



Utility Regulator of Northern Ireland

Review of SONI expenditure Network and system planning case study

June 2020

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1. Introduction

As the Transmission System Operator (TSO) for Northern Ireland, SONI is at the centre of Northern Ireland's electricity system. SONI is responsible for a safe, secure and reliable supply of electricity both now and in the future. It provides homes and businesses with the power they need, whenever it is required. SONI ensures that electricity demand and supply are balanced at all times, which is a complex job.

1.1 Scope of this report

This report provides a summary of SONI's TSO role as the system and network planner and applies a high level comparison against two other TSOs:

- National Grid ESO – UK
- Australian Energy Market Operator (AEMO) – Australia

We understand that SONI's TSO customers have highlighted that SONI could be considering a whole system perspective in areas such as market engagement, commercial frameworks, use of data, as well as developing its traditional focus on developing engineering tools and techniques. The UR is particularly interested in understanding potential gaps in existing SONI service relating to whole system coordination and collaboration. This report covers potential service gaps in this area with a particular focus on the network and system planning service area.

This comparison is not designed to be a comprehensive analysis and comparison of the roles and functions of SONI, National Grid ESO and AEMO. Rather, this report is aimed at highlighting key similarities and differences between the businesses and to trigger discussion and debate to highlight where SONI may be able to deliver good outcomes for customers and consumers.

Figure 1-1 presents a ready comparison of roles and functions of the three System Operators.

Figure 1-1: high-level review of System Operator functions across the three TSOs

Market operator	<p>SEMO</p> <ul style="list-style-type: none"> Operate wholesale market (elec) Gross mandatory pool 	<p>--- ##</p> <ul style="list-style-type: none"> Private contract or via UKPX / nordpool No pool (direct contract) 	<p>AEMO</p> <ul style="list-style-type: none"> Operate wholesale markets (Gas & Elec) All trades through NEM/WEM (hedging allowed)
Transmission system operator	<p>SONI</p> <ul style="list-style-type: none"> Separate licence Wholly owned Group Regulated (UR) Undergoes price control <ul style="list-style-type: none"> Balance the energy system Independent planning, forecasting & modelling Grid Code / European Codes <p>All-Island Transmission Energy Scenarios (TES)</p> <p>All-Island 10 Yr transmission forecast statement</p> <p>Transmission development plan (NI only)</p>	<p>nationalgridESO</p> <ul style="list-style-type: none"> Separate licence Wholly owned subsidiary of NG Group Regulated (Ofgem) Undergoes price control <ul style="list-style-type: none"> Balance the energy system Independent planning, forecasting & modelling Grid Code / European Network Codes <p>Future Energy Scenarios (FES)</p> <p>10 Year Statement (ETYS)</p> <p>Network Options Assessment (NOA)</p>	<p>AEMO</p> <ul style="list-style-type: none"> Registered public company Not-for profit Established under Law (similar to Regulator) Governed by constitution <ul style="list-style-type: none"> Balance the energy system Independent planning, forecasting & modelling <p>Network Development Plan (NDP) **</p> <p>Integrated Service Plan (>20 yrs) (2020)</p> <p>Statement of Opportunities (SOO)</p> <p>XX Annual Planning Report (XARP)</p>
Transmission asset owner	<p>TSO SONI / EirGrid</p> <ul style="list-style-type: none"> Responsibility for investments Operation of the network 	<p>TO National Grid / Scottish Power / Scottish Hydro</p> <ul style="list-style-type: none"> Responsibility for investments Operation of the network 	<p>TO AusNet Services / ElectraNet / Powerlink / TasNet / TransGrid / Western Power</p> <ul style="list-style-type: none"> Responsibility for investments Operation of the network

- the UK does not have a dedicated market operator responsible for procuring power on behalf of the suppliers

** AEMO have revised the 'Network Development Plan' and is now the 'Integrated Service Plan'

In general, all three TSOs produce:

- An 'energy scenarios' document looking out more than 10 years – long term
- A 1 to 10 year plan of opportunities, showing forecasts of generation and demand
- A short term (1 – 5 years) plan of network investments needed to maintain network security

All three TSOs also:

- Manage the updates of their respective Network Codes
- Undertake planning and forecasting of generation and demand
- Model the network and compliance with technical specifications (fault levels etc)

In the case of SONI, it undertakes some unique roles, specifically:

- Processing outline design for network investments
- Obtaining consents and planning permission for transmission projects in NI

In comparison, in the UK and Australia, the Transmission Asset Owner (TAO) usually undertakes the last three roles mentioned above.

