nationalgridESO

ESO RIIO-2 Business Plan Annexes

1 July 2019

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A. ESO RIIO-T1 story

A.1. The external environment

The electricity system has seen an unprecedented amount of change over the course of RIIO-T1, moving from a centralised fossil-fuel dominated system, to a decentralised low-carbon one. Whilst change was anticipated, the nature of that change, and the overall scale and pace was not. The increase in renewable generation, particularly at a distributed level, growth in the number of market participants and new technology advances all add significant complexity to what we do.

Installed solar capacity was forecast in 2011 to be 1 GW by 2020, it is currently over 13 GW. Distribution connected generation now makes up a third of generating capacity. This has resulted in different challenges to manage on the system coupled with much higher number of market participants to interact with, with new and different needs.

This unprecedented level of change in the electricity sector has led to a step change in the task of balancing the system for the ESO, well beyond the extent anticipated at the time of the RIIO-T1 settlement. The industry has changed in two significant ways which has substantially increased the demands on the ESO:

- the mix of participants on the system has changed fundamentally, which makes the task of operating the system more complex, through intermittency and two-way flows of power, as well as different generation and demand patterns; and
- the nature of the participants on the system has changed, which gives rise to a need for very different tools and capabilities to operate the system. Specifically, there are increased numbers of participants with non-traditional business models. Our customers now have different and diverse needs and have different levels of experience of operating in this industry.

The level of influence of European Union (EU) regulation has also expanded over RIIO-2, through the Third Energy Package[1] and the implementation of eight European network codes[2] (ENC). We are also influenced by changes beyond the makeup of the Great Britain (GB) electricity system, with the changing cyber environment bringing new and increased risks to our critical national infrastructure and changing the way we manage cyber security.

A.2 Our performance in RIIO-T1

In our detailed plan for System Operation, we set out three main aims for RIIO-T1. These are:

- Maintain security of supply and the reliability of the transmission network.
- Minimise constraints and maximise the output of renewable generation.
- Maximise the benefit introduced by the transmission owner (TO) capital plans and utilisation of smart network assets.

[1] https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation/third-energy-package
[2] https://www.nationalgrideso.com/codes/european-network-codes

To meet these aims against a rapidly changing backdrop, we initiated and invested in several activities, some of them new. These include:

- Maintaining high levels of transmission system reliability at over 99.999%.
- Implementing products to ensure sufficient generation capacity in advance of the introduction of the Capacity Market (Supplemental and Demand Side Balancing Reserve[3]).
- Becoming the Electricity Market Reform (EMR) delivery body, in which we run Capacity Market (CM) and Contracts for Difference (CfD) auctions and provide analysis to support government decisions related to these.
- Development of our critical infrastructure through the replacement of scheduling and dispatch tools.
- Leading the Power Responsive programme to stimulate increased participation in balancing markets from flexible technology, with over 1,500 participants signed-up.
- Setting a clear direction of travel for development of our balancing services through the *System Needs and Products Strategy (SNAPS)* and product roadmaps that flow from it. We now have over 250 new provider conversations each year.
- Continuing to invest in our relationship with Distribution Network Operators (DNOs) through innovation projects and Regional Development Programmes (RDP).
- Taking on an extended role in the Integrated Transmission Planning Regulation[4] (ITPR) including running the *Network Options Assessment* (*NOA*) process to coordinate efficient and economic network investment in GB.
- Invested in over 50 innovation projects, working with other parties to deliver improvements in the energy industry.
- Becoming a legally separate entity within the National Grid group to make sure we provide transparency in our decision-making, and to give us confidence that everything we do will promote competition, which is ultimately for the benefit of consumers.

We have responded to the changing energy environment by investing in our people and delivering to a consistently high-standard. As RIIO-T1 has progressed, our role has evolved, and we have increased resource to take on new responsibilities in response to the increasingly complex and decentralised energy system and to improve our customer service.

A.2.1 Key metrics and outputs delivered and performance against incentives

During RIIO-T1, the ESO has been regulated as a joint entity with the England and Wales transmission owner as National Grid Electricity Transmission (NGET). The incentives set generally apply to NGET. In some cases, for example the Balancing Services Incentive Scheme[5] (BSIS), incentives are wholly within the remit of the ESO.

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[3] https://www.nationalgrideso.com/codes/connection-and-use-system-code-cusc/modifications/cmftp232-demand-side-balancing-reserve-and

[4] https://www.ofgem.gov.uk/electricity/transmission-networks/integrated-transmission-planning-and-regulation

[5] https://www.nao.org.uk/wp-content/uploads/2014/05/Electricity-Balancing-Services.pdf

The ESO did not have its own RIIO-1 price control, but was integrated with the England and Wales transmission owner as NGET. The ESO's portion of this is shown below.

ESO capex – forecast, allowance and actual (£m)					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Actual	41.0	43.8	42.6	57.4	62.1
Forecast	105.2	49.9	42.5	41.0	42.3
Final proposals allowance proportion	50.9	44.4	38.2	35.3	38.4
Latest allowance proportion[6]	51.1	46.7	38.8	37.4	40.1

ESO opex – forecast, allowance and actual (£m)					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Actual	105.7	104.4	107.2	112.7	120.3
Forecast	101.8	105.8	109.1	111.6	112.8
Final Proposals Allowance Proportion	94.0	95.4	98.1	100.1	101.1
Latest Allowance Proportion	94.4	99.4	108.9	114.1	118.5

[6] Latest allowance proportion reflects the RIIO-T1 allowances plus any reopeners.

A.2.2 Customer and stakeholder satisfaction

The ESO was incentivised, as part of NGET, to deliver good customer and stakeholder satisfaction through two incentive schemes. Throughout the RIIO-T1 period we have seen the number of customers and service providers grow. We have worked hard to deliver for our customers and stakeholders, and this is reflected by our customer and stakeholder satisfaction scores (CSAT and SSAT scores) showing an increase over the RIIO-T1 period. It is not possible to apportion these to the ESO and NGET.

