Transmission Issues and Recommendations for Duke's Proposed Carbon Plan

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OVERVIEW

Transmission assumptions in the North Carolina Utilities Commission's Carbon Plan are critically important given the flexibility and optionality provided by increased grid connectivity that cannot be realized by generation and demand response resources. A strong electric transmission network provides significant options that will benefit customers; these options will not be realized by relying on incremental expansion planning, especially if those planning models are based on known commitments and do not reflect expected conditions for the future.

As discussed further below, I recommend that the North Carolina Utilities Commission ("NCUC" or "Commission") incorporate the following into its Carbon Plan and direct Duke to do the same in future proposed Carbon Plans:

1. Multi-Value Transmission Planning: Proactive, scenario-based, multi-value portfolios of transmission expansion projects, including Grid-Enhancing Technologies and advanced conductors, to identify bulk transmission upgrades to enable better integration of the DEC and DEP, as well as integration of renewable resources, particularly offshore wind. Transmission expansion upgrades need to be identified and vetted that would accelerate the effective integration, consolidated operations, and joint dispatch of DEC and DEP resources. New and upgraded transmission infrastructure should be "rightsized" in anticipation of future needs.[1]

2. Collaborative Planning Studies: Leverage the results of improved collaborative planning efforts with neighboring systems such as the ongoing Southeastern Regional Transmission Planning (SERTP) process, future North Carolina Transmission Planning Collaborative (NCTPC) studies, as well as the Atlantic Offshore Wind Transmission Study.

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[1] In transmission planning, "rightsizing" generally refers to upsizing to a higher voltage class, multiple circuits, or higher capacity equipment when it comes to the bulk power system given the large economies of scale.

3. Advanced Transmission Technologies: Planning decisions regarding long range transmission expansion need to take full advantage of existing assets and corridors. Further, these asset management planning practices should be informed by transparent assumptions. The Duke electric power systems in the Carolinas have an opportunity to capture benefits for both DEC and DEP customers with effective planning and strategic decisions regarding the upcoming replacement of aging assets in, around and between the two systems.

4. Regional Integration: Rigorous analysis and assumptions regarding projects and costs to support future resource needs; in particular, imports and offshore wind developments that may be best addressed in partnership with neighboring systems. Collaborative planning between Duke and its neighbors, such as Dominion, can lead to efficient and resilient transmission infrastructure for new renewable resources such as offshore wind to serve the needs of both systems.

In addition, I recommend that the Commission synchronize development of its Carbon Plan with transmission planning processes in the interests of efficient least-cost planning. Furthermore, the NCUC should direct Duke in its next proposed Carbon Plan to make changes to existing processes to expand the planning horizon and scope of the SERTP process and NCTPC studies to address 20-year holistic planning studies with due consideration of transmission expansion to mitigate system stress associated with extreme weather, physical or cybersecurity threats. In addition, the NCUC should direct Duke to make changes to existing processes to incorporate non-traditional solutions such as system reconfiguration alternatives and other Grid-Enhancing Technologies (GETs). Duke need not wait on mandates from FERC, but should rather work with neighbors and stakeholders to revise its planning processes in a proactive manner.

STUDY ASSUMPTIONS

Transmission cost assumptions for new resources as part of the Duke proposed Carbon Plan vary significantly. As expected, the transmission integration cost assumptions for every resource option in the portfolio of Duke's expansion plan are a very small portion of the total resource costs. While the cost of transmission is small compared to capital requirements associated with resource development as expected, the flexibility and optionality provided by robust transmission expansion to grid operations and future expansion must be considered in any long-term plan.

While the transmission cost assumptions associated with solar and hybrid solar/storage in DEC and DEP are identical, substantial differences are noted for onshore wind with incremental transmission expansion costs for DEC compared to DEP, but that can be expected due to the relative proximity of offshore resources.

Transmission expansion costs for offshore wind in DEP show significant economies of scale beyond 1600MW of resource expansion, which is expected given the lumpy nature of transmission expansion.

The assumptions regarding transmission expansion costs for all other resources, e.g., batteries, pumped storage, SMRs, Advanced Nuclear with Internal Storage, and CTs, are constant with DEP costs being about 10% higher than DEC costs, which is unremarkable.

Transparency is critical for long range transmission expansion planning to be effective. Terminology needs to be used consistently for transmission expansion projects. Terms such as "Reconductor," "Upgrade," and "Rebuild" to describe projects which increase capabilities of existing assets must be standardized across all processes. For example, the four upgrades shown on slide 35 from the TAG Meeting June 27, 2022, appear to be complete rebuilds, rather than simply reconductoring which is noted in the "Upgrade" column.

The inputs and results of the NCTPC 2021 Public Policy Study published May 23, 2022, were reviewed to validate the transmission expansion assumptions for the onshore, offshore and large battery projects in Duke's proposed Carbon Plan.

As demonstrated by recent studies as well as experience in other jurisdictions, proactive transmission planning is a necessary component of any plan to support integration of renewable resources to achieve decarbonization goals and mandates for the bulk power system. Commitments to proactively expand transmission capacity will result in the timely and efficient procurement of the highest quality renewable resources at the lowest cost to consumers. Even though past practices iterate between resource plans and transmission plans, it would be much more efficient to plan resources and transmission at the same time to develop optimal plans.

