Supergen
Energy Networks

Response to OFGEM’s RIIO-2 sector specific methodology consultation on question CSQ48 “Do you think there is a continued need for the [Network Innovation Allowance] NIA within RIIO-2?“ [1].

MARCH 2019

MYRIAM NEAIMEH, Newcastle University

ROBIN PREECE, University of Manchester

EMAIL ADDRESS FOR CORRESPONDENCE:

myriam.neaimeh@newcastle.ac.uk.

[1] https://www.ofgem.gov.uk/system/files/docs/2019/01/riio-2_sector_methodology_0.pdf

About Supergen Energy Networks Hub

The Supergen Energy Networks Hub brings together the vibrant and diverse energy networks community to gain a deeper understanding of the interactions and inter-dependencies of energy networks. Led by Hub Director, Professor Phil Taylor from Newcastle University, the Hub integrates a wide range of industrial and academic partners with other energy network stakeholders.

The Hub's research is carried out by a consortium of Universities:

- Newcastle
- Manchester
- Cardiff
- Bath
- Leeds

The research addresses the challenges of technology, policy, data, markets and risk for energy networks.

For any queries or to find out more about the Supergen Energy Networks Hub, please contact our team by email at **supergenEN@newcastle.ac.uk**

ABOUT THE AUTHORS

Myriam Neaimeh is a senior research associate at the School of Engineering at Newcastle University. Myriam is principal investigator on a £10.6m project investigating vehicle-to-grid technologies.

Robin Preece is senior lecturer in future power systems at the School of Electrical and Electronic Engineering at University of Manchester. Robin is Associate Director for Supergen.

The authors are providing this submission on behalf of Supergen but the views represent those of the authors alone.

Introduction

NIA is an annual allowance received by network licensees as part of their price control settlement to fund small-scale innovative projects. NIA funding can cover research, development and demonstration projects and can cover technical, operational and commercial innovations. Technical aspects include network design, operation and maintenance. For example, the focus of innovation project could be R&D and/or demonstration of new network equipment. The projects should have the potential to deliver benefits to the network licensees and their customers (i.e. financial, supply quality, environmental, safety)[2].

This response document examining the continued need for NIA within RIIO-2 is prepared by Supergen Energy Networks Hub academic partners. Supergen academic partners have an extensive participation in Low Carbon Network Fund and NIA funded projects. This response is based on their experiences from working alongside network companies to formulate and deliver innovation projects, including the implementation of new technologies and practices.

The continuous need for NIA and some of its benefits are listed below. We elaborate on these points through a case-study of innovation funding focusing on electric vehicles (EVs).

Network Innovation Allowance funding:

1. Enables valuable research that would otherwise not happen in the face of uncertainty.
2. De-risks disruptive solutions in a conservative sector.
3. Creates research across disconnected sectors resulting in larger projects and leveraged funding.
4. Helps retain skills and knowledge in the energy networks' sector.
5. Has shown itself to be successful several times.

[2] https://www.ofgem.gov.uk/system/files/docs/2017/07/final_elec_nia_gov_doc_v3_0.pdf

1. In the face of uncertainty, NIA funding enables valuable research that would otherwise not happen

NIA funding can allow research into areas where uncertainty would otherwise lead to business to pause and wait for more certainty on direction. NIA could also help put companies on the front foot with respect to emerging issues.

1.1. EVs are still at an early stage in their evolution and a range of pathways are possible. Consequently, there are still uncertainties regarding EVs and associated charging infrastructure that could go beyond the end of the current price control (e.g. the next electricity distribution price control (RIIO-ED2) starts in April 2023).

One of the EV uncertainties relates to mass uptake projections. The UK government has set a target for all new cars sales to be zero emission by 2040 but this has not yet been followed by a mandate to legally require the sales of zero emission vehicles. Government is leaving it to market forces to help achieve EV uptake targets which creates more uncertainty compared to a legally binding mandate.

Another uncertainty relates to the type and locations of EV charging infrastructure, and consequently charging behaviour of EV users. With the continuous growth of the EV market new charging technology is being developed, namely bidirectional chargers; wireless chargers; and ultra-fast chargers. With increase in battery size (e.g. 24 kWh to 40 kWh) and vehicle on-board chargers (e.g.3.3 kW to 6.6 kW), current 3.7 kW chargers could be replaced by 7kW chargers at residential locations. Most of the innovation projects carried out have focused on unidirectional 3.7kW chargers at residential locations. This creates uncertainty whether the charging behaviour and findings from these previous project would still apply (e.g. diversity maximum demand' (ADMD) assumptions). Moreover, bi-directional chargers allowing reverse power flow might start to become available on the market following recent government investment[3]. V2G technology is still in early development and it might take DNOs more than 5 years to understand the impact of reverse power flow from EV charging infrastructure. In

[3] https://www.gov.uk/government/news/30-million-investment-in-revolutionary-v2g-technologies

addition, wireless chargers are also in a very early development stage and could become available with aspects such as impact on power quality need to be understood before potential mass deployment. Electric Road System for Dynamic Charging of Electric Vehicles[4] (NGSO, Cardiff University, £213k, NIA) is investigating wireless charging even before it is widely available and adopted. Ultra-fast chargers (150-350kW), replacing or complementing existing 50kW chargers, could be installed at urban filling stations and along travel corridors and their impact and mitigation options would also need to be understood.