SONI is unique as in other jurisdictions the TSO will forecast a network constraint due to demand growth; the TSO will identify the area and provide a long-term forecast of the demand. This is transferred to the TAO who will model, design and plan the necessary augmentation to meet the forecast demand.

1.2 System Operator role and network planning

As a holder of a transmission licence, SONI has responsibility to take such steps as are reasonably practicable to:

(a) ensure the development and maintenance of an efficient, co-ordinated and economical system of electricity transmission, which has the long-term ability to meet reasonable demands for the transmission of electricity;

(b) contribute to security of supply through adequate transmission capacity and system reliability; and

(c) facilitate competition in the supply and generation of electricity

In the context of a TSO and network planning, SONI undertakes several roles that are common amongst System Operators. These include:

- Maintaining an up to date Grid Code
- Implementing EU Network Codes for Northern Ireland
- Acting as Expert witness for large investments
- Identifying future investment requirements for the Northern Ireland transmission system
- planning the transmission network from identification of need
- obtaining necessary consents/planning permission (before transferring for construction)
- Providing an annual Generation Capacity Statement,
- Providing a Transmission Forecast Statement and Ten Year Development Plan

1.3 Expertise to the Regulator and government departments

It is common for the TSO to act as a representative of the electricity supply chain when discussions occur within government ministries or with the Regulator. A TSO has access to a wider overview of the state of the market that is not readily available to other industry participants (eg aggregate data on the percentage of electricity generated from renewable sources). As such, the TSO is sometimes called upon as the expert voice for enquires or facilitating government policy.

For the three TSOs mentioned in this report, they have all presented network information during discussions on the future decarbonisation of the electricity network. National Grid ESO and SONI have participated with the wider European Network Codes discussions.

Historically, the transmission owner / system operator has been the representative and expert voice for the industry. There may be a natural progression of this role as energy becomes more politicised and severe events (such as black outs, energy shortage) become more visible. The traditional 'advisor to the government' may be a role less favoured going forward.

1.4 Tools and techniques

To deliver the planning documents shown in Figure 1-1 we would expect that the TSO has access to the following tools.

Network planning

- Dynamic and static modelling tools (e.g. IPSA, PowerFactory)
- Demand forecasting / generation forecasting tools (commonly in Microsoft Excel)
- New connections applications

System operations

- State estimation (can be part of the Control system or part of modelling tools)
- Generation scheduling and dispatch (part of the Control system)
- Ancillary services scheduling and dispatch (part of the Control system)
- Transmission connected generation monitoring (part of the Control system)

All the above tools will be used for both in the Control Centre at short term planning stage and longer term in the production of the suite of documents mentioned in Figure 1-1.

These are the expected suite of tools that a TSO would have access to undertake its role as a TSO. Some larger TSO's have developed these tools in-house (i.e. National Grid ESO has bespoke dispatch tools, however they are available as modules within a Control System or as separate packages from other vendors).

2. SONI TSO Business Plan

The following section provides a perspective on the activities SONI are proposing to undertake as a TSO, based on its business plan. This section is a view of the SONI business plan based on experience of working with other TSOs and is an aide to guide discussion.

2.1 Adding value from a whole of system perspective

SONI's business plan breaks down in to roughly two areas.

Network planning / forecasting from 1 year out to 20 years plus

- Outage planning
- Network augmentation
- Long term generation forecasts, demand forecasts

Real time operation of the network

- Energy balancing / market operation
- Managing ancillary services
- Network security

Its business plan is designed to deliver these services and, where necessary, to look to the future to consider how changes in its planning or operations can improve engagement with users of the network – that is facilitation of the markets.

Currently SONI's business plan focusses on enhancing the current suite of services and improving its internal processes. Examples below.

Renewable Strategy: Initiative F1 researches and develops tools for integrating renewable energy in to the electricity system.

Control Centre Tools: Initiative F2 is enhancing control centre tools that will provide the control centre with improved data analytics and forecasting.

Smarter outage management: Initiative F3 develops a decision tool to improve the estimation of outages and identify the most efficient solution.

Use of IP technology: Initiative F4 will investigate the use of IP technology for control, monitoring and automation of control systems over IP

Cyber security: Initiative G4 enhances SONI's cyber security offering to ensure that, as a provider of critical infrastructure, it have the necessary systems in place.

In general, the proposed initiatives presented by SONI focus internally on improving its own systems, monitoring and forecasting. There is little in the initiatives that provides other users of the system, the Regulator or government departments with additional benefits. Some example of these additional TSO roles/activities are provided below; SONI's business plan contains little along these lines.

Facilitation of market information: Users of the market will be dependent on certain information from the market operator (Single Electricity Market Operator (SEMO) in Ireland) and network conditions. SONI is able to influence the amount of information and its quality and timeliness. Some examples of these initiatives are listed below.