In conclusion, the cost assumptions for transmission expansion associated with new resources in Duke's proposed Carbon Plan appear to be reasonable, with transmission being a small fraction of the total costs for new resources. The costs reflect economies of scale which should be expected for large offshore wind developments due to the lumpy nature of major transmission expansion projects. Major transmission projects show tremendous economies of scale in terms of power density in corridors, as well as the design and small incremental costs for structures to support adding a second circuit or even higher voltage ultimate operation in the long term without considering the advantages of advanced transmission technologies which are proven and being used more regularly to maximize the value of assets.

GENERAL RECOMMENDATIONS

Decisions regarding transmission must be part of co-optimization of integrated long term planning efforts that are pro-active and holistic, rather than an afterthought or an add-on to otherwise isolated power supply resource plans. An iterative approach may be required to identify optimal expansion plans given the lack of software tools and robust algorithms to solve these complex issues.

Electric power transmission is a critical component of the bulk power system whose value is too frequently discounted. A coordinated and collaboratively planned transmission network is a tremendous asset that can enable efficient and effective decisions regarding future supply options. Transmission enables and defines markets. The lack of robust transmission capability can be very costly, not only in terms of limiting supply choices, but also in limiting the flexibility that such robust capability provides for system operations to accommodate necessary rebuilds to replace aging infrastructure as transmission lines approach the end of life. The insurance value of robust transmission can be very significant during extreme weather, physical or cybersecurity events.

Transmission is lumpy with tremendous economies of scope and scale that need to be leveraged by utilities who may be reluctant to work with neighboring systems to achieve the potential benefits of larger regional network solutions.

Based on my observations of resource plans that follow best practices, it seems clear that significantly more clean energy developments will provide better solutions regarding resource plans and that would result in the ability to realize even better economies of scale with more efficient and effective bulk transmission expansion projects. To that end, the NCUC should take actions to accelerate Duke's efforts regarding better regional integration.

The interfaces between power systems are sometimes referred to as "seams." Coordination between transmission service providers to manage flows on the power system network can be a challenge. Seams issues and affected system study costs can be very large and must be considered in any resource planning decisions. Yet, the Duke Carbon Plan gives seams issues and related costs very little consideration, other than a short section regarding the cost to import resources from PJM based only on approved transmission service rates.[2] While these other costs can be difficult to quantify absent detailed studies, assessments can be made in collaboration with neighbors. The cost of affected system studies can very well drive business decisions for projects. The challenges with planning generation interconnection upgrades as well as cost responsibilities for network upgrades on or around the seam of adjacent systems may be difficult problems to solve, but they can be addressed if transmission service providers are willing to work together. Midcontinent Independent System Operator (MISO) and Southwest Power Pool (SPP) are providing some leadership on effective joint planning to displace reactive affected system impact studies with the proactive identification of backbone upgrades to fix their long-standing seam issues.[3] Addressing seams issues can be difficult between grid operators with different tariffs, business practices, market designs, etc. Merging Balancing Authorities provides a foundation for grid operators to capture significant benefits between systems that have struggled due to seams issues and the lack of diversity in resources, loads, etc.

Import and export limitations are critical, and it is important that these assumptions are reasonable when it comes to assessments to support integrated resource planning decisions.

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[2] Duke Proposed Carbon Plan, Appendix P, pp. 22-23.

[3] *See* https://www.misoenergy.org/stakeholder-engagement/committees/miso-spp-joint-targeted-interconnection-queue-study/.

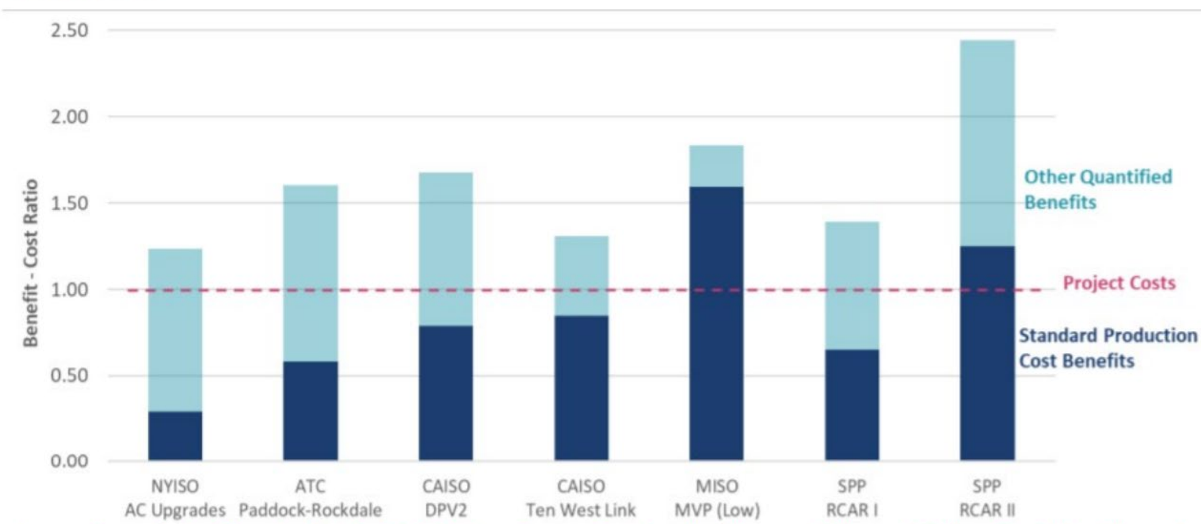
While it may not be appropriate to extrapolate historical imports/exports for planning purposes, that historical data can provide insights regarding the system's capability that may not be reflected in planning assumptions. EIA historical transactions data is posted separately for Duke Energy Carolinas, and the eastern and western systems of Duke Energy Progress. This data can help with investigating the merits of improved connections between the separate systems within Duke's North Carolina territory and help determine if they need to be considered as one unit for long range planning purposes. A quick analysis of the aggregate data demonstrates that the Duke systems in the Carolinas have been able to import more than 2,000MW in periods near peak winter demand in mid-January of 2018. Extreme weather events are easy to predict many days in advance and power system operations commit resources well in advance of need to ensure availability of critical resources during peak consumption periods. It is no surprise that Duke was importing significant amounts of power near peak demands as weather fronts move across the southeast and mid-Atlantic states, because utilities pre-position their fleets in advance to accommodate forecasted peak demands. Neighboring utilities typically have excess capacity in periods adjacent to their own coincident peaks. This fact provides opportunities for adjacent systems to exchange capacity and energy, which will improve system reliability and resilience and allow a reduction in reserves and capacity sharing which should lower customer costs. The bulk power system is a very valuable asset to move capacity and energy.