Customer and stakeholder incentives					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
NGET customer survey target score	6.90	6.90	6.90	6.90	6.90
NGET customer survey score	7.41	7.40	7.54	7.40	7.74
Stakeholder survey target	N/A	N/A	N/A	7.4	7.4
Stakeholder survey score	7.53	7.74	7.53	7.66	7.88

A.2.3 Environmental Discretionary Reward (EDR)

This discretionary reward[7], shared across transmission owners, encourages network companies to find ways to reduce their carbon footprint, and act in a more environmentally friendly way. It is not possible to apportion these to the ESO and NGET.

Environmental discretionary reward					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
NGET score	Proactive	Leadership	Proactive	Proactive	Proactive

A.2.4 Balancing spending

We have worked hard to manage balancing costs over the period, and against a backdrop of complexity brought by the changes to the electricity system. These balancing costs however, have remained broadly flat.

ESO Balancing Spend (£m)					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Target (old money)	960	957	1082	963.5	
Target (new money)	1,048.4	1,025.0	1146.5	999.6	

[7] https://www.ofgem.gov.uk/publications-and-updates/decision-2017-environmental-discretionary-reward

Incentivised balancing cost	970.8	922.7	917.6	985.5	999.7

A.2.5 Levels of return earned

ESO revenue (£m)					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Net underlying revenue	128.8	142.8	147.6	167.6	172.2
Incentives	25.5	23.3	26.8	28.0	0.7
Total underlying revenue	154.3	166.1	174.4	195.6	172.9

A.2.6 Dividends paid out

This is not relevant for the ESO as the dividend policy is a reserved matter for the board of National Grid plc. It reflects the performance of the entire National Grid group, consisting of its core regulated businesses in the UK and USA, and National Grid Ventures. This will be unchanged during RIIO-2.

A.2.7 How do we compare against others?

Benchmarking can be useful when assessing the ESO's cost and performance. However, benchmarking the ESO against cross-sector or international comparators is difficult. This is because both the structure of and the demands on the ESO, are very different to comparable organisations.

Many System Operators (SO) are integrated with transmission businesses and so produce combined end of year statements. The GB energy system is more demanding than many others, which has cost implications.

We have carried out simple testing of top-down internal cost benchmarks, for example, £/customer and £/MWh across a sample of five international SOs; Elia[8] (Belgium), Terna[9] (Italy), Independent Electricity System Operator Canada[10] (IESO), System Operator Northern Ireland[11] (SONI) and California ISO[12] (USA).

The results show significant variation in the resulting values, for example: £/customer values ranged from £1.62 to £52.40 and £/MWh ranged from £0.31 to £10.58, making meaningful conclusions hard to draw. This demonstrates that any benchmarking needs to be carefully designed to ensure that equivalent values are being compared.

[8] http://www.elia.be/
[9] https://www.terna.it/
[10] http://www.ieso.ca/
[11] http://www.soni.ltd.uk/
[12] http://www.caiso.com/Pages/default.aspx

B. ESO Financeability

The introduction of a new regulatory framework for the ESO is a unique opportunity to put in place a funding model and incentive scheme that supports the ESO to deliver the outputs that stakeholders want. In parallel with developing our RIIO-2 business plan, we are working with Ofgem as it designs this new framework.

Ofgem consulted on its proposed regulatory framework for the ESO in December 2018 and published a decision and further consultation in May 2019[13]. We have published our full response, including our detailed view on the regulatory framework, on our website.[14]

While the details of the funding model are continuing to evolve, it is clear that whichever model is chosen, it will need to reflect the new challenges faced by the ESO in the future. Not only will the ESO need to be agile to be able to respond to the changing nature of the electricity system, making the necessary investments to support long term sustainability, it also faces new financeability requirements as part of its recent legal separation from NGET. Specifically, the ESO should be financeable on a standalone basis without relying on direct or indirect parental support.

B.1 Our proposals to support an ESO that can meet the challenges of the future

Our proposal in response to these challenges is to adopt a layered funding model. It combines a return on our Regulatory Asset Value (RAV) with margins based on our other business activities, to allow for a flexible funding model which supports us in delivering the right outcomes for consumers, as well its investors. For our industry revenue management role, it would be appropriate to have a margin on the external costs we transact, to reflect the significant cashflow and profit volatility this drives.

There are a number of options for addressing our ability to absorb downside risk and facilitate the increased investment proposed in our business plan. These include increasing the cost of equity, reducing gearing, increasing the fast money in the capitalisation rate and skewing the expectation for incentives, but these will need to be considered in the round.

At this stage, we would anticipate the following adjustments will be required to support financeability:

- Returns - as set out above, we believe it is appropriate to have a layered funding model providing a return based on RAV augmented with margin returns, including a margin on operating costs, and a margin on revenue for our industry revenue management role, to ensure that the ESO can cope within reasonable downside risk scenarios.
- Cost of equity - we expect that the cost of equity will be proportionate with that of a highly operationally geared, asset light organisation.

[13] https://www.ofgem.gov.uk/publications-and-updates/riio-2-sector-specific-methodology-decision

[14] https://www.nationalgrideso.com/document/139766/download

- Incentives - the level of incentive downside risk is critical to the potential financeability of the ESO. It is anticipated that a positive skew will need to exist to drive the ESO to be ambitious in the interests of consumers without jeopardising its financial stability. However, we would continue to support an incentive downside, to drive the right business behaviours to deliver in the interests of consumers.
- Gearing - a notional company gearing assumption of 60% has been published by Ofgem as a core assumption. As a relatively asset-light business the ESO is not expected to be able to support such high gearing. We expect this to reduce.
- Working capital facility - this will be required to manage the cashflow risks associated with timing, although we recognise that this will not address the profit volatility associated with the industry revenue management role and the impact this has on the ESO's financeability.

