ESO RIIO-2 Business Plan Annex 1

1 October 2019

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A. Summary investment tables

These tables summarise the investments in the Business Plan and help navigate the cost tables.

Table 1 – Summary totex

ESO £m (18/19 prices)	Business plan location	RIIO-1	2021/22	2022/23	2023/24	2024/25	2025/26	2 year average	2 year total
Ongoing opex		70	69	70	71	71	68	69	139
Ongoing business support opex		18	15	15	15	15	15	15	31
Ongoing IT opex	11.1.	41	57	52	51	51	54	55	109
Ongoing business support capex		2	2	4	2	3	3	3	7
Ongoing IT capex	11.1.	63	49	47	34	30	33	48	96
Transformational opex	Annex 2	-	16	21	28	30	32	19	38
Transformational capex		-	35	47	59	53	45	41	82
Total		**194**	**244**	**257**	**261**	**254**	**251**	**250**	**501**
- Opex		***129***	***158***	***158***	***165***	***168***	***170***	***158***	***316***
- Capex		***65***	***86***	***99***	***96***	***86***	***80***	***92***	***185***
- Total		***194***	***244***	***257***	***261***	***254***	***251***	***250***	***501***
- Transformational opex & capex		***-***	***51***	***68***	***87***	***84***	***77***	***60***	***120***
- Ongoing opex		***70***	***69***	***70***	***71***	***71***	***68***	***69***	***139***
- Ongoing IT opex and capex	Section 3.1.3	***104***	***107***	***99***	***85***	***82***	***87***	***103***	***206***
- Ongoing business support opex & capex		***20***	***18***	***20***	***18***	***18***	***18***	***18***	***37***
- Total		***194***	***244***	***257***	***261***	***254***	***251***	***250***	***501***

Note: RIIO-1 number is based on a two year average for Opex, and an eight year average for Capex

Table 2 – Totex view by chapter

ESO £m (18/19 prices)	Business plan location	RIIO-1	2021/22	2022/23	2023/24	2024/25	2025/26	2 year average	2 year total
Theme 1	**Chapter 4**								
Ongoing opex		27	27	27	27	25	25	27	54
Ongoing IT opex		-	1	2	1	2	2	2	3
Ongoing IT capex	Annex 2 - CBA	23	6	7	5	5	5	7	13
Transformational opex		-	5	9	12	15	17	7	14
Transformational capex		-	18	30	41	36	27	24	48
Total	4.1. - Headline	**49**	**58**	**74**	**86**	**82**	**76**	**66**	**132**
- Opex	4.1. - Fig. 16	***27***	***33***	***37***	***41***	***42***	***44***	***35***	***71***
- Capex	4.1. - Fig. 16	***23***	***24***	***37***	***46***	***41***	***32***	***31***	***61***
Theme 2	**Chapter 5**								
Ongoing opex		13	16	17	19	20	18	17	33
Ongoing IT opex		-	8	4	4	4	6	6	11
Ongoing IT capex	Annex 2 - CBA	15	15	10	10	11	11	13	26
Transformational opex		-	8	7	8	6	5	7	15
Transformational capex		-	4	4	3	3	3	4	8
Total	5.1.- Headline	**28**	**51**	**43**	**44**	**44**	**43**	**47**	**94**
- Opex	5.1.4 - Fig. 23	***13***	***31***	***28***	***30***	***30***	***30***	***30***	***60***
- Capex	5.1.4 - Fig. 23	***15***	***20***	***14***	***14***	***14***	***13***	***17***	***34***
Theme 3	**Chapter 6**								
Ongoing opex		2	3	3	3	3	3	3	5
Ongoing IT opex		-	0	0	0	0	0	0	0
Ongoing IT capex	Annex 2 - CBA	-	0	0	-	-	-	0	0
Transformational opex		-	1	1	1	1	1	1	2
Transformational capex		-	3	3	3	2	1	3	6
Total	6.1. - Headline	**2**	**7**	**7**	**7**	**6**	**5**	**7**	**14**
- Opex	6.1.2 - Fig. 27	***2***	***4***	***4***	***4***	***4***	***4***	***4***	***8***
- Capex	6.1.2 - Fig. 27	***-***	***3***	***3***	***3***	***2***	***1***	***3***	***7***
Theme 4	**Chapter 7**								
Ongoing opex		13	15	15	15	15	15	15	31
Ongoing IT opex		-	0	0	0	0	- 0	0	0
Ongoing IT capex	Annex 2 - CBA	3	-	-	-	-	-	-	-
Transformational opex		-	3	4	6	8	9	3	7
Transformational capex		-	9	10	12	13	14	10	19
Total	7.1. - Headline	**16**	**27**	**30**	**34**	**36**	**39**	**29**	**57**
- Opex	7.1.2 - Fig. 32	***13***	***18***	***19***	***21***	***23***	***24***	***19***	***38***
- Capex	7.1.2 - Fig. 32	***3***	***9***	***10***	***12***	***13***	***14***	***10***	***19***

ESO £m (18/19 prices)	Business plan location	RIIO-1	2021/22	2022/23	2023/24	2024/25	2025/26	2 year average	2 year total
Open data	**Chapter 8**								
Ongoing opex		-	1	1	1	1	1	1	2
Ongoing IT opex	Annex 2 - 6.3	-	1	1	1	1	0	1	2
Ongoing IT capex		-	1	1	1	1	-	1	3
Total		**-**	**3**	**3**	**3**	**2**	**1**	**3**	**6**
- Opex	8.2.	***-***	***2***	***2***	***2***	***2***	***1***	***2***	***4***
- Capex	8.2.	***-***	***1***	***1***	***1***	***1***	***-***	***1***	***3***
It infrastructure	**Chapter 11**								
Ongoing IT opex	11.4.	41	47	45	45	45	45	46	93
Ongoing IT capex	11.4.	23	27	28	17	14	17	27	55
Total		**63**	**74**	**74**	**62**	**59**	**62**	**74**	**148**
- Opex		***41***	***47***	***45***	***45***	***45***	***45***	***46***	***93***
- Capex		***23***	***27***	***28***	***17***	***14***	***17***	***27***	***55***
Innovation	**Chapter 12**								
Ongoing opex	12.2.	0.4	0.8	0.8	0.8	0.8	0.8	0.8	1.7
Total		**0**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
- Opex		***0***	***1***	***1***	***1***	***1***	***1***	***1***	***2***
- Capex		-	-	-	-	-	-	-	-
Business Support teams	**Chapter 13**								
Ongoing business support opex	13.1.	18	16	16	16	16	16	16	32
Ongoing business support capex	13.1.	2	2	4	2	3	3	3	7
Total		**20**	**18**	**20**	**18**	**19**	**19**	**19**	**39**
- Opex		***18***	***16***	***16***	***16***	***16***	***16***	***16***	***32***
- Capex		***2***	***2***	***4***	***2***	***3***	***3***	***3***	***7***
Customer, stakeholder and regulation teams	**Chapter 14**								
Ongoing opex	14.1.	15	5	5	5	5	5	5.3	11
Total		**15**	**5**	**5**	**5**	**5**	**5**	**5**	**11**
- Opex		***15***	***5***	***5***	***5***	***5***	***5***	***5***	***11***
- Capex		-	-	-	-	-	-	-	-

Note: RIIO-1 number is based on a two year average for Opex, and an eight year average for Capex

B. ESO RIIO-1 story

B.1. The external environment

The electricity system has seen an unprecedented amount of change over the course of RIIO-1, 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 a 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 Electricity System Operator (ESO), well beyond the extent anticipated at the time of the RIIO-1 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.

B.2 Our performance in RIIO-1

In our detailed plan for System Operation, we set out three main aims for RIIO-1. These were:

- 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 included:

- 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 (RDPs)
- 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
- investing 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-1 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.

B.2.1 Key metrics, outputs delivered and performance against incentives

The ESO did not have its own RIIO-1 price control, but was integrated with the England and Wales transmission owner as National Grid Electricity Transmission (NGET). The incentives set generally apply to NGET but in some cases, for example the Balancing Services Incentive Scheme[5] (BSIS), incentives were wholly within the remit of the ESO. The ESO's portion of the RIIO-1 price control is shown below.

[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

Table 1 – ESO capex – forecast, allowance and outturn

ESO capex – forecast, allowance and outturn (£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	50.9	44.4	38.2	35.3	38.4
Latest allowance[6]	51.1	46.7	38.8	37.4	40.1

Table 2 – ESO opex – forecast, allowance and outturn

ESO opex – forecast, allowance and outturn (£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

B.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-1 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-1 period. It is not possible to apportion these between the ESO and NGET.

[6] Latest allowance proportion reflects the RIIO-1 allowances plus any reopeners.

Table 3 – Customer and stakeholder incentives

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

B.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 this between the ESO and NGET.

Table 4 – Environmental discretionary reward

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

B.2.4 Balancing spend

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.

Table 5 - ESO Balancing spend

ESO Balancing Spend (£m)					
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Target (old money)	960	957	1082	963.5	1,042

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

Target (new money)	1,048.4	1,025.0	1146.5	999.6	1,042
Incentivised balancing cost	970.8	922.7	917.6	985.5	999.7

B.2.5 Levels of return earned

Table 6 - ESO revenue

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

B.2.6 Dividends paid out

Prior to April 2019 NGESO[8] was part of NGET and did not have a separate dividend. NGET typically paid a dividend to maintain gearing approximately in line with the notional rate (60 per cent). Chapter 10 and Annex 5 provide more information about the dividend policy for the legally separate ESO in RIIO-2.

[8] NGESO - National Grid Electricity System Operator

C Benchmarking process

C.1 International benchmarking

This chapter provides more detail on the high-level benchmarking exercise we conducted as part of our approach to ESO cost efficiency. This approach is set out in Section 1 of the main document.

C.1.1 Defining the long-list of comparator organisations

We identified an initial long list of potential comparators that may share similar characteristics with the ESO. This was based on a 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
- organisations that operate in a similar geography and have a similar scale.

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

Table 7 - 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.1.2 Short listing of comparators

From these potential comparators, we reviewed the companies' financial statements and annual reports 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. In addition, the comparator group has been further reduced because:

- 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 revenue information.[9]

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

Table 8 - Proposed short list of comparators

Country	Company Name	High level	Granular
Australia	Australian Energy Market Operator	✓	X
Norway	Statnett	✓	X

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

United Kingdom	SONI	✓	X
Ireland	Eirgrid	✓	X
US	California ISO	✓	✓
US	New York ISO	✓	✓
US	Midcontinent ISO	✓	✓
US	New England ISO	✓	✓
US	PJM Interconnection	✓	✓

C.1.3 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 14 below provides the metrics that have been used for each of the organisations.

Table 9 - 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[10] 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 ISOs the FERC Form 1 provides granular data over the period 2009-18. An initial mapping exercise has been undertaken to align these granular costs with cost groups for ESO.

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

This mapping is summarised in the table below. 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
- regulation business as usual activities.

Table 10 - 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 Data cyber and Artificial Intelligence Control system review	560	Operation, supervision and engineering
		561	Load dispatching
		561.1	Load dispatch- reliability
		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 accounts
		905	Miscellaneous customer accounts expenses
Capacity market	EMR stakeholder and compliance	575.4	Capacity market facilitation
	Capacity Market and CfD auctions		
	EMR modelling		
CUSC	Market development and change		Not mapped (Carried out by the ISO, but unclear where costs fall)
	Code management (commercial)		
Grid Code			
Commercial/Technical	Code management (technical)		
	EU code change and relationships		
LT planning	*NOA*	561.5	Reliability, planning and standards development
	Network operability		
	Market insights, future outlooks (leading the debate train)	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	561.3	Load dispatch- transmission service and scheduling
	Energy forecasting		
		575.3	Transmission rights market facilitation
Innovation	Innovation BAU		Not mapped
Regulation	Regulation BAU	928	Regulatory Commission Expenses
Rates	RIIO 2 BAU		
Running the business	Business change BAU		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.1.4. 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[11] 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.

C.1.5. 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.

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.

