resources set forth their own energy storage target of 200 MWh by 2020.[64] However, unlike California, Massachusetts is not part of a single-state independent system operator like California ISO ("CAISO"). Instead, Massachusetts is a part of ISO New England ("ISO-NE") which serves multiple states.[65] Therefore, state-specific energy goals require the support and cooperation of an outside, non-state entity for success.

Massachusetts has no formal IRP process; however, it does require other long term planning items—in 2014, it required a ten-year grid modernization plan from its distribution companies.[66] Department of Public Utilities Order 12-76-B also required companies to focus efforts on researching, testing and implementing new and emerging technologies, "as renewables, EVs, microgrids, and storage, [are] key to achieving the Commonwealth's climate

[62] *Id.*
[63] *Id.*
[64] COMMW. OF MASS., *Energy Storage Target*, https://www.mass.gov/service-details/energy-storage-target (last visited Jan. 4, 2018).
[65] FED. ENERGY REGULATORY COMM'N., *Electric Power Markets: New England (ISO-NE)*, https://www.ferc.gov/market-oversight/mkt-electric/new-england.asp (last visited Jan. 4, 2018).
[66] MASS. DEP'T. OF PUB. UTILITIES, *Grid Modernization*, http://www.mass.gov/eea/energy-utilities-clean-tech/electric-power/grid-mod/grid-modernization.html (last visited Jan. 4, 2018).

and resiliency goals and statutory requirements."[67] The DPU code also contains a section on criteria for long-term contracts for clean energy generation sources. These contracts must allow renewable generation sources to "be paired with energy storage systems."[68]

c. Oregon has both an IRP process that includes storage, as well as a statewide storage target.

In 2007, Oregon's Public Utility Commission ("PUC") issued Order No. 07-002 which contained updated 20-year IRP requirements.[69] Though the language seems rather dated now, it was intentionally worded to include storage possibilities:

> Guideline 1.A: All resources must be evaluated on a consistent and comparable basis. All known resources for meeting the utility's load should be considered, including supply-side options which focus on the generation, purchase and transmission of power – or gas purchases, transportation, and storage – and demand-side options which focus on conservation and demand response.[70]

The "all known resources" language irritated major Oregon utility PacifiCorp, which requested it be changed to only include commercially viable or near-commercially viable technologies.[71] The PUC rejected PacifiCorp's protest, affirming it truly did intend utilities to consider future technologies. It later clarified there was no need to explicitly require assessment of all forms of renewable energy, because that requirement was already covered in the "all known resources" language.[72] The PUC reiterated this approach under Guideline 12 which requires utilities to evaluate distributed generation technologies on par with supply side

[67] MASS. DEP'T. OF PUB. UTILITIES, *Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid*, (June 12, 2014), http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=12-76%2fOrder_1276B.pdf.
[68] 220 MASS. CODE REGS. 24.00 (LexisNexis 2017)
[69] OR. ADMIN. R. 07-002 (2007).
[70] *Id.*
[71] *Id.*
[72] *Id.*

resources. PacifiCorp again tried to restrict this to commercially available technologies, and the PUC again rejected PacifiCorp's request.[73]

In 2015, Oregon passed HB 2193 which contained a mandate for storage similar to California's but far smaller in size.[74] The legislation required two state utilities to submit proposals for storage systems capable of 5 MWh by 2018.[75] In December of 2016, the state utilities commission released more detailed guidelines for this process. [76] As with the IRP, Oregon requires the Utilities Commission to review proposals to ensure they are consistent with the legislation, that they fairly balance benefits and costs to ratepayers, and are in the public interest.[77]

d. California has incentive programs, a binding legislative storage mandate, and storage-specific consideration in the IRP process.