B.2 Adopting models from the past leave questions unanswered

The option proposed by Ofgem, in its 24 May consultation, of using a pure RAV*WACC funding model may not generate sufficient revenues to allow the ESO to be financeable in the future. This remains true even if we were to set out plans to only maintain our current capabilities rather than delivering a more ambitious programme that our stakeholders wish to see.

The need for the funding model to deliver greater revenues to maintain financeability is driven by four factors:

1. The need for financial capacity to spend money each year to maintain our current capabilities and deliver new ones. We expect the funding model to have a 'slow' money component, i.e. it does not provide cash to pay for capital investments that are depreciated over many years. This limits our capacity to invest without injecting capital.
2. Absorbing downside financial risks - these have a relatively greater impact on the much smaller standalone ESO business, and therefore it needs a sufficient financial buffer to withstand impacts e.g. from any incentive downside or significant shock event.
3. Requirement for the ESO to financeable as a stand-alone, notional company, recognising that separation could be undermined by the ESO relying on support from the wider National Grid group.
4. Maintaining the ESO as attractive for investors, so that it can obtain the necessary support for our plans and invest in a sustainable future. This is in the face of highly volatile profits related to our industry revenue management role, which makes us a fundamentally different investor proposition compared to that of the network companies. The funding model needs to recognise this for both debt and equity investors and allow them to achieve an appropriate return on their investment.

We think the layered model, as considered by Ofgem in its December consultation, is a viable model that remains in the latest consultation published by Ofgem in May. This would apply a margin to groups of activities reflecting the risk that the ESO faces in respect of that activity. With the right parameters, we believe that it could address many of the points above. Each point is further described below.

B.2.1 Financial capacity to invest to deliver ambitious plans for consumers

Our analysis shows that the traditional model for calculating allowed returns for network companies, based on applying a Weighted Average Cost of Capital (WACC) to the value of the company's RAV, may not provide an adequate level of return to enable the ESO to be financeable over the RIIO-2 period. This is because the ESO has a small RAV with high operational leverage.

As the ESO works to deliver its ambition, it will need to invest in new systems, as well as reinvest in existing systems, to ensure they are reliable, resilient and able to meet the requirements of operating an increasingly complex system in the interest of consumers.

We have set out in our draft business plan what we believe is necessary to deliver this ambition. This plan shows an increase in capital investment from that expended in RIIO-T1. This presents a challenge to the short-term financeability of the ESO as slow money revenues are insufficient to fund the new investment requirements. Consequently, there is a need to make cash available earlier in the plan through increased levels of debt and equity injections.

Additional mechanisms are also needed to enable the ESO to generate financial headroom to accommodate downside risk and substantial cashflow and profit volatility.

B.2.2 Absorbing downside financial risks

Ofgem's December 2018 sector-specific consultation document acknowledged that a pure RAV*WACC return model may not be suitable to ensure a financeable ESO against downside risks. (The Competition Markets Authority (CMA) reached the same conclusion in its determination on SONI[15]).

The downside risk that the ESO potentially holds includes:

- Removal of a totex sharing factor leaves the ESO at risk of potential ex-post cost disallowances with no ability to offset this risk with efficiency benefits.
- Incentive downside risk.
- Black Start disallowance risk – potential risk of up to 10% of annual Black Start costs. These costs are not part of the ESO's internal costs but form part of the costs of balancing and are expected to be in the region of £50 million - £60 million per annum.
- Significant risk in relation to the industry revenue management role.

A WACC return on RAV is unlikely to provide sufficient headroom to absorb likely downside risk scenarios, without increasing the WACC to a distorted level due to the above asymmetry.

B.2.3 Licence obligation for ESO to maintain an investment grade credit rating

The financeability of the ESO as a separate legal entity, operating under its own licence and price control framework will require separate consideration. The ESO currently holds an investment grade credit rating, Baa1, provided by Moody's in early 2019[16]. The

[15] https://www.gov.uk/cma-cases/energy-licence-modification-appeal-soni
[16] https://www.moodys.com/research/Moodys-assigns-Baa1-rating-to-National-Grid-Electricity-System-Operator--PR_396553

Moody's report, notes a considerable degree of 'notching up' applied to reflect the ESO's position as part of the National Grid group, stating the assumption that "National Grid would provide financial assistance should it become necessary, to maintain "ESO's credit quality". Without this 'notching up' it is expected that the ESO would, at best, be at borderline investment grade. The notional company cannot assume such implied support.

The ESO has been assessed under a different ratings methodology to the other network companies, using the Regulated Electric and Gas Utilities Methodology Assessment[17] and not the Regulated Electric and Gas Networks Rating Methodology[18]. This reflects the unique risks held by the ESO and needs to be taken into consideration in its financeability assessment.

It is important that financeability is assessed with respect to equity capital as well as debt, to ensure that the regulatory regime allows equity holders to earn a return reflecting the higher level of risk associated with an asset-light, high volatility business. This is particularly relevant when assessing the impact of the industry revenue management role, which significantly increases the equity holders' risk as timing differences can be substantially higher than core returns, leaving the ESO unable to deliver the reliable dividend returns that traditional institutional investors seek.

B.2.4 Maintaining the ESO as attractive to investors

One of our biggest risks arises from our role in collecting and disbursing use of system charges. We manage the flow of around £4 billion of funds across the industry each year, consisting of around £3 billion Transmission Network Use of System(TNUoS) charges and £1 billion Balancing Services Use of System (BSUoS)charges. We act as the contractual counterparty for those paying the charges and bear the short-term costs of any discrepancies between amounts collected, and the amounts paid. During RIIO-T1 these discrepancies for TNUoS have ranged been between +£56 million and -£110 million in a year against an average RAV of less than £200 million.