Seasonal diversity exchanges were commonplace decades ago to leverage the resources in power supply fleets and achieve load diversity. An efficient and effective bulk power system should take advantage of that diversity, but it's only available as a result of adequate transmission planning and expansion projects to capture those benefits. The flexibility provided by extra high voltage (EHV) transmission capability is extremely valuable for the interconnected system during periods of stress. That applies within the Duke North Carolina systems, as well as with its neighboring systems in PJM, TVA, Southern Company and others. Indeed, FERC is expected to draft a methodology to determine minimum interregional transmission capabilities in the upcoming NOPR on interregional planning. Duke could provide some leadership in this area and be proactive in driving these efforts to the benefit of its customers and decarbonization of the future grid. The NCUC should anticipate the impacts of the FERC NOPR and its impact on the final Carbon Plan and should participate in the FERC rulemaking process to the extent appropriate and feasible. At a minimum, the NCUC should not rush to adopt a Carbon Plan in this proceeding that relies too heavily on assuming very low regional integration.

Robust transmission expansion provides operational benefits which are not captured with traditional planning models and tools. Traditional planning models reflect all lines in service, normalized load patterns, and units dispatched at maximum generating capabilities which create unrealistic models of the future. These "pristine" models--that are overly optimistic in terms of facility availabilities--are typically the basis for long-term reliability and economic transmission expansion planning simulations. Reliability and economics are inseparable when it comes to the value proposition of prudent transmission expansion planning. Today's transmission expansion project to address a reliability need, based on existing reliability standards, provides economic benefits to support grid operations. Conversely, economic upgrades in the near term will also provide reliability benefits that are difficult to quantify since operating conditions rarely mirror planned scenarios. The benefits associated with the flexibility and optionality provided by a strong electric transmission network are significant and will not be realized if incremental least cost planning is performed with limited planning horizons, particularly if those do not align with corporate, institutional, state and municipal commitments to decarbonize their electric power supply resources by a date certain, as is the case following enactment of HB951.

The actual benefits of transmission expansion are typically much larger than those projected in economic planning assessments. It's important that due consideration be given to all the benefits that can be provided from an optimally-designed transmission network to customers as part of any long-range system plan. The following graph from the "Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs" report[4] published by Brattle and Grid Strategies demonstrates how quantifying benefits above typical adjusted production costs are critically important to realize effective planning decisions:

FIGURE 5. BENEFIT-COST RATIOS OF TRANSMISSION PROJECTS WITH AND WITHOUT A BROAD SCOPE OF BENEFITS



Source: Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs (brattle.com)

The NCUC must capture the value of transmission in its Carbon Plan, and can leverage recent frameworks and case studies presented by Telos for ESIG,[5] as well as the Brattle/Grid Strategies findings for ACORE. In the recent FERC NOPR in Docket RM21-17, FERC has identified 12

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[4] https://www.brattle.com/wp-content/uploads/2021/10/2021-10-12-Brattle-GridStrategies-Transmission-Planning-Report_v2.pdf

[5] https://www.esig.energy/wp-content/uploads/2022/07/ESIG-Multi-Value-Transmission-Planning-report-2022a.pdf

(twelve) benefit metrics that could be considered as part of prudent transmission expansion planning.[6] Assessments to quantify the value of transmission expansion understate the actual value of those investments. As demonstrated by SPP's latest "The Value of Transmission" study, every dollar spent on transmission expansion in SPP returns at least $5.24 in actual benefits, despite planning studies which justified those projects resulting in their approvals only identifying a fraction of that value.[7] While the benefits of effective regional planning include the capital savings from avoiding and/or deferring local reliability upgrades due to better, long term solutions, there are operational savings such as reductions in reserves, lower system losses, as well as the ability to accommodate better maintenance and rebuild schedules to name a few. These considerations are important attributes of a portfolio of least-regrets, transmission expansion projects which maximize net benefits for consumers.

