

Re: Consultation on Draft Determination for the RP7 price control for NIE Networks

Proposal for Network Innovation Hub: Accelerating Net-Zero Electricity Transition at the Lowest Possible Cost to Northern Ireland's Consumers

To accelerate the transition to net-zero, we request that the Utility Regulator considers funding within NIE Networks' innovation allowances for RP7 to support the development of a Network Innovation Hub to

- **attract and cultivate a highly skilled power engineering workforce,**
- **address strategic challenges in Northern Ireland's energy networks and**
- **accelerate the transition to net-zero electricity at the lowest possible cost to Northern Ireland's consumers.**

Northern Ireland's ambitious objective, as outlined in the Energy Strategy and the Climate Change Act, of generating 80% of its electricity from renewable sources by 2030, brings massive opportunities and challenges. From Jan 2023 to Dec 2023, Northern Ireland generated 45.8% of its total electricity from renewable sources. Of this, wind power was the major contributor, accounting for 82.9%. However, according to the 2023 Northern Ireland Constraints Report, during this period, over 10% of wind energy was either unused or wasted due to curtailment and network constraints. This situation underscores a critical challenge in energy management, that is the need to closely align electricity generation with demand.

In addition, our distribution networks face challenges such as headroom capacity constraints and reversed power flow due to the rise in microgeneration, including rooftop solar, domestic battery storage, and vehicle-to-grid systems. The lack of control over when and where these systems connect can lead to the overloading of existing infrastructure, preventing the connection of additional generation capacity. For example, micro and small-scale solar PV capacity in the Northern Ireland System has grown from virtually zero in 2011 to over 150 MW across over 24,000 sites as of 2021. It is expected that the uncontrolled rooftop PV power feed-in could reach nearly 20% of Northern Ireland's system demand (approx. 800 MW) between 11am and 2pm during sunny days in the summer period. Similarly, the small-scale wind installation, with a capacity of 180 MW, could contribute to about 30% of the system's demand (approx. 500 MW) between 1am and 4am. This challenge is further exacerbated by the increasing adoption of heat pumps and electric vehicles (EVs). More specifically, the adoption of EVs (with NIE estimating 300,000 EVs in Northern Ireland by 2030) adds another layer of unpredictability. As EVs charge, they can introduce significant loads on the system, and the timing of these charging sessions can vary depending on user behaviours, public charging infrastructure, and other factors. On top of that, NIE aims to facilitate 120,000 heat pump installations by 2030. Heat pumps have variable load profiles that depend on their efficiency across temperature ranges, posing additional new challenges for network management.

The interlinking of the transport, heating, and electricity sectors calls for the development of an advanced, integrated energy system, coupled with a comprehensive whole-system strategy, to effectively tackle the challenges inherent in the transition to net-zero energy. Ofgem, the regulator for the electricity and natural gas markets in Great Britain, has launched a five-year £450 million Strategic Innovation Fund (2021-2026), to help shape the future of Great Britain's energy networks and accelerate the net zero transition. This Fund involves a collaborative approach encouraging industry

partnerships and academic institutions, effectively leveraging the industry's practical experience and capabilities alongside the research and analytical expertise of academic institutions.

It is great to see that the Utility Regulator has set new strategic direction for 2024-2029 in their Corporate Strategy, aiming to enable long-term, value for money investment that benefits consumers and drives innovation. The proposal of innovative projects by NIE for the next price control period (2025-2031) is also encouraging.

To accelerate the transition to net-zero electricity at the lowest possible cost to Northern Ireland's consumers, we have a strong interest in working with NIE to address some of the strategic network issues to achieve this objective. This can't be done without research and innovation.