In 2010 California passed AB 2514, the nation's first energy storage mandate. [78] The California Public Utilities Commission ("CPUC") later defined this directive in 2013 by ordering investor-owned utilities to obtain 1.325 GW by 2020.[79] The CPUC also created a Self-Generation Incentive Program ("SGIP") which incentivized advanced storage and other technologies primarily to reduce peak load.[80] The CPUC allocated over 447 million dollars to large scale, residential, storage equity projects.[81]

In 2015 California ratified SB 350, a comprehensive reform bill that established aggressive renewable energy goals, most notably a commitment to a 50% Renewables Portfolio

[73] *Id*.
[74] Peter Maloney, *Oregon PUC release guidelines for energy storage mandate*, UTILITY DIVE (Jan. 6, 2017), https://www.utilitydive.com/news/oregon-puc-release-guidelines-for-energy-storage-mandate/433462/.
[75] *Id*.
[76] OR. ADMIN. R. 16-504 (2016).
[77] *Id*.
[78] CAL. PUB. UTILITIES COMM'N, *Energy Storage*, http://www.cpuc.ca.gov/General.aspx?id=3462.
[79] *Id*.
[80] CAL. PUB. UTILITIES COMM'N, *About the Self-Generation Incentive Program,* http://www.cpuc.ca.gov/General.aspx?id=11430.
[81] CAL. PUB. UTILITIES COMM'N, *Self-Generation Incentive Program*, http://www.cpuc.ca.gov/sgip/.

Standard by 2030.[82] The bill also included explicit storage language which has now been incorporated into its Public Utilities Code and consequently become a checkpoint in the IRP process:

> § 400: Where feasible, authorize procurement of resources to provide grid reliability services that minimize reliance on system power and fossil fuel resources and, where feasible, cost effective, and consistent with other state policy objectives, increase the use of large- and small-scale energy storage with a variety of technologies, targeted energy efficiency, demand response, including, but not limited to, automated demand response, eligible renewable energy resources, or other renewable and nonrenewable technologies with zero or lowest feasible emissions of greenhouse gases, criteria pollutants, and toxic air contaminants onsite to protect system reliability.[83]

Section 400 is a thoughtfully structured standard due to the emphasis on promoting storage "where feasible, cost effective, and consistent with other state policy objectives."[84] It allows flexibility and recognizes the dynamic pricing of storage as the technology evolves, yet still advances storage by placing the onus on utilities to explain why they are not using storage in planned capital projects. Also, despite the fact that California is a restructured market, utilities can include storage capital expenditures in their rate base, which could be of particular interest to North Carolinians.[85]

IV. What are some possible North Carolina approaches to storage policy?

North Carolina is currently at a critical juncture in determining a state perspective on storage. Storage normally requires multiple revenue streams or "value stacking" to be cost-effective,[86] and the most common applications for storage have been for fast response services such as frequency regulation offered through ancillary markets. However, North Carolina has no

[82] CAL. ENERGY COMM'N, *Clean Energy & Pollution Reduction Act, SB 350 Overview*, http://www.energy.ca.gov/sb350/.
[83] CAL. PUB. UTIL. CODE § 400 (West 2017).
[84] *Id.*
[85] Davion Hill & Sudipta Lahiri, *Energy Storage Mandates – What They Mean for the Market*, DNVGL (Aug. 10, 2016), https://blogs.dnvgl.com/energy/energy-storage-mandates-what-they-mean-for-the-market.
[86] *See generally*, Lisa Cohn, *Stacking Energy Storage Values to Make Batteries More Profitable: Brattle Report*, MICROGRID KNOWLEDGE (Sept. 18, 2017), https://microgridknowledge.com/stacking-energy-storage-brattle/.

third-party ancillaries market, and creating a market for storage or just for ancillaries is highly improbable. Actions that would promote storage in a restructured market, like allowing competition or implementing locational marginal pricing, will not help a vertically-integrated market[87] like North Carolina's.