Asset replacement has become a major issue as it now drives capital budgets for transmission projects in most, if not all, utilities. The Duke electric power systems in the Carolinas have an opportunity to capture benefits for both DEC and DEP customers with effective planning and strategic decisions regarding the upcoming replacement of aging assets in, around, and between the two systems. Planning for infrastructure must have a long-term focus and incorporate reasonable assumptions regarding the remaining life of transmission lines, particularly those in critical corridors. Transmission planning to address future needs must take advantage of asset management information to better inform investment decisions. Planning should not just incorporate asset management decisions as an input into its studies, but rather those efforts need to work together in a proactive, holistic manner to identify opportunities for "rightsizing" aging assets that can defer or displace traditional transmission expansion needs from conservative planning assessments done in isolation. A particular focus on critical corridors is warranted to ensure that transmission expansion plans are not short-sighted, focusing only on local needs, but also support the long-term needs for a decarbonized grid in and around Duke's system in the Carolinas.

Effective interregional planning is a critical success factor for efficient offshore wind development and integration. The economic benefits of proactive, coordinated interregional planning for significant offshore wind development scenarios warrant investigation and understanding to ensure that resource plans are prudent. Coordinated planning with Duke and Dominion to integrate offshore wind resources in southern VA and northern NC can be expected to result in large benefits to customers of both systems. Cost effective, collaborative plans should be encouraged for both the optimal wet and dry network designs to harvest and integrate offshore resources for coordinated transmission expansion developments in southern VA and northern NC. Investing in the transmission infrastructure to support offshore wind

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[6] See Paragraph 185+ starting at page 161 of NOPR for RM21-17 that is posted at https://www.ferc.gov/media/rm21-17-000

[7] See "The Value of Transmission" (2021) SPP Study reviewed by the Brattle Group. https://www.spp.org/value-of-transmission

developments in southern VA and northern NC will provide tangible benefits to the larger transmission grid. Even if offshore wind developments are not part of the near-term resource plans, increased connectivity between Duke and Dominion will provide tremendous value by capturing operating efficiencies that will set up for longer term optionality regarding supply options.

FUTURE PLANNING

The FERC NOPR on **Building for a Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection**[8] in Docket RM21-17 issued April 21, 2022, has important implications for optimal system planning. As proposed, the NOPR will require 20-year holistic planning studies which are proactive, scenario-based and consider low-frequency, high-impact events such as extreme weather events. To that end, the NCUC should direct Duke to engage in the SERTP planning process to identify more efficient, cost-effective regional transmission solutions to facilitate meeting the Carbon Plan targets. In addition, to improve the planning process, the NOPR will require the incorporation of Dynamic Line Ratings (DLR) and Power Flow Controllers into planning processes to leverage proven technology and maximize the utilization of existing transmission assets without sacrificing reliability. While the use of DLR can improve operational efficiencies, allowing grid operators to better manage congestion and minimize curtailments of non-dispatchable renewable resources, it will take time to deploy sensors and collect data to update parameters used in static normal and emergency ratings to reflect actual and expected ambient conditions for long range planning studies. The NOPR will also adopt enhanced transparency between local and regional transmission planning to allow "rightsizing" of replacement facilities. Given the broad benefits of robust transmission that facilitates markets, FERC has identified 12 benefit metrics that could be considered in decisions regarding future transmission expansion.

Although comments to this FERC NOPR are not due until mid-August, it would be useful to understand Duke's initial reaction to some of the above key provisions to reform transmission planning. The NCUC should direct Duke to, in its next proposed Carbon Plan, make changes to existing processes to expand the planning horizon and scope of NCTPC to address 20-year holistic planning studies with due consideration of transmission expansion to mitigate system stress associated with extreme weather, physical or cybersecurity threats.

In the NOPR on **Improvements to Generator Interconnection Procedures and Agreements**[9] in RM22-14 released June 16, 2022, FERC is proposing that Transmission Service Providers evaluate Alternative Transmission Technologies. FERC expects that Grid-Enhancing Technologies (GETs) be considered to facilitate the timely integration of new resources stuck in existing generator-interconnection queues. GETs are advanced transmission technologies such as dynamic line ratings, advanced power flow controllers and topology optimization that

[8] https://www.ferc.gov/media/rm21-17-000
[9] https://www.ferc.gov/media/rm22-14-000

leverages sensors and algorithms to better manage flows and congestion of the bulk power system. GETs can also include "Storage as Transmission" that may be a preferred solution as part of an optimal portfolio of transmission expansion projects. The NCUC should direct Duke to, in future proposed Carbon Plans, make changes to existing processes to incorporate non-traditional solutions such as system reconfiguration alternatives and other GETs.

These recent FERC NOPRs will establish minimum study requirements for future planning and generation interconnection studies that are expected to improve and accelerate development of the future grid. Duke need not wait on mandates from FERC but should rather work with its neighbors and stakeholders to revise its current planning processes in a proactive manner. Duke and its stakeholders need to ensure that any revisions to future planning and tariff service processes are not merely "checking a box" to comply with new requirements but are necessary enhancements to improve long term system planning and operational needs of the future grid.