[11] http://www.oecd.org/about/

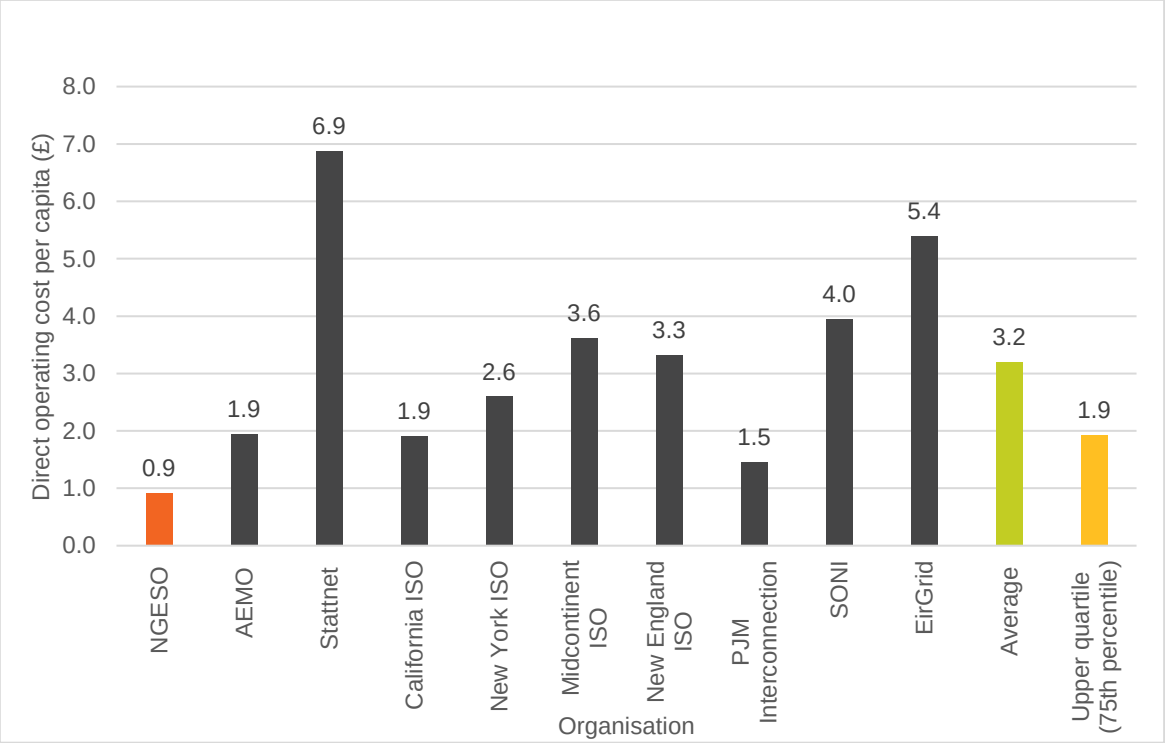


Figure 1- High-level benchmarking: direct operating costs per capita (£, 2018 prices)

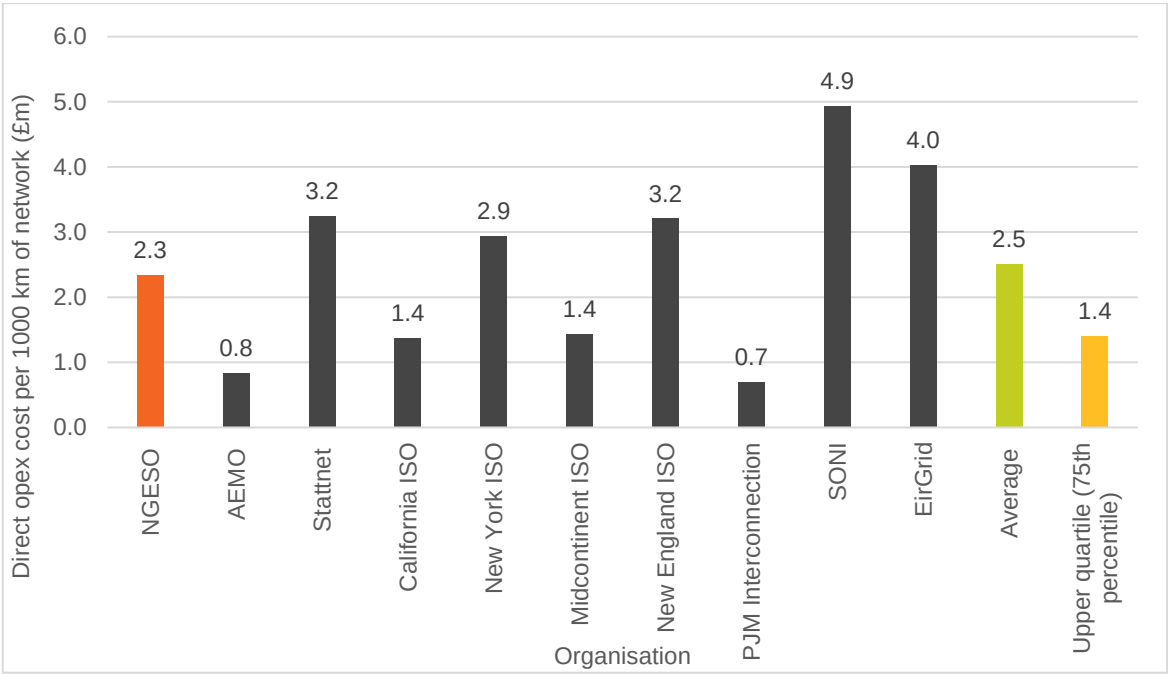


Figure 2 - High-level benchmarking: direct operating costs per 1000 km of network (£m, 2018 prices)

C.1.6 Benchmarking of cost trends

We conducted some high-level analysis of historical adjusted, but not normalised, cost trends versus the comparator companies. The costs are expressed in 2018 prices (using RPI index).

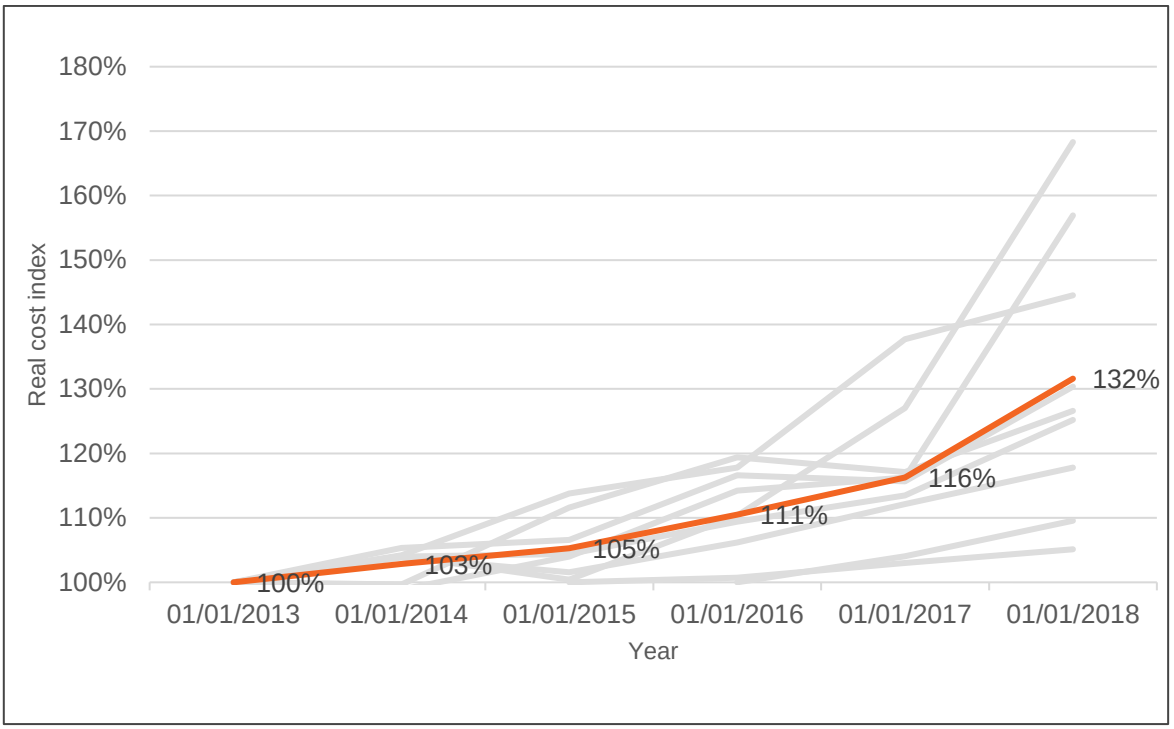


Figure 3 - Historic real costs index (RPI inflation adjusted)

The orange line on the graph shows average increasing real costs through the period 2015-2018, with the grey lines showing 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"[12].

The challenges mentioned by the ESO translate to additional complexity and higher costs. This is also recognised by other system operators. For example, the Australian Energy Market Operator AEMO[13], in its final budget and fees report notes "the changing energy environment is resulting in additional resources and investment being needed to

[12] https://www.nationalgrideso.com/document/140736/download page 2.

[13] https://www.aemo.com.au/

manage: increased complexities of managing the grid day by day”[14]. 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 provisioned in 2018/19 include specialist advice and support relating to modernising our markets and managing the complexities of the grid”[15].

C.2 Conclusion

We have taken a number of steps to adjust the available data to provide a high-level benchmarking exercise. There are complexities and limitations to the data that mean this analysis should be considered as part of a wider consideration of ESO efficiency, which includes more specific, cross-sector activity-based benchmarking as detailed in the main document.

[14] AEMO Electricity Final Budget and Fees 2018-19, page 2

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

D. Metrics

D.1 Introduction

Metrics are a key part of our business plan. An effective suite of regulatory metrics, endorsed by stakeholders and Ofgem, will provide clarity on the performance of the ESO against our plan. We have developed proposals for metrics that will demonstrate the value that we bring to the energy industry and the benefits that we both influence, and directly deliver, for consumers.

We have designed our metrics to demonstrate the performance improvement seen as a result of the delivery of our transformational activities. These activities in turn drive the benefits in our cost-benefit analysis detailed in Annex 2 'CBA Report'. Tracking our proposed metrics will therefore help to show how the benefits in our CBA report are being realised, providing a rounder picture of the wider value and benefits that can be realised from our proposals. We will include proposed targets as appropriate in our December business plan to demonstrate the level of performance improvement that we anticipate.

We will look to understand stakeholder feedback regarding our metrics and weather they provide enough clarity to provide an understanding of the wider value that will be delivered by our transformational activities.

D.2 Our development approach

To develop metrics for RIIO 2, we firstly developed criteria that built on:

- the metrics in our *2019-21 Forward Plan*
- feedback from stakeholders and Ofgem
- guidance provided by Ofgem.

A good metric provides clear standards of performance. For both our ongoing and transformational activities we have developed criteria to demonstrate the value that they provide. The criteria we developed are:

- **Measurability** – Can the metric be reliably measured?
- **Auditability** – can the calculation method to develop the metric be reliably audited internally and externally and provide confidence that the metric is robust and accurate?
- **Availability and appropriateness of historical benchmarks** – where appropriate availability of historical performance can be used to demonstrate performance improvement.
- **Link of historical performance to activity -** clear link between the activities that we are delivering in RIIO-2 and improvement in the relevant performance metric using historical data to establish baselines and set targets.
- **Link to value delivery** – ability to demonstrate the wider benefits from the metric.

We have worked with our teams and stakeholders to create a balanced set of metrics for our ongoing and transformational activities. We have utilised our Control Centre events and bilateral meetings to understand what our stakeholders believe to be the most effective measures for the ESO. We combined this feedback with feedback from Ofgem and have worked to develop a proposed set of metrics which we have then tested

externally at trade association events and in bilateral meetings. The feedback that we have received from stakeholders can be seen within this chapter as well as in the stakeholder report.

D.2.1 Use of Forward Plan 2019-21 metrics

We have used stakeholder feedback on the metrics in our *2019-21 Forward Plan* to inform the development of our metrics for RIIO-2. We propose to keep two of the existing metrics that have received positive stakeholder feedback on how they measure the ESO's performance. These metrics are:

- Customer value savings from *Network Options Assessment (NOA)*
- Code administration customer and stakeholder satisfaction.

D.3 Our proposed metrics

We have listed our proposals by theme, highlighting the activities that would be measured and providing some detail on the scope of the metric.

In our December business plan, we will provide baselines and proposed targets.