The multi-pronged approach used by California, New York, Oregon, and Massachusetts can serve as a guide for North Carolina, but the specific methods employed need to suit the unique environmental, electrical and political considerations in North Carolina. "Purple" North Carolina was closely and bitterly split between Republicans and Democrats in the most recent 2016 election cycle,[88] and renewable energy has become a partisan issue. Remarkably, many disparate stakeholders reached a compromise on mechanics and passed the 2017 landmark energy bill HB 589. However, the bill lacks the standard "whereas" preamble that normally provides the intent and future vision[89] because the language could not be agreed upon. While HB 589 does include language recommending a state analysis of storage, it otherwise contains nothing substantive regarding storage.[90] Given the polarized political landscape, a bipartisan push for a statewide storage mandate or money allocated for an incentive program is not likely at this time.

Although greater IRP accountability will no doubt face political pressures, it seems more feasible than a statewide mandate. Given the lower profile, fewer primary stakeholders, and clearer potential for common sense solution in the IRP process, bipartisan agreement to stronger IRP language is achievable. The IRP process is not just a tool to ensure expected load will be met through practical and cost-effective resources. It is an opportunity for public officials to hold

[87] FED. ENERGY REGULATORY COMM'N, *Electric Power Markets: Southeast*, https://www.ferc.gov/market-oversight/mkt-electric/southeast.asp (last visited Jan. 4, 2018).
[88] Jason Zengerle, *Is North Carolina the Future of American Politics?* THE N.Y. TIMES MAGAZINE (June 20, 2017), https://www.nytimes.com/2017/06/20/magazine/is-north-carolina-the-future-of-american-politics.html.
[89] 2017 N.C. Sess. Laws.
[90] *Id.*

industry stakeholders to a higher standard for fostering a healthier and more sustainable future for citizens and the state. If the natural market will not promote storage in monopolistic states, it is the responsibility of the state government to intervene in order to protect the rights of its citizens.

North Carolina's Utility Commission requires utilities to submit a 15-year forecast of load requirements. [91] The forecast needs to be in compliance with the Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") and requires an assessment of alternative supply-side energy resources:[92]

> (e) Alternative Supply-Side Energy Resources. — As part of its integrated resource planning process, each utility shall assess on an on-going basis the potential benefits of reasonably available alternative supply-side energy resource options. Alternative supply-side energy resources include, but are not limited to, hydro, wind, geothermal, solar thermal, solar photovoltaic, municipal solid waste, fuel cells, and biomass.[93]

The language regarding storage in the IRP is broad and inadequate, only mentioning it explicitly in a section regarding the reporting of any impacts storage may have on the utility's smart grid.[94] Storage is not even explicitly included in the list of possible alternative resources. The standard does later require information regarding "potential alternative supply-side resources" but is limited by it needing to be only "reasonably available"[95] in sharp divergence from Oregon's language that requires an evaluation of "all known resources."[96]

The standard lacks a clear directive and certainly does not encourage the use of storage. In contrast, California's standard, "[W]here feasible, cost effective, and consistent with other state policy objectives, increase the use...",[97] ensures real accountability on this critical matter.

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[91] 4 N.C. ADMIN. CODE 11.R8-60 (2017).
[92] *Id.*
[93] *Id.*
[94] *Id.*
[95] *Id.*
[96] OR. ADMIN., *supra* note 69.
[97] CAL. PUB. UTIL. CODE, *supra* note 83.

The adoption of language similar to California's in the North Carolina IRP process would result in more rigorous analysis of storage, yet would not force utilities to make unwise investments, given the important cost-effective and feasible considerations. Such language is also flexible enough that it need not be frequently updated as this rapidly advancing technology morphs and new applications are discovered.

The crucial lesson from Duke Energy's Notrees Texas installation needs to be considered in this process as well.[98] As generation becomes more distributed and varied, determining the type of resource most suitable to the specific application becomes critical. The IRP process must require careful investigation of intended uses for each generation and storage resource, in order to ensure that the technology of the resource is thoroughly capable of performing the desired function.