The funding model must recognise equity holders' risk in being able to extract a reliable dividend due to this timing risk which drives profit volatility and can be significantly larger than any base return.

[17] https://www.moodys.com/research/Moodys-updates-its-methodology-for-rating-regulated-electric-and-gas--PR_368709
[18] https://www.moodys.com/research/Moodys-updates-its-methodology-for-rating-regulated-electric-and-gas--PR_363559

C. Benchmarking process

C.1 International benchmarking

The results presented in this report represent our early thinking. We will continue to refine our benchmarking studies throughout 2019.

We have undertaken a benchmarking exercise to assess the efficiency of our current and proposed ongoing direct operating costs. Our proposed new and transformational costs have been subjected to cost-benefit analysis and are outlined below. Chapters 14 and 15 set out the benchmarking that we have carried out on shared service and IT costs.

This is the beginning of an overall process to develop meaningful benchmarks which we can consider with our stakeholders. The roadmap for this is set out below. Throughout the process, we will be seeking stakeholder feedback and input.

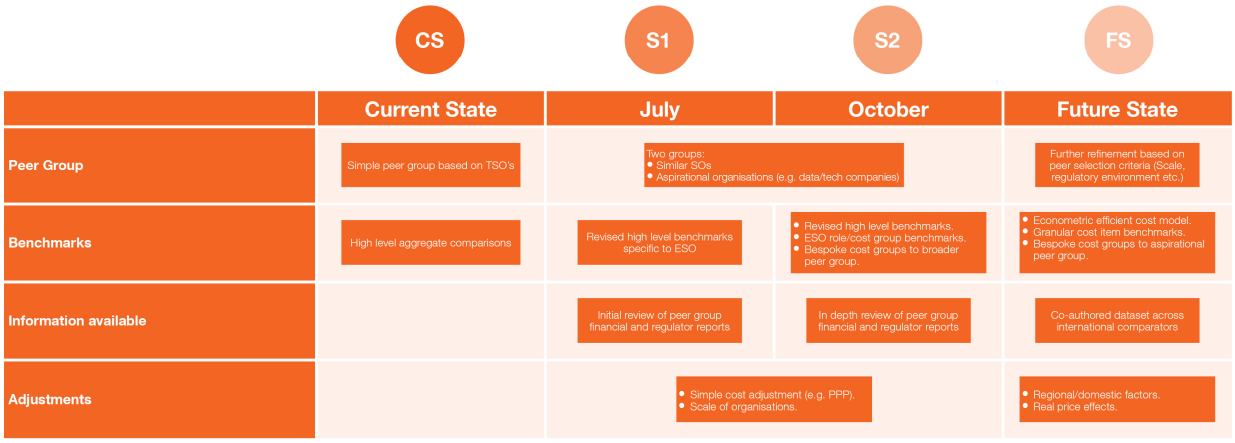


Figure 1 Benchmarking timelines

The analysis will be conducted in two stages:

- stage 1 will comprise high level benchmarking to provide high-level results to inform July submissions; and
- stage 2 will provide refined results to inform the October submission.

We have described these stages in further detail as follows.

C.1.1 Stage 1 – high level cost benchmarking

1. Defining a long list of comparators organisations - the quality of the benchmarking exercise is contingent on the peer group identified. To ensure an appropriate group, it is important to have a broad pool to draw upon. As such, an exhaustive long list of all potentially suitable comparators has been developed (which have similar scope of SO functions).
2. Short list of comparator organisations - after identifying the long list, financial statements and annual reports are reviewed, and relevant costs information extracted.

3. Identification of high-level metrics - the cost information extracted from shortlisted comparators financial reports, is then analysed to generate high-level cost benchmarks. Various ESO specific costs are removed or excluded from the benchmarking exercise to improve comparability.
4. Geographies/time adjustments - **v**arious adjustments are applied, to ensure consistent comparisons between geographies and where relevant, between different years.
5. Normalisation - **t**he mapped metrics are then adjusted and normalised, to ensure like for like cost comparisons across shortlisted peers.
6. Cost benchmarking - **t**he adjusted and normalised comparators cost metrics are then benchmarked against the ESO cost information.

C.1.2 Stage 2 – granular cost benchmarking

1. Define granular comparator group - picking up from the long list of comparators identified in stage 1, a set of comparators for granular cost item level benchmarking are selected. This includes the US ISOs (subject to testing of comparability of cost breakdown) as well as any other companies, who collect and record cost items at a suitably granular and comparable level.
2. Cost groups - These are developed to compare granular costs across comparators. This could require multiple cost group mappings. When developing these cost groups, several characteristics are considered:
    - whether the line items constitute a material element of costs. (e.g. >5% of total opex)
    - whether are significant variations in cost between years; and
    - what is the correct apportionment to be consistent with comparators.
3. Aspirational comparators organisations **-** through a combination of desk-based research and internal stakeholder engagement, a list of aspirational comparators is identified. This group comprise of organisations that have some overlap in terms of functions related to the future direction of ESO and is validated by mapping cost line items with the cost groups identified in the previous step.
4. Granular normalisations / adjustments - an alternative set of measures which are able to account for scale and price levels at a more granular level can then be identified for specific cost groups. This could include measures such as:
    - Cost group scale - to normalise for the relative scale of a specific function, the relative alternative scale measures such as relative headcounts, could be considered.
    - Input prices - to account more accurately for input price differences, industry or factor level analysis could be undertaken.

The more granular efficiency analysis could include using econometric analysis to further improve comparability. Approaches could include simple correct ordinary leased squares, fixed effects and stochastic frontier analysis.

The remainder of this chapter describes the approach and initial results from stage 1.

C.2 Stage 1: High- Level Direct Operating Cost Benchmarking:

The first stage of the benchmarking exercise focuses on identifying appropriate comparators along with appropriate comparable measures of costs. The remainder of this section details the work undertaken so far, with data limitations and areas where additional work is required.