D.3.1 Theme 1

D.3.1.1 Summary of proposed metrics in Theme 1:

Table 11 - Proposed Theme 1 metrics

Activity	Metric	Frequency of measurement
Control centre architecture and systems	Balancing cost	Annual
	Stakeholder satisfaction on design authority	Annual
	Outages of critical national infrastructure (CNI) systems	
Restoration	Number of parties providing restoration services	Monthly
Commercial operations	Forecast accuracy for demand and wind	Monthly

These metrics align to our transformational activities and CBA as follows:

Table 12 - Metric alignment to transformational activities in Theme 1

Theme	Transformational activity	Supporting metric	CBA (5yr NPV £m)
1	Control centre architecture and systems	Balancing cost, Stakeholder satisfaction on design authority, Network reliability	£239
	Control centre training and simulation	-	£20
	Restoration	Number of parties providing restoration services	-£8

D.3.1.2 Balancing costs

We recognise the impact that the cost of balancing the network has on end consumers, during our RIIO-2 engagement events stakeholders have stated that is important we work to minimise balancing costs. We propose to measure and report the total balancing costs monthly in line with feedback from stakeholders. However, there are areas of balancing costs that have external and environmental factors which can strongly influence the total cost of balancing the network. We would like to work with both the industry and Ofgem to develop a metric that provides the confidence and visibility that stakeholders require while also reflects the leverage that the ESO has over balancing spend.

D.3.1.2 Demand and wind generation forecast

We propose to measure demand and wind generation forecast accuracy. Improved accuracy can directly value to consumers through enabling more of the market to self-balance, as well as helping the control room to make better decisions. We understand from stakeholder feedback on the *Forward Plan* that this is an important area, and one which they would like to see more progress in. We would like to explore stakeholder and Ofgem views further in this area to agree the most effective measurement method and ensure that we are providing the appropriate level of visibility to give confidence in our performance.

Similar to the approach in the *2019-21 Forward Plan*, we could be measured against a target set in advance.

D.3.1.3 Network Reliability

We propose to consider the outages of our CNI systems (for example our network control, scheduling and dispatch tools). The measure would be time of planned outage accuracy ± time of unplanned outages. In other words, we would be measured to accurately forecast and deliver planned outages, and minimise unplanned outages. We consider an unplanned outage to be an early or late conclusion of a planned outage, or an outage that was not planned (for example due to system failure). Given that outages of CNI systems increase costs for consumers due to reduced market fluidity causing increased balancing costs, there is a direct link to consumer benefits. Our proposals under Theme 1 should reduce unplanned CNI outage time, so there is a direct link to our

plan delivery. In our engagement, stakeholders have mentioned there is a lack of transparency from the ESO on system health, which this metric would address.

D.3.1.4 Design Authority

A stakeholder satisfaction survey of our design authority would complement the performance-based metrics above. The results from the survey can help us to enhance the service we provide to the industry through the design authority and ensure that value is being created. Our stakeholders would like to have a stronger view and influence of the

We propose a regular annual survey to members of the design authority and industry stakeholders to measure if the design authority is working for them. As no historic performance benchmark will be available a target based on historic customer and stakeholder satisfaction performance could be used for the first year. We would like to agree this with stakeholders to understand its appropriateness for the first year. The target could then be established for the second year once a benchmark set from actual year one performance is understood and appropriate performance uplift is applied.

Performance benchmarks

Current performance: 7.74 (stakeholder satisfaction result for 2018/19)

Proposed year 1 target: 7.74

Proposed target year 2 onwards: to be defined once year 1 performance understood

D.3.1.5 Restoration

A potential performance metric would measure the number of parties providing restoration services, commensurate with our intention to increase the competition. This is aligned to our ambition to operate a carbon free system and would increase the transparency of black start requirements and provisions. Increased competition will also support the lowering of bills to consumers and allow for more low carbon providers to contract in the market.

We will use historic data of the number of providers that are providing restoration services on average per year to set an initial benchmark and target values. We will include this in our December business plan.

D.3.1.6 Stakeholder feedback

In addition to the metrics described above we also engaged stakeholders on potential alternative metrics.

Stakeholders believe we should be measuring our ability to run a zero carbon system in line with our stated ambitions and while we agree that this would be a useful metric. We did consider a metric for the level of low carbon generation on the system, however we are also aware that as the ESO we need to be fuel agnostic and as such cannot have a metric that leads us to have a preference on fuels. Instead we have created proposals in our business plan which create the necessary markets to allow for a greater level of low carbon generation.

We did consult with stakeholders on a metric for our training simulator proposal, using the working method of a measure of the number of people who have been trained. We received feedback from our stakeholders that they do not believe that this metric is one that would provide visibility of the performance of the ESO. As a result, we have removed this metric from our proposals.

D.3.1.7 Transparency of control room decision making

During our engagement, some stakeholders called for a metric that would reflect the transparency of our control centre decision making. A commonly suggested metric was the percentage of times the control centre has dispatched in merit order. We do not believe such a metric would be appropriate because:

- there are numerous factors that our control centre engineers must balance when they make decisions, including the cost, timescale and location of any service they dispatch, as well as the overall operability picture. These must be considered together to judge whether a decision is in merit order – a discrete metric that selects some of these will not do this.
- we are already externally audited on our balancing decisions, as per Condition C16 of the Transmission Standard Licence Conditions. This is published on our website.
- such a merit order metric would not address the root cause of stakeholder feedback, which is transparency of our decision making.

We believe that our proposals under Theme 1 and Open Data, including the creation of a data platform to provide access to stakeholders of all the data we had to make a decision, and our subsequent actions, will provide the necessary levels of transparency. This will build on our Forward Plan work which includes plans to increase the transparency of our despatch decision making process.

D.3.2 Theme 2

D.3.2.1 Summary of proposed metrics in Theme 2:

Table 13 - Proposed Theme 2 metrics

Activity	Metric	Frequency of measurement
Build the future balancing service and wholesale markets	Proportion of balancing and ancillary services procured through competitive means	Quarterly with annual review
Code management / market development and change	For administration continued CSAT scoring. For code manager potential for evaluating consumer benefit of modifications undertaken	1. Annual 2. Quarterly / ad-hoc dependent on commencement of an activity
EMR	1. Ratio of pre-qualified capacity vs. capacity available in a T-1 and T-4 auction 2. Accuracy of T-1 and T-4 peak demand forecast	Following relevant auction Annual

These metrics align to our transformational activities and CBA as follows:

Table 14 - Metric alignment to transformational activities in Theme 2

Theme	Transformational activity	Supporting metric	CBA (5yr NPV £m)
2	Build the future balancing service and wholesale markets	Proportion of balancing and ancillary services procured through competitive means	£67
	Lead a review of wholesale, balancing and capacity markets	-	-
	Transform access to the capacity market	Ratio of pre-qualified capacity v capacity available in a T-1 auction	£62
	Transform the process to amend our codes	Consumer benefit of modifications undertaken	-
	Work with all stakeholders to create a fully-digitised, whole-system Grid Code by 2025	CSAT for code administration	£1
	Look at fully or partially fixing one or more components of Balancing Services Use of System (BSUoS) charges	-	£280

D.3.2.2 Balancing service and wholesale markets

We propose to measure the proportion of balancing services that are procured through competitive markets. We will do this by first identifying all the services that we think should be procured through markets to deliver the best outcome for consumers. We will then measure the proportion of these services (by appropriate unit such as MW of service requirement provided) procured through competitive means such as auctions or tenders as opposed to bilateral contracts. We will be able to monitor our progress over time and track the impact of key actions.

We will measure the spend across three different categories of service contracts that exist: Mandatory, Commercial (other bilateral arrangements) and Tendered (open, competitive markets) volumes to enable a more straightforward read across and allow for comparable units on a quarterly basis with an annual review. We will be proposing an appropriate target for this in our December business plan and will consider that there may always need to be a proportion of contracts that are procured on a bilateral basis as this can sometimes be the more cost-efficient option.

This will promote consumer value by using competition to help us procure the optimal volume of balancing services at an efficient price. This is a good thing to measure

because whilst many of the factors driving the ultimate costs of balancing services are outside of our control, the means of procurement are within our control.

Service providers and industry associations consulted have consistently told us that this would be an appropriate measure for the outcome we are seeking to achieve.

We also engaged stakeholders on a further two metric proposals:

- Reduction in procurement lead-time of services due to introduction of the single market platform.
- Increase in number of service providers following introduction of platform and revised service terms (to facilitate smaller providers).

We received very mixed feedback on these proposals with many service providers suggesting that simply measuring these numbers is not a good reflection of the quality of our outputs. We therefore need to engage further on these metrics to inform the decision on further development.

D.3.2.3 Code management / market development and change

For administration of codes we will continue to survey our customer satisfaction as part of the Code Administrator Code of Practice (CACOP) process. We will then be able to monitor our progress over time and track the impact of key actions.

In addition, for our code manager role there is the potential to measure how effectively we use our enhanced legal capabilities to help drive strategic change. We will investigate whether a measure of consumer benefits can be applied to modifications, with high value consumer benefits being targeted.

This will promote consumer value by ensuring we are improving the quality of service for our customers and prioritising code modifications that deliver the most benefits to consumers This is a good thing to measure because whilst many of the factors driving the ultimate costs of code administration and management are outside of our control, the level of service provided and codes modification prioritisation are within our control.

Service providers and industry associations have told us that this would be an appropriate measure.

D.3.2.4 Capacity market liquidity

As proposed earlier in the business plan we will be aiming to increase the liquidity of the capacity market during RIIO-2, to measure this we propose to measure the amount of capacity that successfully pre-qualifies against the amount of capacity that is available in both the Year ahead Capacity Auction (T-1) and Four year ahead Capacity Auction (T-4) auctions expressed as a ratio. This ratio between pre-qualified and available capacity can indicate the liquidity of the market, the greater the ratio the lower the cost to consumers through more competition in the marketplace.

We would propose this being an ex-post evaluative metric using the auction reports, calculated after the auction and reported annually. We will propose a target based upon our historical data in our December business plan with the baselines and targets being different for T-1 and T-4 auction due to the separate nature of the processes involved

We are also proposing a metric on the accuracy of both the T-1 and T-4 peak demand forecasts where we would measure the percentage difference between our peak demand forecast vs outturn peak demand. The accuracy of our forecasts impacts on how much capacity is secured in the auction vs security of supply, and therefore how much

consumers pay thus there is a direct benefit to consumers in the measurement and increased accuracy of the T-1 and T-4 forecast. We would measure target and report T-1 and T-4 separately for the same reasons above.

We propose to measure this as an ex-post evaluation following the delivery year, with T-1 and T-4 forecast and actuals benchmarked and targeted individually. We will be proposing our benchmarks and targets in the December business plan.

D.3.3 Theme 3

D.3.3.1 Summary of proposed metrics in Theme 3:

Table 15 – Proposed Theme 3 metrics

Activity	Metric	**Frequency of measurement**
Network development	Customer value savings from *NOA*	Annual
	Number of non-TO participants	Annual
	Participant mix and participant satisfaction	Quarterly

These metrics align to our transformational activities and CBA as follows:

Table 16 - Metric alignment to transformational activities in Theme 3

Theme	**Transformational activity**	**Supporting metric**	**CBA (5yr NPV £m)**
3	Transforming network planning through competition	Number of non-TO participants	£663
	Extending *NOA* to end of life asset replacement decisions	Customer value savings from *NOA*	-
	Extend the *NOA* approach to connections wider works	*NOA* Participant mix and Participant satisfaction	-
	Support decision-making for investment at the distribution level	-	-
	Support competition through helping establish the CATO regime.	-	-
	Review of the SQSS	-	-

	Implement and enhance improved analytical capabilities	-

D.3.3.2 *Network Options Assessments (NOA)*

Our *NOA* process drives economic and efficient outcomes from planning, developing and investing in the network. We have received positive feedback regarding our Forward plan metric of the value savings that are passed on to the customer. We propose to continue this metric in RIIO-2 as we continue to drive for optimal network solutions. To do this, we would propose using the calculation methodology set out in *Our Forward Plan*. We propose to set targets for the areas in which the ESO has control (this being either ESO exclusive options or ESO collaborative options and excluding TO exclusive options).

The metric would be calculated where the percentage of the overall *NOA* value generated by the options we are involved in exceeds the percentage they represent of the overall number of options in the optimal path. This shows that as ESO we are driving value through creating and influencing options to best meet system needs.

For reference, to meet our baseline target in the Forward Plan, the percentage of ESO exclusive and ESO collaborative options would be between 10 and 12 per cent of the total number of options in the optimal paths. The value they represent is between three and four per cent of the overall consumer benefit delivered by that *NOA* process. Alongside our measure of customer benefit saved from *NOA*, we would also propose measuring the percentage of different participant types that are in the *NOA* process. The context here is that we intend to expand the *NOA* to a wider range of participants to increase competition, enable us to identify the most efficient and effective network solution possible, and increase the potential for consumer benefits.

