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3rd February 2022

Call for Evidence – National Infrastructure Commission - Second National Infrastructure Assessment: Baseline Report

Introduction

Bodvoc Ltd welcomes the opportunity to respond to the consultation by the National Infrastructure Commission. As the contents of the Baseline Report are overwhelmingly concerned with Carbon Net Zero, this submission focuses on the energy. However, as the national infrastructure sectors are intrinsically linked it will also briefly address the impact that failure in one sector can have across other sectors. In reviewing the Baseline Report the apparent lack of systems thinking is a serious concern, without which piecemeal policy interventions will result in conflicting delivery priorities and the prospect of a reduction in infrastructure and economic resilience. **Bodvoc Ltd recommends that a systems thinking approach is adopted for development of the Second National Infrastructure Assessment.**

Energy Security of Supply versus Supply Security

The Government and Ofgem are obliged under section 172 of the Energy Act 2004, as amended by section 80 of the Energy Act 2011, to report annually to Parliament on the availability of electricity and gas for meeting the reasonable demands of consumers in Great Britain. This is referred to as "Security of Supply". The latest report[1] published in December 2021 sets out the currently projected capability of the electricity industry to meet a reliability standard for security of electricity supply. This standard is expressed as a Loss of Load Expectation (LOLE) with a target of less than three hours per year. It is important to note that this measure is about the capability to meet demand and is not a measure of the expected number of hours in which customers may be disconnected, i.e., without power.

From a national infrastructure perspective an important but unreported measure is "Supply security", i.e., the ability of the infrastructure to deliver the available electricity to consumers. This is in effect a measure of the operational security and resilience of the electricity supply system, considering availability of major sources of supply and the system's ability to respond to and recover from unplanned event. An example of such an event was the power disruption event of

[1] Statutory Security of Supply Report 2021 (HC 898). 14 December 2021. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040468/statutory-security-of-supply-report-2021.pdf

9th August 2019. The 2019 Statutory Report[2] refers to this as a network operation issue, rather than the capacity of the energy system at the time. Ofgem's report[3] records that the combined loss of two large generators, as well as the smaller loss of generation at a local level, together triggered the subsequent disconnection, loss of power and disruption to more than one million consumers. A brief outage lead to hours of disruption across a large part of England.

As a technologically advanced nation, it is essential that the United Kingdom has a reliable and resilient electricity supply network. Our daily lives and national prosperity are heavily dependent on digital and digitally enabled systems, the failure of which could have considerable safety and security consequences. The proposed national decarbonisation, referred to as Carbon Net Zero (CNZ), is envisaged to require a massive modal shift in the use of energy, requiring use of electricity to replace hydrocarbon-based fuels used in transport, heating, etc. This will dramatically increase the demand for electricity and further increase the criticality of electricity supply security. This modal shift will reduce the diversity of primary energy sources used in electricity generation placing greater reliance on use of intermittent renewables and use of interconnectors. It could significantly increase the risk of supply interruptions in the event of lack of capacity and/or supply interruptions.

For organisations where unbroken continuity of electricity supply is business or safety critical, current practice is to install uninterruptible power supplies (UPS) and onsite back-up diesel generators. Without such business continuity measures significant consequences can arise from even short supply interruptions. For example:

- loss of availability of computers, communications and networking systems;
- corruption of file systems and records;
- potential failure of always on equipment when the power is restored;
- lockout of systems due to loss of power-on or operator console passwords;
- failure or impaired operation of security systems.

In the rhetoric about decarbonisation and the Government's CNZ policy we should not lose sight of the need to maintain supply security. Pursuit of the policy goals must not undermine the reliability of electricity supply as the economic and social costs of eroding current availability will be enormous.

[2] Statutory Security of Supply Report 2019 (HC 16). 20 December 2019. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/854522/statutory-security-of-supply-report-2019.pdf

[3] Companies pay £10.5 million over 9 August power cut. Ofgem. 3 January 2020. Available: https://www.ofgem.gov.uk/publications/companies-pay-ps105-million-over-9-august-power-cut

Managing Transition – Transforming the Energy System

The UK electricity system was designed and implemented to achieve efficient 'top down' supply of electricity from major power stations connected to the transmission system through distribution system to end users. Increased embedding of generation and storage within the distribution network will complicate management of both transmission and distribution networks creating a complex system with emergent properties. The situation is potential exacerbated by the shift to renewables with weather conditions affecting the predictability of supply capacity.

The proposed introduction of Demand Side Response (DSR), as envisaged in PAS 1878 & PAS 1879, is predicated on reliable and resilient communications between DSR Service Providers (DSRSPs) and the consumers' managed appliances. Delivery of DSR assumes high availability of Internet services. Recently, intermittent and occasionally prolonged interruptions to broadband connectivity have affected several major UK Internet Service Providers (ISPs). Some interruptions relate to network faults, but others may have been caused by malicious cyber incidents. In addition to the potential communications vulnerabilities, any intermittent loss of power will disrupt network connectivity. Restoration of DSR services will be subject to varying delays whilst end user equipment reacquires network connectivity and appliances re-establish connectivity to the DSRSPs. If effective DSR becomes essential for maintaining security of supply, then any supply interruptions may undermine the industry's ability to manage demand.