C.2.1 Defining the long-list of Comparator Organisations

An initial long list of potential comparators that may sharing similar characteristics with ESO, have been identified based on the following set of criteria including:

- economically developed countries where there is less variation in the wider regulatory environments and system operator requirements
- organisations with comparable functions, and
- organisations that operator in a similar geography, and have a similar scale.

The resulting long list of potential candidate countries and organisations is summarised below.

Table 1 - Proposed Long List of Comparators

Country	Type	Company	Company Name
Australia	ISO	AEMO	Australian Energy Market Operator
Austria	TSO	APG	Verbund - Austrian Power Grid
Belgium	TSO	Elia	Elia System Operator
Denmark	TSO	EN	Energinet.dk
Finland	TSO	FG	Fingrid
France	TSO	RTE	Réseau de Transport d'Électricité
Germany	TSO	TBW	TransnetBW
Germany	TSO	TTG	Tennet TSO
Germany	TSO	AMP	Amprion
Ireland	TSO	EG	EirGrid
Italy	TSO	TER	Terna
Norway	TSO	STN	Statnett
Norway	TSO	NOR	Nordpoll
Portugal	TSO	REN	Redes Energéticas Nacionais
Spain	TSO	REE	Red Eléctrica de España
Sweden	TSO	SVK	Svenska Kraftnät
Switzerland	TSO	Swissgrid	Swissgrid
USA	ISO	CAISO	California ISO
USA	ISO	NYISO	New York ISO
USA	ISO	ERCOT	Electric Reliability Council of Texas
USA	ISO	MCISO	Midcontinent ISO
USA	ISO	ISO-NE	New England ISO
USA	ISO	AESO	Alberta Electric SO

USA	ISO	IESO	Independent Electric SO
USA	RTO	PJM	PJM Interconnection
USA	RTO	SWPP	South West Power Pool
Ireland	ISO	EG	EirGrid
United Kingdom	ISO	SONI	System Operator for Northern Ireland

C.2.1 Short listing of comparators

From these potential comparators, the companies' financial statements and annual reports were reviewed to collect relevant cost information to use in the benchmarking.

The lack of formal separation of the SO function in many of the organisations has limited the availability of comparable data from those statements and accounts. The comparator group has been further reduced because we are seeking to benchmark direct operating costs of the equivalent of the ESO activities, other issues included:

- the available documents did not include the relevant segmented cost information
- the cost information extracted was not directly comparable with ESO cost components, for example Tennet, Svenka Kraftnat and SwissGrid
- for two companies, the financial statements only included revenues information.[19]

The process detailed above has identified nine comparator companies listed in the table below and the type of benchmarking that is currently achievable.

Table 2 - Proposed short list of comparators

Country	Company Name	High level	Granular
Australia	Australian Energy Market Operator	✓	✗
Norway	Statnett	✓	✗
United Kingdom	SONI	✓	✗
Ireland	Eirgrid	✓	✗
US	California ISO	✓	✓
US	New York ISO	✓	✓
US	Midcontinent ISO	✓	✓
US	New England ISO	✓	✓
US	PJM Interconnection	✓	✓

C.2.2 Developing the high-level metrics mapping

Using the shortlisted companies, the relevant comparative metrics were extracted from the financial statements.

Cost lines in the accounts and financial statements have been interpreted to seek to best-match with the ESO direct operating costs. Table 3 below provides the metrics that have been used for each of the organisations.

[19] Further adjustments may allow these to be used (subject to testing), these have currently been excluded (Terna and Elia).

Table 3 - High level metrics

Country	Company Name	Comparative Metrics
Australia	Australian Energy Market Operator	National Electricity market and National Transmission Planner opex (labour, contractor and consulting)
Norway	Statnett	System service costs
United Kingdom	SONI	opex (payroll)
Ireland	EIRGRID	opex (staff costs and contractors)
US	California ISO	Federal Energy Regulatory Commission (FERC) Form 1[20] cost data; aggregation of the account codes shown in the table below.
US	New York ISO	
US	Midcontinent ISO	
US	New England ISO	

For US ISO's the FERC Form 1 provides granular data over the period 2009-2018. An initial mapping exercise has been undertaken to align these granular costs with cost groups for ESO.

This mapping is summarised in the table below. It should be noted that the mapping is preliminary. Elements which have not yet been mapped are highlighted in red. The corresponding ESO cost items have been removed from the benchmark to seek to maintain consistency with peers. The cost groups which have not been included in the overall ongoing activities costs for this analysis are:

- market development and change
- code management (commercial)
- code management (technical)
- EU code change and relationships
- innovation business as usual activities and
- regulation business as usual activities.

Table 4: Mapping of ISO costs

Cost Groups	ESO detailed cost lines	FERC account code	FERC Form 1, line description
Control room	Operate the system - control room Control system support	560	Operation, supervision and engineering
		561	Load dispatching
		561.1	Load dispatch- reliability

[20] https://www.ferc.gov/docs-filing/forms/form-1/data.asp

	Data cyber and Artificial Intelligence Control system review	561.2	Load dispatch- monitor and operate transmission system
		561.4	Scheduling, system control and dispatch services
		575.1	Operation supervision
		575.2	Day-ahead and real-time market facilitation
		575.6	Market monitoring and compliance
Ancillary services (AS)	Managing existing AS markets Continued reform of ancillary service markets	575.5	Ancillary services market facilitation
Invoicing [billing, revenue shared services]	Charging - Settlements Charging - Revenue	901	Supervision
		902	Meter reading expenses
		903	Customer record and collection expenses
		904	Uncollectible acounts
		905	Miscellaneous customer accounts expenses
Capacity market	EMR stakeholder and compliance Capacity Market and CfD auctions EMR modelling	575.4	Capacity market facilitation
CUSC Grid Code Commercial/Technical	Market development and change Code management (commercial) Code management (technical) EU code change and relationships		Not mapped (Carried out by the ISO, but unclear where costs fall)
LT planning	*NOA* Network operability Market insights, future outlooks (leading the debate train)	561.5	Reliability, planning and standards development
		561.8	Reliability, planning and standards development services
Managing Bilateral contracting	Customer connections	561.6	Transmission Service Studies
		561.7	Generation Interconnection Studies