We would also propose supporting the participant-mix metric with a routine Stakeholder Satisfaction (SSAT) measure, which would help to inform how the *NOA* methodology develops in the future. As the expected variety of participants involved in the *NOA* process becomes more diverse, a measure of satisfaction from our process stakeholders will give us a wider range of perspectives from which to drive further improvements in the methodology.

Stakeholders have been supportive of the expansion of the *NOA* to other areas of network development as well as enhancing competition. Our proposed metrics in this area align to that view and support our ambition to create competition everywhere.

D.3.4 Theme 4

D.3.4.1 Summary of proposed metrics in Theme 4:

Table 17 - Proposed Theme 4 metrics

Activity	Metric	Frequency of measurement

Taking a whole electricity system approach to connections	Customer satisfaction	Annually
Network Operability	Balancing cost reduction through new operability approaches Capacity unlocked by our network operability processes	
Network access planning	Customer value opportunities	Quarterly

These metrics align to our transformational activities and CBA as follows:

Table 18 - Metric alignment to transformational activities in Theme 4

Theme	Transformational activity	Supporting metric	CBA (5yr NPV £m)
4	Taking a whole electricity system approach to connections	Whole electricity connection customer satisfaction	£2
	Taking a whole electricity system approach to promote zero carbon operability	Balancing cost reduction through new operability approaches	£469
	Delivering consumer benefits from improved network access planning	NAP customer value opportunities	£205
	Lead the debate	-	-

D.3.4.2 Taking a whole electricity system approach to connections

The number of connection applications to the network that we manage through our customer connections team has been steadily rising through RIIO-1 due to the increased activity and interest in developing distributed energy resource and the move away from centralised generation to more embedded connections continues to increase in RIIO-2. As a result, we are focusing on creating an efficient and effective experience for our customers through further process improvements and the implementation of a customer connections portal, as highlighted earlier. We are proposing a periodic customer satisfaction (CSAT) measure for our customers, where they can rate and comment on their connections experience. This will provide us with an understanding of both our performance and how we can improve our service to our customers.

D.3.4.3 Network operability

We are proposing to measure the savings in balancing costs that have been achieved through our new operability approaches. We would measure this through an outturn vs.

forecast calculation, with the forecast to be taken at a specified time. The implementation of new operability tools will help to reduce the cost of managing the network, which ultimately will mean increased value for consumers.

Additionally, we propose to measure the capacity unlocked by our network operability processes. These creates more space for more potential participants to enter the market by optimising the utilisation of existing infrastructure. Providing that the market is able to fill this capacity the increased competition could lead to a more diverse market through new connections resulting in a potential reduction in bills to end consumers.

D.3.4.4 Network Access Planning (NAP)

We propose to measure the customer value that has been created through by innovative ways of working with TOs and DNOs to release capacity across the whole electricity system, this metric closely aligns to our proposals set out earlier in the document and would measure the MWhrs of capacity saving created through a more efficient outage planning process through a counterfactual. This would then lead to the ESO taking less residual action allowing for a more efficient market outcome.

D.3.5 Open Data

Table 19 - Proposed Open Data metric

Activity	Metric	Frequency of measurement
Proportion of shareable data published	Data shared as a percentage of total data available	Monthly

We propose to measure the proportion of “shareable” data sets held by the ESO that we have published.

As noted above we will document the data sets that we hold and publish this list. In accordance with our presumed open policy we will work through the data sets and publish those that do not have any commercial, security, privacy or sensitivity risks. This metric will measure the proportion of the data sets identified through this process as shareable that we publish over time.

We have consistently been told that transparency of data is a key enabler of efficient markets and innovation. Our progress in data sharing is therefore a good measure of our contribution to efficient competitive markets and our role as a key enabler of innovation across the whole energy system.

Service providers and industry associations consulted have welcomed a metric along these lines.

D.3.6 Cross-ESO metrics

Table 20 - Proposed Cross-ESO metrics

Activity	Metric	Frequency of measurement
IT delivery	To be confirmed for December	
Customer and stakeholder satisfaction	Customer and stakeholder survey	Annually

D.3.6.1 IT Delivery

With technology being inseparable from our ambition, we have heard from stakeholders that they believe it is important for the ESO to measure the delivery of our activities and a metric tracking technology implementation would provide confidence. We need to understand the most effective measurement that incorporates agile delivery and increased stakeholder engagement. Further detail on this metric will be included in our December business plan.

D.3.6.2 Customer and stakeholder satisfaction

Alongside the activities where we have specified potential customer satisfaction survey metrics to understand performance, we propose to continue to undertake an ESO customer satisfaction survey to ensure that we are maintaining and improving the service that we deliver to our customers and stakeholders. We will use our RIIO-1 performance to set realistic benchmarks and targets as appropriate and will report annually our average satisfaction survey scores.

D.4 Stakeholder engagement on metrics

During our stakeholder engagement activities over the summer including the workshops at the Electricity National Control Centre, we asked stakeholders the open question ‘based on the proposed activities in the business plan, how should we measure the performance of the ESO?’ The overarching view from our stakeholders is that they would like to see a suite of metrics that makes the performance of the ESO clear and visible. They were also keen to see the ESO being measured on the delivery of its activities to achieve the ambition, recognising the importance of ESO delivery to the rest of industry.

Following this initial engagement, we then sought feedback on proposals for metrics in each area. We met with a number of industry associations and groups to test our proposals in August and September. The feedback on the proposals for each theme is captured above.

Within the stakeholder report is detailed feedback from our stakeholder events held during July in the Wokingham control centre as well as engagements with industry associations in August and September.

D.5 Further developments

As stated in most of our proposed metrics we will be including relevant benchmarks and targets for our performance in our December business plan. We will also be gaining specific stakeholder feedback on our metric proposals at our October business plan event on the 2 October. We will also be engaging further at industry events and bilateral meetings throughout October.

E. Assumptions about our role and that of other parties

The energy landscape in 2030 will be significantly different to today and the exact scale and pace of this transition is still uncertain, with policy, technology and societal attributes being challenging to predict.

Our ESO business plan is based on *Future Energy Scenarios* (*FES)* 2019[16], which is developed following a highly collaborative stakeholder engagement process, representing views across different fuels, networks and sectors.

Ofgem issued guidance to other RIIO-2 companies to ensure consistency across the RIIO-2 business plans. RIIO-2 companies should "design their baseline revenues around parameters which are no greater than the lowest point of the ranges provided in the ENA Scenario Working Group report, and ensure that their plans can flex," around the ENA common view. While this guidance was not specifically for the ESO, we believe that consistency across networks and fuels is essential to fully understand the whole energy system. The view from *FES* 2019 is no greater than the lowest ENA common scenario range.

E.1 Assumptions tables

Our business plan also makes several more specific assumptions about our role and our interactions with other parties. We have grouped these into four categories:

A. Future power system operation
B. Future markets
C. Future governance
D. Future relationships with network operators, network owners and other parties.

The tables below list our assumptions, their categorisation and our confidence. The impacts are based on the assumption **not** being realised.

E.2 Theme 1: Ensure reliable, secure system operation to deliver electricity when consumers need it

E.2.1 Control centre architecture and systems

Table 21 - Control centre architecture and systems assumptions

Assumption	Category	Confidence	Impact if the assumption is not realised			
			Activity	Timeline	Cost	Benefit
The energy landscape continues the transition to increased levels of smaller,	A	High	Would pursue like-for-like incremental solutions	Potentially similar or longer as would make changes while	Higher opex in control room due to less automation	Less benefit realised as balancing costs remain

[16] http://fes.nationalgrid.com/fes-document/

intermittent renewable and distributed generation		control centre online	high and less efficient use of low carbon plant

E.2.2 Control centre training and simulation

Table 22 - Control centre training and simulation assumptions

Assumption	Category	Confidence	Impact if the assumption is not realised			
			Activity	Timeline	Cost	Benefit
Academia are interested in developing a course	D	Medium – based on stakeholder feedback	Run own qualification and more in-house training	Development of enhanced training would take longer	Extra FTE needed	Same benefit, likely pushed back
Sufficient attraction rate to a course	D	High, based on conversations with academia	Go for direct entry	No impact	Potentially decrease	No guarantee of pipeline of talent into industry
DNO interest in using our training facilities	D	Medium	Potentially less people coming through	Dependent on DNO to distribution system operation transition – potentially pushed back	Depends on numbers, could decrease	ESO would keep more trainees

E.2.3 Restoration

Table 23 - Restoration assumptions

Assumption	Category	Confidence	Impact if the assumption is not realised			
			Activity	Timeline	Cost	Benefit
New restoration standard implemented	A, C	High	If not, decreased requirement for assurance	None	Less cost incurred	Less benefit – restoration timescales

			activities and collation			not guaranteed
ESO is funded to implement standard in 2020/21	A, C	Medium	Delay to restoration standard implementation	Up to 12 months delay	None	Less benefit to same timescale
NIC project will deliver expected services or volume of services	A	Medium	Less requirement to implement solutions	None	Less cost incurred	Less, benefits for shorter timescales due to increase in black start provision not realised

E.3 Theme 2: Transforming participation in smart and sustainable markets

E.3.1 Transforming participation in balancing markets

Table 24 - Transforming participation in balancing markets assumptions

Assumption	Category	Confidence	Impact if assumption is not realised			
			Activity	Timeline	Cost	Benefits
Theme 1 work is carried out	A	Medium	Be unable to fully deliver the ambition	Delayed	None	Less, as not able to fully realise new markets
Increased distributed generation, distribution system operation and flexible assets	A	High	No change	Delayed – may need to create intermediate steps	No change but incurred later	Less, as fewer participants smaller “size of the prize”
Continued capacity market or reform of the balancing mechanism	B	High	Continue with platform, but without capacity	None	None	Less, as smaller “size of the prize”

			market element			

E.3.2 Designing the markets of the future

Table 25 - Designing markets of the future assumptions

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefit
Large volumes of zero marginal cost generation (i.e a change to the market to justify a review)	B	High-medium	Delay / re-plan the review	Delayed	Removed, or incurred later	N/A – would be dependent on output of review

E.3.3 Transform access to the capacity market

Table 26 - Transform access to the capacity market assumptions

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefits
Capacity market restarts after European Court of Justice standstill order	B	High	All CM activities would stop, unless or until another CM type market was put in place	Delayed, or incurred later	Removed, or incurred later	Less, as all CM benefits are removed
CM rules are transferred to the ESO	C	High for some rules; medium overall	Another body administers CM rules	No change	Limited - potential small decrease part of existing FTEs	Limited, potential small decrease as synergies are reduced

Increase in small scale, renewable and interconnection to provide security of supply	A	High	Additional modelling team would be under used	No change	No change	Potential for small increase as traditional generation easier to model

E.3.4 Develop codes and charging arrangements that are fit for the future

Table 27 - Develop codes and charging arrangements that are fit for the future assumptions

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefit
Stakeholder support for regulatory change (energy codes review)	C	High	Stop or review the activity	Potential to delay the process	Reduced costs if not undertaken	Less benefits
Licence change to empower ESO	C	Medium	Stop or review the activity	Potential to delay the process	Reduced costs if not undertaken	Less benefits
Positive outcome from BSUoS review	C	High	Stop or review the activity	Potential to delay the process	Reduced costs if not undertaken	Less benefits, based on our report – potentially realised elsewhere

E.4 Theme 3: Unlocking consumer value through competition

Table 28 - Unlocking consumer value through competition assumptions

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefit
Network operability will become more difficult and expensive	A	High	No change	Moved backwards	Moved backwards	Less in RIIO-2

Competition will be available to encourage more solutions	B	High	Network needs would continue to be met by incumbent TOs	Moved backwards	Costs associated with competitive processes to source alternative network solutions would not need to be incurred	Network needs would continue to be met by incumbent TOs, the efficiency of which would not be tested against other potential solutions
There will be a BM which the ESO can use to fix network issues in lieu of other options. This remains the counterfactual for all *NOA*-related activities	B	High	A suitable alternative would be needed	Moved backwards	Increase, as would need to incorporate an alternative into our analytical process	Depends on alternative counterfactual. In theory, the result should be similar
Key role for the ESO is to highlight the need for network capabilities and facilitate assessment and recommendation of the most efficient option	D	High	Reduced range of potential solutions	Moved backwards	Decrease – less cost associate with competitive processes	Less in RIIO-2
DNOs will have funding and resource necessary to feed in options to a *NOA*-type process	C, D	Medium – depends on RIIO-ED2 and Ofgem implementing whole system licence conditions	Reduced	Pushed back	Reduced	Not realised