Providing project information to developers (AEMO): This initiative would allow new developers to have access to electricity market information, which is currently only available to electricity market participants, but not available to proponents who desire to build a generating

system or an industrial development (a large load) including emerging generation and energy storage. The information allows developers to seek to identify opportunities to enhance the national electricity market arrangements for grid-scale energy storage and other resources on a commercial basis.

Benefits includes allowing more participants to engage in the market, and reducing cost. It also allows niche participants to engage to provide alternative ancillary services or increase system security.

Five-minute settlement periods (AEMO): This initiative is based on a five-minute settlement providing a better price signal for investment in fast response technologies, such as batteries, new gas peaking generation, and demand response. The alignment of the operational dispatch and financial settlement periods are expected to lead to bidding that is more efficient, operational decisions, and investment. The determination is approved and comes into effect on 01-July -2021.

The benefits of the five-minute settlement period include more accurate cost reflection that should in turn reduce the wider network costs. It also allows network participants to respond to network signals faster, that also should have a costs saving benefit through more participants engaged (increase in liquidity of the market).

VAr dispatch (AEMO): A trial has been undertaken to examine the full end-to-end process, and provide reactive plant operators (Generators and Network Service Providers that operate reactive plant in accordance with dispatch instructions from AEMO control centres) and AEMO with an opportunity to validate operations, systems, and processes for the NEM VAr Dispatch Scheduling process in an "as-real-as-possible" operational environment. AEMO will also refine system tuning and evaluate reliability and performance of systems.

With VAr dispatch, this can reflect the true cost of energy that historically has not been captured and also increase the network security by allowing those who can provide the service to benefit by offering the service at a market price.

Open network data (AEMO): data requests are considered on a case-by-case basis to determine if AEMO can provide the requested data. Any participants who is provided data is reported in an open list on a daily basis.

Data is currently provided to Market participants only, however AEMO is looking to allow access to non-participants in the future.

SONI, as the TSO: SONI has access to the necessary information needed to model the network in sufficient detail – although the received detail is from participants can contain commercially sensitive information. This does mean that SONI has to ensure that any data release does not expose confidential data, either direct or inferred. The TSO will normally develop the business case to support the release of data and reviewed by participants prior to release.

Technical solutions to the market: in a similar situation to facilitating markets, the TSO is unique in that it has a role of monitoring and planning the network. This can lead to a set of technical network planning issues that it deals with on behalf of the energy industry. Examples include:

- System inertia on critical clearance times (NG ESO)
- Sub / near synchronous instability in the network (NG ESO)
- Long duration energy storage options (NG ESO)
- Multi vector energy network modelling (NG ESO)

AEMO generally looks to the market first for the provision of solutions to any identified issues from technical analysis. The solutions can involve demand reduction, alternative generation profiles or alternative ancillary service provision.

Independent energy expert: Independent of the TAO, the TSO also undertakes a role as an informed advisor to governments and regulators. This can include long-term strategies and outcomes, for example:

- Probabilistic network planning (AEMO)
- Consumer data rights (AEMO)
- Zero emissions (carbon neutral) transmission system (NG ESO)

As a TSO one of their deliverables is a view of the longer-term plans on network development and this should take into account other stakeholder views. This is exemplified in National Grid ESO's approach to the Future Energy Scenarios (FES) and the progression of the FES to influence the TSO actions in the longer term.

The future of the network: It is common for the TSO to lead and engage on larger energy network issues. This can include:

- Energy storage in the electricity market (AEMO)
- Distributed energy resource program (AEMO)
- Grid scale emerging generation and energy storage (AEMO)
- Statistical techniques to enhance network options assessment (NG ESO)
- Advanced modelling for network planning under uncertainty (NG ESO).

Option value pricing into decision-making (Ofgem): ESO / TSO have traditionally undertaken options analysis based on net present value (NPV). An extension to this is options analysis seeks to value flexibility in investment opportunities – both the flexibility offered to management once the investment is undertaken, and the flexibility of delaying the investment through time. Known as Real Options Analysis.

The real options approach contrasts with the standard approach to investment decision making, the net present value (NPV) approach, which assumes the investment opportunity is a now-or-never decision, and once the investment is undertaken, there is no scope for managers to react to new information and to change course. By ignoring the value of flexibility, the NPV framework has a bias towards projects, which do not provide flexibility (e.g. large-scale capital investments) relative to more flexible options (e.g. interruptible contracts or demand-side options in the context of energy networks).