ST planning	Network Access Planning Energy Forecasting	561.3	Load Dispatch- Transmission Service and Scheduling
		575.3	Transmission Rights Market Facilitation
Innovation	Innovation BAU		Not mapped
			Regulatory Commission Expenses
Regulation	Regulation BAU RIIO 2 BAU		
Rates		928	
Running the business	Business Change BAU (moved to central function)		Not mapped
	Assurance BAU		
	Business Continuity		
		575.8	Market Facilitation, Monitoring and Compliance Services
	Data, transparency and insight	907	Supervision
Customer and Data	Publish User Friendly Info	908	Customer Assistance Expenses
	Customer & Stakeholder BAU	909 910	Informational and Instructional Expenses Miscellaneous Customer Service and Informational Expenses

C.2.3. Making adjustments for comparability

The information extracted requires adjustment to allow robust comparison across organisations. Preliminary adjustments have been made in this phase of the work. This has used a Purchase Power Parity (PPP) adjustment (2018 OECD[21] PPP index currency conversion rates) to eliminate differences in input price levels between countries. The index is a ratio of prices for a basket of goods and services which includes; household consumption, government services, capital formation and net exports.

The time series trend of ESO and comparable organisation costs, has been adjusted to bring all values to 2018 prices using the UK RPI inflation index as published monthly by the Office for National Statistics. In the next iteration, we will further refine this by running sensitivities also using the CPIH[22] index.

[21] http://www.oecd.org/about/
[22] Consumer Price Index - https://www.ons.gov.uk/economy/inflationandpriceindices

C.2.4. Identifying normalisation factors

The metrics also need to be normalised to eliminate various effects to make cost comparisons more like-for-like, for example:

- the relative scale of peers is a key driver of overall variation in cost across peers, with larger companies being more likely to realise potential economies of scale that may exist, and
- the complexity in terms of generating mix will also impact cost, this occurs through the inherent uncertainty associated with renewable energy sources which results in higher system operator costs.

These normalisations are likely to be material. For example, the charts below show two single factor normalisations that have been tested in this initial analysis. In these examples ESO goes from the lowest to one of the more expensive companies.

The post-adjustment figures presented below are then normalised for:

- population served, accounting for population differences, the results are presented in per capita units, and
- network service, adjusting for the kilometres of networks the organisation oversees.

Each is presented separately comparing ESO with the shortlisted comparators in 2018.

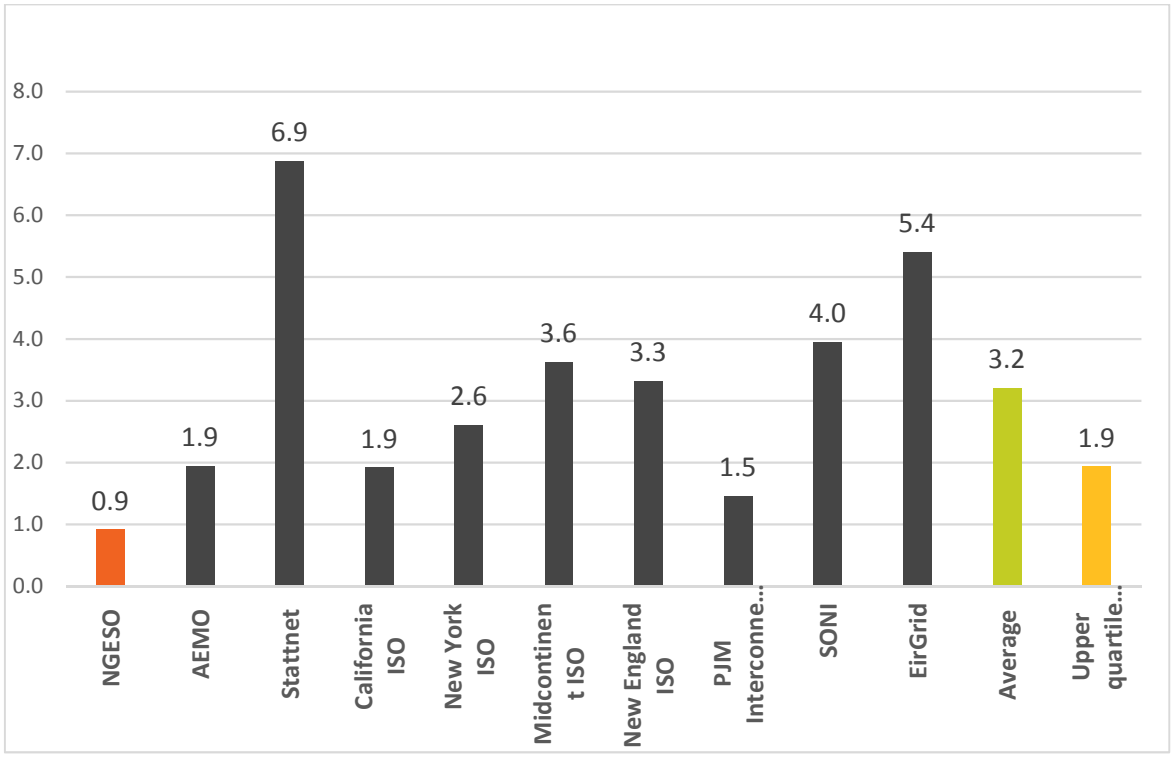


Figure 2- High-level benchmarking: direct operating costs per capita (£m, 2018 prices)