E.5 Theme 4: Driving towards a sustainable, whole-energy future

E.5.1 Taking a whole electricity system approach to connections

Table 29 - Taking a whole electricity system approach to connections

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefit
More non-traditional and “needs guidance” parties wanting to connect, due to continued push for a low-carbon future and an open and competitive market	A, B, C	High	Levelling off in connection activity	Timeline for portal and connections work would remain the same	No change, but would need to consider how to fund the portal if spread across fewer participants	Less benefit realised as less participants benefits from our work creating a simplified process and easier route to market.
No change to licence conditions - we are contract holder for connection and manage the commercial process	C, D	High	Connections work would still need to be done, but potentially by a different party or parties	Depends on licence conditions	Same, possibly incurred by a different party	Same, possibly realised by a different party
The connection platform is a whole system tool, starting with transmission and then moving to distribution	B	High	A reduced roll-out if only implemented by transmission companies	Faster roll-out	Reduced, as reduced roll-out	Reduced, as smaller “size of the prize” and continued complexity
RIIO-ED2 aligns the objectives of DNOs to	C, D	Medium	A reduced roll-out if only	Faster roll-out	Reduced, as reduced roll-out	Reduced, as smaller “size of the prize” and

wider industry (regarding connection portal concept)	implemented by transmission companies	continued complexity

E.5.2 Taking a whole electricity system approach to promote zero carbon operability

Table 30 - Taking a whole electricity system approach to promote zero carbon operability

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefit
Decentralisation of generation and flexibility services	A	High	If less, reduced work If more, likely to "firefight"	If less, flatten off If more, work pushed back	If less, decrease – no need to spend If more, increased balancing cost	If less, fewer opportunities to realise benefit If more, benefits reduced and pushed back
DNO to distribution system operation transition takes place	A	High on need; transition rates may vary between DNOs	Potential need to do more work and early on while they figure themselves out. Work could vary between different DNOs	Depends on transition	Slower transition would lead to less risk of increase in short term costs, but may push costs back Faster transition could lead to more costs if firefighting	A transition done too quickly could reduce innovation. Transition needs to be agreed across industry and coordinated to ensure short and long-term benefits.
Greater decarbonisation	A	High	Unlikely to change as would deliver on	Unlikely to change	Unlikely to change	Unlikely to change

			decarbonisation ambition in line with customer wishes			
Change to whole system network planning and standards across transmission and distribution	C, D	Medium	No need for changes to codes and framework	N/A	Possibly higher due to inefficiency and uncoordinated work	
DNOs funded for new ways of working	C, D	Medium – depends on RIIO-ED2 and Ofgem implementing whole system licence conditions	Reduced	Pushed back	Reduced	Not realised

E.5.3 Delivering consumer benefits from improved network access planning

Table 31 - Delivering consumer benefits from improved network access planning

Assumption	Category	Confidence	Impact if assumption not realised			
			Activity	Timeline	Cost	Benefit
More decentralised generation	A	High	If less, then less need to interact with DNOs than would otherwise be the case	Same timeline	Decrease – less FTE needed	No opportunity to realise benefits
DNO to distribution system operation	A	High	Slower or no transition – as above	If slower, as above	If slower, as above	If slower, as above

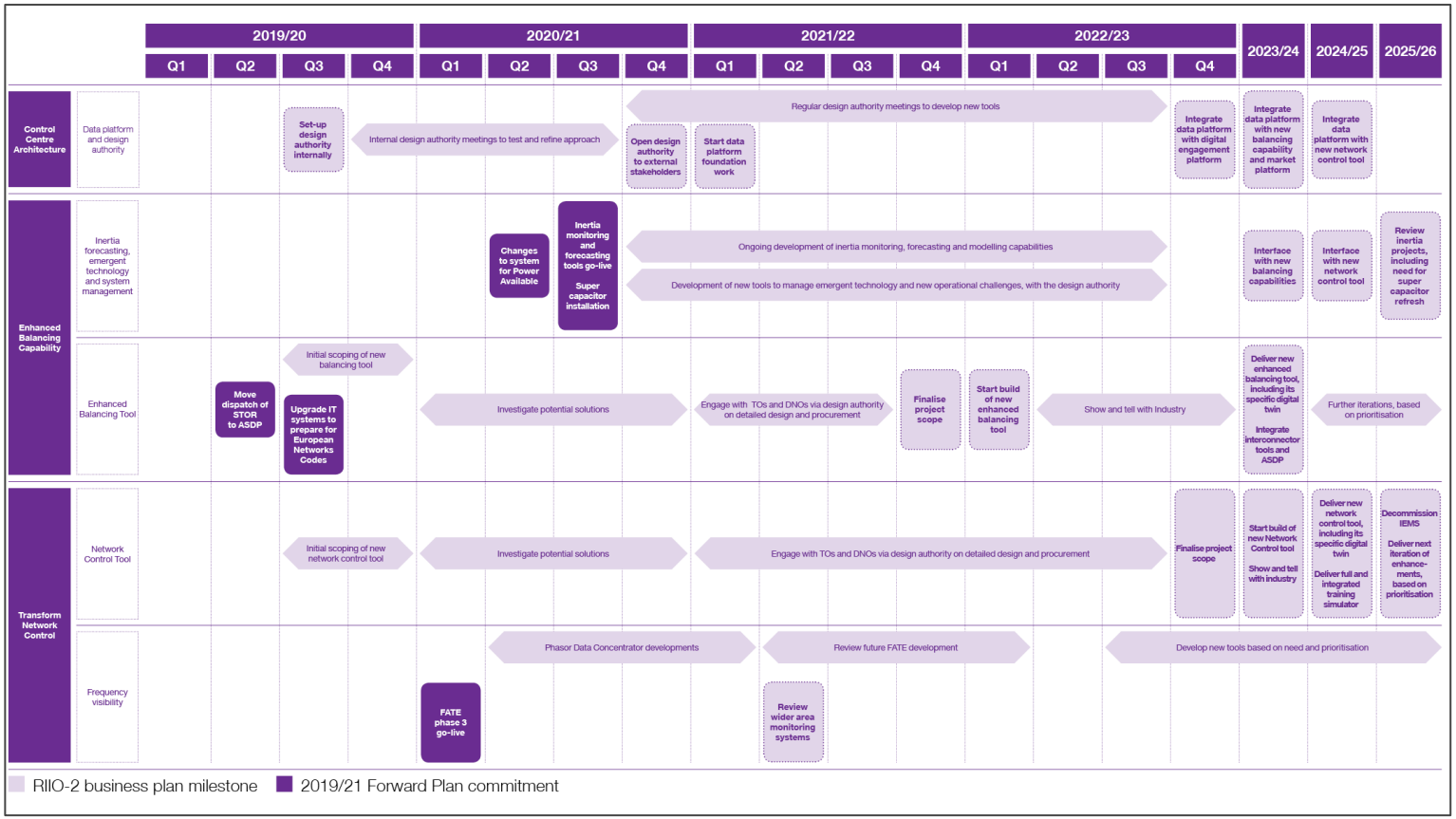
transition, with more active network management from DNOs			Quicker transition – large increase in work	If quicker, would need to bring forward	If quicker, most cost and earlier on	If quicker, same benefit but shifted with timeline
Increased need for flexible system access due to intermittent and unpredictable generation	A, D	High	If did not happen, no need for probabilistic assessment	N/A	Decrease	No opportunity to realise benefits

F. Investment roadmaps

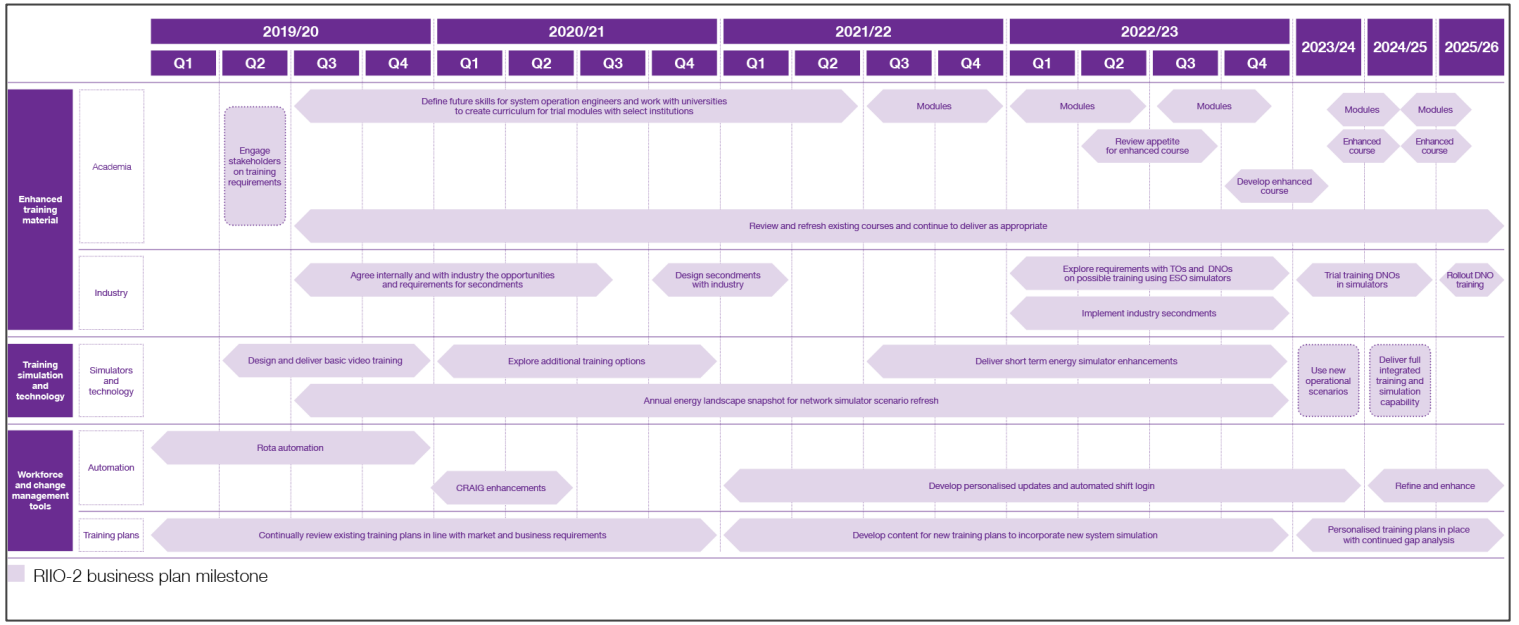
In each of the Theme chapters in the main business plan and in the Open data chapter, there are investment roadmaps against the different activities. To view these with more ease, see the diagrams below.