There are factors, which lead to high real option values, and the circumstances under which we should apply a real options framework. A real options approach should help decision making where the investment environment is characterised by uncertainty and management flexibility in responding to investment needs.

These activities are not necessarily purely within the remit of the TSO, however due to its unique position in the market. It is considered the most appropriate business to lead.

TSO / DSO interfacing and coordination (ENA): Traditionally, there has been a clear distinction between the roles performed by DSOs and TSOs, but as DSOs take on more of an active role, for example active network management allows more distribution connected generation than traditional connections, this can exacerbate problems and undermine balancing actions taken by the TSO.

The current transition of UK DNOS to DSOs is developing the protocols for the DSO / TSO interface and the work culminated with the publication of their common TSO/DSO data management report in line with European Commission and the forthcoming market design and renewables package.

The document aims in particular at sharing recommendations on common principles and criteria for data and information exchanges. The work was organised around two objectives. First, project partners agreed upon a common terminology used to develop a unified understanding of the projects' objectives. Second, the project reached a common understanding of the data needs of certain roles and responsibilities.

The TSO and DSO have worked through five different use cases that aim to clarify data management and data exchange:

- congestion management
- balancing
- use of flexibility
- real-time control and supervision
- network planning.

These will be further developed to define the TSO-DSO interface and how responsibilities will be defined.

SONI business plan analysis: the current SONI business plan for TSO-DSO interface is in its infancy. SONI has identified the DSO as a stakeholder whom engagement is needed, and they have made a commitment to work in partnership with NIE Networks. However, it appear to be an arms-length approach with minimal engagement. SONI are undertaking certain distributed generation monitoring projects with little engagement with the DSO.

The current work being undertaken in the UK and in Europe acknowledges that there is a need for a more integrated approach between the two businesses, which currently is not reflected in the SONI business plan.

Market engagement and development: it is also common for TSOs to build engagement initiatives and trials with new types of customers to help grow the market. For example:

- ESO power responsiveness initiative.
- Stakeholder / participant engagement.

There is a driver, for the TSO /DSO to proactively engage with customers and stakeholders. The premise, which has been adopted by National Grid in the UK via the Future Energy Scenarios (FES). The FES is a high-level forecast built around four options designed to reflect stakeholder engagement and government intent.

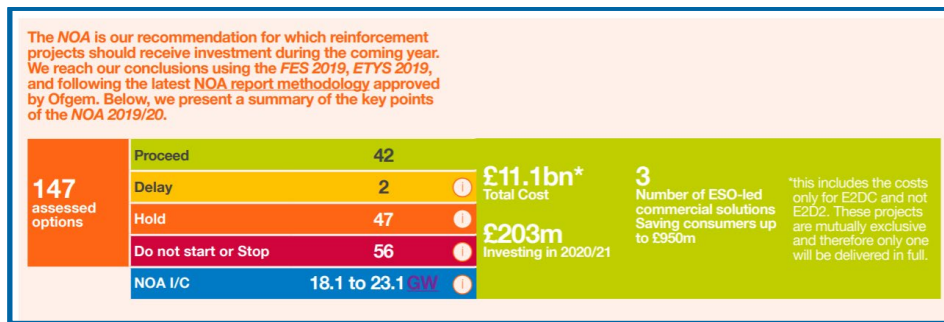
The FES is then further developed to produce long-term network plans and is the basis for the network operations assessment, discussed below.

2.1.1 National Grid ESO – Network Operations Assessment

As part of this overview of SONI roles, the National Grid ESO – Network Operations Assessment (NA) report was examined in more detail.

The purpose of the Network Options Assessment (NOA) is to make recommendations to transmission owners across Britain as to which projects to proceed with to meet the future

network requirements as defined in the Electricity Ten Year Statement¹. The output from this process makes recommendations for the projects to be progressed including timings.



Source: January 2020 Network Options Assessment².

As part of the NOA process, a Network Development Roadmap was identified which included a number of ambitions³:

1. Expand the NOA to invite network and non-network solutions across the transmission and distribution networks to meet transmission needs
2. Assess the year-round transmission network needs to a greater extent through taking a probabilistic approach
3. Apply a NOA-type approach to regional voltage challenges
4. Consider expanding a NOA-type approach to the operability aspects of system stability
5. Working in conjunction with ENA and wider stakeholder groups
6. Phase more detailed, regional information and processes throughout the year alongside the existing annual national assessment

There are similarities with the NOA and SONI's Transmission Investment Plan in that they both identify network issues. However the NOA invites users to offer alternative network solutions (e.g non-network build options).

