<u>Comments of Rhizome Data, Inc., in Response to Sector specific methodology consultation: electricity distribution price control (ED3)</u>

Rhizome Data, Inc. (Rhizome) responds herein to the request for the Sector specific methodology consultation: electricity distribution price control (ED3) sought by Ofgem to the electricity distribution sector from 1 April 2028. Rhizome seeks to provide consultation on the ED3 sector specific consultation on the climate resilience stress testing methodological framework annex and the climate resilience metrics and indicators (CRMI) annex. Rhizome is in alignment with the stress testing methodologies and the initial framework on CRMI, and welcomes the opportunity to provide its expertise in climate and asset risk modelling in future consultations.

About Rhizome

Rhizome is a software-as-a-service ("SaaS") provider that has developed climate resilience planning tools for electrical distribution systems. Rhizome's proprietary platform, Aspen, can quantify the vulnerability of transmission and distribution assets from climate threats and help understand the economic and social benefits of infrastructure investments for optimised resilience planning. This technology has been deployed across diverse geographies in the UK, United States, Canada, and New Zealand.

Rhizome's two core software products for distribution network operators are:

- gridADAPT: a reliability and resilience planning application which can predict asset failures, forecast reliability metrics, and create asset plans and examine alternative interventions to improve resilience, using advanced modeling to build on a combination of downscaled weather and climate data and granular utility system and historical information.
- gridFIRM: a long-term wildfire risk planning tool that helps utilities examine asset-related wildfire risk across its system. Rhizome's platforms can project changes in fire-weather conditions decades into the future, simulateits impact on utility T&D infrastructure, and understand the potential for ignition across the system and which communities could be impacted by fire spread.

Rhizome Responses

1. Climate Resilience

Q91.What are your thoughts on our phased approach to stress testing which seeks to provide greater clarity on investment costs and rationale whilst building up capabilities to support the government in setting national resilience standards/goals?

Ofgem proposes a phased approach to climate resilience stress testing, where Phase A aims to build evidence on investments required to maintain resilience under future climate scenarios, and eventually set long-term resilience standards or goals. This phase focuses on identifying current network vulnerabilities to climate hazards and how they might evolve by 2050/2080, and concentrates on key hazards like windstorms, flooding, and high temperatures to produce results by late this year. Phase 2 and subsequent phases aim to expand capabilities, refine methods, and support adaptive planning in later price control decisions.

However, key gaps emerge when we benchmark this approach against current climate hazard modelling practices in other continents. Firstly, Phase A focuses on only three hazards (windstorms, flooding, high heat), leaving out a broad range of hazards such as wildfires, severe droughts, ice storms, to name a few. For instance, U.S. resilience frameworks list hurricanes, wildfires, extended heat waves, and winter storms among threats that severely strain the grid. While Phase B expands to more hazards, our experience demonstrates that a complete multi-hazard view from the start is more conducive to balancing initial approaches to hazard mitigation. Secondly, Phase A uses a single high-emission climate scenario (~ 4 degree C by 2080, RCP 8.5) as a basis for stress tests, which does not capture the range of plausible futures or nearer-term climate scenarios. Utilities in the United States typically examine multiple timeframes (mid-century 2030-2050s, late-century). Thirdly, Phase A methodology relies on historic fault data correlated with weather to produce fragility curves for assets. While this is a solid foundation, historical correlation can be noisy and not capture complex failure drivers. It should be recognized that advanced modeling approaches, such as machine learning and other AI techniques, can assist in parsing through large geospatial data sets and lead to better results. Furthermore, as climate change accelerates, historical data won't fully describe future risk. By contrast, leading U.S. utilities often partner with national labs or leading technology companies to employ AI-driven modelling to enhance fragility analysis and couple the model with various climate projection scenarios. Lastly, while Phase A rightly aims to identify what investment is "required to maintain current resilience", it falls short of a cost-benefit analysis as part of the investment rationale. Without a built-in-value framework, there is risk that Ofgem's Phase A could identify investments but with insufficient justifications in economic terms.

Overall, Rhizome supports the phased approach, and has identified several areas to strengthen Ofgem's proposal to stress testing. A data driven approach that builds asset level climate fault relationships using AI, along with a robust cost-benefit analysis that calculates the economic and social impact of grid failures and assigns a monetary "value of resilience" to proposed investments will be crucial additions. As DNOs look to build defensible investment cases that align with Ofgem's Phase B goals of informing adaptive pathways and robust business plans, leveraging advanced modelling capabilities can support resilience standards/goals.

Q92. What are your reflections on the stress testing methodological framework for the first phase (see Climate resilience stress testing methodological framework annex)? Does it align with your expectations of the responsibilities of a DNO and current capabilities? Can you foresee any support or changes that might improve its effectiveness? Do you have any views on priorities for future phases of work?