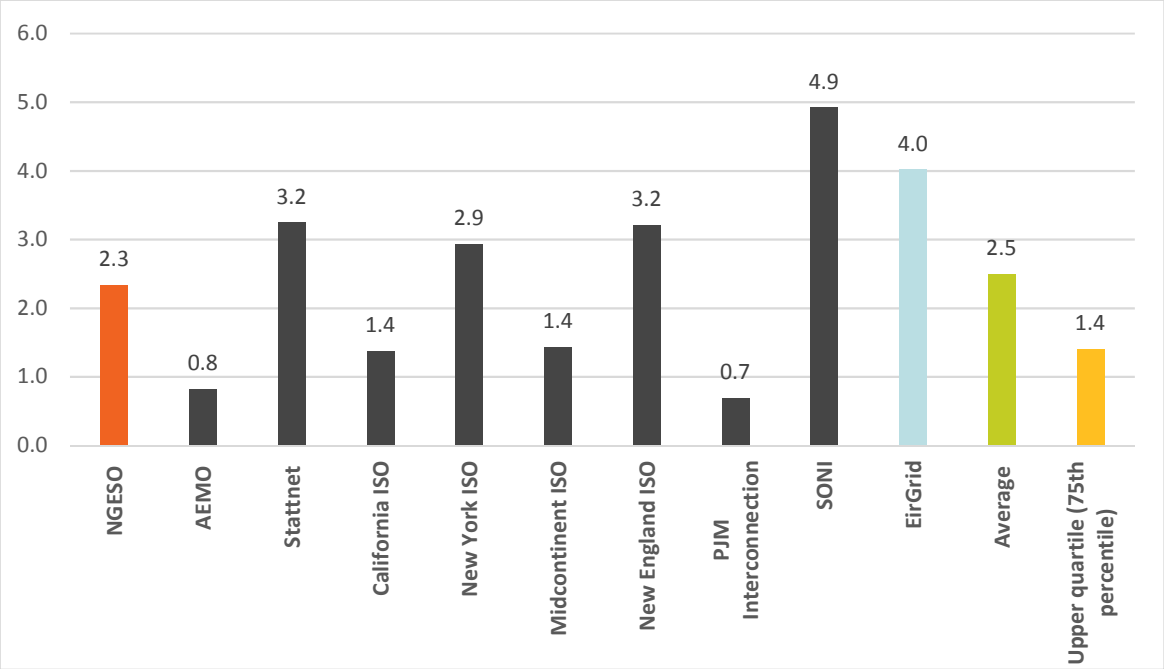


Figure 3 - High-level benchmarking: direct operating costs per km of network (£m, 2018 prices)

Work is ongoing to identify and test a full range of characteristics that should be controlled for now and future looking, and the appropriate metrics to use to make robust adjustments to the cost data. It is also noted that whilst we have adjusted for scale, economies of scale and scope have not currently been addressed. These early results should not be used or relied upon at this stage, we anticipate significant changes to the results.

C.2.5 High level metrics benchmarking output

The discussion above, details the steps undertaken to identify the organisations and the associated cost components, that are used in the initial ESO high-level cost benchmarking. It also highlights the potential complexity and limitations of this preliminary analysis.

This section provides early outputs that illustrate historical adjusted, but not normalised, cost trends versus the comparator companies. The costs are expressed in 2018 prices (using RPI index).

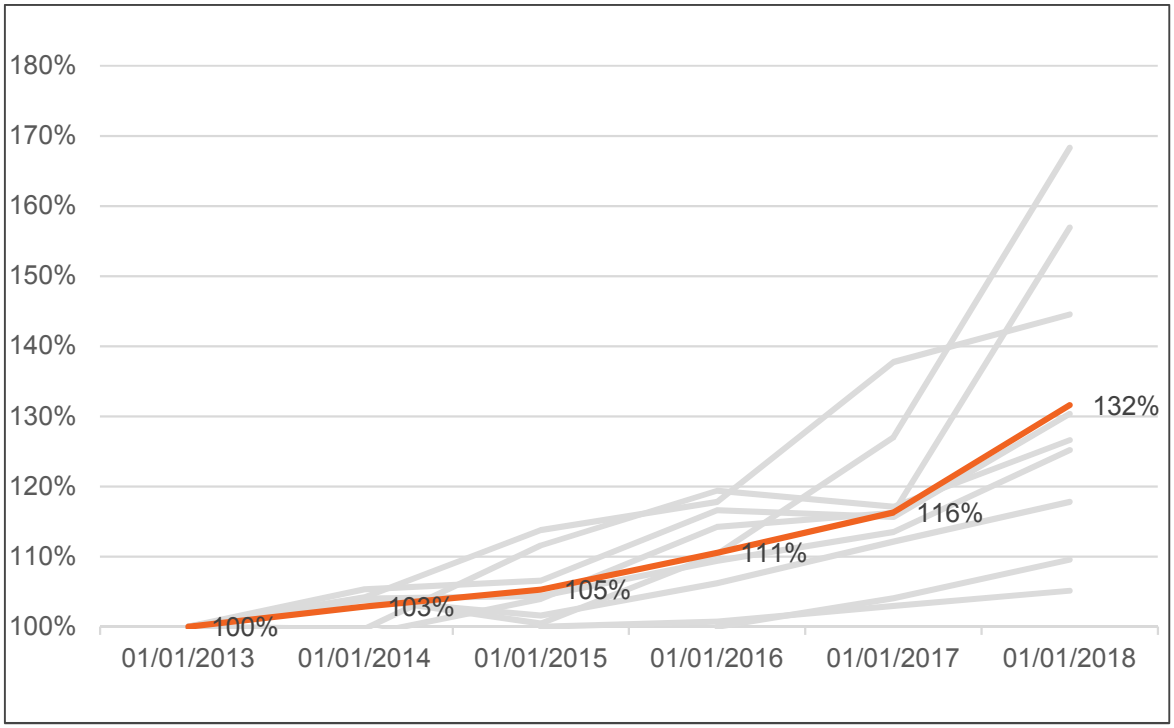


Figure 4 - Historic real costs index (RPI inflation adjusted)[23]

The orange line on the graph shows average increasing real costs through the period 2015-2018, with the grey lines individual organisations. Reviews of the commentary in the accounts and financial statements, suggest the main reason for this is that the organisations are seeing a transformation in the energy market, and an associated increase in complexity in managing the electricity systems.