Affected system studies are important, and Duke notes that the potential cost impacts associated with affected system study costs have not been considered in these analyses. Plans must consider alternatives based on holistic assessments of options and those must consider affected system impacts. While it is difficult to address cost allocation given current processes, progress can be made determining "no regrets" solutions in effective joint planning studies such as the Joint Transfer Interconnection Queue (JTIQ) study[10] which is being finalized now between MISO and SPP after a 2-year study process. NCUC should consider JTIQ as a template for future joint long-range planning studies that can replace, or at least mitigate, the uncertainties and risks to developers associated with affected system studies, which identify long range backbone upgrades that will benefit everyone and not just the generators that are currently being assigned cost responsibilities based on tariff processes. The current transmission planning process in almost all regions, or as demonstrated in the proposed Carbon Plan, will never identify a portfolio of backbone transmission expansion projects to address long term needs because it will always proceed incrementally with smaller projects triggered by the next tranche of resource procurements. Unlike past joint planning efforts which were driven by affected system study provisions in existing tariffs and joint operating agreements, the JTIQ was a forward-looking collaborative, joint planning effort to identify major transmission expansion projects which benefit both SPP and MISO and will help to address decarbonization efforts for both systems and their customers.

Duke needs to lead the way for collaborative planning with neighbors through the North Carolina Transmission Planning Collaborative, SERTP, and other appropriate forums to create an efficient and effective long-range plan to address future planning needs.

Beyond local and regional planning needs, Duke needs to expand its engagement in the NREL-led Atlantic Offshore Wind Transmission Study[11]. The Atlantic Offshore Wind Transmission

[10] https://www.spp.org/engineering/spp-miso-jtiq/

[11] https://www.nrel.gov/wind/atlantic-offshore-wind-transmission-study.html

Study is evaluating coordinated transmission solutions to enable offshore wind resource deployment along the US Atlantic Coast from Maine to South Carolina. Duke should be working with Dominion and others in this study effort to determine optimal offshore developments near the Carolinas to support potential collaborative and coordinated plans to address future needs. Duke needs to provide transparency regarding input into key study assumptions for stakeholders to support the study findings and conclusions, and then determine how to incorporate those results into future proposed Carbon Plans. In addition to study inputs, scenarios and sensitivities should be studied as part of this study and other collaborative efforts to help frame future Duke proposed Carbon Plans and inform decisions regarding the merits and timing of offshore wind development to support Duke's needs.

Synchronizing the inputs, findings and conclusions of planning studies can be a challenge, but it is an important step in making sure that planning evolves and that we can apply the key findings from related efforts, even if assumptions and scenarios do not align. The NCUC could facilitate more transparency and active engagement by all stakeholders in the planning process by sponsoring a workshop to better understand current processes regarding maintenance and rebuild practices. The objective of that initial effort would be to establish a common understanding of existing utility practices and identify reforms which would create a solid foundation for rightsizing select facilities in key corridors. The findings in the **Report on the NC 2021 Public Policy Study May 23, 2022 FINAL REPORT** will need to be incorporated into the next Duke proposed Carbon Plan. Affected system studies are problematic and reforms in that regard are expected from FERC, given recent developments as well as the progress of the MISO-SPP JTIQ study. For its Carbon Plans, the NCUC should direct Duke to incorporate the results of long-range joint studies with other utilities and stakeholders to determine optimal expansion plans in lieu of affected system studies. It is important for plans of alternative portfolios of resource options to reflect a reasonable range of costs to collect and deliver 1600MW of offshore wind into the New Bern 230kV Substation. It appears that existing 230kV facilities are in a key corridor from Duke's backbone transmission system near Raleigh into New Bern and that those lines would be good candidates for "rightsizing" that might address future long term needs and support integration of offshore wind, as well as the DEC and DEP systems. The condition of those facilities (and the long-term plan regarding their replacement/upgrade) needs to be part of any future Carbon Plan.

From **Appendix P of the Carolinas Carbon Plan, Transmission System Planning and Grid Transformation**, pages 14-15, the status of the initial set of "red zone" upgrades shown in Table P-3 needs to be resolved as soon as possible. These upgrades seem to be a reasonable start to provide some certainty for developers to submit competitive proposals so that Duke can be expected to achieve its decarbonization goals within the next decade. Risks regarding proposed project developments translate to higher price offerings, which can be mitigated to a large extent with respect to interconnection costs for renewable projects, especially as it relates to high quality resources in relatively weak portions of the bulk power system. Although Duke is proposing to incorporate Red-Zone Transmission Expansion Plan (RZEP) projects "into the Local

Transmission Plan by mid-year 2022" and they represent an important first step towards resolving constraints, it's critically important to note that these upgrades will not address long term needs. It's important to understand which of these RZEP should be candidates for "rightsizing" and how much incremental capacity at what incremental cost can be expected to result. The ability to "rightsize" key facilities will depend upon many factors including the size of existing ROWs as well as the potential consideration of transmission designs to increase power densities. The existing 230kV facilities from Robinson Plant – Rockingham – West End – Cape Fear, especially given the parallel Robinson Plant – Rockingham 115kV line that also is projected to overload, transverse the high-quality solar zones and appear to be an excellent candidate for "rightsizing."