At the outset, The Phase A methodological framework emphasizes using existing data and expertise, such as mining 15 years of historical fault data and linking it to weather events to gauge vulnerability. Phase A methodology shields DSOs from investing in complex modelling they may struggle to implement quickly. While this approach aligns with the DNO's responsibilities of maintaining resilience, it also builds the case for prioritizing investments using proven machine learning capabilities to perform these analyses more thoroughly and effectively.

However, as noted previously, Phase A does not cover all climate hazards. Near term priorities for Phase B should include expanding to additional hazards like wildfire, severe droughts, ice storms, where relevant to some DNO regions. Next, the focus for Phase B would be to move from maintaining resilience to improving resilience (hardening, undergrounding) by performing cost-benefit analysis on investment options and integrating the stress test results into business planning. As Ofgem expects Phase B to link with ED3 business plan development, these results can directly inform DNO's Climate Resilience Strategies and investment plans. Lastly, future phases can adopt a more probabilistic approach in comparison to Phase A. As DNO capabilities grow, they can simulate a distribution of outcomes to better quantify uncertainties by investing in the aforementioned ML capabilities.

Phase A is designed around five steps: fault data, fragility curves, climate stress test, options and cost analysis, synthesis. Rhizome opines that this framework aligns well with industry best practice, and looks forward to the infusion of forward-looking data, novel modelling techniques such as machine learning, additional climate hazards, criticality, and interdependencies of assets will be considered in the future. As the methodological framework evolves, Rhizome suggests considering two additional components:

- Quantifying equity and vulnerability metrics beyond service quality, critical infrastructure.
- Reporting mechanisms for DNOs to track ongoing investments for their performance against subsequent weather events as additional steps a DNO needs to undertake to estimate investments needed to maintain or improve resilience levels and categorize resilience investments. These would allow for proper evaluation of investment effectiveness for continuous improvement, and can be enabled through deployment of software technology.

Q96. Do you agree with our approach to introduce Climate Resilience Metrics and Indicators (CRMI) at the start of ED3 and use the learnings to shape future decisions (either for future price controls or via a re-opener)?

Ofgem proposes to introduce a suite of Climate Resilience Metrics and Indicators (CRMI) at the start of ED3, to be used on a learning basis to inform future decisions, either via a re-opener or in the next price control. Overall, the proposition encourages DSOs to gather data on climate resilience performance, refine the metrics, and embed them as formal targets are set. There is broad alignment in the approach behind introducing CRMI gradually, as it balances climate resilience as a priority and aligns with Ofgem's historical approach of introducing new output measures as a trial.

This approach is synonymous with resilience quantification efforts in the United States. For instance, metrics like Expected Energy Not Served during extreme weather events, system recovery time, or hardening indices[1] started as research measures before becoming operational.

Q97. Do you have any views on the proposed CRMI Framework (Climate Resilience Metrics and Indicators (CRMI) Annex)? Do the CRMI Framework objectives and attributes reflect what's needed to measure climate resilience? Are there specific metrics or indicators we should consider?

Overall, the CRMI Framework objectives and attributes cover necessary ground. The annex's Chapter 4 outlines metrics such as Customer Interruptions (CI), Customer Minutes Lost (CML), ETR138 Compliance (resilience to flooding of the grid and primary substations), ETR 132 (Improving resilience of overhead networks under abnormal weather conditions using a risk-based methodology). Generally speaking, CI and CML are considered reliability metrics rather than resilience, and we support the acknowledgement of using candidate metrics and indicators from EPRI's Climate READi initiative in the future to use distribution reliability metrics to measure resilience.

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[1] Leddy, Laura, Donald Jenket, Dana-Marie Thomas, Sean Ericson, Jordan Cox, Nicholas Grue, and Eliza Hotchkiss. 2023. Measuring and Valuing Resilience: A Literature Review for the Power Sector. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5R00-87053. https://www.nrel.gov/docs/fy23osti/87053.pdf .

Rhizome is an Advisory Group member with EPRI's Climate READi initiative and has contributed significantly to the framework. In addition to the existing CRMIs, we suggest consideration for the following:

a. **Investment Effectiveness Metrics**: Ratio of avoided outage cost to capex/opex for each resilience program.
b. **Equity Weighted Climate Resilience Metrics**: Quantifying a proportion of climate resilience metrics in disadvantaged communities/vulnerable groups as defined and accepted by the regulation.

The CRMI framework is conceptually strong, and Rhizome welcomes the opportunity to collaborate and refine candidate indicators under different climate and investment scenarios to aid in the adoption of defined metrics in the future.