The next price control period (2025-2031) is critical. Leveraging our established expertise and innovative research, we have a strong interest in partnering with NIE to establish a '**Network Innovation Hub**'. This Hub aims to **(1) attract and cultivate a highly skilled power engineering workforce, (2) address strategic challenges in Northern Ireland's energy networks and (3) accelerate the transition to net-zero electricity at the lowest possible cost to Northern Ireland's consumers.** An estimated investment of £270k per year over the six-year period (2025-2031) is essential to support a strategic research team, including three local and three international PhD students, as well as four three-year postdoctoral research fellows. Our expertise in power and energy system simulation, modelling, optimization, artificial intelligence (AI) and data analysis will be central to this research collaboration. The Hub will focus on

- Optimizing Network Headroom Capacity at the Low Voltage Level.
- Advanced Low Voltage Network Modelling, Monitoring, and Forecasting.
- Evaluating the Impact of EV, Heat pumps and Distributed Generation on Low Voltage Networks and their Potential in Offering Flexible Grid Services.
- Enhancing Smart Energy Systems through Smart Meter Data Analytics and AI.
- Creating a Flexible, Smart, and Digitised Energy System that Integrates Renewables Across Heat, Power, and Transport.
- Development of Evidence-Based Regulatory Policy and Recommendations.

The proposed Network Innovation Hub is strategically designed to complement NIE Networks' existing baseline ex-ante innovation projects and support other individual projects that may necessitate external consultants for efficient and timely execution. Different from these projects, the Hub is dedicated to addressing long-term strategic challenges within the sector. It aligns with the 3 to 4-year duration typical of extensive research projects involving PhD and postdoctoral research fellows. This initiative enables NIE to leverage the extensive expertise and resources available within the university, such as the newly established NIE Networks Sustainable Energy Lab. By attracting a diverse pool of both local and global talent, the Hub positions itself to effectively tackle some of the most pressing strategic research challenges within Northern Ireland's electricity networks.

Northern Ireland's distinct position as an islanded power system offers an invaluable opportunity to lead in the development of pioneering and more flexible and smarter energy systems. The Hub would leverage real-world data not only to enhance consumer value but also to help position Northern Ireland as a world-class research base, creating jobs and wealth for the local community. This Hub will provide NIE networks, Utility Regulator and DfE with evidence-based analysis and reports to aid in

strategic planning and policymaking and strengthen our position as an international leader in energy research. This aligns with the Utility Regulator's Corporate Strategy of 'building a strong data focused research and evidence base that informs our policy outcomes' and DfE's Energy Strategy of 'secure, affordable, and clean energy for current and future generations'. The Hub also aligns with QUB's Strategy 2030, which aims to 'achieve a better and more sustainable future for all', and to 'transition to zero-carbon society', as well as NIE Networks' ambition to 'deliver a sustainable energy system for all'.

Added Value to Consumers and Wider Community

As outline above, the three major benefits that the Innovation Hub will deliver are:

- attract and cultivate a highly skilled power engineering workforce,
- address strategic challenges in Northern Ireland's energy networks and
- accelerate the transition to net-zero electricity at the lowest possible cost to Northern Ireland's consumers.

The research and initiatives proposed by the Innovation Hub represent an investment in our future. By attracting and cultivating a highly skilled power engineering workforce, we are laying the groundwork for sustained innovation and expertise in our region. Addressing strategic challenges in Northern Ireland's energy networks goes beyond immediate fixes. It's about building a resilient and efficient system that can adapt to future demands and unexpected challenges. Most importantly, by accelerating the transition to net-zero electricity at the lowest possible cost to consumers, we're ensuring that the shift to sustainable energy will be beneficial for consumers and the wider society in the long term. Therefore, it seems not only appropriate but also visionary to fund this hub through NIE Networks' RP7 price control, as an investment in a more resilient, sustainable, and prosperous future for us all.

In addition, the knowledge gained will be used to enrich the undergraduate curriculum and attract more students, particularly women who remain underrepresented, to electrical power engineering courses. Utilizing the initial investment, it creates a platform to attract additional funding from sources such as US-Ireland, UKRI/EPSC, and the EU.

In summary, this proposed academic-industry collaboration presents an opportunity to invest in a future-proof initiative that not only addresses immediate research needs but also builds a foundation for long-term, sustainable growth in the field of electrical engineering. QUB is committed to collaborating, driving innovation, and nurturing the next generation of electrical power engineers, who are essential for achieving Northern Ireland's net-zero energy future.

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