F.1 Theme 1

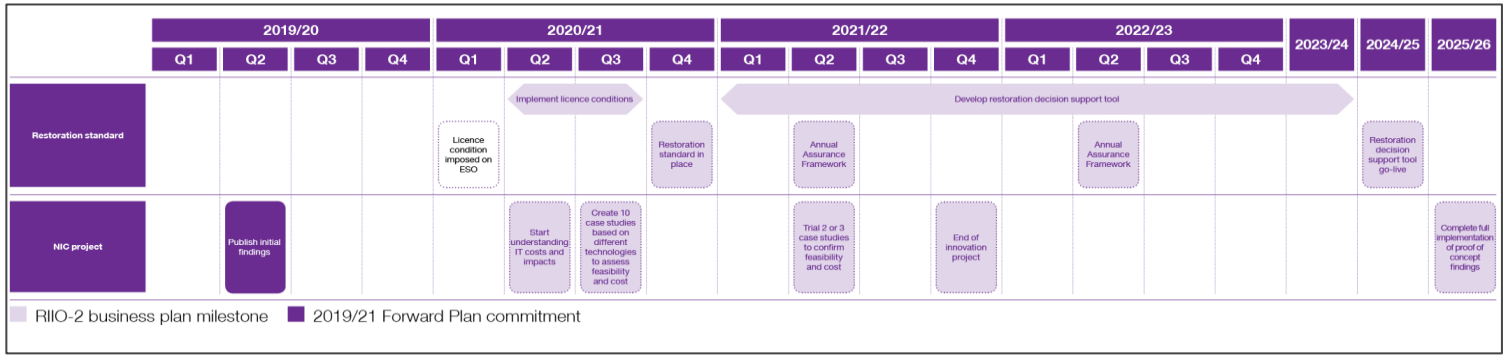
Section 4.2 - Control centre architecture and systems roadmap



Section 4.3 Control centre training and simulation roadmap

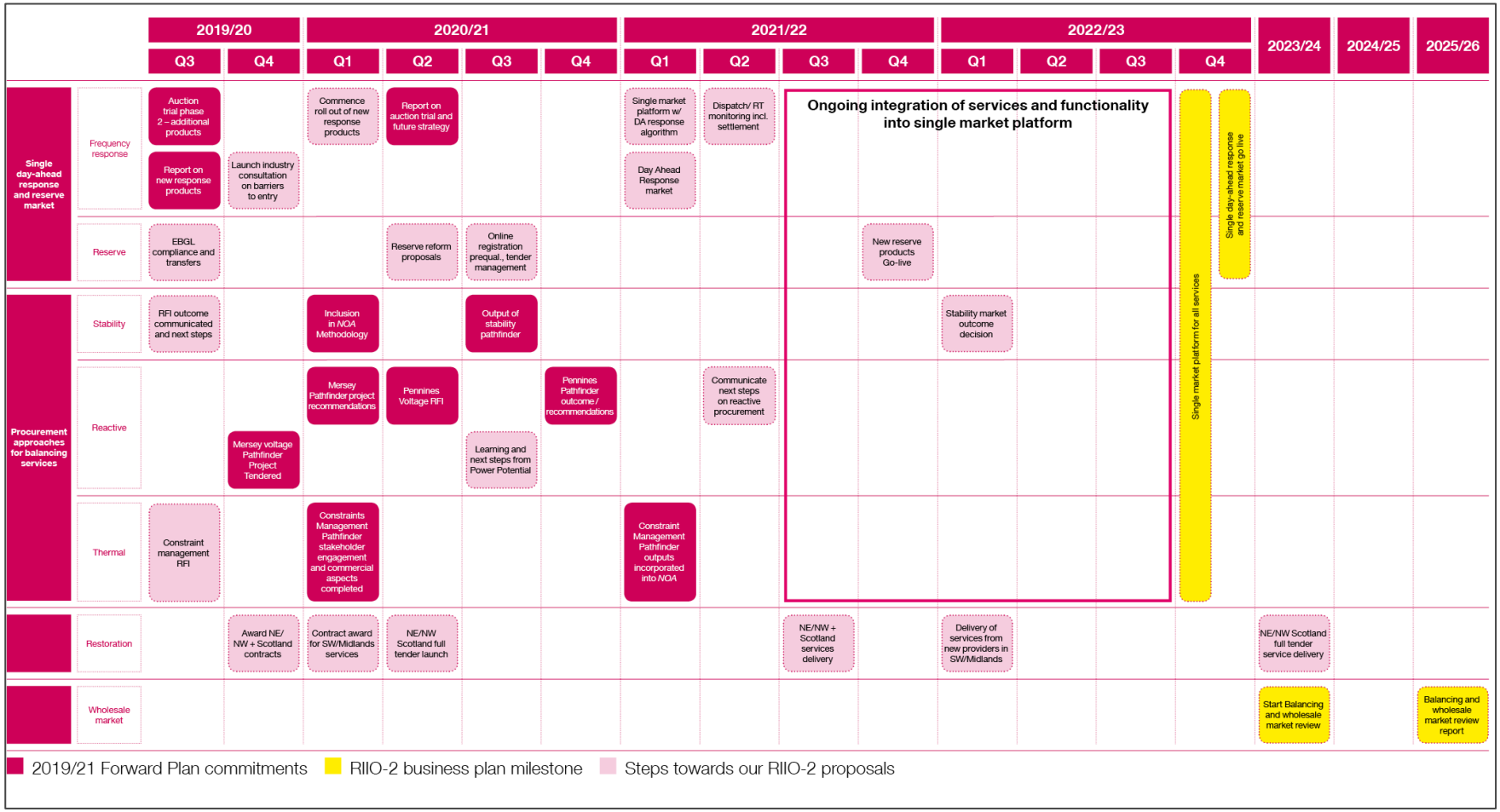


Section 4.4 – Restoration roadmap

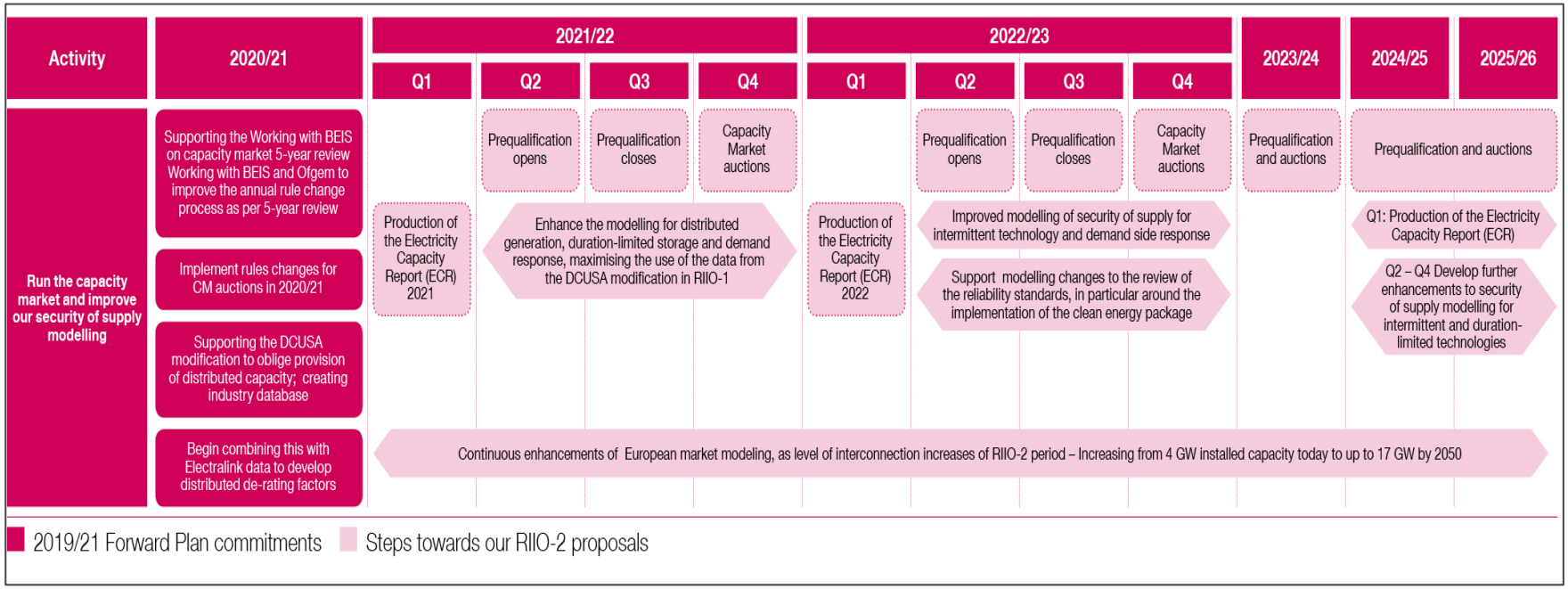


F2 Theme 2

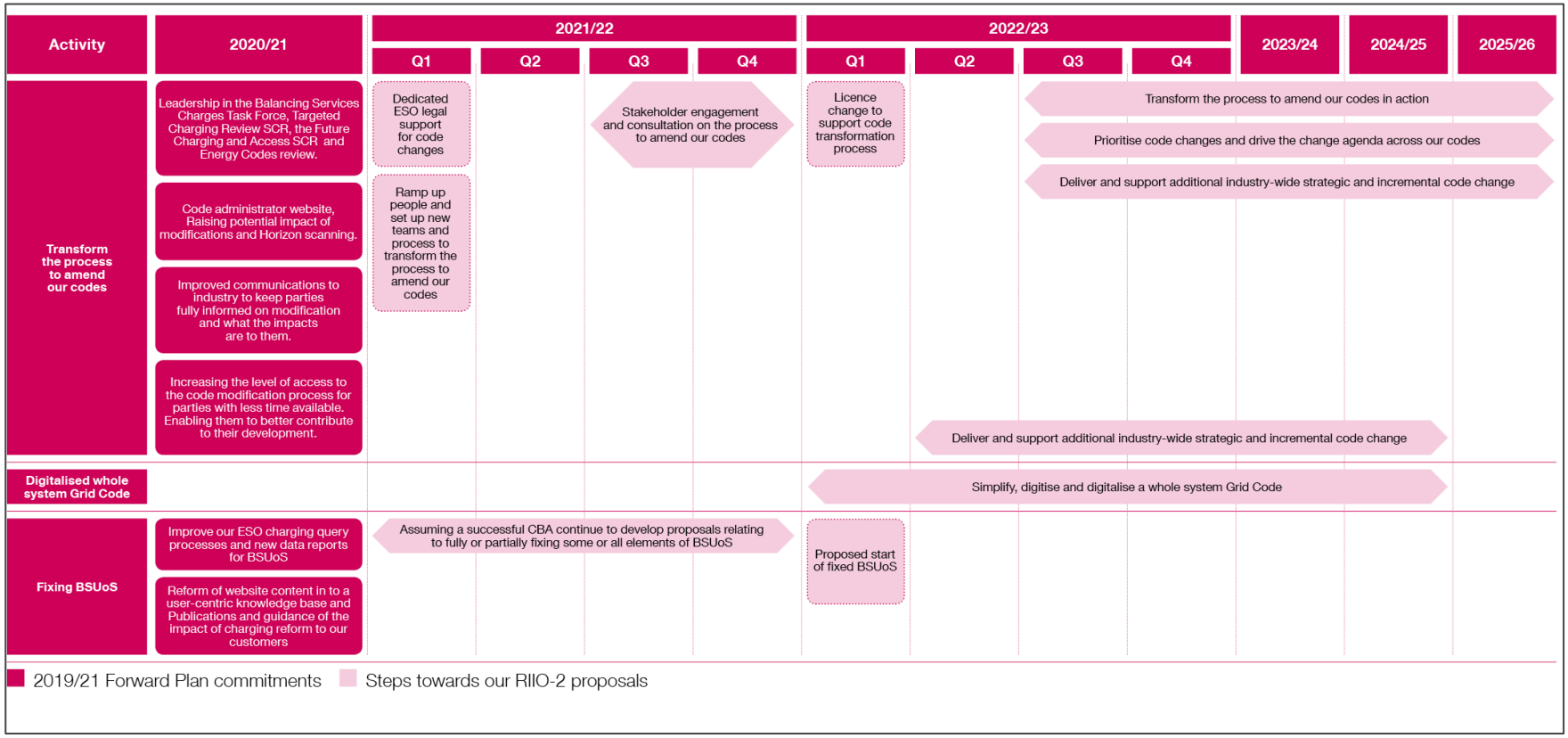
Section 5.2 - Build the future balancing service and wholesale markets roadmap