2. Reliability

Q94. Do you agree that strengthening the rationale for investments is required to allow for differences in local contexts between networks and that our proposed approach to improve guidance for climate resilience strategies and business plans is the best way to do this? Do you agree that we need a clear link between CRS and LINDPs and what are your thoughts on how we can do this?

Across geographies that have established climate resilience frameworks, a robust investment rationale, typically through cost-benefit analysis (CBA) is a core component. Regulatory authorities recognize that quantifying costs and benefits helps prioritize the most effective resilience measures and justify funding. Similar to Ofgem highlighting the development of CBA methods to account for the value of climate resilience, several U.S. states embed cost-benefit evaluations into their climate adaptation plans. For example, the State of Florida now ranks and prioritizes resilience projects partly based on their cost-effectiveness, explicitly requiring an analysis of costs versus benefits as part of its Statewide Flooding and Sea Level Rise Resilience Plan.[2] In Texas, electric utilities file multi-year "resiliency plans" with the PUC that include measures to prevent, withstand, and rapidly recover from extreme weather events.[3] The PUC evaluates each plan's expected resilience benefits versus costs and approves or modifies the plan accordingly.

Q95. Do you think we have struck the right balance between early action and building long term capability? Can you identify any other areas for early action on climate resilience?

The suggestions stated above represent an actionable starting point in addition to what Ofgem proposes. Building on the above examples, New York's utility regulator has established a formal mechanism to track the benefits of resilience investments over time (e.g. fewer outages, lower storm damages), baked into both regulatory requirements and the rate-setting process. This is a clear best practice model – ensuring

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[2] Florida Legislature. (2023). *Florida Statutes § 380.093: Resilient Florida Program.* https://www.flsenate.gov/Laws/Statutes/2023/380.093
[3] Texas Legislature. (2023, April 10). *Bill analysis of S.B. 1111, 88th Legislature Regular Session.* https://capitol.texas.gov/tlodocs/88R/analysis/html/SB01111I.htm

that resilience funding is not simply spent and forgotten, but is subject to ongoing evaluation and public accountability[4].

In all three instances,the trend is clear: public agencies must evaluate and report on how resilience investments are performing over time, moving beyond one-time project implementation to a cycle of continuous improvement. This approach not only provides accountability for funds spent but also helps each state adapt its resilience strategies in response to what the performance data show – a critical feedback loop as climate risks continue to evolve.

Q98. What is the impact of short interruptions on consumers and are certain regions or customer groups more affected? Do you expect the severity of these impacts to change over the ED3 period? If so, in what way and why?

Rhizome's analyses of distribution networks in the U.S. and Canada show that the increasing frequency of **"grey sky" days**: the milder but more frequent non-extreme weather events such as moderate winds, wet snow, heat-humidity combinations, or persistent rainfall can influence the incidence of short interruptions and other short-duration outage metrics. These events typically do not trigger extreme weather thresholds, yet they cause incremental stress on overhead lines, vegetation, and aging assets, leading to higher fault rates and momentary outages. Importantly, several regional climate models project that the frequency and seasonal pattern of these grey-sky conditions will shift over the coming decade, even in areas not traditionally associated with severe storms.

Therefore, we recommend that ED3's climate resilience assessments and demand forecasting should explicitly account for changes in the frequency and characteristics of grey-sky events, not only headline extreme events. This will help anticipate potential upward pressure on short-interruption metrics over the ED3 period and ensure that mitigation and asset management strategies are appropriately calibrated.

Q99. What drives short interruptions and how can these be reduced? Could innovation, data analytics, and enhanced network visibility play a role in reducing the frequency and impact of short interruptions? If so, how?

As mentioned above, short interruptions are often driven by minor asset faults, vegetation contact, protection operations, and "grey sky" days that increase transient faults. Rhizome's work shows these grey-sky events are becoming more common and can meaningfully raise short-interruption rates. Climate models suggest their frequency and seasonality may shift over the ED3 period, making them an important emerging driver of momentary outages.

Innovation and data analytics can play a significant role in reducing these interruptions. Rhizome has demonstrated that machine learning is particularly effective at identifying correlations between specific weather patterns, vegetation factors, and short-duration faults. These insights enable targeted interventions, and improved network visibility further helps detect and isolate faults quickly, reducing both the frequency and customer impact of short interruptions.

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[4]New York State Public Service Commission. (2024, December 19). *PSC approves utility climate change resilience plans* [Press release]. NYS News. https://apps.cio.ny.gov/apps/mediacontact/public/view.cfm?parm=BBECFE40-EAEA-9C5A-A4CFB170FDA430A4&backButton