Cleaner forms of energy like wind and solar are increasingly replacing traditional fossil fuel generation. These changes "will present huge challenges for the infrastructure and security of energy supplies, which lie at the heart of our role as GB's System Operator – and we too will need to evolve to meet these challenges if we are to remain at the heart of GB's energy system"[24].

The challenges mentioned by ESO translates to additional complexity and higher costs. This is also recognised by other system operators. For example, the Australian Energy Market Operator AEMO[25], in its final budget and fees report, the system operator notes "the changing energy environment is resulting in additional resources and investment being needed to manage: increased complexities of managing the grid day by day"[26]. Furthermore, the AEMO also states that "Labour increase includes increases in resources along with a provision for ongoing resources to manage the increasing complexity of our work. Consulting costs are higher in 2018-19. Consulting costs

[23] Note: the analysis presented above does not control for any normalisation factors such as the varying levels of complexity across various networks.
[24] https://www.nationalgrideso.com/document/140736/download page 2.
[25] https://www.aemo.com.au/
[26] AEMO Electricity Final Budget and Fees 2018-19, page 2

provisioned in 2018-19 include specialist advice and support relating to modernising our markets and managing the complexities of the grid”[27]

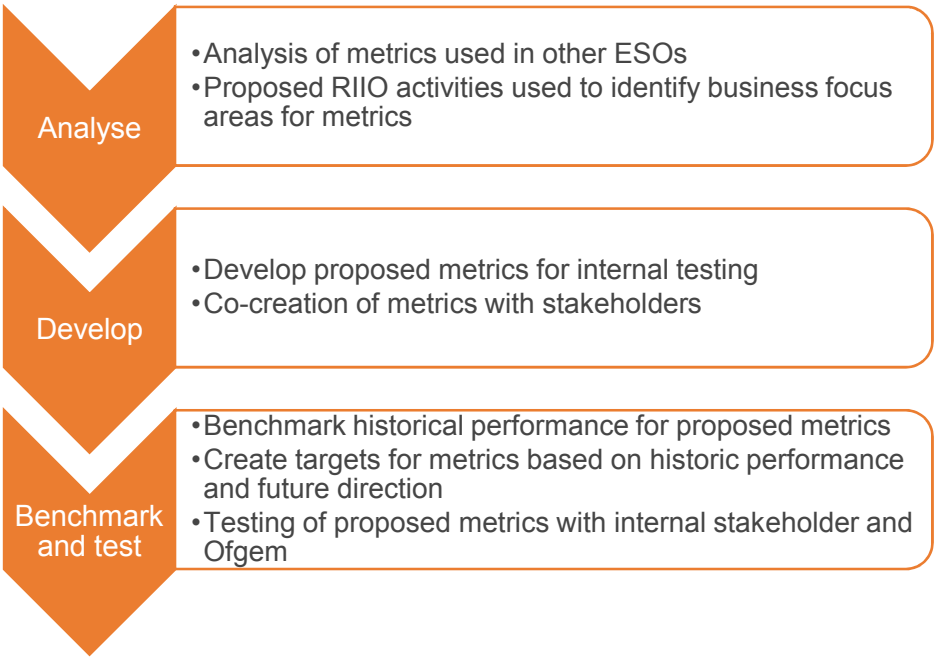
[27] AEMO Electricity Final Budget and Fees 2018-19, page 6

D. Metrics

We are currently in the process of developing our proposed metrics for RIIO-2. It is important for us as the ESO to ensure that our metrics reflect the ambitions that we will deliver to 2030, and provide a clear demonstration of the value that we are delivering for end consumers and industry. We want to ensure that our proposed activities are developed and communicated with stakeholders to enable a suite of metrics to be designed that are complementary. To that end we will propose RIIO-2 metrics in the October business plan, after developing these metrics with our stakeholders through the summer.

Alongside the requirement to demonstrate value, we will also be proposing metrics that provide clarity on the delivery of our outputs towards our 2030 ambitions alongside our ongoing activities, and are both benchmarked and auditable to ensure continued confidence in ESO delivery.

The development process for our metrics is set out below:



We will undertake an analysis of our proposed activities and suggest a suite of potential metrics. We will do this by understanding best practice in industry. Metrics will either be a measure of the ongoing performance of the ESO, or a measure of our delivery towards our 2030 ambition. This set of potential metrics will be tested internally and with Ofgem, with the intention of creating quality examples that can be used to support the development of remaining metrics for the business plan.

We recognise the importance of stakeholder co-creation for metrics and see this as a key success criterion for our metrics proposals. Through July and early August will be targeting trade association meetings, bilateral meetings and our hosted RIIO-2 events, as opportunities to gain views on what the ESO could measure, as well as testing our proposals. The results of this engagement activity will be contained within the business plan submitted to the Challenge Group on the 1 October.

Following this period of co-creation, we will undertake benchmarking of our historic performance against the proposed metrics in order to establish an understanding of consistent performance levels and set targets for the RIIO period.

We have included our *Forward Plan* metrics in our data tables to indicate the direction in which we are looking to develop the metrics that will be included in the October business plan. We will use our suite of *Forward Plan* metrics as the start point for our development during July and August using the approach set out above.

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