Therefore, continuous research is required to robustly stratify various representative charging profiles to take into account different types of charging infrastructure (e.g. ultra-fast; bidirectional) at different locations (e.g. urban fillings stations; workplace; urban/rural networks); and an uptake of EVs by various customer groups enabled by the mass availability of EVs. With the continuous growth of the EV market and new charging technologies, network operators need to be continuously adapting to these fast-paced changes to ensure cost-effective security, quality and reliability of supply. It is likely that NIA funding, beyond RIIO-ED1, is key to help DNOs in their adaptation in the face of uncertainties related to electric mobility.

1.2. Additional uncertainty is created when EVs are bundled with other new low carbon technologies such as electric heat pumps. Facing these uncertain pathways of LCT uptake and use, further work is required to characterise the variety of new demand as uptake increase. Substation load profiles, assumptions on ADMD and network planning methods need to be continuously evolving.

1.3. New business models and customers' propositions (e.g. paying for a mobility and heat services as opposed to paying for kWhs) could emerge following possible changes in regulations. These changes include plans for legislation of smart charging, half-hourly settlements, reform of transmission and distribution network charging, and development of a market for grid services at distribution level. For example, procurement of customer flexibility need to be tested to demonstrate to network

[4] http://www.cardiff.ac.uk/people/view/364348-cipcigan-liana

operators that it could replace network solutions (i.e traditional reinforcement, network flexibly). Residential customer flexibility is unlikely to progress and be demonstrated without higher uptake of LCTs and it requires further research and innovation work to design market offering which is reliable and location-specific.

1.4. Network operators recognise that a small proportion of R&D technologies make it through to being widely deployed on networks. It is important to note that these R&D technologies address emerging issues or an anticipated need, not one that already exists. These R&D projects prepare DNOs in the case that the need do arise and ensure that they are not under prepared (e.g. designing market-led solutions for smart charging).

2. NIA funding de-risks disruptive technologies in a conservative sector

The energy networks' sector is risk-averse and would not easily adopt novel solutions. In addition, NIA funding provides a route to fund in areas and invest in skills not found within energy networks' companies.

2.1. Advanced EV charging control strategies, which could delay charging, control charging rate and enable bi-directional power flows, require advanced sensing, communication and control infrastructure that is not typical of a distribution network. Additional research and real world demonstrators are required to provide evidence on the scalability, reliability, and responsiveness of these methods to support network operation and maintain acceptable level of reliability and quality of supply at an economic cost. Evidence on the suitability of these methods is necessary if DNOs are to invest in the required infrastructure and adopt them as business as usual to transition from conventional passive network reinforcement towards active network management.

2.2. Some on-going NIA projects are investigating charging technologies with low TRL and uncertain adoption rate to prepare DNOs in case these technologies become widely adopted. NPg's Vehicle to Grid (V2G) - the network impact of grid-integrated vehicles[5] (NPg, Newcastle University, etc., £250k, NIA) and TransPower[6] (UKPN,Newcastle

[5] http://www.smarternetworks.org/project/nia_npg_014
[6] http://www.smarternetworks.org/project/nia_ukpn0033

University, University of Leeds,etc., £1.345m, NIA) are investigating if V2G technology could help mitigate the impact of EVs on distribution networks. While NPg's project is testing the new technology in a small trial; UKPN's project is analysing the impact from several real world trials including different types of vehicles (cars, vans, buses).

3. NIA creates research across disconnected sectors resulting in larger projects and leveraged funding

NIA may provide funding for research across sectors that may not otherwise be well connected/joined up. NIA also allows large leveraging of funding by creating new relationships.

3.1. Data acquisition and processing is expected to significantly change. Larger datasets could become available from smart meters; EV charging infrastructure; LV networks; etc. Methods to analyse the data and extract information is also experiencing significant change (e.g. machine learning; cloud computing). Network operators would also need to embrace these unprecedented changes and adapt how they currently operate. NIA funding could facilitate development and trial of advanced data collection, storage, and processing. NIA funding could encourage DNOs to get involved in an unfamiliar and fast-evolving field of data science. Innovation funding could also encourage DNOs to develop and put new processes in place to produce and share data, which would be useful across different sectors.

3.2. NIA funding can lead to significantly larger projects compared to the initial NIA funding. For example, NPg's V2G project facilitated the establishment of a new relationship between network companies and car companies. This led to continuous discussions and planning and application for a large scale demonstrator of V2G that was funded by Innovate UK (The Innovate UK project cost is 40 times larger than the NIA V2G project). The follow-up large scale V2G project included the participation of additional network companies and energy suppliers[7].

[7] https://utilityweek.co.uk/network-firms-join-nissan-drive-world-first-9-8m-v2g-trial/

Other examples of EV NIA projects leading to larger innovation projects are the NIA Recharge the Future (UKPN, £240k), Black Cab Green[8] (UKPN, £175k) and CarConnect (WPD, £5,8m) leading to NIC Optimise Prime[9] (UKPN, £35m).