In addition to "rightsizing" upgrades to address long term needs to support decarbonization targets, Duke needs to give serious consideration to the use of advanced conductors to increase the capability of existing lines without upgrading existing structures, if appropriate. Regarding "reconductoring" projects, Duke needs to give serious consideration to the use of high temperature, low sag composite core conductors ("Advanced Conductors"), such as ACCC or TS Conductor, as an alternative to traditional ACSR. While reconductoring with Advanced Conductors has a cost premium, the ability to leverage existing towers can greatly accelerate renewable project integrations as reported in **Advanced Conductors on Existing Transmission Corridors to Accelerate Low Cost Decarbonization.**[12] In some cases, existing structures, not just conductors, need replacement. Then, a rebuild using Advanced Conductors needs to be considered since that design can be expected to result in fewer and shorter structures that can more than offset the cost premium associated with the conductor choice. Advanced Conductors provide greater efficiency/lower losses and higher loadability to help with extreme weather/resilience events, which are notable benefits that may not be considered as part of conductor selection.

In the recent Order in Dockets NO. E-2, SUB 1297 and E-7, SUB 1268, the NCUC has asked parties to comment in the Carbon Plan proceeding on the need for the inclusion of the RZEP projects to achieve the goals of the Carbon Plan and H951. Proactive planning has been a demonstrated success in transmission expansion to support renewable project integration in several jurisdictions, e.g., ERCOT CREZ, MISO MVPs, etc. Most recently, the Colorado Public Service Commission approved the high-capacity, backbone Power Pathway 345kV double circuit project to support efficient and effective wind/solar development and integration to realize decarbonization mandates in that state. That major transmission expansion project will allow Xcel Energy's Public Service of Colorado to address the challenge of the "chicken or the egg" to the benefit of its customers and the ability to achieve carbon reduction targets. Timing can be a challenge given tariff processes, but the fact that Duke's analyses continue to show these facilities as upgrades in numerous generation interconnection studies provides evidence that

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[12] https://gridprogress.files.wordpress.com/2022/03/advanced-conductors-on-existing-transmission-corridors-to-accelerate-low-cost-decarbonization.pdf

these RZEP should be considered “no regrets” projects that will facilitate decarbonization of the grid. As appropriate, the scope of these projects should consider “rightsizing” in initial design to support longer term needs. One of the key lessons from the approved portfolios of transmission expansion projects in many jurisdictions is that new facilities are oversubscribed upon energization and clearly inadequate for long term needs.

Duke notes that there is no available import capability from DEC to DEP on page 16 of the Appendix P. Transmission expansion upgrades need to be identified and vetted which could accelerate the effective integration, consolidated operations and joint dispatch of DEC and DEP. In addition to rightsizing and future-proofing select lines in key corridors, Duke needs to give serious consideration of the effective deployment of GETs or Advanced Conductors to facilitate grid decarbonization efforts. Duke should evaluate the merits of deploying GETs, such as Dynamic Line Ratings, Advanced Power Flow Controls or Topology Optimization, to address project system overloads/congestion and/or accelerate the integration of renewable resources in advance of planned transmission expansion projects. As a next step, Duke should consider the merits of deploying GETs in lieu of $200M+ for 100kV upgrades identified on 5 lines in the 2021 Public Policy Study. Similarly, Advanced Conductors should be considered for future reconductors, as well as uprates of existing lines to higher operating temperatures to address known clearance issues.

GETs can also enhance the value of, and provide operational flexibility to complement, major transmission expansion projects too. For example, lower voltage facilities tend to limit the value of major backbone projects in operations that may not even be considered in planning efforts. This is especially true given outages to replace/rebuild aging facilities that create congestion for existing and proposed resources. GETs can be deployed and redeployed as the grid evolves to manage system flows and congestion. GETs can even become part of permanent solutions too, as appropriate. RZEP identifies the need to rebuild both the 115kV and 230kV circuits between Robinson Plant and Rockingham. Duke and the NCUC should consider non-traditional solutions not only because they are likely to lead to a least-cost path to the HB951 carbon-reduction targets in the near term, but also provide benefits in addressing longer term needs and leveraging those facilities in that key corridor.

NEW OPPORTUNITIES TO DRIVE CHANGE

As a result of the Bipartisan Infrastructure Law, significant resources are now available to Duke and others to support future grid developments. Further, on July 6th the DOE released the first $2.3 Billion Formula Grant under the Building a Better Grid Initiative. Duke needs to work with DOE and other partners to fully capitalize on the grants and other programs in the new Building a Better Grid Initiative. Additional provisions to enhance transmission expansion such as a large Investment Tax Credit (ITC) for qualifying major transmission expansion projects are being considered in current budget reconciliations. An ITC would be expected to have a profound impact on the payback for major transmission expansion projects which could easily justify “rightsizing” and future proofing select projects in critical corridors. For example, in select corridors such as the 230kV upgrades shown for the path from Robinson Plant – Rockingham – West End – Cape Fear Plant on slide 44 from the TAG Meeting June 27, 2022 meeting, Duke needs to assess the feasibility and value of future optionality in building initial structures that can support a second 230 or even 500kV circuit in the same corridor to support long term planning needs. DOE resources may be available to support non-traditional transmission expansion solutions which would provide long-term benefits to Duke and its customers.