V. How is storage development uniquely suited to North Carolina?

The international storage market is projected to be 250 billion dollars by 2040[99] and North Carolina is in an unusual position to potentially capitalize on this economic opportunity. Storage is an advanced yet evolving resource, requiring complex software[100] and physical components. The triple sectors of manufacturing, software and research are areas of competitive advantage and expertise in North Carolina.

Storage is a rapidly increasingly market that traverses multiple industries from the traditional energy world to the auto industry and virtually all power electronics. Since World War II, North Carolina has seen sharp drops in its proud history of manufacturing; the textile

[98] Andy Colthorpe, *supra* note 35.
[99] Peter Maloney, *Report: Energy storage market to reach $250B by 2040*, UTILITY DIVE (June 15, 2016), https://www.utilitydive.com/news/report-energy-storage-market-to-reach-250b-by-2040/420903/.
[100] Herman K. Trabish, *Greater than the sum: How aggregation is making storage into a software business*, UTILITY DIVE (June 13, 2016), http://www.utilitydive.com/news/greater-than-the-sum-how-aggregation-is-making-storage-into-a-software-bus/420753/.

manufacturing sector alone has seen an 82% decrease in employment since the mid-1990s, leaving empty factories and unemployed workers.[101] However, several manufacturers of storage systems and components have now established locations in North Carolina. Rockwood Lithium North America, Celgard and Tec-Cel all supply Li-ion storage components and have local facilities.[102]

At the same time, the Research Triangle and Charlotte tech sector hubs have established powerful electronics and software expertise. Robust software capable of controlling both renewable generation and storage facilities to aggregate and optimize services, possibly provided simultaneously, is expanding the possibility and structure of distributed generation.[103] IBM, Cisco, SAS and other locally-headquartered companies are world leaders in big data analytics and already working together with the energy industry.

North Carolina is also home to several highly regarded research-focused universities actively pursuing renewable energy projects. NC State's Future Renewable Electric Energy Delivery and Management ("FREEDM") Systems Center has been collaborating with ABB on grid modernization efforts for years.[104] The University of North Carolina at Charlotte developed the Energy Production & Infrastructure ("EPIC") Center that works with energy heavyweights Duke Energy, Siemens, and AREVA.[105] The state has also become a hub of clean energy companies and entrepreneurs with almost a thousand companies in 2016 and several

[101] Katherine Peralta, *View from a former NC textile town: Trump's jobs promise will be hard to keep*, CHARLOTTE OBSERVER (Apr. 1, 2017), http://www.charlotteobserver.com/news/business/article141927994.html.
[102] U.S. DEP'T OF ENERGY, *Southeast Clean Energy Opportunities Roadmap North Carolina Roadmap: Lithium-Ion Battery Manufacturing Industry*, https://energync.org/wp-content/uploads/2017/03/NC-DOE-Roadmap-Project-Storage.pdf.
[103] Herman K. Trabish, *supra* note 100.
[104] U.S. DEP'T OF ENERGY, *supra* note 102.
[105] U.S. DEP'T OF ENERGY, *supra* note 102.

organizations such as the Research Triangle CleanTech Cluster and the NC Sustainable Energy Association ("NCSEA").[106]

VI. Conclusion

Storage is vital to the future of renewable energy. In order to ensure the long-term wellbeing of its citizens and limit the damage from harmful fossil fuel generation, North Carolina should adjust the IRP requirements to ensure a more rigorous evaluation of storage. North Carolina has a history of innovation and the current capability to potentially capture a significant market share of a growing multi-billion-dollar industry. A stronger commitment to storage will open North Carolina to new economic development opportunities and businesses, particularly as storage evolves and becomes more economically viable. More importantly, embracing storage will demonstrate the deep respect North Carolinians have for each other and for their beautiful environment.

[106] Shannon Cuthrell, *Cleantech Sector a Powerhouse in North Carolina's Startup Ecosystem*, EXITEVENT (Feb. 27, 2017), https://www.exitevent.com/2017/02/clean-energy-sector-a-powerhouse-in-north-carolinas-startup-ecosystem/.