Within the NOA, there is focus on the positive financial benefits to customers by resolving the network issue. This can range from calculating the reduction in ancillary services requirements to the savings from reduced network losses. As a general rule, if the proposed investment does not provide a saving to the customer, it is not progressed.

2.2 Potential service provision gaps

Reviewing the initiatives undertaken by National Grid ESO and AEMO, the following section provides a summary of some initiatives that SONI does not mention in its business plan.

Network Inertia: recent knowledge from other European TSOs has identified that network inertia is dropping and may affect the stability of the network – in short, the effect of a lower network inertia was not fully understood. Inertia is a function of the generating units on the network, and it is usually the TSO that has the responsibility through its licence to establish if there is an issue and to identify potential remedies.

Black start from alternative sources: large conventional power stations traditionally provided black start. As they close, the black start services need to be procured from other sources. Management and research into alternative ancillary services has been within the remit of the TSO and this initiative investigates the use of distributed generation.

¹ <https://www.nationalgrideso.com/publications/network-options-assessment-noa>

² <https://www.nationalgrideso.com/document/162356/download>

³ <https://www.nationalgrideso.com/document/162336/download>

Ancillary services from storage and/or DSU: new technologies are being deployed and these include energy storage (not only batteries; it can include pneumatic, chemical, or rotating storage). As these technologies have unique operating profiles and mechanisms, they may not fit the traditional. The TSO can provide a significant path to development for these new technologies through governance and potential review and relaxation of Code requirements, for example for short periods of operation. Or for evaluating the services that are procured to see if there are alternatives to the current suite of services.

As an aside, this is seen as one of the most difficult hurdles for innovative technologies to overcome as the Grid Code and the Ancillary Service market is shaped around existing service providers, rather than potential future providers with different characteristics. A new entrant may not be able to provide a like-for-like service, but can offer something different that, when assessed on its merits, can be a useful service for the TSO.

Commercial frameworks to develop markets: An ESO can encourage and facilitate competition in markets. In particular, balancing and ancillary services markets where the ESO is the lead and principal buyer and other markets that the ESO can affect (ie, wholesale and capacity markets).

The ESO procures a number of balancing services to ensure the needs of the system can be met. The design of these services and approach to procurement can have a significant impact on the revenue available to different providers and the ability for new entrants to compete with existing providers. This can have a further impact upon short-term price signals and revenues in the main electricity market.

An ESO's approach to procuring balancing services must follow the high level framework is usually set out in the Transmission Licence as to ensure that the ESO does not inadvertently reduce market participation, or sterilise it altogether.

The ESO should ensure its procurement of balancing services, including the rules and processes, maximise competition where possible, and are simple, fair and transparent to all participants.

Coordinated TSO-DSO procurement and dispatch: in established TSO / DSO jurisdictions (Nordics, New Zealand, Australia) the role of the TSO and DSO has clearly defined roles. These have morphed over time as markets have matured. The interface between the TSO and DSO is important to market participants, as it will set the interface and the Codes and Regulations that they operate under. A strong case for TSO-DSO procurement and dispatch is the ability to coordinate the use of network capacity, especially where demand is increasing but route access is limited. In the short term, coordinated transmission and distribution capacity can allow larger transfers whilst maintaining network security.

We see the TSO / DSO as a facilitator of procurement and dispatch of smaller generators. Depending on the rules in place, they can encourage engagement.

Unlocking transmission transfer capacity: The transmission network has traditionally been planned on static planning limits. As planning and forecasting has improved and real time data can be used in short term planning, this can release transmission capacity.

This does increase the risk exposure of the TSO, however understanding this risk and the benefits is key to unlocking capacity. The TSO will be the prime driver for enhancements of this nature. Examples from National Grid ESO and AEMO include:

- Dynamic line ratings / cable ratings
- Real time transformer monitoring and cyclic ratings

This technology can also allow larger intermittent generation to connect due to the peak loadings. For example, a wind farm is rarely exporting its maximum capacity for a sustained period; it exports to a consistent lower level with intermittent peaks. With real time monitoring, either a larger wind farm can be installed, or smaller assets can be used.

2.3 Summary

In summary, SONI undertakes the expected roles of a TSO with the addition of design, planning and consenting of network investments. In other jurisdictions, these three functions are undertaken by the TAO.

SONI's business plan has a focus on improving monitoring of users of the network and improving internal planning and forecasting solutions. It is not demonstrated that the improvement in these systems aids users of the network. Rather the approach is more akin to policing of the users than facilitating.

There are initiatives being undertaken by more mature TSOs that do not appear to be mentioned by SONI, for example:

- Black start from alternative sources
- Ancillary services from storage
- Coordinating TSO-DSO procurement and dispatch
- Unlocking transfer capacity

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