In the policies related to CNZ there is an assumption that the market will shape the structure, supply chain and "system architecture" for electricity supply. The rapid growth of renewables generation reflects such market behaviour which was incentivised by both the UK's regulatory regime and the financial incentives offered through green levies. A massive transformation is required to achieve a future electricity supply system that supports government CNZ objectives regarding electrification of transport, decarbonisation of heating, etc. This is not something that can be left to the market. There is a pressing need for a Systems Architect function proposed in the Institution of Engineering and Technology (IET) report[4] on transforming the electricity system. Adoption of the IET's recommendation regarding the systems architect function should be addressed by the Commission in its Infrastructure Assessment.

Whilst much has been made about the need for new generation and storage capacity. Relatively little has been published on the need to upgrade the "last mile" of electricity supply network, i.e., local distribution sub-stations and their connectivity to premises. This local distribution infrastructure is now expected to take the additional loads from a future mix of heat pumps, electric heating and cooking and the charging of electric vehicles. Except in new housing estates, it is unlikely to have been designed to accommodate the increased aggregated load.

[4] Transforming the Electricity System: How other sectors have met the challenge of whole-system integration. IET. 2 October 2014. Available: https://www.theiet.org/media/9384/transforming-the-electricity-system-full-report.pdf

Western Power Distribution has noted in their latest business plan[5] that: *"The biggest challenges when providing power for heat pumps will be linked to domestic properties. We anticipate that this will lead to the need for service upgrades for around a third of all heat pump installations. [3.61 on p71]"*. It is notable that this statement only refers to part of the additional load that consumers will impose on the network. Press coverage[6] of this statement suggests that the cost of such upgrades could effectively double the cost of heat pump installation. This has serious implications for both network investment and consumer affordability.

Managing Transition - Implications for Consumers

The UK electricity system is a complex socio-techno-economic system, where decisions taken, and behaviours of individual consumers (domestic and SMEs) have a significant impact on system performance. Whilst the loss of supply is relatively rare, the effect on individuals and businesses can be dramatic. The impact of Storm Desmond on Lancaster in 2015 is well documented[7]. Recently Storm Arwen[8] led to susytained loss of power to consumers in the North of the UK. Because of storm damage some consumers were without power for more than a week[9]. In both cases, despite a loss of power many premises still had access to gas for cooking and the landline phone network was still available. In future, a greater dependence on electricity for heating and cooking will increase the impact on premises when power is lost. As was noted in both these storms, disruption to the mobile telephone network occurred as cellular base stations lost power or exhausted any local back-up supply. Currently this is not an issue for premises with a landline as traditional wired handsets are powered from the telephone exchange. In future, following the move to an all-fibre network, loss of premises power may result in loss of all communications services. This is a potentially serious issue for the vulnerable and those needing emergency assistance. Systems thinking is required to address issues like this that will arise from decarbonisation.

There has been much media coverage of the Government's proposal that property owners should install heat pumps to replace gas boilers. As noted above, this could require an upgrade to the local distribution network and the connection to the premises. There is also an assumption that heat pump technology is appropriate. For many premises there may be physical constraints such as lack of space, or planning restrictions associated with listed building and

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[5] Our Business Plan 2023 – 2028 Final Submission. Western Power Distribution. December 2021. Available: https://yourpowerfuture.westernpower.co.uk/riioed2-business-plan

[6] Thousands of homes will need electricity boost for heat pumps to work. Daily Telegraph. 31 January 2022. Available: https://www.telegraph.co.uk/environment/2022/01/31/thousands-homes-will-need-electricity-boost-heat-pumps-work/

[7] Living without electricity – One city's experience of coping with loss of power. Royal Academy of Engineering. May 2016. Available: https://www.raeng.org.uk/publications/reports/living-without-electricity

[8] Storm Arwen named. Met Office. 25 November 2021. Available: https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2021/storm-arwen-named

[9] 'We were living like animals': What life was like for those hit by Storm Arwen power cuts for more than a week. iNews. 6 January 2022. Available: https://inews.co.uk/news/long-reads/storm-arwen-power-cuts-living-like-animals-uk-weather-1383590

conservation areas. In dense housing areas such as terraced streets and newer housing estates the noise level could be significant once the number of heat pump installations increases. Air source heat pumps include a fan, so noise levels will inevitably rise over time as components wear and the housing becomes worn or distorted from routine maintenance. Use of acoustic enclosures may reduce this noise but represent an additional cost that would be borne by the property owner. In urban areas where large buildings employ ground source heat pumps the impact on the sub-surface need to be carefully considered.

Conclusion

The National Infrastructure Commission should adopt a systems thinking approach to its second national infrastructure assessment. The national infrastructure is a complex system-of-systems with interdependencies that affect the integrity of individual sectors and the entire UK infrastructure. Of the sectors identified in the Commission's Baseline Report, energy and communications are both critical to all other sectors, but without electricity most other sectors are generally unable to operate. This will certainly be the case if CNZ is achieved. In addition to security of supply, supply security must be addressed, it is of little benefit to have the capacity available if the electricity cannot be delivered to the consumers and services that need it.

About Bodvoc Ltd

Bodvoc Ltd is a specialist consultancy that advises on security and information management topics regarding the built environment, with a particular emphasis on national infrastructure. Focussing principally on the energy, communications, transport, and defence sectors, Bodvoc Ltd contributes to policy, guidance, research and academic knowledge in these sectors.