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Experience

- **Sept 2020 – present Grid Strategies LLC**
- **Vice President**

Leveraging 40+ years of utility and RTO experience to assist clients in realizing a clean energy future grid that is efficient, effective, secure and resilient

Co-author Brattle and Grid Strategies report filed in FERC RM21-17 entitled "Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs"

Participated at North Carolina Utility Commission technical conference on Duke's 2020 IRP

Filed answer testimony in support of Clean Power Pathway in Colorado PUC CPCN docket

Filed testimony in support of Gateway South CPCNs at the Wyoming and Utah commissions

Co-author ACEG papers including "Planning for the Future: FERC's Opportunity to Spur More Cost-Effective Transmission Infrastructure" regarding FERC Order 1000 reforms and "Disconnected: The Need for New Generator Interconnection Policy"

WATT Coalition support including lead role in "Unlocking the Queue" which was a Grid Enhancing Technologies (GETs) case study in KS and OK for 2025

Team leader for ESIG workshops and white paper on "Transmission Planning for 100% Clean Electricity"

- **2001 - 2020 Southwest Power Pool**
- **Director – Research, Development & Tariff Services (RDTS)**

Manage research projects and funding priorities for SPP while providing strategic consulting for SPP executives and management

Direct RDTS staff in support of programs and projects to support strategic objectives of SPP - Dynamic Line Rating pilot projects with AEP and Sunflower Electric, PMU deployment roadmapping, special studies like High Priority Incremental Load Study (HPILS), Value of Transmission, WAPA/Basin IS integration

Direct all customer requested service studies including generation interconnections, transmission service and congestion hedging

Co-lead for Technical Review Committee for DOE-funded, NREL-led Interconnections Seam Study

Member of EPRI Grid Operations, Planning and Renewable Integration Leadership Team

Steering Committee for TransGrid-X 2030 Symposium at Iowa State University

U.S. Representative on CIGRE C1.35 and C1.44 evaluating merits of a global electric grid

2012 – 2013 Senior Policy Advisor – U. S. Department of Energy in Electricity Delivery and Energy Reliability (OE)

Educate DOE and agency staff on grid operations and planning
Serve on Grid Tech Team
Recommend changes in research priorities and organizational structure of OE
Member of WAPA Joint Outreach Team to facilitate grid modernization

Director – Transmission Development / Engineering

Led transmission expansion policy development within SPP and beyond, as well as strategic and other benefit assessments for EHV transmission.
Led inter-regional coordinated and collaborative planning studies, Eastern Interconnection Planning Collaborative (EIPC), WECC TEPPC, SWAT, SIRPP, etc.
Represent SPP on the Technical Review Committees for the Eastern Wind Integration and Transmission Study (EWITS) sponsored by DOE/NREL, as well as Nebraska Power Association Wind Integration Study, and several ARRA funded projects for EPRI, et al.
Chair EPRI Program 173: Enabling Transmission for Large Scale Renewables
Staff Secretary for SPP's Design Best Practices and Performance Criteria Task Force which led to SPP's design standards including 3,000 Amps for new 345kV regionally funded lines
Direct activities of the Technical Studies & Modeling, Planning and Tariff Studies Sections of t Engineering Department at SPP
Direct development of SPP's EHV Overlay plan, as well as Wind Penetration Study
Develop/Manage Engineer-In-Rotation program for all engineering groups at SPP
Led implementation of Economic Upgrades within SPP, e.g., Westar's Wichita – Reno Co – Summit 345 kV and KETA's Spearville – Knoll – Axtell EHV projects
Chair ISO/RTO Council Planning Committee
Development and implementation of the SPP Transmission Expansion Plan (STEP)
Develop process and template for economic transmission expansion planning
Initiate and direct coordinated planning activities, e.g., ERCOT/SPP Joint Study
Represent SPP on NERC Transmission Issues Subcommittee (TIS) and RAS

- **1981 – 2000 Illinois Power**

Increasing levels of responsibility beginning with System Planning, and expanding expertise in Energy Supply, Regulatory Services, and Retail Marketing. Began career in Transmission Planning performing technical analyses as well as serving as IP's representative on the MAIN Engineering Committee, supporting Research & Development, negotiating and implementing the nation's first retail wheeling pilot program with industrial customers and transitioning interruptible customers to real time pricing tariffs, and then working with utilities and legislatures to get approval of retail choice in Illinois prior to developing and implementing marketing plans for commercial and industrial customers.

Education

University of Illinois	Bachelor of Science in Electrical Engineering with a Power Systems emphasis
Iowa State University	Course requirements for a Masters of Engineering

Memberships

2009 – Present Institute of Electrical and Electronics Engineers
2009 - Present Power and Energy Society
2016 – Present CIGRE

Awards

2011 UWIG Achievement Award for the advancement of transmission planning and markets in the SPP footprint, *Utility Wind Integration Group*

2012 Technology Transfer Award for DOE Integration of Southwest Power Pool Wind by Southeast Utilities, *Electric Power Research Institute*

2017 UVIG Service Award for 11 years of service to the UVIG Board of Directors, *Utility Variable-generation Integration Group*

2019 Sullivan Alumni Association Hall of Fame Award, Sullivan Illinois

2020 Honorable Mention Energy Central's Leaders in Innovation in the Electric Power Industry

2020 Electric Power Research Institute Power Delivery and Utilization Sector Transmission Operations and Planning Advisory Leadership award for outstanding contributions to the Transmission Operations and Planning Advisory Leadership Team from 2010 to 2020

