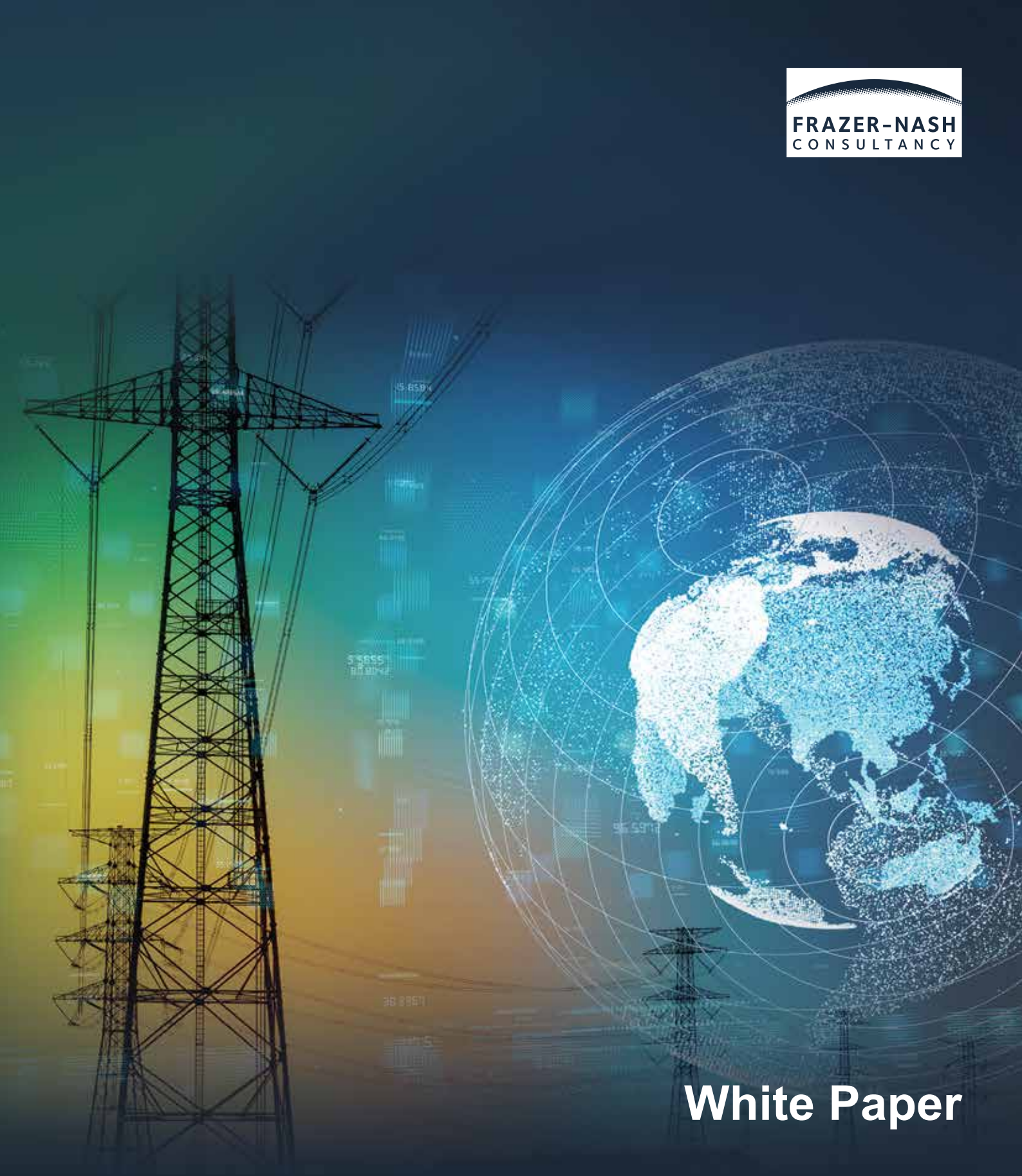

FRAZER-NASH CONSULTANCY

White Paper

Black starts – the benefits of sharing the load

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SYSTEMS AND ENGINEERING TECHNOLOGY

Black starts – the benefits of sharing the load

Frazer-Nash Power, Transmission and Distribution Business Manager, Anuj Nayyar, discusses how sharing the load could help restore power in a 'black start' scenario.