Section 5.3 – Transform access to the Capacity Market roadmap

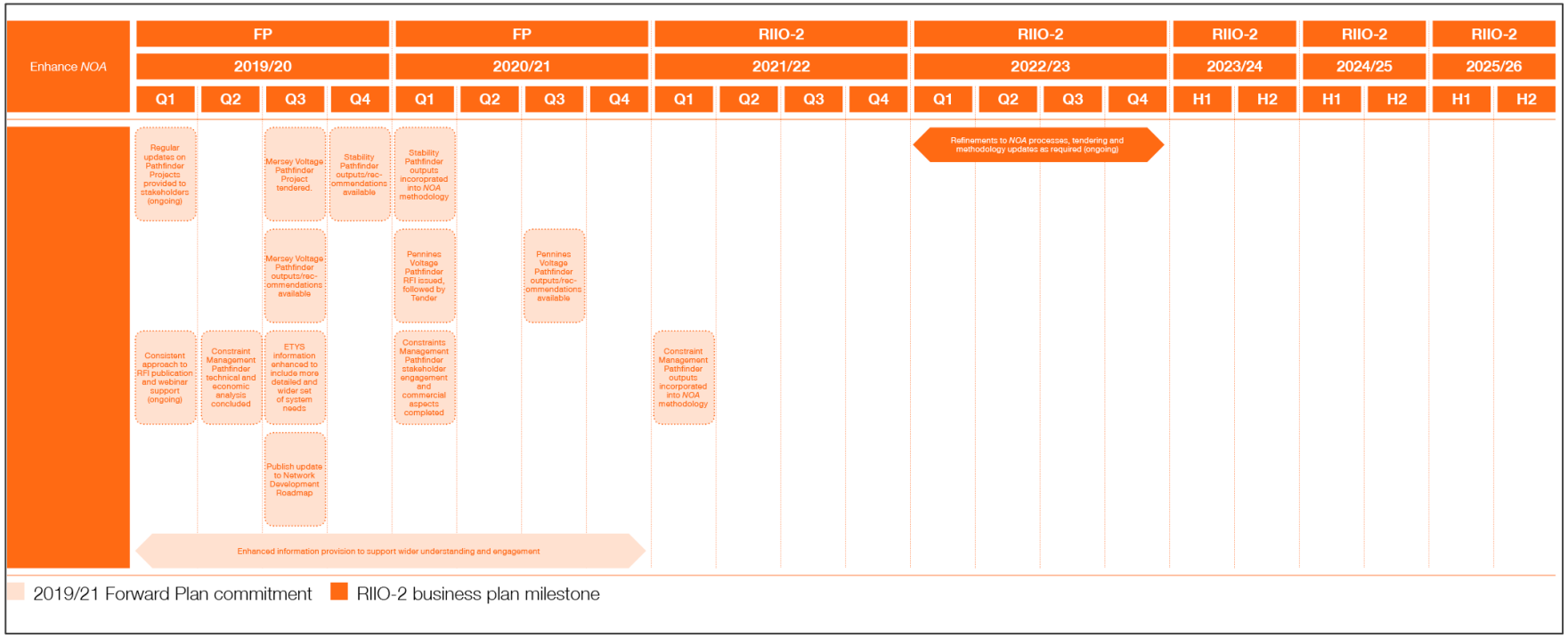


Section 5.4 – Develop code and charging arrangements that are fit for the future

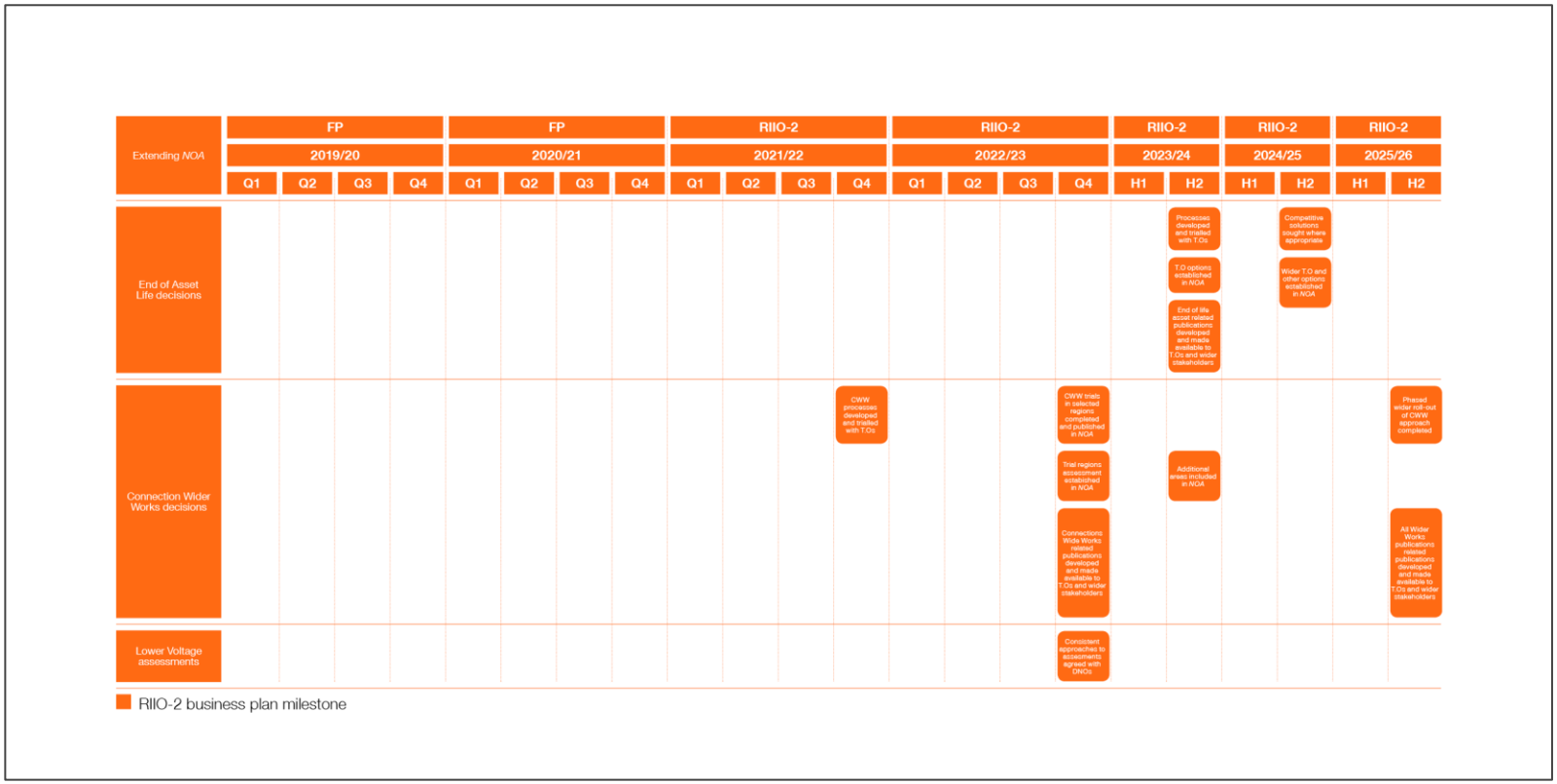


F3 Theme 3

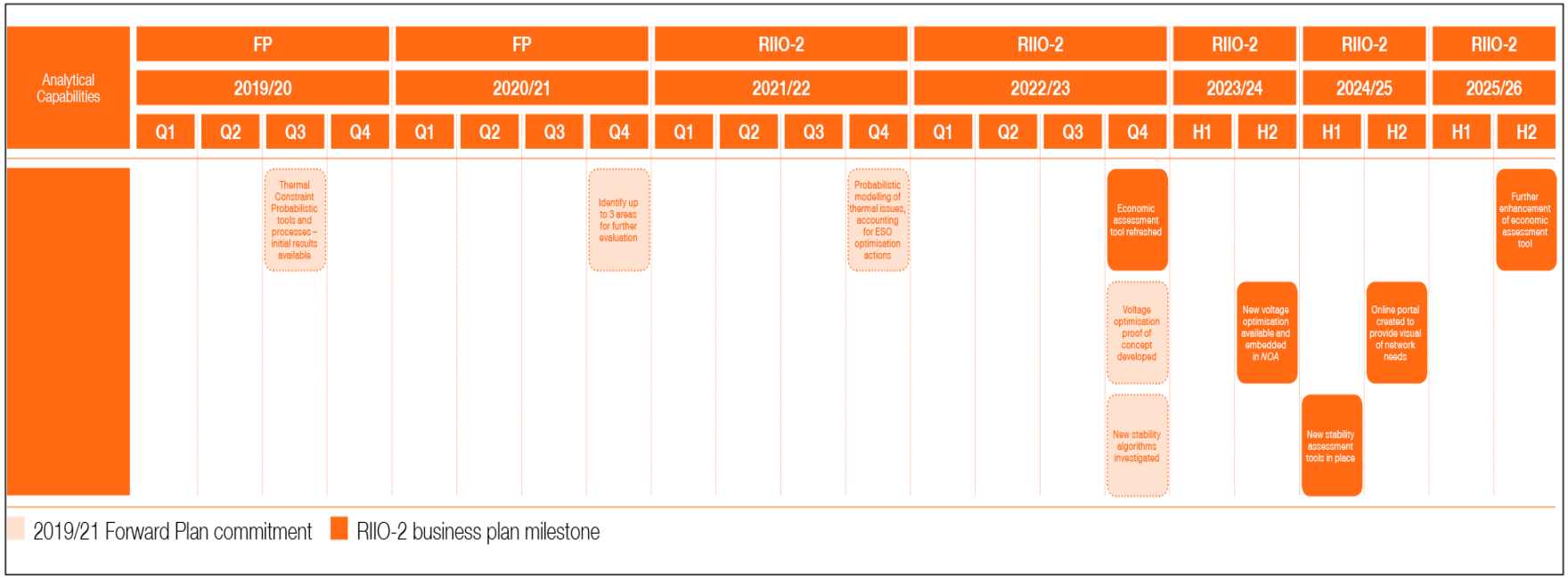
Section 6.2.3.1 – Network development: Enhance *NOA* roadmap



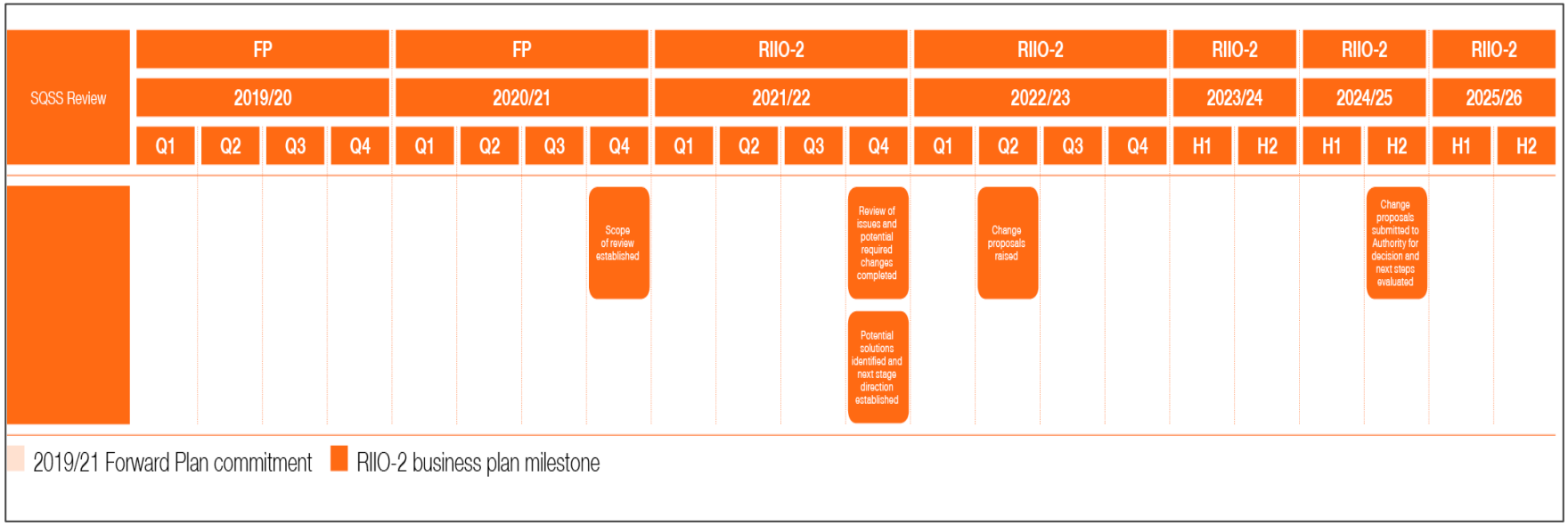
Section 6.2.3.2 – Network development: Extending *NOA* to end of life asset replacement decisions and connections wider works roadmap



Section 6.2.3.4 – Network development: Enhance our analytical capabilities to support these activities roadmap