Service Activities

2009 – 2012 NERC Integrating Variable Generation Task Force, Task 2.3 BA Services and Coordination Chair

2009 – 2020 Industry Advisory Board for Power Systems Engineering Research Center (PSERC) and GRid-connected Advanced Power Electronics Systems (GRAPES), including Chair for each organization

2009 – 2020 Member of Electric Power Research Institute Grid Planning & Operations Leadership Team

2016 – 2018 U. S. Department of Energy, Electricity Advisory Committee

2021 NSF Innovation-CORPs Midwest Cohort Industry Mentor for Bastazo

2021 - Present Member of SPP Independent Expert Panel (IEP)

2022 Chair of EUCI's GETs Fundamentals symposium, February 2022

2022 Chair of Infocast's Transmission Planning and Interconnection Summit, Arlington VA, June 2022

2022 Member of ESIG Transmission Benefits Valuation Task Force which published *Multi-Value Transmission Planning for a Clean Energy* report

Publications

Jay Caspary et al, *Unlocking the Queue with Grid-Enhancing Technologies: Case Study of the Southwest Power Pool,* CIGRE Paris, August 2022

Jay Caspary and Ted Bloch-Rubin, *A transatlantic perspective: unlocking the queue for renewables*, European Energy & Climate Journal, February 2022

Michael Goggin, Rob Gramlich, Jay Caspary, Jesse Schneider, *Fleet Failures: How Interregional Transmission Keeps the Lights on When Generation Fails*, November 2021

Debbie Lew, Jordan Bakke, Aaron Bloom, Patrick Brown, Jay Caspary, Christopher Clack, Nicholas Miller, Antje Orths, Alison Silverstein, John Simonelli, Robert Zavadil, *Transmission Planning for 100% Clean Electricity*, IEEE Power & Energy Magazine, November/December 2021

Rob Gramlich, Michael Goggin, Jay Caspary, Jesse Schneider, Johannes Pfeifenberger, Kasparas Spokas, J. Michael Haggerty and John Tsoukalis, *Transmission Planning for the 21st Century: Proven Practices that Increase Value and Reduce Costs*, October 2021

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Caspary, J., Goggin, M., Gramlich, R., and Schneider, J., Americans for a Clean Energy Grid (ACEG) *DISCONNECTED: The Need for New Generator Interconnection Policy*, January 2021

Wang, W., Ramasubramanian, D., Farantatos, E., Bowman, D., Scribner, H., Tanner, J., Cates, C., Caspary, J., and Gaikwad, A; *Evaluation of Inverter Based Resources Transient Stability Performance in Weak Areas in Southwest Power Pool's System Footprint*, CIGRE Session 48, 2020

Figueroa-Acevedo, A., Jahanbani-Ardakani, A., Nosair, H., Venkatraman, A., McCalley, J., Bloom, A., Osborn, D., Caspary, J., Okullo, J., Bakke, J., and Scribner, H., *Design and Valuation of High-Capacity HVDC Macrogrid Transmission for the Continental US*, IEEE Transactions on Power Systems, 2019

Bowman, D., McCann, R., Subramanian, D., Farantatos, E., Gaikwad, A., and Caspary, J., *SPP Grid Strength Study with High Inverter-Based Resource Penetration*, North American Power Symposium, 2019

Caspary, J., Bowman, D., Dial, K., Schoppe, R., Sharp, Z., Cates, C., Tanner, J., Ruiz, P. A, Li, X., and Tsuchida, T.B., *Application of Topology Optimization in Real-Time Opera*tions, CIGRE US National Committee 2019 Grid of the Future Symposium, 2019

McCalley, J., Caspary, J., Clack, C., Galli, W., Marquis, M., Osborn, D., Orths, A., Sharp, J., Silva, V., and Zeng, P., *Wide-Area Planning of Electric Infrastructure: Assessing Investment Options for Low-Carbon Futures*, IEEE Power and Energy Society Magazine, November/December 2017.

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Osborn, D., Henderson, M., Nickell, B., Lasher, W., Liebold, C., Adams, J., and Caspary, J., *Driving Forces Behind Wind,* IEEE Power and Energy Society Magazine, November/December 2011.

Caspary, J., Power Engineer Profile, *IEEE-USA Today's Engineer*, June 2011

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BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-100, SUB 179

In the Matter of: Duke Energy Progress, LLC and Duke Energy Carolinas, LLC 2022 Biennial Integrated Resource Plans and Carbon Plan	))))))	Verification of Jay Caspary

VERIFICATION

I, Jay Caspary, first being duly sworn, say that I am employed as the Vice President of Grid Strategies, LLC and have read the foregoing **Transmission Issues and Recommendations for Duke's Proposed Carbon Plan**, and know the contents thereof; and that the contents are true, accurate and correct to the best of my knowledge, information, and belief.

Jay Caspary
Signature

STATE OF Arkansas

COUNTY OF Cleburne

Signed and sworn to (or affirmed) before me this 14 day of July, 2022.

Vicki Morgan
Signature of Notary Public

Vicki Morgan
Printed or Typed Name of Notary Public

My Commission Expires: 08/22/2024

[Official Seal or Stamp]

Vicki Morgan
State of Arkansas
County of Cleburne
Commision #12401918
Expires 08/22/2024