4. NIA can help retain skills and knowledge in the energy networks sector.

NIA is a flexible funding mechanism that could provide continuity of knowledge after projects finish and it could retain high quality people in energy networks' research. It supports capacity building and an innovation mentality within the network companies and partner organisations.

4.1. Distribution network models and assessment methods were developed as part of Customer Led Network Revolution[10] (NPg, Newcastle University, etc. ; £52.6m; LCNF Tier2) to examine impact of EV charging. These models and methods would be used again in NPg's NIA V2G project. Similarly, it was possible to retain staff who were employed on CLNR to work on NIA V2G. When a specific area was identified to require additional research (e.g. impact of bidirectional power flow from electric cars), NIA provided flexibility to continue and build on existing research topics and research teams, whether with the academic partner or with the network company.

5. NIA funding has shown to be successful several times

The funding resulted in numerous success stories with respect to value generated and adoption which should not be ignored.

5.1. Previous and on-going EV innovation projects are producing results that are agnostic to EV uptake numbers and charging infrastructure types, despite uncertainties and an evolving environment.

For example, research on CLNR examined impact of EVs on different network types (e.g. urban and rural) and found that distribution networks are not a homogenous group, which raised the importance of bespoke studies. These findings would apply irrespective of charging technology used. Moreover, CLNR research found that spreading charging

[8] http://www.smarternetworks.org/project/nia_ukpn_0026
[9] https://www.ofgem.gov.uk/publications-and-updates/electricity-nic-2018-submission-ukpn-optimise-prime
[10] http://www.smarternetworks.org/project/cet2001

demand in space (e.g. home and work), and consequently in time would alleviate impacts of EV charging on distribution networks and could reduce the need for reinforcement. In addition, CLNR collected LV network data to develop and validate case-study real world network models, which could be used in the future to examine changes in EV charging technology and behaviour[11]. Similarly, My Electric Avenue[12] (SSEN, University of Manchester, etc.; £9.1m; LCNF Tier 2) developed charging profiles using data collected from 3.7 kW residential chargers; however the project developed distribution network models that could be used in subsequent studies. CarConnect[13] (WPD, £5.8m, NIA) is building a monitoring algorithm that could detect EV charging by monitoring LV substation. Data collected from future types of charging infrastructure could be used to refine the CarConnect algorithm.

Some NIA projects are examining the potential to procure flexibility from EVs to support the operation of LV networks and reduce the need for reinforcement. For example, Smart Charging Architecture Roadmap(SmartCAR)[14] (UKPN, £430k, NIA) have already produced designs to test market-led smart charging solutions at distribution level. Shift[15] (UKPN, £1.3m,NIA) is building on the results of smartCAR by demonstrating these designs. While technology change might challenge some of the assumptions used, developing and demonstrating designs provide valuable insights for DNOs to deal with upcoming flexibility markets at distribution levels. While SmartCAR and Shift are carrying out detailed analysis for EVs, Customer led distribution system[16] (NPg, Newcastle and Bath Universities; £1.9m, NIA) is taking a holistic view and investigating market designs at distribution network level for DER energy products including EVs.

Conclusion

NIA funding, consisting of almost half of network innovation funds, is dedicated to investigate and demonstrate low TRL solutions that might not lead to financial benefits in the short term but could still generate new knowledge. NIA helps de-risk disruptive

[11] A probabilistic approach to combining smart meter and electric vehicle charging data to investigate distribution network impacts https://www.sciencedirect.com/science/article/pii/S0306261915001944
[12] http://www.smarternetworks.org/project/sset205
[13] http://www.smarternetworks.org/project/nia_wpd_013
[14] http://www.smarternetworks.org/project/nia_ukpn0034/documents
[15] http://www.smarternetworks.org/project/nia_ukpn0045
[16] http://www.smarternetworks.org/project/nia_npg_019

solutions in a conservative sector. NIA projects might result in solutions that increase the toolkit of options available to DNOs to plan, operate and maintain the energy networks in the face of uncertainty. Moreover, NIA strengthen the opportunity to attract and retain individuals to address challenges and develop state of the art solutions that could support energy networks in the transition to low carbon economy. Compared to a competition process, NIA provides an agile route to allow network operators to investigate network license specific issue, tackle arising issues, build on existing projects, and test new collaboration opportunities and relationships across different sectors.

Shortcomings in the governance and delivery of NIA projects have been identified[17]. Some issues include using NIA to fund BAU operational and maintenance projects. In addition, NIA does need better mechanisms for extracting and sharing knowledge.

NIA shortcomings must not be interpreted as synonymous to a failure of innovation allowance funding, but could be used to improve selection and assessment criteria of future projects. Several benefits of NIA funding have been identified in this response to support the case for improving NIA governance without removing the funding.

---

[17] Innovation in regulated electricity distribution networks: A review of the effectiveness of Great Britain's Low Carbon Networks Fund https://www.sciencedirect.com/science/article/pii/S0301421518301101