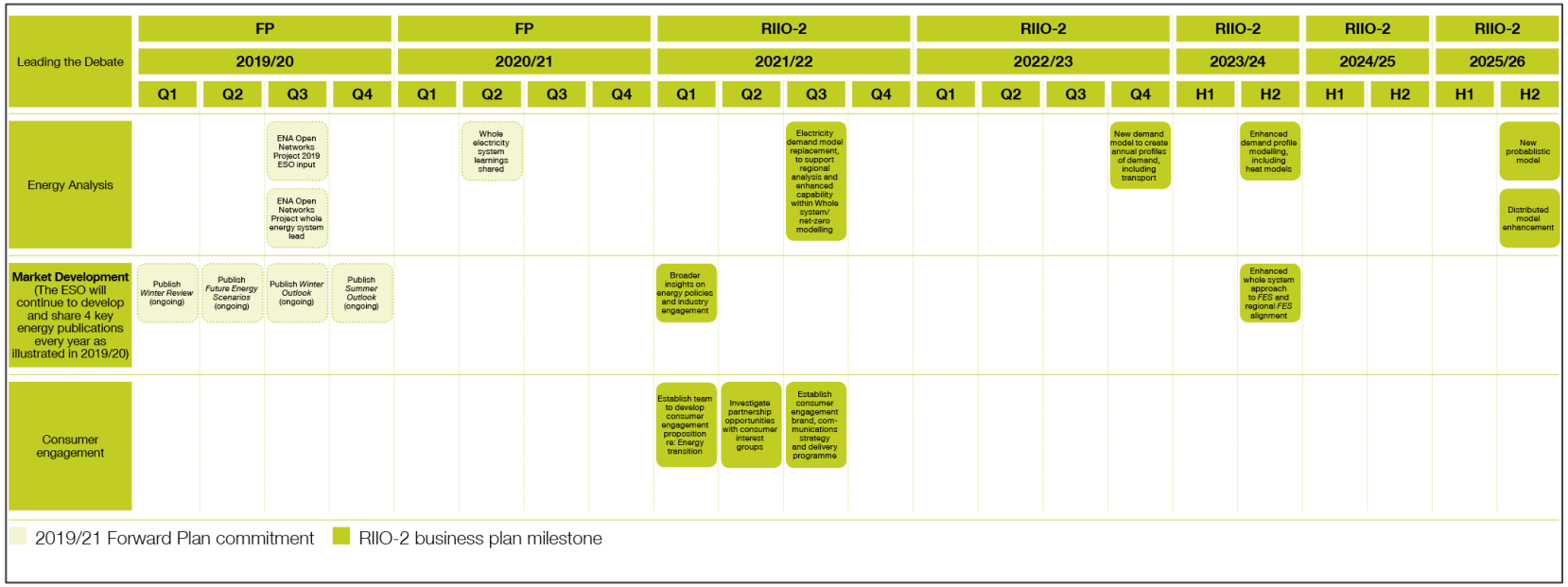


Section 6.3 – Review of the SQSS roadmap

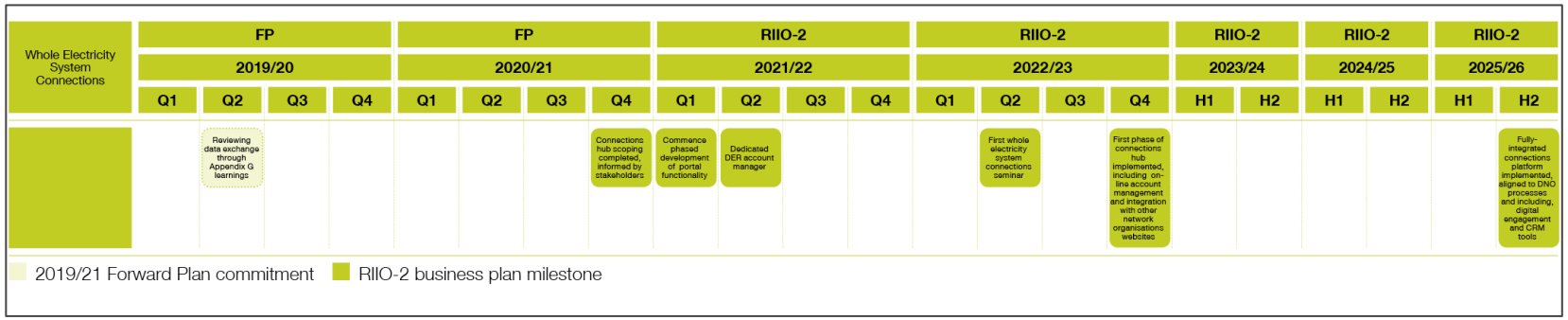


F4 Theme 4

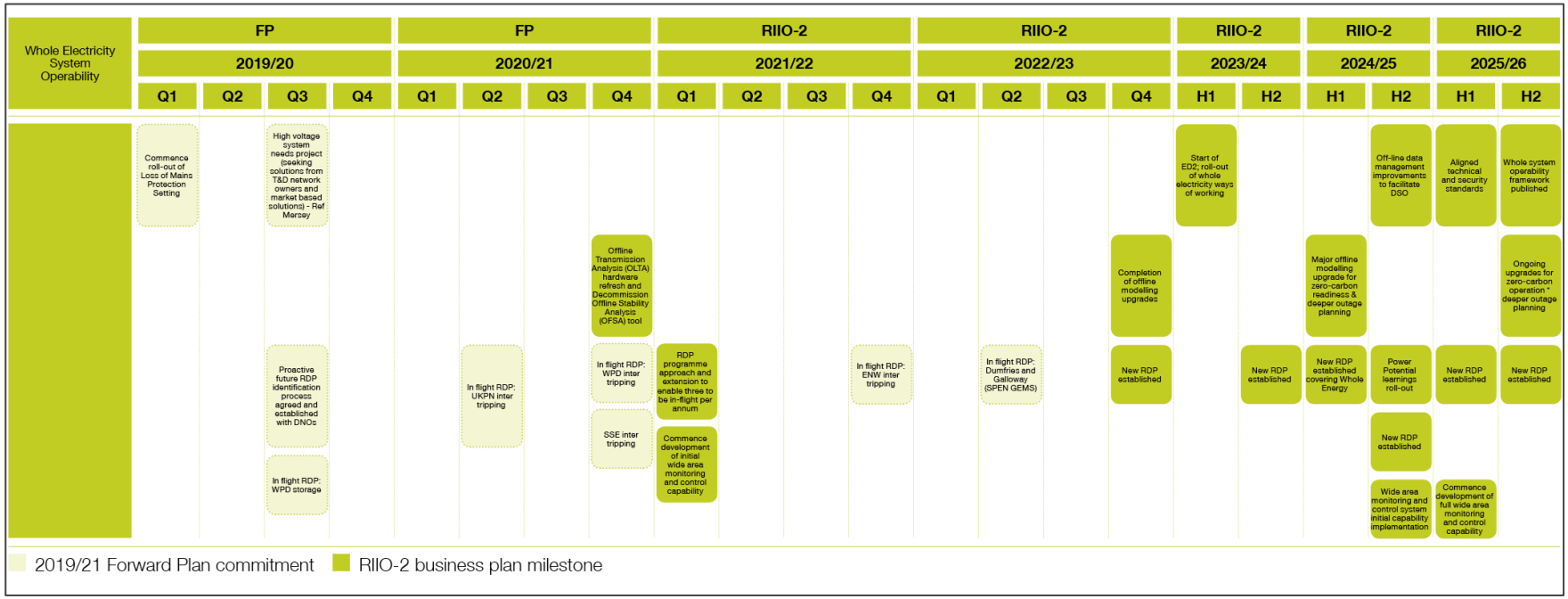
Section 7.2 – Leading the debate: providing energy analysis and market insights to drive the energy transition roadmap



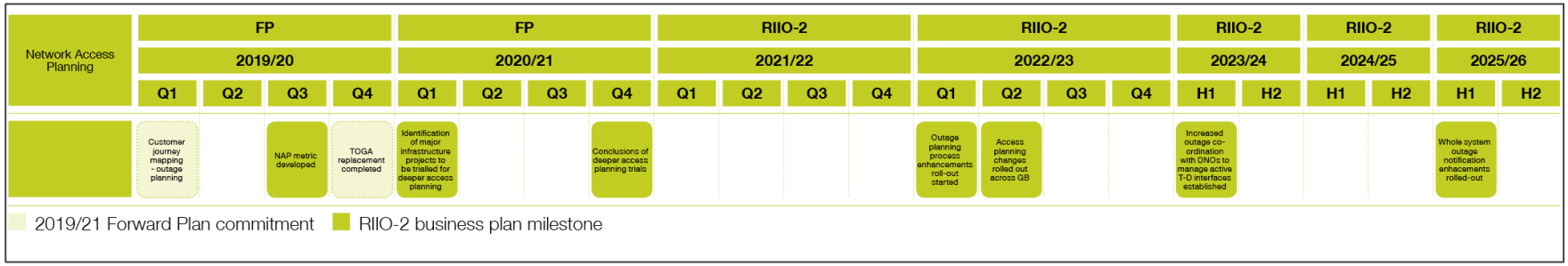
Section 7.3 – Taking a whole electricity system approach to connections roadmap



Section 7.4 – Taking a whole electricity system approach to promote zero carbon operability roadmap

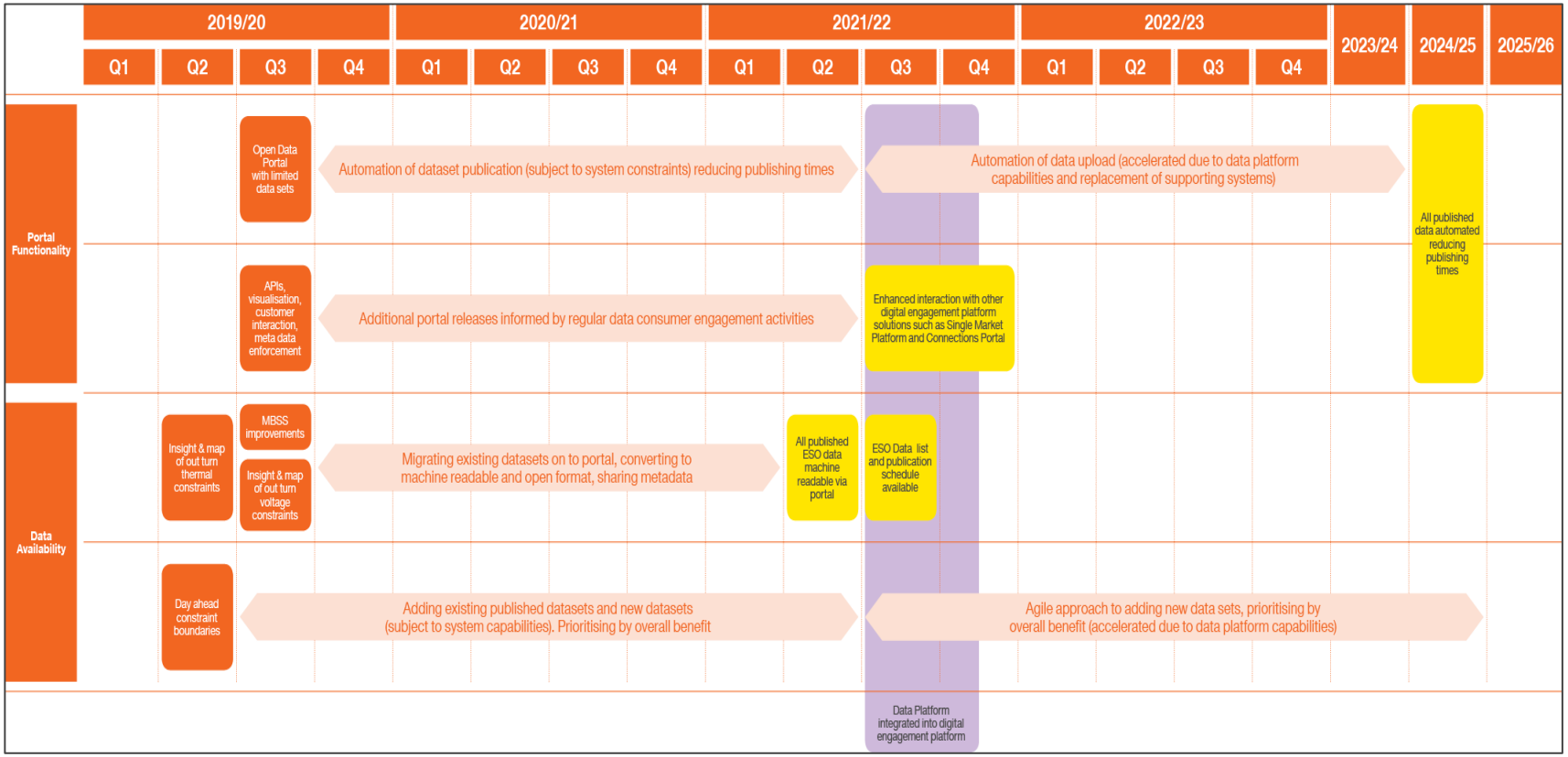


Section 7.5 – Delivering consumer benefits from improved network access planning roadmap



F5 Open Data

Section 8 – Open data roadmap



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