The cinema darkens as the latest disaster movie starts. It's a dramatic story, in which a cyber and physical attack on the UK's power grid somehow causes a cascade of power station failures, leaving Britain in the dark. In this fictional world, our hero or heroine defeats the villains, solves the cyber puzzle, and flicks a single switch that returns light and power across the whole country instantaneously. In real life, of course, the concept of 'black start' – restoring power in the unlikely event that the whole grid goes down – is a much more complex issue, and one which transmission system operator, National Grid, has extensive plans in place to deal with.

But power generation is changing. The number of large, conventional fossil fuel stations is reducing, while provision by smaller renewable and thermal generation resources is increasing. Future energy predictions suggest that, in the long term, homes are likely to be heated by low-carbon electric heating pumps, and that appliances currently fuelled by natural gas may be using hydrogen. This, combined with the growth of electrically-powered vehicles and machinery, will mean we will be even more reliant on the UK's electrical infrastructure.

National Grid's most recent Black Start Strategy (April 2018) and Restoration Roadmap (May 2018) recognised this, and proposed the investigation of new technologies and approaches that can be used to support the restoration of power during a black start event.

Currently, if a black start event took place, customers would initially be reconnected area by area by their Distribution Network Operator (DNO). Each DNO, as a black start provider, would have to carefully match its output to the amount of demand in its area: the individual groups of providers and local networks would initially operate as 'power islands', not connected to each other or the wider network. But with the ongoing transition of Distribution Network Operators into Distribution Systems Operators (DSOs), who will be required to take on additional network intervention functions, this may offer a catalyst for changes to be made to these processes. New solutions, which National Grid has been considering for potential introduction into its restoration plans, include the development of combined services, so that a black start provider is no longer expected to meet all requirements by itself but can combine its efforts with others. Alongside this, it is considering the removal of existing barriers to entry, to enable a wider range of technologies to take part in black start provision, focusing on interconnectors, distributed energy resources (DER), wind technologies and energy storage/batteries.

But adding these newer types of energy provider into the mix does, of course, bring its own challenges. Currently, fossil-fuelled power stations – particularly strategically-placed gas-fired ones – have played an integral part in the black start process, because they remained in a 'warm' state of readiness to re-energise the grid. Newer methods of generation, though, may not be able to offer this stable generation

against an open grid. Solar power, for example, would struggle to deliver the circa 30MW of electricity required to ramp up from a black start if a blackout occurred at night. Wind turbines, too, may have difficulty repositioning their blades to harvest additional power from the wind in a black start situation. However, they may be able to play a role in restoration in collaboration with other providers, as outlined above.

Distributed energy resource generation, embedded within the DNO networks, certainly has the potential to 'share the load' and to participate in the restoration of services. National Grid has recently been awarded £10.27 million from the 2018 Electricity Network Innovation Competition, to research 'Black start from distributed energy resources' – the funding will be used to develop and demonstrate the technical and organisational arrangements that would be necessary to procure black start services from DERs.

they can deliver safe and reliable services, but that they are embracing innovation. This could include the development and use of novel disruptive technologies within the electrical network to deliver black start solutions.

The Energy Networks Association's Open Networks, Future Worlds consultation (July 2018), which looks at a number of future market models, sees an increased role for DNOs – as DSOs – in some of its envisioned future worlds. DNOs/DSOs would have a more in-depth knowledge of the black start providers in their area, and an understanding of who could work in collaboration with auxiliary suppliers to spread the demand load. They may also have an increased awareness of resource availability, and of the Local Joint Restoration Plan for their region. National Grid would, of course, retain its coordination role to ensure a cohesive response across the country.

> *"Our electricity distribution system is at the heart of everything we do. Modern society has become increasingly dependent on technology, so we have created for ourselves a single point of failure. It is essential for us to go further than admiring the problem – which is real, serious and potentially existential for our way of life – and begin to propose solutions. This paper from Frazer-Nash is an admirable move in that direction."*
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> Rt Hon Lord Arbuthnot of Edrom
> Senior Consultant, SC Strategy

Further 'sharing of the load' could be seen through an increased scope to the role played by DNOs in coordinating emergency activities and black start network restoration. This could, arguably, be a means of increasing resilience and responsiveness during a black start event. DNOs are currently facing the need to prepare their investment plan submissions for regulator OFGEM's next price control period, RIIO 2, in which they will have to demonstrate not only that

Using a broader range of energy providers and resources; and adopting new approaches that harness the expertise of DNOs and DSOs would enable National Grid to move towards its stated aim of a 'Whole System Approach'. While future trends in generation, and emerging technologies are still on the horizon, taking a flexible, holistic approach to restoration, ensures that any black start event avoids the drama of a disaster movie.